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In The Name of God

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Articles on Oil & Gas in the English section,
in cooperation with IranOilGas.com

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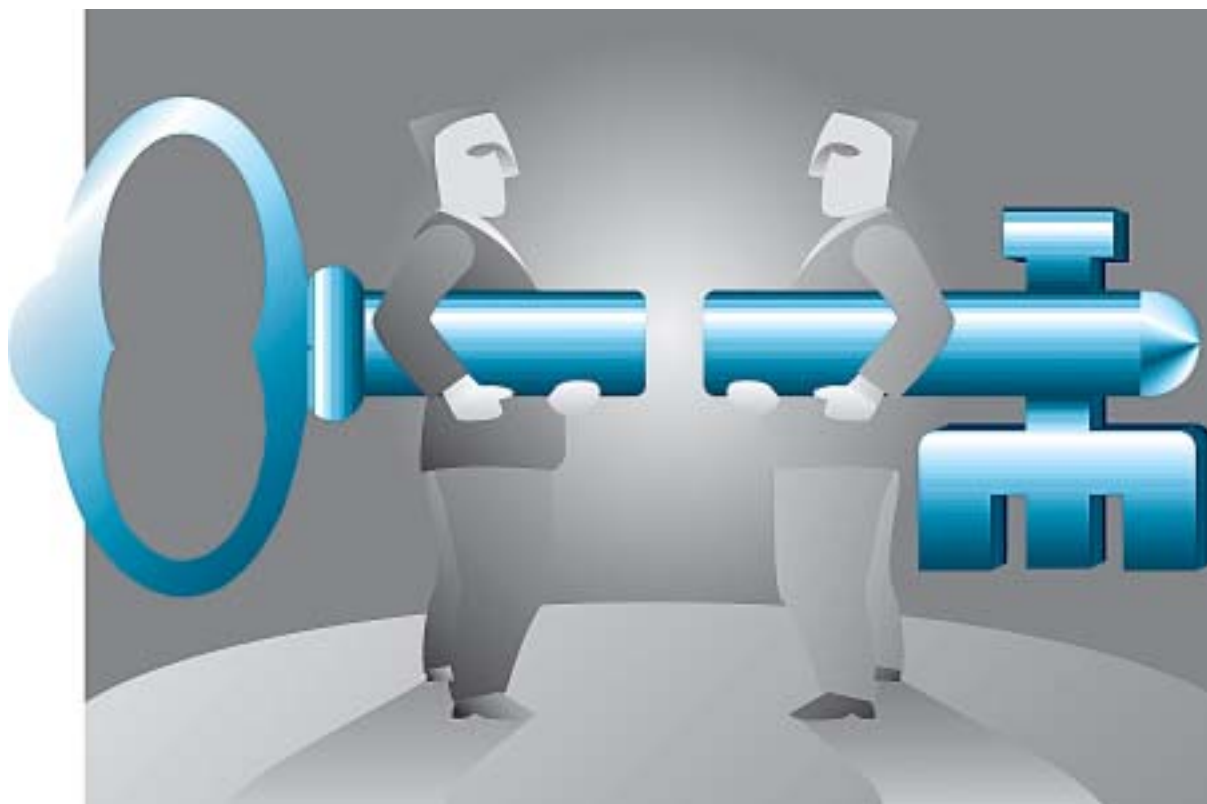
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From Baku-Ceyhan to Nabucco

Signing of an agreement by the governments of Turkey, Bulgaria, Romania, Hungary and Austria for the official commencement of the construction of Nabucco natural gas transport pipeline marked one of the world's most important events in the area of energy last month. Nabucco gas pipeline is a relatively age old project which had been placed on the EU agenda more seriously in winter of 2006 when Russians cut off flow of natural gas to Europe. However, signing of the agreement for the construction of this US\$11 billion pipeline is believed to be a turning point in the world's history of energy developments particularly considering the political and operational com-

plexities that are associated with this project. Nabucco pipeline is the main axis of the strategy which targets diversification of sources of natural gas supply to EU in an attempt to dispense with the Russians' monopoly of natural gas market. Following gas flow cut to Europe in the winter of 2006, a crisis that was repeated in the winter of 2008, the EU stepped up its strategy of diversifying natural gas supply routes and sources.¹ In the past few years, the Russia has tried hard to use its pressure levers against her former strategic allies such as Hungary and Romania. To this end, the Russians designed and proposed the South Stream project that was intended to make the said countries give up the idea of Nabucco

project. The Russians' preservation and use of South Stream project as a pressure lever against West Europe has been viewed as Russian Federation's most strategic foreign policy element and commencement of operation of Nabucco pipeline will deal a heavy blow on Russia's geopolitical status in terms of supply of energy to Europe.

The US's switch of policy in the face of this project and the latter's agreement to the construction of Nabucco pipeline is interesting amidst all available analyses and assumptions. The US special envoy, Richard Morningstar, had been dispatched to attend the ceremonies marking signing of Nabucco project agreement. That was in fact a sign of the US support for this project.

It was exactly ten years ago when Morningstar played a key and determining role in the signing of Baku-Tbilisi-Ceyhan oil transport pipeline that was scheduled to transfer Central Asian crude to Ceyhan port on the shores of Mediterranean Sea in Turkey. That agreement was signed in Istanbul as well. Signing of Baku-Tbilisi-Ceyhan agreement in fact deprived Russia of her role as the sole supplier of the Central Asian crude to global markets, illustrating some form of transfer of Russia's power to the US strategic ally i.e. Turkey.

Iran's stance in the face of Baku-Tbilisi-Ceyhan pipeline project was

entirely similar to that of Russia and the US insisted on the construction of the pipeline in order to prevent transfer of Central Asian crude through Iranian and Russian territories. In the case of transfer of gas however, things are totally different and Nabucco gas pipeline project will not make sense in the absence of Iran. That is perhaps one main reason why Americans rejected the project in the past.

Turkmenistan is Central Asia's key natural gas potential supplier. Turkmenistan has undertaken many contractual obligations and liabilities insofar as sale of gas is concerned. For instance, that country has vowed to supply huge volumes of natural gas to China and thus it is short of sufficient volumes of gas to be injected into the Nabucco pipeline. And in the very unlikely event that Turkmenistan manages to provide for sufficient amount of gas to be injected into Nabucco pipeline, there are three options or better to say, there are three routes available to carry her natural gas. These routes include; Russian territory, the Caspian Sea route and the



Iranian soil. The first option i.e. Russian territory route is practically not feasible, for Turkmenistan is currently using this route to transfer gas to Russia allowing them to maintain their monopoly of the market. The Caspian Sea route and constructing a gas pipeline underneath the sea bed for the transport of Turkmenistan's natural gas to Azerbaijan and from that point to Turkey and ultimately to Nabucco is not possible either due to uncertain and unclear legal regime of the Caspian Sea. After all, the five littoral states of the Caspian Sea have already reached agreement that any project hazardous to the living environment of the Caspian Sea can only be implemented based on consensus of all these littoral states. Therefore, no option other than the Iranian territory is left for Turkmenistan to transfer her gas to Nabucco. Nabucco pipeline thus needs Iran's natural gas and territory while the Americans refuse to support Iran's merger with Nabucco as long as Iran's nuclear dispute remains on the table and Tehran-Washington relations continue to be blurred.

It is reasonable to admit that Nabucco does not make sense in the absence of Iran in which case, the United States' agreement to the construction of Nabucco pipeline on the one hand and their objection to Iran's having a share of the pipeline on the other hand appear to be contradictory. A precise examination and analysis of such an apparent contradiction together with the survey of power equations in Central Asia, lead the way to the forecast of future developments.

Iran and Russia have entered into some marginal alliances in the area of gas policies in recent years. In case Iran plans to act as a strategic ally of Russia

in the field of gas policies, construction of Nabucco pipeline will prove to be a failure to Americans and Europeans alike. The Russians have almost always been inclined to push Iran into the Eastern markets, a tendency which has experienced failure to this date due to the ongoing situation in India and Pakistan. Iran's foreign policy particularly her nuclear case and relations with the United States have impeded the country from increasing natural gas production capacities within South Pars gas field in particular.

US's agreement to the construction of Nabucco pipeline project can serve as a signal displaying her disagreement with the growing trend of expansion of ties between Iran and Russia. Such an agreement can, meantime, reflect the fact that there have occurred certain events based on which, the Americans demand necessary guarantees for the settlement of their disputes with Iran before Nabucco pipeline becomes operational. It can also show that in the course of his visit to Moscow, US President Barak Obama has probably reached serious and strategic agreements with the Russian officials.

If none of the above is true, the Americans' agreement to the construction of Nabucco pipeline could reveal their assumptions, predictions and probably plans for the Middle East region as the heart of the world's energy in the years to come. Additionally, the US consent to construct the Nabucco pipeline, taking into account Europe's dire need in new sources of natural gas supplies can act both as an incentive for Iran and as a pressure lever for change of policy and attitude. Future developments are expected to reveal more facts.


Director

OPEC's New Approach



crude oil stocks is usually referred to as a favorable range. Another assumption suggests that as long as the level of stocks in the OECD member states stands above 52 to 54 days of future consumptions, OPEC will insist on its regulatory policy and refuse to change production levels. According to an OPEC report, the level of commercial crude oil stocks in the OECD member states by the end of the first quarter of

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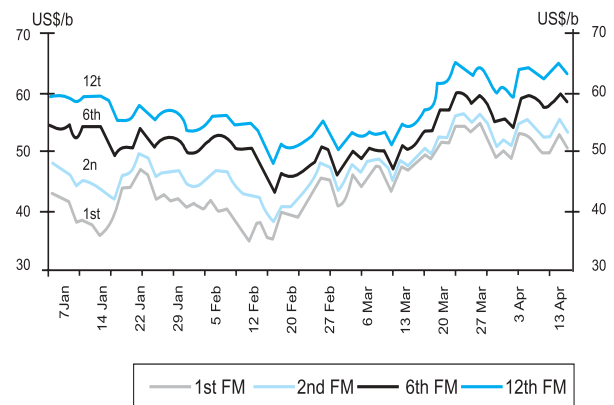
 OPEC officials have recently stated that the Organization, in order to regulate production, will from now on also pay attention to the level of commercial crude oil stocks in the OECD member states and in the event such stocks fail to drop to the required level, OPEC member states will avoid raising production rate {1}. The same officials have meantime reiterated the point that when making decision concerning production ceiling, what matters most is not the level of oil prices alone rather it is the level of commercial crude oil stocks that counts. The previous five year average range of commercial

2009 stood at 61 days. The International Energy Agency (IEA) has estimated this figure at 62 days. According to OPEC's statistics, OECD's commercial crude oil stocks' average of the previous five years has been 54 days and according to the statistics presented by IEA the average has exceeded 52.7 days.

Some oil experts believe that crude oil stocks of 50 days for future consumptions will raise prices to a great extent, 53 days will strengthen prices, 57 days will bring about price recession and 60 days will cause dramatic price falls. Therefore, it is no surprise if OPEC officials are inclined to see that commercial crude oil stocks in the OECD states fall even below 52 to 54 days for future consump-

tion. A drop in the level of oil stocks would mean that not only there does not reside any surplus oil in the market but consumers will have to withdraw oil from their stocks in order to be able to meet demand and for that reason oil prices will raise. Use of the criterion of the number of days of oil storage for deciding about OPEC's oil production quota is useful since in that case, OPEC will not be accused by the consumers of having violated the principles of the free market, thus, political pressures on OPEC producers will subside to some extent. Meantime, application of this new criterion within the context of production control is also associated with certain inefficiencies to which OPEC officials should pay due attention. According to OPEC's supply and demand balance table, the oil market was quite balanced in the first quarter of 2009 meaning that in the first quarter of 2009, no surplus was seen in the market. However, according to OPEC's report, the overall oil stocks in the OECD states in the first quarter of 2009 compared with the last quarter of 2008 increased to 65 million barrels (an increase of approximately 43 million barrels in commercial stocks and 21 million barrels in strategic stocks) and the volume of oil kept in vessels or storage tankers has just decreased by 41 million barrels. That is to say, shortage of oil in the market has had no effect on commercial and strategic stocks in the OECD states. In fact, commercial crude oil stocks in the OECD region have gone up from 59 to 61 days. Of course, one may argue that crude oil stocks in the non-OECD countries which, by tradition, refuse to release their figures, may have decreased, however, that is not convincing, for in the first quarter of 2009, the price of oil in the stock market (futures) was higher than the earlier month. At a time when prices were assumed to increase in the subsequent months, withdrawal from stocks has not been logical (diagram 1). News released reveal

Graph 1- Price of WTI oil in the futures market 2009



FM=future month

Source: OPEC Monthly Oil Market Report, April, 2009

that commercial crude oil stocks in China have been completed and under circumstances when prices have slipped compared to those in the same period of time last year, Chinese companies have attempted to complete their commercial crude oil stocks.

On the other hand, unlike OPEC which in their supply and demand table portrayed market situation in the first quarter of 2009 as quite balanced, the International Energy Agency's supply and demand table estimates 200 thousand barrels of surplus oil per day. The Agency believes at the same time that the total stocks in the OECD countries have increased by 700 thousand barrels per day (500 thousand barrels in commercial crude oil stocks and 200 thousand in strategic stocks). Additionally, 500 thousand barrels per day have been added to oil contained in vessels and storage tankers. On that basis, International Energy Agency has had to admit that one million barrels of oil which includes unreported stocks in the OECD countries and stocks in the non-OECD states have been reduced per day. Of course, the Agency's statistics do not justify withdrawal from stocks at a time when prices are expected to jump. At any rate, according to

OPEC's report, although the OPEC member states have cut their production by 2 million barrels in the first quarter of 2009 compared with the fourth quarter of 2008, stocks in the OECD states have been on the increasing, a fact that is also admitted by the Agency. In other words, these statistics indicate that no longer exists a link between stocks and OPEC's production regulating program.

These facts indicate that lack of access to precise and timely statistics is the underlying reason why the level of oil stocks cannot be used as an accurate criterion for regulating and controlling production. All these inefficiencies are the result of the fact that change of commercial crude oil stocks is not originated in the supply surplus or shortage of supply in the market, rather other factors are also responsible for changes in the level of stocks. When futures market (FM) prices exceed current prices (Contango structure dominates the market) consumers of oil prefer to increase their

stocks in order not to purchase more expensive oil for future use. And the longer such a gap, the more consumers are inclined to store oil. On the contrary, in case the current prices exceed the FM prices (state of Backwardation dominating the market) consumers prefer to withdraw oil from their stocks and provide for their future oil requirements at lower market prices.

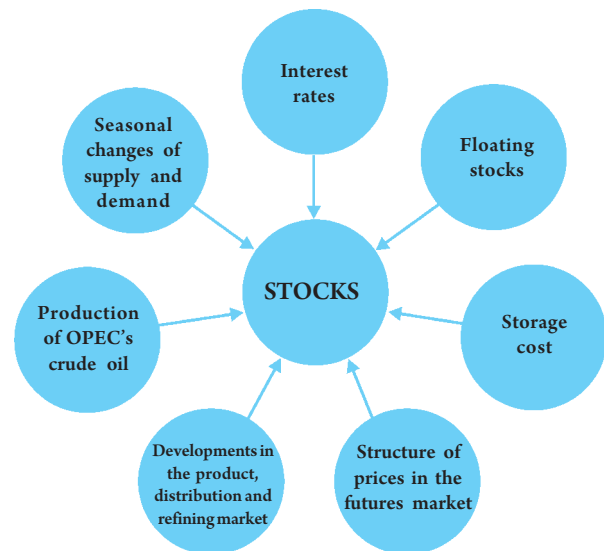
Theoretically speaking, cut in OPEC's production quota could lead to physical shortage of oil in the market, rise in the current prices and reduction of Contango structure in which case there will remain less incentive for storage of oil. The effect of the measure drawn up by OPEC in compliance with the level of stocks' criterion should be tangible and any change in the level of stocks should reveal whether OPEC has reduced or increased its production. Such a thing has practically not taken place in the oil market, for determining the FM prices in the futures market is not controlled by OPEC alone and depends on other factors as well.



Political developments, global economic prospects, predicting changes in seasonal demand, foreseeing likely disruption of supply due to seasonal climatic fluctuations, interpretation of price swing by stock exchange players and brokers and their reaction to these swings as well as many other factors can affect price levels in the months to come. Meantime, interest rates and the storage costs are factors influential in specifying whether or not storage of oil is economically feasible. Refinery gains and operations may as well impact the level of oil stocks. The interesting point is that prices and their structures for the next few months in the futures market impact stocks attitude, whereas, these prices are not just under the influence of fundamental market factors, rather these are stock exchange brokers and financial institutions that play a fundamental role in the formation of prices. Expectations of stock exchange brokers of future events affect their reactions though these expectations may never be materialized. Meantime, financial institutions benefit from the futures market to preserve the value of their assets. When the value of US dollar drops against other hard currencies or when the inflation rate jacks up, they pour into the stock exchange markets and change prices and such prices well influence storage behavior (diagram 2).

There also reside floating stocks which in turn make more complicated the criterion of stock levels for the control of production. Oil companies and dealers such as Shell and BP, store oil in giant tankers in the vicinity of consumption destinations and at a point when oil prices are attractive enough worldwide, they sell these stocks in the market. To follow such a process, these companies have to consider interest rates and tanker lease costs. According to the information released in late June 2009, over 70 million barrels of oil were stored in vessels which shows an increase of 20 million

Graph 2- Factors influential on commercial crude oil stocks level



barrels compared with May 2009. As crude prices increase, storage of crude in vessels does not appear to be rewarding any more. The cost of storing each barrel of oil in vessels is almost one USD per month. Therefore, these companies try to supply their oil stocks to the market and such a measure may impede OPEC's production regulating and control plan.

It seems therefore that the ambiguities and complexities that are associated with the criterion of the number of oil storage days in the OECD countries will prevent officials to use this criterion for regulating or stabilizing market. Evidently, the prices of single commodity market are influenced by factors other than physical market and are not just under the influence of OPEC behavior. Therefore, the question is whether or not OPEC's decisions should be linked to a criterion which is associated with numerous ambiguities and complexities as long as a proper alternative has not been discovered for the Price Band?

1- Reuters, 08.06.2009

2- Dow Jones Newswire, 04.07.2009

IOEC seals \$2.2 Bln rig contract with China



Iran Offshore Engineering & Construction Company (IOEC) has concluded a \$2.2 Bln deal with China's heavy lifting vessel specialist Zhenhua Heavy Industry (ZPMC) to build offshore and onshore rigs.

The deal, signed on Monday in Shanghai between ZPMC and ADHK, an investment company understood to be

registered by IOEC in Spain, is worth \$2.2 billion and calls for ZPMC to build 10 jack-up rigs, seven land rigs and two floating cranes. Delivery is due by the end of July 2012.

The facilities will be built on spec, with no charter agreements so far, other China-based industry sources said.

Sources said the deal was approved by the government and has won a joint credit line from China Development Bank. Last month, ZPMC obtained a credit line of \$10 billion for five years from the bank to fund its offshore sector.

It is understood the China Export & Credit Insurance Corporation is providing credit insurance for the deal.

According to sources, IOEC also approached other Chinese

yards, including Cosco Shipyard for the deal.

However, these approaches were unsuccessful because the Iranians were only willing to make a 30% down payment for the deal, with the remainder being paid in eight tranches in crude.

It is the first major deal ZPMC has won after moving into the offshore sector.

The new facilities will be built at the company's yards in Shanghai and Nantong.

Company president Guan Tongxian said ZPMC's revenue from the offshore sector will amount to \$1.5 billion, accounting for 30% of its total revenue in 2010. Guan expects the revenue in from the offshore sector to increase to \$4 billion in three years.

Detailed engineering of Topsides for phase 12 at 65%



According to a report released by the PR office of Iranian Offshore Engineering and Construction Company (IOEC), the detailed Engineering design of platform 'Topsides' of development of phase 12 of Iran's South Pars gas field, underway by Worley Parsons, has moved some 65% so far. The Procurement sector of the project has made over 8.5% progress, the report has added.

There are three 'Topsides' for

platforms of A, B and C of phase 12 that are to be fabricated. Building the 'steel-sheet pillar' of those 'Topsides' got underway in Isfahan few days ago, the first of which (for A) will take two months to complete, plus another two months for the other two (B & C), four months in total.

The main fabrication of the platform 'Topside' for A will begin in October at Khorramshahr yard of IOEC.

6% of NDC shares sold for \$ 22 Mln

Shares of 'North Drilling Company' (NDC), as the first oil upstream-related company to be privatized, were sold yesterday for almost Rials 220 Bln (\$ 22 Mln) at the Bourse (Stock Exchange Market).

According to the news

agency of Iran's oil ministry, a 6% share-block of NDC consisting of 156,324,300 single shares were sold at a total of Rials 218,854,020,000, showing the value of 'discovered' share to be Rials 1,400 (\$ 1.4) per share.

Dividend of each share of NDC was Rials 19 per share

(p/s) three years ago, reached Rials 79 p/s two years back and was Rials 104 p/s last year. The dividend is expected to rise to Rials 158 p/s in the current year.

Privatization of NDC was first raised two years ago, but was postponed twice before yesterday's breakthrough.

Draft prepared for Iran's gas export in 5th Development Plan



Iran's Comprehensive Gas Export Plan (CGEP) during the country's fifth 5-Year Development Plan (20th Mar 2010- 20th Mar 2015) has been finalized in the oil ministry and presented for further scrutiny

and final approval to the office of Iran's Vice-President for 'Planning & Strategic Supervision'.

According to the Mehr news agency, based on that CGEP, Iran should be capable of exporting about 200 Mln cubic meters/day (mcm/d) of natural gas through pipeline by the final year of the 5th Plan (Iranian year ending 20th March 2015).

Europe will be a target for export of some 35 mcm/d of Iran's natural gas by the Plan's final year, as foreseen by the CGEP.

Given that Iran's Persian Gulf neighbors are badly in need of gas, they are seen by CGEP as accessible markets for Iran's natural gas export in about 5 years' time.

By March 2015, Kuwait is anticipated to be importing 8.6 mcm/d of Iran's gas,

Oman and Bahrain will each be importing 28 mcm/d and the UAE will be taking 12.3 mcm/d of Iran's natural gas.

In line with the CGEP draft, Iran should be exporting nearly 27 mcm/d of gas to India and about 20 mcm/d to Pakistan in about 5 years' time.

Although 'Iran LNG' project has made over 20% progress so far, still CGEP has not foreseen any LNG export in the 5th Plan.

Iran's 20-Year Prospect Plan (Mar 2005-Mar 2025) has projected Iran's LNG export to reach 88 Mln tons/year by its final year (Iranian year ending March 2025).

The CGEP draft has foreseen Iran's gas export to Turkey to be raised to a mean of 27 mcm/d and to Armenia to hit a mean of 4.8 mcm/d, by the final year of Iran's 5th Development Plan.

Iran inaugurates Alborz semi-sub rig



On Thursday, Iran's President Mahmoud Ahmadinejad inaugurated Alborz semi-submersible drilling rig in the Caspian Sea for the exploration

of oil and gas reserves.

Reportedly, the semi-floating rig weighs 14,000 tons and will facilitate oil exploration in the southern part of the Caspian Sea. It can operate at water depths up to 1,030 meters and can drill down to 6,000 meters under the seabed.

After winning the international tender offered by the National Iranian Oil Company for the construction of the Iran-Alborz platform in 2002, the (Iranian) Sadra Group, with a 95 percent

of share, kicked off the project in a joint venture with the Swedish company GVA, which held another 5 percent of share, Press TV said.

Iran's Oil Minister Gholam Hossein Nozari said that his country located 46 oil fields in the Caspian Sea, the satellite Press TV reported on Thursday.

"Eight of the fields (out of 46) are presently ready for exploitation," Nozari was quoted as saying.

Privatizing NPC in 'holding' set for September

Ali Kardor, head of 'Special Committee' in National Iranian Oil Company (NIOC) for implementing Article 44 of Iran's Constitution (which calls for the privatization of state-run companies) said: "Preparation for privatizing Iran's petchem companies, in the form of a 'Holding', is being finalized. And by September this year, the 'Holding' of 10 state-run petchem companies will be presented to the Bourse (stock exchange market)".

According to the news agency of Iran's oil ministry, Kardor

has added that initially that 'Holding' consisted of 13 petchem companies, three of which have been excluded because they were incurring loss.

Privatization of NPC as 'holding' was supposed to be materialized before the end of last Iranian year (ending 20th March 2009).

Following petrochemical companies will be included in the 'holding':

Bouali Sina, Bandar Imam Petrochemical Co. (BIPC), Fajr, Mobin, Borzouyeh, Pars, PCC int'l, Petrochemical Terminal & Tankfarm Co., Petrochemical Commercial Co. (PCC) and Petrochemical Special Eco-

nomie Zone (PETZONE).

The NIOC official has also said that 29% of shares of OIEC and 100% shares of Pira Drilling & South Engineering Services & Turbine Industrial Equipment Companies, of NISOC, would be ready for privatization in the beginning of autumn this year.

Asked when some more share-blocks of NDC would be floated on the Bourse, Kardor replied: "After the General Assembly of NDC, 15% to 25% share-blocks of the company will be made available at the Bourse".

A 6% share-block of NDC was sold at the Bourse on 22nd of this July.

Venezuela to invest in 12 exploratory blocks of Iran

According to the news agency of Iran's oil ministry, Iran's oil minister Gholamhossein Nozary has said: "Talks with the visiting

Venezuelan oil delegation were ongoing during the whole of last week in Tehran and lasted until Saturday this week.

Talks centered on the Venezuela's investment in developing 12 of Iran's explor-

atory blocks (out of the total 16 blocks put out to tender earlier). It has been agreed that Venezuela will invest for the exploration/development of 12 of the blocks of its choice, out of the 16 blocks".

Iran's oil ministry will sell \$ 5 Bln public bonds in 5th Plan

In line with Iran's 5th Development Plan (Apr 2010-Apr 2015), some \$ 5 Bln worth of public bonds will be issued in a 5-year period for developing Iran's oil

industry, particularly the remaining phases of South Pars gas field, says Iran's oil minister Gholam Hossein Nozary.

According to the news agency of Iran's oil ministry, asked about the \$ 1 Bln public bonds, supposed to be issued in local &

foreign currencies for South Pars projects, Nozary explained: "That is a separate issue. The Cabinet ruling for issuing that \$ 1 Bln bonds has been sanctioned to oil ministry and a consultant is working out details of the scheme".

Iran's 2nd 'CNG Conference' executed in Tehran

With the aim of focusing on CNG Issues & Optimization of Energy Consumption and CNG Prospects in Iran and the World, Iran's 2nd 'CNG Conference' and the side exhibition of 'CNG-Related Industries' executed in Tehran.

According to the news agency of Iran's oil ministry, addressing the gathering in his inaugural speech, Iran's oil minister Gholamhossein Nozary said that his ministry was busy planning for boosting Iran's natural gas production to 1.1 Bln cubic meters/day (bcm/d) by the end of the country's 5th Development Plan (Apr 2010-Apr 2015).

Nozary also said he hoped to add another 400 CNG filling stations to the existing 800 stations in the country by the end of this year (ending 20th Mar 10).

Another official who addressed the Conference was Mostafa Alavi, managing director of Iran's 'Vehicle Gas Company' (VGC). Alavi said: "During the past year, about 465,000 vehicles were converted into Dual-Fuel consuming type (equipped with CNG kits), raising the total number of Dual-Fuel consuming vehicles in Iran to over 1.5 Mln".

Head of Iran's 'Transport Fuel Management' Mohammad Rouyanian told the gathering that the share of CNG in Iran's 'Energy Basket' had reached 7%.

Special roundtables of Iran's 2nd CNG Conference will be debating topics such as; how to secure the financial needs of expansion of CNG related industries in Iran, how to use the services of the private sector in CNG field, how to use global & regional experience in CNG industries, Iran's CNG & presence in global markets and ways of boosting efficiency of CNG service stations.

The inaugural session of the Conference was attended by dignitaries from Tehran Embassies of Argentina, Brazil, Malaysia, Pakistan, India, Korea and China plus representatives of companies involved in the manufacture of CNG equipments from Germany, France, Argentina and Turkey.

Expansion of Natural Gas Exports Iran Can Serve as a Regulator of Global Gas Market

Russia's involvement in skirmishes with her neighboring states, has given major European consumers of natural gas the incentive to think of diversified resources to meet their natural gas requirements. Discontinuation of gas supplies to Europe in the freezing January of 2008 was enough incentive for the EU member states to switch to Iran's natural gas resources and LNG. For that matter, the EU member states have entered into serious negotiations with Iran for the construction of LNG units, transfer of natural gas from Iran to Europe and purchase of LNG. Iran, meantime, has examined export of natural gas to Europe and is resolved to have a 10% share of global gas market. Seyyed Reza Kasaeizadeh, the managing director of Iran Gas Exports Company has commented on the construction of the recently proposed Persian Pipeline as follows.

- What regional or international energy objectives of Iran have given way to the construction of Persian Pipeline?

- The 1800 km long pipeline is scheduled to run from Asaluyeh in the south to the northwestern Bazargan border region. Construction of the project has been assigned to Iran Gas Exports Company while the BOO scheme contract for the construction of this pipeline has been put to tender. Negotiations are underway with the Turkish officials aimed at financing construction of a portion of this pipeline and we are looking forward



to receive the approval of the working group of the Economic Council at the ministry of oil. There are other alternatives available in addition to the Turkish route. German and Italian Companies have conducted comprehensive feasibility studies and introduced five different routes. One of these routes is Pars Pipeline and others include Nabucco and Iraq-Syria pipelines. Of course, there are some advantages and disadvantages attached to these pipelines and Iran will ultimately select the kind of pipeline that will guarantee secure supply of energy. Therefore, the pipeline needs to cross low risk countries. No route has yet been specified for this purpose, however, a letter of understanding has been signed with a Turkish company for the transfer of natural gas. Meantime, the Europeans are interested to involve Iran in the Nabucco pipeline, however, the final decision should be made by Iran. Europeans are very much interested to interact with

Iran due to their ever increasing need in energy, for Iran is the world's second largest producer of natural gas after Russia. Iran has provided the required infrastructures and prioritized such subjects as production, transfer of gas to the borderlines and observation of efficient consumption patterns at home.

- When there is talk of security of the host country, which matters most; local security or closer relationship with any given country?

- Security of demand and security of transit constitute our priorities. Security of transit is a function of the host country while security of demand depends on the destination states. Thus, we shall select countries that guarantee security of the pipeline. Our relationship with the host country is a factor as well, however, the status of any such country in the world arena is of prime significance to us.

- What are Iran's most favorite demand markets in terms of demand security?

- Long term demand security is a priority to us since that will guarantee return of capital and achievement of long term strategic objectives. The results of our studies suggest that natural gas demand markets in Europe and the Far East states guarantee materialization of Iran's long term strategic objectives as well as transfer of technology and closer international cooperation.

- Iran's gas export projects are experiencing delay, does that not expose Iran to the risk of losing markets in the Sub-continent, Arab and European states?

- Estimates suggest that by 2030, global demand for natural gas will experience an annual increase of over 2% while the likelihood exists that demand will surpass production and supply of natural gas in the succeeding years. Securing maximum national interests and sustainable development is subject to availability of consistent and key global markets such as the European and Far Eastern ones and exploita-

tion of gas fields in the shortest possible period of time particularly those shared with the Persian Gulf littoral states.

- Why have gas export projects been prolonged? Do technical or economic issues underlie the delay?

- Implementation of gas supply projects requires conducting of extensive economic and technical studies due to the international nature of such projects, relevant long term obligations and liabilities and finally huge investment that should be made. Gas export contracts are by nature more complicated than contracts for the sale of fossil fuel and for that reason one can not reiterate with certainty that technical impediments alone are involved.

- Is Iran's approach towards European markets a result of prolonged India-Pakistan Peace Pipeline?

- Supply of gas to the European states is a priority due to promising economic conditions and high consumption rates in those states.

- Will Iran keep on pursuing LNG projects?

- Negotiations are underway for the implementation of Iran's LNG projects. Such projects require huge investment. So far, we have reached consensus on part of the contents of contracts with our LNG project partners and negotiations are about to be finalized soon. Additionally, construction of Iran LNG project is experiencing a progress rate of 14%.

- It so appears that crude oil is the main paradigm in the pricing of Iran's gas supplies to overseas markets. Have you signed any contracts that would foresee prices in compliance with the thermal value of gas?

- In contracts, the thermal value is typically specified on a certain base and in case gas fails to comply with that thermal base, suppliers shall be subject to penalty. Iran's Crescent contract is an example which has never gone into effect.

- Revision of formula or non-adherence to

Crescent contract are two options before you. Which one do you prefer?

- Pricing is not the only impediment in the way of Crescent contract. Four months ago, four major impediments were officially communicated to our company in writing. One such problem is revision of prices in such a manner that would approximate prices contained in other contracts signed by Iran. The gas delivery port needs to be changed as well. Meantime, an operation agreement should be signed and we need to be in receipt of a valid guarantee. All these revisions should be made before we can deliver gas to Crescent, otherwise, we have other applications for this amount of gas. Salman-Asaluyeh gas pipeline is undergoing final stage of construction. Other UAE companies have requested to purchase natural gas from Iran at market rates. Our contract with Crescent shall be cancelled should they refuse to buy gas from Iran at market rates. The Crescent people should be aware that the price of gas is a long term factor which is calculated under a specific formula.

- Is export of gas to the littoral states of the Persian Gulf economically and technically feasible? What about delay in the construction of Dolphin pipeline?

- Whether or not Dolphin pipeline becomes operational, export of gas via pipeline to the littoral states of the Persian Gulf is technically and economically feasible in such a manner that we have defined this region as one of our target markets. Anyway, Dolphin pipeline project is under construction.

- Does there reside coordination between Tehran and Ankara on the expansion of infrastructures required for the transfer of Iran's natural gas?

- In fact, this is Iran which enjoys all the required potentials to become the region's energy hub. Some of the facilities and infrastructures needed for the export of gas already exist in Iran. A 20 thousand kilometer long high pressure gas pipeline available in

Iran is connected to the network of the world's largest natural gas suppliers such as Russia, Turkmenistan and Qatar and that makes Iran's status in the region strategic. Iran is in a position to regulate the price of natural gas. Consistent flow of natural gas from and via Iran shall be possible subject to the construction of a number of LNG storage tanks and a few man-made underground natural gas reserves.

- What policy does Iran pursue through transfer of gas via Turkish territory? Sale of gas or payment of transit fee?

- We prefer to pay transfer fee because in that case, we shall have the choice to deliver gas to European purchasers directly.

- Are there any plans underway for the transfer of gas to Switzerland and Austria?

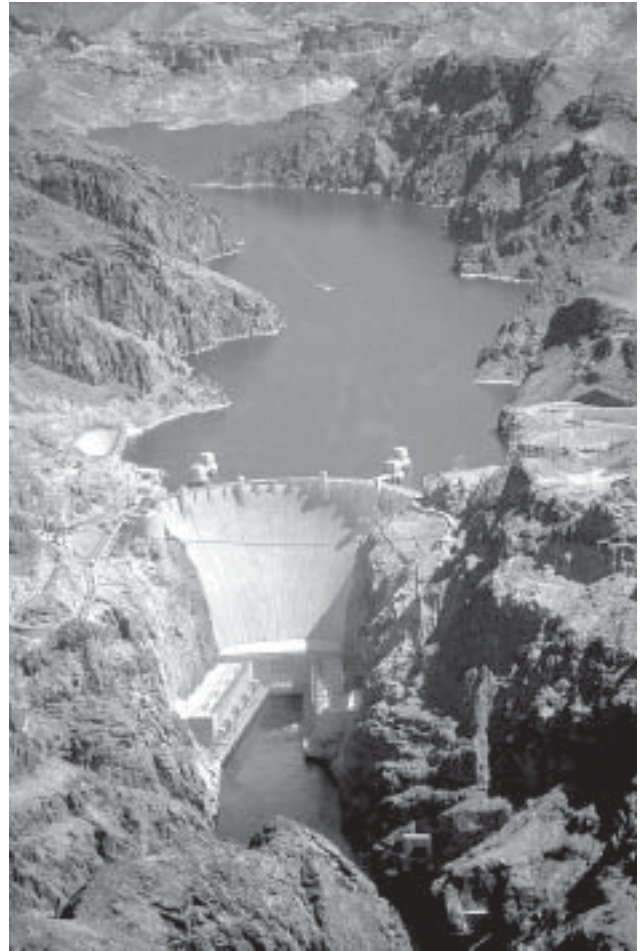
- We have conducted promising negotiations with these two states while the main contract has also been finalized. Pricing of gas and certain details in the operational contract remain to be discussed in our negotiations and are expected to be finalized soon. We expect to start exporting gas to Switzerland sometime in September 2009 hopefully. According to schedule, we are prepared to export gas to Switzerland in 2009 and the required infrastructures have been prepared for this purpose.

- The upstream gases in refineries are sweet, why are they burnt outdoors?

- The pressure of gas containing oil drops when it is pumped into refinery and at each stage an oil condensate is isolated from it. In the past, such gases were burnt outdoors due to low prices, risk of explosion, absence of technology required for the collection and transfer of sour gas to refineries, however, currently these gases are collected and transferred to refineries. In some cases however, low pressure gas is burnt outdoors because it is not feasible to transfer it to relatively far away refineries and may cause industrial hazards and damage the living environment.

Application of System Dynamics Model

in Management of Hydroelectric Power Plants



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ABSTRACT

Nowadays, in spite of all attempts in the area of project management, projects often fail due to project complexity, lack of holistic approach to project and finally inattention to non-linear aspect and dynamics of projects especially by project managers. This complexity will be more controversial in EPC companies specifically in HEPP construction companies.

This article aimed initially to enhance awareness and understanding of dynamics behavior more in EPC companies in the field of HEPP and as a case study in FARAB Co. by making a gen-

eral project management dynamic model for this company to support the effective teaching of dynamic thinking among project managers. Secondly, one of the controversial projects was proposed by the company to be simulated in a dynamic model based on the actual information aiming to act as a conflict resolution tool.

As a result, holistic SD model of PM was created for company by involving project managers. In addition, the second model revealed that the major exogenous factors affecting such cost and time overruns are comprising man power idle time caused by client or improper weather conditions and etc. as well as rework and repairs caused by manufacturing of the equipments out of sequence and high defect rate of those equipments.

ABBREVIATIONS:

EPC	Engineering, Procurement and Construction
HCLD	Holistic Causal Loop Diagram
HEPP	Hydro Electric Power Plant
SD	System Dynamics
PM	Project Management or Project Manager

Introduction

Projects, during the last 50 years, have played a tremendous role in industries as well as our life. Project-oriented business and restructuring of organizations based on project objectives became the main trend among others. Furthermore, as companies were more dependent upon timely, low cost project implementation, to be more successful, management-by-projects turned out to be a widely used management phenomena.

In parallel, considerable development of project management area has been undergone. When organizations found out its obvious benefits, they started to look for better ways of managing projects effectively. The major competitive advantage for companies in the market has been converted into the project management capability.

Therefore, this area of the knowledge has been scrutinized and researched extensively which has resulted in development of a number of management techniques as well as project management tools applied to the different areas.

However, in spite of all these attempts, projects often fail! Schedule and cost overruns have become a rule for the majority of projects in defense, aerospace, software, construction and many other industries (Sterman 1992). Morris (1987), based on a review of 3500 projects, revealed: "Overruns are the norm, being typically between 40% and 200%". A survey showed that less than 50% of corporate research and development projects met their objectives (Williams

2002a). Based on a recent study in a sample of ten projects, the average budget overrun was 86% and the average schedule overrun was 55% (Lyneis 2001). Cooper and Mullen (1993), by examining of a sample of large civilian and military projects, found that commercial projects cost 140% and took 190% as long as originally scheduled, while defense projects cost 310% of the original estimates and took 460 % as long to complete.

Why do projects miss their target?

This is the question which always comes in minds that why, despite of different advances in this area, such problems like schedule and budget overruns have been remained for decades. General project management tools and techniques can not cope with the complexity, systems, and dynamics of the projects. Probability of cost and schedule overruns for projects increases as they become larger and more complex. A complex system means more than the sum of its parts and projects are characterized by complex characteristics. Also, traditional project management tools and techniques like decomposition-based methods are really useful and effective at operational levels but when it comes to strategic level of project management, they often fail due to ignorance of the wholeness of projects (Lyneis 2001). Furthermore, the traditional analysis of the projects has been described as linear or as static and closed (Davidson and et al. 1991). However, managers, in actual situations, need to respond to new information during the project dynamically and adjust the plan regarding new circumstances. In such situations, learning from projects, post project learning, has been ignored in most organizations which is the other reason in failing of projects. Finally, project managers are not equipped by appropriate tools to deal with these project characteristics and to cultivate learning from projects.

The increasing demand on the use of project computer simulation is the main result of complexity raise

in projects and simulation modeling has played an important role as a project management tool. Following table chronologically describes the main attempts in this regard.

Problem Definition

Effective teaching of project management skills to EPC (Engineering, Procurement, and Construction) company managers especially in Hydro Electric Power

Table 1- attempts in application of SD in PM

Roberts	1964	R&D	Perceived vs. real progress
Kelly	1970	R&D	Development of R&D dynamics, multi-project Management
Richardson, Pugh	1981	R&D	Productivity and rework generation staff hiring policy
Jessen	1988	R&D, construction	Project team motivation and productivity, client and project team relationship
Keloharju, Wolstenholme	1989	R&D	Time-cost trade-off
Abdel-Hamid	1988-1993	Software Development	Project staffing policies, multi-projects scheduling, quality assurance policies, cost and schedule estimates as targets, managerial turnover
Barlas, Bayraktutar	1992	Software Development	Simulation based game, staffing policies
Pugh-Roberts Associates	1993	Various large Projects	Various large Projects
Smith et al.	1993	Software Development	Charles Stark Drapper Laboratory
Chichakly	1993	Software Development	High Performance System Inc, technology transition
Lin	1993	Software Development	NASA Jet Propulsion Laboratory: integrating engineering and management
Aranda	1993	Software Development	Aragon Associates Inc, TQM and product life cycle
Cooper, Mullen	1993	Software Development	The rework cycle, project monitoring progress ramps
Williams et al.	1995	Product Development	Dispute resolution, impact of parallelism
Rodrigues, A.G.;	1996	Software development	System dynamics integrated to traditional project management (a hybrid approach). Implemented for BAeSEMA Company.
Williams, T.M	1996	Software Development	System dynamics integrated to traditional project management (a hybrid approach). Implemented in KDCOM project for Korea Navy
Kimberly and James	1999	R&D	Discussing the rework cycle, feedback effects, and knock-on effects which create budget and schedule overrun

Plant (HEPP) industries is a timely and important topic for several reasons. Perhaps more than other disciplines, engineering or otherwise, EPC work is project based.

Moreover, due to the increasing technological complexity of constructed facilities, the growing market demand for shortest possible completion time and the fact that concurrent design and engineering (i.e., fast tracking) is becoming more common, construction projects are becoming increasingly more complex and difficult to manage than before.

Due to the lack of system thinking and dynamic approach before making the contracts, some external factors and their impact on each other are not considered in initial estimations. This lack of dynamic awareness in EPC companies mostly has resulted in tremendous cost and schedule overruns after the completion of projects as well as future controversial claims.

Additionally, since client behavior such as imposed idle time as well as rework and repairs are among the main and common problems in EPC companies, the effect of these changes has been studied more by analyzing the impact of such behavior on some indicators such as quality, time and cost. This is in such situation that EPC companies has gained enough experience in their field of work, however, as the know-how has not been fully achieved or sometimes impossible to be attained, due to uncertain characteristic of such projects, these companies face with different difficulties.

Nowadays, the application of SD method to analysis of the impact of client behavior on project quality, cost and time is an attractive subject especially as a tool for conflict resolution. However, most companies are not aware of SD magic and tremendous efforts are required to be made in this regard.

Aims of this Study

Since the lack of awareness about SD knowledge and its applications is common in EPC companies, this study was aiming, in the beginning, to make a general knowledge of dynamic behaviors and SD applications

and its potential, in FARAB Co. as an EPC General contractor of Hydro Electric Power Plant (HEPP) construction in Middle East and CIS countries. In this regard, a general project management causal loop diagram for this company was created based on literature reviews and some interviews within the company. This model, by involving project managers in building this general causal loop diagram, will try to make a wider insight about SD application in different stages of project life cycle.

Since the first causal loop diagram was so general and complex with different likely factors, an applicable SD model regarding one of the controversial subprojects within the company was simulated. Since this second model is aiming to act as a conflict resolution tool to convince client about the side effects of their behavior on that subproject comprising schedule overruns and cost overruns, client also was involved.

Methodology

First, to build the initial holistic causal loop diagram for Project Management (PM), different literatures were reviewed, some interviews were conducted followed by some questionnaires among operational managers, with the aim of increasing the awareness about system thinking and holistic view of projects among the project managers. The collected information was used to define the cluster of factors and their interactions and relationships which are relevant to the PM model. This initial holistic model was presented in the company aiming to brain storm this idea among operational and strategic managers to make the causal loop diagram more précised and applicable as a tool for better understanding and effective teaching of project managers about PM dynamics.

Second, Due to so much cost and schedule overruns in different projects and also based on an initial survey within the company, which came out with this belief in the company that the client behavior can be one of the main sources of such overruns, company

managers were interested to check the impact of such behavior on one of the contentious project within the company as a result of this study. Since the suggested project was controversial and client had claimed the company for schedule overrun, client was involved in building the model to make it more realistic and also convince them about the validity of model.

Holistic Causal Loop Diagram

Derived from literature reviews (Rodrigues & Williams 1998; Rodrigues 2001, Williams & Eden & Ackermann & Tait 1995; Williams 2002, Williams et al. 2003; Williams et al. 2005) and some interviews with operational managers in the company, Figure 2 represents the holistic causal loop diagram and the feedback structure with the key 'vicious circles' identified for the company.

Since the main focus of this study is on impact of client behavior such as imposed scope changes on project performance indicators, "work scope changes" factor will be considered as the starting point of this model to be described which imposes other changes

over the project.

As it is illustrated in Figure 2 "work scope changes" causes a vicious circle. It means that the more company receives changes in work scopes, the more extra efforts is perceived which results in more schedule adjustment and consequently postponement of schedule completion date. Until now all the links are positive which means that the effect is positively related to the cause. However, "schedule completion date" has a negative effect on "perceived schedule slippage", as an important factor in this diagram, which means that the less "perceived schedule slippage" results in less "schedule pressure". When schedule pressure increases or decreases, "acceptance for further changes" alters at the same direction, which has the positive effect on the work scope changes.

The side effects of "work scope changes", shown in dotted lines within the model, are usually complex and subjective. These side effects are the sources of major cost and time over-runs. One of the most important results of these scope changes is "doing the work out of sequence". i.e. doing the work out of the sequence of the agreed activity network. For example, in case of this

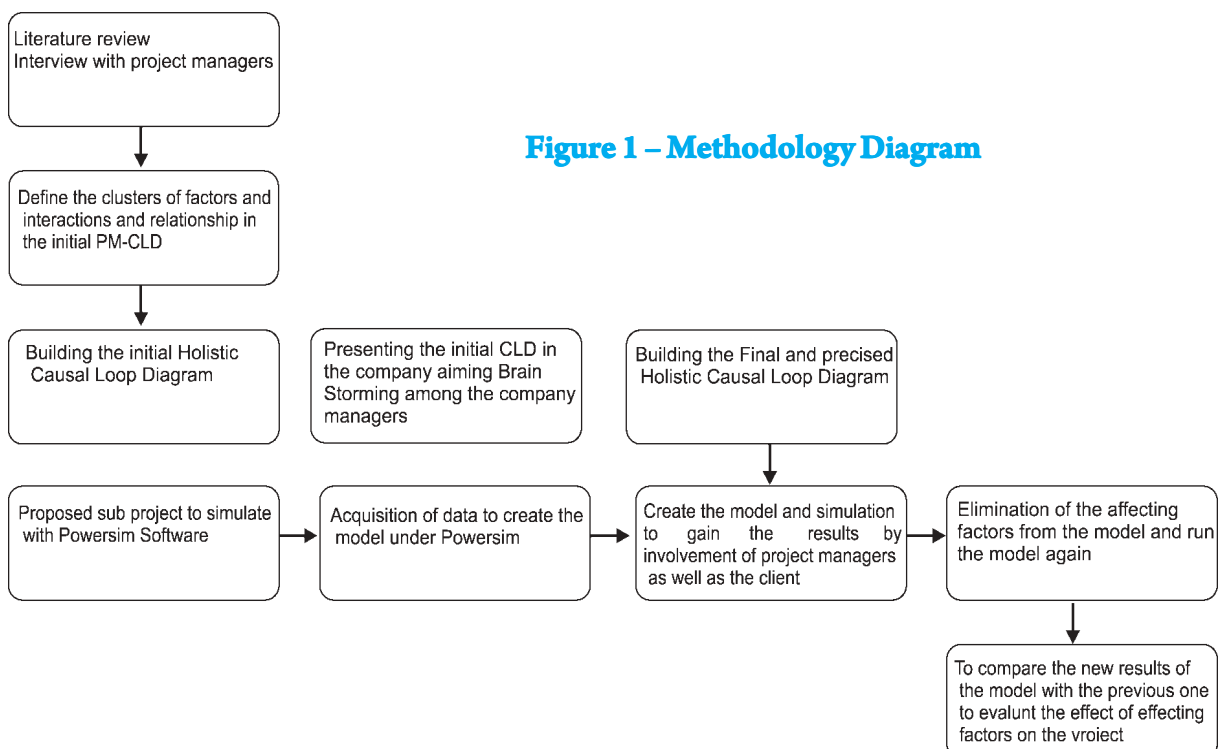
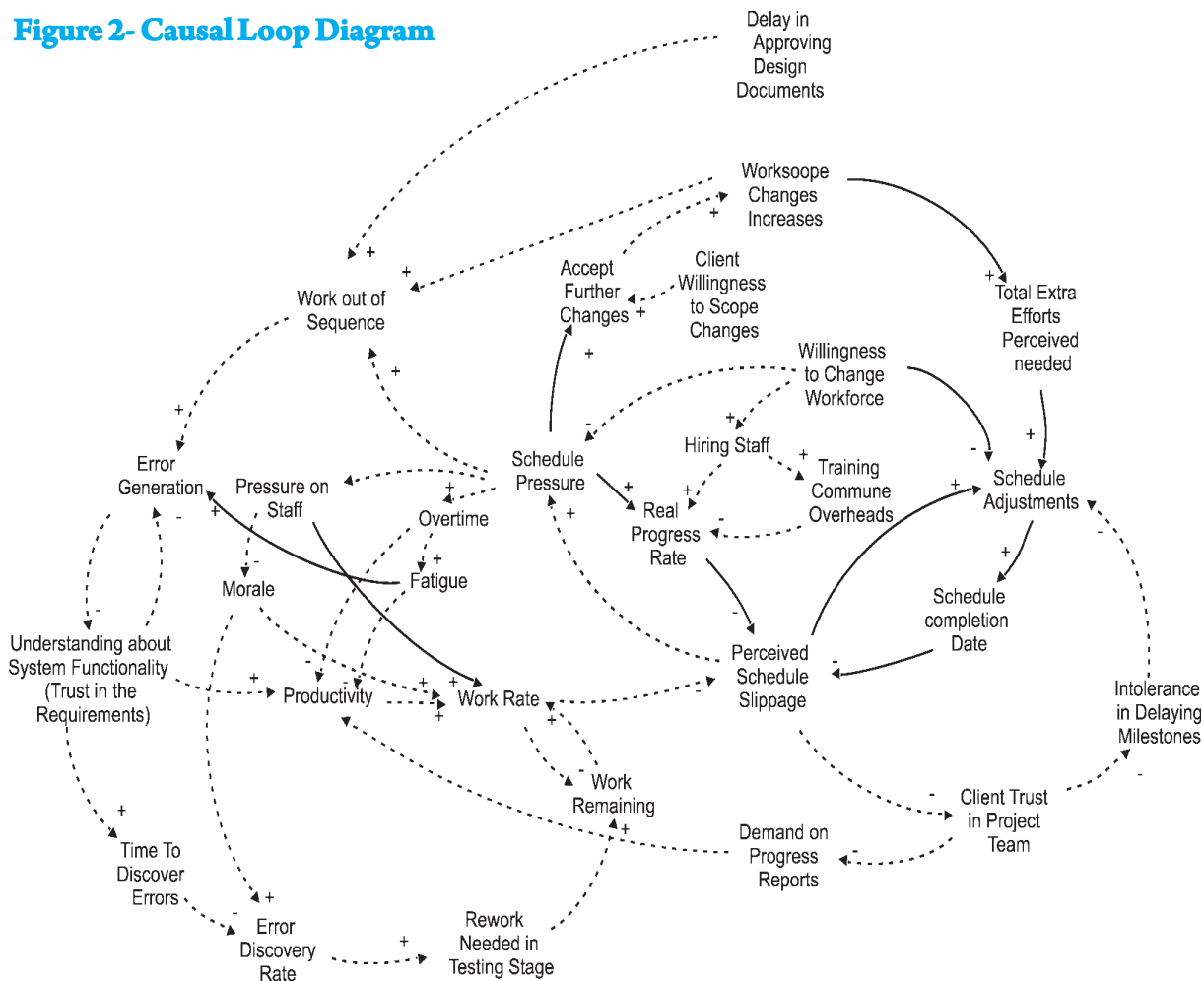


Figure 1 – Methodology Diagram

Figure 2- Causal Loop Diagram



study, delivering of equipments to site has done before doing pre-assembly tests in manufacturing workshop.

Furthermore, “client delays in approving technical documents” forces the company to work out of sequence not to have more delays in this regard which has the same effects as “working under pressure” that causes staffs to direct their efforts to those areas that seem to be more stable.

Error generating is another matter which should be taken into consideration in this model. As it is demonstrated in Figure 2 “doing work out of sequence” also increases the number of errors in the work. It means that when a new error is detected in the system, staffs lose their “trust about the system requirements”. While “trust about the system requirements” is about to fall down, it results in prolonging of the “time to discover

errors”, as well as reducing the “productivity”. In addition, “productivity” has a positive impact on “work rate” same as “moral” in comparison to “fatigue” which has the negative impact on schedule pressure. In such situation with lower “work rate” and higher “number of errors” in the system, more “schedule delays” and “perceived schedule slippage” would be obvious.

Furthermore, more “perceived schedule slippage” decreases the “trust of the client about the project team” and performance of the subcontractors which makes the client intolerant in accepting schedule adjustments and demanding for more progress reports with more detail items. This demanding attitude of client, whereas the resources of Contractor Company are constraint, makes the productivity factor diminish.

When delay happens in projects, the best way for

contractors to persuade the client is to concede more changes in the system at no extra cost. Such introduction of changes in the system exacerbates the lack of trust in the stability of system and motivates staffs to do work out of sequence even in those areas where the requirements are stable. As stated in Rodrigues (1998) "... while doing work out of sequence might be a good approach on the 10% of requirements that are in doubt, it could be disaster in the 90% where the requirements are clear and stable."

Facing delays, project managers ask for a way to increase work rate together with readjusting the schedule. It is apparent that finding an equilibrium combination of these two is a tricky task and client also can intensify the problem.

Increasing amount of delays in project and imposing restrictions on schedule adjustments consequently cause project managers to raise work rate, e.g. hiring new staff, diminishing QA, putting pressure on staff to work faster, increasing activity concurrency and using over-time. As it is clear at the centre of Figure 2, the "willingness of manager to change work force" can indirectly affect the "real progress rate" by hiring new staff, training programs and so on. However, in this situation overcrowded workers cause long-term disruptive effects which are very difficult to estimate and quantify.

As mentioned before, to study the scope changes which impose from client side, a controversial subproject in field of Hydro mechanical Equipment in one of the biggest dam and hydro-electrical subprojects in Iran was suggested to be simulated. Because of some changes in inflow water of the reservoir, client necessarily changed the design of this subproject during the construction of dam body, which means a complete change in technical specification and design of the hydro-mechanical equipments. Normally, the installation of equipments was done in parallel with the dam body concreting. This change happened in a situation that subcontractor had manufactured, procured and transported all equipments to the site and was prepared to

install them based on primary time schedule.

Due to those changes, Client was underwrote all cost arose from the changes. They also asked subcontractor to perform manufacturing and installation in parallel to reduce further delays.

On the other hand, civil contractor, as the other subcontractor of the project, worked in parallel with equipment installation subcontractor (FARAB Co), for construction of dam body including concreting of installed and welded equipments. These two subcontractors handed over the work in different steps to each other in presence of client.

During the completion of this subproject, there was no delay in delivering of manufactured equipment but manufacturing company imposed many delays to FARAB mostly due to required extra work and modifications which caused by defective equipments of manufacturing company. Therefore, this subproject, which was really critical for impounding of dam, was commissioned and delivered with delay.

Although client was so satisfied about the quality of final work and good cooperation and coordination of FARAB with civil contractor, they claimed about the delays which postponed the impounding of dam and accordingly commissioning of power plant.

In response to this claim, FARAB indicated different factors associating with these delays such as:

1. The duration of contract was so compressed for installation of such equipments which also caused too much pressure on personnel.
2. FARAB also faced some idle days during the project life cycle due to bad weather condition, which led the operation time in cold season, moreover, cable crane problems, civil contractor delays in concreting and so on which were out of FARAB's responsibility.
3. Since client wanted to compress the project, they asked manufacturing company to do final assembly and inspection of equipments in site instead of in factory and doing some part of manufacturing project out of sequence which imposed more de-

lays in installation step, and increased defect rate of equipments in manufacturing process resulted in more rework for FARAB.

As a part of this study, it was decided to model this situation as a practical example in application of system dynamics in project management to see how a Powersim software model can act as a document for claiming a contract. To make the model more realistic, client also has been involved in building the model

non-linear aspects and dynamics of projects especially by project managers.

Companies involving in EPC projects are facing more technological complexity than others. Furthermore, companies dealing with Hydro Electric Power Plant (HEPP) projects are facing more uncertainty and complexity due to complicated characteristic of such underground projects.

Providing EPC managers with solid project manage-

ment skills is therefore critical for the future of the individual professions and the EPC industry as a whole. Furthermore, client intervention in the projects is among the main and repetitive problems.

This article tried to widen, firstly, the insight about dynamics behavior more in EPC companies in the field of hydro electric power plant and as a case study in FARAB Co. As the first result, a general project management dynamic model for FARAB, as an EPC company in the field of HEPP, was created. During the process of model building, company managers were involved by means of different inter-



views and questionnaire. This method facilitated the effective teaching of dynamic thinking among project managers by linking them in building the general causal loop diagram.

which makes the result of model and claim more reasonable to be accepted by client. In spite of all attempts in widening the knowledge about the projects, they often fail! Schedule and cost overruns have become a rule for the majority of projects in defense, aerospace, software, construction and many other industries due to project complexity, lack of holistic approach to the projects and finally inattention to

Furthermore, concerning FARAB request, one of the controversial subproject of company, was modeled by Powersim software to analyze this subproject which was claimed by client due to its time overruns. Since this

model was supposed to operate as a conflict resolution tool, client also was involved in making the items and relationships of the model. FARAB, before building the model, believed that the majority of these overruns have been caused by client.

The final result of simulation revealed the following items as the causes of schedule and cost overruns:

- Man power idle time caused by client or improper weather conditions
- Rework and repairs caused by delivering of manufactured equipments out of sequence and high defect rate of those equipments all imposed from client side.

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Storing Gas in ‘Serajeh’, a Controversial Issue Now

Even though managing director of Iran’s Gas Storing Company (IGSC) Masoud Samivand has recently said injection of treated natural gas into ‘Serajeh’ underground storage tank was brought forward by three years to the end of this Iranian year (late March 2010), the official statistics of NIGC, however, show that injection of gas into Serajeh and even its re-production should have been operational in this Iranian year anyway.

Serajeh gas reservoir covers an area of 25 X 5 km and is located 40 km Southeast of Qom City. Because of its proximity to Iran’s gas consumption hub, Serajeh has been earmarked to be converted into a suitable underground natural gas storage tank.

In 1961, the first well was drilled in Serajeh, which is capable of storing about 3.3 Bln cubic meters of gas.

In line with the gas sector of Iran’s fifth 5-Year Development Plan (Apr 2010-Apr 2015), there

should be adequate gas-injection & storing facilities in place in the country to permit re-production of 100 mcm/d of stored gas by the ending year of the Plan.

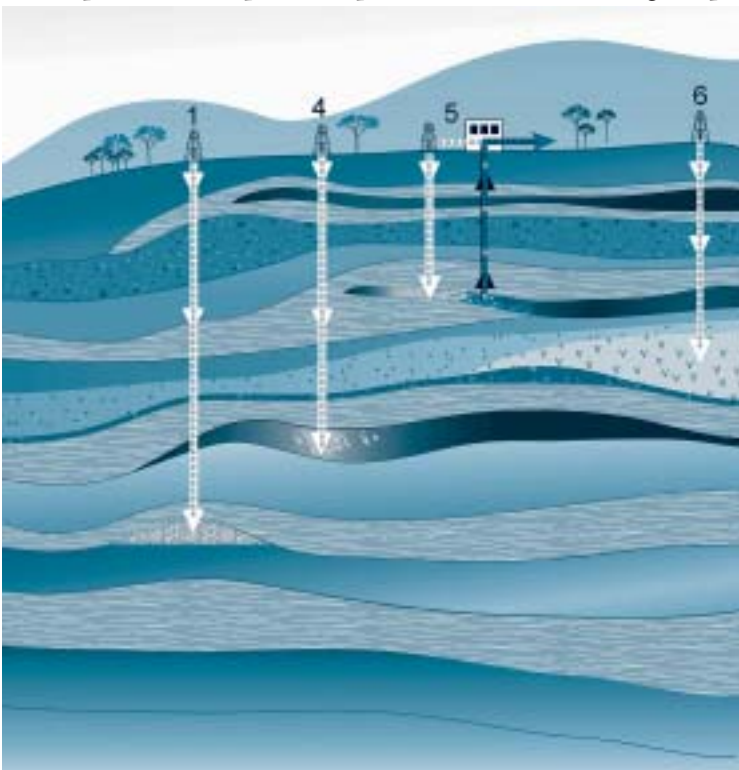
In 2004, the French Sofregaz started studying ‘Serajeh’ gas storing project.

Two methods of storing gas in ‘Serajeh’ were raised then. One was to start injecting gas for storing it in the reservoir without recovering the gas and gas-liquids that still remained in it, which was recommended by Sofregaz. The other was to first recover the reservoir’s contents and then start injecting gas for storing.

According to ISNA, an informed source in Iran’s oil ministry said: “Recommendation of Sofregaz was not heeded and small volumes of gas and liquids were recovered from ‘Serajeh’, and even new wells were drilled in it. This has now created variations in the levels of gas, liquids and water in the reservoir and that is why,

before any investment in the gas storing plan, the ‘gas storing capacity’ of ‘Serajeh’ has to undergo fresh and thorough assessment”.

While official reports say NIGC managers changed the plan last year from gas production from ‘Serajeh’ to gas injection into it, yet information obtained show that in previous years some 700-800,000 cubic meters/day of gas were produced from ‘Serajeh’, which has caused the current drop in its pressure. When the studies began on ‘Serajeh’ gas storing plan in 2004, authorities promised the plan would be operational in 2005. This was, however, later pushed back by another two years to 2007 and afterward.



Breakdown of Iran's Crude/Gas Upstream in Past 4 Years



The office of Iran's deputy oil minister for 'planning' has released a report about the performance of the oil ministry during the four years of the rule of the incumbent government, which coincides with the first four years of Iran's 4th Five-Year Development Plan (End March 2005- End March 2010).

The report has highlighted the steps taken towards fulfilling the objectives foreseen in the oil and gas chapter of the 4th Plan.

The highlights of activities in the 'Downstream Sector' of Iran's crude oil industry, in the said four years, were covered by IranOilGas on the 3rd of this June. Following is the second part of the report which has focused on the 'crude/gas upstream' of the industry:

Recoverable Oil & Gas Discovered

A total of 8.2 Bln barrels crude-oil-equivalent worth

of oil and gas reservoirs were discovered in the first year of the 4th Plan. The figure was reduced to 2,255 Bln barrels in the second, but rose to 5,442 Bln barrels in the third and dropped to 1,363 Bln barrels of crude oil equivalent in the fourth year of the Plan.

These volumes correspond to 547% of the Plan in the first year, to 150% in the second, to 349% in the third and to 90.9% of the Plan in the fourth year.

Crude Oil Production Capacity

The capacity to produce crude oil stood at 4.26 Mln bpd in the first year of the 4th Plan. This rose to 4.275 Mln bpd in the second, to 4.335 Mln bpd in the third and fourth years of the Plan.

These volumes correspond to 96.8% of the Plan in the first year, to 95% in the second, to 94.2% in the third and to 90.3% in the fourth year of the Plan.

Actual crude oil production stood at a mean of 4.021 Mln bpd in the first year of the Plan. This rose to 4.056 Mln bpd in the second, further to 4.103 Mln bpd in the third and dropped to 4.016 Mln bpd in the fourth year of the Plan.

These volumes correspond to 96.4% of the objectives planned by NIOC for the first year, to 98.29% for the second, to 96.89% for the third and to 94.1% of the NIOC plan for the fourth year.

Rise in Recovery Rate of Crude Oil Production (Primary & Secondary)

Rise in the rate of Iran's crude oil recovery (Primary & Secondary) was zero during the first three years of the 4th Plan. An annual rise of 0.3% has been foreseen that rate in the Plan. No statistics are yet available for any probable rise in the fourth year.

Remainder Lifetime of Oilfields

Iran's oilfields could produce for another 93 years

in the first year of the 4th Plan, for another 86.7 years in the second and for another 86.2 years in the third year of the Plan.

These figures correspond to 106.3% of the Plan in the first year, to 97.34% in the second, to 94.7% in the third year of the Plan. No statistics are yet available for the remainder lifespan of oilfields in the fourth year.

Crude Oil Export

A total of about 2,427,500 bpd of crude oil were delivered to Iran's oil terminals for export in the first year of the 4th Plan. The figure rose to 2,472,200 bpd in the second, further to 2,496,400 bpd barrels in the third and dropped to 2,451,900 bpd of crude oil in the fourth year of the Plan.

These volumes correspond to 101% of the objectives planned by NIOC for the first year, to 97.9% in the second, to 94.8% in the third and to 93.7% of NIOC plan for the fourth year.

Proceeds of Crude Oil Export

Given the steep rise in the global price of crude oil, Iran earned a total of \$ 43,972,3 Mln by exporting crude oil in the first year of the 4th Plan. This rose to \$ 51,171.3 Mln in the second, further to \$ 68,701 Mln in the third year. No statistics are yet available for the fourth year output.

These earnings correspond to 99.6% of the objectives planned by NIOC for the first year of the 4th Plan and to 102% in the second year of NIOC plan. No statistics are yet available for the foreseen earnings for the last two years of the Plan.

Natural Gas Production

An average of 436 Mln cubic meters per day (mcm/d) of gas was produced in the first year of the 4th Plan. The figure rose to 464 mcm/d in the second, further to 505.8 mcm/d in the third and finally to 551.9 mcm/d in the fourth year of the Plan.

These volumes correspond to 111.2% of the Plan in the first year, to 116% in the second, to 112.4% in the third and to 105.1% of the Plan in the fourth year.

Remainder Lifetime of Gas Fields

Iran's gas fields could produce for another 169.8 years in the first two year of the 4th Plan and for another 142.9 years in the third year of the Plan.

These figures correspond to 100.8% of the Plan in the first year, to 109% in the second and to 98.6% in its third year. No statistics are yet available for the remainder lifespan of the gas fields in the fourth year.

Production of Condensate, Gas-Liquids & Naphtha

Alongside the rise in the production of rich gas in the mentioned four years, production of condensate, gas-liquids and naphtha rose as well.

A total of 352,500 bpd of condensate, gas-liquids and naphtha were produced in the first year of the 4th Plan. The figure rose to 383.3 bpd in the second, further to 408,500 bpd in the third and finally to 442,200 bpd in the fourth year of the Plan.



These volumes correspond to 87.9% of the objectives planned by NIOC for the first year, to 88% in the second, to 82.5% in the third and to 87.7% in the fourth year of the NIOC plan.

Independently, condensate production stood at a total of 213,700 bpd in the first year of the 4th Plan. The figure rose to 233.2 bpd in the second, further to 253,900 bpd barrels in the third and finally to 282.7 bpd in the fourth year of the Plan.

These volumes correspond to 85.5% of the Plan for the first year, to 93% in the second, to 76.9% in the third and to 62.8% in the fourth year of the Plan.

Gas Available for Injection into Oilfields

An average of 77.3 Mln cubic meters per day (mcm/d) of gas was available for injection into oilfields in the first year of the 4th Plan. The figure dropped to 73 mcm/d in the second, further to 71.2 mcm/d in the third and finally rose to 77.7 mcm/d in the fourth year of the Plan.

These volumes correspond to 111.2% of the Plan in the first year, to 74% in the second, to 61.4% in the third and to 52.1% of the Plan in the fourth year.

Injection of Water into Oilfields

An average of 270.9 kbpd of water was injected into oilfields in the first year of the 4th Plan. The figure rose to 357 kbpd in the second, further to 364.2 kbpd in the third and finally rose to 420.6 kbpd in the fourth year of the Plan.

These volumes correspond to 68.7% of the Plan in the second year, to 73.6% in the third and to 97.8% in the fourth year of the Plan. No statistics were available about the volume of water injected into oilfields in the first year of the Plan.