Skill and Competency of Human Resources in Handling Oil and Gas Projects

By

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A project dissertation report submitted to the Petroleum Engineering Programme
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Approved

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TRONOH, PERAK

JANUARY 2015

CERTIFICATION OF ORIGINALITY

This is a certification that I am the one who did this project and the one responsible for all the work in this project. Moreover, all the work is my own unless it was stated in the references. Furthermore, all the original work that was done in this report had been done by me. Not by any unspecified people or sources.

…….

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ABSTRACT

The oil and gas industry is an extremely fast growing industry; this is due to the increased demand for energy. For the industry to continue its survival and its growth, it depends on several factors. The most important of them all is the human resources. A few previous reports talked about how important are the human resources for handling oil and gas projects.

This project had identified the roles and skills that are needed by reservoir, drilling and production engineers. Moreover, it found out the most pressuring problem facing the oil and gas industry. It also managed to identify the best solutions that will solve those problems in a way that will not backfire in the near future. This was achieved by coming up with a survey from previously used surveys. This survey was passed to petroleum engineers of the previously identified disciplines from Egyptian and Malaysian oil and gas companies. The answers of the surveys were analyzed, those answers had their reliability and validity tested by the statistical software SPSS. Eventually, the best solutions that were chosen and identified will later on help the industry and the new graduates.

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CHAPTER 1: INTRODUCTION

1.1 Project Background

The oil and gas industry is one of the biggest industries of the world. Moreover, it is also one of the fastest growing industries that exist. Human capital is extremely needed for the oil and gas companies. Human capital can be identified as the set of knowledge and expertise that individuals have or possess. Without the human capital the industry would not even exist.

Nowadays, there are a lot of processes that are needed for the oil industry; this requires a lot of different engineers from different backgrounds. For example, the development of a specific field would need proper understanding of geological and reservoir characteristics in order to get the optimum performance and production from that field. Those engineers are required to have specific set of skills and knowledge, so they can help the industry achieve its goals. Furthermore, engineers should have the ability to solve the technical problems that are faced during any phase of the industry.

Despite the fact that there are a lot of universities around the world that offer the petroleum engineering courses, there are still problems facing the industry, such as shortage of skilled workers. It is not easy to find engineers with enough experience and knowledge that are beneficial for the industry. A lot of solutions have been tried, but they mainly handle the short term issue, they do not treat the root of the problem, thus having the risk of facing the same problem again but this time it will be extremely hard to deal with it. For example, some companies tried to solve the shortage of skills in the market by delaying the retirement of the senior employees. Not to mention, another

company tried luring the employees of another organization by providing them with better benefits and salaries.

It is the job of engineers to find long term solutions for the technical problems that the industry faces, this can be done by having engineers from different companies and organizations collaborate together to help identify the main problems being faced and find the best ways to solve them. An example of that collaboration was one that occurred in Canada between several oil and gas companies such as, Apache Canada, ARC Resources and Bonavista Energy. They managed to identify the main challenges facing the industry and they came up with a few solutions that may help face those problems.

1.2 Problem Statement

Due to the increased numbers of populations, the demand for energy has increased. This increase in energy demand is requiring more skilled workers for the industry. This is a huge issue facing the, as it is really hard to find and develop talents for the industry. It is well known that the current workforce of the industry consists of a lot of aging employees; this is causing a crisis on the availability of skilled and qualified workers for the industry. The problem emerging is there will be no one to pass the experience and knowledge of those workers to the fresh graduates and the young employees. Most of the solutions that have been suggested till now are short terms solutions that do not solve the real issue, they just cause the prices to go up and they do not contribute any structural solutions (Parry, 2009).

If the current workers do not possess the required skills for handling oil and gas projects, this may lead to other problems such as:

- Health, Safety and Environment (HSE) Issues.
- Drilling and production issues.

1.3 Objectives

The objectives of this research are:

- Identify the skills required by different engineers in Malaysian and Egyptian oil and gas companies.
- Identify the most pressurizing problems facing the industry.
- Come up with long term solutions for the issue of shortage of skilled workers and employees.

1.4 Scope of Study

The scope of this study will include these following points:

- Prepare surveys for several engineers of Malaysian and Egyptian oil and gas companies to help identify the main skills required for each engineer.
- Interview engineers to find out the best ways of improving those skills.
- Try to solve the problem of shortage of skilled engineers with long term solutions instead of short term ones, by modifying a couple of solutions that had been used in Canada and USA.

CHAPTER 2: LITERATURE REVIEW

2.1 Roles and Skills of Engineers

Development of any field requires a proper understanding of all the provided data. This will help in finding out the best and most suitable way of drilling, production and completion without violating and of the HSE regulations. To achieve that, skilled, experienced and knowledgeable engineers are needed.

It is the duty of HR personnel is to hire and seek those engineers. In addition to that HR is responsible of ensuring that all the employees are capable of doing their jobs. This can be achieved by trying to stop seeing the workers as expenses to the company and start seeing them as assets (Bianca. A, 2013).

Examples of what Schlumberger has been searching for in their engineers are stated below:

- People who are detail-oriented and analytically oriented.
- Enthusiastic to have a quick progress.
- Team players.
- Proficient in communication.

Petroleum engineers are the most needed engineers for the oil and gas industry, because they have the most responsibility in the process of producing oil and gas. They aid in the exploration and searching for reservoirs that contain hydrocarbons. Sloan Career (2011) mentioned that petroleum engineers should determine which method of drilling shall be used, supervise the operations of drilling and production. Moreover, they should be able to find out the best equipments and design that would allow the most production. Not only should they have knowledge about designing, but they should also be experts in

using computer simulators, to help in simulating drilling operations or forecast future flow and characteristics of the reservoir (Sloan Career, 2011).

According to Greg (2014), for an oil field to be developed, several aspects should be covered, thus petroleum engineers can be classified and divided into different disciplines

- Reservoir Engineers
- Petroleum Geologists
- Production Engineers
- Drilling Engineers
- Petrophysicsts

According to a report produced by Halliburton in 2011, reservoir engineers are responsible for the optimization of oil and gas production by using Enhanced Oil Recovery (EOR) methods. They also should have good knowledge on simulating the risks and future predictions of the reservoir. Thomas. A (2007) stated that geologists are responsible for the search of hydrocarbons by inspecting the structures of the subsurface with methods of geology. They should have knowledge of structural geology and stratigraphy. The responsibility of production engineers is managing the relation between wells and reservoirs. They should have knowledge of perforation and selection of the equipments on the surface (Greg, 2014).According to Chevron, drilling engineers should be responsible for drilling the well. They should have knowledge of new drilling techniques, in order to avoid damaging the well and formations.

Clegg and Joe Dunn (2007) have stated in their book "Petroleum Engineering Handbook" that all production engineers should be able to:

- Determine the performance of the flow between the wellbore and the reservoir itself.

- Choose which instrument and equipment will be used for the process of artificial lift.

If the engineers are not skillful, they might fall into human errors which might cause safety hazard s (Benjamin R. Poblete, 2014). Jim Raney (2010) has stated in an offshore safety panel, that four of every five accidents that occur offshore, happen due to human errors. An example of this is the incident of Gulf of Mexico spill, which occurred due to careless conduct and human errors.

2.2 Shortage of skilled workers

2.2.1 Problems facing the industry

In 2011, Ernst & Young the consultancy firm conducted surveys to find out the most pressurizing problems that are facing the industry in Canada and the USA. The results can be seen in the figures below.

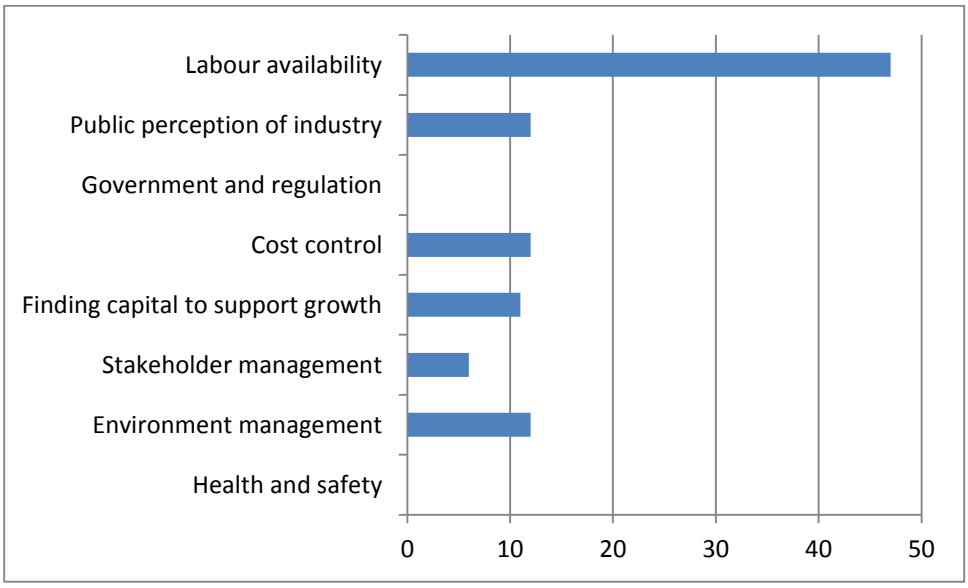

Figure 1: Issues facing the industry in Canada

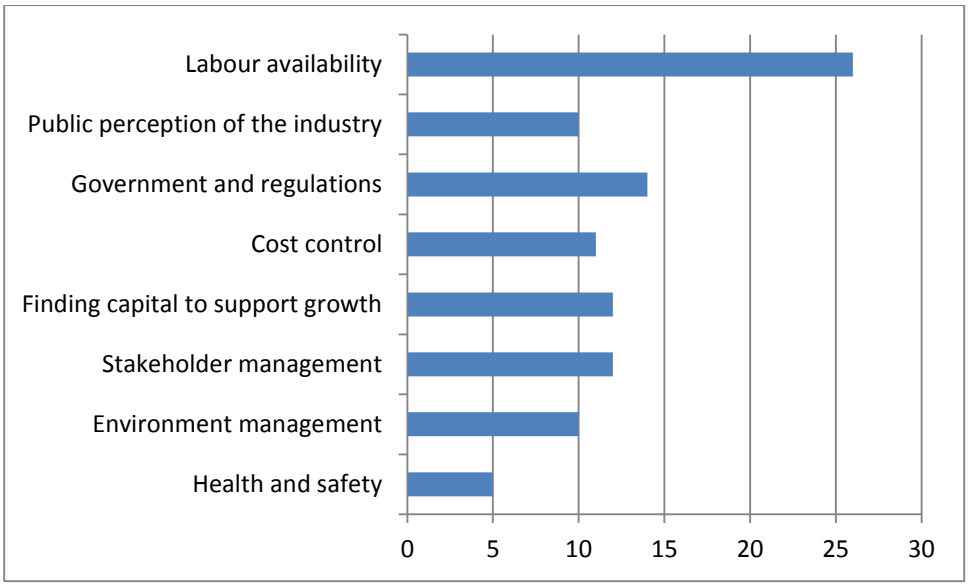

Figure 2: Issues Faced In USA

The table below will compare the results of the above figures:

Table 1: Comparison between the industry issues in Canada and USA

Canada	**USA**
0% of the issues regard health and safety and government regulations.	5% of the issues regarded health and safety and 14% regarding government and regulations.
12% of issues regarded environment management, cost control and public perception of the industry.	10% regarded environment management, 11% regardedcost control, 10% for public perception of the industry
11% were related to finding capital for growth.	12% were related to finding capital for growth.
47% were related to labor availability.	26% were related to labor availability.
6% were related to stakeholder management.	12% were related to stakeholder management.

From the survey, it is obvious that the main problems facing the oil and gas companies are:

- The most pressing problem is labor availability, due to decrease and deficiency of human capital (Pyron, 2007).
- Health and safety.
- Environment Management and Stakeholder Management.
- Government regulations.
- Public perception of the industry.

2.2.2 Reasons behind shortage of skilled workers

Mehta (2011) stated that the main reasons behind the shortage of human capital are:

- Prices of oil and gas as they control the recruitment.
- Ageing workforce and knowledge transfer.
- No proper marketing strategies.
- Competition for talents and hunting employees due to higher demand.
- Not enough communication with universities.
- People do not want to leave their families and go work at rural areas.

Kebede (2008) stated for the New York Times that energy industry at USA is developing slowly, as it is hard to find skilled workers. Not to mention, the industry did not really work on depicting itself as an attractive profession (Kebede, 2008).

Hopkins (2008) mentioned that most of the engineers who started their trainings in the 1970s are going to retire soon. On the other hand, the young engineers that are approaching this industry, due to the high salaries, are still raw and young, they do not have the ability to take over instead of the engineers who are going to retire, as it usually more than three years for the newly employed engineers to get to understand how the industry works. Furthermore, it would take more than ten years for them to develop a discipline that is professional.

The Oil and Gas Compact Commission, has found out the average age of the engineers in service companies is between 46 and 49 years, while the retiring age is of 55 (Hopkins, 2008). Ryder, J. (2007) mentioned that the number of employees in the oil and gas industry had declined from 860000 in 1982 to 26000 in the 2000s. This can be related to fewer employees joining the industry in the end of the 1980s and the beginning of the 1990s, because a lot of firing and laying the engineers off happened during that time. Moreover, Ryder, J. (2007) talked about the problem that will face the industry whenever that generation retires and leaves the industry, as there will be a huge gap in the knowledge and it will be extremely hard to transfer the knowledge from this older generation to the newer generations. Mehta (2011) stated that the shortage in finding people with sufficient skills has been called the "Great Crew Change." It is a gap in skills that was formed by the perfect storm of an old working force.

During the financial crisis of 2008, numerous organizations had to go through layoffs; they also had to stop some of the graduate programs for a few years which meant that there will be a shortage in skilled engineers for a few years (Harvey, 2013).

Schlumberger Business Consulting conducted a survey by 2010, the results were that an estimate of 22000 engineers and geoscientists will retire or leave their positions by 2015. On the other hand, this survey claimed that the new graduates can fill in those positions, but those graduates do not have the ability to replace the expertise that was lost.

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2.3 Long term solutions for the issue of shortage of skilled employees

Oil and natural gas are from the most consumed products in the world. Experts predict that the consumption would still increase, thus a strategic solution for recruitment problems that lasts for a long time is needed.

Parmesh. M (2008) has suggested a new model that can face today's needs. This model will show the difference between the modern and old recruitment.

- In the past, recruitment would only occur whenever a talent is needed, but today the search for new talent should always be on.
- In the past, recruitment would be done via familiar and known sources. However, nowadays hiring can be done via wide range of talents and those talents can be improved by the use of training.

A comparison between the solutions (Parry et al., 2007) has stated and (Mehta. P, 2011) solutions can be seen in the table below.

Table 2: Comparison between Mehta and Parry

Parry et al. (2007)	**Mehta. P (2011)**
One of the best solutions out there is put the effort into developing their own talent, this will also help in fighting off the problem of shortage of skillful and talented workers.	Has summed up a few factors and solutions that have been mentioned in the International Energy Conference in 2011 at Houston and what Parmesh. M (2009) suggested. Those solutions are stated below.
• Shell started the Learning@EPiCentre in Rijswijk that has the ability to train 5000 students per year with the most up-to-date equipments and technologies • Exxon Mobils' Houston centre has the ability to train 4000 students per year. Moreover, it is planned to have more centers like this around the world to attract young talents	• Partnerships should be made with universities and high schools. • Better working environments should be provided. • Chase international and global talents. • Use social media for advertisements and building a better reputation for the industry. • Special internal training for development, provided by the company.

Mehta (2011) has stated that the problem of human capital deficit can be solved by:

- Partnerships with the institutes of education:

    1. The industry can help the universities come up with proper curriculums that will actually match the requirements of the industry in the future.
    2. Build a better reputation for the industry, as nowadays the marketing for the industry has been terrible. This can be related due to the industry being on the news for disasters such as spills and oil prices affecting the economy in harmful way. Not to mention, try to show the students how they would have good options for their career industry, due to the rapid growth and the high salaries.

- Improve recruitment by:

    1. Having specialized managers for recruitment such as the SMEs (Skilled subject Matter Experts), who are well known in the industry. Those SMEs will enhance and develop the methods of selection of recruits and candidates.
    2. Professional organizations that will provide websites that are available all around the world for organizations to have a wider range of talents to select from. Furthermore, the companies can use those websites to advertise for job openings. Examples of those websites are: Society of Petroleum Engineers, International association of drilling engineers and American Association of Drilling Engineers.
    3. Social media can help provide a wider pool to choose from, as numerous people use those Medias such as facebook and LinedIn. The companies can use them to improve the awareness of the teenagers. Moreover, it can help the companies keeping the people involved with the industry's' news and job opportunities.

According to Bradwell (2011), high school students are a valuable element that can help fill the vacancies that the oil and gas industry is constantly creating. This can be seen in the program that Saudi Aramco has started for the students of high schools where they can work and see the plants during their holidays. Whenever a student is interested, Aramco will provide a scholarship for that student to continue his studies in any field of studies that concerns the oil and gas industry.

A study that was conducted by Society of Petroleum Engineers and was sponsored by British Petroleum has stated that more than 53% of the engineers would consider leaving their companies for another competitor, due to lack training programs, as this would cause a dent in their career. Not to mention, 75% of the respondents claimed that they will choose their employment place depending on the amount of training they can get at that place. Good examples for solving the problem of training and having more suitable engineers for the work can be seen at:

- BPs' "Challenge Program", this program is special for the new recruits of fresh graduates it goes for the first three years of their employment with the company.
- GE has its own Edison Engineering Development Program which consists of two years of rotation for the fresh graduates.

Mehta (2011) mentioned that another solution to the problem of shortage of skilled engineers is to start targeting women, as the women can come up with different points of views and perspectives that can help in overcoming the upcoming problems facing the industry. The best way to do this is to make the industry more attractive to the females; this will be achieved by reaching them in the early stages of education and try to show them that a job in engineering for oil and gas can be more satisfying than other jobs and the females can handle the life of the job and the family.

CHAPTER 3: METHODOLOGY

3.1 Research Methodology

This particular study was based on researches, surveys and interviews conducted with engineers from couple of Malaysian and Egyptian oil and gas companies. Research was done to check the current findings and statistics about skills needed by engineers in the oil and gas industry. After that, questions for a survey were established by researching previous surveys, checking which form of questions are used, how many questions are used and which form of answers is used.

Most of the previous surveys varied from 15-30 questions, so the survey for this project will be of 21 questions. Some of those questions required the engineers to choose one of the answers provided, some other questions required the engineers to rate the solutions provided out of 10and the last form of questions used were open ended question that requires the engineer to specify a certain number. Those questions were used, because they were used in most of the past surveys.

This survey was passed to thirty petroleum engineers, ten from the reservoir engineering department, ten from the drilling engineering department and ten from the production department. The answers of the engineers for this survey did help this study, to get to know the roles engineers in the industry, the skills needed, which skills are hard to find and obtain and how to solve the problem of skills shortage in a proper way that will not affect the industry after a few years.

After the data has been gathered, data evaluation and analysis started. The author tried to find out which skills, problems and solutions have been chosen the most by the petroleum engineers. The answers of the engineers in the survey were changed into relative important index, this data will be imported into the SPSS (Statistical Package for Social Sciences) software to calculate the:

- Reliability test by using the Cron bach alpha which should be between the range of 0.7-1

- The validity should be closer to 1 which indicates that our collected data is valid and it will be calculated by using the formula mentioned below:

$$Validity = \sqrt{Reliability}$$

The figure below will show the flow of this study:

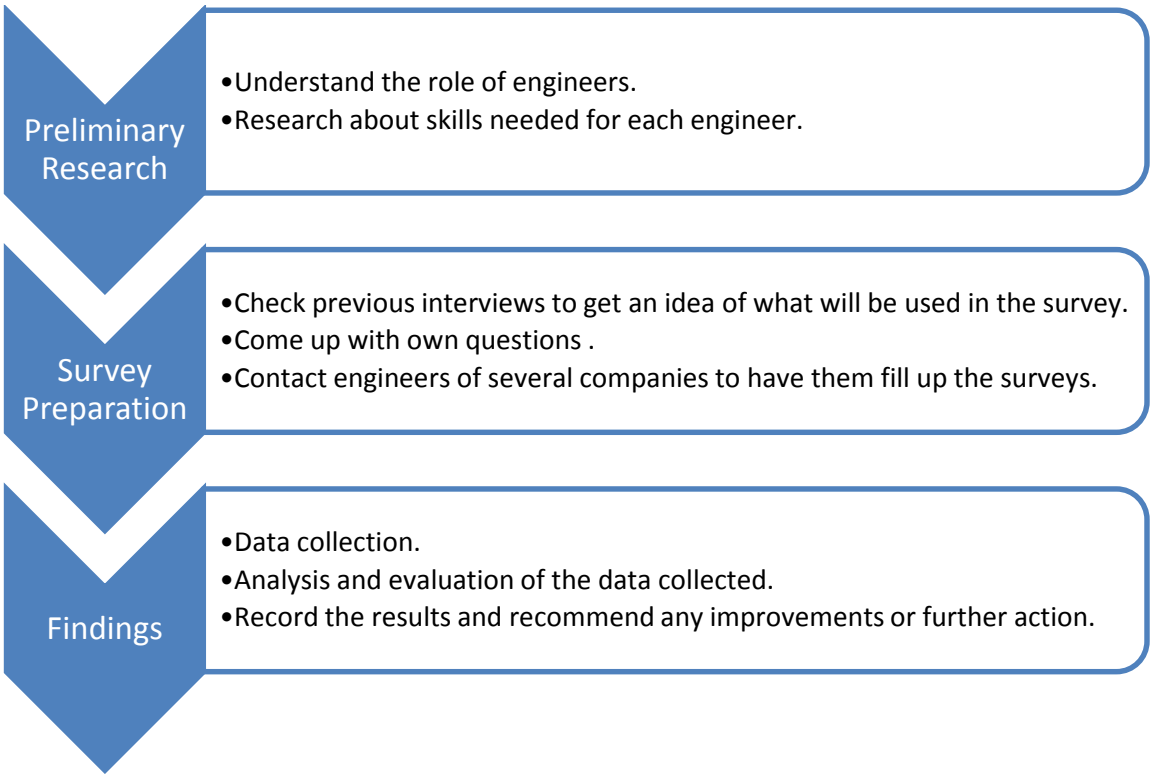

Figure 3: Methodology

3.2 Gantt chart and Key milestones

Gantt chart for Final Year Project 1 and Final Year Project 2 can be seen in the figures below:

Table 3: Gantt chart for FYP 1

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Selection of project title														
Preliminary research work														
Submission of extended proposal														
Proposal defence														
Requisition for material and equipment														
Submission of interim draft report														
Submission of interim report														

Table 4: Gantt chart for FYP 2

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Experimentation														
Submission of progress report														
Data analysis and reporting														
Pre-SEDEX														
Submission of draft final report														
Submission of dissertation (Soft bound)														
Viva														
Submission of dissertation (Hard bound)														

Table 5: Key milestones for the project

Activities	Start Date	End Date	Duration
Selection of project title	22-Sep-14	20-Oct-14	4 weeks
Preliminary research on skills and roles of engineers	20-Oct-14	1-Dec-14	5 weeks
Preparation of surveys and contacting engineers	1-Dec-14	22-Dec-14	3 weeks
Conducting Surveys and interviews	12-Jan-15	2-Feb-15	3 weeks
Data analysis	2-Feb-15	16-Feb-15	2 weeks
Data interpretation and report	16-Feb-15	2-Mar-15	2 weeks

CHAPTER 4: RESULTS AND DISCUSSION

For the current time being, thirty petroleum engineers answered the first few questions of the survey, ten from each discipline of petroleum engineering. The answers of the survey from the engineers are illustrated in the diagrams below. Those diagrams will show the skills and roles that are needed by each petroleum engineers and how important are those skills to the industry. The answers of the whole survey from the thirty engineers will be collected and analyzed in the final dissertation.

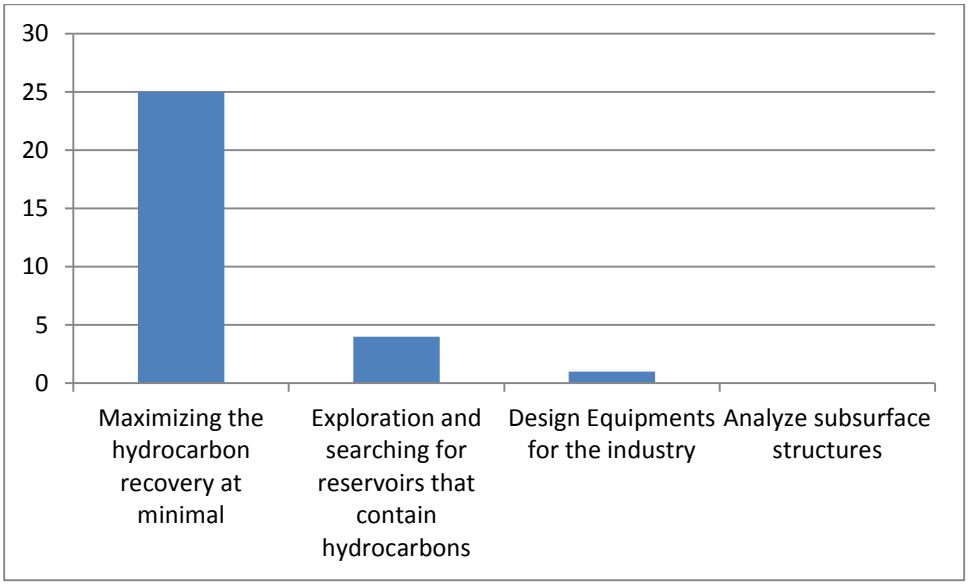

Figure 4: Role of petroleum engineers

Figure 4 shows the responses of thirty petroleum engineers to the question of the role of the petroleum engineers, twenty five engineers chose that maximizing the hydrocarbon recovery at minimal cost is the role of petroleum engineers, while another three chose aiding in the exploration and searching for reservoirs that contain hydrocarbons, two chose designing equipments for the industry and none chose analyzing subsurface structures, as it is mainly a job for geoscienetists.

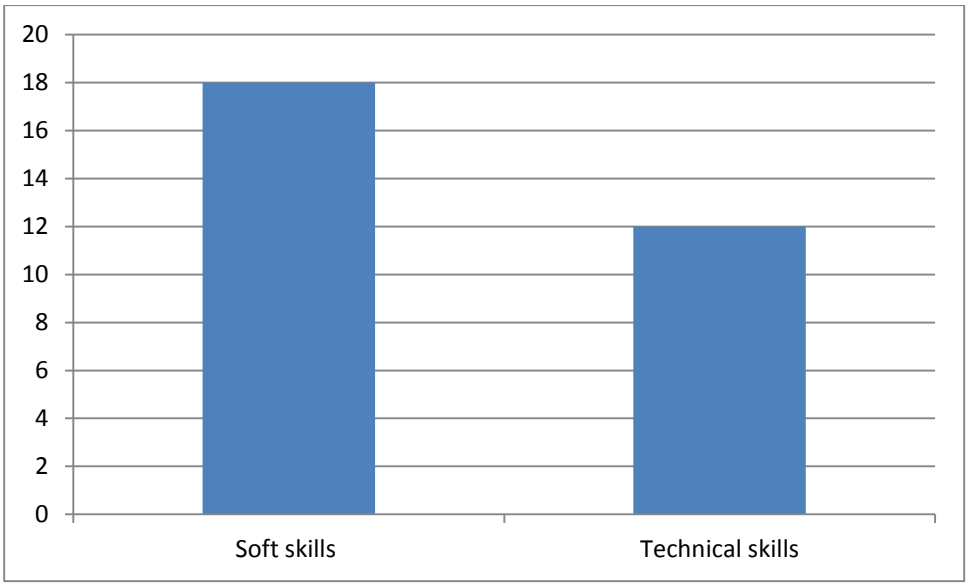

Figure 5: Skills needed in a recruit

Figure 5, shows that eighteen engineers prefer soft skills to technical skills in their recruits while the other twelve preferred technical skills to soft skills.

Table 6: Average rating of soft skills

Soft skill	**Rating**
Team players	9.9
Proficient communication skills	9.3
Enthusiasm about progress	8.5
Detail oriented and analytically oriented	7

Table 6, shows that the most important soft skill needed to be in the recruits is being a team player, as most of the projects in the industry depend on groups of engineers working together, so if a recruit is not a team player then this will hinder the project. Second is, a proficient communication skill, as the engineers need to explain the progress to clients. Thirdly is, enthusiasm about progress, as the recruit has to be up to date on all the new techniques and software without his manager pushing for it. Finally, the last one is being a detail oriented and analytically oriented.

The Cronbac alpha test was conducted for the above mentioned results can be seen in the table below

Table 7: Cronbach Alpha Test for soft skills

Cronbach's Alpha	N of Items
0.807	4

	Corrected Item Total Correlation	Cronbach's Alhpa if Item deleted
Team Players	0.786	0.789
Communication Skills	0.765	0.795
Enthusiasm for progress	0.755	0.799
Detail oriented and analytically oriented	0.698	0.803

Table 7, shows that the values of the Cronbach's Alpha test was 0.807; this is the value of reliability of those results. To get the validity of those results can be obtained by the square root of the reliability which will be 0.8983.

Table 8: Average rating of role of reservoir engineers

Role of reservoir engineers	**Rating**
Optimization of oil and gas production by using Enhanced Oil Recovery (EOR) methods	9.5
Simulating the risks and future predictions of the reservoir	9.7
Monitoring and interpretation of fluid identification and sampling data acquired by other departments	8.3
Establish and maintain relationships with the reservoir technical community	6.7

Table 8, showed that the most important role of reservoir engineers was simulating the risks and future predictions of the reservoir, as it had a rating of 9.7, this was followed by optimization of oil and gas production by using EOR, as it was rated 9.5, monitoring and interpretation of fluid identification and sampling data acquired by other departments came third as it was rated 8.3. Finally, establishing and maintaining relationships with reservoir technical community came in last with a rating of 6.7.

Table 9: Average rating of skills of reservoir engineers

Skills of reservoir engineers	**Rating**
Proficiency in using multiple software modules to perform basic interpretations related to fluid gradient and contact calculations	10
Up scaling geological models for dynamic fluid flow analysis using numerical simulators	9.7
Enthusiasm in keeping up to date with the newest advances in the reservoir area	8.7
Use conceptual skills to develop new approaches	7.1

Table 9, showed that the most crucial skill needed by reservoir engineers was proficiency in using multiple software modules to perform basic interpretations related to fluid gradient and contact calculations, followed by, up scaling geological models for dynamic fluid flow analysis using numerical simulators, then enthusiasm in keeping up to date with the newest advances in the reservoir area and finally, using conceptual skills to develop new approaches.

Table 9: Cronbach's Alpha for Skills of Reservoir Engineers

Cronbach's Alpha	N of Items
0.789	4

	Corrected Item Total Correlation	Cronbach's Alhpa if Item deleted
Software modules for contact calculation	0.754	0.776
Upscaling geological models	0.798	0.765
Enthusiasm in staying up-to-date	0.677	0.78
Conceptual skills to develop approaches	0.652	0.786

Table 10, shows that the values of the Cronbach's Alpha test was 0.789; this is the value of reliability of those results. To get the validity of those results can be obtained by the square root of the reliability which will be 0.8883.

Table 10: Average rating of role of drilling engineers

Rolls of drilling engineers	**Rating**
Provide directional drilling operations and clients with drilling plans and designs	9.5
Support delivery and sales process with technical expertise	6
Provide real time decision support to other engineers	10
Ensure that well plans and design comply with HSE regulations	9.7

Table 11, showed that the most needed role for a drilling engineer is to provide real time decision support to other engineers, as the drilling engineer needs to think fast and relay the needed information to other departments, as this fast thinking would help in avoiding catastrophes. It is followed by making sure that the well plans and design comply with the HSE regulations, as some countries really care about the environment, so if the regulations were to be breached this might cause the oil and gas company its contract

leading to heavy losses and might also affect the ecology. This was followed by providing directional drilling operations and clients with the plans for drilling. Finally, supporting the sales process with technical expertise came last, it is important but it is not the main task of the drilling engineer.

Table 11: Average rating of skills of drilling engineers

Skills of drilling engineers	**Rating**
Knowledge on quality, health, safety and environment management systems	8
Knowledge about drilling software	7
Mathematical skills on cementation equations	9
Use logic to solve problems with effective solutions	9.5
Ability to design and plan wells	9.7

From the table above, the highest rated skill needed for drilling engineer was ability to design and plan wells, the engineer should know the basic knowledge about designing wells, they should have information about fracture pressure, pore pressure and cementing. This was followed by using logic to solve problems with effective solutions. The drilling engineer should think fast on the spot, to come up with proper solutions for the problems that they face during the process of drilling, so that would not cost any losses to the company. The next important skill was good mathematical knowledge for the cementation equations, as those are the most important equations used in drilling, because if the cement job was not done properly, this might affect the whole integrity of the well which may lead to well fracture and losing the production later on. Knowledge about QHSE management systems and drilling softwares came last, as they can be taught to the new recruits.

Table 12: Cronbach's Alpha for Skills of Drilling Engineers

Cronbach's Alpha	N of Items
0.811	5

	Corrected Item Total Correlation	Cronbach's Alhpa if Item deleted
Knowledge on QHSE management systems	0.787	0.799
Knowledge on drilling software	0.753	0.807
Mathematical skills on cementation eqns	0.798	0.781
Use logic to come up with effective sol.	0.796	0.767
Design and plan wells	0.789	0.799

Table 14, shows that the values of the Cronbach's Alpha test was 0.811; this is the value of reliability of those results. To get the validity of those results can be obtained by the square root of the reliability which will be 0.9006.

Table 13: Average rating of roles of production engineers

Roles of production engineers	**Rating**
Managing the relation between wells and reservoirs	8.5
Provides technical contribution to Production Optimization Studies with respect to near well-bore, lower and upper completion production	10
Technical contribution in artificial lift and work over programs	7.7
Constructing production and economic stochastic models to handle low certainty environments	6

The highest rated roles of a production engineers were, providing technical contribution to production optimization studies with respect to near well-bore, lower and upper completion production. It was followed by managing the relation between well and reservoirs. Eventually, technical contribution in artificial lift and work over programs was rated at 7.7 and then followed by constructing production and economic stochastic models to handle low certainty environments.

Table 145: Average rating of skills of production engineers

Skills of production engineers	Rating
Ability to work with other departments	7
Knowledge on sand control methods	10
Knowledge on formation damage control	9.6
Knowledge on completions	8.5
Knowledge on hydraulic fracturing	10

From the table above, the highest rated skills needed by a production engineer were knowledge on hydraulic fracturing and sand control methods. For hydraulic fracturing, it is one method the needed for stimulating the well for better production. The engineer should know about the minimum insitu stress, pore pressure and fracture pressure of the formation. For sand control methods, the production engineer should have proper knowledge on how to counter them, as some of the formations might be unconsolidated which means there would be some sand production during the life of the well. This produced can cause damage to the equipments used which will cause extra costs for the company. The engineer should know how to calculate a particle size distribution graph to get to know the sorting coefficient and the uniformity of the sand particles. As soon as those data were calculated the engineer should know which sand control method should be more suitable for that certain sand grains. The next skill was knowledge on formation damage, it was rated at 9.6. The engineer should know how to counter the problems of formation damage that might occur because of completion, inorganic and organic scales and cementing, as those are from the well stimulation methods. This was followed by knowledge on completion it was rated at 8.5, the production engineer should have knowledge on the design of Christmas trees and wellhead, as they are extremely useful for the production. Eventually, the last skill was the ability to work with other departments, it is also important, but it is not possible to hire someone who is just good in the communication without knowing about the other skills.

Table 15: Cronbach's Alpha for Skills of Drilling Engineers

Cronbach's Alpha	N of Items
0.858	5

	Corrected Item Total Correlation	Cronbach's Alhpa if Item deleted
Work with other departments	0.789	0.868
Sand Control Knowledge	0.801	0.836
Formation Damage Control Knowledge	0.803	0.822
Completion Knowledge	0.792	0.834
Hydraulic Fracturing Knowledge	0.806	0.819

Table 16, shows that the values of the Cronbach's Alpha test was 0.858; this is the value of reliability of those results. To get the validity of those results can be obtained by the square root of the reliability which will be 0.9262.

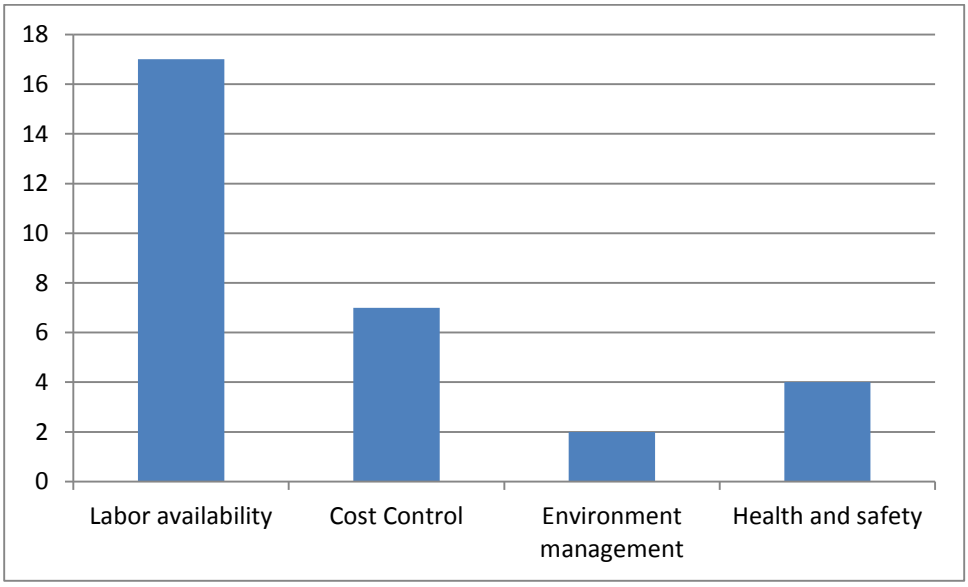

Figure 6: Most pressuring problems facing the company

From the figure above, 17 engineers chose the availability of skilled engineers as the most pressurizing problem facing their companies, while another 7 chose the cost

control, 2 engineers chose environment management while another 4 chose health and safety, as in Malaysia there are more strict regulations for the HSE. It is obvious from the respondents that the shortage in skilled engineers is the main problem facing the companies.

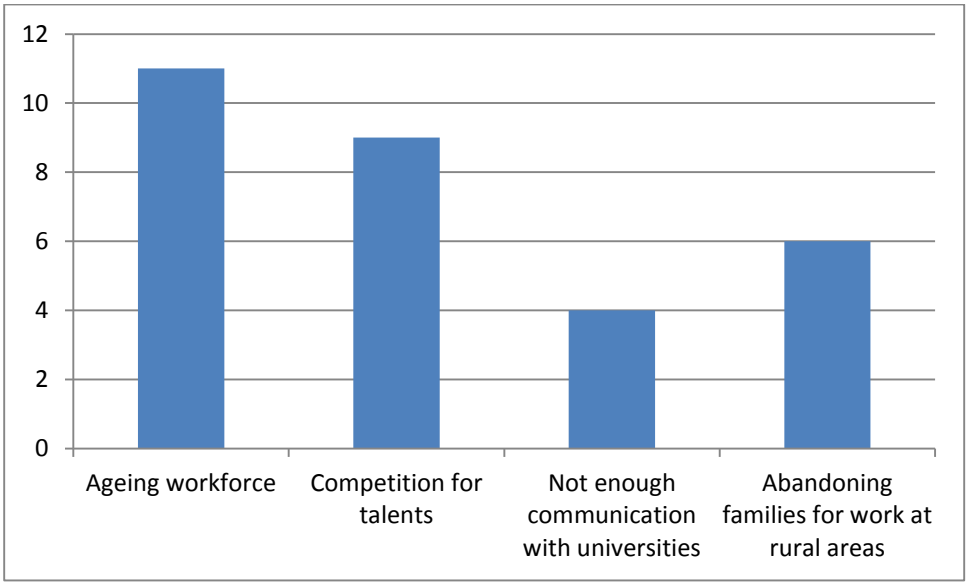

Figure 7: Reasons for shortage of skilled engineers

Figure 7 shows the reasons behind the problem of shortage of skilled engineers, eleven engineers chose the ageing workforce and knowledge transfer as the main problem causing the shortage, as it will not be easy to transfer the knowledge and expertise that was lost with the retirement of those engineers, another nine engineers chose competitions for talents as the demand for energy is increasing, so the companies have to compete together for the petroleum engineers which are not much if compared with other disciplines of engineering, six engineers chose abandoning families for work at rural area, as nowadays a lot of engineers would prefer to stay with their families, instead of going to rural areas even if it is for more salary and finally, four engineers chose that less communication between the companies and the education institutes is a main problem, as this leads to students studying some courses that will not benefit them in their career later on.

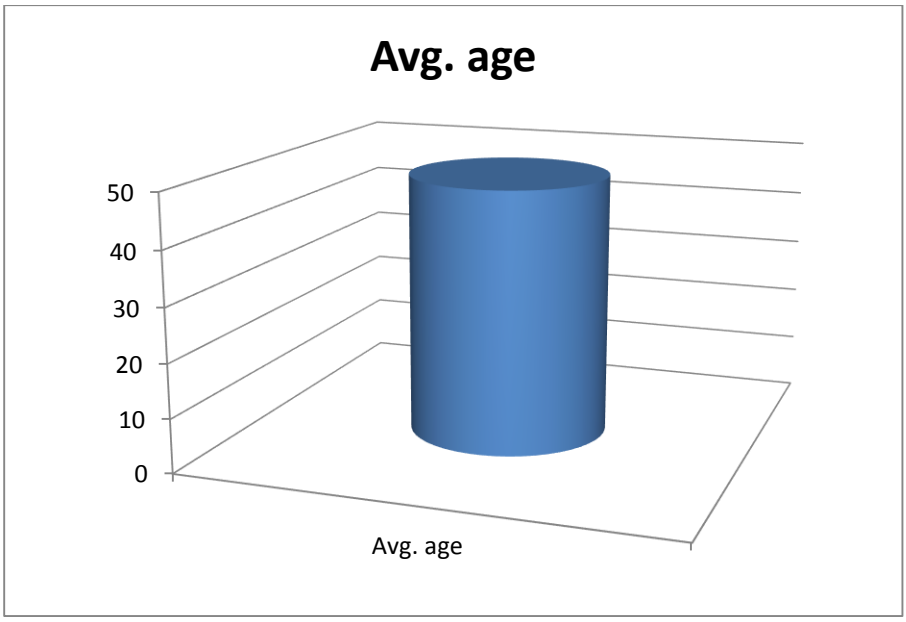

Figure 8: Average Age of Petroleum Engineers

The average age of the petroleum engineers in the oil and gas companies turned out to be 48.6. This is an extremely high average. This result actually proves that companies are having a hard time finding younger and new recruits, which is causing the problem of shortage in skilled workers.

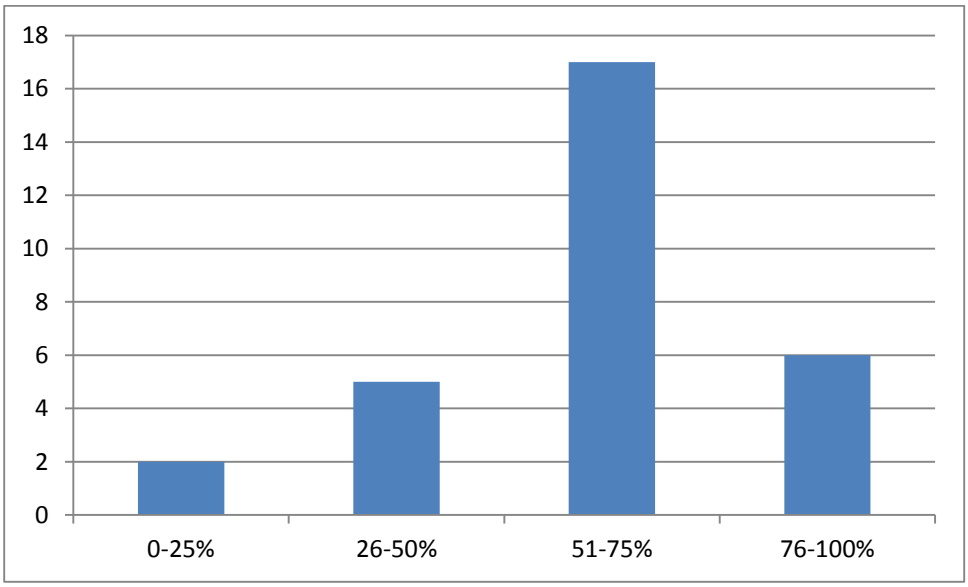

Figure 9: Estimated proportion of recruitment that cannot be completed due to insufficient talent

In figure 9, seventeen engineers chose that the percentage of estimated proportion of recruitment that cannot be completed due to insufficient talent was 51-75%, while six stated that the percentage was 76-100%, five stated that it was 26-5% and finally two said it was between 0-25%. All of this proves that insufficient talent is causing numerous problems for the industry and hindering its growth.

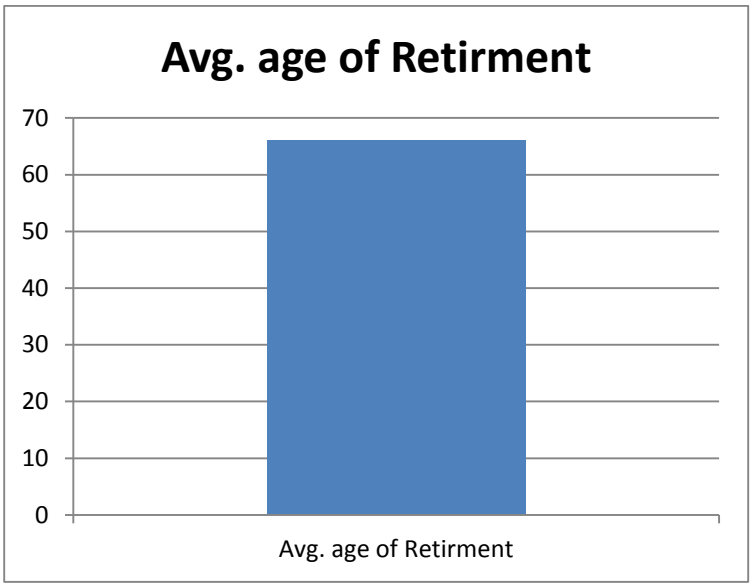

Figure 10: Average age of retirement

The figure above shows that the average age of retirement for the engineers in Egyptian and Malaysian oil and gas companies is 66. This number is high, which indicates that some of the employees are asked to stay with the companies, as their knowledge is needed and it is not easy to replace them with the younger engineers as they do not have the proper experience and skills needed.

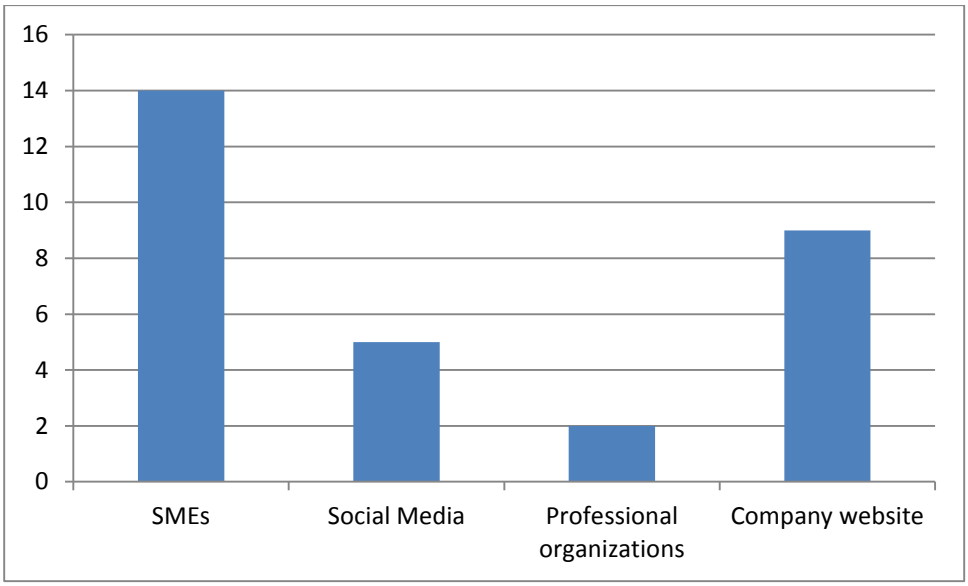

Figure 11: Methods of recruitment by companies

When the engineers were asked about which method is mostly used by their companies for the recruitment, fourteen engineers chose SMEs. The SMEs are people who are well known in the industry. Those SMEs will enhance and develop the methods of selection of recruits and candidates. Nine engineers stated that their companies would rather hire engineers who apply through the company's own website. Five engineers chose social media, as it can help provide a wider pool to choose from, as numerous people use those Medias such as facebook and LinedIn. The companies can use them to improve the awareness of the teenagers. Moreover, it can help the companies keeping the people involved with the industry's' news and job opportunities. Finally, two engineers stated that their companies would use professional organizations that will provide websites that are available all around the world for organizations to have a wider range of talents to select from. Furthermore, the companies can use those websites to advertise for job openings. Examples of those websites are: Society of Petroleum Engineers, International association of drilling engineers and American Association of Drilling Engineers.

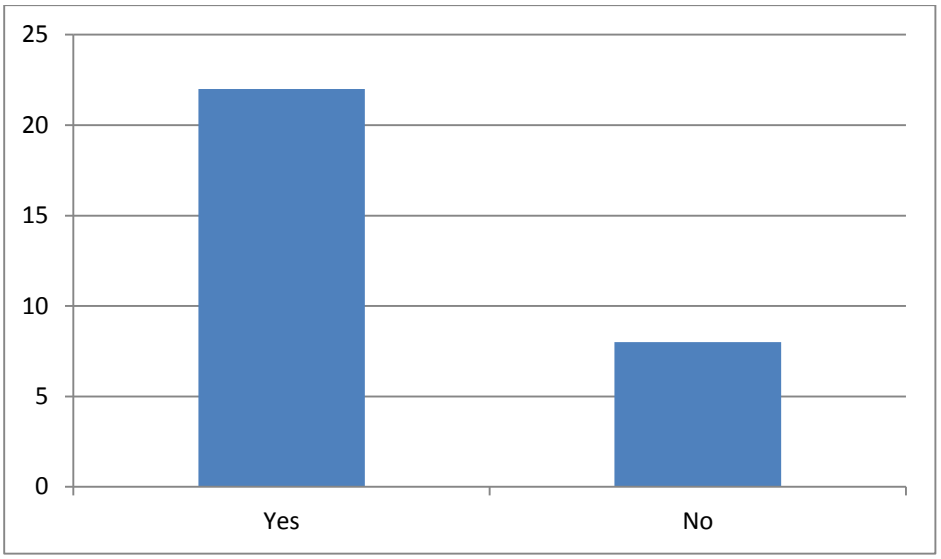

Figure 12: Hiring retirees

When the engineers were asked if their company's do hire back retired engineers, twenty two of the engineers stated that their companies hire back retired engineers, as it is not easy to find engineers with the proper expertise to perform the job. Furthermore, not all the engineers have the required skills for those jobs, so it will be easier for the companies to get back the retired people, who have the proper expertise, knowledge and skills. Eight of the respondents said they would rather get fresh blood into the company, as it is not easy to get those retirees back. Moreover, those retirees' salaries would cost more than fresh graduates or people with average experience.

Table 16: Solutions to solve the problems facing the company

Solutions for the problems facing the company	**Rating**
Develop own talent through training centers	8.4
Poach talents from other companies	4.1
Partnerships with educational institutions	9.3
Provide better work environment	8

Use new ways of recruitment	7.5

The worst solution was poaching employees of other companies as it got a rating of 4.1, this solution can help a company for the current time being, but most of the engineers did not like it, as it does not solve the long term problem. If a company steals an experienced engineer from another competitor, that did not actually solve the problem of less skilled workers in the market. Eventually, this solution will backfire on all the oil and gas companies, because when those employees, retire, it will not be easy to find a replacement, as the companies did not try to solve the root of the problem which is preparing more engineers with enough skills.

The best solution was partnerships with educational institutes as it got a rating of 9.3 by all the engineers that participated in the survey, as by doing those partnerships the industry can actually help the universities modify their structure and curriculum so it would become a proper structure that can help the students and prepare them to face the real problems facing the industry, it will also save time for the companies in training their newly employed engineers, as they would be prepared by the curriculum that the industry and the universities have made.

Table 17: Cronbach Alpha for Solutions the problems facing the industry

Cronbach's Alpha	N of Items
0.799	5

	Corrected Item Total Correlation	Cronbach's Alhpa if Item deleted
Develop own talent through training centers	0.867	0.781
Poach talents from other companies	0.675	0.802
Partnerships with educational institutions	0.873	0.789
Provide better work environment	0.799	0.794
Use new ways of recruitment	0.864	0.785

Table 18, shows that the values of the Cronbach's Alpha test was 0.799; this is the value of reliability of those results. To get the validity of those results can be obtained by the square root of the reliability which will be 0.89387.

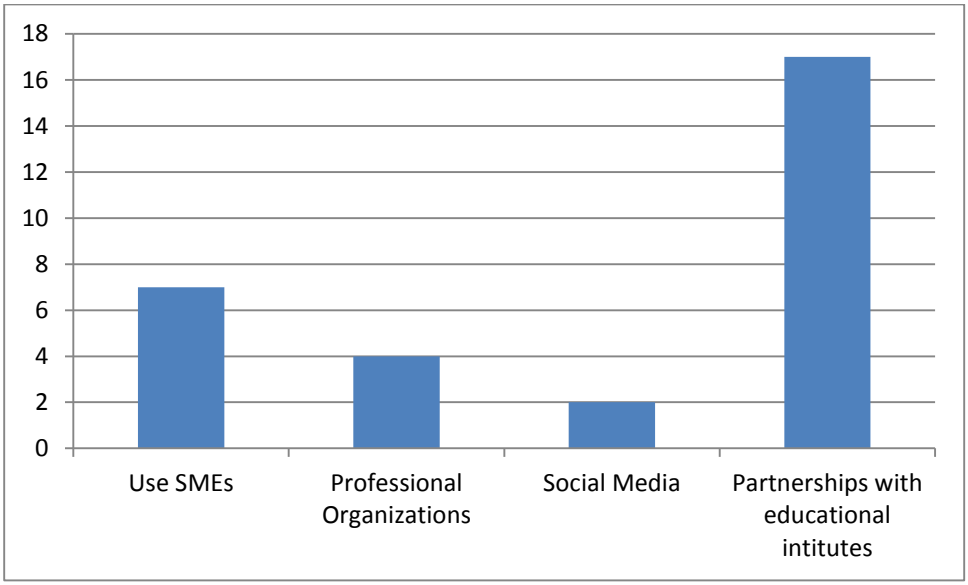

Figure 13: Methods of improving recruitment

Seventeen of the thirty engineers chose the partnerships with educational institutions as the best solution to improving the methods of recruitment. If the companies had partnerships with universities, it would be easier for the companies to actually monitor the students. Not to mention, the universities usually have a big number of students which the companies can come do interviews and choose which student can be suitable for the company. This should be better for the companies, as those students were familiar with the company's software and procedures, they will require less time of training, unlike hiring from social media and professional organizations. Seven of the engineers chose using SMEs, as they have the experience and the knowledge to find the best recruits. Four engineers chose using professional organizations such as SPE to find more skilled engineers. Eventually, the least favorable option seems to be social media, as just two of the respondents chose it to be their source for recruitment and searching skilled workers.

The average of the validity of the results obtained can be calculated by adding all the validities together then dividing them by their number.

Average Validity= (0.8983+0.9006+0.8883+0.9555+0.8983)/5= 0.9082

CHAPTER 5: CONCLUSION AND RECOMENDATIONS

The aim of this study was to try to identify several points regarding the skills and competencies of human resources. The study was conducted by passing a survey to several Egyptian and Malaysian oil and gas companies. The author started with the roles of different disciplines of petroleum engineers in the oil and gas companies and the significance of each role. The different disciplines that were targeted in this project were drilling engineers, reservoir engineers and production engineers

Not to mention, this research tried to identify the skills needed for each discipline of engineers that will help in field development. Moreover, the study identified the main problems facing the industry and which one is the most pressuring one. Those problems were, labor availability, cost control, environment management and health and safety. Furthermore, the study concentrated on the problem of labor availability as it is the main problem facing this industry and hindering its growth. The research managed to figure out the causes of this problem that were, ageing workforce, poaching of engineers from other companies, not enough communication and partnerships between educational institutes and the industry. Eventually, the study managed to come up with solutions for those problems such as, developing own talent, establishing partnerships with educational institutions and use new improved ways of recruitment.

For recommendations of any future projects, the researcher can follow the same survey, but this time try to involve different disciplines of the industry, such as geologists and geophysicists. Not only, can different disciplines be surveyed, but different problems facing the industry can be targeted to find better solutions for them and help the industry grow. Furthermore, the survey can be distributed and used on oil and gas companies that are in countries other than Egypt and Malaysia, so the problems facing the industry in those countries can be studied properly and solved.

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APPENDIX

SURVEY

1. **What is the role of Petroleum Engineers?**

a. Aid in the exploration and searching for reservoirs that contain hydrocarbons
b. Design equipments for the industry
c. Maximize hydrocarbon recovery at minimal cost
d. Analyze subsurface structures

2. **Which set of skills is more important for a recruit?**

a. Soft skills
b. Technical skills

3. **Rate the following soft skills out of 10**

a. Team players
b. Proficient communication skills
c. Enthusiasm about progress
d. Detail oriented and analytically oriented

4. **What are the major classifications of Petroleum Engineers? (Please list down)**

……...

5. **What is the number of each classification of engineers in your company?**

   ……..

6. **Rate the following roles of Reservoir Engineer out of 10**

a. Optimization of oil and gas production by using Enhanced Oil Recovery (EOR) methods
b. Simulating the risks and future predictions of the reservoir
c. Monitoring and interpretation of fluid identification and sampling data acquired by other departments
d. Establish and maintain relationships with the reservoir technical community

7. **Rate the following roles of Drilling Engineers out of 10**

a. Provide directional drilling operations and clients with drilling plans and designs
b. Support delivery and sales process with technical expertise
c. Provide real time decision support to other engineers
d. Ensure that well plans and design comply with HSE regulations

8. **Rate the following roles of Production Engineer out of 10**

a. Managing the relation between wells and reservoirs
b. Provides technical contribution to Production Optimization Studies with respect to near well-bore, lower and upper completion production
c. Technical contribution in artificial lift and work over programs
d. Constructing production and economic stochastic models to handle low certainty environments

9. Rate the following skills of Reservoir engineers out of 10

a. Proficiency in using multiple software modules to perform basic interpretations related to fluid gradient and contact calculations
b. Up scaling geological models for dynamic fluid flow analysis using numerical simulators
c. Enthusiasm in keeping up to date with the newest advances in the reservoir area
d. Use conceptual skills to develop new approaches

10. Rate the following skills of Drilling Engineer out of 10

a. Knowledge on quality, health, safety and environment management systems
b. Knowledge about drilling softwares
c. Use logic to solve problems with effective solutions
d. Mathematical skills on cementation equations
e. Ability to design and plan wells

11. Rate the following skills of Production Engineer out of 10

a. Ability to work with other departments
b. Knowledge on sand control methods
c. Knowledge on completions
d. Knowledge on hydraulic fracturing
e. Knowledge on formation damage control

12. Rate the following negative impacts of hiring unskilled engineers out of 10

a. Failure to meet deadlines
b. Wrong estimations for wells
c. Damage to wells and equipments

d. HSE issues

13. Which of the following is the most pressuring problem facing the company?

a. Labor availability
b. Cost Control
c. Environment management
d. Health and safety

14. What are the reasons behind the problem of shortage of skilled engineers?

a. Ageing workforce and knowledge transfer.
b. Competition for talents and hunting employees due to higher demand.
c. Not enough communication with universities.
d. People do not want to leave their families and go work at rural areas

15. What is the average age of engineers?

……..

16. What is the estimated proportion of recruitment that cannot be completed every year because of insufficient talent?

a. 0-25%
b. 26-50%
c. 51-75%
d. 76-100%

17. What is the average age of retirement?

……

18. How do you recruit the engineers?

a. Skilled subject Matter Experts (SMEs)
b. Social Media such as LinkedIn

c. Professional organizations such as SPE

d. Company website

19. Do you bring back retirees?

a. Yes

b. No

20. Rate the following solutions for the problems facing the company out of 10

a. Develop own talent through training centers

b. Poach talents from other companies

c. Partnerships with educational institutions

d. Provide better work environment

e. Use new ways of recruitment

21. How would you improve recruitment?

a. Use specialized managers for recruitment such as SMEs

b. Use professional organizations that provide websites such as SPE

c. Use of social media

d. Establish partnerships with educational institutions