
CHAPTER-7

CONCLUSION AND FUTURE RESEARCH

7.1 Strategic Growth Options for India's O&G ESO Industry & Recommendations to the Government	207
	243
7.2 Overall Conclusions of this Study	245
7.3 Limitations of this Study	246
7.4 Contributions of this Study	246
7.5 Future Directions of Research	

CHAPTER-7

CONCLUSION AND FUTURE RESEARCH

The task before me was to chart a vision and recommend a suitable strategy for sustaining and developing the O&G ESO industry in India with concrete and implementable recommendations/action points for making the industry globally competitive. While drafting the recommendations, a well-rounded analysis of the industry has been done - small, medium and large players have been included in the study as also a mix of Captive, Strategic alliance/joint ventures and Third party/Vendor units.

This chapter distils the issues discussed in earlier chapters and also examines the strategic growth options for India's O&G ESO service provider industry based on Survey results in Phase-II of the study so that a clear lead can be maintained over existing and emerging players from competing nations. The action points that emerged out of the discussions, interviews and surveys with the 35 industry experts (18 in Phase-I, 27 in Phase-II out of which 10 were common in both Phase-I and II studies) are expanded in this chapter to provide a comprehensive set of recommendations to the Industry and policy makers so that the available market opportunity is addressed in the best possible manner by Indian O&G ESO players.

Sub-sections 7.1.1 and 7.1.2 of this chapter cover the results of the Objective Nos. 5 and 6 listed in Section 1.3 of Chapter-1. The overall conclusion of this study is presented in Section 7.2. The chapter ends with the limitations of the study, contributions and directions for future research which are covered in Sections 7.3, 7.4 and 7.5 respectively.

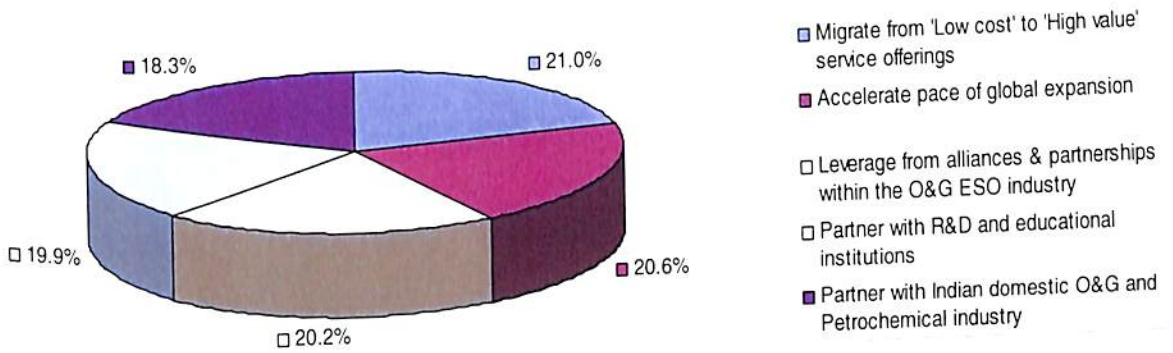
7.1 STRATEGIC GROWTH OPTIONS FOR INDIA'S O&G ESO INDUSTRY & RECOMMENDATIONS TO THE GOVERNMENT

What are the strategic growth options available to India's O&G ESO industry? It is important for both policy makers in the Government as also the players in the Indian O&G ESO industry to know this so that they develop or modify their strategies to

ensure robust growth in this area. The following two subsections lists a five-point action plan each for the O&G ESO industry and Government as the key steps required for India to gain maximum market share of the O&G ESO business.

7.1.1 Action Points for the O&G ESO Industry

I present herewith the findings on the key action points for the O&G ESO service provider industry that have been identified in consultation with industry experts in the Phase-II survey. 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.



Note: Weighted score in % of Total 27 respondents

Figure 7.1: Phase-II Survey result on action points for the Indian O&G ESO industry
Question: In your opinion what is that the O&G ESO service provider industry in India must do in order to maintain and further expand its market share against competing nations?

These action points mentioned below form the five strategic growth options for the Indian O&G ESO service provider industry and are the findings against Objective No. 5 of this study as mentioned in Section 1.3 of Chapter-1.

1. Migrate from 'Low Cost' to 'High Value' Service offerings
2. Accelerate pace of global expansion

3. Leverage from alliances & partnerships within the O&G ESO industry
4. Partner with R&D and educational institutions
5. Partner with Indian domestic O&G and Petrochemical industry

The above proposed strategic growth options are detailed below.

Strategic Growth Option No. 1: Migrate from 'Low Cost' to 'High Value'

Service offerings

The fact that India has been able to provide relatively good quality services has distinguished it vastly from other competing countries sought by end-user companies and overseas consultants for O&G ESO outsourcing. However, there is an increasing demand to increase offshoring of service lines involving higher value-added activities, such as conceptual design, product development, technical support and R&D. India's wage differential with other low cost competitors is fast diminishing and unless concerted efforts are put in by the industry players to move up the value chain it would be extremely challenging to sustain India's value proposition and attractiveness as a hub for O&G engineering and technology. Moving up the value chain by building consulting expertise, innovation engineering and R&D base is a must to create value positioning. What is required is to adopt a business model that can add strategic value to the end users. There is more savings for end-users and buyers at the higher end of the value chain as compared to the low end. Developed economies such as the USA, the UK, and Western European countries are already facing a shortage of highly trained and specialized professionals in high end knowledge-intensive sectors. Earlier talent from low-wage developing countries which produce highly educated scientists and professionals could be sourced. This has been the practice in countries like the USA for the past several decades. The USA permits emigration of engineers and scientists from developing countries such as India and China. However, with tighter visa regulations in the developed countries and cost-reduction pressures on MNCs, global offshoring of high-end services to low-wage countries to tap the existing talent pool in a cost effective manner is a more viable and lucrative

option. Also, current low-cost destinations may no longer remain low-cost due to increase in salaries and hence, may not be able to provide cost-arbitrage benefits to companies that want to offshore these services. For example, Indian salaries have increased at an average of 14 percent per year from 2000 to 2007. If this trend continues, they are expected to increase 2.5 times the current salaries (in constant Dollars) by FY 2015, thereby reducing the cost-arbitrage benefit from the present 40 to 25 percent. Indian O&G ESO service providers must focus on providing value-added specialty engineering services, engineered and fabricated systems, design of key process equipment, start-up services and provide ongoing technical support services. Indian O&G ESO industry must transform from being a basic engineering service provider to an Integrated Solutions Provider that can also provide consulting solutions.

O&G ESO players in the country should focus on expanding the service basket and value added services by moving ahead in the value chain. There is a need for India to start concentrating on the knowledge arbitrage instead of labour arbitrage by providing 'High Value' services. A list of 'High Value' services that Indian O&G ESO Industry can aim to provide in the near term are listed in Table 7.1. The list has been compiled from in-depth interviews with industry experts.

Table 7.1: List of proposed 'High Value' services for the Indian O&G ESO industry

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
1	Multi-disciplinary	Technical Consultancy	<p>Provide technical recommendations and solutions to end-user O&G upstream and downstream companies to minimize manufacturing and processing problems that can lead to frequent plant trips that result in significant production loss. Product development and support is another area where services could be provided since this requires extensive resources. Many end users are experiencing difficulties in finding the time to investigate or generate new, innovative products whilst maintaining a strong operational availability. The service could be about identifying batch-to-batch variation in product, identifying unknown deposits (e.g. foreign elements in lubricants), off-spec analysis of end product etc. The service could extend to providing analytical services to identify new technology and innovation opportunities, process improvements, identification of design improvements and product testing.</p>
2	Multi-disciplinary	Technical Consultancy	<p>Provide services for performance improvement programme using Benchmarking techniques. This is a starting point for a deeper analysis of strengths and weaknesses, and helps identify valuable opportunities for improvement. All O&G upstream and downstream facilities have different strengths and weaknesses across their operations. This prospective service is about identifying improvement opportunities and making recommendations regarding the thrust areas for gap closure. This requires multi-disciplinary skill set opportunity and the scope could cover providing services in the following areas:</p> <ul style="list-style-type: none"> • Health and safety • Personnel Asset management • Operating costs • Asset utilisation and availability • Production and energy • Environmental impact analysis
3	Multi-disciplinary	Technical Consultancy	<p>Provide services for Business improvement projects leveraging the combined experience and expertise of O&G ESO principals, service providers and end user companies. The scope includes identifying performance gaps and improvement opportunities in key business areas and setting the financial case as the first step. The next step could be to deliver an integrated business improvement plan and managing the flow of the change process by building upon progressive short term improvements that help create momentum and sustainable improvements that are long lasting. A repository of such solutions could be maintained and used for other client locations.</p>

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
4	Civil engineering	Technical Consultancy	<p>Provide consultancy services on civil structures so as to help end-user O&G companies defer / reduce / avoid capital expenditure and reduce operating and maintenance costs. Key services could include:</p> <ul style="list-style-type: none"> • Structural engineering (risk-based inspections, integrity reviews, dynamic analysis, due diligence reviews, decommissioning assistance) • Buildings - Heating, Ventilation and Air Conditioning • Flue gas stacks, flare stacks • Civil maintenance, scaffolding • Fireproofing • Painting (condition-based maintenance approach) • Hot, cold and cryogenic insulation • Refractory, erosion-resistant and chemical-resistant linings • Conventional storage tanks (tank integrity management system, emission reduction, dead-stock reduction and tank cleaning) • Pressurised, mounded and underwater storage • Drainage and primary water treatment (effluent water master planning)
5	Multi-disciplinary	Contracting and Procurement consultancy	<p>Providing contracting and procurement consultancy - Maintenance functions of many end user O&G companies are heavily reliant upon outsourced contractors' workforces. This could be stream lined by establishing a contracting and procurement strategy that is in alignment with end user business objectives. The scope could include:</p> <ul style="list-style-type: none"> • Contracting and procurement performance assessment • Supply chain management • Procurement targeting • Contract management • Contractor incentive alignment • Advising end users on how to develop the best contracting strategy for a project • Assisting in the contractor selection process, from pre-qualification through to contract award • Participating in the critical elements of the contractor selection process, including preparation of bidding documents, management of the bidding process and negotiation • Coordinating the interfaces with engineering, legal, insurance and intellectual property professionals • Advising on the commercial aspects of fixed costs or T&E (Time and Expenses), including rate verification, cost management and audit management • Providing inputs that may be able to help with in disputed or contentious commercial and contractual issues

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
6	Mechanical engineering	Combustion and Heat transfer engineering consultancy	<p>Provide Combustion and heat transfer engineering technical consultancy services so that end user O&G companies achieve their objective of optimal heat integration with clean, safe and reliable equipment. End user benefits could be one or more of the following:</p> <ul style="list-style-type: none"> • Lower fouling rates in heat exchangers • Lower pressure drop on the shell side • Elimination of damaging flow-induced tube vibration • Improved heat transfer capabilities • Reduced running costs <p>Key areas of service could include :</p> <ul style="list-style-type: none"> • Design of heat transfer equipment • Burner technology and clean combustion • Debottlenecking studies and troubleshooting on Heat transfer equipment • On-site and start-up assistance • Safeguarding and control of heat transfer equipments • Modelling heat transfer and flow • Heat exchangers design/rating and debottlenecking • Thermal insulation consultancy • Heat integration • Verification design packages of contractors • Periodic Inspection of critical heat transfer equipment
7	Multi-disciplinary	Shutdown, Turn-around and Start-up services	<p>Provide shutdown and turnaround services, commissioning and start-up assistance so as to help O&G end users facilitate improvements in critical path management, assist early system testing and provide structured handover to the operators.</p>
8	Multi-disciplinary	Training Services	<p>Provide training and Competence consultancy services so that end users can focus on their core business and raise standards of operating and management personnel.</p>

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
9	Multi-disciplinary	Cost engineering	<p>Provide Capital cost engineering service that includes :</p> <ul style="list-style-type: none"> • Capital and counter estimates for projects • Revamp related studies • Capital cost risk assessment and analysis • Implementation of contract and support during negotiations • Capital estimates tools and techniques • Cost control and reporting • Planning • Control and process measurement • Asset evaluation • Capital cost and project performance benchmarking
10	Chemical engineering	Crude oil evaluation	<p>Provide Crude oil evaluation consultancy to offer cost-effective solution to Refiners and exploration companies worldwide. The service offerings could include:</p> <ul style="list-style-type: none"> • Crude oil assays • Crude oil and feedstock quality tracking • Crude oil and feedstock valuation • Crude oil and condensate marketing consultancy • Diet optimisation
11	Chemical engineering	Distillation Column & Vessels consultancy services	<p>Provide consultancy on primary distillation, phase separation and membrane technology. Key services could include:</p> <ul style="list-style-type: none"> • Technical advice and troubleshooting • Scouting, feasibility and debottlenecking studies • Heat integration studies • Safety reviews/model check • On-site service and start-up assistance • Column and vessel internals • Membrane applications and testing • Crude oil dehydration • Process design/integration and licensing • Design and development of Distillation columns

Detailed description of service proposed		
S.No.	Branch of engineering	Type of service proposed
12	Electrical engineering	Technical Consultancy services
		<p>Provide Electrical engineering design and consultancy services to improve the performance and cost-effectiveness of electrical facilities and technologies at O&G companies. Key services could include the following :</p> <ul style="list-style-type: none"> • Power system studies, protection and controls • Master plan reviews, feasibility studies • Electrical safety (equipment and procedures) • Electrical site audits, system health checks • Benchmarking, safety and operational studies • Project fit-for-purpose design and engineering, construction and commissioning • Skill pool resourcing and competency enhancement • Training : electrical engineering courses, workshops • Specialist advice from equipment technical experts
13	Mechanical/Auto mobile engineering	Technical Consultancy services
		<p>Provide consultancy services for engine and vehicle testing for fuels and lubricants and emissions measurement</p>
14	Multi-disciplinary	Energy audit
		<p>Provide services to improve the reliability and availability of Energy systems and utilities to reduce energy costs through efficient energy management. Key services could include the following:</p> <ul style="list-style-type: none"> • Master planning • Scouting and feasibility studies • Energy conservation studies • Development studies • Basic design and engineering • Project specification and detailed engineering • Pre-commissioning and start-up assistance • Performance testing and safety audits • Training of professional staff

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
15	Environmental / Civil engineering	Technical Consultancy services	<p>Provide technical consultancy in environmental engineering to maximise land value, reduced expenditure and achieve compliance for O&G companies. Key services could include the following:</p> <ul style="list-style-type: none"> • Due diligence assessment • Risk-based environmental site assessment • Environmental soil and groundwater audits • Geo-hydrological survey • Health, safety and environment management system and audits • Spill prevention and containment plans • Advise on site closures, demolition, abandonment • Preventive engineering for environmental protection • Technical regulatory interaction on soil and groundwater corrective action • Field (supervision) assistance • Contracts/contractor management • Providing risk-based land management training • Environmental engineering advice • Site remediation/restoration • Groundwater monitoring and control systems • Soil stabilisation and solidification techniques
16	Mechanical engineering	Machinery health consulting	<p>Provide services on Machinery Health management and failure diagnosis to increase competitive edge of O&G companies and eliminate unplanned shutdowns. Key service areas could include</p> <ul style="list-style-type: none"> • Failure diagnosis consultancy specialising in lubricant- and fuel-related problems • Workshop training • Recognition of key failure features • Identification of failure causes • Determination of preventive measures • Failure diagnosis

Detailed description of service proposed	
S.No.	Branch of engineering proposed
17	Fire & Safety engineering
18	Mechanical engineering
19	Chemical engineering
20	Mechanical / Chemical engineering
21	Multi-disciplinary
22	Chemical / Mechanical engineering

Type of service proposed	Detailed description of service proposed
Technical Consultancy	Provide technical consultancy services on flame/gas detection and mapping the risk to ensure detection equipment coverage is adequate to meet Fire, Explosion and Risk Analysis (FERA) recommendations.
Thermo-hydraulic consultancy	Provide Thermo-hydraulic consultancy for Flow related problems for liquids that are congealing in nature (e.g. Wax, Asphalt and emulsions and scales) to minimize the problem of flow interruptions.
Catalytic Cracking operations	Provide consultancy services on catalytic cracking operations, hardware and catalysts. Key services could include: <ul style="list-style-type: none"> • Licensing and design of new catalytic cracking units (very long term plan) • Revamp studies and implementation • Continuous performance improvement • Remote monitoring • Simulation test runs • Catalyst selection • Troubleshooting • Pacesetting studies
Fluid flow and thermodynamics	Provide expert advice on Fluid Flow and Thermodynamics problems to avoid hazards like gas hydrate plugs, liquid surging and congealing pipelines and lead to improvement in reliability and throughput.
Asset Integrity reviews	<p>Consultancy services for Asset integrity reviews for mechanical, electrical and instrumentation equipments and assets of O&G facilities. The process involves the following key steps:</p> <ul style="list-style-type: none"> • Identifying and validating critical equipment with respect to current condition • Providing a firm understanding and independent evaluation of equipment repair and replacement needs into the future • Deliver risk-prioritised equipment recommendations to improve long-term equipment integrity • Assist business planning for asset integrity and future equipment budgets (capital and expense) <p>Provide technical services related to fuels products to help end users achieve reduction in operating costs and increase competitiveness. The scope could include providing product quality advice for refineries and marketing companies to help them meet fuel specifications at minimum cost. Key steps would include the following:</p> <ul style="list-style-type: none"> • Advice on setting product supply specifications • Survey and benchmarking of competitor products • Rig simulation, engine and vehicle testing • Running a remote customer service unit for technical queries on fuels and lubricants
Fuel products - Technical consultancy services	

Detailed description of service proposed		
S.No.	Branch of engineering	Type of service proposed
23	Chemical engineering	<p>Provide technical services on Gas/Liquid treating and sulphur processes to end user O&G companies to reduce emission levels. The scope could include developing new processes as also optimise existing ones to improve solvent quality management and finding the best adsorbents for trace element removing and drying. Key service offerings in this area could include:</p> <ul style="list-style-type: none"> • Process training • Start-up and shutdown assistance • Troubleshooting and plant optimisation • Plant testing and chemical analyses • Solvent monitoring and reclaiming • Process selection • Feasibility and debottlenecking studies • Basic design packages • Project and detailed engineering support • Safety reviews and audits for gap closure
24	Multi-disciplinary	<p>Technical services on LNG/LPG and product terminals. Key service areas could include:</p> <ul style="list-style-type: none"> • Business development support • Concept and scouting • Feasibility studies • Site screening and selection studies • Quantitative risk assessment and health, safety and environment • Functional value analysis • Terminal and power plant integration • Project services and project management • Cost estimating • Project execution and strategy advice • Technical support on Floating LNG terminals

		Detailed description of service proposed	
S.No.	Branch of engineering	Type of service proposed	
25	Multi-disciplinary	Technical Consultancy – logistics, feedstock and product quality	<p>Technical services on Oil and gas logistics, feedstock and product quality to enable end users boost margins. Scope could include tailor-made products and services for storage and handling, blending, and receipt and delivery facilities. This could be further expanded to a total blending solution that can be achieved through integration and improvement of planning, scheduling and blending optimisation. Key service areas could include one or more of the following:</p> <ul style="list-style-type: none"> • Oil movements master planning • Projects and facility design • Stock and storage management • Vapour recovery and emission management • Storage and transport of LPG • Product quality margin improvement programs • Crude oil quality and evaluation • Total blending solutions • Pipeline operations consultancy • Laboratory Pacesetting
26	Chemical engineering	Research services - GTL	<p>Research services on Gas to liquids conversion to make the most of hydrocarbon resources for utilization of remote gas reserves.</p>
27	Chemical engineering	Research services – Gasification and Hydrogen manufacturing	<p>Research services on Gasification and hydrogen manufacturing to find our more economical and efficient means of producing Syngas or Hydrogen. Key services could include:</p> <ul style="list-style-type: none"> • Plant performance evaluation and optimisation recommendations • Troubleshooting • Catalyst evaluation • Plant capacity tests • Hydrogen management studies • Basic design packages
28	Multi-disciplinary	Health & Safety services	<p>Providing Health, Safety and Environmental consultancy to O&G customers to meet global standards while keeping bottom line intact</p>

Detailed description of service proposed	
S.No.	Type of service proposed
29	<p>Branch of engineering Mechanical engineering</p> <p>Type of service proposed Technical consultancy - Hydraulic power solutions</p> <p>Providing technical consultancy on Hydraulic power solutions to help O&G end users understand root cause of hydraulic fluid degradation that results in frequent and expensive oil changes or prevent fires in hydraulic systems. Key service offerings could include:</p> <ul style="list-style-type: none"> • Research and development • Field testing and service consultancy • Technical training to train maintenance personnel on accurate application of hydraulic fluids
30	<p>Branch of engineering Multi-disciplinary</p> <p>Type of service proposed Operational strategies</p> <p>Providing Operational strategies for Hydrocarbon margin improvement. Key areas include:</p> <ul style="list-style-type: none"> • Revamping business processes • Reviewing and making suitable changes in Refinery planning tools • Crude and feedstock selection support • Refinery production optimisation (feedstock routings, operating strategies) • Product handling, storage and quality • Reduction in Energy and loss
31	<p>Branch of engineering Chemical engineering</p> <p>Type of service proposed Hydro-cracking</p> <p>Research and development on Hydro-cracking to reduce downtime, lower operating costs and better yields. Key service areas could include:</p> <ul style="list-style-type: none"> • Process modelling using proprietary catalyst modelling and flow sheets for process optimisation, including new feedstock processing and tighter product quality legislation • Unit constraints analysis for operating window optimisation and revamping • Revamps for higher capacity, increased product yields and improved product qualities • Reactor internals retrofitting for optimum catalyst performance • Catalyst bed fouling study for avoiding pressure-drop problems • Detailed unit benchmarking
32	<p>Branch of engineering Chemical engineering</p> <p>Type of service proposed Residue Hydro-processing</p> <p>Research and development in Residue hydro-processing to boost margins of O&G customers by increasing yields of high-value products. Key R&D areas could include:</p> <ul style="list-style-type: none"> • Fouling reduction, run-length improvement and shortening of shutdown duration • Evaluation and improvement of bunker and fixed-bed catalysts • Understanding of factors affecting catalyst performance • Increasing catalyst life thus saving Dollars for end users • Development of monitoring tools to allow optimisation of unit operations • Technology development for new residue hydro-processing units and moving bed retrofits of existing units

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
33	Chemical engineering	Hydro-treating	<p>Research and development in Hydro-treating to maximise margins of O&G end users optimising usage of existing assets. Key services could include:</p> <ul style="list-style-type: none"> • Technical advice (on/off site) • Troubleshooting, performance monitoring and unit optimisation • Catalyst selection and handling, reactor loading patterns reactor design services for various distillate streams • Operational procedures and best practices • Start-up and shutdown assistance • Process and project support • Scouting and feasibility studies • Design preparation studies • Basic design packages for new/revamped units • Assistance during detailed engineering and construction phases • Technical training
34	Multi-disciplinary	In-site measurement services	<p>Providing In-situ measurement services for product performance to reduce the cost of giveaway, reducing re-blends and achieving cost efficient laboratory operations.</p>
35	Information Systems	Information management and data handling services	<p>Providing Information management and data handling services to O&G end users to achieve Operational integrity between field, control room and board room. The scope could include network-based remote monitoring services that enable all personnel to connect to real-time process operations data using their PCs, so that data, graphics, reports, documentation and spreadsheets can easily be accessed and manipulated.</p>
36	Information systems	Software engineering and life cycle data management services	<p>Providing software engineering and life cycle data management services. Key services could include:</p> <ul style="list-style-type: none"> • Hydrocarbon logistics application portfolio • IT security/business continuity • General IT advice and strategy • Electronic document management and repository services for critical business data archival

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
37	Metallurgical engineering	Inspection technology services	<p>Providing inspection technology services using leading-edge non-destructive testing techniques that will help O&G customers to meet their inspection requirements in a cost effective way. The scope could include loss detection in tanks and pipelines, corrosion inspection, assessment of degradation in exchanger and furnace tubes, weld joints, insulation etc.</p>
38	Mechanical engineering	Integrated pipeline services	<p>Providing integrated pipeline services for pipelines operating in remote and tough environments. The scope could include feasibility study, design, construction, operation, inspection, maintenance services as also decisions on abandoning oil, gas and multiphase pipelines on and offshore. Key services could cover one or more of the following:</p> <ul style="list-style-type: none"> • On and offshore pipelines • Crude oil, condensate and gas lines from production facilities • In-field transportation lines • Product lines • Gas transmission and distribution networks • Hot tapping services
39	Multi-disciplinary	Investment planning services	<p>Providing investment planning services that could include techno-commercial feasibility studies, risk analysis and cash flow studies on proposed investments. Examples of projects that could be taken up include LNG/LPG product terminals, Natural gas processing, LNG and cryogenic storage.</p>
40	Multi-disciplinary	Master planning and hydrocarbon logistics	<p>Providing services for Master planning and hydrocarbon logistics to help O&G customers improve bottom-line benefits by optimising storage, blending, receipt and delivery procedures and facilities for refineries, depots or terminals. Key problems that modern refiners face are :</p> <ul style="list-style-type: none"> • Facility complexity too high • Problems such as high demurrage, frequency re-blends or safety • Maintenance backlog causing unplanned downtime of critical equipment • Supply or demand changes, e.g. inappropriate allocation of products to tanks • Impending obsolescence of instrument or control systems
41	Mechanical engineering	Advanced Machinery Health Management services	<p>Providing advanced Machinery Health management services including machinery component failure diagnosis using infrared cameras, Oil analysis tools, Portable and Online Vibration analysis systems and motor current analysis tools.</p> <p>Key service areas could include:</p> <ul style="list-style-type: none"> • Failure diagnosis consultancy specialising in lubricant and fuel-related problems • Training services • Recognition of key failure features • Identification of failure causes • Determination of preventative measures for bearings, gears and other rotating machinery parts

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
42	Multi-disciplinary	Maintenance, reliability and operational excellence services	<p>Providing maintenance, reliability and operational excellence services to O&G customers to enable them to achieve sustainable increases in plant availability – without jeopardising integrity and in accordance with health, safety and environmental regulations. Key services could include:</p> <ul style="list-style-type: none"> • Availability assurance and reliability modelling • Integrating asset management processes • Risk and reliability management tools • Health, safety and environmental management systems • Evaluation of technical integrity of assets • Asset management services • Risk management for criticality assessment and Risk based inspection services • Analyzing maintenance practices and providing advice on Reliability Centred management
43	Mechanical engineering	Marine facilities	<p>Provide technical consultancy on marine facilities of O&G customers by offering cost-effective design services for harbours, coastal and hydraulic engineering, jetty structures and floating facilities. Scope could be expanded to include rejuvenation master plans to help clients to extend the service life of their facilities. Key services could include the following:</p> <ul style="list-style-type: none"> • Harbours, breakwaters and coastal structures • Jetties • Single-point moorings • Multi-buoy moorings • Berthing, mooring and anchoring facilities • Dredging technology and spoil disposal • Shore crossings, tunnelling • Subsea pipelines • Storm and environmental warning systems • Navigational aids for Jetty top works and marine loading arms • Meteorological and oceanographic data analysis of Hydraulic and structural aspects of (cooling) water intakes and outfall structures • Flood protection and coastal defence structures

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
44	Multi-disciplinary	Asset Integrity Management	<p>Provide Asset integrity management and inspection services for the O&G industry. Scope could include consultancy services for:</p> <ul style="list-style-type: none"> • Corrosion monitoring and control to ensure integrity of platform, pipelines, plant and storage facilities • Feedstock flexibility • De-bottlenecking and increasing throughput by process optimisation • Fitness for service of major equipments, pipelines and vessels • Cracking monitoring and prediction
45	Instrumentation engineering	Technical consultancy on measurement and instrumentation	<p>Provide technical consultancy on measurement and instrumentation aspects of O&G customers. Key services could include:</p> <ul style="list-style-type: none"> • Measurement and plant automation solutions • Master planning, re-instrumentation strategy and system integration • Control and protection systems, including fire and gas detection • Measurement and online analysis support • Custody transfer metering advice • Health, safety and environment measurements, hydrogen sulphide, Benzene-Toluene-Xylenes (BTX), hydrocarbon emissions and oil-in-water monitoring • Instrument maintenance and engineering services • Maintenance management and best practices development • Integrated reliability reviews and quality measuring instrument reviews • Instrumented protective function classification • New technology implementation (e.g. Wireless and Foundation Fieldbus as compared to Wired systems) support • Gate-keeping of new technology developments and implementing this in 'test cases' before commercial launch

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
46	Multi-disciplinary	Storage and movement facilities	<p>Services for O&G storage and movement facilities till custody transfer and terminal management. Key services could include technical advice, design/development studies, concept and feasibility studies and basic design packages for:</p> <ul style="list-style-type: none"> • Conventional oil product storage tanks; emission reduction, tank cleaning, fit-for-purpose and integrity assessment • Pressurised LPG Horton spheres and bullets • Refrigerated liquefied gas storage tanks; containment concept studies, rejuvenation and risk assessment • Oil and gas movement facilities including integrated off-plots design and maintenance management • Earthquake design parameters and risk engineering (e.g. blast and fire loading) for civil, marine and storage structures • Cost reduction, criticality review, benchmarking, due diligence reviews, audits • Emergency shutdown systems and Fire & Gas systems • Oil movements master planning • Projects and facility designs • Stock and storage management • Vapour recovery and emission management • Storage and transport of liquefied petroleum gas • Product quality margins • Crude oil quality and evaluation • Total blending solutions • Pipeline operations
47	Multi-disciplinary	Planning and scheduling	<p>Providing services on planning and scheduling to maximise profits for O&G customers. Key services include:</p> <ul style="list-style-type: none"> • Best practices in supply planning, refinery scheduling and supply chain optimisation • Advice on the best planning and scheduling tools on the market • Consultancy to maximise the benefit from supporting tools in the context of the business process • Consultancy on integration of real-time data and business data to steer and monitor performance • Provision of economic and investment analysis tools • Mathematical modelling and optimisation techniques to support business logistics modelling

Detailed description of service proposed		
S.No.	Branch of engineering	Type of service proposed
48	Chemical engineering	<p>Process Modelling and Plant Optimization</p> <p>Providing plant optimization and process modelling and implementing advanced control strategies for optimizing operating margins</p>
49	Chemical engineering	<p>Process control and Production optimization consultancy</p> <p>Providing Process control and Production optimisation consultancy for higher performance and value-adding control solutions. Key service areas could include:</p> <ul style="list-style-type: none"> • Consulting and technical services in base layer control systems (control system design, control audit studies, project support, pre-start-up and start-up assistance) • Study of dynamic behaviour and controllability of specific parts of a plant (reactor, steam system, fuel system, hydrogen integration) • Design, consulting and studies in process safeguarding, (instrumented protective functions) • Design, improvement, troubleshooting of special-purpose control systems (combustion control, boiler control, compressor control) • Advanced process control studies (master plans, scouting, feasibility, design and post-implementation review) • Consulting in dynamic simulation, including specification of training simulators • Consulting in plant information systems (system definition, functionality, applications) • Advanced Project Control project services, from design to commissioning
50	Chemical engineering	<p>Product quality and laboratory services</p> <p>Providing product quality and laboratory services. Key services could include:</p> <ul style="list-style-type: none"> • Product quality margins • Crude oil quality and evaluation • Total blending solutions • Pipeline operations
51	Multi-disciplinary	<p>Project Management</p> <p>Providing Project management services for customers throughout the O&G businesses by identifying substantial cost saving areas and adding value to their projects for E&P, Refining, petrochemical, LNG processing, coal gasification, and civil/marine/terminal facilities</p>

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
52	Mechanical engineering	Rotating equipments	<p>Provide consultancy services on rotating equipment engineering for safe, reliable and cost-efficient operation of machinery. Key services could include. Key services could include:</p> <ul style="list-style-type: none"> • Providing substantial input on international standards and policies • Compiling the most recent and proven improvements by contact with manufacturers and global users • Maintaining a best-practices database for applications in refineries, and gas and chemical plants • Providing conceptual and detailed advice on rotating equipment for projects, revamps and studies • Specifying, evaluating and selecting rotating equipment for projects or plant changes, conducting acceptance tests and performance verification • Contributing to the safe and environmentally acceptable operation of equipment
53	Multi-disciplinary	Statistics and Chemometrics R&D services	<p>Statistics and Chemometrics R&D services to help O&G customers to achieve a better understanding of their business processes through data analysis. The key service offerings could include one or many from the following list:</p> <ul style="list-style-type: none"> • Making data-based decisions that are statistically sound and defensible, and economically efficient. Obtaining a useful understanding of large volumes of data stored in multiple locations in different formats. • Reliably automating laborious data processing tasks • Advanced spectroscopic and analytical methods to infer sample properties. • Help O&G customers recognising when a key indicator (e.g. commodity price, a process setting or a safety performance level) is changing unusually and advising what mitigating action to take. • Identifying the drivers of business performance. • Advice on adjusting operating or investment strategy in uncertain or changing economic environment <p>The proposed team could include statisticians, Chemometricians, data analysts and modellers who assist clients in the analytical, commerce, finance, process and product development industries to help develop better business solutions.</p>
54	Multi-disciplinary	Technical and economic study services	<p>Strategic technical and economic study services to help customers embarking on major projects to accurately make economic assumptions and market expectations. Focus areas may include:</p> <ul style="list-style-type: none"> • Identifying the main drivers of refinery profit • Supply and selection of crude oil • Market demand • Economics of crude and products (prices and main profit drivers) • Selection of suitable processing configuration and operational efficiency • Supply and distribution

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
55	Mechanical engineering	Thermal conversion services	<p>Thermal conversion services to improve margins and plant availability. Key services could include:</p> <ul style="list-style-type: none"> • Unit optimisation within refinery/market constraints • Troubleshooting in the field • Feedstock appraisal/selection and fuel blending advice • Run length/cracking severity optimisation • Shutdown advice and support development services • Pilot-plant studies • Fundamental feedstock characterisation studies • Process/kinetic models • Modelling services that provide the basis for improved furnace designs
56	Geological engineering	Upstream Development services	<p>Upstream Development services to identify, define and assess surface development concepts and develop surface and subsurface field development plans.</p>
57	Chemical engineering	Water and waste treatment	<p>Water and waste treatment consultancy services. Key services could include:</p> <ul style="list-style-type: none"> • Effluent treatment • Process water integration • Industrial water • Primary treatment and drainage • Sludge treatment • Water master plans • Configuration studies • Design packages • Start-up/training • Optimisation and troubleshooting
58	Instrumentation engineering	Alarm management	<p>Software development for process control alarm management to reduce alarm floods and improve alarm quality so as to increase reliability, production, safety and working conditions while reducing costs for O&G operating companies.</p>

S.No.	Branch of engineering	Type of service proposed	Detailed description of service proposed
59	Multi-disciplinary	Asset effectiveness	Security, Reliability, Performance
60	Multi-disciplinary	Production Management	Planning, logistics, execution
61	Multi-disciplinary	Operations Optimisation	Monitoring, Performance, Compliance
62	Logistic Services	Technical Consultancy	Optimisation of logistic services for plant personnel and barge movement using Operations Research Transportation theory techniques for upstream Offshore Oil platforms
63	Instrumentation engineering	Alarm management	Software package development for Multivariate analysis of real time and historical data from Distributed Control systems and prediction of process failures and diagnoses the root causes of poor performance before they lead to out of spec production
64	Instrumentation engineering	Alarm management	Software development to integrate with third party Distributed Control systems to provide valuable information on production cycle, enabling O&G customers to target and repair the causes of the most costly delays and minimize disruptions that have the greatest impact on productivity
65	Instrumentation engineering	Alarm management	Software development to monitor all assets from a single web portal and have a performance management dashboard
66	Telecom & IT Engineering	Technical Services	Communication – Provide solutions for communication network between offshore platforms and also between offshore platforms and base office using Supervisory Control And Data Acquisition (SCADA) and telemetry technology

Source: Expert Interviews

Strategic Growth Option No. 2: Accelerate pace of global expansion

Indian O&G ESO companies should look outside USA and English speaking countries in Europe and expand to niche markets in Europe and even its competitors like China. This will be a strategic move since getting a foothold in China would also improve the business in other South East Asian Countries like Japan. Indian O&G ESO firms should look to offset their exposure to any single market by targeting high-growth geographies and also bid for government projects on their home turf. Traditionally, Indian ESO firms have earned a little over half their revenue from the United States and Europe. However, these firms must strengthen their foothold in continental Europe and establish beachheads in several other countries. A possible route for this could be to acquire smaller companies in France and Germany and looking at Japan, Australia, Canada, the Middle East and even Africa as high-potential emerging markets for expansion. Wherein language barrier maybe a hindrance to expand (e.g. Norway or Scandinavian countries), hiring local talent is an option that Indian O&G ESO industry could adopt.

Strategic Growth Option No. 3: Leverage from alliances and partnerships within the O&G ESO industry

Currently the industry body named NASSCOM (National Association of Software and Service Companies) is the only active body in India that takes the lead in acting as a common platform with a pan-India presence for the IT/ITeS/BPO and ESO/KPO companies in India. NASSCOM also has started a dedicated wing to address the needs of the ESO industry. O&G ESO service provider companies in India could decide to form a separate body or could form a dedicated group within the NASSCOM ESO group and drive a marketing effort using NASSCOM's global footprint of representative offices. Lead offices could be located in the cities that house the engineering headquarters of key end users like BP, Shell and Exxon Mobil. Such marketing offices could also be located in areas such as Shanghai and Singapore to play a role in gathering competitive intelligence to benchmark stakeholder actions.

Such industry bodies could work closely with bodies such as the 'World Energy Cities Partnership forums (WECP)' whose current members are Aberdeen (Scotland UK), Calgary (Canada), Dammam (Saudi Arabia), Daqing (China), Dongying (China), Halifax (Canada), Houston (USA), Luanda (Angola), Malabo (Equatorial Guinea), Perth (Australia), Port Harcourt (Nigeria), San Fernando (Trinidad & Tobago), St. John's (Canada), Stavanger (Norway) and Villahermosa (Mexico) where road shows and expositions could be conducted to explain the capabilities of Indian O&G ESO players. Such O&G ESO trade shows could also be scheduled to coincide with major O&G trade shows around the world in order to broaden the industry's network of contacts and assist businesses with newer opportunities.

Strategic Growth Option No.4: Partner with R&D and educational institutions

The high concentration of young talent willing to work on challenging environments and the decreased enrolment of students in the science and engineering streams in USA and Europe together provide a unique opportunity for the India's O&G ESO to spread and expand wings globally and increase market share. Many MNC companies have set up R&D centres in India and this include GE Technology Centre at Bangalore, Saudi Basic Industries Corporation (SABIC) Research Centre at Vadodara, Mitsubishi Chemicals Research Centre at Haldia and Lanxess Research Centre at Vadodara. In order for the Indian O&G ESO industry to move from being a 'low cost' solutions provider to a total solutions provider there is a clear need to collaborate and work with R&D firms and educational institutions to create commercially significant innovations that address the needs of the industry. Knowledge networking is of recent origin in India. Serious efforts are needed to develop networking between Industry, R&D Institutions and academia so as to attain synergy for value addition to existing knowledge base. Industry should be willing to integrate the available national R&D resources into its business strategy. This would require improved communication and understanding, faith in mutual growth and development of congenial working relationship.

Strategic Growth Option No. 5: Partner with Indian domestic O&G and Petrochemical industry

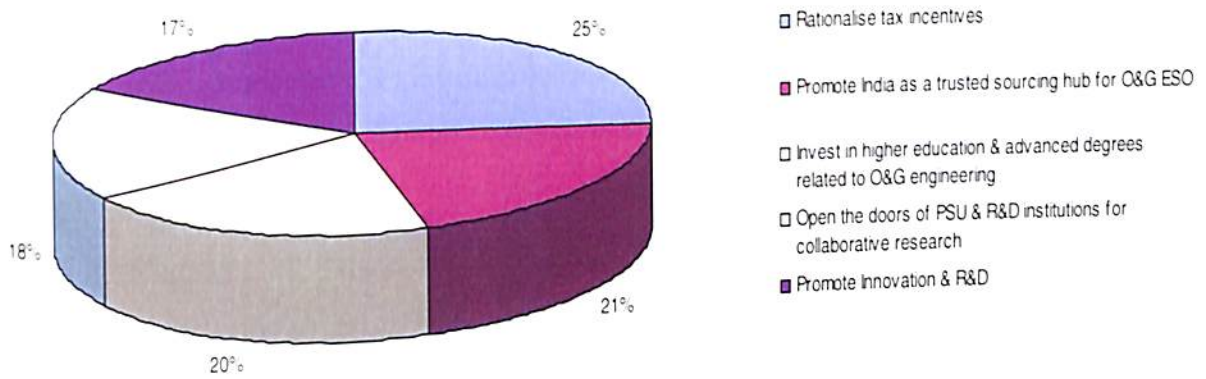
To move up the value chain Indian O&G ESO industry must partner with Indian domestic O&G and petrochemical majors so that inventions could be commercialized and tested. Indian O&G ESO industry will find it difficult to begin consulting services with overseas consulting and end users whereas the domestic O&G and Petrochemical manufacturing companies are the best 'test grounds' for any innovations.. At this point in time there are very few examples of successfully networked projects wherein end user industry and O&G ESO industry have partnered together or worked jointly. Indian O&G industry must seek end-user industry help to ensure technology transfer from global O&G majors for execution of offset contracts. It has been proven in that ESO and IT companies in India are the main beneficiaries of the multi-billion dollar defence and aerospace contracts that Indian government has signed with overseas companies. Under such offset clauses, overseas suppliers that win these contracts are obligated to do business worth 30 per cent of the value of the contract locally. In some contracts, such as the 10 BUSD contract for the procurement of 126 multi-roll combat aircraft, the offset is much higher at 50 per cent because of its large size. The IT and ESO industry are major beneficiaries of contracts signed by the Indian government for aerospace and defence with Boeing, Lockheed Martin, Mirage, MiG, Eurocopter and Saab AB of Sweden. The aerospace and defence sectors are among the largest revenue earners within engineering services business for Indian companies such as Tata Consultancy Services (TCS) and Infosys Technologies. This model could be replicated for the benefit of the O&G ESO service provider industry that could partner with end user companies to ensure offset clause in contracts for exploration and production and while setting up of refineries and petrochemical plants.

The services segment in oil E&P business is emerging as big business opportunity in India as several entities are now looking to participate in the exploration activities under the government's New Exploration Licensing Policy (NELP). In the eight rounds of NELP so far, the government has offered over 200 O&G blocks and more

than two dozen companies have participated in bidding process. ONGC, India's largest public sector upstream production company) is looking at this as a potential service opportunity since several of the companies participating in NELP rounds do not possess expertise for E&P. ONGC is currently working out a major revamp to create independent subsidiaries to tap the growing market of drilling, engineering, construction and logistics services consumed by oil companies. The 640 BNR (Billion Indian Rupees) company plans to establish these subsidiaries as independent businesses, doing work for not just ONGC but other oils companies as well. ONGC plans to invite overseas players to partner in these subsidiaries, so that joint ventures can be formed to leverage the technical expertise of global majors in combination with ONGC's strengths. These subsidiaries would function as standalone commercial entities rather than just depend on the demand generated by ONGC. ONGC also plans to tap the overseas market for O&G ESO services through the subsidiaries rather than limiting them to the domestic market. The Indian Petroleum Ministry has asked ONGC to finalize a blueprint for restructuring ONGC with proposed O&G ESO subsidiaries dealing with drilling, logistic support, engineering, construction and development for the oil sector in India and abroad. These new operations may take the shape of special purpose vehicles (SPV) where collaboration may be sought from technology and service providers.

7.1.2 Action Points for the Government

Figure 7.2 presents the results of the Phase-II survey intended to identify the policy changes required from the Government to assist the Indian O&G ESO industry in sustaining competitive advantage and maximising market share. 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.



Note: Weighted score in % of Total 27 respondents

Figure 7.2: Phase-II Survey result on action points for the Government to support O&G ESO industry
Question: In your opinion what steps must the Government of India and its various ministries/departments/state governments/local bodies adopt in order to support the O&G ESO industry maintain and further expand its market share against competing nations?

These action points mentioned below form the five key recommendations to the Indian government that have emerged from this survey and are the findings against the last and final Objective No. 6 of this study as mentioned in Section 1.3 of Chapter-1.

1. Rationalise tax incentives
2. Promote India as a trusted sourcing hub for O&G ESO
3. Invest in higher education & advanced degrees related to O&G engineering
4. Open the doors of PSU & R&D institutions for collaborative research
5. Promote Innovation & R&D

The above recommendations to the government are detailed below.

Recommendation No. 1: Rationalise Tax incentives

The Indian Government has been supportive of the IT/BPO/KPO/ESO sectors and has extended the tax incentives under Section 10A/10B of the Income Tax act until March 2011 (from the earlier deadline of March 2010). However, the tax holiday under Section 10A/10B of the Income Tax Act must provide parity with the SEZ scheme. This is particularly required for the SME (Small and Medium Enterprises) sector and tier-2/3 cities in the country, wherein the SEZ scheme will not be viable. O&G ESO

companies in India need an enabling fiscal regime, as they face issues of enhanced competition from other countries. The extension also needs to be done for a definite period ahead, as extension by a year, while useful, does not help to promote investment. The government also needs to correct the anomaly in Section 10AA of the SEZ Act with retrospective effect. The Government needs to bring changes in Section 10AA of the Income Tax Act to rectify an anomaly in the wording of the Section that adversely affected SEZ units. This will act as a major stimulus measures to step up investment in SEZ and beat the ongoing slowdown. It will significantly boost the prospects of IT/ITeS sector and ESO industry as it accounts for a majority of the total SEZ projects. The O&G ESO industry would also be a direct beneficiary of this change.

The current clause is resulting in discriminatory treatment of assessee having units located both in SEZ and the Domestic Tariff Area (DTA) vis-à-vis assessee having units located only within the SEZs. This anomaly has been in place since February 2006 when the SEZ Act and Rules became operational. The rectification of the anomaly will be a very big incentive for companies to move into the SEZs as they can keep the tax rebate earned on exports from SEZs separate from similar rebate earned from their units in DTA (or the area outside SEZs in the country where normal taxes and duties apply). As per current Section 10AA, 'export turnover of the unit' is divided by the 'total turnover of the assessee' for calculation of exemption from income tax on export profit. Industry leaders in the O&G ESO industry say this is currently hurting the units, particularly those of the big ESO companies, as in many cases the companies have units outside the SEZ too. The current wording of the provision significantly limits the extent of tax holiday. Due to this anomaly, big companies with units in the SEZs and outside SEZs, practically do not get any tax holiday. Industry leaders say that the 'total export turnover of an SEZ unit' should be divided only by the 'total turnover of the SEZ unit' and not by the 'total turnover of the assessee company.'

For instance, companies in IT/ESO sector running units in zones like Software Technology Parks and in SEZs will not need to set up separate shell companies for both areas. Before the year 2000, Section 10A relating to Software Technology Parks

of India (STPI) and the erstwhile Export Processing Zones and Section 10B (relating to Export Oriented Units) of the Income Tax Act were worded as 'total turnover of the assessee' regarding calculation of income tax. Later on in Finance Act 2000, the finance ministry issued a clarification that in the context of Section 10A and 10B of the Act, the total turnover of the 'assessee' means the turnover of the 'undertaking'. The clarification said the section shall not have any material relationship with the other business of the assessee outside these zones. Similar correction is required in the current provision of the SEZ act also. After the aberration is removed, many O&G ESO players like ABB Global Industry & Services Limited, Emerson Export Engineering Centre, Shell Technology India, Aker Solutions Limited, Bechtel India Limited etc. would not need to set up separate companies for units running in different tax jurisdictions.

Recommendation No. 2: Promote India as a trusted sourcing hub for O&G ESO

Today, there is a clear need to communicate India's potential to serve the entire spectrum of O&G ESO from outsourcing to consulting and research to markets across the globe. The Government of India should use its influence to address any concerns that the industry and governments in foreign markets may have regarding investing in India and attract more technology investments to India. The Indian Commerce Ministry can take lead to promote the country as an O&G ESO hub in partnership with existing O&G ESO players in the country, bodies like Federation of Indian Chamber of Commerce and Industries (FICCI), Confederation of Indian Industries (CII) and National Association of Software and Service Companies (NASSCOM) to replicate the country's success in IT/ITeS/BPO sectors by embarking on novel initiatives to attract investors, end user O&G companies, consulting companies, engineering companies, entrepreneurs and venture capitalists to set up O&G ESO centres in India. This will accelerate the government's efforts to create investment and jobs. As we have seen in earlier chapters, India's main competitor in this market is China and governmental support to promote India as an offshore destination of O&G engineering services can make the difference.

The industry body Confederation of Indian Industry (CII), coined the phrase 'Served from India' that is being tout as an umbrella brand for Indian services, similar to the 'Made in India' brand being used for manufactured Indian products. CII has geared up to launch this brand and has finalized its design and logo. Thrilled by its creation, the industry body has even applied for a copyright. The brand will encompass sectors like software, IT enabled services, design services and bio-technology. It will be used as an umbrella brand to promote the Indian services sector, both within India and overseas. A strong country brand helps companies that operate in it. Over time, a strong country brand equity also helps retain market share and command price premiums. Building a strong country brand should include a distinctive and credible proposition that is consistent with the brand, aggressive and targeted communication and consistent, aligned execution.

The government could support the O&G ESO industry to host events like expositions, road shows and seminars both within the country and at overseas locations to provide an opportunity for the industry to explain India's value proposition and evince interest among target customers. Such events will enable the stakeholders to interact and network on collaborations and partnerships and also showcase India's capability in research and innovation engineering in O&G sector amongst key players like Australia, Britain, Germany, United Kingdom, France, Japan, Korea and the United States. There are a number of Indian private firms already established in the O&G ESO business together with state run research and development organizations doing path-breaking work in R&D in O&G who can use these forums to showcase their domain expertise, services and achievements. The Indian government could instil confidence among international investors and end user O&G companies on the following aspects:

- India is a safe destination to do business. The issues fundamentalists and terrorism is today a global issue and even countries like the United States of America and the United Kingdom are not immune to this
- Instil confidence among investors and end user O&G companies that the processes for doing business in India is hassle-free and that government control will be minimum and only as ombudsman

- Explain India's long-term sustainable competitive advantage in both people and infrastructure
- Promote India as a leading global hub for both low cost and high-value activities
- Explain India's sustained political commitment irrespective of the political parties that form the government. It is very important to project continuity as the essence of the Indian Government's policy and strengthen investor confidence
- Explain India's strength in R&D to the International investor community
- Showcase India's global delivery model and communicate the business value and competitive edge to global enterprises
- Propagate success stories of Fortune 500 companies that are operating in India to the investor community

In short, what is required is to build a brand in O&G engineering and technology which has never been attempted by any nation so far.

Recommendation No. 3: Invest in higher education and advanced degrees related to O&G engineering

Demographic studies forecast India to be one among the few countries with the distinct advantage of surplus personnel within the employable age group by the year 2020. Notwithstanding this, with the current growth rates in the service industry, professional bodies like NASSCOM estimate that India will face a severe shortage of skilled personnel to meet the estimated growth requirements for the software and engineering service industry. This shortage is already evident in the IT/ITeS/BPO segment and India's ability to emerge as a hub for engineering services, technology innovation and R&D will depend upon the adequate availability of high skilled human resources. Moreover, the high growth rates in the software industry in India is creating attractive employment opportunities for the young engineers and science graduates creating a dearth of good talent available for core engineering and manufacturing disciplines. Significant changes are needed in the education system as well as infrastructure and faculty requirement to meet the growing demands of the industry. The road ahead for India in the services sector is directly linked to creation of quality higher education Institutions in a big way. It is not just the quantity of

engineering graduates that matter, the quality too is of utmost importance. The current resources owned and aided by the government for higher education are inadequate to serve the needs of the industry. Moreover, Government should be able to attract private investors and FDI into investing in setting up world class institutions in the country.

Following are my recommendations after this study to ensure ample talent pipeline for the O&G ESO industry:

- Start specialized institutions of higher learning in the field of Petroleum, Energy and Oil & Gas in the model of University of Petroleum and Natural Gas Studies, Dehradun (UPES) on a Public Private Partnership model.
- Existing educational institutions should focus on imparting specialized courses to improve domain expertise (e.g. M. Tech in Petroleum Refining and Petrochemical Engineering offered Anna University, Chennai and M. Tech offered by Indian Institute of Information Technology, Pune jointly with UPES) and impart exposure to global practices and systems.
- In view of the expanding role of World Trade Organization to include higher education, the Government should encourage foreign universities to come to India to set up independent operations or collaborate with existing Indian Institutions, colleges/institutes. Foreign Direct Investment (FDI) in education should be hassle free and made free from long drawn approval processes.
- Help needy students get loans by being a co-guarantor for educational loans and deciding interest subsidy based on actual family income status. Developed countries like United Kingdom and the United States have implemented such schemes which have paved way for their advancement in Science and Technology.
- While a regulatory set up is required to ensure that there is no cheating or hoax, fixation of fees should not be in state control.
- With an aim to develop qualified manpower to serve the needs of the global O&G industry the Ministry of Petroleum and Natural Gas (MOPNG) should accredit courses, conduct short term bridge training programmes, long term AICTE approved courses like ME / M. Tech and three year Diplomas in

Exploration and Production engineering and Hydrocarbon technology in addition to the normal engineering disciplines. In this way the MOPNG should contribute to the development of required skills rather than solely depend on the Ministry of Human Resource Development to accredit and create world class engineers and technologists.

Recommendation No. 4: Open the doors of PSU & R&D institutions for collaborative research

India has a number of technology and research and academic institutions under Government control. However, the doors of these Public Sector Units (PSUs) are not open for the industry or the O&G ESO companies. Collaboration between Industry, R&D organizations and academia will help India position itself as an O&G technology hub to the world. The Government should allow exchange of information and facilities between these institutions to attain synergy for value addition to existing knowledge base. Industry should be willing to integrate the available R&D resources into its business strategy. This would require improved communication and understanding, faith in mutual growth and development of congenial working relationship. There are a number of research institutions doing work in 'islands' e.g. Engineers India Limited – R&D laboratory, Indian Institute of Petroleum, Dehradun, R&D centres at end-user companies e.g. Kochi Refineries Limited, Ambalamugal, Kerala (now a subsidiary of Bharat Petroleum Corporation Limited), Chennai Petroleum Corporation Limited, Manali, Chennai, Tamilnadu (now a subsidiary of Indian Oil Corporation Limited) and Indian Oil Research Centre at Faridabad, Haryana. In addition to this India has the following research institutions - Indian Institute of Petroleum, Dehradun; Engineers India Limited R & D Centre, New Delhi; Reliance Research Laboratories; National Chemical Laboratory, Pune (NCL); National Environmental Engineering Research Institute, Nagpur (NEERI); Industrial Toxicology Research Centre, Lucknow (ITRC); Gas Turbine Research Establishment (GTRE); National Aerospace Laboratories, Bangalore (NAL); Indian Institute of Chemical Technology, Hyderabad (IICT); Centre for Military Airworthiness and Certification, Bangalore (CEMILAC) and academic institution laboratories at the Government owned Indian Institutes of Technology, Indian Institute of Science,

Bangalore and University Institute of Chemical Technology and UPES and TIFR in the Private sector. Each of these organizations have their independent core strength areas and success lies in integrating these objectives into a common national goal of making India an O&G ESO hub for the world. A typical proposed collaborative research model is as depicted in Figure 7.3.

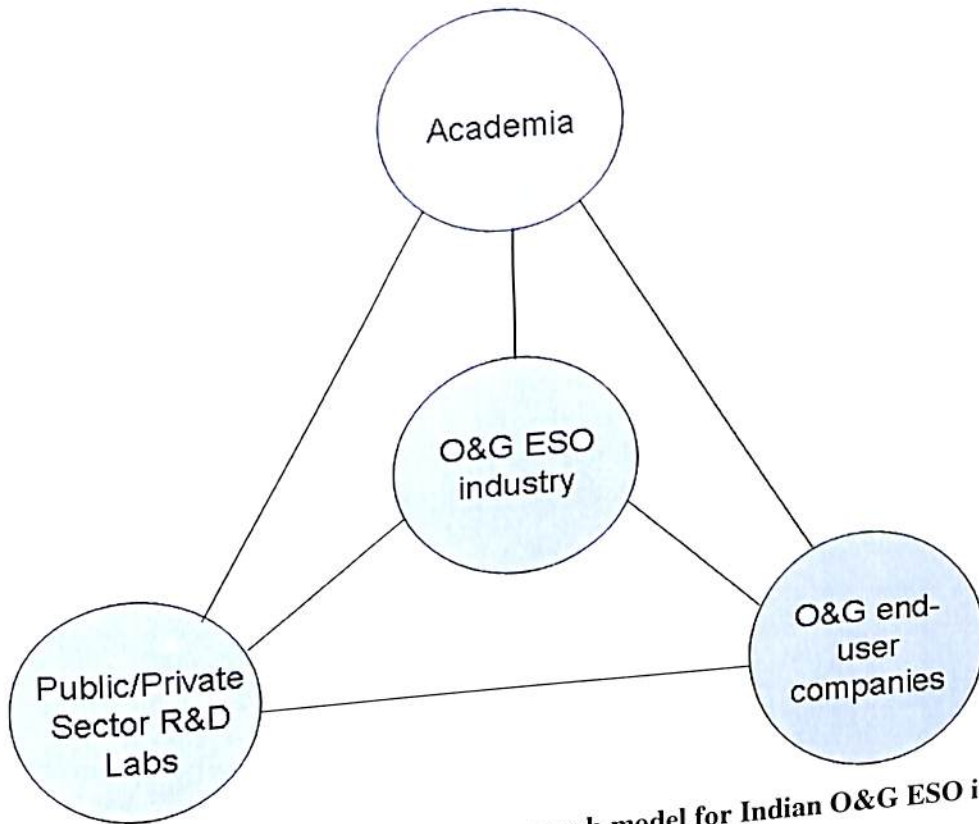


Figure 7.3: Proposed collaborative research model for Indian O&G ESO industry

Recommendation No. 5: Promote Innovation and R&D

Innovation will be a key requirement for success in the future. India has the potential to emerge as a leading hub of innovation in low-cost technology and process reinvention for O&G engineering. To realise this potential, the government and the industry can undertake several actions to transform the eco-system and create enablers of innovation. In the medium term, the government should focus on enhancing and enforcing IPR laws to match the best in the world. India already has strong IPR laws; they need stronger enforcement to encourage companies to commercialise in-house developed technologies and processes.

Further the government should catalyse investment in R&D to match the best in the world. Current spending on R&D in India amounts to 0.85 per cent of GDP, lower than in

China (1.44 per cent) and Russia (1.77 per cent). A comparison of the number of researchers per million people across countries shows that India is lagging behind the developed nations. The following enablers are required to promote Innovation and R&D:

- Provide 150% weighted tax exemption on in-house R&D expenditure in the O&G ESO sectors
- The draft Innovation law proposed by Ministry of Science, Technology and Earth Sciences should be thoroughly examined from an O&G ESO perspective. The focus should be on the various collaborative R&D scenarios on IP ownership and revenue sharing models and using best practices should arrive at a set of prescribed models that will be followed for each scenario. E.g. for Industry-academia collaboration, industry-government collaboration etc.
- Thematic Innovation Clusters specifically for developing new and innovative solutions for O&G services, integrated design and process plant hubs for automotives. Identify 3-4 Tier2/3 cities as emerging innovation hubs and build an integrated plan to develop and promote these (e.g. Vadodara due to close proximity to Koyali refinery, Kochi due to close proximity to Refinery and Petrochemical plants).
- International Collaboration on R&D - Enter into bi-partite agreements with foreign Government institutions
- Investment in innovation infrastructure - There is a huge requirement for Measurement, Standardization, Testing and Quality centres across the country. This infrastructure requires substantial capital investment which is difficult for small O&G ESO players in particular, and sometimes even the large companies to bear. The government should create and collate these with premier education colleagues and allow industry to use on a pay-per-use basis.
- Encourage Public Private Partnership for R&D in O&G sector
- The government must create a fund to provide grants to O&G ESO players for global patenting and copyrights. This is an expensive process, and many O&G ESO do not have the funds to file global patents, thus losing their chance to have rights on the intellectual property created by them.

7.2 OVERALL CONCLUSIONS OF THIS STUDY

This study has identified the ten elements to compare Location Attractiveness of BRIC nations for O&G ESO industry and have ascertained the following using a complementary approach of Comparative Case study (that primarily relied on data from secondary sources) as well as from the Statistical analysis of primary data surveyed.

- India emerged as a **Highly Favourable** location for O&G ESO industry in all the three types of analysis techniques (Comparative Case study MVA and One-way ANOVA) used in this study.
- India has a marginal lead from its nearest competitor China among the block of BRIC nations as a service provider destination for the O&G ESO industry that has been ascertained by the Highest Median and Lowest Standard Deviation. The variables used for this analysis are identified in Section 5.1 of Chapter-5.
- Russia ranked behind both India and China as 'Moderately Favourable' destination and Brazil emerged an 'Unfavourable' location in the comparison of Location Attractiveness for O&G ESO.
- The increasingly heated competition for talented and skilled workers globally is resulting in an overall shortage of technical personnel with specialised skill sets related to the O&G domain consequentially resulting in higher wages for the fewer resources available.
- India takes a commanding lead in the overall outsourcing business as compared to other BRIC counterparts in general owing to its long association of over two decades with IT/ITeS and BPO industry. In addition India also has established presence of several ESO companies operating in the Automotive, Aerospace, Hi-Tech (Semiconductor, Telecom, Consumer Electronics, Industrial Automation, Medical devices, Computing systems) and Utilities domain.
- Every year, the Indian educational system graduates around half a million technical professionals. India's top technical institutions, led by the Indian Institutes of Technology and the Indian Institute of Science, Bangalore are renowned globally as institutes that produce world's best technical brains. India is also setting up specialized universities like University of Petroleum & Energy

Studies, Dehradun, Uttarakhand; Pandit Deendayal Petroleum University, Gandhinagar, Gujarat and Rajiv Gandhi Institute of Petroleum Technology, Rai Bareilly, Uttar Pradesh.

- The labour force in India is familiar not only with the job content, but also with the work ethics, processes, quality and productivity expectations of major global clients due to the long association with established MNC O&G ES players in the country.
- While on the people front, India clearly leads amongst the BRIC constituents, infrastructure weaknesses pull down India's ratings on the 'Operations technology and Infrastructure' variable.
- Data security and intellectual property protection are growing concerns for MNC companies with offshore operations. However, India scores better against both China and Russia but trails behind Brazil on this front.

The O&G ESO industry in India is still in a nascent stage and provides an opportunity that is capable of catapulting Indian players into a high growth orbit. The transformational impact that this industry can achieve has the potential for India to not only achieve global leadership, but also build a truly inclusive growth environment in the country together with the Upstream, Midstream and Downstream activities in the country. Achieving these ambitious outcomes will require breakthrough collaboration amongst industry players, central and state governments, and industry bodies (e.g. NASSCOM, CII, FICCI) - to ensure that appropriate actions required to maximize the global sourcing market potential and sustain India's superiority as the preferred sourcing destination are executed in a timely manner. To that end, this thesis outlines the policy actions required in key areas such as:

- Developing high calibre talent pool
- Developing niche service areas and 'High-end' consultancy services for O&G ESO industry
- Building adequate basic, business infrastructure
- Ensuring a favourable business policy and regulatory environment
- Collaborative approach with existing players

- Fostering a sustainable ecosystem for Innovation and R&D
- Establish India as a trusted global hub for O&G ESO - managing risks effectively

7.3 LIMITATIONS OF THIS STUDY

There could be limitations of the study some of which are mentioned below.

- The scope of the study is limited in geographical terms to the four BRIC economies – Brazil, Russia, India and China. Although, in some sections of the report data and information about other developing economies have been used, this has been done solely for reference purposes only so as to present a wider comparative perspective. Otherwise, the study and analysis and recommendations are focused on the four BRIC nations only.
- There are limitations in terms of the research methodology used. Based on the Case study method, the primary data presented in the study is qualitative. The quantitative data is derived from secondary sources and carries the disadvantages typically associated with such data. For instance, some of the secondary data may be outdated, partly irrelevant or left partially unutilized for the purpose of analysis.
- Only variables that polled more than 11 votes out of 18 respondents (60%) in the Phase-I study have been used for the Comparative case study and Statistical analysis to arrive at Location attractiveness of BRIC nations for O&G ESO.
- The analytical methods used for comparative case study are deductive and discursive in nature limited to the nature of the methodology of case study used. Statistical methods have been used only to validate the results of the individual country rankings for O&G ESO obtained from Comparative Case study analysis. Single variable frequency and percentage distribution have been used to arrive at the recommendations and suggestions and action points for growth.
- Only a selected sample of twenty five O&G ESO companies have been considered in Chapter-6 to validate findings from the survey on the measures currently being adopted by the Indian O&G ESO industry.

7.4 CONTRIBUTIONS OF THIS STUDY

The major contributions of this study can be enumerated as below.

- The immediate contribution of the study is to add to the available literature on emerging trends in the engineering outsourcing industry related to the O&G industry.
- The significant contribution of this study is to make a comparison of the investment climate with specific reference to O&G ESO in the four BRIC countries studied and reported in the study. A reading of the comparative description is likely to provide a good understanding to an observer and analyst of the O&G ESO industry.
- The study makes an in-depth and all rounded analysis of elements of location attractiveness for the O&G ESO and compares it across the four BRIC countries. This comparison is expected to provide a tangible basis to the industry observer of the factors that contribute to the location attractiveness specifically with reference to the O&G ESO industry. The relative differences between countries also help to bridge the gap and suggest corrective steps.
- The study presents a detailed list of the proposed 'High Value' services that the Indian O&G ESO industry could provide and strengthen itself by insulating against wage arbitrage with new countries that are trying to enter into this market space.

7.5 FUTURE DIRECTIONS OF RESEARCH

I earnestly hope that this research study may lead to some interesting works on allied subjects. Some of the future directions for research are suggested below:

- Future researchers could consider developing studies based on the framework adopted for this study. In doing so, they could replicate the study for other emerging economies e.g. the new block of countries N-11 (the Next Eleven) as christened by the Goldman Sachs Economic Research Group in a BRIC update report published in December 2005. The Next Eleven consists of Bangladesh, Egypt, Indonesia, Iran, Korea, Mexico, Nigeria, Pakistan, Philippines, Turkey and Vietnam. These countries are fast vying attention of investors and getting their acts right to emerge as manufacturing and service outsourcing engines for the world.

- Similar studies could also be done for specific regions. For instance, country specific studies could be done for Eastern European nations that are also vying for the market share in the O&G ESO business.
- Alternative research methodologies such as detailed survey questionnaires could be used to generate a lot more numerical data amenable to rigorous statistical analysis. This could lead to a different perspective of some of the issues addressed in this research.
- Research studies advancing the agenda of the present study could also offer meaningful future research directions. For instance, an extension to the study can be done by taking up individual elements of the issues discussed in this study. Such an approach could present opportunities for an in-depth analysis of the issues explored in the present study.

Overall this research study can be considered as an attempt to push the boundaries of knowledge in the theoretical and practical areas of O&G ESO opening up opportunities for future research.