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## Factors Influencing Claims Procedure under Unstable Financial Condition

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### Abstract

Recently, the economic system has faced a several unstable financial conditions (UFC) which affected the construction industries. As a result of the instability, this led to an increase in the number of claims during implementation. Therefore, the importance of studying the impact of (UFC) on management and settlement of claims has appeared. Also, the enhancement of an effective claim management system is highly needed. Therefore, this research attempts to qualitative and quantitative analysis of factors affecting the claim process. Qualitative analysis was performed by identifying and ranking the key factors influencing the management of claims for construction projects. Depending on the literature review and expert interview, 30 factors were determined and categorized into four major categories:1) human framework 2) claim characteristics 3) organizational issues ,and contractual issues. The questionnaire survey was conducted to get the opinion of 133 participants, including contract managers, claim experts, and project managers. The data was analyzed statistically using (SPSS) software. Then, factors were ranked using the total importance index (T.R.I.I). Based on the results, the routine of public authorities ranked first. Whereas less-experienced parties come in the scored of the overall rank. While the third factoris economic uncertainty and increasing inflation rates. Quantitative analysis of the factors influencing claims was performed using the fuzzy model. Thus, the fuzzy model was developed to estimate the percentage of affected cost increase resulting from the occurrence of critical factors. The model conducted a case study to verify the validity of the model application. Depending on the study and examination of the factors. This model attempts to provide a contract manager with a visually makes decisions by estimating the impacted costs. Contribute to measuring the extent of (UFC)damage to the claims process. This model is characterized by ease of application and addressing the ambiguity associated with the impact of factors arising from financial conditions. It also removes ambiguity about the interrelationship of factors with each other. Through this it is possible for the contract manager to develop an acceptable response strategy to enhance the chance of successful claims settlement and reduce the potential for disputes by avoiding or minimizing the impact of emerging factors

**Keywords:** Claim management, Fuzzy logic, contract,unstable financial conditions (UFC).

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## 1. Introduction

Lately, the Middle East has encountered numerous circumstances that affected the economic systems. Therefore, the construction industry is facing chronic problem with(UFC) affecting its progress, which led to uncertainty in implementation processes [1].Therefore, many challenges were faced for managers and stakeholder of construction projects [2].The (UFC) can cause increasingly variation orders resulting a complex contract [1]and [3].Correspondingly, claims are becoming an integral feature of any modern contract [4] as stated by LU [5]. Where, the contract manager must carefully examine the causes and frequency of recurring claims

Both public and private funded projects are susceptible to construction claims and disputes. Through this fact, neither project could be considered exempt to a potential claim. As a result, it is fundamentally important for all parties, including the owner, designer, and contractor to fully understand the claim process [7]

According to past research, there are six stages in the claim procedure. It begins with the identification of claims, then continues with notification, examination, documentation, submission and negotiation of claims. Consequently, it is apparent that evaluating claims is an essential and effective component of the construction process. Also evident is the significance of identifying the stages of claims, problems, and obstacles that involved parties in claims management may experience in order to achieve a satisfactory claim settlement. In addition, they must be well-versed in identifying, preparing, and defending a claim. For this reason, the claim procedure should be clear and easily comprehensible by all project participants, so that they know how to submit a claim in a manner that ensures acceptance of their entitlements. The purpose of this research impact of financial condition by qualification of the key factors influencing the claim management process. By conducting extensive study on literature review [3]and[6]. Also, the questionnaire survey was considered to identify the factors that affect the claim procedure, these factors were categorized into four major groups 1-human frameworks,2- with characteristics of the claim, 3-organizational and legal issues, and finally 4- contractual issues.

Despite a large number of research concerned with the study of claims management. As project manager continues to face challenges in managing

and resolving claims fairly and equitably. Also, there are difficulties to avoid quarrels and conflicts. Previous studies in many countries are concerned with the problems and obstacles that affect the management of claims. It is worth mentioning that these studies were concerned with studying the stages of claims and the problems involved in each stage. No study has concerned with claims management under exceptional conditions and changes that the world is going through, such as the unstable financial conditions that the world has faced in recent years due to diseases and wars, the importance of studying claims management and the extent to which it is affected by those conditions, especially the unstable financial conditions, to shed light On the most important factors to improve or avoid them in the future in the face of similar condition

## 2. LITERATURE REVIEW:

### 2.1 Claim Management Process:

several forms of standard contract used in the civil engineering and construction sectors recognize the need for an effective contracting regulation to compensate the contractor and the more contractual disagreements the behavior of the owner and his employees leads to or is expected to result in additional costs [7].Therefore, claims have become a common standard in the delivery of construction projects.

Accordingly, the definition of claims has been illuminated. A “claim” is defined as a request by one party of the contract, commonly the Contractors, for compensating damages generated by the other party's failure to perform his commitments as defined in the contract one of the relevant parties. In the construction

process demanding consideration or change claims were often. as [14- 15] defined the claims as the representation of a legal right to compensation, property, or restitution. Claims have become the rule rather than the exception on construction projects. As a result, profitable projects aren't those that have the fewer number of claims but are rather those projects having the best claim processing [10]

Therefore, the importance of investigating the phases of claims and as mentioned by [11] The critical stage for claim management, also referred to as the process of coordinating resources for the evolution of claims, beginning with their identification and analysis and continuing through their notification, examination, presentation,

documentation, negotiation, and claim settlement. So that, the importance to focus on challenge affecting the claim process. Several research studies have been conducted. Factors affecting on the claim process as problems and obstacles that faced management of this process and mansion related to stage of the claim process.

also, [12] and [13] explored the issues relevant to the procedure of claim submission from the standpoint of contractors, while [14] explored the issues relevant to the procedure of claim from contractors and consultants standpoint by examining basic operational procedure classifications, which have been broken down into six stages.

Including [11],[13],[14], and [15] all have analyzed the affluence of construction claims regarding to the stage of the claim stated above. In parallel to these studies, [13] states the factors

affecting the claim process without categories mentioned for factors.

With exception of previous, L.V inetconducted a study[16] the factors influencing claims management practices in Nigeria and categorized the main factor identifies as positive factors in these groups that were organization factors; quality and schedule factors; procurement and environmental factors; and cost and time management factors. Also identifies four groups of negative influencing factors that must be mitigated before claims could be settled amicably.

based on earlier research, thirty factors have been highlighted. These factors influencing claim procedure have been recognized and listed in the four relevant groups, summarized in Table 1. It shows the claim factors studied by reference, and their stage according to the literature review.

**TABLE 1.**Literature review of claim factors, stage and reference

	Factors	Stage	Reference
1	Varied project parties have different perspectives on receivables and the determination of differential claims.	negotiation	[11]
2	Multiple stakeholders of the project with a variety of objectives, and adversarial relationships with other parties that may occur as a result of grappling with each party's profit goals	negotiation	[11],[14],[17]
3	Inadequacy of staff knowledge of contract term to notice claim on timely manner and the contractual clauses	identification, notification	[14]
4	Un-documented verbal promises and agreements from the owner which lead to a breach of the promises and agreements on financial compensation that lead to obstructing the operation of the claim	notification, documentation	[14],[17]
5	Need for effective communication and cooperation between parties of the contract to identify and present the claim	identification, notification, examination, presentation	[18],[17]
6	Less-experienced Parties in dealing with the claim management subjected financial change	identification, notification	[18],[11][13],[17]
7	Absence of qualified experts and specialists in claims for unforeseen changes	presentation	[13],[11]
8	Poor negotiation skills and dealing with the dispute	negotiation	[18],[14],[17]
9	Absence of standard format to evaluate the impact and record data and submission of change of price on claim submits	notification, examination, documentation presentation	[18],[11][17]

	Factors	Stage	Reference
10	Appearance claims from the client to modify the specification of a specific substance or the place of manufacturing owing to the necessity to decrease costs resulting from a rise in customs charges		[19]
11	The challenge of assessing the reasons and events that led to each item's strict claim is considering unforeseen change.	documentation, examination	[11] [14]
12	Response to Claim information inadequate time for presentation	presentation	[17]
13	Inaccessibility of documents when needed. Absence of a strong documenting strategy and competent technical staff can identify claims during project implementation.	identification, notification, documentation, presentation	[18] [17] [11] [13]
14	The complexity of records used for cost analysis and estimation for the damage resulting from change (in the examination stage).	examination	[11] [17]
15	unclear procedures for claim	examination, presentation	[14] [17]
16	Overdue to retrieving the needed document, delay in the retrieval of the required document or its absence in the administrative authorities	notification, documentation	[11] [13] [17]
17	biases when being involved with disputes and claim management.	All stage	[13]
18	The routine and bureaucracy that public authorities suffer from, including import orders, disbursement of financial payments, and dispute settlement.	All stage	[20]
19	A-large powers enjoyed by the owner and allow it to intervene to work and make changes.		[13]
20	Required modification in the legal procedures (as Tax-free or changing in the tax value).		[13]
21	Challenging to resolve a dispute without proceeding to arbitration or litigation.	Resolution, negotiation	[17],[11][14]
22	Economic uncertainty and increasing inflation rates lead to fluctuating prices, volatility of claims, and random use of contingency sums in the bill of quantities	All stage	[13] [14]
23	A significantly more competitive contracting environment with a greater number of players and reduced profitability.	All stage	[14]
24	Need for clarity of contract provisions or agreement related to responsibility to achieve accurate consumption.	examination	[14]
25	Contractual limitations and the inability to change a contract or request for special clauses to ensure eligibility for claims in cases of unforeseen funds not included in the contract.		[16]
27	Delay in payment of compensation or the value of compensation doesn't cover actual cost *payment process takes long period after implantation of the project.	All stage	[20]

	Factors	Stage	Reference
28	cost with retrieving required information	documentation	[14] [17]
29	Need to prepare a contractual arrangement for the substantial change order in the case of insufficient contractual compensation.		[16]
30	Unclear procedures for claim	examination, presentation	[14] [17]

**2.2 Fuzzy Logic Theory:**

The fuzzy logic theory has provided a simulation mathematical formulation for modeling the unpredictability of human mental processes. It's also defined as a numeric logic that reflects mathematical uncertainty and fuzziness and includes formal tools because of its treatment[21].

The reason for using the fuzzy model in this search is exemplified by the fuzzy system's ability to explain its thought process with clear applications. Fuzzy set theory is quite arbitrary and connected to the uncertain and inaccurate information that considered in construction projects[22],[23].

**3. RESEARCH METHODOLOGY:**

To fulfill the objective of the research, an extensive literature review and claim expert judgment was obtained. Thirty factors influencing claim management were identified. Then, questionnaires were designed and then emailed to a variety of contract professionals. Therefore, analyses have been performed using (SPSSV22). Factors influencing claim procedure were ranked using (T.R.I.I%), and model development for designing an impacted cost model using Fuzzy theory and validation case studies have been applied. As shown in fig.1 .

**3.1. Sampling:**

Sample survey of the respondents with an experience in contract and claim management. (Under UFC)

The sample size was selected based on the calculated minimum sample size as explained below. Equation (1) was used to determine the sample size of the unlimited population [24] ,[25]:

$$SS = \frac{Z^2 \times P \times (1-P)}{C^2} \tag{1}$$

where:

SS = Sample size.

Z = Z value (e.g., value = 1.96 for 95 percent confidence level).

P = percentage picking a choice, expressed as a decimal (0.60 used for sample size needed).

C = margin of error (8 percent).

$$SS = \frac{1.96^2 \times 0.5 \times (1 - 0.5)}{0.08^2} = 150.075$$

The correction for the finite population was calculated using equation (2):

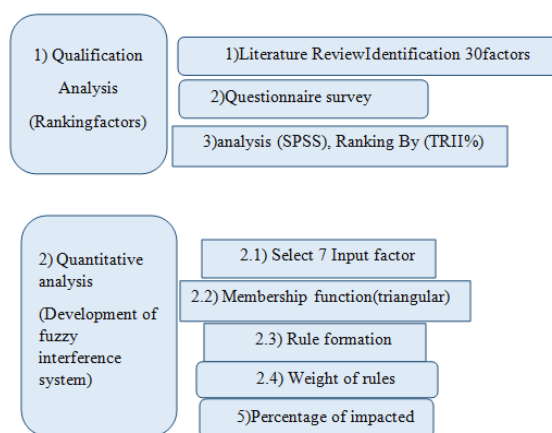
$$SS_{new} = \frac{SS}{1 + \frac{SS-1}{POP}} \tag{2}$$

where POP (the theoretical population) = 1000

$$SS_{new} = \frac{150}{1 + \frac{150-1}{1000}} = 130.5483$$

Thus, the minimum required sample for this study is 73 respondents.

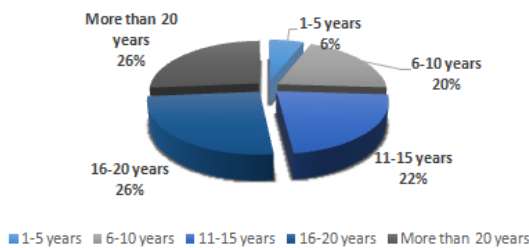
Based on the above equation, it was decided to randomly select and target a total of 156 respondents; 133 completed questionnaires were received.



**FIGURE 1.** Reserch methodology

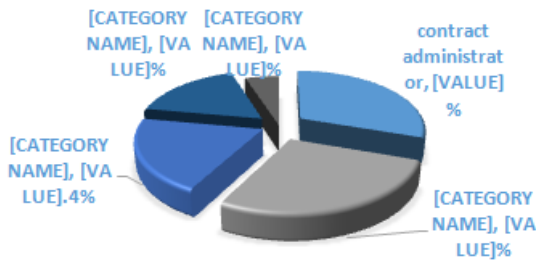
**3.2 Data Collection:**

A survey was carried out to evaluate the impact of the main factor influencing the management of the claim process Data was collected from different four construction projects located in the Middle East (Egypt-KSA). Questionnaire survey that was distributed to 155 respondents. Only 133 respondents answered the questions. Criteria for respondents used with an experience in contract and claim management shown in (figure 2). 74% of the respondents have experience of more than 15 years in contract and claim management, and 22% of the respondents have an experience between (11-15) years.



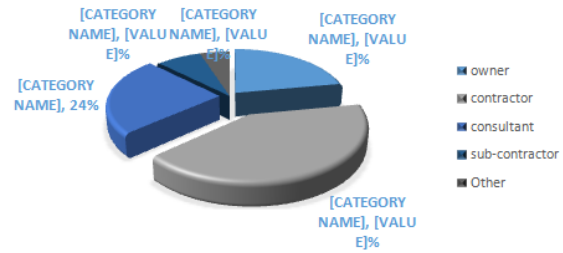
**FIGURE 2.** Experience of Respondent in Contract Management

The respondent's positions included technical office engineers with a percentage of 17%, project control managers (27.4%), claim experts (20.4%), and contracts administrators (30.20%) which is the largest in the survey as shown in Figure 3.



**FIGURE 3.** Position of the Respondents.

The participating projects represented entities such as the owner, contractor, and consultant. As shown in Figure 4, the contractors represented 41.42%, the consultants 24%, the owner's rate was 22.06%, and subcontractors 7.5% which is the lowest percentage results of the distribution. Type of construction project referred public organization with a percentage 73% and 57% referred to a private organization.



**FIGURE 4.** Percentage of the organization type.

**3.3 Validating data**

For the most part, the questionnaire was then processed using descriptive analysis using the SPSS V22 program after data collecting is concluded, by using Cronbach's alpha (α) Validation of data dependability was verified [26]. The (SPSS V22) software was utilized to evaluate the alpha coefficient for the frequency of prevalence of impact factor influencing claim procedure, the impact of claim factor on the cost, and time for thirty factors, which were α = 0.941, 0.939, and 0.928, respectively. This result is more than 0.5 as a limited value, demonstrating confidence in the consistency and reliability of information ([27], [28], and [29])

**4. DATA ANALYSIS AND DISCUSSION:**

Likert scale with five degrees 1-5 was used to analyze the frequency for each factor in which 1 indicates "rarely", 2 - seldom, 3- sometimes, 4- often, and 5-always. Also, the impacted factors time and cost have been provided, where 1 indicates very low, 2-low, 3-high, 4-very high. The (SPSS) software has been utilized for information processing. Before rating the factors, the data's reliability was verified. This scale of five-point scale became changed to a total Relative Importance Index (RII) for each factor, using the following equations

Frequency Index: is an equation to compute the frequency of recurrence for claim factors due to financial change as determined by respondents and computable under Equation (1) according to [30],[26]:

$$\text{Frequency Index (F.I)}(\%) = \frac{\sum a (n / N) * 100}{5}, \tag{3}$$

Where "a" indicates constant addressing the weight of each response (range 1 for rarely up to 5 always), "n" indicates the frequency of the

response, and “N” indicates the total number of responses.

Impact Index: is equations to compute the impact on cost and time manner as determined by respondents'opinion and computable in accordance Equation (2) according to [24 and25]:

$$\text{Impact (time/cost) Index (IT/IC) (\%)} = \frac{\sum a(n/N) * 100}{5}, \quad (4)$$

Where “a” indicates constant addressing the weight of each response (range 1 for very low up to 5 for very high), “n” indicates the frequency of the response, and “N” indicates the total number of responses.

Importance Index of factors Cost and Time Impact (I.I.T)/ (I.I.C): can be computed as equations of both frequency and impact indices [24 and25]. This indicator shows the impact of each claim factor on cost or time, as represented in Equation (3):

$$\text{(I.I.C) or (I.I.T) (\%)} = \text{F.I (\%)} * \text{I.I} \frac{\%}{100}, \quad (5)$$

Where: F.I (%) and I. I (%) represent the frequency and impact indices for the specific factor affecting the claim process, which was calculated from Equation (1) and Equation (2)

Total Relative Importance Index (T.R.II): can be computed as a function of both importance indices for project cost and time impact and can be computed as represented in Equation (4):

$$\text{T.R.I. I\%} = ((\text{I.I.C}) + (\text{I.I.T}))/2, \quad (6)$$

Where: T.R.I.I. is the total average importance index for impact factor

I.I.C is the importance index for cost impact

I.I.T is the importance index for time impact [26]

#### 4.1 Result Discussion:

All information obtained from 133 participants was processed to organize information about 30 factors affecting claim management. It was categorized according to the human framework, claim characteristic, organization legal issue, and contractual issue.

##### 4.1.1 Factors Associated with Human Frameworks:

As shown in Table 2, the eight factors associated with Human Frameworks may affect claim management. According to experts' opinion, the most influential factor was the less-experienced

parties to dealing with the claim management. It was ranked second among all factors since that is one of the most sufficient factors affecting claim management. With (T.R.I.I) =70.267%. According to previous studies[18], [11], it was influencing in identification and, notification stage of the claim process. However, the second factor in group rank and the fifth factor in overall rank were varied. Project parties have different perspectives on receivables with (T.R.I.I) =65.027%. Also, the 3rd factor of group rank and 7th of overall 30 factors affecting the claim process was “Absence of qualified experts and specialists in claims” with (T.R.I.I) =64.227%.

##### 4.1.2 Factors Associated with Characteristic of the Claim

In Table 3, eight factors are associated with the characteristic of the claim which means that related events and procedures may affect the management of the claim process. As a result of the survey, the most affecting factor in this group is “Difficulty of obtaining records used to analyze, estimate cost which is the first rank in this group and 9th of among thirty factors affecting the claim process with (T.R.I.I) =62.366%.

The second factor ranked in the group was “absence of standard format also has 10th rank of overall 30 factors affecting the claim process

##### 4.1.3 Factors Associated with organizational and legal issue.

Table 4 illustrates the rank of the eight factors associated with an organizational and legal issue. According to the questionnaire outcomes, the most influential factor is “The routine and bureaucracy that public authorities suffer from” with (T.R.I.I) =71.33% which ranked second of the most influencing factor on the management of the claim process.

The second factor of group rank was a-large powers enjoyed by the owner, and the 4th of overall rank with (T.R.I. I) =66.61%.While the third factor was economic uncertainty and increasing inflation rates which lead to fluctuation price and the 4th of overall rank with (T.R.I.I) =65.38%. as [29] Potentially float the Egyptian currency against foreign currencies and drastically raise the cost of materials. Consequently, stakeholders were pushed to undertake numerous significant changes (change order, change specifications, or material).This caused a substantial impact on the cost and duration of the project.

**TABLE 2.** Factors Associated with Human Frameworks

Category	Symbol	Factors	FP%	IP%	IC%	IIT%	IIC%	T. R.II %	Rank Group	Overall Rank
A. Factors associated with Human Frameworks	FA1	Varied project parties have different perspectives on receivables and the determination of differential claims.	77.89	76.74	90.23	59.77	70.28	65.03	2	5
	FA2	Multiple stakeholder of the project with variety of objectives (foreign investment) Adversarial relationship with other parties that may occur as a result from grappling with each party's profit goals	66.84	66.05	78.38	44.15	52.39	48.27	8	27
	FA3	Inadequacy of knowledge of contract term to notice claim in timely manner due to contractual clauses	78.80	80.41	81.69	63.36	64.37	63.87	4	8
	FA4	un-documented Verbal Promises and agreement from owner which lead to Easily breach the promises and agreements on financial compensation that lead to Obstructing the operation of the claim	69.25	80.71	68.42	55.89	47.38	51.64	6	22
	FA5	Need to effective communication and cooperation between parties of contract to identify and presentation the claim	74.66	80.11	61.80	59.81	46.14	52.98	5	20
	FA6	Inexperience of Parties to dealing with the claim management under the influence financial change	87.44	73.65	87.07	64.40	76.14	70.27	1	2
	FA7	Absence of qualified experts and specialists in claims for unforeseen changes	77.60	82.67	82.86	64.15	64.30	64.22	3	7
	FA8	Poor negotiation skills and dealing with dispute	69.55	74.51	69.32	51.82	48.21	50.02	7	23

**TABLE 3.** Factors Associated with Characteristic of the Claim

Category	Symbol	Factors	FP%	IP%	IC%	IIT%	IIC%	T. R.II %	Rank group	Overall rank
B. Factors associated with characteristic Of the claim	FB1	absence of standard format to evaluate impact and record data and submission of change of price On claim submit	74.83	75.64	84.21	56.60	63.02	59.81	2	10
	FB2	The development of composite claims, , changes the value of claims and increases their complexity, Increase the number of claims submitted during the implementation period of the project	71.43	76.69	81.20	54.78	58.00	56.39	5	16
	FB3	Appearance claims from the client to modify the specification of a specific substance or the place of manufacturing owing to the necessity to decrease costs resulting from a rise in customs charges	68.27	70.08	72.48	47.84	49.48	48.66	8	26
	FB4	Difference in value of claim cost calculated by barites	72.03	73.53	62.86	52.97	45.28	49.12	7	25
	FB5	The challenge of assessing the reasons and events that led to each item's strict claim in light of unforeseen change.	71.13	79.40	75.19	56.47	53.48	54.98	6	18
	FB6	Response to Claim information inadequate time for presentation	76.09	80.15	69.77	60.99	53.09	57.04	4	15
	FB7	Inaccessibility of documents when needed. Absence of a Strong documenting strategy and competent technical staff able to identify claims during project implementation	74.29	83.31	74.74	61.89	55.52	58.70	3	11
	FB8	Complexity of records utilized for cost analysis and estimation (direct and indirect) for the damage resulting from change (in examination phase on claim process)	73.53	81.35	88.27	59.82	64.91	62.37	1	9



**TABLE 4.** Factors Associated With organizational and legal issue

Category	Symbol	Factors	FI%	IT%	IC%	IIT%	IIC%	T. R. I.I %	Rank group	Overall rank
C. Factors associated with organizational and legal	FC1	unclear procedures for claim at all stages due to financial changes	72.33	78.80	81.05	56.99	58.63	57.81	4	13
	FC2	Overdue in retrieving the needed document Delay in retrieval of the required document or its absence in the administrative authorities	71.73	76.99	77.74	55.23	55.77	55.50	6	17
	FC3	biase when being involved with disputes and claim management	76.54	76.24	73.83	58.36	56.51	57.43	5	14
	FC4	The routine and bureaucracy that public authorities suffer from in their work in import orders, disbursement of financial payments and dispute settlement	86.17	83.91	81.65	72.30	70.36	71.33	1	1
	FC5	A-large powers enjoyed by the owner and allow it to intervene to work and make changes and procedures	81.95	82.11	80.45	67.29	65.93	66.61	2	3
	FC6	Modification Is required in the legal procedures (as Tax free or changing in the Tax Value.)	69.47	72.03	80.15	50.04	55.68	52.86	7	21
	FC7	Challenging to resolve a dispute without proceeding to arbitration or litigation	62.11	72.78	50.00	45.20	31.05	38.13	8	30
	FC8	Economic uncertainty and increasing inflation rates which lead to fluctuation price ,volatility of claims and random use of contingency sums in Bill of Quantities	80.00	79.40	84.06	63.52	67.25	65.38	3	4

**4.1.4 Factors Associated with contractual issue.**

Effective management of construction contracts plays an effective role in the success of claims management. Under the influence of financial changes, the contracting environment is relatively more competitive.

Table 5 illustrate the six factors associated with the contractual issue that may affect the management of the claim process. According to the questionnaire, the most sufficient factor was “Need of Clarity of contract provisions or agreement related to responsibility to achieve acutance consumption “as it is one of the main factors. It was ranked 9th among all factors with (T.R.I.I) =62.07%.

Also,” the absence of independent departments for contract management, mostly because of a paucity of contract knowledge “ranked second in the group and 13th in overall rank (T.R.I.I) =85.10%.

**4.2 Ranking the Influencing Factors on Claim Procedure**

Table 6 shows the most influencing factors in the origin of 30 factors according to the Total Relative Importance Index (T.R.I. I%) that Influence the management of the claim process. All ten factors have (T.R.I.I%) above 55%. The most influential factor is “The routine that public authorities suffer from” with 71.329%. And the second is, the inexperience of parties to processing the claim

management under the influence of financial change with 70.267%, therefore, the. The factor less expressed Parties to handling the claim was ranked as the most affecting problem on the claim process As mentioned in their previous study [12], [11], [13], and [17]. And second in this study. The factor “economic uncertainty and increasing inflation rates” is ranking 4th on this search compared to the rank 10th in paper [13].

**5. MODEL DEVELOPMENT:**

**5.1 objective**

1. Model attempts to provide a contract manager with a visually making decisions by estimating the impacted costs. Contribute to measuring the extent of (UFC) damage to the claims process.

2. The fuzzy model was developed to estimate the percentage of affected cost increase resulting from the occurrence of critical factors

3- The model conducted a case study to verify the validity of the model application. Depending on the study and examination of the factors

In this research has designed a fuzzy logic-based modeling approach to determine impacted cost during (UFC. MATLAB fuzzy logic toolbox is employed to create this model. This software enables the analysis, development, and simulation

of fuzzy logic-based systems with the operation of a fuzzy set [31]

**5.2 Stage of Application Model in The Fuzzy Logic:**

In fuzzy application there are seven factors defined as input with corresponding weight and only on output defined as (impacted cost).

As table7 illustrate input of model with weight and membership function

**TABLE 5.** Factors Associated With contractual issue.

Category	Symbol	Factors	FI%	IT%	IC%	IIT%	IIC%	T. R.II %	Rank group	Overall rank
D. Factors associated with contractual issue	FD1	A significantly more competitive contracting environment with a greater number of players and reduced profitability.	74.59	77.44	56.39	57.76	42.06	49.911	4	24
	FD2	Need of Clarity of contract provisions or agreement related to responsibility to achieve accurate consumption	87.89	84.36	61.89	74.15	54.40	64.274	1	6
	FD3	Contractual limitations and the inability to modify a contract or request for special clauses to ensure eligibility for claims in cases of unforeseen funds not included in the contract	80.15	83.01	50.75	66.53	40.68	53.604	3	19
	FD4	Delayed payment of compensation or the value of Compensation don't cover actual cost *payment process take long period after implantation of project	70.38	79.10	56.64	55.67	39.86	47.764	5	28
	FD5	the absence of independent departments for contract management, mostly attributable to a paucity of contract knowledge	76.54	83.16	68.67	63.65	52.56	58.106	2	12
	FD6	Need to Preparing a contractual arrangement for the substantial change order. in case of Insufficient Contractual Compensation	69.77	77.74	53.01	54.25	36.99	45.616	6	29

**TABLE 6.** Ranking the Influencing Factors on Claim Procedure via relative importance index

Symbol	Factors	T. R.II %	Group	Rank
FC4	1-The routine that public authorities suffer from, disbursement of financial payments	71.329	organizational	1
FA6	2-Less-exposed parties to dealing with the claim management under the influence financial change	70.267	Human Frameworks	2
FC5	3-A-large powers enjoyed by the owner and allow it to intervene to work	66.611	organizational	3
FC8	4- Economic uncertainty and increasing inflation rates which lead to fluctuation price, volatility of claims and random use of contingency sums in Bill of Quantities	65.383	organizational	4
FA1	5-Varied project parties have different perspectives on receivables and the determination of differential claims.	65.027	Human Frameworks	5
FA7	6-Absence of qualified experts and specialists in claims for unforeseen changes	64.224	Human Frameworks	6

Symbol	Factors	T. R.II %	Group	Rank
FD2	7-Need of Clarity of contract provisions or agreement related to responsibility to achieve acutance consumption	64.011	contractual	7
FA3	8-Inadequacy of knowledge of contract term to notice claim in timely manner due to contractual clauses	63.867	Human Frameworks	8
FB8	9-Complexity of records utilized for cost analysis and estimation (direct and indirect) for the damage resulting from change (in examination phase on claim process)	62.366	characteristic of the claim	9
FB1	10-absence of standard format to evaluate impact and record data	59.811	characteristic of the claim	10
FB7	11-Inaccessibility of documents when needed. Absence of a Strong documenting strategy and competent technical staff able to identify claims during project implementation	58.702	characteristic of the claim	11
FD5	12-the absence of independent departments for contract management, mostly attributable to a paucity of contract knowledge	58.106	contractual	12
FC1	13-unclear procedures for claim at all stages due to financial changes	57.810	organizational	13

**Table 7:**Definition of The Factors as Input on Fuzzy Logic System

Code	Factors	Weight (T.R.II) %	MFS
FA6	1-Less-expressed parties to dealing with the claim management under the influence financial change	70.267	1-V.Low 2-Low 3-Meduum , 4-High 5-V.High
FC5	2-A-large powers enjoyed by the owner and allow it to intervene to work	66.611	1-V. Low 2-Low 3-Meduum, 4-High 5-V.High
FC8	3- Economic uncertainty and increasing inflation rates which lead to fluctuation price,	65.383	1-V.Low 2-Low 3-Meduum , 4-High 5-V.High
FA7	4-Absence of qualified experts and specialists in claims for unforeseen changes	64.224	1-V.Low 2-Low 3-Meduum , 4-High 5-V.High
FD2	5-Need of Clarity of contract provisions or agreement related to responsibility to achieve acutance consumption	64.011	1-V.Low 2-Low 3-Meduum , 4-High 5-V.High
FB8	6-Complexity of records used for cost analysis and estimation (direct and indirect) for the damage resulting from change (in examination phase on claim process)	62.366	1-V.Low 2-Low 3-Meduum , 4-High 5-V.High
FB7	7-Inaccessibility of documents when needed. Absence of a Strong documenting strategy	58.702	1-V.Low 2-Low 3-Meduum , 4-High 5-V.High

The following analysis stages are done on the fuzzy logic toolbox of MATLAB software to construct a model

### 5.2.1 Choice of The Fuzzy Inference System (FIS)

1. The FIS demonstrates basic information on a fuzzy inference system. Input and output parameters have been established at this stage[31].

2. The first step of the fuzzy inference system is defining the input and output variables for the model development. In the FIS editor of MATLAB, seven inputs (claim factors) were selected by a claim expert as shown in Table 7 and only one output (impacted cost).

Input variables were chosen as the important claim factors. The FIS are applied Mamdani inference system. The FIS editor from the fuzzy toolbox is shown in Figure 5.

### 5.2.2 Formulation of Membership Functions (MF)

1. second step of the design of the model consists of defining the memberships functions for each linguistic variable. A membership function is a curve that describes the mapping of the value of a fuzzy variable to establish its membership degree between 0 and 1. Membership functions are used in the so-called fuzzification process to convert the input values (crisp values) to fuzzy values. all membership functions are represented as triangular membership functions with five segments, namely Very Low (VL), Low (L), Medium (M), High (H), and Very High (VH) as stated in Table 7.

2. Triangular membership functions have been selected in this research because this type is used almost intuitively for all variables more

commonly with cost related, and fuzzy set have only three value[32].

3. Figure 6 Described as a tool that allows users to view and modify all membership functions connected with all variables of input and output for the full fuzzy inference system. [21].

### 5.2.3 Establishment of If-Then Rules (Rule Editor)

During this stage, the fuzzy inference system has already been completely defined as shown in Figure 7. Only 110 rules combining seven factors input and one output are generated utilizing rule editor. Table 7 illustrated all seven inputs and the weight of each rule[33][31].

Rules which combined input to output are stated. In this model 110 rules are generated in the form of IF-THEN (and) Also correlation indicates relation between factors to help in formation rules combining between Factors stated[34].

Rule1: if the frequency of factor FA6 is very low then the impacted cost is very low.

Rule2: if the frequency of factor FA6 is low then the impacted cost is low.

Rule3: if the frequency of factor FA6 is medium then the impacted cost is medium.

Rule4: if the frequency of factor FA6 is high then the impacted cost is high.

Rule5: if the frequency of factor FA6 is very high then the impacted cost is very high.

Rule6: if the frequency of factor FA6 is very high and the frequency of factor FA3 is very high then the impacted cost is very high.

Total relative indexes (TRIIs) of impacted factors are attributed as a weight to the fuzzy rules to create the assessment model estimation of the percent of impacted cost [31]. To establish the assessment model, the relative percentage based on the Relative Importance Index (TRII) of the claim component was identified and interred to the fuzzy rules as weight of rule

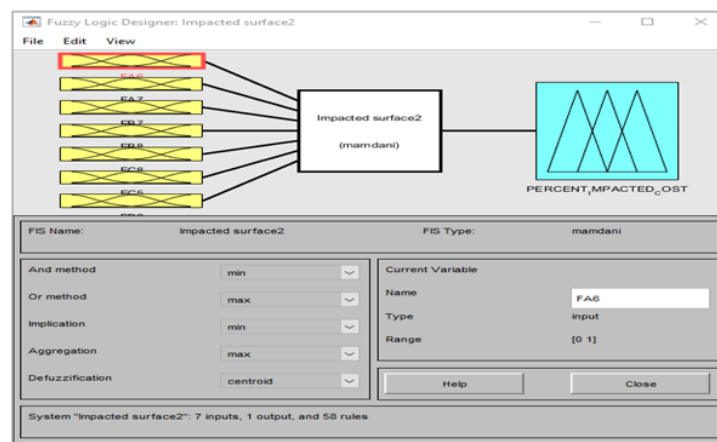


FIGURE 5. Fuzzy Inference of Seven Selective Input and One Output (FIS)

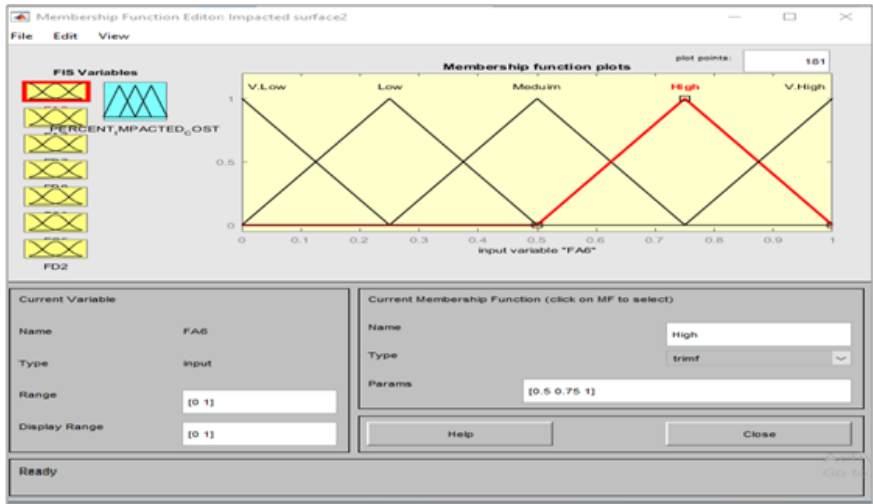


FIGURE 6: Triangular Membership Function of Input and Output (MF)

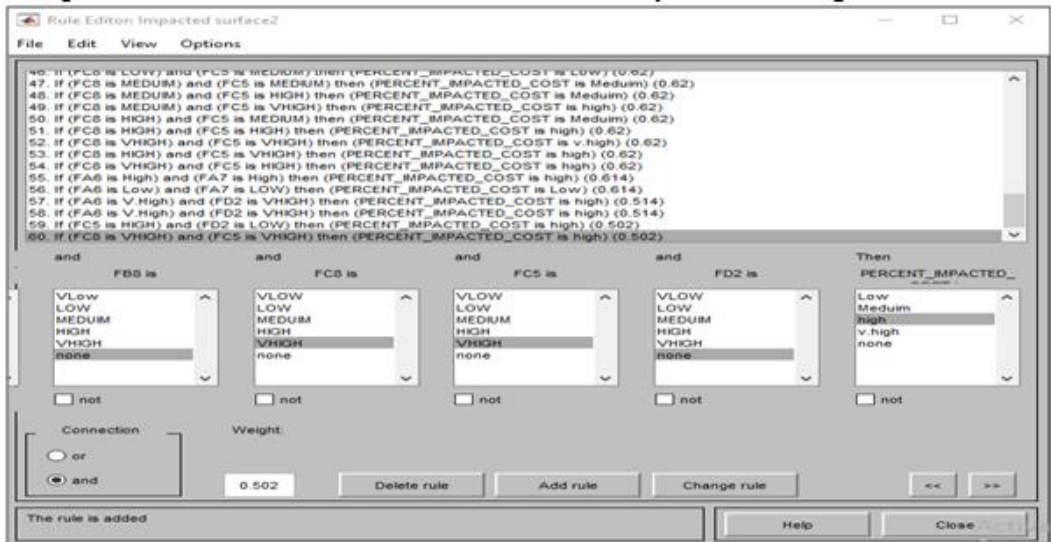


FIGURE 7: Rule Editor with corresponding Weight

**5.2.4 Rule Viewer**

The Rule Viewer provides an overview of the entire fuzzy inference technique. It is based on the diagram of fuzzy inference discussed in the previous section. The Rule Viewer permits simultaneous interpretation of the complete fuzzy inference process[22]. In the last phase of the fuzzy inference process called defuzzification, the fuzzifier converts the fuzzy output value into a crisp value. Figure 8 shows that all seven input factors with weights value and fuzzy output value into a crisp value=0.518

**5.2.5 Surface Viewer**

Figure 9 shows a three-dimensional curve which represents the mapping from variability of any two input claims factor in combination with output (impacted cost). The surface view of the inputs (less-experienced parties)(FA6), (the absence of qualified

experts) (FA7), and its corresponding output percentage of impacted cost equal 45% have been given in the diagrams. The quantification factor contributes significantly to the success of the controller.

**5.1.6 Defuzzification:**

Is the process in which outcomes of models in the form of fuzzy numbers can be converted to impacted cost output numbers. Fuzzy outcomes of fuzzy control model, including effects of all input variables of problem, and considering integrated effects of them by accessing fuzzy rules, are undergone fuzzy removing process and percentage of cost is determined as an interval of zero to one. Then the output value defuzzification by centroid method by applying C.O.G method.

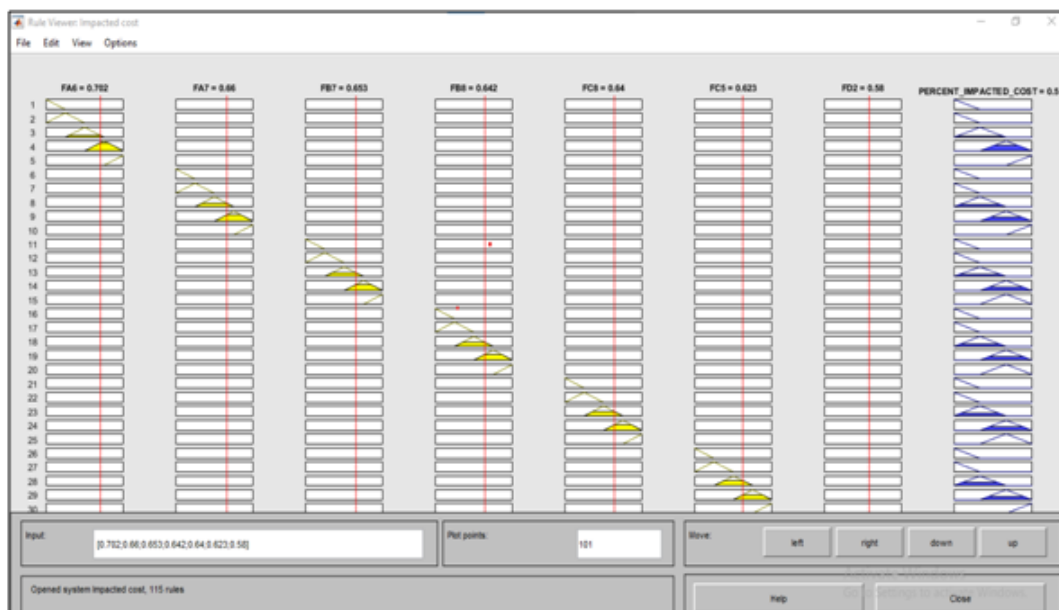


FIGURE8:Rule and Result Viewer

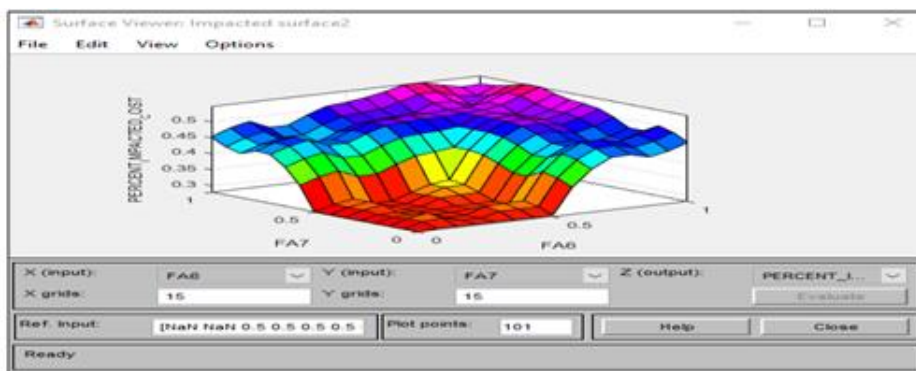


FIGURE9:Surface digram variation of input (inexperience of parties(FA6)), and input (absence of qualified experts (FA7)) with respect of output percentage of impacted cost45%.

**6. Validation case study:**

A case study was conducted to validate the model results regarding the most influencing factors in the management of the claim process. 7 from 13 factors were selected as sufficient factors of the claim process. The case study involves interviews with construction managers and claim experts to give an approximate percentage of the cost for each factor, with a detailed study of project documents and contracts. Seven of the most affecting factors were chosen by managers as being more appropriate. A case study validation model was generated using quantitative data from a project on roads and bridges in Egypt. The project information is stated in Table 8:

It is worth mentioning that this project was subjected to two (UFC) currency exchange and

inflation (floating the Egyptian pound against other currencies and increasing the price of materials dramatically). Therefore, this caused increasing the prices of materials such as fuel, gasoline, and diesel. In this case study, the claims of the project consist of compassion price fluctuations of material and change order for specification in terms of increasing cost of material, labor, and equipment. During the project implementation period contractor submit a claim of consumption increase price of Item: (Manufacturing, painting, supplying and installing steel girder per ton). Claim paid was(13,985,547.00L. E). Table 9below represent examples of calculate cost% of factors as input of fuzzy model.

examples were given in Table 9 to calculate the actual cost percentage for factors. The impacted cost percentage was calculated for each of the influencing factors and the actual impacted cost was

calculated and shown in Table 10. Then the affected cost was calculated through the model as shown in the figure 13.

**TABLE8.** Details of the Case Study

Project name	The regional ring road from Benha to Alexandria Desert Road with a length of 6.40 km
Contract value	984,448,462.652
Estimated cost	1,054,658,362.652
Contract period	735 days
Starting date	24/9/2015
Finishing date	19/10/2018
Owner	Ministry of Transportation
Main contractor	Ministry of Military Production
Sub-Contractor	CEESEC company (GHCB)

**TABLE9.** Example Of Calculation % Actual Cost of Factors

no	Item description	unit	quantity	unit price	price	cost %	corresponding factors
1	late notification of increasing price of gas	days	68	36,561.92	2,486,210.69	17.78%	Inexperience of parties dealing with the claim management
2	losses due to additional workclearance of site	m	4,755.09	400	1,902,034.39	13.60%	A-large powers enjoyed by the owner
3	increasing price of steel	ton	1500	2,480.10	3,720,155.50	26.6%	Economic uncertainty and increasing inflation rates

**TABLE10:** Case Study Cost% And Actual Impacted Cost.

Factors	Cost%
1. Inexperience of parties dealing with the claim management under the influence of financial change	17.73%
2. A-large powers enjoyed by the owner and allow it to intervene to work	13.60%
3. Economic uncertainty and increasing inflation rates which lead to fluctuation price, volatility of claims, and random use of contingency sums in Bill of Quantities	26.60%
4. Need for clarity of contract provisions or agreement related to responsibility to achieve acutance consumption	13.00%
5. Absence of qualified experts and specialists in claims for unforeseen changes	16.00%
6. Complexity of records used for cost analysis and estimation (direct and indirect) for the damage resulting from change (in the examination phase of the claim process)	15.03%
7-Inaccessibility of documents when needed. Absence of a good documentation system	15.01%
<b>Impacted Cost (Actual)</b>	<b>16.65%</b>

Results achieved by implicating the generated model in the case study are summarized in Figure 13. Results show the value of all input factors in this model gives percentage of impacted cost resulting of the worst activity of different seven factors in the claim process. Figure 13 represent cost% of seven input and output of impacted cost value.

The actual impacted cost in the case study is 16.65% while the impacted cost resulting in the fuzzy model output is 14.30 %, so the difference deviation between them was 2.3%. This indicates

that the model has an efficiency of  $\pm 95\%$ , considering the initial combination of main percentage of seven factors.

As shown in Table 10, the factor “economic instability and dwindling inflation rates” have the largest percentage of impacted cost. Whereas “the absence of qualified experts and specialists in claims” ranked second. The third factor of this case “Absence of qualified experts and specialists in claims”. Should be noted the percentage of impacted costs differs from one project to another.

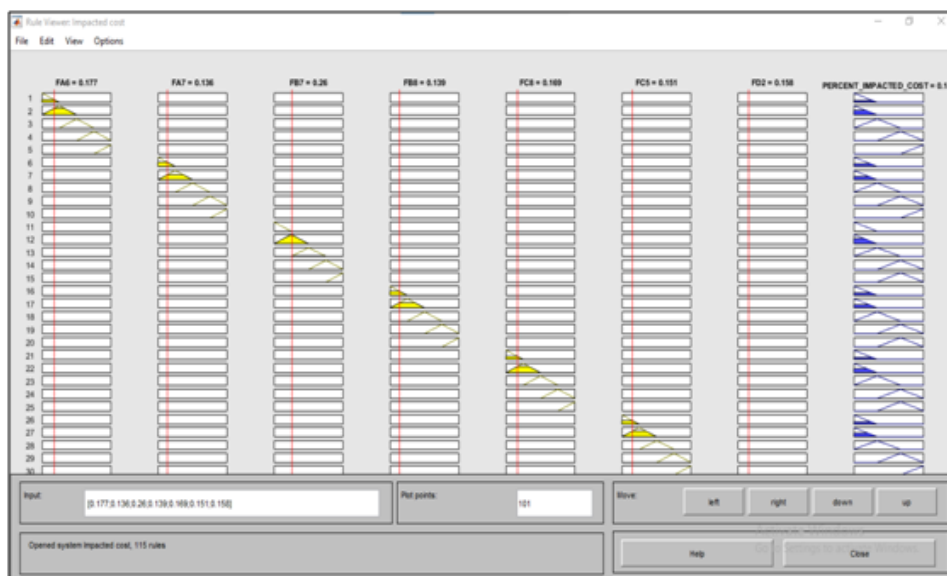


Figure 13: Rule Viewer of Input and Output

## 7. CONCLUSIONS:

Generally, Unstable Financial Conditions (UFC) have a negative impact on the construction industries and project objectives. For that reason, in order to increase the chances of project success, an effective early claim management is needed to reduce potential dispute and enhance decision making. These conditions may significantly affect claims management, an inevitable part of the current construction projects

This research intends to examine the impact of (UFC) on claim process by identification and ranking of sufficient factors of the claim process. This research thoroughly analyzed previous studies regarding claim factors and problems in construction projects. A questionnaire was conducted on 26 claim experts, 40 contract administrators in the Middle East. The factors were ranked by using (T.R.I. I%), thirty factors are identified and classified into four main groups

(Human Frameworks, characteristics of the claim, organizational legal issues, and contractual issues). This research concluded that factors ranked as the most influencing, namely 1-the routine that public authorities suffered from, 2-less- experienced parties to handle the claim management, 3-the large powers enjoyed by the owner, 4- economic uncertainty and increasing inflation rates, 5- absence of qualified experts and specialists in the claim, 6- needing for clarity of contract provisions or agreement. And finally, inadequacy of knowledge of contract term to notice claim,

Qualitative analysis of factors affecting claims was performed using the fuzzy model. Thus, the fuzzy model was developed to estimate the percentage of affected cost increase resulting from the occurrence of critical factors. Then, the model conducted a case study to verify the application of the model

According to the case study and examination of factors. This model attempts to provide the contract manager with visual decision making by estimating the costs affected. Contribute to the measurement of harm caused by the impact of the UFC on the



management of the claims process. When they encounter changes while submitting claims, this form provides a tool to help them decide on a cost.

In the case study conducted, seven of the most influential factors were selected by the manager as the project factors. Different schemas can be set to display a set of different combinations of two factors to claim with respect to the impacted cost.

The results also showed that the average percentage accuracy for each project is  $\pm 5\%$ . Therefore, the model developed in this paper is an example of a suitable model to generate the approximate average cost effect that occurs in the claim process and appropriate mitigation measures can be implemented to overcome the conditions of unexpected financial changes and disruption. Economy - price fluctuations

This model is characterized by ease of application and addressing the ambiguity associated with the impact of factors arising from financial conditions. It also removes the ambiguity about the interrelationship of the factors with each other. Through this, the contract administrator can take necessary measures and precautions by avoiding or improving each influencing factor. Then develop an acceptable response strategy to enhance the chance of successfully settling claims and reduce the potential for disputes by avoiding or minimizing the impact of emerging factors.

## 8. ACKNOWLEDGMENTS:

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