Evaluation of construction contract documents to be applied in modular construction focusing ambiguities; A text processing approach

Ali Azghandi-Roshnavand

A Thesis

In the Department

Of

Building, Civil and Environmental Engineering

Presented in Partial Fulfilment of the Requirements

For the Degree of

Master of Applied Science (Building Engineering) at

Concordia University

Montreal, Quebec, Canada

September 2019

CONCORDIA UNIVERSITY

School of Graduate Studies

This is to certify that the thesis prepared

By: Ali Azghandi Roshnavand

Entitled: Evaluation of construction contract documents to be applied in modular construction focusing ambiguities; A text processing approach

and submitted in partial fulfillment of the requirements for the degree of

Master of Applied Science (Building Engineering)

Complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the final Examining Committee:

_____ Chair
Dr. Zonglong ZHU

_____ Examiner
Dr. Zonglong ZHU

_____ Examiner
Dr. Joonhee Lee

_____ Supervisors
Dr. Mazdak Nikbakht & Dr. Sang Hyeok HanHide

Approved by Dr. Ashutosh Bagchi,

Chair of Department or Graduate Program Director

March 14, 2019 Dr. Amir Asif, Dean, Gina Cody School of Engineering and Computer Science

Dean of Faculty

Abstract

Evaluation of construction contract documents to be applied in modular construction focusing ambiguities; A text processing approach

Ali Azghandi Roshnavand

Modular coordination in building construction has become increasingly popular, particularly in Northern Europe and North America. In Canada, modular construction came to considerable attention over the last decade due to its valuable effect on project constraints, safety, and preventing construction and demolition waste. However, the modular construction industry still adopts the same administrative procedures designed for the conventional construction industry, even though the features of modular and conventional construction are different in terms of construction processes and methods. Due to this trend, ambiguities in administrative documents are widely occurred and are one of the main causes to generate conflict, disputes, and claims between owners and modular suppliers as general contractors. As a first step in the this research to overcome this challenge, the research team focuses on investigating the contents and structures of the current standard contracts and modular RFPs, which are one of the major sources of confusion in modular construction, in order to mitigate and/or remove the ambiguities based on the considering the specifications of off-site construction procedures and system. In this case, this research illustrates a conceptual framework that has two parts: First, classification of the main sources of ambiguities in construction contracts (both Conventional and modular) and second, to identify the similarities and differences between Canadian documents (standard contracts and modular RFPs) and benchmark countries by applying through text processing and readability analysis. We applied text processing to find top terms, including terms with high frequency (TF) in each document, also high TF-IDF terms, which species occur in one document and not others then, we detected manually the three standard contracts and four RFPs and compare them with the output of literature review to identify the major issues that are common. The readability analysis shows the textual complexity of a document and to what extent the documents are difficult to read. The main findings indicate that the modular industry in Canada suffers from a lack of specific standard contract documents for modular construction.

Acknowledgment

I would first like to thank my supervisors Dr. Nikbakht and Dr. Han, for giving me this chance to explore the topic for which I am passionate, and their wisdom truly guided me to finish this process. I would also like to thank them for understanding my special situation during my studies.

Lastly, I would like to thank my parents for their tremendous support, love and encouragement to pursue my Master's degree. This accomplishment would not have been possible without their inspiration.

I would like to thank Concordia University for giving me this chance to follow my dream and providing excellent accommodation to pursue my graduate degree.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

Request for Proposal	RFP
Term Frequency	TF
Term Frequency-Inverse Document Frequency	TFIDF
Flesch Reading Ease Score	FRES
Construction Industry Cost Effectiveness	CICE
United Kingdom	UK
United States	US
British Colombia	BC
Canada	CA
Florida	FL
Georgia	GA
New Canadian Contracting Method	NCCM
Structural Equation Model	SEM
Design-Build	DB
Design-bid-Build	DBB
Dispute Review Board	DRB
Canadian Construction Claim Tracker	CCCT
New Engineering Contract	NEC
Institute of Civil Engineers	ICE
Engineering and Construction Contract	ECC
New Engineering Contract (Engineering and Construction Contract)	NEC ECC
Central Public Works Department	CPWD

Military Engineering Services	MES
Analytical Network Process	ANP
Fédération Internationale des Ingénieurs-Conseils	FIDIC
Industrialized Building System Modular System	IBSMS
Industrialized Building System	IBS
Critical Success Factors	CSFs
Permanent Modular Construction	PMC
Swedish Transportation Administration	STA
Natural language processing	NLP
Information Extraction	IE
Canadian Construction Documents Committee	CCDC
American Institute of Architects	AIA
Canadian Manufactured Housing Institute	CMHI
Natural Language Toolkit	NLTK
Official Code of Georgia Annotated	OCGA
Goods and Services Tax	GST
Provincial Sales Tax	PST
Quebec Sales Tax	QST
Value Added Tax	VAT
Refurbishment & Demolition	R&D
Term Count	TC
Standard Deviation	SD
The Joint Contracts Tribunal	JCT

1- Introduction

1.1. Background and Motivation

The construction industry suffers from many disputes and conflicts between all parties of construction contracts. Ambiguities in contract documents are among the major causes of conflicts, disputes, and claims in the construction industry. When it comes to modular construction, the issue of ambiguity and the undesired consequences becomes even more critical. A study by Jaillon and et al. [1] in 2014 shows a high range of precast adoption in construction in European countries such as Denmark (43%), the Netherlands (40%), Sweden, and Germany (both around 31%) from 1996. In North America, the Canadian construction industry has turned toward a new approach named Permanent Modular Construction (PMC) since the 1990s. Modular construction in Canada gained considerable attention over the last decade due to its positive impact on project constraints, safety, and preventing construction and demolition (C&D) waste [2]. Koskela, L., and Ballard, G. [3] in their paper said that there is always a risk in modular construction that a wrong decision may result in project failure since it is a complex combination of philosophy, system and techniques. The different essential nature of modular construction processes (compared to traditional construction) necessitate administrative procedures to be adjusted and modified to match the specific needs of such processes.

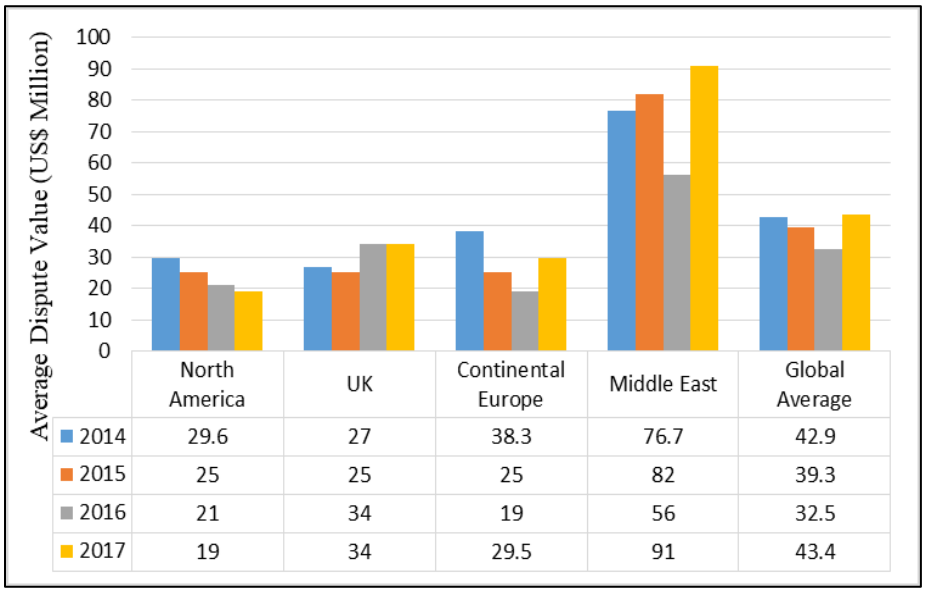
'Modular Construction' is the ability to manufacture in a different place and transport to the place of installation in one or more sections [4]. Modular coordination in building construction has become increasingly popular, particularly in countries with geographically remote areas such as Sweden and Northern Canada, as well as where the feasibility of on-site construction is low [5]. This form of construction was introduced to European and North American countries after World War II. Primary motivations of modular construction are cost, schedule, safety, and quality. Using motivations vary from country to country. One of the methods introduced to improve the construction industry is the efficient, innovative, and productive modularization industry. The industry involves a production process specially tailored to a factory environment (factory prefabricated) or under the open air at the site (site prefabrication). The term off-site is .used when both pre-construction and pre-assembly are integrated [6]. As Azhar and et al [7] study showed, modular construction which is known as an industrial process, has been using as an alternative for conventional or traditional construction in which various modules are prefabricated, transport and joined to form a part of the final installation. Some advantages of the manufacturing process versus traditional one include the controlled environment, minimal waste, improved safety and quality control, low cost, faster completion and high productivity [7].

There are two preparatory steps before attempting to prepare a construction contract. Since there are numbers of delivery methods, first of all, the suitable method of delivery should be determined, and the next one is selecting the standard form of contract which most closely fits the project's requirements. Conventional construction is involved of planning, designing whose primary structural elements are constructed entirely or largely on-site while the process of modular construction is included of planning, designing, fabricating the element in the factory, transporting, storing and assembling them in the site. On the other hand, stakeholders involved in these two types of projects are different [8]. The conventional construction has four main parties such as Owner, Architect, Engineer, and Contractor/Constructor but when it comes to modular construction, the issue of stakeholders becomes more highlight since the modular construction stakeholders are Owner, Architect, Engineer, Fabricator, and Contractor [9]. Construction Contracts, from both aspects of content and structure, are among the major items to be revisited, reconsidered and updated for the specific uses in the modular construction industry. All the available construction standard contracts are prepared for conventional projects, and companies modify them to use in their projects but when modular construction comes to the contracting step, it needs to have enough information and knowledge about standards, specification and limitations, critical success factor, strategies for integrating the use of modular production technologies, factors that influence the adoption of modular construction to the traditional construction processes, risk mitigation, the sources of disputes, managing uncertainties, design considerations and coordination between factory and on-site activities, and how modular projects should be planned and executed. Fateh et al [10] in 2016 through their research, which was formulating the standard form of contract for Industrialized Building System (IBS), presented some significant barriers to IBS in Malaysia such as 'lack of integration', 'lack of standard form of contract', and 'lack of standards for IBS projects'. Their suggestion at the end of their paper is to develop a standard form of contract for modular construction in their country.

A study by Office of Legislative Oversight in 2015, indicate on 'change orders' in modular buildings increased 30.3% of the time and 8% in contract overall costs [12]. In 2014, the lack of clarity in contract documents known as one of the main sources of disputes between project parties by Rameezdeen and Rodrigo [13]. Their study shows inconsistencies between 'modified clauses' and the rest of the standard contract document so that 60% of 281 modified clauses from large infrastructure projects implemented in Sri Lanka, were more difficult to read compared to non-modified clauses.

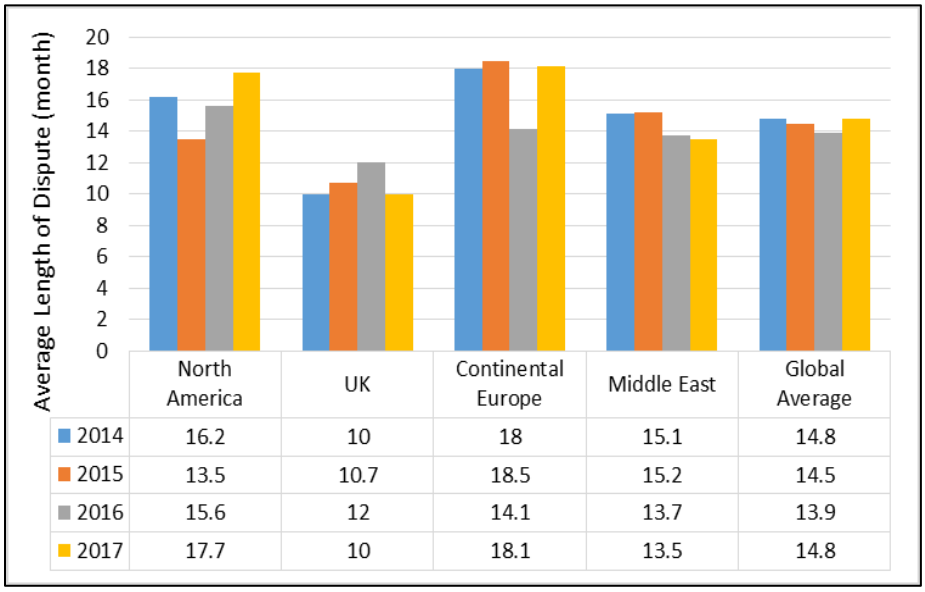
Arcadis Construction Disputes Report [14], showing that 30 percent of construction projects in North America ended up in dispute in 2017. Contract and specification reviews were considered the most effective claims avoidance technique. Owner/contractor willingness to compromise was the most crucial factor in the mitigation/ early resolution of disputes encountered. Also, as shown in Figure 1 and Figure 2, while the average dispute value (US$ million) in North America declined in the last five year, the average length of dispute increased. Contrary, the UK's average dispute value had considerable growth, but the average length of dispute in this country was steady [14].

In North America, The 'errors and/or omissions in the contract documentation', 'failure to properly administer the contract', and 'owner/contractor/subcontractor failing to understand and/or comply with its contractual obligation' (see Table 1) are listed the main causes of disputes in North America's construction industry [14]. On the other hand, Global Construction Dispute Report [14] identified the main sources of disputes in the UK as 'failure to properly administer the contract' while in North America it belongs to 'errors and omissions in the Contract Document.'(Table 2)



	North America	UK	Continental Europe	Middle East	Global Average
2014	29.6	27	38.3	76.7	42.9
2015	25	25	25	82	39.3
2016	21	34	19	56	32.5
2017	19	34	29.5	91	43.4

Figure 1- Global Average Dispute Value (US$ Million)



	North America	UK	Continental Europe	Middle East	Global Average
2014	16.2	10	18	15.1	14.8
2015	13.5	10.7	18.5	15.2	14.5
2016	15.6	12	14.1	13.7	13.9
2017	17.7	10	18.1	13.5	14.8

Figure 2- Global Average Length of Dispute (month)

Table 1- Main Cause of Disputes in North America

2017 Rank		2016 Rank
1	Errors and omissions in the Contract Document	1
2	Failure to properly administer the contract	3
3	Owner/contractor/subcontractor failing to understand and comply with its contractual obligation New in 2017	New in 2017

Table 2- Main Cause of Disputes in the UK

2017 Rank		2016 Rank
1	A failure to properly administer the contract	1
2	Employer/Contractor/Subcontractor failing to understand and comply with its contractual obligations	3
3	Failure to serve the appropriate notice under the contract	New in 2017

Based on a report prepared by Harvey [15], Canadian construction industry suffers from skilled labour shortages, abbreviated building schedules and tighter budgets which are leading to more disputes, undue cost overruns, and delays on major capital construction projects, but the benefits of modular construction can overcome these obstacles. The significant issues related to starting a modular construction are the site condition, inefficient standard contract documents, transportation conditions, local codes, skilled labour unavailability, design complexity, and organizational readiness [7]. Since the contracts have this ability to reduce the risk of the project in earliest stages, they have this potential to unfairly be abused by one of the parties to transfer the risk to other parties by using some unfair and unclear provisions or clauses. Therefore, the construction industry turned to the use of standard contracts that are provided by experienced architects, contractors, owners, subcontractors, engineers, and lawyers and then approved by leading professional teams [15]. Standard contract documents provide consistency and eliminating the ambiguities.

1.2. Why Design-Build delivery method?

A report by Smith and Rice [12] in 2015 published by the University of Utah, found that 'Design-build' delivery method instead of 'Design-Bid-Build' led their projects in the future to reduce the disputes. This finding was the result of the study on the 'Stem school' project that was built on Lake Washington in 2010. In 2015, Dakhiliet et al. [16] studied in the modular construction processes in France to find how to adapt it with traditional construction. This research is included of two case studies, one with Design-Build (DB) delivery method and another one by Design-bid-Build (DBB). The result shows that 'contracting with the wrong delivery method,' 'mismatch regulation,' and 'change management system' play the major roles in modular construction contracting. The report provided by three main leader companies in British Colombia [17] shows that the use of Design-Build contract and related project management software helps the project to reduce or eliminate the ambiguities of defects or damages are noticed on-site after delivery by identifying the overall project from concept through the operation. Because of the very early involvement of all parties (owner and design-builder team) in Design-Build, it is more collaborative than Design-Bid-Build Contract that the general contractor involves the project after the design process is done and there is no chance to utilize the knowledge and experience of the DBB team. A survey done by NIBS OSCC shows that more collaboration at the beginning of the project would be easier if there were a delivery method in place that is more beneficial to this level of cooperation such as Design-Build. One of the case studies on this publication concludes that several issues, like structural alignment, point to the need for a Design-Build process in the future [18]. Use of modular construction in multi-trade projects needs more collaborative delivery systems such as Design-Build [19]. Molavi and Barral [20] in their paper suggested choosing construction management or Design-Build as a project delivery method for modular construction due to early involvement with the precast manufacturer and the installation contractor. Based on a case study done by Schoenborn [21] among five modular companies, one company which produces both relocatable buildings and permanent modular buildings, used Design-Build delivery method because its document complies with government requirements and manufacturer's system.

1.3. Aims and Objectives

Many researchers have been studying the sources and effects of confusion in traditional construction contract documents, but there is not enough number of comprehensive research work for the modular construction contract. Most studies that have been taken are related to challenges and industrializing process, environmental impact, and new technologies that modular project are facing. The disputes in construction are numerous reasons and identifying a specific cause is not simply possible regarding the complexity associated with the procurement of projects. Disputes seem to be a never-ending story within the construction industry [22]. Their view, the project management strategy juxtaposed with the organizational management practices and the behaviour of people are the constructs that will influence disputes. International studies by Mitropoulos, P.,

& Howell [23] indicate that drivers of dispute development within construction contracts can be arranged into as little as three main categories: 'Project uncertainty,' 'Contractual problems,' and 'Opportunistic behaviour.' Kamar et al. [24]illustrated some benefits of modular construction as construction time reduction, better site management, reduced wastage are some of the benefits that will ultimately produce better products for the customer.

Up to this moment, there are no studies that have been conducted on the main sources of ambiguities in the Canadian modular construction contract documents, which is the topic of this research. Given the fact that the modular industry is developing rapidly, there is a strong need for specific studies related to Canadian standards and zone. The main objectives of the current research are: (1) presenting a conceptual framework for classification of the major sources of ambiguities in construction contract documents (conventional and modular); (2), to identify the similarities and differences between related construction standard contract documents through text processing; (3) to identify the similarities and differences between modular construction RFPs through text processing; and (4) applying through readability analysis (FRES) to measure the readability through available metrics in contract documents.

1.4. Organization of the thesis and its chapters

The first chapter of this literature review starts with an introduction and talk about the background and motivation of this research, then the objectives and scope of the work defined. In the literature review chapter, the conceptual framework of our analysis based on a comprehensive survey of the literature will develop. The scope of this study was both conventional and modular construction-related publications (Conventional since 1980 and modular since 2000). We started by collecting the sources of confusion in general construction contracts, from the review of 48 publications. We detected causes and classified them into five main categories (each of which further classified into sub-categories). This formed a primary taxonomy for construction contract confusion. Afterwards, we limited the scope of the search into modular construction contracts. We surveyed the literature and analyzed 35 publications in this regard. We mapped our findings to the original taxonomy, and the outcomes revealed some new sources in modular contracts, mostly due to the new technologies involvement and industrialization of the processes. We then used this framework and performed a quantitative comparison among major standard construction contract documents and then RFPs in use for or related to modular construction in Canada, the US and UK through text processing and readability analysis. We evaluated similarities and distinctions among the documents, within the dimensions of our analysis framework, through evaluation of measures such as TF (Term Frequency), TFIDF (Term Frequency-Inverse Document Frequency), and FRES (Flesch Reading Ease Score). On the result chapter of this study, the results of the text processing and readability analysis and comparing the findings will discuss. Finally, in the last chapter, Discussion and Conclusion, the study will come

with the conclusion and define the contributions of this research and as well, limitations and future work for this study.

2- Literature Review

This chapter frames the theoretical background of this research by reviewing the literature on the main sources of ambiguities in both conventional and modular construction contract documents. In the first phase (which is conventional construction contract documents) we started a comprehensive review of the literature by collecting the sources of confusion in conventional construction contracts, by the reading 48 publications related to conventional contract documents. We detected causes and classified them into five main categories (each of which further classified into sub-categories). This formed a primary taxonomy for construction standard contract confusion. Afterwards, the framework will be expanded by a comprehensive review of publications related to the modular construction contract by reviewing and analyzing 35 publications in this regard.

2.1. Conventional Contract Literature Review

Construction projects are becoming more complex, larger and more challenging and employers are demanding faster delivery and higher quality while the projects must adhere to numerous standards, regulations, and building codes, on time and budget. In the 1980s, the Business Roundtable Construction Industry Cost Effectiveness (CICE) reported that in North America, Contract improvement could reduce around 5% of the cost of the projects, including the costs of

disputes. CICE named some avoidance strategies to reduce the dispute costs like; appropriate selection of the right contract type, contractor selection based on capability and fit to the requirements of the project, contract wording that eliminates potential disputes, contract administration procedures [25]. In 1986, James P. Groton published an article [26] about the importance of the improving the construction contracts and presented some of the sources of dispute which are related to the contracts such as 'selection of inappropriate standard form of contract', 'non-uniformity in contract terms and conditions', 'conventional legal language and approach', 'informal language', 'lack of familiarity with construction language'. In 1992, P. Fenn and R. Gameson [27] in their book noted some sources of dispute in construction contracts such as, 'poor drafting,' 'payment conditions,' 'uncertainty,' and 'unclear role divination.' Micheal V. Griffin [28] in 1993 listed some sources of disputes like, 'change orders,' 'payment conditions,' 'incorrect interpretation of specifications,' and 'changes in the method or sequences of the work.' At the same time, Joseph C. Lavigne [29] in his thesis released that 'shifting unrealistic responsibility through the wording incorporated in the contract documents' by parties as one of the main sources of disputes. In 1993, Francis T. Hartman in his book [25] presented a new approach to construction contracting in North America specifically in Canada that named New Canadian Contracting Method (NCCM) addresses four main dispute issues for, Confrontational construction, Dispute resolution problems and costs, The project execution team selection process, and Completion of contracts. Fenn and et al. [30] (1997) in the UK by comparing the standard form of contracts of construction industry vs chemical listed a variety of sources of dispute and conflict in this industry. Gerald Aksen [31] (1999) stated that one important issue in a construction contract is the rules and responsibilities of Arbitration and Arbitrator which if it does not define clearly, become one of the sources of conflict and confusion. In 2000, a Structural Equation Model (SEM) that has been done by K. Molenaar, and et al. [32] from the questionnaires completed by 159 construction projects in the US, measured both quantitative and qualitative aspects of contract disputes. Understanding of the contractual terms and causes of claims is one way to avoid the dispute in construction projects, Ayman H. Al-Momani [33] found through a quantitative analysis of 130 projects in Jordan. Odeh and Battaineh survey [34] (2002) shows that the main reason of disputes in conventional construction is the traditional and adversarial type of contracts since it is awarded to the lower bid which is also the awarding strategy in many of developing countries. This paper which has been done from consultants, owners and contractors through a survey from a traditional type of contracts, indicate that consultants and contractors agreed that in Nigeria, the major causes of delays are 'poor contract management,' 'change in the conditions,' 'improper planning' and so on. Also, in construction projects in Saudi Arabia, 'slow decision making,' 'executive bureaucracy in owner's organization,' 'approval of workshops,' and 'delay in payments' are the most reasons of delays. Finally, in Lebanon, the main causes of delays are 'financial issues' and 'contractors regarded contractual relationships.' M. Skene and R. Shaban [35](2002) in their paper, tried to show the strategies to resolve and avoid construction disputes. Emmie West [36] found that 'warranty remedies,' 'changes to the work,' 'uncertainties of common law' and 'lack of uniformity in contract document forms' are some of the sources of disputes. E.

Chan and A. Yu [37] reviewed the issues concerning the roles and responsibilities, design liability and contractual provisions between the designer and Design-Builder in the DB contractual documents. David Chappell and et al. [38](2005) on their book studied the contract claims in building and introduced 'Acceptance Criteria,' 'Time extension,' 'Site Conditions' and 'Inaccurate Drawings' as the main sources of claim. J. K. Yates and A. Epstein [39] (2006) defined type of delays in construction projects and mentioned that numerous factors including 'improperly drafted contract documents', 'erroneously prepared bids', 'owners failing in their responsibility to provide site access or to take other required action in a timely manner', and 'inadequate contract administration' are important dispute causes. This author with [40] (2006) in his other paper, introduced a Dispute Review Board (DRB) which is a method that helps to resolve disputes on both public and private construction projects. The main sources of disputes in this research are named; 'Project uncertainty,' 'Process problems,' 'People issues.' In 2007, M. Sambasivan, Y. W. Soon [41] classified and rated the main causes of delay in the Malaysian construction industry. Their finding indicates that that the 'contract issues' has the rate 4 and five among eight causes. Another research in Malaysia has been done by N. Othman [42] in 2008 and investigated the influence of standard forms of contract or conditions of the contract, which are modifying in construction projects and are one of the primary sources of conflict in this industry. Based on this research, 'contract drafter' and 'drafting policies' are two important parts of modifying a contract. In the construction industry, the lack of understanding of the contract provisions and jurisdiction of legal cases is a common problem. In this order, H. Y. Chong and et al. [43] introduced an electronic dispute resolution template, known as e-Dispute Resolution (e-DR), is prototyped by using a database tool based on the guidelines of contractual variations to bridge this gaps. On the other hand, in Canada, Amir Chehayeb and et al. [44] (2007) presented another methodology to classify, categorize, and analyze Canadian case-law construction claims by collecting 567 Canadian court cases and implemented by a computer-integrated system called the Canadian Construction Claim Tracker (CCCT). Most construction contracts are not complete because of vague and confusions. For this matter, the level of risk at the first processes of all projects is high, and the parties cite some contingency clauses, management reserves, and contingency reserves. F. Walker and S. Pryke [45] (2009) investigated this incompleteness function and addressed this shortcoming. Bob Keen, a senior consultant at Revay and Association Ltd. [46] on his report in 2010, mentioned that the incomplete contract documents at the time awarding of the contract increases the risk and is one of the substantial causes of future disputes. A case study in New Zealand has been done by J. Nevan Wright and W. Fergusson [47] to show the benefits of standard construction contract by comparing NEC ECC (NEC Engineering and Construction Contract) as developed and published by the Institute of Civil Engineers (ICE) and is a popular standard contract worldwide versus traditional form of contract. Some major benefits of NEC ECC contract are 'Flexibility in its terms and conditions,' 'Clear, plain language,' and 'Clear definition of contract roles and allocation of responsibilities.'

The construction industry has known the second largest industry in India. The most public projects have to standard contracts, which are published by the two government organizations 'Central

Public Works Department (CPWD)', and 'Military Engineering Services (MES).' Hence, K.C. Iyer and et al. [48](2008) developed a rule-based expert system that can assist the contract administrators to understand and evaluate the worth of their claims before taking it to litigation. Many authors also explored the negative effects of changes, such as deterioration of productivity, cost and time overruns. For instance, M. Sun and X. Meng [49] findings show that the cost of rework, which is occurred because of the changes in construction projects, is 10-15% of the contract value. N. Hamzah and et al. [50] listed some items which are Malaysian lead projects to the delay such as 'Inadequate experience of the consultant,' 'Contract modifications,' 'Incomplete documents,' etc. Richard J. Sebastian and Bill Davison [51] (2011) worked on the root causes of problems in construction contract management. They listed a variety of this causes in their paper-like 'unable to draft adequate specifications,' 'Inadequate writing skills,' 'changes in scope,' 'ambiguous specification,' 'inadequate bond and insurance.' D. Mendis and et al. [52] (2013) analyzed standard contractual documents in Canada, the USA and Australia in terms of their potential to generate rework and waste with a comparative study to propose changes/amendments to the existing standard contract documents to minimize/avoid rework. Trinkūnienėa and Trinkūnasb [53](2014) presented the model of information system which its main purpose is to help to prepare construction contracts by presenting instrument for contracts structural analysis. They believe that the luck of all projects is closely related to the right prepared contract. S. Mitkusa and T. Mitkus [54](2014) studied the causes of conflict in Lithuania, and their research shows that the unsuccessful communication between parties is one of the main reason for conflict and in their opinion, a conflict can be managed, while a dispute must be resolved; it cannot be managed. A survey in 2015 in Egypt by Elziny [55] and et al. used a questionnaire to study dispute sources and resolution methods among Egyptian projects and check the validity by providing four case study applications. The finding shows the most important sources of the dispute were contract management 74.04%, the second was contract documents 71.49%, the third was financial issues 67.80%, the fourth was project related issues 63.92%, and the lowest one was other sources (such as force majeure) 61.58%. Max Feldman [56] presented some factors that have effects on disputes such as 'vague catch-all contractual clauses,' 'low calibre specification writers,' and 'role and responsibilities' definition.'

H. Mohamed and et al. [57] (2014) categorized 31 main sources of disputes in international literature into three major groups, behavioural, contractual and operational matters. Following the results of 102 interviews leaded the research to introduce the eight main causes like 'incomplete drawings and specification,' 'poorly written contracts clauses,' and 'change orders.' R. J. Gilson and et al. [58] (2014) studied the effects of text and context and contract interpretation in the construction contract. 'Policy language,' 'unfair provisions,' 'plain language' are some the factor which their influences on the contracts are inevitable. Niu and Issa [59] in their paper mentioned the result of a case study using AIA A201 General Conditions of the Contract for Construction (2007) and Developed taxonomy for the domain ontology of contractual construction semantics.

In 2014 a study was carried out by E. Cakmak and P. Cakmak [60] using the Analytical Network Process (ANP) approach to determine their relative importance. They classified the common causes of disputes into seven broad categories as owner related disputes, contractor related disputes, design-related disputes, contract-related disputes, human behaviour related disputes, project-related disputes and external factors and at the end "contractor related disputes" recognized the highest relative importance factor with value 0.3 of 1.0. Mashwama and et al. [61] has been done a study by sending a questionnaire to investigate the effects and cost of dispute in Swaziland in 2016. The main effects of a dispute in the construction projects listed as; 'additional expense in managerial and administration,' 'possibility of litigation cases,' 'Time delays and cost overruns' and so on. Ibrahim Mahamid [62] identified 29 direct and 32 indirect dispute causes (micro and macro level) in residential building projects in Saudi Arabia by collecting the questionnaire from 120 contractors. The highest direct ones are 'payment condones,' 'unrealistic contract duration' and 'change orders and on the other hand, the top indirect ones are 'inadequate contractor's experience,' 'lack of communication between parties' and 'ineffective planning and scheduling.' W. Matwiejczuk and et al. [63] studied the organizational and legal barriers in the final value of construction projects in Poland by study the effective forms of investment projects implementation management that have been working for decades in the European context, based for instance on FIDIC procedures, in Polish conditions. The output of this research shows the most important factors as: 'lack of precise and uniform provisions in contractual agreements', 'ambiguity of contract provisions and large discrepancy in interpretation of legal provisions in the contractual agreements', 'inertia of the contracting authority in regard to selection of project management model and methods' and etc.

An exploratory study has been done by Holi Ali [64] to investigate Sudanese translation practitioners' perceptions about language-related challenges encountered when translating legal contracts. This study shows that well-trained and certified translators should translate legal contracts. Legal translation in two major ways differs from other types of translation: the legal system and the terms, which associated with it. Legal translation requires the usage of translation methodology according to the challenges it possesses.

Figure 3 illustrates the number of publication which has been related to the dispute in the conventional construction contract since 1980. Based on this figure, the number of publications in the past two decades increased by two times more than before, which indicate on importance of this issue for researchers.

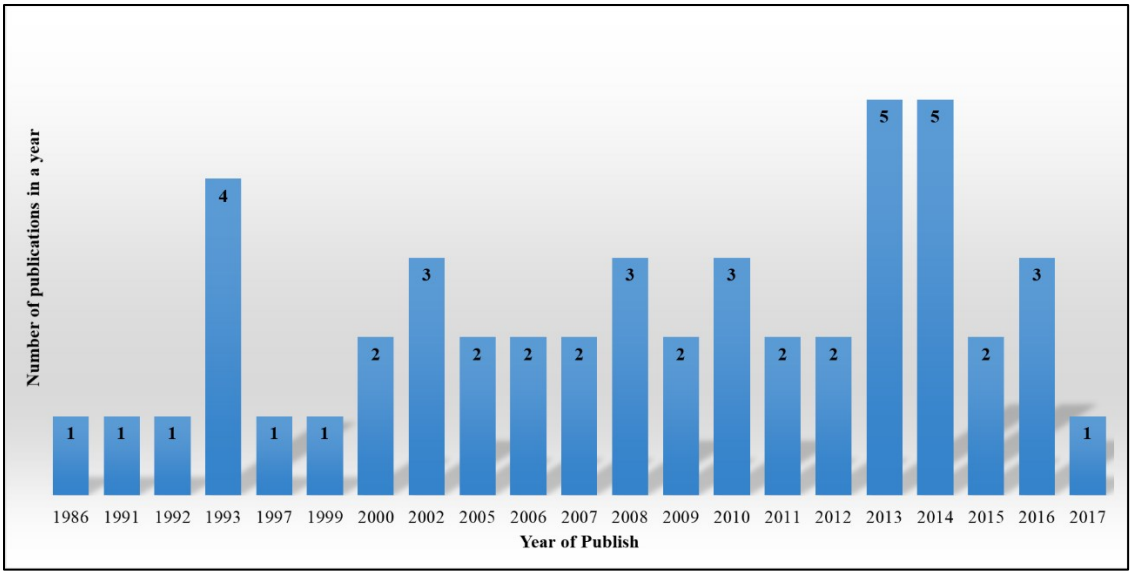


Figure 3- The dispersion of publications related to conventional construction contract since 1980

2.2. Modular Contract Literature Review

The Modular construction, as a modern method of construction, has numerous and far-reaching benefits. A survey conducted by Lu [65] among 138 architects, engineers, general contractors and owners from across the United States displayed the advantages of modular construction (prefabrication & Modular) as listed: 'reduction of the overall time of project', 'increasing the quality', 'higher productivity', 'higher safety', and 'minimum impact on environment'. This kind of construction was introduced to European and North American countries after World War II. Reports in 1996 show high precast levels in Denmark 43%, the Netherlands 40%, and Sweden and Germany 31% [1]. In the early 1970s, Eastern and Western Europe started using this method for construction of new suburbs, towns, and public buildings, thus, they set up specific standards for examining component specifications such as tolerance and installation standards [66]. Because of high demand and lower costs, this industry became popular in Asian countries that as Malaysia and India. A Survey in 2003 shows 15% of construction in Malaysia was built, using the Industrialized Building System (IBS). Therefore, the government started a program which insisted that all public projects must contain 70% IBS components [67].

In 2002 in Malaysia, a survey conducted by Yuosre et al. [68] discussed industrialized building systems technology and examined problems and constraints associated with these technologies. The most highlighted issues known as 'supply delay,' 'bad weather,' 'and shortage of raw material,' and 'lack of labour experience.' Another study by Kamar et al. [24] in Malaysia shows that 'negative perception,' 'readiness issues,' 'cost and equipment,' 'poor planning and regulations,' 'poor knowledge and awareness issues' are the main barriers to a modular building.

Musaet et al. [67] studied the organizational readiness framework for Industrialized Building System Modular System (IBSMS) in Malaysia. The findings identified the readiness elements and criteria (sufficient fund and financial plan, machinery, equipment and facilities), as the main components of the framework. Fateh et al. [10] in 2016 through their research, suggested developing a standard form of contract for modular construction in their country.

In 2012, a case study by Schoenborn [21] introduced some constraints and barriers in modular construction in the USA which are 'transportation restrictions,' 'unknown material,' 'the lack of knowledge of manufacturing processes among architects,' the 'lack of transparency regarding the means and methods of construction.' Another case study by Panet et al. [69] analyzed two modular projects in the UK to integrate the use of Off-Site Production Technologies in House Building. 'Lack of knowledge,' 'decision processes,' and 'supply chain management' mentioned as the sources of disputes in this study. Choi et al. [70] In 2016, through qualitative comparative analysis, confirmed that Critical Success Factors (CSFs) on the cost and duration interactively and collectively affect modular industrial project performance. Eriksson et al. [71] in their paper cited some sources of disputes in modular construction such as 'lack of standard contract forms' and 'lack of procurement method', while Nasrollahzadeh et al. [72] recognized "inappropriate projects delivery methods' and 'Managing uncertainties in supply' are the sources of conflict in modular construction. Some concerns, such as design considerations and coordination between factory and on-site activities, lead the modular projects to easily undermine if an appropriate procurement method is not selected. Molavi and Barrel [20] presented a fundamental conception of the prefabricated system and suggested a procurement method for modular construction procurement system based on the type of project to achieve more sustainability. This study shows its concerns about 'transportation criteria,' 'contracting with suppliers and sub-contractors,' 'project delivery method' and 'modules limitations.'

Furthermore, this new industry, like other new industries, always hurdles and difficulties exist in the first steps, such as lack of knowledge about the modular construction industry, design and construction culture [11]. Insufficiently grounded, qualitative, and quantitative research is another issue in the way of PMC [12]. El-Abidiet et al. [74] mentioned 'transport costs,' 'supply chain management,' 'revised national policies and regulations,' and 'job site conditions' as sources of disputes in the prefabricated building.

Rauschet al. [75] in their paper which is about the optimum assembly planning for modules found another specific factor which has to be considered in contract document such as 'tolerance criteria,' 'method of manufacturing,' 'equipment requires,' 'transportation criteria,' and 'material.' One of the pioneer countries in modular construction in Sweden, Larsson et al. [76]. Swedish Transportation Administration (STA) in 2012 has been launched research to identify the ways to increase productivity and find the barriers of the modular industry in this country. The major obstacles this study shows are, 'lack of large-scale and repetition possibilities,' 'inappropriate delivery method,' 'impaired aesthetics and quality.' One of the important issues in the

prefabricated industry is tolerance management, while tolerance specification is often regarded as the critical link between engineering design and production and is known as one of the sources of disputes. In this case, Shahtaheriet et al. [77] studied the tolerance strategies for design and manufacturing construction to mitigate the risks. Despite the rapid development of the modularization method, this industry suffering from differences between modular and non-modular approaches. In this order, 19 research team members and two academic researchers identified, classified, and grouped 107 differences (with conducting three case studies) in how modular projects should be planned and executed [78]. The findings show that the main differences pertained to one of the following topics: 'planning and cost estimating,' 'modularization scoping,' 'layout processes,' and 'plot plan.' Figure 4 shows the dispersion of modular publication since 2000, and its slope shows a significant increase in scientific research in recent years in the field of modular construction contracting.

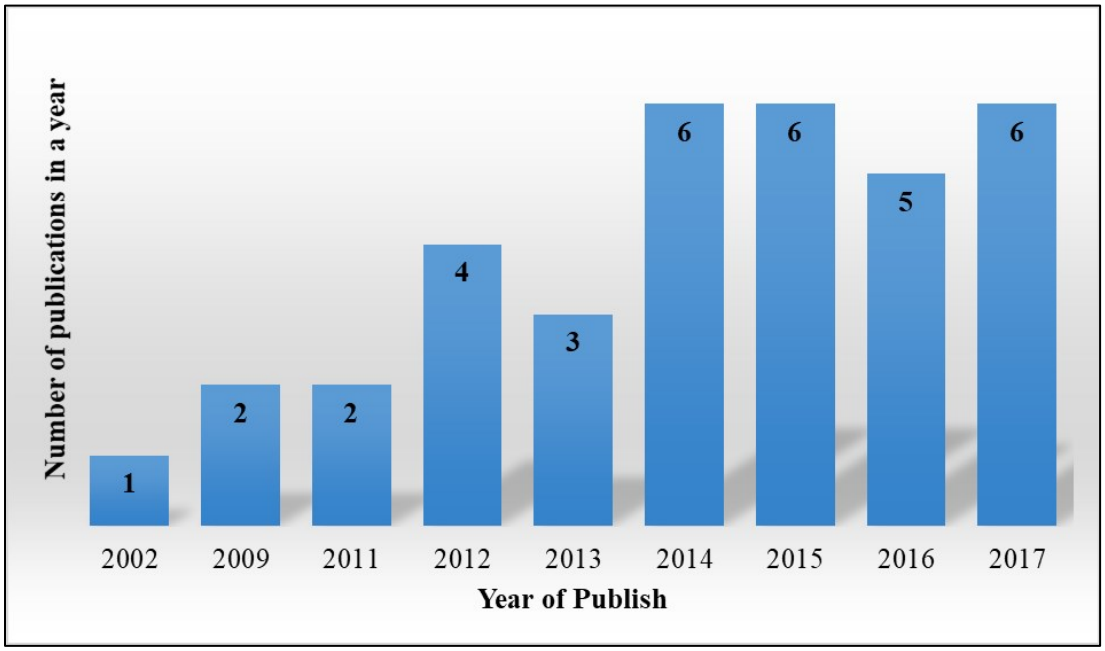


Figure 4- The dispersion of publication related to Modular construction contract since 2000

2.3. Modular Construction in Canada

The first European permanent structures erected in Canada in 1605 at Port-Royal, Nova Scotia for recently landed immigrants to New France [15]. Modular construction is not a strange concept while it started its journey at 1837 [15] in London when Henry Manning prefabricated Manning Portable Cottage and shipped to British emigrants across the empire. International and Universal Exposition in Montreal, or Expo 67, in 1967, announced a new age of technologies related to the

construction industry in Canada. Habitat 67, built as a pavilion for Expo 67, a residential project known as a famous modular building in Canada, consisted of modular boxes constructed at factories, delivered to site and installed by crane in different angles [79]. Its coordination in the building became increasingly popular through countries which are located in geographically remote and cold areas such as Sweden and Northern Canada or where the feasibility of on-site construction is low [5]. While permanent modular construction in Canada has languished, the rest of the world has taken note and embraced the benefits. Value of permanent modular construction in Canada accounted for a mere $250–300 million, representing just 2% of worldwide construction [80]. In North America, the Canadian construction industry has turned toward a new approach named Permanent Modular Construction (PMC) since the 1990s. Modular construction in Canada gained considerable attention over the last decade due to its positive impact on project constraints, safety, and preventing Construction and Demolition (C&D) waste [2].

The construction operation in Canada is complicated when it is geographically wide and climatically challenging conditions. In Canada, the construction industry is concerned with solving technical issues and developing new and innovative methods and materials. ‘poor contract administration’, ‘inadequate claims’, ‘ambiguous contract documents’, ‘failure to comply with commercial contractual deliverables’, and ‘design deficiencies’ are top five categories exacerbating construction disputes in Canada which has published in www.Constructioncanada.net website in 2018 by Steven T. F. Karst [81], an experienced construction claims consultant from Toronto. He believes if appropriate efforts are made before or at the beginning of a project, most disputes can be avoided.

A workshop held at Concordia University in October 2015 to discuss challenges and opportunities for modular construction in Canada. During this workshop, experts released some reasons, which have been determined as the barriers to off-site projects in Canada including standards, regulations, and procurement strategies that favour conventional construction technologies such as a value-based system [9]. Unfamiliarity with the transportation regulations and inability to convince the state government to allow transport the modules overstate highways caused $2 million US cost overrun for Kearl Oil Sand project in Canada [82]. In the U.S., the average cost per square foot of a manufactured home was $42, versus $86 for site-built homes, excluding land [4]. Insufficiently grounded, qualitative, and quantitative research is another issue in the way of PMC [18].

Cal Harvey [15] in 2016 published his thesis with this name “Factors that Influence the Adoption of Modular Construction in Western Canada” by Royal Roads University (Victoria, British Columbia, Canada). Seven potential non-engineering barriers identified through its literature review, which has been examined by a survey of 10 participants (non-random) in British Columbia, and Alberta then found to be likely impediments to the broader adoption of modular construction in Western Canada. Larger, multi-year projects are providing more certainty and financial stability in the marketplace and, ‘despite media focus on the residential housing market, a relatively balanced construction marketplace is evolving, with demand for industrial, commercial

and residential projects across Canada. This provides a broad, diverse base of work and spreads the economic benefits to a greater number of companies' are two developing trends that are suggested by Burleton et al. [83] which are creating opportunity in the Construction industry of Canada. Province of Alberta, specifical University of Alberta, is a known place for its modular construction projects in Canada. Tarek Salama et al. [84], researchers of University of Alberta and Concordia University (Montreal) mentioned in their paper that 'transportation constraints and limitations' and 'the national regulation' are some of the major modular construction issues which have to be considered during the designing and contracting process.

2.4. Readability Analysis

Readability started its journey in the 1920s in a secondary school where numbers of children going to increasing, figuring out exactly what they should be taught became a hot topic. Advice arrived in the form of Thorndike's (1921) The Teachers' Word Book. The book listed 10,000 words, each assigned a value based on his calculation of the breadth and frequency of use. The idea was that the book could inform teachers as to which words they should be emphasizing in their teaching so that those words most commonly used could be instilled in the vocabulary of their students [85]. In 1975, the 'Flesch–Kincaid' reading grade level was developed under contract to the U.S. Navy by J. Peter Kincaid and his team [86] and used by army for assessing the degree of difficulty of technical manuals and after that became a United States Military Standard [86] and now is common requirement in some states in USA. This formula uses for legal documents such as insurance policies where they have to write on a specific level of readability.

"Why construction contracts are lacking in clarity?" This question raised by Broome and Hayes [87] which the results are listed as follows: 'original standard contracts did not provide by experts, and they did not have enough knowledge about construction projects and their nature', 'the language they used was very old with lots of archaic phrases that are hard to define for the new technologies and methods construction companies are using', 'contract forms are increasing because of the numbers and types of projects so, there is a requirement to reuse these forms by revising and recording them and their changes to be more efficient and accessible'. There are some factors to decrease the degree of unclarity that presented by ICE [87] in 1987; 'avoiding legal jargon and using simple language', 'as far as possible use the identic phrases', 'avoiding to add new and unfamiliar data to the core conditions of contracts', 'all the responsibilities and duties has to be defined clearly', 'preventing of paraphrasing the existing law', 'avoiding to use of specific technical specifications', and 'finding an effective way to define and demystify the complicated texts.

An acceptable degree of commonality in the interpretation of construction contract documents is a prerequisite, in this order, Rameezdeen and Rajapakse [88] in 2007 in their research studied the relationship between the readability of construction contract clauses and their interpretation. They compared the readability of two popular standard contracts: 'FIDIC' and 'NEC' and they found out that when the clauses are easily readable, there is a high degree of commonality in interpretation by different readers. His new study carried out on the clarity of contract conditions and its relationship to comprehension. Rameezdeen and Rodrigo [89] revealed that the successive standard forms of construction contracts have become easier to read. Finally, another research on this field was done in 2014 by Rameezdeen and A. Rodrigo [13], and they studied the impact of modification to standard forms of the construction contract on readability. They used 281 modified clauses from large infrastructure projects implemented in Sri Lanka. Their finding shows that 60% of the sample clauses were more difficult to read after modification by parties, which means more ambiguities come to the contract documents. With this analysis, we can compare the clarity or readability of each contract and make a comparison between the Canadian one and the rest of them. Rameezdeen and Rodrigo [13] identified four basic elements, which decide the ease of reading of a text, which is 'Content,' 'Style,' 'Structure,' and 'Design.' The result of readability helps us to learn more about the unknown causes of ambiguity in modular contract documents.

2.5. Natural Language Processing (NLP) for Contract

Faster data processing rather than we humans can with using computers software and working with standardized and structured data looks great. In this regard, the study needed automated regulatory compliance checking to analysis the data it had and extracted the data it needs to interpret the result. Natural language processing (NLP) helps computers communicate with humans in their language whereas it is one of the sub-branches of computer science, information engineering, and artificial intelligence in particular how to program computers to process and analyze natural language data. NLP is one of the most important technologies of the information age and enables computers to process human languages and understand them to get computers to understand human languages in closer and higher level and help us to overcome the language barriers [90]. Due to a large number of construction regulatory documents and their provisions, Information Extraction (IE) is a complicated task that needs complex analysis to process the input data. The manual process of data analysis or compliance checking is costly, time-consuming and less accurate so, J. Zhang and et al [91] proposed a Semantic NLP based information extraction from construction documents for automated compliance checking. In this order, NLP helps the study to automatically analysis and process the text and extract the requirements from contract documents.

Given the historical efforts to dispute challenges of modular construction, and the new tendency being paid to reducing this kind of time and cost consuming issues, between owners, engineers,

architects, and manufacturers, specific attention needed in order to increase the barriers have hampered the higher productivity of modular projects.

3- Methodology

This chapter has three major phases; 'developing an analysis framework,' 'text processing,' and 'readability analysis' to analyze standard contract documents and RFPs. Figure 8 illustrates the high-level methodology of the work in this research.

3.1. Development of Fish-bone for Conventional Construction contract documents

Construction contracts are usually formed based on standard forms of contract, which have been developed by several independent professional organizations and are intended to be used in different contractual arrangements. In the first phase of this study, an analysis framework developed through a comprehensive review of the 'Conventional' construction literature. In this regard, construction contract documents publications since 1980 were reviewed and analyzed. That part of the study synthesizes results of 48 papers under five major categories (contract language, the contract document, stakeholders, design-related issues, and external factors) as well as sub-categories and their classes that mapped on a Fish-bone diagram (see Figure 5). The results of that work are reported elsewhere, but, given the objectives of the present paper, the scope has limited to the category called "contract documents." Sub-categories of this category in our conceptual framework, as well as some of the causes (reported in the literature) giving rise to each sub-category, are listed in Appendix 1.

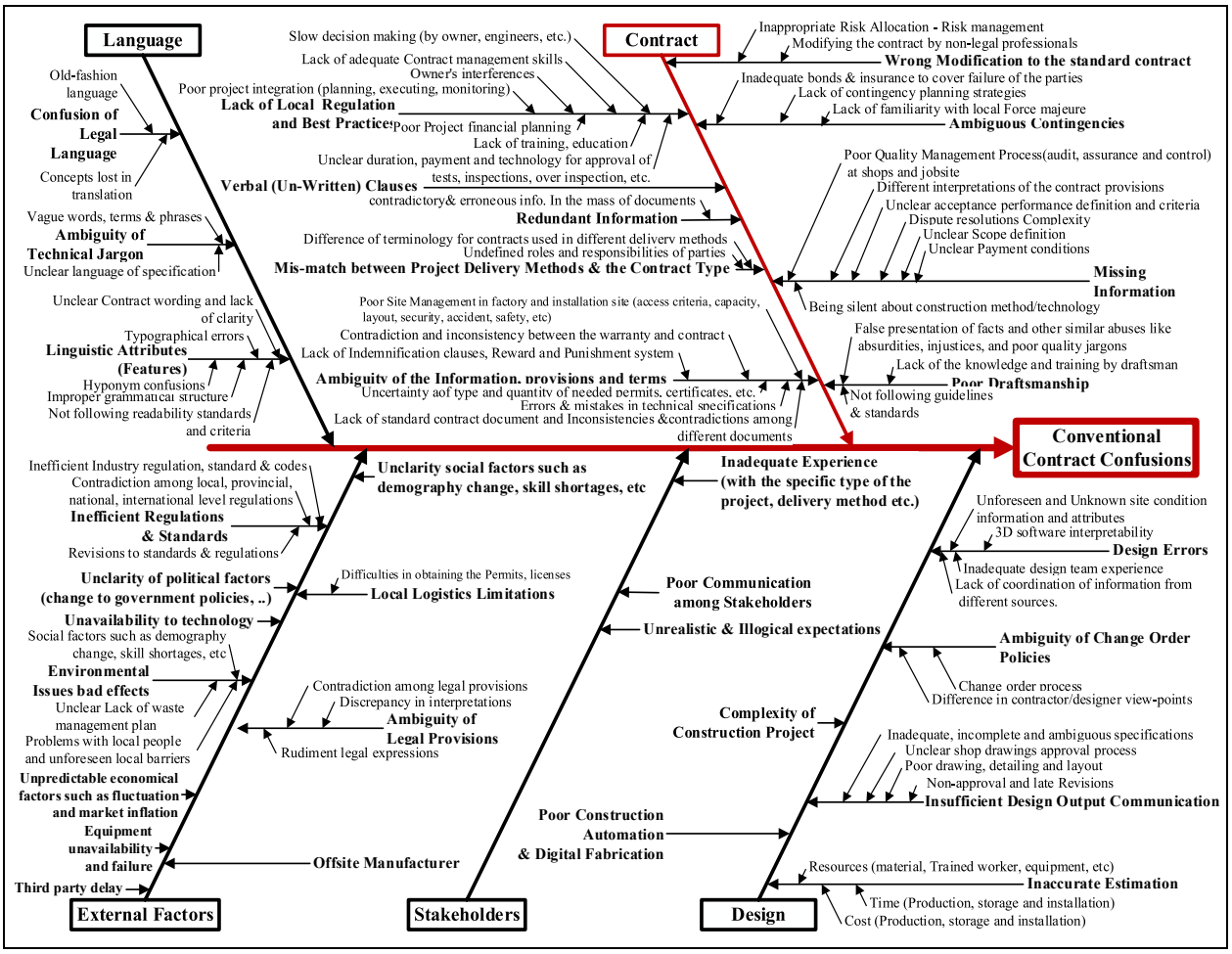


Figure 5- Fish-Bone diagram for sources of confusion in Conventional construction contract documents based on the literature review

3.2. Development of Fish-bone for Modular Construction contract documents

The same process is done for section 3.1 repeated for this section. A comprehensive literature review of 35 modular international publications related to the construction contract, which have been published since 2000. The sources of confusion in modular contract documents detected and classified into five main categories. The result categorized the same as conventional construction classification to; contract, design, stakeholders, external factors, language, and their sub-categories and mapped on a Fish-bone diagram (see Figure 6). The new findings mapped to the original taxonomy, and the outcomes revealed some new sources of confusions in modular contract documents, mostly due to the new technologies' involvement and logistic regulation and limitation. As explained in the previous section, the scope of this section has limited to the "contract documents" category. Sub-categories of this category in our conceptual framework, as well as some of the causes (reported in the literature) giving rise to each sub-category, are listed in Appendix 2.

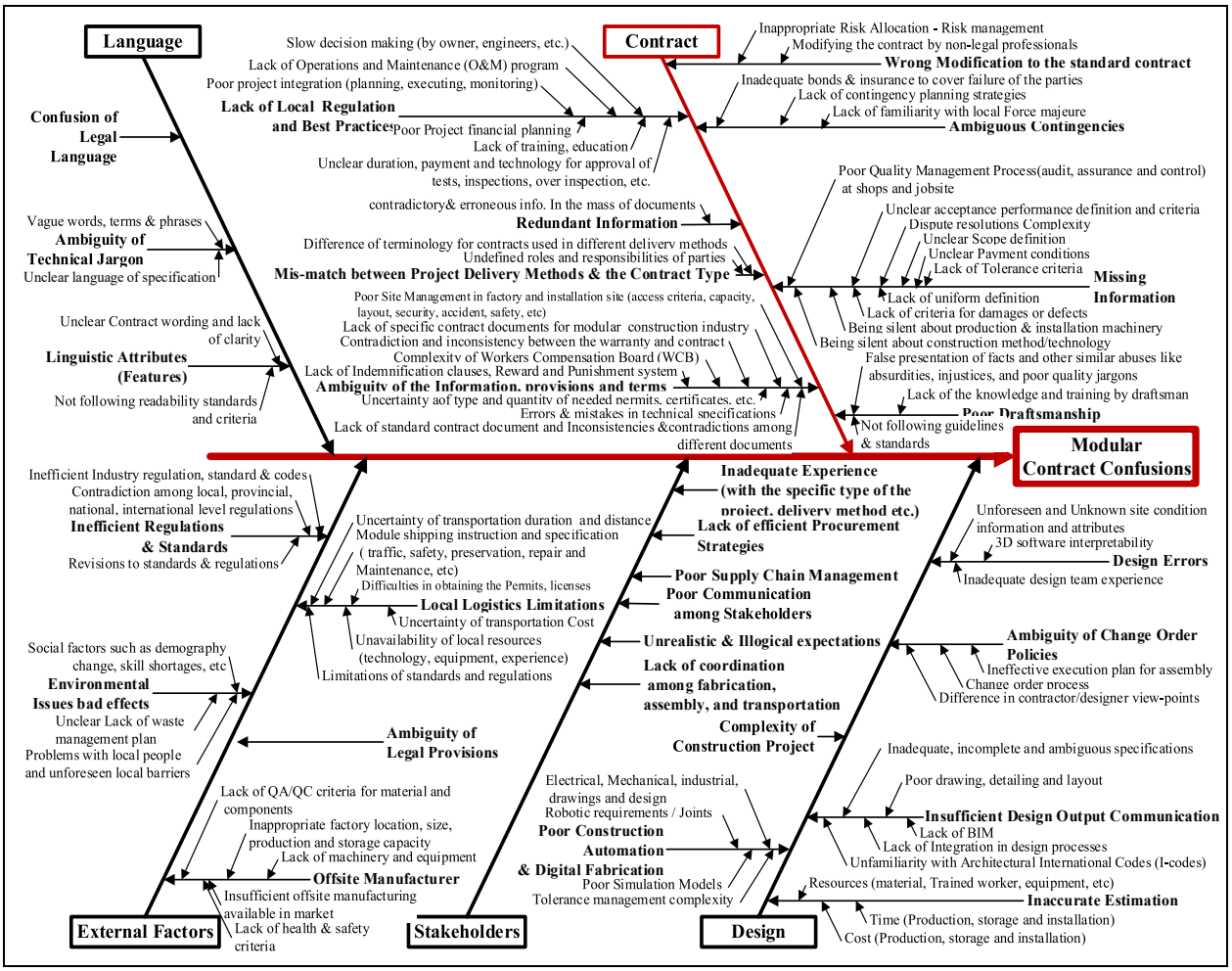


Figure 6- Fish-Bone diagram for sources of confusion in Modular construction contract documents based on the literature review

3.3. Data Collection

The main target of this research is the Canadian modular construction contract document. That is why some other benchmark documents from other countries needed to be compared to see if there is any missing in Canadian modular contracts or not.

3.3.1. Standard Contracts

In this study, two English-speaking countries (USA and UK) with a considerable background of not only modular construction but also publishing standard contract documents for the construction industry have been chosen as the main benchmarks. The UK is one of the pioneer countries in standardizing the construction contracts, and its newest standard contract is New Engineering

Contract (NEC). The New Engineering Contract (NEC3) is created by the Institution of Civil Engineers that leads the drafting of standard documents on civil engineering and construction projects awarding and administering contracts and is published in 1993 and is a radical departure from the existing building and engineering contracts. It is written in plain English language and designed to stimulate proper management. NEC ECC(NEC Engineering and Construction Contract), is a group of individual contracts in preparing complete project management required for the entire project. It covers planning, defining legal relationships and procurement of works, project completion, management and beyond. The NEC3 complies fully with the AEC (Achieving Excellence in Construction) principles. The Efficiency & Reform Group of The UK Cabinet Office recommends the use of NEC3 by public sector construction procurers on their construction projects. The contract consists of two essential parts; Data provided by the Employer and Data provided by the Contractor. This family of standard contracts is used in the UK and English speaking countries including New Zealand, Australia, Hong Kong and South Africa. NEC standard contract has been four editions, the first in 1993, the second in 1995, the third in 2005 and the most recent in 2017. The NEC3 was launched in 2005, and it was amended on April 2013 [92].

On the other hand, in the USA, the American Institute of Architects (AIA) chose as the American standard contract. It publishes nearly 200 contracts and forms that are recognized throughout the design and construction industry as the benchmark documents for managing transactions and relationships involved in construction projects. AIA was founded in 1857 by 13 architects and now has more than 200 chapters around the world with more than 94,000 members strong. The AIA's committee continues to draft new and revised Contract Documents. In 2017, the updated suite of core Contract Documents for 2017 series (which is the AIA's 17th edition of standard documents) was released [93].

Finally, for Canada, the Canadian Construction Documents Committee (CCDC) has been selected as the input for this research, since it is the most popular one in the Canadian industry. CCDC provides balance, uniformity and standardization for bidding and contracting procedures. CCDC documents have been developed through a consultative process with representatives from all sectors in the construction industry. Four constituent national organizations endorse all CCDC Documents; Association of Consulting Engineering Companies – Canada (ACEC), Canadian Construction Association (CCA), Construction Specifications Canada (CSC), and Royal Architectural Institute of Canada (Architecture Canada). CCDC representation also includes a lawyer from the Canadian Bar Association (Construction Law Section), who sits as an ex-officio member [94].

Next step is choosing the right project delivery method, which the critical decision is made by the owner embarking on a construction project. As stated in section 1.2., the Design-Build delivery method not only has more adaptability with the modular construction but also the modular contract documents based on Design-Build have fewer ambiguities than other methods [86]. As a result of the three previous paragraphs, standard contracts of three different countries detected and finally

three standard contracts selected as the CCDC uses CCDC14 (2013) for Design-Build projects, AIA uses the AIA141 (2014) and finally, the NEC that does not have a specific Design-Build contract, but the closest contract to Design-Build is NEC3 or Engineering and Construction Contract (ECC) (2013) (see figure 8).
There are some limitations in this section as 'lack of access to modular construction executive contract documents from modular companies (since the contracts are the private assets of each company)' and 'lack of specific standard modular contract document across the world [95].

3.3.2. RFPs

Following the previous section, two English-speaking countries (USA and UK) with a good background in standardizing the construction contract documents have chosen as the benchmarks for this study; therefore, the modular construction RFPs also selected from those countries.
To select the right RFPs, 16 RFPs from benchmark countries have been downloaded, then based on the year of propose and the completeness, one RFP from the UK and two RFPs from the USA selected. Also, based on the report by CMHI (Canadian Manufactured Housing Institute) [96], the top building manufacturer in Canada are located in the following provinces; Ontario, BC, and Quebec. Quebec removed from the targeted list since its first formal language is French. At first five modular RFPs from Ontario and BC in Canada downloaded, and at last one, RFP from BC that was close to the study's criteria has been selected.
The Canadian modular RFP is 'Modular Office Building at Austin Works Yard' with RFP No. 17-03-03, issued at 2017 from City of Coquitlam, British Colombia. This RFP requested proposals to design, supply, deliver and install a new approximately 6,000 square feet Modular Office Building. In the UK, we chose RFP from 'Compton School' issued in 2018 in Newbury. It is a single-story modular school building and associated external works in West Berkshire. It should be mention that in this RFP the form of contract to be entered into would be the JCT (The Joint Contracts Tribunal), 2016. The works comprise the demolition of an existing external block and its replacement with a modular classroom including all necessary builders and associated site and external works. The last country is the USA, which two RPFs from two significant states have been selected that are working in the modular industry [96], one from Georgia and the other one from Florida. The RFP from Florida is 'Modular Classroom and Non-Instructional Building Purchase and Placement' which is asked by School District of Palm Beach County in 2012 (the scope of services will be as defined in the form of Agreement between Owner and Contractor) and RPF from Georgia is a 'Modular Office Building' in Dawson County released in 2009 with PRF number #9009RFP. Modular Office Building at the Burt Creek Complex designed and built by contractor to house the Dawson County Road Department. The completed facility will be approximately 1400 Sq. Ft and include four private offices, an open training area, and restrooms.
Figure 7 shows the process of selecting the resources used in this study.

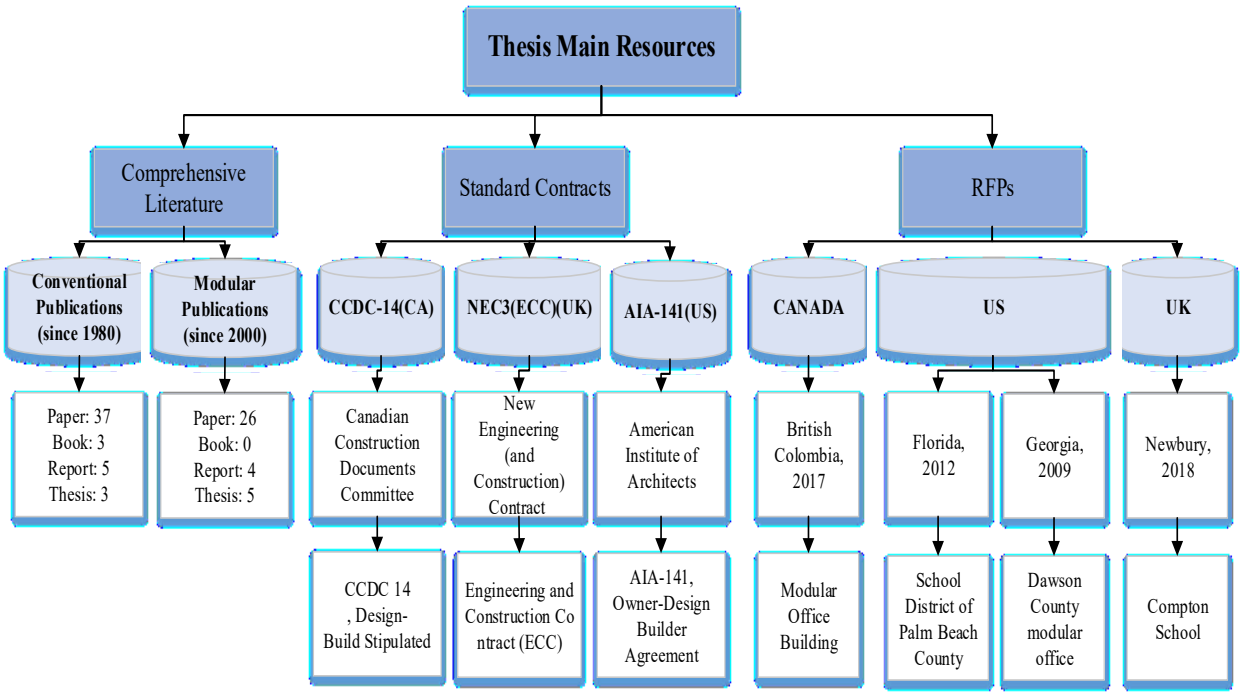


Figure 7. An overview of the resources used in this research

The limitation of this section is the lack of access to modular construction RFPs since in recent years most of the countries reveal construction RPFs just online and to the registered, authorized, and local companies/proposers and limited the access to their documents for unauthorized people.

3. 4. Criteria for selecting the scope

This study has two types of documents, the first one is construction Design-Build standard contract documents that as mentioned in section 1.2., have more adaptability with modular construction. The second type of documents is modular construction RFPs. The study has two different input and output for its analysis with two analysis framework as being defined in section 3.1, and 3.2.

As mentioned in section 1.1., there is not specific modular construction standard contract for this industry, so in this research Design-Build standard contracts which are defined as the most suitable one to modular construction, has been chosen. In this case, conventional framework analysis is used as the base of the scope (see figure 5 and Appendix 1) for this part because this framework prepared based on the conventional publications. On the other hand, for modular RFPs, the modular analysis framework has been used to define the scope (see figure 6 and Appendix 2). To identify and select the relevant clauses from standard contracts and modular RFPs and define the scope of the work, four criteria have been used; (1) With the help of titles in 'Table of contents', each document, section or part which were completely related to any item of the framework of the study (tables 3 & 4) have been identified, copied, pasted, and saved to a targeted file. (e.g., to select related clauses for item 'Dispute resolutions Complexity' with 'code 13', in standard contract

CCDC-14, 'Part 8 – Dispute Resolution' which is completely cover this item, selected.). (2) By helping the sub-titles, the paragraphs or clauses which were related to the scope, identified, copied and pasted to their related file. For instance, item 'Lack of Indemnification clauses, Reward and Punishment system' with 'code 21', in part 12 (Indemnification, limitation of liability, waiver of claims, and warranty) of CCDC-14, there is a related sub-title 'GC 12.2- Indemnification' that has been selected. (3) By using the text search tools and specific terms and keywords, clauses that were related to scope identified and located into the targeted files. (4) In the end, the classes for which they failed to find relevant clauses in all the three contracts (for Conventional construction) and in all four RFPs (for modular construction) have been excluded.

After applying these four steps, from 31 identified causes of ambiguities (listed in Appendix 1), nine causes have been remained as the primary scope for conventional standard contract documents (as shown in Table 3), and from 34 causes of confusion that were identified by modular construction literature review (listed in Appendix 2), 21 causes remained as the primary scope for modular RFPs (as shown in Table 4).

Table 3- Primary scope of conventional construction

Sub-category	Feature (topical class)	Codes (Link to Appendix 1)	Standard Contracts (Term count*)		
			CA	USA	UK
Missing Information	Unclear Acceptance performance definition and criteria	**6**	1149	306	563
	Unclear Payment conditions	**10**	2533	1829	2245
	Dispute resolutions Complexity	**13**	1743	2362	2194
	Poor Quality Management Process(audit, assurance and control) at shops and jobsite & Inspection and Test Criteria	**15 & 27****	372	269	346
The ambiguity of the information,	Contradiction and inconsistency between the warranty and contract	**18**	139	684	181
	Poor Site Management in factory and installation site (access criteria, capacity, layout, security, accident, safety, etc.)	**20**	493	115	184
Ambiguous Contingencies	Lack of familiarity with local force majeure	**32**	70	35	41
	Lack of contingency planning strategies	**33**	289	386	319
	Inadequate bonds & insurance to cover failures of the parties	**34**	2172	829	541

* Size is based on the total number of words in each class.

** Items 15 and 27 in standard contracts (Table 3) were combined because both are important items but with small size clauses].

Table 4- Primary scope of modular construction

Sub-category	Feature (topical class)	Codes (Link to Appendix 2)	Modular RFPs (Term count*)			
			BC	Florida	Georgia	UK
Missing Information	Unclear Acceptance performance definition and criteria	**6**	180	257	168	267
	Lack of criteria for damages or defects	**8**	422	424	351	148
	Unclear Payment conditions	**10**	211	434	450	1843
	Dispute resolutions Complexity	**13**	209	191	340	706
	Lack of Tolerance criteria	**14**	0	0	371	132
	Poor Quality Management Process(audit, assurance and control) at shops and jobsite	**15**	68	0	113	991
Ambiguity of the information, provisions and terms	The complexity of Workers Compensation Board (WCB)	**16**	0	27	66	0
	Lack of specific contract documents for the modular construction industry	**17**	0	**AIA**	0	**JCT**
	Uncertainty of type and quantity of needed permits, certificates, etc.	**19**	116	181	51	459
	Poor Site Management in factory and installation site (access criteria, capacity, layout, security, accident, safety, etc.)	**20**	380	268	138	3474
	Lack of Indemnification clauses, Reward and Punishment system	**21**	146	772	174	328
	Errors & mistakes in technical specifications	**22**	0	633	183	0

	Lack of standard contract document and Inconsistencies & contradictions among different documents	**23**	0	103	14	126
Lack of local regulations and	Unclear duration, payment and technology for approval of tests, inspections, over inspection, etc.	**27**	160	0	21	150
	Poor project financial planning	**31**	0	0	0	368
Ambiguous Contingencies	Lack of familiarity with local force majeure	**32**	0	0	54	47
	Lack of contingency planning strategies	**33**	0	97	0	21
	Inadequate bonds & insurance to cover failures of the parties	**34**	146	864	216	149
Mis-match between project delivery methods	Undefined roles and responsibilities of parties	**35**	90*	1067	471	1396
Wrong modification to the standard contract	Inappropriate Risk Allocation - Risk management	**38**	0	0	0	21
	Modifying the contract by non-legal professionals	**39****	0	0	0	0

* Size is based on the total number of words in each class.

** It is kept because it is the base country of comparison either, its size is more than 40 words.

3.4.1. The final scope for Standard Contracts

Following Table 3, from the 31 classes began with, nine classes remained as the primary scope of work. To define the final scope for standard contracts, the classes for which the size of relevant clauses in the three contracts was significantly different, have been removed; in this regard, the classes in which the size of text (term count) for one contract was five times less than total average of all three (by summing up the number of terms of all three related classes, and dividing them by three), have been excluded. Then, classes in which the size of text (term count) for one contract was less than 50 words, have been excluded. Because when the output of TF and TFIDF is defined to be 25 words, the chance for a term with a frequency of one is low to have an important semantic role in a document (e.g. Code 32 in Table 3 has been removed since the size of documents of the USA (Term count=35), and UK (Term count=41) is less than 50 words).
In the end, seven classes and their associated sizes (number of terms) in each contract have been remained and listed in Table 5 as the final scope of standard contract documents.
Figure 9 shows the process of classification of data in standard contracts.

3.4.2. The final scope for Modular RFPs

Following Table 4, from the 34 classes began with, 21 classes remained as the primary scope of modular RFPs. To define the final scope for modular RFPs, the classes for which the size of relevant clauses in the four modular RFPs were significantly different, have been removed; in this regard, the classes in which the size of text (term count) for one contract was five times less than total average of all three (by summing up the number of terms of all three related classes, and dividing them by four), have been excluded. Then, classes in which the size of text (term count) for one contract was less than 40 words, have been excluded. Because when the output of TF and TFIDF is defined to be 20 words, the chance for a term with a frequency of one is low to have an important semantic role in a document.
In the end, nine classes as well as class 39 (which is related to readability analysis) and their associated sizes (total number of terms) in each contract, have been remained and listed in Table 6 as the final scope of modular RFPs documents.
(There is just one exception; size of class 35 with 90 words which is related to Canadian RFP, is less than average of 195 words (average of total terms of this class in four RFPs) and should be excluded but, because it belongs to the Canada (which is the base country of comparison) either, its size is more than 40 words, has been kept for analysis).
Figure 10 shows the classification process of data in modular RFPs.

Table 5. The final scope of standard contract documents investigated in this study and the associated size of relevant clauses in the three standard contracts studied

Feature (topical class)	Codes (Link to	Standard Contracts (Term Count*)

	Appendix 1)	**AIA 141**	**CCDC 14**	**NEC3**
Unclear Acceptance performance definition and criteria	**6**	1149	306	563
Unclear Payment conditions	**10**	2533	1829	2245
Dispute resolutions Complexity	**13**	1743	2362	2194
Poor Quality Management Process & Inspection and Test Criteria	**15 & 27**	372	269	346
Poor Site Management in factory and installation site	**20**	493	115	184
Lack of contingency planning strategies	**33**	289	386	319
Inadequate bonds & insurance to cover failures of the parties	**34**	2172	829	541

* Size is based on the total number of words in each class.

Table 6. The final scope of modular RFPs investigated in this study, and the associated size of relevant clauses in the four RFPs studied

Feature (topical class)	Codes (Link to Appendix 2)	Modular RFPs (Term Count*)			
		BC	**Florida**	**Georgia**	**UK**
Unclear Acceptance performance definition and criteria	**6**	180	257	168	267
Lack of criteria for damages or defects	**8**	422	424	351	148
Unclear Payment conditions	**10**	211	434	450	1843
Dispute resolutions Complexity	**13**	209	191	340	706
Uncertainty of type and quantity of needed permits, certificates, etc.	**19**	116	181	51	459

Poor Site Management in factory and installation site (access criteria, capacity, layout, security, accident, safety, etc.)	**20**	380	268	138	3474
Lack of Indemnification clauses, Reward and Punishment system	**21**	146	772	174	328
Inadequate bonds & insurance to cover failures of the parties	**34**	146	864	216	149
Undefined roles and responsibilities of parties	**35**	90	1067	471	1396
Modifying the contract by non-legal professionals	**39**	all documents and each class			

* Size is based on the total number of words in each class.

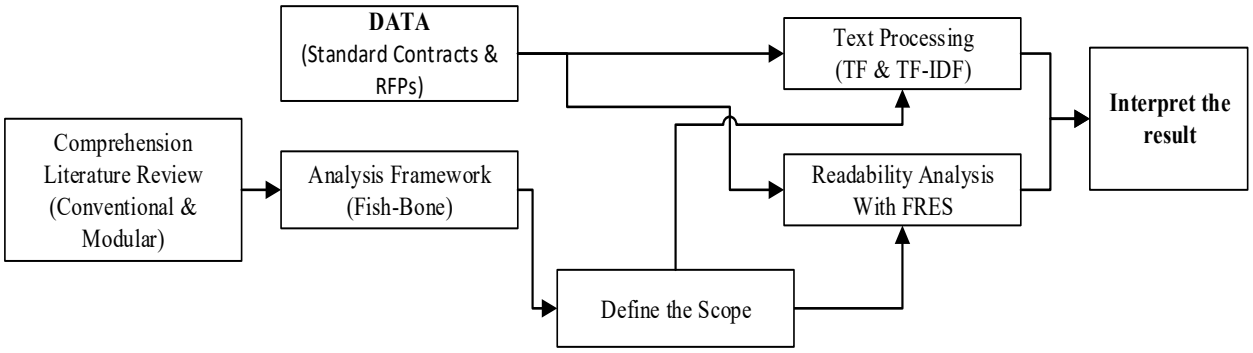


Figure 8. The high-level methodology of the work

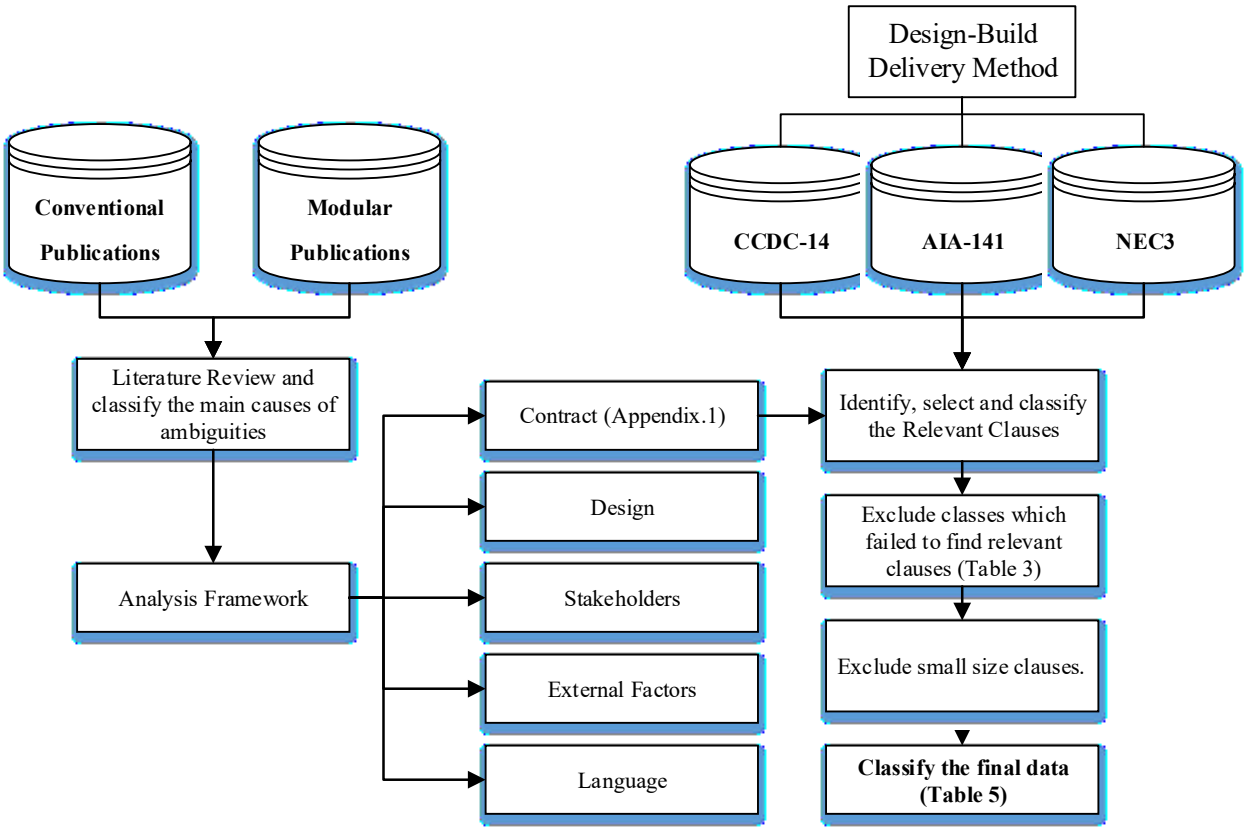


Figure 9. Classification process of standard contracts for text processing and readability analysis

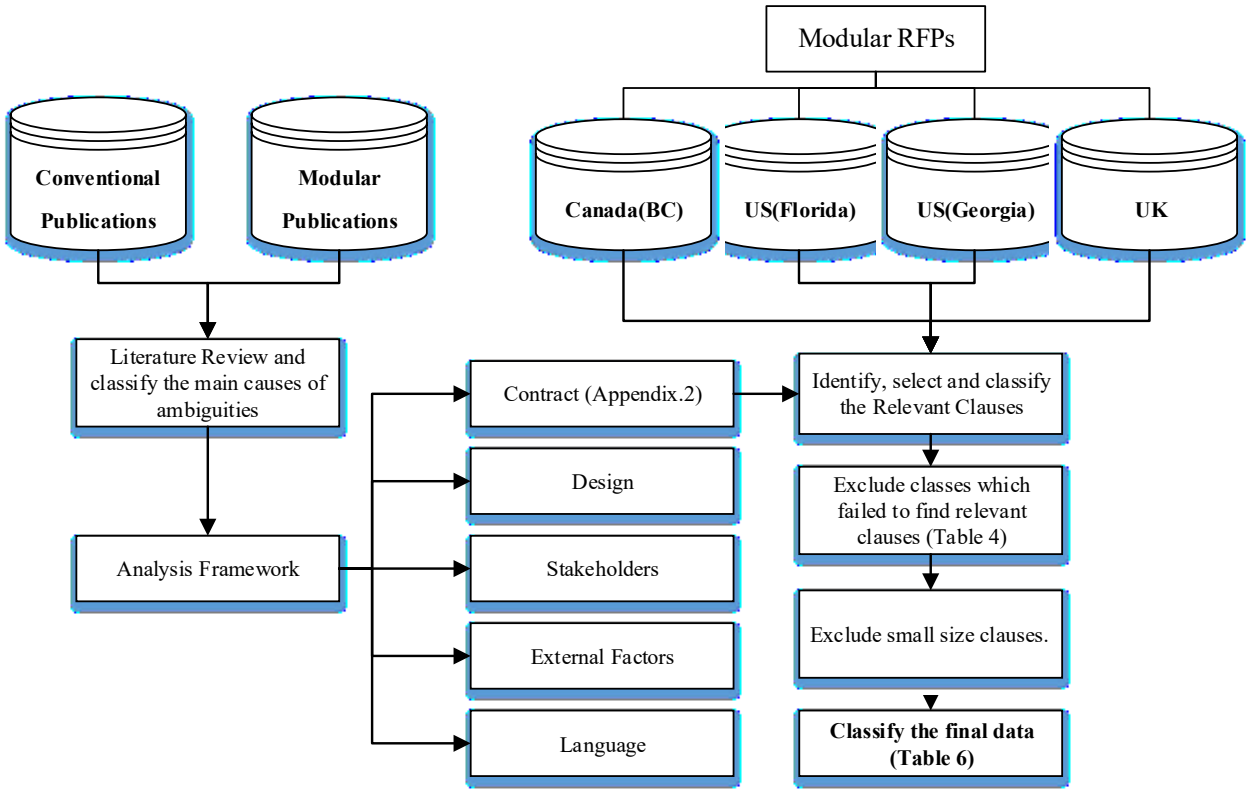


Figure 10. Classification process of Modular RFPs for text processing and readability analysis

Text-processing followed by interpretation of results has been used for quantitative analysis and comparison of the documents within our conceptual framework. More specifically, similarities and distinctions among the documents evaluated within the dimensions of study analysis framework, through evaluation of simple and basic text mining measures such as TF (Term Frequency) and TF-IDF (Term Frequency-Inverse Document Frequency).

Now, with the data selected in Table 5 and 6, the study is ready to begin the next step, which is text processing and readability analysis.

3.5. Text Processing

In this step, text-mining tools used and followed by interpretation of results, for quantitative analysis and comparison of the documents within the conceptual framework. More specifically, similarities and distinctions among the documents have been evaluated within the dimensions of analysis framework and thorough evaluation of simple and basic text mining measures such as TF (Term Frequency) and TF-IDF (Term Frequency-Inverse Document Frequency).

The collected text was mixed with unneeded data (including terms, characters, etc.) which must be filtered before the analysis. Thus, all the collected texts converted into Unicode (since they were in different encoding formats) then, a stop list used to clean the data from common words with no specific semantics (such as punctuations, conjunctions, articles, etc.). Next step of the preprocessing after the cleaning was tokenizing the input text (to their terms). In this regard, specific compound words which communicate semantics in the context of our study (such as 'Contract Price' and 'place of work'), as well as some specific terms (such as 'Design-Builder' and 'Federal Arbitration Act') were merged (to 'contractprice', placeofwork, 'designduilder', and 'federalarbitrationact' respectively). It is worthwhile emphasizing that merging such terms happened before applying the cleaning step. The cleaned and tokenized data were used as the input of text analysis [95]. (See Appendix 3 to 9)

We started text processing by evaluating frequency metrics, taking advantage of the Natural Language Toolkit (NLTK), which is a suite of Python libraries for symbolic and statistical natural language processing for the English language. We focused on top terms in the corpus, including terms with high TF (frequency of occurrence) in each document (i.e. accumulation of related clauses from each contract in each topical class), and high TF-IDF (high frequency of occurrence, uniquely in each document). Therefore, if term i appears fij times in document$j$, then [98]:

$$\mathrm{TF}_{ij} = {f_{ij}}\Big/{m_j} \qquad (1)$$

In which $m_j = \max i\,(f_{ij})$ and if n shows the number of documents to be compared, then:

$$\mathrm{IDF}_i = \log\,(n/1 + d_i). \qquad (2)$$

TF-IDF is then calculated for each term in each document as the product of its TF and IDF [95].

Terminology difference in different countries was one of the challenges in this research. Even-though all contracts and RFPs were selected from English speaking countries; differences in the names used to refer to the same concept in the three countries confused our text-mining engine and the results. For instance, NEC3 uses the term 'employer' to refer to the 'owner,' as called by CCDC14 and AIA141. As another example, the term 'place of the work' in CCDC14 is the same as the term 'site' in AIA and NEC. In this regard, the work faced some limitations such as lack of systematic method also, TF-IDF limitations in terms of detecting the synonyms, proverbs, compound words, expressions, etc. (For large document collections, this could present an escalating problem). In order to resolve this issue, some post-processing applied, where the

synonyms systemically detected among terms with high TF or TF-IDF and replaced by uniform equivalents. In this paper, CCDC14 has been selected as the basis for synonyms and changed terms of other two contracts to their synonyms in CCDC14 and RFP from BC as the basis for RFPs. The TF & TF-IDF process iteratively performed and followed by the post-processing until the no synonyms were left among top TF and/or TF-IDF words. Figure 11 shows the whole process of text processing and readability analysis in our research. (See Appendix 9-10)

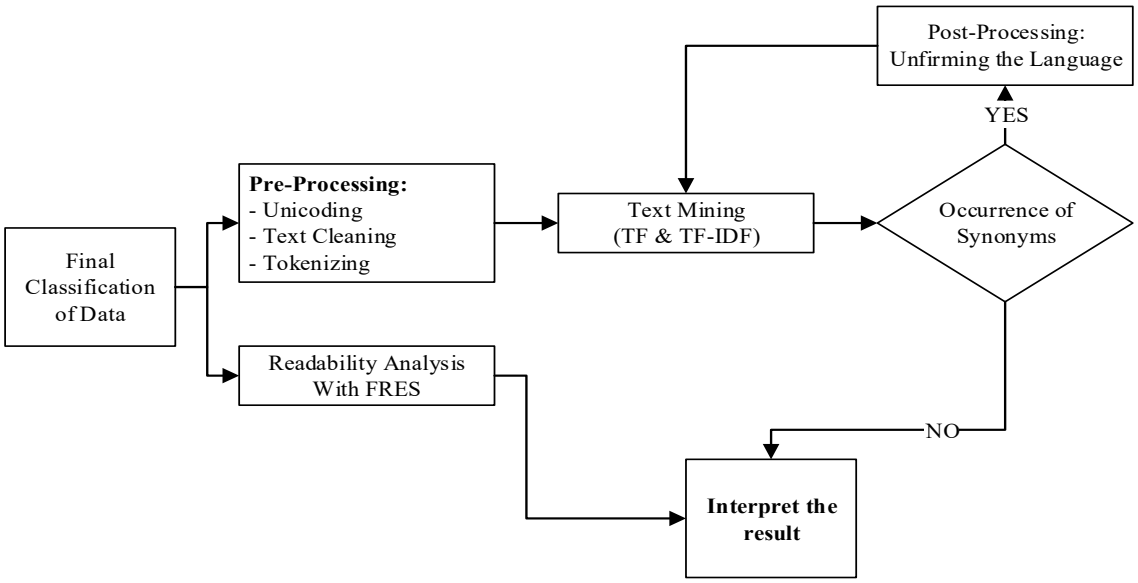


Figure 11. The process of Text processing and Readability Analysis

By trial and error, top 25 TF and TF-IDF terms for each class of standard contracts have been selected (since the size of clauses is great) and on the other side, top 20 TF and TF-IDF terms for each class of modular RFPs. This number was set so that the terms in the lists have meaningful frequencies (more than one) in the text they come from. This is because there is not the chance for the terms with the frequency of one to have an important semantic role in a document and since the terms with a count of one do not have any priority over other terms, all the terms with count=1 have been removed from the output tables.

The lists of high TF and high TF-IDF terms, although being good indicators, providing a starting point for interpretation, are not enough for making a meaningful comparison among the texts. Hence, after finishing TF and TF-IDF analysis, instances of occurrence of those terms in the documents have been searched and those parts manually reviewed to complete the comparison between standard contracts and RFPs as well. (See Appendix 12 and Appendix 13).

Then, from the terms that considered to be important (based on the TF & TF-IDF), they were read in the corresponding text in the related files and were compared manually with the other text files in that category. If a remarkable point is observed, this is referred to as a finding in the findings

section. The analysis ended when the terms found. From that point on, this comparison manually has been done. Alternatively, the meaning of the terms or related clauses manually compared.

3.6. Readability Analysis

What are the differences between 'Readability' and 'Comprehension'? Readability measures the textual complexity of a document, while Comprehension is the reader's understanding [99]. As Rameezdeen and Rodrigo [100] extracted from their literature review, readability formulae are the most popular tools for assessing the clarity of a text. Researchers highlighted some limitations for readability formulae as it does not take word order or grammar into consideration and the reader characteristics, too [99]. Moreover, not all features that promote readability can be measured mathematically, and these mathematical equations cannot measure comprehension directly [88]. Although there are many available readability formulae, and majority of them calculate the grade level of a text using syllables count, Term count and sentence length, Flesch Reading Ease Score (FRES) is a popular, tested, more reliable formula which is being consistent and highly associated with other indices to analysis the readability of a construction document text [100] [99]. Therefore, FRES is considered suitable for assessing the readability levels of our clauses against the standard conditions. FRES has seven levels starts from 0 to 100, where the score (0-30) indicates that a text is 'Very Difficult' to read. Table 7 listed the 'FRES Scores,' 'Difficulty Level' and 'Estimated Reading Grade.' It is obtained using the following formula [100] [99]:

Flesch Reading Ease Score (FRES)

$$FRES = 206.35 - (1.015 \times ASL) - (84.6 \times ASW)$$

Where,

ASL = Average sentence length (the number of words divided by the number of sentences)
ASW = Average number of syllables per word (the number of syllables divided by the number of words).

In order to find the best readability calculator to analyse the document's readability based of FRES, several readability online websites such as https://www.online-utility.org/english/readability_test_and_improve.jsp, https://www.webfx.com/tools/read-able/, http://www.readabilityformulas.com/free-readability-formula-tests.php, and https://readable.com/ have been recognized. Finally, based on the organization structure and https://readable.com/ has been selected as the online readability machine since it is specifically working on this field and is the world's most powerful readability score app [85]. This website is the most specialized among readability online websites because of its qualitative and quantitative structure and that it has all the relevant formulas and provides the users with relevant text Statistics, text Quality, results and analysis in all the details. The readability of each class separately analyzed then, the result of each related class compared together.

In order to verify the consistency of the results and also in cases that the FRES showed anomaly, they were re-analyzed by another online machine (http://www.readabilityformulas.com/) and manually too. To make the comparison of readability, the statistical significance in the difference of readability of different sections in different documents has been evaluated. In this matter, the average (mean) and standard deviation (SD) has been used. The mean and the standard deviation (SD) for each class are calculated and compared in order to test the hypothesis. SD is defined as the average amount by which scores in a distribution differ from the mean, ignoring the sign of the difference. SD is also defined as the average distance between any score in a distribution and the mean of the distribution [88]. The output of readability analyzes were imported into Excel then, using the Excel program formulas, the SD and mean calculated and results are shown in the readability related graphs.
The average (mean) calculated to see which documents are more readable and SD used to see how measurements are spread out from the average (mean). It should be mention here that the clauses used in this method are original clauses that have been picked from the sources documents. Not all features that promote readability can be measured mathematically, and these mathematical equations cannot measure comprehension directly.

3.6.1. What is a Flesch Reading Ease score?

Rudolph Flesch in the late forties, was a consultant with the Associated Press, came with the new and innovative readability formula named Flesch Reading Ease (1948) by developing methods for improving the readability of newspapers. This could tell us what level of education someone needed to easily read a piece of text by giving the text a score of between 1 and 100. This study used it to help assess the ease by which a piece of text will be understood and engaged with. [85].

Table 7: FRES guide to comparisons of readability [88]

FRES	Difficulty Level	Estimated Reading Grade
0-30	Very difficult	Postgraduate
31-50	Difficult	College
51-60	Fairly difficult	High school
61-70	Standard	8th to 9th Grade
71-80	Fairly easy	7th Grade
81-90	Easy	5th to 6th Grade
91-100	Very easy	3rd to 4th Grade

The following chapter summarizes the results of the research for each part.

4- Results

Modular RFPs are specifically prepared for modular construction purposes while standard contracts inherently belong to general projects. While the RFPs are written by the company's drafter who is not as professional as standard contract drafters are, organizations that publish standard contracts, benefit from a wide range of expertise in related fields like financial advisors,

insurance advisors, management team, legal counsels, architects, advocates, experienced engineers, and consultants who are some of their committee members. As mentioned in the literature review, 'poor draftsmanship' and 'wrong modification to the standard contracts' are known as the sources of ambiguities in construction contract documents.

4.1. Comparison of Standard Contracts (Canada vs. UK and US)

Comparison between the three standard contracts shows that the size (TC) of classes 'Dispute Resolution (code 13)' and 'Payment Condition (code 10)' is considerably greater than the size of other classes among three standard contracts. The size (TC) of class 'Inadequate bonds & insurance to cover failures of the parties (code 34)' and class 'Unclear Acceptance performance definition and criteria (code 6)' in AIA-141 is significantly higher than the other two countries which indicate that American contract tried to reduce the ambiguities by adding more clauses in these classes (see Table 5). It shows that these classes are recognized important by experts and they used extra complementary clauses for them so, it can be a good indicator for construction contract owners and engineers to look at these clauses when they are drafting the new contract or modifying the existing one in their projects.

As mentioned in the literature review, one of the issues in modular construction is organization readiness. Three standard documents compared by looking at different actors in their content. NEC3 introduces the 'Project Manager,' as an additional role who is allocated and hired a person to act on behalf of the employer by a high level of authority to communicate with other parties involved in the project. This can be partial because NEC3 is Engineering and Construction Contract (it is not Design-Build but the closest one to that delivery method) and substantially different from the other two design-build contracts. Term 'project manager' has a high TF and TF-IDF in the majority of classes from NEC3 contract, which indicate that it has specific responsibilities in this document. Based on the PMI (Project Management Institute) [92] the project manager's position in projects is crucial since this actor has full responsibility and accountability and must apply lessons learned, define roles and responsibilities, lead project planning and tracking, perform risk management, apply best practices, communicate to the project sponsor and team, promote client involvement, mentor, promote good working relationships, and make things happen. In addition, a project manager with high experience in modular construction hired by owner at the beginning bidding process can be beneficial for the project specially for classes such as 'Acceptance performance definition and criteria (code 6)', 'Payment condition (code 10)', 'Dispute resolutions (code 13)', 'Contingency planning strategies (code 33)', 'Poor Project financial planning (code 31)' 'bonding & insurance (code 34)', and 'Undefined roles and responsibilities of parties (code 35)'. This role has not been defined in American AIA-141 and Canadian CCDC-14, and also RFP from BC does not have this significant role. (See Table 8)

Furthermore, CCDC-14 has a new role of 'Payment Certifier' assigned by the owner in which makes the payment in order to certify the payment after reviewing and certifying the Design-

Builder's application for payment. This role can be beneficial in case of reducing the effect of 'unclear payment conditions (code 10)', 'Unclear acceptance performance definition and criteria (code 6)', 'Poor Quality Management Process (code 15)', 'Inadequate bonds & insurance to cover failure of the parties (code 34)', 'Poor Project financial planning (code 31)'. (See Table 8)

Table 8: Different Roles in RFPs and Standard Contracts

Canada		**USA**			**UK**	
CCDC14	**RFP**	**AIA141**	**RFP (Florida)**	**RFP (Georgia)**	**NEC3**	**RFP**
-	-	-	**Project Manager**	**Project Manager**	**Project Manager**	**Project Manager**
Design-Builder	Contractor	Design-Builder	Contractor	Contractor	Contractor	Contractor
Owner	City	Owner	Owner	Owner	Employer	Employer
Consultant	Consultant	Consultant	Consultant	Consultant	Consultant	Consultant
Payment Certifier	-	-	-	**Construction Inspector**	-	-

Dispute resolution procedure among the three standard contracts, as shown in Table 9 and Table 10, has different processes and roles. The major roles are defined as 'Adjudicator' in NEC3 and 'joinder person' in AIA-141. Comparison of related clauses in two contracts shows that role as 'project mediator' in CCDC14 has the same role as the term 'adjudicator' in NEC3 standard contract, but with responsibilities that are less detailed. Occurrence frequency results for terms such as 'project mediator' in CCDC14 (and 'mediator' in AIA141), compared to 'adjudicator' and 'arbitrator' in NEC3 could indicate that the Canadian contract documents would recommend resolving disputes through negotiation rather than judicial authorities.

In this category, the findings show considerable differences among the three standard contracts (Summarized in Table 9). The difference partially has roots in terminology difference of the documents, and partially shows variations in the process of claim and dispute resolution. In CCDC14, the dispute resolution is suggested to solve the problems with amicable negotiations at first, if unsolved, then to proceed with mediation by assigning a 'project mediator,' and at the end, it offers the arbitration process. In AIA141, 'initial decision' (inherently similar to 'negotiation' but with a longer procedure) is explained, and the details of communication between parties to manage the dispute are elaborated. The initial decision is followed by 'mediation' and then either 'arbitration' or 'litigation.' Lastly, NEC3 offers different terminology and process. In this contract,

'adjudicator' has the main role in the dispute resolution. Disputes are referred to the adjudicator by an 'adjudication table.' If the parties cannot resolve the disputes through the adjudication process, they then go to the 'tribunal' as the last step of dispute resolution. Administrative tribunals are set up to be less formal, less expensive, and a faster way to resolve disputes compared to the traditional court system. These clauses can use to reduce the 'dispute resolution complexity (code 13)' in construction projects.

Table 9- Process of Dispute Resolution in modular RFPs and Standard Contracts

Canada				USA				UK			
CCDC-14	**Freq. of occurre**	**BC**	**Freq. of occurre**	**Dispute Process**	**Freq. of occurre (AIA-141)**	**(Freq. of occurre) FL**	**(Freq. of occurre) GL**	**NEC3**	**Freq. of occurre**	**UK (RFP)**	**Freq. of occurre**
Negotiation	6	Negotiation	5	Initial Decision	14					Negotiation	2
Mediation Negotiation	5	Mediation	4	Mediation	19					Mediation	1
	-							Adjudication	10	Adjudication	7
Arbitration	14			Arbitration	25		1	Arbitration	6	Arbitration	15
Court	5			Court	8						
-	-	Litigation	2	Litigation	1	5		Tribunal	24		

Table 10. Main roles related to dispute resolution in the three standard contracts

AIA141	**Freq. of occurrence**	**Size of document**	**CCDC14**	**Freq. of occurrence**	**Size of document**	**NEC3**	**Freq. of occurrence**	**Size of document**
Mediator	1	1743	Project Mediator	7	2362	adjudicator	95	2194
Arbitrator	4		Arbitrator	0		Arbitrator	4	

Joinder Person	4		-	-		-	-	

Time is one of the main three constraints of each project, and the units for measuring the time in contracts must be well defined. There are different units for measuring the time in these three contracts. AIA-141 uses the term 'day' (mean Calendar Day), and NEC3 uses the 'week' as the time unit. On the other hand, CCDC-14 is using its two different units of time for different parts of the contract (see table 14). It uses the term 'Working Day' for part 6 (changes in the contract), part 7 (right to suspend or terminate), and part 8 (dispute resolution) while it is using the term 'Calendar Day' for part 5 (payment), part 11 (insurance and contract security), and part 12 (indemnification, limitation of liability, waiver of claims, and warranty). The definition of terms that use for measuring the time is; 'Calendar day: midnight to midnight,' 'Working day: Monday to Friday', and 'Business day: Monday to Friday (Business hours).' This can be an indicator of providing more objectively and clearly defined duration units by CCDC14 (for both windows of submitting new claims and reasons for more disputes) [95]. (See Table 11)

Table 11- Units for measuring the time used in Standard Contracts and RFPs

Unit	**Canada**		**USA**			**UK**	
	RFP (BC)	**CCDC14**	**(RFP) Florida**	**(RFP) Georgia**	**AIA141**	**RFP**	**NEC3**
Week	-	-	-	Bid Process	-	All	All
Business day	Bid Process	-	Bid Process	Payment	Insurance & Bond	Bid Process	-
Calendar day	-	Payment, Insurance and Warranty	Execution & Payment	Bid Process	Payment	-	-
Working Day	-	Change management and Dispute process	Bid Process	-	-	Execution & Payment	-

Operating day	-		-	-	-	Training of Employer's Staff	-

NEC3 suggests the concept of "Defects Certificate" which is helping to monitor the defected modules and material of the work, either certify that there are no patent defects or lists any uncorrected defects. This term does not exist in CCDC-14 and AIA-141. This certificate (list of defects) provided by the supervisor (who is issuing his certificates to the Project Manager and the Contractor), being corrected by the contractor during a defect correction period; or a statement that there are none, at the end of the defect correction period. This term helps the project in some categories mentioned in the scope, such as 'performance acceptance criteria' (code 6), 'payment conditions (code 10)', 'lack of criteria for damages or defects (code 8)', and 'Inadequate bonds & insurance to cover failures of the parties (code 34)'.

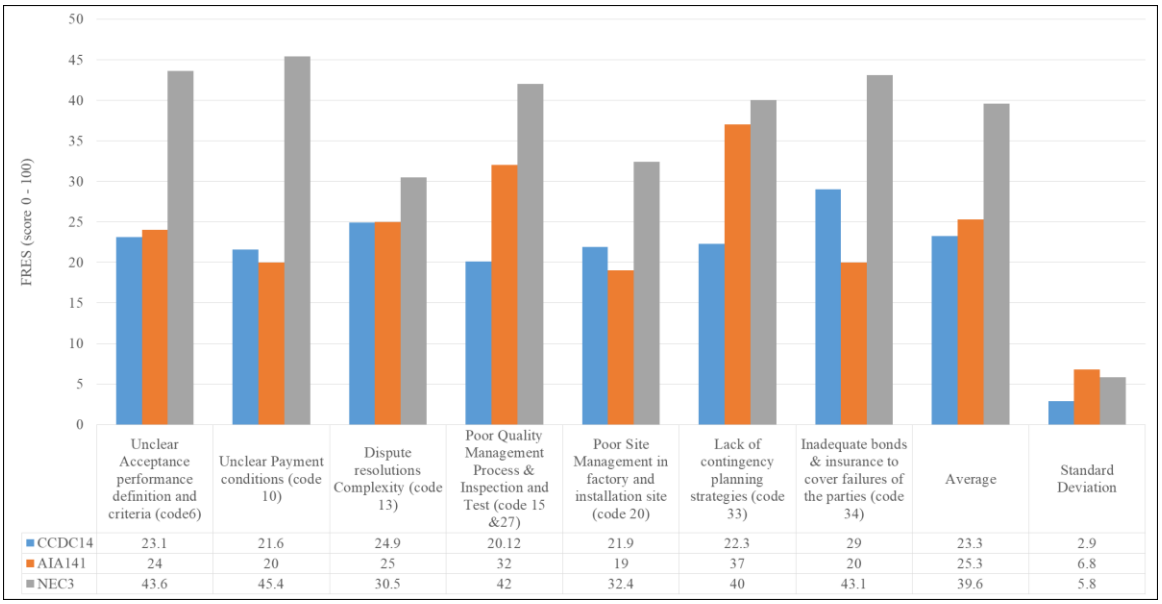
There are other clauses in NEC3 about the delay, and associated responsibilities or extra costs due to repeating the tests and/or inspection. In AIA141, there is only one sentence regarding the cost of additional tests and inspection, which in on the design builder's expense. On the other hand, CCDC14 has only one clause that mentioned delays by "common carriers" for extra time, entitled the design-builder.

AIA141 has a clause mentioning the acceptance and payment for materials, equipment, and the owner, at a location agreed upon in writing, must approve products stored outside the place of the work in advance. Similarly, in CCDC14, the 'payment certifier' approves the products delivered to the place of work as of the last day of the payment period. More considerably, NEC3 has a clause mentioning that the materials and plants, which are outside the site, are not allowed to be transported to the site before approval of tests and inspections (as required by contract in the work information). These findings are specifically important for modular construction projects, as they normally have large amounts of modules built off-site in the factory. Lack of information regarding terms and conditions of transportation, inspection, acceptance and payment for such modules usually is one of the main sources of ambiguities reported in the literature. This paragraph can be related to items 'Unclear payment conditions (code 10)' and 'unclear scope definition (code 12)'.

CCDC14 (The Canadian standard contract) tries to support cross-provincial projects (i.e. companies based outside Quebec, planning to work in this province or Quebecer companies, willing to use a Canadian standard contract). Based on the literature review, 'Lack of Local Regulations and Best Practices' is one of the major causes of disputes in construction contract documents. The term 'Quebec,' which is a Canadian province with a fundamentally different language, standards, rules and regulations, has a high TF and mentioned nine times in CCDC14. The information provided includes the duration of holdback amount for the design-builder, sub-contractor and suppliers, Quebec sales tax, Quebec pension plan and different civil code for substantial performance of the work. This can be evidence of providing support for the lack of local regulations and best practices, reported in our conceptual framework (subcategory 'Lack of Local Regulations and Best Practices').

In case of readability, to evaluate which standard contract is more readable than others, the comparison based on their average FRES of clauses in each document (as shown in Figure 12) has been done and the result shows that the average FRES for classes belong to all three standard contracts is less than '50' which means they are below 'Fairly difficult'. Accordingly, the readability statistics of the CCDC-14, AIA-141, and NEC3 contract taken as a whole are summarized in Figure 12. It shows that NEC3, which is having a higher overall FRES score, is more readable than the other two standard forms of contract. NEC3 with an average readability score of '39.57' is between 31-50 which is known as a 'Difficult' document to read based on FRES table guide, AIA-141 with FRES of '25.29', and CCDC-14 with average FRES of '23.27' are in the category 'Very Difficult' to read. It can be because contract draftsmen of NEC3 are more expert than the other two.

On the other hand, comparison of Standard Deviation (SD) indicates that classes in CCDC-14 with SD=2.9 are less spread out from the average (mean) rather than other two standard contracts. SD is the statistical measure for each set of clauses that were compared to find out whether SD decreases when FRES increases. Results reveal that there is an inverse relationship between FRES and SD for each set of clauses (see Figure 12). The reason can be the complexity of the clauses chosen as the scope of the work and the writing knowledge of the draftsmen of each one. When the documents are easily readable, there is a high degree of commonality in interpretation by different readers. The result shows that the contract document's readability will be affected by the 'lack of knowledge and training by draftsmen (code 3)'.



	Unclear Acceptance performance definition and criteria (code6)	Unclear Payment conditions (code 10)	Dispute resolutions Complexity (code 13)	Poor Quality Management Process & Inspection and Test (code 15 &27)	Poor Site Management in factory and installation site (code 20)	Lack of contingency planning strategies (code 33)	Inadequate bonds & insurance to cover failures of the parties (code 34)	Average	Standard Deviation
CCDC14	23.1	21.6	24.9	20.12	21.9	22.3	29	23.3	2.9
AIA141	24	20	25	32	19	37	20	25.3	6.8
NEC3	43.6	45.4	30.5	42	32.4	40	43.1	39.6	5.8

Figure 12: Readability Analysis (FRES) of classes of three standard contract

Comparing the classes of Canadian standard contract (CCDC-14), the bar chart illustrates the FRES of each class and the solid line shows the mean of them. The average FRES of these classes

with FRES ‘23.27’ is in ‘Very Difficult’ level, and as the graph shows, the majority of classes are less than mean FRES but very close to the mean. It indicates that based on FRES guide (table 7) all clauses of this standard contract are in ‘Very difficult’ level which is because of ‘Lack of the knowledge and training by draftsmen’ but written by a group of drafter by same knowledge of writing standard or reviewed and edited by the readability experts. (See figure 13)

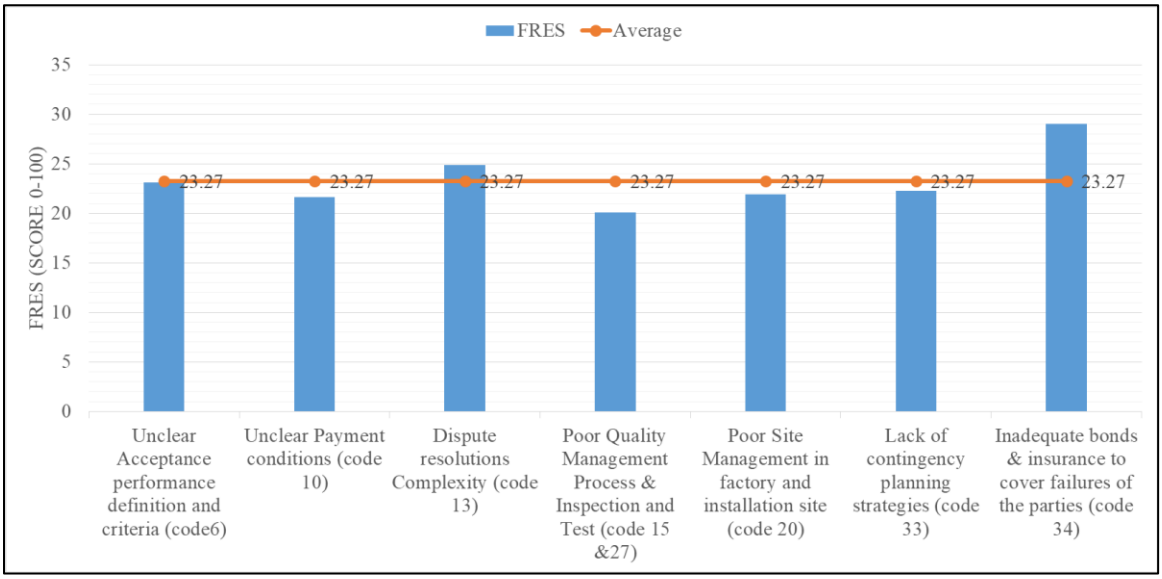


Figure 13: Readability Analysis (FRES) of classes of CCDC-14 standard contract

As Figure 14 Shows the comparison among classes of AIA-141, not only classes with code ‘15&27’ and ‘33’ are above the mean (with FRES = 25.29), but also they are between 31-50 which put them in ‘Difficult’ level that is a higher than others. This would be because drafters who write them have a higher knowledge of expertise.

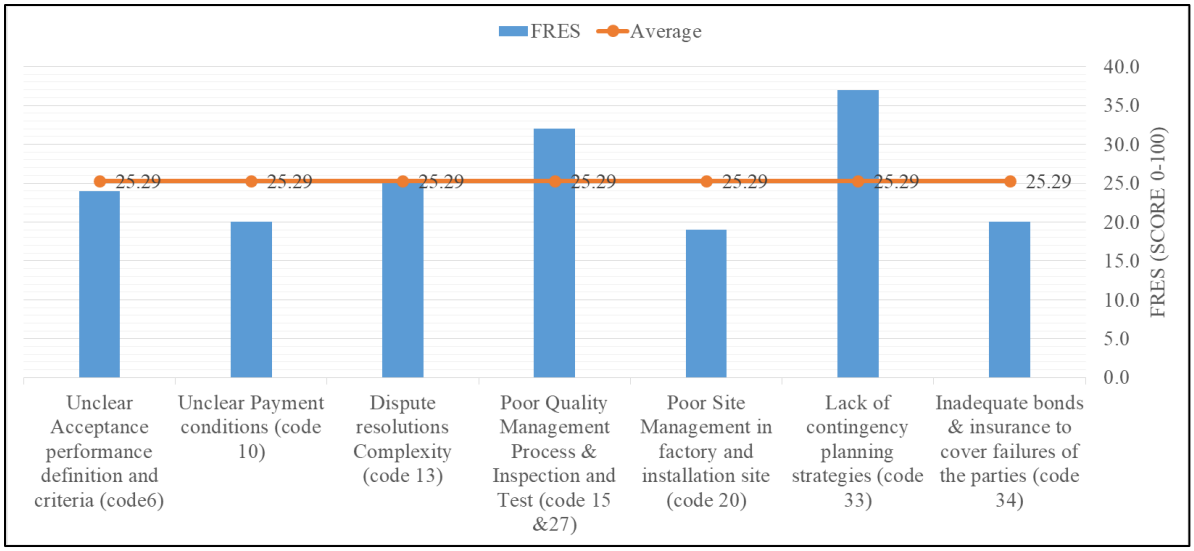


Figure 14: Readability Analysis (FRES) of classes of AIA-141 standard contract

Overall, five classes in this contract have FRES between 31-50 and are in 'Difficult' level also, as the graph shows, their FRES are near mean, while other two classes with FRES between 0-30 are far away from mean and belong to 'Very Difficult' level. The class 'Dispute Resolution (code 13)' has the lowest FRES=30.5 among all classes which is because it is included of legal clauses which are inherently more difficult to read and understand rather than general clauses, and it is provided by a non-professional contract legal draftsmen.

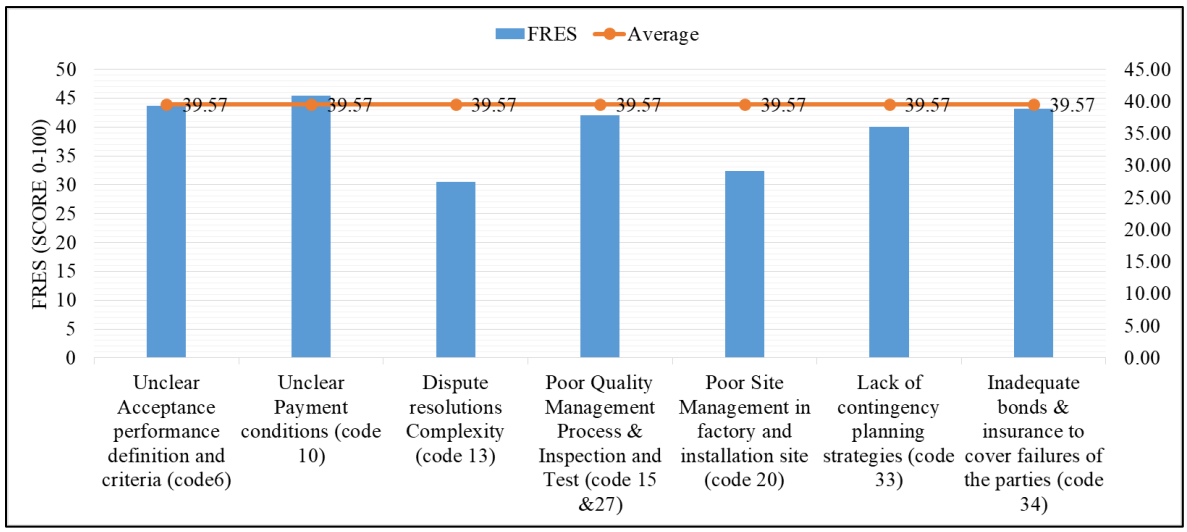


Figure 15: Readability Analysis (FRES) of classes of NEC3 standard contract

4.2. Comparison of Modular FRPs (Canada vs. UK and US)

We started comparing the modular construction RFPs by looking at local, state and federal codes and standards in four modular RFPs. In Florida and BC all equipment, material and workmanship shall comply with their provincial and national codes and standards such as; 'National Building Code' and 'Provincial Building Code' in BC and 'Florida Building Code,' 'Florida Accessibility Codes' and 'District Master Specifications' in Florida. Georgia using 'Georgia Arbitration Code' and 'Official Code of Georgia Annotated' as some of the state codes. The occurrence frequency result for term 'WorkSafeBC' in BC indicates on importance of this mandate, including prevention of occupational injury and occupational disease. It is a provincial mandate, which is used in BC, and for other provinces in Canada, it can be different. In UK goods and material used in the execution of the Work shall, as far as is practical, have been produced within the 'European Community.' These national and provincial codes and standards supporting the contracts to come with more reliable 'criteria for damage and defect' (code 8), 'tolerance criteria' (code 14), 'Poor Quality Management Process & Inspection and Test Criteria' (code 15&27), and preventing 'errors and mistakes in technical specification' (code 22).

'Lack of Local Regulations and Best Practices' is one of the major issues for modular construction contract documents which is mentioned in the literature review. While we were looking for clauses related to high TF & TF-IDF terms, we manually detected that all four modular RFPs have their department for transportation and their standards and regulations in which they should apply for required permits for transportation (shown in Table 12). Also, it shows that transportation regulations and standards, which are one of the crucial issues in modular construction have been considered in all modular RFPs while conventional standard contracts did not mention them.

Table 12- Different Transportation Department

Canada	**USA**		**UK**
	FL	**GL**	
BC Ministry of Transportation and Infrastructure	FDOT (Florida Department of Transportation)	Dawson County Road Department	Department of Transport standard specification for Road and Bridge works

In case of a defect, Florida asked the contractor to design the system for transporting without damage to the building. In the UK, the contractor must handle, store, prepare and use or fix each product by its manufacturer current printed or written recommendation /instruction. The contractor must obtain instruction before proceeding with work, which may either 'cover-up' or otherwise 'hinder accesses' to the defective construction, or be rendered abortive by the carrying out of

remedial work. Among all RFPs, just in BC, the owner advised the contractor to guarantee the work and material against any defect arising from faulty installation, and faulty material supplied under the contract, or faulty workmanship which may appear within one year from the date of acceptance of the work by the Owner. Moreover, the contractor advised for optional 5-year warranty against original defect in manufacture and workmanship from the date of substantial completion. Other RFPs talked about guarantee but did not mention any specific term of modular specifications. This additional insurance looks important to modular because materials and modules can be damaged at the factory or even while transporting in case of any unforeseen conditions or accidents. These clauses are using for items 'criteria for damages or defects' (code 8), 'performance acceptance criteria' (code 6), and 'Unclear scope definition' (code 12).

In term of 'payment condition,' there is a big difference between conventional and modular construction where there are three major phases in modular life cycle such as 'Manufacturing,' 'transportation' to the site and 'storage & Installation' the modules in the place. In this case, all parties shall define the suitable payment conditions for their project to reduce the disputes. In Georgia, monthly invoice submitted at the contract price shall be eligible for payment for 'units in place' upon inspection and acceptance of all items by the Owner and 'Owner employee signature' must appear on the delivery receipt or invoice. Owner prefers to make payment after delivery confirmation. Florida, no payment will be made on partial shipments. This clause prevents projects from additional transport and workers fees. In BC, the contractor shall submit prices for the entire scope of the work including all labour, tools, equipment, materials, travel, transportation, customs clearance, duties, deliveries, including all components and any ancillary items necessary to complete the project to the satisfaction of the owner. Delivery of all materials and equipment to the project site location shall be included in the price freight prepaid FOB (Free on Board). In modular construction, these terms are important since transportation is one of the main steps in the project life cycle. UK clauses with 1843 words (see Table 6) and specific terms like 'Final Date For Payment', 'Final Payment Notice', 'Final Payment', 'Interim Payment', 'Payment Notice', and 'Pay Less Notice' shows that payment criteria are well defined in this RFP and can be used as a good sample for Canadian contracts. It should be considered that in the UK, the amount of an interim payment should not include the value of any off-site goods and materials. The clauses related to this issue are 'acceptance performance criteria (code 6),' 'payment condition (code 8),' 'scope definition (code 12),' 'permit and certificate criteria' (code 19), 'Poor Site Management in factory and installation site (code 20),' and 'bonding and insurance (code 34)'.

There is a term as 'fluctuations' used in the UK, which said that 'No adjustment for fluctuations' for this contract while other RFPs are silent about this term. The Canadian sales taxes include the Provincial Sales Tax (PST), the Quebec Sales Tax (QST), the Goods and Services Tax (GST), and the Harmonized Sales Tax (HST), which is a combination of the PST and the GST in some provinces. In the case of tax payment, BC used specific terms 'GST and PST', UK mentioned the term 'VAT' (Value Added Tax). Florida is silent and in Georgia, the owner is exempt from tax

(see table 13). Well-defined federal and provincial tax criteria can help projects to reduce the disputes in case of 'payment condition (code 10)', and 'Poor project financial planning (code 31)'.

Table 13- Comparison of Tax criteria among RFPs

Role	CA	FL	GA	UK
Owner	-	NA	Shall Not to Pay	Based on the current Law
Contractor	GST / PST	NA	Shall Pay	VAT (Value Added Tax)

As mentioned in section 4.1, units for measuring the time are a major part of construction clauses like payments and execution of the work. Clearly defined time units will lead the project to fewer claims and disputes. Units for measuring the time are different in four RFPs since the UK uses a new measure as 'Operating day' for measuring the time in a clause related to 'Training of Employer's Staff,' which neither used in other RFPs nor standard contracts. BC uses just 'Business day' for the process of bidding, use terms 'day' and 'week' for the execution of the work while the rest of RFPs use at least two measures for different clauses (see table 14). This unit must be defined very well to reduce the disputes arising from time related claims such as 'Poor project integration (planning, executing, monitoring, etc.) (code24)', and 'Unclear duration, payment and technology for approval of tests, inspections, over inspection, etc. (code 27)'.

Occurrence frequency results for terms such as 'mediator' and using terms 'amicable negotiation', 'good faith negotiation', and 'reasonable effort' in BC, compared to 'adjudicator' and 'arbitrator' in UK, could indicate that the Canadian RFP would recommend resolving disputes through negotiation rather than judicial authorities. (It should be mention here that we reached the same result in section 4.1 for Canadian standard contract). In the UK, if 'adjudicator' does not have appropriate experience and expertise, shall appoint an independent expert with such expertise and experience to advise and report in writing on whether or not the instruction under the clause is reasonable in all the circumstances. Both American RFPs asked the contractor to hand their litigation history before awarding the contract. (Florida past ten years and Georgia past five years) Which can help the owner to get more familiar with the contractor's background so, in case of any dispute, this background can help them to resolve the issue easier. Other RFPs and standard contracts are silent.

'Test certificates' has been defined as a term in the UK including but not limited to drain pressure tests, and systems test, electrical circuit tests (including fire and security alarms and emergency lighting), corrosion tests, type tests, work tests, start and commissioning tests for the drainage and services installations and plant, equipment, valves, etc. used in the installations. This term is using

for items like ‘Performance acceptance criteria (code 6)’, ‘Quality Management Process (code 15)’, ‘Payment conditions (code 10),’ and ‘Lack of criteria for damages or defects (code 8)’.

UK has with terms like ‘Asbestos R&D’ (Refurbishment & Demolition) and asbestos-containing materials regulation, which preventing and Site waste management environmental impacts of the site are reflected in UK and Georgia, but other RFPs are silent about it. This clause can effect on item ‘Poor Site Management in factory and installation site (Code 20)’.

UK’s significant finding is ‘bond in respect of payment for offsite materials and/or goods,’ which is related to the modular construction. In Florida, ‘Installation Floater’ is an insurance policy that covers personal property installed, fabricated or erected by a contractor. Contractor in Georgia shall be responsible for providing adequate limits of insurance when working within property owned by ‘railroads,’ as established by such railroad company. In the case of transporting the modules by train, it can be a useful term. Contractors from Florida shall be responsible for the relocation of the various type and size of the modular unit. It is imperative that a modular unit within a cluster be capable of being relocated without disrupting the function of the units remaining in the cluster. Contractor shall be responsible for the manufacture, delivery, site work, assembly, placement and complete turnkey internal hook-up of systems. Contractor shall be responsible for off-loading, unpacking/uncrating all material and equipment at the job site and install railings by specification herein and all attachments. Canadian RFP is silent about bonding criteria.

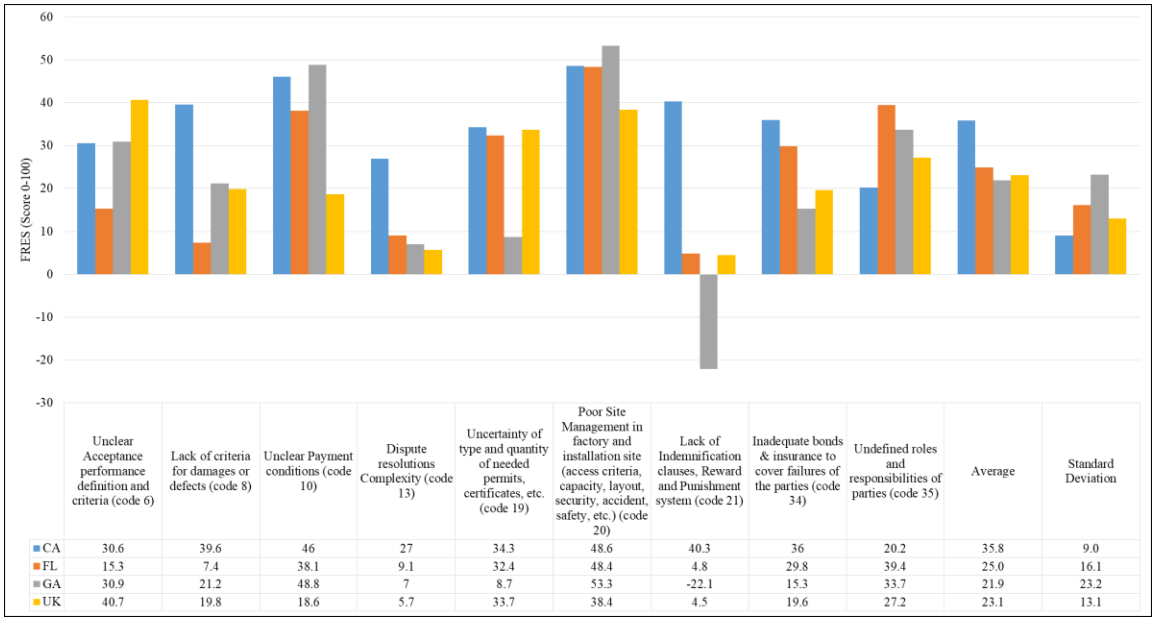
Georgia has a new role named ‘Construction Inspector’ who is assigned by the owner and shall review plans to ensure they meet building codes, local ordinances, zoning regulations, and contract specifications, approve building plans that are satisfactory, monitor construction sites periodically to ensure overall compliance. In modular construction the modules have to be inspected at the factory (after fabrication) and while arrived at the job site. Moreover, the quality of material and installation are important issues. This role can help the project to reduce the disputes arising from ‘Unclear Acceptance performance definition and criteria (code 6),’ ‘Lack of criteria for damages or defects (code 8)’, ‘Poor Quality Management Process (code 15),’ ‘Poor Site Management in factory and installation site (code 20)’, ‘Errors & mistakes in technical specifications (code 22)’, and ‘Undefined roles and responsibilities of parties (code 35)’.

Based on RFP from BC, equipment must be in good mechanical repair and not require excessive maintenance or create excessive downtime that jeopardizes the Contractors ability to provide the work agreed to. It has a term ‘Equipment insurance,’ which is required for all equipment owned or rented by the Contractor and employees that provides coverage against all risks of loss or damage. In all four RFPs, the contractor is responsible for all loss, damages, cost and expenses.

The Readability Analysis of RFPs based on Flesch Reading Ease Score (FRES) shows that the Canadian RFP with average FRES of ’35.8’ is greater than other RFPs which means it is easier to read and understand rather than others. Georgia, with the lowest score (FRES=21.9), is the hardest one to read (See Figure 16).

As shown in Figure 16, except one class from Georgia with FRES '53.3', the scores of all classes are less than '51' thus, based on FRES guide (see Table 7), they are 'Fairly Difficult' to read documents. Regarding data have shown in Figure 16, two classes 'Dispute Resolution (code 13)' and ' Indemnification clauses, reward and Punishment (code 21)' in RPFs from USA and UK have the lowest FRES scoring. Since these classes are related to legal issues and they are modified clauses, it can be the reason of unfamiliarity of draftsmen with legal clauses or lack of writing knowledge by legal drafters. While detecting the analysis of these items, it is found that a very long length of their sentences is the major reason to have lower FRES. The significant issue in this section is RFP from the UK in which it is included of modified clauses based on JCT standard contract, but it has one of the lowest readability scores. This can be a reason for modifying the clauses by non-legal professional contract drafters.

As calculation shows in Figure 16, Georgia, with SD= 23.2 has the highest standard deviation among all RFPs which illustrate scores are spread out over a large range of FRES. It can be a reason that Georgia's contract modifier was not professional enough rather than other RFP drafters. It can be affected by 'Lack of knowledge and training by draftsmen (code 3)' and 'modifying the contract by non-legal professionals (code 39)'. SD is the statistical measure for each set of clauses that reveal there is an inverse relationship between FRES and SD for each set of clauses (see Figure 16).



	Unclear Acceptance performance definition and criteria (code 6)	Lack of criteria for damages or defects (code 8)	Unclear Payment conditions (code 10)	Dispute resolutions Complexity (code 13)	Uncertainty of type and quantity of needed permits, certificates, etc. (code 19)	Poor Site Management in factory and installation site (access criteria, capacity, layout, security, accident, safety, etc.) (code 20)	Lack of Indemnification clauses, Reward and Punishment system (code 21)	Inadequate bonds & insurance to cover failures of the parties (code 34)	Undefined roles and responsibilities of parties (code 35)	Average	Standard Deviation
CA	30.6	39.6	46	27	34.3	48.6	40.3	36	20.2	35.8	9.0
FL	15.3	7.4	38.1	9.1	32.4	48.4	4.8	29.8	39.4	25.0	16.1
GA	30.9	21.2	48.8	7	8.7	53.3	-22.1	15.3	33.7	21.9	23.2
UK	40.7	19.8	18.6	5.7	33.7	38.4	4.5	19.6	27.2	23.1	13.1

Figure 16: Readability Analysis (FRES) of classes of RFPs

While looking at each modular RFP separately, as it is shown in the graph below (see figure 17), the FRES of the majority of classes in Canadian RFP from BC is between 31-50 which means they

are ‘Difficult’ to read. Its average score with FRES = 35.84 also shows that this RFP is on the same level as its most classes are. Since the RFPs are prepared by modified clauses, the only class with low FRES ‘Undefined roles and responsibilities of parties (code 35)’ (FRES = 20.2) shows that its modifier has remarkably lower knowledge than other contract drafters.

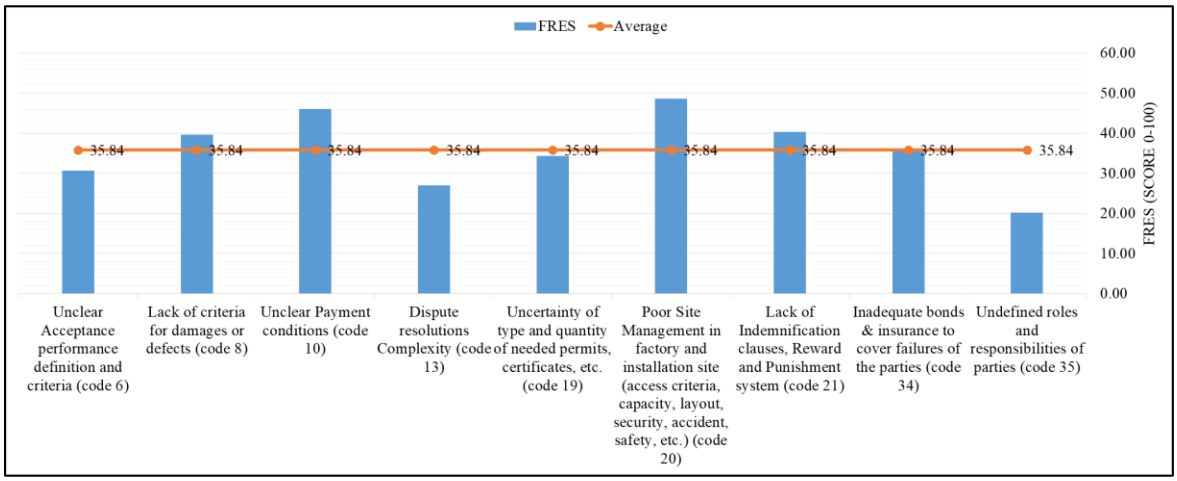


Figure 17: Readability Analysis (FRES) of classes of Canadian (BC) RFP

One of the American modular RFPs is from Florida with an average FRES of ‘24.97’ (between FRES 0-30) is recognized as a ‘Very Difficult’ readable text (see figure 18). The significant point of this graph is far differences between highest class (code 21 with FRES of ‘4.8’) and lower class (code 20 with FRES ‘48.4’) which is showing weak modification based on readability criteria.

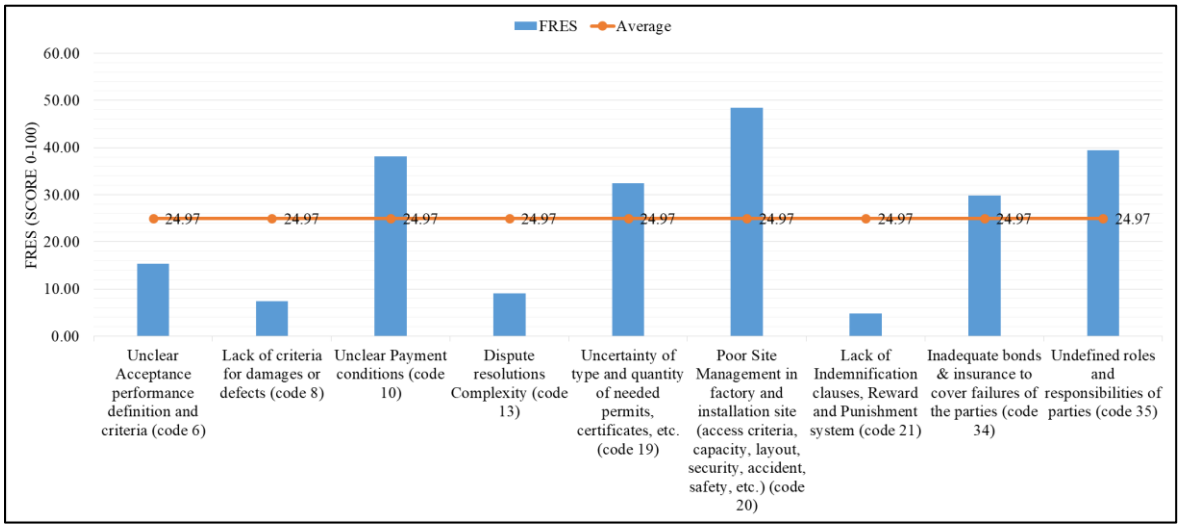


Figure 18: Readability Analysis (FRES) of classes of American (Florida) RFP

Georgia is another American modular RFP with an average FRES of '21.87' which is regarding the FRES guide is a 'Very Difficult' to read the document. As it is shown in Figure 19, there is one class (code 20) with FRES between 51-60 which is 'Fairly Difficult' readable one, and three classes (code 6, 10, 35) with FRES between 31-50 which are 'Difficult' classes and four 'Very Difficult' to read classes with FRES between 0-30. The important point here is the score of class 'code 21' which is '-22.1'. Since there is no score below 'Zero' in the FRES table guide. The close result has been achieved after 're-calculation' the text by another online machine (http://www.readabilityformulas.com/ FRES= -17.8) and even calculation manually (FRES= -22.64, One sentence in this class has 143 words with an average of 1.59 syllables per word). The evaluation also shows that the less readable classes are related to legal clauses such as 'class (code 13), Dispute Resolution with FRES=7', 'class (code 19), Permit and certificates with FRES=8.7', 'class (code 21), Indemnification, rewards, and punishment', and 'class (code 34), Inadequate Bond and Insurance with FRES=15.3' that can be because of the nature of legal clauses are hardest to read and understand by people.

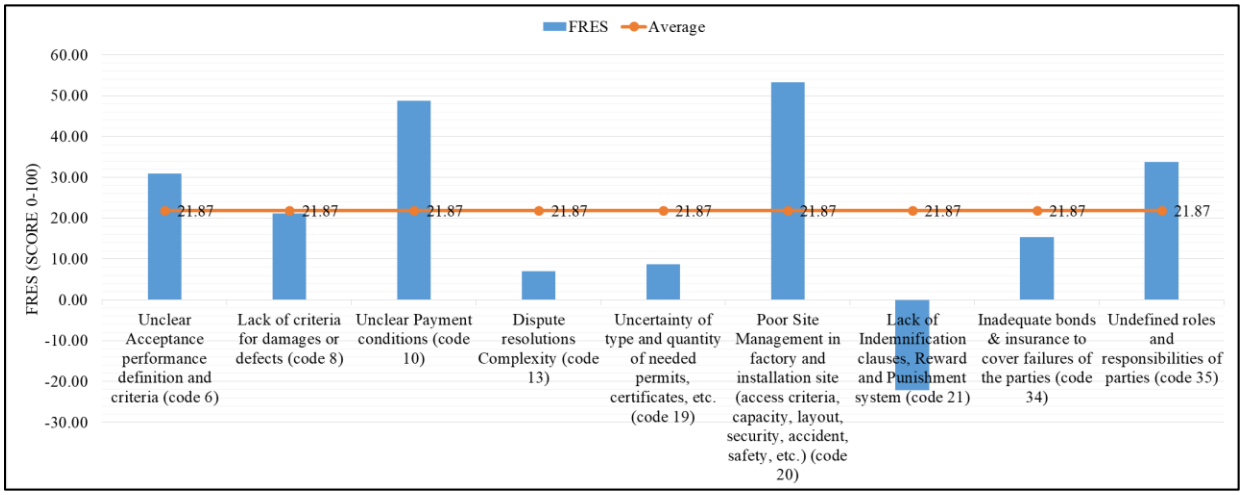


Figure 19: Readability Analysis (FRES) of classes of American (Georgia) RFP

Finally, the RFP from the UK with average readability of '23.13', which is in level 'Very Difficult' to read. Since this RFP is written based on JCT (another popular standard contract form the UK), the differences among FRES of classes specifically low FRES of related legal clauses indicate on the lack of enough knowledge and training by draftsmen who modified the clauses.

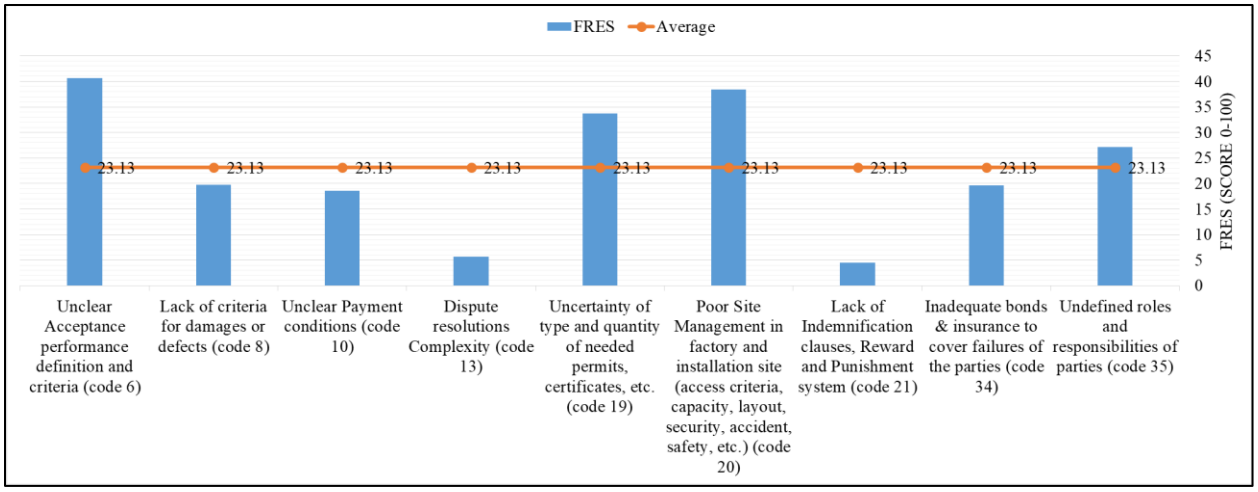


Figure 20: Readability Analysis (FRES) of classes of RFP from the UK

Note: All Text processing outputs (TF and TF-IDF) are available in the Appendix section at the end of this paper.

1. Appendix 12: Standard Contracts related high 25 TF and TF-IDF output for each class in the scope

2. Appendix 13: Modular RFPs related high 20 TF and TF-IDF output for each class in the scope

5- Summary and Conclusions

The features of modular and conventional construction are different in terms of construction processes and contract documents then, ambiguities in administrative documents are widely occurred and are one of the leading causes to generate conflict, disputes, and claims between owners and modular suppliers as general contractors. In total, in this study, 24 sources of ambiguities have been found that the following are mentioned.

The **First** group of ambiguities are associated with missing roles and responsibilities includes:

1. *Project manager*: The result shows that this role has high TF and TFIDF in NEC3 as well defined in RFPs from UK and USA but did not mention in AIA141, Canadian RFP and CCDC14. Based on PMI, one of the critical roles in each project is 'Project Manager,' which is and this role must be defined and assigned at the early stages of the contracting of a project. This role with his/her experience and expertise can manage the project to less dispute and claim.
2. *Construction Inspector*: This role has been mentioned in Georgia's RFP assigned by the owner and shall review plans to ensure they meet building codes, local ordinances, zoning regulations, and contract specifications, approve building plans that are satisfactory, monitor construction sites periodically to ensure overall compliance. In modular construction the modules have to be inspected at the factory (after fabrication) and while

arrived at the job site. This role can lead the project to reduce the disputes arising from errors, mistakes and quality in technical specifications.

3. *Payment certifier*: CCDC-14 has a new role of 'Payment Certifier' assigned by the owner who certifies the payment after reviewing and certifying the Design-Builder's application for payment. This role's responsibility is to approve the products delivered to the place of work, which is necessary for modular construction because of the high volume of modules delivered to the site. This role can ease the payment and acceptance process and prevent more disputes.

In case of Modular Construction, 'dispute resolution' becomes more complex and sensitive because of either new types of modular disputes or different types of stakeholders in this method such as 'Manufacturer,' 'Transporter,' 'Installer,' and 'Machinery suppliers.' The findings based on a comparison among 'Dispute Resolution' parts of three contracts and four modular RFPs show considerable differences in this subject (Shown in Table 9). The different words, different terms and roles showing differences in the process of dispute resolution (See Table 13).

The **Second** group of ambiguities are associated with dispute resolution and includes:

4. *Administrative Tribunals*: This term, which is defined as the last step of dispute resolution process in NEC3, set up to be less formal, less expensive, and a faster way to resolve disputes compared to the traditional court system. In Canada, Tribunals are set up by federal or provincial legislation, known as "empowering legislation. They are specialist judicial bodies which decide disputes in a particular area of law. Based on its advantages, these clauses can be useful to reduce the complexity of dispute processes in modular construction projects.
5. *Litigation history*: Florida in its RFP, asked the contractors to hand their past ten years litigation history and Georgia asked their past five years litigation history. This term can help the owner to get more familiar with the contractor's dispute resolution procedure and in case of any dispute, help them to resolve the issues easier.

The size (Term count) of class 'Inadequate bonds & insurance to cover failures of the parties' in American AIA-141 is significantly higher than the other two standard contracts which indicate that this class is recognized important by American contract drafters and they tried to reduce the ambiguities by adding complementary clauses. So, it can be a good indicator for Canadian modular drafter to look at these clauses when they are drafting the new contract or modifying the existing one for their projects.

The **Third** group is ambiguities that are associated with Insurance and Bonds includes:

6. '*Installation Floater*: In Florida, 'Installation Floater' is an insurance policy that covers personal property installed, fabricated or erected by a contractor until the installation work is accepted by the purchaser or when the insured's interest in the property installed ceases.

This term should be considered in the modular contracts since installation is one of the critical processes in modular construction.

7. *Equipment insurance*: This term provide the coverage insurance against all risks of loss or damage which is required for all equipment owned or rented by the Contractors and employees. Since the modular construction is using many types of equipment in its process, having this kind of term can help the parties to protect their rights in case of damage, loss, and maintenance of equipment.
8. *Bond in respect of payment for offsite materials and/or goods*: This term is one of the UK's significant findings which is cover payment in the event the contractor fails to pay for them under the terms of the contract. In modular construction after manufacturing the parts, they have to be protected, stored at the factory then transport to the installation site, so the restoration conditions on the factory and related bonding have to be considered in the contract clauses. Moreover, it can be an indicator that insurance and bonding clauses have to be considered for all other steps of modular construction such as manufacturing, transporting, and installation. This additional insurance looks important to modular because materials and modules can be damaged at the factory or even while transporting in case of any unforeseen conditions or accidents.

There is a difference between conventional and modular construction process where three major phases in the modular process are included of 'Manufacturing,' 'transportation' to the site and 'storage & Installation' the modules in the place. Comparison between the three conventional standard contracts shows that the size (TC) of class 'Payment Condition' is considerably greater than the size of other classes among three standard contracts which is indicated on importance of payment terms in construction contract documents.

Group **Four** of ambiguities is associated with payment conditions includes:

9. *Specific Payment Conditions Terms*: NEC3 has clauses by 1843 words (see Table 6) and specific terms like 'Final Date For Payment', 'Final Payment Notice', 'Final Payment', 'Interim Payment', 'Payment Notice', and 'Pay Less Notice' which is not found in Canadian documents. It shows that payment criteria are better defined in this standard contract and can a reliable benchmark document for drafting the clauses related to payment conditions in Canadian modular contracts to prevent future disputes or reduce them.
10. *Fluctuations*: RFP from the UK has a term as 'fluctuations' which is said that 'No adjustment for fluctuations for this contract' while other documents are silent about this term. Fluctuation's provisions in construction contracts provide a mechanism for dealing with the effects of inflation, which on large projects lasting several years can be very significant and lead the parties to disputes. Since inflation is undeniable in each society, Canadian modular contract documents should consider this term in their documents clearly.

11. *TAX criteria*: In the case of tax payment, Value Added Tax in Canadian CCDC-14 includes the Provincial Sales Tax (PST), the Quebec Sales Tax (QST), the Goods and Services Tax (GST), and the Harmonized Sales Tax (HST). RFP from BC just put the place for calculating the GST, and there is no clause related to paying the taxes. RFP from the UK used the term 'VAT' (Value Added Tax). Tax clauses must be well-defined for Canadian modular contract documents not only based on their region but also it should be considered if the modules are manufactured in other region and delivered from other to installation site. If the modules need to pass by border or more than one region with different transportation regulations and standards tax criteria should be clearly defined.
12. *Holdback Amount*: This term is very common in purchase and sale agreements and is the legal requirement found in most common law jurisdictions' contract law considers the criteria for a particular percentage of the payment for a stipulated length of time held by the owner. CCDC14 has defined the payment criteria for this term for both federal and province of Quebec while the RFP from BC did not mention this term at all. This term should be defined in all modular contract documents to ensure that any parties working on a contract are paid.
13. *Payment for products stored outside of the place of work*: All three standard contracts have some clauses concerning this term, AIA141 has a clause mentioning that products stored outside the place of the work must be approved before payment. CCDC14 says, the 'payment certifier' must approve the products delivered to the place of work as of the last day of the payment period. More considerably, NEC3 does not allow the materials and plants outside of the site to be transported to the site before approval of tests and inspections. These findings are specifically important for modular construction projects, as they normally have large amounts of modules built off-site in the factory. Lack of information regarding terms and conditions of transportation, inspection, acceptance, and payment for such modules usually is one of the sources of ambiguities reported in the literature.

The **Fifth** group of ambiguities are associated with transportation criteria and includes:

14. *Railroad Transportation*: Contractor in Georgia shall be responsible for providing adequate limits of insurance when working within property owned by 'railroads,' as established by such railroad company. In the case of transporting the modules by train, this kind of clauses should be mention in the contract documents.
15. *FOB (Free on Board)*: Canadian RFP came with this term and mentioned that delivery of all materials and equipment to the project site location should be included in the price Freight Prepaid FOB (Free on Board). In modular construction, this term is essential in case of transporting the products and equipment through ports.
16. *Transportation Regulations and standards*: manually detection of four modular RFPs showed that all have their department for transportation in which they should apply for required permits for transportation (shown in Table 12). In Florida, contractors shall be

responsible for the relocation of the various type and size of the modular unit. Contractor shall be responsible for off-loading, unpacking/uncrating all material and equipment at the job site and install railings by specification herein and all attachments. It shows that transportation regulations and standards in modular construction have to be considered in Canadian modular contracts.

The **Sixth** group of ambiguities are associated with criteria related to test, defect, and damage that includes:

17. *Defects Certificate:* Modular construction needs to set up a process to monitor the defected modules, material and equipment from factory to installation site. Define specific standards for various type of tests and inspections for modular construction while the modules (with different material) must be tested at the factory, after delivery or even before/after installation. In this case, terms such as 'Defects Certificate' that extracted from NEC3, can help the project to monitor the situation of the defected portion at any place from manufacturer to installation place.
18. *Criteria for Damage and Defect:* Modular construction projects have a large number of modules built in the factory and ready to be tested and delivered to the place of the work, and the terms and criteria for damage, defect or not meeting specification goods, which occur prior to delivery, during the delivery, storage and protection at the site and additional insurance, must be considered.
19. *Test certificates:* This term in RFP from the UK including but not limited to drain pressure tests, and systems test, electrical circuit tests (including fire and security alarms and emergency lighting), corrosion tests, type tests, work tests, start and commissioning tests for the drainage and services installations and plant, equipment, valves, etc. used in the installations. A test certificate is issued for a successful product or system following a detailed assessment including both laboratory testing and inspections. This certificate is necessary when working in a modular manufacturer to reduce the ambiguities arising from quality management, payment criteria, and damages or defects.

In addition, there are other ambiguities that are listed below:

20. *Criteria for storage outside of the site:* Among the findings, some clauses have been found which are related to the transportation, inspection and payment criteria for 'stored material and equipment outside of the site,' which is essential. Since modular construction and the majority of the work, should be done off-site and deliver to the site. Considering the storage criteria for material and equipment which are outside of the site is one of the significant ambiguities in which RFPs and standard contracts did not mention comprehensive criteria for that.
21. *Time measurement:* The differences between measures for the time among standard contracts and RFPs is vital since one of the three main scopes of each project is time and if the measures

of the time are not defined clearly in the contract documents, they can drive the project to more claims and disputes.

22. *National and Provincial codes and regulations:* Comparison among three countries shows that RFPs defined their specific national and provincial codes, standards, regulation, and also particular taxes since they are prepared for a specific project in a particular area. For building codes and regulation in Canada, each province and territory can adopt any code or standard that suits their needs. There are processes in place that work to minimize variations in codes and standards and promote consistency and uniformity. So, for the most part, building codes are based on National Model Codes and are adopted in each of the provinces and territories with little or no change. Modular contract documents in Canada have to come with clear clauses providing guidelines for regulating the building construction activities across the country and their provinces.
23. *Language barriers:* Even though all three contracts are from English speaking countries, but findings show that there are considerable differences among these documents based on the names, idioms, and measures. When it comes to modular construction, the issue becomes even more critical since this method has included unknown and undefined names and idioms, measure, etc. The parties have to overcome language barriers by providing the appropriate strategies like using simpler terms, define modular keywords, use plain and simple language, and so on.
24. *Readability standards:* The comparison of readability among all documents (three standard contract and four RFPs) shows that all RFPs and standard contracts have FRES lower than 61 that based on FRES guide (Table 7), all are below 'Standard' score (which is set up between 61-70). It shows that more works shall be done to improve the writing quality of not only RFPs but also standard contract documents. Moreover, comparison among readability of RFPs shows that classes included of legal clauses (like dispute resolutions) are less readable than other items, which is because of weak modification to the original clauses and lack of knowledge by RFP draftsmen and shows that construction legal experts should be involved while writing the contracts.

5.1 Major contributions

The objectives and contributions regarding this project are as follows:

Since there was not a comprehensive classified model for sources of ambiguities for conventional construction based on the contract documents and all publications discussed the main reasons for disputes and claims in construction projects, the **first** contribution of this study is the Fish-bone diagram in which all detected sources of ambiguities in conventional construction from 48 publications since 1980 mapped in this diagram. This study introduced this classification that can be useful for those who are construction contract drafters.

The **second** one is the modular Fish-bone diagram in which main sources of ambiguities in modular construction contract extracted from 35 publications since 2000 and mapped on it. This diagram is included of main sources of confusion in modular construction, which is developed through a comprehensive literature review. With this conceptual framework, the sources of ambiguities classified into five major category and related sub-categories.

The **third** contribution is detecting the differences between Canadian construction contract documents (conventional and modular) and two famous English speaking benchmark countries. Highlighted terms that extracted by data processing tools like TF and TF-IDF helped the study to extract their different clauses efficiently. The identified differences between Canadian documents (standard contract and RFPs) and benchmark countries were the main sources of ambiguities in Canadian modular construction contract documents. In this part, 24 major sources of ambiguities have been identified which have to consider in Canadian modular construction contract documents while drafting the new contract.

The **fourth** contribution of this study is evaluating and comparing the readability of modular construction contract and RFPs by readability formula. When drafting the modular construction contract documents, it is inevitable to use modifications to standard forms in differing project settings, so the readability and clarity of the documents need to be seriously considered. Preventing disputes as the main objective of this study should be considered by contract drafters involved in construction projects when they modify clauses. One of the specific roles of construction contract drafters is to prevent disputes then, while they are modifying clauses, unintentional problems might creep into a project that could have a devastating impact on the project's success. In this case, the degree of readability of clauses in each document gained by FRES formula. This analysis shows that the readability quality of RFP clauses, which are containing modified clauses, are less than standard contracts. The readability analysis result of this study shows an average reduction in some modified clause, while a few clauses became easier to read after modification. The results of this study show that the SD (standard deviation) of classes selected from standard contracts is between 2.9 to 6.8 (from 100) while this range is between 9.0 to 23.2 for RFPs which indicate that standard contracts have been followed readability standards while drafting the clauses. This study has a message for the company's contract drafters; while drafting modifications to contract documents, consider how the readability and clarity can be improved.

5.2 Limitations

The limitations of this project are listed as follows:

- The first limitation is that our analysis is based on the limited number of standard contracts. Contract documents which are using in the projects are standard contract documents that are modified by parties and these contracts are considered as the confidential documents of each company, and access to them is not possible for unauthorized persons. Companies' modular modified standard contract document could lead the research to discover more sources of ambiguities in this type of construction projects.

- This study basically used the Design-Build standard contract, assuming (based on the literature) that this is the most common standard contract for modular projects, but we still cannot say that this analysis is confidentially for modular projects because there is no specific standard contract for the modular project yet defined.
- Another limitation of the study is limited access to public and private modular construction RFPs. More modular RFPs could help this study to identify more sources of confusion in the modular industry based on real documents. More data in the comparison analysis, lead the study to find more and specific sources of ambiguities for this research. The lack of access to modular RFPs, the small size of RFPs based on their clauses, and lack of access to the modular RFPs from non-English speaking areas are three main reasons that decreased the chance to have more RFPs. Lack of access to contract documents and modular RFPs from other (pioneer) countries (e.g. Sweden, Germany, Denmark, etc.) and even some provinces (like Quebec which is a French-speaking province) due to the Language barrier is one of the major limitations of this study. The access to the standard contract documents and RFPs from these countries could lead the study to more and unknown corners of the topic while these pioneer countries are their own experiences.
- The Next one is TF-IDF limitations in terms of detecting the synonyms, proverbs, compound words, and expressions for large document collections, present an escalating problem. TF-IDF is based on the bag-of-words (BoW) model, therefore it does not capture the position in the text, semantics, co-occurrences in different documents, etc.
- There is some level of subjectivity about the fact that is the limitation of the work, which is error-prone that might have mistaken. Anything which is not done by machine has a certain level of subjectivity. This study should not claim that covered all phrases and clauses about each class in the contract document and all parts that this research went through, are not relevant because of the differences in interpretation of clauses and inevitable human mistakes.
- Using just one readability measure in this research is known as the final limitation. The readability formula measures certain features of the text that can be subjected to mathematical calculations. While readability formulae provide an objective measurement of the level of difficulty of reading, it is essentially based on quantifiable text. Readability formulae do not take word order or grammar into consideration and the reader characteristics. Moreover, not all features that promote readability can be measured mathematically, and these mathematical equations cannot measure comprehension directly.

5.3 Future Work

While the scope of this research was determined by the level of analysis needed to answer the questions posed earlier, future work can add more insights by looking at more resources among more benchmark countries. In term of text analysis, going beyond single terms into bi-grams and tri-grams, PoS & semantic classes in the feature extraction may add to the meaning of these results. Furthermore, testing analyses with a different scope (adding more benchmark countries and different languages) can help to verify or add to the findings of this paper. Finally, adding modular construction contracts from private companies helps the outputs of this research to take into a new

level and shed more light on the content of the modular contract. Finally, use more up-to-date readability relationships to measure the readability of text.

6- References

[1] L. &. P. C. S. Jaillon, "The evolution of prefabricated residential building systems in Hong Kong: A review of the public and the private sector.," *Automation in construction, ,* vol. 18(3), pp. 239-248, 2009.

[2] C. H. B. ASSOCIATION, "2010 ANNUAL REPORT," www.chba.ca, Ottawa, 2010.

[3] L. &. B. G. Koskela, "What should we require from a production system in construction?," *Construction Research Congress 2003,* pp. 1-8, 2003.

[4] L. F. P., "Issues in Manufactured Home Construction Litigation," 9th Annual Construction Law Institute, Montana, 2013.

[5] M. L. De La Torre, "A review and analysis of modular construction practices.," *http://preserve.lehigh.edu/etd/275 ,* p. 164, 1994.

[6] A. G. Gibb, Off-site fabrication: prefabrication, pre-assembly and modularisation., New Jersey: John Wiley & Sons., 1999, p. 8.

[7] S. L. M. Y. A. I. Azhar, "Modular v. Stick-Built Construction: Identification of Critical Decision-Making Factors," in *48th ASC Annual International Conference Proceedings*, Florida, 2012.

[8] R. E. Smith, "Off-site and modular construction explained," *Off-Site Construction Council, National Institute of Building Sciences,* 2014.

[9] C. University, "Challenges and Opportunities for Modular Construction in Canada," Concordia University, Montreal, 2015.

[10] M. A. M. Fateh, M. F. Mohammad and a. A. S. A. Shukor, "Review in formulating the standard form of contract for Industrialized Building System (IBS) construction approach in Malaysia," in *MATEC Web of Conferences*, 2017.

[11] NIBS_OSCC, "National Institute of Building Sciences(NIBS) 2015 annual report," MBI, Virginia, 2015.

[12] R. E. &. Q. J. D. (. Smith, Offsite architecture: constructing the future, Utah: Taylor & Francis, 2017.

[13] R. R. a. A. Rodrigo, "Modifications to Standard Forms of Contract: the Impact on Readability," *Australasian Journal of Construction Economics and Building,* vol. 14, no. 2, pp. 31-40, 2014.

[14] Arcadis, "Global Construction Dispute Report," Arcadis, Amsterdam, 2018.

[15] C. Harvey, "Factors that Influence the Adoption of Modular Construction in Western Canada," Royal Roads University, Victoria, 2016.

[16] Z. L. M. B. Zakaria DAKHLI, "Key considerations before integrating modular construction: adaptation to the traditional French construction processes," in *Modular and Offsite Construction Summit*, Alberta, 2015.

[17] M. H. A. o. BC, "Modular and prefabricated housing: literature scan of ideas, innovations, and considerations to improve affordability, Efficiency, and Quality," BC Housing, Vancouver, 2014.

[18] R. E. Smith, "Permanent Modular Construction," Modular Building Institute Foundations, Utah, 2015.

[19] E. Cowles and P. Warner, "FMI 2013 Prefabrication and Modularization in Construction Survey Results," FMI Capital Advisors, Inc, Raleigh, 2013.

[20] D. L. B. Jeffrey Molavi, "A CONSTRUCTION PROCUREMENT METHOD TO ACHIEVE SUSTAINABILITY IN MODULAR CONSTRUCTION," *nternational Conference on Sustainable Design, Engineering and Construction,* vol. 145, pp. 1362-1369, 2016.

[21] J. M. Schoenborn, "A Case Study Approach to Identifying the Constraints and Barriers to Design Innovation for Modular Construction," Joseph Schoenborn, Virgina, 2012.

[22] P. E. D. P. L. K. &. J. T. Love, "Causal modelling of construction disputes," in *Twenty-fourth annual ARCOM conference* , Cardiff, 2008.

[23] P. &. H. G. Mitropoulos, "Model for understanding, preventing and resolving project disputes," *Journal of Construction Engineering and Management,* vol. 127, no. 3, pp. 223-231, 2001.

[24] K. A. M. A. M. a. H. Z. Kamar, "BARRIERS TO INDUSTRIALIZED BUILDING SYSTEM (IBS): THE CASE OF MALAYSIA," in *International Postgraduate Research Conference (IPGRC)*, BuHu, 2009.

[25] F. T. Hartman, Construction dispute reduction through an improved contracting process in the Canadian context, Loughborough: ©Francis T. Hartman, 1993.

[26] J. P. GROTON, "A Guide to Improving to improving the construction contracts," *The Arbitration Journal,* vol. 41, no. 2, pp. 21-24, 1986.

[27] R. G. P. Fenn, Construction Conflict Management and Resolution, Manchester: © 1992 Peter Fenn and Rod Gameson, 1992.

[28] M. V. Griffin, "How to avoid Claims, and what to do about them if they occur," *National Assocciation of County Engineers Annual Convention,* pp. 1-11, 1993.

[29] J. C. Lavigne, "Construction Contract claims and methods of avoiding contract litigation through dispute resolution alternatives," University of Florida, Florida, 1993.

[30] D. L. a. C. S. PETER FENN1, "Conflict and dispute in construction," *Construction Management and Economics,* vol. 15, pp. 513-518, 1997.

[31] G. Aksen, "Resolving Construction Contract Disputes Through Arbitrations," *American A rb itra tio n Association Journal,* pp. 141-161, 1999.

[32] s. W. J. D. K. Molenaar, "Stractural equation model of construction contract dispute potential," *Journal of Construction Engineering and Management ,* vol. 126, pp. 268-277, 2000.

[33] A. H. Al-Momani, "Construction delay: a quantitative analysis," *International Journal of Project Management,* vol. 18, pp. 51-59, 2000.

[34] H. T. B. Abdalla M Odeh, "Cause of construction delay: Traditional contracts," *Internationa Journal of Project MAnagement,* vol. 20, pp. 67-73, 2002.

[35] M. S. a. R. Shaban, "Strategies to Avoid and Resolve Construction Disputes," in *Pacific Business & Law Institute*, Vancouver, 2002.

[36] E. West, "Construction Contracting: Building Better Law with the Uniform Commercial Code," *Case Western Reserve Law Review ,* vol. 52, no. 4, pp. 1067-1089, 2002.

[37] A. T. Y. Edwin H.W. Chan, "Contract strategy for design management in the design and build system," *International Journal of Project Management,* vol. 23, pp. 630-639, 2005.

[38] V. P.-S. &. J. S. David Chappell, Building Contract Claim, Oxford: Blackwell Publishing, 2005.

[39] J. K. Yates and a. A. Epstein, "Avoiding and Minimizing Construction Delay Claim Disputes in Relational Contracting," *JOURNAL OF PROFESSIONAL ISSUES IN ENGINEERING EDUCATION AND PRACTICE,* vol. 132, pp. 168-179, 2006.

[40] J. K. Y. a. J. Duran, "Utilizing Dispute Review Boards in Relational Contracting: a case study," *JOURNAL OF PROFESSIONAL ISSUES IN ENGINEERING EDUCATION AND PRACTICE,* vol. 132, pp. 334-341, 2006.

[41] Y. W. S. Murali Sambasivan, "Causes and effects of delays in Malaysian construction industry," *International Journal of Project Management,* vol. 25, pp. 517-526, 2007.

[42] N. Othman, "Standard Froms of Contract and its Influence on Construction Professionals," *Jurnal Alam Bina,* vol. 11, pp. 45-60, 2008.

[43] H. Y. Chong, R. M. Zin and a. S. C. Chong, "Employing Data Warehousing for Contract Administration: e-Dispute Resolution Prototype," *JOURNAL OF CONSTRUCTION ENGINEERING AND MANAGEMENT,* vol. 139, pp. 611-619, 2013.

[44] M. A.-H. a. P. F. Amir Chehayeb, "An integrated methodology for collecting, classifying, and analyzing Canadian construction court cases," *Can. J. Civ. Eng.,* vol. 34, pp. 177-188, 2007.

[45] F. Walker and S. Pryke, "Role, definition and dimensions of incomplete construction contract documents," in *RICS COBRA Research Conference,*, Cape Town, 2009.

[46] B. Keen, "The Pitfalls of Incomplete Contract Documents," Reavay and Association Ltd., Toronto, 2010.

[47] J. N. Wright and W. Fergusson, "Benefits of the NEC ECC form of contract: A New Zealand case study," *International Journal of Project Management,* vol. 27, pp. 243-249, 2008.

[48] K. Iyer, N. Chaphalkar and G. Joshi, "Understanding time delay disputes in construction contracts," *International Journal of Project Management,* vol. 26, pp. 174-184, 2008.

[49] M. Sun and X. Meng, "Taxonomy for change causes and effects in construction projects," *International Journal of Project Management,* vol. 27, pp. 560-572, 2009.

[50] M. K. I. A. N. M. T. a. A. I. C. A. N. Hamzaha, "Cause of Construction Delay - Theoretical Framework," in *The 2nd International Building Control Conference*, Bangi, 2011.

[51] R. J. Sebastian and B. Davison, "The root causes of contract administration problems.," *Journal of Public Procurement,* vol. 11, no. 2, pp. 171-189, 2011.

[52] D. Mendis, K. N. Hewage and a. J. Wrzesniewski, "Reduction of construction wastes by improving construction contract management: a multinational evaluation," *Waste Management & Research ,* vol. 31, no. 10, pp. 1062-1069, 2013.

[53] V. T. Eva Trinkūnienėa, "Information system for construction contracts structural analysis," *Procedia - Social and Behavioral Sciences,* vol. 110, pp. 1226-1234, 2014.

[54] T. M. Sigitas Mitkusa, "Causes of conflicts in a construction industry: a communicational approach," *Procedia - Social and Behavioral Sciences,* vol. 110, pp. 777-786, 2014.

[55] M. M. ,. H. I. ,. M. A. F. A.A. Elziny, "An expert system to manage dispute resolutions in construction projects in Egypt," *Ain Shams Engineering Journal,* vol. 7, pp. 57-71, 2015.

[56] M. Feldman, "A CONTRACTOR LOOKS AT THE CAUSES OF CONSTRUCTION CONTRACT DISPUTES," *THE ARBITRATION JOURNAL,* vol. 27, no. 3, pp. 145-168, 2013.

[57] A. H. I. A. A. S. Hossam H. Mohamed, "Reducing Construction Disputes through Effective Claims Management," *American Journal of Civil Engineering and Architecture,* vol. 2, no. 6, pp. 186-196, 2014.

[58] R. J. Gilson, C. F. Sabel and R. E. Scott, "Text and Context: Contract Interpretation as Contract Design," *Cornel Law Review,* vol. 100, no. 1, pp. 23-98, 2014.

[59] R. R. I. Jia Niu, "Developing taxonomy for the domain ontology of construction contractual semantics: A case study on the AIA A201 document," *Advanced Engineering Informatics,* vol. 29, pp. 472-482, 2015.

[60] P. I. C. Emre Cakmak, "An analysis of causes of disputes in the construction industry using analytical network process," *Procedia - Social and Behavioral Sciences,* vol. 109, pp. 183-187, 2014.

[61] X. A. a. T. Mashwama, "Investigation of construction stakeholders' perception on the effects & cost of construction dispute in Swaziland," in *Creative Construction Conference*, Budapest, 2016.

[62] I. Mahamid, "Micro and macro level of dispute causes in residential building projects: Studies of Saudi Arabia," *Journal of King Saud University – Engineering Sciences,* vol. 28, pp. 12-20, 2014.

[63] T. M. A. M. Wieslaw Matwiejczuka, "Organizational and Legal Barriers in Shaping the Final Value of Construction Contracts," in *7th International Conference on Engineering, Project, and Production Management*, Bialystok, 2017.

[64] H. I. H. Ali, "Legal Contract Translation Problems: Voices from Sudanese Translation Practitioners," *Arab World English Journal (AWEJ),* vol. 5, pp. 124-143, 2016.

[65] N. Lu, "Investigation of the designers' and general contractors' perceptions of offsite construction techniques in the united states construction industry," Doctoral dissertation of Clemson University, Clemson, USA, 2007.

[66] H. J. Milton, International and national standards on dimensional coordination, modular coordination, tolerances and joints in building., vol. 18(3), Washington DC: U.S Department of Commerce, National Beareau of standard, 1990, pp. 239-248.

[67] M. F. M. M. R. Y. R. A. Muhamad Faiz Musaa*, "Industrialised Building System Modular System (IBSMS) Organisational Readiness Framework," *Procedia - Social and Behavioral Sciences,* vol. 222, pp. 83-92, 2016.

[68] Y. F. Badir, M. R. A. Kadir and a. A. H. Hashim, "Industrialized Building Systems Construction in Malaysia," *JOURNAL OF ARCHITECTURAL ENGINEERING /,* pp. 19-23, 2002.

[69] W. Pan, A. G. F. Gibb and a. A. R. J. Dainty, "Strategies for Integrating the Use of Off-Site Production Technologies in House Building," *JOURNAL OF CONSTRUCTION ENGINEERING AND MANAGEMENT,* vol. 138, no. 11, pp. 1331-1340, 2012.

[70] Jin Ouk Choi, J. T. O'Connor and a. T. W. Kim, "Recipes for Cost and Schedule Successes in Industrial Modular Projects: Qualitative Comparative Analysis," *Journal of Construction Engineering and Management,* vol. 142, no. 10, pp. 1-9, 2016.

[71] S. O. H. S. a. K. W. PER ERIK ERIKSSON, "Managing short-term efficiency and long-term development through industrialized construction," *Construction Management and Economics,* vol. 32, no. 1, pp. 97-108, 2014.

[72] A. K. M. a. M. M. T. Tahereh Nasrollahzadeh, "Critical Success Factor for Industrialized Building System Process Protocol Map by Lean Construction management," *Journal of Civil & Environmental Engineering,* vol. 6, no. 5, pp. 1-6, 2016.

[73] D. L. B. Jeffrey Molavi, "A CONSTRUCTION PROCUREMENT METHOD TO ACHIEVE SUSTAINABILITY IN MODULAR CONSTRUCTION," *Procedia Engineering,* vol. 145, pp. 1362-1369, 2016.

[74] K. M. A. El-Abidi and a. F. M. Ghazalia, "Motivations and limitations of prefabricated building: An overview," *Applied Mechanics and Materials,* vol. 802, pp. 668-675, 2015.

[75] C. Rausch, M. Nahangi, M. Perreault, C. T. Haas and a. J. West, "Optimum Assembly Planning for Modular Construction Components," *Journal of Computing in civil engineering,* vol. 31, no. 1, pp. 1-14, 2017.

[76] P. E. E. T. O. a. P. S. JOHAN LARSSON, "Industrialized construction in the Swedish infrastructure sector: core elements and barriers," *Construction Management and Economics,* vol. 32, no. 1, pp. 83-96, 2014.

[77] C. R. J. W. C. H. M. N. Yasaman SHAHTAHERI, "Risk Mitigation through Tolerance Strategies for Design in Modularization," in *1st International Conference on the Industrialization of Construction (ICIC)*, Edmonton, 2015.

[78] J. T. O'Connor, W. J. O'Brien and a. J. O. Choi, "Industrial Project Execution Planning: Modularization versus Stick-Built," *Practice Periodical on Structural Design and Construction,* vol. 21, no. 1, pp. 1-11, 2015.

[79] M. Safdie and J. (. Kettle, Beyond habitat, Montreal: The MIT Press., 1973.

[80] H. G. J. &. L.-C. D. Bernstein, "Prefabrication and modularization: increasing productivity in the construction industry.," McGraw Hill Construction, Bedford, 2011.

[81] S. T. F. Karst, "Construction Canada," Construction Canada Magazine, 9 March 2018. [Online]. Available: https://www.constructioncanada.net/.

[82] M. L. S. Carriker, "Factors Affecting Large Scale Modular Construction Projects," *Associated Schools of Construction,* p. 8, 2014.

[83] D. I. D. &. F. N. Burleton, "Canada's non-residential construction outlook," TD Bank, Toronto, 2015.

[84] A. S. O. M. M. A.-H. Tarek Salama, "Near optimum selection of module configuration for efficient modular construction," *Automation in Construction,* vol. 83, pp. 316-329, 2017.

[85] www.readable.io, "What is readability and how can it help you?," Readable.io, 2018. [Online]. Available: https://readable.io/.

[86] B. R. M. J. Kincaid JP, "Electronic authoring and delivery of technical information," *Journal of Instructional Development,* vol. 11, no. 2, pp. 8-13, 1988.

[87] J C Broome and R W Hayes, "A comparison of the clarity of traditional construction contracts and of the new engineering contract," *International Journal of Project Management,* pp. 225-261, 1997.

[88] R. R. a. C. Rajapakse, "Contract interpretation: the impact of readability," *Construction Management and Economics,* vol. 25, pp. 729-737, 2007.

[89] R. R. a. A. Rodrigo, "Textual Complexity of Standard Conditions used in the Construction Industry," *Australasian Journal of Construction Economics and Building,* vol. 13, no. 1, pp. 1-12, 2013.

[90] G. Seif, "Towards data science," TDS, 1 October 2018. [Online]. Available: https://towardsdatascience.com/an-easy-introduction-to-natural-language-processing-b1e2801291c1. [Accessed 27 December 2018].

[91] J. Zhang and N. El-Gohary, "Semantic NLP-Based Information Extraction from Construction Regulatory Documents for Automated Compliance Checking," *Journal of Computing in Civil Engineering,* vol. 30, no. 2, 2015.

[92] NEC, "NEC, procure, manage, deliver," Thomas Telford Ltd., 2014. [Online]. Available: https://www.neccontract.com/.

[93] T. A. I. o. Architects, "AIA," AIA.org, 2019. [Online]. Available: https://www.aia.org/.

[94] C. C. D. Committee, "CCDC," Canadian Construction Documents Committee, 2019. [Online]. Available: http://www.ccdc.org/.

[95] M. N.-B. a. S. H. H. Ali Azghandi R., "Towards automated analysis of ambiguity in modular construction contract documents (a qualitative & quantitative study)," in *35th CIB W78 2018 Conference: IT in Design, Construction, and Management*, Chicago, 2018.

[96] M. B. Institute, "Modular Advantage," Modular Building Institute, Virginia, 2016.

[97] C. (. M. H. Institute, "Manufactered Building Survey, 2015 Annual report," CMHI.Ca, Ottawa, 2016.

[98] M. K. S. N. E.-D. T. E. NikBakht, "NEWS AND SOCIAL MEDIA AS PERFORMANCE INDICATORS FOR PUBLIC INVOLVEMENT IN TRANSPORTATION PLANNING: Eglinton Crosstown Project in Toronto, Canada," *TRB 94th annual meeting, At Washington DC., USA,* p. 9, 2015.

[99] R. R. Rodrigo Anushi, "Textual Complexity of Standard Conditions used in the Construction Industry," *Australasian Journal of Construction Economics and Building,* vol. 13, no. 1, pp. 1-12, 2013.

[100] R. R. a. A. Rodrigo, "Modifications to Standard Forms of Contract: the Impact on Readability," *Australasian Journal of Construction Economics and Building,* vol. 14, no. 2, pp. 31-40, 2014.

Appendix

Appendix 1. Sources of confusion in Conventional Construction contract documents "Contract Documents" category and its sub-categories according to the literature review.

Sub-category	Cause	Code
Poor Draftsmanship	False presentation of facts and other similar abuses like absurdities, injustices and poor quality jargons	1
	Not following guidelines & standards	2
	Lack of the knowledge and training by draftsmen	3
Missing Information	Being silent about construction method/technology	4
	Unclear Acceptance performance definition and criteria	6
	Different interpretations of the contract provisions	9
	Unclear Payment conditions	10
	Unclear Scope definition	12
	Dispute resolutions Complexity	13
	Poor Quality Management Process(audit, assurance and control) at shops and jobsite	15
Ambiguity of the Information, provisions and terms	Contradiction and inconsistency between the warranty and contract	18
	Poor Site Management in factory and installation site (access criteria, capacity, layout, security, accident, safety, etc.)	20
	Lack of Indemnification clauses, Reward and Punishment system	21
	Errors & mistakes in technical specifications	22
	Lack of standard contract document and Inconsistencies & contradictions among different documents	23

Lack of Local Regulations and Best Practices	Poor project integration (planning, executing, monitoring, etc.)	24
	Lack of adequate Contract management skills	25
	Unclear duration, payment and technology for approval of tests, inspections, over inspection, etc.	27
	Slow decision making (by owner, engineers, etc.)	28
	Lack of training, education	29
	Owner's interference	30
	Poor project financial planning	31
Ambiguous Contingencies	Lack of familiarity with local force majeure	32
	Lack of contingency planning strategies	33
	Inadequate bonds & insurance to cover failures of the parties	34
Mis-match between Project Delivery Methods & the Contract Type	Undefined roles and responsibilities of parties	35
	Difference of terminology for contracts used in different delivery methods	36
Redundant Information	Contradictory & erroneous info. In the mass of documents	37
Wrong Modification to the standard contract	Inappropriate Risk Allocation - Risk management	38
	Modifying the contract by non-legal professionals	39
Verbal (Un-Written) Clauses		40

Appendix 2. Sources of confusion in Modular Construction contract documents "Contract Documents" category and its sub-categories according to the literature review.

Sub-category	Cause	Code
Poor Draftsmanship	False presentation of facts and other similar abuses like absurdities, injustices and poor quality jargons	1
	Not following guidelines & standards	2
	Lack of the knowledge and training by draftsmen	3
Missing Information	Being silent about construction method/technology	4
	Being silent about production & installation machinery	5
	Unclear Acceptance performance definition and criteria	6
	Lack of criteria for damages or defects	8
	Unclear Payment conditions	10
	Lack of uniform definition	11
	Unclear Scope definition	12
	Dispute resolutions Complexity	13
	Lack of Tolerance criteria	14
	Poor Quality Management Process(audit, assurance and control) at shops and jobsite	15
Ambiguity of the Information, provisions and terms	Complexity of Workers Compensation Board (WCB)	16
	Contradiction and inconsistency between the warranty and contract	18
	Uncertainty of type and quantity of needed permits, certificates, etc.	19
	Poor Site Management in factory and installation site (access criteria, capacity, layout, security, accident, safety, etc.)	20
	Lack of Indemnification clauses, Reward and Punishment system	21

	Errors & mistakes in technical specifications	22
	Lack of standard contract document and Inconsistencies & contradictions among different documents	23
Lack of Local Regulations and Best Practices	Poor project integration (planning, executing, monitoring, etc.)	24
	Lack of Operations and Maintenance (O&M) program	26
	Unclear duration, payment and technology for approval of tests, inspections, over inspection, etc.	27
	Slow decision making (by owner, engineers, etc.)	28
	Lack of training, education	29
	Poor project financial planning	31
Ambiguous Contingencies	Lack of familiarity with local force majeure	32
	Lack of contingency planning strategies	33
	Inadequate bonds & insurance to cover failures of the parties	34
Mis-match between Project Delivery Methods & the Contract Type	Undefined roles and responsibilities of parties	35
	Difference of terminology for contracts used in different delivery methods	36
Redundant Information	Contradictory & erroneous info. In the mass of documents	37
Wrong Modification to the	Inappropriate Risk Allocation - Risk management	38

	Modifying the contract by non-legal professionals	39

Appendix 3: Pre-Processing of specific compound words in RFP from BC

(Canada) B.C	
Main Format	**Pre-Processed**
Work Safe BC	WorkSafeBC
Contractor	Designbuilder
Business License	BusinessLicense
City of Coquitlam	Owner
written notice	writtennotice
Certificate of Insurance	CertificateofInsurance
City	Owner
Industrial Health and Safety	IndustrialHealthandSafety
designated representative	designatedrepresentative
project site	site
work site	site
International Commercial Arbitration Centre	InternationalCommercialArbitrationCentre
British Columbia	BritishColumbia
Vancouver area	Vancouverarea
Provincial Motor Vehicle Act	ProvincialMotorVehicleAct
Workplace Hazardous Material Information System (WHMIS)	WorkplaceHazardousMaterialInformationSystem(WHMIS)

Ministry of Transportation and Infrastructure	MinistryofTransportationandInfrastructure
License Department	LicenseDepartment
Modular Building	ModularBuilding
Building Permit	BuildingPermit
substantial completion	substantialcompletion
good faith	goodfaith
faulty installation	faultyinstallation
Adverse weather	adverseweather
Faulty material	faultymaterial
Purchase Order	PurchaseOrder
Regulations	regulation
Sole discretion	solediscretion
Coquitlam Fire Rescue	CoquitlamFireRescue
work hours	workhours
authorized representative	authorizedrepresentative
Commercial General Liability Insurance	CommercialGeneralLiabilityInsurance
Equipment Insurance	EquipmentInsurance
National and Provincial Building Code	NationalandProvincialBuildingCode
seismic design	seismicdesign
Automobile Liability insurance	AutomobileLiabilityinsurance

Appendix 4: Pre-Processing of specific compound words in RFP from Florida

(USA) Florida

Main Format	Pre-Processed
Contract Document	ContractDocument
Florida Building Code	FloridaBuildingCode
Florida Accessibility Codes	FloridaAccessibilityCodes
written notice	writtennotice
School District	SchoolDistrict
Request for Proposal	RequestforProposal
General Contractor Services	GeneralContractorServices
Disaster Recovery Assistance	DisasterRecoveryAssistance
Florida Statute Chapter	FloridaStatuteChapter
performance of the work	performanceofthework
At completion of work	Atcompletionofwork
purchase order	purchaseorder
Purchasing Department	PurchasingDepartment
employees	employee
Project Representative	ProjectRepresentative
clerk-of-the-works	clerkoftheworks
non-compliance	noncompliance
Payment Bond	PaymentBond
Bid Bond	BidBond
Performance Bond	PerformanceBond
Georgia Insurance Commission	GeorgiaInsuranceCommission
’s	-

Change Order	ChangeOrder
Notice of Protest	NoticeofProtest
ContractualLiability	ContractualLiability
Accounts Payable	AccountsPayable
Accounting Services	AccountingServices
School Board	SchoolBoard
Palm Beach County	PalmBeachCounty
Contractor	Designbuilder
Non-Instructional Buildings Purchase and Installation	NonInstructionalBuildingsPurchaseandInstallation
Employers' Liability	EmployersLiability
PBSD FORM	PBSDFORM
Fiscal Accounting Department	FiscalAccountingDepartment
Preconstruction Conference	PreconstructionConference
Office of Diversity in Business Practices	OfficeofDiversityinBusinessPractices
District Master Specification Design Criteria	DistrictMasterSpecificationDesignCriteria
authorized representative	authorizedrepresentative
Request for Proposal	RequestforProposal
Relocatable Modular Classrooms	RelocatableModularClassrooms
District Master Specifications	DistrictMasterSpecifications
Educational Specification	EducationalSpecification
Liquidated Damages	LiquidatedDamage
calendar day	calendarday
Sub-subcontractor	Subsubcontractor

District Staff	DistrictStaff
work site	worksite
Building Code Requirements	BuildingCodeRequirements
Structural Concrete for Buildings	StructuralConcreteforBuildings
Department of Environmental Regulation	DepartmentofEnvironmentalRegulation
South Florida Water Management District	SouthFloridaWaterManagementDistrict
Business day	Businessday
Contract Sum	ContractSum
Attorney-In-Fact	AttorneyInFact
State of Florida	StateofFlorida
Surety Bond	SuretyBond
Labor and Material Payment Bond	LaborandMaterialPaymentBond
federal Bond	federalBond
Florida Statute	FloridaStatute
Department of Insurance	DepartmentofInsurance
Commercial General Liability Form	CommercialGeneralLiabilityForm
Builder Risk Insurance	BuilderRiskInsurance
Trench Safety Act	TrenchSafetyAct
Laws of Florida	LawsofFlorida
School District	owner
palm beach school district	PBSD
Minority/Women Business Enterprise	M/WBE

Appendix 5: Pre-Processing of specific compound words in RFP from Georgia

(USA) Georgia	
Main Format	**Pre-Processed**
Modular Office Building	ModularOfficeBuilding
Contractor	Designbuilder
Purchasing Department	PurchasingDepartment
Georgia Arbitration Code	GeorgiaArbitrationCode
State of Georgia	StateofGeorgia
Dawson County	DawsonCounty
State and Federal Law	StateandFederalLaw
Contract Document	ContractDocument
PROPOSAL BONDS	Proposalbonds
PAYMENT BONDS	Paymentbonds
PERFORMANCE BONDS	Performancebonds
Official Code of Georgia	OfficialCodeofGeorgia
Invitation for Bids	InvitationforBids
Georgia Open Records Act	GeorgiaOpenRecordsAct
Workers Compensation	WorkersCompensation
Credit card	Creditcard
State Unemployment	StateUnemployment
Federal Social Security	FederalSocialSecurity
subcontractors	subcontractor
days	day
purchase order	purchaseorder

Competitive Sealed Proposals	CompetitiveSealedProposals
BOC/Owner	Dawson County Board of Commissioners
O.C.G.A.	Official Code of Georgia Annotated (State Statute)
Dawson County Board of Commissioners	Owner
County	Owner
Proposer	Designbuilder
Labor and Materials	LaborandMaterials
Construction Inspector	ConstructionInspector
acts of God	actsofGod
Industrial disturbances	industrialdisturbances
Liability Insurance	LiabilityInsurance

Appendix 6: Pre-Processing of specific compound words in RFP from UK

(UK) RFP	
Main Fromat	**Pre-Processed**
West Berkshire Council	WestBerkshireCouncil
Nicola Lang Project Officer	NicolaLangProjectOfficer
organisation	organization
Contractor	Designbuilder
Employer	Owner
Employer Agent / EA	Employeragent
West Berkshire’s Maintenance Term	WestBerkshire’sMaintenanceTerm

Health and Safety at Work	HealthandSafetyActatWork
Control of Asbestos Regulations 2012	ControlofAsbestosRegulations2012
Act 1974	Act1974
Working at Height Regulations	WorkingatHeightRegulations
Statutory Regulations	StatutoryRegulations
Local Authority	LocalAuthority
Health & Safety Conduct Standards	HealthandSafetyConductStandards
Preliminary Clauses	PreliminaryClauses
Sub-Contractor's	SubContractor
Neighbourhoods	Neighborhoods
Environmental Protection Act 1990	EnvironmentalProtectionAct1990
Environmental Protection (Duty of Care) Regulations 1991	EnvironmentalProtectionAct1990
Clean Neighborhoods and Environment Act 2005	CleanNeighborhoodsandEnvironmentAct2005
Control of Pollution (Amendment) Act 1989	ControlofPollution(Amendment)Act1989
Registration of Carriers and Seizure of Vehicles	RegistrationofCarriersandSeizureofVehicles
Regulations 1991	Regulations1991
Hazardous Waste Regulations (HWR) 2005	HazardousWasteRegulations(HWR)2005
Site Waste Management Plans (SWMP) Regulations 2008	SiteWasteManagementPlans(SWMP)Regulations2008
Environmental Information Regulations	EnvironmentalInformationRegulations
duty of care	dutyofcare
Waste Acceptance Criteria	WasteAcceptanceCriteria
Landfill (England and Wales) Regulations 2002	Landfill(EnglandandWales)Regulations2002

odour	odor
Deposit of Poisonous Waste Act 1972	DepositofPoisonousWasteAct1972
waste materials	wastematerials
Methods for the Determination of Hazardous Substances	MethodsfortheDeterminationofHazardousSubstances
asbestos containing materials	asbestoscontainingmaterials
Employer Tree Officer	EmployerTreeOfficer
minimise	minimize
Quantity Surveyor	QuantitySurveyor
Contract Sum Analysis	ContractSumAnalysis
Cash Flow	CashFlow
Conditions of Contract	ConditionsofContract
Performance Bond	PerformanceBond
Data Protection Act 1998	DataProtectionAct1998
Data Protection	DataProtection
Human Rights Act	HumanRightsAct
co-ordination	coordination
Construction Design and Management Regulations	CDMRegulations
CDM Regulations	CDMRegulations
Construction Phase Plan	ConstructionPhasePlan
Authorities Policy Statement	AuthoritiesPolicyStatement
Employer Project Manager	EmployerProjectManager
materials	material
samples	sample

Sections	Section
tests	test
inspections	inspection
days	day
works	work
Design and Build	DesignBuild
liabilities	liability
Procedures	Procedure
Plumbers	plumber
United Kingdom Standard Specification	UnitedKingdomStandardSpecification
Standard Code of Practice	StandardCodeofPractice
International Standard	InternationalStandard
UK Standard	UKStandard
Water Industry Approved Plumber Scheme (WIAPS)	WaterIndustryApprovedPlumber Scheme(WIAPS)
Forest Stewardship Council (FSC)	ForestStewardshipCouncil(FSC)
Products containing CFC or HCFC.	ProductscontainingCFCorHCFC.
Climatic Conditions	ClimaticConditions
Periodic Payments	PeriodicPayments
Stage Payments	StagePayments
Payment Notices Interim Payments	PaymentNoticesInterimPayments
European Community	EuropeanCommunity
Electrical contractor	Electricalcontractor
Electrical contractor Association	ElectricalcontractorAssociation

National Inspection Council for Electrical Installation Contracting	NationalInspectionCouncilforElectricalInstallation Contracting
contractor	designbuilder
Valuation Date	ValuationDate
Interim Payment application	InterimPaymentApplication
Interim Valuation Date	InterimValuationDate
Exempted Information	ExemptedInformation
Contract Particulars	ContractParticulars
owner Requirements	ownerRequirements
Final Payment Notice	FinalPaymentNotice
Interim Payment	InterimPayment
final payment	finalpayment
Pay Less Notices	PayLessNotice
Final Statement	FinalStatement
working day	workingday
Gross Valuation	GrossValuation
Value of Work	ValueofWork
Confirmed Acceptance	ConfirmedAcceptance
Fluctuations Provision	FluctuationsProvision
Construction Industry Model Arbitration Rules	ConstructionIndustryModelArbitrationRules
Quality Management System	QualityManagementSystem
Project Quality Plan	ProjectQualityPlan
Site Inspection	SiteInspection
Checking Proformas	CheckingProformas

Quality Audit	QualityAudit
Noncompliance Reports	NoncomplianceReports
Nonconformance Reports	NonconformanceReports
United Kingdom Standard	ukStandard
Recognized European Standard	RecognizedEuropeanStandard
British Standard	BritishStandard
British Board	BritishBoard
Thames Water Pollution Control	ThamesWaterPollutionControl
Asbestos Removal contractor Association(ARCA)	AsbestosRemovalcontractorAssociation(ARCA)
written permission	writtenpermission
Working Area	WorkingArea
person in charge	personincharge
Operating and Maintenance Manuals	OperatingandMaintenanceManuals
Practical Completion	PracticalCompletion
Permit to Work	PermittoWork
less than	lessthan
final date for payment	finaldateforpayment
Retention bond	Retentionbond

Appendix 7: Pre-Processing of specific compound words in CCDC14

(Canada) CCDC-14	
Before	**After**
Work performed	Workperformed

Contract Document	ContractDocument
Design-Builder	DesignBuilder
Design-Build	DesignBuild
General-Condition	GeneralCondition
Place of the Work	PlaceoftheWork
Payment Certifier	PaymentCertifier
Substantial Performance	SubstantialPerformance
designate portion of Work	designateportionofWork
calendar day	calendarday
Substantial Performance of Work	SubstantialPerformanceofWork
in writing	inwriting
Statement of REQUIREMENT	StatementofREQUIREMENT
Contract Time	ContractTime
progress payment	progresspayment
Change Order	ChangeOrder
Change Directive	ChangeDirective
Notice in Writing	NoticeinWriting
Working Day	WorkingDay
Construction Dispute	ConstructionDispute
dispute resolution	disputeresolution
Design Service	DesignService
cash allowance	cashallowance

Contract Price	ContractPrice
Automobile Liability Insurance	AutomobileLiabilityInsurance

Appendix 8: Pre-Processing of specific compound words in AIA-141

(USA) AIA-141	
Before	**After**
Certificate for Payment	CertificateforPayment
progress payment	progresspayment
Substantial Completion	SubstantialCompletion
Design-build document	Designbuilddocument
designate portion	designateportion
Design-Builder	DesignBuilder
Design-Build	DesignBuild
Certificate of Substantial Completion	CertificateofSubstantialCompletion
written acceptance	writtenacceptance
Contract Time	ContractTime
Change Order	Changeorder
Owners Criteria	OwnersCriteria
Portion of the Work	portionoftheWork
Contract Sum	ContractSum
dispute resolution	disputeresolution
FINAL PAYMENT	FINALPAYMENT

written notice	writtennotice
American Arbitration Association	AmericanArbitrationAssociation
Construction Industry Arbitration Rule	ConstructionIndustryArbitrationRule
Federal Arbitration Act	FederalArbitrationAct
Preliminary Design	PreliminaryDesign
Construction Document	ConstructionDocument
Commercial General Liability	CommercialGeneralLiability
Automobile Liability	AutomobileLiability
Workers Compensation	WorkersCompensation
Employer Liability	EmployerLiability
Pollution Liability	PollutionLiability
Professional Liability	ProfessionalLiability
sub-subcontractor	subsubcontractor
actual cost	actualcost
Agreement Automobile Liability	AgreementAutomobileLiability
Construction Industry Mediation Procedure	ConstructionIndustryMediationProcedure

Appendix 9: Pre-Processing of specific compound words in NEC3

(UK) NEC3	
Before	**After**
Work Information	WorkInformation
Completion Date	CompletionDate

Project Manager	ProjectManager
Defect Certificate	DefectCertificate
Contract Data	ContractData
Key Performance Indicator	KeyPerformanceIndicator
Incentive Schedule	IncentiveSchedule
Working Area	WorkingArea
Low performance	lowperformance
Completion of the work	completionofthework
Parent company	parentcompany
Termination certificate	terminationcertificate
Risk register	RiskRegister
work done to date	WorkDonetoDate

Appendix 10: Post-Processing of synonym words of AIA-141 (changed to terms in CCDC-14)

(CA) CCDC-14	**(USA) AIA-141**	
Main Format	**General**	**Post-Processed**
Owner	Owner	-
-	-	-
Design- Builder	DesignBuilder	-
Substantial Performance	Substantial Completion	SubstantialPerformance
Place of the work	Site	Placeofthework

Contract document	designbuilddocument	contractdocument
notice in writing	writtennotice	noticeinwriting
Paragraph	section	paragraph
consultant	consultant	-

Appendix 11: Post-Processing of synonym words of NEC3 (changed to terms in CCDC-14)

CCDC	**NEC3**	
Main Format	**General**	**Post-Processed**
Owner	Employer	Owner
-	Owner	
Design- Builder	Contractor	DesignBuilder
Substantial Performance	completion of the whole of the work	SubstantialPerformance
Place of the work	Site	Placeofthework
Contract document	contractdata	contractdocument
notice in writing	-	-
Paragraph	-	-
consultant	supervisor	consultant

Appendix 12: Standard Contracts related TF and TF-IDF output

6- Unclear Acceptance performance definition and criteria					
High TF					
AIA	**WC**	**CCDC**	**WC**	**NEC**	**WC**
owner	37	designbuilder	13	stated	8
designbuilder	36	work	10	incentiveschedule	7
work	35	substantialperformanceofwork	9	owner	6
contractdocument	19	contractdocument	6	designbuilder	6
accordance	14	owner	6	keyperformanceindicator	5
substantialperformanceofwork	11	performed	5	target	4
correction	9	certificate	5	performance	4
paragraph	9	consultant	4	completion	4
period	9	date	4	work	3
correct	7	designateportionofwork	3	contractdocument	3
designateportion	7	accordance	3	payment	3
portionofthework	7	paymentcertifier	3	forecast	2
requirement	7	application	3	final	2
complete	7	requirement	3	lowperformance	2
year	6	substantially	3	achieved	2
obligation	6	include	2	report	2
date	6	correct	2	date	2
inspection	6	pay	2	defectcertificate	2
certificateofsubstantialcompletion	6	applicable	2	improved	2
time	6	designateportion	2	pay	2
receipt	5	state	2	measurement	2
performed	5	lien	2	defect	2
promptly	5	advise	2		
make	5	legislation	2		
cost	5	inwriting	2		
WC: Word Count					

6- Unclear Acceptance performance definition and criteria		
High TF-IDF		
AIA	CCDC	NEC
period	paymentcertifier	stated
paragraph	designateportionofwork	incentiveschedule
portionofthework	inwriting	keyperformanceindicator
certificateofsubstantialcompletion	reason	target
year	legislation	performance
inspection	difference	defectcertificate
time	lien	report
obligation	examination	achieved
list	information	forecast
make	value	lowperformance
item	advise	improved
promptly	agree	measurement
warranty	review	defect
completed	dispute	achieve
use	calendarday	starting
acceptance	confirm	associated
contracttime	substantialperformance	completiondate
correcting	called	decides
extended	refer	using
condition	generalcondition	reduce
expense	defective	indicator
constitute	examined	week
removal	result	changed
occupancy	workperformed	improving
writtenacceptance	document	add

10- Unclear Payment conditions					
High TF					
AIA	WC	CCDC	WC	NEC	WC
designbuilder	87	designbuilder	45	payment	64
owner	79	payment	44	designbuilder	47
work	37	owner	35	projectmanager	22
payment	36	paymentcertifier	34	contractdata	21
applicationforpayment	20	application	27	contract	20
contractor	19	work	25	assessment	19
consultant	18	holdback	22	equipment	18
architect	17	cashallowance	13	date	18
service	16	certificate	13	cost	18
contractsum	16	legislation	12	owner	17
contractdocument	16	calendarday	10	price	16
entity	15	designservice	10	stated	16
provide	15	applicable	10	pay	13
material	15	progresspayment	9	bank	11
person	15	placeofthework	9	advanced	10
claim	13	provide	9	assessed	10
providing	12	value	8	termination	10
make	11	lien	8	included	10
evidence	11	contract	8	work	10
equipment	11	receipt	7	rate	9
day	10	product	7	listed	9
required	10	supplier	7	defined	9
portionofthework	9	day	7	currency	9
certificateforpayment	8	workperformed	6	total	9
amendment	8	claim	6	project	9
WC: Word Count					

10- Unclear Payment conditions		
High TF-IDF		
AIA	CCDC	NEC
applicationforpayment	paymentcertifier	projectmanager
architect	holdback	contractdata
contractsum	cashallowance	assessment
entity	legislation	price
providing	calendarday	assessed
portionofthework	designservice	termination
certificateforpayment	lien	advanced
security	contractprice	defined
request	workperformed	currency
designbuild	enforceable	listed
execution	prime	project
encumbrances	retain	placeofthework
data	satisfy	week
furnish	monetary	charge
costofthework	authority	workdonetodate
previously	monthly	late
money	subcontract	named
guaranteedmaximumprice	apply	calculated
right	profit	purchase
invoice	distribution	authorisation
stored	valueaddedtax	multiplied
waiver	valid	contractdate
determination	exercise	insurer
changedirective	notwithstanding	hours
payrolls	quebec	market

13- Dispute resolutions Complexity					
High TF					
AIA	WC	CCDC	WC	NEC	WC
claim	45	claim	73	arbitrator	99
party	31	party	55	party	77
owner	27	designbuilder	40	dispute	47
designbuilder	21	owner	33	decision	31
arbitration	19	paragraph	28	court	24
mediation	19	noticeinwriting	21	owner	21
paragraph	19	provide	19	contract	19
decision	15	contract	17	time	19
initial	13	dispute	16	action	18
agreement	13	arbitration	14	arbitration	16
accordance	10	placeofthework	13	designbuilder	15
contract	10	event	13	matter	14
binding	10	lien	13	week	14
day	10	substantialperformanceofwork	13	refer	13
person	10	arising	13	referred	13
demand	9	date	12	day	12
provide	9	right	12	notify	12
disputeresolution	9	respect	10	notification	12
proceeding	8	period	10	information	11
applicable	8	indemnification	9	notified	9
law	7	applicable	9	disputed	9
subject	7	closing	9	stated	8
request	7	work	9	related	8
inwriting	7	insurance	9	connection	8
date	7	indemnify	9	act	8

13- Dispute resolutions Complexity		
High TF-IDF		
AIA	CCDC	NEC
initial	placeofthework	week
person	insurance	notification
demand	indemnification	disputed
entity	workingday	notified
inwriting	closing	connection
data	designservice	stated
filing	submit	decided
render	legislation	referral
mutually	calendarday	decides
condition	generalcondition	subcontract
relating	negotiation	review
joinder	indemnity	resigned
initiated	series	extended
consolidation	reasonable	decide
administering	defect	accepted
file	contractprice	assessment
selected	releases	quotation
surety	instructions	choose
stayed	bid	treated
profit	advanced	nominating
term	proposal	inaction
finalpayment	result	revise
precedent	resulting	instruct
written	province	dissatisfied
financing	interim	predecessor

15 & 27 Poor Quality Management Process & Inspection and Test					
High TF					
AIA	**WC**	**CCDC**	**WC**	**NEC**	**WC**
owner	13	owner	16	stated	2
designbuilder	13	designbuilder	9	lowperformance	2
contractdocument	7	contractdocument	6	contractdocument	2
architect	7	cost	5		
work	5	error	4		
submittal	4	statementofrequirement	4		
responsible	3	omission	4		
preliminarydesign	3	accept	3		
perform	3	requirement	3		
accordance	3	constructiondocument	3		
include	3	information	3		
employee	3	inwriting	3		
constructiondocument	3	design	3		
omission	3	advise	2		
modification	3	meeting	2		
OwnersCriteria	2	changeorder	2		
requirement	2	promptly	2		
performing	2	behalf	2		
discover	2	inconsistency	2		
plan	2	provide	2		
act	2	significant	2		
building	2	responsibility	2		
failure	2	relieve	2		
portionofthework	2	specification	2		
noticeinwriting	2				
WC: Word Count					

27 Poor Quality Management Process & Inspection an		
High TF-IDF		
AIA	**CCDC**	**NEC**
submittal	statementofrequirement	stated
employee	accept	lowperformance
modification	inwriting	defectcertificate
accordance	review	performance
preliminarydesign	design	included
perform	behalf	pay
responsible	meeting	level
include	advise	defect
performing	significant	respect
building	inconsistency	damage
portionofthework	changeorder	control
ownerscriteria	recorded	following
relieved	ensure	accordance
failure	liable	error
agent	arrangement	architect
contractor	cost	paragraph
person	fail	work
entity	correct	consultant
consultant	affected	conformity
architect	general	behalf
discover	expressly	agent
act	resulting	proceed
plan	supply	prepare
authorizing	conformity	submit

20- Poor Site Management in factory and installation site					
High TF					
AIA	**WC**	**CCDC**	**WC**	**NEC**	**WC**
owner	15	condition	6	placeofthework	5
designbuilder	14	placeofthework	2	information	5
placeofthework	9	party	2	designbuilder	4
provide	8	materially	2	access	4
condition	8	differ	2	placeoftheworkinformation	4
contractdocument	7	contractdocument	2	work	3
project	5	physical	2	taken	2
promptly	5	designbuilder	2	account	2
operation	5			date	2
physical	4			physical	2
materially	4			referred	2
differ	3			assumed	2
required	3			condition	2
indicated	3			contract	2
legal	3			use	2
work	2			included	2
receipt	2				
authorization	2				
control	2				
contractsum	2				
remains	2				
continue	2				
notice	2				
determine	2				
obtain	2				
WC: Word Count					

- Poor Site Management in factory and installation s		
High TF-IDF		
AIA	**CCDC**	**NEC**
project	party	placeoftheworkinformation
operation	discover	access
promptly	apparent	date
legal	noticeinwriting	included
required	underground	account
authorization	weather	referred
features	commencement	assumed
suspend	location	use
contractsum	observing	taken
control	workingday	visual
notify	commencing	allow
regarding	structure	expected
contracttime	existed	surroundings
continue	differ	experienced
encounter	materially	assessing
remains	concealed	allowed
article	observance	shown
notice	reasonably	compensation
request	generally	purpose
existence	activity	favourable
affect	construction	obtainable
receipt	inherent	state
arising	recognized	including
regulation	exist	judging
entitlement	nature	ambiguity

33- Lack of contingency planning strategies					
High TF					
AIA	**WC**	**CCDC**	**WC**	**NEC**	**WC**
owner	9	designbuilder	18	date	9
designbuilder	6	delay	11	designbuilder	7
delay	6	owner	10	delay	7
separate	3	result	6	work	5
work	3	time	5	owner	5
contractor	3	reasonable	5	compensation	5
cost	2	work	4	projectmanager	5
damage	2	contracttime	4	quotation	5
defective	2	extended	3	damage	5
cause	2	cause	3	completion	4
changeorder	2	directly	3	event	4
timed	2	extension	3	completiondate	4
incur	2	performance	3	assessed	4
activity	2	designservice	3	planned	3
time	2	cost	3	keydate	3
improperly	2	indirectly	3	acceptedprogramme	3
construction	2	engaged	3	later	3
		delayed	3	time	3
		incur	3	benefit	2
		employed	3	taking	2
		agreed	3	stated	2
		action	2	reduced	2
		lockout	2	repayment	2
		member	2	extension	2
		noticeinwriting	2	shown	2
WC: Word Count					

33- Lack of contingency planning strategies		
High TF-IDF		
AIA	CCDC	NEC
separate	result	date
defective	performance	projectmanager
improperly	engaged	owner
construction	indirectly	quotation
activity	directly	compensation
timed	designservice	completiondate
justify	action	completion
responsible	reimbursed	assessed
determine	lockout	planned
recovery	noticeinwriting	acceptedprogramme
binding	order	keydate
section	issued	length
progress	member	shown
consultant	adverse	taking
casualties	recommended	benefit
payable	labour	stated
delivery	continuing	repayment
neglect	given	reduced
reimburse	make	taken
disputeresolution	abnormally	assessment
authorized	decreed	reply
determines	contractdocument	proportion
preclude	fault	submit
labor	provide	earlier
mediation	shorter	overpayment

4- Inadequate bonds & insurance to cover failures of the partie					
High TF					
AIA	**WC**	**CCDC**	**WC**	**NEC**	**WC**
owner	58	designbuilder	26	designbuilder	25
insurance	57	owner	21	owner	21
designbuilder	40	work	20	insurance	20
required	30	insurance	15	certificate	13
paragraph	24	insurancerequirement	11	provide	11
agreement	20	date	10	policy	11
property	19	policy	10	contract	8
provide	16	substantialperformanceofwork	8	insure	8
policy	16	provide	8	submit	7
coverage	15	commencement	8	risk	7
loss	14	year	6	stated	6
work	13	designservice	6	contractdocument	5
insured	12	contract	5	date	5
limits	11	damage	5	insurer	5
project	10	coverage	5	acceptance	5
contractor	10	loss	5	required	5
liability	9	liability	5	starting	4
expiration	9	calendarday	4	cost	4
consultant	9	restoration	4	pay	4
maintain	9	required	4	comply	4
purchase	9	property	4	require	4
damage	8	consultant	4	bond	3
subcontractor	8	use	3	event	3
policies	8	construction	3	projectmanager	3
bond	8	specified	3	responsibility	2
WC: Word Count					

dequate bonds & insurance to cover failures of the		
High TF-IDF		
AIA	**CCDC**	**NEC**
paragraph	insurancerequirement	submit
project	substantialperformanceofwork	acceptance
purchase	year	comply
expiration	designservice	starting
policies	restoration	projectmanager
exhibit	calendarday	accept
written	entitled	given
fiduciary	addition	bank
cancellation	increased	accepting
person	published	contractdate
separate	watercraft	reason
including	version	instruct
architect	purposes	strong
forth	closing	table
injury	specifies	signed
covered	receive	fraud
replacement	continuously	defectcertificate
described	extension	broker
inwriting	paymentcertifier	state
entity	insurer	borne
primary	advisor	accepted
covering	consecutive	week
excess	aircraft	force
partial	progresspayment	defect
article	bid	terminationcertificate

Appendix 13: Modular RFPs related TF and TF-IDF output

6-Unclear Acceptance performance definition and criteria							
High TF							
BC	**WC**	**FL**	**WC**	**GA**	**WC**	**UK**	**WC**
work	8	design builder	9	work	4	work	5
design builder	4	work	6	design builder	3	material	3
including	3	contract	6	specified	2	design builder	3
bc	2	date	5			employer agent	3
equipment	2	termination	4			approved	3
electrical	2	school district	3			building	3
comply	2	prior	2			design	3
mechanical	2	scope	2			notice	2
responsibility	2	written notice	2			information	2
regulation	2	effective	2			needs	2
excessive	2	day	2			approval	2
		compensation	2			single	2
		service	2			choices	2
		option	2			finishes	2
		described	2			storey	2
		request fo rproposal	2				
		specification	2				
		entitled	2				
		agreement	2				
		terminate	2				
WC: Word Count							

6-Unclear Acceptance performance definition and criteria			
High TF-IDF			
CA	FL	GA	UK
including	termination	specified	design
mechanical	school district	performed	building
excessive	date	completing	employer agent
regulation	agreement	conditions	choices
electrical	compensation	furnish	finishes
comply	writtennotice	aware	storey
bc	received	properly	needs
responsibility	option	performance	approval
pertaining	entitled	job	information
labour	city	entire	single
ensure	effective	performing	approved
jeopardizes	day	appliance	doubt
failure	terminate	mentioned	satisfy
provide	scope	affect	allow
experienced	prior	fixed	confirmed
successful	district master specification design criteria	progress	avoidance
sanitary	incorporated	satisfied	supporting
ministry of transportation and infrastructure	cause	satisfaction	purpose
reject	prohibit	cost	external
national building code	profits	manner	generally

8-Lack of criteria for damages or defects							
High TF							
BC	**WC**	**FL**	**WC**	**GA**	**WC**	**UK**	**WC**
design builder	14	design builder	14	work	10	work	8
owner	14	owner	4	damage	10	design builder	5
damage	11	employee	4	claim	7	material	4
loss	7	omission	4	design builder	7	damage	3
cost	6	act	3	loss	5	employer agent	3
work	5	contract	3	vendor	4	access	2
property	3	unit	3	expense	4	information	2
defect	3	work	3	party	4	owner	2
satisfaction	3	school district	3	owner	3	loss	2
period	3	damage	3	obligation	3	cover	2
responsible	3	field	3	goods	3	competent	2
year	3	provided	2	property	3	responsible	2
repair	3	agent	2	resulting	3	theft	2
workmanship	3	apply	2	employee	3		
site	2	hold	2	arising	3		
guarantee	2	lines	2	damaged	3		
pay	2	internal	2	person	3		
faulty	2	water	2	injury	3		
opinion	2	subcontractor	2	bear	2		
caused	2	responsible	2	indemnify	2		
WC: Word Count							

8-Lack of criteria for damages or defects			
High TF-IDF			
CA	**FL**	**GA**	**UK**
period	field	vendor	employer agent
defect	unit	party	theft
year	school district	goods	coverup
faulty	measurement	claim	competent
use	water	account	access
date	lines	bear	emergency
rectified	elected	destruction	trade
pay	roof	cause	necessary
opinion	liability	costs	delay
guarantee	apply	including	specified
workmanship	subcontractor	removed	sample
repairing	systems	concealed	person in charge
measure	sewer	resulting	adequately
public	official	obligation	hinder
rights	internal	injury	hour
substantial completion	omission	officers	supervisor
injured	incident	element	carrying
care	indemnification	sustained	plant
owing	payment	statutes	telephone
faulty installation	verify	case	ensure

10-Unclear Payment conditions							
High TF							
BC	WC	FL	WC	GA	WC	UK	WC
invoice	5	design builder	9	owner	16	clause	54
owner	5	invoice	5	payment	14	design builder	29
price	4	payment	5	invoice	12	owner	24
design builder	4	owner	4	pay	7	date	22
work	4	sum	3	design builder	5	payment	21
payment	3	agreed	3	creditcard	5	sum	18
number	2	number	3	date	4	party	13
goods	2	vendor	3	discounts	4	accordance	12
completion	2	liquidated damage	3	receipt	4	work	12
submit	2	damage	2	time	4	stated	12
equipment	2	applicable	2	accounts	4	given	9
receipt	2	additional	2	prompt payment	3	referred	9
submitted	2	work	2	tax	3	pay less notice	8
project	2	money	2	delivery	3	interim payment	8
acceptance	2	completion	2	subcontractor	3	pay	8
service	2	agrees	2	correct	3	day	7
material	2	appropriate	2	accepted	3	calculated	7
including	2	zero	2	acceptance	3	interim payment application	7
		expenses	2	directed	2	value	7
		pay	2	computed	2	subject	7
WC: Word Count							

10-Unclear Payment conditions			
High TF-IDF			
CA	**FL**	**GA**	**UK**
price	liquidated damage	credit card	clause
effort	money	accounts	party
canadianfunds	expenses	discounts	date
freight	delay	accepted	given
net	calendar day	correct	referred
transportation	agrees	prompt payment	pay less notice
complete	said	tax	interim payment
satisfaction	additional	claimed	sum
clearance	pbsd form	furnish	value
tools	month	proposal	interim payment application
scope	vendor	inquiries	calculated
ancillary	sum	exempt	payment notice
components	penalty	law	contract particulars
labour	documentation	connection	relevant
deliverables	achieve	directed	respect
sent	agreement	signature	final payment notice
duties	report	time	applies
FOB	understand	date	fluctuations provision
firm	written	subcontractor	final payment
allinclusive	partial	order	notice

13-Dispute resolutions Complexity							
High TF							
BC	**WC**	**FL**	**WC**	**GA**	**WC**	**UK**	**WC**
party	10	design builder	13	claim	7	party	15
dispute	6	loss	4	work	5	dispute	11
mediator	5	owner	4	regulation	5	arbitration	11
mediation	4	action	3	law	4	arbitrator	8
negotiation	3	including	3	ordinance	4	rule	8
day	3	taken	3	order	4	notice	7
resolve	3	litigation	3	decree	4	difference	7
reasonable efforts	2	performance of the work	3	arising	3	adjudicator	6
metro	2	claim	2	design builder	3	article	5
resolution	2	cost	2	owner	3	apply	5
british columbia	2	statement	2	employee	3	clause	5
notice	2	occurrences	2	material	3	subject	5
appointment	2	party	2	observe	2	accordance	4
vancouver area	2	injury	2	future	2	contract	4
make	2	schooldistrict	2	accord	2	decision	4
litigation	2	arising	2	officer	2	experience	3
goodfaith	2	gender	2	affecting	2	award	3
		occurrence	2	existing	2	pursuant	3
		field	2	comply	2	opinion	3
		law	2	state of georgia	2	determine	3
WC: Word Count							

13-Dispute resolutions Complexity			
High TF-IDF			
CA	**FL**	**GA**	**UK**
mediator	design builder	decree	arbitrator
negotiation	loss	material	difference
resolve	performance of the work	regulation	adjudicator
dispute	taken	work	subject
goodfaith	occurrence	future	article
metro	alleged	observe	clause
british columbia	act	said	arbitration
reasonable efforts	actual	state of georgia	dispute
make	occurrences	comply	accordance
vancouverarea	gender	affecting	decision
mediation	statement	existing	rule
day	filed	ordinance	instruction
bear	school district	employee	expertise
document	owner	design builder	experience
commence	including	owner	jct
mutually	action	used	edition
participating	directly	in writing	determine
bc	disease	arise	proceedings
negotiated	alleging	disposition	award
amicable	price	organization	opinion

19-Uncertainty of type and quantity of needed permits, certificates, etc.							
High TF							
BC	**WC**	**FL**	**WC**	**GA**	**WC**	**UK**	**WC**
owner	6	design builder	4	design builder	2	equipment	9
design builder	5	trench safety act	3	agency	2	work	8
building permit	3	comply	2	required	2	plant	7
apply	2	trench	2	guideline	2	valves	5
responsible	2	compliance	2	responsible	2	installation	5
required	2	design	2	regulation	2	item	4
		certificate	2	government	2	schedule	4
		owner	2			testcertificate	4
		required	2			including	4
		specification	2			technical	3
		prior	2			number	3
						procedure	3
						installed	3
						building	3
						drawing	3
						drainage	2
						diagrammatic	2
						security	2
						operation	2
						new	2
WC: Word Count							

19-Uncertainty of type and quantity of needed permits, certificates, etc.			
High TF-IDF			
CA	FL	GA	UK
building permit	trench safety act	agency	equipment
apply	specification	guideline	plant
valid	design	regulation	valves
website	compliance	publisher	test certificate
information	prior	regulatory	item
designed	certificate	state	including
ramp	trench	city	work
free	afforded	license	procedure
submission	set	federal government	number
paid	florida accessibility codes	said	building
mechanical	excavations	independent	installed
necessary	safety	government	installation
submit	hereinafter	goods	record
modular building	educational	meeting	cross referenced
license department	analysis	recognized	drainage
plumbing	expertise	requirement	used
sealed	contain	responsible	diagrammatic
valid	estimated	hazardous	figures
obtain	insurance	failure	security
order	subpart	coquitlam building permits department	service

20- Poor Site Management in factory and installation site(access criteria, capacity, layout, security, accident, safety, etc)							
High TF							
BC	WC	FL	WC	GA	WC	UK	WC
design builder	14	site	11	building	6	work	74
work	9	design builder	10	owner	3	design builder	57
worksafebc	7	material	7	site	3	site	46
site	6	rubbish	6	modular	2	provide	20
safe	5	equipment	5	area	2	damage	17
safety	4	responsible	4	schematic	2	temporary	16
regulation	4	scrap	4	shower	2	service	16
owner	4	tool	4	website	2	necessary	15
clean	3	work	3			prevent	15
responsible	3	neat	3			required	14
meeting	3	operation	3			time	14
attend	2	orderly	3			existing	13
coordinate	2	construction	3			access	12
use	2	leave	3			completion	12
deemed	2	machinery	2			material	11
accordance	2	frequent	2			employer agent	11
times	2	transported	2			appropriate	11
secured	2	remove	2			asbestos	11
progress	2	premise	2			owner	11
sites	2	responsibility	2			comply	10
WC: Word Count							

20- Poor Site Management in factory and installation site(access criteria, capacity, layout, security, accident, safety, etc)			
HighTF-IDF			
CA	**FL**	**GA**	**UK**
worksafebc	scrap	building	damage
safe	tool	schematic	temporary
progress	neat	shower	service
coordinate	rubbish	modular	prevent
sites	frequent	website	existing
deemed	transported	green	employer agent
detours	pickup	essential	appropriate
secured	refuse	footage	asbestos
policies	at completion of work	requested	precautions
times	surplus	training	provide
create	machinery	grading	kept
safety	leave	resistant	make
regulation	construction	approximately	accommodation
clean	operation	final	road
meeting	orderly	design	carried
zones	testing	delivery	adequate
absolutely	project	cleaned	premises
perform	barricades	open	fencing
workers	operating	shown	maintain
regular	schooldistrict	room	allow

21- Lack of Indemnification clauses, Reward and Punishment system							
High TF							
BC	**WC**	**FL**	**WC**	**GA**	**WC**	**UK**	**WC**
owner	4	design builder	25	party	4	design builder	8
work	3	contract	11	act	2	owner	8
additional	3	school district	8	costs	2	act	7
design builder	3	owner	6	person	2	indemnify	5
claim	2	work	5	loss	2	contract	4
reason	2	sum	5	obligation	2	statutory	4
		date	5	indemnify	2	breach	4
		liquidated damage	4	extent	2	brought	3
		termination	4	caused	2	arises	3
		time	4	expense	2	agents	3
		said	4	damage	2	comply	3
		damage	4	employee	2	information	3
		agreed	3	claim	2	costs	3
		hold	3			duty	3
		harmless	3			council	2
		penalty	3			including	2
		agent	3			actions	2
		elected	3			proceedings	2
		act	3			expenses	2
		completion	3			demands	2
WC: Word Count							

21- Lack of Indemnification clauses, Reward and Punishment system			
High TF-IDF			
CA	**FL**	**GA**	**UK**
additional	schooldistrict	person	**breach**
considered	sum	party	statutory
included	said	indemnified	comply
compensated	liquidated damage	rules	arises
unforeseen	time	attorneys	information
cancelled	termination	wrongful	duty
requirements	completion	construed	data
opportunity	law	abridge	disclosure
description	agrees	directors	council
invoice	elected	wanton	servants
submitted	agent	reduce	proceedings
judgement	agreed	described	costs
recovery	received	certificate	brought
deem	date	professionals	section
solediscretion	monies	exist	respects
unreasonable	injury	statutes	employer
make	way	reckless	crime
written	alleged	regardless	series
price	total	court	decision
circumstance	consideration	contractor	protection

34- Inadequate bonds & insurance to cover failures of the parties							
High TF							
BC	**WC**	**FL**	**WC**	**GA**	**WC**	**UK**	**WC**
owner	6	design builder	15	insurance	4	owner	5
design builder	5	owner	12	percent	3	work	5
insurance	3	required	11	accept	2	insurance	3
required	3	bond	9	including	2	required	3
owned	2	contract	8	bonding	2	notice	2
certificate of insurance	2	surety	7	owner	2	loss	2
		company	7	design builder	2	company	2
		rating	6	certificate	2	site	2
		better	6	authorized	2	parent	2
		florida statute	6	companies	2	guarantee	2
		maintain	5	claim	2	damage	2
		current	5	property	2	claim	2
		performance bond	5	company	2		
		project	5	stated	2		
		insurance	5	acceptable	2		
		operations	4	required	2		
		minimum	4				
		work	4				
		recent	4				
		insurers	4				
WC: Word Count							

34- Inadequate bonds & insurance to cover failures of the parties			
TF-IDF			
CA	FL	GA	UK
certificate of insurance	florida statute	bonding	notice
approval	better	percent	site
commercial general liability insurance	project	georgia insurancec ommission	parent
transfer	current	railroads	person
written notice	labor and material payment bond	effective	insert
alteration	minimum	publication	employer agent
lapsed	recent	insuring	respect
day	bond	personal	occurs
provides	contract	general warranty	caused
assignment	forth	business	line
altered	according	paragraph	forthwith
rented	size	change order	3rd
thirty	included	automatic	proceeding
used	purchase	introduction	rise
equipment insurance	effect	listed	owner
inclusive	dollars	adequate	incorporation
assigned	million	working	receipts
cancellation	financial	described	clause
transferred	school board	liability insurance	indemnify
cancelled	following	proposal	starting

35- Undefined roles and responsibilities of parties							
High TF							
BC	**WC**	**FL**	**WC**	**GA**	**WC**	**UK**	**WC**
site	5	design builder	36	design builder	14	design builder	32
owner	4	work	15	work	11	owner	19
design builder	3	site	14	employee	8	information	18
modular office building	2	responsible	10	owner	5	health	9
work	2	owner	9	subcontractor	5	safety	9
		contract	6	accounts	4	work	8
		modular	6	pay	4	site	8
		school	6	law	3	including	8
		material	6	payment	3	contract	8
		provide	5	responsible	3	principal	8
		times	5	requested	3	construction	7
		office	4	construction	3	ensure	7
		unit	4	public	3	applicable	5
		school district	4	inspector	3	provide	5
		campus	4	equipment	2	legislation	5
		equipment	4	sufficiency	2	request	5
		construction	4	agents	2	phase	5
		prior	4	provision	2	indemnify	4
		condition	4	site	2	hazardous	4
		cost	4	ditches	2	item	4
WC: Word Count							

35- Undefined roles and responsibilities of parties			
High TF-IDF			
CA	**FL**	**GA**	**UK**
modular office building	school	pay	health
clearing	modular	accounts	principal
resulting	campus	inspector	legislation
cubicles	school district	ditches	phase
consultants	subcontractor	sufficiency	applicable
tree	condition	perform	necessary
injury	unit	adequacy	designer
related	employees	observe	employer agent (EA)
security	working	cause	publication
cabling	systems	efficiency	item
geotechnical investigation	lines	requested	regulation
lockers	leave	payment	relating
measure	rubbish	law	safety
rough	main	meets	including
staff	sign	decree	defined
work stations	field	ordinances	duties
preparation	times	deductions	governing
foundations	measurements	decrees	servants
following	scrap	conduct	planning
loss	task	used	relevant