CHAPTER 5

DATA ANALYSIS & INTERPRETAITON

5.0 Introduction

In the preceding chapter, we have identified 185 numbers of risk variables related to the Construction of Substation Project in UAE. These Risk Variables were identified initially from literature reviews and then revisited and duly revised & modified utilizing the Nominal Group Technique. The risk variables were subsequently categorized based on Activity-wise Stakeholder-wise Work Break Down structure, developing into 20 such categories with allocation of the identified risk variables accordingly.

In this chapter the risk variables which were categorized based on the Work Breakdown structure earlier are analyzed using Factor Analysis being part of the Objective – 1 of this study. For this, SPSS was utilized as a tool. The risk variables which are having considerable factor loading as a result of the factor analysis were considered to be significant risk variables.

Upon identification of the significant risk variables, they were further utilized for the hypothesis testing using Chi-Square test to study the contingency perception of different stakeholders as part of the Objective - 2. For this testing, SPSS & excel spreadsheet were utilized as a tool. The test result has provided an insight of the various stakeholder perceptions on contingency estimation in construction of substations in UAE.

The following section of this chapter provides the process of analysis carried out by utilization of the methodology detailed in the Chapter -3 and provides the analytical outcome of the responses in the form of the Findings & Interpretation which were taken up for further utilization including the model formulation in subsequent chapter for this study.

5.1 Objective 1

The first objective of this study was to identify the activity wise significant risk variables impacting contingency applicable to construction of substations in UAE. In order to identify the significant risk variables, the list of risk variables derived as output at Chapter – 4 along with the formulation of the Questionnaire – 1 were considered as a basis here.

While the list of risk variables was derived and was grouped into various categories, the questionnaire as formulated (Questionnaire Design / Sampling Technique / Sample Size) and detailed at Chapter – 3 was utilized for obtaining the responses from various professionals having experience in the field of construction of substations in UAE; with the questionnaire having the 5 point scale as listed below:

1–Not Important; 2–Least Important; 3–Important; 4–More Important

& 5–Most Important

The questionnaire was sent out by means of e-mail and hand delivery of the hard copies. The respondents were requested to fill out their response based on their experience and their field of expertise which are relevant as categorized in the overall Questionnaire # 1. Filled out responses were received from the respondents by means of e-mail with soft copy attachment, hand collected responses in hard copies; and few by means of filling out of questionnaire responses through telephone calls filled out manually.

Table 5.1 below shows the completed responses received against each category of Questionnaire # 1 sent.

Table 5.1 – Summary of Responses received for Questionnaire # 1

Sl. No.	Category	Number of Questions	No. of Questionnaire sent	No. of Completed Responses received
1	FINANCE	9	168	42
2	HR / ADMIN	14	152	56
3	HSEQ	20	160	65
4	CONTRACTS	8	168	62
5	DESIGN	15	170	61
6	CIVIL - General	8	163	67
7	CIVIL - Soil Investigation	2	163	67
8	CIVIL - Piling	8	163	67
9	Civil - Super structure	6	163	67
10	Civil - Finishing	8	163	67
11	Civil - External	7	163	67
12	MEP - General	8	157	59
13	MEP - Procurement / Manufacturing	6	157	59
14	MEP - Fabrication / Installation	7	157	59
15	MEP - Testing	7	157	59
16	ELEC - General	5	170	70
17	ELEC - Procurement / Manufacturing	6	170	70
18	ELEC - Installation	7	170	70
19	ELEC - Testing	15	170	70
20	PROJECT MANAGEMENT	19	212	63

The responses as received were reviewed and are taken up for further analysis.

5.1.1 Data Analysis

5.1.1.1 General Response Pattern

The Appendix A6 attached provides the detailed output of the responses received from various respondents indicating their importance as per the 5 point scale given against the Risk Variables listed out in the Questionnaire # 1; which are considered to have an impact on the contingency estimation for the project; duly summarized in the form of a table including all the completed responses against each Category wise – Risk Variable wise results.

It was generally observed that the responses against the Risk Variables follow the trend as discussed during the Nominal Group Technique; providing a minimal response towards negativity of their importance to the contingency estimation for the project; while there was a mixed response from various respondents towards their importance; be it a nominal or more or most.

These responses received against the categories are further analyzed using SPSS and the analysis is enumerated in subsequent sections below.

5.1.1.2 Reliability Testing by Cronbach's α (alpha)

The SPSS tool was utilized to analyze the reliability of the data (response) as received and tabulated in Appendix A6, taking each category of questionnaire # 1 individually and applying Factor Analysis. The result as obtained from the Factor Analysis output related to the Cronbach's α for each category are tabulated in Table # 5.2.

Table 5.2 - Summary of Cronbach's α Results

Sl. No.	Category	Number of Questions	No. of Completed Responses received	Cornbach's Alphan (Reliability)
1	FINANCE	9	42	**0.703**
2	HR / ADMIN	14	56	**0.805**
3	HSEQ	20	65	**0.897**
4	CONTRACTS	8	62	**0.793**
5	DESIGN	15	61	**0.902**
6	CIVIL - General	8	67	**0.77**
7	CIVIL - Soil Investigation	2	67	**0.684**
8	CIVIL - Piling	8	67	**0.76**
9	Civil - Super structure	6	67	**0.743**
10	Civil - Finishing	8	67	**0.762**
11	Civil - External	7	67	**0.737**
12	MEP - General	8	59	**0.81**
13	MEP - Procurement / Manufacturing	6	59	**0.838**
14	MEP - Fabrication / Installation	7	59	**0.815**
15	MEP - Testing	7	59	**0.808**
16	ELEC - General	5	70	**0.724**
17	ELEC - Procurement / Manufacturing	6	70	**0.811**
18	ELEC - Installation	7	70	**0.812**
19	ELEC - Testing	15	70	**0.865**
20	PROJECT MANAGEMENT	19	63	**0.895**

The above values of Cronbach's α are reviewed against the set criteria stated and detailed in the interpretation section.

5.1.1.3 Sample Adequacy Test [Kaiser-Meyer-Olkin Measure (KMO)]

The SPSS tools was utilized to analyze the Sample Adequacy of the data (response) as received and tabulated in appendix A6, taking each category of Questionnaire # 1 individually and applying Factor Analysis to obtain the KMO values. The result as obtained from the Factor Analysis output related to the KMO Test for each category is tabulated in Table # 5.3 below.

Table 5.3 - Summary of KMO Results

Sl. No.	Category	Number of Questions	No. of Completed Responses received	KMO (Sample Adequacy)
1	FINANCE	9	42	**0.650**
2	HR / ADMIN	14	56	**0.704**
3	HSEQ	20	65	**0.783**
4	CONTRACTS	8	62	**0.770**
5	DESIGN	15	61	**0.766**
6	CIVIL - General	8	67	**0.743**
7	CIVIL - Soil Investigation	2	67	**0.500**
8	CIVIL - Piling	8	67	**0.695**
9	Civil - Super structure	6	67	**0.709**
10	Civil - Finishing	8	67	**0.703**
11	Civil - External	7	67	**0.674**
12	MEP - General	8	59	**0.772**
13	MEP - Procurement / Manufacturing	6	59	**0.818**
14	MEP - Fabrication / Installation	7	59	**0.721**
15	MEP - Testing	7	59	**0.770**
16	ELEC - General	5	70	**0.684**
17	ELEC - Procurement / Manufacturing	6	70	**0.797**
18	ELEC - Installation	7	70	**0.805**
19	ELEC - Testing	15	70	**0.727**
20	PROJECT MANAGEMENT	19	63	**0.817**

The above values of KMO Measure are reviewed against the Values stated and detailed in the interpretation section.

5.1.1.4 Factor Analysis for Identification of Significant Risk Variable

The SPSS tool was utilized to carry out the Factor Analysis for identification of Significant Risk variables from the compiled list of 185 Risk Variables as given in the Questionnaire # 1. The loadings in the Rotated Component Matrix for each category wise Risk Variable were taken up for identification of their significant. The summary of output report of the Factor Analysis carried out is tabulated in Table # 5.4 below while the complete Factor Analysis report for the data as received is attached as Appendix A7.

Table # 5.4 – Summary of Factor Analysis Output for Questionnaire # 1

SUMMARY OF FACTOR ANALYSIS OUTPUT FOR QUESTIONNAIRE # 1 (OBJECTIVE # 1)							
CATEGORIES	No. of Initial Questions	No. of Response	Cornbach's Alphan (Reliability)	KMO (Sample Adequacy)	Determinant	Total Variance Explained %	No. of Variables above 0.700 value of factor loading
FINANCE	9	42	0.703	0.650	0.037	68.522	6
HR / ADMIN	14	56	0.805	0.704	0.007	61.270	5
HSEQ	20	65	0.897	0.783	9.38E-06	66.983	9
CONTRACTS	8	62	0.793	0.770	0.099	55.273	5
DSGN	15	61	0.902	0.766	0.00E+00	61.705	8
CIVIL - Gen	8	67	0.770	0.743	0.106	56.438	5
CIVIL - Soil Inv	2	67	0.684	0.500	0.728	76.095	2
CIVIL - Piling	8	67	0.760	0.695	0.097	70.001	8
Civil - Super stru	6	67	0.743	0.709	0.24	62.683	4
Civil - Finishing	8	67	0.762	0.703	0.052	60.405	5
Civil - External	7	67	0.737	0.674	0.196	57.356	4
MEP - General	8	59	0.810	0.772	0.069	58.586	5
MEP - Proc / Mfg	6	59	0.838	0.818	0.085	56.411	4
MEP - Fab / Inst	7	59	0.815	0.721	0.055	65.144	5
MEP - Testing	7	59	0.808	0.770	0.078	63.115	6
ELEC - General	5	70	0.724	0.684	0.31	70.326	5
ELEC - Proc / Mfg	6	70	0.811	0.797	0.109	70.057	5
ELEC - Inst	7	70	0.812	0.805	0.106	63.344	4
ELEC - Testing	15	70	0.865	0.727	0.00E+00	70.724	8
PROJ MGMT	19	63	0.895	0.817	4.16E-05	61.809	5

This analysis report was reviewed and the findings are detailed in the interpretation section.

5.1.2 Findings & Interpretation

5.1.2.1 Reliability Test

Cronbach’s Alpha was a tool for assessing reliability developed by Lee Creonbach in 1951 (Mohsen, Reg; 2011). Cronbach’s Alpha called “Cronbach's α” is the average value of the reliability co-efficient obtained for all possible combinations of given items. It is calculated for internal consistency reliability (Anil, 2012). As Theoretical Value of alpha varies from zero (0) to One (1) being a ratio of two variances. However, depending on the estimation procedure used, estimates of alpha can take on any value less than or equal to 1, including negative values, although only positive values make sense. Higher values of alpha are more desirable for reliability. Most of the analysis require a reliability of 0.70 or higher, obtained on a substantial sample, as a rule of thumb, before they use the data as an instrument for analysis. However, in some instances a maximum alpha value of 0.90 has been recommended to avoid redundancy. The range of Cronbach’s alpha and their interpretation of the value are shown in below Fig # 5.1:

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Fig # 5.1 – Cronbach’s Alpha Reference value (Source: Wikipedia)

Internal consistency i.e. reliability should be determined before a test can be employed for further examination or research to ensure its validity.

The result obtained shows that for all the categories in the questionnaire, the alpha value are between 0.684 and 0.902. On detailed examination, it has been distinguished that the lower Cronbach's Alpha value of 0.684 has been achieved in the category "Civil – Soil Investigation" due to only two Risk Variables are included. Since this value was nearer to 0.700 and has been considered acceptable in general, the result for this category was considered for further analysis. Furthermore, the Cronbach's Alpha value of all other categories was in the Acceptable range (0.700 to 0.900) and hence was also considered for further study.

5.1.2.2 Sample Adequacy Test [Kaiser-Meyer-Olkin Measure (KMO)]:

KMO i.e. Kaiser-Meyer-Olkin measures the sampling adequacy. KMO Test is an important part of the output produced by the SPSS tool using factor analysis; where the KMO statistic varies between zero (0) and one (1). A value of '0' indicates that the sum of partial correlations is large relative to the sum of correlations, indicating diffusion in the pattern of correlations. A value close to '1' indicates that pattern of correlations are relatively compact and so factor analysis should yield distinct and reliable factors.

Kaiser (1974) recommends a value greater than 0.5 as acceptable. The range of KMO value and their interpretation of the value as suggested are shown in below Fig # 5.2:

KMO Value	Degree of Common Variance
0.90 to 1.00	Marvelous
.80 to 0.89	Meritorious
0.70 to 0.79	Middling
0.60 to 0.69	Mediocre
0.50 to 0.59	Miserable
below 0.50	Unacceptable

Fig # 5.2 – KMO Range (Source – Kaiser (1974))

The Sample Adequacy should be determined on the response for each category before the data can be utilized for Factor Analysis.

The result obtained shows that for all the categories in the questionnaire, the KMO values are between 0.500 and 0.818, which fall into the acceptable range. Hence, the factor analysis has been considered as appropriate for these data.

On detailed examination, it has been distinguished that the lower KMO value of 0.500 has been achieved in the category "Civil – Soil Investigation" due to only two Risk Variables are included. Since this value is 0.500 and has been considered acceptable in general even though being termed as "Miserable", the data obtained for this category has been considered for Factor Analysis. Furthermore, the KMO value of four categories are between 0.650 and 0.695 which falls under the "Mediocre" range; while 12 categories are between 0.703 and 0.797 which falls under "Middling" range and three categories are between 0.805 and 0.818 which falls under "Meritorious" range.

Since the result as obtained are in the Acceptable range as per above stated criteria, the data as obtained from respondents are confirming to the sample adequacy and were taken up for further analysis.

5.1.2.3 Factor Analysis for identification of Significant Risk Variable:

The primary requirement for carrying out the Factor Analysis was to identify the significant Risk Variables relevant to the field of Construction of substations in UAE based on the responses received against the Questionnaire # 1 having set of questions related to activity wise breakup as 20 numbers of categories, which are grouped together for the relevant stakeholders.

As per Hair et al. (1998) Table of Loadings for Practical Significance (p112), variables having a factor loading of more than 0.7 can be considered as having practical significant in the SPSS output, as shown in Fig # 5.3 below.

Factor Loading	Sample Size needed for significance
0.30	350
0.35	250
0.40	200
0.45	150
0.50	120
0.55	100
0.60	85
0.65	70
0.70	60
0.75	50

Fig#5.3 - Table of Loadings for Practical Significance (Source - Hair et al. (1998)

Accordingly, the Factor Analysis output against each category as obtained and attached at Appendix A7 was taken up for detailed interpretation to identify the variable which are having factor loading of more than 0.7.

The rotated component matrix (also called the rotated factor matrix in factor analysis) is a matrix of the factor loadings for each variable onto each factor. This matrix contains the same information as the component matrix except that it is calculated after rotation. Before rotation, most variables loaded highly onto the first factor and the remaining factors didn't really get a look in. However, the rotation of the factor structure has clarified things considerably.

Based on the above, the Risk Variables were identified and were considered as significant based on their factor loading value of above 0.700. The abstracted significant risk variables as identified are attached as Appendix A8.

The above identification had resulted in a total of 108 Risk Variables across the 20 categories which are further taken up as part of the Questionnaire # 2, enabling to proceed further with Objective # 2 of this study.

5.2 Objective 2

The second objective was to study the contingency perception of different stakeholders for the identified risk variables which are significant as obtained in objective # 1 and their impact on project performance, in terms of cost and time, in construction of substations in UAE.

To obtain the Contingency perception of the stakeholders for the identified significant risk variables in various categories, the Questionnaire # 2 was formulated with the following Questionnaire format & scale for obtaining response, as given at Figure 5.4 below:

SL NO	RISK VARIABLE	Details	Very Low	Low	Moderate	High	Very High
1		Probability	☐	☐	☐	☐	☐
		Cost Impact	☐	☐	☐	☐	☐
		Time Impact	☐	☐	☐	☐	☐

Reference		Probability		Impacts		
Scale	Rating	Range	Detail	Cost	Schedule	Performance
1	Very Low	Upto 10%	Highly unlikely to occur. May occur in exceptional situations.	No increase	No change	Will still achieve all mandatory requirements
2	Low	11% ~ 25%	Most likely will not occur. Infrequent occurrence in past projects.	< 5% increase	< 1 week delay	Minor shortfalls in desirable requirements
3	Moderate	26% ~ 50%	Possible to occur.	5-10% increase	1 - 2 weeks delay	Minor shortfalls in one or more key requirements
4	High	51% ~ 75%	Likely to occur. Has occurred in past projects.	10-20% increase	2 - 4 weeks delay	Major shortfalls in one or more key requirements
5	Very High	76% ~ 100%	Highly likely to occur. Has occurred in past projects.	> 20% increase	> 4 weeks delay	Major shortfall in mandatory requirements

Fig. # 5.4 – Format & Scale for obtaining response of Questionnaire # 2

The respondents were requested to provide their responses for each significant variable for Probability of occurrence of the significant risk variable and its Cost Impact and Time Impact. In order to have a common platform for the response, a reference table showing the range of Probability, Cost Impact and Time Impact for the above 5 point scale was provided as shown in Fig # 5.4. The Table # 5.5 below shows the completed responses received against each category of Questionnaire # 2 sent.

Table 5.5 - Summary of Responses received for Questionnaire # 2

Sl. No.	Category	Number of Qtns.	No. of Questis. sent	No. of Responses recd.
1	FINANCE	6	168	50
2	HR / ADMIN	5	152	43
3	HSEQ	9	160	47
4	CONTRACTS	5	168	59
5	DESIGN	8	170	53
6	CIVIL - General	5	163	48
7	CIVIL - Soil Investigation	2	163	48
8	CIVIL - Piling	8	163	45
9	Civil - Super structure	4	163	48
10	Civil - Finishing	5	163	48
11	Civil - External	4	163	48
12	MEP - General	5	157	46
13	MEP - Procurement / Manufacturing	4	157	46
14	MEP - Fabrication / Installation	5	157	46
15	MEP - Testing	6	157	46
16	ELEC - General	5	170	60
17	ELEC - Procurement / Manufacturing	5	170	60
18	ELEC - Installation	4	170	60
19	ELEC - Testing	8	170	60
20	PROJECT MANAGEMENT	5	212	56

This Questionnaire # 2 was sent out by means of e-mail and hand delivery of the hard copies to all the respondents as done during Questionnaire # 1. The respondents were once again requested to fill out their response which was relevant as categorized in the overall Questionnaire # 2. Filled out responses were received from the respondents by means of e-mail with soft copy attachment, hand collected responses in hard copies; and few by means of filling out of questionnaire responses through telephone calls filled out manually.

The responses as received were reviewed and are taken up for further Hypothesis testing as required in the Objective # 2.

5.2.1 Data Analysis

5.2.1.1 General Response Pattern

Appendix A9 provides the detailed output of the responses received from various respondents indicating perception based on their experience of the Probability of Occurrence and their Impacts on Cost and Time, of the identified Significant Group of Risk Variables for the Substation Construction works in UAE. These risk variables are considered to have an impact on the contingency estimation for the project; duly summarized in the form of a Table including all the completed responses against each Category wise – Risk Variable wise results.

It is generally observed that the responses against the Risk Variables follow the trend of lenience towards the Moderate to High levels of occurrence and their impact. These responses received against the categories are further taken up for Hypothesis testing and the analysis output is enumerated in subsequent sections below.

5.2.1.2 Hypothesis Testing:

A statistical hypothesis is an assumption about a population parameter. This assumption may or may not be true. Hypothesis testing refers to the formal procedures used by statisticians to accept or reject statistical hypotheses. The best way to determine whether a statistical hypothesis is true would be to examine the entire population. Since that is often impractical, researchers typically examine a random sample from the population. If sample data are not consistent with the statistical hypothesis, the hypothesis is rejected.

There are two types of statistical hypotheses.

- **Null hypothesis:** The null hypothesis, denoted by H_0, is usually the hypothesis that sample observations result purely from chance.
- **Alternative hypothesis:** The alternative hypothesis, denoted by H_1, is the hypothesis that sample observations are influenced by some non-random cause.

Statisticians follow a formal process to determine whether to reject a null hypothesis, based on sample data. This process, called hypothesis testing, consists of four steps viz. State the Hypotheses, Formulate and analysis plan, Analyze sample data and Interpret result.

In this study, the Hypotheses stated as below:

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H0 (Null Hypothesis)

There is no significant relationship between the perception of the stakeholder pertaining to contingency on project performance.

H1 (Alternate Hypothesis)

There is significant relationship between the perception of the stakeholder pertaining to contingency on project performance.

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In this hypothesis, we have two categorical variables from a single population. Here in this study, the sampling method utilized is random sampling; the two categorical variables are ‘Probability of Occurrence’ and project performance in terms of ‘time’ and ‘cost’, which are being evaluated separately.

Zulfiqar Ali and S Bala Bhaskar (2016) had explained that there are three type of tests (or tools) available for analyzing the categorical or nominal variables, which are part of this study as stated above. They are Chi-square test, Fischer's exact test and McNemar's test.

The Chi-square test compares the frequencis and tests whether the observed data differ significantly from that of the expected data if there were no differences between groups (i.e., the null hypothesis). It is calculated by the sum of the squared difference between observed (*O*) and the expected (*E*) data (or the deviation, *d*) divided by the expected data by the following formula:

$$\chi^2 = \sum \frac{(O - E)^2}{O}$$

Fischer's exact test is used to determine if there are non-random associations between two categorical variables. It does not assume random sampling, and instead of referring a calculated statistic to a sampling distribution, it calculates an exact probability.

McNemar's test is used for paired nominal data. It is applied to 2×2 table with paired-dependent samples. It is used to determine whether the row and column frequencies are equal (that is, whether there is ‘marginal homogeneity’). The null hypothesis is that the paired proportions are equal.

Mary L. McHugh (2013) had stated that ‘Chi-square test of independence (also known as the Pearson Chi-square test, or simply the Chi-square) is one of the most useful statistics for testing hypotheses when the variables are nominal’. Accordingly, Chi-square test was utilized for this study.

The data as collected from the Questionnaire # 2 response as stated above were taken up for the analysis in the following sequence:

a) Hypothesis testing using Chi-Square test (using SPSS for 95% confidence level)

b) Hypothesis testing using Chi-Square test (using Excel spreadsheet for 95% & 99% confidence levels).

For the above received data Crosstabs using SPSS was applied while manual calculation with formula were utilized in Excel Spread sheet for 95% & 99% confidence levels. The SPSS output and the Excel Spreadsheet output is summarized and attached as Appendix A10.

The detailed interpretation of the output is provided in the subsequent section.

5.2.2 Findings & Interpretation

The hypothesis testing was carried out on the data received from the various stakeholders to find out whether there is significant relationship between the perception of the stakeholder pertaining to contingency on project performance or not.

5.2.2.1 Hypothesis Testing Using Chi-Square Test (using SPSS)

The SPSS output of the Chi-square test as obtained was reviewed for all the 108 numbers of Significant Risk Variables for which the data was collected from various respondents. The review was also done verifying the Chi-square result for "Probability & Cost Impact" and "Probability & Time Impact", which reflects the project performance.

The result obtained for all the Risk Variables across the categories, shows that the Chi-Square value as obtained in the SPSS output are over and above the theoretical value based on their Degree of Freedom (95% confidence level).

The output suggests that the "H0 Null Hypothesis" can be rejected in favor of the "H1 Alternate Hypothesis" for all the 108 number of Significant Risk Variables that were taken up for this Objective # 2. The same has been stated in the Appendix A10.

5.2.2.2 Hypothesis Testing Using Chi-Square Test (using Excel spreadsheet for 95% & 99% confidence levels)

The Excel spreadsheet output of the Chi-square test as obtained was reviewed for all the 108 Nos of Significant Risk Variables for which the data was collected from various respondents. The review was also done verifying the Chi-square result for "Probability & Cost Impact" and "Probability & Time Impact", which reflects the project performance with 95% confidence level & 99% confidence levels.

The result obtained for all the Risk Variables across the categories, shows that the Chi-Square value as obtained in the Excel spreadsheet output are over and above the theoretical value based on their Degree of Freedom with both 95% confidence level & 99% confidence levels.

The Excel spreadsheet output with 95% confidence level was also reviewed with the related SPSS output for all the significant variables as a point of rechecking and both the results found to be same.

Thus the result obtained suggests that the "H0 Null Hypothesis" can be rejected in favor of the "H1 Alternate Hypothesis" for all the 108 number of Significant Risk Variables that were taken up for this Objective # 2. The same has been stated in the Appendix A10.

5.3 Chapter Summary

The significant Risk Variables related to the Construction of Substation project in UAE are identified as part of the Objective # 1. Factor Analysis was applied to the overall 185 Nos. of Risk Variables (which were grouped into 20 Nos of categorized based on Activity-wise Stakeholder-wise Work Break Down structure), duly filtering out the Risk Factors which are having considerable factor loading. As a result of the factor analysis and the obtained factor loading for the individual Risk Variables, 108 Nos. of Significant Risk Variables across the 20 Nos. of categories were identified. The Reliability of the data received from the respondents was verified using the Cronbach's Alpha (α) value obtained from the SPSS output as part of the Factor Analysis for each Category shows that the data as received are in the Acceptable range. The Sample Adequacy test by Kaiser-Meyer-Olkin measure (KMO Test) for each category was done using SPSS and found the result to be within the Acceptable criteria. Thus, the Reliability and Sample Adequacy confirmation provide that the Objective # 1's output as obtained from the Factor Analysis resulting into 108 Nos. of Significant Risk Variables across 20 Nos. of Categories are suitable to be taken up further for study as required for Objective # 2.

These identified Significant Risk Variables obtained as output from the Objective # 1 were taken up to study the contingency perception of different stakeholders as part of the Objective – 2. Hypothesis testing using Chi-Square test with both SPSS (for 95% confidence level) & Excel spreadsheet (for both 95% & 99% confidence level) were done and the result confirms the perceptions on contingency estimation in Construction of substations in UAE as below:

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H1 (Alternate Hypothesis)

There is significant relationship between the perception of the stakeholder pertaining to contingency on project performance.

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Since the result confirms to the Alternate Hypothesis, the data as obtained as part of the Objective # 2 are taken up for further utilization for formulation of the Contingency Estimation Model in subsequent chapter of this study.

This chapter provides the validation of the Research by concurring to the significant relationship between the perception of the stakeholders pertaining to the contingency on the project performance, which initiates the next step of this study, towards the process required for the formulation of a model for the contingency estimation and subsequent validation of the formatted model based on the Historical data obtained from earlier executed substation construction project in UAE.

5.4 Reference

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