BE CIVIL ENGINEERING PROJECT REPORT

A HYBRID-DELPHI (PESTLE-SWOT) PARADIGM FOR OIL AND GAS PIPELINE STRATEGIC PLANNING IN CPEC

Project submitted in partial fulfilment of the requirements for the degree of

BE Civil Engineering

SUBMITTED BY

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Military College of Engineering

National University of Sciences and Technology

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(2019)

This is to certify that the
BE Civil Engineering Project titled

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Has been accepted towards the partial fulfilment of the requirements for

Bachelor of Engineering in Civil Engineering Degree

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Project Advisor
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DEDICATED TO
OUR
PARENTS & TEACHERS

ACKNOWLEDGEMENT

First of all we thank **Almighty Allah** for His blessings and secondly our **parent's** prayers and support which provided us with the much needed inspiration and encouragement throughout the degree & to take on this project. We thank and highly appreciate our advisor **(Approved) Lt Col Dr Rai Waqas Azfar Khan** for his guidance and counselling at each step of the endeavour who was always available to guide us in times of struggle.

ABSTRACT

China, being the world's largest population and energy consuming country strives till date for the security and optimization of its crude oil imports to fulfil its growing energy demands. Presently, the two maritime routes [Via Myanmar (12 days) and Via Malacca (22 days)] are not serving the purpose owing to their inbuilt strategic, security and time/space limitations which have been highlighted in the study. For instance, Beijing fears that during a national security crisis ships carrying energy capitals could be prohibited by hostile naval forces. Any disruption to the free flow of energy resources into China could disrupt the economic progress on which the Chinese government depends to build up its legitimacy and pursue its great power desires. The narrowest point in the strait is only 1.7 miles wide, which creates a natural bottleneck for shipping. Pakistan being part of China's BRI initiative can serve the purpose mutually benefitting both nations. Firstly the transport security and secondly, the sea travel time can be reduced to only 4 days via Gawader. The evaluation and selection of alternative transnational export routes is a complex multi-criteria problem with conflicting objectives. The study was carried out in 6 distinct and logically leading steps. The experts were asked to carry out a series of DELPHI rounds to arrive at the most manageable and rational issues pertinent to each route. The experts were assisted by the facilitators for compiling and sharing results incognito. We identified 7 potential routes which can be used to transport crude oil to China. 2 of them were eliminated in initial phases of study through logical dominance. The remaining 5 routes were examined and evaluated using the PESTLE-SWOT factor analysis. 144 strategic PESTLE factors were identified and managed through DELPHI rounds after listing as per SWOT by experts. Each potential route was studied against 27 finalized factors; their normalised weights were calculated by balancing strengths, weaknesses, opportunities and threats. Results were plotted on a scatter plot and ranked by calculating their Euclidean distances. As a result, a ranking of routes which was balanced and weighed according to the importance and positivity of each strategic factor was achieved. The potentials of CPEC being part of BRI were further illuminated to utilize them in best possible way by incorporating crude oil transportation pipeline. An endeavour has been made to highlight the significance of CPEC route by a qualitative and systematic study with a view to encourage further research in the field and contribute in nation building.

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LIST OF ABBREVIATIONS

DMs: Decision Makers

OBOR: One Belt One Road

PMBOK: Project Management Body of Knowledge

PMI: Project Management Institute

BRI: Belt Road Initiative

PESTLE: Political Environmental Social Technological Legal Economical

MCE: Military College of Engineering

SWOT: Strength Weakness Opportunity Threat

CPEC: China Pakistan Economic Corridor

OECD: Organization for Economic Cooperation and Development

OGDCL: Oil and Gas Development Company Ltd

OBS: Organizational breakdown structure

BIM: Building Information Modeling

CAD: Computer Aided Design

CHAPTER 1

1 INTRODUCTION

1.1 Introduction

The oil and natural gas industry is the pillar of the world economy. The rapid economic growth in developed countries tied with the growing economies in countries such as China has precipitated a steady increase in the demand for energy, especially oil and natural gas. China has moved to the top spot of energy consumption in 2010 with 20.3% of the global demand, ahead of the U.S i.e 19% according to British Petroleum's 60th annual statistical review of world energy. The U.S.'s consumption enclosed up 3.7% last year compared with an 11.2% growth in China. According to British Petroleum the demand for all practices of energy grew 5.6% in 2010.The consumption growth enhanced by 3.5% in the organization for economic co-operation and development (OECD) countries (which includes 34 countries including the U.S, U.K, France, Germany and Japan) while the consumption grew by 7.5% in the non-OECD countries. The vital importance of energy to get her with the constant increase in demand for oil and gas obliges the exploration, development and distribution of new sources of energy.

China's One Belt One Road (OBOR) enterprise seeks better connectivity among 60 countries in Asia, Europe and Africa. China Pakistan Economic Corridor (CPEC) is a portion of OBOR initiative. The total investment for the CPEC is US $46 million which includes roads, railways tracks, oil and gas pipe lines, fiber optic cable for communication, air ports and dams. Amount worth US $16 billion will be operated in infrastructure (roads and railways) development. Envisaged by the Chinese President Xi Jin ping the CPEC project will result in uplift of Pakistan's economy. At present China is the largest trading partner of Pakistan. China and Pakistan enjoy strong mutual trade and commercial links, starting in January 1963 when first consensual trade agreement was signed between the two countries. Moreover two countries have often exchanged high-level visits and a lot of contracts and investments have been made at government level as well as private level. Pakistan and China signed a bilateral Free Trade Agreement in 2006 which came into effect in 2007. Total trade of Pakistan and China under FTA rapidly boosted from US $4 billion in 2006 to US $13.77 billion in 2016.

Pakistan's exports to China in Financial year 2016 were US $1.6 billion while imports from China were US $12.1 billion.

In this study we identify and quantify a total of 27 factors that will shape the future of China oil and natural gas import via Pakistan. In doing so we propose a hybrid model for evaluating potential pipeline routes for transporting the oil and gas from the Middle East region to the China market. The model integrates strength, weakness, opportunity and threat (SWOT) analysis with the Delphi method and captures the DM's belief s through a series of intuitive and analytical methods. The next section presents the details of the Delphi-SWOT hybrid paradigm followed by its application to the gas and oil pipeline evaluation to China. The final section presents the conclusions and future research directions.

1.2 Problem statement

Problems to China

CPEC being the present-day hot topic in Pakistan with unquestionable benefits and transforming capacity for Pakistan is being termed as a game changer for the nation. Apart from the traditional proclaimed projects associated with the OBOR scheme of China, it has a potential to integrate crude oil transportation system via pipelines to China. It will be a project of mutual benefit for both the countries and will provide China with the advantages as developed through the study.

China's rapid economic growth and industrialization have augmented the plea for energy to exceed domestic supply notable to energy security concerns. Energy security is an important aspect of China's national security and fortifying access to plentiful oil supplies are one significant element of its energy security plan. China's oil consumption has exceeded 11 million barrels per day and the country became the world's largest net importer of oil in 2014. Its total net oil import addiction almost doubled from 30% in 2000 to around 57% in 2014 posturing a serious challenge to the Chinese government with respect to devoting in the security of its strategic oil reserves. Listed the three risks confronted by oil-importing countries as source dependence, transit dependence, and facility dependence. With respect to source dependency China currently imports oil from more than 15 countries of which Saudi Arabia, Russia, Angola, Iran, Iraq, and Oman are the major suppliers. Since the sources of oil imports are fixed, the transportation network (transit routes) is measured to address the oil security dilemma. Further, with respect to the transportation of oil most China bound oil is supplied using oil tankers and pipelines. Nearly 83% of China's oil supplies are seaborne, of which around 80% come through the Strait of Malacca which is a geopolitically dubious

zone. Therefore the increasing demand for oil and the dependency of China on a single route is creating a potential oil security challenge

1.3 Project Objectives

The main objectives of this project are:

- To carry out analysis of various potential routes for crude oil transportation to China
- To identify the relevant factors using PESTLE analysis
- To carry out SWOT analysis of the identified factors
- To identify best suitable route based on DELPHI-SWOT hybrid model as a result of logical process
- To formulate strategies for the identified best option (route)

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1.4 The Delphi-SWOT hybrid paradigm

Summary of methodology

Strategy development is a multipart and tentative process that detects and evaluates changes for utilizing an organization's resources to reach its mission. Because of real uncertainty and professed haziness the process of strategy development requires input from and cooperation of many organizational functions and DMs .The hybrid Delphi-SWOT paradigm anticipated in this study is used to identify and gage strategies for locating a pipeline to transport oil and gas from the Middle East being a major exporter of crude oil to China markets. The Delphi method was developed at the RAND Corporation to obtain the most reliable harmony of opinion from a group of knowledgeable individuals about an issue not subject to objective solution. It is a structured group collaboration that proceeds through multiple rounds of opinion collection and unidentified feedback. Each round in Delphi involves a written survey of the doorway followed by statistical response to them for each survey question. After seeing the results from the previous round the participants are asked to reconsider their opinions. Generally, there is a conjunction of opinions after three or four rounds and a stabilized group opinion emerges. This group opinion may reflect agreement, divergence or some of each. The optimum number of partakers depends on the number needed to have a representative amalgamating of views. Since its inception in the early 1950,s SWOT analysis has been used with growing success as a premeditated planning tool by both canvassers and practitioners. The technique is used to isolate environmental factors and forces into internal

strengths and weaknesses and external opportunities and threats. The SWOT matrix advanced by Weih rich in 1982 for situational analysis is one of the most important references in the field. However, SWOT remains a useful tool for supporting DMs to structure complex and ill-structured problems.

1.5 Expected outcomes

Through the mounting petition for dynamism from settled economies and countries the demand for oil and natural gas has harshly faced the policy makers and world leaders in a pursuit to their stable survival. In retort pipelines are used to transport oil and natural gas over long distances within countries and across borders to meet the bump demand. The spaces between the source of the petroleum products (Gulf states in our case) and the terminus (China) for energy requirements can be thousands of miles over hard and varying terrain. In this environment China has already started to gauge alternative import routes from the Strait of Hormoz because of its vast feeding of oil and natural gas products. China is fronting problems both economic and security on its already existing routes as discussed in the study. CPEC already being undertaken has the potential of an additional respite to both Pakistan and China for this purpose

1.6 Project Report Structure

- Chapter 1 (Introduction): In this chapter, introduction to the selected problem and its background along with the approach towards it are elaborated.
- Chapter 2 (Literature review): In this chapter, the theory regarding the conception and concept of the project has been explained in detail.
- Chapter 3 (Methodology): The method adopted to solve the problem and findings have been illustrated.
- Chapter 4 (Results): The discussion on results that have been achieved.
- Chapter 5 (Strategy development): Description of the concept and the proposed strategy based on the results.
- Chapter 6 (Conclusions and Recommendations): The topic concluded, recommendations made and possible future research directions suggested.

1.7 Research design

- Step 1 (Identification of potential routes): In this step potential routes are identified through group discussion and expert opinion
- Step 2 (Identification of relevant issues): In this step PESTLE analysis is used and the relevant factors are identified against six of the macro environment PESTLE issues , factors are also organized has per SWOT
- Step 3 (Delphi Rounds): A series of pre decided Delphi rounds is carried out to synthesis the relevant factor identified in step 2
- Step 4 (Delphi-SWOT analysis of synthesized factors): The factors are classified as external and internal. Delphi rounds are used to further reduce the factor into more manageable manner
- Step 5 (Evaluation of each route against 27 strategic factors): Hybrid Delphi SWOT analysis is used to scrutinize and evaluate each potential routes against the factor identified
- Step 6 (Results and strategy): Basing on the obtained results, respective strategies are proposed

The process is illustrated in Fig 1.1 below.

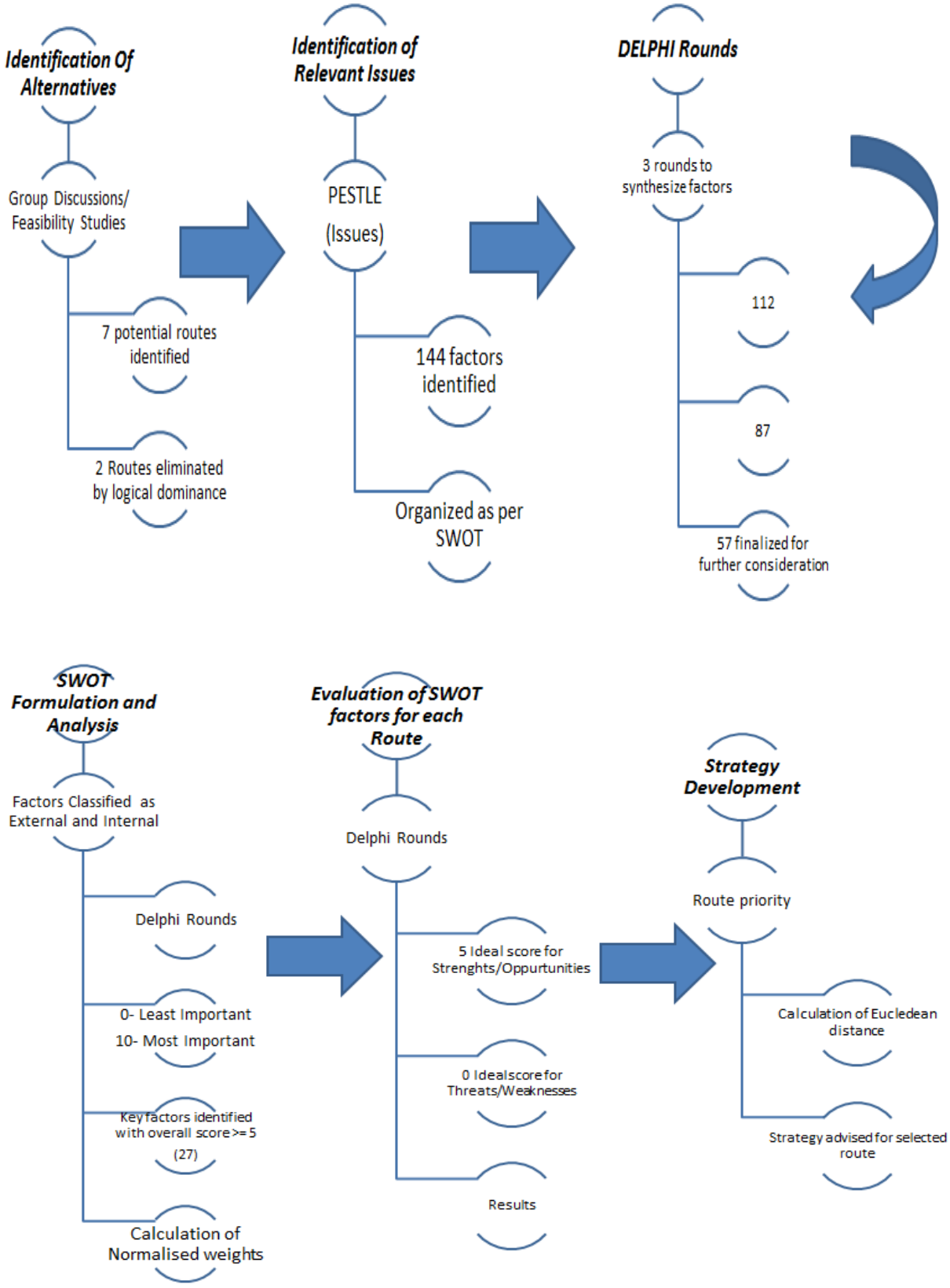

Fig 1.1 – Research Design

Chapter 2

2 LITERATURE REVIEW

This chapter is divided into 6 Sections

2.1 DELPHI Method

2.1.1 Definition

The Delphi method is a forecasting process framework based on the results of several rounds of questionnaires sent to a panel of experts. Several rounds of questionnaires are sent out, and the unnamed responses are aggregated and shared with the group after each round. The specialists are allowed to adjust their answers in subsequent rounds. Since multiple rounds of questions are asked and the panel is told what the group thinks as a whole, the Delphi method pursues to reach the correct response through consensus.

Delphi is based on the principle that forecasts from an organised group of personalities that are more precise than those from amorphous groups. The professionals answer questionnaires in two or more rounds. After each round, a facilitator provides an unnamed summary of the experts forecasts from the previous round as well as the reasons they provided for their judgments. Thus, experts are encouraged to revise their earlier answers in light of the replies of other members of their panel. It is believed that during this process the range of the answers will decrease and the group will converge towards the *correct* answer. Finally, the process is stopped after a predefined stop condition (e.g., number of rounds, achievement of consensus, stability of results), and the mean or median scores of the final rounds control the results.

2.1.2 Origin and Mechanism

The Delphi method was originally apprehended in the 1950s by Olaf Helmer and Norman Dalkey of the RAND Corporation. The name refers to the Oracle of Delphi, a minister at a temple of Apollo in ancient Greece known for her forecasts. The Delphi method allows experts to work towards a mutual agreement by steering a circulating series of questionnaires and releasing related feedback to further the discussion with each subsequent round. The experts' replies shift as rounds are completed based on the material brought forth by other experts participating in the investigation.

First, the group facilitator selects a group of experts based on the topic being examined. Once all participants are established, each member of the group is sent a questionnaire with the guidelines to comment on each topic based on their personal opinion, experience or previous research. The questionnaires are returned to the facilitator who groups the comments and prepares copies of the information. A copy of the compiled comments is sent to each participant, along with the opportunity to comment further. At the end of each comment session, all questionnaires are returned to the facilitator who decides if another round is necessary or if the results are ready for publishing. The DELPHI mechanism is shown in Fig 2.1 below.

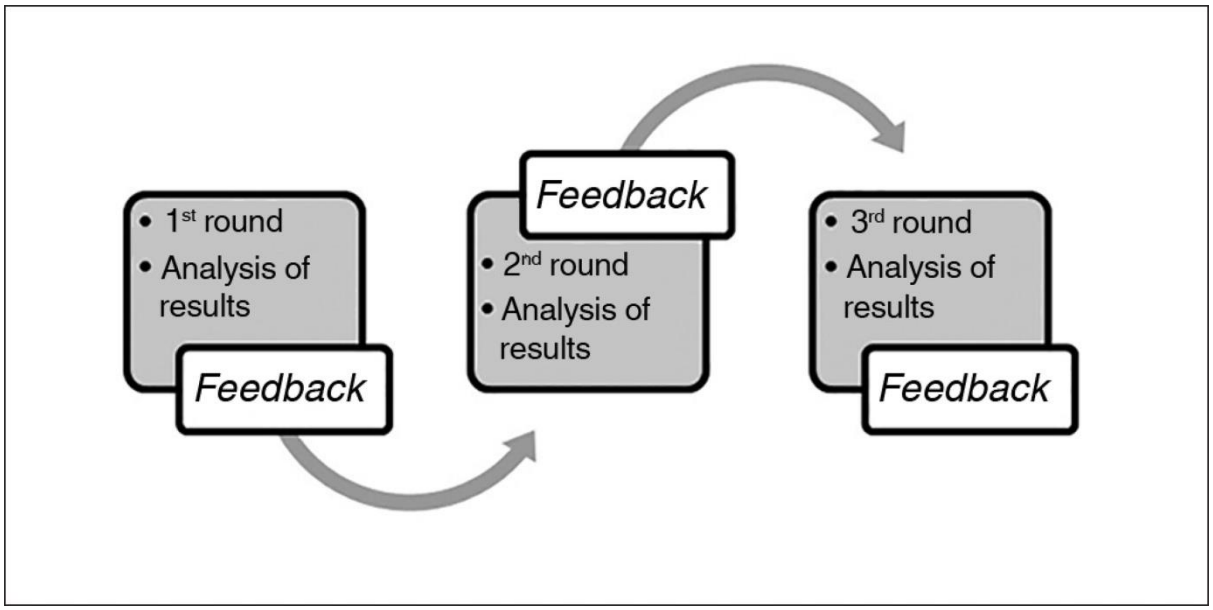

Fig 2.1 – DELPHI Mechanism

2.1.3 Applications

- **Forecasting**

  First applications of the Delphi method were in the field of science and technology forecasting. The objective of the method was to combine expert opinions on likelihood and expected development time, of the particular technology, in a single indicator. One of the first such reports, prepared in 1964 by Gordon and Helmer, assessed the direction of long-term trends in science and technology development, covering such topics as scientific breakthroughs, population control, automation, space progress, war prevention and weapon systems. Other forecasts of technology

were dealing with vehicle-highway systems, industrial robots, intelligent internet, broadband connections, and technology in education.

Later the Delphi method was applied in other places, particularly those related to public policy issues, such as economic trends, health and education. It was also applied successfully and with high accuracy in business forecasting. For example, in one case reported by Basu and Schroeder (1977), the Delphi method predicted the sales of a new product during the first two years with inaccuracy of 3–4% compared with actual sales. Quantitative methods produced errors of 10–15%, and traditional unstructured forecast methods had errors of about 20%. The Delphi method has also been used as a tool to implement multi-stakeholder approaches for participative policy-making in developing countries. The governments of Latin America and the Caribbean have successfully used the Delphi method as an open-ended public-private sector approach to identify the most urgent challenges for their regional ICT-for-development eLAC Action Plans. As a result, governments have widely recognized the value of collective intelligence from civil society, academic and private sector participants of the Delphi, especially in a field of rapid change, such as technology policies.

- **Policy Making**

  The DELPHI technique has proven to be useful in policy making when there are large numbers of people which are affected by factors having diverse nature. From the 1970s, the use of the Delphi technique in public policy-making introduces a number of organisational innovations. In particular the need to examine several types of items leads to introducing different evaluation scales which are not used in the standard Delphi. The difficulty of the issues posed in public policy-making leads to give more importance to the arguments supporting the evaluations of the panellists; so these are often invited to list arguments for and against each option item, and sometimes they are given the possibility to suggest new items to be submitted to the panel. For the same reason, the scaling methods, which are used to measure panel evaluations, often include more urbane approaches such as multi-dimensional scaling.

- **Online Delphi systems**

  A number of Delphi forecasts are conducted using web sites that allow the process to be conducted in real-time. For instance, the TechCast Project uses a panel of 100 experts worldwide to forecast breakthroughs in all fields of science and technology. Another example is the Horizon Project, where educational futurists collaborate online using the Delphi method to come up with the technological advancements to look out for in education for the next few years.

2.2 SWOT Analysis

2.2.1 Definition

SWOT analysis is a strategic planning technique used to help a person or organization identify strengths, weaknesses, opportunities, and threats related to business competition or project planning. SWOT analysis is a framework used to evaluate a company's competitive position by identifying its strengths, weaknesses, opportunities and threats. Specifically, SWOT analysis is a initial assessment model that measures what an organization can and cannot do, and its potential opportunities and threats. SWOT analysis is a basic, analytical agenda that assesses what an object, usually a business, though it can be a place, industry or product can and cannot do, for factors both internal and external. Using environmental data to evaluate the position of a company, a SWOT analysis determines what assists the firm in accomplishing its objectives, and what obstacles it must overcome or minimize to achieve desired results: where the organization is today, and where it may go. For example, back in 2015, a Value Line SWOT analysis of The Coca-Cola Company noted strengths like its well-known brand name, vast delivery network and opportunities like emerging markets, but it also noted weaknesses and threats such as foreign currency fluctuations, a growing taste for "healthy" beverages and the subsequent competition from providers of such beverages. Coca-Cola took steps to address these concerns, ramping up its marketing, advertising and publicity activities, and expanding into other beverage categories. As a result, within a year, its dividend-per-share rose from 33 to 35 cents, and its stock, which was hovering around $39 per share, climbed to $46. It's fallen since, but remains up about 13 per cent over the past three-year period.

2.2.2 Elements of SWOT Analysis

When using SWOT analysis, an organization needs to be realistic about its good and bad points. The organization needs to keep the analysis specific by avoiding gray areas and analysing in relation to real-life contexts. For example, how do the officialdom's products and services compare to those of competing firms? SWOT analysis should be short and simple, and should avoid complication and over-analysis because much of the information is subjective. Thus, companies should use it as a guide and not a medicament. Pictorial illustration in Fig 2.2.

- **Strengths** describe what an organization excels at and separate it from the competition a strong brand, loyal customer base, a strong balance sheet, unique technology and so on. For example, a hedge fund may have developed a proprietary trading strategy that returns market-beating results. It must then decide how to use those results to attract new investors.
- **Weaknesses** stop an organization from performing at its optimum level. They are areas where the business needs to improve to remain competitive: higher-than-industry-average turnover, high levels of debt, an inadequate supply chain or lack of capital.
- **Opportunities** refer to favourable external factors that an organization can use to give it a competitive advantage. For example, a car manufacturer can export its cars into a new market, increasing sales and market share, if a country cuts prices.
- **Threats** refer to factors that have the potential to harm an organization. For example, a drought is a threat to a wheat-producing company, as it may destroy or reduce the crop yield. Other common threats include things like rising costs for inputs, increasing rivalry, tight labour supply and so on.

Fig 2.2 – Components of SWOT

Analysts present a SWOT analysis as a square with each of the four areas making up one quadrant. This visual arrangement provides a quick overview of the company's position. Although all the points under a particular heading may not be of equal importance, there is insight in seeing how the number of opportunities measures up to the number of threats, and so forth.

2.2.3 Executing a SWOT Analysis

Pre-SWOT Homework

Before you set out to do a SWOT analysis with your management team or other group, there is preparation to go through. The first step is to take a stab at creating a company profile. This is a description of what the business does and who the main customers are. If time allows or your company is sprawling and complex, you may need to profile each segment to capture what they add to the business. It also helps to outline strengths, weaknesses, opportunities and threats you've perceived so you can prompt the group if needed.

Leading the Process

When performing a SWOT analysis, it is best to start with a clean chart. Lay out the four quadrants and outline the content you are looking to populate it with as above. Again, in highly segmented business we may find the leads in the separate areas have more specialized knowledge as to the strengths and weaknesses in their areas. In extreme cases, you may need to do a segment-by-segment SWOT and feed it up into the larger one. For most companies, however, a single SWOT chart captures the current condition of the business. At first, you want to capture everything you can from the group in a rush. When the pace of input drops off, we can go over the chart and eliminate duplicate/overlying entries and ensure each entry is in the right category. Walk the group through our reasoning if you are outright eliminating an entry or combining concepts. This is basic courtesy and shows the company values their input. The group can also help in adding and removing entries within the SWOT chart to distil it to a mutually agreed upon essential.

Working with the Chart

We probably have an imbalance between internal and external factors. People are much more aware of the current state within a company and less likely to think of the whole business sector's direction. If needed, you can prompt more entries under opportunities by encouraging them to think about how the company can leverage a current strength to create new opportunities or how fixing a weakness could lead to a larger opportunity.

2.3 PESTLE

A PESTEL analysis or PESTLE analysis (previously known as PEST analysis) is an outline used to analyse and screen the macro-environmental factors that may have a weighty impact on an organisation's performance. This tool is especially useful when starting a new business or entering a foreign market or carrying out any study for research in order to best evaluate the expected outcomes. Fig 2.3 shows these factors.

Fig 2.3 – FACTORS OF PESTLE

The details of these six factors and areas they cover in a particular study are covered in Section 3.2.2

2.4 Relevant Studies

- Transportation of heavy and extra-heavy crude oil by pipeline:
  A review by Rafael Martine[z]
- A hybrid Delphi-SWOT paradigm for oil and gas pipeline strategic planning in Caspian Sea basin by Dennis T Kennedy
- What's SWOT in strategic analysis? By David W. Pickton and Sheila Wright
- Identifying the Criteria Set for Multicriteria Decision Making Based on SWOT/PESTLE Analysis: A Case Study of Reconstructing A Water Intake Structure by Zorica Srdjevic
- China's energy security, the Malacca dilemma and responses by ZhongXiang Zang

2.5 BRI

The Chinese Belt and Road Initiative (BRI) is an aspiring programme to connect Asia with Africa and Europe via land and maritime networks along six corridors with the aim of improving regional incorporation, increasing trade and encouraging economic growth.

The name was devised in 2013 by China's President Xi Jinping, who then drew inspiration from the idea of the Silk Road established during the Han Dynasty some 2,000 years. The BRI has also been referred to in the past as 'One Belt One Road'.

The BRI consists of a Silk Road Economic Belt which is a transcontinental passage that links China with south east Asia, south Asia, Central Asia, Russia and Europe by land. Also a sea route connecting China's coastal regions with south east and south Asia, the South Pacific, the Middle East and Eastern Africa, leading all the way to Europe.

Fig 2.4 – BELT ROAD INITIATIVE

The BRI consists of 6 economic corridors (Fig 2.5) as a whole. CPEC being one corridor has been selected and is under study in this project. CPEC has been elaborately discussed in the subsequent paragraphs in context to our study.

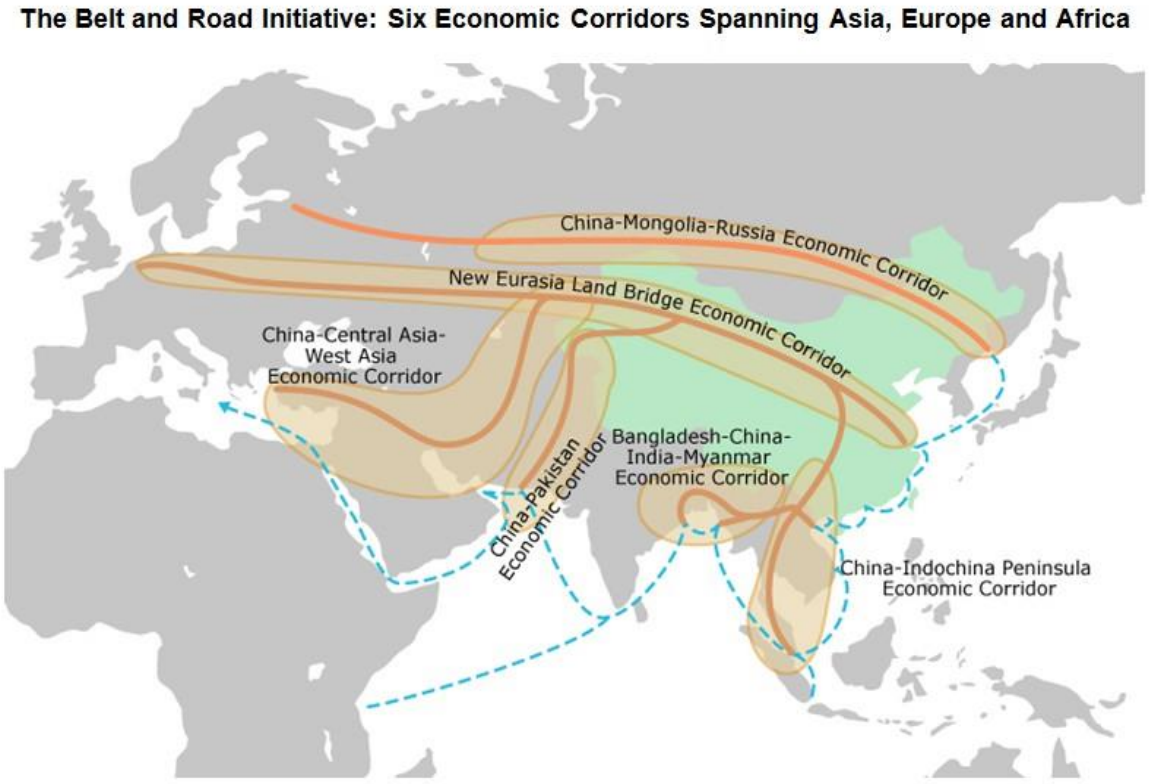

Fig 2.5- BRI Corridors

Table 2.1 – Six BRI Corridors

China-Pakistan Economic Corridor (CPEC)	Bangladesh-China-India-Myanmar Economic Corridor (BCIMEC)	China-Central Asia-West Asia Economic Corridor (CCWAEC)	China-Indochina Peninsula Economic Corridor (CICPEC)	China-Mongolia-Russia Economic Corridor (CMREC)	New Eurasia Land Bridge Economic Corridor (NELB)
Pakistan	Bangladesh	Iran	Cambodia	Mongolia	Belarus
	India	Kazakhstan	Laos	Russia	Czech Republic
	Myanmar	Kyrgyzstan	Malaysia		Kazakhstan
		Tajikistan	Myanmar		Poland
		Turkey	Thailand		Russia
		Turkmenistan	Vietnam		Germany*
		Uzbekistan			

*Not included within the geographic scope of the analysis

2.6 CPEC and China's increasing oil demand

2.6.1 CPEC

China's One Belt One Road (OBOR) initiative seeks better connectivity among 60 countries in Asia, Europe and Africa. China Pakistan Economic Corridor (CPEC) is a part of OBOR initiative. The total investment for the CPEC is US $46 Million which is includes roads, railways tracks, oil and gas pipe lines, fiber optic cable for communication, air ports and dams. Amount worth US $16 billion will be utilized in infrastructure (roads and railways) development. Envisaged by the Chinese President Xi Jinping, the CPEC project will result in uplift of Pakistan's economy. At present China is the largest trading partner of Pakistan. China and Pakistan enjoy strong mutual trade and commercial links, starting in January 1963 when first bilateral trade agreement was signed between the two countries.

Moreover, two countries have frequently exchanged high-level visits and a lot of agreements and investments have been made at government level as well as private level. Pakistan and China signed a bilateral Free Trade Agreement (FTA) in 2006 which came into effect in

2007. Total trade of Pakistan and China under FTA rapidly enhanced from US $4 in 2006 to US $13.77 billion in 2016. Pakistan's exports to China in Financial year 2016 were US $1.6 billion while imports from China were US $12.1 billion. Silk Route was established more than 2,000 years ago with the support of China's envoy Zhang Qian which was major trade routes that connected China with central Asia and rest of the world. According the Chinese President Xi Jinping, in the 21st Century the abandoned Silk Road should be reused to connect more than sixty-four countries in three continents. At present the combined GDP of countries linked by OBOR initiative is US $21 trillion. CPEC, which is part of BRI project will connect Xinjang province in China to the deep-sea port Gwadar in south of Pakistan. It is expected that CPEC (Fig 2.6) will further improve the bilateral relationships between two countries at economic and public level.

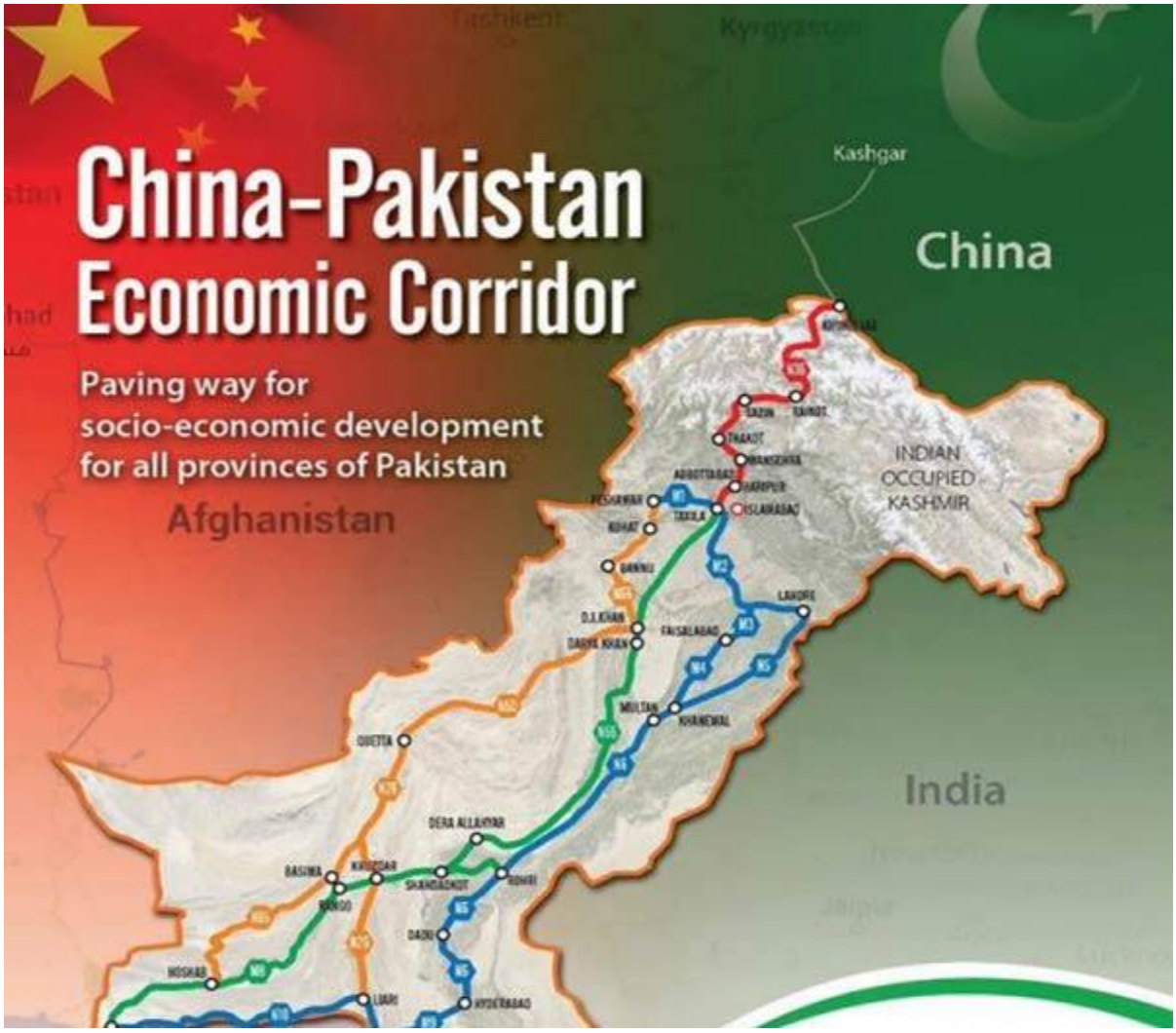

Fig 2.6 – CPEC POSTER

Second important part of OBOR is to establish maritime silk route, which will connect China to its markets in Asia, Africa and Europe). At the moment eighty percent of the China Oil is being transported through along routes from Strait of Malacca. After successful completion of the CPEC the link between Gwadar and Xinjian will provide an alternative to use of strait of Malacca to do trade with Europe and Africa for China. It will reduce the travel. After the establishment of CPEC economic growth of Pakistan will increase by 2.5 percent and the project will result in 2 million direct and indirect jobs opportunities in Pakistan between 2015-30.

The One Belt One Road is very important for China due to its rise as super power in the entire world. The amount of investment on OBOR is expected to be in region of US $4 trillion to 8 trillion. Although CPEC includes the development of various aspects including geopolitical issues, this my research is only focused on the logistic aspect of CPEC. The amount is being invested by a specialized investment bank which will provide lone for the successful completion of the project.

2.6.2 CPEC as Economic Corridor

Economic corridor is basically combination of networks of infrastructure with in designed geographical area in order to increase economic development. The corridors can be developed with in one country or between different countries. There are corridor which exit in Asia, Africa and other areas of the world. Mostly Economic corridors are based on feature infrastructure such as road, rail and ports that links cities are countries. In other word economic corridor is a feature that links manufacturing hubs with areas of high supply/demand locations. At present the CPEC is integral part of China grand strategy to rise as great power in the world by investing US $46 billion.

Bilateral trade and economic cooperation between China and Pakistan has increased with passage of time. At the moment China is one of the major trading partner of Pakistan regarding imports and exports. CPEC is such a corridor which has been planned after a lot of deliberation and it comprises of various projects regarding the development of transportation infrastructure network with in Pakistan. Under one belt one road policy China is investing a huge amount of funds which includes the silk roads economic belt and Maritime Silk Road of 21st century. Major part of CPEC is the investment in the field of transportation (road and rail) network which is 11 billion USD. This amount is approximately twenty four percent

of the entire project that is 16 billion USD. Under this project 1100 kilometers highway will be constructed from coastal city of Karachi to Lahore. This project will facilitate to uplift the economic growth and eternal connectivity.

It is expected that China-Pakistan Economic Corridor (CPEC) will further strengthen trade and economic cooperation between the two countries. Chinese Premier Li Keqiang stressed the construction of the CPEC during his visit in May 2013 to Pakistan. The sole aim of CPEC is to connect Kashgar located in province (Xinjiang Uygur) of China which is Autonomous Region of south-western Pakistani port of Gwadar.

It is clearly evident from the economic survey which was conducted in 2015-2016 that volume of trade between China and Pakistan has increased from US $4.1 billion in year 2006 to US $13.77 billion in the year 2016. After the successful culmination of the corridor it will work as a basic trade route between China Middle East and beyond. This corridor will connect Kashgar with Gawadar Port in Balochistan. At present oil supplies of China are being transported through a long route that involves extra time and cost. In this way 12000 kilometer long route will be curtailed. CPEC is well thought out development plan under which Gawadar Port will be linked with China through highway and railways. In this connection major physical construction is required that include 2700 kilometer highway starting from Kashgar to Gawadar. Cargo train will link with China and by this activity regional connectivity with Afghanistan, Iran and other countries will increase. Under this project further extension of Karakorum highway will connect Xinjian province of China with various region of Gilgit and Khyber Pakhtunkhwa. At the moment the prime focus of China is to achieve its energy needs and increase its exports and in this way economic connectivity with different countries of the world will eventually increase. In near future after the successful completion of CPEC Pakistan will emerge as hub of trade and commerce in this region. Moreover, several economic and industrial zones will be established, road and railway links will be constructed.

2.6.3 China’s Emerging Oil demand

Fig 2.7 – Oil Refinery

China's quiet shift to net oil importer status in 1993 marked a forced departure from the Communist Party's three-decade experiment in self-sufficiency and opened the possibility that China could, someday, be as vulnerable as other industrial nations to unexpected events affecting global oil markets. Being a net oil-importer should, logically, bring China's interests closer to those of the oil dependent West. In 1990, China abstained when the US mobilised an international coalition to drive Iraqi troops from Kuwait. A future crisis, after China has become a major importer, might elicit a more supportive stance. But the change to Chinese interests and orientations also poses challenges for the West: in effect, the industrialised oil-consuming countries of the US, Europe and North-east Asia must convince an ambitious, energy-hungry China that secure supply for all requires a cooperative foreign policy. So far, unfortunately, China is taking a different approach.

Globalization and trade liberalization have benefitted China by making it the world's largest manufacturing centre and the country has emerged as an engine of Asian economic growth. However, in recent years, China has faced a slowdown of its domestic economy that has affected global and inter-regional trade. To overcome this Fall off various foreign trade policies and transnational agreements have been made by the Chinese authorities in recent years. One of them is reviving the ancient silk route into the New Economic Silk Belt that links China overland to Europe, through Central and Western Asia, and the 21st Century Maritime Silk Road that connects China and Southeast Asian countries via the sea to Africa and Europe. The two initiatives are jointly referred to as the ''One Belt-One Road" (OBOR). The OBOR initiative features prominently in China's 13th five-year plan (2016–2020) and aims to support a paradigm shift in the inter-regional and foreign trade.

With respect to the infrastructure and strategy development for the OBOR initiative, improving and reconfiguring logistics and transportation networks along the OBOR trade corridors and connectivity among them are primary objectives of the initiative. But the logistics and transportation related activity has a tendency to change over time on being induced by various political and international trade agreement decisions. Subsequently, the logistics distribution flow adapts to the new spatial structure, resulting in various uncertainties that are difficult to handle instantly leading to financial losses. To handle the stochastic and time-varying challenges of logistics distribution flows in the OBOR strategic context, international logistics networks must be restructured with reconfigured resources from the perspective of space-time interaction technically referred to as spatial-temporal interaction of the logistics distribution flows.

2.7 Existing Routes

2.7.1 via Myanmar

Sino-Myanmar pipelines refer to the oil and natural gas pipelines linking Myanmar's deep-water port of Kyaukphyu (Sittwe) in the Bay of Bengal with Kunming in Yunnan province of China.

The oil and natural gas pipelines run in parallel and start near Kyaukphyu on Made island port on the Bay of Bengal in Myanmar, run under the sea for 5.3 KM to mainland and then run through Mandalay, Pyin Oo Lwin, and Muse in Myanmar before entering China at the border city of Ruili in Yunnan province. The oil pipeline, which eventually terminates in

Kunming, capital of Yunnan province, is 771 kilometres (479 mi) long. The natural gas pipeline will extend further from Kunming to Guizhou and Guangxi in China, running a total of 2,806 kilometres (1,700 mi). The China-Myanmar crude oil pipeline project operation corresponds with China's "Belt and Road" Initiative, which will provide more direct way for China's imports of crude oil to bypass the crowded Malacca Strait. China plans to construct additional pipelines in coming years.

Fig 2.8 Myanmer Route

The total route length including the maritime travel from strait of hormoz is about 7865 kms.

The oil pipeline has a capacity of 12 million tonnes of crude oil per year. It diversifies China's crude oil imports routes from the Middle East and Africa, and avoids traffic through the Strait of Malacca. Oil storage tanks have been built on an island near the port of Kyaukphyu. For oil processing China built refineries in Chongqing, Sichuan, and in Yunnan. The gas pipeline allows delivery of natural gas from Burma's offshore fields to China with an expected annual capacity of up to 12 bcm of natural gas. China receives natural gas from Burma's Shwe project through the pipeline. The operators group also includes Myanmar Oil

and Gas Enterprise, GAIL, and Korea Gas Corporation. The total project of pipelines costs US$2.5 billion. A railway connects Muse and Lashio being part of the project. The railway is 80 miles long and includes 41 bridges, 36 underground tunnels and 7 stations.

2.7.2 via Strait of Malacca

Fig 2.9 Malacca Route

Despite increased imports through Russia and Kazakhstan, China remains heavily dependent on Middle Eastern oil, with up to 80 percent of its energy supply passing through the Straits.

Having little control over the passage, any disturbance ranging from piracy to fears of a potential naval blockade by the United States and its allies will have an adverse impact on China's long-term food and energy security.

The route originates from 3 main exporter states, i.e Venezuela, Angola and strait of Hormoz. But the main contributors are the middle eastern states. This route originates from the Hormoz, follows the maritime route through the Malaccan Strait, enters the South China sea and terminates at Guangzhou, China. Total distance is around 10000 kms. Oil trade flows of China are shown in Fig 10 below.

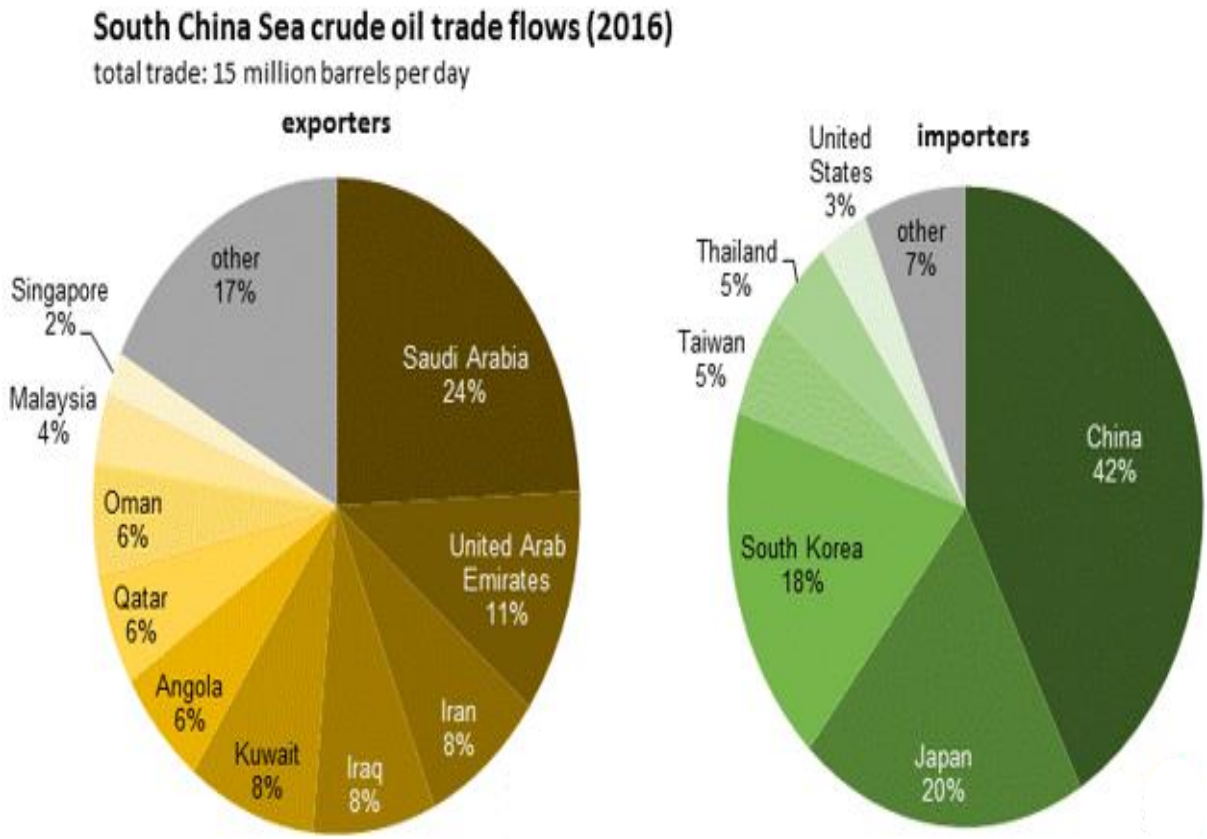

Fig 2.10 – China Oil Trade Flows

2.7.3 Concerns

The Malacca dilemma of China is shown in Fig 2.11. Others primary concerns are as follows,

- Piracy
- Choke point
- Blockade by the United States
- Indian Rivalry
- Less control
- Longer distance
- Longer transit time
- Increasing demand vis a vis China's growing economy
- Need for better alternatives

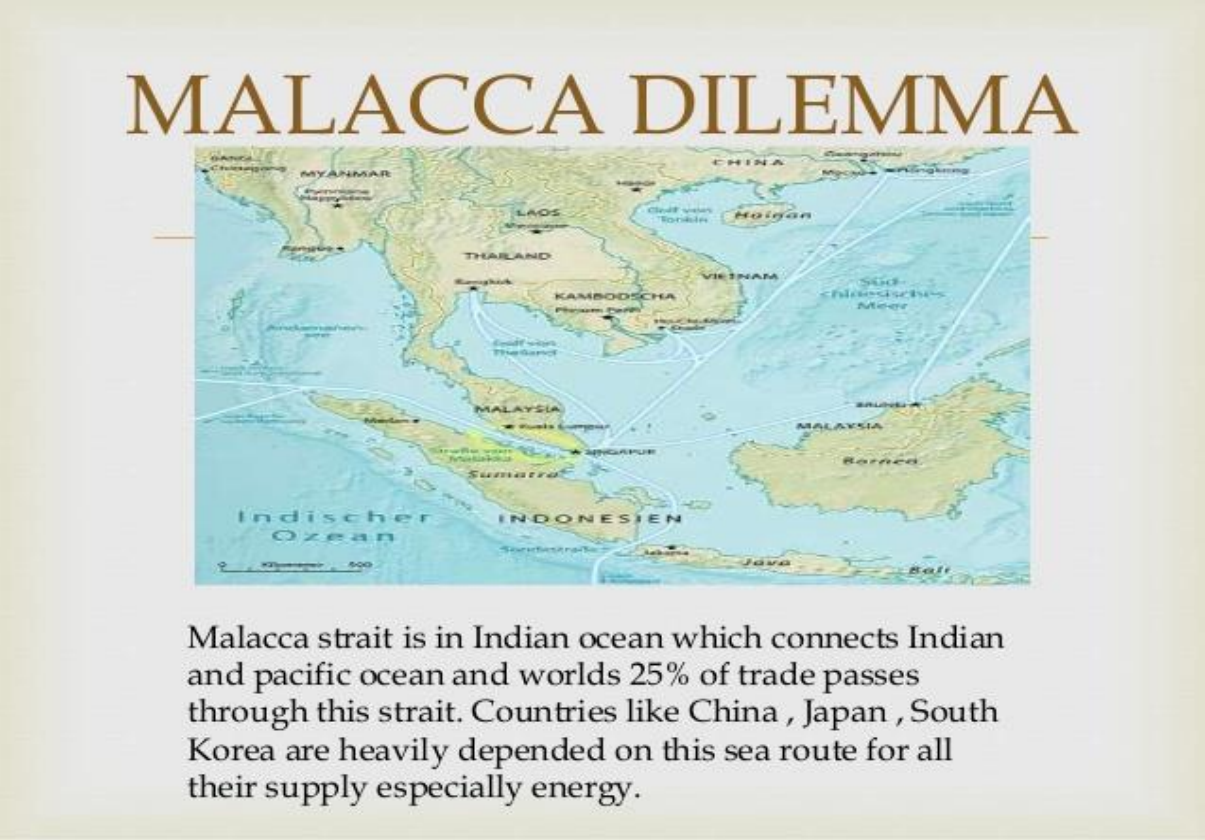

Fig 2.11 – Malacca dilemma

2.7.4 Malacca Dilemma

Energy security, and predominantly oil supply security, has developed a major concern for the Chinese government over the previous several years. The focus is the defencelessness of seaborne energy consequences. At present, China lacks the naval power necessary to protect its sea lanes of communication. Beijing fears that during a national security crisis ships carrying energy capitals could be prohibited by hostile naval forces. Any disruption to the free flow of energy resources into China could disrupt the economic progress on which the Chinese government depends to build up its legitimacy and pursue its great power desires. China's heavy use of the Malacca and Lombok/Makassar straits in Southeast Asia is representative of this concern. The Malacca Strait is a narrow and congested waterway separating Indonesia and Malaysia, with Singapore located at its southern tip. As the shortest route between the Indian and Pacific oceans, the strait is one of the world's most important waterways. More than 60,000 vessels transit the strait each year, transporting 25 percent of global trade approximately. This route is better known Malacca Strait.

For China, the strategic significance of these straits increases every year. At present, approximately 65 per cent of China's crude oil imports originate in the Middle East, and this figure is expected to rise to 75 per cent by 2019. Oil from the Persian Gulf and Africa is shipped via the Malacca straits. Over the past few years Chinese leaders have come to view the straits, especially the Malacca Strait, as a strategic susceptibility. In November 2003 President Hu Jintao declared that "certain major powers" were bent on controlling the strait, and called for the adoption of new strategies to moderate the apparent vulnerability. Thereafter, the Chinese press devoted considerable attention to the country's "Malacca dilemma," leading one newspaper to declare: "It is no exaggeration to say that whoever controls the Strait of Malacca will also have a stranglehold on the energy route of China" (China Youth Daily, June 15, 2004).

Over the recent years, the Malacca Strait has attracted the attention of security analysts for reasons other than China's oil supply security. Recently, the straits have witnessed an upsurge in pirate attacks. This could be a threat to global commerce. International criticism led the littoral states (Indonesia, Malaysia, and Singapore) to step-up strait security through the establishment of coordinated air and naval patrols. As a result of these and other initiatives, the number of pirate attacks in the area declined 2008 onwards. Yet piracy and

other multinational threats in the strait remain major anxieties. Due to sensitivities over sovereignty, Indonesia and Malaysia have firmly disallowed the impression of external powers such as the U.S., Japan or India enduringly stationing military forces in the strait. They have welcomed help from external powers, but in the form of capacity building, intelligence exchanges, and training.

Chapter 3

3 METHODOLOGY

3.1 Delphi-SWOT pipeline planning process

This study was conducted for the evaluation and discovering potentials of CPEC route as oil and gas pipeline transmission route for multinational oil and natural gas producing and consuming states. A group of well-versed individuals to pool expertise from many realms and evaluate several alternative routes for transporting Crude oil and gas to China markets was established. The group included a total of five experts and four external facilitators. A common group decision making activity evaluated and decided upon various alternatives. Decision making bodies in organizations are often formed as groups to assess decision alternatives by collecting and blending information from different perspectives. Group decision making is an effective way to overcome judgment errors and produce fruitful results in organizations due to human imperfection. Maier (2010) summarizes the virtues of group decision making as follows: first, if every group member exerts effort to become informed, groups can gather more information than individual members. Better information can lead to better decisions. Second, if all group members have the same information, they may not reach the same conclusion since group members typically have different backgrounds and experiences. Third, if some information is erroneous, a group can pool signals and reduce uncertainty. Fourth, groups provide an insurance against extreme preferences of individual DMs.

The key areas of working for the group included the following:

(a) Identifying and selecting the most preferable route for transporting crude oil and gas.

(b) Supervision of all phases of the evaluation process.

(c) Resolving conflicts as they arise, if any

(d) Developing an action plan for the selected route.

Table 3.1 – Details of Experts

Ser	Expert's position/Qual	Experience	Sector
1	Ph.D Transportation	23 years	Academia
2	Ph.D Environmental	12 years	Academia/ Industry
3	PD FWO	24 years	Industry
4	Asst Logging Engr, OGDCL	7 years	Industry
5	Snr Engr production, OGDCL	10 years	Industry
6	Ph.D CE&M	20 years	Academia

3.2 The Process

The process consists of 6 steps. It is a logical process leading from one step to the other by harmonizing various techniques and involvements. Pictorial flow chart is shown in Fig 3.1 below. Steps are elaborated in the next chapter under analysis.

3.3 PESTLE

PESTLE stands for *Political, Economical, Social, Technical, Legal and Environmental*. The paradigm is shown in Fig 3.1

Political Issues. During the Soviet era, the sea trade route was dominated by the USSR with Moscow controlling regional activities including energy exploration, development and transit. The disintegration of the Soviet Union has fundamentally changed the geopolitical conditions around the globe. New regional and global actors have emerged asserting their own particular interests. Kaliyva (2004) had identified three primary interest groups: the Gulf states, the transit countries and global and regional powers. The Arab states of the Persian Gulf are the seven Arab states which border the Persian Gulf, namely Bahrain, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE). These countries

are interested in the development of their rich energy resources and in exporting them to world markets. It is predicted that these countries financial situation may advance even further with the discovery and development of new energy fields and the signing of new production sharing agreements between governments and international oil and gas companies particularly China. However, it cautions that transparency and accountability on the management of energy resources is needed for maximizing the economic and financial benefits of oil and gas for future generations. It is also emphasized that all policies should seek to restore the deterioration of environmental conditions and support sustainable growth.
Transit states include India, Bangladesh, Iran, Afghanistan, Myanmar and Pakistan. These countries seek to benefit from their geographic location between the Gulf oil and gas fields and world markets by promoting pipelines that transit their territories. Global and regional powers with economic and strategic interests in the Gulf region include Russia, the EU, the US, China, India, Pakistan, Iran and Turkey. These countries endeavour to strengthen their positions as a platform for endorsing their global or regional approaches.

These competing economic and national interests make the region the most dangerous and geopolitically complicated area in the world. Consequently, the critical challenge is to maintain stability and security in the region. The worries range from environmental accidents to political instability and terrorism.

Economic Issues. Building an oil or gas pipeline is basically a corporate proposition. Therefore, return on investment (ROI) is a primary decision adjustable. While ROI is a principal factor in the selection of a pipeline route, it is affected by other factors including cultural, environmental, geographical, legal, political, social and technological issues. This impacts the ROI by worsening environmental and legal problems as well as technological difficulties. A plan for a pipeline transiting for China would invoke all the littoral states in evaluating the environmental risks. In addition, the technologies required to build a seabed pipeline would be difficult and costly to transport. All these factors would significantly alter the ROI of a seabed route which favours land transportation. For all routes, political factors would impact the risk integral in estimating the ROI because the transport countries are not friendly or terrorist groups operate within their borders. In some cases, ancient cultural and religious dissonance is widespread. These factors can interact to increase the costs and risks with a project. Consequently, ROI is truly a socioeconomic variable in the decision to choose a pipeline route.

Social Issues. The routes identified are likely to pass through diverse cultural areas with various religions, sects, societies and races. All these interact with each other basing on regional and national interests. During the Soviet era, Moscow imposed a dictatorial regime that blocked these cultures and forced order. The dissolution of the Soviet Union removed political, economic and military restraints. Pakistan and India owing to their historical differences are likely to sabotage and interdict each other's regional interests. This has released diverse social and religious forces that generate friction if not complete fight. Similarly, the Islamic Movement of ISIS and Iran/ Saudi conflict is a fundamentalist sect that utilizes guerrilla tactics. These present severe threats to any attempt to construct an export pipeline.

Technological Issues. All export of energy resources from the Gulf states to China involves extensive pipelines. Routes may be planned to transit the seabed. Constructing this pipeline would require bringing highly specialized underwater excavating equipment into the region. Transporting this massive machinery overland would be difficult, costly and risky. Proposed routes cross very difficult topography. Land routes to the east, south and west all encounter mountainous terrain at some point. They also confront extreme meteorological conditions that are challenging for people, equipment and the pipeline.

Legal Issues. These are the issues pertaining to the law and legislation of the countries and their sea routes. China if interested in trade through these routes would be required to pay close attention and studies to these factors. Law and order situations which are quite fluid these days and their implications over the trade activity through a particular country needs special emphasis.

Environmental Issues. Economic activity in the region is fundamentally linked to energy exploration, development and export. The oil and gas industry has been the cause of severe air pollution as well as soil and water uncleanness. The problems began in the Soviet period when the resources were exploited using environmentally unreliable practices. After the collapse of the Soviet Union, the situation became worse because of the lack of cooperation among states. Furthermore, the pollutants are accumulating because they are trapped within basin. This aggravates the risk to farming, fishing and the health of the human population.

The solution to this multifaceted environmental crisis requires creating a legal framework that insures a regional approach to environmental management and sustainable development.

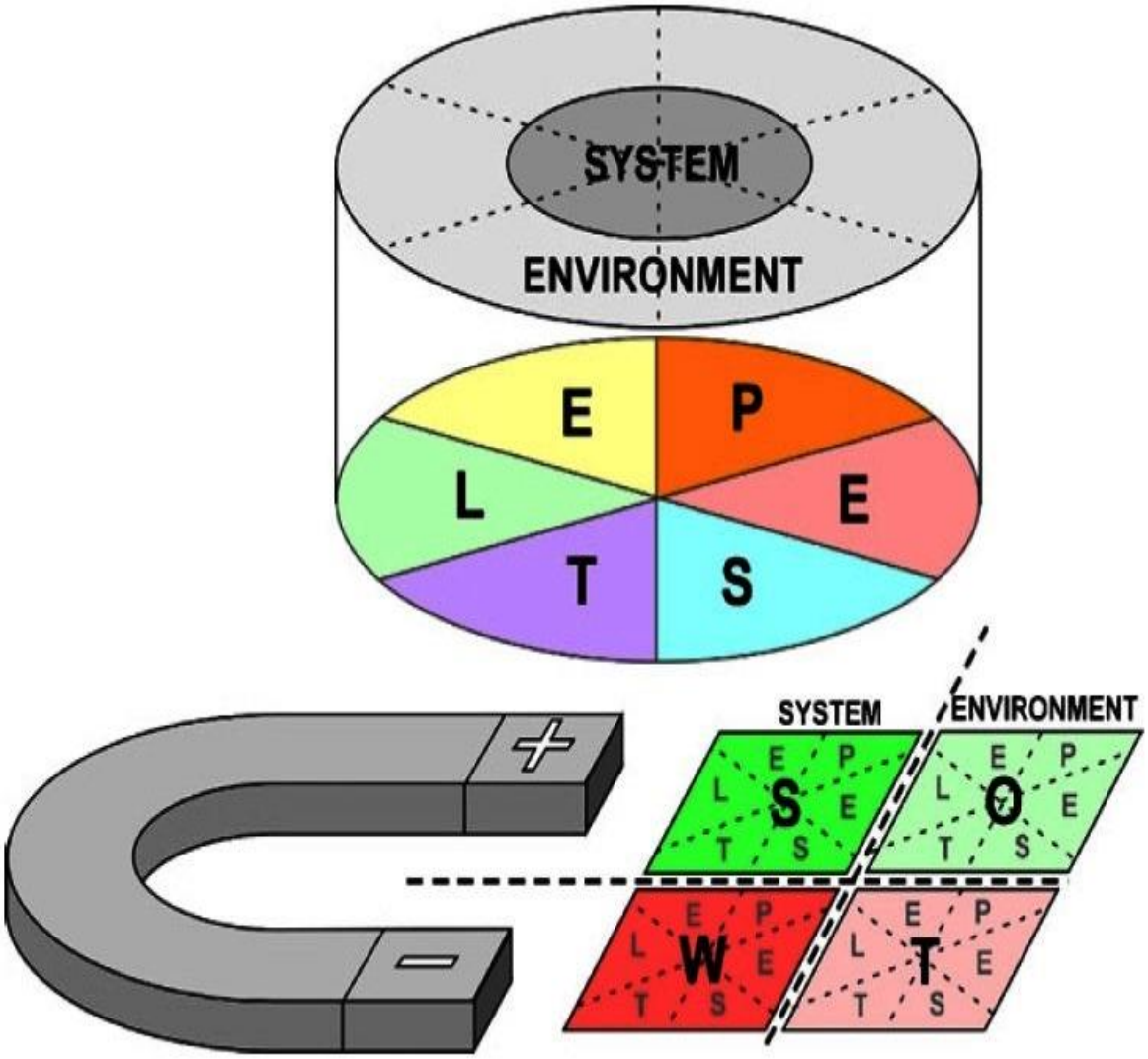

Fig 3.1 – SWOT PESTLE Paradigm

Flow chart of complete process is shown in Fig 3.2 below.

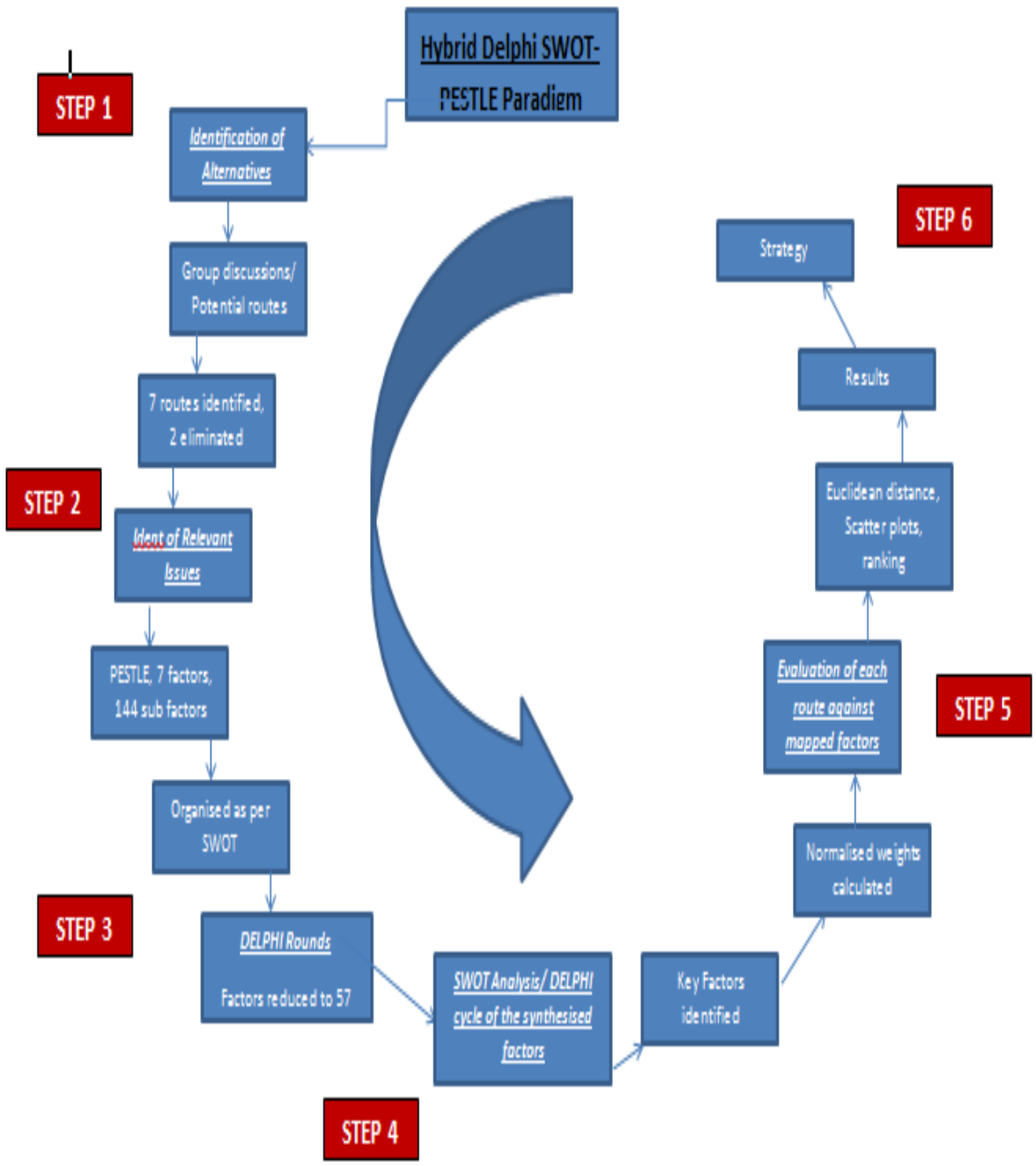

Fig 3.2 – Complete Research Process Cycle

Chapter 4

4 ANALYSIS AND RESULTS

The process consists of following 6 steps as mentioned in methodology.

4.1 Step 1 (Identification of potential routes)

China as described earlier is a country having the world's largest population and second largest area on the globe. Such a huge human resource and potential of development has been well managed by China sofar. This management envisages the continuous need of energy supply for which China banks mostly on crude oil imports.

The existing sea routes have already been described in Chapter 2 with adequate details. For the purpose of this study, a total of 7 potential routes were identified which could be used for transporting crude oil on sea vessels till shores and then through pipelines to China. Routes are shown in Fig 4.1.

(a) Route 1 – Pakistan (Gawadar to Kashgar)
(b) Route 2 - Myanmar (Yangon to Kunming) *Existing*
(c) Route 3 - Strait of Malacca (To Guangzhuo) *Existing*
(d) Route 4 - Iran (Bandar – e – Abbas to Xinjiang)
(e) Route 5 – India (Mumbai to Tibet)
(f) Route 6 – Bangladesh (Chittagong to Tibet)
(g) Route 7 – Philippines (Banda Sea to Shanghai)

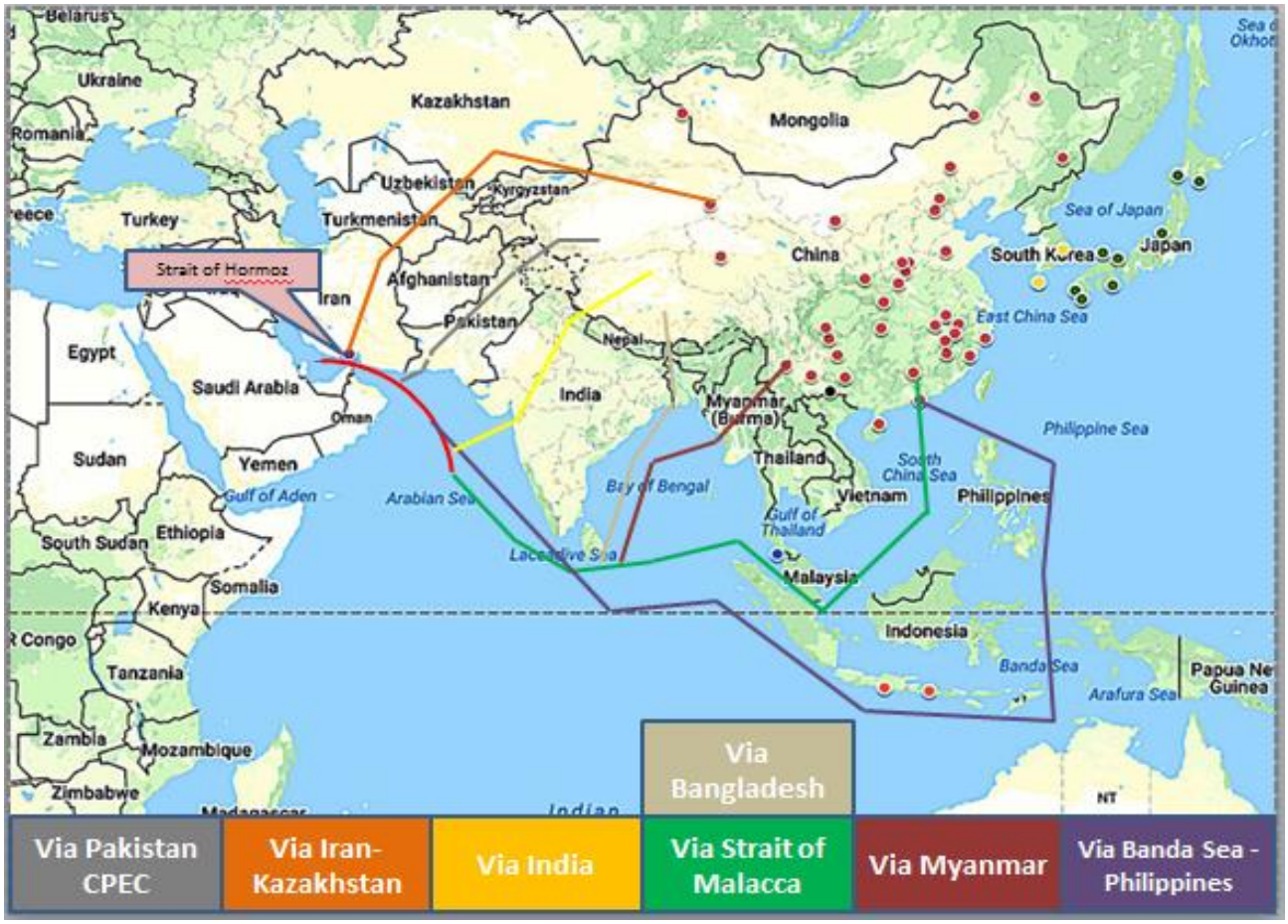

Fig 4.1 – Identified Potential Routes

4.1.1 Concept of logical dominance

The rule for logical dominance followed was that if alternative route A is better than alternative route B on some objectives and no worse than B on all other objectives, B can be eliminated from consideration. In such cases, B is said to be logically dominated by A. The external facilitators carried out a detailed analysis basing on the PESTLE factors to evaluate and compare the 7 identified routes.

As a result of the discussions and evaluations, routes 6 and 7 were eliminated from further considerations primarily due to the following reasons,

- Route via Banda sea was eliminated basing on it being the longest distance route with potential disadvantages of likely being exposed to pirate and extreme weather actions for a prolonged time. Fig 4.2

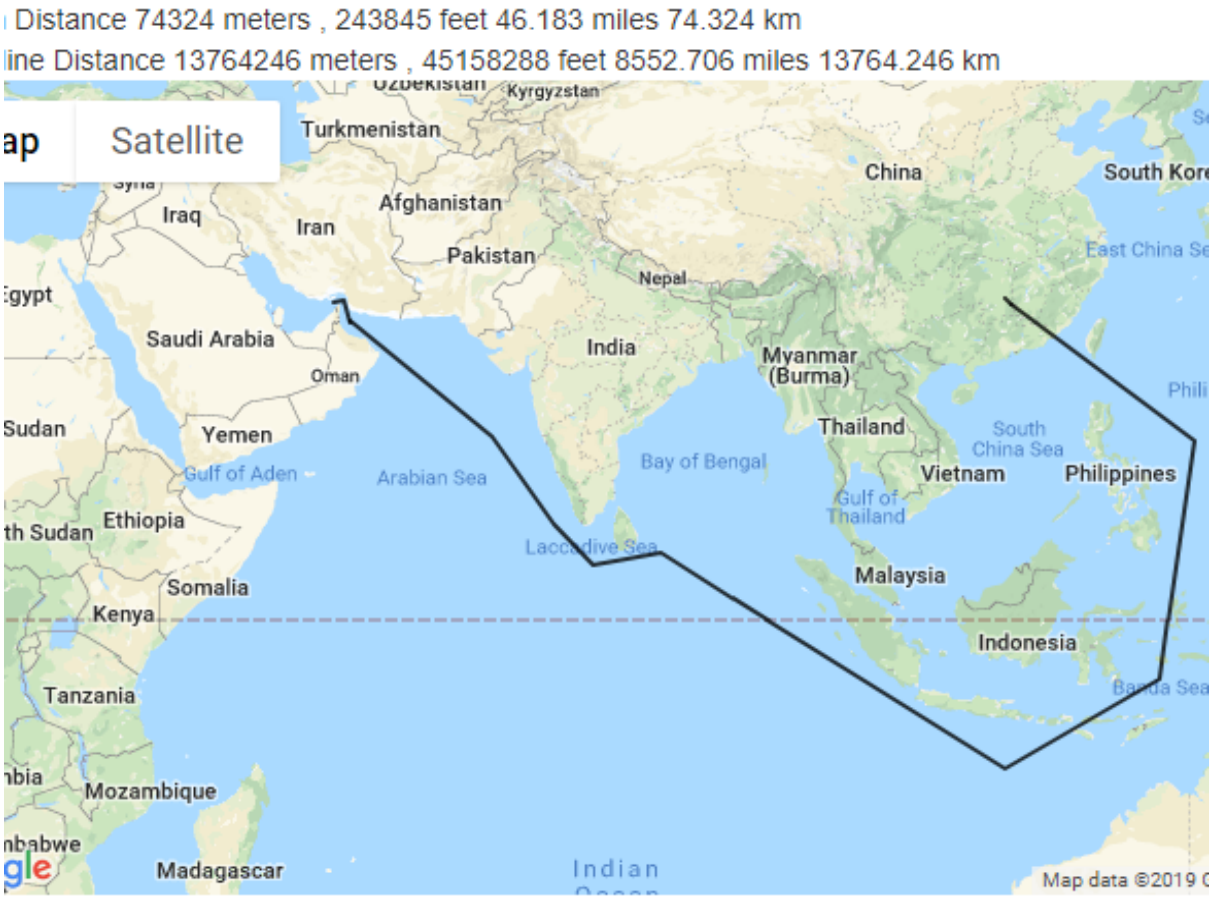

Fig 4.2 - Route via Banda Sea

- Route (Bangladesh) involved a portion of pipeline to be passed through India or Nepal, thereby involving more than two stakeholders. Fig 4.3

Fig 4.3 - Route via Bangladesh

4.1.2 Route Description

- **Route 1**
  This route originates from the strait of Hormoz and following the maritime route reaches Gwadar port. Thereafter the oil is transported through pipelines passing through Balochistan, KPK, Gilgit Baltistan and terminates at Kashgar. Total distance is calculated to be around 3000 kms.

Route 1

- **Route 2**

This route originates from the strait of Hormoz and following the maritime route reaches Bandar e Abbas port Iran. Thereafter the oil is transported through pipelines passing through Iran and terminates at Kunming. Total distance is calculated to be around 4100 kms.

Route 2

- **Route 3**
  This route originates from the strait of Hormoz and following the maritime route reaches Mumbai port. Thereafter the oil is transported through pipelines passing through India and terminates at Tibet China. Total distance is calculated to be around 4050 kms.

Route 3

4.2 Step 2 (Identification of relevant issues)

As in Step 1, the facilitators began their discussion of the issues relevant to selecting a pipeline route in head-on devising sessions. Based on these discussions, the group collectively decided to consider the following issues (PESTLE) when identifying the relevant factors for the SWOT analysis.

Table 4.1 – Routes and Time/Distance Calculations

Ser.	Route	Distance	Time (Maritime)	Remarks
Route 1	Via Pakistan	3000 kms	3 days, 2 hrs	
Route 2	Via Myanmer	7865 kms	12 days, 18 hrs	
Route 3	Via Strait of Malacca	10000 kms	23 days	
Route 4	Via Iran	4100 kms	2 days	
Route 5	Via India	4050 kms	4 days, 11 hrs	

4.2.1 Organization of factors as per SWOT

A total of 144 sub-factors were discovered under the 7 PESTLE factors relevant to the pipeline routes. These factors were identified on the basis of regional and international dynamics. Details are as per Annex A. Screenshot in Fig 4.4

FACTOR	SUB-FACTOR	SWOT	Relevant Yes/No
Economical			
1	Financial support of the international community	Opportunity	
2	Availability of investment tax credits for oil and gas explorations in the region countries	Opportunity	
3	High ROI potentials	Opportunity	
4	Financial support of the region/pipeline countries for oil and gas explorations	Opportunity	
5	Availability of cheap labour in the region/pipeline countries	Opportunity	
6	High level of export in the region/pipeline countries	Opportunity	
7	Potential for high and stable energy demand in the region/pipeline countries	Opportunity	
8	High level of GDP in the region/pipeline countries	Opportunity	
9	High tax rate in the region/pipeline countries	Threat	
10	High cost of building and maintaining pipelines in the region/pipeline countries	Threat	
11	High level of tariffs and commissions in the region/pipeline countries	Threat	
12	High cost of oil and gas transportation and transfer in the region/pipeline countries	Threat	
13	High oil and gas drilling and exploration expenses in the region/pipeline countries	Threat	
14	Negative effect of pipelines on other industries such as tourism and fishing	Threat	
15	Economic dependency of the region/pipeline countries to other countries	Threat	
16	Investment security in the region/pipeline countries	Strength	
17	Qualified and productive labor force in the region/pipeline countries	Strength	
18	Economic stability of the region/pipeline countries	Strength	
19	High current oil and gas supply	Strength	
20	Low non-oil and gas import/export level in the region/pipeline countries	Weakness	
21	Poor oil and gas quality	Weakness	
22	Poor forecast for oil and gas supply	Weakness	
23	Equipment's to be used	Opportunity	
24	Financials support from friendly countries	Opportunity	
25	Lack of funds	Weakness	
26	Financial condition of Pakistan	Weakness	
27	Negative effects of pipeline	Threat	
28	Qualified staff for the project	Strength	
29	High cost on maintenance	Threat	

Fig 4.4 - Stage 1

4.3 Step 3 (Delphi Rounds)

Delphi rounds were carried out to synthesize and reduce the sub factors as identified in step 2 in a more manageable form. This step involved a series of Delphi rounds to develop a set of relevant factors for use in the SWOT analysis. In the first Delphi round, the experts were asked individually to consider the economic, political, legal, environmental, cultural and social, geographical and technological issues chatted in Step 2 and to compile a set of factors considered to be important in the pipeline decision. These individual lists were then shared incognito. Then, the facilitators combined all of these factors into a list with 144 factors.

In round 2, this list was shared with all the experts. They were asked to consider this feedback and then revise and resubmit their initial individual list. The facilitators combined all of these factors into a new list with 87 factors. Again in round 3, the synthesized list of factors from round 2 was shared with all the experts, and they were asked to revise and resubmit their individual list from round 2. The facilitators then combined all of these factors

into another new list with 57 factors. At this point, the experts agreed that they could not make significant changes to the list. Thus, a decision was made to use the 57 factors presented in Annex B in the succeeding steps.

FACTOR	SUB-FACTOR	SWOT
Economical		
1	Availability of investment tax credits for oil and gas explorations in the region countries	Opportunity
2	Financial support of the region/pipeline countries for oil and gas explorations	Opportunity
3	Availability of cheap labour in the region/pipeline countries	Opportunity
4	Potential for high and stable energy demand in the region/pipeline countries	Opportunity
5	High tax rate in the region/pipeline countries	Threat
6	High level of tariffs and commissions in the region/pipeline countries	Threat
7	High cost of oil and gas transportation and transfer in the region/pipeline countries	Threat
8	Investment security in the region/pipeline countries	Strength
9	Economic stability of the region/pipeline countries	Strength
10	Lack of funds	Weakness
11	High cost on security of pipeline	Threat
Geographical		
1	Accessibility to open sea and oceans	Opportunity
2	Suitable beaches with calm waves	Opportunity
3	Shorter distance	Opportunity
4	Hilly and mountainous terrain	Threat
5	Active Earthquake region	Threat
6	High temperature and humidity problems	Threat
7	Low temperature and icy conditions	Threat
8	Desert terrain	Threat
9	Swampy terrain	Threat

Fig 4.5 - Stage 2

4.4 Step 4 (Delphi-SWOT analysis of synthesized factors)

In a follow up questionnaire, the participants were asked to score the factors in each category on a scale from 0 to 10, with an increment of 1. Where a score of 0 represents non-importance and a score of 10 indicates extreme importance. Annex C gives the details of these. The scoring was done as per the Likert scale.

Below is given a list of Sub-factors being considered for oil and gas pipeline transportation potential routes evaluation to China. Please grade each sub factor on ***likert scale*** from 0 to 10.

0 - Least Important

10 – Most Important

FACTOR	SUB-FACTOR	SWOT	Likert Score
Economical			0-10
1	Availability of investment tax credits for oil and gas explorations in the region countries	Opportunity	2
2	Financial support of the region/pipeline countries for oil and gas explorations	Opportunity	1
3	Availability of cheap labour in the region/pipeline countries	Opportunity	4.5
4	Potential for high and stable energy demand in the region/pipeline countries	Opportunity	4
5	High tax rate in the region/pipeline countries	Threat	6.5
6	High level of tariffs and commissions in the region/pipeline countries	Threat	6
7	High cost of oil and gas transportation and transfer in the region/pipeline countries	Threat	7.5
8	Investment security in the region/pipeline countries	Strength	8
9	Economic stability of the region/pipeline countries	Strength	6.5
10	Lack of funds	Weakness	2
11	High cost on security of pipeline	Threat	7
Geographical			
1	Accessibility to open sea and oceans	Opportunity	7.5
2	Suitable beaches with calm waves	Opportunity	6
3	Shorter distance	Opportunity	8.5
4	Hilly and mountainous terrain	Threat	5.5
5	Active Earthquake region	Threat	3
6	High temperature and humidity problems	Threat	2.5
7	Low temperature and icy conditions	Threat	4
8	Desert terrain	Threat	4
9	Swampy terrain	Threat	2
10	Offshore distance	Threat	5
11	Accessibility to straits for passage	Threat	2
12	Cyclone in areas	Threat	3.5

Fig 4.6 – Stage 3

Scores present the importance assigned by each expert as an average for all.

‘‘Shorter distance’’ (GEO03), was perceived as leading opportunity by the experts. In contrast, the group considered ‘‘danger of terrorism in the region/pipeline countries’’ (POL01) as the primary potential threat. While the highest rated strength was ‘‘economic investment safety’’ (ECO09), and ‘‘Insufficient number of ports for oil and gas transportation’’ (TECH7) was seen as the greatest weakness.

Next, out of these 57, key factors were identified to further make the study more manageable. The experts then decided to remove those factors that they considered to be relatively unimportant. They approved to use a threshold of 5 out of a possible10. Five opportunities, twelve threats, three weaknesses and seven strengths had a weight of 5 or greater. This resulted in a more manageable number of factors to consider and equilibrium between the external and internal factors in the SWOT analysis. The 27 opportunities, strengths, threats and weaknesses are presented in Annex D along with their importance weights

Key Factors with overall score >= 5

SWOT	Sub-Factor	Overall Score
Opportunities	GEO 1	7.5
	GEO 2	6
	GEO 3	8.5
	TECH 1	6
	TECH 2	5.5
Strengths	ECO 8	8
	ECO 9	6.5
	SCO 2	5
	SCO 6	5.5
	SCO 8	7
	TECH 8	6.5
	POL 2	7.5
Threats	ECO 5	6.5
	ECO 6	6
	ECO 7	7.5

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Fig 4.7 – Strategic Key factors

Then, the importance of weights presented in Annex D were normalized using Eq. (1) and (2) in Appendix 2 to ensure that the total of the weights for the positive factors (opportunities and strengths) and the negative factors (threats and weaknesses) each sum to 1. The normalized weights for the 27 strategic factors are presented in Annex E.

Key Factors and their normalised weights

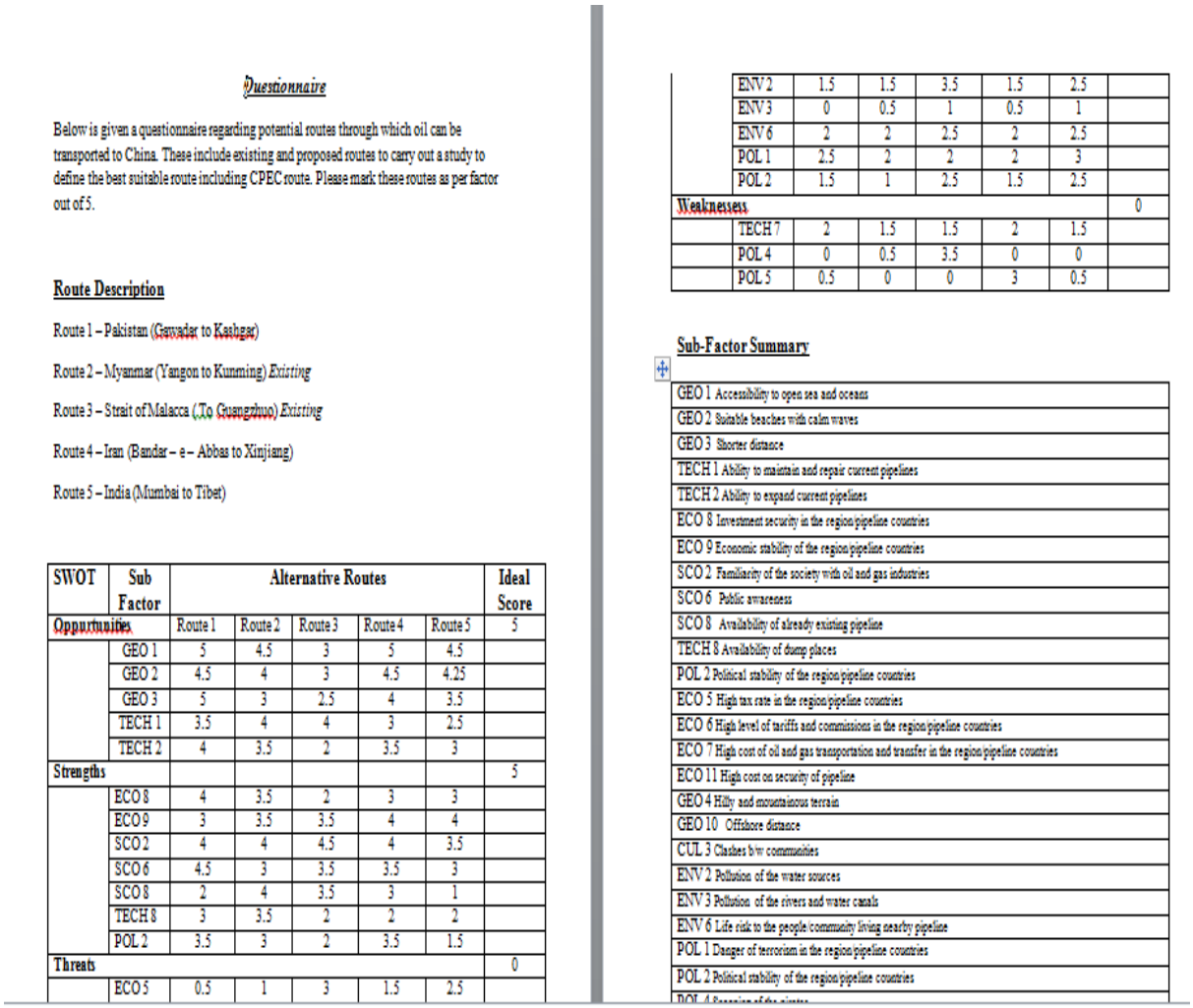
SWOT	Sub-Factor	Overall Score
Opportunities	GEO 1	0.094
	GEO 2	0.075
	GEO 3	0.12
	TECH 1	0.076
	TECH 2	0.069
Strengths	ECO 8	0.1
	ECO 9	0.081
	SCO 2	0.062
	SCO 6	0.069
	SCO 8	0.088
	TECH 8	0.081
	POL 2	0.094
Total Weight		***1.000***
Threats	ECO 5	0.067
	ECO 6	0.062

Fig 4.8 – Normalised Weights Calculations

4.5 Step 5 (Evaluation of each route against 27 strategic factors)

A questionnaire intended to use a Likert scale with 0 as unlikely and 5 score being very likely was developed to allow the experts to evaluate the likelihood of each of the 27 SWOT-PESTLE factors for each of the 5 alternative routes. Higher scores were preferred to lower scores for the positive factors i.e those identified as opportunities or strengths. In contrast, lower scores were preferred to higher scores for the negative factors, those perceived as

threats or weaknesses. Therefore, the ideal and most achievable likelihood score on each positive factor, any opportunity or strength, is 5. Similarly, the ideal likelihood score on each negative factor, any threat or weakness, is 0. The ideal scores for each factor and the average of the scores assigned by the DMs to each factor for each route are presented in Fig 4.9 below. Details are attached at Annex E.



Questionnaire

Below is given a questionnaire regarding potential routes through which oil can be transported to China. These include existing and proposed routes to carry out a study to define the best suitable route including CPEC route. Please mark these routes as per factor out of 5.

Route Description

Route 1 – Pakistan (Gawadar to Kashgar)

Route 2 – Myanmar (Yangon to Kunming) *Existing*

Route 3 – Strait of Malacca (To Guangzhuo) *Existing*

Route 4 – Iran (Bandar – e – Abbas to Xinjiang)

Route 5 – India (Mumbai to Tibet)

SWOT	Sub Factor	Alternative Routes					Ideal Score
Oppurtunities		Route 1	Route 2	Route 3	Route 4	Route 5	5
	GEO 1	5	4.5	3	5	4.5	
	GEO 2	4.5	4	3	4.5	4.25	
	GEO 3	5	3	2.5	4	3.5	
	TECH 1	3.5	4	4	3	2.5	
	TECH 2	4	3.5	2	3.5	3	
Strengths							5
	ECO 8	4	3.5	2	3	3	
	ECO 9	3	3.5	3.5	4	4	
	SCO 2	4	4	4.5	4	3.5	
	SCO 6	4.5	3	3.5	3.5	3	
	SCO 8	2	4	3.5	3	1	
	TECH 8	3	3.5	2	2	2	
	POL 2	3.5	3	2	3.5	1.5	
Threats							0
	ECO 5	0.5	1	3	1.5	2.5	
	ENV 2	1.5	1.5	3.5	1.5	2.5	
	ENV 3	0	0.5	1	0.5	1	
	ENV 6	2	2	2.5	2	2.5	
	POL 1	2.5	2	2	2	3	
	POL 2	1.5	1	2.5	1.5	2.5	
Weaknesses							0
	TECH 7	2	1.5	1.5	2	1.5	
	POL 4	0	0.5	3.5	0	0	
	POL 5	0.5	0	0	3	0.5	

Sub-Factor Summary

GEO 1 Accessibility to open sea and oceans
GEO 2 Suitable beaches with calm waves
GEO 3 Shorter distance
TECH 1 Ability to maintain and repair current pipelines
TECH 2 Ability to expand current pipelines
ECO 8 Investment security in the region/pipeline countries
ECO 9 Economic stability of the region/pipeline countries
SCO 2 Familiarity of the society with oil and gas industries
SCO 6 Public awareness
SCO 8 Availability of already existing pipeline
TECH 8 Availability of dump places
POL 2 Political stability of the region/pipeline countries
ECO 5 High tax rate in the region/pipeline countries
ECO 6 High level of tariffs and commissions in the region/pipeline countries
ECO 7 High cost of oil and gas transportation and transfer in the region/pipeline countries
ECO 11 High cost on security of pipeline
GEO 4 Hilly and mountainous terrain
GEO 10 Offshore distance
CUL 3 Clashes b/w communities
ENV 2 Pollution of the water sources
ENV 3 Pollution of the rivers and water canals
ENV 6 Life risk to the people/community living nearby pipeline
POL 1 Danger of terrorism in the region/pipeline countries
POL 2 Political stability of the region/pipeline countries

Fig 4.9 – Stage 4

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4.5.1 Overall Strength-Opportunity and Threat-Weakness score

The average likelihood scores in Fig 4.7 above were normalized and used with the normalized weights in Fig 4.8 to derive an overall opportunity–strength and an overall threat–weakness score for each route. Equations (3) and (4) in Appendix 2 pronounce the process.

4.5.2 The Euclidean distances

Each of the 5 alternative routes is plotted by its opportunity–strength and threat–weakness scores in the scatter diagram portrayed in Fig 4.10 below. Witness that the ideal approach would have coordinates of (5, 0) on the opportunity–strength and threat– weakness axes of the Fig. The Euclidean distance between each alternative route and the ideal route is calculated using Equation (5) in Appendix 2. Alternative routes with a smaller Euclidean distance are closer to the ideal route and chosen. *These Euclidean distances are the basis for ranking the alternative routes presented in the results*.

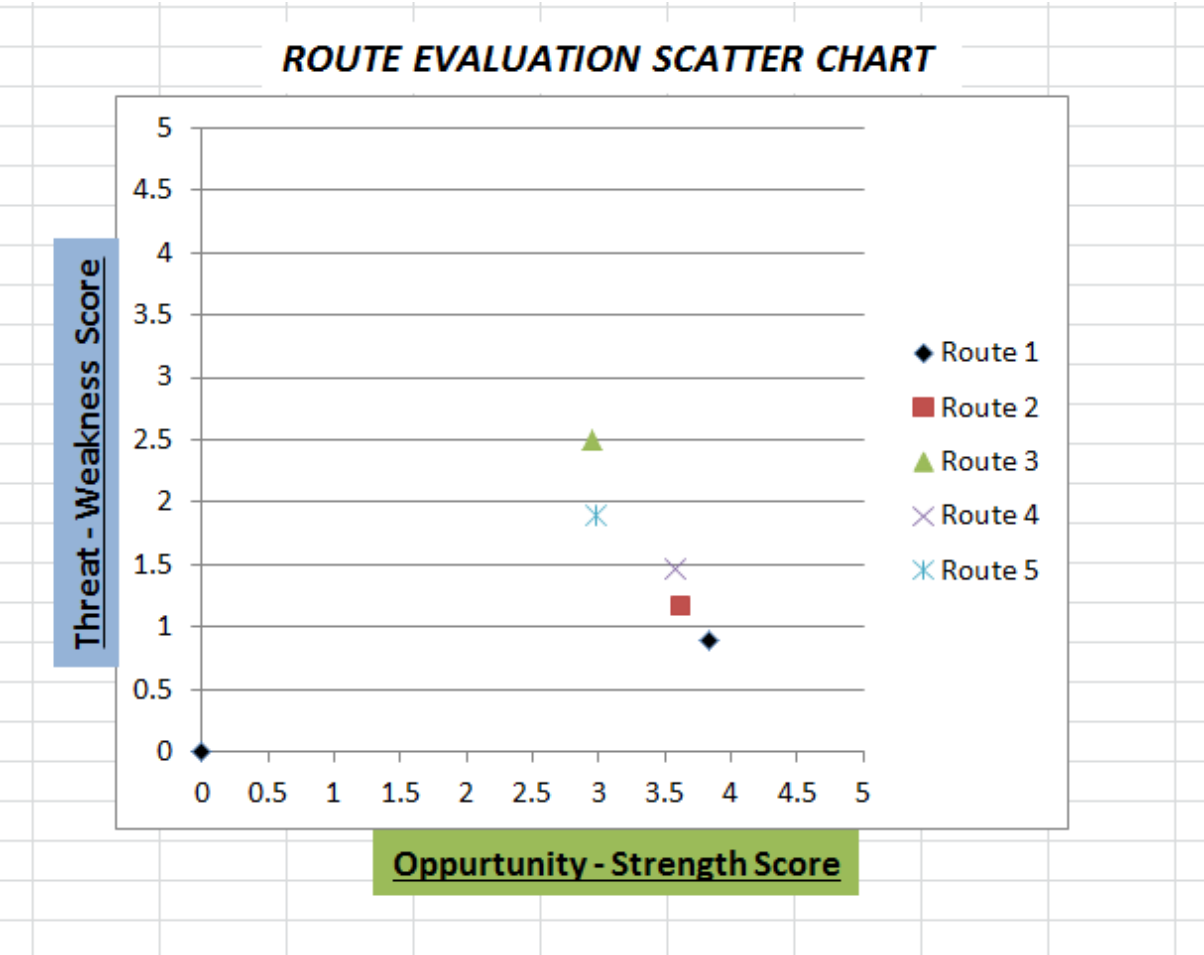

Fig 4.10 – Scatter Chart for Euclidean Distance Calculations

4.6 Step 6 (Results and strategy)

These are discoursed in the succeeding paragraphs. Strategies are explained in chapter (5) comprehensively.

4.7 The Results

As shown in Fig 4.10 above, routes 1 and 2 are the alternatives closest to the ideal route. The gap analysis in this figure discloses that the opportunity–strength score for the route 2 (3.625) is slightly lower than the score for the route 1 (3.83) resulting in a smaller opportunity–strength gap from the opportunity–strength ideal score of 5 for the latter route (1.17) compared with the opportunity–strength gap for the former route (1.375). However, the threat–weakness score for route 1 (0.899) is significantly lower than the route 2 (1.167) and

the other three remaining routes resulting in the best threat–weakness gap of 4.101 from the threat–weakness ideal score (0).

Route 1 with the Euclidean distance of 1.48 and Route 2 with the Euclidean distance of 1.803 were picked as the best and second-best options, respectively. The overall ranking of the alternative routes can be used as the basis for developing a security strategy if some degree of broadening (more than one route) is needed. Although the broadening of oil and gas pipeline routes can significantly lessen risks due to dependency on a specific route. Table 4.2 shows the details.

Table 4.2 - Ranking Based on Euclidean Distances

Route Via	Opportunity-Strength Score	Threat-Weakness Score	Opportunity-Strength gap	Threat-Weakness gap	Euclidean distance	Ranking
Pakistan	3.83	0.899	1.17	4.101	1.48	*1*
Myanmar	3.625	1.167	1.375	3.833	1.803	*2*
Malacca	2.958	2.5	2.042	2.5	3.23	*5*
India	2.98	1.9	2.02	3.1	2.77	*4*
Iran	3.583	1.467	1.417	3.533	2.04	*3*

Chapter 5

5 STRATEGY DEVELOPMENT

5.1 Strategy Development

Strategy is vital because the assets available to achieve specific goals are usually limited and at times, restricted. Strategy generally involves setting goals, shaping actions to achieve the goals, and mustering resources to execute the actions required. A strategy describes how the ends (goals) will be achieved by the means (resources). Strategy in our case is intended, aimed at achieving the goals defined as a result of our study. It involves undertakings such as strategic planning and strategic thinking.

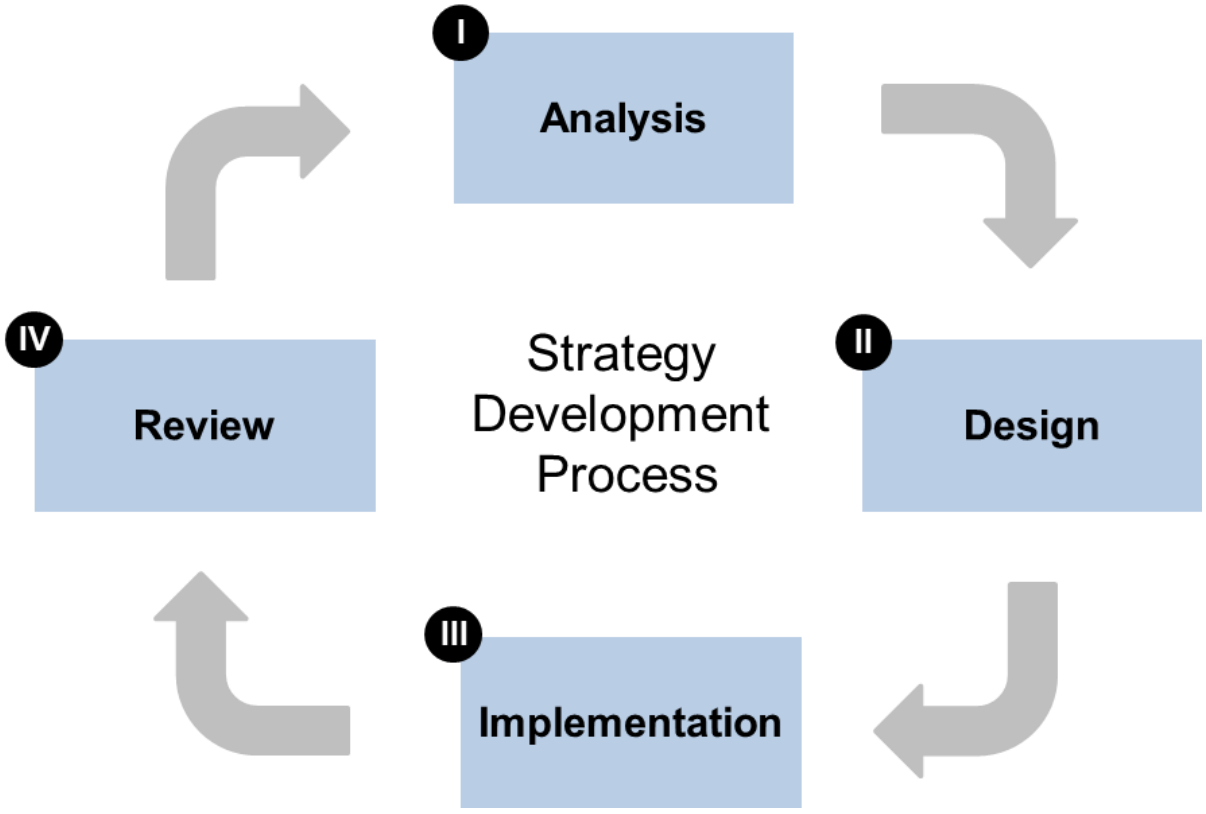

Fig 5.1 – Strategy Development Process

5.2 Strategy Proposed

The experts and facilitators organized a series of added meetings to develop a set of strategies for exploiting the 27 precarious success factors identified in the SWOT analysis. The proposed strategies are presented in Table 5.1

- The *opportunity* strategies proposed were five against the five sub factors. The most important strategies were development of warm water ports and harbours, development of beach infra-structure, provide state of the art shipping and oil transport facilities, strengthening the capacity of employment on oil and gas transportation and establishment and training of pipeline maintaining workshops.

- The proposed *threat* strategies were categorized into twelve groups including preventing further terrorist attacks, more control over terrorist groups, Govt to give subsidies on the project, strict check and regularization of tariffs, creating better conditions for attracting foreign investment, Govt to give subsidies on the project/ financial support of China, LEAs to be detailed for security, public awareness, pipeline to bypass populated areas, incorporate necessary precautions and design accordingly and reducing the costs associated with construction and maintenance of pipelines.

- The strategies related to the *strength* factors were in seven categories. Creating more investment friendly environment, sound economic reforms, carrying out of maintenance and repairs of existing pipelines and strengthening the insurance industry.

- The strategies linked to the *weakness* factors were divided in three types. The prime strategies were enhancing the security of pipelines, strengthening the infrastructure of oil and gas pipelines, construction of new ports ensuring military solidity and using other domestic routes that have better soil quality because of climate variability.

Table 5.1 – Proposed Key Strategies

Rank	Strategy	Remarks
1	Development of warm water ports and harbours	To take advantage of GEO 1 opportunity
2	Development of beach infra-structure	To take advantage of GEO 2 opportunity
3	Provide state of the art shipping and oil transport facilities	Exploitation of GEO 3 opportunity
4	Estb and training of pipeline maintaining workshops	To take advantage of TECH 1 opportunity
5	Strengthen the oil and gas pipeline infrastructure	To take advantage of TECH 2 opportunity
6	Create more investment friendly environment	To increase ECO 8 strength
7	Sound economic reforms	To increase ECO 9 strength
8	Create public awareness and interest	To increase SCO 2 strength
9	Arrange seminars at national level	To increase SCO 6 strength
10	Carry out maintenance and repairs of existing pipelines	To increase SCO 8 strength
11	Develop and refine access infrastructure	To increase TECH 8 strength
12	Rule of law to be ensured at all costs	To increase POL 2 strength
13	Govt to give subsidies on the project	To overcome ECO 5 threat
14	Strict check and regularization of tariffs	To overcome ECO 6 threat
15	Govt to give subsidies on the project/ financial support of China	To overcome ECO 7 threat
16	LEAs to be detailed for security	To overcome ECO 11 threat
17	Develop and refine access infrastructure	To overcome GEO 4 threat
18	Construction of jetties	To overcome GEO 10 threat
19	Public awareness and ensure law and order	To overcome CUL 3 threat
20	Incorporate necessary precautions and design accordingly	To overcome ENV 2 threat
21	Incorporate necessary precautions and design accordingly	To overcome ENV 3 threat
22	pipeline to bypass populated areas	To overcome ENV 6 threat
23	Prevent further terrorist attacks	To overcome POL 1 threat
24	Rule of law to be ensured at all costs and political stability	To overcome POL 2 threat
25	Better maritime and sea security in own waters	To reduce POL 4 weakness
26	Diplomacy	To reduce POL 5 weakness
27	Construction of new ports	To reduce TECH 7 weakness

Chapter 6

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

- With the growing demand for energy from developed economies and countries, the demand for oil and natural gas has strictly challenged the policy makers and world leaders in a pursuit to their stable survival.
- In response , pipelines are used to transport oil and natural gas over long distances within countries and across borders to meet the swelling demand.
- The distances between the source of the petroleum products (Gulf states in our case) and the destination (China) for energy requirements can be thousands of miles over difficult and varying terrain. In this environment, China has already started to evaluate alternative import routes from the Strait of Hormoz because of its vast consumption of oil and natural gas products.
- China is facing problems both economic and security on its already existing routes as discussed in the study. CPEC already being undertaken has the potential of an additional relief to both Pakistan and China for this purpose.
- Few of the major advantages of this route (ROUTE 1) to China are
    - Shorter distance
    - Already existing mutual understanding
    - CPEC activity being done.
    - Road and communication infrastructure
    - New and state of the art warm water port at Gawader
    - KKH
    - Security
    - Least travel time

- Few of the major advantages of this route (ROUTE 1) to Pakistan are
    - Foreign investment
    - Own oil requirements met
    - Job opportunities
    - Economic growth and national stability
- The evaluation of alternative transnational export routes for oil and natural gas is a complex task with contradictory and mutual objectives under one umbrella.
- The study endeavoured to use a hybrid model combining SWOT-PESTLE analysis with the Delphi method to assist experts in evaluating potential transit routes for crude oil transport to China.
- The model decomposed the process into controllable steps and combined the results to arrive at a solution that was consistent with our goals.
- The decomposition encouraged experts to think systematically and consider carefully the elements of indecision. However, the proposed outline does not suggest a deterministic approach to multi-criteria decision making.
- The effectiveness of the model relies on the expert's cognitive competences.

6.2 Recommendations

Based upon the study conducted by us, we recommend the enactment of the following points for attaining max benefits for Pakistan (if the proposal materializes).

- All weather solutions for the protection of pipeline to be devised to prevent it against extreme weather and climatic conditions.
- Detailed geological survey to be carried out to identify fault lines and zones which are required to be avoided.
- Installation of pumping stations and dump/ storage areas enroute.
- Own coursework regarding development of Gawader port, dump sites, transporters and pipeline alignment.
- Foreign investments to be invited
- Security parameters to be worked out and comprehensive planning to be done. This will also facilitate in convincing China of the proposal.

- Diplomatic and Foreign Office exchange of idea with China after refinement.

6.3 Future research directions

The outline developed in this study can lead the researchers towards a new approach in order to engage many practical applications and problems requiring a systematic logical outcome. Nonetheless, there are a number of challenges involved in the present research that provide a window of opportunities for future research. For example,

- Delphi and SWOT when used in isolation can lead to confines. Conversely, the hybrid method leads to a more proficient approach for integrating particular judgments with complex multi-criteria problems.
- Can we estimate a confidence and reliability index?
- In what way the time factor important?
- How does the continuous and active time factor affect the results?
- How do the short and long term considerations influence the model?
- Cost analysis of the proposed pipeline/ crude oil transport.
- Quantitative analysis of the pipeline, routes and its impacts specific to Pakistan.

We hope that our study inspires others to pursue further research.

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Appendix 1. Mathematical notations and equations

m	number of key positive factors
n	number of key negative factors
Xi	score of the key positive factor i
Yj	score of the key negative factor j
~Xi	normalized score of the key positive factor i
~Yj	normalized score of the key negative factor j
Ki	average likelihood of the key positive factor i
Lj	average likelihood of the key negative factor j
Wos	overall opportunity–strength score for each route
Wtw	overall threat–weakness score for each route
D	overall distance of each route from the ideal route

We first normalize the positive (opportunity and strength) scores using the following normalization process:

$$\tilde{X}_i = \frac{X_i}{\sum_{i=1}^{m} X_i} \ (i = 1,\ldots,m) \tag{1}$$

Similarly, we normalize the negative (threat and weakness) scores using the following normalization process:

$$\tilde{Y}_j = \frac{Y_j}{\sum_{j=1}^{n} Y_j} \ (j = 1,\ldots,n) \tag{2}$$

We then calculate the overall opportunity–strength score for each alternative route as below:

$$W_{os} = \sum_{i=1}^{m} \tilde{X}_i \times K_i \tag{3}$$

Similarly, the overall threat–weakness score for each alternative route is obtained from the following equation:

$$W_{tw} = \sum_{j=1}^{n} \tilde{Y}_j \times L_j \tag{4}$$

Finally, we calculate the overall distance of each alternative route from the *ideal route* (5,0) as

$$D = \sqrt{(W_{os}-5)^2 + (W_{tw}-0)^2} \tag{5}$$

The Euclidean distances are used to rank the alternative routes. The alternatives closer to the *ideal route* are preferred to those farther away from the *ideal route*.

FACTOR	SUB-FACTOR	SWOT	Relevant Yes/No
Economical			
1	Financial support of the international community	Opportunity	
2	Availability of investment tax credits for oil and gas explorations in the region countries	Opportunity	
3	High ROI potentials	Opportunity	
4	Financial support of the region/pipeline countries for oil and gas explorations	Opportunity	
5	Availability of cheap labour in the region/pipeline countries	Opportunity	
6	High level of export in the region/pipeline countries	Opportunity	
7	Potential for high and stable energy demand in the region/pipeline countries	Opportunity	
8	High level of GDP in the region/pipeline countries	Opportunity	
9	High tax rate in the region/pipeline countries	Threat	
10	High cost of building and maintaining pipelines in the region/pipeline countries	Threat	
11	High level of tariffs and commissions in the region/pipeline countries	Threat	
12	High cost of oil and gas transportation and transfer in the region/pipeline countries	Threat	
13	High oil and gas drilling and exploration expenses in the region/pipeline countries	Threat	
14	Negative effect of pipelines on other industries such as tourism and fishing	Threat	
15	Economic dependency of the region/pipeline countries to other countries	Threat	
16	Investment security in the region/pipeline countries	Strength	
17	Qualified and productive labor force in the region/pipeline countries	Strength	
18	Economic stability of the region/pipeline countries	Strength	
19	High current oil and gas supply	Strength	
20	Low non-oil and gas import/export level in the region/pipeline countries	Weakness	
21	Poor oil and gas quality	Weakness	
22	Poor forecast for oil and gas supply	Weakness	
23	Equipment's to be used	Opportunity	
24	Financials support from friendly countries	Opportunity	
25	Lack of funds	Weakness	
26	Financial condition of Pakistan	Weakness	
27	Negative effects of pipeline	Threat	
28	Qualified staff for the project	Strength	
29	High cost on maintenance	Threat	

30	High cost on security of pipeline	Weakness	
Geographical			
1	Accessibility to open sea and oceans	Opportunity	
2	Suitable beaches with calm waves	Opportunity	
3	Shorter distance	Opportunity	
4	Hilly and mountainous terrain	Threat	
5	Active Earthquake region	Threat	
6	High temperature and humidity problems	Threat	
7	Low temperature and icy conditions	Threat	
8	Desert terrain	Threat	
9	Swampy terrain	Threat	
10	Offshore distance	Threat	
11	Accessibility to straits for passage	Threat	
12	Accessibility and availability of oil and gas reserves in the region	Strength	
13	Poor soil condition and quality	Weakness	
14	Area influencing by high wind	Threat	
15	Cyclone in areas	Threat	
16	Tsunami in areas	Threat	
17	High speed wind in areas	Threat	
18	Ice burg in areas	Threat	
19	Hurricane in areas	Threat	
Social			
1	Open society	Opportunity	
2	Availability of jobs and public assistance programs	Opportunity	
3	Educated and trained workers	Opportunity	
4	Familiarity of the society with oil and gas industries	Strength	
5	Traffic obstacles	Threat	
6	Availability of trained workers	Strength	
7	Poor nation	Weakness	
8	Interference of landlords community	Threat	

9	Lack of education	Threat	
10	Public awareness	Strength	
11	Effect on existing structure	Threat	
12	Mentality of nation	Opportunity	
13	Availability of already existing pipeline	Strength	
14	Availability of skilled staff	Strength	
Cultural			
1	Common race in the region/pipeline countries	Strength	
2	Common culture and customs in the region/pipeline countries	Strength	
3	Common national identity in the region/pipeline countries	Strength	
4	Common history in the region/pipeline countries	Strength	
5	Language diversity in the region/pipeline countries	Weakness	
6	Religion diversity in the region/pipeline countries	Weakness	
7	Diversity of religious sects in the region/pipeline countries	Weakness	
8	Different tribes in the region	Weakness	
9	Different culture in the region	Weakness	
10	Different sect in region	Weakness	
11	Common religion in the region	Strength	
12	Clashes b/w communities	Threat	
13	Attachment b/w different tribes	Strength	
14	Attachment b/w different sects	Strength	
Technological			
1	Ability to maintain and repair current pipelines	Opportunity	
2	Ability to expand current pipelines	Opportunity	
3	Ability to convert natural gas to liquid gas	Opportunity	
4	Adequacy of technologically advanced oil and gas tankers	Strength	
5	Adequacy of technologically advanced oil and gas trucks	Strength	
6	Adequacy of the oil and gas refineries	Strength	
7	Adequacy of the railroad infrastructure	Strength	
8	Lack of scientific and technological foundation of the society	Weakness	

9	Poor oil and gas transportation infrastructure	Weakness	
10	Lack of roads with proper surface and foundation	Weakness	
11	Insufficient number of ports for oil and gas transportation	Weakness	
12	Poor rail/road infrastructure	Weakness	
13	Lack of oil plants	Weakness	
14	Lack of technical staff	Weakness	
15	Lack of technical education	Weakness	
16	Availability of ports	Strength	
17	Availability of routes/roads for further transportation	Strength	
18	Condition of existing infrastructure	Weakness	
19	Availability of the PSO **&** SW & NG	Weakness	
20	Availability of dump places	Strength	
21	Transportation proposal	Opportunity	
22	Efficiency of drivers/operators	Strength	
23	Transportation means in Pakistan	Strength	
24	Maintenance of vehicles	Weakness	
Environmental			
1	Pollution of the sea surface	Threat	
2	Pollution of the sea bottom	Threat	
3	Pollution of the beaches	Threat	
4	Pollution of the water sources	Threat	
5	Pollution of the water destinations	Threat	
6	Pollution of the rivers and water canals	Threat	
7	Pollution caused by nuclear activities	Threat	
8	Availability of underground water sources along the route	Threat	
9	Aquatic life will disturb in case of leakage	Threat	
10	Life risk to the people/community living nearby pipeline	Threat	
11	In case of any incident nearby mountainous area it will destroy the forest/animal life	Threat	
12	Pollution of the seashore	Threat	
13	Less chance to the availability of clean water sources along the route	Threat	
14	Pollute the air in case of leakage	Threat	

15	Effect on human life during leakage	Threat	
Legal			
1 2 3 4	Oil and gas reserve ownership disputes in the region/pipeline countries Availability and stability of insurance industry in the region/pipeline countries Strict import/export laws and regulations in the region/pipeline countries Strict foreign investment rules and regulations in the region/pipeline countries	Threat Strength Weakness Weakness	
Political			
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	Political support of the neighbouring countries for the project Political support of the international community for the project Possibility of Russian control of the pipeline Danger of terrorism in the region/pipeline countries Nuclear proliferation initiatives in the region/pipeline countries Foreign oil and gas dependency of the region/pipeline countries Political stability of the region/pipeline countries Poor security in the region/pipeline countries Military instability of the region/pipeline countries Indian inspiration Possibility of Indian control on pipeline Political control in the countries Personal interest of politician Political support of the Asian communities for the project Possibility of state of Alaska control of the pipeline Foreign policy Political relation with in the country & with other countries Political support of the ASEAN for the project Requirement of the pipeline Snooping of the pirates	Opportunity Opportunity Threat Threat Threat Threat Strength Weakness Weakness Threat Threat Opportunity Opportunity Opportunity Threat Strength Strength Strength Opportunity Threat	

21	Effect on project due to Iran & Saudi smashes	Threat	
22	Interference of terrorist	Threat	
23	Agreements b/w the pipeline countries	Strength	
24	Iran inspiration	Strength	

Total Factors - 144
Relevant Declared - _____
Round - _____
Signed By - _____

Signature - _____

Anx A

Below is given a list of Sub-factors being considered for oil and gas pipeline transportation potential routes evaluation to China. Please grade each sub factor on ***likert scale*** from 0 to 10.

0 - Least Important

10 – Most Important

FACTOR	SUB-FACTOR	SWOT	Likert Score
Economical			0-10
1	Availability of investment tax credits for oil and gas explorations in the region countries	Opportunity	2
2	Financial support of the region/pipeline countries for oil and gas explorations	Opportunity	1
3	Availability of cheap labour in the region/pipeline countries	Opportunity	4.5
4	Potential for high and stable energy demand in the region/pipeline countries	Opportunity	4
5	High tax rate in the region/pipeline countries	Threat	6.5
6	High level of tariffs and commissions in the region/pipeline countries	Threat	6
7	High cost of oil and gas transportation and transfer in the region/pipeline countries	Threat	7.5
8	Investment security in the region/pipeline countries	Strength	8
9	Economic stability of the region/pipeline countries	Strength	6.5
10	Lack of funds	Weakness	2
11	High cost on security of pipeline	Threat	7
Geographical			
1	Accessibility to open sea and oceans	Opportunity	7.5
2	Suitable beaches with calm waves	Opportunity	6
3	Shorter distance	Opportunity	8.5
4	Hilly and mountainous terrain	Threat	5.5
5	Active Earthquake region	Threat	3
6	High temperature and humidity problems	Threat	2.5
7	Low temperature and icy conditions	Threat	4
8	Desert terrain	Threat	4
9	Swampy terrain	Threat	2
10	Offshore distance	Threat	5
11	Accessibility to straits for passage	Threat	2
12	Cyclone in areas	Threat	3.5
13	Tsunami in areas	Threat	3
14	High speed wind in areas	Threat	3
15	Ice burg in areas	Threat	3.5

Social			
1	Educated and trained workers	Opportunity	4
2	Familiarity of the society with oil and gas industries	Strength	5
3	Traffic obstacles	Threat	3.5
4	Poor nation	Weakness	4
5	Interference of landlords community	Threat	4.5
6	Public awareness	Strength	5.5
7	Mentality of nation	Opportunity	2
8	Availability of already existing pipeline	Strength	7
Cultural			
1	Language diversity in the region/pipeline countries	Weakness	1.5
2	Different culture in the region	Weakness	3
3	Clashes b/w communities	Threat	6
Technological			
1	Ability to maintain and repair current pipelines	Opportunity	6
2	Ability to expand current pipelines	Opportunity	5.5
3	Adequacy of technologically advanced oil and gas tankers	Strength	4
4	Adequacy of technologically advanced oil and gas trucks	Strength	4
5	Adequacy of the oil and gas refineries	Strength	2
6	Adequacy of the railroad infrastructure	Strength	6.5
7	Insufficient number of ports for oil and gas transportation	Weakness	7
8	Availability of dump places	Strength	6.5
Environmental			
1	Pollution of the beaches	Threat	4.5
2	Pollution of the water sources	Threat	6

3	Pollution of the rivers and water canals	Threat	6.5
4	Availability of underground water sources along the route	Threat	2
5	Aquatic life will disturb in case of leakage	Threat	2.5
6	Life risk to the people/community living nearby pipeline	Threat	7
Legal			
1	Strict foreign investment rules and regulations in the region/pipeline countries	Weakness	4.5
Political			
1	Danger of terrorism in the region/pipeline countries	Threat	8.5
2	Political stability of the region/pipeline countries	Strength	7.5
3	Political support of the Asian communities for the project	Opportunity	4
4	Snooping of the pirates	Threat	6
5	Effect on project due to Iran & Saudi smashes	Threat	5.5

Total Factors - 57
Marked By - _____

Signature - _____

Anx B

Anx C

Key Factors with overall score >= 5

SWOT	Sub-Factor	Overall Score
Opportunities	GEO 1	7.5
	GEO 2	6
	GEO 3	8.5
	TECH 1	6
	TECH 2	5.5
Strengths	ECO 8	8
	ECO 9	6.5
	SCO 2	5
	SCO 6	5.5
	SCO 8	7
	TECH 8	6.5
	POL 2	7.5
Threats	ECO 5	6.5
	ECO 6	6
	ECO 7	7.5
	ECO 11	7
	GEO 4	5.5
	GEO 10	5
	CUL 3	6
	ENV 2	6
	ENV 3	6.5
	ENV 6	7
	POL 1	8.5
	POL 2	7.5
Weaknesses	TECH 7	7
	POL 4	6
	POL 5	5.5

Anx D

Key Factors and their normalised weights

SWOT	Sub-Factor	Overall Score
Opportunities	GEO 1	0.094
	GEO 2	0.075
	GEO 3	0.12
	TECH 1	0.076
	TECH 2	0.069
Strengths	ECO 8	0.1
	ECO 9	0.081
	SCO 2	0.062
	SCO 6	0.069
	SCO 8	0.088
	TECH 8	0.081
	POL 2	0.094
Total Weight		***1.000***
Threats	ECO 5	0.067
	ECO 6	0.062
	ECO 7	0.076
	ECO 11	0.071
	GEO 4	0.056
	GEO 10	0.051
	CUL 3	0.062
	ENV 2	0.062
	ENV 3	0.068
	ENV 6	0.072
	POL 1	0.087
	POL 2	0.076
Weaknesses	TECH 7	0.073
	POL 4	0.061
	POL 5	0.056
Total Weight		***1.000***

Anx E

Questionnaire

Below is given a questionnaire regarding potential routes through which oil can be transported to China. These include existing and proposed routes to carry out a study to define the best suitable route including CPEC route. Please mark these routes as per factor out of 5.

Route Description

Route 1 – Pakistan (Gawadar to Kashgar)
Route 2 – Myanmar (Yangon to Kunming) *Existing*
Route 3 – Strait of Malacca (To Guangzhuo) *Existing*
Route 4 – Iran (Bandar – e – Abbas to Xinjiang)
Route 5 – India (Mumbai to Tibet)

SWOT	Sub Factor	Alternative Routes					Ideal Score
Oppurtunities		Route 1	Route 2	Route 3	Route 4	Route 5	5
	GEO 1	5	4.5	3	5	4.5	
	GEO 2	4.5	4	3	4.5	4.25	
	GEO 3	5	3	2.5	4	3.5	
	TECH 1	3.5	4	4	3	2.5	
	TECH 2	4	3.5	2	3.5	3	
Strengths							5
	ECO 8	4	3.5	2	3	3	
	ECO 9	3	3.5	3.5	4	4	
	SCO 2	4	4	4.5	4	3.5	
	SCO 6	4.5	3	3.5	3.5	3	
	SCO 8	2	4	3.5	3	1	
	TECH 8	3	3.5	2	2	2	
	POL 2	3.5	3	2	3.5	1.5	
Threats							0
	ECO 5	0.5	1	3	1.5	2.5	
	ECO 6	1.5	1.5	3.5	2	2	
	ECO 7	1	1.5	3	2.5	2.5	
	ECO 11	0.5	1.5	4	1	2	
	GEO 4	1.5	2	3.5	1.5	3	
	GEO 10	0	0.5	1.5	0	0.5	
	CUL 3	1	0.5	2.5	1	2.5	
	ENV 2	1.5	1.5	3.5	1.5	2.5	
	ENV 3	0	0.5	1	0.5	1	
	ENV 6	2	2	2.5	2	2.5	
	POL 1	2.5	2	2	2	3	
	POL 2	1.5	1	2.5	1.5	2.5	
Weaknessess							0
	TECH 7	2	1.5	1.5	2	1.5	

	POL 4	0	0.5	3.5	0	0	
	POL 5	0.5	0	0	3	0.5	

Sub-Factor Summary

GEO 1 Accessibility to open sea and oceans
GEO 2 Suitable beaches with calm waves
GEO 3 Shorter distance
TECH 1 Ability to maintain and repair current pipelines
TECH 2 Ability to expand current pipelines
ECO 8 Investment security in the region/pipeline countries
ECO 9 Economic stability of the region/pipeline countries
SCO 2 Familiarity of the society with oil and gas industries
SCO 6 Public awareness
SCO 8 Availability of already existing pipeline
TECH 8 Availability of dump places
POL 2 Political stability of the region/pipeline countries
ECO 5 High tax rate in the region/pipeline countries
ECO 6 High level of tariffs and commissions in the region/pipeline countries
ECO 7 High cost of oil and gas transportation and transfer in the region/pipeline countries
ECO 11 High cost on security of pipeline
GEO 4 Hilly and mountainous terrain
GEO 10 Offshore distance
CUL 3 Clashes b/w communities
ENV 2 Pollution of the water sources
ENV 3 Pollution of the rivers and water canals
ENV 6 Life risk to the people/community living nearby pipeline
POL 1 Danger of terrorism in the region/pipeline countries
POL 2 Political stability of the region/pipeline countries
POL 4 Snooping of the pirates
POL 5 Effect on project due to Iran & Saudi smashes
TECH 7 Insufficient number of ports for oil and gas transportation