PETROFED

Petroleum Federation of India

Workforce Sustainability & Talent Management in the Indian Oil & Gas Upstream Industry

August 2006

A study in association with Member Company and Knowledge Partner

PRICEWATERHOUSECOOPERS

Acknowledgements

Petroleum Federation of India (PetroFed) is presenting this study in Knowledge Partnership with its member company **PricewaterhouseCoopers** Private Limited (PwC).

We thank MoPNG officials for the inspiration provided during the process of preparation of this study.

PetroFed was assisted by PwC in preparation of this paper which included soliciting views of industry, conducting interviews of industry and academia officials, researching the issues associated with the industry, presenting the views of industry in perspective and providing information on other countries.

We are also appreciative of the participation and responsiveness of PetroFed member and non-member companies in the upstream sector and other experts. Without their involvement, preparation of this study would not have been possible within the timelines set. We are thankful to PwC for their efforts.

Table of Contents

1. Executive Summary

1.1. Background of this study

1.1.1. The Government of India is sensitive to the requirement, of the oil & gas industry as a whole and the upstream industry in specific, for trained and skilled manpower. The local upstream industry as well as the global industry looks at India as a source of skilled and cost optimal manpower. In order to help planning actions that will result in servicing this demand, Ministry of Petroleum & Natural Gas has suggested that PetroFed undertakes a study and puts it up for consideration of the MoPNG.

1.1.2. This study covers the scenario of human resource requirements and availability in the upstream industry and comments on the potential India has, to develop such resource to service local as well as global need for trained manpower and actions needed to achieve the same.

1.2. Current Situation

1.2.1. Significant discoveries have been made for Oil & Gas around the world in the past 5 years which would result in enhanced E&P activity in the coming years. In 2006 alone, over 26 countries have announced the Lease sales and all these directly correspond to significant amount of workforce requirements particularly in the areas of Petroleum Engineering, Production Engineering, Drilling Crews and Geoscientists.

1.2.2. India has also witnessed an increase in the E&P activity. India is the fourth largest oil consumer in the Asia-Pacific region and the Indian Oil and Gas sector accounts for more than 30 percent of India's import bill. This is bound to increase further as evidenced by the growth of the key

sectors that use Oil & Natural Gas for their energy requirements unless substantial discoveries are made in India.

1.2.3. The Government of India has awarded over 110 blocks through international competitive bidding under five previous rounds of NELP. As of 2005, less than 20 percent of India's sedimentary basin area has been well explored. The area opened up in NELP 6 is more than twice the area opened for exploration in NELP 5, demonstrating government's intentions to speedily explore for hydrocarbon reserves.

1.3. The Challenge

1.3.1. Against a backdrop of rising demand locally as well as globally and positive intention of the government to actively explore further, a boom is expected in the E&P sector. As a consequence of this, the human resource scenario has already reached an increasingly competitive stage and in future the industry may struggle to maintain the required level of exploration and production due to lack of trained manpower.

1.3.2. According to the Society of Petroleum Engineers (SPE) the current Global E&P Petrotechnical Workforce strength is expected to be around 375,000. With the rising E&P activity the overall shortfall for the same is expected to be about 30,000 professionals by the year 2012.

1.3.3. India too is facing a crunch of manpower in critical skills. The gap on account of demand supply mismatch may further be aggravated by the exit of these critical skills from the domestic industry on account of international requirements.

1.4. Approach to developing recommendations

1.4.1. The study involved estimation of demand of manpower from projected E&P activity in India over the next 10 years considering possible scenarios related to opening up of acreage for exploration.

1.4.2. The four scenarios of awarding additional percentage of sedimentary basinal area for exploration, considered for the purpose of this study are as follows:

- Scenario 1 – 12 percent additional area on an annual basis from 2007 to 2010.
- Scenario 2 – 12 percent additional area once every 2 years from 2008 to 2014.
- Scenario 3 – 12 percent additional area once every 3 years from 2008 to 2017.
- Scenario 4 – Addition of variable percentage of area once every 2 years from 2008 to 2014.

1.4.3. In discussion with the E&P experts in India, Scenario 2 was considered to be the most likely scenario for E&P activity in India. This scenario assumes that 88 percent of the sedimentary basin in India is offered for exploration by 2014. This study considers E&P activity as envisaged in this scenario to estimate the workforce requirements for E&P skills in India.

1.4.4. To arrive at the final projections of talent pool in the E&P Ecosystem, interviews and workshops were conducted with the key representatives from leading organizations in the E&P sector (public sector, private sector and the oil field service companies), MoPNG officials and educational institutions.

1.4.5. Some of the key steps in arriving at the projections and the talent gaps included scenario analysis, stage-wise analysis of the skill & workforce strength requirements, current workforce analysis (including retirement, attrition etc.) and supply side analysis (institutes, courses offered, number of seats available, potential for expansion etc.)

1.4.6. Global E&P activity has also been assessed through secondary research and talent requirements on account of global demands have also been considered for developing the recommendations with a view to prepare the Indian workforce to address the global requirements as well.

1.5. Critical Issues identified

The key issues faced by the E&P industry:

1.5.1. **Scarcity of Skills**: Geologists, geophysicists, loggers, toolpushers, drillers, petro-physicists and production engineers are considered a global commodity rather than that belonging to a country. In these sets of critical skills a significant shortfall is expected in the next 10 years. Indeed similar acute shortage exists in the same sets of skills globally.

1.5.2. Most of these skills are in excess today in India; however, in view of the significant E&P activity expected; the projected demand in India will far exceed the supply of talent. Example, the projection model shows that the peak demand supply gap for skills requiring Geosciences will be 2,267 (in the year 2010) (refer Group I analysis - Section 6.2.2). The peak shortfall across all key skills (refer Section 6 Demand / Supply Analysis) is expected to be 8,777 (in year 2016), if remedial action is not taken immediately. This makes the situation of talent gap in India far more acute.

1.5.3. **Not enough talent available to the sector at the entry level**: The E&P sector faces a critical challenge in attracting the young talent. Shortage of talent at entry level in North America, Russia and Middle-East is estimated to be up to 930 every year in the next decade.

1.5.4. The Indian education sector prepares around 400+ students in E&P related geo-science courses. Of the students passing out of petro-technical streams only 56 percent join E&P companies with 12 percent of these being recruited for overseas positions. The entry to E&P sector is limited to 56 percent due to the low awareness of the job opportunities in the sector at the entry level and the perceived higher attractiveness of other sectors mainly IT, Telecom (29 percent of students move to other such sectors). The Indian industry will require an additional 800 petro-technical students by 2017 (600 of these by 2012). This will require an

increase in the number of students taking up education related to this sector. However, the sector faces the following challenges in attracting young talent:

- **Low Industry Awareness:** College as well as school students are not aware of the career paths and opportunities available in the E&P sector (short term and long term) and how they compare with career in other sectors.
- **Low Industry Attractiveness:** Generally tougher working conditions and low attractiveness of the field job, coupled with a favourable alternate job market scenario make the E&P sector low on attraction for employees at all levels.

1.5.5. **Ageing Workforce:** More than 850 of the critical skills in the industry will retire in the next 10 years, with only a limited availability of younger profiles, making the industry vulnerable to talent vacuum in the near future. As these critical skills are honed on the job, their exit is likely to erode the competitiveness of the sector in the country.

1.5.6. **Pull from overseas job opportunities:** Currently critical skills command far higher compensation outside of India. Talent in India may continue to be attracted to the overseas opportunities given the significant shortage globally and in particular Middle East & Russia.

1.5.7. **Retention:** Retention of mid-career talent will be a severe challenge. The retention issues will peak for the companies in India as the talent squeeze is felt by each of them. NOCs in particular are highly vulnerable as they hold the highest number of trained human resources available in the industry which is being actively sought out by the private players.

1.6. Global initiatives to address the talent gaps

1.6.1. Few of the countries in the world are already gearing up to close this gap. Countries such as Canada and UK have adopted key initiatives with a proactive view to address these challenges. These initiatives can broadly be categorized into three levels viz. at the government level, at the educational system level and at the organization / industry level.

1.6.2. **Government Bodies:** These bodies are taking primary responsibilities for addressing the information gaps through the following initiatives:

- Collection and analysis of data on data on human resource demand mapped to industry- identified skill categories.

- Establishing forums of educators and industry professionals to develop and implement national strategy on addressing talent gaps in the E&P sector.
- Develop understanding of the capability and inclination of the contractor firms in supplying workforce to address skill gaps that may arise in the future.

1.6.3. Education Sector:

- Work with industry to establish occupational standards, apprenticeship, certification and training programs for occupations where supply gaps exist or will exist to improve workforce mobility, career path options and training consistency.
- Within each region, develop in association with industry an information strategy to communicate with potential entrants, their parents and others who play a role in influencing career choices. The strategy may include approaches such as the development of a website, participation in career fairs, servicing career practitioners, or targeted marketing.
- Collaborate with the industry to explore opportunities to provide practical application examples for curriculum so that students and educators can obtain a better understanding of how mathematics and science are applied on the job.

1.6.4. Organization Level

- Develop prior learning assessment tools to assess the skills of the semi-skilled workforce to improve attraction and retention and to streamline the selection process.

- Explore potential partnerships to share human resources with industries that use similar resource and experience the same challenge of attracting and retaining employees.

1.7. Recommendations for India

The key recommendations on the basis of the issues identified above are as follows:

1.7.1. Augmentation of these skills required in the immediate term (2007-2009) through innovative means such as :

- Hire talent with alternative educational qualifications and supplement by aggressive training and certification methods.
- Strengthen the curriculum of existing institutes with increased industry participation in order to prepare the students for the jobs in the shortest time.

1.7.2. Set-up defined mechanism to enable utilization of retired / retiring professionals as mentors /trainers to enable transfer of knowledge to the relatively younger talent force.

1.7.3. Involve college students, at entry levels, using focussed development programs to improve their understanding of the E&P Sector, groom them and ready them for the industry.

1.7.4. Increase number of talent available to the sector: India has been considered to be naturally gifted with large, talented pool of population. Given that the E&P sector worldwide is experiencing shortage, much like the IT sector, the E&P skills are increasingly considered as a global commodity. It is vital for India to provide for enough manpower to take care of the talent needs for the industry–public and private sector companies as well as provide an opportunity to industry to use Indian talent globally. Two important initiatives with regard to this include:

- Set-up higher numbers of appropriate educational institutions, expand the existing capacity in institutes across the country with increased industry participation. The increased capacity will enable India to cater to domestic as well as global demand (there exists a potential for the Indian talent to tap 20 percent of the short-fall per annum in Russia and Middle-East.). The existing institutes in the country are already planning to add around 65 sets in the next 2-3 years. Other institutes are also willing to consider expansion but have expressed need for assistance with infrastructure and faculty. A proposed institute being considered plans to supplement with 300+ seats per annum five years after starting and a total of 500+ seats per annum in 10 years. Still, an additional capacity for 285 seats per annum by 2012 and 385 per

annum by 2017 will be required to be addressed through new institutes.

- Implement a plan to communicate the attractiveness of the industry. We suggest a "Go Explore" campaign where students, right from class 10th onwards, from all levels of economic and social backgrounds, hear and understand about the career opportunities in the E&P sector. Institute a large number of scholarships for high caliber talent throughout the country.

1.7.5. Strengthening the industry and education sector participation to prepare and encourage talent into the industry:

- Set-up an Industry–Academia interface to plan the effort to draw young talent to the E&P related streams and provide mechanisms to develop this talent as per industry requirements. The efforts of the forum should be directed towards improving the quality of talent at the point of entry into the educational institution as well as during the education program.
- Set up targeted communication campaigns to attract talent shifting to other sectors at entry level. Additionally, industry to partner with institutes to organize seminars, workshops and career counselling sessions.
- Industry to collaborate with educational institutes to strengthen the curriculum as per job requirements and setting up training programs to improve readiness of students for the industry. Further, industry alongwith educational institutes to set up programs for student participation such as industrial trainings, internship programs, on-site visits, student workshops etc.

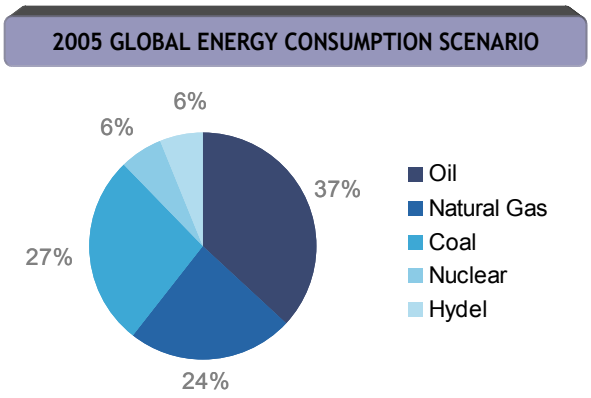
- Organizations to partner with educational requirements and run dedicated programs to offer students with opportunities for apprenticeship, jobs through appropriate mechanisms.
- Organizations to partner with select institutes by instituting more chairs and scholarships.
- Increase faculty-industry interaction, train faculty on newer developments in the sector.
- Consider adoption of college going students at entry level to nurture their growth and readiness for the industry.

1.7.6. Findings of this study were presented in the industry meeting held in PetroFed office on August 21, 2006 which was attended by HR Directors of PSU oil companies, senior industry officials, CEOs and senior officials of Service Companies and MoPNG officials. In the interactive presentation to the attendees, the conclusions of this study and the recommendations made were discussed. Observations expressed by the attendees have been incorporated in this study.

2. E&P – Current status & Outlook

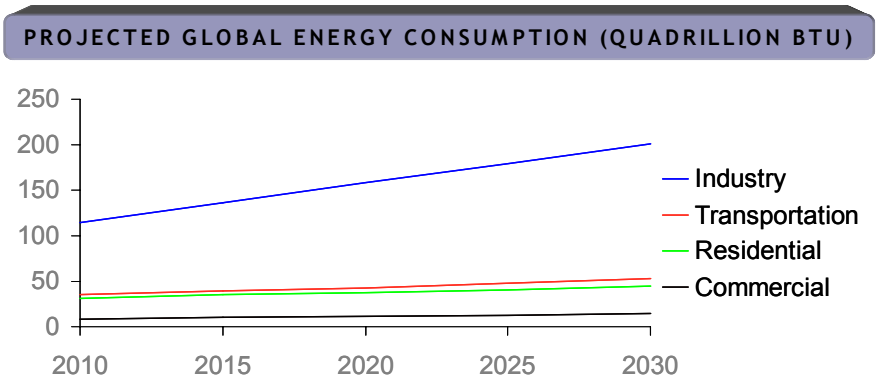
2.1. The Up-Stream Oil & Gas Industry Worldwide

Globally, Petroleum accounts for over 61 percent of the energy requirements.



Source: BP Statistical Review, 2006

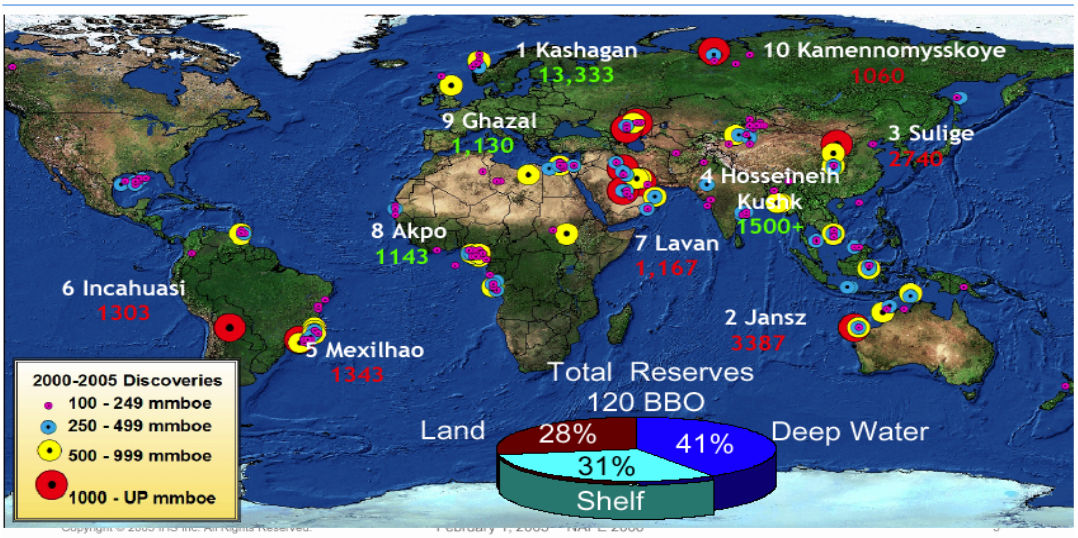
2.1.1. Further, the global requirement of Oil & Natural gas is bound to increase further in the future. This is evidenced by the growth of the key sectors that use Oil & Natural Gas for their energy requirements.



Source: International Energy Outlook 2006, EIA, DoE, USA

2.2. Recent Discoveries and Emerging Prospects

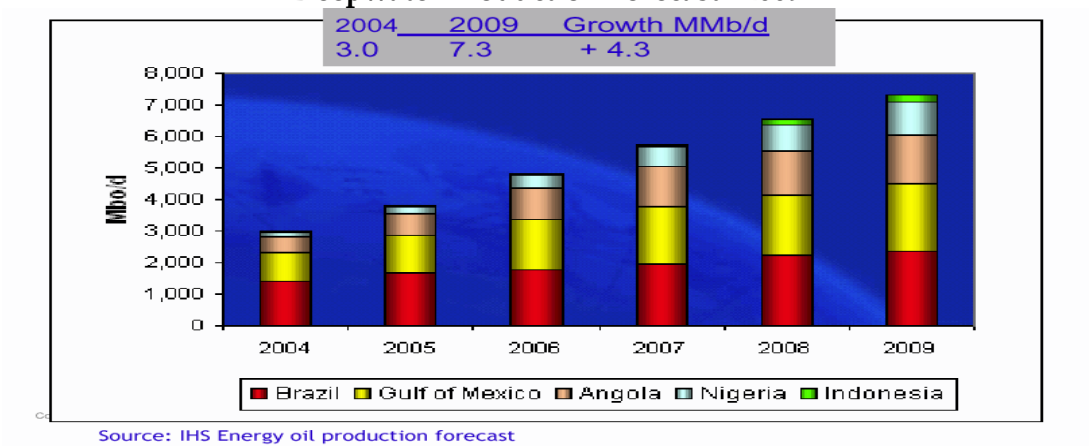
2.2.1. Significant discoveries have been made for Oil & Gas around the world in the past 5 years.



Source: "E&P Challenges and Opportunities", IHS Energy

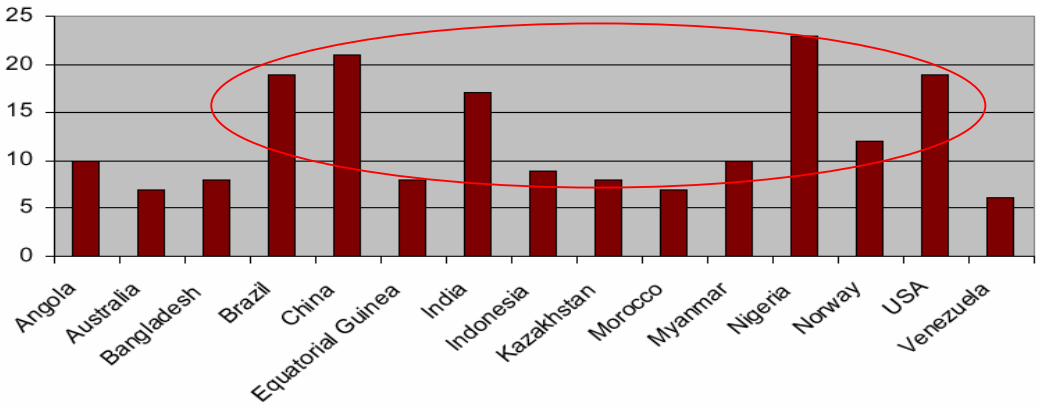
2.2.2. Correspondingly, in the next few years significant investments and activities in the Production of these finds can be expected. Brazil, Mexico, Angola, Nigeria and Indonesia are the top 5 countries where significant production related activities can be expected from their Deep water reserves. By 2009, close to 7000 MMb/d can be expected to be produced from these 5 countries alone.

Deepwater Production Forecast –2009



2.2.3. In the next few years, significant exploration activities are expected in many countries around the world with nearly 41 countries announcing Bid rounds. In 2006, over 26 countries have announced the Lease sales and all these directly correspond to significant amount of workforce requirements. The following chart depicts the countries and the number of prospects they have that may be greater than 250 MMBoE. Rig & crew availability (especially in the petrotechnical skill areas) are considered to be some of the most critical issues for all these countries.

2.2.4. Location of >250 MMBoE Prospects (by Country) - 2007

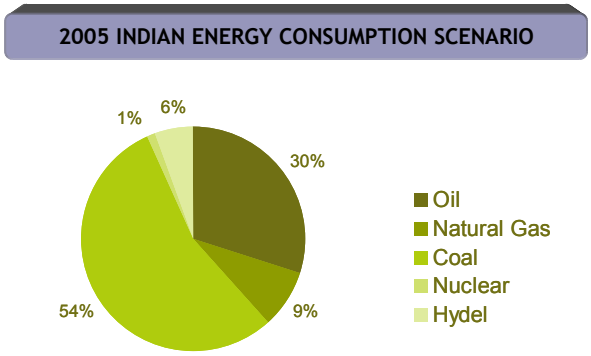


Source: "Where are the Elephants? - A Global Review of significant prospects which may be drilled in 2005-2007", IHS Energy

2.3. The Indian Up-Stream Oil & Gas Industry

2.3.1. In Exploration & Production (E&P), Indian oil and natural gas fields have opened up to the private sector as well as to foreign participation under production sharing contracts.

2.3.2. Petroleum is an important source of energy which accounts for about 39 percent of India's total energy requirements next only to coal. Indian Oil & Gas sector accounts for more than 30 percent of India's import bill.



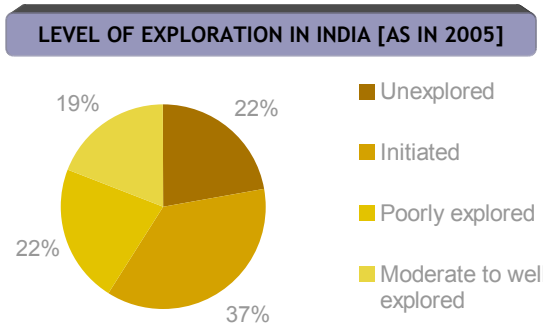
Source: BP Statistical Review, 2006

2.3.3. India is currently the fourth largest oil consumer in the Asia-Pacific region after Japan, China and South Korea and for GDP growth rate of 6 to 8 percent, India's POL and NG consumption is projected to increase at a CAGR of between 4.5 & 6.0% and 6.9 & 9.1% respectively for period between 2004 and 2030[1].

2.3.4. More importantly the need for India to ensure that it identifies and generates its own oil has never been higher with increasingly higher usage of oil in the country. The Government of India has awarded over 110 blocks through international competitive bidding under 5 previous rounds of NELP, to boost the oil and gas reserve identification &

[1] PetroFed "Fuelling India's Growth", PwC analysis. Naphtha is included in NG rather than POL for analysis.

production. As of 2005, less than 20% of India's sedimentary basin area has been well explored. The area opened up in NELP 6 is more than twice the area opened for exploration in NELP 5, demonstrating government's intentions to actively explore for hydrocarbon reserves.



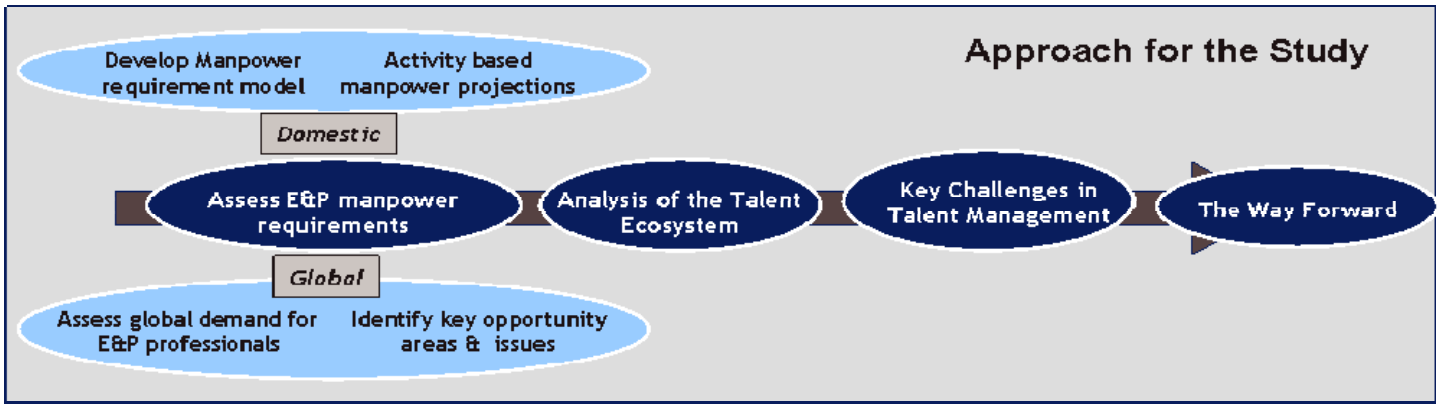
Source: Activity Report, 2004-05, DGH & NELP Data

3. Approach and Methodology

3.1. Introduction

3.1.1. This study takes into consideration the global concerns and local demands / issues in arriving at an approximate estimate of the future workforce required.

3.1.2. Our Approach and Methodology are detailed in this section. Our approach has been cascaded as follows.



3.1.3. The assessment phase involved establishing the requirement for E&P professionals on account of both global and domestic E&P activity over the next 10 year horizon. The same have been detailed in sections 8 and 5 respectively.

3.1.4. The manpower requirements for the domestic E&P activity have been established using an activity based workforce projection model (refer Section 3.2 below).

3.1.5. As a part of information gathering and validation for this study, we have interviewed senior managers and members of the leadership team from leading E&P organizations (ONGC, RIL, Essar Oil, Indian Oil, Tata

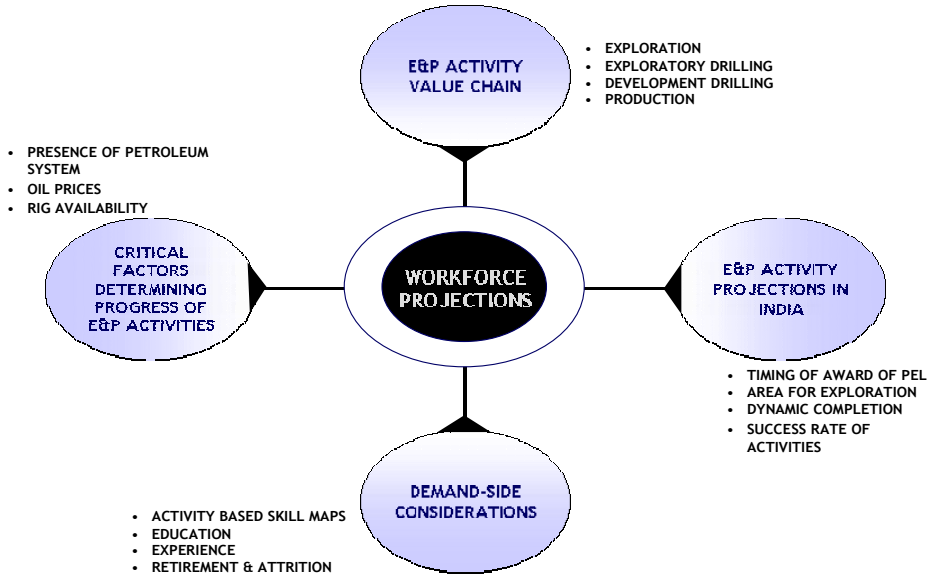
Petrodyne, Jindal Drilling etc.). Key inputs from the industry have been used to develop the E&P activity and workforce projection model.

3.1.6. On the talent supply side, we have assessed the supply available to the industry at the entry level. For this, we also held discussions / interviews with representatives from the academia (including representatives from – Indian School of Mines (Dhanbad), IIT Mumbai, IIT Kharagpur, IT – BHU, IIT Roorkee, MIT Pune etc).

3.1.7. The inputs from both the industry and the academia have also been used to identify key challenges faced by the E&P sector on the talent front and to develop recommendations to address the same.

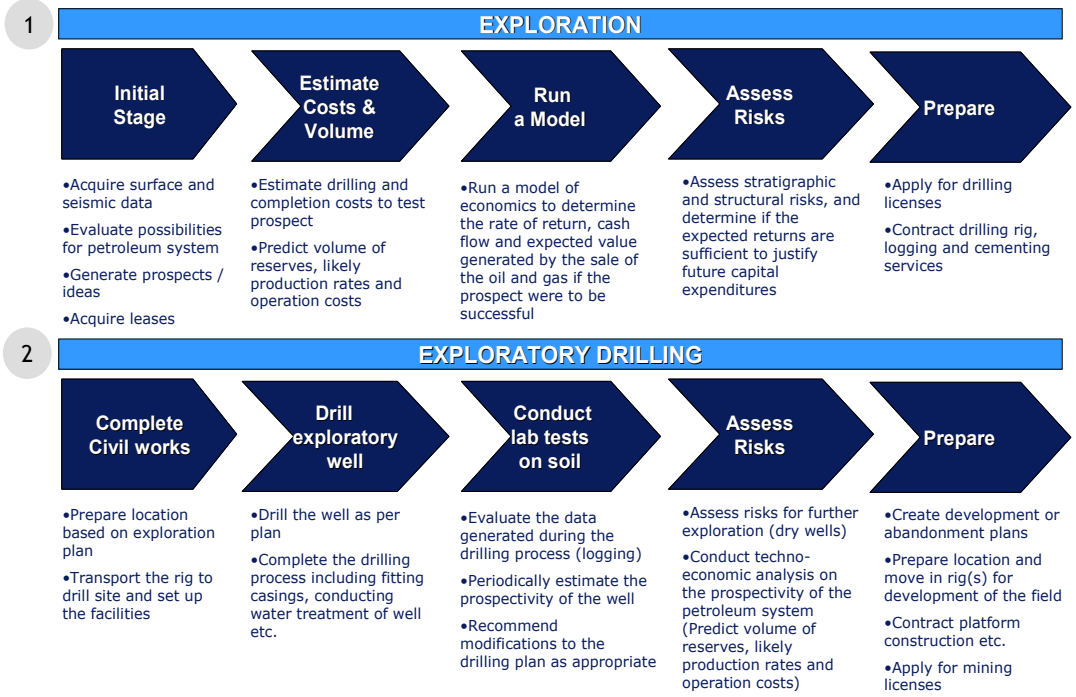
3.2. Activity Based Workforce Projections

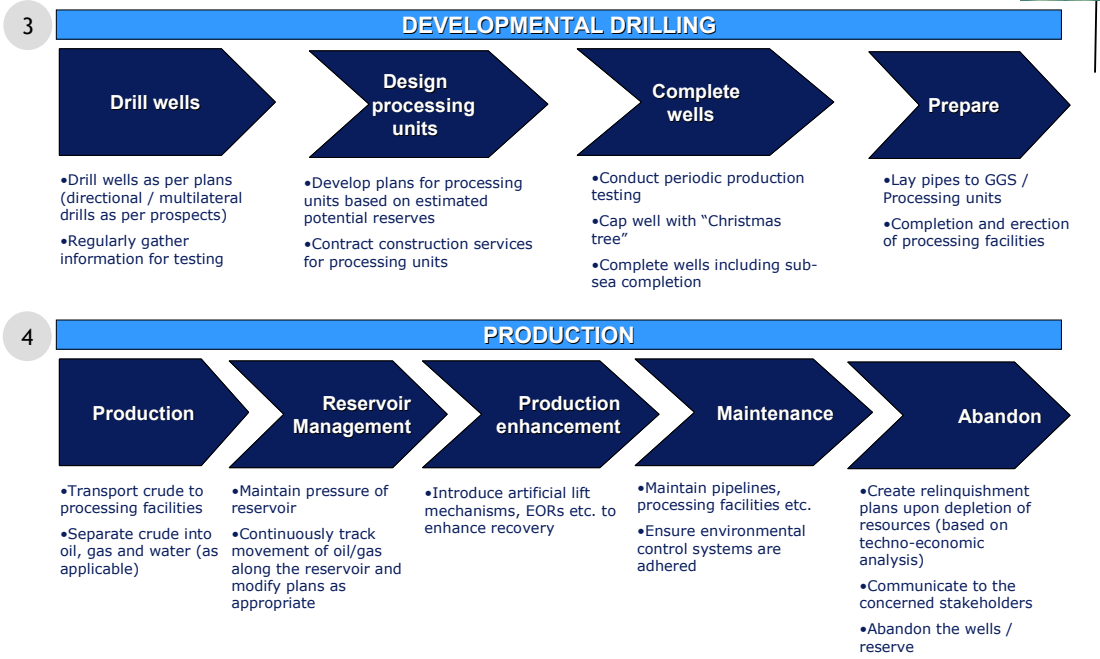
3.2.1. The activity based workforce projections model has been used to project the manpower requirements for the projected E&P activity in India. This includes 4 key stages as depicted below.



3.2.2. **E&P Activity Value Chain:** The E&P activities have been categorized into four different phases viz. Exploration, Exploratory Drilling, Development

Drilling and Production. Exploration activities cover the prospecting activities conducted in the search for oil and gas. These activities include but are not limited to aerial, geological, geophysical, geochemical, palaeontological, palynological, topographical and seismic surveys, analysis, studies and their interpretation, investigations relating to the subsurface geology including structural test drilling, exploratory type stratigraphic test drilling, drilling of exploration and appraisal wells and other related activities such as surveying, drill site preparation and all work necessarily connected therewith for the purpose of oil and gas exploration. Similarly, the other phases also have innumerable number of activities based on parameters like block sizes, financial capabilities, rig availabilities, procurement of licenses, prospectivity etc. For the purposes of this exercise, we have summarized these phases into the following stages.





3.2.3. **Critical factors determining the progress of E&P activities:** While there are many parameters that determine the progress and pace of E&P activities we have considered 3 critical issues as a part of our approach.

- **Presence of Petroleum System**: It is assumed that only 2.3% of the sedimentary basin area of 3.14 Mn Sq Km has potential reserves. The calculations of the same are detailed in the Appendix.
- **Oil Prices**: Oil prices have been considered to remain attractive enough to motivate organizations to venture for E&P.
- **Rig Availability**: Although there appears to be difficulties in procuring rigs for drilling, it is assumed that the companies will surely procure rigs to ensure that they complete their minimum work commitments on time and also proceed for developmental drilling phases. Forming of a consortium of E&P companies for rig procurement and long term leases are some of the ideas that are already in consideration in India.

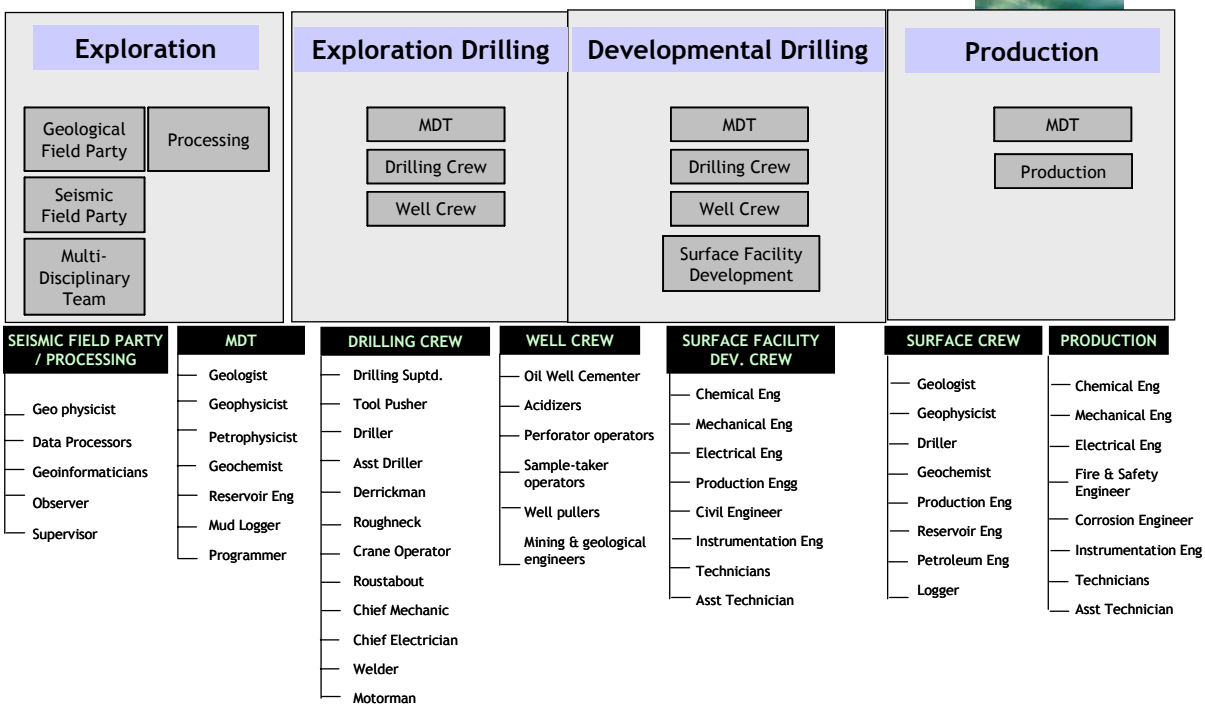
- **Other issues** like availability of funds, licenses etc. are assumed to be provided and will not hamper the assumptions on the activity timelines.

3.2.4. **E&P Activity Projections in India:** In order to arrive at the E&P activity projections, the following assumptions have been utilized.

- **Timing of Award of PEL**: Sensitivity Analysis (Scenarios 1-3) are based on when the acreage is opened for exploration and consequently the award of PEL (1 year later).
- **Area for Exploration**: Sensitivity Analysis (Scenario 4) is based on conservative estimate of area opened for exploration. We have considered acreage based on NELP 6 situation and the government's intentions to actively explore for hydrocarbons.
- **Dynamic Completion**: While market dynamics and fund situations determine faster / slower completion of the activities undertaken, we have assumed that at least the minimum work commitment will always be met on time.
- **Success Rate of Activities**: Upon abandonment of the select block areas where hydrocarbon presence may not be detected, only 2.3% of the initial area is considered to have economic hydrocarbon presence. [Refer 9.6.1]

3.2.5. **Demand Side Considerations:** Five key parameters have been considered for the workforce projections viz. Skills, Academic requirements, Experience requirements, Retirement and Attrition.

- Activity Based Skill Maps: In order to arrive at the various skills required for the efficient and effective completion of the E&P activities, the following matrix has been arrived at. Each of the phases and their sub-activities require varying skill sets and in varying numbers.



- **Retirement**: Given the age-profile in the Indian E&P sector, a conservative estimate of 2.5% of the population is considered to retire every year. For select skills like Data Processors, Programmers etc. 1% of the population is considered for retirement based on insights provided during industry interactions. The details are provided in the Appendix.
- **Attrition**: For key skills like Drilling, attrition of 8% to foreign countries is estimated. For other skills conservative estimates of 4% and 2% have been used. The details are provided in the Appendix.
- **Education & Experience**: The minimum academic qualifications and experience requirements (and substitute options) that enable the job holder to be effective enough to handle responsibilities are detailed below. While every role is critical in its own domain, some of the skills require significant education and experience vis-à-vis others. The criticality of these roles is also presented along with.

Job ↓ / Academic Profile →	Year of Minimum Experience	Geology	Geophysics	Maths	Computer Science	Physics	Chemistry	Petroleum Engg	Drilling Engg	Chemical / Process Engg	Electrical / Electronics Engg	Mechanical Engg	Civil Engg	Other Engg
Geologist	4	■	■											
Geophysicist	5	■	■			*								
Geoinformatics	3													
Petrophysicist	4	■	■					■						
Programmer	2				■									
Drilling Engineers	5								■	■	■	■		■
Reservoir Engineer	5	■	■	■		■		■		■				
Chemical / Process Engineers	3									■				
Production Engineers	1							■		■		■		
Civil Engineers	3												■	
Mechanical Engineers	3											■		
Electrical, Instrumentation & Control Engineers	3									■	■	■		

**with electronics*

■	Preferred
■	Accepted

Source : PwC analysis based on industry interaction

3.3. Estimating the required Workforce

3.3.1. The following approach has been used to arrive at the talent shortages in the E&P sector.

3.3.2. Estimating the total activity possible in the E&P sector

- Multiple Scenarios arrived at based on the frequency of opening up of the blocks as well as on the acreage that may be opened up for future (either through NELP or Open Acreage system as followed in many other countries)
- Year-wise estimates of the area that may be explored, number of exploratory & development wells drilled (based on number of blocks & identified development area), platforms designed & developed, processing units designed and utilized.

3.3.3. Estimating the workforce required to complete the activities

- The team sizes depicted in the activity based skill maps are used to arrive at the overall workforce requirements for the various phases of E&P
- Approximations on Retirement and Attrition (outside India) have also been considered at this stage

3.3.4. Estimating the talent shortages

- As-Is projections have been approximated based on total number of employees employed in select companies in India and consequently extrapolating it to the overall industry scenario
- The Maximum & Minimum requirements of workforce (skill-wise) based on the 4 identified scenarios are compared with the As-Is projections to arrive at the talent gaps that may emerge in the future

3.3.5. This has been gathered & validated though discussions with officials of leading organizations and PwC research.

3.4. Assumptions and Limitations of the model

3.4.1. The model for activity based workforce projections has been developed in consultation with E&P practitioners from both the public as well as the private sector. In order to arrive at the projections the following assumptions have been made:

3.4.2. Assumption regarding the future opening up of blocks for exploration has been based upon the history of E&P activity in India and also keeping in view the government's intention to support active exploration

3.4.3. The crew composition, as detailed in Appendix Para 9.1, for various groups has been arrived at by discussions with various companies operating in the E&P space. Different companies actually may have variations in the composition based upon operating models followed. The

composition used in the model has been arrived at after factoring in such considerations and is understood to be applicable to all.

3.4.4. Success rate – Only 2.3 % of the total initial area available for exploration is assumed to have economic hydrocarbon presence (for details of success rate calculations please refer to Appendix - Section 9.6).

3.4.5. Future improvements in technology are likely to reduce manpower and increase efficiencies. Also, technological changes may modify the skill for E&P professionals.

3.4.6. Coal Based Methane and Gas Hydrates exploration and production would involve similar skill sets and are likely to draw from the common talent pool available to the Oil and Gas E&P industry; which may increase the demand for common skills.

3.4.7. Additionally, assumptions related to parameters affecting the progress and pace of E&P activities such as- presence of petroleum system, oil prices, infrastructure have been discussed in section 3.2.3.

4. Demand Side Projections & Assessments (India)

The following section details the estimation of workforce for the projected E&P activity in India over the next 10 year horizon. This is based on determining the extent of exploration and production activity for four different scenarios and considering the most-likely scenario of E&P activity for workforce assessment.

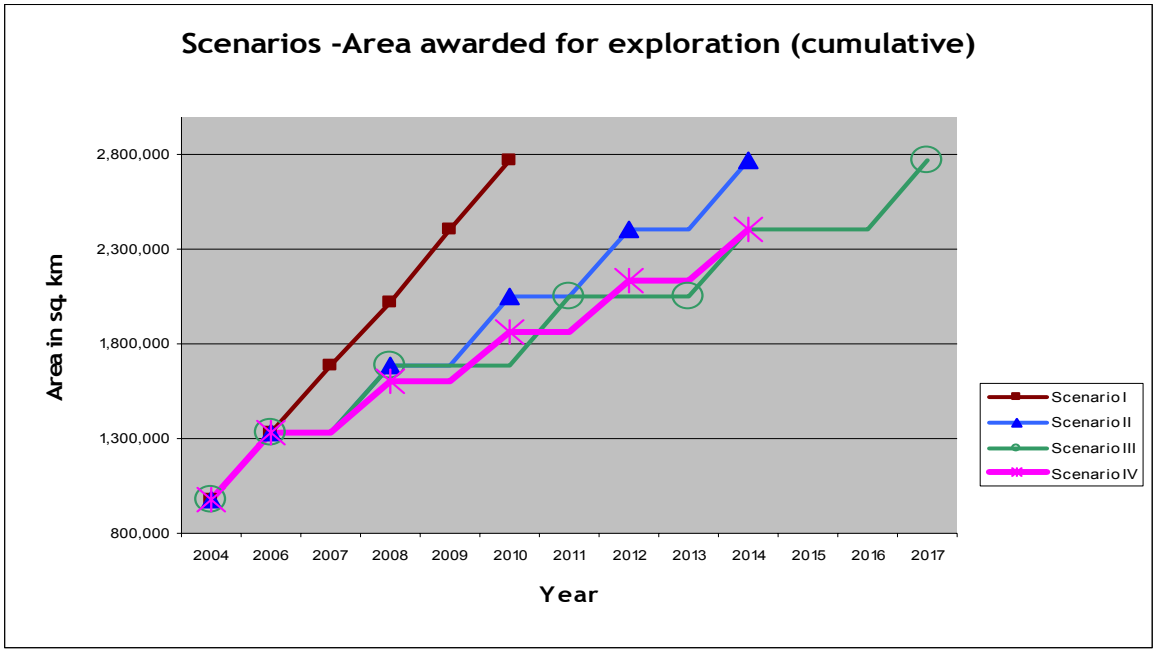
4.1. Scenarios

4.1.1. Workforce demand has been arrived at considering the most likely scenario of E&P Activity in India.

4.1.2. While numerous such scenarios are possible, we have restricted our research to four scenarios given the focus of maximum exploration in the near future. The four scenarios are described as follows:

- **Scenario 1** – The focus is on immediate exploration and NELP blocks are opened every year (2007, 2008, 2009 and 2010).
- **Scenario 2** – Exploration is staggered through the next decade and NELP blocks are opened every 2 years (2008, 2010, 2012 and 2014).
- **Scenario 3** – Exploration is staggered beyond the next decade and NELP blocks are opened every 3 years (2008, 2011, 2014 and 2017).

- **Scenario 4** – The focus is on staggered exploration through the next



decade and the blocks are opened every 2 years as in scenario 2 but area opened is 75% of scenario 2.

4.2. Acreage Estimation

4.2.1. The breakup of the acreage into onland, deepwater and offshore is given below:

Scenario 1 – Focus on immediate exploration

YEAR	NELP #	ON-LAND	DEEPWATER	OFFSHORE	TOTAL	CUMULATIVE	% areas opened for exploration
2007	NELP 7	60000	275000	25000	**360000**	**1687953**	54%
2008	NELP 8	60000	275000	25000	**360000**	**2047953**	65%
2009	NELP 9	60000	275000	25000	**360000**	**2407953**	77%
2010	NELP 10	60000	275000	25000	**360000**	**2767953**	88%

Scenario 2 – Focus on exploration staggered through the next decade

YEAR	NELP #	ON-LAND	DEEPWATER	OFFSHORE	TOTAL	CUMULATIVE	% areas opened for exploration
2008	NELP 7	60000	275000	25000	**360000**	**1687953**	54%
2010	NELP 8	60000	275000	25000	**360000**	**2047953**	65%
2012	NELP 9	60000	275000	25000	**360000**	**2407953**	77%
2014	NELP 10	60000	275000	25000	**360000**	**2767953**	88%

Scenario 3 – Focus on exploration staggered beyond the next decade

YEAR	NELP #	ON-LAND	DEEPWATER	OFFSHORE	TOTAL	CUMULATIVE	% areas opened for exploration
2008	NELP 7	60000	275000	25000	**360000**	**1687953**	54%
2011	NELP 8	60000	275000	25000	**360000**	**2047953**	65%
2014	NELP 9	60000	275000	25000	**360000**	**2407953**	77%
2017	NELP 10	60000	275000	25000	**360000**	**2767953**	88%

Scenario 4 – Focus on exploration staggered through the next decade, less area opened for exploration

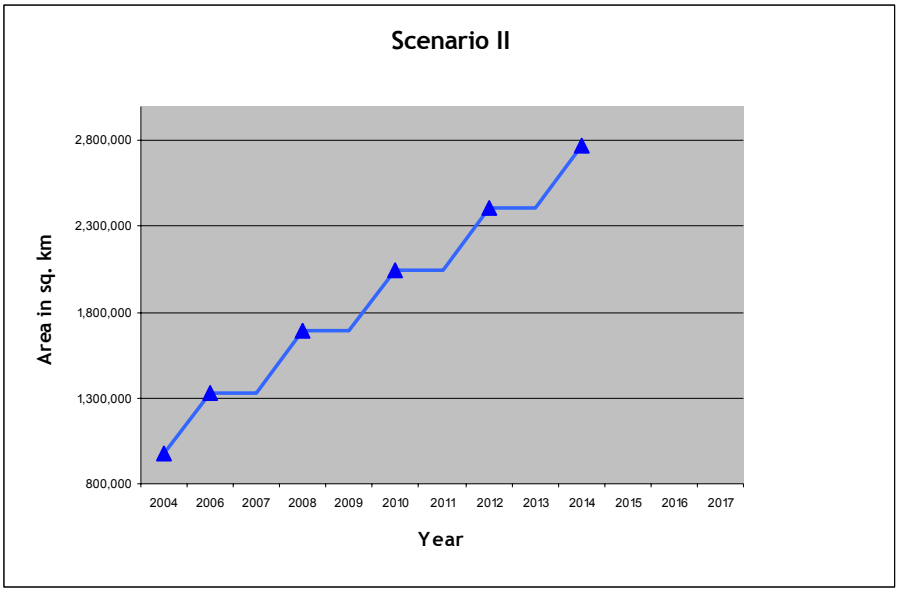
YEAR	NELP #	ON-LAND	DEEPWATER	OFFSHORE	TOTAL	CUMULATIVE	% areas opened for exploration
2008	NELP 7	45000	206250	18750	270000	1597953	51%
2010	NELP 8	45000	206250	18750	270000	1867953	59%
2012	NELP 9	45000	206250	18750	270000	2137953	68%
2014	NELP 10	45000	206250	18750	270000	2407953	77%

Note: Open Acreage system, if in place, is assumed to generate significant increase to comparable trends as in NELP rounds

4.2.2. Note: In the above table, the cumulative area also includes the area already opened up till 2007 which is equal to 1327953 sq. km

4.3. Most likely Scenario for E&P Activity

4.3.1. Based upon the discussions with the industry professionals, Scenario 2 has been recognized as the most likely scenario for E&P Activity in India. The details for the same are as follows.



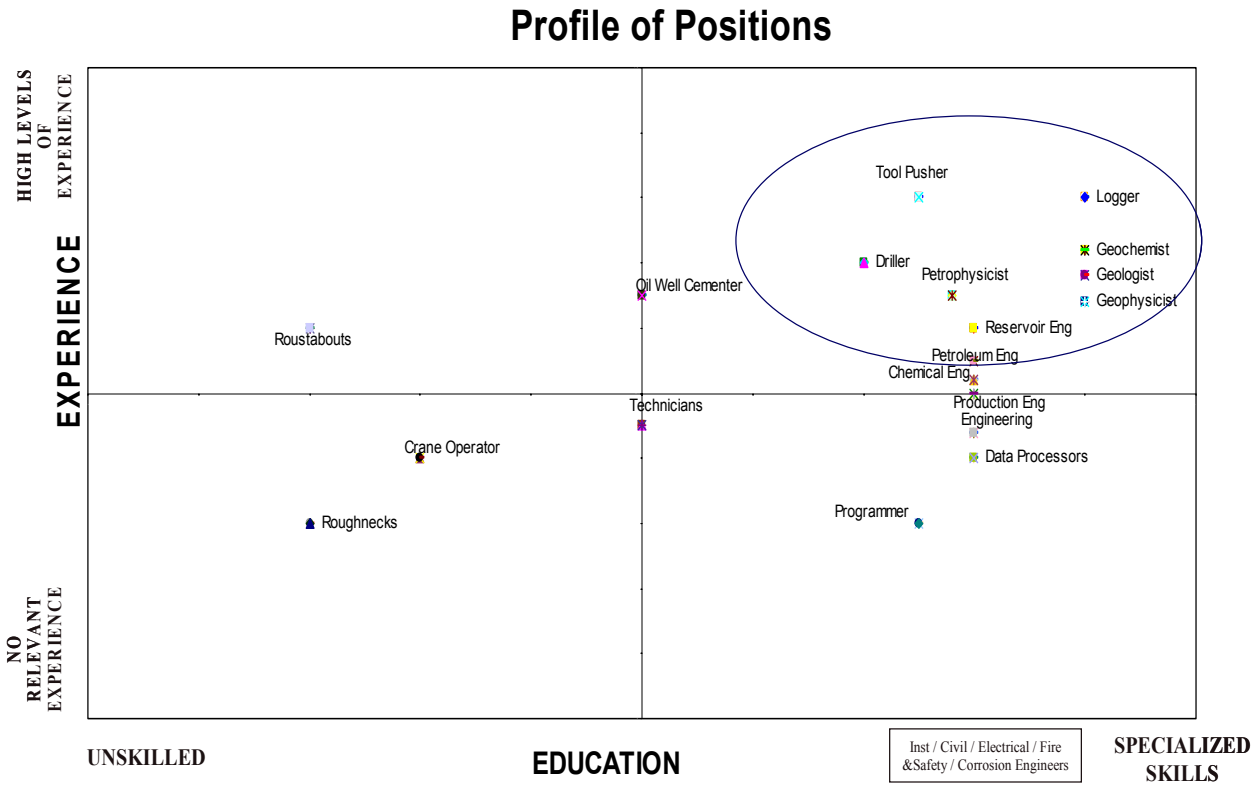
4.3.2.

Scenario II		*Area awarded (in Sq. Km)*					
Year of award		**Onland**	**Deepwater**	**Shallow Off**	**Total**	**Cumulative (till year)**	**% of sedimentary basinal areas opened for exploration**
Pre NELP	Pre NELP	56624	14904	3831	**75359**	**75359**	2%
1998	NELP 1	27562	54770	86008	**168340**	**243699**	8%
2000	NELP 2	18074	118258	53171	**189503**	**433202**	14%
2001	NELP 3	22922	146405	35343	**204670**	**637872**	20%
2002	NELP 4	31155	161555	0	**192710**	**830582**	26%
2004	NELP 5	32868	103948	8364	**145180**	**975762**	31%
2006	NELP 6	56866	273291	22034	**352191**	**1327953**	42%
2008	NELP 7	60000	275000	25000	**360000**	**1687953**	54%
2010	NELP 8	60000	275000	25000	**360000**	**2047953**	65%
2012	NELP 9	60000	275000	25000	**360000**	**2407953**	77%
2014	NELP 10	60000	275000	25000	**360000**	**2767953**	88%

4.4. Categories of Skills

4.4.1. The demand trends have been segregated into four categories of skills based on the specialization of their education and depth of specialized training.

Education & Experience Criticality of the various skills

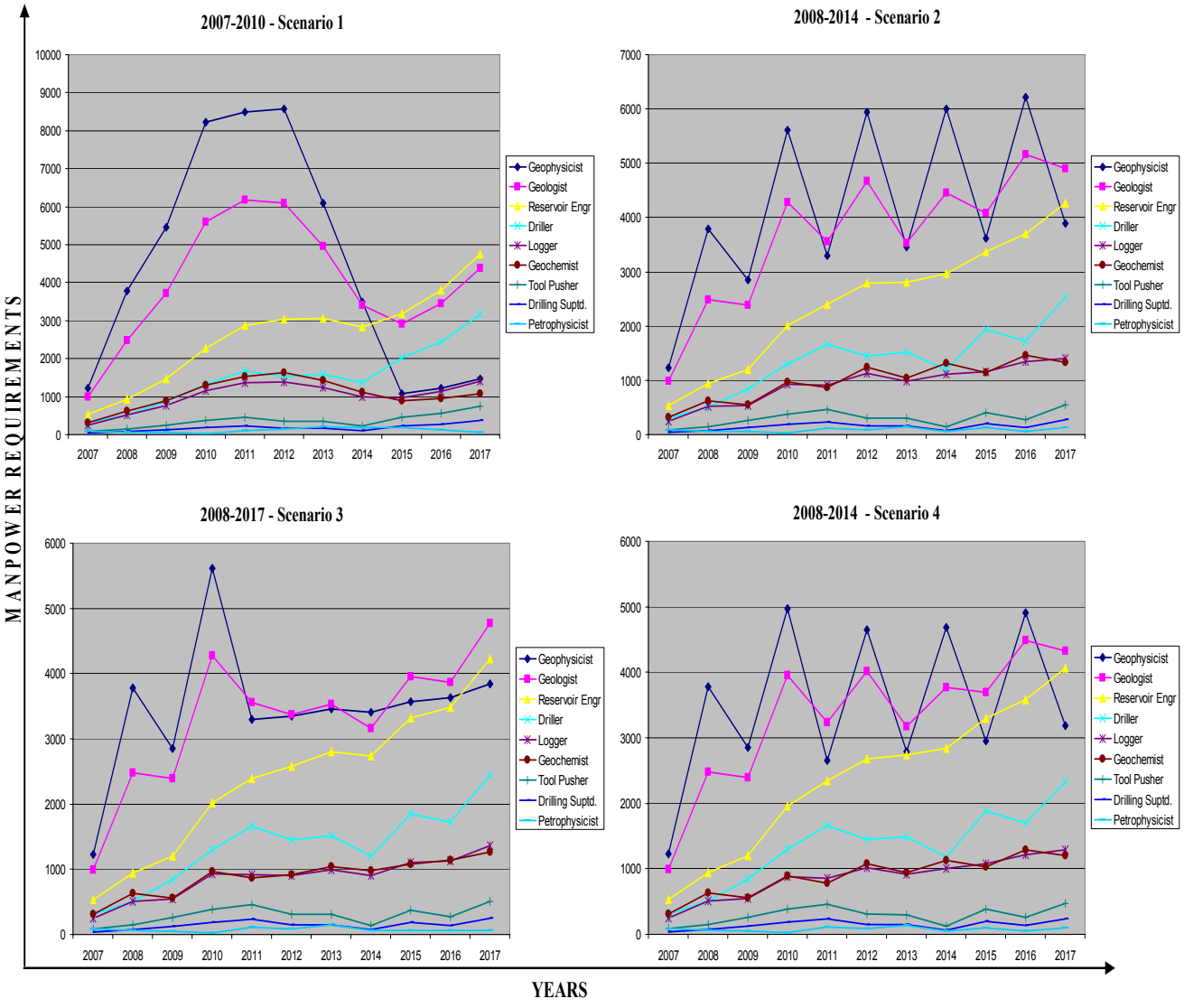


Source : PwC Analysis based on Industry Interaction

4.4.2. On the basis of the classification of education and experience, four broad areas emerge. These are described in following paragraphs:

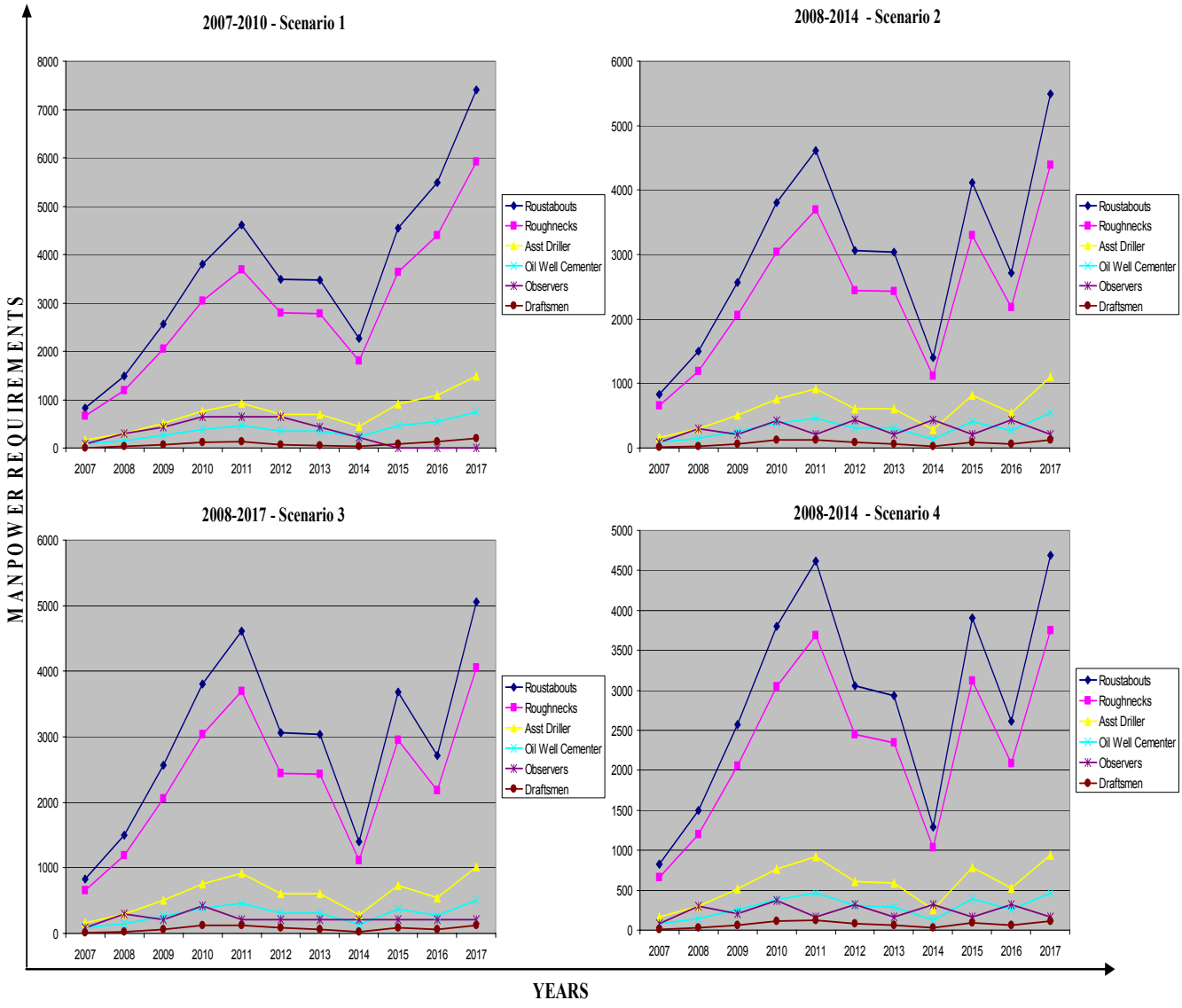
4.4.3. **Specialty Education & High Degree of Training**: This category includes roles that require specialized education like Post-Graduation in Geology / Geophysics, Engineering in specialized categories like Petroleum / Petrochemical / Reservoir Engineering, Mechanical Engineering with further specialization in Drilling etc. Also the time taken for an entry level

employee to mature into a productive and independent resource takes much longer due to the rigour in specialized training.



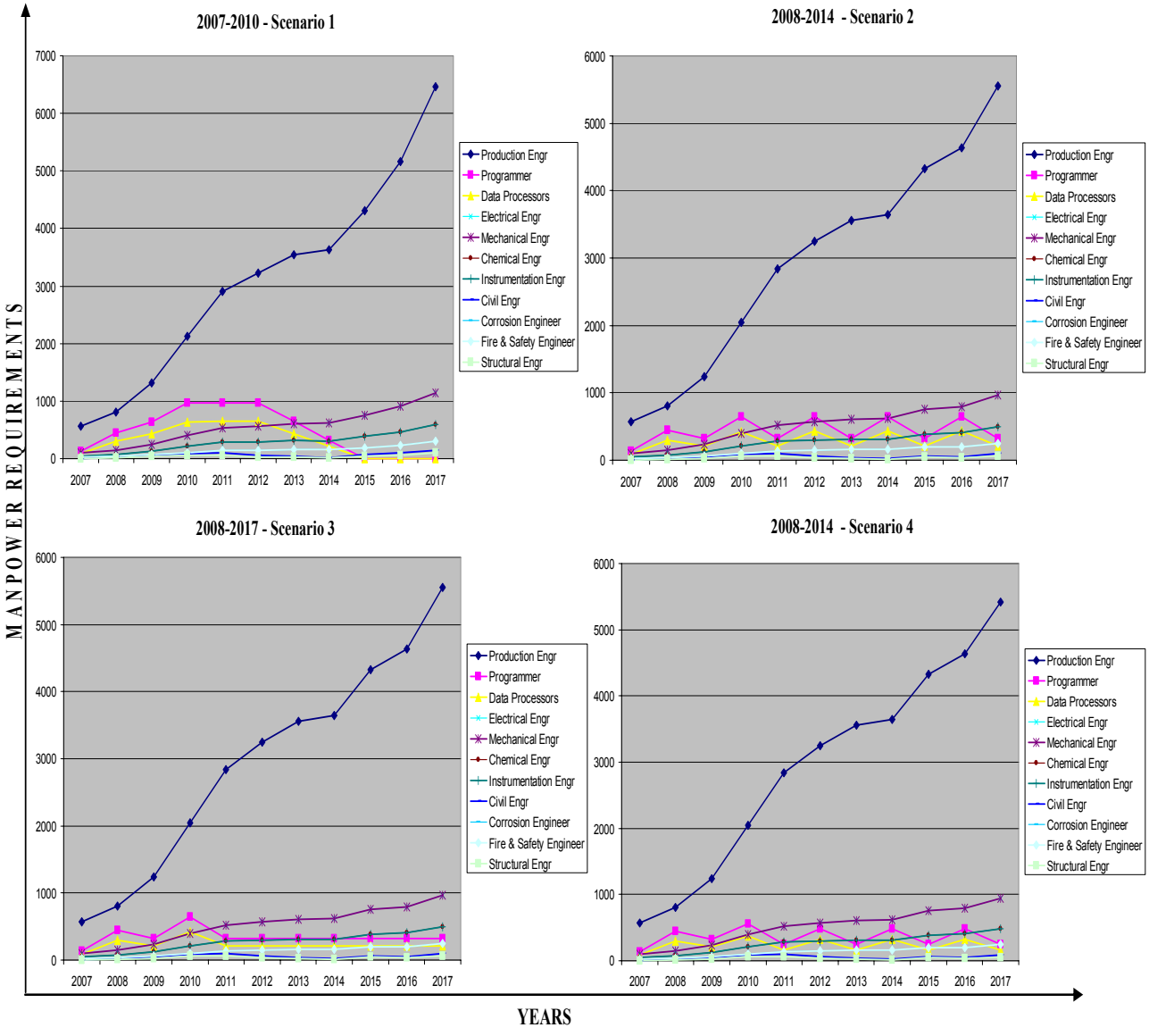
4.4.4. **Low / Medium Education & High Degree of Training**: This category involves skills that typically require people with Low / Medium level of education. These roles can be filled by employees who have minimum academic completion of Higher Secondary or a Diploma in any of the

related streams. But these skills require significant on-the-job training and in certain cases certifications and licenses.

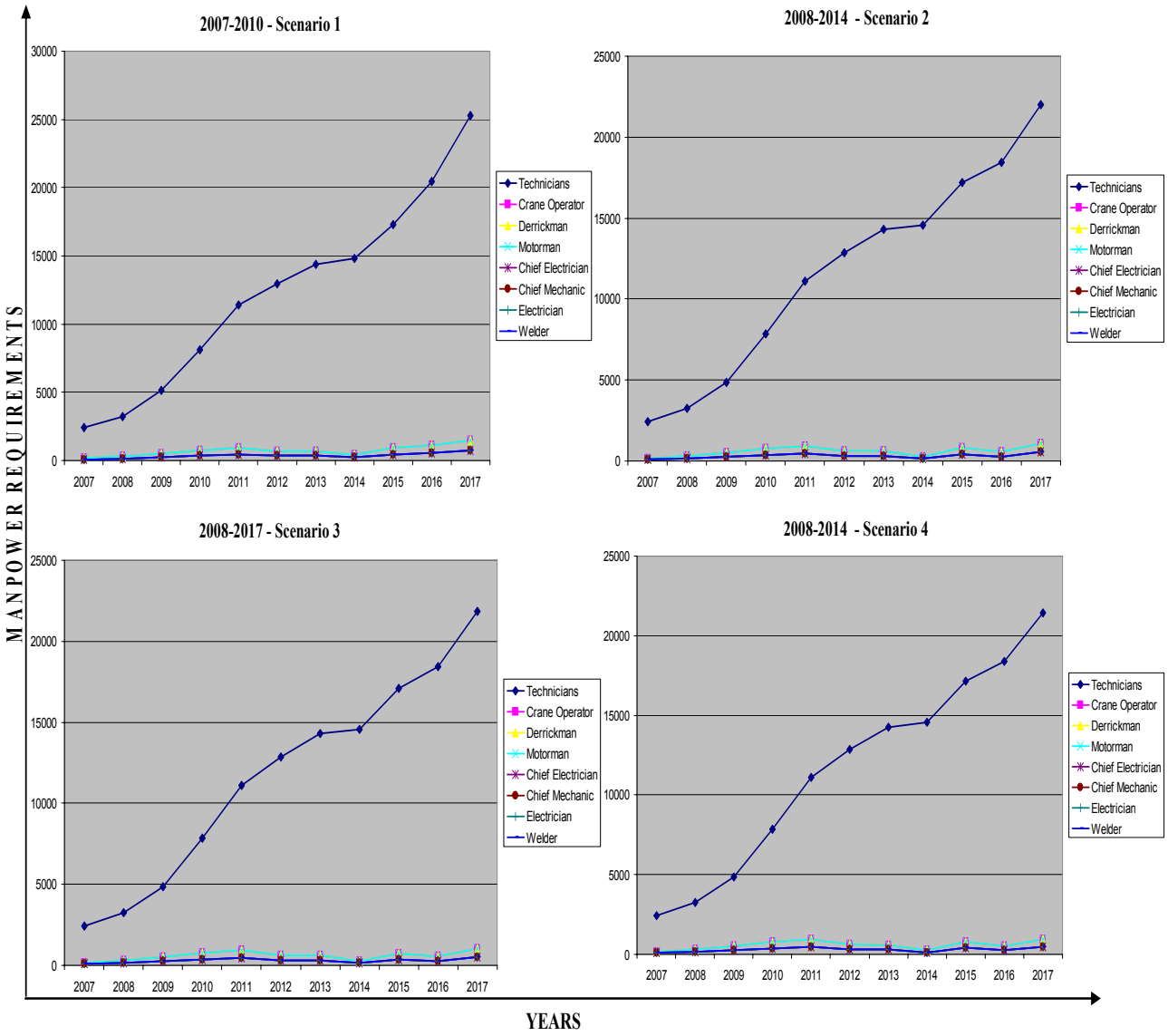


4.4.5. **General Education – Low/Moderate Training**: This category of skills requires high levels of education, but these are prevalent in the country. This includes Engineering education in Mechanical / Chemical / Production / Instrumentation / Electrical / Civil etc. Further education or specialization for select roles like Corrosion Engineers or Fire & Safety

Engineers is preferred but not compulsory. These skills do require exposure to Oil & Gas upstream industry work and working conditions. But gathering this training can be done in a relatively shorter time span of 1-2 years.



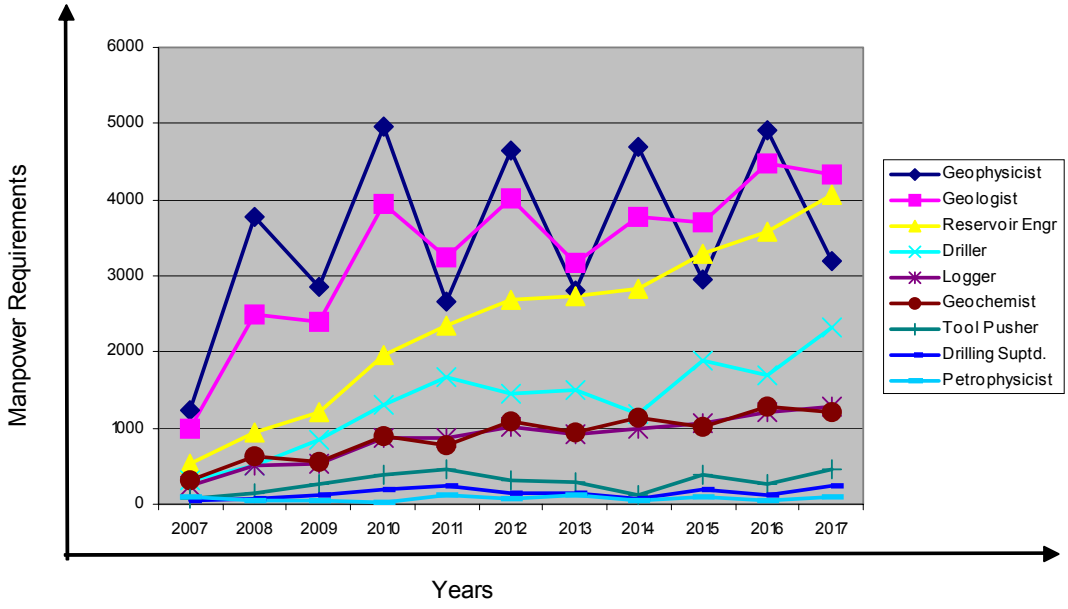
4.4.6. **Low / Medium Education – Moderate Training**: This category involves skills that require education like Diplomas in concerned fields or sometimes just the completion of Secondary schooling. The skills required for the job can be gathered in any of the related engineering industry segments and can then be further transferred to Oil & Gas Upstream requirements.

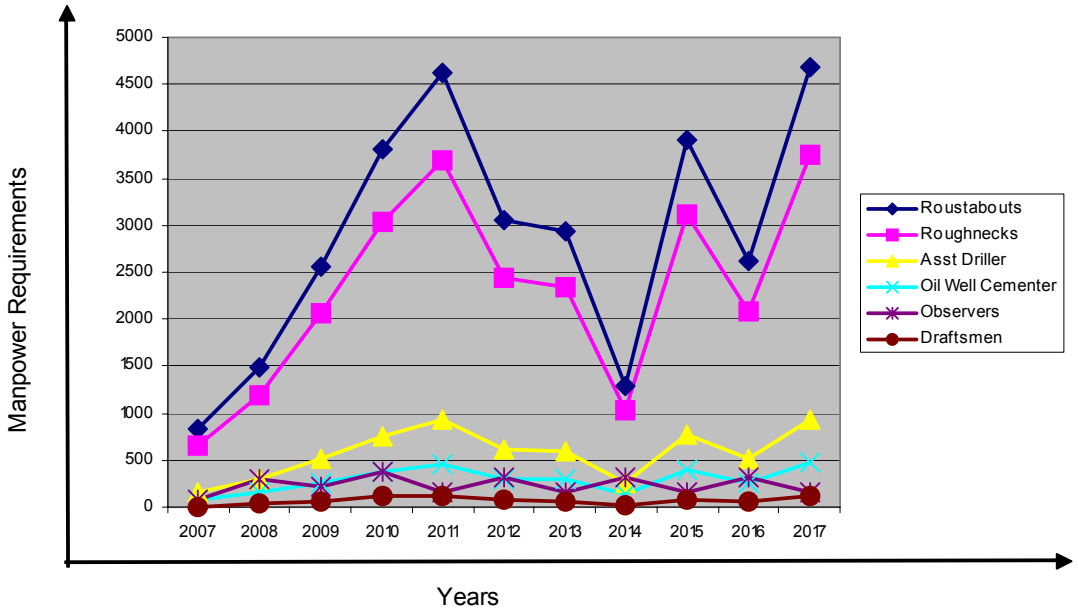


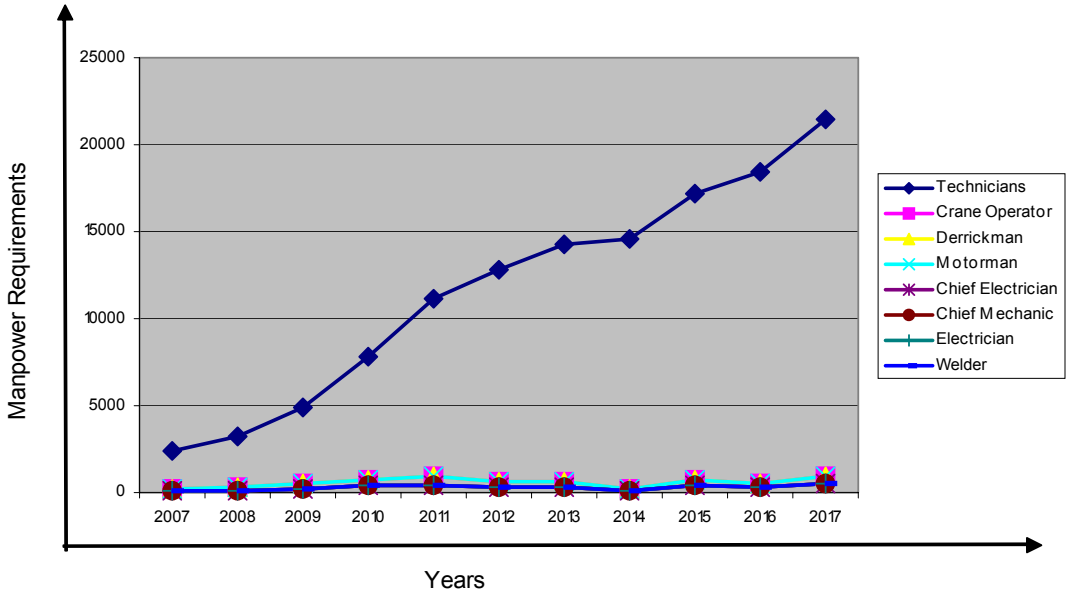
4.4.7. **Analysis of Scenarios**: As evident from all the set of graphs shown above, it is clear that the skill requirement in case of Scenario I is very high and will be very difficult to be supported by adequate workforce. Hence, from a manpower point of view, Scenario I has been excluded in further discussion.

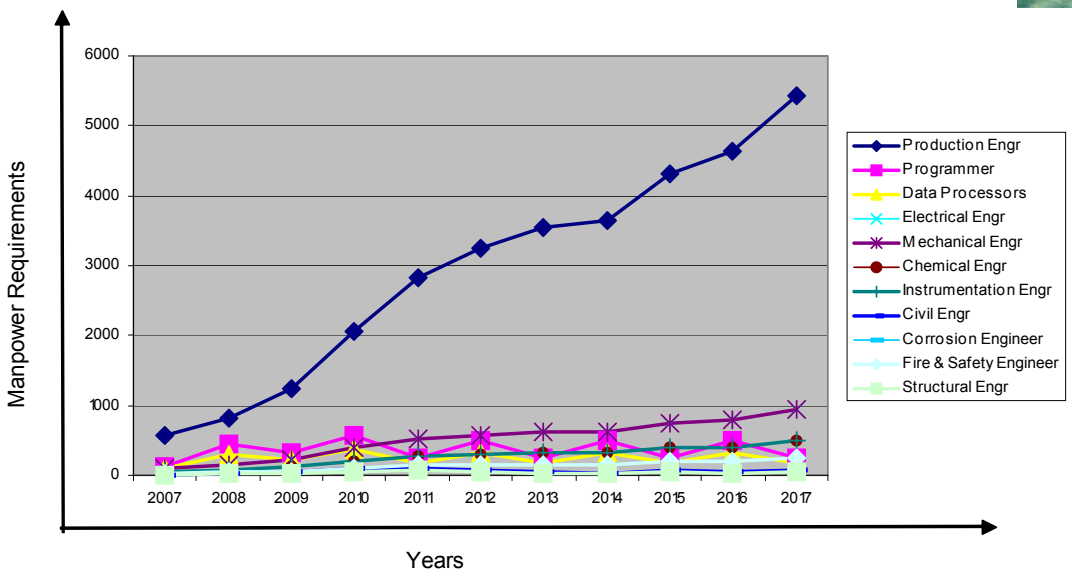
4.4.8. Of the remaining three scenarios, Scenario 2 was established to be the most likely scenario in terms of the projected E&P Activity. Keeping this is view, we have considered workforce projections as established using Scenario 2 to make our recommendations.

4.4.9. The workforce projections corresponding to Scenario 2 are again summed up in the following graphs-




Manpower Requirements
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Years
Roustabouts
Roughnecks
Asst Driller
Oil Well Cementer
Observers
Draftsmen


Manpower Requirements
25000
20000
15000
10000
5000
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Years
Technicians
Crane Operator
Derrickman
Motorman
Chief Electrician
Chief Mechanic
Electrician
Welder

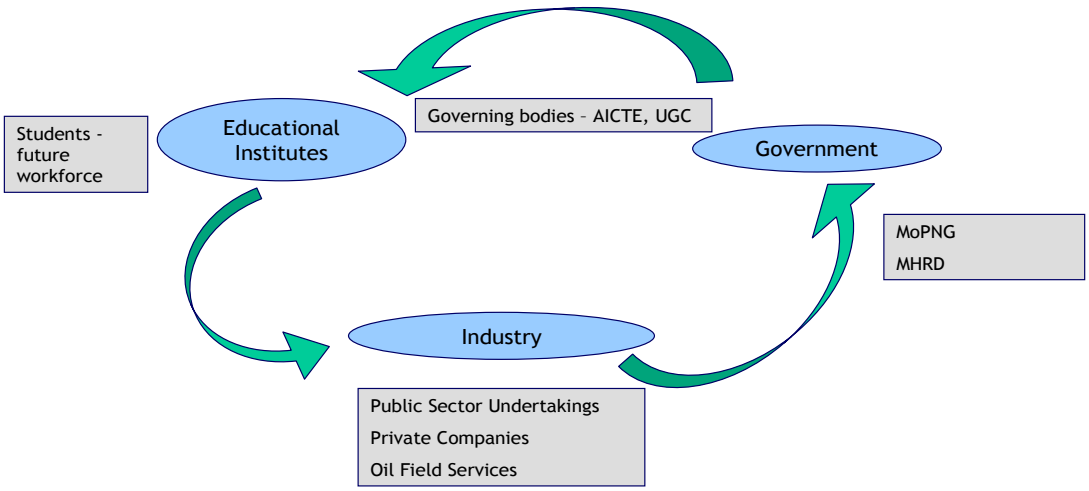

Manpower Requirements
6000
5000
4000
3000
2000
1000
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Years
Production Engr
Programmer
Data Processors
Electrical Engr
Mechanical Engr
Chemical Engr
Instrumentation Engr
Civil Engr
Corrosion Engineer
Fire & Safety Engineer
Structural Engr

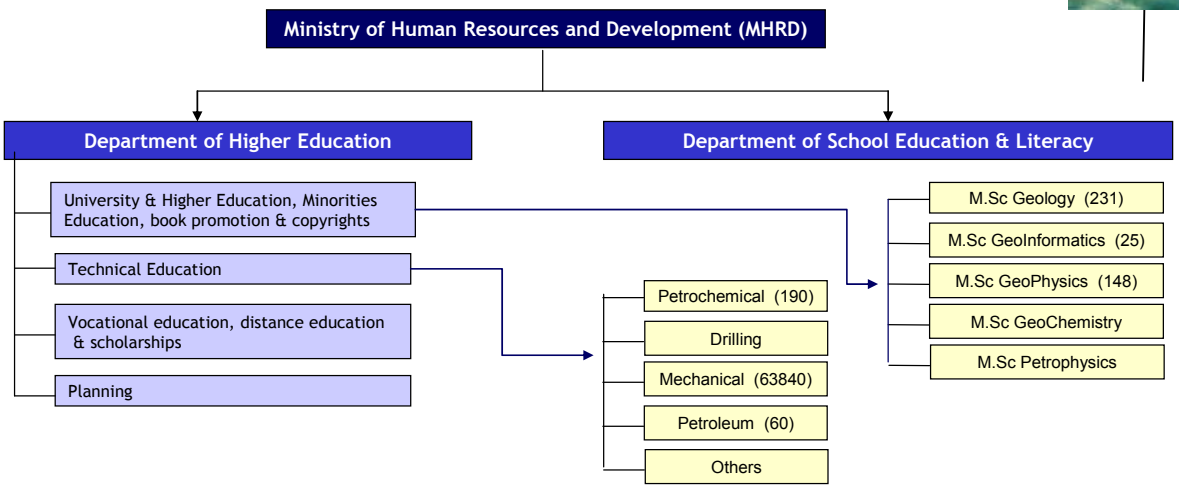
5. Supply side Projections & Assessments (India)

5.1. Key Players

5.1.1. In order to enable the supply of sufficient fresh talent into the industries there are many stakeholders. Some of the key players and how they interact has been captured in this diagram below.

5.1.2. Educational Setup in India: The HRD Ministry in India is the ultimate authority on the education infrastructure and development in India. The fresh talent pool for the E&P industry is sourced from amongst science graduates, engineers and diploma holders. An overview of our educational set-up viz these streams is provided below:





5.2. Institutions

5.2.1. The E&P sector requires specialist skills in the form of technical graduates with specialization in courses related to petroleum, earth-sciences and processes like drilling. The number of institutes offering these courses is limited and has a low intake on an annual basis. The top institutions for sourcing talent educated in E&P related studies and the courses/certifications awarded therein, are listed below:

NAME OF INSTITUTE	COURSES OFFERED
ISM, Dhanbad	Chemistry, Computer Science, Mechanical, Drilling, Environment, Petroleum, Applied Geophysics, Petroleum Exploration, Fuel
IT, Roorkee	Geology, Geophysics, Chemical
IT, BHU	Chemical, Environment
Andhra University	Chemical, Geo-engineering, Applied Geology, Environment, Geology, Geophysics
IIT, Mumbai	Chemical, Applied Geology, Applied Geophysics
IIT Kharagpur	Chemical, Geology, Geophysics, Applied Geology
Cochin University	Chemical, Environment, Instrumentation, Marine Geology, Marine Geophysics, Safety & Fire,
Kurukshetra University	Geophysics, Environment
Osmania University	Chemistry, Geochemistry, Geology, Geophysics, Environment
MIT Pune	Petroleum, Petrochem,
Jadavpur University	Chemical, Energy, Environment, Applied Geology
Kolkata University	Instrumentation, Chemical, Petrochemical, Environment, Geology

5.2.2. We had conducted discussions with select representatives of the institutes catering to the skill requirements of the E&P industry.

5.2.3. Institutes recognize the impending demand from the industry and would be willing to scale up facilities to address these requirements. They also recognized the need for higher industry involvement viz providing internships, scholarships and project exposure to work.

5.2.4. Key highlights of these interactions are summed up in the following table:

Sno	Institute	Key Highlights
1	IIT - Mumbai	1. Faculty: Expressed need specialist faculty. Retention of faculty is an area of concern. Also, compensation levels offered (to the faculty) by the industry cannot be matched. 2. Infrastructure: Desire assistance in infrastructure if there is an expansion of facilities required. 3. Industry participation: Organizations may provide summer training opportunities and sell jobs to the students.
2	ISM - Dhanbad	1. Faculty: Expressed need specialist faculty. 2. Infrastructure – Desire support with infrastructure - hostel and lab facilities. 3. Concern: 50% of students do not get jobs in E&P.
3	IT-BHU	1. Faculty: Need specialist faculty 2. Infrastructure: a. Labs (particularly related to reservoir) b. Will require space, enhanced laboratory facilities in terms of equipments and funds to support expenditure on consumables to help augment the number of seats at post graduate level. Industry could consider sponsoring such upgradation.

		3. Suggestions: a. Institute scholarships, b. Develop one/ year post M. Sc. Diploma in Petroleum Exploration with six (6) months practical / field training c. Industrial / field training d. The course content of petroleum geoscience should be upgraded and made uniform in the leading University Departments. e. Participation of eminent geologists / geophysicists of oil sector as guest faculty / visiting faculty. f. Industry participation - Provision by Industry for running 1 (one) year Diploma Courses in 'Petroleum Exploration' in leading Earth Science Departments should be considered. In addition, field training programme of two months duration at R&D centers and/or drilling/production sites should be supported by the oil sector. 4. Concerns: Nearly 70-80% students join organizations not involved in Petroleum Exploration.
4	IIT KGP	1. Concern : Shortage of faculty
5	IIT Roorkee	1. Concern: 80% of students going to IT jobs and to downstream.
6	Maharashtra Institute of Technology, Pune	1. The institute has expressed the ability to augment the number of seats from 30 to 60, immediately.
7.	Andhra	1. Concern: Nearly 80-90% of the students from E&P related

	University	streams go to other sectors (employment trends for past 5 years). 2. The university is looking to increase the capacity in its exiting E&P related courses (Delta Studies Institute of Andhra Studies has the capacity to triple the intake for M Tech course in Petroleum Exploration from 20 to 60). The institute has expressed need for financial support to do the same.

5.2.5. Overall, of the students passing out of petro-technical streams only 56% join E&P companies with 12% of these being recruited for overseas positions. The entry to E&P sector is limited to 56% due to the low awareness of the job opportunities in the sector at the entry level and the perceived higher attractiveness of other sectors mainly IT, Telecom (29% of students move to IT/ITES/Communication). An estimated 13% go to mineral and mining industries.

5.2.6. A detailed summary of the available Engineering College seats in the country and the possible number of Diploma students is also provided along with.

Engineering Stream	**Total**
Automobile Engineering	1,670
Chemical Engineering	7,935
Civil Engineering	20,218
Comp Sc. & Engineering	86,837
Electrical & Electronics Engineering	41,375
Electrical Engineering	17,795
Electronics Engineering	110,990
Environmental Engineering	340
Fire and Safety Engineering	30

Fire Technology	60
Information Technology	47,747
Instrumentation Engineering	8,025
Mechanical Engineering	64,230
Petro-Chemical Engineering	135
Petroleum Engineering	60
Grand Total	**459,037**

5.2.7. India also generates plenty of Diploma graduates in Engineering and other specialized skills like Mechanical, Electrical, Electronics, Civil, Chemical etc. The number of such institutes is approximately 1,250 having potential to generate over 250,000 diploma engineers every year.

5.2.8. Other sectors such as IT, ITES are foreseeing significant shortage (150,000 professionals by 2010: NASSCOM) and will also be looking at this talent pool to fulfil some of their requirements. Similarly, significant activity expected in the minerals and mining industry will put additional strain on the available talent pool.

5.2.9. While these numbers clearly indicate a huge talent pool, the next section indicates the critical challenges that exist in attracting this pool towards the Upstream E&P industry.

6. Skill-wise Demand / Supply Analysis (India):

6.1. The Approach

6.1.1. We have grouped the skills into groups as it has been seen that skills in one group can be replaced by each other with marginal training.

6.1.2. The shortfall in each skill is showcased through the tables provided for each skill-group along with the group description. The format followed for the table is illustrated and explained below:

Skill-family name	Skills covered in this group.										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Demand Supply Gap	Year on year gap in the manpower available with the industry and projected requirement (assuming no action)										
Net gap accounting for corrective action	Year on year gap factoring in the measures adopted in the previous year.										
Hire & train	Numbers from alternative education background, trained aggressively especially to meet short to medium term demands. The value in this row indicates the numbers available to the industry in the year as indicated by the column; for this to happen it is assumed that the requisite hiring and training has been initiated as per the training period required for that skill.										
Imports	Numbers from foreign markets used to address the immediate demand for experienced professionals and spikes in demand										
Capacity	Numbers that can be added from increasing the skill pool generated from the educational set-up by either increasing the capacity of existing institutes or setting-up new institutes The value in this row indicates the numbers available to the industry in the year as indicated by the column; for this to happen it is assumed that the required capacity (batch size) has been initiated as per the duration of the respective courses.										
Retention & redeployment	Industry can manage these numbers by retaining talent moving out of the Indian Industry and alternatives strategies such as utilizing the retiring workforce on consulting / contract / service extension basis.										

NOTE: For these tables, a positive value indicates demand and a negative value indicates excess in the numbers.

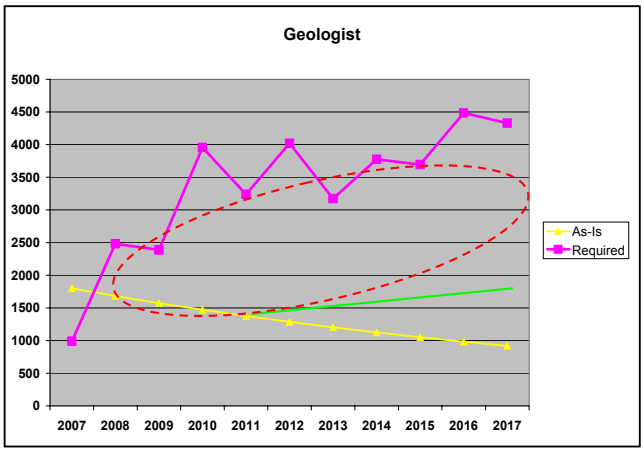
6.2. Group I: GeoSciences

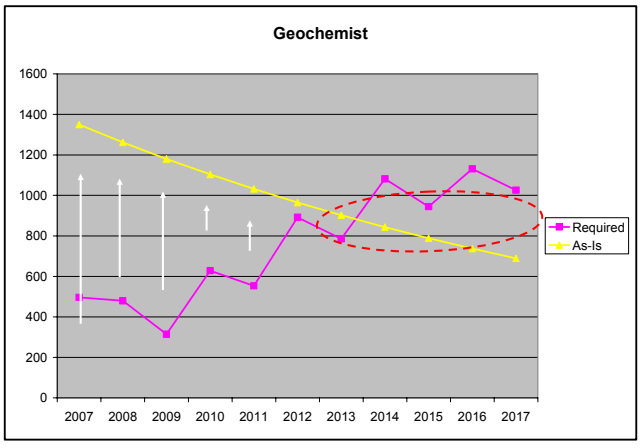
6.2.1. The following skills have been taken in this group:

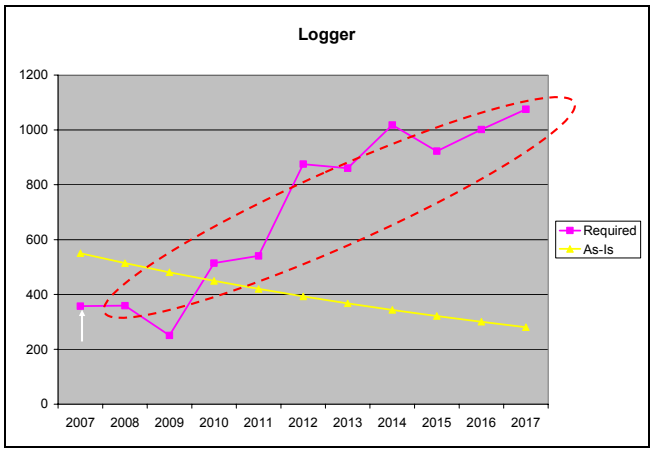
- Geologist
- Geochemist
- Logger

6.2.2. The required numbers for these skills as per the most likely scenario are provided in the table below *(current denotes the numbers available from the existing workforce)* as well as depicted in graphs. As per the following, the peak demand supply gap for Group I skills amounts to 2,267.

Geologist	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Current	1800	1683	1574	1471	1376	1286	1203	1124	1051	983	919
Demand	990	2482	2386	3956	3238	4019	3174	3774	3694	4485	4327
Geochemist											
Current	1350	1262	1180	1103	1032	965	902	843	789	737	689
Demand	314	628	553	892	786	1081	944	1131	1026	1283	1200
Logger											
Current	550	514	481	450	420	393	367	344	321	300	281
Demand	251	514	541	875	860	1018	922	1001	1075	1219	1289
Cumulative supply from Institutes*	0	0	0	231	462	693	924	1,155	1,386	1,617	1,848
* Assuming the available capacity is fully available to the Indian E&P Industry											







PwC Research & Analysis

6.2.3. An analysis of the demand-supply gap for the above three skills is provided in the table below:

Source : PwC Research & Analysis

Skill-family name	Geologists										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Demand supply gap	-810	799	813	2,253	1,401	2,040	1,047	1,495	1,257	1,885	1,560
Net gap accounting for corrective action till previous year	-810	749	713	2,003	901	1,290	-3	245	-238	190	-335
Hire & train			100	100	100	100		45			
Imports		699	563	1,753	651	990					
Capacity Intake				100	100	150	150	150	150	150	
Retention & redeployment	50	50	50	50	50	50	50	50	50	50	50

6.2.4. In case of geologists, the requirements are high in the early phase itself and continue to remain so. However, taking corrective actions to build a skill-pool of geologists will soften the net demand in the later part of the 10 year horizon.

Skill-family name	Geochemist										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Demand supply gap	-1,036	-634	-627	-412	-646	-483	-758	-712	-963	-854	-1,089

6.2.5. In case of geochemists, the numbers from existing workforce as well as the input from the educational set-up will be sufficient to meet the

projected demands. Skill upgradation of the existing workforce may be required due to newer technologies etc.

Skill-family name	Logger										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Demand supply gap	-299	0	60	426	440	624	555	658	754	919	1,008
Net gap accounting for corrective action till previous year	-299	-30	0	336	30	184	30	103	96	165	89
Hire & train				290		55		73	66	135	59
Imports				16		99					
Capacity Intake											
Retention & redeployment	30	30	30	30	30	30	30	30	30	30	30

6.2.6. In case of loggers, the requirements would be met by utilizing the experienced professionals in allied work areas. Typically experienced geologists further take up the role of loggers. Keeping this in view, the fresh intake from existing educational institutes and on account of capacity build-up has been excluded from the solution set to meet the requirements for loggers.

6.2.7. Recommendations for Augmenting Skills:

- **Hire & Train**: This will involve taking on-board the professionals with lesser than required degrees and preparing them using aggressive training programs and certifications. For this skill group, graduates in geology, chemistry (B Sc.) shall be considered. These numbers can be varied over a large range to accommodate sudden spikes in requirements. In case of geology, these skills with lower qualifications may be used for basic activities or trained aggressively in specific job-role related areas to compensate for the lack of higher qualifications. In case of logging jobs, hire and train indicates taking in professionals from allied work areas and training for logging jobs.
    - The gap addressed in above table using hire and train suggests the actual available manpower from this route during the corresponding year; for e.g. 100 geology professionals shall be

available to the industry using this option in 2009 for this to take place the industry will need to hire and train these professionals in advance such that they are ready by 2009.

- **Imports**: Skills will need to be imported from external markets to address the immediate requirements and the projected drops in numbers subsequent / intermediate years. The priority being to keep these imports to a minimum. For geology, a significant import of skills is envisaged in the early years due to high requirements.
- **Capacity**: The increased intake / new institutions will be able to supply geosciences skills to the industry in about three years post set up. We propose a phase increase in the capacity of educational institutes, starting with adding 100 specialized post-graduate (MSc) courses, increasing the same to 150 over a two year gap and scaling up to 500 over the subsequent three years. The industry shall utilize this available capacity as per requirement.
- **Retention and redeployment**: The industry looses key experienced skill in geosciences on account retirements and attrition to foreign markets. We estimate 80 such geology and logging professionals can be retained in the industry by checking such attrition and using service extensions to professionals moving towards retirement or retaining them in the industry using contracts or consulting agreements.

6.3. Group II: Drilling

6.3.1. The following skills have been taken in this group:

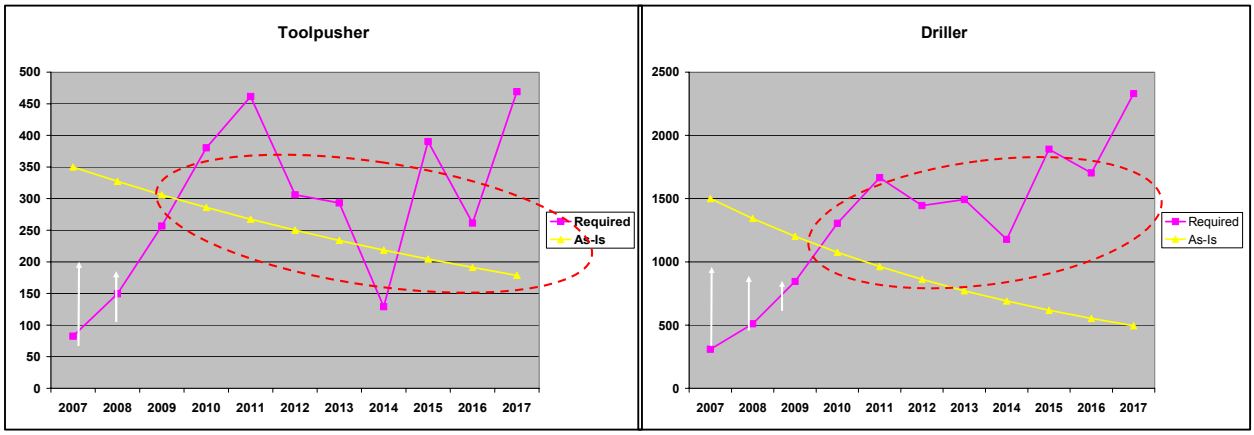
- Toolpusher
- Driller

6.3.2. The required numbers for these skills as per the most likely scenario are provided below as well as depicted in the following graphs:

Tool Pusher	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Current	350	327	306	286	267	250	234	219	204	191	179

Demand	83	150	257	380	461	306	293	129	390	261	469
Cumulative Supply from Institute	-	-	-	0	0	0	0	0	0	0	0
Driller											
Current	1500	1343	1202	1075	962	861	771	690	618	553	495
Demand	309	510	844	1304	1665	1444	1493	1177	1890	1703	2329
Cumulative supply from Institute	-	-	-	-	40	80	120	160	200	240	280
* Assuming the available capacity is fully available to the Indian E&P Industry											

Source: PwC Research & Analysis



6.3.3. An analysis of the demand-supply gap for the above two skills is provided in the table below:

Skill-family name	**Tool Pusher**										
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Demand supply gap	-267	-178	-49	94	194	56	59	-90	186	70	290
Net gap accounting for corrective action till previous year	-267	-178	-49	94	169	6	-16	-190	61	-90	115
Hire & train				10	10	10	10	10	10	10	10
Imports				69	144				36		90
Capacity Intake											
Retention & redeployment				15	15	15	15	15	15	15	15

Source: PwC Research & Analysis

6.3.4. In case of tool pushers, the requirements would be met by utilizing the experienced professionals from drilling and importing the requisite skills. Typically experienced drillers further take up the role of tool pushers.

Keeping this in view, the fresh intake from existing educational institutes and on account of capacity build-up has been excluded from the solution set to meet the requirements for tool pushers.

Skill-family name	Driller										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Demand supply gap	-1,191	-832	-357	228	662	503	602	327	1,073	910	1,555
Net gap accounting for corrective action till previous year	-1,191	-832	-357	228	522	173	82	-313	313	-20	455
Hire & train				70	70	70					50
Imports				88	332				143		235
Capacity Intake					50	50	50	50	100	100	100
Retention & redeployment				70	70	70	70	70	70	70	70

Source : PwC Research & Analysis

6.3.5. Recommendations for Augmenting:

- **Hires & Training**: This will involve taking on-board the professionals and preparing them using aggressive training programs and certifications. For this skill group, mechanical engineering shall be considered. These numbers can be varied over a large range to accommodate sudden spikes in requirements. Such variations are observed in drilling related jobs especially towards the end of the ten year horizon – in 2010 -12 and 2017.
- **Imports**: Skills will need to be imported from foreign markets to address the projected drops in numbers subsequent / intermediate years. The priority being to keep these imports to a minimum. For drilling related jobs, a significant import is envisaged in 2011 (332 professionals) and 2017 (235 professionals).
- **Capacity**: The increased intake / new institutions will be able to supply drilling skills to the industry in four years post set up. We propose a phase increase in the capacity of educational institutes, starting with adding 50 seats in specialized drilling engineering, increasing the same

to 100 over a four year gap such that 100 skilled professionals are available to the industry in 2015.

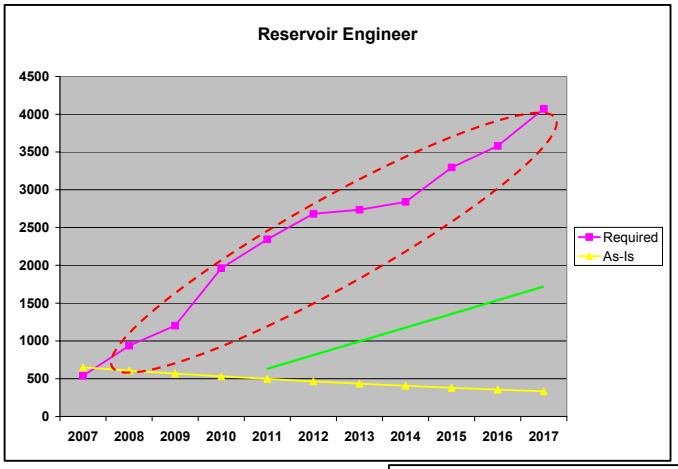
- **Retention and Redeployment**: The industry looses key experienced skill in drilling on account retirements and attrition to foreign markets. We estimate 85 such professionals can be retained in the industry each year by checking such attrition and using service extensions to professionals moving towards retirement or retaining them in the industry using contracts or consulting agreements.

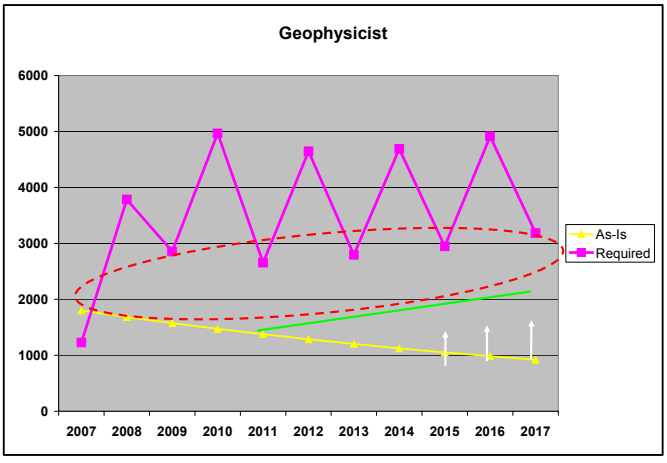
6.4. Group III: Other critical skills

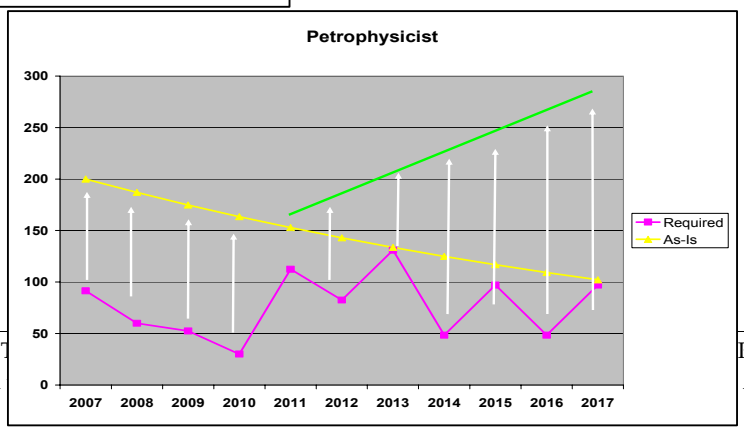
6.4.1. The following skills have been taken in this group:

- Reservoir Engineer
- Geophysicist
- Petrophysicist

6.4.2. The required numbers for these skills as per the various scenarios are as shown in the following graphs:







PwC Research & Analysis

6.4.3. Reservoir Engineer

Skill-family name	Reservoir Eng										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Demand supply gap	-112	329	635	1,430	1,787	2,098	2,121	2,193	2,615	2,865	3,319
Net gap accounting for corrective action till previous year	-112	329	605	1,120	1,197	978	571	213	255	125	199
Hire & train			250	250	250	150	150				
Imports		299	325	840	667	548	141				
Capacity Intake					250	250	250	350	350	350	350
Retention & redeployment		30	30	30	30	30	30	30	30	30	30

Source: PwC Research & Analysis

6.4.4. For reservoir engineering the high initial demand may be addressed using a combination of options as specified above. Hire and train option would involve taking in professionals from allied engineering streams and training them..

6.4.5. Recommendations for Augmenting Skills:

- **Hires & Training**: This will involve taking on-board the professionals and preparing them, using aggressive training programs and certifications. For this skill group, chemical engineering shall be considered. These numbers can be varied over a large range to accommodate sudden spikes in requirements. In case of reservoir engineers this option is stressed on to meet the requirements in the early part of the ten year horizon.
- **Imports**: Imports form a significant route to address the requirement for reservoir engineer, especially in the period 2008-13.

- **Capacity**: The increased intake / new institutions will be able to supply reservoir (or petroleum) engineering skills to the industry in four years post set up. We propose a phase increase in the capacity of educational institutes, starting with a capacity of 250 seats in the related engineering courses which would be available to the industry in 2011 and scaling up the number of seats to 350.
- **Retention and redeployment**: We estimate 30 professionals can be retained in the industry each year by checking such attrition and using service extensions to professionals moving towards retirement or retaining them in the industry using contracts or consulting agreements.

6.4.6. Geophysicicst

Skill-family name	Geophysicist										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Demand supply gap	-573	2,102	1,282	3,496	1,130	3,065	1,149	2,974	1,156	3,042	1,230
Net gap accounting for corrective action till previous year	-573	2,102	842	2,616	-340	1,005	-1,101	524	-1,534	152	-1,900
Hire & train		400	400	400	400						
Imports		1,662	402	2,026		815		284			
Capacity Intake				150	150	150	200	200	200	200	
Retention & redeployment		40	40	40	40	40		40		40	

Source : PwC Research & Analysis

6.4.7. Recommendations for Augmenting Skills:

- **Hires & Training**: This will involve taking on-board the professionals and preparing them using aggressive training programs and certifications. For this skill group, BSc in allied courses shall be considered. For geophysicist requirements such skill will be available 2008 onwards to be working in the industry.
- **Imports**: Imports form a significant number for geophysicists especially in the next few years as high number of trained and experienced professional are required during these years. Also the

demand for geophysicists varies significantly during consecutive years, thus increasing the reliance on importing skills. These numbers range between 2026 in 2010, dipping to 284 in 2014. This option enables the industry to address sudden fluctuations in the numbers requirements.

- **Capacity**: The increased intake / new institutions will be able to supply geophysics skills to the industry in three years post set up. We propose a phase increase in the capacity of educational institutes, starting with a capacity of 150 seats in MSc courses which would be available to the industry in 2010 and scaling up the number of seats.
- **Retention and Redeployment**: We estimate 40 professionals can be retained in the industry each year by checking such attrition and using service extensions to professionals moving towards retirement or retaining them in the industry using contracts or consulting agreements.

6.4.8. Petrophysicist:

6.4.9. For this set of skills, the demand arising from the projected E&P activity is significantly lower in numbers as compared to the other skill sets.

Skill-family name	Petrophysicist										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Demand supply gap	-109	-127	-122	-133	-40	-60	-3	-76	-20	-61	-5

Source : PwC Research & Analysis

6.4.10. The demand for petrophysicists can be met with the current numbers. Hence the industry focus on ensuring talent availability in this field may be limited.

7. Workforce Analysis for the Global E&P Sector

7.1. Global Demand & Supply

7.1.1. Identification of Reserves greater than 500 MMBoE in Africa (Angola, Nigeria, Morocco etc.), Middle East, select European countries (Kazakhstan, Norway etc.) and Asia (primarily Indonesia, Myanmar, Bangladesh, India etc.), Venezuela, Brazil and Australia have played a key role in increasing the demand for workforce in Exploration and Production.

7.1.2. With more reserves being identified in the Shallow offshore (Shelves) and Deepwater areas specialized and expert skills are becoming more in demand. These activities are also expected to boost the demand for the corresponding workforce especially in the areas of Petroleum Engineering, Production Engineering, Drilling Crews and Geoscientists.

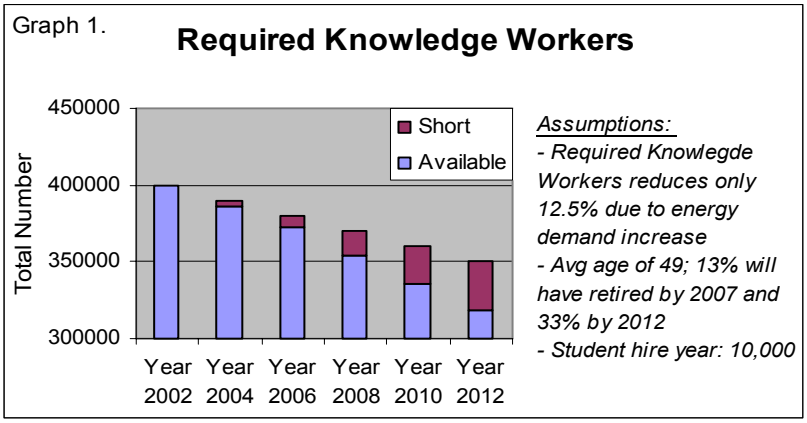
7.1.3. While E&P activities require a wide spectrum of skills and expertise, reports suggest that the critical technical skills (listed below) are concerns for the global industry.

- Geologists (Includes Petroleum Geologists, Palaeontologists, Mineralogists, Stratigraphers)
- Geophysicists (Includes Geophysical Prospectors, Gravity & Seismic Observers, Seismologists)
- Geochemists
- Petrochemical Engineers (Includes Petroleum Engineers, Reservoir Engineers, Petrophysicists)
- Drilling Crew (Includes Drillers, Drilling Superintendents, Tool pushers, Well Loggers, Mud Engineers)

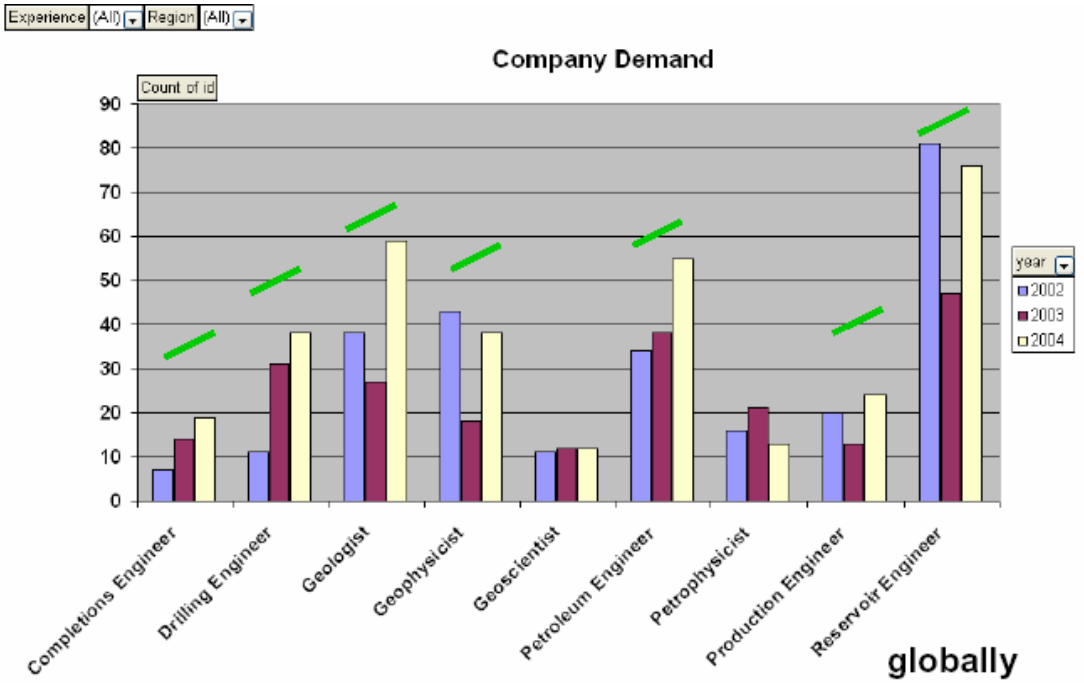
7.1.4. Current Global E&P Petrotechnical Workforce strength (excluding Drilling crew as listed above) is expected to be around 375,000 according to Society of Petroleum Engineers. The overall shortfall expected by the year 2012 is about 30000 professionals. (Global retirement estimated at approximately 13% by 2007, and 33% by 2012)

Source: "Skills Shortage – The Way Forward", SPE Paper 81587

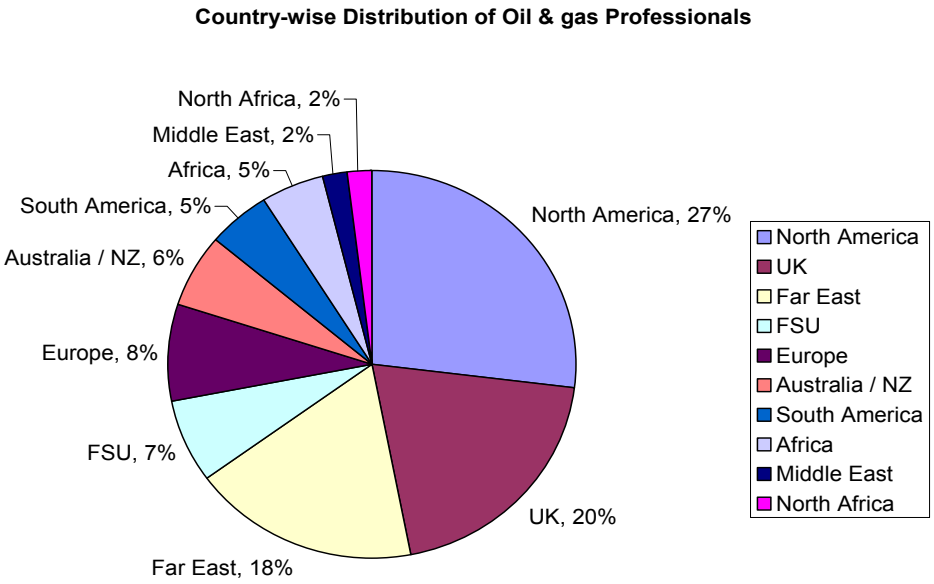
Graph 1.



7.1.5. Skill –wise demand for E&P professionals (Source worlwideworker.com)



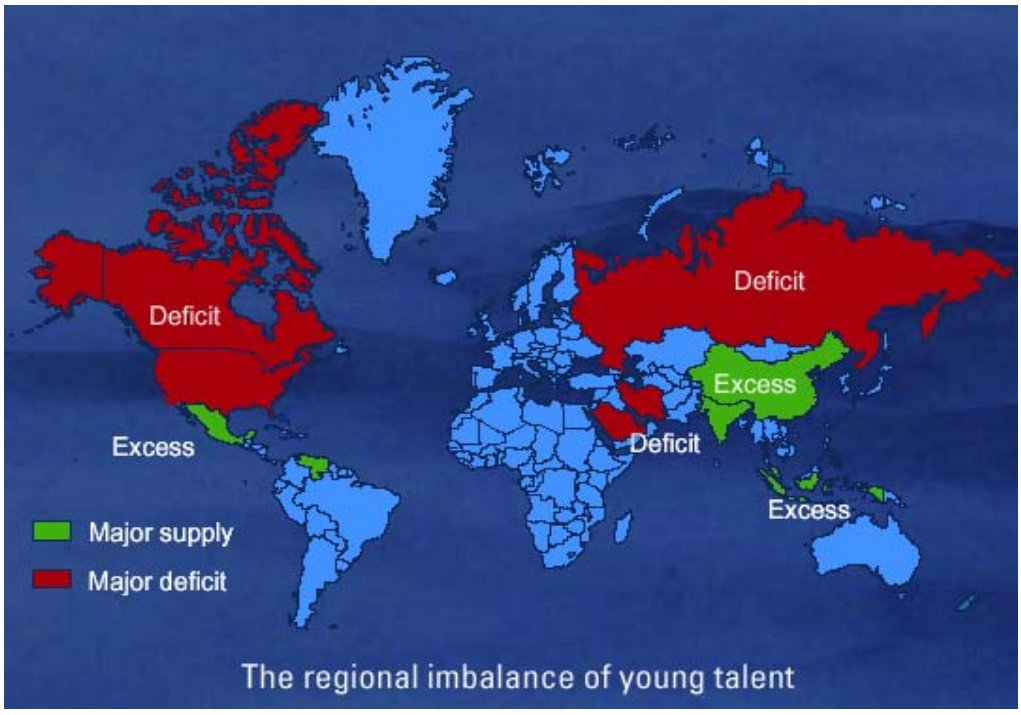
7.1.6. Analysis of the distribution of E&P workforce indicates that most of the knowledge workers are from European and North American continents (55%).



Source: "Skills Shortage – The Way Forward", SPE Paper 81587dvzsfdx

7.1.7. A global survey quantifying the supply & demand of petrotechnical expertise indicates that Asian countries like India, China, Indonesia, Venezuela and Mexico generate more talent.

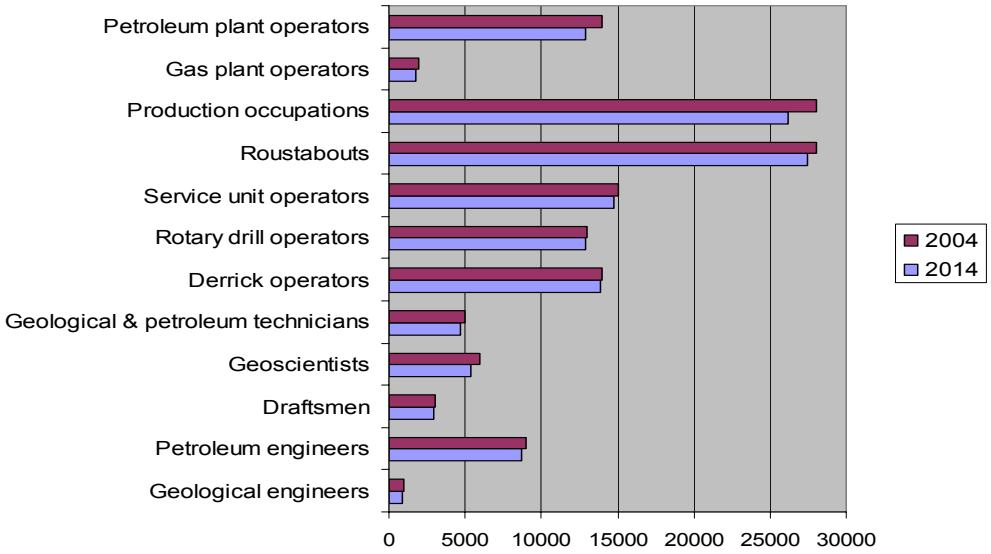
7.1.8. While this study considers the situation as of 2005, with increasing focus within this region and in Africa, significantly higher talent pool need to be generated than what is projected in the study.



Source: "Surviving the Skills Shortage", Schlumberger Consulting

7.1.9. A similar study, as is being done now for India, conducted in USA indicates a shortfall of almost all the key skills.

Skill-wise Workforce Projections till 2014



Source: US Department of Labor

7.1.10. Many other global studies have also predicted a shortage of skilled workforce in the future.

- American Petroleum Institute's 2004 survey (By 2009): 38% shortage of geoscientists & engineers and 28% shortage of instrumentation & electrical workers
- National Petroleum Council of US (By 2015): Personnel shortage of approx. 40% as a result of retirements
- PwC Research (By 2015): In Canada, 60% of all geoscientists will be aged 65 or older, with few too young miners coming up through the ranks to replace them.
- AMEC, an energy services firm cites fierce competition for a skilled labour pool because of severe skill shortages especially in Africa, theMiddle East and parts of the former Soviet Union Oil.

- Worldwide Worker survey (By 2008): The number of white collar oil and gas workers in the Middle East will increase by 6,000 and by 12,000 in the FSU. In contrast, there will be a deficit of 14,000 white collar professionals in the United States.

7.1.11. Overall, it can be concluded that there will be significant amount of activities in both the Exploration and the Production sides around the world in the years to come and indeed in the next 10 years.

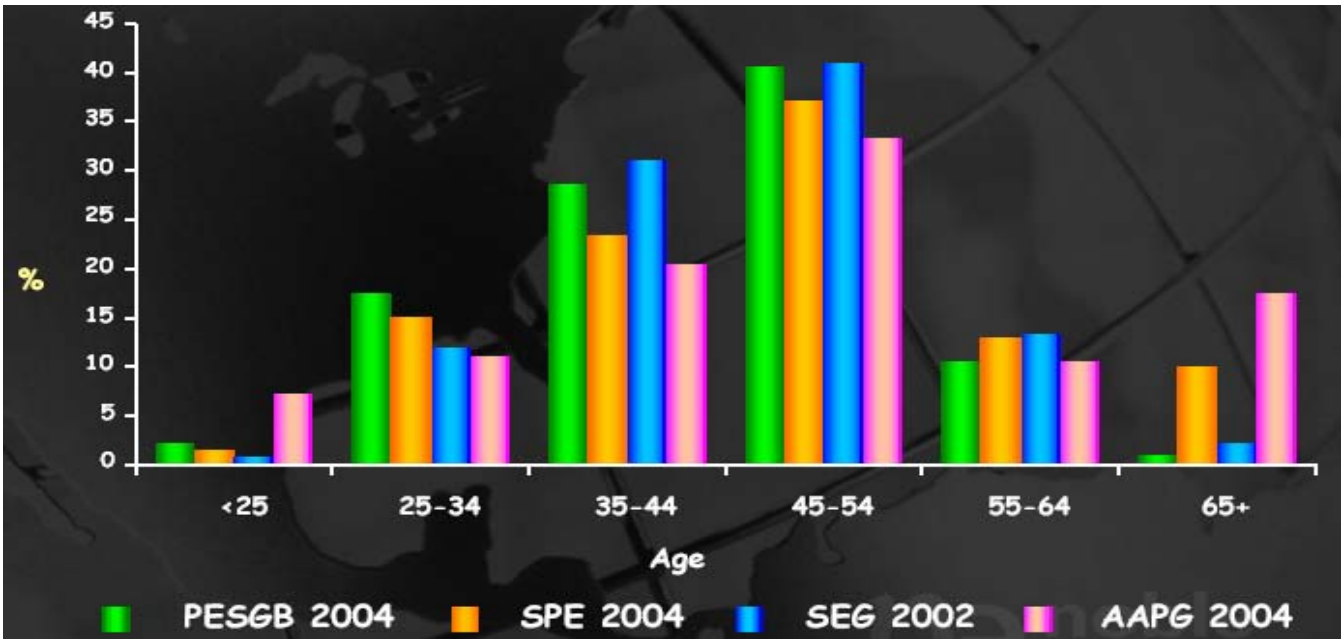
7.1.12. Further more, professionals are required to pursue research & development activities how to explore & produce in a cost-effective manner, ewer technologies and process innovations are mandatory, provided the high costs involved to conduct these activities. Availability of local / global talent is emerging as one of the most critical concerns.

8. Key talent issues in the E&P Sector

8.1. Key workforce issues identified for the global E&P sector

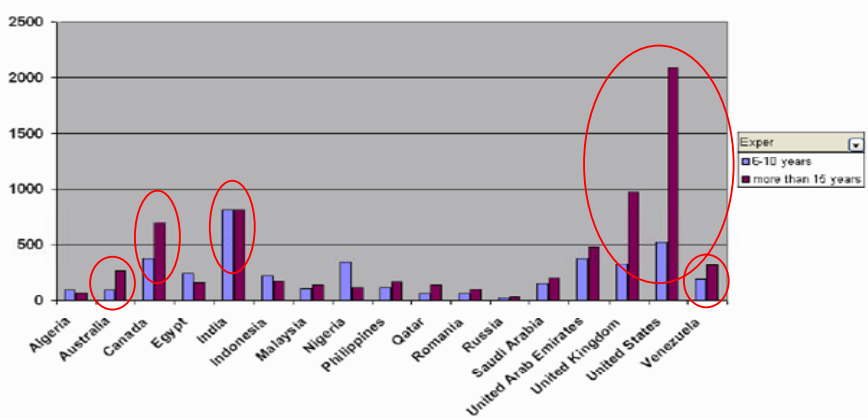
8.1.1. Analysis of Global Upstream Oil & Gas workforce reveals two predominant concerns viz. ageing workforce and consequently significant talent gaps.

8.1.2. While experience is highly valued in the E&P industry, the current average age of the workforce in the critical positions, globally, is very high. The baby boomer generation is beginning to retire and the impact on account of this exit will be felt over the next decade. This coupled with declining population growth in the western countries further aggravates the situation. The wave of anticipated retirements will further create a new set of challenges in availability of quality talent.



Demographics of Oil & Gas Industry Societies
Source: demographics section of the websites of each organisation

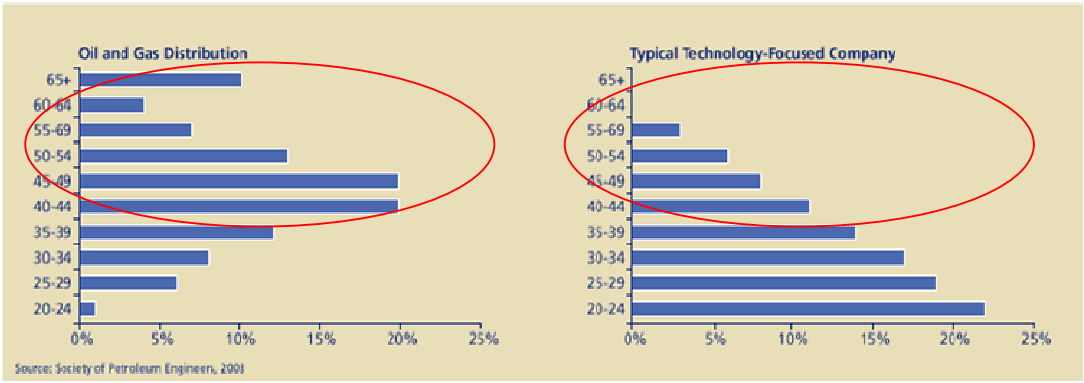
Workforce Experience



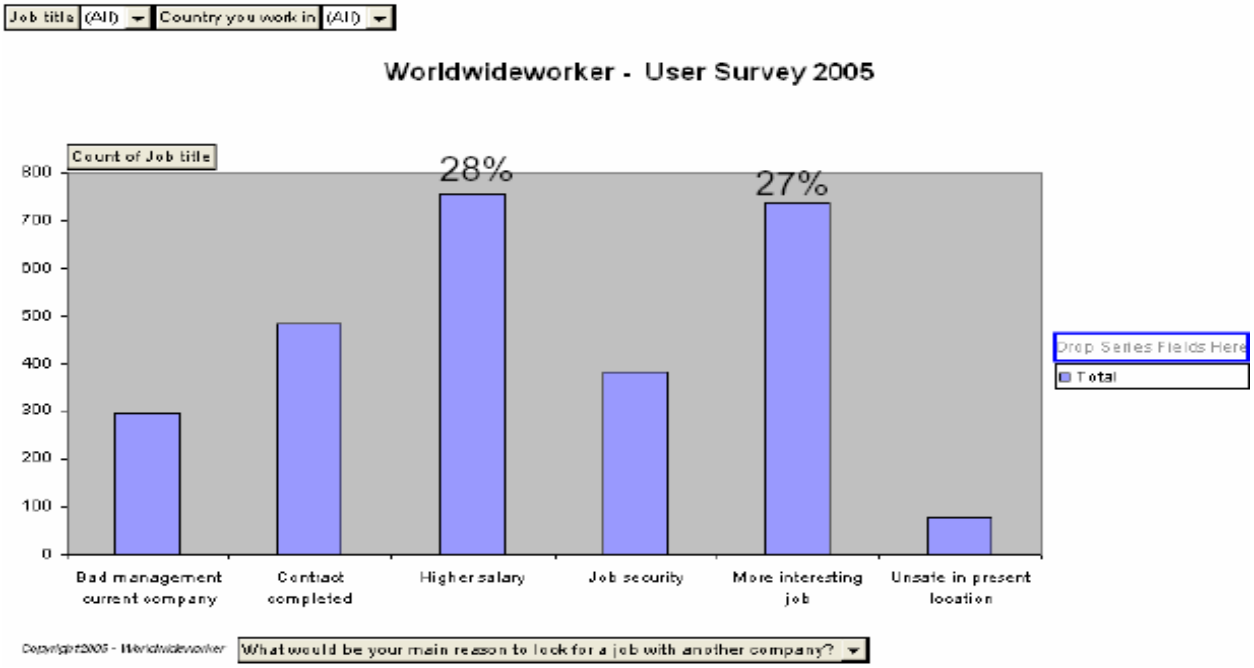
Source: Salary Trends Survey 2006, Worldwide Worker

8.1.3. With emerging industries competing for the next generation workforce, Oil & Gas companies worldwide are balancing acts with a constrained talent pool. An analysis of the Oil & Gas Industry age profiles with a typical technology focused company indicates tangential distribution of age profiles.

Workforce Age Distribution



8.1.4. Remuneration and more interesting job opportunities rank as the top two reasons for professionals to quit their existing jobs (Source: Worldwide Worker)



8.2. Workforce Challenges in Indian E&P Sector

The issues faced by the Indian E&P industry can be classified broadly into three categories, viz. Industry Awareness, Industry Attractiveness coupled with lower levels of remuneration (within India) and Ageing workforce.

8.2.1. **Scarcity of Skills**: , In view of the significant E&P Activity expected; the projected demand in India will far exceed the supply of talent available. Example, the projection model shows that the peak demand supply gap for skills requiring Geosciences will be 2,267 (in the year 2010) (refer Group I analysis - Section 6.2.2). The peak shortfall across all key skills (refer Section 6 Demand / Supply Analysis) is expected be 8,777 (in year

2016), if remedial action is not taken immediately. This makes the situation of talent gap in India far more acute.

8.2.2. **Not enough talent available to the sector at the entry level**: The E&P Sector faces a critical challenge in attracting the young talent. The Indian education sector prepares around 400+ students in E&P related geo-science courses. Also, of the students passing out of petro-technical streams only 56% join E&P companies with 12% of these being recruited for overseas positions. The Indian industry will require an additional 800 petro-technical students by 2017 (600 of these by 2012). Also, Indian talent has the potential to tap 20% of the short-fall per annum in Russia and Middle-East. This will require an increase in the number of students taking up education related to this sector.

8.2.3. **Low Industry Awareness:** The majority of college students have low awareness of the oil & gas industry's many career paths and opportunities. There is limited understanding of how much the industry has improved methods and equipment, lowered risks to workers and reduced impacts on the environment.

8.2.4. **Low Industry Attractiveness:** The industry faces very low attractiveness vis-à-vis other industries.

- Some of the toughest working conditions. For example, Shifts on rigs are for 12 hrs with typical work-cycles of 15/27 days.
- High incubation period for professionals – typical training time range from 3 to 6 years
- Favorable alternate job market scenario – IT, ITES, Retail and Telecom Sectors
- Exit options from E&P industry are limited on account of unique nature of jobs.

8.2.5. **Ageing Workforce:** While experience is highly valued in the E&P industry, the current average age of the workforce in the critical positions, in India and globally, is very high [above 50 yrs excluding the recent recruitments]. In India, similar trends were observed with the some of the leading E&P companies. Analysis of the workforce age profiles of one of India's leading National Oil Companies indicates that nearly 24% of its Geologists, 30% Geophysicists, 18% Drillers and 20% Production Engineers are aged over 50 years of age. The wave of anticipated retirements will create a new set of challenges in availability of quality talent at the middle and senior level – lack of adequate talent pipeline.

8.2.6. **Lower Levels of Remuneration:** The compensation levels in Indian E&P industry, for the critical skills pose challenges. On an average, salaries in India are lower than those in regions like the Middle East. Also since the salaries in Middle East are tax free, companies cannot compete with such geographies when attracting talent through rewards. Hence, Indian organizations need strong retention programs for critical skills to offset the negative impact of compensation levels.

8.3. Key Talent Management Issues

8.3.1. Key Talent Management Issues faced by companies in India have been mapped by the following parameters:

- Workforce experience levels and
- Critical stages in the talent management cycle

STAGE OF TALENT MANAGEMENT	PUBLIC SECTOR UNDERTAKINGS	PRIVATE SECTOR LARGE	PRIVATE SECTOR SMALL	SERVICE PROVIDERS
MEDIUM TO HIGH EXPERIENCE				
ATTRACT				
DEVELOP				
RETAIN				
ENTRY LEVEL				
ATTRACT				
DEVELOP				
RETAIN				

Source: PwC Research & Analysis, RED indicates area of weakness, GREEN: indicates area of strength

8.3.2. Skill-wise Talent Issues in Indian E&P Sector have been arrived at in the following sub-sections. For the purposes of this exercise, we focus on the following skills as their relative Demand is in significant numbers and procuring the same needs to be focused more. Similarly strategies for other skills can be evolved as per requirements.

- Geologists, Geophysicists
- Drillers / Drilling Engineers
- Loggers
- Reservoir Engineers
- Production Engineers

9. Key initiatives undertaken globally to address the talent issues

9.1. Overview

9.1.1. Few of the countries in the world are already gearing up to close this gap. Countries such as Canada and UK have adopted key initiatives with a proactive view to address these challenges. These initiatives can broadly be categorized into three levels viz. at the government level, at the educational system level and at the organization / industry level.

9.1.2. **Government Bodies:** These bodies are taking primary responsibilities for addressing the labour market information gaps through setting up forums of educators and industry professionals to develop and implement national strategy on addressing talent gaps in the E&P sector.

9.1.3. **Education Sector:** The educational institutes are partnering with the industry to establish apprenticeship, certification and training programs for occupations where supply gaps exist or will exist to improve workforce availability. They also provide forums for industry to interact with the potential entrants, their parents and others who play a role in influencing career choices.

9.1.4. **Organization Level:** Organizations world-over are emphasizing on improved attraction and retention methods to target the critical skills. They are also exploring potential partnerships to share labour resources with industries that use similar resource requirements and experience the same challenge of attracting and retaining workers.

9.1.5. Some key steps taken globally are showcased below. The steps taken are organized country-wise for ease of presentation.

9.2. Canada

9.2.1. **Petroleum Human Resources Council of Canada** (Petroleum HR Council). This is a national, not-for-profit collaborative forum supported by 11 oil and gas national and regional industry organizations, including one union, and represents the key sectors of the petroleum industry in Canada. The purpose of this council is to address the human resources issues within the petroleum industry.

9.2.2. PetroHRC has specifically conducted projects studying the connection between training programs and industry needs.

9.2.3. It also directed the strategic human resources study of the upstream petroleum industry: The Decade Ahead (2003, 2004revised)

9.3. UK

9.3.1. Similar studies to assess workforce sustainability issues in the E&P Sector have been carried out for UK.

9.3.2. The Industry Leadership Team (ILT) is an industry working group comprising senior managers from operating, contracting and supplier companies as well as trade unions. This group developed a strategic skills agenda focusing on establishing future skills requirements and ensuring workforce sustainability.

9.3.3. Organisations have set up Careers in the Oil & Gas Sector (COGS), a network bringing together UKOOA, employers and representatives from educational bodies. Since 2000, COGS has been promoting career opportunities in the oil and gas sector by visits to educational institutions including at the school level and establishing a presence at major careers events across the UK.

9.3.4. Initiatives such as - Talking Jobs, an innovative online career information service, launched in 2002; 'Opportunities' career road show etc with a view to inform young people about the E&P industry and the career opportunities offered by the same.

9.4. Norway

9.4.1. International cooperation initiatives - The Norwegian Petroleum Directorate organized assistance work financed by NORAD. Assistance was also provided by a number of firms. The majority of the assistance was directed towards the co-operating countries including: Angola, Namibia, Mozambique, Bangladesh and Vietnam.

9.5. British Columbia

9.5.1. In May 2004, the Government of British Columbia created the British Columbia Oil and Gas Education and Training Consortium - a partnership among industry, educators, Aboriginal1 organizations and government - to develop a comprehensive and coordinated approach to meeting the education and training needs of the oil and gas industry and increase the number of British Columbians employed in the industry.

9.6. Kazakhistan

9.6.1. Key actions initiated to address the situation include:

9.6.2. From 2005; state financing for upgrading existing schools ($2 million for 3 years)

9.6.3. National certification centre of Ministry of Education (with branches in each oblast) is to be established in 2005

9.6.4. National Program of Education Development for 2005-2010

9.6.5. To update the education content and structure based on national traditions and international experience

9.6.6. To move to 12 years secondary general education

9.6.7. To restructure vocational education system

9.6.8. National Plan task to establish 4 modern inter-regional educational and training centres (colleges) for those industries where there is shortage of qualified labour force:

- Oil &Gas – in Atyrau oblast (2006)
- Fuel and energy complex –in Pavlodar oblast (2007)
- Processing industry – in South-Kazakhstan oblast (2008)
- Machinery construction – in Eastern-Kazakhstan oblast (2009)

9.7. Egypt

9.7.1. Ministry of Petroleum has established the Egyptian Petroleum Institute (EPI) as a specialized training center. EPI has been established in collaboration with Northern Alberta Institute of technology in Canada, to ensure high quality skilled manpower serving Egypt and the region.

9.8. Industry involvement initiatives

9.8.1. Industry involvement initiatives such as Ambassador Program by Schlumburger. Ambassadors are advocates for Schlumberger within the university and for the university within Schlumberger. They organise recruiting campaigns and petroleum engineering research efforts on these campuses.

9.8.2. Another such initiative is Shell's Gourami Business Challenge. This is a part of its unconventional recruiting strategy in an attempt to woo some of the best and brightest college talent. In the program, students team up to solve complex, real-world challenges from the energy sector while

being coached by experienced Shell employees. At the end of the week, the teams presented their strategies, proposals, and billion-dollar budgets at a mock company shareholders meeting.

10. Recommendations for India

10.1. Action points for Government:

10.1.1. **Increase number of talent available to the sector**: India has been considered to be naturally gifted with a large pool of talented population. Given the E&P sector worldwide is experiencing shortage of skills that are increasingly considered as a global commodity, it is vital for India to provide for sufficient manpower to take care of the talent needs of the industry.

10.1.2. The following important initiatives may be considered for ensuring the availability of talent:

- The Ministry of Petroleum and Natural Gas may implement a plan to communicate the attractiveness of the industry. We suggest a "Go Explore" campaign where students right from the class 10, onwards, from all levels of economic and social backgrounds, hear and understand about the career opportunities in the E&P sector.
  - Career counselors and educational institutes to conduct periodic sessions / workshops to educate high school graduates about the career options in the E&P sector.
  - Students to be encouraged to explore options available in the E&P sector through dedicated assistance channels.
  - Institute scholarships for high caliber talent at various levels, through out the country.
- MoPNG and Ministry of HRD to set up a joint committee to monitor and address the talent requirements of the industry
  - Conduct periodic reviews of the talent availability in the industry by working closely with companies.

- Identify the manpower requirements for the short, medium and long term based on the talent strategies adopted by companies.
- Institute higher number of educational institutions across the country and initiate skill upgradation / refresher courses to ensure skill availability based on the industry manpower requirements.
  - **Course and Curriculum review**
    - Plan courses offered (specializations) and intake (number of seats). The existing institutes in the country are already planning to add around 65 sets in the next 2-3 years. Other institutes are also willing to consider expansion but have expressed need for assistance with infrastructure
    - Update curriculum in view with industry requirements
    - Set-up appropriate vocational / part time / short –term executive courses
  - **Plan infrastructure to provide higher quality of education**
    - Campus and lab facilities.

10.2. Action points for Organizations:

10.2.1. In view of the impending manpower shortage of critical skills in the E&P sector in the next few years (2007-2009), a high degree of collaboration between the industry and educational institutions is warranted. This collaboration may look at strengthening the prevalent curriculum to hone the skills of students at the education stage and cut down the training time when they join the organization. The collaboration may also extend to prepare the students for the jobs in the shortest time possible by offering longer stints of training as part of the curriculum.

10.2.2. Organizations to take up the manpower planning issues with the '**Joint committee**' and institute Industry Academia Interface (refer Section 10.3) to communicate the consolidated requirements on a periodic basis.

10.2.3. Organizations will also need to work closely with the education sector to initiate the following:

- Establish sector specific programs like workshops, seminars, technical contests etc.
- Provide training and support material to educational institutes to help cater to the industry requirements.
- Industry sponsorships, scholarship schemes.
- Industrial / on-site visits as a part of the courses.
- Inputs on technological/ new developments worldwide
- Provide students with opportunities for apprenticeship, jobs through appropriate mechanisms.
- Consider adoption of college going students at entry level to nurture their growth and readiness for the industry

- Involve college students, at entry levels, using focussed development programs to improve their understanding of the E&P Sector, groom them and ready them for the industry.

10.2.4. Set-up or participate in a communication campaign aiming to draw young talent to the E&P sector. The communication program should target student population in colleges as well as schools. Organizations could partner with educational institutions to run this campaign.

10.2.5. Set-up defined mechanisms to enable utilization of retired / retiring professionals as mentors /trainers to enable transfer of knowledge to the relatively younger talent force.

10.2.6. For the short term [2007-2009] manpower requirements to be met, organizations will have to aggressively augment critical skills, required in the short term.

- The industry may have to lower their requirement for the specialized educational requirement in the critical jobs identified in this report. This will have to be augmented with best in class and aggressive training programs and skill certification methods.
- However, in an industry where skills are not easy to find or develop, it is difficult to find trainers for these critical skills. Organizations may want to look into their databases and target retired employees to provide best-in-class training to these new employees.

10.3. Action Points for the Education Sector

10.3.1. To prepare and encourage talent into the E&P industry, the education sector can consider the following:

- Expand training programs to address immediate and emerging skills shortages;

- Implement programs that orient students to and prepare prospective employees for careers in the oil and gas industry;
- Expand current initiatives to achieve an appropriate level of applied research programs including interdisciplinary research that address conditions and challenges found in the Indian E&P industry;
- Expand current capacities (intake in E&P related courses) as well as set up new courses. The Indian industry alone will require an additional 800 petro-technical students by 2017 (600 of these by 2012). Additionally, the expansion in capacity also needs to consider global potential opportunities.
- Increase the level of common industry standards for vocational training across India.
- Establish feedback mechanisms to get industry and professional's opinions on the effectiveness of the educational system in catering to the E&P industry:
  - **Infrastructure and curriculum**
    - Courses offered (specializations) and intake (number of seats)
    - Vocational / part time / short –term executive courses
    - Campus and lab facilities
  - **Faculty**
    - Increase faculty-industry interaction
    - Train faculty on newer developments in the sector
    - Emphasize research – collaborate with industry. Industry can sponsor research project led by faculties which will also involve student project teams.
- Increase student participation in E&P related activities-

- Collaborate with organizations for participation in E&P sector career fairs / awareness campaigns – outline career opportunities/options
- Institute special programs –e.g.:
  - Student exchange programs with world renowned universities catering to E&P Sector [sponsored/non-sponsored]
  - Establish student chapters of E&P industry bodies like SPE etc.

10.3.2. Indian Institutes to plan to cater to the global opportunities. Institutes to prepare students for work opportunities abroad -

- Collaborate with organizations offering global careers
- Set-up exchange programs for students to familiarize with other locations
- Design curriculum keeping in mind international requirements. Offer high-end specialization to compete with the best in class institutes.
- Provide supplemental courses such as language courses to develop a more global workforce.

11. APPENDIX

11.1. Appendix 1: Team composition during Exploration:

Exploration - Acquisition Field Party	per 100 sq. km of 3D
Geologist	4
Geophysicist	12
Observers	2
Data Processors	2
Crew Manager	2

MDT - Processing & Interpretation	per 100 sq. km of 3D
Geologist	8
Geophysicist	12
Geochemist	3
Reservoir Engg	2
Mud Logger	2
Programmer	3

Source : Industry Inputs

11.2. Appendix 2: Team composition during Exploratory Drilling:

MDT	per rig
Geologist	6
Geophysicist	2
Petrophysicist	3
Geochemist	3
Reservoir Engg	2
Mud Logger	2

Drilling Crew	per rig
Drilling Suptd. (Rig Manager)	1
Tool Pusher	2
Driller	4
Asst Driller	4
Derrickman	4
Oil well cementer	2
Roughnecks	16
Crane Operator	4
Roustabout	20
Chief Mechanic	2
Chief Electrician	2
Welder	2
Motorman	4
Electrician	2

Source : Industry Inputs

11.3. Appendix 3:Team composition during Development Drilling

Drilling Crew	per rig
Drilling Suptd. (Rig Manager)	1
Tool Pusher	2
Driller	4
Asst Driller	4
Derrickman	4
Oil well cementer	2
Roughnecks	16
Crane Operator	4
Roustabout	20
Chief Mechanic	2
Chief Electrician	2
Welder	2
Motorman	4
Electrician	2
MDT - Subsurface - I	per 4 wells
Geologist	8
Geophysicist	2
Production Engineer	4
Reservoir Engg	8
Mud Logger	4
Driller	2

Source : Industry Inputs

11.4. Appendix 4: Team composition during Production / Processing:

Sub surface team	per unit
Geologist	12
Geophysicist	4
Drilling Engr	12
Geochemist	4
Production Engr	16
Reservoir Engg	16
Logger	8

Production	per unit
Chemical Engg	2
Production Engg	10
Mechanical Engg	4
Electrical Engg	4
Fire & Safety Engineer	1
Corrosion Engineer	1
Instrumentation Engg	2
Technicians	96

Surface Team	per unit
Geologist	2
Geophysicist	1
Reservoir Engineer	4
Production Engineer	2

Source : Industry Inputs

11.5. Appendix 5: Attrition and Retirement Assumptions

11.5.1. The following percentage assumptions (year on year) have been made for calculating the workforce (As-Is) post-retention and attrition. These figures indicate professionals exiting the Indian E&P Sector.

	Attrition	Retirement
Geophysicist	4%	2.50%
Geologist	4%	2.50%
Reservoir Engr	4%	2.50%
Driller	8%	2.50%
Logger	4%	2.50%
Geochemist	4%	2.50%
Tool Pusher	4%	2.50%
Drilling Suptd.	4%	2.50%
Petrophysicist	4%	2.50%
Roustabouts	2%	0.00%
Roughnecks	2%	0.00%
Asst Driller	4%	1.00%
Oil Well Cementer	4%	1.00%
Observers	2%	1.00%
Draftsmen	2%	1.00%
Production Engr	4%	2.50%
Programmer	4%	0.00%
Data Processors	4%	0.00%
Electrical Engr	4%	1.00%
Mechanical Engr	4%	1.00%
Chemical Engr	4%	2.00%
Instrumentation Engr	4%	1.00%
Civil Engr	2%	1.00%
Corrosion Engineer	4%	1.00%
Fire & Safety Engineer	4%	1.00%
Structural Engr	4%	1.00%
Technicians	4%	2.50%
Crane Operator	2%	1.00%
Derrickman	2%	1.00%
Motorman	2%	0.00%
Chief Electrician	4%	2.50%
Chief Mechanic	4%	2.50%
Electrician	2%	1.00%
Welder	4%	1.00%

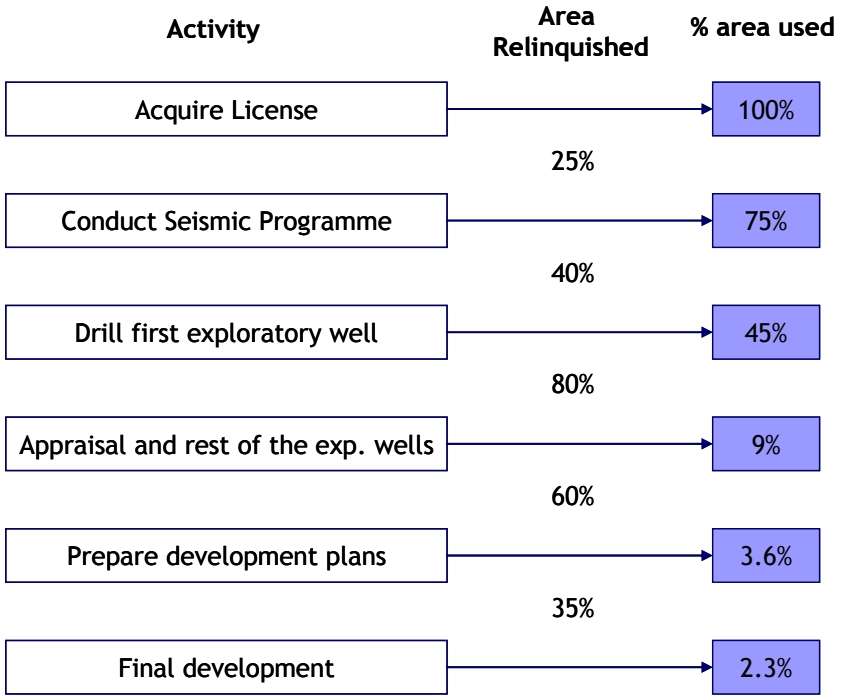
Source : Industry Inputs

Note: The 0.00% retirement rate suggests that the age of the workforce in the specific positions is very low and employees are not in the range of retirement age.
The above rates (%) have been applied year on year for the population for the corresponding skill. E.g, for Geologist: estimated number of professionals =1800(2007).

Reduction in workforce due to attrition & retirement = (4%+2.5%)*1800.

11.6. Appendix 6: Success Ratio Assumption

11.6.1. In calculating the eventual quantum of activities that will happen at various stages, the following assumptions have been used. These have also been validated by select members from the industry.



Ref: Hydrocarbon Perspective Report [Sunderajan Committee]

11.7. Appendix 7: Minutes of the Meeting held with key industry representatives:

Date: August 21, 2006

Venue: Conference Hall, PetroFed, IOCL Bhawan, New Delhi

Key inputs from industry:

The Talent Crunch:

11.7.1. Industry acknowledges the shortage in certain functional areas and recognizes the need to consider the allied streams to mitigate the high requirements. E.g. consider the combined pool of drilling, mechanical and production engineers for drilling related positions.

11.7.2. There is a need to use the available talent pool in a just manner. The jobs should be classified as per skill requirements which will help distribute the requirements across different source pools, namely - engineering, diploma and ITI.

11.7.3. The pressure on Indian talent on account of increasing global requirements was also discussed.

- Schlumberger report specifies India alongwith China, Indonesia, Venezuela and Mexico as possible talent sources.
- Of these India is the preferred source on account easy availability of English speaking professionals versus the others.

Industry Awareness & Attractiveness:

11.7.4. Need to proactively work on the industry's perception amongst the target talent set:

- "We are a high technology industry; however students do not perceive us to be so".
- Upstream jobs are perceived as very labour intensive as against a typical white collared desk-job. This coupled with the perceived work image of the industry – jump suits / hard hats deter the candidates by making the jobs seem very 'non-executive-like'. (This was quoted as an actual feedback obtained by an E&P service provider from the student of a premier engineering college).

11.7.5. Greater industry involvement - Need for a more open channel between the student community and the industry:

- Communicate the opportunities available in the E&P sector.
- Use of student bodies, alumni associations to communicate the E&P sector opportunities and work.
- Hold direct interactions between members of the industry and the students on the career prospects in E&P.
- Obtain feedback and provide clarification.
- Industry internship programs
- Integrated involvement programs spread across the entire period of graduation so as to build in commitment to the industry as well.
- Initiate programs at the school level. Industry could seek talent at +2 level, involve them with E&P, provide scholarships for further specialization.

11.7.6. Compensation - The discussion also veered towards the issue of compensation offered by the industry. Representative from a PSU organization expressed inability to attract the desired talent on account of unattractive pay structure. However, the fact that the compensation

offered by the PSUs compare favorably as against that offered by players in IT/ITES sectors was also brought forward. The need recognized was to communicate the career opportunities and create a favorable perception of the industry in the student community to draw them to the sector.

11.7.7. A few members indicated that the younger population is more driven by short term results today and hence the need to consider other motivational factors such as fast career growth etc. to attract them.

Educational Sector:

11.7.8. Capacity- Need to scale up the capacity of educational sector to cater to the requirements of the industry. The suggestion of scaling up the capacity / setting-up new institutions was welcomed by the industry as a forward looking initiative.

11.7.9. Industry expressed its concern in terms of the "job-readiness" of students on account of outdated curriculum.

11.7.10. Industry would particularly be interested in an institute catering specifically to the Oil & Gas and allied industries which can act as a Center of Excellence (CoE). Government's intention to set up an institute on similar lines was shared alongwith prospects of greater participation from the industry in the same.

11.7.11. The topic on industry participation for funding of such an initiative was also discussed favourably.

11.7.12. Furthermore, having the required degree / educational qualification may not necessarily translate into employability. Industry is keen on generating the pool of employable rather than just qualified professionals.

11.7.13. Industry and academia to have greater interaction, to have a common understanding of the requirements and prepare for the same.

- Petrotech has initiated a system of quarterly meetings between the industry and the academia to be held in different regions.