QATAR UNIVERSITY

COLLEGE OF ENGINEERING

FACTORS OF SUCCESSFUL TECHNOLOGY TRANSFER IN OIL AND GAS INDUSTRY IN QATAR STATE

BY

NASER AL-HAJRI

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COMMITTEE PAGE

The members of the committee approve the thesis of Naser Al-Hajri defended on 04-05-2016.

_____

Khalifa Al-Khalifa
Thesis/Dissertation Supervisor

_____

Dinesh Seth
Committee Member

_____

Farayi Musharavati
Committee Member

_____

Mohamed Haouari
Committee Member

Approved:

_____

Khalifa Al-Khalifa, Dean, College of Engineering

Abstract

Technology transfer is highly regarded in business circles and it is one of the vital business strategies. Any developed country seeks to own a new technology and to be transformed from technology receiver to technology transmitter became one of the few Industrial countries to affect its economy positively. For a Technology that meant to be transferred successfully, several factors should be recognized.

The essential objective of this research work is to provide the factors that can lead to a successful transfer of technology in the oil and gas sector and investigate the situation here in Qatar State by applying a survey.

The result obtained from the survey analysis shows that researcher's role that is considered to one of the most recognized factor for the success of technology transfer has not been utilized in Qatar as it should, also some factors with less Importance scale with high availability such as Administration support compared to other factor that has less availability and higher importance scale just to redirect factors funds based on importance scale and this study must be repeated on a regular base to reflect the current situation regarding the same matter.

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Participants

- Fawas Al-Shammari ; RasGas – Operation Expansion Technical Manager
- Talip Al-Athba ; RasGas Operation Expansion Commissioning Manager
- Meshal Al-Saud ; RasGas Train 3,4, and 5 Asset Manager
- Howaider Al-Hajri; QP – Head of Technical service
- Nyef Al-Nuaimi; QP – Head of Rotating Equipment (offshore Ops.)
- Khalid Al-Hajri ; Tasweeq

Family

This work is dedicated to each one of my family who supported me.

DEDICATION

I dedicate this project to my late Father (May Allah Be Merciful to him), my mother Maria, and my wife Loubna.

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Chapter 1: Introduction

1.1 Introduction

Technology transfer involves the transfer of knowledge to the manufacturing of main commodities between different industries or institutions. The transfer of technology between diverse sectors of an economy can help spur growth as the companies employ the use of the best technology available. The best technology that is available in the market should get distributed to the other sectors to ensure efficiency and transfer of knowledge (Kavousi and Ansari, 2014). Due to globalization technology transfer has gone global. Countries now share technology on the best practices. The more technologically advanced nations have the obligation of ensuring they pass their technological know-how to the less developed world. In that way, technology transfer can help spur growth in all corners of the earth. The main method of technological transfer is the horizontal way (Mabadi, 2007). The method involves the transfer of technology from one area to another. Vertical transfer of technology involves passing of knowledge or technology from the research centers to the departments concerned with development.

Technology transfer encompasses several legal processes due to patents. Those who come up with the technological ideas might not be the ones who commercialize it and, therefore, have to collaborate with others who have the financial muscle to see through the ideas. Without patents, there would be several legal battles with individuals claiming ownership of certain technologies. The best way is for institutions and research centers to come up with the best technologies and help transfer them to the other industries. Most technology transfer offices or research centers work in collaboration with multinationals

and governments. Big multinational companies pay huge amounts of money for the technologies available so that they can gain a competitive advantage over competitors (Wayne State University, 2007). That is because companies try to look for a competitive advantage over their rivals, and any new technology that can give them the advantage over their rivals usually gets snatched at the earliest time possible. In the case where those who have the technology are startups, the fees for the technology in most cases gets waived in favor of a stake in the new company. As the company grows, those who had the technology benefit due to the shares they hold. The transfer process involves many disciplines such as engineers, economists, scientists, markets, and lawyers. That explains the complexity of the matter.

The changing face of technological development and the emergence of a few specialized individual who have the necessary skills mean that there is a necessity for technology transfer in the industry today. No single company can claim to have a monopoly of the technology available in the market. That means they have to share the technology they have. Researchers also understand that they need to pass the technology that they make to others who can further develop it into new forms. The diffusion and transfer of knowledge are useful in the modern economies that have several new ways of doing things. Most of the new technologies emerge in the developed countries that have the ability to pay the researchers the required amounts in order for them to conduct research. The changes in the information technology and the reducing costs of processing and production of goods have transformed the economic and social activities across the world.

The knowledge of technology transfer is a difficult and complex process when it happens across different sections and departments in the same industry. The challenges of technology transfer happen when it happens across various companies or continents. Technology in most instances flows from the technologically advanced nations to the developing countries. Most of the developing countries cannot fund the research needed in the development of new technologies. They have to rely on companies from developed countries for technology. Technology transfer has taken the form of a global strategy that crosses borders and become truly global.

1.2 Statement of Problem

As Qatar is having a huge economical and industrial growth in the last 15 years, many projects are now running in Qatar especially in the oil and gas industries which means that many new technologies are entering the country. Therefore the leadership in Qatar is looking forward to localize these new technologies and own it to be transformed from a country that receives the technology to one that transmits it.

The objective of that is to create a large amount of job opportunities, investment attraction, community development, economic growth, and resources sustainability, therefore the government and several national companies top managements are making a lot of efforts to get these technologies to be transferred successfully in to Qatar.

Despite these efforts that was been made, many technologies have not been transferred successfully even when they entered the country long time ago. Some companies were able to own the facility but could not own the technology and they became just operators

not creators since the technology didn't transferred, and all these efforts that didn’t achieve their goal are considered wasted resources.

In response to this problem, our study proposes is to identify the factors that should be available to ensure that any new technology in the oil and gas industry in Qatar will be transferred successfully, and to get the most of that study; all these factors will be analyzed and applied to a survey that will be distributes to several employees who are working with leading companies in oil and gas industry in Qatar to get the result and made recommendations.

1.3 The Objectives of The Research and The Research Questions

Although a large amount of empirical research has been devoted to the problems of development in general, there are very few specific empirical investigations with regard to technological transfer, which is at the core of the development problem. The present research is aimed at identifying those technology factors that significantly affect the rate of successful technological integration. For this purpose, appropriate statistical methods are used to analyses a set of specific data.

It was awareness that the effectiveness of technology transfer is highly influenced by many factors among them, the top management support, training capability and social conditions of the recipient countries. It is therefore intended to explore these conditions and to gain a quantitative insight as well as more empirical knowledge by using the statistical data. Examples of techniques which have been used in this study are multiple regression analysis, stepwise regression.

A questioner based on the successful factors of technology transfer is been distributed to many employees who are working in several companies in the oil and gas industries in Qatar and the result will be collected and analyzed, the result will be demonstrated with list of recommendations.

So what are these factors? How can they contribute to any new technology to be transferred? How can these factors are utilized to make the technology transferred successfully, which factors are suite more in Qatar case, and which factor we have to focus more?

1.4 Research Structure

This research will be consisting of three parts. The first part of this research, we will look at technology transfer in general; Overview and Description will be presented; looking at the various models of technology transfer, modes of technology transfer and the process of technology transfer will also be looked at in this part, after that the Planning and Implementation of the Technology Transfer process will be demonstrated.

The second part will look at technology transfer in the oil and gas sector and list some factors that can help in technology transfer clearly defining the concept of technology transfer with a bias in the oil and gas industry, All the issues regarding the transfer of technology in the sector will be covered in detail in this discussion as it is an important part in the growth of the important sector in the economy of the world..

The third part will be about the Oil & Gas industry in Qatar and based on the list of successful factors that affecting the technology transfer a questioner will be made and

applied in several companies in the oil and gas industry in Qatar to come out with list of recommendations for the technology transfer in Qatar in the Oil & gas industries.

Chapter 2: Factors of Successful Technology Transfer in Oil and Gas Industry in Qatar

2.1 Technology Transfer in General

2.1.1 Overview and Description of Technology Transfer

The interest in technology transfer began around six decades ago. That was mainly during the colonial period where the colonizers moved technology from their countries to help in production in the territories they conquered. The primary sectors they transferred the technology was in mining, agriculture, and plantation. After independence, many countries had to rely on their colonial masters to supply them with the technology they required for import substitutions (Ramanathan, 2007). At that time, many multinational companies and other non-profit making organizations got actively involved in the transfer of technology. They did that in order to improve the living conditions of the population in those countries. In later years, the transfer of technology through foreign direct investments became controversial and faced resistance due to the mode of operations of the companies and their conduct in general. Most of them faced discrimination and got accused of enhancing a Western agenda. Many thought that their activities represented a modern form of colonization. Recently there are several measures put in place and several changes introduced to help in the realization of the best technology transfer modes. The collapse of the Soviet Union and the emergence of other economies such as China and India have ensured that the technology transfer in modern times continues at an unprecedented scale.

Technology dominates the modern society meaning there is a large amount of knowledge available. That is why it is called the society of the intellectual value and knowledge. Instead of the knowledge visible the modern times community looks for the amount of invisible knowledge found in the brain. More attention usually given to the impact the technology available can have an impact on the economy of a particular country. The Intellectual property dominates most debates and is a subject of several court cases. Demand for intellectual property is more than the supply available because the world today requires several technologies to drive the current technological wave. The transfer of technology requires strategic management in order to ensure it achieves the desired purpose and use in the business environment or the company. Creation of technological transfer opportunities through sharing of the available knowledge and information in a good way is vital for development. Due to that, some corporations have specialized in the sale or the supply of the required technology in a certain business field or environment. The form of technology transfer between the supplier and the buyer often involves wide consultations and good teamwork. That is to ensure the technology supplied meets the needs of the organization it gets supplied. There are several participants in the technology transfer business; all the participants need to work in unison in order to ensure successful transfer of technology.

Global technology transfer has undergone profound changes due to the emergence of new world economies such as China, Brazil, and India. The innovations found in those countries means there are opportunities available for sharing of knowledge among them. There are several patents in the last two decades that come from the emerging world economies. The economies collaborate with each other and engage in some research

projects together. The driving force for the sharing of knowledge is to reduce the dominance of western companies on the global stage. The improved bilateral relationship between the emerging economies calls for the sharing of available technology (Mabadi, 2007). In most instances, the technology transfer happens between the firms from the concerned countries who share the intellectual property without the need for government intervention. A good and healthy relationship between the countries ensures that the companies feel comfortable while dealing with each other.

A good business and inter-country relationship play an important role in the transfer of technology. In some instance, the countries or firms conduct and fund joint research projects in areas of interest. Such interactions between researchers from various countries and firms mean an enhanced transfer of technology. That is what has in the last few years changed the economic situation of the countries. The increased technological transfer has created the increased technological growth in the countries. Cooperation between entities sharing technology is vital especially when they get involved in conducting joint research operations. Without a good will and creation of a transparent atmosphere, even the researchers involved will not feel free and comfortable enough in their research activities and that can hinder technological development and transfer.

The technology transfer highly regarded in business circles and is one of the vital business strategies in today's fast changing and dynamic world. The high complex products produced in the world today require technology transfer among the countries and the companies. That gets done in order to improve the quality of the product or the service delivered to the client, meet the requirements of the customer and save time.

Many organizations due to poor planning cannot accomplish the technological transfer in the right way. Such companies lack an assessment and predictive team that can help determine the direction the world of technology is going. Companies that predict the market accurately and prepare adequately can take advantage of the market and the situation. The strategies the company adopts can change overtime as the constant changes in the technological field dictate. Companies in the developed world are the main suppliers of technology in the world today although those in emerging economies have done considerably well to introduce new technologies. The hindrance to technological development is the lack of research funding. Many that have not invested adequately in the technology sector have to rely on others in the sector to develop, and then they purchase it from them.

A complete technology transfer happens when it moves from the developer after a successful negotiation with the buyer who then assimilates it into their system. When the buyer of the technology does not use it in their organization, it cannot be said it is technological transfer. In order to ensure that the transfer process is complete, the technology bought has to be the one that suits a company's purpose and needs. When there is a mismatch between the two, the transfer process is deemed inadequate or incomplete. The technology transfer is effective when the companies involved have good internal and external structures. The internal factors related to the presence of the necessary infrastructure, adequate planning and the goodwill of the company towards the adoption of new technologies. The external factors related to the ability of the technology investors and the company to observe the technology needs and adequately place the required technology in the organization (Wayne State University, 2007).

An efficient and successful transfer of technology requires a codified strategy and the creation of a transfer mechanism. A technology fully and successfully transferred when the crystallization, adaptation and transfer conditions are fully satisfied. A country can be said to be successful in technology transfer when conditions for internal transfer are fully satisfied, and the transferee can then assimilate and reproduce the technology given to them. A country or a company needs some solutions before they can say that the transfer process of technology is complete. When the solutions available do not meet the necessary requirements of the company, there is a need for companies to ensure that they invest in the technologies that help them. Investing in the wrong technologies means a waste of resources that could have helped to improve other sectors of the organization.

2.1.2 Definitions of Technology Transfer

Although technology transfer is not a relatively new business model, there is no consensus on the definition, which is due the complexity of the technology transfer process. Technology transfer definitions depend on the user and the way they define technology. Technology transfer in most instances has the definition as the technological movement from one company or entity to another one. The transfer is said to be complete when the receiving entity obtains it and can then use it and assimilate it in their operations. The technological movement may involve the transfer of physical assets and certain capabilities. Technology transfers also refer to information or knowledge from the laboratory to the industry or from one application to another domain in a different industry. It may also get termed as the transfer of personnel or information. Others argue

that it is the transfer of knowledge, values, organization and capital from the generation site to the place of adaptation or application.

From those definitions, it is clear that technology transfer involves several aspects and the definition one adopts depends on the way they want to use the technology. In the oil and gas sector, technology transfer could involve the exchange of drilling technologies or refining technologies that can help maximize the productivity in the company. The new technologies also help in the increase in the revenue collection obtained from the sale of the oil. The more technologically advanced countries help the developing countries with new technologies that can help them maximize production. The definitions adopted in the various countries depend on the way the transfer takes place. Some countries require personnel transfer while others require equipment supply. As time goes, the definitions will continue to evolve to include several other factors not included in the definitions today.

2.1.3 Modes of Technology Transfer

In most cases, the initial transfer of technology involves the learners competing to develop the best technologies depending on the market demand. They initially compete based on the low wages, governments support, and the adaptation of the existing technologies. The recipients of the technology have to ensure that they receive from the developers adequately used in order to realize the benefits intended by the researchers. In most cases, the users of the technology work backward to reach the required level by the researchers.

The technology building concept has two main wings. The first wing involves the research, development, production and distribution stages done by the distributor of the technology. The other wing is the exnovation wing that involves the users of the technology. The two wings help in the transfer of technology between different parties. Transfer of technology takes place in different stages depending on the receiver and the person transferring the technology. The term innovation used in that context may confuse many people because of the various definitions it has in different areas. In technology transfer in most instances, it is referred as technology generation while those who receive it get referred as the transferee or the assimilators. Those term help in avoiding confusion caused by the use of terms such as innovations (Choi, 2007).

In some instances, the transfer of technology occurs in several different stages. If multinationals transfer knowledge to their subsidiaries overseas that cannot get referred as technology transfer. Commercial transfer of technology is the mutually agreed or the intentional, proactive process by which the transferor of the technology gives it to another entity that requires the technology. The parties discuss the costs and expenditure involved in the transfer. When the receiver of the technology adequately assimilates the technology transferred to them, then the technology transfer is termed to be complete.

The transfer of technology can either be vertical or horizontal. The vertical transfer involves the transfer of knowledge from basic research to the areas where the research gets applied. A horizontal transfer involves the movement or the use of the technology in one place. In today's globalized world, most technology transfer models get deployed depending on the chains of development adopted by the transfer and the transferee. The

transfer can begin initially from a simple level and develop a more complex model with time. The mode chosen for the transfer depends on different management strategies used by the transferor and the transferees. The level of technology between the two parties also impacts how the technology transfer takes place between the two parties. Some companies utilize higher levels of technology and engaging in transfer of technology with others using outdated technology (Kavousi and Ansari, 2014).

2.1.4 Planning and Implementation of The technology Transfer Process

The cycle of the planning and implementation of the technology transfer process follows a stage gate approach that was developed by Jagoda and Ramanathan. In their approach, they had a holistic view of the technology transfer from its inception to the conclusion. They developed six stages and gates that the transfer process has to undergo in order for one to say that the technology has gone full cycle.

First stage: this involves the spotting of the opportunities and the technologies that enhance value in this stage the developers evaluate the market and direct the same towards the customer expectations, preferences. They also have to check the government regulations and preferences of the competitors. They should also conduct an assessment of the resources required for the successful creation and adoption of the technology. The first stage involves a company identifying the unique technologies. They can develop and which can give them a competitive advantage over other companies.

Gate 1: the first gate involves the confirmation of the identified technologies the top management in an organization has to set the criteria to meet while reviewing the proposal. The possible financial returns the project might have get assessed at this stage

in the financial calculations such as the payback period. The evaluation also targets identifying the set of tools required for the project.

Stage 2: the stage involves a focused search of technology. It is the most important stage in the cycle as it is where a strong case for the transfer of technology is built. In this stage, there is a consideration of the strategic fitness of the technology, technological leadership and the attractiveness of the market. It is necessary to embark on a thorough business study and plan adequately for the project. There is also a need for the establishment of clear technology specifications in this stage.

Gate 2: the second gate is vital in that it is the final gate before the negotiations start. It can lead to the death of the project if not well handled. It examines the first gate and critically examines the second stage and critically stage used in the first gate. All the suggestions concerning the choice technology needed and the capabilities needed. The technology is assessed rigorously based on the strategic politics and socials factors.

Stage 3: the stage is the negotiation stage all the shortlisted suppliers are called at this stage the critical issue in the transfer process is the value of the technology that is being transferred. The price of the technology depends on the negotiation powers of both the parties. There is a need for both the parties to preserve their financial benefits. In order to ensure effective negotiation, both parties should maintain close contact and communication channels. At this stage, all the parties have to discuss the benefits that each party will get from the project.

Gate 3: the third gate involves the operationalization of the agreement. It gets operationalized once the negotiations have reached satisfactory levels for all the parties

involved. It involves the comprehensive and detailed transfer agreements. There is also a need for the protection of intellectual property and other arrangements. There is also the need for the appropriateness of the mechanisms chosen for the technology transfer. The gate also calls for the suitability and the affordability in the payment procedures. The methods and procedure chosen should be comfortable to the transferor and the transferee.

Stage 4: The stage involves preparation of the technology transfer project implementation plan. Creation of a sound and functioning organizational structure is key to the implementation of technology transfer the stage focuses on the adoption of strategies that will make it easy for the organization to receive the technology. An organization should at this stage identify the organizational changes they need to undertake to receive the technology. They should also know how to change the knowledge management to suit the new technology. There should also be a good personnel relationship between the transferor crew and the workers in the organization.

Gate 4: The fourth gate involves the approval of the implementation plan adopted. The gate scrutinizes a number of key factors such as the; adequacy of the methods of training, adequacy of the infrastructure implementation, measure for the protection of intellectual property. The duration critical activities will take and the schedules of payment. If the management deems all those factors satisfactory, then the go-ahead is given for the implementation of the plan. If the agreement is not satisfactory, then there is a need for a review of the process.

Stage 5: The implementation of the technology transfer involves good project management. A change of the process or product technology may be essential for the

implementation of a transfer process. At this stage, a company should look for the individuals who can help in the implementation of the process and have to maintain corporation with the transferor of the technology. At this stage, there is the need to identify the product changes required to suit the local conditions. They should also select the personnel required for the successful implementation. The management has to keep track with the government regulations and the policy changes.

Gate 5: In this stage the scheduled goals and activities get evaluated the barriers that can prevent successful implementation should get evaluated at this gate. That audit may focus on evaluating project implementation with respect to factors such as experienced conflicts, the commitment displayed, incurred costs, the extent of skill and learning upgrading and the effectiveness of communication. The audit should outline the lessons learned and identifying critical success and failure factors. That can help solve problems in the future projects learn from the experiences of those that took place before.

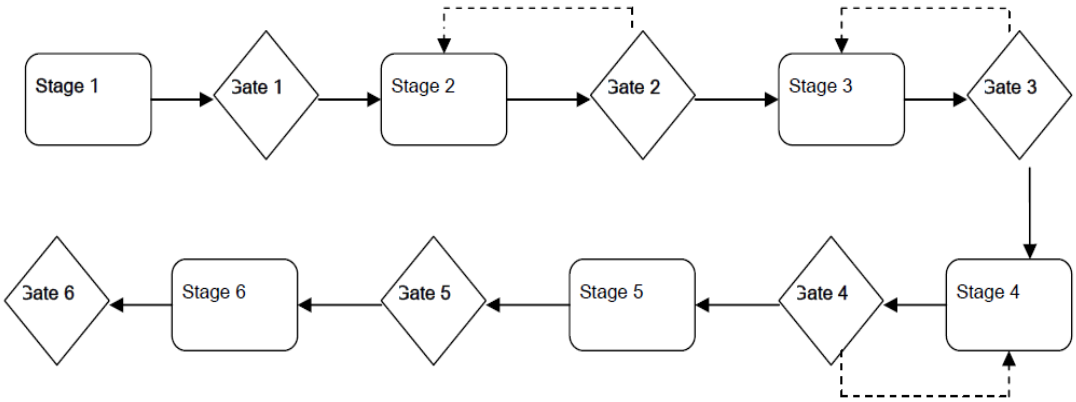
Stage 6: the sixth stage is the technology transfer impact assessment. The assessment of the impact of technology transfer is complex because of the extended life of a project. There are multiple outcomes that can come out during the life of a project. It is also hard to measure the intangible impacts of a project. It is vital for organizations to create a good structure that can help determine the suitability and impact of a project an organization should develop a balanced scorecard to help in the assessment of impacts. They also need to identify the variations between the expected and the actual outcomes also they need to identify the new technologies that can help improve on the gains already made.

Gate 6: the stage involves the formulation of the guidelines for the post-transfer period. There are important decisions that the management should make at this stage of the process. A decision on whether to continue using the same technology or to go to another technology transfer project is necessary in this gate. Guidelines may be formulated based on the previous gains made when using another technology the guidelines can also help the company when they may need to look for new technologies to transfer in the future.

The success of the technology transfer process depends on the effectiveness and the commitment of the management to the transfer of technology. The management has to have a full commitment towards carrying out all the stages and gates. Without a good management and the will to carry out all the transfer processes and procedures, the transfer process will fail to achieve the desired results. Following the processes keenly helps to realize the benefits of the technology transfer procedure. The technology adoption and transfer should have a basis on priorities and not just any criteria. Though it is good to follow all the stages of the process, not all the projects have to follow them some smaller projects that do not have many risks can skip some of the steps without risking failure.

The success of the approach used depends on the seriousness and the skills possessed by the managers involved in the transfer process (Asghari & Rakshanikia, 2002). Though the process may seem like it is bureaucratic, it is not and following all the procedures is good for any organization. Any organization that follows the due process increases the chance to achieve success. Following a particular model steps may not necessarily lead to success but that should not discourage any organization from following the procedure.

The success of the model chosen depends on the commitment of the organization to follow the required procedures. The suitability of the model to the requirement of the company may also affect the success of the chosen model below is a discussion of the technology transfer process in the oil and gas sector.



Stage 1: Identifying CVD enhancing technologies
Stage 2: Focused technology search
Stage 3: Negotiation
Stage 4: Preparing a TT project implementation plan
Stage 5: Implementing technology transfer
Stage 6: Technology transfer impact assessment

Gate 1: Confirming identified technologies
Gate 2: Technology and supplier selection
Gate 3: Finalising and approving the TT agreement
Gate 4: Approving the implementation plan
Gate 5: Implementation audit
Gate 6: Developing guidelines for a new project

Figure 1 The Planning and Implementation of The Technology Transfer Process (Dr. K. Ramanathan, 2007)

2.2 Technological Transfer in Oil and Gas Industry

The oil industry is one of the most effective and biggest industries in the world. The importance of the oil sector cannot get underestimated. The sector plays an important role in the world and will continue to do so for several years to come. Oil industries impact in oil producing countries is immense and gets distinguished from two aspects. The first aspect is the risk of the countries depleting all their oil resources going into the future. The second aspect is the role of oil related technologies and the role they can play in increasing the revenue collected. Most oil-producing countries especially those in the developing world rely on technology transfer to realize their potential for maximum production of oil in their economies. The exploration and extraction of oil resources in most developing countries get done by multinationals from developed countries that have the required personnel and technology (Kavousi and Ansari, 2014).

Most countries depend on technology transfer from big corporations and other foreign technology suppliers. In recent times, technology transfer has become a recurrent theme in many international meetings on world economies. It is important for countries to adopt the concept of technology transfer especially in the oil and gas sector. That is in order to bridge the gap between the revenues collected by the technology suppliers and the technology buyers. In most instances, the developed countries pay more attention towards the development of new technologies to improve the efficiency in their oil exploration and extraction. The developing countries do not pay much attention towards the development of technologies and have to rely on technology transfer from the developed countries. The only way such countries can maximize their revenue potential is by

investing adequately on the development of technologies rather than simply rely on purchasing.

In the oil industry, the modes the technology transfer is vital in ensuring an increase in production in the industry. The users of the technologies try to achieve the best efficiency using the technologies available. Many countries try to use the best methods that enable them to control all the phases of the development process. Without a mastery of the related technologies, it is hard for many countries to realize their full exploration targets. The countries have to ensure that the exploration targets and the rates of production are consistent with the national interests. In cases where the oils and gas resources in a country do not attract the attention of the multinational companies, the countries should employ the use of available technologies domestically to exploit the resources. Such instances occur when the oil and gas resources in a particular country are not large enough to attract the interest of multinational companies. Additionally, they are large enough to be utilized by the country domestically (Kavousi and Ansari, 2014).

The technologies used in the oil and gas sector come from various sources. In the mid-1980s, many companies involved in the oil sector abandoned their research activities citing reduced profitability in the sector. Several service companies and organizations took the initiative and started conducting research with an intention of selling the technologies to the multinationals or the governments. With time, the companies had developed various technologies that they transferred to different parts of the world. Innovations in technology mean transfer methods continue to change in the face of changing technologies available.

In most cases, there are usually divergent interests in technology transfer between the oil producing countries and the multinational companies that provide the technology. The relationship between the two entities determines the level of technological transfer. It is vital for all the petroleum producing countries to understand the necessity of technology transfer. Sometimes, companies fear transferring technology to others creating a shortage in the market. They do that in order to exploit the market loopholes fully and increase the price of the technology they have (Mabadi, 2007).

Technology transfer in the oil and gas sector is beneficial to the companies as it leads to the adoption of new drilling technologies. To the national government, the adoption of new technologies helps in the conservation of natural resources because it increases the output levels. The increased output level helps the economies because of the increased revenues accrued. The level of technological advance and transfer in the oil and gas industries affects operations of various organizations who feel that the technologies can also help them. The oil and gas sector is multi-faceted and needs coordination on many levels to ensure efficient technology transfer.

Technology transfer in the oil and gas sector has to see the need for technology transfer clearly in order for them to accrue the benefits of having a clear strategy for the adoption of technologies. There is no need for any organizations do not have the adoption of the best available technologies at heart as no country can claim to have other needs apart from the best technology in the market. In order to accrue the benefits of technology transfer, oil companies have to follow the technology transfer procedures discussed earlier. New technologies can help in the efficiency in the transfer process between the entities involved in the process.

There are several models for the transfer of technology in the market today. The managements of the oil and gas companies have to make sure that they adopt the model best suited for their company. The chosen model has to ensure maximum returns for the company. All companies need to look at the technology transfer models that work best for the companies in their sector. The oil and gas sector is no exception, and a company's management has to ensure they follow the necessary procedures and recommendation in that particular model in order to guarantee the success of the process. Many of the oil multinationals that have enjoyed tremendous success in the technology transfer process have adopted and followed the procedures necessary for the transfer of technology. At every level in the technology transfer process, there is a need for the creation of the necessary tools needed for the success of the technology transfer.

Technological improvements tend to follow or alternate between short periods of success and longer periods of use of technologies from before. In most of the times, the new technologies introduced in the gas and oil sector build on the previous technologies but improve certain aspects of it. That is an improvement in either the exploration or the extraction method. New technologies on the exploration have helped in the discovery of huge gas and oil deposits in several countries. Previous technologies would not have led to such discoveries as they do not have the accuracy of the new methods. Managing the timing and the adoption of technologies can be helpful to a firm that is looking for efficiency and effectiveness.

Managers have to create the plan for the adoption of the technologies, utilizing the opportunities and exploiting the periods of the regular use of technologies. The planning can help when the companies are looking to adopt new technologies and take advantage

in case other technologies in the sector come up the technology transfer. Technological advances in the oil and gas sector increases the uncertainty and complexity making the end users depended on few specialized technology providers. The complexities also build barriers for new potential buyers of the technologies in cases where there is no adequate knowledge of the potential barriers to the diffusion of technology. The few specialized providers work in unison in order to ensure that the technologies they develop go to the companies they want limiting the spread and transfer of technology across the world. Research and transfer of technology in the oil and gas industry should receive constant scrutiny to avoid some few individuals using their position to manipulate the system to their advantage.

2.2.1 Concept of Technology and Technology Transfer in the Oil and Gas Industry

2.2.1.1 Concept of Technology in General

There are various definitions of technology emanating from different sources. Definition of technology consists of more technological innovations in products and production. Most of those get protected by patents. In this context, we try to define it without regard to whether they have patents or not. The definition includes all the definitions whether they have the patented or not. The technology defined as the systematic manufacturing knowledge for producing various products whether goods or services. It usually does not extend to the transactions that merely involve the production of goods and services. It usually does not involve products or services that get finished. Technology can get divided into two sides; the first one involves the knowledge that leads to the production of the end product. The other one is the capacity and level of organization in a company.

The organization levels help in the utilization of the technology available for the production of end products using the technology available (Mabadi, 2007).

Therefore, technology includes the knowledge necessary to improve an existing production method or to continue with the method available. It can, in some instances, lead to the development of new products or services. They are the knowledge's that can get used in the production of goods and services some people divide technology in two ways. The two are either the tangible or intangible technologies. The tangible technology involves the physical embodiment of the technology available or presented in tools, machinery, and equipment. Intangible technology refers to the skills and knowledge's that help an individual to repair and create modifications of physically imported assets. Critics of the mentioned methods of technology transfer argue that the introduction of equipment cannot help in the definition of technology as they can get termed as having been produced using a related technology.

The transfer of technology involves the process of transferring of certain specific knowledge for product manufacture, process applications or the purpose of rendering services. The mere sale and buying of goods cannot get included as a transfer of technology. The transfer of technology gets assimilated. In some areas such as the European community, the technology transfer exemptions mean the transfer of knowledge from the more developed countries to the industrially poor countries in the developing world. Most of the times, the transfer involves the transfer of finances into the countries. They do that in order to enable the countries acquire techniques in the field of

product and good production. They also help the countries acquire certain technologies they can use to explore oil and gas in their countries.

Many countries in the developing cannot afford the technologies for exploring and extracting the oil and gas resources in their countries because they do not have the technological know how to exploit them fully. The developed nations have the capacity but limit the transfer of knowledge to other countries because of the significance of the oil and gas resource to their economies. Countries that dominate in the exploration of the oil and gas sector determine the direction they take. In order to ensure equity in the sector, there should be a more technological transfer between the developed and the developing countries. The realization of such a scenario is rare because of the need to control the political and economic interests of their country. Countries that have the better exploration techniques can use the knowledge to gain more oil finds placing them at an economic advantage over their competitors.

The transfer of technology to enables others to do certain tasks that do not interest them. In the oil and gas sector, the transfer of technology should refer to giving the countries the ability to explore and use their oil resources for the betterment of their economies. For a long time, their development is hampered by the multinational companies who refuse to transfer the know-how or the technology they can use to maximize the productivity in their systems. The countries also have their problems in that their governments do not have the goodwill to allow the development of such capacities and technologies. Therefore, in the oil sector the transfer of technology should mean the ability to purchase the technological know-how and the necessary equipment to enable them maximize the

productivity of oil and gas. The efforts in the transfer of technology should gear towards ensuring that they give the countries the required personnel and manpower to enable them know how to use modern, sophisticated equipment's used in the oil sector. The reason for the above analysis is because the most technological flow happens among the more technologically advanced nations to the developing countries.

The primary objective for any country, when developing and making an agreement in the gas and oil sector, is to explore the natural resources available in their countries. In order to do that, they have to devise strategies that use the available resources to purchase technology and equipment necessary for the exploration purposes. Without the transfer of technologies, many developed countries and their multinationals will continue to exploit the developing ones. There are numerous aspects that can help in the enhancement of transfer of technologies. Those include factors such as education, management capabilities among others. The factors that can help in the successful transfer of technology in the oil and gas sector discussed in detail below.

2.2.1.2 The Concept of Technology in the Oil and Gas Sector

In the oil and gas sector, the most technologies have engineering and a scientific base. They involve geological, seismic, computer software services, reservoir engineering, and the various installations used in refining of the petroleum products. All the processes in the sector require careful and coordinated technological approach. Without a coordinated effort to adopt the technologies available, several countries do not have the technological know-how to use the technologies. It is not easy for such countries to exploit their

resources fully. Scholars have identified four categories of technology that any petroleum producing country needs.

The first one is the managerial capabilities that can help in the organization and the coordination of development and exploration programs. The second one is the adoption of technological expertise that can help in the decision, making at certain critical stages of the exploration process. That involves the ability to analyze and assess results of geological and geophysical surveys. Third is the knowledge, and technological capabilities of the oilfield equipment and services needed together with the practices and policies needed for their production. The final one is the skill in oilfield tool maintenance and servicing (Ramanathan, 2007)

In some others view, technology is the process that includes design, organization and management methods, as well as plant and equipment. The three elements they consider as essential in the transfer of technology include; the technical know-how and skill, scientific principles and the underlying technological knowledge, data, engineering designs, manuals, and calculating methods. Alongside those, there are services, skilled personnel, equipment and manpower required to facilitate the management and operational aspects necessary in the industry

Due to the increase in specialization in the oil and gas sector, some companies have monopolized some of the skills used in the production of petroleum and its products. Many companies with some specialized knowledge refuse to transfer the technology for selfish reasons. They usually want to manipulate the system and capitalize on their

knowledge about the field to gain maximum profits. Such companies specialize in the consultancy services, integrated engineering, and oil equipment manufacturing.

2.3 Factors Affect the Technology Transfer in Oil and Gas Industry

Based on previous researches and resources used here, the number of factors that affect any technology to be successfully transferred are many, one of the factors that could affect the technology transfer is the level of education of the receivers, also the environment and local culture of the community that receive the technology is another factor, the plan that been made for a particular technology to be transferred is another factor.

Also the administration support and organization role in any company and how the staff are been identified are also considered as factors for a technology to be transferred successfully, level of accepting risks is another factor.

Research's and researcher's role are one of the most important factors of technology transfer, also the relation between the sender and the receiver is another factor which can be broken in to the Attitude and communication between them and their motivations.

2.3.1 A Strong Administrative Support

The administration of an organization should recognize and support technology transfer. They should commit themselves to finding the best talent in the market that can match the administration objectives and ensure that they understand the goals set in terms of the research they conduct. The administrations of oil companies should support committing resources to research and adequately staff the new programs. The top level managers can show their support to the continuation and transfer of technology through the speeches

they make. The mission statement should also show the support for the transfer of technology in the organization. Oil and gas companies usually many employees at different capacities from the top level management to the bottom level employees. The administrators have the obligation of ensuring that each employee commits their efforts towards ensuring there is clear and precise technology transfer (Asghari and Rakshanika, 2002).

The management in any organization is the load bearing wall, and all the success comes due to their dedication. If the organization supports integration and technology transfer, the other employees can easily follow tin those footsteps and create the perfect atmosphere that enables technology transfer. The management has to back the objectives they set and support the programs the organizations set aside (Asghari and Rakshanika, 2002). The management has the duty of ensuring that the invention by their researchers achieves the commercial potential. They should also guarantee that there are passable channels for presenting grievances in the organization. Many oil and gas organizations are multinationals and have operations in several countries and have a large number of employees. The top and middle-level managers should ensure that each employee in the organization is well satisfied. That creates the best atmosphere for the transfer of technology. With the management keen to deliver on the promises it becomes easier to transfer technology and achieve the maximum potential.

Because the researchers enjoy a fruitful relationship with the management, they can commit their efforts towards finding the best technologies, and that can in turn increase the revenues of the company. That means the relationship between the two is vital in

ensuring the realization of an organization's maximum potential. The management should also retain their research team who help the company advance or forge ahead in the technological field. There should be a mutual agreement on rules and regulations that all the parties in the firm have to strive to achieve. The management also has to ensure that they manage the expectations of the firm. That makes it easy for the researchers to work freely and develop new technologies. They can do that by engaging in conservative success reporting.

2.3.2 Culture and Environment

The culture and the environment of a particular country or organization can have a huge effect on the success or failure of the transfer of technologies. A healthy organization culture can help a firm to adopt new technologies easily. Researchers have to understand the organization culture in a particular place if they are to formulate a successful technology transfer procedure. In the period after the Second World War, the United States was the main supplier of the technologies used in the world. In most cases, the technologies failed to take up because of a lack of understanding of the different cultures in the targeted areas. In those instances, the donor countries did not understand the cultural and natural environment of the areas they were supplying the technology. There are several technologies useful in the developed countries that may be detrimental in their countries.

An appropriate technology is usually an innovation strategy aimed at achieving a good fit in the context they are operating or where it is used. The values found within that particular context play an important role in determining the success of the process.

Technological development aims at the endogenous characteristics within a particular community. Each society usually has their unique problems that can get solved with the development of technology transfer. Fresh problems in the society call for the adoption of technologies that can help those particular problems facing the society at that time. Understanding the culture and values that the community holds dear is vital in the development of technology (Mabadi, 2007).

In most instances, people tend to maintain their cultural identities and values. That tendency is what led to the emergence of cultural varieties. The ideas, beliefs and the customs shared and accepted by people in the society have a base on the cultural variables. Culture has an influence on the way technology used in the transfer process. In studies, researchers found that it was not easy to integrate western concepts of management in the African context due to the variation in the social and cultural complexity. In order for the transfer of technology to be successful it has to be tailor made to suit the culture of the places where it is available.

Most oil and gas multinationals operate in several countries and understanding the various complexities can help the company during the technology transfer process. The companies that employ the use of technologies and practices that are tailored to match the culture of different parts of the world have a likelihood of succeeding in the areas they operate. A person's cultural context determines how they perceive, evaluate and judge certain situations if a person feels that the technology used does not suit or match their culture they might resist its use in their area. The degree to which two different cultural norms and values of two different countries differ referred as ‘cultural distance'. The

‘cultural distance' is a major hindrance to the transfer of technology and conducting business on the international stage. The perceived cultural differences or distance influences the decisions of managers in a company when entering new markets.

Since organizations and individuals are part of the culture and society they operate in, it is safe to say that the culture affects the way technology gets transferred in that society. Localized training is vital in determining whether the technology proposed can survive the cultural barrier. Oil and gas companies are no exceptions, and they need find and understand the culture of the people in the place they operate. Through that the companies can easily transfer technology to the locals, and that can help reduce the cost of paying expatriates to work in their organizations.

Studies in the present highlight that cultural similarity and dissimilarity is an important predictor of the whether boundary-spanning communication can get facilitated or not. The more developers understand the method, values and norms of doing things in a particular area, the greater the chance of successful technology integration. The differences manifest themselves in the technology transfer models adopted.

For a new technology to be transferred; this new technology requires a particular environment if it has to realize the commercial potential. There is no guarantee that technology developed for a particular environment can thrive in another environment. Local environmental factors are important in the development of and transfer of technology. When technologies get transferred to a new country, it has to adapt to certain local environment factors. Even factors such as the physical features of a country can affect the transfer of technology. The environment can affect the supply of the material

required to ensure a successful transfer of technology. That implies the environment affecting the transfer of technology can either be physical or organizational. The physical environment can affect a particular technology because it might have been developed in a totally different climate. That could mean the technology cannot get applied in other areas. Firms should consider the various areas the technology could receive application before deciding on whether to purchase a particular technology or not (Ramanathan, 2007).

The management of an organization has to ensure that the technology available for transfer meets the best environment. Without an enabling environment, it becomes extremely difficult to enjoy the benefits of technology transfer. Many of the organizations in the oil and gas sector that have enjoyed growth over time are those that have adopted the best possible environment for technology transfer. A good workplace environment can enable the developers of the technology to develop the technology an organization requires freely. Technology transfer consultants call for the creation of an environment that ensures the transfer of technology.

A sour organization environment leads to a breakdown in communication and the morale of the technology developers. In order for there to be a successful technology transfer, there also needs to be a clear communication process between the developers of the technology and the receivers of the technology. The competitors in the place where the technology is transferred to can shave a huge effect on the technology transferred. The competitors can either collaborate or create an enabling environment for the adoption of the technology required in the industry or they can create a hindrance in a new

technology. That is in cases where they feel that the new company could develop a technology that would help them gain a competitive advantage over them. Without proper coordination and a proper technological environment, it is not easy for technology developers to work properly.

2.3.3 Planning and Technology Transfer

The amount of planning done by the management affects the level at which the technology gets transferred. The management has to conduct adequate and deliberate planning is to ensure that technology adoption is complete and seamless in the company. The plan includes the concrete ways in which the recipients and the donors corporate during the technology transfer process. Collaborations usually needed if there is to be an effective technology transfer process between the transferor and the transferee the technology transfer process depends on the willingness of the two parties to corporate. That corporation helps them during adoption and assimilation of the new technologies (Chui 20).

In the international scene, the development of technologies is usually guided by a profit motive. In order for the technology transfer to be successful, there is a need for the development of an elaborate plan. The plan should involve the adoption of a model that is likely to guarantee success in the technology transfer. In most of the instances in the technological transfer process the countries in the western world are the main donors while those in the developing world are the receivers. Those in the developing world fail in the transfer of technology because they lack an elaborate plan that can guarantee the success of the whole process. Several of the countries do not create the best environment

for sustained and improvement of the technology available in the market. In most of the times, the countries in the developing countries buy the technology and adopt it without planning for making future modifications. The suppliers also do not create an enabling environment that can help the countries develop technologies. The profit motive means that they like the countries to continue purchasing technologies.

A critical test of technology transfer is the whether it has the ability to stimulate further innovations in the recipient countries or companies. The technology transfer cannot be said to be effective if those receiving it do not try and modify it. Oil and gas companies should aim at transferring technology that can receive further modifications in the future. The countries can only ensure the modifications or innovating through the creation of an elaborate plan. Without a clear plan, the countries or companies in the developing world will never have the ability to develop new technologies. Most technologies in the oil sector build on the available technologies. The countries deemed as the transferors of technology only innovate on what is already available in the market. Through adequate planning, the companies can clearly identify the technology patterns in the global stage. They use that knowledge to look for new ways of doing things in order to take advantage of the market situation.

The planning should ensure Maximum Corporation between the donor and the receiver of the technology. A company in the oil sector gains a competitive advantage when they adequately plan for the future. In a company, planning helps in the transfer process because the company can identify the new technologies and initiate technology transfer procedures the ease with which a company assimilates the technology available can give

the firms a competitive advantage. The company plan could include the creation of the transferor individuals and the training of the individuals in the organization who will help in the transfer process. When the company plans ahead and ensures that those already in the organization understand the new technology they will adopt, and then the assimilation of the new technology in the organization becomes easier and seamless.

In the early stages of its development, South Korea made concrete plans aimed at the seamless transfer of technology. The government support helped them greatly. The plan included training a large number of highly educated people who could help in the assimilation of technologies available in the market at the time. Those factors made the transfer of technology easier in the country and that helped it to become a major technology donor in the high tech sector such as communication, information technology, and electronics. Their plan included the elimination of factors that affect the transfer of technology such as political interference, economic and other physical constraints that prevent the successful adoption of technologies. Oil producing countries that do not have the necessary plan to enable the transfer of technology should follow South Koreas blueprint. Adoption of an elaborate plan could make them donors of technology with time.

No country can monopolize technology because researchers come from different corners of the globe. The difference between those that gain from technological transfer and those that do not is the level and kind of plans formulated. If the planning does not make it easy for the transfer of technology there is no room for technological innovation in the future and such countries will most likely continue being technology transferee for the

foreseeable future. With the increase in globalization, it is easy for countries to create an elaborate plan with the help of their partners in developments. The plan is vital to the development of the best technology for the future.

2.3.4 Education and Technological Transfer

Education can get termed as the key area in which the transfer of technology can take place. The level of education in a particular country gives an idea of the level of technological advancement and research. The countries that have the best education have the best technologies. In order to ensure smooth technological transfer, the countries should target increasing the technological understanding in the areas where they want to transfer the knowledge. Many institutions have the reputation for commercializing research. Such institutions like Harvard produce high-quality researchers that they sell to interested corporations. The development of the necessary skills in the areas of oil and gas exploration could help in transferring knowledge about certain operations in the sector.

The countries that have the technological understanding about the use of certain technological equipment and processes in the sector should help the others without the knowledge by training some personnel. The trained personnel can help pass the knowledge they obtain from the technological nations into their country. Some countries invest more in technological research than other. Japan and Germany have for a long time emphasized the need for extensive research. Other countries place more emphasis on the publication of journals. Each of the methods has their advantages and disadvantages the

method that a county uses determines the level in which technological transfer takes place (Asghari and Rakshanika, 2002).

Funding the educational research in the area of oil and gas can help in the transfer of technology. The developed countries that have the financial muscle can help fund researchers in the oil and gas sector. They can also decentralize their research operations to other countries that require more investment in the research sector. Scientists researching or developing new technologies for use in the exploration and extraction can work with the countries to assist in them the transfer of the knowledge on the technologies they develop (Wayne State University, 2007). In the process, the others can acquire the technological expertise in the skills necessary for the operation of the sophisticated equipment used in the sector.

Multinationals with operations in various parts should ensure that they take some of the locals and fund their education in the field of oil and gas. Most of the companies do not have the good will of the host countries; therefore, they fail to transfer the technology on the way their equipment leaving the locals exploited and without the necessary knowledge. Educating a number of their employees from a different part that does not have that particular technology would be advantageous.

Countries should also ensure that the results obtained from research reach the market without restrictions. The literature that targets the oil and gas sector should be made available to all researchers. That is because researchers build on previous works done by researchers when developing new technologies. Without the necessary educational material, people in developing countries and areas where technological knowledge about

exploration researchers cannot work to their potential. Education gives people the power to help themselves. That means in order to have a successful transfer of technology; the education process in any country should set up the necessary structures that support technological transfer. In countries that have huge natural resources such as oil and gas, the education system should be tailor made to ensure that researchers handle research on the technologies that they can use in the exploitation of resources.

Feedback represents the best way in which the research conducted through education can flow between those with the knowledge can pass it to those that do not have it. Interested parties in the areas that do not have a particular knowledge should get the opportunity to interact with those who have the educational capacity and proficiency and in that way technology can pass in the educational forums. Exchange programs also help students from developing countries access education in Ivy League colleges. The countries that have oil should encourage students to study and conduct more research in the oil and gas area. More incentives should be given to encourage as many individuals undertake research.

Education and training play an important role in the advancement of new technologies. It plays a major role in the creation and movement of the invisible aspects of education. The capacity to adapt, assimilate and to generate technology comes through education and training. If the recipients of the technology lack the necessary skills to assimilate the technology, then the technology transfer cannot be said to be complete. The recipients have to receive the necessary education that can help them assimilate and maintain the technology. Technology is usually a passive resource whose effectiveness depends on the

human beings. The most critical component in the transfer of technology is the ability of the individual to learn and understand the new technology. That can only have benefits after extended periods in education (Kavousi and Ansari, 2014).

2.3.5 Role of Organizations and Staffing in Technological Transfer

The level of communication in different sectors helps in the transfer of technology. The technological transfer can be affected by the staff available in an organization. A lot of sociological research has gone into determining the level at which those working in a firm affect the way technology flows. The organization structures affect the way information flows. The size and composition has an effect on information flow in a business. If the organization has a large pool of resources, the technological transfer in it can be starkly different from that of organizations with fewer resources. Organizations that have fewer resources cannot compete in terms of the technology available to them.

The larger the originations, the greater the amount of resources they can dedicate to technological research. That means they have a higher chance and probability of transferring technology to the oil sector. Large multinationals do can employ the best researchers in the market. It is such organizations that can help in transferring the technology to exploration and other processes to other areas that do not have a similar capacity. Without the multinationals working through their funds, the technologies available today would not be available. The individuals working in such organization also have a role in the transfer of technology. Big organizations have numerous employees. Without all of them working towards changing and transferring technology it is impossible for the technological knowledge they have to flow to other areas.

The way organization set up their structure also affects the technology transfer of information. A good structure is a huge factor that can enable the transfer of technology from them to other sectors or departments in the oil and gas sector. Several rigid structures prevent companies from realizing their full potential concerning research and development. That means they hinder the transfer of technologies. Researchers' in the oil sector need flexible systems to realize their potential and ensure that no hurdles prevent the realization of the technological transfer. Flexible structures also make it easy for an organization to adopt technologies easily. That means the organization can coordinate easily with other companies in the same sector such as those in the oil and gas sector. The technologies used in the sector are similar, and only a few changes and innovations change over time. When the organization has the required and simple structures, they can collaborate easily with others in the field. That makes it easy to liaise with the others and enables the easier transfer of technologies (RTI, 2002).

Also the staffing in any Organization is considered as a subcategory in the advancement of technology in the organization itself. The type of staff hired should be one that has the necessary skill to complete the tasks and expectations the company has. Many oil and gas companies have the resources they need to ensure that all the programs they run have enough staff. When the staff available is not enough, those available get overworked, and that hinders their performance. That also hinders the sharing of technology in the organization. The staff available contributes to the success of an organization because of their combined experience and the skills they have in terms of their knowledge in oil and gas exploration or extraction. The staff has to be familiar with the innovations available in the sector in order to realize the maximum potential for the company. The staff

employed has to be team players. They should be able to work well with others and in groups. Healthy relationships improve the working atmosphere, and that helps improve the level at which technology transfer takes. The harmony created at the workplace creates the perfect atmosphere for the company to enjoy success (Asghari and Rakshanika, 2002).

With the staff in the organization working in tandem, it is easy for the realization of the company goals and objectives and that enable the easier flow and sharing of technology. The good relationships also help quickly to resolve problems and any other emerging problem in the organization. The staff available should be made to understand their roles and duties in order to ensure smooth operations and enabling working conditions. The hired staff should have the knowledge and an understanding of the technology available. Hiring the wrong staff and those that do not fit the roles they are supposed to take in the organization is a recipe for failure. The researchers employed in the organization should have the dedication and interest in conducting research in the oils and gas sector. There are several fields of research and choosing those that have an interest in improving the practices and technology used in the exploration and extraction of oil and gas.

The top leadership positions should also get filled by competent individuals. The competent employees ensure continuity of the company. It also ensures that there is a success in the company. The leadership determines the direction an organization takes, not filling those positions with qualified individuals who understand the need for technological research and advancement would create. Adequate training should get provided to the staff in the organization. That should be directed especially to the

research teams and employees working on innovations should receive constant training to help the advancement.

2.3.6 Role of Researchers

Various research types affect the transfer of technology. The policies that companies in the oil sector adopt have an effect on the transfer of technology. The distribution of research funds during the process of technology transfer affects the level and the extent to which the transfer occurs. Though the basic research does not get attributed to technological transfer, it provides the necessary platform for the development of technology. Another way research affects the transfer of technology is in the readiness in which the researchers want to transfer the technology. If there are no enough funds, it becomes extremely difficult for the researchers to conduct their research freely, and that affects the level of technological transfer (Ramanathan, 2007). The amount of funds available for the transfer of technology affects the amount of technologies developed, transferred and so forth. The quantity of resources set aside for the demonstration and evaluation of technologies may not affect the level of technology transfer, but it will mean the transferable technologies not transferred in the most appropriate way possible.

The criteria that companies use for setting the research priorities affect the type of technological transfer. Research priorities can only fill the gaps available in the market. Several companies in the oil and gas sector should prioritize the areas that improve efficiency in the survey and mining of oil and gas (Asghari and Rakshanika, 2002). The research policies that they adopt are a huge factor that affects the way technology gets transferred to the industry and the company. The research policies that the companies

employ should be well informed to avoid those that stall or hamper the transfer of technology. The programs chosen for research should get selected according to merit and not just any way. Their potential usefulness for organizations in the oil and gas sector should guide the selection of research programs. That will ensure that there is no wastefulness of funds due to the selection of programs that do not match the vitals priority areas.

The place where the research takes place also affects the transfer of technologies. That is in respect to the degree that the organization gets plugged in the literature or technology relevant to a particular field. Organizations in the oil and gas sector know the places where their research should take place. The research policies that they adopt should ensure the technological transfer targets such places where the company feels will ensure the best transfer of technology. Companies that have huge exploration and extraction portfolios are more likely to move into new procedures. That means there is a more technological transfer in them than in relatively smaller companies that are skeptical to direct their research funds to the necessary places that will ensure maximum transfer of technology (Ramanathan, 2007).

2.4 Technology Transfer in The Oil and Gas Sector in Qatar

In 1938 the drilling for Oil started in Qatar, one year later Petroleum was discovered in Dukhan in a commercial amount and the first shipment exported in 1949.Qatar Production was only 4000 Barrels per day in 1940. In 1961 Qatar joined the Organization of the Petroleum Exporting Countries (OPEC), in 1972 Qatar National Petroleum Company was established and after several discoveries of an offshore and onshore oil

fields Qatar reserves reached in 1990 4.5 Billion barrels, while in 1997 Qatar began exporting Liquefied Natural Gas "LNG" beside its oil production

Qatar became the largest producer of liquefied natural gas (LNG). Beside LNG; Qatar produce crude oil, and other petroleum products adding great value to the Government revenue. In 2006, Qatar was at the top of liquefied natural gas (LNG) producers, and in 2012 Qatar became the fourth largest dry natural gas producer, also it was recognized as the Home of gas-to-liquids (GTL) facilities since it is leading the world towards GTL production. Today, Qatar produces about 1.6 million barrels per day (bbl/d) of liquid fuels; 730,000 (bbl/d) of that is a crude oil. Today Qatar owns several of leading Industrial Oil and Gas Plants and multi-billion Projects in the Oil and Gas sector.

As Qatar became one of the leading Countries in the Oil and Gas Industry; new technologies have entered the country in many aspects, and since Qatar is supporting the Qatarization process in its facilities, owning the new technologies has to be considered to move Qatar from technology receiver to technology sender.

Also; Qatar is looking for future carefully through its 2030 Vision. In November 2008 the Emir Sheikh Tamim Bin Hamad Al-Thani, launched Qatar National Vision 2030 (QNV 2030), which foresees Qatar continuing to transform into a diversified and advanced knowledge economy capable of sustaining its own development and providing a high standard of living for all its people for generations to come. OECD define knowledge-based economy as “an expression coined to describe trends in advanced economies towards greater dependence on knowledge, information and high skill levels, and the increasing need for ready access to all of these by the business and public sectors

QNV for 2030 manly is about four major principles on the basis of which the State of Qatar will make a sustainable economy and advance the standard of living of its people. Some factors of the successful technology transfer that been discussed in this research are similar or close enough to some of the four major principles of QNV 2030. The four principles are the following:

1. Human development – the development of education for making a sustainable and prosperous society.
2. Social development – the development of a society which is capable of establishing global partnerships.
3. Economic development – the development of an expanded economic that secures and maintain a high standard of living for future.
4. Environmental development – to maintain a balance between economic and social development and environment protection

As been presented above, Qatar is aiming to keep being the leader of oil and gas production, beside that it is committed to develop and depend more on local (rather than Oil and Gas) industrial products to vary the national income sources, Increase the industrial growth, and keep producing national job opportunities.

As a result, Qatar need to own the required technology and become capable to achieve its goals that been mentioned above. The current status of Qatar economy is at risk since it depends on oil and gas as the country major resource; therefor the need for technology is a must. Therefor the successful factors of technology transfer in oil and gas industries that been presented in the literature review will be tested here in Qatar by gathering

feedback from a questionnaire that will distributed to a list of leading companies in oil and gas field, the next chapter will explain that process.

In summary, the technology transfer is the transfer of knowledge to the manufacture of products or in the provision of services. There are several factors that affect the transfer technology in an industry. The transfer has to feature the transferor of the technology to the transferee who adopts the technology available. Developed countries get associated with the development of technologies. They normally have the funds to finance the research process the new technologies come from careful research and proper assimilation in the industry. In order for the transfer of technology to be considered complete the receiver of the technology has to assimilate it fully into their system. In the oil and gas sector technology transfer has always taken at various stages.

The sector is usually dominated by engineering technologies, and there is a need for the adoption of a policy of technology transfer in the different company's and countries. Countries in the developed world have the best and most modern technologies for the adoption of technologies in the sector. There are various models that companies can use while developing a strategy for technology transfer. When the transfer of technology is effective, it can help a company of a country increase revenue collection in the oil and gas sector. The sector plays an important role in the economies of several countries. Having the best technologies can help such countries increase their revenue collection. That can in turn help improve the economic situation of affected individuals.

The management and leadership of an organization set the tone and the mood for the transfer of technology. When the adopting management team understands and support

technological transfer, it is easy for the organization to incorporate any new technology available in the market. The knowledge and accumulation, application, transfer, and diffusion are vital in ensuring the profitability of the emerging globalized world. Rapid changes in the development of new technologies have changed the social and economic situation of the world. The current world and knowledge-based world is different from the industrial revolution period and has moved from the physical and tangible things to the intangible resources. The current systems require intangible resources based on technology and knowledge.

Transfer of technology to the oil and gas sector involves the passing of knowledge to the operation and maintenance of complex equipment found in the sector. The transfer has to ensure that the technology transferred is completely understood by both parties in the transfer process without fail such complex equipment operation should only be handled by qualified individuals who fully understand the technology. The company has to prepare for the adoption of new technologies by creating the perfect environment that enables the transfer of technology in the organization.

Various models developed help in the transfer of technology. A company should choose the model that best suits their need for technological transfer. Although it is advisable for a technology transfer company to follow all the steps suggested in a particular model some steps can be skipped when the technology transfer being proposed is not complex. Simple technologies do not need complex processes, and a company can shift to the later stages of the transfer model in question. A model may in some instances not lead to the successful implementation of the transfer procedure. New models that create the perfect

condition and processes that can help in the development of technology should get developed.

With technology regarded as one of the important business strategies in the world today, organizations need to develop new technologies in order to deliver better services and increase their productivity. Careful planning is vital to the adoption of the technology. Several scholars have suggested that technology transfer is affected by the internal factors as well as external factors in the organization. As discussed in this research there are several factors that affect the transfer of technology in the oil and gas sector. Each factor as discussed has various issues attached to it.

The management of the organization plays the most important role in ensuring a successful transfer of technology in the organization. The manager approach to the technology transfer procedure has to include a carefully devised strategy that will ensure the full integration of the technology. The communication channels set are also vital in the development and adoption of a particular technology. There should be constant and carefully coordinated communication between the developers of technology and the company that funds them. The researchers should involve the company in order to make sure that the technology developed suits the company. That ensures the company makes those inputs to the technology transfer process.

Chapter 3: Methodology & Hypothesis of The Research

3.1 Methodology of the Research

3.1.1 Introduction

In this chapter we demonstrate the research methodology basis and show the method of the research; also the design of the questionnaire and the pilot study are presented.

3.1.2 Methodology Basis

Even though a large amount of empirical research has been dedicated to the problems of development in general, there are very few specific empirical investigations with regard to technological transfer, which is at the core of the innovation process.

This research is intended at identifying those technology factors that significantly affect the successful technological transfer especially in oil gas industry sector in qatar state. For this purpose, appropriate statistical methods are used to analyses a set of specific data. It seems there is a considerations that suggest the desirability of using quantitative techniques as tools for exploring the structure of the underlying phenomena involved in any problem of development, and in particular.

The problem of technological transfer in oil gas industry is that, there are a number of debated attitudes towards this problem, which may make it difficult to establish a well-defined hypothesis the amount of even approximately validated knowledge relating to the issues governing this phenomenon is small. Besides that, the amount of even

approximately validated knowledge relating to the issues governing this phenomenon is small.

So, empirical research may then help in understanding of certain aspects of the phenomenon. One may attribute the success or failure of technology transfer to a number of factors without knowing their relevance in practical terms. Also, as a theoretical model, it may be lacking in specifying more or less exactly the amount of influence. Thus one cannot be certain of its theoretical formulation. Hence, an attempt to model such a phenomenon may be very useful and may complement the existing literature in providing more empirical evidence.

There are two most important factors for technology transfer success, the first one is that , the most notable factor that separated successful from unsuccessful the new technology was the extensive training on technology transfer and implementation. In other word awareness that the effectiveness of technology transfer is highly influenced by the adequacy of the training received. The second one is the commitment from senior management is considered as significant factor for succeed. It is therefore intended to concentrate on explore these conditions besides the other factors in order to gain a quantitative insight as well as more empirical knowledge by using the statistical data. Examples of techniques which have been used in this study are multiple regression analysis' stepwise regression best-subsets regression factor analysis and cluster analysis.

3.1.3 Research Method

The research method in this research is a questionnaire designed based on the literature review and been applied to collect data and feedback. Figure 2 summurizes the step followed in the researh in order to achieve the research objectives.

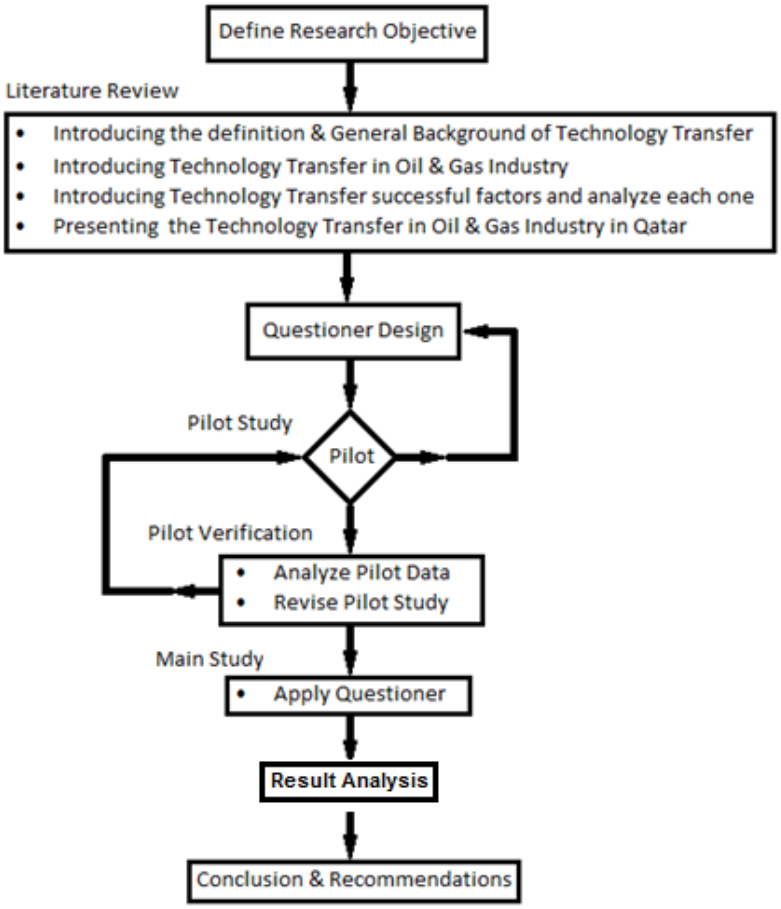


Figure 2 Research Method

3.2 Research Hypothesis

The Hypothesis been applied for each successful factor on this research is as follow:

Table 3.1 Research Hypothesis

Hypothesis 01	Strong Administrative Support towards, technology transfer will be positively related to the success of technology transfer
Hypothesis 02	Culture and Environment that in aligned with the new technology that to be transferred will be positively related to the success of technology transfer
Hypothesis 03	Planning for technology transfer to set the strategy and process will be positively related to the success of technology transfer
Hypothesis 04	Education will be positively related to the success of technology transfer
Hypothesis 05	Role of Organizations that includes Technology transfer one of its item will be positively related to the success of technology transfer
Hypothesis 06	Role of research's that support technology transfer will be positively related to the success of technology transfer

Since there are many factors of technology transfer, an Importance scale survey been distributed to number of employees who are working in training and development department in Qatar Petroleum, RasGas, Maersk, and Tasweeq which considered as major companies in Qatar that works in the oil and gas industries.

The objective of that survey is to identify each factor importance level among the other factors by rating each factor from 0 to 4; where 0 is the less importance and 4 is the high importance.

The following table will demonstrate the list of all factors that been considered as a factors of successful technology transfer on the beginning of this research and showing the level of importance of each one based on the Importance scale survey result:

Table 3.2 Factors Importance Level

#	Factor	Importance level
1	Strong Administrative Support	2.9
2	Regulations and Reimbursement Policies	1.7
3	Attitude between sender and receiver	1.3
4	Culture and Environment	2.5
5	Planning	2.8
6	Risk Acceptance and Mitigation	1.5
7	Education	3.7
8	Role of Organizations and Staffing	2.9
9	Role of the Researchers	3.3
10	Motivation	1.5
11	Communication	1.4

This research work will focus only on the factors that have the level of Importance more than two and they will get tackled in details; these factors are the following:

1- Strong Administrative Support.

2- Culture and Environment.

3- Planning for Technology Transfer.

4- Education and Technology Transfer.

5- Role of Organizations and Staffing.

6- Role of Researchers.

Chapter 4: Questioner and Data Analysis

4.1 Respondents Selection and Questioner Structure:

Based on the literate review and the importance scale, six factors have been identified as the factors of successful transfer of any new technology in the oil and gas industry, and from each factor a group of statements were generated to test the validity of that particular factor.

The total number of the generated statements for all factors is twenty nine statements. Also seven more questions have been added to gather the respondent general information.

This study aims to measure the performance of technology transfer in oil and gas industry in Qatar state; therefore, therefore the survay been used for two main reasons:

- Identify which factors are related to Qatar by applying Important Index Level.
- Gather all data from respondants who are working in the fieled in the Oil and Gas Industry, and their resuls will reflect the reiality of Qatar.

The questionnaire was distributed to number of respondants who are working for leading Industrial oil and gas companies in qatar state such as Qatar Petroleum "QP", RasGas, QatarGas, Qatar–Maersk Oil, and Tasweek - Qatar. A pilot questionnaire was designed to test the statement validity and all Pilot questionnaire responses were gathered and analyzed to go back to the questionnaire design and modify it. Since this research is about the factors of successful technology transfer in oil and gas industry in qatar, the questionnaire was designed based on that each question or statement is a validity norm

of one of the successful factors. Therefore the questionnaire has to be fully answered to test each successful factor of technology transfer.

The respondents have to comment on each statement by choosing one answer; Strongly Agree, Agree, Disagree, Strongly Disagree, or No opinion. After the survey rectification (eliminating skipped answers), the total number of those who did fully answer the questioner is 140 respondent. The Tables 3, 4, 5, 6, 7, 8 and 9 summarize information about the research respondents:

Table 4.1 Respondent Nationality

Nationality	Number of Respondents	Percent
Qatar	76	54.4%
Arab	12	8.6%
Other	52	37%
Total	140	100%

Table 4.2 Respondent Gender

Gender	Number of Respondents	Percent
Female	25	17.7%
Male	115	82.3%
Total	140	100%

Table 4.3 Respondent Age

Age	Number of Respondents	Percent
18 ~ 24	6	4.3%
25 ~ 34	41	29.3%
35 ~ 44	55	39.3%
45 ~ 54	29	20.7%
55 and above	9	6.4%
Total	140	100%

Table 4.4 Respondent Job Status

Employment Status	Number of Respondents	Percent
Full Time	133	95%
Part Time	6	4.3%
Other	1	0.7%
Total	140	100%

Table 4.5 Respondent Experience in Qatar

Working in Qatar	Number of Respondents	Percent
More than 15 years	58	41.4%
11 to 15	21	15%
6 to 10	32	22.9%
2 to 5	27	19.3%
Less than 2 Years	2	1.4%
Total	140	100%

Table 4.6 Respondent Qualifications

Qualification	Number of Respondents	Percent
PHD	3	2.1
Master	10	7.2
Bachelor	74	52.9
Diploma	37	26.4
High School	16	11.4
Total	140	100

Table 4.7 Respondent Position

Job Title	Number of Respondents	Percent
Manager Or Above	15	10.7
Section Head	25	17.9
Advisor/ Lead	12	8.6
Engineer, Analyst, Clerk, etc	79	56.4
Other	9	6.4
Total	140	100

The statements of the questioner have been generated to scale each factor of six factors of successful technology transfer; the following table shows the list of questions corresponding to the factor that it has been generated from:

Table 4.8 Factors With Their Corresponding Survey Questions

Factor	Statement
Strong Administrative Support	The top level managers show their support to the continuation and transfer of technology through the speeches they make in several occasions
	The mission statement shows the support for the transfer of technology in the organization
	The management guarantees that there are passable channels for presenting complaints in the organization
	The relationship between the top and middle-level managers with the other employees is vital and leads to a friendly environment
	My manager has been visibly supportive of the learning of the new implemented technology
Culture and Environment	The company promotes Qatari Culture to the other Partners, Ventures, and to the employees in many Occasions
	The company present and highlight the cultural similarity and dissimilarity among its employees and to the vendors in many occasions
	The Company ensures that the technology available meets the local environment
	The General attitude of the individuals in the company is optimistic and positive
	The Company is conducting a plan to ensure the cooperation between the company and the vendors for training and development
Planning for Technology Transfer	The Company is conducting a Plan to ensure that technology adoption is complete
	The Company is conducting a plan to ensure that the employees are able to innovate or make modifications to the existing (system/facility/technology) in the company
	The Company is conducting a plan for individuals training to be able to innovate or make modifications to the existing (system/facility/technology) in the company
Education and Technology Transfer	The Company is sponsoring locals and fund their education in the field of oil and gas and other engineering fields
	The Company is Funding the educational research in the area of oil and gas industry and other engineering fields
	Adequate training is been provided to the staff in the organization
	The company offer training to the employees before any change in the system or technology
	The Company has Flexible structures so information can easily flow
	The number of staff available is enough and the work load is fair
	The harmony created at the workplace creates the perfect atmosphere for the company
Role of Organizations and Staffing	If any special tooling is required to use this new technology appropriately, it will be purchased.
	Any accessories need to use the new technology it will be purchased.
	It is easy to find a resource to help me to solve any problem that I might encounter when using the new technology
	Financial support and resources availability are behind successful learning process and acceptance of the new technology.
	Changing the Technology been applied would make the process more easy
	The Company is applying the results obtained from research without restrictions
Role of Researchers	The Company funds research centers and The amount of funds is available once researchers need it
	The Communication between the Company and researchers is always present
	Changing the way of doing things will not lead to loss my job

4.2 Data Analysis

4.2.1 Data Preparation

The data of the questioner has been prepared by extracting the questioner results in to excel file and the data run through the following process:

a- **Data rectification:** Data rectification is done by eliminating skipped answers since the respondent who skip more than 30% of the questioner will be considered as he didn't do the questioner at all, while the respondent who skipped less than 30% will be considered and the skipped questions will be considered as been answered with (No Opinion)

b- **Factor Tables Segregation:** Each group of Questions/Statements that reflect or generated from a factor have been segregated in to separated table, therefore we had six tables; each table represent one factor and has the number of columns equal to the number of questions generated by that factor and number of row equal to number of respondents.

c- **Data scoring:** Data scoring is simply changing the respondent's response from statements Like "Strongly Agree, Agree,..etc." into numbers to be able to evaluate it, therefore the following table shows each response and its equivalent value:

Table 4.9 Data Scoring

Statement	Score Value
Strongly Agree	4
Agree	3
No Opinion	0
Disagree	2
Strongly Disagree	1

4.2.2 Reliability Test

In this research work, the internal consistency reliability test(reference) has been applied in order to estimate the survey reliability. To apply the Internal consistency reliability test on the data extracted two steps must be considered:

Step 1: The data must be trasformed into the type of 0 , 1 answers or Yes, No answers. he following table will show how the extracted data has been trasformed:

Table 4.10 Transforming Data Into (Yes: No) Answers

Statement	0 : 1 answers
Strongly Agree	1
Agree	1
No Opinion	Skipped
Disagree	0
Strongly Disagree	0

Step 2: Cronbach's coefficient alpha "CC alpha" must be calculated: The CC alpha measures internal consistency reliability among a group of items combined to form a single scale, It is a reflection of how well the different items complement each other in their measurement of different aspects of the same variable or quality, it Interpret like a correlation coefficient were (≥0.70 is good).In this study, the CC alpha will be applied for each of the six factor. The CC alpha is calculated by using the following:

$$CCalpha = \left[1 - \frac{\sum(\%positive)_i(\%negative)_i}{Var}\right]\left[\frac{k}{k-1}\right] \quad (1)$$

Where:

(% positive) = total (1's; Yes) answers per Question/all respondents answered (1or 0: yes or no)

(%negative) = total (0's or No) answers per Question/all respondents answered (1or 0: yes or no)

K = number of questions of the factor

Var = Sample Variance. It can be calculated as follows:

$$Var = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1} \quad (2)$$

where x_i and $\bar{x}$ are the sum of scaled score and the average, respectively and *n* is the number of respondents . Table 13 illustrate the calculated sample Variance (Var) and the Cronbach's coefficient alpha (CC alpha) for each factor. As it can be seen from Table 13, the CC alpha values of all suggested factors are greater than 0.70; that , for sure, confirms the high reliability level of the survey results.

Table 4.11 Calculating Var and CC Alpha For Each Factor

Factor	Calculated *Var* and CC alpha.
Strong Administrative Support	*Var1* = 2.5753609
	CC alpha1 = 0.839559 ≥0.70 is good
Culture and Environment	*Var2* = 2.7177693
	CC alpha2 =0.789427 ≥0.70 is good
Planning for Technology Transfer	*Var3* =3.7323565
	CC alpha 3 = 0.842093≥0.70 is good
Education and Technology Transfer	*Var4* = 2.0022452
	CC alpha 4 = 0.787332≥0.70 is good
Role of Organizations and Staffing	*Var5* = 10.198217
	CC alpha 5 = 0.903508≥0.70 is good
Role of Researchers	*Var6* = 9.5072464
	CC alpha 6 = 0.918751≥0.70 is good

4.2.3 Factors weighting

The Factor Weight is actually the weight calculated from the Questioner wich represent the availablity of that factor in Qatar which the Qustioner is reflecting.In factors weighting each factor been represented in a table that shows the number of respondents who answered "Strongly Agree", "Agree", "No Opinion", "Disagree", and "Strongly Disagree" per Question, then we calculate Total Data Scoring per Question (TDSQ) by adding all the respondents scoring (0 to 4) per question.

In this work, we assumed that all questions and statements of the questioner have the same weight (QW =1) and the (Total QW =total number of questions).Therefore we can calculate each Factor Weight (FW) by applying the following equation:

$$FW = \frac{\sum (\mathrm{TDSQ})_i \mathrm{X} (\mathrm{QW})_i}{\mathrm{Total\ QW}} \qquad (3)$$

The following table shows the calculated Weight for each factor and the scale is out of 4:

Table 4.12 Calculating Factor weight "FW"

Factor	Calculated FW out of 4
Strong Administrative Support	2.73
Culture and Environment	2.47143
Planning for Technology Transfer	2.23929
Education and Technology Transfer	2.58214
Role of Organizations and Staffing	2.31964
Role of Researchers	1.45893

The Importance vs Availability chart is the chart that will show the status of each factor with respect to its Importance on the Y-axis and its availability on the x-axis, while the chart is been divided in to four parts by crossing two lines on the scale of two on the Y-axis and the X-axis as it is been demonstrated below:

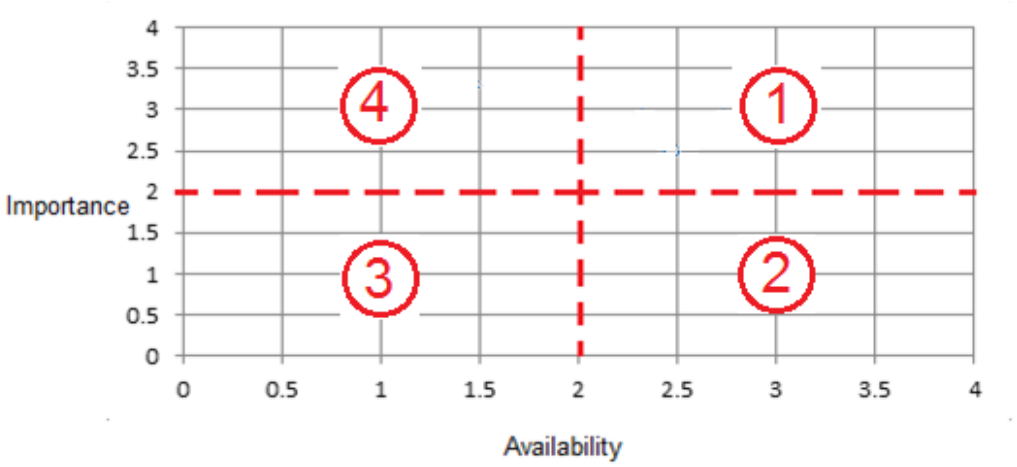


Figure 3 Importance VS Availability Chart

In that chart, the Upper Right Corner (1) means that all the factors in that corner are Important factors and available in Qatar and that' is what we aim for.The Lower Right Corner (2) means that all the factors in that corner are available in Qatar but they are not that Important; so there is no need to support these factors because supporting such

factors is considered as a loss or unnecessary cost. The Lower Left Corner (3) means that all the factors in that corner are Not Important factors and not available in Qatar and that' is what we should do, since all non-important factors should not be available to save cost and effort. The upper left corner (4) means that all the factors inside that corner is very Important but not available in Qatar and here where we should focus more to push these factors Important from ULC to URC and make them available.

Now we can demonstrate each Factor with respect to its availability (weight) and it's Importance Level, from the following table:

Table 4.13 Importance Level and Availability For Each Factor

Factor	Importance Level	Calculated FW
Strong Administrative Support	2.9	2.73
Culture and Environment	2.5	2.47143
Planning for Technology Transfer	2.8	2.23929
Education and Technology Transfer	3.7	2.58214
Role of Organizations and Staffing	2.9	2.31964
Role of Researchers	3.3	1.45893

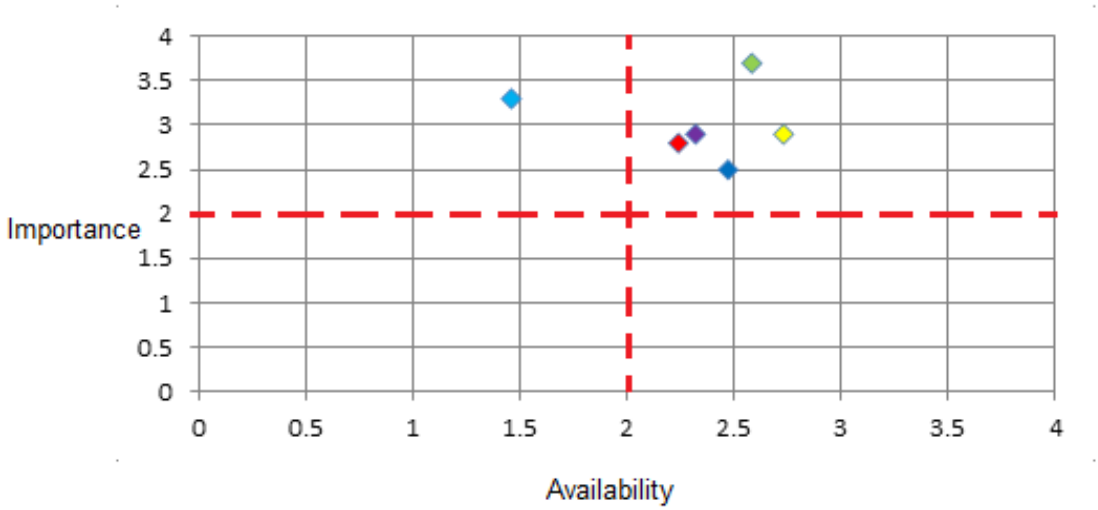


Figure 4. Factors Location on Importance VS Availability Chart

Where:

- Represent the Strong Administrative Support factor
- Represent the Cultural and environment factor
- Represent the Planning factor
- Represent the Education factor
- Represent the role of organization and staffing factor
- Represent the Role of Researchers

Chapter 5: Recommendations

Based on the location of each factors on the Importance vs Availability chart the following are the list ofconclusions and recommendations:

1- The funds and the efforts been spend regarding the Strong Administrative Support, Culture and Environment, Planning, Education, and the Role of Organizations and Staffing factors must directed more to the upper right corner of the chart, and each factor has the higher importance scale must get the highest funding priority.

2- Regarding the Role of Researchers factor, more effort must be spent to move that Important factor from the Upper Left corner to the Upper Right corner and this can be done by focusing more on researchers and research centers, also applying results obtained from research's without any restrictions, more over; the government with the local companies and organizations should be funding research centers and The amount of funds should available once researchers need it, also the communication between a Company or an organization and researchers must be always present.

   The most important recommendation is that Government and local companies must utlize research centers to become a center for solving problems as it should be.

3- The other factors that been Ignored in this project as they have less important level should be subjected to this study to identify if they are available or not in Qatar and find ways to eliminate them if they are available as a part of saving effort and cost, as the factors importance level will change by time.

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