

## Diagnosing Technology Transfer Processes in the Oil Industry: The case Study of National Iranian Oil Company (NICO)

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### Abstract

This study aims to describe the experience of technology transfer process performed in national Iranian oil company (with regard to rich resources of gas and oil in Iran) using the phase-gate model. The present study is applied and uses the descriptive analysis method. The present study is qualitative and is in descriptive-oriented practice category. The statistical society includes 12 experienced experts involved in studied projects. In this study the technology transfer is referred as a process composed of some stages and gates in order to making centralized decision. A technology transfer project cannot be effective unless it provide development and profitability for organization. In today developed world the technology transfer should be considered not only as a technological project but also as strategy theme.

**Keywords:** Evaluation, technology transfer, stag-gate model

### Introduction

Technology transfer is regarded as one of the important business strategies in today dynamic and fast changing world. Organizations increasingly need technology transfer to deal with highly complex products, to deliver better services ( Muhamed et al, 2012), to save time and finally to meet the customer requirements( Sodhi,2007). Many companies cannot accomplish transfer process due to lack of careful planning, lack of appropriate supportive team and lack of assessment and prediction process. Study of many technology transfer projects in different industries showed that in many projects the technology transfer has been considered only as purchase project from foreign party and many important activities associated with technology transfer have not been considered during this process. Many studies conducted by scholars suggest that technology transfer is effective when internal factors related to will,

suitable planning, presence of infrastructures required to technology transfer and external factors related to tendency of external technology investors and owners to invest in technology are observed (Robert and Berry,2001, Wong et al 2003., ,2004 and Phal,Cohen , Choi and Lee, Cheisa,.1994,Moo,1998.). The successful and efficient technology transfer requires codified strategy and created transfer mechanisms. Technology is completely and successfully transferred when its attraction, adaptation and crystallization conditions are provided. A country or an industry has been proved to be successful in technology transfer when the internal conditions of technology have been provided for it and technology transferee has obtained ability to produce and extend technology (Jasinski, 2009).So some solutions are required that can manage the technology transfer process correctly and attend efficiently to key factors and resources (Olson, 2010). This study presents the technology transfer experience in three selected projects in national Iranian petroleum industry. Stage-gate model has been used in several industries in the world successfully. This approach has been developed by Jagoda and Ramanatan (Jagoda and Ramanatan, 2005, Jagoda et al, 2010). This model is concentrated on some stages and gates. The present study contains 4 sectors including description of model stages and gates, a brief description about method and specifications of three selected projects, analysis sector of data considered from 3 projects in model, then discussion and conclusion sector and finally the resources.

#### Identification of the analytic Stage-gate model

This model has been used successfully to plan the development of new products in big industries. Stage-gate system is a management tool to develop the new product that is proposed by Cooper in late 1980 decade (Cooper, 2008). This model was currently used in management processes of new products development some years after being presented by Cooper. Jagoda and Ramantan presented a conceptual model for technology transfer management in order to develop the systematic achievement (Ramanatan and Jagod, 2005, Jagoda et al, 2010). Although the stage-gate process has been initially presented to develop the new product and it can be claimed that it is the best method in this area . This method can be also used as a structured decision making tool in each investment and research project that observes all attitudes of the beneficiaries. This model is a practical framework composed of six stages and gates. Each stage or phase consists of a set of prescribed activities and duties and a technology transfer team is undertaken to gather, integrate and analyze the information . In each gate the go, kill, recycle or hold decisions is taken. The decisions may go back activities in order to be performed again or advance them to the next stage. This model allow organization to minimize the risk of their failure in technology transfer process. To use this model readily in the technology transfer projects, the model template is divided into three stages: start, planning and implementation. These stages are divided into three sectors in each stage based on key factors of the management team. The intended model has been shown schematically in figure 1 and then the mentioned cases in stages and gates are explained.

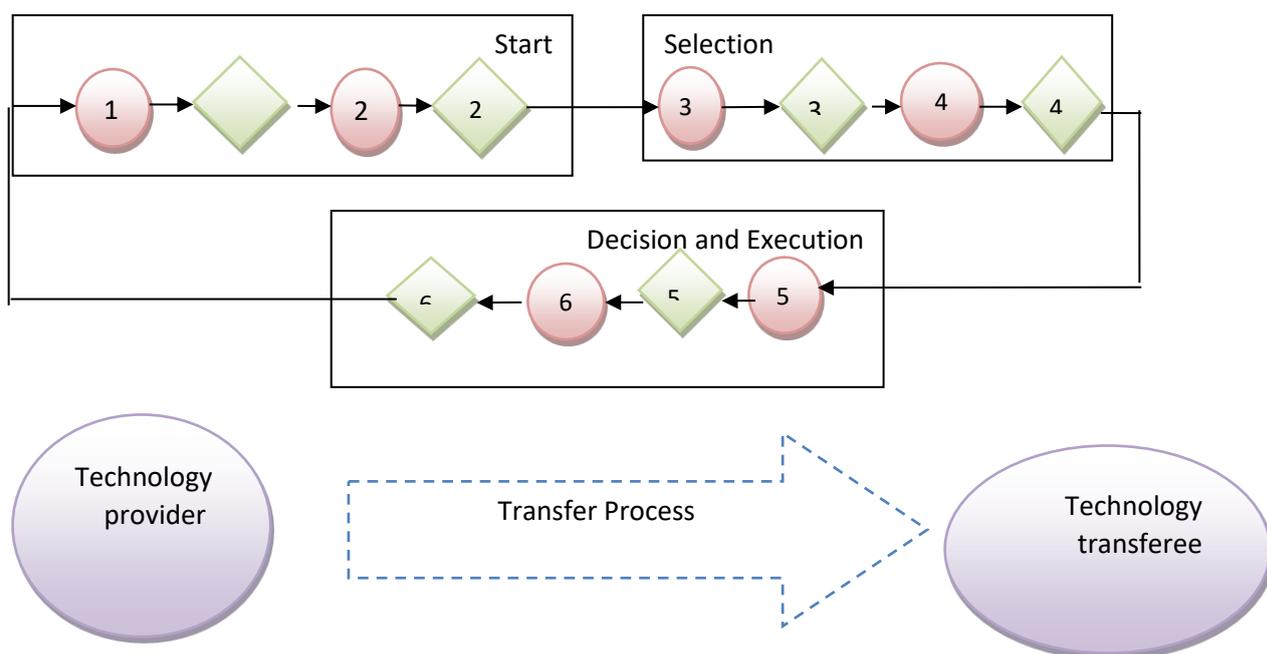


Figure 1. Phase-gate Model

Table 1-2 summary of the stages and gates of the stage-gate model

Start stage	Planning stage	Implementation and assessment Stage
Stage1: opportunities spotting and identifying value enhancing technologies	Stage 3: Negotiation	Stage 5:Implementing technology transfer
Gate1: confirmation of the identified technology	Gate 3: finalizing and approving agreements	Gate 5: Implementation audit
Stage 2: focused technology search	Stage 4: preparing of technology transfer project implementation plan	Stage 6: Assessment of technology transfer impact
Gate2: confirmation of project	Gate 4: Approving implementation plan	Gate 6:developing guidelines for post-technology transfer activities

The first stage (opportunity spotting and identifying value enhancing technologies): This stage is the starting point in each technology transfer project. In this stage the project team that in present research is a group of the technology transfer projects experts in petroleum industry evaluate the market tendency and direct it toward customer preferences and expectations, technological and economical feasibility or cost analysis, competitors preferences and government regulation in order to detect the potential technologies.

Gate 1 (confirmation of the identified technology): In this gate a top manager team evaluates the proposed proposal based on organization strategies and operational criteria. Also the financial feasibility of the proposal is evaluated in order to evaluation tools of the project.

Second stage (focused technology search): The strategic fitness, market attractiveness and technological leadership is considered. This study also includes technology specifications, financial costs of the project, project planning and business study.

Second gate (project confirmation): this gate is critical. An initial list of the technology providers is identified and determined based on technology strategy of the institute. The top managers stop project to return it back to the second stage if they were not satisfied about business examples. If they make a Go- decision the technology transfer committee is changed to a full technology transfer project team.

Third Stage (Negotiations): This stage is started when negotiations with the shortlisted suppliers is started. This process may continue until they reach agreement on issues related to payments while financial benefit of two parties is preserved. The competitive level of a project, business requirements and transparency of the purposes are considered. To manage the process better two transfer parties should be in frequent contact and communication.

Third gate (finalizing and approving agreements): This stage is completed once negotiations have reached a satisfactory level and details and terms of the agreement are approved by parties. Technology transfer team and top managers evaluate the comprehensiveness of the transfer agreement details, the appropriateness of the proposed mechanisms, and affordability of the payment amounts and time frames. If revisions are needed the project may have to go back to third stage.

Fourth stage: (preparing technology transfer project implementation plan): some purposes are determined for activities based on amount of access to customer and quality of the assessment system. Technology transfer steering team and transferor present the initial technology transfer plan.

Fourth gate (approving implementation plan): top managers' team and steering committee evaluate feasibility of the technology transfer implementation schedule and efficiency and adequacy of training. This review is conducted by results obtained from transferor. The technology transferee should be very careful and pay special attention in this stage since very irrecoverable difficulties will be developed in implementation stage if this stage is passed incomplete. Some or all activities exited from the stage 4 will be again returned back to the same stage to be implemented again or refined if requests of the top managers are not satisfied by technology transfer steering committee or results are not consistent with the standards. Also initial payment to transferor is performed in this gate.

Stage 5 (implementing technology transfer process): Technology transfer process implementation needs suitable and good project management. In case training is required the information transfer procedure should be immediately performed. Also it is necessary to consider the time those material, parts and services are provided to ensure the implementation of the intended programs.

Gate 5 (implementation audit): This stage is focused on gaining an understanding of barriers that prevent successful technology transfer. The top managers may develop an internal or external audit committee to gather reports related to presented trainings. This report may be focused on experience of implementation with critical factors like necessity of the presentation for both technology transferor and transferee, antonym experiences,

preservation of the time frame integrity, cost imposition, training area and skill upgrading , produced information and information effectiveness.

Stage6( Technology transfer impact assessment): Evaluation of technology transfer projects is difficult since it is a complex process with multiple outcome that could be emerged across the life of a project. Also it is very difficult to evaluate marginal profit of the technology transfer project. The enough precautions should be taken to evaluate the technology transfer projects effects from financial, technological, market and organizational using balanced score card.

Six gate (developing guidelines for post-technology transfer activities): The important decisions are made in this stage. In this stage the decision is taken whether to continue the use of available technology by improving profitability or try another technology transfer process. In this condition some guidelines are presented by top management to accelerate the future activities of the technology transfer by giving consultation to the technology transfer steering committee. These activities may include new technology transfer project, development of technology through internal research and development or applying a combination of both in partnership with technology transferor.

### **Method**

In this research 3 studied cases were used to present the technology transfer (TT) experience in national Iranian petroleum industry. According to Jagoda study (2010) the case study strategy is very effective when research involves why and how questions. Case studies have gained considerable acceptance in business research over the recent years, particularly as a selection method to

examine some phenomena in real life settings. This research considers transfer of 3 technologies namely drilling rig between Baker company and electric utility company, Demercaptanization or DMP process between VIINUS company and petroleum industry research institute and reservoir studies technology between Statoil and research institute. They were selected because they were close to study time, were presenting new technology process in oil products and pieces, were presenting high quality products and observing environmental considerations and also importance of the transferred technologies. The first technology transfer project was started since 1993 and domestic party stated that it enter into a contract if manufacturing process is performed inside .The contract was canceled due to sanctions imposed by America after 12 years of cooperation. Then they continued their activity for some years by providing an internal consortium agreement but the agreement was canceled again due to lack of enough equipment and new technology. Some next years an agreement was signed with French and it was canceled because sanctions were imposed and foreign party did not obligate to supply equipments and now it is prorogated. The second project was started in 2001 and finished in 2012. The third project was started since 2001and was completed successfully in 2004. The transfer of intended technologies provides ability for domestic party to manufacture and use that technology for a while after completion of transfer. This research was performed by 12 persons of the national oil industry managers in cooperation with researchers in a 9 months period and type of this quantitative research was applied.

The mentioned companies, that their activity axle is oil and gas products, are famous from expert's perspective for having regulated policies and new and top management methods. In this project we focus on TT performed by these technologies and analyze it by Stage-gate model.3 projects of drilling rig between Baker company and electric utility company,

Demercaptanization or DMP process between VIINUS company and oil industry research institute and reservoir studies technology between statoil and research institute were selected to perform this research because they are close to the time of study, present high quality products and observe environmental considerations, present new technology process in oil products and also these transferred technologies are important. The mentioned projects provide a comprehensive insight into advantages and disadvantages of the TT process. To gather information documents of the projects and semi structured interview with top managers involved in projects were considered. Stage-gate approach was used to develop the search and conduct interview subjects in order to perform information collection process. These interviews were conducted for 45 minutes up to 2 hours during research. Three selected projects are very similar to each other functionally and are included in medium- sized companies group. According to oil technology transfer companies in developing countries like Iran the production of these companies reach to 10 million dollar annually and are referred as the biggest and most developed companies in country. On of the most important factors in conducting qualitative interview is flexibility.

## **Analysis**

### **1-start**

1-1-Opportunity spotting stage in 3 studied projects:

Project 1: Demercaptanization TT, as respect to increasing exploitation from reservoirs that has enhanced sulfur contents in crude oil and also sour crude oil exchange agreement with neighbors, the sulfur contents concentration of the refineries feeds has been increased gradually throughout country . Merox process is one of the sulfur reducing processes licensed by a American company and recent sanctions have developed some problems in this procedure. The R&D center decided to transfer DMD technology from a Russian company called VNIIUS in result of understanding necessity of demercaptanization technology in country refineries in order to select suitable technology and supplier and with the aim of satisfying needs and solving problems of the country refineries. In this method the crude oil is also demercaptanized beyond oil and gas products that is unique property of this technology. The technology transfer agreement has been started since 2001 and will be implemented for 20 years The foreign party has undertaken to provide updated and developed technologies for Iranian party by considering technological changes.

Second project: technology transfer of reservoirs studies project: The reservoirs studies plan was presented due to technology transfer of localization and improvement of Iranian consulting engineering companies in reservoirs studies . To achieve this aim the international famous companies were required to select an domestic party for themselves in comprehensive study of hydrocarbon reservoirs. In implementation of this plan( comprehensive study of the field and providing the plan of Ahvaz, Maroun and Bibi Hakimeh fields development) statoil and oil industry as executive, research and development management presenting national oil company as employer and National Iranian South Oil Company Were as supervisor. It was determined to conduct the project over 3 years and contract was signed by parties after some rounds of negotiations in July 2001 and each 3 plans were completed successfully in 2003. Since statoil company in Norway was one of the biggest oil producing companies in north sea and with respect to this fact that most hydrocarbon resources of Norway is studied and developed by this company so it has many useful experiences and could help to develop these reservoirs in three defined gas fields and meet technological need of country. On the other hand entrance of this technology provides the

new knowledge and skill within country that require training and proficiency of the involved forces.

Project 3: Drilling rig transfer: Electric utility company assigned the production of strategic products in upstream petroleum industry as macro purpose and it was very possible that oil and gas drilling industry meet serious problems since these products were monopolized by some American companies and many sanctions were imposed us. One of the long term and important purposes of this company has been localization of the most up to date strategic equipment and technologies and so Iranian electric utility company has stated in its signed agreement that it purchase equipment provided a part of these equipment are manufactured inside country to increase this share inside and also it developed necessary condition in country in order to provide manufacture opportunity. Equipment localization developed many side benefits for country. Of all these benefits is that the industry sector achieved higher self assurance and power to bargain to such an extent that a company like Cameron returned back to Iran, after these equipment were manufactured and the local capability of Iranian company was reflected, to complete its incomplete activities. The Cameron Company left Iran in result of sanctions that developed serious problems for oil industry. One of the technologies was xMax technology that the electric utility company entered to agreement with foreign parties after several rounds of negotiations, when it could not reach agreement with some domestic companies, and could constitute a consortium composed of Arak Machine Manufacturing, Iran oil equipment and Hadid Machine Manufacturing with its management. After implementing consortium the company had to cancel consortium due to lack of suitable equipment and technology and signed an agreement with Baker company that was first performed with 40 percent aid provided by the Baker company and then was performed with 100 percent domestic production after the expiration of the contract. The technology transfer has been initiated since 1993 and is continued until now.

#### 1-2- Effect of the diagnosed technologies in each of the three cases

Project 1: with regard to presentation of available opportunities in previous stage the steering team concluded that catalyst consumption is less in this process with regard to higher activity and stability of this catalyst. Also with regard to higher thermal resistance of catalyst the caustic survival operation is easier and need much less thermal control in process. Economically this process need less cost than other processes and also country will not be more dependent on foreign country when it is localized.

Project 2: according to this contract the valid database software was purchased, installed and trained for oil company and petroleum research institute industry. Some achievements of this plan are on the job training for project managers particularly about team work and project management, prepared three squares database, improved scientific capability of institute staff, transferred group work culture, improved data transfer protocols and culture to used them, developed self assurance of staff about their potential and actual abilities, unique organization and identification of specialized software.

Project 3: with regard to the provided opportunities by transfer process the drilling rig can be transferred into country. Drilling rig is referred as one of the most important and strategic goods in upstream petroleum industry. This product is strategic to some extent that in past decade only some American companies were monopolized to produce it and were not interested to cooperate in the field of technical knowledge with different companies. So with regard to stated contents the consistence of offered proposal to transfer technology with strategy of organization was confirmed. As respect to the achievement of producing this rig

inside country without any significant need to cooperation of the foreign party the necessary condition to produce another related technologies can be provided.

#### 1-3- Consideration of focused process in each project

Project 1: In result of conducting library and internet searches the research institute found that two similar processes of demercaptanization named sulfurex presented by French and merox presented by U.S and with regard to sanctions it was not possible to cooperate with American party and also French party was able to cooperate and present technology to the country under very special and limited condition in such a way that French party did not show any tendency to communicate directly with institute and tried to be in contact indirectly. In technology transfer period communication was conducted through the president office that shows necessity of direct state intervention in technology transfer process. This intervention made the office as a center for technology monitoring that try to identify domestic technological weaknesses and opportunities to transfer technology from abroad.

Project 2: in this transfer process the technological experiences, documents and information were more transferred than equipments and plants. Since this process was naturally different from other processes so using the current pattern was somehow difficult and on the other hand this TT contract was in fact side product of a main contract namely reservoir study so stages of the TT process were not passed or were passed incompletely.

Project 3:As it was mentioned before the electric utility company developed the close and continuous communication with domestic agents like Arak machine manufacturing and foreign agents like Baker Hughes and Belgian company. This helped them to recognize their weaknesses. In this stage the company selected some companies to sign agreement with them that some of them like Belgian company did not communicate for a long time with domestic party. The researches showed that necessary tools were identified and purchased to decrease defaults resulted from entrance of the new technologies and results suggested that in this transfer process machine was transferred as well as technology. The foreign experts entered country during transfer process from foreign party and started to produce inside country. The pieces were imported from abroad if needed and the domestic work force were trained to used them.

#### 1-4- confirmation of each Project

Project 1: It was not possible to buy technology and cooperate with American country due to presence of economic constraints in country and domestic party could start cooperation with French company after some rounds of negotiations by considering and observing limitations and regulations of the foreign party. The sulfurex process were performed provided that domestic party undertake to repair and remain and foreign party will provide technological information if needed.

Project 2:National Oil Company were ready to sign reservoir study contract and also made correct diagnosis but no systematic study was conducted due to technological need with the aim of TT and in fact faced a performed practice and even if we suppose that needs were assessed the main need of institute was obtaining study technology of Fractured limestone reservoirs and preparation of field development scenario that Statoil has not enough experience about first subject and perhaps better alternatives could be selected. To conduct this study the Statoil used institute experts and also Iranian scholars abroad.

Project 3: The Baker Company has continued no longer to cooperation with Iran since 5 years ago following international sanctions imposed to Iran by America. Then a famous Belgian company was informed about cancelation of cooperation and offer cooperation with Iranian party. After several negotiations the foreign party accepted to sign contract but the request

of electric utility company to insure purchase from petroleum ministry was performed with some changes and it is some years that this production has been stopped too which shows weakness in technology transfer due to presence of economic sanctions and inconsistency in management and making decision sections of the petroleum industry. TT related to Baker and Belgian company was conducted as transfer of technology and transfer of machinery too.

## **2-Planning Stage**

Planning is the second stage of the technology transfer. This stage is started after the decision was taken to transfer technology. In this stage it is necessary to focus on planning a key map to manage TT process. This stage has important role in TT process. The company negotiates on details of the TT and design a plan for TT.

### **2-1- Negotiation in each of the 3 projects**

Project 1: since the VIInus company announced its complete tendency to transfer this technology and also to manufacture its catalyst inside the country the institute negotiated with this company to achieve its aim through cooperation with mentioned company that has modern and acceptable technology in this regard. The legal transferor of related technology to research institute of the Petroleum industry is TAT petroleum company that signed contract with research institute of the Petroleum industry on behalf of VIINUS to transfer technology .In this contract the foreign party has identified two research and engineering units and legal and international unit as involved units in order to sign contract that engineering unit presented information related to technology content and domestic party has confirmed it after various considerations. Any type of cooperation related to DMD process was conducted during 20 years partnership and VIINUS Company was obligated to inform institute technology developments and changes. Since in this type of TT process technological information were often transferred, in transfer of some tools except reservoir and transformer that is performed by domestic experts according to agreements the pieces were imported country through Caspian Sea and all shipment costs like insurance premium to delivery in ship must be paid by foreign party and after that pieces were released cost must be paid by domestic party. Also according to contract transfer costs have been paid by president office from country oil budget after each transfer process over 20 years cooperation. At the end of negotiation TT was divided into two phase of providing technology pilot in institute and technology industrialization.

Project 2: Complete cooperation was formed between statoil and institute that provided supervision and control on Maroon oil and Gas Company. During implementation of this plan 10 GMC and 28 TC were totally manufactured and study was entered to next stage after confirmation of each stage by employer and supervisor. With regard to reasons presented in previous stages the main negotiations were on field study and TA was not very discussed in these negotiations so presence of experts was not used in negotiation and signing contract stage and also no clear and private work description was provided for this subject. Following terms and contents of the agreement Norwegian experts presented in Iranian petroleum fields to consider condition and then performed reservoir studies using their developed modeling and planning. So transfer in information and experts type was performed and devices were imported to country if needed and all transportation and shipment insurance costs was undertaken by foreign party. Payments were concluded as contractual that were paid them in several periods after completion of each phase.

Project 3: Electric utility company negotiated with foreign parties through policy making entities like good company to obtain necessary validity. It must be noted that according to

statements of this company some agreements and paragraph of the contract were set by intervention and consultation of the good company. According to contract the foreign party had to use the most up to date technologies in country and this one of the requirements of the contract and Iranian party had undertaken to pay all rights of the foreign party and only allow the international famous companies to present and interfere within country. This is also interesting that after successful cooperation of this company with other companies especially with a company like Baker other international famous companies asked Iranian companies to cooperate because presence of their competitors in Iran market. So this policy provided competition in private sector and with presence of international famous companies. The Managing director of the electric utility company could force the American Baker company to negotiate with Iran and sign a contract that half of the production process was performed within country and locally when he approved that Iran can purchase petroleum equipment from Russia and a part of production process can be performed locally. In this type of negotiation an interface named governmental interface company had mutually interaction with domestic and foreign party.

#### 2-2- Completion and confirmation of the agreements in each project

Project 1: According to agreement the VIINUS company is obligated to provide the required catalyst of the process and institute is decide to purchase catalyst from VIINUS or from a third party. Also institute can refer to related court to complain if catalyst is not provided by the VIINUS.

Project 2: According to conducted negotiations Statoil company has undertaken to consider necessary field to provide reservoir in three regions of Bibi Hakimeh, Maroon and Ahvaz during contract period and present required conditions to reservoirs plan. Otherwise domestic party can ignore its obligations and does not pay necessary amounts. Also it can impose the delay cost to foreign party.

Project 3: It is clear that according to performed negotiations started procedure in that years has been accepted and confirmed by two transfer parties but according to wrong policies that are not discussed anywhere this procedure has been stopped from 5 years ago and again 12 years need to be passed in order that we can continue that procedure.

#### 2-3- Preparing a functional plan in any transferring project

First project: Research center has the necessary ability to perform fundamental and detailed planning and has made utmost use of this potential. But regarding making equipment and elements, some parts such as pumps and instruments are imported from foreign countries and the rest such as vessels and heat exchangers are supplied by internal contractors. Therefore there is a need for making changes in refinery so that it can obtain sufficient skill and expertise to make internal parts.

Thus there is a need for holding instructional classes and providing the relevant courses inside and outside the country so that manpower can enhance enough information for designing and making machineries and sets. Functional instruction must be performed by expert managers. They present and devote their knowledge based on previous technology transfer projects and code the relevant cases so that they can update system information. Lack of interest in formulating has confronted functional programs of actual technology transfer process with loss. It is worth noting that as far as there is no formal and legal connection between two parties, research center does not receive surplus protection with new technology. Based on agreements the process of installing and starting up the machineries and sets are borne by Importer Company during the term of the agreement by two parties. If there were a need for importing new equipment for studying vessel accompanied by

machinery, a foreign expert would arrive to the country and instruct all details and functions to Iranian experts, after that they had the ability to perform operation process of machineries and sets.

Second project: technology transfer program which was considered in the contract included holding official courses for special subjects, holding instructional and scientific seminars, in service instruction and purchasing required soft wares so that Iranian party can perform similar job independently or with more participation share and as the direct in charge party with foreign partner cooperation by obtaining following cases after finishing the subject of contract. Considering the emergence of new technology there is a need for instructional courses for the employees so that they can learn new knowledge and use it for their more efficiency but general title had been specified in the contract for example holding instructional classes but nothing was mentioned about the type, quality and location of the classes and the same subject and disputes between Iranian parties( oil exploitation company and Maroon gas Iran national oil company, oil industry research center) caused some of the opportunities are lost and also the same subject is true for subjects and contents of scientific seminars and soft wares. Administrational problems for dispatching experts to foreign countries were among other existing problems in transfer process in its functional plan. To perform a common job it was necessary whether Acetate Oil personnel would attend in Iran which was impossible due to shortage of software and hardware facilities but became possible with financial supply at the end of plan or oil company research center experts would attend in Norway which in spite of all attempts performed many missions and tours were not done due to many different administrational problems in getting permission from presidency institution that was a great impact to in service common instruction. Also American economical sanctions caused that some softwares and hardwares are imported from European countries which were not consistent with the conditions of Acetate Oil Company.

Third project: In project functional plan, reproducing and repairing the equipment are very remarkable. After Baker Company has left Iran, some of its experts remained and these sets were built with the exclusive plans of instrument making company. One of the problems the company encountered with was that the raw materials included nickel which was among sanctioned materials and an interesting method was used for its importing to Iran. Raw materials were purchased by a foreign company and primary drilling operations were performed on them in a European country so that raw material is converted to new material and then shipped to Dubai and transferred to Iran so that production operations would be performed in Iran to last final step. According to Company's approach for instruction it was decided that 3 persons would be dispatched to Hues Baker Company for three months to get familiar with production line , standards and working culture of our country.

2-4-finishing time program of any project transfer

First project: The term of this contract is ten years and its starting time is since 1380(2001). The trend of exchanges between two parties show that technological information transfer has been performed in written and non-written form in the specified time and based on timetable ratified and negotiated between two parties. Also the time of executing process was based on determined time period.

Second project: the execution period of this contract is 3 years and its starting time is since 1380(2001). With regard to arrival of Norwegian experts to perform geological investigations, three locations have been specified to create more sources for technology transfer in the form dispatching experts and transferring study and technological information for which researches conducted occasionally based on the needs of foreign party. Many problems

dissolved when doing the plan but they created negative effects due to delay in effectiveness and efficiency of technology transfer.

Third project: the time period of performing technology transfer process has been since 1372(1993) till now that has been conducted by two foreign parties: American and internal production consortium respectively with the support of one instrument and two other internal companies and finally with cooperating with Baker company that this cooperation was interrupted as well. Three consecutive meetings were held in Bahman (February) and Esfand (March) of 1390 (2011). Existing sources were used due to absence of some experts since 12 years ago until now and by changing the positions of some of them and by performing investigations and considering the fact that this project was selected among case studies it became evident that cooperation had just been made with a completely private and foreign company that has been among successful projects in initial years but finally regarded as failed projects.

### **3- Performance and conducting step**

This step is the last step in technology transfer process. The complexity of transfer process in this step depends on the manner of performing previous steps in the company. The receiver of the transfer performs fundamental changes in order to receive new technology and some of the problems might not have been solved. Company assesses the experience of technology transfer in this step. The successful result and the development of obtained information in this step often results in growth.

#### **3-1-The process of performing all three projects**

First project: the research center could in the process of transferring this technology make utmost use of internal experts and specialists so that all basic and process detailed planning was done completely by the experts of research center and internal required equipment was built inside the country. The quality of imported Mercaptan technology was assessed based on existing standards and confirmed. Also considering the fact that research center could establish and perform technology some while after its arrival, this can reduce displacement costs of parts and equipment. On the other hand the arrival of new technology that has been accompanied by building some locations for manufacturing vessel, heat exchanger and other utilities, has provided suitable opportunities for internal experts and could absorb young and expert man powers from the universities in the field of new aspects.

Second project: among functional problems during transfer process we can refer to not predicting technology transfer in the part of Iranian party to Acetate Oil Company. In some steps of the study especially regarding geological science, research center experts were more proficient than Acetate oil ones due to valuable records and experiences that existed in in research center about geology of lime cleavage vessels and in this section it is Acetate oil experts who attained a new technological knowledge. The witness for this claim was scientific disputes arisen for the problem of BiBi Hakimeh square and Ahvaz geology among experts of oil industry research center and Acetate Oil resulted in arbitration of Imperial University outstanding professors which held in favor of Iranian party. For this reason if this issue had been predicted perhaps we could have benefited more in its return. Among other problems in performance step is not having minimum necessary preparedness for obtaining technology. As mentioned before, no comprehensive study was conducted on the situation of research center before starting the plan, therefore the needs and shortages were not considered completely. For example research center had no relevant person for some sections who can obtain technology with participation in the plan and or some of the persons who were present could not participate effectively in the plan due to shortage of knowledge and their

insufficient information and in some cases shortage and not suitability of software and hardware made the same problem exactly. Among other problems we can refer to lack of identifying special needs. In some cases Iranian parties themselves did not know what they wanted and thus a remarkable time period was lost for this reason. Acetate oil continuously requested Iranian party the list of requirements and usually it was delivered by delay and it is interesting to note that the list of Maroon oil and gas exploitation company was not sent up to the end of year. Also in performance step it became evident that Acetate Oil Company has not used its best experts. In Maroon oil and gas Exploitation Company the relevant experts were in charge of supervising the plan in one hand which actually must have had greater technical knowledge than the plan implementers and on the other hand they had to play the role of receiver of the technology in technology transfer process that this contradiction showed itself during performing the job and made some problems in some cases. During performing the project research center organization was not suitable for this work due to insufficient work in study plans with regard to line and staff. Among other functional problems we can refer to cultural and relational problems. The research center did not have such a close relationship with a foreign company before, so there were cultural differences, weaknesses in English language and communication culture and teamwork culture which had many negative effects on the job. On the other hand non conformity of weekly vacations in calendars made many problems in communications in terms of annual vacations. It is worth noting that Norway country has many official vacations in terms of day off like Iran.

Third project: after performing transfer process project it became evident that the personnel and the evaluators of purchase plans and goods and equipment supply in oil industry lack the necessary expertise in this respect and this caused the import of non-qualitative goods such as Chinese goods to the country and oil industry complex. Also it was announced that some of internal big excavation companies have been converted to dealers for foreign companies and tend to foreign purchases. These companies have started cooperation with Chinese companies especially in recent years which offer their products with cheap price. These products have very low efficiency that is specified with the simultaneous assessment of price and productivity that is not cost effective in terms of price as well. Also it was observed that those personnel who were in charge of order confirmation did not have necessary competence. Excavation drill is regarded as an important and leading technology for the country in technology identification process. The results showed that no long term support was made for this project. There was a need for presence of experts familiar with technology management terms to provide some help in documentation making, amendment and development of transfer processes and aboriginating in the identification step that this important job was not done in the project. It also seems that in protection phase no suitable proceeding have not been performed so that an aboriginated process was stolen by a Chinese company.

3-2- investigating the performance process of any of the projects

First project: when the intended technology objectives (meeting company's needs improving economic situation and conforming technology to company environment) were determined, different potentials and limitations (manpower, technology cost and supporting services) were evaluated. When objectives were determined and different potentials and limitations were understood very well, there was a need for preparing criteria and standards (such as technological development, economical sources, technical properties etc.,) to specify the rate of objectives fulfillment that was not done for this project. Among those operations which

must be performed in evaluation phase we can refer to successful evaluation of protection activity that was not considered.

Second project: Transfer Receiver Company expects to be able to import technology from its origin of production at least for specified time that has been three years in this case. The ability to perform technology by 100 percent and understanding required inputs for the main subject in receiver country was regarded as one of the main concerns. In this project all developed problems during performing transfer based on contract were divided between presenter and the receiver of the transfer.

Third project: considering the shutdown of the project in recent years, transfer functional step follow up shows that transfer process of excavation drill was done successfully by instructing 4 internal personnel in foreign party country for three months and arrival of foreign party expert so that Iranian party could establish consortium with some internal companies independently and continue its production that unfortunately because of equipment shortage and lack of new technology this production process was interrupted as well.

### 3-3-Evaluation of technology transfer in three projects

First project: the experiences obtained from this study showed that technology transfer from technology source has been done directly. In this plan technology transfer was fulfilled in its real meaning and key information and technology have been transferred so that now research center alone is able to start up Mercptan omitting units in industrial scales. The emergence of new technology results in upgrading knowledge of employees engaged in the project and learning has been performed periodically and worth noting point is that some of the employees were not willing to learn new technologies and confronted learning trend with delay. Also no suitable assessment was considered for work group learning so that after specified time no proceeding was done for assessing the knowledge and the employees' update and this factor itself was an obstacle in the way of transfer process.

Second project: if we want to analyze technology transfer process with the objective oriented outlook it can be said that in spite of existing problems, objections and obstacles this process was totally finished successfully. The witness for this claim is that research center could proceed independently to make contract with oil development engineering company for studying Yadavaran (Koshk and hosseinieh) field and Azadegan field just some months after finishing research center plan and only used the cooperation of an Austrian company for some parts. By assessing the scientific quality of participants in the plan and comparing them before and after performing the plan we can explicitly reach to above conclusion. Of course employees' personal properties is very important in this respect. Except technology transfer in technical fields what is interesting is that many experiences were gained in the fields of plan management and performing it by multi-disciplinary teams and Norwegian useful methods were used.

Third project: evaluations regarding supports show that we must consider this point that technological cooperation formation of this company with foreign parties and movement towards technological aboriginating transfer process were severely influenced by the manner of public institutions protection and especially the intermediate goods providing companies so that in the beginning of common activity of producing excavation drill the cooperation trend with the support of goods providing company is assessed suitable but considering raised materials in relevant meetings, company's managers consider public improper supports as one of the important factors for technological cooperation interruption. Regarding the cooperation environment we can declare that sanctions have had great impact on common trend of cooperations and this point can be found in announced historical trend in the report.

Regarding substructure also it seems that electricity equipment producing company has made use of experienced managers and experts and could lead technology transfer process in initial years and attract the foreign parties trust to transfer technology to the country with the objective of upgrading internal potential.

3-4- Guiding development to perform following activities of each of the projects

First project: due to company's success in transferring technology, some contracts have been made to establish some plants in the country. Based on announced reason and enhanced experiences by the managers in transferring this kind of technology, authorities came to know that they could manage technology transfer projects in this respect. They themselves also could design and start up new brands of these Mecaptan heat exchangers and undertake their maintenance.

Second project: no exact assessment on the project was done before that can develop the study of vessels in the country by the help of a foreign company. Based on enhanced experiences from this study, the relevant authorities felt that they could manage technological transfer projects by a new way. As mentioned they can perform investigation process of vessels independently or with the little help of foreign party inside the country so they can obtain accessory articles to complement technology transfer process although no serious decision is made regarding it.

Third project: this project has continued since 1372(1993) automatically and raised as the first case study with a completely foreign company that could finish technology transfer with success at the start but for the mentioned reasons it has been shut down for some years so the assessment of interfering factors causing the project shut down and prioritizations of the defects can provide strategies to remove them and continue the operation of the project so that other technology transfer projects can be implemented.

#### **Discussion and conclusion:**

Step-threshold model was used in present study offered by Jagoda and Ramanatan in 2003 and 2005 to investigate the experience of technology transfer in oil national industry in this report. Based on Step-threshold model the key issues affecting on the success and failure of technology transfer in any step were determined. Technology transfer process as used by Jagoda and Ramanatan was investigated in all three projects and in two steps. Companies which were parties to the contract and engaged in industrial affairs for more than two decades could identify the proper technology. The key issues related to allocated operations at the first steps of this model can be enumerated as follows.

Technology has not been identified as the first priority in oil industry, the development pattern for development in Iran oil industry has been based on exploitation and operation. Presence of this pattern was due to formational basics of oil industry in Iran and also the intense dependency of our country to oil industry. All managers (those who were interviewed) have emphasizes on this point as one of the main reasons for not developing of the technology in oil industry.

Internal provision industries are not able to attract transferred foreign technologies to oil industry. This problem was arisen due to lack of industrial substructures in internal industries and more important than that lack of effective communication between government and research and university centers and industry.

Intimate communication and continuous relationship among high ranking managers helps in better performance process of technology transfer team in the first step. Intimate communication and continuous relationship among high ranking managers can cause sharing

the information in different aspects. The experienced team members could identify and assess the outreach sources and fill the vacancy in the second step.

Having information and experiences in other technology transfer techniques and local market information and customers 'needs which are mainly from China, Korea and India help the receiver of the transfer to identify its required technology.

The above mentioned companies did not present a complete picture in the first step. Capital investment was done due to interest of internal party managers and authorities to obtain the technology as soon as possible and more market share and equally more interest which was not questioned and this hypothesis was replaced that new technology can produce new products with higher quality and thus initial costs are covered by more selling and many expenses were borne by internal party.

Comparing with the initial activities, planning step has been done with some weaknesses in abovementioned companies.

Negotiations were made only on the prices and other key factors were ignored. Project team tried to accelerate transfer process and reach to implementation step. Some of the functions even weak function of some individuals was ignored. Raised key issues in this section regarding all three projects are as follows:

The existing problems in disclosing information in transfer process of above projects in this section, confront s step 5 and 6 with obstacles and postpones the transfer.

Delay in developing fundamental changes to receive technology in the receiver company itself caused redesigning and remanufacturing the equipment to provide the conditions for arrival of technology (due to delay in arrival of more advanced technologies and predicting for arrival of this new suitable technology). Therefore much expenses are imposed on receiver of the technology which is the Iranian party. Also lack of supporting information and research in the first steps (step 1 and 2) can have an effective influence on this section and itself makes different problems.

Technological strategies have not been prepared in the industry. This problem is due to previous problem. However the lack of technological strategies in the industry which is main objectives of the country is very effective in not developing. By preparing technological strategies in a clear manner, the domains of technology objectives are determined and programming will be done for developing this technology. Finally functional sections have the responsibility for implementing these programs whose implementations result in technology transfer in the industry.

The experience of the receiver of the technology is very important in its success because the receiver proceeds for better identification by using its experience and learning from previous deficiencies. Regarding technology transfer projects in oil industry level suitable projects have been performed but none of its players had enough previous experience but were in charge of identification process in three projects of the plant and there was enough credit for all projects denoting that oil industry does not have any financial problems but it seems that the main problem was lack of a dynamic and proper system to perform identification process in oil industry.

Regarding oil contracts it must be mentioned that technology transfer has been included in them over time but its performance is more important than the contracts. Considering the fact that the aim of such contracts is to provide financial and non- financial capital from oil companies and also the priority of executive managers is exploitation and production in the specified time, little technology transfer happens. On the other hand in sanction conditions

many super oil companies which have superior technologies are not prepared to cooperate with Iran oil industry and this issue causes that no technology arrives to Iran.

As mentioned in the model transfer process does not finish here and must undergo implementation and assessment steps as well. Regarding the obtained results from investigating three projects, following key issues were noted:

The results show that the receiver of technology transfer has not performed any intended evaluations in any of the projects regarding the effect of technology transfer in six steps. Evaluation of the effect of technology transfer must be assessed considering such cases as efficiency, privilege, upgraded skill and customer satisfaction so that we can benefit from its results for following technology transfer projects.

The receiver of technology transfer is not able to reach to its technological objectives in the sixth step which is due to installing and functioning of the machines in the fifth step in which investigation was not done properly and objectives were not tuned with the intended objectives.

Identifying the properties and dimensions of the selected project has been done successfully in most of the cases but the weakness is that there are no special standards and methods to perform the process of acquisition in the oil industry for example some of the projects confronted with problems in terms of contractual and legal processes with foreign party. In most of the projects all technology transfer acquisition routes were not considered perhaps due to lack of experience and insufficient familiarity with all technology transfer acquisition routes and lack of assessing other routes on the part of internal party. For this reason there are no indices to assess different routes in oil industry. In those projects done outside oil industry research center there is no indices for the involved individuals in technology transfer acquisition process including technology managers.

Step model: threshold creates a proper and ideal framework to plan and manage technology transfer projects. If the managers and programmers of technology transfer project follow the step model of threshold and perform the offered activities can reduce the obstacles to technology transfer to minimum and wherever possible the supporting equipment can prevent from existing problems. The above case study has provided remarkable and worthy viewpoints to promote technology transfer in oil industry which is covered by Iran national oil company. The factors for failures provide two critical points: first there is a critical need for programmers of technology transfer projects to develop sufficient skill to analyze technology regarding business and consequently market and customer expectation. Second when technology arrives to a new market there is a need for simultaneous attempts to develop the market to support technological attempts. A technology transfer project is not regarded as successful unless it is fruitful for the company and enhances its interest and causes the development of the company. In today business technology transfer is regarded as a combination of business and it is not just as a mere technology project.

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