Assessment of Construction Disputes on a Worldwide Scale

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Abstract

Construction claims and disputes, according to multiple researchers and practitioners, are inevitable. Consequently, a better understanding of their types and causes is much needed to help mitigate their effect on the construction industry. Thus, the purpose of this paper is to identify the most occurring construction claims and/or disputes, as well as their causes worldwide. To that end, the adopted research methodology utilizes an electronic survey instrument disseminated to practitioners (1) with different roles in the industry, (2) from both genders, (3) from five continents, and (4) with substantial professional experience. The administration of the instrument yielded 78% response rate with 5% sample error at a confidence interval of 95%. Among the findings are "changes" and "differing site conditions" are the most two occurring types of claims and/or disputes in the construction industry and "contract documents" and "contractor practices" were the most two prominent causes. The findings of this research can provide all types of the construction practitioners with crucial knowledge that allows them to be proactive in dealing and alleviating the effects of claims and/or disputes in the entire industry.

Introduction

Over the years, construction disputes have gained more attention in the construction industry due to their increase in occurrence and deteriorating consequences on project performance. Earlier studies indicate that 72% of construction claims and/or disputes were attributed to

design changes, extra work, and errors (Dickmann & Nelson, 1985). Inevitably, the increased complexity of construction projects and extensive coordination processes play a major role in this phenomenon. Among the most common effects on construction projects, which could result in less than a successful execution, are cost overrun, time delays and extensions, as well as shutdown in some cases. For instance, in the United Kingdom, 52% of construction projects have suffered from claims, resulting in a financial overrun of approximately £1.2 billion (Ren, Anumba, & Ugwu, 2001). Comparatively, it has been estimated that the construction industry in the United States bears a yearly cost of more than $5 billion due to construction claims and disputes (Peña-Mora, Sosa, & McCone, 2003).

In addition to the financial burden, another factor that affects decision-making processes is time delays in settlements, which has doubled between 1984 and 1992 (Treacy, 1995). Such extended court proceedings render litigation excessively costly. For instance, although settlements in court cases have increased by 309% between 1979 and 1990, legal fees have increased by 425% (Marcotte, 990). In 2008, as Iwamatsu, Akiyama, & Endo (2008) state, the Construction Relation Lawsuit Committee reported that the number of construction-related cases in US courts exceeded 2,800, 28% of which were withdrawn before reaching a decision. Although litigation has many advantages, such as being binding to disputing parties, the extended time of reaching a decision and the financial burden have pushed practitioners in the construction industry to adopt other mechanisms like alternate dispute resolution. However, unless the contract allows for such mechanisms, the disputing parties are forced to use litigation. Thus, an exploration of this area and a better understanding of the frequency and types of disputes faced in the construction industry are essential to provide practitioners with proactive mitigation options.

In an effort to address this issue, researchers have attempted classification of construction claims and disputes (Dickmann, & Nelson, 1985), modeling construction claims processes (Ho & Lui, 2004; Yates & Epstein, 2006; Semple, Hartman, & Jergeas, 1994; Chehayeb & Al-Hussein, 2005), risk allocation and analysis (Hanna, 2007), and claim avoidance mechanisms (Ren, Anumba, & Ugwu, 2003; Hegab & Nassar, 2005; Jergeas & Hartman, 1994). Despite the undoubtable contribution of these research endeavors, none has focused on the associations between the characteristics of the contractors and the classification of construction claims and disputes on a large scale. Thus the focus of this paper is to investigate the types and frequency of the most common construction disputes and their causes worldwide and the existence of any association between contractors' characteristics, project characteristics, and the different types of disputes.

Background

Chester & Hendrickson state, "Construction projects are often delayed by unforeseen conditions and poor management practices. The drive to build cheaper and faster sometimes results in several problems for engineers and managers on the construction site" (2005). This fact makes the liability in a situation of a dispute often hard to define (Kraiem & Diekmann, 1987). Consequently, researchers in the construction domain have attempted many methodologies to investigate, address, and mitigate their effects.

To emphasize the cost of claims on construction projects, a study analyzing 22 federally funded construction projects to quantify the occurrence of different types of claims was performed in 1985 (Dickmann & Nelson). The research involved 427 claims and related them to six categories: design error, changes, differing site conditions, weather, strikes, and value engineering. The study concluded that the highest claim frequency (72%) was due to design errors or changes by the owner. In 1994, a study focused on delay and cost overrun claim by assessing 24 projects in Western Canada (Semple, Hartman, & Jergeas, 1994). The authors indicated that there is a direct relation between the owner type and cost overrun claims: 60% of the situations resulting in cost overruns were related to private owners' projects. Similarly, 90% of the private owner projects included a time delay greater than 60% of the original duration.

To help mitigate claims in the construction industry, claim avoidance and minimization has been the focus of numerous researchers. In 1994, a set of guidelines were developed by Jergeas and Hartman (1994) to provide contractors with the needed knowledge about minimizing and mitigating the effects of different types of construction claims. The authors' work addressed 10 causes, some of which are, but not limited to, increase in the scope of work, incomplete bidding information, owners' faulty and/or late provided materials and equipment, and inadequate time for bidding (Jergeas & Hartman, 1994). The proposed guidelines included actions related to recordkeeping, contractual knowledge, right preservation, change order qualifications, planning and scheduling mechanisms, and proactive approaches. Similarly, Yates and Epstein (2006) provided a more comprehensive approach to dealing with delay claims. Their discussion details aspects of the different types of delays, appropriate methods of documentation from a practical as well as a legal point of view, critical path methodology for delay analysis, and quantification methods.

Another group of researchers attempted developing decision support systems and models that detail claim processes. To that end, in 2003, a multiagent model for negotiations was presented to the scientific community (Ren, Anumba, & Ugwu, 2003). The system employs Zeuthen's bargaining model with a Bayesian learning mechanism to achieve the most feasible results. Although the model utilizes specific assumptions about such negotiating entities as rationality and fixed utility functions, it defines a specific set of protocols for successful completion of negotiations. In an attempt to provide insight into claim-related processes, Ho & Lui (2004) presents a decision support system that captures the relation between different claim situation and bidding strategies. The model was based on game theory and addressed the bidding opportunistic behavior regarding different situations, whether encouraging or discouraging to such behavior. The authors found that negotiated settlements provide the most suitable and rational means of resolving construction claims. In addition, a decision support methodology for commencement delay claims was created in 2005 (Hegab & Nassar, 2005), using the case study of El-Gabal El Asfar, a sewer treatment project in Egypt. The proposed model utilized a decision tree methodology for the evaluation of all available alternatives to solve a commencement delay. It assumed probabilities of success and loss of each alternative, as well as the associated costs, to define the cheapest and most effective solution.

Despite the great achievements of these research efforts, they were localized to a singular type or case of claim/dispute. Thus, there is still a need to better understand the types and frequencies of construction claims/disputes on a large scale. Accordingly, the purpose of this paper is threefold: to gain an understanding of the frequency of occurrence of different types of construction claims/disputes within a worldwide construction market, to define the most prominent causes of these claims/disputes, and determine if there is a relation between contractor and project characteristics and high frequency types and causes.

Methodology

Research methodology to achieve the this goal is, as depicted in Figure 1, data collection through a survey and data assimilation involving general analysis of the survey results.

Data Collection

To that end, an electronic survey instrument was created for data collection. The instrument included a set of 15 multiple choice and ranking questions. These were part of a larger and more comprehensive survey aiming at analyzing bidding strategies and the effect of trust on the construction industry (Mahfouz, Gad, Jones, Warrner, & Attallah, 2017). Questions for the current activity were divided into two sections. The first collects anonymous demographic information, which does not include any personal identifiers. These included gender, years of experience, company size, type of involvement in construction projects (i.e., owner, contractor, subcontractor, etc.), among others. The second related to the frequency, nature, and causes of construction claims/disputes encountered. For the purpose of cross validation, two types of classifications and groupings of disputes were utilized. The first, described in Table 1, groups disputes into three categories: project uncertainty, process problems, and people issues. These were based on the researchers' professional experience in the construction field, taking into consideration the most common aspects contractors include in their bidding contingencies. The second classification has originally been defined and verified by Bramble et al. in 1995 in which construction disputes are grouped into seven categories: changes, design/engineering defects, differing site conditions, site access of site management failure, third party actions, delay/impact, and contract management, and performance practices (Bramble et al., 1995). The details of dispute types included within each category are provided in Figure 2. Causes include eight categories adopted from Bramble et al. (1995): contract practices, contracting agency practices, personal factors, institutional factors, contract documents, contract award, contract administration, and claims settlement practices. Table 2 provides a detailed breakdown of the causes per dispute type.

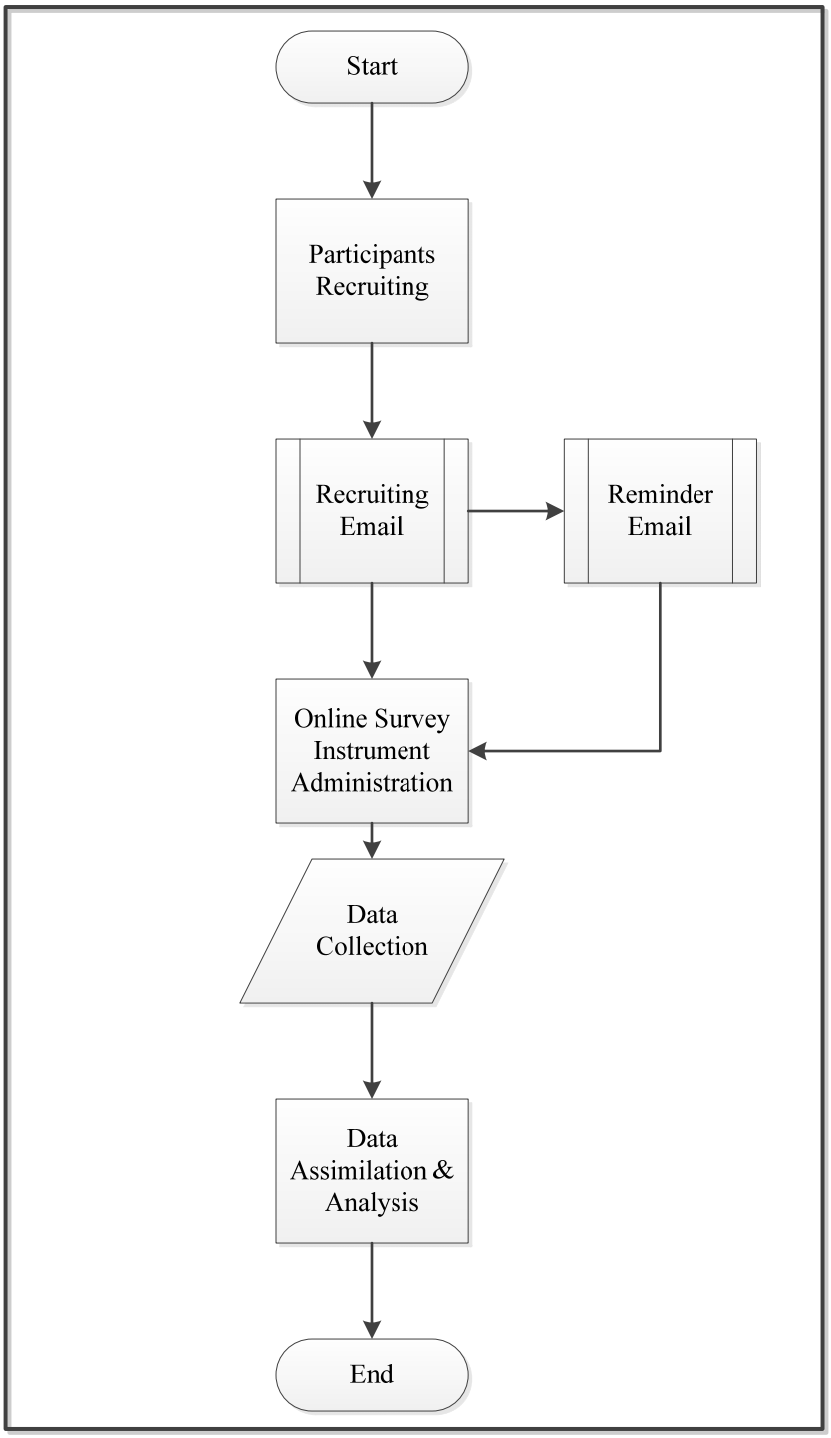
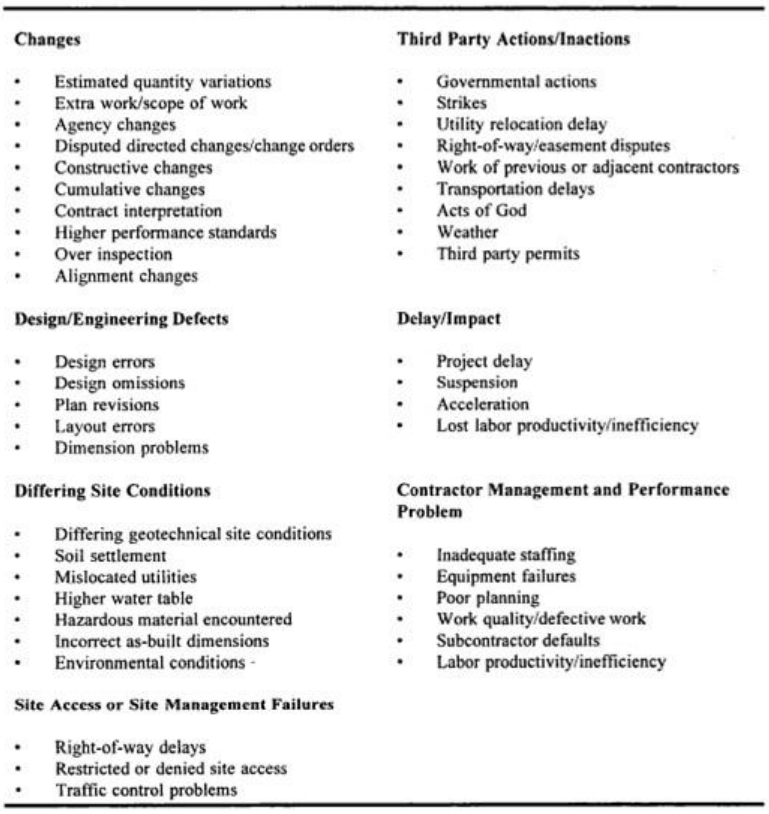


Figure 1. Flow chart of the adopted research methodology.

Table 1. Breakdown of dispute types per category.

Construction Claim or Dispute Category	**Construction Claim or Dispute Types Per Category**
Project Uncertainty	Differing site conditions (DSC) Pre-existing conditions Outside forces (Weather, Strikes, etc.) Complexity of the project.
Process Problem	Imperfect Contracts (including ambiguity of contract clauses) Incomplete scope definition Overlay rigid contractual agreements Poor performance of the contractor Lack of cooperation of the owner/owner representative
People Issues	Poor interpersonal skills Opportunistic behavior Lack of responsiveness Poor communication



Changes

- Estimated quantity variations
- Extra work/scope of work
- Agency changes
- Disputed directed changes/change orders
- Constructive changes
- Cumulative changes
- Contract interpretation
- Higher performance standards
- Over inspection
- Alignment changes

Design/Engineering Defects

- Design errors
- Design omissions
- Plan revisions
- Layout errors
- Dimension problems

Differing Site Conditions

- Differing geotechnical site conditions
- Soil settlement
- Mislocated utilities
- Higher water table
- Hazardous material encountered
- Incorrect as-built dimensions
- Environmental conditions

Site Access or Site Management Failures

- Right-of-way delays
- Restricted or denied site access
- Traffic control problems

Third Party Actions/Inactions

- Governmental actions
- Strikes
- Utility relocation delay
- Right-of-way/easement disputes
- Work of previous or adjacent contractors
- Transportation delays
- Acts of God
- Weather
- Third party permits

Delay/Impact

- Project delay
- Suspension
- Acceleration
- Lost labor productivity/inefficiency

Contractor Management and Performance Problem

- Inadequate staffing
- Equipment failures
- Poor planning
- Work quality/defective work
- Subcontractor defaults
- Labor productivity/inefficiency

Figure 2. Breakdown of dispute types per category, adopted from Bramble (1995)

Table 2. Breakdown of dispute causes per category.

Construction Claim or Dispute Category	**Construction Claim or Dispute Types Per Category**
Contract Practices	Inadequate investigation before bidding Unbalanced Bidding Bidding below cost and over optimism Poor planning and use of wrong equipment Failure to follow authorized procedures
Contracting Agency Practices	Change in plans or specifications Inadequate bid information Inadequate time for bid preparation Excessively narrow interpretation of plans & specs Restrictive specifications Contract requirements for socioeconomic objectives unrelated to the construction process
Personal Factors	Incomparable personalities Adverse attitudes/Opportunistic behavior Lack of responsiveness Poor communication
Institutional Factors	Complex construction Lengthy performance period High quality requirements
Contract Documents	Exculpatory clauses Mandatory notice requirements Finality of engineer's decisions Changed conditions clauses Out of date specifications
Contract Award	Diversity of state contract award procedures Treatment of bid mistakes
Contract Administration	Coordination Interpretation of policy Inspection standards Administrative style Documentation Funding schedule Political considerations
Claims Settlement Practices	Encouragement of project level settlement Delegation of settlement authority to field supervisors Effectiveness of field/headquarter consultation

The survey instrument was created and administered using Qualtrics. Participants were invited via emails sent through the Qualtrics server. Each email included a copy of the informed consent form and notified the participants about their selection, the purpose of the survey, complete anonymity of participation, volunteer participation, information about the investigators' affiliations and contact information, description of the survey instrument breakdown and questions, expected outcomes of the survey, time needed for the survey as well as any burdens, among other essential items. To facilitate participation and minimize any expected cut-offs, the survey instrument was created with an auto-save mode that allowed participants to finish the survey in multiple sessions. Participation was allowed over a period of three months (Mahfouz et al., 2017). The participants included professionals from different geographic locations, different roles (owners, contractors, subcontractors, designers, and consultants), both genders, and sufficient years of experience.

Data Assimilation

As mentioned earlier, all collected data are anonymous. Thus, no identifiers that could relate the participants to any responses were collected. All responses are coded in a numeric matrix with a key available only to the researchers. Those data are stored on a password-secured external hard drive. General statistics to identify the most frequent dispute type as well as causes are reported, as is analysis between multiple factors to define a relation or causality between any parameters. For example, a matrix is defined between the existence of a contract administration department within a company and the number of disputes encountered to measure and if having dedicated resources for legal encounters might increase or decrease within construction projects facing problems.

Results and Discussion

Participant Statistics

A total of 120 participants were invited worldwide over the period of three months through an invitation email and a reminder email sent 10 days apart. Figures 3 and 4 provide the demographic information of the total number of participants. Throughout the three-month period, a 78% response rate was achieved due to 22 candidates not participating and 4 not completing the survey within the allotted time. Thus, it could be deduced from the previous data that the sample error is to be 5% at a 95% confidence interval (Mahfouz et al., 2017). Further examination of the participants' data illustrates that the female to male ratio is 1:1.2, resulting in a well-distributed set as shown in Table 3.

Overall, general contractors represent the highest portion of the participants followed by owners, subcontractors, and others (designers, consultants, etc.) in that order. Table 4 highlights the distribution of the participants by sector. Total percentage exceeds 100% as participants were allowed to choose more than one sector in relation to their professional experiences. In more than one instance, the data relates individuals' experiences with more than one role within the construction industry, thus giving more perspective and more confidence that results are not affected by being narrowed to a specific sector. This is further supported by the wide variety of projects type that participants were exposed to as well as

their years of professional experience. Using the average number of years within each category, the total number of years of professional experience for all participants is 1,114. Table 5 provides detailed information about the participants' experience, company size, and professional level of knowledge of the construction industry while Figure 5 illustrates the nature of projects with which the participants were involved.

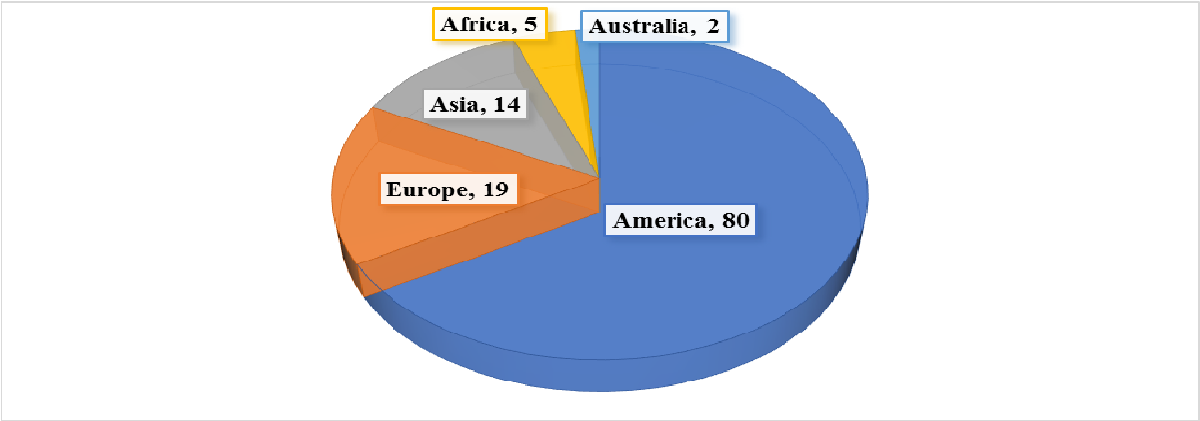


Figure 3. Breakdown of number of invited participants per continent.

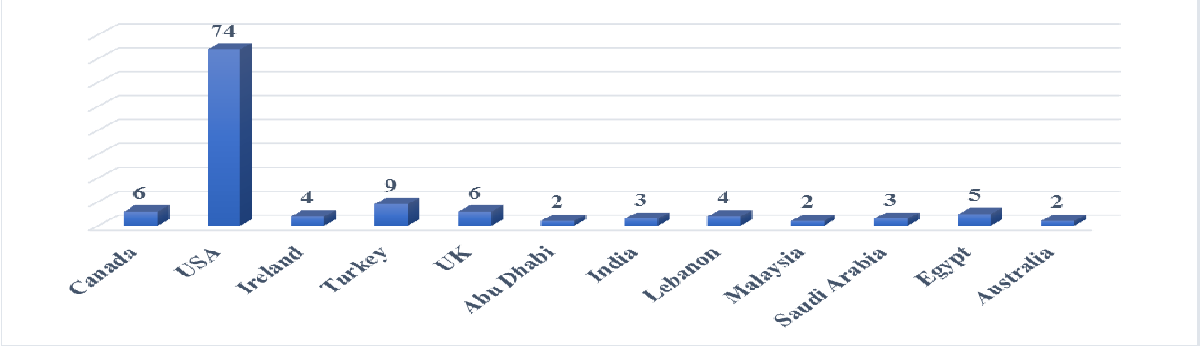


Figure 4. Breakdown of number of invited participants per country.

Table 3. Gender distribution of participants.

Gender	% of Participants	No. of Participants
Female	43.00	40
Male	51.00	48
Preferred Not to Disclose	6.00	6
Total	100.00	94

Table 4. Sector distribution of participants.

Sector	% of Participants	No. of Participants
General Contractor	57.00	53
Owner	40.00	38
Subcontractor	30.00	28
Others	8.00	7

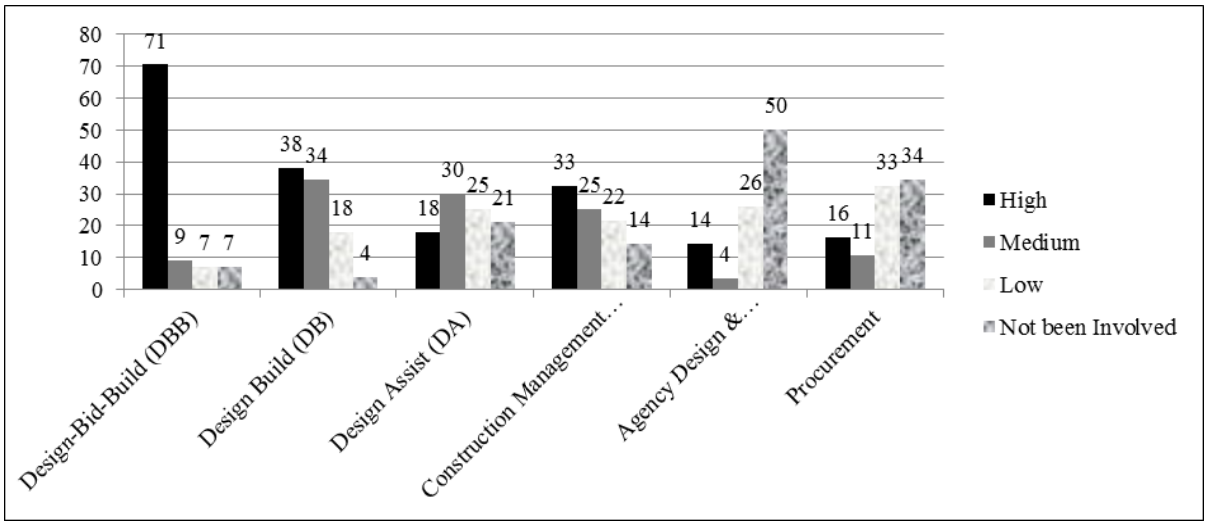


Figure 5. Percentage distribution of participants delivery method experience, adopted from Mahfouz et al., (2017).

Table 5. Demographic distribution of participants, adopted from Mahfouz et al., (2017).

Company Size		**Participants' Experience**		**Experience Level**	
Employees	Response	Years of Experience	Response	Participants' Choices	Response
<5	2%	<1	0%	Novice	10%
5 to 10	2%	1 to 5	31%	Regular	33%
11 to 25	13%	6 to 10	21%	Avid	31%
26 to 50	21%	10 to 15	19%	Expert	27%
50 to 100	19%	16 to 20	15%		
>100	42%	>20	13%		

It is clear from the data, tables, and figures that participants reflect a balanced representation, and thus adequate information about the problem being analyzed, leading to the results not being skewed towards a specific group or a project type.

Type of Construction Claims and Dispute Analysis

A first look at the data highlights that over 86% of the participants have experienced construction claims/disputes within the last five years of their professional career. The highest percentage (37.25%) of the participants have experienced between 1 and 5 claims. An alarming observation is the percentage of participants (21.57%) indicating experiencing more than 15 situations over the aforementioned period of time, which ranks second among all categories. Figure 6 provides a detailed breakdown of all categories. A cross tabulation of the number of construction disputes with the level of experience of the participants, illustrated in Table 6, indicates that the majority of the participants who have experienced 1 to 5 or more than 15 disputes within the last five years have professional experience ranging from 1 to 10 years. Such a fact indicates the increased number of disputes within the construction industry over the last few years, which, in turn, necessitates more attention to alleviate the damaging effect to the industry.

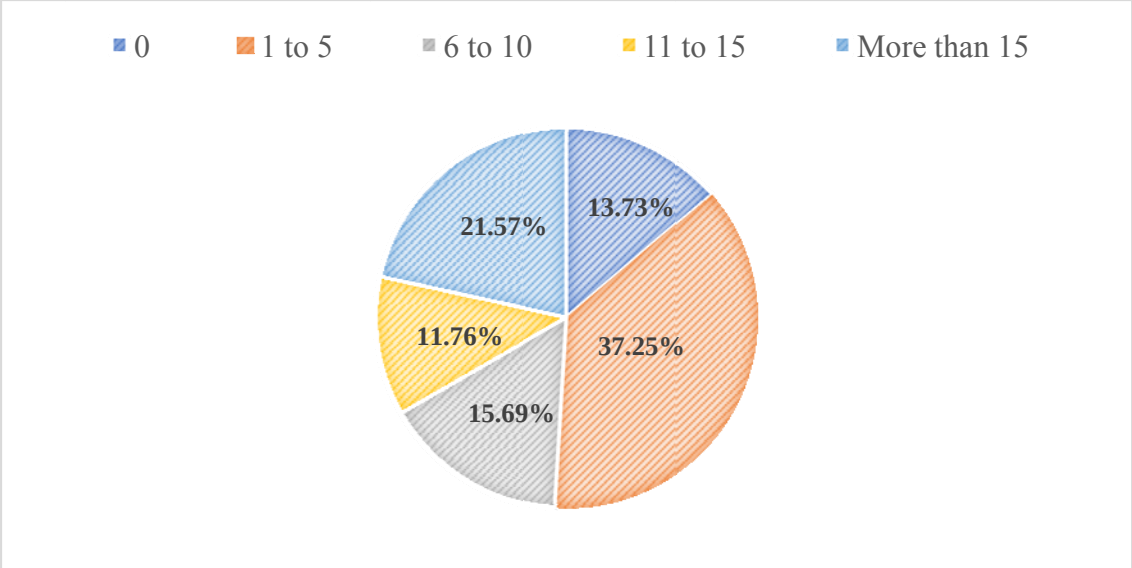


Figure 6. Percentage distribution of construction dispute occurrence.

To fulfill that goal, a closer examination of the most frequent dispute types is needed. To that end, the participants equally ranked project uncertainty and people issues as the most two frequent categories of construction disputes at 33%, each followed by the process problems at 29%; while 5% was assigned to others. Further investigation of the detailed responses for these categories, shown in Table 7, yields the following: (the data within these categories are based on a ranking question from the most frequent to the least).

- Project Uncertainty Category
  - Differing site condition disputes were classified the highest among the first rank at 44%.
  - Pre-existing condition disputes were categorized the highest among the second rank at 41%.
  - Complexity of the project related disputes were defined as the highest among the third rank at 42%.
  - Outside forces (weather, strikes, etc.) disputes were identified as the highest among the fourth rank at 47%.
  - Overall differing site condition disputes ranks the highest when considering the average of recorded selection at 25% with a minor margin over the other types.

Table 6. Experience vs. encountered frequency of disputes within the last 5 years.

		Number of Disputes					
		0	1 to 5	6 to 10	11 to 15	> 15	Total
Years of	Less than 1	0	0	0	0	0	0
	1 to 5	2	9	0	5	8	24

	6 to 10	3	8	0	0	8	19
	10 to 15	4	6	6	4	0	20
	16 to 20	4	4	7	0	2	17
	> 20	0	8	2	2	2	14
	Total	13	35	15	11	20	94
	Overall %	14%	37%	16%	12%	21%	100.00%
Level of Knowledge	Novice	0	2	0	1	5	8
	Regular	2	14	0	2	9	27
	Avid	5	11	7	2	6	31
	Expert	6	8	8	6	0	28
	Total	13	35	15	11	20	94
	Overall %	14%	37%	16%	12%	21%	100.00%

- Process Problems Category
  - Incomplete scope definition was identified as the most frequent construction dispute within this category over multiple ranks. Within the first rank, it was assigned 27% by participants while it was evaluated at 41% within the third rank.
  - Imperfect contracts (including ambiguity of contract clauses) was defined as the second most frequent construction claim whereas poor performance of the contractor was ranked at the top of the fourth selection.
  - Overly rigid contractual agreements were ranked midway through all ranks.
  - Lack of cooperation of the owner/owner representative came up at the top of the fifth rank.

- People Issues Category
  - Opportunistic behavior was classified at the top of the first rank, while it was defined to be high over all other ranks. This could be attributed to the problem of information asymmetry (Shafaat, Mahfouz, Alinizzi, & Kandil, 2016). In such cases, it is assumed that contractors are more knowledgeable about the intricate details of the construction project and process, which allows them to conceal information that might affect the overall cost. When this notion is coupled with the fact that the benefits of the contracting parties are inversely proportional, in which contractors' profits leads to lower owners' savings, the general belief of opportunistic behavior overwhelms such partnership. A closer look at the details of the responses supports this argument, as 42% of the participants within this category are owners.
  - Poor interpersonal skills, lack of responsiveness, and poor communication ranked at the top of the second, third, and fourth selections, respectively.

Table 7. Response breakdown of disputes per category.

Category	Dispute Details	Rank				
		1	2	3	4	5
Project Uncertainty	Differing Site Conditions (DSC)	44%	16%	25%	16%	N/A
	Pre-existing conditions	25%	41%	19%	16%	
	Outside forces (weather, strikes, etc.).	19%	20%	14%	47%	
	Complexity of the project.	17%	26%	42%	15%	
Process Problems	Imperfect Contracts (including ambiguity of contract clauses)	21%	25%	21%	14%	18%
	Incomplete scope definition	27%	18%	41%	14%	0%
	Overlay rigid contractual agreements	21%	21%	11%	29%	18%
	Poor performance of the contractor	21%	14%	18%	32%	14%
	Lack of cooperation of the owner/owner representative	11%	21%	7%	11%	50%
People Issues	Poor interpersonal skills	15%	29%	35%	21%	N/A
	Opportunistic behavior	42%	24%	24%	11%	
	Lack of responsiveness	21%	23%	26%	30%	
	Poor communication	26%	18%	15%	41%	

As mentioned earlier, two dispute classification methods have been used to gain more insight into the construction industry. To that end, when participants were asked about occurrence frequency using the Bramble classification (Shafaat et al., 2016), the responses yielded the followings:

- Construction disputes were ranked in the following order from most frequent to least. The results are based on the average of the "often" and "sometimes" categories. The details or the responses are provided in Table 8.
    - Changes
    - Differing site conditions
    - Design/Engineering defects
    - Contractor management and performance problems
    - Delay/impact
    - Site access or site management failures
    - Third party actions/inactions

Table 8. Responses distribution for the Bramble classification.

	Often	Sometimes	Rarely	Never
Changes	48%	40%	6%	6%
Design/Engineering defects	38%	34%	18%	10%
Differing Site Conditions (DSC).	40%	40%	14%	6%
Site access or site management failures	18%	36%	30%	16%

Third party Actions/Inactions	16%	18%	42%	24%
Delay/Impact	14%	54%	24%	8%
Contractor management and performance problems	10%	60%	20%	10%

As can be seen from the above information, both classifications yielded similar results, which indicates that participants understood the different types of disputes. For more elaboration, Table 9 provides a sample comparison of the two most frequent disputes in support of this notion.

Table 9. Sample comparison between the two construction dispute classification methods.

	Classification Method	
Item #	Researcher	Bramble
Differing Site Conditions (DCS)	Defined as a separate dispute under the project uncertainty category; Was ranked at the top of the category followed by Pre-existing conditions	Defined as a separate category; Included pre-existing conditions as one of the types within the category; Was ranked second overall.
Changes	Defined under the process problem category; The Incomplete Scope definition and Imperfect Contracts were ranked at the top of the category.	Defined as a separate category; Included the scope and contract problems as subcategories; Was ranked as the most frequent dispute category.

However, to gain more understanding of the dispute frequency, associations between these types and the contractors' characteristics is needed. To that end, it could be deduced from the achieved results that

- Concerning the role within the construction industry, there is no specific relation between the type of the participant and a specific type of dispute. Between 80% and 90% of the participants within each role category (owner, contractor, subcontractor, and/or others) have ranked the previously mentioned most frequent disputes as the top ones.

- There is a direct relation between the size of the company and the number of construction dispute encountered. Seventy seven percent to 90% of the participants indicating a higher number of these disputes at the top rank had between 50 to more than 100 employees. This is attributed to the fact that companies with higher number of employees has larger number of projects and/or more volume of work to generate enough annual revenue to cover direct expenses, indirect expenses, general overheads, and profits. This makes them more prone to experiencing an increase in the number of dispute due to the diversified market engagement.

- Between 91% and 100% of the participants with 10 years or more of experience and between 90% and 93% with avid or expert knowledge have ranked these disputes at the top of the different categories. This further support the accuracy of the achieved ranks.

- Between 94% and 97% of the participants with high experience in both design-bid-build (DBB) and design-build (DB) have confirmed the ranking of the construction disputes. Although this might be expected within a DBB project due to the separation of the design and construction processes, it was surprising to be observed within DB projects, which is utilized to better integrate all processes. A closer look at the DB data highlights that "changes disputes" are the most frequent ones. This suggests that even though the integration of design and construction activities has proven successful to minimize the majority of construction disputes, it is still prone to problems due to after-the-fact changes.

- There is no observed relation between the frequency of disputes and having a contract administration or a legal department within the company. To that end, 55% of the participants who have confirmed the achieved ranking of construction dispute indicated having a dedicated contract administration and/or legal departments in comparison to 35% without. Although there is a difference of 20%, no direct relation could be deduced, since the majority of these companies are smaller in size. Thus, they could be outsourcing such legal activities or have experienced personnel who serve in this capacity among other duties.

- In comparison, 67% of the participants confirming the dispute ranks have indicated that their companies use standard contracts or contracts derived from standard forms. This could be attributed to the fact that standard contract forms are well balanced and have been tested and/or modified over many years. Thus, they include provisions that govern such disputes and provide the grounds for both parties to claim their rights. Further examination of the data highlights that 94% of these participants use the International Federation of Consulting Engineering Contracts (Fédération Internationale Des Ingénieurs-Conseils – FIDIC) in comparison to 91% that use the American Institute of Architects (AIA) contracts. The percentages per type of contract are more than a hundred as participants were allowed to pick more than one type.

Construction Claims and Dispute Causes Analysis

Knowing the key factors that cause construction disputes is another essential component of this research. Providing the contracting parties with such knowledge can lead to better means of mitigating these causes, thus decreasing the damaging effects of construction disputes on the industry related to both finances and time. As mentioned earlier, the participants were asked to indicate the most prominent causes identified by Bramble et al. (1995); reference is made to Table 3.

- Dispute causes were ranked in the following order from most frequent to least. The results are based on the average of the "often" and "sometimes" categories. The details or the responses are provided in Table 10.

    - Contract documents
    - Contractor practices
    - Contract administration
    - Personal factors
    - Contracting agency practices
    - Institutional factors;
    - Claims settlement practices
    - Contract award

Table 10. Dispute causes distribution (Bramble classification).

	Often	Sometimes	Rarely	Never
Contractor practices	30%	48%	14%	8%
Contracting Agency Practices	20%	40%	34%	6%
Personal factors	42%	26%	20%	12%
Institutional factors	6%	48%	30%	16%
Contract documents	50%	32%	14%	4%
Contract Award	14%	26%	44%	16%
Contract Administration	24%	46%	20%	10%
Claims Settlement Practices	6%	38%	40%	16%

- Cross tabulation of the achieved ranks of the dispute causes with the contractors' characteristics yields the following:
    - Concerning the role within the construction industry, there is no specific relation between type of the participant and the ranking of a specific dispute cause. Seventy five percent (75%) of the owner and 77% of the contractor participants have confirmed the aforementioned ranks over all causes.
    - Between 70% and 77% of the participants with 10 years or more of experience and between 71% and 73% with avid or expert knowledge have ranked these causes at the top of the different categories.
    - About 77% of the participants with high experience in both DBB and DB have confirmed the aforementioned ranking of the dispute causes.
    - Seventy one percent of the participants confirming the dispute causes ranks have indicating that their companies use standard contracts or contracts derived from standard forms. Further examination of the data highlights that equal portions (83%) of these participants use the International Federation of Consulting Engineering Contracts (Fédération Internationale Des Ingénieurs-Conseils – FIDIC) as well as the American Institute of Architects (AIA) contracts. The percentages per type of contract are more than a hundred as participants were allowed to pick more than one type.

Conclusion

The goal of this research is to assess and identify the main types of construction disputes and their causes worldwide. To that end, construction professional from five continents, serving in different roles (owner, general contractor, subcontractor, designers, consultants, etc.), and from both genders were recruited. A response rate of 78% was achieved by 94 out of 120 participants completing the online survey instrument. The collected data highlight that construction disputes are frequent within the construction industry with "changes" and "differing site conditions" categories ranking as the most two occurring ones. Within the former, "incomplete scope of work" and "incomplete contracts" rank at the top whereas for the latter "DSC" and "pre-existing conditions" are defined as most frequent. In regard to the causes of construction disputes, the two most prominent are "contract documents" and "contractor practices." The outcomes of the current research activity provide much-needed information for the industry at all sectors. Having this knowledge offers the construction practitioners with means of being proactive by identifying, mitigating, and having action plans in place for these disputes, which will result in financial saving and time dedication to more productive activities.

It is important to mention that this research have some limitations especially in regards to the sample size. In order to develop statistical models that can predict the existing relations between the analyzed parameters, a larger sample is needed that is balanced over all geographic locations. Such issue is the focus of the authors' future work. Although the sample size is not large, the response rate of 94 participants (78%) provides a sample error of 5% at a 95% confidence interval, which, in turn, provides confidence in the results. Furthermore, there are no statistical inferences that are drawn from the data, and it is only used for the mere purpose of knowledge gain. Consequently, the sample is sufficient for the research.

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