

# RESEARCH TECHNIQUES, DATA ANALYSIS AND INTREPRETATION ON “STUDDING HOW A COLLABORATIVE PROCUREMENT APPROACH (PROJECT PARTNERING) RESPONDS TO CURRENT PROJECT ISSUES ...”

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## **Abstract**

The global construction industry is increasingly focusing on project partnering, which requires transforming organizational norms and culture to foster the partnering enabling factors towards project partnering. Successful organizational structures can shape and reflect cultural and behavioral characteristics. Our former article in this journal aimed to identify impacts of the organizational culture, organizational structure, and partnering enabling factors on the partnering activities. Therein the understanding of complex human behavior was crucial for effective research methodology. Positivism and interpretivism approaches were considered effective for addressing above aspects of partnering. A layered approach is used to select appropriate research philosophy and methods, as explained in the Chapter 1 to 4 of the Leading author's PhD Thesis. The purpose of this article is to summarize Chapters 5 of the collection and analysis of qualitative data, Chapter 6 of the collection and analysis of quantitative data and the Chapter 7 of the thesis recommendations. Thus, mixed methodology research technique was chosen following the philosophy. Accordingly, a *questionnaire to distribute among 200 people and semi-structured, open-ended interviews to conduct with 20 participants* were prepared as per problem statement. The population and samples calculated using standard sampling techniques, and standard data collection protocols were adhered to. To guarantee the reliability, validity and normality in the study, the advanced statistical tests of Cronbach Alfa, K. Smirnov and Shapiro-Wilk, Kruskal wallis, Chai square, Pearson core relation tests were conducted in conjunction with the relevant statistical programs of NVIVO20 & SPSS26.

**Keywords:** Research Approach, Research Techniques, Advance Statistical Tools, Advance Statistical Tests and Data Analysis.

## **1. RESEARCH TECHNIQUES**

Research procedures, which are part of the inner ring of nested research methodology, comprise both data gathering and analysis. As indicated in table 1 below, there are two techniques of data collecting used in this mixed-method study: qualitative and quantitative approaches;

**Table 1: Characteristics of Data Collection & Analysis s vs. Qualitatively & Quantitatively**

Characteristic	Qualitative	Quantitative
Sample size	Small; Typically, <b>20</b> , based on saturation ( <b>20 used</b> ).	Large; using standard formulas; typically, 100 – <b>200 (200 done)</b> .
Method of data collection	# Interviews (Nonrandom, semi structured used), # Observational study, # Focus group.	# Surveys (Questionnaires used) # Online - web captures
Type of data	# pattern of Behavior, # Natural language.	Numeric.
Data analysis	Comprehend the data pattern / frequency of participant's behavior and replies. <b>i.e. using of NVIVO20 etc.</b>	Using numerical methods and statically analysis. I.e. <b>Using of SPSS26</b> , the testing of data and analysis of variables including non-parametric tests.
Data visualization	Quotes, frequencies and tabular formats of the content analysis.	Tables, graphs and charts with their relationships, tests result and determinations.

## 2. RESEARCH QUESTIONS

Using research questions instead of research hypotheses is the most effective technique to define research propositions in a phenomenological inquiry. The selection of research subjects for this study is further justified by the exploratory nature of the research. Based on the identified theoretical gaps, the following basic research questions are created in order to accomplish the above indicated aims and objectives. The questions were developed to collect *data both quantitatively and qualitatively*.

- ❖ **Qualitative data;** Following, N. Mathers (2019) and B. Marr (2019), the ***semi-structured, open-ended interviews (17 Nos questions per participant) and were conducted to collect qualitative data***, with a ***sample size of nonrandom 20 participants depending on the saturation threshold***, majority from ***the consultancy servicing SME firms***. This made it possible for researchers to create additional ***codes and themes (nodes) for the data's content analysis*** and to contextualize the results in real-world settings.
- ❖ **Quantitative data;** In accordance with Pahwa (2023) and M. Sadgir (2019), a questionnaire was sent out to a calculated ***partial random sample of 200 people***, representing the whole Sri Lankan construction sector, in order ***to acquire quantitative data***. There are "sub questions" in each of the questionnaire (i.e. ***45 No's*** questions), which are further detailed in ***the "Chapter 4"*** of the thesis. However, both qualitative and quantitative questions are ***initially based on the 5 themes*** and are sought to gather information about important variables in the questions. Nonetheless, ***ordinal and nominal measures are employed in SPSS to construct qualitative variables***; they may also be used to automatically create ***categories and organize replies, converting unstructured survey data into quantitative data***.

## 2.1 Semi Structured Interview Questions for the Content Analysis via NVIVO20;

- a) Section 1; is the introduction and necessary information to participants.
- b) Section 2; 1<sup>st</sup> theme studies how understanding the partnering idea (4 int. questions).
- c) Section 3; 2<sup>nd</sup> theme studies the awareness of international partnering methods (5 questions).
- d) Section 4; 3<sup>rd</sup> theme studies about SLCI's organizational structure and culture (5 questions).
- e) Section 5; 4<sup>th</sup> theme studies the importance of organizational culture in partnering (2 questions).
- f) Emergent theme; 5<sup>th</sup> theme studies how participants rank the important enabling factors for partnering (1 question).

## 2.2 Questions for the Questionnaire (SPSS26)

The purpose of the questionnaires in the study is to enable the researcher to gather comprehensive feedback from industry experts about the implementation of partnering and the types of organizational cultures seen in Sri Lankan construction firms.

The questionnaire consists of five components with multiple choice questions in each section;

- a) Section (I): Participant profile (8 questions).
- b) Section (II): Understanding the idea of partnering (theme 1); (19 questions).
- c) Section (III): 3 questions: awareness of international partnering techniques (theme 2).
- d) Section (IV): 10 questions about organizational culture and structure in SLCI (Theme 3).
- e) Section (V): 4 questions; the importance of organizational culture in partnership (Theme 4).

Note; All questionnaires, semi structured interview questions are provided.

## 3. DATA COLLECTION

To fulfill the "aims and objectives" of this study, **five distinct themes** are used and selected mixed **method** data collection techniques demonstrate how to appropriately answer the research questions.

**20 construction professionals were selected based on the saturation from the consultancy servicing SME firms and participated in the semi-structured interviews that produced qualitative data, which contained 17 open-ended questions.** In the **quantitative** data collection procedure, 200 participants from top management to

employee level were invited (*targeted sample calculated using the standard sampling techniques consists of professionals working in any of the 6 segments from the SLCI population, including few participants from 4 samples firms employed in the qualitative analysis*), **but 185 out of 200 participants truly responded** to the questionnaires that were delivered to them by email, postal mail, and in-person hard copy pickup.

As previously said, these were centered on five themes in order to assess the participants' status for the same (*based on the categories contained in the conceptual framework above*).

The organizational, personal, cultural, and structural barriers that each participant faces have been compiled in this context, along with the underlying causes of the challenges and the corresponding collaboration methods. In order to acquire data for the aforementioned goals, "survey technique" is considered to be the main source of field survey information. To support this process, a survey protocol technique is used to gather relevant rich data for analysis.

In order to maximize the benefits of the evidence, Yin (2003) proposes three more guidelines for gathering data. These include creating a survey database, maintaining a set of supporting documents, and utilizing a variety of evidence sources. These concepts used in relation to construct validity and reliability design testing.

Construct validity is important when it comes to correctly applying operational measures. Furthermore, special consideration is paid to the validity, reliability, and normality concerns in the LR, interviews, and questionnaires.

#### 4. DATA ANALYSIS

**Chapter 5** details the Qualitative data analysis (using **NVIVO20** statistical tool) and **Chapter 6** details the quantitative data analysis (using the **SPSS26**) in the thesis. The data are examined, categorized, cross-tabulated, tested and rearranged during the analysis (both quantitative and qualitative) in order to answer the research's initial hypotheses.

The general analytical method in this study is best described by relying on theoretical premises to developing theme descriptions and frameworks based on competing explanations. Because it is more explanatory, the explanation building analytical technique is better suited for this research.

The method's potential drawbacks will be reduced by using survey methodology, survey databases, and chain of evidence. Also, data distribution normality tests (K. Smirnov and Shapiro-Wilk test suited on sample size) showed that data abnormality, as shown in the Figure 1 below;

**Tests of Normality**

	Nature of business (Q8)	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Collaboratively working with other firms (Q10)	1	.504	48	.001	.450	48	.001
	2	.521	57	.001	.389	57	.001
	3	.455	38	.005	.576	38	.005
	4	.492	6	.001	.496	6	.000
	5	.443	24	.003	.573	24	.002
	6	.530	12	.001	.327	12	.004
Corporative relationships with other firms, within and beyond projects (Q11)	1	.446	48	.003	.571	48	.002
	2	.438	57	.004	.587	57	.001
	3	.446	38	.003	.570	38	.005
	4	.293	6	.005	.822	6	.005
	5	.292	24	.003	.796	24	.002
	6	.374	12	.005	.640	12	.004

a. Lilliefors Significance Correction

**Figure 1: Screen-print of the Data Normality Test Results in SPSS26**

All significance values are less than 0.05 for dependent variables of each responder. Accordingly, a range of non-parametric tests on abnormal data, such as cross tabulation, Kruskal Wallis, Chai square & Pearson etc. are used for both analyses to identify the frequency distribution, correct contributions, relationships, null hypothesis, and aberrant data etc. Furthermore, Cronbach's alpha ( $\alpha$ ) has been used to examine the internal consistency of the quantitative study as shown in the Figure.2, below.

**Reliability**

**Warnings**

Scale has zero variance items.

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Scale: ALL VARIABLES

**Case Processing Summary**

		N	%
Cases	Valid	185	100.0
	Excluded <sup>a</sup>	0	.0
	Total	185	100.0

a. Listwise deletion based on all variables in the procedure.

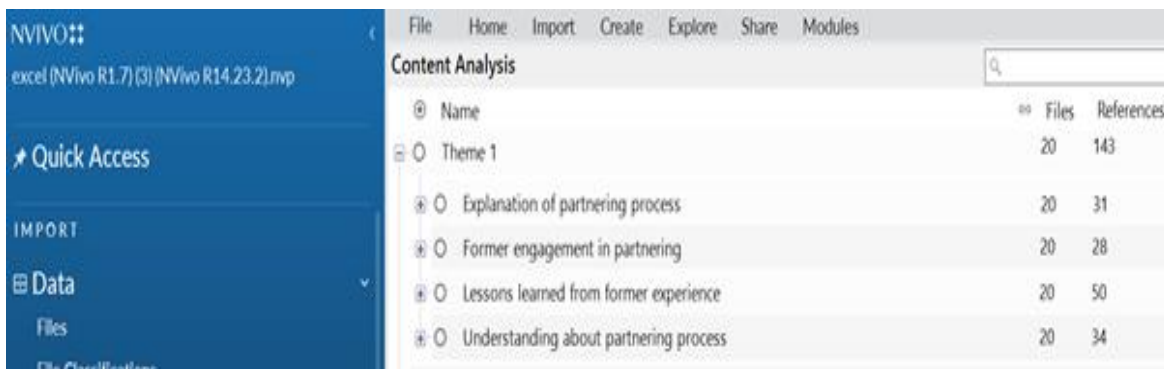
**Reliability Statistics**

Cronbach's Alpha	N of Items
.729	30

**Figure 2: Screen Shot for Reliability Test as shown in SPSS 26.**

It is produced from pairwise correlations between items that should yield similar findings. Since negative numbers did not arise and among 0.7 -0.8, the sampling procedure or the questionnaires were deemed to be reliable and valid. These improve the internal validity of the study. The survey and interview results and the details of the data analysis are disclosed in the 5<sup>th</sup> progress meeting.

The frequency distribution of the data resulted in the content analysis of Theme 1 via NVIVO20 is shown in the figure 3, below;



**Figure 3: Qualitative Content Analysis Results by NVINO20**

The references show the frequency distribution of the participants for each parent and child nodes of the themes and number of files corresponded to the total number of participants. Considering the quantitative data analysis in SPSS26, the Chi square test is used to determine if the responses given by participants in the questionnaire were the product of random chance or respondent choice to determine the null hypothesis.

The Chi-squares' p-value is a statistical tool that determines the probability of a test statistic being the minimum observed value, given the null hypothesis being true. In this test, the null hypothesis is established as random responses with no relationship between the two phenomena, with a 95% confidence level. If the p-value is less than 0.05, the null hypothesis is rejected, increasing confidence in the data's validity and correlation. The Table 2 below, shows the statistical significance for few items in the questionnaire;

**Table 2: The Degree of Statistical Significance (p) for Answers to Few Questions (10-28)**

Qtn No	Tested theme in the question	Chi-square?	Significance, p?
Q10	Collaboratively working with other firms.	31.826	0.000
Q11	Corporative relationships with other firms, within and beyond projects.	31.826	0.004
Q15	Attempting (ratio) in flexible procurements	97.732	0.000
Q16	Whether limit to fixed forms of procurements	97.732	0.013
Q25	Preference of similarities in the work ethics and organizational culture.	78.771	0.000
Q28	Extra efforts are required for synchronization with other firms.	78.771	0.000



The Kruskal-Wallis test is a non-parametric, one-way ANOVA test used to determine if a single nominal variable and measurement variable violate the normality presumption of an ANOVA. It is suitable for abnormally distributed data and aims to determine if respondents' responses are influenced by their profile or background. This test is commonly used in research situations where a single variable is used.

A sample analysis is given below, which employs "Respondent Profile" as an independent variable and "Response Analysis" as a dependent variable, with age, management level, years of experience, current organization experience, and firm type as independent variables. The results for few questions are presented in Table 3, below.

**Table 3: Kruskal-Wallis ANOVA Test Analysis on Few Questions (Q10 -Q28)**

Qtn No	Tested theme in the question (Few are selected here)	PROFILE OF THE RESPONDENT				
		Age	Mgt. level	Industry Experience	Experience in Current organization	Type of firm
Q10	Collaboratively working with other firms.	0.004	<b>0.050</b>	<b>0.000</b>	0.005	<b>0.050</b>
Q15	Attempting (ratio) in flexible procurements	0.006	<b>0.050</b>	0.013	<b>0.000</b>	0.030
Q17	Adherence to client's procurement preferences	<b>0.000</b>	0.003	<b>0.000</b>	<b>0.000</b>	0.017
Q22	Financially independent commitments.	<b>0.000</b>	0.004	0.009	0.001	0.010
Q25	Preference of similarities in the work ethic & organizational culture.	<b>0.000</b>	0.002	<b>0.000</b>	<b>0.000</b>	0.033
Q28	Extra efforts are required for synchronization with other firms.	0.040	0.012	<b>0.050</b>	0.001	0.007

Above table shows that certain background characteristics significantly impact respondents' responses to questions. The green results have 0.000 significance P values for "Industry Experience", "Age", and "Experience in Current Organization", indicating a significant influence on responses to a few question replies.

Similar way the Cross tabulation is done and results are in the thesis can be indicatively shown in the table.4 (screen shot), below;

**Table 4: Cross Tabulation of Few Enabling Factors vs. Respondent's Age Category**

Partnering enabling factor	Qtn No	Theme in the question	Responses	Age category (in years) Question 4 vs Enablers					
				20 - 24	25 - 34	35 - 44	45 - 54	Above 55	Sub totals
Collaboration & cooperation	Q10	Collaboratively working with other firms.	Strongly Disagree / Very unlikely	0	0	0	-	-	0
			Disagree / Unlikely	2	1	1	-	-	4
			Not sure	1	17	8	2	2	30
			Agree / Likely	17	44	12	29	7	109
			Strongly agree / Very Likely	1	10	16	15	-	42
Trust	Q12	Establishing trust towards the free exchange of open information.	Strongly Disagree / Very unlikely	-	-	-	-	-	-
			Disagree / Unlikely	-	14	13	12	6	45
			Not sure	2	4	4	11	1	22
			Agree / Likely	17	36	4	6	1	64
			Strongly agree / Very Likely	2	18	16	17	1	54
	Q13	Whether working only with the conversant and trusted firms.	Strongly Disagree / Very unlikely	-	13	-	6	-	19
			Disagree / Unlikely	-	27	-	23	-	50
			Not sure	3	10	15	6	-	34
			Agree / Likely	17	15	16	11	7	66
			Strongly agree / Very Likely	1	7	6	-	2	16
	Q14	Efforts to building trust within the project	Strongly Disagree / Very unlikely	12	4	2	4	-	22
			Disagree / Unlikely	-	20	-	-	-	20
			Not sure	3	12	17	13	-	45
			Agree / Likely	5	29	17	25	2	78
			Strongly agree / Very Likely	1	7	1	4	7	20

Appropriate theory building is accomplished using this approach. The chapter 7 offer recommendations on the functions and responsibilities of partnering enabling factors, organizational structure & culture, etc. to address the challenges in partnering projects. The theory-building processes and the group technique will be used to accomplish this.

Pearson correlation analysis is a statistical method used in this thesis to determine the strength of a linear relationship between two variables. It uses Pearson's correlation coefficient (r) to measure the relationship between variables. The test uses responses from the questionnaire's Section II, which are categorized based on partnering enabling factors. Each category is tested to determine if there is a correlation among these factors. Strong negative correlations have a -1 value, while strong positive relationships have a +1 value. Positive correlations indicate that when one variable increases, the other also increases, while negative correlations indicate that one variable rises and the other falls. A zero value indicates no linear correlation. I.e. Each questions of partnering enabling factors of policy (Q23 & Q24) vs. trust (Q12-Q14) were tested by Pearson and results are summarized table.5, below;

**Table 5: Pearson Correlation on Enabling Factors of Policy (Q23 & Q24) vs. trust (Q12-Q14)**

Enabling factors & person correlation (r.)		Trust		
		Establishing trust towards free exchange of open information(Q12)	Whether working only with the conversant and trusted firms (Q13)	Efforts to building trust within the project (Q14)
Policy	Availability of enough regulation(s) for the partnering (Q23)	0.045	0.002	0.005
	Government supports to foster partnering (Q24).	0.004	0.032	0.005



The analysis reveals significant correlations between partnering policy and procurement factors, possibly due to the government's influence and industry client status. The government plays a crucial role in setting policies related to partnering projects' procurement. Respondents believe flexible procurements are more likely to occur if partnering-related legislation and necessary assistance are in place. However, there is less correlation between the availability of enough regulations and the limit to fixed procurement forms. Government support to foster partnering and adhering to client procurement preferences also have less correlation.

## 5. CONCLUSIONS

This paper conducted a thorough investigation of the current partnering practices, status and stages, barriers, available and non-available key enabling factors, usable and non-usable partnering strategic approaches, potential implementation methods, understanding level of partnering and potential solutions in the SLCI, as well as framing the outcomes, has been conducted through the LR and data analyses. The overall results are displayed in a clear visualization diagram in the thesis chapter 7.

Also, this thesis developed a framework for successful partnering in SLCI based on literature review and data analyses, and prepared a clear visualization diagram as shown in the thesis chapter 7. The framework prioritizes organizational culture over other factors, aiming to minimize knowledge gaps and connect partnering and organizational cultures. Accordingly, the appropriate culture for partnering can be developed by considering enablers and identifying organizational culture types based on industry-specific dimensions, ensuring flexibility and inclusivity for partnering firms. This approach may include adhocracy and clan cultures instead of the existing hierarchy culture in SLCI.

## 6. RECOMMENDATIONS

The research recommends a comprehensive study of all segments of the Sri Lankan construction industry, including architects, contractors, designers, manufacturers, and clients, to determine their expertise and preparedness for partnering. More research is needed to map organizational cultures for all segments, allowing for the development of segment-specific methods for organizational culture alignments. The mapping should focus on workforce orientation, teamwork orientation, and innovation to ensure flexibility and inclusivity in partnering firms.

The partnering practices of UK and Sri Lanka should be adapted to the specific characteristics of the Sri Lankan Construction Law (SCLI). In-depth investigations should be conducted to identify key enabling factors, create strong policies for partnering, and establish techniques for trust building and commitment.

However, all culture types and dimensions in the SLCI are correlated to one another, so potential culture types and dimensions should be selected and developed at the same operational level as working as a system. Industry participant's age, management level, and experience greatly influence organizational culture dimensions.

To create a positive culture, organizations must establish capable and dedicated staff, promote efficient communication, train their staff, and establish an incentive system for employees who succeed in partnering. Teams should be assessed to find who might work together to fulfill collaborative and innovative obligations.

Further research should focus on assessing the effectiveness of partnering-related policies in the Sri Lankan construction industry, considering the role of government and relevant authorities in regulating partnering efforts and implementing policies. Government entities should also pay special attention to reducing political influences, corruption, illegal transactions, bid rigging, and contract breaches, as well as amending laws and regulations supporting collaboration and promoting flexibility and efficiency.

The framework created in this study should be tested in future work, including a long-term qualitative study.

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