CHAPTER-6

STATISTICAL ANALYSIS OF SURVEY DATA & PROFILE OF KEY INDIAN O&G ESO PLAYERS

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In this chapter, the Statistical analysis of the survey data to determine location attractiveness of BRIC nations as O&G ESO service provider destinations is presented. A comparison of the results obtained from the different methods used in this study is also presented in the concluding part of section 6.1. The results of the Phase-II study on the current status of the Indian O&G ESO industry are included in this chapter. The profile of twenty five select O&G ESO companies is detailed in this chapter to gain an understanding of the current industry trend. The result of the Objective No. 2 listed in Section 1.3, Chapter-1 is presented in the concluding part of Section 6.1 and the results of Objective Nos. 3 and 4 are covered in Section 6.2 respectively.

6.1 STATISTICAL ANALYSIS OF SURVEY DATA TO DETERMINE LOCATION ATTRACTIVENESS

The survey data (refer Appendix-D1) obtained from the Phase-II survey questionnaire (refer Appendix-C) was first tested for Normality using the Minitab software. The screenshots of the outcome are as shown in Figure 6.1. The Probability Plot response in Figure 6.1 pointed out that the 'P Value' was less than 0.05 indicating that the data distribution was NOT NORMAL.

The second test that was performed was for testing the independence of the survey data results. The screenshots of the outcome are as shown in Figure 6.2. The Independence test response in Figure 6.2 pointed out that the 'P Value' was less than 0.01 indicating that the data distribution was RANDOM.

The summary of both the tests explained above are as mentioned below:

- Data is Non-Normal
- Data if transformed will loose its functionality

- The sample size was small – 27 respondents
- The Data is Independent and Random

The Data has multiple factors (X) and One Output (Y) as mentioned below:

- Y = Country Rating (Continuous)
- X = Location (Discrete)
- X = Questions (Discrete)
- X = Respondents/Experts (Discrete)

As explained in the Chapter-2: Research Methodology, the data from survey results are analysed using Non Parametric tests – Muti-Vari chart and One-Way ANOVA. The detailed Test selection criterion is also explained in Chapter-2.

The Multi-Vari Analysis chart output is as shown in Figure 6.3. The Analysis of the Multi-Vari chart highlighted the variation in each unit and the key points are as follows:

- The largest family of variation is in Respondent, this variation is consistent for all locations
- The Variation is seen in Location to Location
- The Variation is seen in Question to Question
- The Variation is seen in Respondent to Respondent
- Mean ratings for India is highest

However, since the Muti-Vari chart does not quantify the variation and only showed where the variation is, the One-way Analysis Of Variance (ANOVA) was used to test the Hypothesis 'That the Means of several populations are equal' as detailed in the Chapter-2. The results of the One-way ANOVA are depicted in Figure 6.4. The detailed steps to arrive at the conclusion were as follows:

Practical Statement

To identify the Preferred Location from among Brazil, Russia, India and China for O&G ESO.

Statistical Statement

Null Hypothesis (H_o): All the Locations are Preferred Location for O&G ESO (Ho: $\mu b = \mu c = \mu i = \mu r$)

Alternate Hypothesis (H_A): At least One Location is Non preferred Location for O&G ESO (Ho: $\mu b \neq \mu c \neq \mu i \neq \mu r$)

Analysis

As explained in Figure 2.7 (Test Selection Chart in Chapter 2) One-way ANOVA is being used for analysis of data since there are Multiple factors and the Mean Measurement is used.

Statistical Conclusion

P-Value = 0.00

Reject Ho

Practical Conclusion: At least One Location is Non preferred location

Boxplots - also called Box-and-whiskers plots are used at the end of the Statistical Analysis study to illustrate the shape and mean properties of the data for each level. The results are shown in Figure 6.5.

The conclusions drawn from the Boxplots are as follows:

- India has the Largest Mean
- Brazil has the Smallest Mean and The Smallest Median
- China has the Largest Spread of Values, as indicated by the ends of the Whiskers
- There are no Outliers (Asterisks) in the data

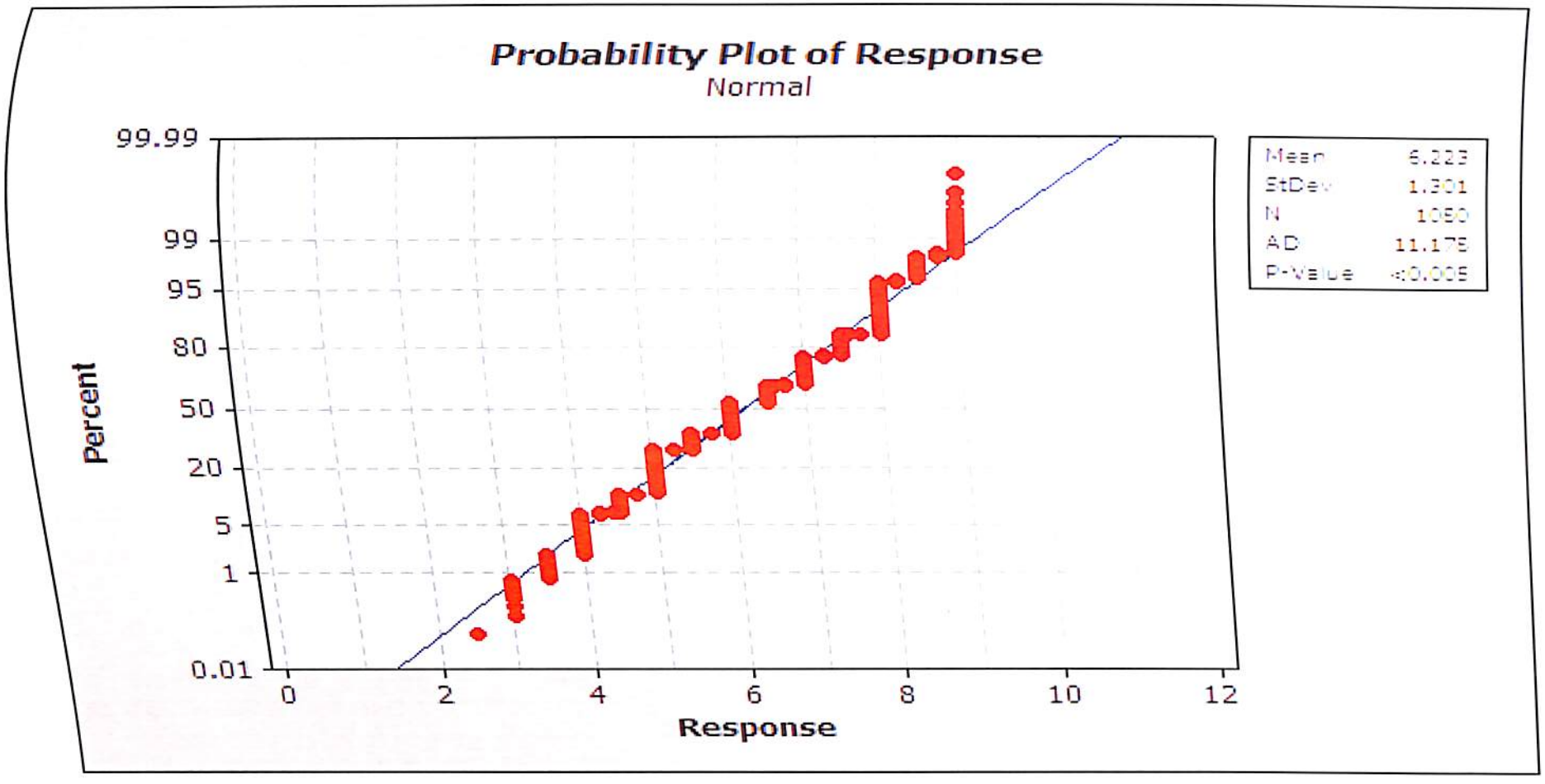


Figure 6.1: Results of Normality Test of Survey data collected to determine Location Attractiveness of BRIC Nations for O&G ESO industry

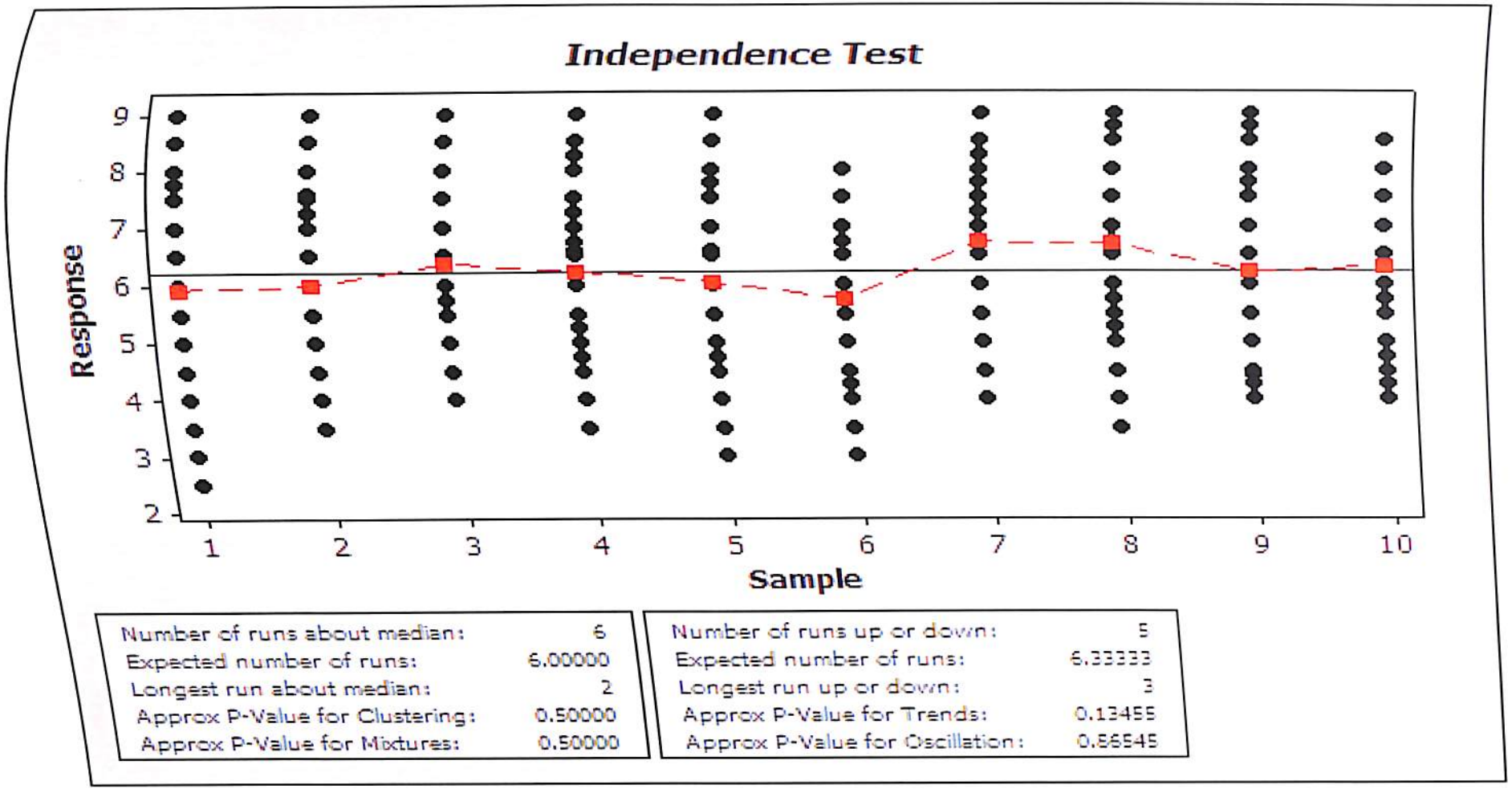


Figure 6.2: Results of Data Independence Test of Survey data collected to determine Location Attractiveness of BRIC Nations for O&G ESO industry

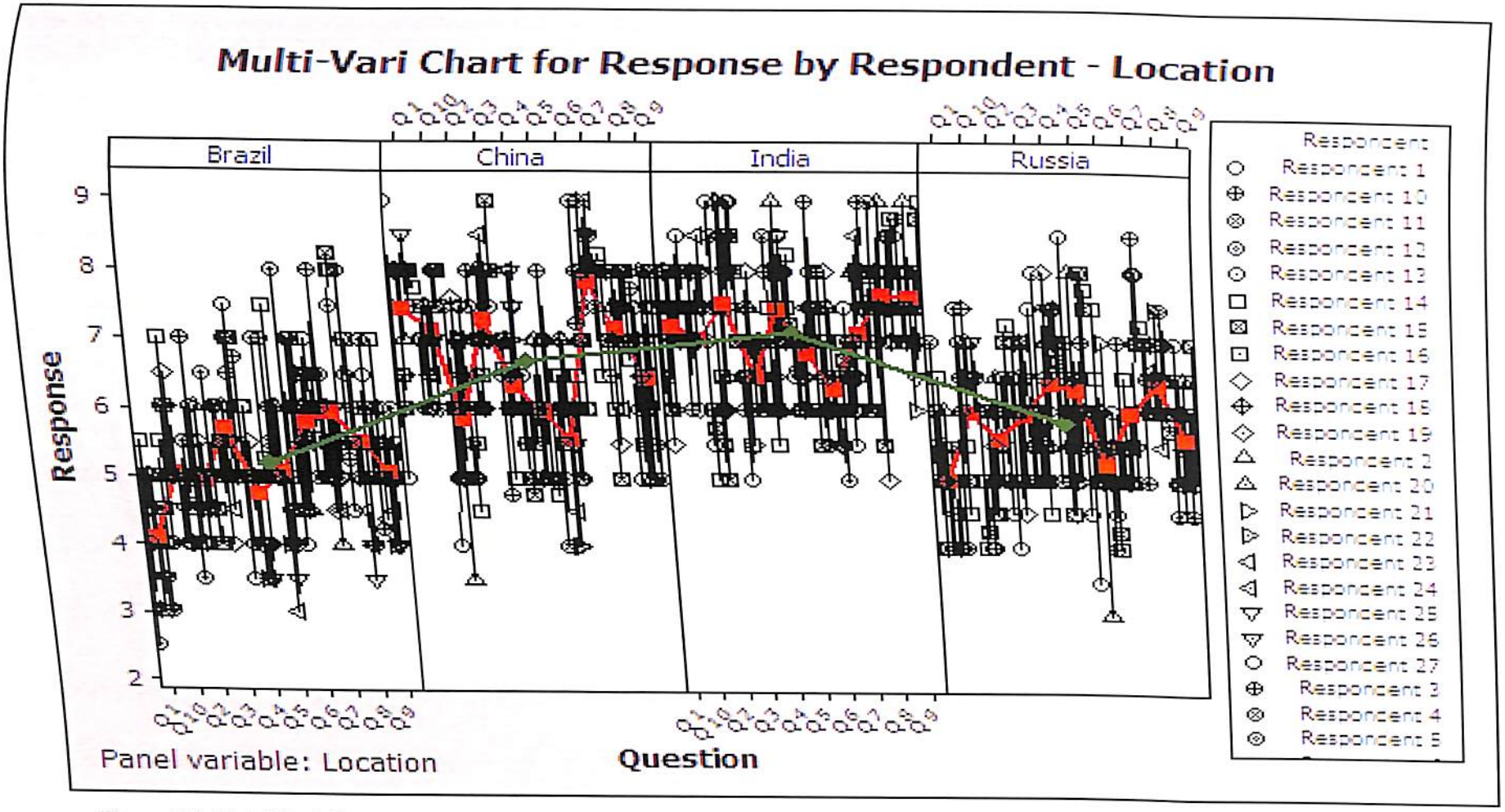


Figure 6.3: Multi-Vari Chart Analysis of Survey data collected to determine Location Attractiveness of BRIC Nations for O&G ESO industry

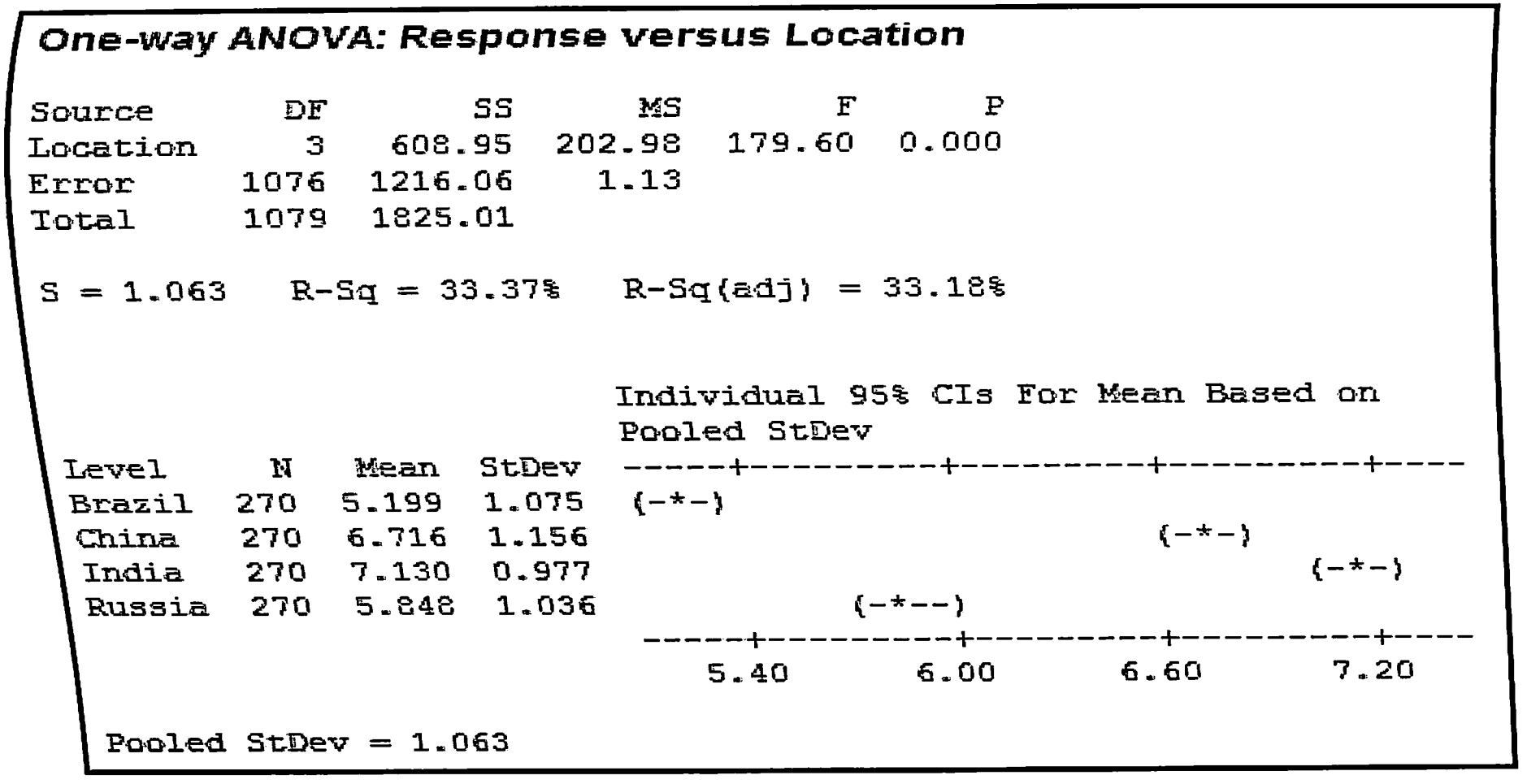


Figure 6.4: Result of One-way ANOVA of Survey data collected to determine Location Attractiveness of BRIC Nations for O&G ESO industry

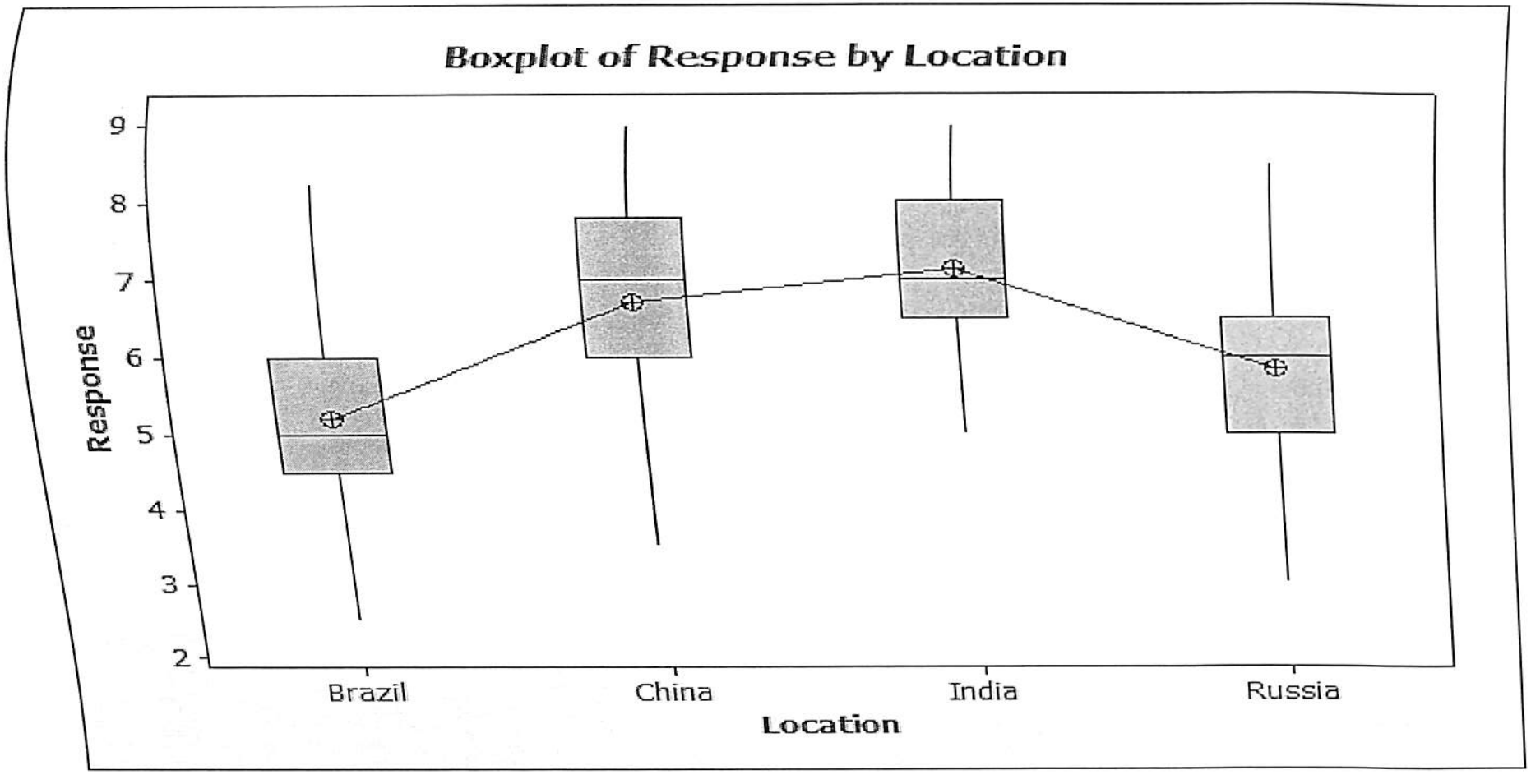


Figure 6.5: Boxplot of Survey data collected to determine Location Attractiveness of BRIC Nations for O&G ESO industry

Summary and Conclusions of the Statistical Analysis

The individual country rankings of BRIC nations using all the three methods - Comparative Case Study method (in Chapter-5), Pictorial Analysis and Statistical Analysis are summarised in Table 6.1.

Table 6.1: Comparison of results obtained for Country Location Attractiveness for O&G ESO using three different Analysis techniques

		Statistical Analysis		Pictorial Analysis
Location	**Comparative Case Study Method**	**One-way ANOVA**		**Multi-Vari Graph Rating**
		Mean	**Standard Deviation**	
Brazil	Unfavourable (UF)	5.199	1.075	4
Russia	Moderately Favourable (MF)	5.848	1.036	3
India	**High Favourable (HF)**	**7.130**	**0.977**	1
China	Favourable (F)	6.716	1.156	2

- The results of the Comparative Case Study Analysis, Graphical (Multi-Vari) analysis and the Statistical (ANOVA) analysis compliment each other.
- India has highest mean and lowest rating spread.
- The Statistical analysis was duly done and further corroborated the rankings of BRIC nations for O&G ESO done using the Comparative Case study method.
- **Result for Objective No.2 in Section 1.3 of Chapter-1:** India emerges as the most preferred location (HF) for O&G ESO industry followed closely behind by China (F), Russia (MF) and Brazil (UF) in decreasing order of location attractiveness.

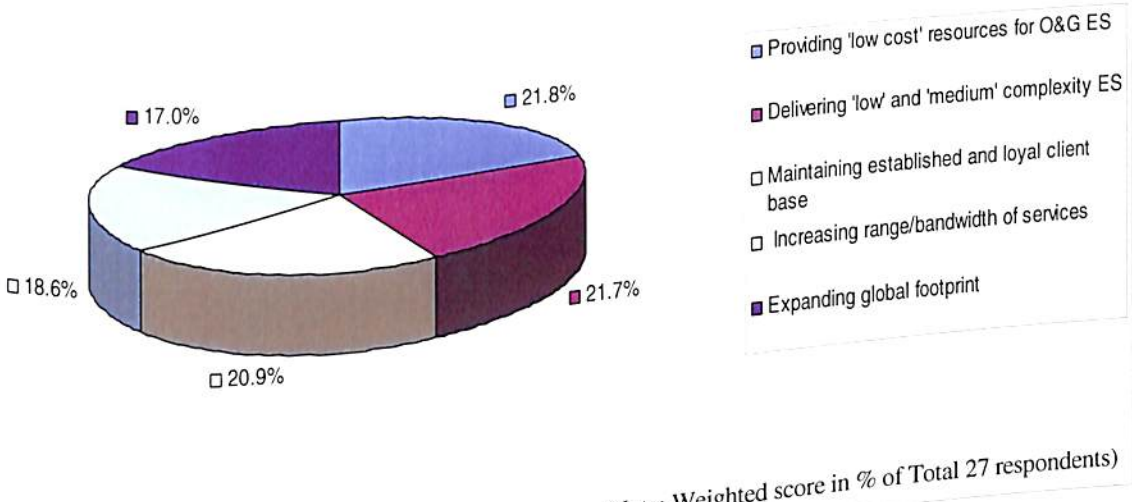
6.2 EXAMINING THE O&G ESO LANDSCAPE - PROFILE OF KEY INDIAN PLAYERS

To gain an understanding of the current industry trends in O&G ESO industry in India, detailed interviews were conducted with 27 industry experts in Phase-II of this study. The structured questionnaire used for the same is attached herewith to this thesis as Appendix-C. The tabulated raw data collected using Appendix-C is

appended as Appendix-D2. The analysis in this section covers the results of Objective No. 3 and 4 of this thesis mentioned in Section 1.3 of Chapter-1.

The summary of the findings on the steps that the Indian O&G ESO service provider industry are currently adopting to maintain its market share (refer Figure 6.6) are as follows:

1. Providing 'low cost' resources for O&G Engineering Services
2. Delivering 'low' and 'medium' complexity Engineering Services
3. Maintaining established and loyal client base
4. Increasing range/bandwidth of services
5. Expanding global footprint



(Note: Weighted score in % of Total 27 respondents)

Figure 6.6: Phase-II Survey result on steps currently adopted by Indian O&G ESO industry
Question: In your opinion what is the O&G ESO service provider industry in India currently doing to maintain its market share against competing nations?

To the question in the survey on the support that the O&G ESO industry derives from the government, 89% of the respondents replied in the negative (refer Figure 6.7) and opined that the Indian government is yet to identify O&G ESO as a potential area that requires focus and attention. The Indian government has been supportive of the IT/ITeS/BPO industry and there are a number of steps being taken both at the State and Central government levels to boost FDI and investment by domestic players.

These incentives are also extended to KPO and ESO sectors and the O&G ESO industry is also a beneficiary of these policies. However, these policies lack specialised focus on O&G ESO taking into account the potential of this business to grow to 6 BUSD by year 2020.

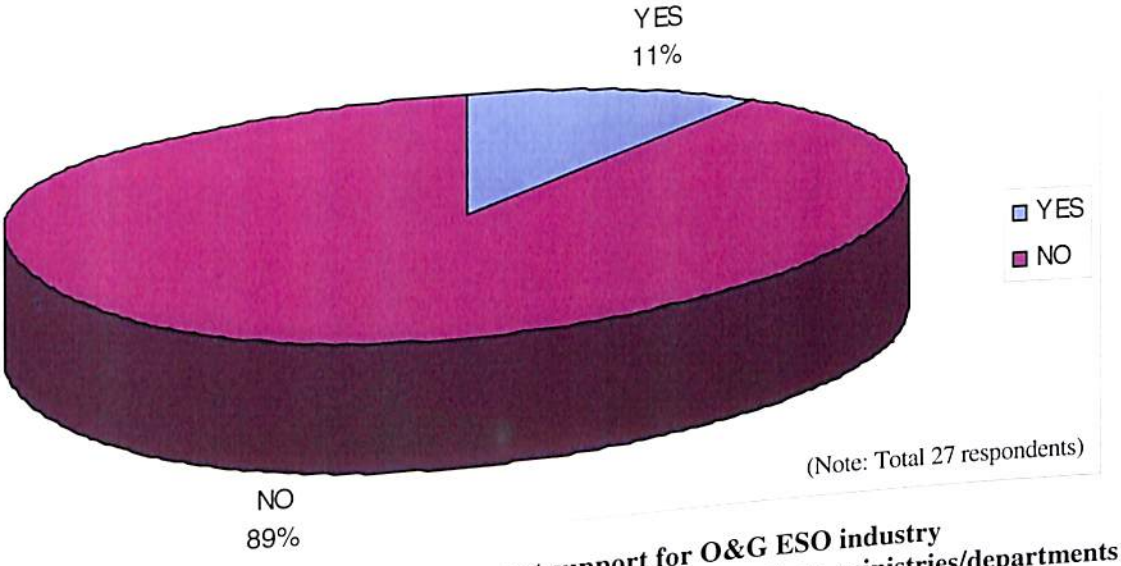


Figure 6.7: Phase-II Survey result on Government support for O&G ESO industry
Question: Do you think the Government of India and its various ministries/departments recognise the potential of the O&G ESO industry and are supporting the industry adequately?

A detailed study of 25 key Indian O&G ESO service players corroborated the survey results that most Indian O&G ESO players are currently engaged in rendering 'low' and 'medium' complexity services. Other points that emerged in the study of the 25 key Indian O&G ESO players are that Indian O&G ESO industry is currently focusing on supply of resources at a lower cost to OFS companies, EPCs and detailed engineering consultants for overseas onsite projects. United States and Western Europe are the main revenue sources for Indian O&G ESO service providers; however a few players are expanding to other regions including Middle East, Africa and Eastern Europe. All the companies that were studied are deploying resources for onsite projects and this formed a significant chunk of their revenues. Only four companies out of the list of 25 that were researched – Shell Global Solutions, GE John F.Welch Technology Centre, Honeywell India Limited and Emerson Electric Co. Ltd. - are focusing on cutting edge research and innovations from their Indian centres. Most companies are focusing on global project

implementation but not covering the full-service required throughout the O&G asset life cycle. There are, however, a few companies like Shell Technology India, Uhde India Private Limited and Lurgi Services that are providing asset care services for O&G end user companies during the asset operational phase. The complete list of companies that were studied are:

1. Aker Solutions Limited
2. Toyo Engineering India Limited
3. Technip India Limited
4. Uhde India Private Limited
5. Jacobs Engineering Group Inc
6. Saipem India Projects
7. Lurgi India Company Ltd
8. Fluor Daniel India Limited
9. Foster Wheeler India Limited
10. Shell Technology India
11. Bechtel India Limited
12. Halliburton India Limited
13. Schlumburger India Limited
14. Mott MacDonald India Limited
15. GE John F.Welch Technology Centre
16. Emerson Electric Company Limited
17. ABB Global Industry and Services Limited
18. Honeywell India Limited
19. Tecnimont ICB Limited
20. Infosys-Alstom R&D Centre
21. Shaw Rolta Limited
22. Engineers India Limited
23. QuEST Global Solutions Limited
24. Tata Consultancy Services Limited
25. Punj Lloyd Limited

In the list above, companies from serial numbers 1 to 18 are Captive units of their overseas principals. Captive units comprise the units of international engineering and design firms. These offshore captive centres were originally set up to take advantage of cost arbitrage, but over time, are being seen as complementary to other global centres. Captives are independently managed and work on projects for its business units globally. Companies 19 to 21 are strategic alliances or joint ventures of an overseas company with an Indian partner. In addition to the Captive players and Joint venture service providers, India also has a third category of companies e.g. QuEST Global Solutions Ltd, Tata Consultancy Services (TCS) and Punjj Lloyd Limited that provide ES to the O&G industry. Indian software companies have successfully carried out outsourcing in other fields such as IT and Automotive industry and these have served as examples for the new entrants into the O&G ESO service provider industry in the last one decade. This outsourcing has been enabled by India's vast supply of relatively less expensive engineering talent suitable for the outsourcing industry. For instance, TCS and QueST Global Solutions originally started off as IT Outsourcing service providers but have later on expanded to KPO services and have ventured into O&G ESO as a niche area where they are focusing on expansion. These companies (22 to 25 above) are termed as third party units or O&G ESO vendors. Out of the above, Engineers India Limited (No.22 in the list above) is the only Government owned and controlled company with a very long track record of over 45 years. All these companies operate either in Tier-1 cities (Metros – Delhi, Mumbai, Kolkata, Chennai, Hyderabad and Bangalore) or in Tier-2 cities (Pune, Kochi, Vadodara, Noida, Chandigarh etc.) or in both in some cases. A brief of each of the company listed above is given below. All revenue figures of companies listed in this section are based on 2008 financial results.

1. Aker Solutions Limited

Aker Solutions ASA, headquartered at Norway operates in India out of its offices at Mumbai, Pune, and Kakinada through its subsidiary Aker Powergas Private Limited. This subsidiary has been operating in India for over fifty years. Aker Powergas provides engineering and construction management services to the O&G, power, process and metals sectors. From initial concept through technology development,

process technology application, design, procurement, construction, commissioning and modification, Aker Powergas provides customers with a wide range of asset lifecycle services. In total, the Indian subsidiaries employ over 1500 engineers.

2. Toyo Engineering India Limited

Toyo Engineering India Ltd (Toyo India) was established in 1976 by Toyo Engineering Corporation (Toyo Engineering - Japan). During early days, Toyo India was primarily supporting Toyo Engineering Japan for their Middle East and India projects. Toyo India is today a professionally managed corporate entity undertaking EPC, Project Management Consultancy (PMC) or Erection Procurement and Construction Management (EPCM) project assignments. Toyo India executes medium and large size projects predominantly for O&G and Petrochemicals. The participation in such Indian and overseas projects, is either independently or through consortium approach in addition to the support to Toyo Engineering - Japan for their third country projects under Global Toyo operations. The company employs over 2500 people out of which an estimated 2000 staff are engineers.

The range of services provided by Toyo Engineering India Limited include:

- Feasibility Studies and Detailed Project Report (DPR): Preparing DPR or Budgeted cost estimation for the intended project. Typically activities for such services comprise of technology selection, market survey for raw material and product, site selection, cost estimation: capital expenses, running / operating costs and economic feasibility studies.
- Process Design and Front Engineering Design (FEED): Toyo India provides process design and basic engineering package for open art process units.
- Engineering (Basic and Detailed): Conceptual design, Front-end engineering, Basic and detailed engineering with Computer Aided Design (CAD) capability on Autocad, Autoplant, Plant Design Solution (PDS) & several other bought out as well as in house software, covering the disciplines of Process, Instrumentation, piping, Mechanical, Electrical & Civil.
- Procurement or Procurement Management: In EPC contracts on Lump Sum Turn Key (LSTK) basis, Toyo India procures and supplies all goods and services

required for the successful execution of the project. Typical activities include issue of enquiry, bid tabulation and evaluation, placement of orders and payment, transportation, insurance, customs clearance, inspection and expediting. In EPCM type of project implementation methodology Toyo India provides procurement services to the client. This generally includes all procurement activities except issuing purchase order and payments. The client takes the responsibility of issuing purchase order and payments.

- Construction or Construction Management: In EPC-LSTK type of contracts, the complete construction activity for the project is undertaken by Toyo India. This responsibility is managed by in-house construction planning department in association with competent and suitable sub-contractor for actual site construction work. Typical activities include co-ordination with client and contractors, civil work and underground piping, installation and erection of equipment, piping and systems, instrument, electrical, insulation and painting work, safety enforcement, field inspection, stores management and material reconciliation.
- Project Management: Conceptual planning, Site Survey, Co-ordination with Licensers, Kick-off Meeting, Launching Meeting, Project Schedule, Budget & Cash Flow, Construction Planning, Selection of Vendors, Engineering co-ordination with Licensers, Vendor Drawing Review and Approval, Materials Management, Construction and Commissioning.

3. Technip India Limited

Backed by 50 years of experience, expertise and know-how of its teams, Technip is a key contributor to the development of technologies and sustainable solutions for the exploitation of the world's O&G resources. Technip provides ES in three segments of the world O&G market - Subsea, Offshore and Onshore. This market represents 97% of the group's global revenues. On behalf of its clients, for the most part IOCs and NOCs; Technip executes infrastructure projects that are increasingly ambitious, complex and demanding: ultra-deep waters, extreme climates, mega-sized projects, non-conventional resources and optimization of environmental performance. In India Technip started operations in 1998 and operates out of its offices at Mumbai, New Delhi and Chennai.

4. Uhde India Private Limited

Uhde India Private Limited combines the expertise, innovation and experience of a worldwide network of offices to provide global capability to serve the upstream and downstream O&G sectors, from upstream production and processing though gas pipelines and LNG / LPG extraction to downstream refining. Uhde India Private Limited provides services to support clients through all phases of the project lifecycle; from concept development, sourcing of technology, feasibility assessment and delivery of projects using a range of contract models through to ongoing support to plant operations and identification of opportunities for further plant improvements. Uhde is one among the few Indian O&G ESO players that provides asset management services during plant operation phase. As a major technology supplier and contractor in the chemical and petrochemical industries, Uhde India Limited assists customers with the supply of technologies and plants for the processing of natural gas and refinery products to a wide range of further products including hydrogen, ammonia, methanol, synthetic fuels, aromatics, olefins and polymers. The company started operations in India in 1979 and has offices at Mumbai and Pune.

5. Jacobs India Limited

Jacobs India Limited provides full-service engineering, design, construction, modular fabrication, maintenance, and construction management services to clients in the upstream areas of E&P. The company also provides consulting services, process assessments, facility appraisals, feasibility studies, technology evaluations, project finance structuring and support, and multi-client subscription services in the areas of Offshore platforms, Heavy oil processing (e.g. Oil sands thermal extraction projects), Oil recovery through steam injection, Gas treating, Gas gathering, Gas storage including extraction of commercially valuable elements of the gas stream. A renewed market focus for the company is offshore production, where Jacobs is actively pursuing and winning project opportunities in engineering and design of topside facilities. The company started operations in India in 1993 and has offices at Mumbai, Ahmedabad, Navi Mumbai, Vadodara and New Delhi.

6. Saipem India Projects

Saipem is one of the largest and best balanced turnkey contractors in the O&G industry and finds place in the Top 10 O&G contractors in the McGraw-Hill Construction ENR 2008 report. The organisation, while providing specialised services and maintenance, modification and operations - has been rationalised into three global business units: Onshore, Offshore, Drilling. It enjoys a superior competitive position for the provision of EPIC/EPC services to the oil industry both onshore and offshore; with a particular focus on the toughest and most technologically challenging projects - activities in remote areas, deepwater, gas, difficult oil. Saipem's drilling services continue to be distinctive, operating in many of the O&G industry's 'hotspots', frequently in synergy with the Group's onshore and offshore activities. Along with its strong European content, the major part of its human resource base comes from developing countries. Saipem employs over 30,000 people comprising more than 100 nationalities. Saipem's India operations started in 1983 and currently has offices at New Delhi and Chennai.

7. Lurgi India Company Ltd

Lurgi is a leading international technology company operating in the field of process engineering and plant contracting having an order intake of more than GBP 1.3 Billion. For more than hundred years Lurgi has been building process plants all over the world. In the course of the life cycle of a plant, the marginal conditions, the feed materials, product quality, energy and environmental conditions are increasingly undergoing substantial changes. The Lurgi customer service function, Lurgi Services, which operates in India from New Delhi, offers plant operators all necessary services in order to meet all these requirements. Customer service function comprises the continuous plant care based on service contracts and projects to complete revamps, from plant audits through to studies including consultancy, market studies, prefeasibility and feasibility studies, product marketing, financial engineering, countertrade, contracting, global sourcing, global engineering, project management and construction.

8. Fluor Daniel India Limited

With more than 42,000 employees deployed on projects in more than 70 countries, Fluor Inc has the global expertise to deliver projects with focus on quality and safety

its clients expect. Fluor provides EPCM and project-management services to global clients in diverse industries, predominantly O&G. The company's India operations are based out of Gurgaon near New Delhi. The India centre provides design, engineering, and construction management support to Fluor projects in every part of the world. Capabilities include - 3D design and automation tools, Full-service engineering, procurement, and project management capability, FEED, feasibility studies, estimating, detailed engineering, procurement, project management and site support services.

9. Foster Wheeler India Limited

Foster Wheeler AG is a global engineering and construction contractor employing over 14,000 employees with specialized expertise for O&G projects. Foster Wheeler has over hundred years of experience and has highly skilled personnel providing services worldwide to design, engineer and construct leading-edge processing facilities and related infrastructure for the upstream O&G, LNG and gas-to-liquids, refining, chemicals & petrochemicals, pharmaceuticals, biotechnology & healthcare, environmental and power industries. Foster Wheeler's Indian operation was initially established in Chennai by Foster Wheeler Global Power Group in the year 1998 with a focus on energy projects. Since then, Foster Wheeler India has grown tremendously, not only in size, but in the scope of work it executes. The Indian operation is an integral part of the group's Global Engineering and Construction Group and, since January 2005, is being sponsored by the UK headquarters of the company. In November 2006, the company opened a centre in Kolkata and in May 2009 the company started a new office at Gurgaon. Using an effective work-share execution methodology, Foster Wheeler India has executed over 4 million manhours of work since 2005 on projects around the world, in O&G upstream, midstream, LNG, refining and chemicals. Foster Wheeler India employs about 1,500 employees in its three Indian centres put together.

10. Shell Technology India

Shell Technology India (STI) is part of Shell Global Solutions and delivers technology and consultancy to help executives in the energy and processing industries

to address the strategic and operational issues that lie ahead. Formed in 2006, this centre, takes its place alongside Shell's leading technology centres in Westhollow, Houston, USA, and in Amsterdam and Rijswijk, the Netherlands. STI is currently rapidly building up its staff and employs over 600 professionals who cover the full range of scientific, engineering and technical disciplines. These professionals are involved in delivering advanced technical studies, projects and services for Shell and Shell clients worldwide and supporting the group's activities in India. Services span upstream exploration and production activities, and downstream chemical, gas and refinery operations. STI is also developing niche areas of technical work with the objective of becoming a centre of excellence in these fields. The activities of the centre include cutting-edge downstream R&D and working with the latest upstream technologies and processes. STI has established ties with leading research institutions to conduct R&D in energy, and will continue to build close working links with industry and academia.

11. Bechtel Corporation India Limited

For more than 30 years, Bechtel has been a worldwide leader in chemical, petrochemical, and LNG plant construction. With client focus and a broad range of technologies, Bechtel has built over 375 refining and chemical projects. Bechtel provides industry-specific expertise for site development, process design, project management, EPC, and start-up for clients in the O&G industry as also a wider range of other industry verticals like Food and beverage, specialty chemicals and Biotechnology. Bechtel India is located at New Delhi and supports Bechtel offices globally for detailed engineering and design services.

12. Halliburton India Limited

Halliburton serves the Upstream O&G industry throughout the life cycle of the reservoir - from locating hydrocarbons and managing geological data, to drilling & formation evaluation, well construction & completion, and optimizing production through the life of the field. Halliburton has O&G ESO centres in New Delhi and Pune. The centre mainly provides resources for pre-commissioning, commissioning, maintenance and decommissioning services to the group's O&G pipeline, onshore,

offshore and power plant projects. Halliburton Pipeline and Process Services is unique within the industry as being the only company that can provide the complete range of services required for a major pre-commissioning project or major shutdown from the company's own in-house personnel and equipment resources. The India centre provides skilled resources for rendering these services to the company's Global headquarters.

13. Schlumburger India Limited

Schlumberger Limited is the world's largest OFS corporation operating in approximately 80 countries, with about 80,000 people of 140 nationalities. Schlumberger supplies a wide range of products and services from seismic acquisition and processing to formation evaluation, well testing and directional drilling, well cementing and stimulation, artificial lift, well completions and consulting, and software and information management. The company has centres in Gurgaon and Mumbai in India that provides trained and skilled resources for projects worldwide.

14. Mott MacDonald India Limited

Mott MacDonald is a global consultancy with a turnover of GBP 1 Billion and unrivalled diversity. The company provides leading-edge solutions for public and private sector clients across twelve core business sectors the primary source of revenue being O&G and the energy vertical. The company employs over 14,000 staff globally and has established offices in over forty countries and delivered projects in a further hundred countries. The company started operations in India in 1973 and has offices in Mumbai, Kolkata, Ahmedabad, Bangalore, Chennai, Kochi, Delhi and Hyderabad. The O&G design centres of the company are located at Mumbai and Kochi in India. Project design and engineering is the core capability of Mott MacDonald in India, working on front end and basic engineering including process design, detailed engineering, developing specifications for items & packages, quantity take-off & construction tenders, design-construct implementations and quality checks during construction. Much of the design capability is process-based and both inside battery limits as well as outside. This capability is combined with a proven track record in industrial advisory and asset valuation, providing the potential to serve customer's needs right from planning and market analysis through to commissioning.

15. GE John F. Welch Technology Centre

The John F. Welch Technology Centre (JFWTC) in Bangalore, India, is a multi-disciplinary R&D centre that expands GE's research and development capabilities, accelerating the company's delivery of advanced technology to its global customers. The Centre collaborates with GE's three other R&D facilities that form the GE Global Research team (the Research Centre in Schenectady, NY; Munich, Germany; and Shanghai, China) to conduct research, development and engineering activities for all of GE's diverse businesses worldwide. Research in energy, O&G and alternative energy sources forms the key charter of the Indian centre. Drawing on India's unique multi-disciplinary skills - from mechanical and electrical engineering to polymer science and chemical engineering - the Centre incorporates the latest technology and e-engineering tools to facilitate real time global interaction with GE's businesses, technology centres, customers and suppliers. The centre, inaugurated in September 2000, is home to state-of-the-art laboratories working on R&D in the areas of mechanical engineering, electronic & electrical system technology, ceramics, metallurgy, catalysis & advanced chemistry, chemical engineering & process, polymer science & new synthetic materials, process modelling & simulation, power electronics and analysis technologies. The 545,000 square feet centre has filed for more than 185 patents for R&D and been granted 12 till end 2008. In addition to the GE Global Research activities, the JFWTC is also home to technology teams from other GE organizations including GE Advanced Materials, GE Consumer & Industrial, GE Energy, GE Transportation and GE Healthcare.

16. Emerson Electric Company Limited

Emerson has five captive centres in India to support its global operations - two in Pune, one in Chennai, one in Chandigarh and one in Noida. In contrast to many other MNCs that have concentrated their India operations in one location Emerson has chosen to be multi-locational. The reasons for the five centres are need talent availability and proximity to operating centres. The work done from the Pune, Chennai and Noida centres are primarily in engineering design and support. The centre at Chandigarh provides back end IT support for the group's operations

worldwide. Put together, over 1700 engineers work in the Engineering design centres at Pune, Chennai and Noida and over a 1000 out of them are directly related to O&G projects or product designs that are ultimately deployed in the O&G industry.

17. ABB Global Industry and Services Limited

ABB has its Corporate Research centre and a Global Engineering & Procurement centre at Bangalore under the umbrella of ABB Global Industry and Services Limited. The Corporate Research Centre's goal is to carry out both research and software development activity to support ABB's Industrial automation systems that are primarily used in O&G upstream and downstream sites. The research centre, employees a little in excess of 300 engineers and the global engineering centre has another 500 engineers. The global engineering centre provides resource support to O&G and life sciences and metals projects globally and carries out implementation and post implementation support for front-end offices in other countries. Put together the Research centre and the engineering centre employs over 400 engineers who are employed for the O&G domain.

18. Honeywell India Limited

Honeywell Technology Solutions Lab (HTSL) is a captive global engineering and technology centre of excellence providing technology, product and business solutions for Honeywell Inc, USA. HTSL has offices in Bangalore and Madurai in India. Honeywell also has a Global Engineering Centre at Pune that provides software and service support for Industrial automation projects for Honeywell offices worldwide. Put together, both these centres employ around 500 engineers who work for the O&G vertical - either in product design or in project engineering and implementation.

19. Tecnimount ICB Limited

Headquartered in Mumbai, Tecnimont ICB (TICB) a wholly owned subsidiary of Tecnimont S.p.A Italy, an integral part of the Maire Tecnimont Group, is a premier Engineering, Procurement and Construction (EPC) company having varied capabilities and vast experience to execute large and complex projects worldwide on Lump-sum turnkey (LSTK) basis. The company caters to a wide spectrum of business sectors that mainly includes O&G, chemicals & petrochemicals, refineries, fertilizers,

energy, civil engineering and infrastructure, from 'concept to commissioning' backed up by over five decades of experience in multi discipline engineering services.

20. Alstom-Infosys R&D Centre

Alstom teamed up with Infosys, the Indian global consulting and IT services major to set up an R&D centre at the latter's campus in Bangalore. Created on the strength of a multi-year relationship, the R&D centre provides engineering solutions that give Alstom a competitive edge, leveraging Infosys's Global Delivery Model (GDM) for rapid design and deployment, thereby reducing time-to market. These solutions, by using new materials, increase the life span and efficiency of mechanical components, thus improving performance and cost effectiveness. The products designed will be primarily used by energy industry client's that are Alstom's primary customers.

21. Shaw Rolta Limited

Shaw Rolta Limited (SWRL), a joint venture company between The Shaw Group Inc., USA and Rolta India Limited, offers engineering and design, procurement and construction management services for refinery, petrochemicals, and power projects in India. In addition, SWRL offers engineering and procurement support services for projects worldwide to its affiliate companies Shaw Energy & Chemicals Group and Shaw Power Group. With a heritage of more than a century of experience and a strong local presence, SWRL is ideally positioned to deliver solutions to the petrochemical, refinery and power industries. SWRL is one of the fastest growing EPCM companies in India providing ES to a large number of customers in India as well as across the globe through Shaw offices globally. SWRL leverages Shaw Group's leadership and expertise of more than 115 years in Process and Power industries.

SWRL offers customers integrated project services, combining Shaw Group's expertise and Rolta's advanced engineering design automation capabilities to create a vertically integrated organization providing a unique blend of talent, technology and resources. SWRL has access to Shaw Group's proprietary technologies for the development, consulting, engineering and construction of process plants for olefins, polymers, refining and power plants. SWRL is equipped with a large range of the

latest design automation software tools for process engineering calculations, process optimization, simulation, modelling and CAD. The full range of ES provided by SWRL is illustrated in Figure 6.7.

Figure 6.8: Range of O&G ESO services provided by Shaw Rolta Limited
Source: Company website, *http://www.rolta.com/rolta-stone-webster*

22. Engineers India Limited

Engineers India Limited (EIL) was established in India by the Government as early as 1965 to provide engineering and related technical services for petroleum refineries and other industrial projects. In addition to petroleum refineries, with which EIL started initially, it has diversified into and excelled in other fields such as pipelines, petrochemicals, oil and gas processing, offshore structures and platforms, fertilizers, metallurgy and power. EIL now provides a complete range of project services in these fields and has emerged as Asia's leading design and engineering Company. Engineers India Limited is diversifying into several new areas including Highways & Bridges, IT, Airports, Mass Rapid Transport Systems, Ports & Terminals, Power Projects, Non-conventional / Renewable Energy Sources, Specialist Materials and Maintenance Services, Intelligent Buildings, Water and Urban Development projects. However, its main revenue source still remains O&G upstream and downstream verticals.

23. QuEST Global Solutions Limited

QuEST Global Solutions is a leading provider of diversified engineering services to customers in the aerospace, consumer electronics, healthcare, industrial products,

marine, nuclear engineering, O&G, power generation, and transportation verticals to cut product development costs, shorten lead times, extend capacity and maximize engineering resources availability by providing support across the complete product life cycle from design and modelling through analysis, prototyping, automation, data documentation, instrumentation and controls, embedded systems development, manufacturing support, vendor management, and in-house precision machining. Through its Global Product Development (GPD) framework and the on-site/off-shore/on-shore models, QuEST leverages local presence and global reach to support globalization initiatives for its customers. QuEST Global employs over 1700 professionals and has delivery centres in India, USA, Italy, Japan, Germany, France and footprints in UK and Spain. Figure 6.9 illustrates the range of services QuEST provides to global customers in the O&G domain.

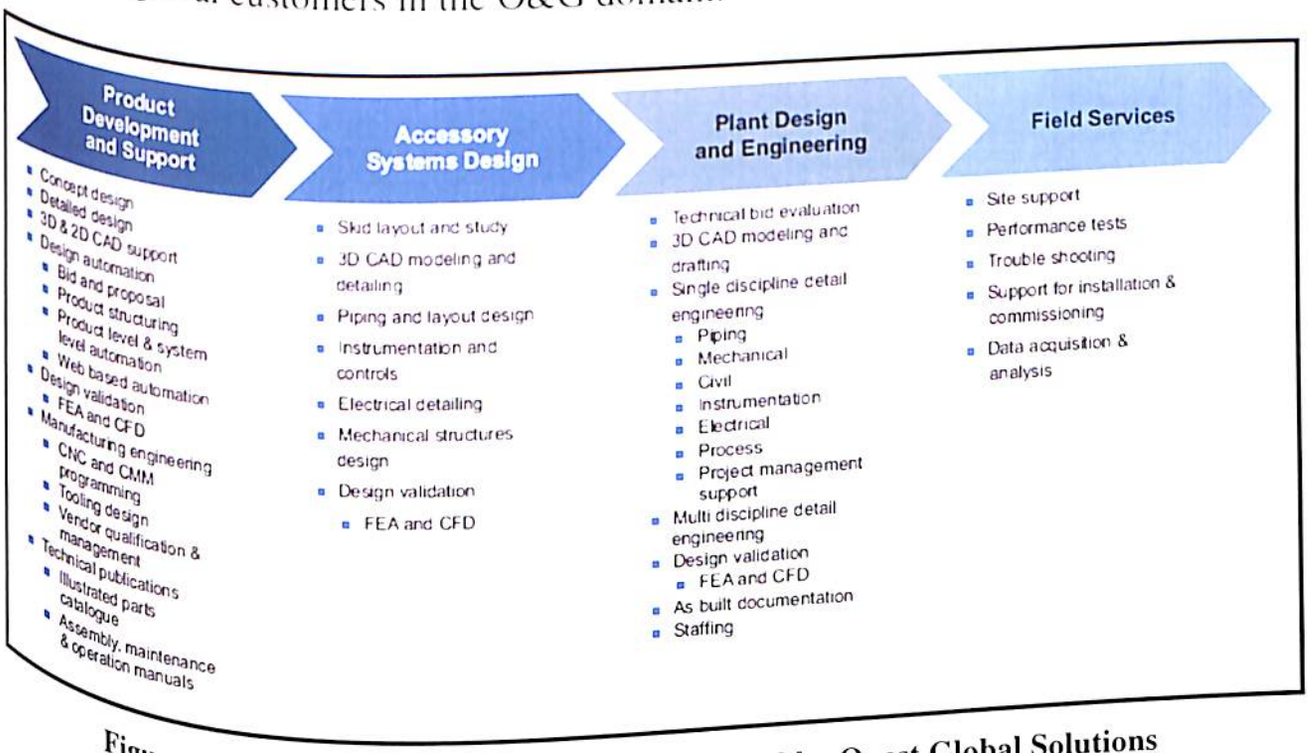


Figure 6.9: Range of O&G ESO services provided by Quest Global Solutions
Source: Company website, *http://www.quest-global.com*

24. Tata Consultancy Services Limited (TCS)

Established in 1968, Tata Consultancy Services has grown to its current position as the largest IT services firm in Asia based on its record of outstanding service, collaborative partnerships and innovation. In addition to IT services TCS also offers a wide range of KPO and ESO services to its global clients. The plant solutions and services division renders services for the O&G domain by providing plant design engineering, control automation engineering, digital manufacturing solutions,

Manufacturing Execution & Intelligence (ME&I), Integrated Asset Management (IAM), sourcing solutions, process optimization solutions like process benchmarking studies, development of customized plant-wide Information Management Systems (IMS) & Advanced Process Control (APC) optimization solutions for the O&G industry.

25. Punj Lloyd Limited

Punj Lloyd Limited is a transnational company based in India specializing in the energy and infrastructure sectors. Its operations spread across the Middle East, Africa, the Caspian, Asia Pacific and South Asia. Punj Lloyd is into Engineering, procurement, fabrication and installation of offshore wellhead and process platforms including topsides and jackets, risers, submarine pipelines, underwater cables and single buoy mooring systems. The company also undertakes EPC contracts for Onshore field development and Gas processing from wellhead to finished product including transportation, gas liquid separation and treatment, liquid recovery and fractionation, compression and liquefaction, LNG storage and re-gasification. Other areas of operation are in planning, design, engineering and construction services for civil infrastructure, pipelines, tanks and terminals and Power plants. The company has recently forayed into value added services like Industrial Operation and Maintenance (O&M), commissioning/start-up services, safety audit cum procedures recommendation services, quality procedures assessment, audit cum redefinition services and asset preservation and management for non-operating units, re-commissioning, clean-up and re-start services. The Plant & facility Management arm oversees the preservation and maintenance of distressed assets or plant and machinery under litigation. In December 2006, Punj Lloyd Limited set up a new company for carrying out back office engineering activities for the Punj Lloyd Group in India. Simon Carves India Limited - the new company is a wholly owned subsidiary of Punj Lloyd Ltd., catering to the Group's captive engineering requirements. The company has specialised verticals for O&G to provide offshored engineering services for the group's projects across the globe.

A summary of the profile of the above companies are presented in table 6.2.

Table 6.2: Profile of 25 Indian O&G ESO players

S.No.	Name of O&G ESO service provider company	Type – Captive/JV/Third-party Vendor	Global revenues of parent company (Year 2008)	Parent company Headquarters location	Location of O&G ESO offices in India	Countries for which O&G ESO service rendered from India centre
1	Aker Solutions Ltd.	Captive	58.25 Billion NOK	Norway	Mumbai, Pune, Kakinada	Norway
2	Toyo Engg. India Ltd.	Captive	3.32 BUSD	Japan	Mumbai, New Delhi	Japan, Middle East
3	Technip India Ltd.	Captive	7.5 BUSD	France	Mumbai, New Delhi, Chennai	France, Italy, Germany,USA, Malysia, Australia, Egypt
4	Uhde India Ltd.	Captive	2.61 BUSD	Germany	Mumbai, Pune	Egypt, Switzerland, Saudi Arabia, Oman, Taiwan, Philippines, Germany, South Africa
5	Jacobs India Ltd.	Captive	4.36 BUSD	USA	Ahmedabad, Mumbai, Navi Mumbai, Vadodara, New Delhi	USA, Asia Pacific & Western European countries
6	Saipem India Ltd.	Captive	5.17 Billion Euro	Italy	Chennai, New Delhi	Middle East, Asia Pacific, Europe
7	Lurgi India Company Ltd	Captive	13.1 BUSD	Germany	New Delhi	Germany, Poland, India, USA, South Africa
8	Fluor Daniel India Ltd.	Captive	3.36 BUSD	USA	Gurgaon	All over the world
9	Foster Wheeler India Ltd.	Captive	1.42 BUSD	Switzerland	Chennai, Kolkata, Gurgaon	All over the world
10	Shell Technology India	Captive	458.36 BUSD	Netherlands	Bangalore	All over the world
11	Bechtel India Ltd	Captive	2.22 BUSD	USA	New Delhi	All over the world
12	Halliburton India Ltd.	Captive	1.51 BUSD	USA	Mumbai, Pune	Primarily Asia Pacific
13	Schlumburger India Ltd.	Captive	27.16 BUSD	France	Gurgaon, Mumbai, New Delhi	All over the world
14	Mott MacDonald India Ltd.	Captive	900 Million GBP	UK	Mumbai, Kochi	USA and Western Europe
15	GE John F. Welch Tech. Centre	Captive	113.38 BUSD	USA	Bangalore	USA, Germany

S.No.	Name of O&G ESO service provider company	Type – Captive/JV/Third-party Vendor	Global revenues of parent company (Year 2008)	Parent company Headquarters location	Location of O&G ESO offices in India	Countries for which O&G ESO service rendered from India centre
16	Emerson Electric Co. Ltd.	Captive	24.8 BUSD	USA	Pune, Chennai, Noida	All over the world
17	ABB Ltd.	Captive	34.91 BUSD	Switzerland	Bangalore, Chennai	All over the world
18	Honeywell India Ltd.	Captive	36.55 BUSD	USA	Bangalore, Pune	All over the world
19	Tecnimount ICB Ltd.	Joint Venture	1.6 Billion Euro	Italy	Mumbai, New Delhi	Asia, Europe, Middle East America
20	Infosys R&D Centre (with Alstom)	Joint Venture	18.7 BUSD	France	Bangalore	All over the world
21	Shaw Rolta Ltd.	Joint venture	2.26 BUSD	USA	Mumbai	All over the world
22	Engineers India Ltd.	Third party vendor	4.07 BINR	India	New Delhi, Navi Mumbai, Kolkata, Chennai, Vadodara	All over the world
23	QuEST Global Solutions	Third party vendor	4.5 BINR	USA	Bangalore	USA, Italy , Japan, Germany, France, UK, Spain
24	Tata Consultancy Services	Third party vendor	189.79 BINR	India	Mumbai, Pune, Bangalore	All over the world
25	Punj Lloyd Ltd.	Third party vendor	454.17 BINR	India	Gurgaon, Hyderabad, Mumbai	Middle East, Africa, Caspian, Asia Pacific, South Asia

Source: Company Annual Reports, Company Websites, Expert Interviews