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Minimizing Liability of the COVID-19 Pandemic on Construction Contracts—A Structural Equation Model for Risk Mitigation of Force Majeure Impacts

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Abstract: A pandemic is a force majeure event, and contracting parties can invoke conditions under force majeure to minimize liability for unforeseen, uncontrollable, and unavoidable circumstances. This study develops a conceptual model to assist in the management of delays and cost overruns due to force majeure events arising from the construction sector in Small Island Developing States (SIDS). A critical case study analysis of past epidemics and pandemics was conducted to develop a survey questionnaire for administration to construction professionals in Trinidad and Tobago. Based on the empirical data of 65 construction professionals, the structural equation model shows that there are strong causal effects from the implications of COVID-19 and force majeure events, which in turn have a dire impact on the construction industry. The leading implication of COVID-19 is the drastic increases in the cost of materials. Also, granting an extension of time to contractors was the main risk variable under the force majeure conditions. From the results, the measurement model verifies that events under force majeure and its perceived implications strongly influence the construction industry, and proposes that force majeure contractual clauses require explicit treatment of the periodic reoccurrence of pandemics to avoid conflicts among contracting parties. This research explores and builds on new avenues from the latest COVID-19 scholarship to better understand existing impacts on the construction industry, and consequently add to the novel body of knowledge on the implications of pandemics on construction contracts. Overall, this research provides a risk-guidance framework for construction professionals and academia to mitigate unforeseen, uncontrollable, and unavoidable risks on construction projects.

Keywords: COVID-19; force majeure; contracts; liability; structural equation modeling (SEM); construction

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1. Introduction

On 11 March 2020, the World Health Organization (WHO) declared the outbreak of COVID-19 as a pandemic. The virus had spread to more than 220 countries with an update of 1,433,316 deaths worldwide [1], resulting in many countries implementing lockdown measures and closure of national borders. This type of government action has adversely impacted the construction industry, resulting in delays, cost overruns, loss of employment, and ultimately, suspension and termination of construction projects [2]. As a mitigative effort, contracting parties relied on the application of the "force majeure" condition of contracts to limit, and/or exit, contractual obligations.

The term, "force majeure", refers to a superior unanticipated or uncontrolled event that prevents either or both parties from fulfilling contractual obligations [3]. Plagues, epidemics, natural disasters, fire, explosions, nuclear, biological, or chemical contamination, civil war, disorder, and general labor disturbances are covered under force majeure [4]. Conditions of force majeure are included in several standard form contracts (for example FIDIC 2017) to address the specific uncontrollable events that can occur after contractual acceptance. Due to the pandemic affecting construction industries in many countries, contracting parties' performance under the contract manifest in delays [5] and cost overruns [6,7]. As a consequence of the pandemic, parties depend on the force majeure clause to mitigate, or even escape [3], contractual obligations [8]. The invocation of the force majeure condition requires proof that a party's performance was directly affected and, to further prevent the foreseeable liability of impossibility to perform, a direct causal link between the party's failure to perform obligations and the impact of the force majeure event must be established [9].

For a pandemic to be classified as a force majeure, certain criteria must be met. These criteria include that the circumstances must have been unforeseeable at the contracting time; the event must have been unavoidable; the event was beyond the party's control, therefore making it difficult to overcome; and the event affected the party's ability to perform making it impossible, inadvisable, impractical, or even illegal [10]. However, the force majeure clause can be problematic for events that are not defined or otherwise identified in the contract. The question becomes "how to classify and qualify an event under force majeure?". In the FIDIC 1999 form of contract, the standard form of construction contract adopted in Trinidad and Tobago, a Caribbean Small Island State (SIDS), a pandemic may be classified as an exceptional event under sub-clause 19.2, (a) to (d) [11]. Yet ambiguity exists in its identification, implications, and more so impacts on the construction industry. For the 52 SIDS nations, as defined by the United Nations as small islands with volatile economies that are dependent on larger nations and are adversely impacted by climate changes and natural hazards, the construction sector forms the backbone of employment and infrastructural development. Thus, understanding factors associated with a pandemic and the implications under force majeure within the geographical context of SIDS can prevent excessive delays and cost overruns currently being experienced on projects.

As such, the aim of this research is to firstly understand the contractual and decision-making processes available in scholarship as it pertains to pandemics and force majeure and secondly, to determine associated risk variables construction professionals need to pay attention to and immediately address as soon as practicable to reduce the extent of the potential impact of the COVID-19 pandemic on construction contracts in the Caribbean SIDS. To address the former, a comparison of the findings from the outbreak of the COVID-19 pandemic was undertaken in the literature review to determine the applicability of force majeure. Also, through a questionnaire survey identifying the selected standard form construction contracts used in Trinidad and Tobago, the latter part of the aim focused on a review to determine the effectiveness of risk management provisions between contractual parties, i.e., the contractor who is affected and the employer/engineer who bears the risk of the project. As the COVID-19 pandemic is an ongoing event and continues into 2022, scholarly works in this area of expertise are very limited. Thus, this paper adds to the new and growing body of knowledge on the effectiveness of construction contracts as a control mechanism under a pandemic and highlights the effects, implications, and mitigating factors to guide both academia and construction professionals in identifying key variables during the decision-making process of construction.

2. Theoretical Background

One of the major viruses that affects the human respiratory system is the corona virus. Much research has been done in order to predict and detect COVID-19 using machine learning and deep learning in the medical sector [12–14]. The rapid spread and unexpected impact of the COVID-19 outbreak negatively affected the construction industry

resulting in a significant number of contractors being unable to meet contractual obligations. Worldwide, governments followed the advice of the World Health Organization and took measures to curb the spread of the virus. These measures included border closures, lockdown measures such as curfews, and other restrictions, which hampered economic productivity. For SIDS, who are unable to benefit from economies of scale due to their small economies and high logistics costs, the construction industry suffered due to the lack of access to building materials. The inability of contractors to meet their contractual obligations is concerning, and several liabilities arose under their agreed contracts. All the parties to these contracts, namely employers, contractors, engineers, sub-contractors, and suppliers, relied on guidance from the force majeure clause to suspend performance to renegotiate scope and adjust time and cost [1]. This reliance, and ultimately effectiveness, of invoking force majeure depends on the circumstances and duration and particulars of the event. For force majeure events of short duration, performance obligations can be suspended. If however, the duration of the effects of the force majeure event cannot be determined, then there is a possibility that a contract may no longer be binding and is subject to termination [2]. A few past studies have developed models evaluating the performance of construction companies during the COVID-19 pandemic [15,16].

2.1. Force Majeure in Law Jurisdictions

The term force majeure, of French origins, is found in the French Napoleonic Civil Code [1] and defined in Article 1218 as an event in a contractual matter that was unforeseen, unavoidable, and uncontrollable at the period of the end of the contract [17]. The force majeure consequences are fully dependent on whether obstruction and prevention of the obligations are temporary or permanent. Whether the pandemic qualifies as a force majeure event requires a historical examination under context-specific cases to unearth jurisdictions, respective laws, and court rulings that state explicitly or implicitly the triggers for force majeure. These triggers are inclusive of outcomes declaring and releasing the defaulting party from acting on their contractual liabilities and obligations. For example, material unavailability on a construction site due to border closure can be considered a temporary prevention, and works can resume provided that the pandemic is no longer effective and safety restrictions are lifted within a short duration. However, permanent prevention to perform contractual obligations is treated under Article 1351 of the French Civil Code [17,18], which states that in a force majeure event, if contractual obligations have become impossible, the affected party is relieved of all litigation unless the said party had agreed to take full responsibility for such risk in the contract [1]. In other civil law countries, such as China and the United Arab Emirates, an affected party in litigation may invoke a force majeure clause where rightful entitlement or claim applies without being stated in the contract.

The restrictive measures enforced by the Chinese government to mitigate the effects of the virus led to disputes in contractual obligations and, to settle these disputes, China's International Trade Commission granted force majeure certificates to Chinese companies who provided evidence for the factual presence of the force majeure event occurring in the contract. These certificates bound the Chinese court's interpretation of the national force majeure requirements outlined in Articles 117–118 of the PRC's Contract Law and Article 180 of the General Rules of the PRC Civil Law [17]. In a logical sequence, Article 117 provided the condition that an affected party's liability can only be removed when the contractual obligations cannot be met due to a force majeure event, or the occurrence of a circumstance that is unforeseen, unavoidable, uncontrollable, and unable to be overcome. Article 118, however, qualified the precedent condition as a duty of the party, unable to continue contractual obligations, to inform and provide evidence of force majeure to the other party immediately to mitigate losses [19]. Consequently, Article 180 provided for no civil legal responsibility to be endured in the case of failure to perform civil obligations due to force majeure [1,14], unless otherwise provided by law. Similarly, the United Arab Emirates Civil Code (Federal Law Number 5 of 1985) [20] established the description

and limitations of the force majeure event and the consequences activated. These explicit treatments under civil law jurisdictions allow for the simplification of the force majeure application to construction contracts.

In common law countries, such as England and India, force majeure clauses are not always clearly defined and can only be invoked if the clause and its terms and conditions are stated in the contract [3]. English law, however, does not consider force majeure as a legal conception as it is neither stated in statute nor civil law [21]. For a party to claim liberation from a force majeure event, the clause must be specifically stated in detail in the contract [22]. A party seeking relief from its contractual obligations must show evidence of its incapability to perform the tasks. If a force majeure clause is not clearly stated in the contract, then the doctrine of frustration of contracts is applied as a relief of a party's obligations by terminating the contract [23]. Likewise, the Indian Contract Act (ICA) of 1872 has no explicit definition of force majeure. However, the Supreme Court of India stated that where the term force majeure is executed, the intention is to prevent the contracting party from the consequences provided that the contractual obligation is impossible or there is no control over it [24]. Even though the governing law does not define the term force majeure, two section laws come into effect when dealing with force-majeure-like events [3]. Section 32 of the Indian law states that contingent contracts cannot be enforced by law unless an unforeseen event occurs and, if the said event makes it impossible to perform the contract, then the contract becomes null and void [25]. Section 56 ensures that the contract becomes void if the event renders it impossible to complete or unlawful according to the doctrine of possibility. If COVID-19 is not stated in detail as a force majeure event but the contract agreed upon includes a force majeure clause, then the affected party may claim relief on the grounds of frustration in terms of the impossibility of contractual obligation performance under Section 56 of the ICA [3].

2.2. The Activation of the Force Majeure Clause

The activation of the force majeure clause is dependent on the wording and interpretation of the clause and whether the event which delays the contractual obligations is listed in the said clause. However, if a pandemic is not stated precisely in the contract, then the party will have to resort to another event that is mentioned in the force majeure clause or provide sufficient evidence or reasons why it should be considered. To exemplify, as of 2020, the international business community, the International Chamber of Commerce (ICC), classified a force majeure event as the occurrence of a circumstantial event that prevents a party from accomplishing its obligations in the contract due to the event being unforeseen, unavoidable, and uncontrollable at the time leading up to the completion of the contract [26]. Though the ICC force majeure clause does not specifically list pandemics in the clause, epidemics are included and are considered as a force majeure event. Since the pandemic is an epidemic of a global magnitude, it can be also interpreted as a force majeure event and, therefore, the said clause can be activated. However, due care is also taken for contractual obligations established during the latter and continuing phase of COVID-19. Contracting parties can now recognize and acknowledge the event; thus, principles of foreseeability and unavoidability may not apply. This suggests that force majeure cannot apply to contracts established during the current COVID-19 period. The affected party invoking the force majeure clause must provide convincing evidence that alternative steps were taken to mitigate or avoid the consequences of the event [2].

Thus, the literature review supports the assumption that the onset of the COVID-19 outbreak constitutes a force majeure event. To determine the main risk variables in the construction industry in SIDS, this research proposes the following research questions:

RQ1: What are the critical risks and impacts of COVID-19 on the construction industry?

RQ2: What mitigation factors can reduce the impact of COVID-19 on the construction industry?

Based on the above research questions, perceptions from actors in the construction industry were gathered via a closed-ended questionnaire and analyzed using a structural

equation model. This conceptual structural equation model seeks to provide a first empirical assessment of risks for construction practitioners to prioritize and manage construction claims arising from the extension of time delays and associated cost implications. The interpretation of these findings allows for attention to the third research question posed in this research:

RQ3: What lessons from the literature and tacit knowledge can be adopted towards Caribbean SIDS to treat the critical risks and their associated interrelatedness?

3. Methodology

This study aligns with a positivist theoretical perspective to guide the quantitative fact-finding approach adopted for the data-gathering and analysis phases. In sum, positivist theoretical alignment assumes that the phenomenon under investigation is independent from reality or the state of actual existence. That is, identifying critical risk variables from the COVID-19 pandemic through the collation and analysis of participants' perceptions and developing a conceptual model to aid construction professionals to manage associated claims arising from delays and associated cost implications due to force majeure events. Figure 1 illustrates the workflow of the research process to visualize the three-staged deductive approach of the research design.

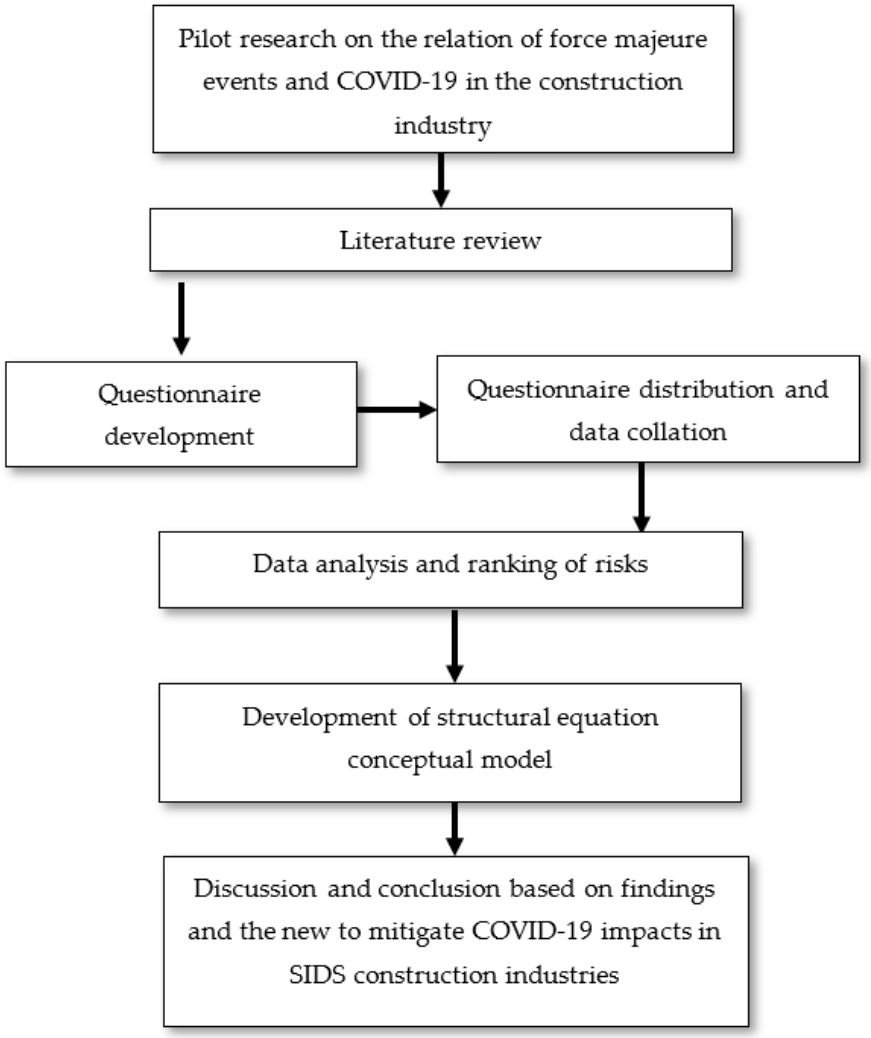

Figure 1. Work flow of the study.

The first stage of the research design was to determine the need for the study. An exploratory pilot survey was undertaken to target key stakeholders in May 2021 of the

following organizations: the Construction Management Institute of Trinidad and Tobago (COMITT), the Association of Professional Engineers of Trinidad and Tobago (APETT), Trinidad and Tobago Contractors Association (TTCA) and the Board of Engineers of Trinidad and Tobago. Inputs from members of these organizations were clustered into two broad categories, namely, the contracting stakeholders' knowledge and understanding of force majeure and the impacts of the COVID-19 virus as qualified as a force majeure event. The consensuses among these four influential organizations in Trinidad and Tobago's construction industry indicated that the force majeure concept, though widely known, is not understood by their membership. Moreover, an understanding of the impacts of COVID-19 was strongly recommended.

The outcomes of the first stage justified the need for the research to examine and extract leading risk variables arising out of the COVID-19 pandemic. The second stage of the research design, therefore, was to probe the available scholarship to extract impacts and associated risk variables. The authors were unable to find any literature associated with SIDS, which again signified the need and novelty of this research. COVID-19 risk variables and impacts were therefore extracted from the limited international literature as it pertains to the construction community. From the literature survey, 36 peer-reviewed journal articles were selected, reviewed, and critically analyzed to attain a greater understanding of the topic, the main risk variables, the impacts on context-specific construction sectors, and the main lessons learned. To gain a better understanding of the varying perceptions among contractors, consultants, and clients within Trinidad and Tobago's construction industry, this information was extracted and structured into a questionnaire tool for distribution.

Stage three involved the design, administration, and collation of data. The survey tool of choice is a closed-ended questionnaire [27] designed using the web based platform, SurveyMonkey®. The targeted population was stakeholders from the construction industry, namely representatives from the contractor, client, and engineer demographics. The questionnaire was the source of inquiry for this study on varying perceptions of the implications of the virus in the construction industry as it pertains to a force majeure event. The questionnaire was divided into three sections. Section 1 gathered demographic information related to the stakeholders' profession, public or private sector employment, and experiences. Section 2 assesses the views of the stakeholder on the level of risk via the risk index ($Risk\ Index\ (RI) = \sqrt{(\text{Probability} \times \text{Severity})}$, and participants were asked to rate both the probability of occurrence and severity of various selected risk variables associated with the implications of COVID-19 on the construction industry. A five-point Likert scale was used to allow the participants to express themselves regarding their level of agreement and ranged from 1 to 5 where '1' was 'not significant' and '5' was 'extremely significant' [28]. All participants were informed of the ethical process involved in conducting this research. Participants were assured that no personal data would be gathered, all responses would be anonymized, and they could stop participating in the survey at any point in time, without any reason or justification. Section 3 of the questionnaire aimed to gather perceptions on the theoretical implications of the pandemic using a similar Likert scaling (either strongly disagree, disagree, neutral, agree, or strongly agree) and further investigated the participants' understanding of the COVID-19 impacts on the construction industry. From the eighty questionnaires submitted, 65 were deemed complete and valid for analysis.

The data collated was inputted into the statistical software program SPSS 26® (version 26). The Statistical Package for the Social Sciences Statistics program (SPSS 26) provided both basic and detailed statistical functions, some of which include cross-tabulation, bivariate statistics, and frequencies [29–31]. Data were organized under the respective participants' responses to risk variables. The rankings of probabilities and severities were then summarized to calculate each variable's relative importance index (RII) to determine the ranking of the variables in order of risk prioritization as it relates to how much the pandemic affected them in the construction industry.

The RII is calculated using the following equation:

$$Relative\ Importance\ Index,\ RII = \frac{\sum w}{A \times N},\ (0 \leq \text{RII} \leq 1) \quad (1)$$

where w = weighting given to each factor by the respondents and ranges from 1 to 5 where '1' is 'not significant' and '5' is 'extremely significant', A = highest weight (i.e., 5 in this case), and N = total number of respondents.

As a reliability check, the Spearman rank correlation coefficient, ρ was also calculated as a non-parametric measure to determine the degree of correlation of two data sets. That is, the correlation coefficient provides a numerical value to represent the strength and direction between two groups on an individual risk variable. To use ρ, multiple paired sets of data, that is, between contractor and engineer, or engineer and client, on how the pandemic is affecting the construction contracts as a force majeure event, can be calculated using Equation (2).

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)} \quad (2)$$

where d_i is the difference in paired ranks and n is the number of cases.

Prior to the development of a conceptual structured equation model (SEM) [32] to assist the contracting parties in managing variations and associated extension of time due to delays, a factor analysis was conducted using the SPSS Amos program. In factor analysis, the two main methods applied are exploratory or confirmatory factor analysis [33]. Exploratory factor analysis (EFA) occurs when researchers create a new theory by exploring the latent factors of the variables relating to their differences and interrelations, whereas confirmatory factor analysis (CFA) is used to assess and test an existing theory. With the use of various fit statistics, CFA analyzes a structured SEM to determine whether the model corresponds to, and represents, the data sufficiently. The use of CFA minimizes the reflecting measurement error by having numerous independent variables/indicators per latent/dependent variables and can assess models with multiple dependent variables as well as mediate the model and error terms. Since factors were derived from existing literature, the CFA test was used rather than the EFA as the outcome of the CFA results is more accurate and the conditions that are required to execute the CFA are satisfactory in most cases [34].

Based on the outcome of the CFA, a conceptual SEM was proposed to determine the critical factors and their interrelatedness [35]. The SEM involved a model consisting of two dependent variables (the implications of COVID-19 and force majeure events), that is, a measurement element and a theoretical element. The measurement element specified how measured variables come together to represent theory, whereas the theoretical element represents how constructs are related to other concepts [36]. The SEM was based on the working hypothesis that the COVID-19 pandemic has a negative impact on the construction industry as it relates to force majeure risk events. This conceptual SEM provides guidance to determine what risk variables motivate different indicators and what the observed strengths of the association between the theoretical constructs are [35]. Finally, after the analyses were completed, the information and results were gathered and carefully studied to provide a risk framework for the control and mitigation of the associated risk variables.

4. Results and Analysis

The data gathered for Section 1 of the questionnaire via the survey were analyzed using SPSS, as observed in the Appendix. Figure 2 showcases the distribution of respondents as per their professions. The questionnaire data was based on occupation, sector of employment, industry type, experience in the field, and several employees and projects involved in their organizations. It was presented using descriptive statistics. The respondents consist of 64.6% engineers, 13.8% contractors, 3.1% employers, 6.2% consultants, and 12.3% other

roles comprising assistant engineers, technicians, and supervisors. Of the respondents, 47.7% work in the public sector, and 52.3% work in the private sector.

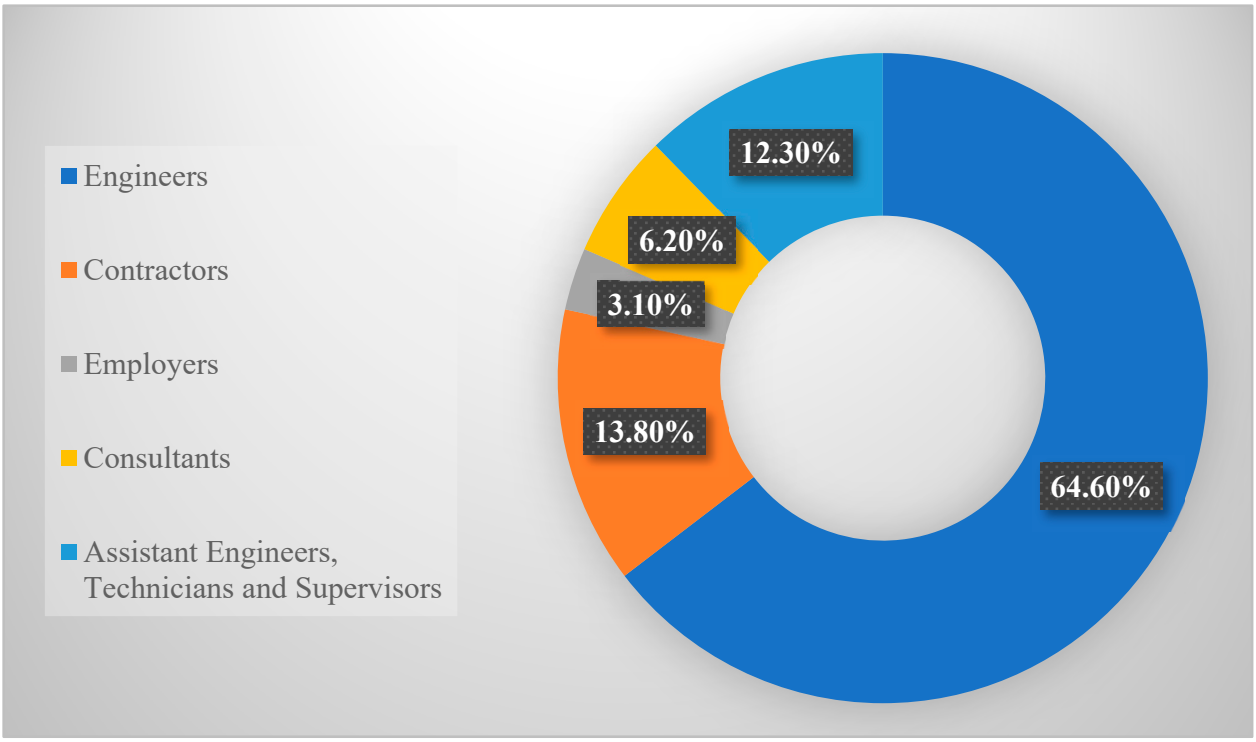

Figure 2. Distribution of respondents according to profession.

Figure 3 presents the distribution of respondents according to their experience in number of years. As per the data received it can be seen that over 45% of respondents have less than five years of experience in the construction industry.

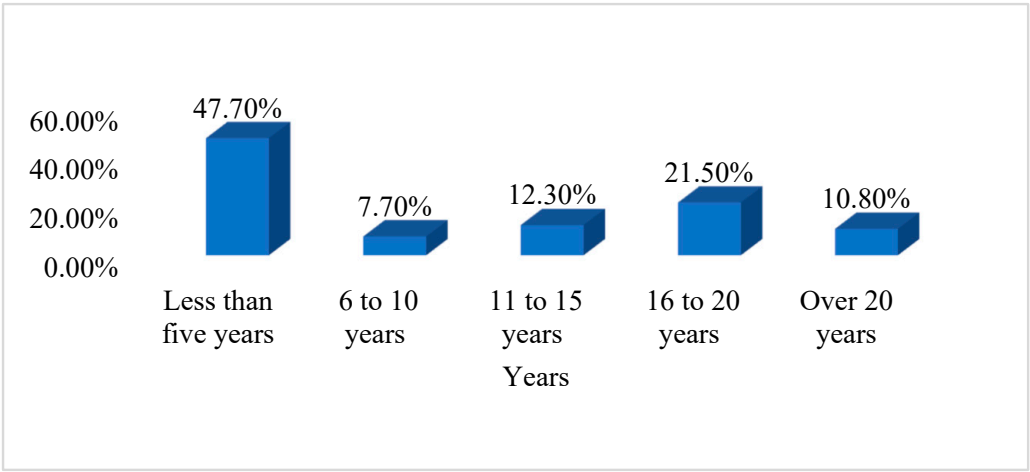

Figure 3. Distribution of respondents according to years of experience in the construction field.

Over 70% of the respondents were involved in construction projects during the time of the survey. Although others were not involved in construction projects at the time of the effect of COVID-19, 13.8% of respondents were involved in six to 10 projects, 4.6% of respondents were involved in 11 to 15 projects, and the remaining 6.2% were involved in more than 20 projects, as stated in Table 1.

Table 1. Demographic information of the respondents.

Description		Percentage (%)
Respondent's profession	Engineer	64.6
	Contractor	13.8
	Employer	3.1
	Consultants	6.2
	Assistant engineers, technicians, and supervisors	12.3
Company's type	Government employees	46.2
	Contractor	35.4
	Consultants	15.4
	Other	3.1
Size of technical personnel in the organization	Less than 20 personnel	23.2
	21–50 personnel	24.6
	51–100 personnel	9.2
	101–150 personnel	1.5
	151–200 personnel	4.6
	More than 200 personnel	36.9
Respondent's involvement in the construction projects	Currently involved in construction projects	75.4
	Involved in 6 to 10 construction projects	13.8
	Involved in 11 to 15 construction projects	4.6
	Involved in more than 20 construction projects	6.2

4.1. Data Preparation

With the use of SPSS Amos, researchers conducted an analysis of Sections 2 and 3 of the questionnaire. The purpose of the test was to assess the consistency of the five-point Likert scale applied in the questionnaire as a measure of the implications of the COVID-19 pandemic on the construction industry. Table 2 indicates the maximum, minimum, mean, and standard deviation of the variables as per the responses for the five-point Likert scale.

Table 2. Basic statistics of the variables.

Variables Name	Description	Max	Min	Mean	SD
S2P1	The pandemic has negatively impacted you in the construction industry. (PROBABILITY)	5	2	4.108	3.675
S2S1	The pandemic has negatively impacted you in the construction industry. (SEVERITY)	5	2	3.769	3.360
S2P2	The pandemic affected your project/contract in terms of cost overrun. (PROBABILITY)	5	2	3.892	3.469
S2S2	The pandemic affected your project/contract in terms of cost overrun. (SEVERITY)	5	2	3.846	3.442
S2P3	The pandemic affected your project/contract in terms of time delay. (PROBABILITY)	5	2	4.169	3.746
S2S3	The pandemic affected your project/contract in terms of time delay. (SEVERITY)	5	2	4.108	3.692
S2P4	The pandemic affected your project/contract in terms of suspension of contract. (PROBABILITY)	5	1	2.954	2.578
S2S4	The pandemic affected your project/contract in terms of suspension of contract. (SEVERITY)	5	1	3.138	2.785
S2P5	The pandemic affected your project/contract in terms of termination of the contract. (PROBABILITY)	5	1	2.554	2.134
S2S5	The pandemic affected your project/contract in terms of termination of the contract. (SEVERITY)	5	1	2.815	2.424
S2P6	The activation of the force majeure clause is dependent on how the clause is specifically worded in the contract. (PROBABILITY)	5	2	3.862	3.410
S2S6	The activation of the force majeure clause is dependent on how the clause is specifically worded in the contract. (SEVERITY)	5	1	3.523	3.113

Table 2. *Cont.*

Variables Name	Description	Max	Min	Mean	SD
S2P7	The terms and conditions of a contract should allow for review and renegotiation under extenuating circumstances such as those faced during a pandemic. (PROBABILITY)	5	2	4.215	3.770
S2S7	The terms and conditions of a contract should allow for review and renegotiation under extenuating circumstances such as those faced during a pandemic. (SEVERITY)	5	1	3.800	3.415
S2P8	The price of construction materials has increased drastically since borders were closed. (PROBABILITY)	5	3	4.446	3.961
S2S8	The price of construction materials has increased drastically since borders were closed. (SEVERITY)	5	2	4.292	3.831
S2P9	The local industry is unable to meet the supply and demand needs of the construction industry during the pandemic. (PROBABILITY)	5	2	3.538	3.143
S2S9	The local industry is unable to meet the supply and demand needs of the construction industry during the pandemic. (SEVERITY)	5	2	3.523	3.118
S2P10	Construction companies can face bankruptcy if force majeure is not applied/invoked. (PROBABILITY)	5	2	3.938	3.477
S2S10	Construction companies can face bankruptcy if force majeure is not applied/invoked. (SEVERITY)	5	2	3.800	3.360
S2P11	The pandemic made it more difficult in tendering contracts. (PROBABILITY)	5	2	3.708	3.324
S2S11	The pandemic made it more difficult in tendering contracts. (SEVERITY)	5	2	3.523	3.093
S2P12	Due to the pandemic, construction job opportunities were shortened. (PROBABILITY)	5	2	4.231	3.787
S2S12	Due to the pandemic, construction job opportunities were shortened. (SEVERITY)	5	2	4.046	3.603
S2P13	Due to the pandemic, there was a significant increase in project cost due to purchasing of PPE to mitigate the spread of the disease. (PROBABILITY)	5	2	3.631	3.268
S2S13	Due to the pandemic, there was a significant increase in project cost due to purchasing of PPE to mitigate the spread of the disease. (SEVERITY)	5	2	3.554	3.215
S2P14	Your company delegated more people to work from home. (PROBABILITY)	5	2	3.646	3.268
S2S14	Your company delegated more people to work from home. (SEVERITY)	5	1	3.477	3.088
S2P15	The project should continue during the COVID-19 pandemic with tight health protocols. (PROBABILITY)	5	2	4.092	3.637
S2S15	The project should continue during the COVID-19 pandemic with tight health protocols. (SEVERITY)	5	2	3.938	3.495
S3101	A pandemic is an event that invokes the force majeure.	5	2	4.092	3.646
S3102	Force majeure should usually be invoked as a contractual defense for breach of contract.	5	2	3.585	3.172
S3103	Once foreign markets cannot be accessed for goods and services required for the construction industry, force majeure should automatically be applied.	5	2	3.446	3.008
S3104	Construction projects in general often overrun budget sum.	5	2	3.908	3.455
S3105	The presumed best way to manage the risk is to distribute the risk to the party more capable of controlling and managing the risk event and bearing its consequences.	5	2	3.923	3.477
S3106	The contractors should be granted a time extension for unforeseen events.	5	2	4.169	3.717
S3107	The contractors should be granted cost compensation for unforeseen events.	5	2	3.831	3.415
S3108	Government contractors should have amendments made to protect the interests of contractors under circumstances such as a pandemic.	5	2	3.969	3.517
S3109	The government should intervene in subsidizing losses and thus minimize the effect of the pandemic on the construction industry.	5	1	3.554	3.196

4.2. Reliability and Validity

To evaluate the reliability of the data collected, both Cronbach's alpha and the Spearman–Brown coefficients were obtained. Cronbach's alpha is a measure used in defining a concept in terms of its reliability and internal consistency that is the measurement of how similar and consistent a group of data is to a concept [37,38]. The Spearman–Brown split-half reliability coefficient "embodies the best practice for stating reliability of a set of measurements acquired from multi-item scales" [39]. According to [39], a Cronbach's alpha greater than 0.70 and a Spearman–Brown reliability coefficient greater than 0.70 is considered reliable and consistent. Tables 3 and 4 show the summary of the results obtained. Based on the results obtained ($\alpha > 0.7$ and Spearman–Brown Coefficient > 0.7) the scale used was reliable.

Table 3. Summary of SPSS output results obtained for Cronbach's alpha and Spearman–Brown Coefficient.

Description	No of Items	Cronbach's Alpha	Spearman–Brown Coefficient
Section 2 (probability)	15	0.763	0.740 (unequal length)
Section 2 (severity)	15	0.827	0.852 (unequal length)
Section 3	9	0.808	0.836 (unequal length)

Table 4. Showing the variables from the questionnaire and SPSS analysis.

Variables Name	Description
S2RI1	The pandemic has negatively impacted you in the construction industry.
S2RI2	The pandemic affected your project/contract in terms of cost overrun.
S2RI3	The pandemic affected your project/contract in terms of time delay.
S2RI4	The pandemic affected your project/contract in terms of suspension of the contract.
S2RI5	The pandemic affected your project/contract in terms of termination of the contract.
S2RI6	The activation of the force majeure clause is dependent on how the clause is specifically worded in the contract.
S2RI7	The terms and conditions of a contract should allow for review and renegotiation under extenuating circumstances such as those faced during a pandemic.
S2RI8	The price of construction materials has increased drastically since borders were closed.
S2RI9	The local industry is unable to meet the supply and demand needs of the construction industry during the pandemic.
S2RI10	Construction companies can face bankruptcy if force majeure is not applied/ invoked.
S2RI11	The pandemic made it more difficult to tender contracts.
S2RI12	Due to the pandemic, construction job opportunities were shortened.
S2RI13	Due to the pandemic, there was a significant increase in project cost due to the purchasing of PPE to mitigate the spread of the disease.
S2RI14	Your company delegated more people to work from home.
S2RI15	The project should continue during the COVID-19 pandemic with tight health protocols.
S3101	A pandemic is an event that invokes the force majeure.
S3102	Force majeure should usually be invoked as a contractual defense for breach of contract.
S3103	Once foreign markets cannot be accessed for goods and services required for the construction industry, force majeure should automatically be applied.
S3104	Construction projects in general often overrun budget sum.
S3105	The presumed best way to manage the risk is to distribute the risk to the party more capable of controlling and managing the risk event and bearing its consequences.
S3106	The contractors should be granted a time extension for unforeseen events.
S3107	The contractors should be granted cost compensation for unforeseen events.
S3108	Government contractors should have amendments made to protect the interests of contractors under circumstances such as a pandemic.
S3109	The government should intervene in subsidizing losses and thus minimize the effect of the pandemic on the construction industry.

4.3. Ranking of Implications of COVID-19 (Section 2)

Table 5 below shows the ranking of the implications of COVID-19 in the construction industry corresponding to its relative importance index (RII). The ranking of the Section 2 questions was conducted based on the severity, probability, and risk index of each implication factor on how COVID-19 has affected the construction industry. As observed in Table 3 below, the respondents ranked the level of risk implications of COVID-19 in the industry from highest to lowest in terms of relative importance index. The top three implications of COVID-19 that respondents indicated to have the most effect on the construction industry will be discussed below.

Table 5. The relative importance index and its ranking for the probability, severity, and risk index of implications of COVID-19.

ID	Section 2—Implications of COVID-19	Relative Importance Index			Rank		
		Probability	Severity	Risk Index	Probability	Severity	Risk Index
S2RI8	The price of construction materials has increased drastically since borders were closed.	0.889	0.858	0.872	1	1	1
S2RI3	The pandemic affected your project/contract in terms of time delay.	0.834	0.822	0.824	4	2	2.5
S2RI12	Due to the pandemic, construction job opportunities were shortened.	0.846	0.809	0.824	2	3	2.5
S2RI15	The project should continue during the COVID-19 pandemic with tight health protocols.	0.818	0.788	0.799	6	4	4
S2RI7	The terms and conditions of a contract should allow for review and renegotiation under extenuating circumstances such as those faced during a pandemic.	0.843	0.760	0.795	3	6	5
S2RI1	The pandemic has negatively impacted you in the construction industry.	0.822	0.754	0.783	5	8	6
S2RI10	Construction companies can face bankruptcy if force majeure is not applied/invoked.	0.788	0.760	0.771	7	6	7
S2RI2	The pandemic affected your project/contract in terms of cost overrun.	0.778	0.769	0.77	8	5	8
S2RI6	The activation of the force majeure clause is dependent on how the clause is specifically worded in the contract.	0.772	0.705	0.733	9	10	9
S2RI11	The pandemic made it more difficult in tendering contracts.	0.742	0.705	0.72	10	10	10
S2RI13	Due to the pandemic, there was a significant increase in project cost due to purchasing of PPE to mitigate the spread of the disease.	0.726	0.711	0.714	12	9	11
S2RI14	Your company delegated more people to work from home.	0.729	0.695	0.707	11	13	12
S2RI19	The local industry is unable to meet the supply and demand needs of the construction industry during the pandemic.	0.708	0.705	0.703	13	10	13
S2RI4	The pandemic affected your project/contract in terms of suspension of the contract.	0.591	0.628	0.603	14	14	14
S2RI5	The pandemic affected your project/contract in terms of termination of the contract.	0.511	0.563	0.563	15	15	15

Respondents identified the price of construction materials to be the highest risk index as it relates to the implications of COVID-19 as prices have increased drastically since borders were closed. Due to the lockdown of the Trinidad and Tobago borders, the imported materials used in construction would be unavailable and difficult to purchase at the regular price hence drastically increasing the cost of the local materials available in the country due to limited stock. Due to the Trinidad and Tobago government's lockdown of the country to mitigate the spread of the virus, construction projects were automatically placed on pause which would have drastically delayed the completion of projects. It follows that the second highest rank and risk index was the time delay in being able to finish construction projects. Due to the lockdown protocols and collapse of the economy of Trinidad and Tobago, the shortening of construction job opportunities due to the pandemic had the third-highest risk index and rank.

It can be concluded that the shortage or lack of materials used in the industry because of the closed borders, which has already resulted in the increased price of materials, will further contribute to cost overruns, project delays, and even the suspension or termination of contracts. These implications will result in further disputes between the contractor and the client in terms of fulfillment of contractual obligations as stated in the literature.

4.4. Ranking of Force Majeure in the Construction Industry (Section 3)

In Section 3, the respondents were asked questions related to the implications of COVID-19 as a force majeure event. Upon assessing the responses, it can be stated the pandemic is considered an event that invokes force majeure. A total of 78.4% of respondents either strongly agreed or simply agreed to the statement, whereas 3.1% of the respondents disagreed and 18.5% of the respondents remained neutral. According to the second question, 58.4% of the respondents indicated that force majeure should be invoked as a contractual defense for breach of contract with 27.7% of the respondents remaining neutral to this statement and the remaining 13.8% disagreeing. According to [11], under subclause 18.2, force majeure can only be invoked by the contractor, provided that 14 days' notice is given for the unforeseen and unavoidable event. The issue with the force majeure definition is that parties struggle to define the event when it occurs, which usually leads to disputes as a force majeure notice shall be rejected by the defending party in denial of the event existing and results in a counterclaim lawsuit towards the claiming party for breach of contract, hence it is essential to include specifically stated force majeure clauses in the contract. It can be stated that not mentioning explicit force majeure events in contracts will result in unavoidable legal action, which is not recommended. Therefore, it can be debated that the definition of a force majeure situation must be improved to prevent disputes.

The majority of the respondents agreed with Question 6 (83.1%) and Question 7 (61.5%), agreeing that contractors should be granted cost compensation and time extensions for the unforeseen event, which is considered as subclause 20.2, provided that subclauses 18.1–18.4 are invoked first [11]. According to feedback given by the respondents, contractors should be granted time extensions because of the restrictions enforced by the government and the necessary precautions to prevent the spread of COVID-19. Mandatory lockdowns and the shutting down of sites would have resulted in lost time. Contractors must abide by all laws and not just the contract with the client. Additionally, unforeseen shortages and difficulties in sourcing materials from foreign or even local suppliers would cause further project delays. The cost of materials stated in the contract at the time of tendering would have drastically increased due to the shortage of the materials locally or the unavailability of foreign materials due to the lockdown. Cost compensation should also be granted because there is a cost to mitigating an unforeseen event or risk. Regardless of whether the risk could be managed, once the contractor is determined to be not at fault for not anticipating the event, they should be compensated. During the pandemic, the projects were still delivered within the time, but the cost of the project would be increased to facilitate handwashing stations, hand sanitizer, and temperature guns, and some companies

issued regular COVID-19 testing. Furthermore, cost and/or an extension of time should be granted to ensure projects are completed under specifications and standards.

According to Question 8, 75.4% of the respondents agree that government contractors should have amendments made to protect the interests of contractors under circumstances, such as a pandemic, with 21.5% of the respondents being neutral and the remaining 3.1% disagreeing. Government projects are important for the growth of the economy. Ensuring that government contractors are protected will assist in the timely distribution and handover of government projects, which can contribute to encouraging growth within the local economy. Shortened construction periods with increased costs without the support of the government will only place a further strain on the contractor's ability to complete the project on a timely basis and within budget. Moreover, terminating the contract would prove more expensive and tedious for the government. The government should have amendments to protect government contractors so they can claim for extension of time or cost for ongoing projects that are affected by the pandemic. However, the contractors must provide evidence under subclauses 18.1–18.4 to not be held liable for the delay of said project.

According to Question 9—should the government intervene, subsidize losses, and minimize the effect of the pandemic on the construction industry—52.3% of the respondents agreed with this statement, whereas 18.5% disagreed, and the remaining 29.2% of the respondents were neutral. The responses provided to this question by the respondents were mixed. Some respondents indicated that to intervene and subsidize losses would cut losses in time as well as construction costs. Both would positively impact the government as it would result in an earlier completion date and less need for variations and exceeded project budgets as well to ensure that contracting companies remain afloat and not face bankruptcy. The impact of the pandemic affects the entire local economy and should not just affect the contractor alone. In this instance, contractors may resist completing projects in terms of claims and delayed lengthy projects, whereas other respondents indicated the government should not have to intervene and subsidize losses to the construction industry because every single type of construction company should have a contingency fund for force majeure events. The government would have to stretch thin to provide new healthcare services and facilities for the public.

Once foreign markets cannot be accessed for goods and services required for the construction industry, force majeure should automatically be applied. According to this question, 47.7% of the respondents agreed with this statement, whereas 41.5% remained neutral, and the remaining 10.8% disagreed. According to the literature, to activate the force majeure clause, the contractor must prove the pandemic is directly linked to the prevention of access to goods and materials, which results in a delay in completing the contractual obligations. The presumed best way to manage the risk is to distribute the risk to the party more capable of controlling and managing the risk event and bearing its consequences. According to Question 5, 73.9% of the respondents agreed with this statement, whereas 21.5% of the respondents were neutral and the remaining 4.6% disagreed. During the tendering process, before the contract is set in motion, the client and the contractor must come to an agreement based on the circumstances of the specifically stated force majeure clauses regarding which party will manage and bear the consequences of the risk as stated in the literature.

Table 6 below shows the ranking of the force-majeure-related factors in the construction industry. According to Table 6, respondents indicated that contractors should be granted time extensions for unforeseen events as the highest relative importance index. The second-highest relative importance index, as indicated by the respondents, states that a pandemic is an event that invokes force majeure. The statement, as agreed by respondents, that government contractors should have amendments made to protect the interests of contractors under circumstances, such as a pandemic, had the third-highest relative importance index in Section 3. According to the literature review, these questionnaire responses are the most important criteria about force majeure in the construction industry because

the pandemic is considered a force majeure event as it was unforeseen, and the contractor could not control its effects, hence why the respondents agreed that the contractors should have been granted a time extension for unforeseen events and why the government should be intervening in aiding the contractors during the pandemic.

Table 6. The relative importance index and its ranking for Section 3 questions as it relates to force majeure in the construction industry.

ID	Section 3—Force Majeure	RII	Rank
S3106	The contractors should be granted a time extension for the unforeseen events.	0.834	1
S3101	A pandemic is an event that invokes the force majeure.	0.818	2
S3108	Government contractors should have amendments made to protect the interests of contracts under circumstances such as a pandemic.	0.794	3
S3105	The presumed best way to manage the risk is to distribute the risk to the party more capable of controlling and managing the risk event and bearing its consequences.	0.785	4
S3104	Construction projects in general often overrun budget sum.	0.782	5
S3107	The contractors should be granted cost compensation for unforeseen events.	0.766	6
S3012	Force majeure should usually be invoked as a contractual defense for breach of contract.	0.717	7
S3109	The government should intervene in subsidizing losses and thus minimize the effect of the pandemic on the construction industry.	0.711	8
S3103	Once foreign markets cannot be accessed for goods and services required for the construction industry, force majeure should automatically be applied.	0.689	9

4.5. The Structural Equation Modelling (SEM) for the implications of COVID-19 as a Force Majeure Event in Confirmatory Factor Analysis

According to [34], confirmatory factor analysis (CFA) is an SEM procedure that applies quantitative data analysis. The use of confirmatory analysis minimizes the reflecting measurement error by having numerous independent variables/indicators per latent/dependent variables and can assess models with multiple dependent variables as well as mediate the model and error terms.

A structural equation model was developed using the data collected based on the hypothesis that the COVID-19 pandemic harms the construction industry as it relates to force majeure and risk events. The purpose of this was to develop a conceptual model to assist the contracting parties to manage construction claims. The model was developed in Amos involving the relationship (correlation) between the risk index of COVID-19 implication risks and force majeure with Risk Index (RI) = $\sqrt{}$ (Probability $\times$ Severity).

The standardized loadings in this model (Figure 4) are correlations between the indicator/independent variables (in boxes) and the latent/dependent factors (ovals). The double-headed arrows among the latent factors (ovals) correspond to correlations. The double-headed arrows between error terms correspond to reflecting correlations/covariance among the measurement errors. The decimal numerals shown on the reflecting correlation arrows are the regression weights, which are the regression coefficients [40]. Figure 5 shows the modified model.

A model fit was carried out on the model taking into consideration the following model fit reference values as indicated in Table 7, which shows the model fit reference values.

Table 7. Showing the model fit reference values [40,41].

Measure	Terrible	Acceptable	Excellent
CMIN/DF	>5	>3	>1
CFI	<0.90	<0.95	>0.95
RMSEA	>0.07	>0.06	<0.03
PClose	<0.01	<0.05	>0.05

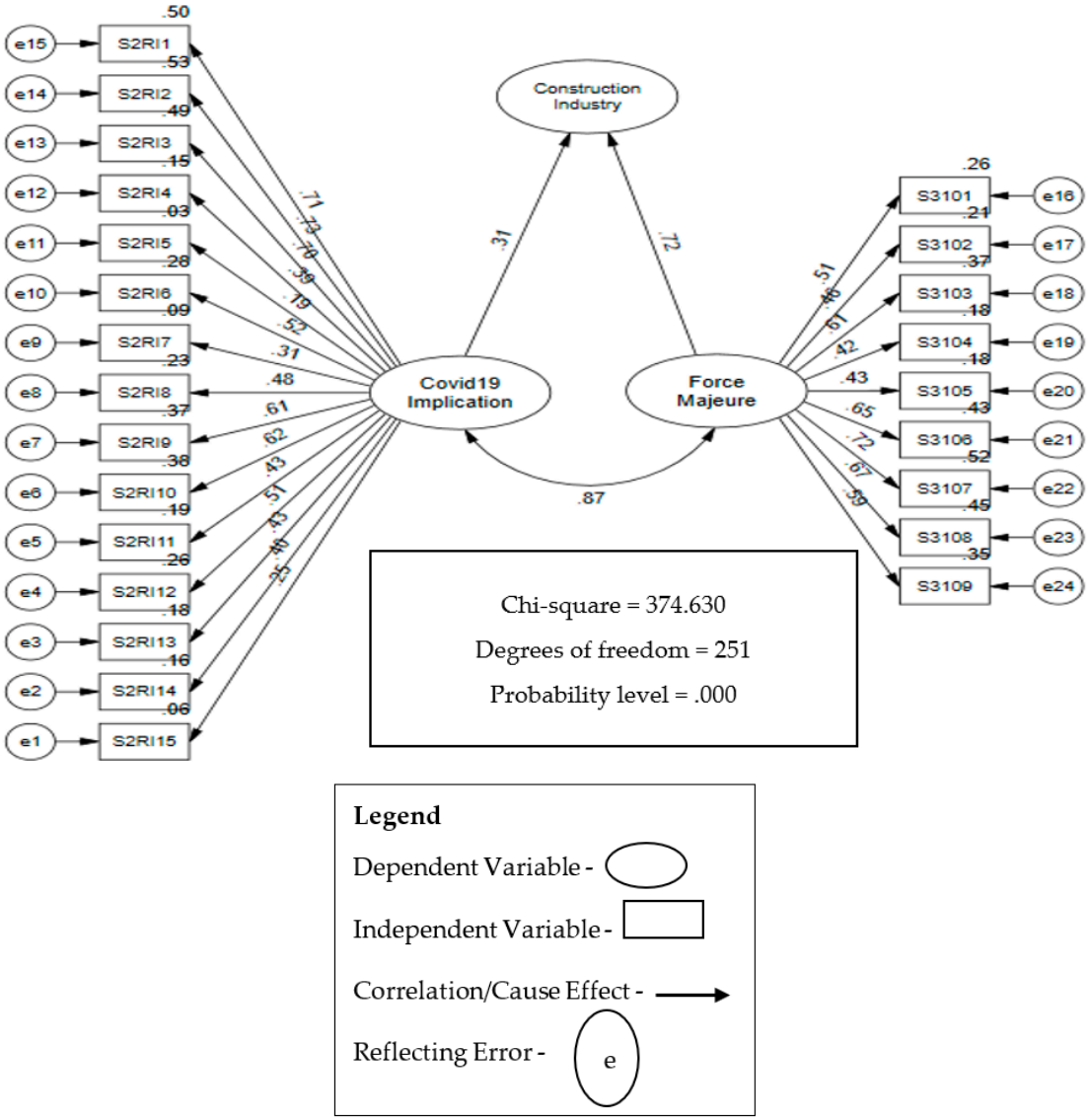

Figure 4. Unfit model.

The SPSS Amos output data were used to determine the model fitness of the SEM model by assessing the goodness of fit indices. The indices were analyzed in terms of the chi-squared (X2), the comparative fit index (CFI), the root-mean-square error of approximation (RMSEA), and the PCLOSE test. The recommended level of the indices was referenced from the studies conducted by [40,41].

According to Table 8, the output values indicated the model was deemed unfit as the CFI, RMSEA, and PCLOSE indices were observed as terrible, which resulted in a modification to obtain a better-fitting model. It is common that occasionally the model does not fit at first. Therefore, through the application of modification indices, the required reduction in the overall model fit chi-square for each possible path of the model can be estimated and created via SPSS Amos. The possible regression weights and covariances of the independent variables are integrated into the SEM model by correlating the error terms that would lead to significant modifications in the model fit chi-square number. Variables with low correlation coefficients of less than 0.20 should be eliminated from the analysis as this is an indication of high levels of error [41,42]. Standardized regression weights/coefficients are the standardized estimates of the regression analysis whose variances of the dependent and independent variables are equivalent to 1. The correlation link between either variable can be either positive or negative. The standardized regression

weights are used to indicate the impact of different independent variables on a dependent variable using regression analysis [43].

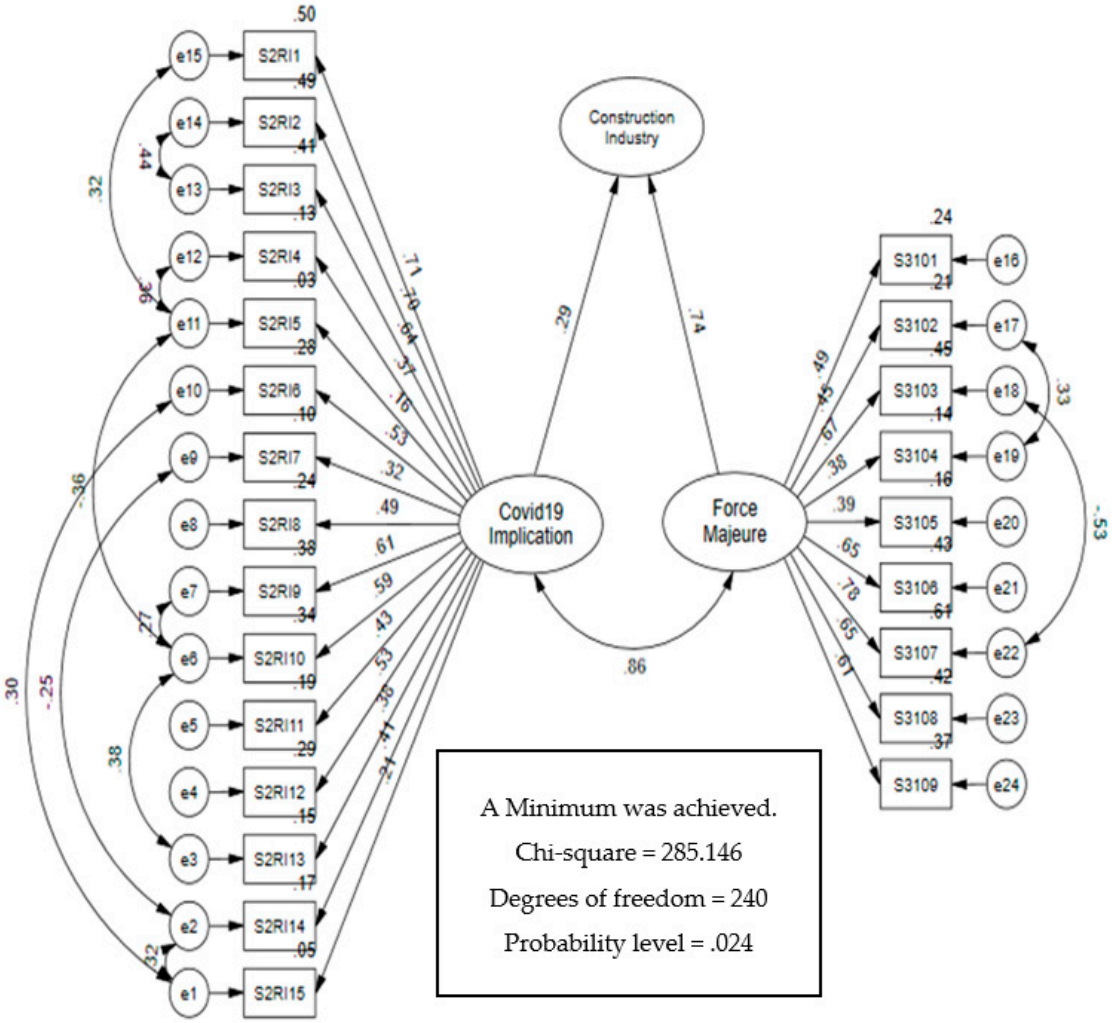

Figure 5. Modified model.

Table 8. Showing the output for unfit model and modified model.

Output (Unfit Model)	Output (Modified Model)
CMIN/DF: 1.493 (Excellent)	CMIN/DF: 1.188 (Excellent)
CFI: 0.732 (Terrible)	CFI: 0.902 (Acceptable)
RMSEA: 0.088 (Terrible)	RMSEA: 0.060 (Acceptable)
P-Close: 0.001 (Terrible)	P-Close: 0.348 (Excellent)

In Table 8 of the modified output data, it can be observed that all indices were considered acceptable. The minimum discrepancy CMIN/DF of the output data is a representation of the chi-square value that is applied in testing the goodness of fit. According to Kline [44], the chi-square goodness of fit is applied to assess whether a model differs significantly from one that fits precisely to the data. The model created had an excellent output of 1.188. The comparative fit index (CFI) assumes that all latent/dependent variables are not correlated and evaluates the fit of the model to the independent model. The CFI has a statistical range between 0 to 1 with a good fit value closer to 1. The CFI value was observed to be 0.902 and considered an acceptable fitting model as the cutoff value is 0.90 [45]. According to Kline [44], the root-mean-square error of approximation (RMSEA) can be deemed an absolute fit index, with 0 signifying the best fit and values > 0 indicating a worse fit. In

other words, the RMSEA prefers closeness in that it will select the model with a lesser number of parameters. In the modified output data, the RMSEA = 0.06, which falls between 0.03 (close fit) and 0.08 (terrible fit), therefore indicating an acceptable good fit. The PCLOSE test provides another way of measuring the close fit of a model based on the RMSEA. A PCLOSE test result where $p > 0.05$ can be considered as validating the null hypothesis of close model fit. The model is considered a closed-good fit as it has a P-CLOSE value of 0.384, therefore supporting the model's hypothesis.

Concerning the SEM model created, the top five considerable risks of the dependent variable, the implications of COVID-19 are the independent variables S2RI1 that "the pandemic has negatively affected the construction industry," with a loading of 0.71, which is the most significant weighty risk followed by the variable S2RI2 of "the pandemic affected project in terms of cost overrun," with a loading of 0.70, and then the variable S2RI3, "the pandemic affected project in terms of time delay," with a loading of 0.64. The fourth variable S2RI9, "the local industry is unable to meet the supply and demand needs of the construction industry during the pandemic," has a loading of 0.61. Furthermore, the fifth variable S2RI10, "construction companies can face bankruptcy if force majeure is not applied/invoked," has a loading of 0.59. Tables A1–A3 in Appendix A indicate the standardized regression weights in the modified model, squared multiple correlations in the modified model, and correlations in the modified model, respectively.

The top five considerable independent variables of the dependent variable, force majeure events, are S3107, S3103, S3106, S3108, and S3107, respectively. The variable S3107, "the contractors should be granted cost compensation for the unforeseen events" has a loading of 0.78, which has the highest regression weighting. The variable S3103, "once foreign markets cannot be accessed for goods and services required for the construction industry, force majeure should automatically be applied", has the second-highest weighting of 0.67. The variable S3106, "the contractors should be granted a time extension for the unforeseen events", has the third-highest loading of 0.65 along with the variable S3108, "government contractors should have amendments made to protect the interests of contractors under circumstances such as a pandemic", followed by the variable S3109, "the government should intervene in subsidize losses and thus minimize the effect of the pandemic on the construction industry", which has a weighting load of 0.61. A high coefficient regression weighting indicates the variables are significantly important to the model.

The implications of COVID-19 on construction projects is one of the recently popular research topics among many scholars. Previous studies have found that implications include disruptions in the supply chain of major construction resources, additional costs because of the safety and health measures [46,47], delay or additional costs emanating from changes of the law restricting the activities, decrease in productivity [46,47], and price escalation [46]. One study has pin-pointed the COVID-19 impacts on cash flows and payments, especially in small construction firms; further, they mentioned that securing contracts for construction projects has been negatively affected since preventing COVID-19 spread inside construction projects was considered more. Moreover, they proved the fact of adverse impacts on work progress on site due to COVID-19; thus, they could not secure materials for their projects, which affected work progress relating to time and cost [47]. Though they have identified important facts that consider the implications of the COVID-19 pandemic on construction projects, there is a lack of a proper framework that considers the critical reasons and effects of the COVID-19 pandemic on construction projects. Hence, the current study provides a significant model for risk mitigation of force majeure impacts. Further, Table 9 shows a comparison between the implications identified through the current study and the previous studies.

Table 9. Comparison between the implications identified through the current study and the previous studies.

Implications of COVID-19	Reference
The price of construction materials has increased drastically since borders were closed.	[46], current study
The pandemic affected your project/contract in terms of time delay.	[47], current study
Due to the pandemic, construction job opportunities were shortened.	[46,47], current study
The project should continue during the COVID-19 pandemic with tight health protocols.	[47], current study
The terms and conditions of a contract should allow for review and renegotiation under extenuating circumstances such as those faced during a pandemic.	Current study
The pandemic has negatively impacted you in the construction industry.	[48,49], current study
Construction companies can face bankruptcy if force majeure is not applied/invoked.	Current study
The pandemic affected your project/contract in terms of cost overrun.	[47], current study
The activation of the force majeure clause is dependent on how the clause is specifically worded in the contract.	Current study
The pandemic made it more difficult in tendering contracts.	Current study
Due to the pandemic, there was a significant increase in project cost due to purchasing of PPE to mitigate the spread of the disease.	[46–48], current study
Your company delegated more people to work from home.	[46], current study
The local industry is unable to meet the supply and demand needs of the construction industry during the pandemic.	[47], current study
The pandemic affected your project/contract in terms of suspension of the contract.	[46], current study
Projects put on hold.	[47]
The pandemic affected your project/contract in terms of termination of the contract.	[5,46], current study

4.6. Recommendation/Strategies to Mitigate the COVID-19 Implications in the Construction Industry

The following recommendations were suggested [7,48–51] to mitigate the COVID-19 implications in the construction industry:

1. Contract review and renegotiation: The review and renegotiation of contractual clauses and obligations are recommended to comprehend what obligations and assistance entitlement are eligible for a claim due to the pandemic event. The main purpose of force majeure terms and conditions in a contract is to protect the contractor from liability by classifying whether a pandemic can be categorized as a force majeure event and if the contractor meets the contractual notice requirements. In a situation where the clause stated in the contract does not indicate that the pandemic is a force majeure event, then the client and contractor must undergo renegotiation of the contract to continue fulfilling the contractual obligations. If the contractor does not fulfill the contractual notice requirement, then they will waive all rights to the entitlement of time and cost extensions.
2. Documentation of project implications due to COVID-19: The impact of the project can be classified into five categories. The contractor needs to identify and document these risks' impacts before attempting to mitigate them.
    - 2.1 Cost overrun: Any cost of the contract pertaining to COVID-19 should be assessed separately in terms of costly damages and cost barriers. The cost assessment should be done in terms of the scope of work, idle equipment, general conditions, and additional preventive measures, such as employee screening, thermal reading, and facilities management.
    - 2.2 Schedule: Assess and record the idle time, the incurred cost to date, and schedule delays caused by the pandemic. With the use of the Gantt chart, the contractor can determine and update the schedule of project completion.
    - 2.3 Resources: Assess the availability of resources due to safety and social distancing regulations.
    - 2.4 Logistics: Assess the effect of critical path time on the delivery of materials, shipments, and essential components.
    - 2.5 Quality: Assessing the quality of work to ensure it is up to engineering construction code standards.
3. Updating risk register: The client and contractor need to identify and assess the future risks, designate ownership, and establish mitigation plans about risk criteria for the

completion of contractual obligations of the project. When COVID-19 first occurred in 2019, the virus was considered an unknown risk and it was difficult to mitigate the uncontrollable risk. By late 2020, however, the responsible stakeholder could now design and implement a plan to mitigate COVID-19-related risks to fulfill contract requirements. The main risks that should be considered for mitigation are material and labor inflation, the availability of resources, social distancing guidelines, limited productivity, additional COVID-19 PPE and sanitizing requirements, and the number of cases rising due to the spreading of the virus and lack of a vaccine.

4. Development and execution of mitigation plan: The mitigation plan can be designed pertaining to how the project's contractual obligations will be executed. This plan included forecasting the completion dates of projects' objectives due to the impact of COVID-19, creating provisional obligations for the remaining work, and fast-tracking the project schedule by working multiple tasks parallel to each other to decrease the project's duration. With the implementation of the approved changes to meet the client's demand, the plan is then executed to accomplish the project's obligations through proper communication planning.

4.7. Section 3 of the Questionnaire Allowed the Respondents/Professionals to Indicate Suggestions for the Mitigation of COVID-Risks Impacts in the Construction Industry in Trinidad and Tobago

1. Construction companies need to evaluate the likelihood of late or prevented deliveries of materials from the suppliers and ensure the availability of labor, material, and equipment. Alternate procurement measures may be necessary. The use of local suppliers over international suppliers may need to be taken into consideration. However, the price and amount of the specific material may either be of higher cost to international suppliers or the shortages of the specific materials due to international availability during a lockdown.
2. The project team must maintain constant communication and coordination during construction. However, due to the social distancing guidelines which would affect the in-person meetings, new methods of communication, such as online conference calls/meetings via different platforms are encouraged and executed. It is also essential to have limited persons onsite. Therefore, a rotation system can be implemented as well as the use of online video conference calling for communication purposes.
3. As a contractor, it is important to always communicate with stakeholders, suppliers, and staff during a project's development and construction during a pandemic. Communication in terms of notifying a client regarding terms of delays or cost overruns or even lack of material will determine, upon reviewing of contract's force majeure clauses, whether the project can become extendable or if it's necessary to suspend or terminate the contract.
4. Construction companies need to evaluate the concerns for the safety of their employees in the prevention of the virus spreading. This can be done by installing hand sanitizer stations, mandatory temperature screening for everyone entering or leaving the site, the mandatory wearing of facemasks, signs enforcing the importance of facemasks, social distancing, and the sanitization of hands and equipment used daily. A health and safety officer should be present onsite to ensure everyone is following safety protocols and health and safety meetings should occur daily as it pertains to following protocols and guidelines.

5. Conclusions

This study forms part of an ongoing investigation into the implications of COVID-19 on the SIDS construction industry. The literature review supports the assumption that the onset of COVID-19 qualified as a force majeure event. In response to RQ1, i.e., the critical risks and impacts of COVID-19 on the construction industry, the top five critical risks and impacts found were drastic increases in prices of construction materials (S2RI8, RII = 0.872), delays (S2RI3, RII = 0.824), curtailed job opportunities (S2RI12, RII = 0.824), the continuation of projects under strict health protocols (S2RI15, RII = 0.799), and renegotiation of contractual terms and conditions (S2RI7, RII = 0.795).

In response to the second research question on the mitigation factors to reduce the impact of COVID-19, the study concluded that the leading factor is the award of an extension of time for unforeseen events (S3106, RII = 0.834), followed by a pandemic as an event which invokes force majeure (S3101, RII = 0.818). Government contractors should have amendments made to protect the interests of contracts under circumstances such as a pandemic (S3108, RII = 0.794) and the presumed best way to manage the risk is to distribute the risk to the party more capable of controlling and managing the risk event and bear its consequences (S3105, RII = 0.785) are other mitigative strategies available to contracting parties.

Moreover, the proposed conceptual SEM provided valuable insights into the interrelatedness of these important factors/variables. The SEM model supported the hypothesis that the COVID-19 pandemic has a negative impact on the construction industry as it relates to force majeure and risk events. The results of the fitted SEM produced the top five critical risk variables with the highest loadings as the individual participant being directly negatively impacted by COVID-19 (S2RI1, 0.71 loading), curtailed job opportunities (S2RI2, 0.7 loading), delays (S2RI3, 0.64 loading), the construction industry's inability to meet supply and demand needs (S2RI9, 0.61 loading), and contractors facing bankruptcy if force majeure is not applied (S2RI10, 0.59 loading). The following are the top five critical factors for force majeure events: contractors should be granted cost compensation for the unforeseen events (S3107, 0.78 loading), the automatic application of force majeure based on the inability of foreign markets to access goods and services required for the construction industry (S3103, 0.67 loading), the award of an extension of time for unforeseen events (S3106, 0.65 loading), contractual amendments made to public sector contracts to protect interests (S3108, 0.65 loading), and the intervention by government to subsidize losses and thus minimize the effect of the pandemic on the construction industry (S3109, 0.61 loading).

The third research question on lessons learned from both literature and tacit knowledge was addressed by the proposal of recommendations to mitigate the impact of COVID-19 in the industry. Construction organizations are reminded that the health and safety of their staff are never to be compromised, and all attempts are to be made to protect the employees' interests. Also noteworthy is the consistency and openness of communication among stakeholders during these events to notify all parties and build a collaborative environment during difficult situations. A party cannot become complicit to operationalize its contractual obligations. As the full impacts of COVID-19 are still ongoing, the employer, engineer, and contractor are obligated to practice a duty of care to all stakeholders. Each party must demonstrate proper conduct and thorough due diligence and compliance within this period and be accountable for any cost overruns or time delays. Finally, the contractor is reminded of its obligation to provide unambiguous and written notice to the other party of any delays and prove that multiple measures were applied to mitigate the effects when the force majeure event occurred.

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Appendix A

Table A1. Showing standardized regression weights in the modified model.

			Estimate
S2RI15	<—	Covid19_Implication	0.215
S2RI14	<—	Covid19_Implication	0.408
S2RI13	<—	Covid19_Implication	0.383
S2RI12	<—	Covid19_Implication	0.534
S2RI11	<—	Covid19_Implication	0.431
S2RI10	<—	Covid19_Implication	0.585
S2RI9	<—	Covid19_Implication	0.612
S2RI8	<—	Covid19_Implication	0.492
S2RI7	<—	Covid19_Implication	0.324
S2RI6	<—	Covid19_Implication	0.530
S2RI5	<—	Covid19_Implication	0.163
S2RI4	<—	Covid19_Implication	0.367
S2RI3	<—	Covid19_Implication	0.644
S2RI2	<—	Covid19_Implication	0.702
S2RI1	<—	Covid19_Implication	0.709
S3101	<—	Force_Majeure	0.495
S3102	<—	Force_Majeure	0.454
S3103	<—	Force_Majeure	0.670
S3104	<—	Force_Majeure	0.376
S3105	<—	Force_Majeure	0.394
S3106	<—	Force_Majeure	0.655
S3107	<—	Force_Majeure	0.784
S3108	<—	Force_Majeure	0.651
S3109	<—	Force_Majeure	0.609
Construction_Industry	<—	Covid19_Implication	0.287
Construction_Industry	<—	Force_Majeure	0.743

Table A2. Showing squared multiple correlations in the modified model.

	Estimate
S3109	0.371
S3108	0.424
S3107	0.615
S3106	0.428
S3105	0.156
S3104	0.142
S3103	0.449
S3102	0.206
S3101	0.245
S2RI1	0.502
S2RI2	0.493
S2RI3	0.414
S2RI4	0.135
S2RI5	0.027
S2RI6	0.281
S2RI7	0.105
S2RI8	0.242
S2RI9	0.375
S2RI10	0.342
S2RI11	0.186
S2RI12	0.285
S2RI13	0.147
S2RI14	0.167
S2RI15	0.046

Table A3. Showing correlations in the modified model.

			Estimate
Covid19_Implication	<–>	Force majeure	0.858
e13	<–>	e14	0.441
e11	<–>	e15	0.325
e11	<–>	e12	0.362
e18	<–>	e22	−0.533
e17	<–>	e19	0.330
e6	<–>	e11	−0.360
e6	<–>	e7	0.268
e3	<–>	e6	0.380
e2	<–>	e9	−0.246
e1	<–>	e2	0.323
e1	<–>	e10	0.297

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