

# EVALUATION METHODOLOGY FOR TRANSNATIONAL INFRASTRUCTURE GAS PROJECTS : A CASE STUDY OF PAKISTAN

By

Sidra Nisar Malik<sup>1</sup> and Nasir Hayat<sup>2</sup>

## Abstract

The commercial and industrial sector of Pakistan economy is suffering due to inadequate and inconsistent supply of natural gas. This necessitates the search for alternative sources of gas supply which are developed or being developed outside the country. A number of options i.e central Asian states through Afghanistan, Iran, Gulf states like Qatar etc are available and being considered in this regard. All the available options are different in term of their supply, need of finance, completion period, payback period, revenue generation and risks and uncertainties associated with those options. In this paper an attempt has been made to propose a suitable course of action to meet the rising gas demand while keeping in view the broader geopolitical environment in the region. A mechanism has been proposed to evaluate infrastructure gas projects and economic analysis of the chosen/ best option has also been carried out. The significance of the work will be that it can facilitate the decision makers responsible for the energy planning of the country.

## 1. Introduction

Pakistan is facing the growing challenge of supplying enough energy to meet rising demand. The country is in a tight market because the local reserves are insufficient to meet growing demands. It is assumed that world oil prices will return to previous high levels after 2012 [1]. So consumers are looking for the comparatively less expensive and environmental friendly natural gas for their energy needs [2].

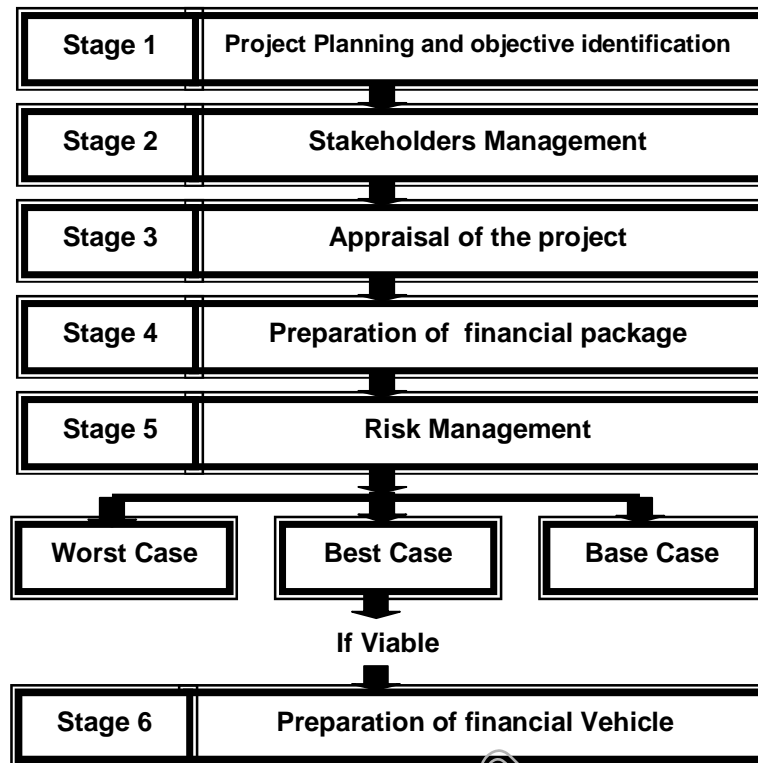
Pakistan's largest energy source is natural gas, making up 50 percent of Pakistan's energy mix in FY 2004/2005 [3]. The total proven natural gas reserves in Pakistan are estimated to be 28 trillion cubic feet (Tcf) [4]. Estimated proven reserves are not sufficient to meet continuously increasing demand. Pakistan is seeking import options to increase natural gas supply in the country[5]. Keeping in view the above the only option left is to look outside the country. However various factors need to be carefully analyzed before embarking upon such a project so that continuous, uninterrupted and economical gas can be made available to various sectors of Pakistan economy. In this paper an attempt has been made to identify the risks, uncertainties, costs and special legal requirements for a transnational infrastructure gas project with reference to Pakistan keeping in view the broader geopolitical environment of the region.

## 2. Methodology

First of all a mechanism incorporating the concepts of project finance, financial instruments, financial engineering, risk management and the key factors related to gas field development projects has been developed .The developed mechanism consists of six stages and is shown in Fig. 1.

---

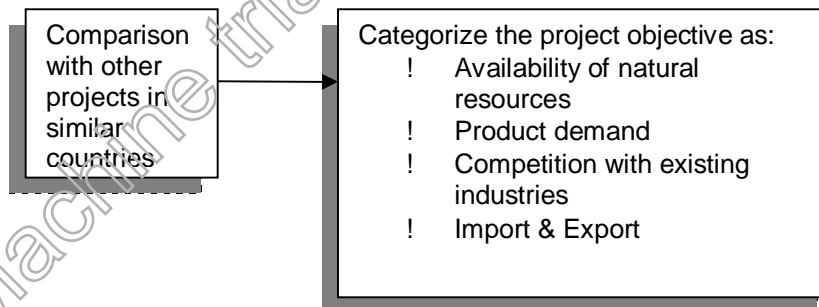
1. Department of Chemical Engineering; COMSATS Institute of Information Technology, Lahore  
2. Faculty of Mechanical Engineering; University of Engineering and Technology, Lahore



**Fig 1: Proposed Mechanism**

**2.1 Stage One: Project planning and Objective Identification**

In the first stage the objectives of the project should be clearly identified. A systematic project objective(s) identification process for transnational infrastructure gas project should cover the various aspects as shown in Fig 2 below.



**Fig 2: Project objective identification Process**

**2.2 Stage Two: Stake holders Management**

Every project has to deal with the complex project environment occupied by different parties. The projects which do not deal with these parties efficiently face delays and problems in the regulation, appraisal, approval, implementation and commissioning processes. Stakeholder identification and management helps to identify those parties and their probable impacts on the project completion. This stage is significant in the context of transnational nature of gas pipeline project, where various cultures and legal framework is involved.

**2.3 Stage Three: Appraisal of the Project**

Once the stake holders have been identified and managed, the next step in the procurement of a project is to do the detail appraisal. This stage consists of complete evaluation of the project in terms of economic viability, capital investment and the engineering and design studies. The

length of the route, effect of change in climate conditions; shares in equity; operation, etc should be considered at this stage.

#### 2.4 Stage Four: Preparation of a Financial Package

To finance any infrastructure project there is a need to model the financial package for that particular project. By developing a financial package the impact of different debt, equity and risk on the project can be analyzed and then the financial package on the basis of these assumptions can be finalized. There is a need of careful analysis of cash flows because of its extreme importance to the lenders and stakeholders. This stage begins with some basic assumptions as shown in Fig 3 below.

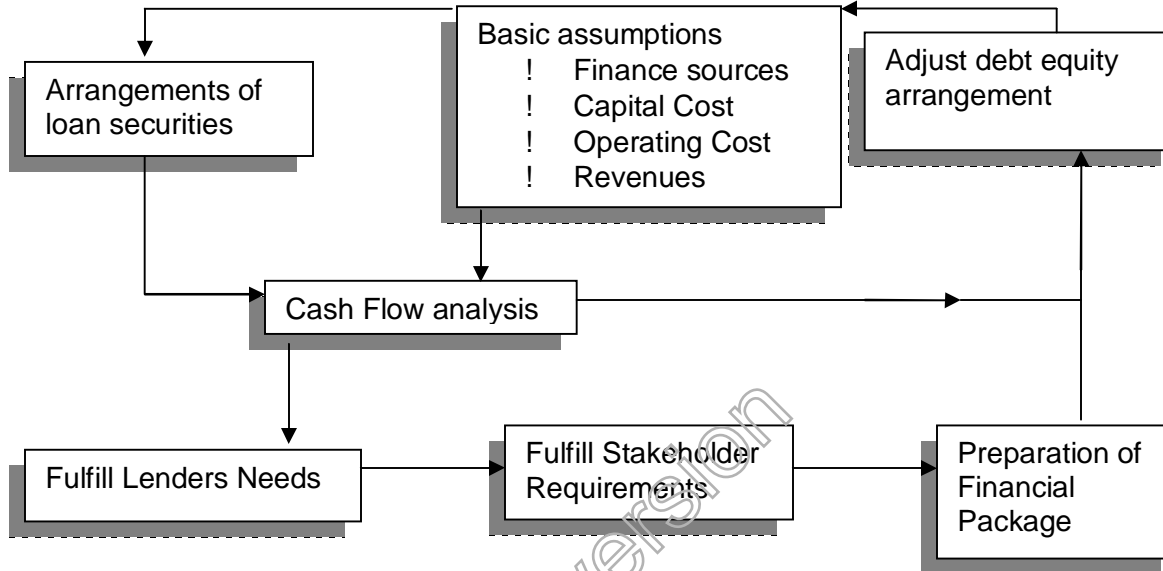


Fig 3: Mechanism for Financial Package

#### 2.5 Stage Five: Risk Management

Once the financial package has been made and finance is allocated the next step is to carry out the risk management process. It consists of three major steps that are as following:

- Risk Identification
- Risk Analysis
- Risk Response

The details are discussed in the next section.

#### 2.6 Stage Six: Financial Vehicle

After the risk management process, the commercial viability of the project is concluded. If the project is commercially viable then the economic parameters like IRR and NPV are analyzed then the financial vehicle to complete the project in an efficient way is prepared.

### 3 Proposed Transnational Natural Gas Pipeline Projects under consideration in Pakistan

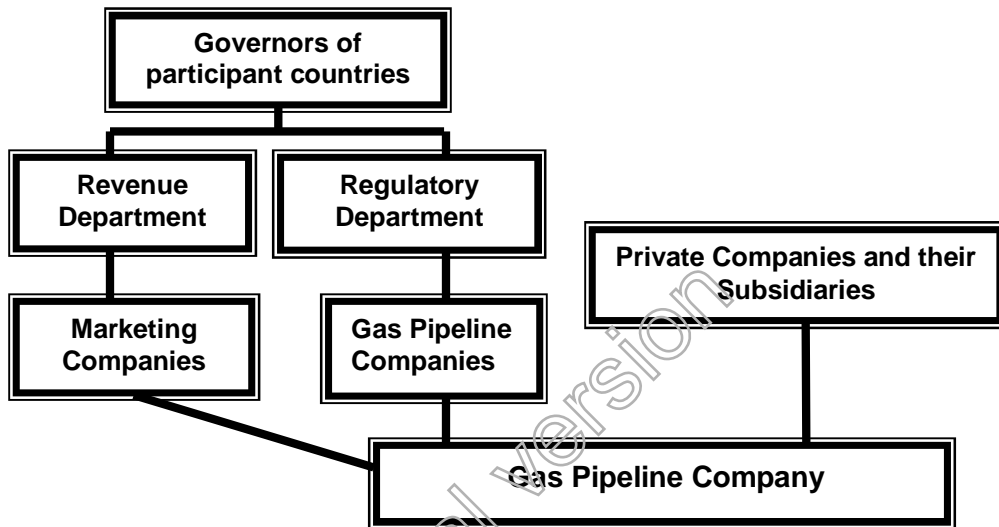
In this section various transnational gas pipeline projects under consideration in Pakistan have been examined in the light of the mechanism developed in previous section. Table 1 shows the details of various projects under consideration.

**Table 1: Various Transnational projects**

Name/ Project	Length (km)	Capacity (Bcf/d)	Capital Required (\$ Billions)
Iran-Pakistan-India (IPI) Pipeline Project [6]	2775	5.4	7.4 as on 2006
Dolphin Project. Qatar-U.A.E-Oman-Pakistan Pipeline Project [7]	1600	1.6	2.7
Turkmenistan-Afghanistan-Pakistan-India (TAPI) Pipeline Project [8], [9]	2000	0.11	2

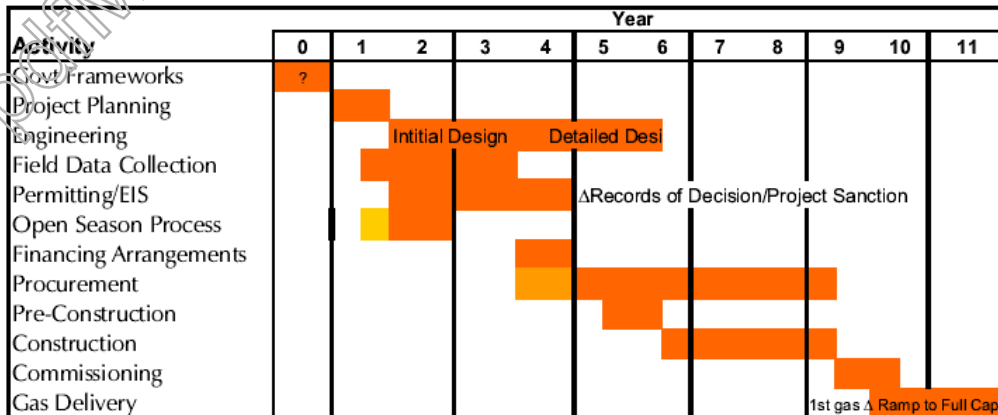
**3.1 Objective Identification & Project Planning**

Before identification of the objectives; a conceptual ownership structure has been proposed (Fig 4) so that subsequent analysis could be performed from adequate viewpoint.



**Fig 4: Conceptual Project Ownership Structure**

For a transnational infrastructure gas pipeline project, the identification of the objectives(s) should be from participants' viewpoint. From Pakistan's viewpoint; the objective should be to ensure the uninterrupted supply of natural gas according to the demands of various sectors of economy at competitive price. Work breakdown structure is almost similar for all the options and a conceptual project planning highlighting the major activities and associated timing is envisioned as shown in Fig 5 below:



**Fig 5: Conceptual Project Planning**

### 3.2 Stakeholders Management

Various internal and external stakeholders and their concerns are shown in Table 2(a) and 2(b) below:

**Table 2(a): Stakeholders identified for the project**

Internal Stakeholders		External Stakeholder	
Demand Side	Supply side	Private	Public
Governments of Participant countries	Falcon Constructions Public Developments Ltd.	City Council Tax Payers  Local Residents	Development Authorities

**Table 2(b) Stakeholders Mapping and their Importance**

Stakeholders Handling	Stakeholders
Minimal Effort	Council Tax Payers
Keep Informed	Local Residents Development Authorities
Keep Satisfied	Net West Pak Public Development
Key Player	Regulatory Department

### 3.3 Financial Estimate of Projects

The estimates of capital cost and annual cash flows are presented in Table 3 (a & b) below;

**Table 3(a): Cost of the Components**

Component	Amount (\$ billion, 2009)
Gas Treatment Plant	2.5
Mainline	8.5
Gas transmission pipelines plus NGL plant	2.0
<b>Total Cost</b>	<b>13.0</b>

**Table 3(b): Gas pipeline Model Revenues and Costs over the project life**

Revenues	\$ Billions	Costs \$	Billions
Gas sales	\$142	Principal and interest	\$7
Tariff income on excess capacity	\$2	Operating costs	\$3
Corporate income tax	\$14	Marketing costs	\$1
Local field distributions	\$8	Upstream cost allowance	\$4
Upstream PILT	\$2	Property taxes	\$1
Midstream PILT	\$3	Maintenance Cost	\$3
PILT on distribution lines	\$1		
<b>Total</b>	<b>\$172</b>	<b>Total</b>	<b>\$21</b>

It can be seen that in spite of higher capital cost; there are sufficient cash inflows to make the project a promising option.

### 3.4 Risk Identification Management

A comprehensive checklist covering various aspects has been developed to identify the risk associated with transnational gas pipeline project. The proposed checklist is shown in Table 4 below

**Table 4: Risk Identification Checklist**

Source	Risk Area	Uncertainty	Yes, No, Not Known	
<b>Project Risks</b>	<b>Project Brief and Definition</b>	Clarity in the project objectives and definition	Yes	
		Clarity in the project scope	Yes	
		Identification of Stakeholders agreement on the project objectives	No	
	<b>Project Requirements</b>	Clarity in the project requirement	Yes	
		Stability in the project requirement	No	
		Confirmation of the availability of all the required specifications	Yes	
		Project brief and objectives are acceptable to all the participants	Yes	
		Clarity in the user interface requirements	Yes	
		<b>Reservoir Performance</b>	Wells are the exploration wells	Yes
			Wells are the development wells	No
	Reserve size is known		Yes	
	Gas composition is known		Yes	
	Determination of water content and other liquid associated with the gas		Not Known	
	Any impurities associated with the gas		No	
	Availability of data of reservoir like pressure, temperature, porosity and permeability		Yes	
	<b>Procurement Strategy</b>	Procurement strategy is best suitable to handle the risk and to increase the commercial viability	Not known	
	<b>Project Management Team Performance</b>	Project management and leadership skills of project manager are sufficient	Yes	
		Project management team is a combination of skilled people from all the departments	Yes	
		Project team members are devoted to project	Yes	
		Project team members are highly experienced	Not known	
		Project management team can work together?	Yes	
		Communication between members is efficient and effective	No	
		<b>Planning and Quality Control</b>	Project planning and schedule is well defined	Yes
	Number of QA/QC inspectors working and their experience is enough		Yes	
	<b>Complexity</b>	Complexity of the project is well understood and analyzed	Not known	
		Size of project is manageable	No	

		Sufficient time is spent to control and integrate the system	Yes
		Project involves proven technology	Yes
		Laboratory tests have been carried out	Yes
		Field tests have been carried out	Yes
		PMT training is sufficient	Yes
		Any risks associated with construction?	Yes
		Problems may encounter during operation and maintenance	Yes
	<b>Purchasing and Importation</b>	Sufficient time has been spent on equipment purchase	Yes
		Problems may occur during purchasing	No
		Relations with purchasers are long term	Yes
		Permits required for import of gas and other goods are obtained	No
	<b>Labour</b>	Skilled manpower is available	Yes
		Religious matters that can affect the labour effectiveness	Yes
Government regulations required for employing local people are clear		Yes	
Any restrictions in the use of foreign labour?		No	
<b>Political Risk</b>	<b>Political Stability</b>	Political stability in the country	No
		Relation between company and government is good	Yes
	<b>Petroleum agreements</b>	The agreement is well defined and well understood between parties	Yes
		Agreement is balanced and provide a reasonable profit for the company and the countries involved in the project	Yes
		Any expectations of unfavorable change in the agreement during the life cycle of the project	Not Known
		Any possibility of unwanted change in tax provisions	No
<b>Law Risks</b>	<b>Law of the host country</b>	Project would be progressed according to the law of regional, home country and host country	Yes
	<b>Change in law</b>	Any change in the law is expected during project life cycle	No
<b>Natural Risks</b>	<b>Ground Condition</b>	Reservoir soil structure is stable for drilling	Yes
		Any shallow gas expected during drilling	Yes
		Any chances of earthquake?	No
	<b>Weather</b>	Any risk of severe weather affect to construction?	No
		Extreme weather expected during on-shore construction work	Yes
		Any depth of water and surface effect the project	No

<b>Safety Risks</b>	<b>Safety Regulations</b>	The project is according to all safety regulations of host country and regional safety regulations	Yes	
		Safety policy and rules have been put in place	Yes	
		Health and safety training has been given to all employees?	Yes	
		Safety apparatus and first aid kit is provided for the employees	Yes	
<b>Environmental Risks</b>	<b>Social Environment</b>	Effect of project on the population	Not known	
		Is the support of people and media to the project	No	
	<b>Green Risk</b>	The project progress will impact the life of animals and plantations in location of project	No	
		Project can effect the population to water, air and soil	No	
		EIA is carried out during appraisal process and economic evaluation of project	Yes	
	<b>Regulation</b>	Project activities like design, construction and operation is according to regulation of host country	Yes	
		Regulatory bodies are ready to provide the permits for project	Yes	
	<b>Commercial Risks</b>	<b>Market</b>	Market for the gas is available in the host country	Yes
			Future demand is stable	Yes
			Any other competitors are present in market	Yes
Other fuels in competition with gas			Yes	
Infrastructure pipeline project connects the producers and consumers			Yes	
Inflation rate is stable			No	
Share market is stable			No	
<b>Commercial Business Practices</b>		Project is commercially acceptable	Yes	
		Business practices in the host countries are established	Yes	
		Any business restrictions from government	No	
		Any differences between method of business in home and host countries	No	
<b>Project funding</b>		Funding for the project is satisfactory	Yes	
		Relationship between customers and host government are in good conditions	Yes	
		Currency of revenue is exchangeable	Yes	
<b>Price</b>		The International gas price is stable	No	
		The alternative fuel prices, particularly crude oil is stable	No	
		The local gas pricing policies are well established	No	
<b>Economic</b>		The economic circumstances of host country and regional countries stable	Yes	
		The exchange rate of currencies is stable	No	

After identification, the severity of risks is analyzed by employing probability impact table method to quantify the qualitative risks and their impact on various aspects of the project as shown in Table 5 below:

**Table 5: Probability Impact Table**

<b>Risks</b>	<b>Cause</b>	<b>Probability (1=low, 5=high)</b>	<b>Impact (1=low, 5=high)</b>	<b>Priority (Low, Medium, High, Very High)</b>
Political Risks	Instability in the government policy	4	4	High
Legal Risks	Disputes Among project parties	5	5	Very high
Environmental Risks	Effect of surroundings	3	2	Low
Exploration Risks	Lack of geological data	5	5	Very high
Reservoir Quality Risks	Instability in the reservoir pressure	3	4	medium
Design Risks	Incompetent design	3	2	Low
Technical Feasibility Risks	Implementing new technology without verification	3	4	medium
Site Conditions Risks	Careless analysis of site selection	3	2	Low
Construction risk	Accidents during construction	3	4	medium
Weather Risks	Natural disaster	3	4	medium
Supply Risk	Non availability of resources	3	2	Low
Operation and Maintenance	Complex maintenance and poor management	4	4	high
Price Risk	Variation in gas prices in market	5	5	Very high

The following actions shown in Table 6 are suggested to mitigate the risks which have already been identified.

**Table 6: Proposed Mitigation Actions**

Source	Risk Area	Uncertainty	Yes, No, Not Known	Mitigating Action
<b>Project Risks</b>	Project Brief and Definition	Identification of Stakeholders agreement on the project objectives	No	Meetings with the stakeholders to align their objectives
	Project Requirements	Stability in the project requirement	No	Find out the probability of changes in demands
	Reservoir Performance	Determination of water content and other liquid associated with the gas	Not Known	Do the Drilling Stem Tests(DST)
	Procurement Strategy	Procurement strategy is best suitable to handle the risk and to increase the commercial viability	Not known	Analyze the procurement strategy. Analyze the result of risk analysis and carry out the mitigated actions to the procurement strategy
	Project Management Team Performance	Project team members are highly experienced	Not known	Checkout the experience of team members in relevant technology and field
		Communication between members is efficient and effective	No	Arrange workshops and group discussions
	Complexity	Complexity of the project is well understood and analyzed	Not known	The facilities of the gas project are having potential problem. Recruit a specialist consultant to deal facilities and control system
		Training given to PMT is sufficient	No	Make training package for the PMT members
		Risks associated with construction	Yes	Ensure construction companies have sufficient experience
		Problems may encounter during operation and maintenance	Yes	Analyze design capacities of vessels and pipeline against the designed fluid volumes
Religious matters that can affect the labour effectiveness		Yes	Consider prayer timings in the construction schedule	

		Government regulations required for employing local people are clear	Yes	Analyze the regulatory procedures
<b>Political Risk</b>	Political Stability	Political stability in the country	No	Negotiations should be done to improve company and government relations
		Relation between company and government is good	Yes	Carefully analyze and review the contractual arrangements and changes in government regulations
	Petroleum agreements	Any expectations of unfavorable change in the agreement during the life cycle of the project	Not Known	Review other petroleum agreements
<b>Natural Risks</b>	Ground Condition	Any shallow gas expected during drilling	Yes	Drilling should be carried out with safety precautions
	Weather	Extreme weather expected during on-shore construction work	Yes	Analyze the worst case scenario when calculating safety factors for equipment and construction activities
<b>Environmental Risks</b>	Social Environment	Effect of project on the population	Not known	Team must be allocated to investigate the impact on local population
<b>Commercial Risks</b>	Market	Any other competitors are present in market	Yes	Carefully analyze and monitor the impact of other producers on supply. Analyze the plant design so that construction and operating costs can be minimized to remain competitive
		Other fuels in competition with gas	Yes	Analyze substitute fuels costs and availability in the market. Design of plant should be optimized to stay competitive with other fuels
		Inflation rate is stable	No	Analyze the effect of inflation rate variation

		Share market is stable	No	Assess the impact of share markets variation and prepare a plan to reduce risk
	Price	The International gas price is stable	No	Examine the international gas price
		The alternative fuel prices, particularly crude oil is stable	No	Examine the alternative fuel prices and assess their effect on gas price
		The local gas pricing policies are well established	No	Examine and evaluate the strategy
	Economic	The exchange rate of currencies is stable	No	Evaluate the effect of local currency variation

### Selection Criteria among Available Options

Selection Criteria	IPI Pipeline Project	Central Asia / TAPI Pipeline Project	Qatar- Pakistan Pipeline Project
Project Identification	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stakeholder Management	x	x	x
Project Appraisal	<input type="checkbox"/>	<input type="checkbox"/>	x
Source of Funding	<input type="checkbox"/>	x	x
Risks Associated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Risks can be mitigated	<input type="checkbox"/>	x	x

Turkemenistan-Afghanistan-Pakistan-Iran (TAPI) pipeline could not meet the needs of Pakistan and Dolphin project is at its inception stage, therefore, for the purpose of economic analysis, IPI project has been chosen.

#### 4 Case Study : Economic Analysis of the Selected Option

The aim of the gas pipeline is to provide the gas to the main consumer in Pakistan which is basically the state owned company called Sui Northern Gas Company (SNGP) and to the power plant in Karachi. This pipeline also provides the gas to one power plant in Delhi India. The data and the names used in this case study are hypothetical ones. For economic analysis; three

cases have been developed i.e. base; best and worst. The economic analysis has been carried out by considering the physical components of the project; as shown in Table 7 below

**Table 7: Physical Components considered for Economic Analysis**

Component	Description
<b>Gas Treatment Plant</b>	Location: Iran South pole Purpose: To remove CO <sub>2</sub> , H <sub>2</sub> S & other impurities
<b>Mainline</b>	Diameter = 48-52inch; Pressure = 2500 psi Feature: Buried pipe with compressing station along the length to maintain pressure. Location: Iran along Pakistan Highway
<b>Gas Transmission Pipelines</b>	Will receive gas from different fields like Tehran; Esfashan, Bandare emam, and Kerman Unit fields
<b>N.G.L Plant</b>	Purpose: To diversify the products range

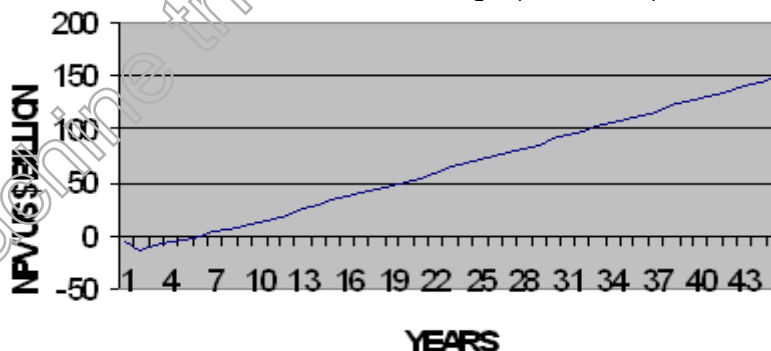
#### 4.1 Financial Modeling and Cash flow Analysis

The project involves building a large-diameter, large-volume natural gas pipeline and related facilities with a design capacity to transport over 5.4 (Bcf/d) of gas from Iran to Pakistan and Indian markets. Cumulative cash flows and the financial modeling of the base, best (after risk mitigation) and the worst case (before risk mitigation) is described in Table 8:

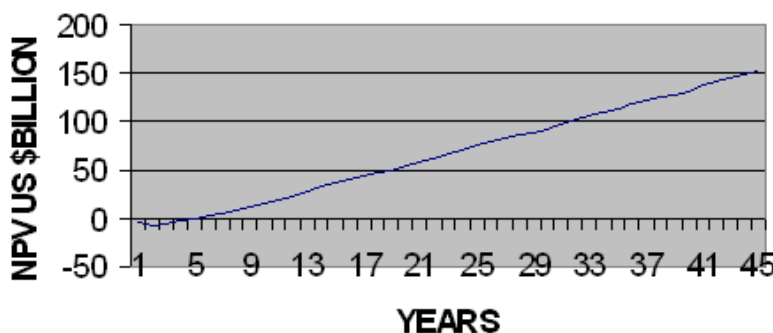
**Table 8: Financial Modeling and Cash flow analysis**

Case	Financial Model	Construction Cost (\$ Billions) 2009	Operation & Maintenance cost per year from year 3 (\$ Billions) 2009	Cost of Finances (\$ Billions) 2009	Estimation of revenues (\$ Billions) 2009
Base	Equity 10% Debt 90%	13	0.14	4.5 for 7 years	172
Best	Equity 0% Debt 100%	10	0.1	5 for 7 years	172
Worst	Equity 20% Debt 80%	13	0.2	5.5 for 7 years	

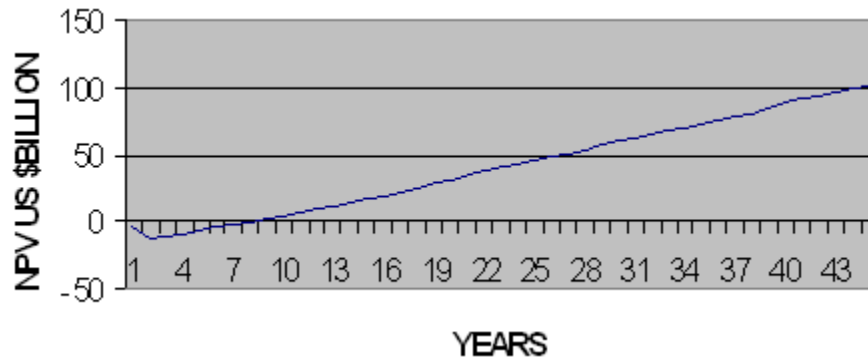
The cash flow patterns for three cases are shown in Fig 6(a, b and c)



**Fig 6 (a) Cash Flow for Base Case**



**Fig 6 (b) Cash Flow for Best Case**



**Fig 6 (c) Cash Flow for Worst Case**

**4.1.1 Base Case**

For base case the following data has been assumed

**Construction cost** = \$ 13 Billions

**Operation and Maintenance Cost** (Operation and Maintenance Cost includes O+M of compressors, chillers, GTP, NGL plant, mainline, and gas transmission pipelines)  
 O+M = \$6 Billions for 43 years starting from year 3

**Cost of Finances**

Debt = \$ 4.5 Billions at IRR 24% for 7 Years

**Projected Revenues**

Revenues	\$ Billions(2009)
Gas sales	\$142
Tariff income on excess capacity	\$2
Corporate income tax	\$14
Upstream PILT	\$2
Midstream PILT	\$3
PILT on distribution lines	\$1
Local Pars field Iran distributions	\$8
<b>Total</b>	<b>\$172</b>

**Calculations for Discount rate**

$$NPV = -C_1(P/F, i\%, 1) - C_2(P/F, i\%, 2) + (R - O)(P/A, i\%, 43)(P/F, i\%, 2) - (COF)(P/A, i\%, 7)(P/F, i\%, 2) - (E)(P/A, i\%, 8)(P/F, i\%, 2)$$

where

- C1 = Construction Cost in year1
- C2 = Construction Cost in year 2
- R = Revenues
- O = Operations and Maintenance Cost
- COF = Cost of Finance
- E = Equity

NPV at 15 i%

$$NPV = -5(0.8696) - 8(0.7561) + (4 - 0.14)(6.64)(0.7561) - (0.64)(4.1604)(0.7561) - (0.0625)(4.4873)(0.7561) = 6.75$$

NPV at 25%

$$\begin{aligned} \text{NPV} &= -5(0.8) - 8(0.64) + (4 - 0.14)(3.99)(0.64) - (0.64)(3.1611)(0.64) - \\ &\quad (0.0625)(3.3289)(0.64) \\ &= -0.691 \end{aligned}$$

**Discount Rate**

$$\frac{25\% - 15\%}{-0.691 - 6.75} = \frac{i\% - 15\%}{0 - 6.75}$$

$$i\% = 24\%$$

**The discount rate is 24%**

#### 4.1.2 Best Case

For best case following assumptions are made

**Construction Cost** (The gas pipeline would be constructed within 2 years with all equipment ready in operation)

Construction cost = \$ 10 Billions

**Operation and Maintenance Cost** (Operation and Maintenance Cost includes O+M of compressors, chillers, GTP, NGL plant, mainline, and gas transmission pipelines).

O+M = \$4.3 Billions for 43 years starting from year 3

#### Cost of Finances

Debt = \$ 5 Billions at IR 29% for 7 Years

#### Revenues

Revenues	\$ Billions(2009)
Gas sales	\$142
Tariff income on excess capacity	\$2
Corporate income tax	\$14
Upstream PILT	\$2
Midstream PILT	\$3
PILT on distribution lines	\$1
Local Pars field Iran distributions	\$8
Total	\$172

#### Calculations for Discount rate

$$\text{NPV} = -C_1(P/F, i\%, 1) - C_2(P/F, i\%, 2) + (R - O)(P/A, i\%, 43)(P/F, i\%, 2) - (\text{COF})(P/A, i\%, 7)(P/F, i\%, 2)$$

where

C1 = Construction Cost in year1

C2 = Construction Cost in year 2

R = Revenues

O = Operations and Maintenance Cost

COF = Cost of Finance

NPV at 15 i%

$$\begin{aligned} \text{NPV} &= -4(0.8696) - 6(0.7561) + (4 - 0.1)(6.64)(0.7561) - (0.714)(4.1604)(0.7561) \\ &= 13.4 \end{aligned}$$

NPV at 30%

$$\begin{aligned} \text{NPV} &= -4(0.78) - 6(0.61) + (4 - 0.1)(2.99)(0.61) - (0.714)(0.61)(2.8) \\ &= -0.88 \end{aligned}$$

$$\text{Discount Rate} \quad \frac{30\% - 15\%}{-0.88 - 13.4} = \frac{i\% - 15\%}{0 - 13.4}$$

$$i\% = 29\%$$

**The discount rate is 29%**

#### 4.1.3 Worst Case

For worst case following assumptions have been made

**Construction Risks** (delays in supply of material, Inflation rate)  
Construction cost = \$13 Billions

**Operation and Maintenance Risks** (Cost overruns due to repair of compressors, pipeline failure, Maintenance of GTP and NGL plant, Inflation rates)  
O+M = \$8.6 Billions

**Financial Risks** (Interest rates increases, Dividends payments increases as project performs well)  
Cost of Finance = \$5.5 Billions for 7 years

**Revenues** (Reduction in revenues is due to GTP failure, Less sales)  
R = \$ 129 Billions

#### Calculations for Discount rate

$$\text{NPV} = -C_1(P/F, i\%, 1) - C_2(P/F, i\%, 2) + (R - O)(P/A, i\%, 43)(P/F, i\%, 2) - (\text{COF})(P/A, i\%, 7)(P/F, i\%, 2) - (E)(P/A, i\%, 8)(P/F, i\%, 2)$$

where

- C1 = Construction Cost in year1
- C2 = Construction Cost in year 2
- R = Revenues
- O = Operations and Maintenance Cost
- COF = Cost of Finance
- E = Equity

NPV at 15 i%

$$\text{NPV} = -5(0.8696) - 8(0.7561) + (3 - 0.2)(6.64)(0.7561) - (0.628)(4.1604)(0.7561) - (0.1375)(4.4873)(0.7561)$$

$$= 1.2187$$

NPV at 25%

$$\text{NPV} = -5(0.8) - 8(0.64) + (3 - 0.2)(3.99)(0.64) - (0.628)(3.1611)(0.64) - (0.1375)(3.3289)(0.64)$$

$$= -3.532$$

$$\text{Discount Rate} \quad \frac{25\% - 15\%}{-3.532 - 1.2187} = \frac{i\% - 15\%}{0 - 1.2187}$$

$$i\% = 17\%$$

**The discount rate is 17%**

#### Cash Flow Analysis

Economic parameters	Base Case	Best Case	Worst Case
NPV (US \$ billion)	148	152	102
IRR (%)	24	29	17
PAYBACK(years)	7	6	9

The economic parameters of the project show that the NPV of the best case after risk mitigation is acceptable. The IRR=29% of the project is greater than the MARR (Minimum Acceptable Rate of Return=20%). So the project is commercially viable.

### **Conclusion and Recommendations**

The mechanism has been developed for the evaluation of transnational infrastructure gas pipeline projects. The risks have been identified for the proposed project and mitigation measures have been suggested. The developed mechanism has been applied to a hypothetical case study on three options i.e base, best & worst for a MARR 20 %. The calculated IRR= 29% is satisfactory indicating that the project is worth undertaking. The significance of the work is that it could facilitate the energy planners of the Pakistan in the prevailing regional scenario.

### **References**

- [1] International Energy Outlook
- [2] Natural gas official website,  
<http://naturalgas/overview.com>
- [3] Pakistan Energy Yearbook, 2005
- [4] Energy Information Administration official website,  
<http://www.eia.doe.gov/cabs/Pakistan/pdf.pdf>
- [5] Economic Survey of Pakistan, Ministry of Finance Govt. of Pakistan
- [6] The Iran--Pakistan--India Pipeline THE INTERSECTION OF ENERGY AND POLITICS  
David Temple
- [7] REGIONAL & INTERNATIONAL INTEREST IN OIL & GAS PIPELINES TO GAWADAR  
Jehanzeb, Iftikhar Ahmad & S. Shehzad
- [8] Hamid Naved Dr. Pakistan Oil and Gas Conference 2004. Are Regional Gas Pipelines Possible? 4 May 2004 Islamabad.
- [9] Taking Pakistan into the 21st Century: The Economic and Political Challenges Washington, D.C., July 24, 2002. Oil and Gas Developments : Challenges and Opportunities By Zakauddin Malik