
CHAPTER-2

RESEARCH METHODOLOGY

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CHAPTER-2

RESEARCH METHODOLOGY

This chapter details the Research Methodology adopted for this study, the type of samples used and analysis techniques deployed to arrive at the results. The systematic sequential research process that has been followed will be detailed in this chapter and illustrated in Figures 2.1, 2.3 and 2.5.

2.1 RESEARCH METHODOLOGY AND PROCESS FLOW

Firstly, a wide survey of literature was carried out which is presented in detail in Chapter 3 - Review of Literature. The initial background material was gathered from national or international press reports and from other published sources such as company annual reports and research reports from Society of Petroleum Engineers (SPE), National Association of Software and Service Companies (NASSCOM), China Software Industry Association (CSIA), McKinsey, AT Kearney, Gartner Research, Booz Allen Hamilton (BAH), Goldman and Sachs, Frost and Sullivan etc. Based on the review of literature, it was decided to adopt the following statement as the research topic: *'A Comparative study of location attractiveness of BRIC nations for O&G Engineering Services Outsourcing (O&G ESO) and strategic growth options for India's O&G ESO industry'*.

After finalization of the topic for research, the data collection for the study started for which data from both the sources: primary as well as secondary have been gathered. Main sources of primary data were interviewing, observing and analyzing documents. For the interviews, a blend of unstructured, semi-structured and structured interview techniques has been followed. For collection of primary data for this project, I have used my vast contacts within the O&G ESO industry and undertaken field trips to several O&G ESO companies in India and abroad and also interviewed professionals from overseas companies who are working in India or were visiting India. I have also

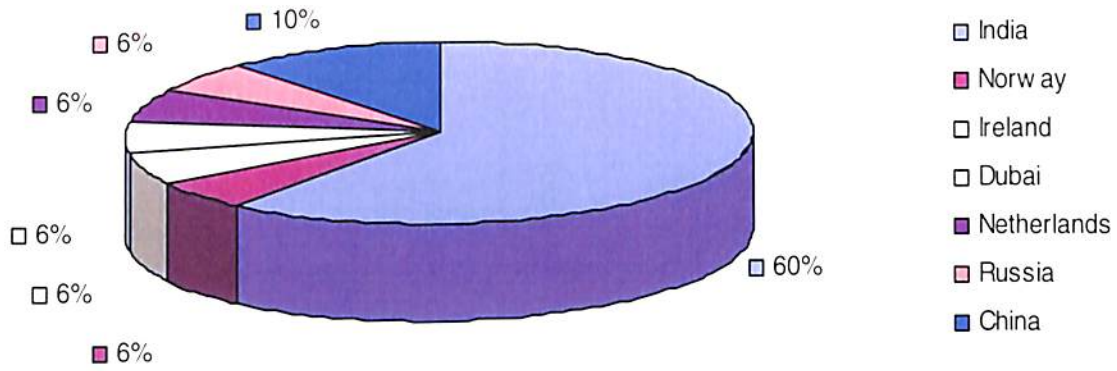
conducted several telephonic discussions with senior managers from overseas and Multi-National (MNC) companies. For the interviews, senior level managers who are responsible for decision making have been contacted. The companies and organizations include Aker Solutions (Stavenger, Norway and Mumbai, India offices), Toyo Engineering Limited (Tokyo, Japan and Mumbai, India offices), Saipem Limited (Chennai, India); Punj Lloyd Limited (Gurgaon, India); Simon Carves Limited (Gurgaon, India), Foster Wheeler Corporation Limited (Chennai, India and Kolkata, India); Mott Macdonald Limited O&G Design Centre (Mumbai, India); Larsen & Toubro Ltd. O&G Special Projects division (Mumbai, India), Bechtel Inc. (Gurgaon, India and London, United Kingdom offices) etc. The response of these executives varied from giving the overview of their engineering activities, talking about current and future directions of the investment of the companies and future directions of growth. Getting the hard data on investments was very difficult and in some cases impossible since most officials were from captive engineering centres or Unlisted (in Indian stock exchanges) subsidiaries of MNC companies who are not authorised to divulge details of their company investment plans. But these discussions have helped in authenticating the public data used for the analysis. Most of the executives preferred not to be quoted in the research report, keeping in line with the confidentiality agreements they have with their clients, end-users and MNC principals. The data collected from these sources has been used for writing the case studies, statistical analysis of survey data and to arrive at strategic growth options.

The sample of countries - Brazil, Russia, India and China - was selected based on choice considering their increasing influence in the Outsourcing industry. Several research reports by academicians, research scholars and management consultants have been published comparing the location attractiveness of BRIC nations for the IT/ITeS/BPO services, but there is no published data available for comparing the location attractiveness for the O&G ESO industry. The choice of BRIC nations was judgemental since they are well known and are comparable in size and scale with each other.

The Research process was divided into two phases. In Phase-I of the Research process, a list of 24 companies operating in the O&G ES field was randomly drawn out from the Top 200 International design firms listed in McGraw-Hill Construction

Engineering News Record (2008). Senior executives of these 24 companies were approached via e-mail/telephone or personal visit to seek their permission to participate in the study. The primary objective of the Phase-I study was to determine the factors that could be used to compare the location attractiveness for outsourcing Engineering and Design work to destinations in the scope of this study - Brazil, Russia, India and China. 18 senior executives representing 14 of these 24 companies agreed to participate in the study process. 4 among these executives who participated in the Phase-I data collection study were from the 'outsourcer' side (MNC Design firms with Overseas offices) and the rest of the senior executives interviewed were from the service provider side with operations in one of the BRIC nations. The executives represented 14 different companies. Wherever, two interviewees were from the same company, it was ensured that both of them are not from the same office and belonged to different geographical locations of the same company. The senior executives comprised of top management executives from O&G ESO service provider companies operating in one or more of the BRIC nations and also senior executives (not less than a General Manager designation), from Multinational (MNC) O&G design and engineering companies that outsource engineering/design work to Brazil, Russia, India and/or China. MNCs are defined as companies in which foreign investment comprises more than 50 percent of the companies' capital structure. This 'mix' ensured that a blended and holistic view from both sides was obtained and that the in-depth interview and survey results are unbiased. The profile of the respondents/companies that participated in the Phase-I study are detailed in Figure 2.1. The author has personally spoken to all these 18 executives during the in-depth interview process to gain further insight about specific aspects of the research. The in-depth interviews began with a round of preliminary unstructured interview followed by a session of interview using a structured survey questionnaire for determining the elements/variables required for comparative case study to determine the location attractiveness. The semi-structured interview questionnaire is attached to this thesis as Appendix-A. After completing the semi-structured interview with all the 18 Experts, the survey using the structured questionnaire attached herewith as Appendix-B was conducted. All elements/variables that were mentioned by more than 60% of the participants (11 out of 18 respondents) are considered for the comparative case study.

In which country are you based? (Total Respondents = 18)



How much of the total engineering and design manhours related to the O&G industry does your company outsource from other countries? (Total Companies = 14)

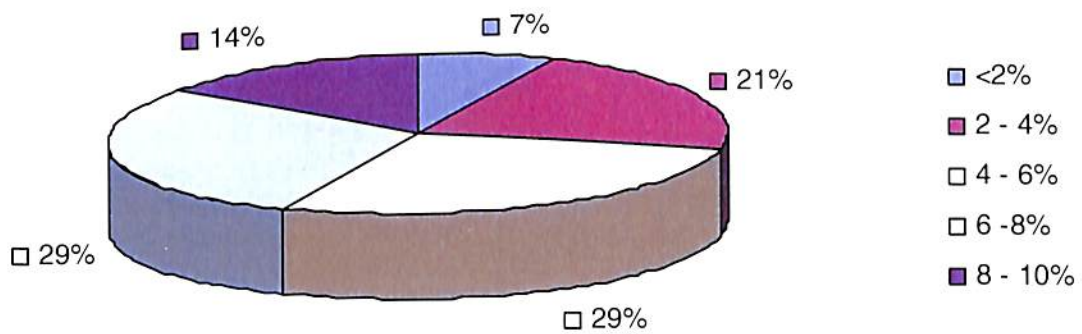
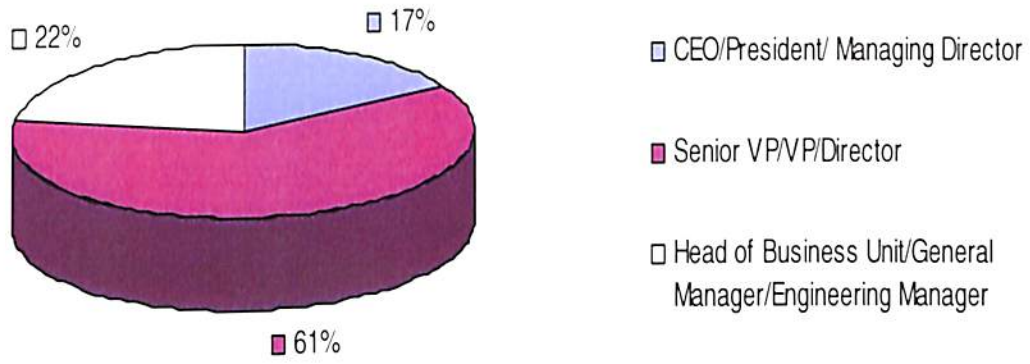


Figure 2.1: Profile of respondents/companies in Phase-I study

Which of the following best describes your title? (Total Respondents = 18)



What best describes your Functional Role? (Total Respondents = 18)

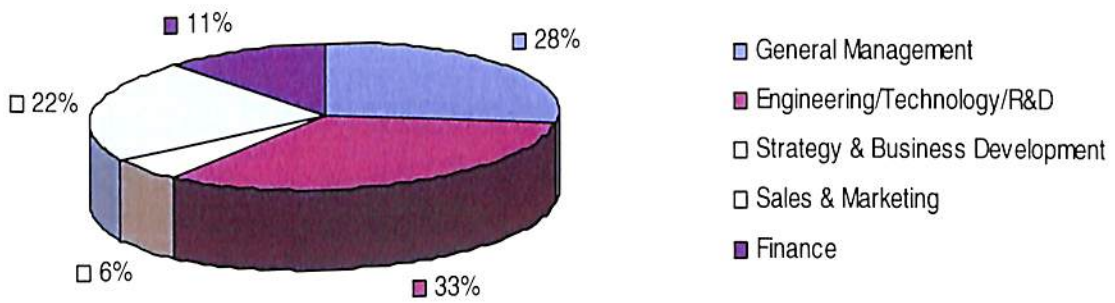


Figure 2.1: Profile of respondents/companies in Phase-I study (Contd...)

The process flow of the Phase-I research process is summarized in Figure 2.2. All selected variables are considered to have equal weightage in determining the country location attractiveness for O&G ESO.

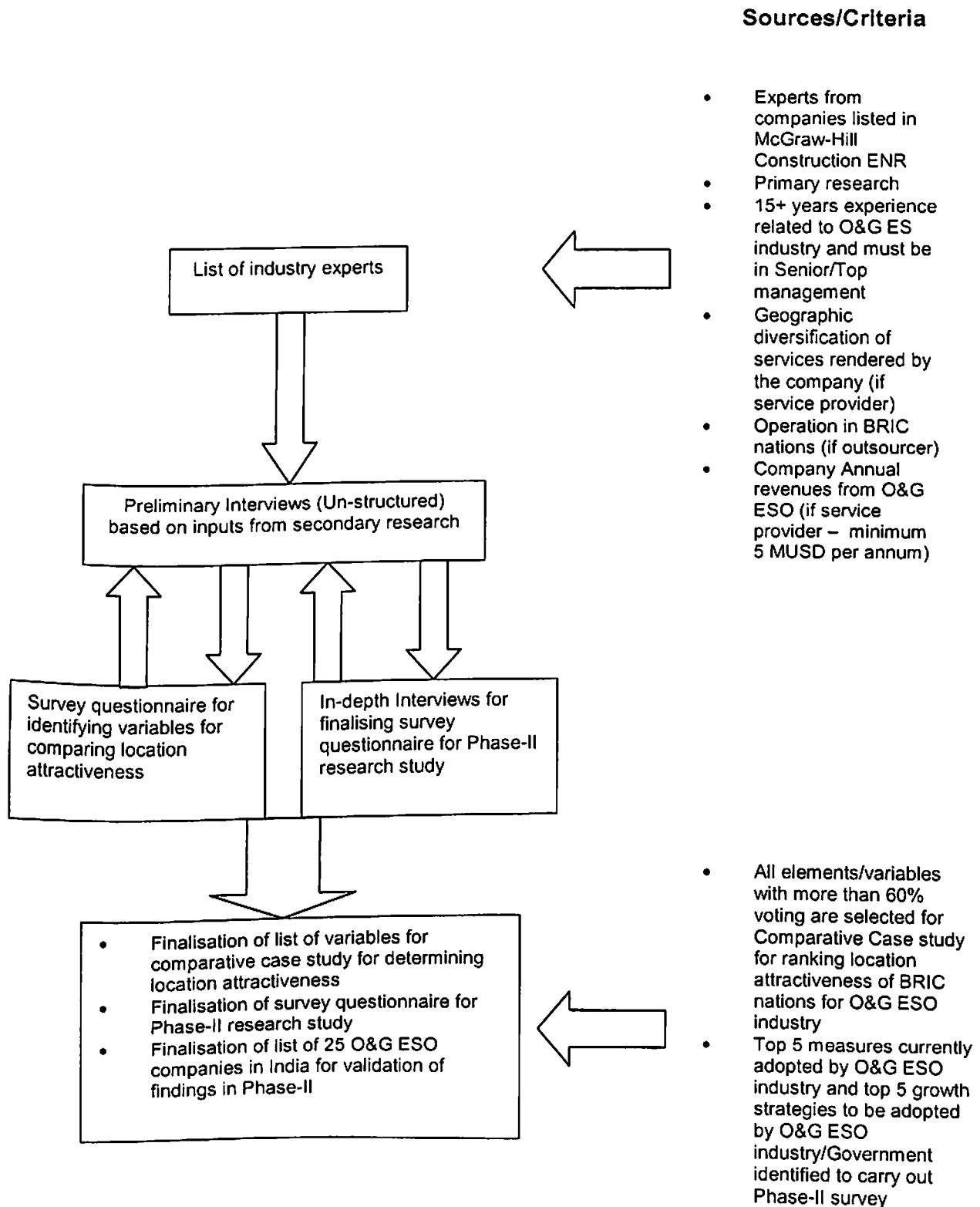
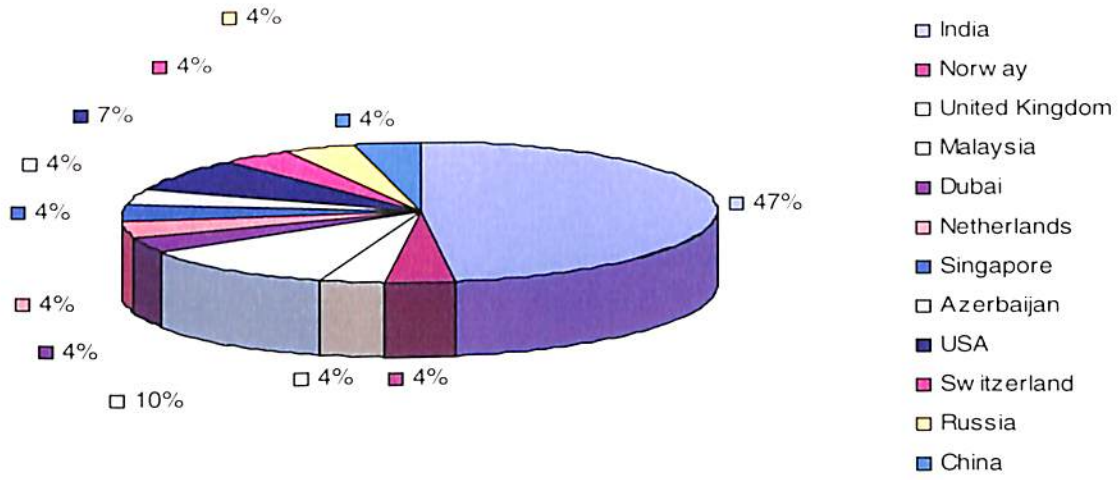


Figure 2.2: Phase-I research process

In the second phase of the research process, a further list of 24 companies operating in the O&G ES field was randomly drawn out from the Top 200 International design firms listed in McGraw-Hill Construction Engineering News Record (2008) to perform a deep dive on current status of O&G ESO industry in India and the recommendations to be made for growth. This was again a random selection of companies after excluding the 14 companies that participated in the Phase-I study. Senior executives from these companies were approached via e-mail/telephone or personal visit to seek their permission to participate in the study. Also, a survey questionnaire (attached herewith as Appendix-C) was administered to all the executives in the Phase-II study seeking their scores on identified elements of location attractiveness of BRIC Nations for O&G ESO service provider industry. 17 senior executives representing 15 different companies out of the list of 24 companies agreed to participate in the Phase-II in-depth interview and survey process. 10 respondents who took part in the Phase-I of the study were also approached in the Phase-II study and they agreed to contribute to the study taking the total number of respondents for the Phase-II study to 27. The 27 executives represented 25 different companies and the profile of the respondents/companies that participated in the Phase-II study is detailed in Figure 2.3. Wherever, two interviewees were from the same company, it was ensured that both of them were not from the same office and belonged to different geographical locations of the same company. The author has personally talked to all these 27 executives for the in-depth interview and survey process – either telephonically or in person. These 27 executives are top management executives and business leaders from O&G ESO industry and are Subject Matter Experts in the field of O&G Engineering Services with relevant domain expertise in the O&G engineering industry. The interviewed executives had the following position titles: General Manager, President, Vice President (Engineering), Director of R&D, Quality Assurance Director, Chief Engineering Manager, Technology/Engineering Director and Chief Executive Officer. The survey questionnaire (Appendix-C) also contained questions on strategic growth options and recommendations for the industry and government. The process flow of the Phase-II research process is summarized in Figure 2.4.

In which country are you based? (Total Respondents = 27)



How much of the total engineering and design manhours related to the O&G industry does your company outsource from other countries? (Total Companies = 25)

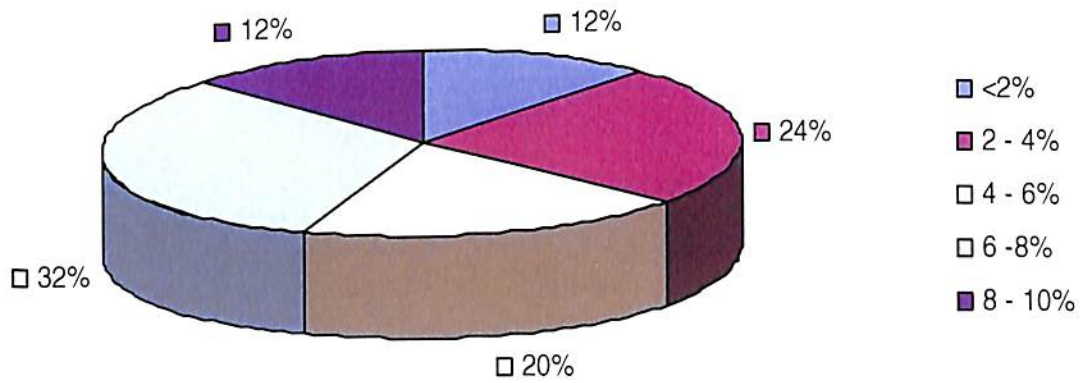
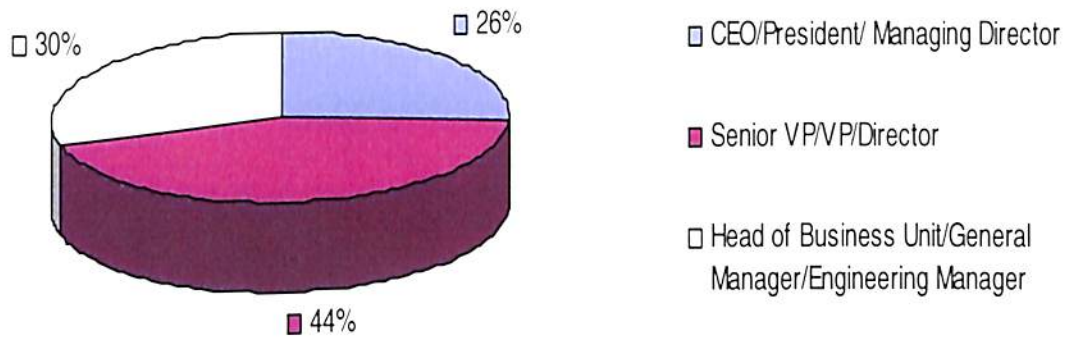


Figure 2.3: Profile of respondents/companies in Phase-II study

Which of the following best describes your title - CEO/President/Managing Director, Senior VP/VP/Director, Head of Business Unit/General Manager/Engineering Manager? (Total Respondents = 27)



What best describes your Functional Role? (Total Respondents = 27)

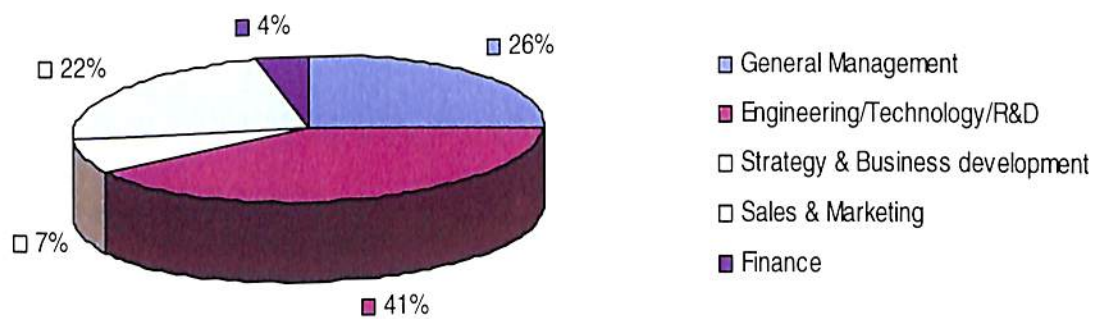


Figure 2.3: Profile of respondents/companies in Phase-II study (Contd...)

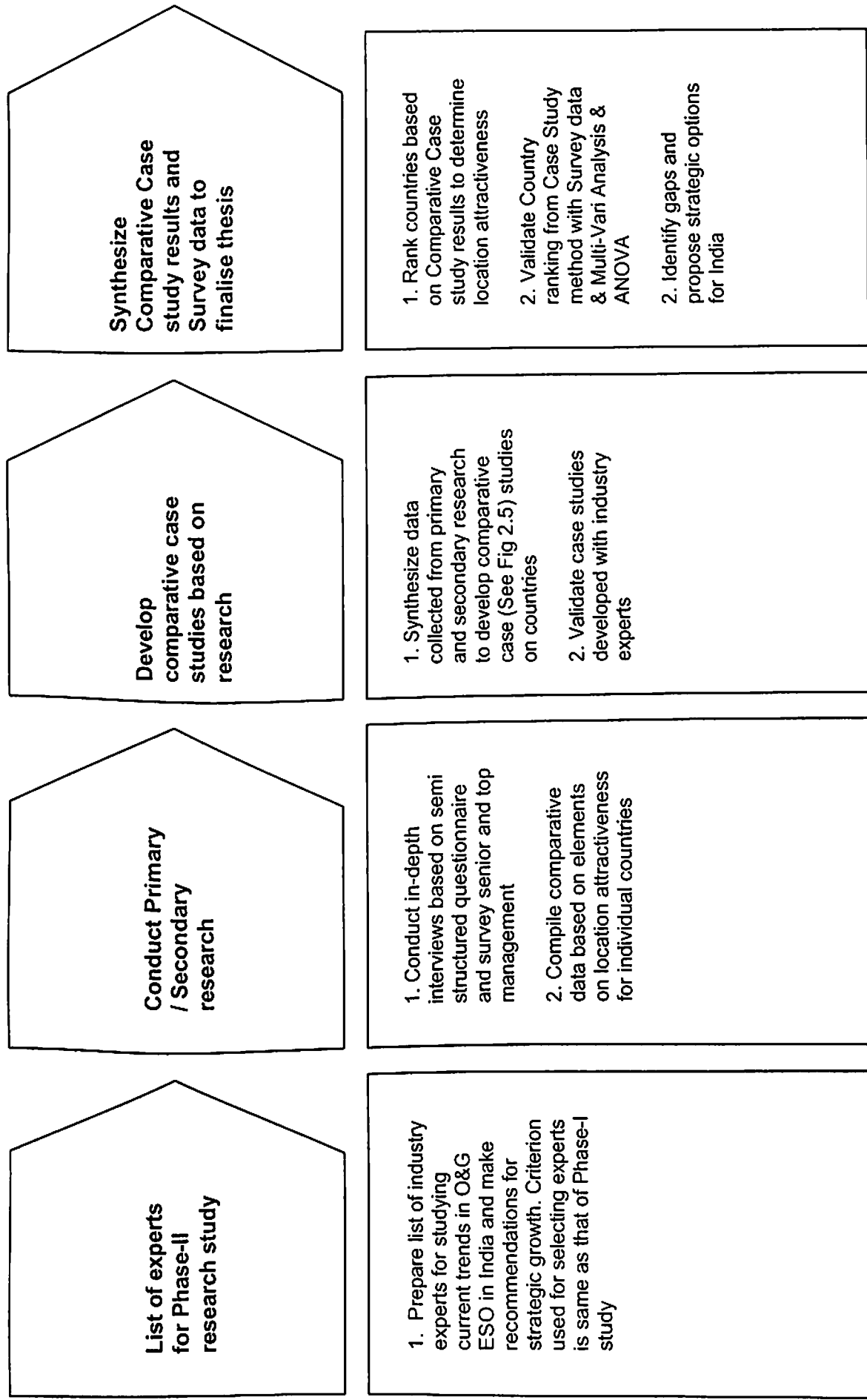


Figure 2.4: Phase-II research process

The statistical analysis of survey responses on questions related to strategic growth options and recommendations for the industry and government were analyzed based on single-variable statistics. This method identifies the frequency of each response. Both the frequency distribution and percentage distribution are shown for the results of most of the questions in the survey. In order to validate the ranking of individual countries on elements of location attractiveness that was arrived at using the Comparative Case study method (that primarily relied on data from secondary research) the scores of the 27 industry experts was further tested statistically using the Minitab Software deploying Muti-Vari Analysis (MVA) and Analysis Of Variance (ANOVA) methods. This ensured that the rankings were arrived at by using quantitative methods deploying statistical tools.

The Phase-I research process was conducted between June and December 2008 and the Phase-II research process and further analysis was conducted between January and June 2009.

2.2 RESEARCH STRATEGY DEVELOPMENT AND DATA SOURCES

Given the lack of readily available raw data and published material on the O&G ESO industry, several different but complementary approaches as mentioned earlier are used in this study. These techniques comprise the questionnaire or survey method; comparative case study research method; interview techniques; and content analysis. When conducting a research project, the researcher is in need of a strategy for how to do this. The choice of research strategy depends on what kind of questions are to be answered and the problem to be solved. Yin refers to five different research strategies: experiment, survey, archival analysis and case study. In order to choose a strategy, it is necessary to understand the difference between them. The strategies are shown in Table 2.1.

Table 2.1: Research strategy development

Strategy	Forms of research questions	Requires control over behavioural events	Focus on contemporary events
Experiment	How, Why	Yes	Yes
Survey	Who, What, Where, How many, How much	No	Yes
Archival analysis	Who, What, Where, How many, How much	No	Yes/No
History	How, Why	No	No
Case study	How, Why	No	Yes

Source: Yin, Robert K., 1994

One of the research questions for Phase-II research process to determine the location attractiveness of individual countries was formulated as to how and why questions and hence the Case study method was deployed. The analyses of the case studies cover a country-level comparison of the O&G ESO service provider industry in the four countries that form the BRIC block. However, since the comparative case study results primarily relied on data from secondary sources a statistical analysis of survey results was duly done to validate the results.

The following sub-sections provide a description of each of these research techniques that were deployed to achieve the objectives of this study and also the data collection techniques deployed.

Questionnaire or Survey Development

A questionnaire is a research instrument consisting of a series of questions that people answer about their life condition, beliefs, or attitudes (Thomas 2000). The main advantage of this method is its quantitative aspect. Questionnaires are less expensive than interviews, they are self administering, they can be administered to many persons simultaneously, they can be mailed, they are logistically easier to manage than interviews, and they call for uniform responses (although items may often be subject to widely different interpretations). At the same time, they are impersonal and limit the respondent's response range significantly (Guba and Lincoln 1981).

Surveys by questionnaire were performed in Phase-I and II of the study. The survey questionnaire was shared with the select sample of 18 (in Phase-I) and 27 (in Phase-II) top management executives who supported me in the study. These are attached herewith as Appendices-A, B and C. The survey questionnaire in Phase-II was prepared to obtain a significant amount of data related to the status-quo of the O&G ESO industry in India and the steps to be taken in the future to grow and expand the business. The questionnaire was primarily adapted from previous research studies on similar topics. Brain storming sessions were held with the guides and the list was refined into survey questions and then deployed for the study. The questionnaire also contained scoring sheet for each identified element of location attractiveness for O&G ESO service provider industry and the respondent was requested to award individual scores for each BRIC nation.

An important factor that was considered while developing this survey was to keep open-ended questions to a minimum. This was done to get the maximum number of responses to the survey.

Preliminary Unstructured Interviews

To obtain qualitative results from this study, in-depth interviews with decision makers (both from O&G ESO outsourcers and service providers) were performed during both phases of the data collection process. This research aimed to incorporate two approaches towards interviewing. One was to perform structured interviews where the objective is usually to get representative or 'typical' responses, and 'a deviation is ordinarily handled statistically' (Dexter 1970). The other format would be to perform unstructured interviews which are typically used in any of the following circumstances (Guba and Lincoln 1981) :

- When the interviewer is dealing with elite subjects, that is, subjects who have special status or knowledge;
- When the interviewer is interested in pursuing some subject in depth;
- When the interviewer is operating in a discovery, rather than a verification mode;
- When the interviewer is interested in the etiology of some condition;
- When the interviewer is interested in a direct interaction with a certain respondent;
- When the interviewer is interested in uncovering some motivation, intent, or explanation as held by the respondent (Dexter 1970); or
- When the interviewer is trying to ascribe meaning to some event, situation, or circumstance.

When performing interviews, it is important to consider interviewer bias. Bias is "a tendency to observe the phenomenon in a manner that differs from the 'true' observation in some consistent fashion" (Simon and Burstein 1985). One method to reduce the impact of bias is to perform an unstructured interview or to develop questions that do not require the interviewee to answer within the interviewer's

framework. Another method is to systematically analyze the interview data by a content analysis procedure. Content analysis is a phase of information processing in which communication content is transformed, through objective and systematic application of categorization rules, into data that can be summarized and compared (Holsti 1969). In this study, the particular technique used during the content analysis was to carefully take notes during the interviews and then manually organize the relationships between concepts and domains discussed in that interview.

All the interviewees identified for the interview phase of this study were top executives from the O&G ESO industry or MNC clients. This preference was due to the fact that most of the executives were decision makers who were directly involved in whether or not to adopt the use of offshoring model. Their experiences and lessons would prove invaluable for this research.

To gain more insight into the O&G ESO concept and understand more about the current status of O&G ESO in India and the recommendations to be made to the industry players and the policy makers, the interview questions were broadly categorized into six sections: background information; current steps being taken by O&G ESO service providers, future steps to be taken by O&G ESO service providers, current support levels from the Government, future support levels required from the government and concluding questions.

The goal of collecting background information was to gain an understanding of the level of responsibility and experience of the interviewee with the O&G ESO model. The second set of questions touched upon aspects related to the industry's current working model and also included the scoring sheet for each identified element of location attractiveness for O&G ESO service provider industry and the respondent was requested to award individual scores for each BRIC nation. The third set of questions dealt with questions regarding what is lacking in the current plan to formulate the direction for future growth. This focuses on the details of work done in the past, technology requirements, intellectual property concerns etc. The fourth set of questions addresses the conscious steps being taken by the Government to support the

Outsourcing industry, particularly the O&G ESO industry. The fifth set of questions were intended to obtain the views of industry players and government officials regarding the steps to be taken to support the O&G ESO industry in a better way. The last set of questions were aimed at obtaining the interviewee's thoughts regarding the future trends of O&G ESO industry and any other additional comments or items that they feel are important for this research.

Case Study and Case Study Design

When a phenomenon can be studied in a real life situation, the case study is considered to be a research strategy of greater relevance. A case study is an empirical inquiry that studies a phenomenon within a real life situation where the boundaries between the phenomenon and the context are not clearly evident. The case study is especially advantageous when 'how' or 'why' questions are being asked about events over which the investigator has limited control. "A major reason for the popularity and relevance of theory building from case studies is that it is one of the best (if not the best) of the bridge from rich qualitative evidence to mainstream deductive research" (Eisenhardt & Graebner, 2007). The case study is built up around a deductive approach where we want to find information that suits the existing theories. A case study was, therefore, considered the most appropriate research methodology for determining the location attractiveness of Brazil, Russia, India and China and O&G ESO service providers. The case study plays a significant role within research and there exists at least five different applications. The most important application is to explain causal links in real life settings that are too complex for survey or experimental strategies. The second application is to describe the real settings within the context that it occurs. The third application is that a case study can illustrate certain topics within an evaluation. Fourth, the case study can explore those situations in which the intervention evaluated has no clear outcomes. Fifth, the case study can be a meta-evaluation - a study of an evaluation study. Searches are made for relevant theories and appropriate materials on the subject keeping in view the identified problems of the present thesis. The theories regarding strategic investment decisions have been identified to explore them further.

Yin (1994) proposes the idea that all empirical research has a research design that follows a logical sequence connecting empirical data and the study's initial research questions finally leading to its conclusions. The research design can be defined as "the plan that guides the investigator in the process of collecting, analyzing, and interpreting observations". Yin discusses four different types of research designs relevant for case studies; single case designs, multiple case designs, holistic designs and embedded designs. These are shown in Table 2.2.

Table 2.2: Basic types of design for case studies

Strategy	Single case design	Multiple case design	Focus on contemporary events
Holistic (Single units of Analysis)	Type 1	Type 2	Yes
Embedded (Multiple units of Analysis)	Type 3	Type 4	Yes

Source: Yin, Robert K., 1994

When designing a case study, it is of great importance to make a distinction between single and multiple case designs. The single case design is useful when the case represents 'the critical case in testing a well formulated theory'. The single case can be used to discover whether the theories developed are relevant and if there are ways in which they can be extended and further developed. When the same study contains more than a single case the use of a multiple case design becomes relevant. That is, there exist several individual units of analysis that as a whole can be considered as multiple case designs. The single- and multiple case studies can be holistic or embedded. The embedded case study involves more than one unit of analysis and attention is also given to sub-units. When no logical sub-units can be identified or when there is a global nature of the problem, the holistic design is preferable. In this thesis, the embedded multiple case studies methodology has been used to determine the location attractiveness of Brazil, Russia, India and China as O&G ESO service provider nations. A diagrammatic representation of Case study research process adopted for arriving at location attractiveness is shown in Figure 2.5.

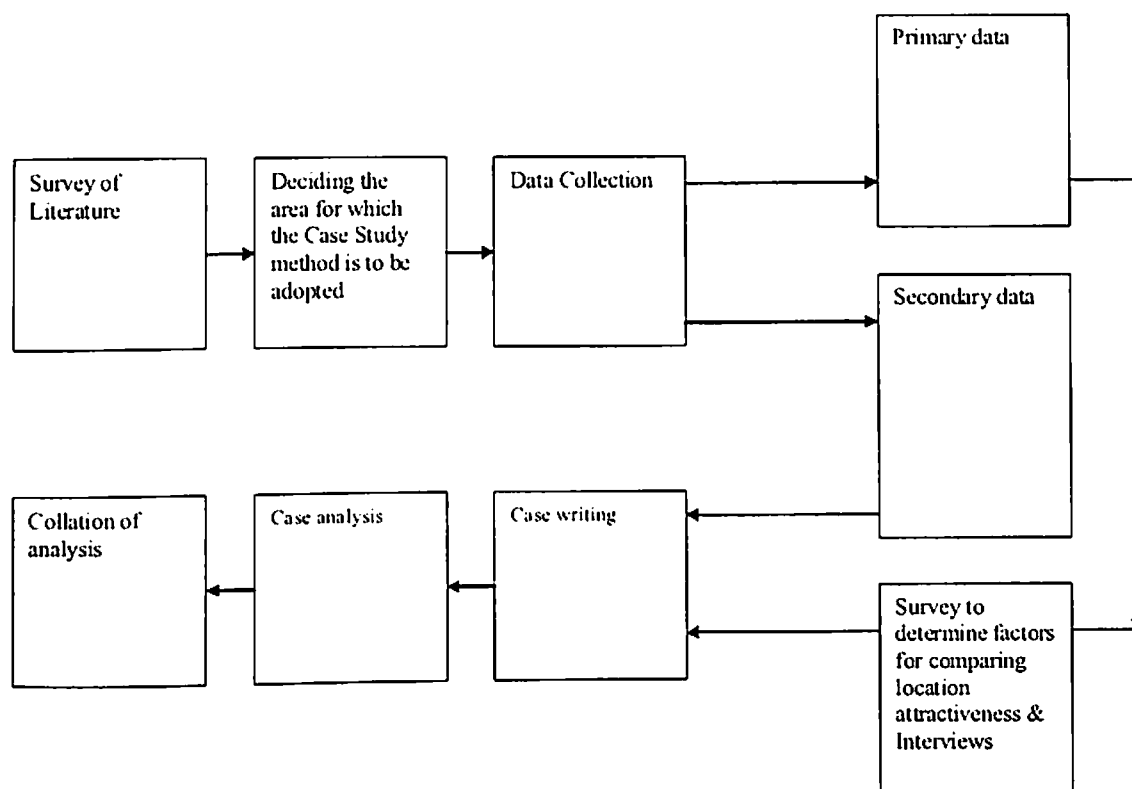


Figure 2.5: A diagrammatic representation of research process adopted for arriving at location attractiveness of BRIC countries as O&G ESO service providers using Comparative Case Study method

Data Collection

When a researcher collects data there are two major alternatives. The researcher can use primary or secondary data. I explain further the differences between them and how this is applied in this thesis.

Primary Data: Primary data are data that are collected specifically for the research. According to Merriam (1998) there are three forms of strategies in data collection in the case study. These three strategies are interviewing, observing, and analyzing documents. In this study, I used a mix of these three data collection strategies. In order to conduct a valuable study, it was of great importance for me to understand the region in question: Brazil, Russia, India and China and the specific environment for the O&G ESO business.

Interviews can be categorized into three different forms: structured, semi-structured and non-structured. When I conducted the interviews, I leaned towards semi-structured type of interviews since I decided to conduct them personally and not to employ investigators for the purpose. Certain areas of interest have been formulated

into more or less structured question topics. The semi-structured interview technique gives the researcher the possibility to reflect and respond to the situation at hand and also to explore new ideas on the topic. The questions in the interviews were formulated so as to stimulate discussions between the researcher and the interviewee. The cultural difference between some of the interview participants and mine were so prominent that I required a deeper understanding of the interviewee's cultural setting prior to starting the investigation. There is otherwise a risk that information collected is not interpreted in its right context. As I have worked overseas and traveled extensively to more than 25 countries as part of my work during the last one decade, my exposure to various culture and business environments has been helpful for this study. The use of English as the language of communication fortunately does not pose much of a problem as all the senior-level executives interviewed were well equipped in the proficient use of this language.

Secondary Data: Secondary data are data that already exist with no particular connection to the specific case. Secondary data can for example be articles, books, previous studies and Internet searches. The theoretical framework used in the thesis is built up around Location attractiveness decisions and O&G engineering. Some of the sources of secondary data used for this study have been listed below:

- Annual Reports, Company Brochures and websites of Oil & Gas and O&G ESO companies
- Annual Reports, Statistical Data, Year Book, Periodical Publications of Governments, Ministries, Government Authorities of BRIC countries
- Books on Outsourcing and O&G engineering
- Chemical & Engineering News
- Chemical Market Reporter
- International Monetary Fund (IMF) & World Trade Organization (WTO)
- Research papers from the archives of Society of Petroleum Engineers
- Papers from the United States Trade Representative office containing researched data on BRIC nations

Statistical Methods Deployed to Arrive at Location Attractiveness of BRIC Nations for O&G ESO Service Provider Industry

The Survey in Phase-II study was conducted to rank the 4 BRIC Nations as preferred O&G ESO service provider nations and to give the study a statistical perspective based on individual scores awarded by the 27 respondents who are Subject Matter Experts in the O&G domain. The survey questionnaire (attached as Appendix-C to this thesis) had 10 questions with a scoring scale of 0 (indicating least attractiveness for the particular variable) to 10 (indicating Highest attractiveness for the particular variable) for each of the identified element of location attractiveness for each nation in the BRIC block. The aim was to statistically rank the preferred location for O&G ESO outsourcing and test the comparative case study results. The statistical analysis was carried out with the use of Minitab software.

The data characteristics were established by using the steps described below:

- The 1080 data points (27 respondents, 10 questions, 4 countries) were initially tested for Normality Test by looking at the P value as explained below in this section.
- The data was also checked for randomness by using the Independence Test utility on Minitab statistical software.
- The Data has Multiple Factors (X) and one Output (Y) as explained below:

Y = Rating (Continuous)

X = Location (Discrete)

X = Questions (Discrete)

X = Experts (Discrete)

In Statistical hypothesis testing, the P-value is the probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. The fact that P-values are based on this assumption is crucial to their correct interpretation. The lower the P-value, the less likely the result, assuming the null hypothesis, the more 'significant' the result, in the sense of statistical significance. One often rejects a null hypothesis if the P-value is less than

0.05 or 0.01, corresponding to a 5% or 1% chance respectively of an outcome at least that extreme, given the null hypothesis.

The Data characteristics satisfy the criteria set for Non-Parametric test and hence the data was analysed by Non-Parametric Test and Minitab software was used for Analysis.

The Non-parametric tests used for analysis of multiple factor are:

Multi-Vari Analysis: Multi-Vari Analysis (MVA) is a graphical technique for examining a quick snapshot of a process. Multi-Vari charts are used as a preliminary tool to look at interactions among data. MVA is based on the statistical principle of multivariate statistics that involves observation and analysis of more than one statistical variable at a time. In design and analysis, the technique is used to perform trade studies across multiple dimensions while taking into account the effects of all variables on the responses of interest. The MVA is a technique for viewing multiple sources of process variation. Different sources of variation are categorized into families of related causes and quantified to reveal the largest causes. MVA was used as the first tool in the Analysis of Location attractiveness of BRIC nations for O&G ESO industry. Although simple in nature, such a chart has considerable power. It can help you identify the major (dominant) family of variation. However, this doesn't quantify the variation and only shows where the variation is. Once the list of inputs is narrowed down, other advanced analysis methods are used to quantify the variation.

Multi-Vari is the perfect tool to determine where the variability is coming from in your process because it does not require manipulating the independent variables (or process parameters) as one would with design of experiments. Because it provides a great way of analysing the effects of multiple factors multi-vari analysis is widely used in six sigma projects. One can display the effect of categorical type inputs on a response on a Multi-vari chart. It is one of the tools used to reduce the trivial many inputs to the vital few. In other words it is used to identify possible Xs or families of variation, such as variation within a subgroup, between subgroups, or over time. Figure 2.6 is the Tree Structure adopted to determine relative location attractiveness of BRIC nations for O&G ESO industry.

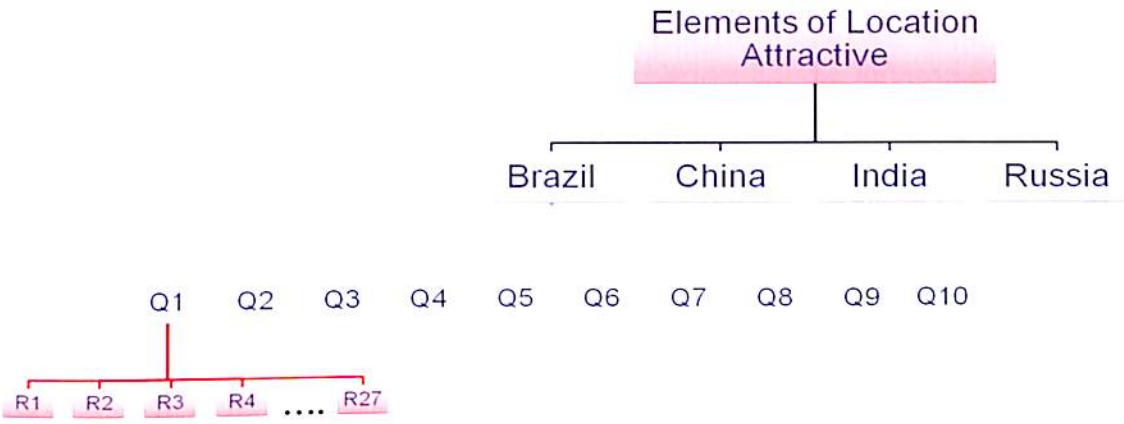


Figure 2.6: Tree Diagram of Multi-Vari Analysis adopted to determine Location Attractiveness of BRIC Nations for O&G ESO

ANOVA: In statistics, ANalysis Of VAriance (ANOVA) is a collection of statistical models, and their associated procedures, in which the observed variance is partitioned into components due to different explanatory variables. In its simplest form ANOVA gives a statistical test of whether the means of several groups are all equal, and therefore generalizes Student's two-sample t-test to more than two groups. ANOVAs are helpful because they possess a certain advantage over a two-sample t-test. Doing multiple two-sample t-tests would result in a largely increased chance of committing a type I error. For this reason, ANOVAs are useful in comparing three or more means. Figure 2.7 illustrates the Test Selection criteria adopted for this study. A One-way Analysis Of Variance (ANOVA) was used to test the Hypothesis ‘That the Means of several populations are equal’.

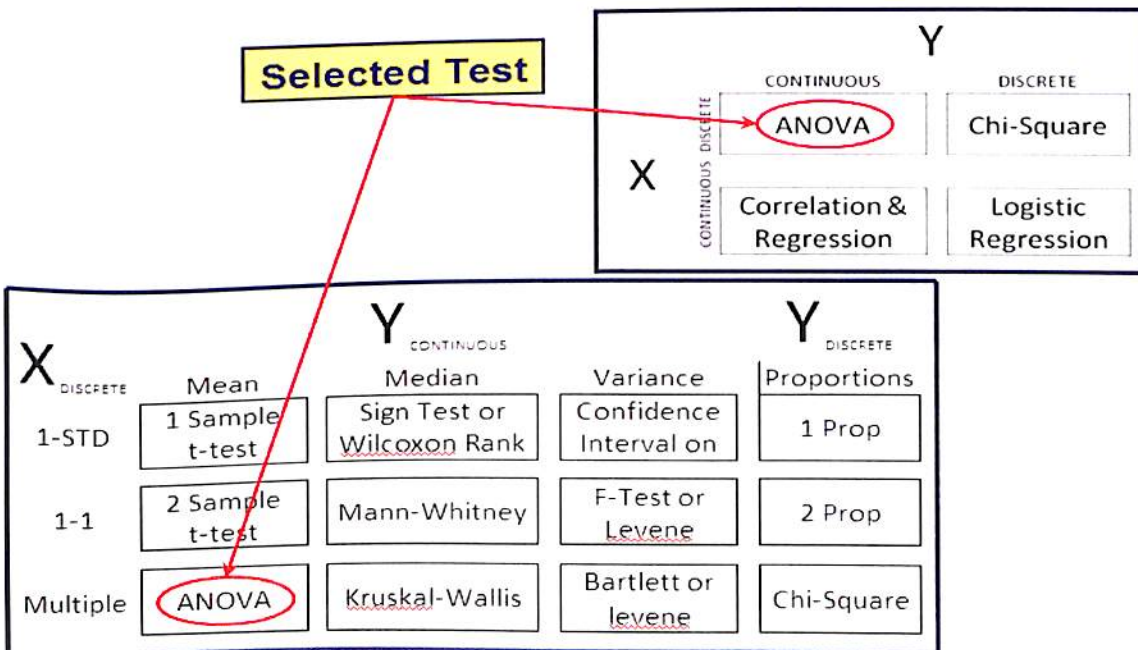


Figure 2.7: Test Selection Chart to determine Location Attractiveness of BRIC Nations for O&G ESO

The detailed Tree Diagram for ANOVA is as shown in Figure 2.8.

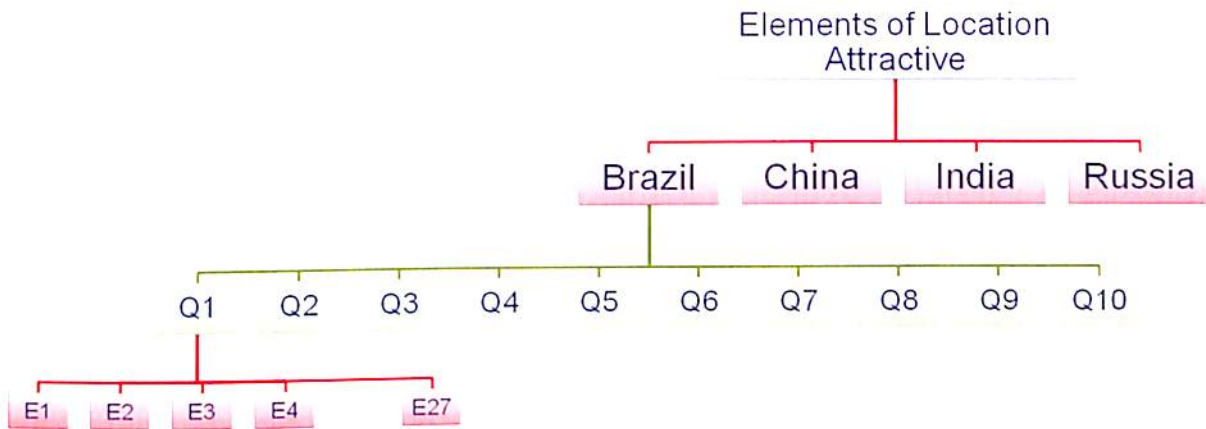


Figure 2.8: Tree Diagram of ANOVA to determine Location Attractiveness of BRIC Nations for O&G ESO

Figure 2.8 shows that the factors are nested at Level -1 and crossed at Level – 2. As we have crossed factors we can study the Interaction Effect. All the factors are fixed and hence the interaction between the factors is also fixed.

Boxplots - also called Box-and-whiskers plots are used at the end of the study to illustrate the shape and mean properties of the data for each level. A Boxplot is a way of summarizing a set of data measured on an interval scale. It is often used in exploratory data analysis. It is a type of graph which is used to show the shape of the distribution, its central value, and spread. The picture produced consists of the most extreme values in the data set (maximum and minimum values), the lower and upper quartiles, and the median. Box plots are also very useful when large numbers of observations are involved and when two or more data sets are being compared. They are helpful for indicating whether a distribution is skewed and whether there are any unusual observations (outliers) in the data set.