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The Geography of Kuwaiti Oil Transportation 1970-1980

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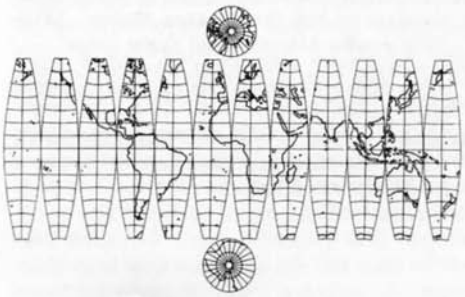

ABSTRACT

The transportation of oil from Kuwait between the years 1970–80, which was a period of relative political stability, is discussed. Based on physical, geopolitical and economic factors the country elected to use tankers rather than pipelines as did many other Gulf countries. During the period 1970–80 the oil field to transport facilities, onshore and offshore rapidly expanded and technologically improved. Paralleling this active growth, oil tanker construction and capacity had increased. In recent years geopolitical circumstances in Kuwait and emerging Asian markets justify the option of tankers moving oil via the Gulf over pipeline transport to Mediterranean ports.

KEY WORDS: oil, transportation, pipelines, Kuwait, geopolitics.

INTRODUCTION

The state of Kuwait stands at the head of the Arabian Gulf between latitude 28°45′ and 30°5′ north and longitude 46°30′ and 48°30′ east (Fig. 1). It is a small, flat, desert country of about 6.9 million square miles on the northwestern coast of the Arabian Gulf between Iraq to the north and Saudi Arabia in the south. It shares with the latter the ownership and administration of a neutral zone of about 2,500 square miles on the coast between the two countries (Cooper and Alexander, 1972). Kuwait's borders were established by the 'Uqair Treaty' between Iraq, Saudi Arabia, and Kuwait under British supervision. In June 1961 Kuwait was declared an independent state.

Oil is the basic natural resource of the country's economy. Its discovery dates back to 1934 when the late ruler of Kuwait, Shaikh Ahmed al-Jaber al-Sabah, signed the first agreement with the Kuwait Petroleum Company Ltd. (KPC) for the exploration and drilling in Kuwait. Exploration and prospecting continued throughout the State of Kuwait. Today there are 16 oil fields and 1563 wells in Kuwait. In addition to the 16 oil fields, there are 3 joint marine fields in the Gulf opposite the zone divided between State

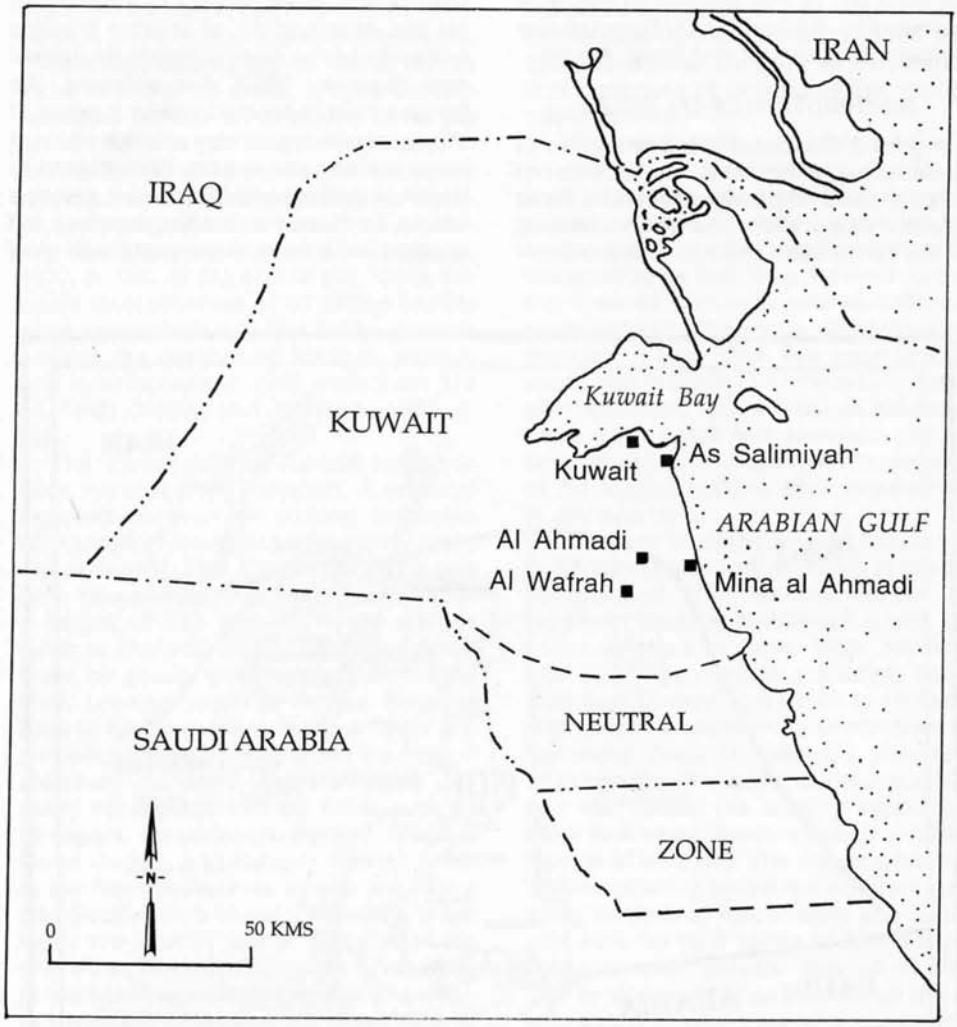

FIGURE 1. Kuwait and adjacent countries.

of Kuwait and Kingdom of Saudi Arabia. These fields are managed by the Arabian Oil Company for the mutual benefit of the state. The first productive well was in the Burgan field in 1938. Production had to be temporarily suspended due to World War II. The first shipment of Kuwait oil was exported in 1946 from the Al Ahmadi terminal which was specifically constructed as an oil exporting site.

The oil fields are geographically distributed into two groups. The Northern Group is the smaller of the two as it includes five oil fields. It constitutes about 19 percent of the total Kuwait oil wells. The Al-Ritqa oil field lying beneath on the Kuwait-Iraq boundary, was the basis of the Iraqi regime's allegation for invading Kuwait.

The Southern Group consists of 11 fields including the Burgan oil field, the largest in Kuwait and the second largest in the world. This group produces about 80 percent of the total Kuwait oil. The neu-

tral zone lies in this group and the oil is marketed by the Arabian Oil Company for the benefit of Kuwait and Saudi Arabia.

DISTRIBUTION OF OIL FIELDS

Figure 2 illustrates the distribution of Kuwait's major oil fields, the location of seaports, and oil pipeline networks. Most recently exploration has been centered on the continental shelf so that transportation costs could be kept to a minimum by the construction of shorter pipeline networks to the marine terminals (Issawi and Yeganeh, 1962). For example, the Burgan field is located within 2 miles of the coast which provides suitable sites for large-scale ocean export. With regard to depth of drilling, conditions vary, but as a whole, in Kuwait and adjacent areas, oil production comes from wells not over

FIGURE 2. Concession boundaries of oil companies, pipelines. Oil fields and main ports of Kuwait in 1970s. (Source: Freeth and Winstone, 1972, p. 183).

five or six thousand feet in depth. By comparison in the United States or Venezuela, the average depth reaches 10,000 feet or more in many oil wells. Middle Eastern countries contain what seems to be the world's largest petroleum reservoirs. In Kuwait for example, the Burgan field once was the the world's largest single oil field. Its average production was 2 million barrels of oil per day (Kuwait Oil Company, 1970, p. 10). At the end of the 1960s Kuwait's total reserves of 60 billion barrels were concentrated in five fields. In comparison the number of fields in production in Venezuela in 1960 were from 114 oil fields (Issawi and Yeganeh, 1962, p. 92).

The topography of Kuwait helps reduce the cost of oil transport. A series of exposed north-south striking hogbacks composed of resistant sedimentary rocks dip eastward. The Ahmadi ridge is one such topographical escarpment rising to a height of 370 feet. Oil from storage tanks at Ahmadi ridge is conveyed down slope by gravity flow to terminals on the Gulf. Located south of Kuwait Bay, the Burgan field was discovered in 1938, and pumping began in 1946 when the first oil shipment departed Kuwait. There are many other important oil fields such as Minagish, Rawdhatain, Sabiria, Magwa, Umm Gudair, and Bahrah. The oil fields in the Neutral Zone as shown are Wafra and South Umm Gudair. As noted, most fields are located within 30 miles of the shoreline. The main ports are Al Ahmadi, to the south of Kuwait Bay, and Shuaibah to the south of Al-Ahmadi in addition to the offshore islands which serve as embarkation points.

OIL LOADING FACILITIES

The loading facilities of Kuwait Oil Company (KOC) as shown in its reports are among the best in the world (Kuwait Oil Company, 1970, Fig. 3). The port of Al-Ahmadi has been continuously expanded, equipped and modernized since the first crude shipment occurred in 1946. This expansion and updating has been undertaken by KOC to met the ever increasing traffic of tankers in size and number. Al-Ahmadi port is known for the rapid and safe loading operation. The facilities and services of the port are adequate to answer the swift arrival, loading and departure of tankers in the shortest possible time.

The port facilities at Al-Ahmadi may be divided into the Southern and Northern Docks. The Southern Dock commissioned in 1959, includes eight loading berths with a water depth varying between 40 to 44 feet. This terminal formed the apex of a triangle whose base was represented by the towns of Fahaheel and Shuaiba. It was from this base that the south pier of Mina Al-Ahmadi (Al-Ahmadi port) emerged with a pipeline extending more than 4,000 feet seaward into the Gulf. Its capacity is designed to fuel eight of the largest tankers, then in existence, at any one time.

The significant increase in tanker traffic in numbers as well as in size at the port necessitated the construction of the Northern Dock of Al-Ahmadi which was commissioned in June, 1959. Although this dock has only four loading berths with depths varying from 55 to 60 feet, it is in some respects more useful than the Southern Dock (Kuwait Oil Company, 1970, p. 10). The commissioning of this pier had raised the loading capacity of Mina Al-Ahmadi to more than two million barrels of oil a day. The construction of a 30-inch pipeline to link the northern gathering centers of Raudhatain and Sabiriyah with the tank farms at Ahmadi provided an even greater flow of oil from well to tanker. At Mina Al-Ahmadi the average turn around time was significantly reduced from 40 hours 44 minutes to 24 hours 49 minutes (Freeth and Winstone, 1972, p. 190).

OFFSHORE LOADING FACILITIES

As crude oil tankers expanded in length, beam and draft, shore facilities became outdated. To accommodate larger vessels, an artificial island 10-miles offshore was constructed. By 1968, this sea island terminal was serving the new generation of 326,000 ton super tankers. Oil from the northern fields is carried by a 48-inch pipeline overland along a 77-

FIGURE 3. Tanker loading at an offshore facility in Kuwait.

mile route to a tank farm. From here another 20-inch pipeline transports the oil to the offshore docking facilities.

THE OPERATION OF OIL SHIPPING

Oil Storage

There are 14 berths at the port of Al-Ahmadi. Eight of them are in the Southern Dock, four in the Northern Dock and two on a floating platform some 10 miles offshore. In addition to these, there are four emergency flexible loading lines with buoys. Offshore submarine pipes carry oil to these loading terminal points located a mile from shore. The Kuwait Oil Company (KOC) keeps these under vigilant maintenance so they are always available for emergency use.

A storage tank center is connected to the Northern Dock by three pipelines, 38 to 48 inches in diameter. Also, a 48-inch pipeline starts at the storage area, passes into the Gulf and feeds the Alistin'lya loading facilities. A pumping unit or station installed on the coast pumps the crude oil to the offshore site. A storage tank site is similarly connected to the Southern Dock by seven pipelines whose diameters vary between 22 inches to 34 inches. A lateral pipe 48 inches in diameter branches out and merges with the 48-inch pipeline feeding Alistina'lya (an industrial island). Since the storage tank areas are located well above sea level, the crude oil moves by gravity flow to the coast and into the loading berths. However, by employing a pumping station, the rate of oil flow can be significantly increased.

Loading Operation

The KOC is informed by Telex about eight days prior to the arrival of a tanker. The notice of arrival consists of the name and type of tanker, the nature and size of cargo (e.g. crude oil and/or marine diesel oil) to be loaded. It also indicates the approximate arrival time and prepares necessary legal documents for loading and the tanker's final destination. The captain of the tanker confirms these data 72 hours before the arrival at Al-Ahmadi port. He indicates the approximate time of arrival, the amount of crude oil and marine diesel fuel needed and the loading speed required. He also transmits this information to the clearing agents (The Kuwait Oil Tankers Co.) of that particular tanker at the port. The message relayed to the clearing agent may contain the request for food, supplies, medical care needed and other services which the clearing agent provides. Accordingly, the KOC and the clearing agent can coordinate their efforts to receive the tanker and avoid any unnecessary delays in loading and departure.

IMPACT OF OIL FIELDS AND PIPELINE LOCATION ON URBAN EXPANSION

There were two main factors which directed urban expansion in Kuwait City: (1) a property acquisition scheme developed in 1951 and; (2) the application of comprehensive planning. The 1951 property acquisition scheme had two objectives; (a) to direct oil-revenue funds directly into the economy's private sector and, (b) to facilitate the urban renewal of the old city. Property owners within the old city and its surroundings were offered high prices to encourage them to move to new suburbs. Almost K.D. 600 was provided to the Kuwaitis of the old town between 1951–1960.

The application of comprehensive urban planning started along with the acquisition scheme. That was when the government invited a number of consultants to present a comprehensive urban-structure proposal to cover elements of future urban expansion. Those plans were undertaken by western consultants in cooperation with the Kuwait Municipality:

(1) Master plan of 1952 (by Manpower, Spencly & MacFarlane)
(2) Urban plan of 1967 (by Kuwait Municipality)
(3) Master plan of 1970–1995 (by Buchanan)
(4) Master plan of 1977–2000 (by Shankland)
(5) Master plan of 1983–2005 (by Buchanan)
(6) Master plan of 1989/90–2015 (by Marzoog and Atkins)

As a result Kuwait City in particular and Kuwait in general, adopted a semi-circular road system through which crossed urban land use (Fig. 4).

According to the Buchanan Master Plan of 1970–1995 there are a number of constraints which are likely to effect future urban expansion to include oil fields and pipeline location, exclusive surface rights and future development. Planning for Kuwait's system of ring roads was limited to seven around the city. An eighth was proposed but because oil fields and urban settlements separated from the old city as suggested by consultants was not pursued. New towns were in fact recommended in the Shankland plan (1977). There were two proposed towns, one north of Kuwait, the second in the south (Fig. 5). Each town was designed to accommodate a population of about 70,000 residents. The urban development, located at the perimeter of the present city is away from oil fields. Also the two focal points are near highways, thus providing rapid access to and from the city center.

WHY DOES KUWAIT CHOOSE TANKERS FOR ITS OIL TRANSPORTATION?

As noted Kuwait is a small country compared to its neighbors. A population of less than 1.5 million according to 1994 census, and its modest political stature have not provided Kuwait with the capability of extending its oil pipelines through adjacent countries. For example, there have been a border disputes between Kuwait and Iraq, resulting in re-

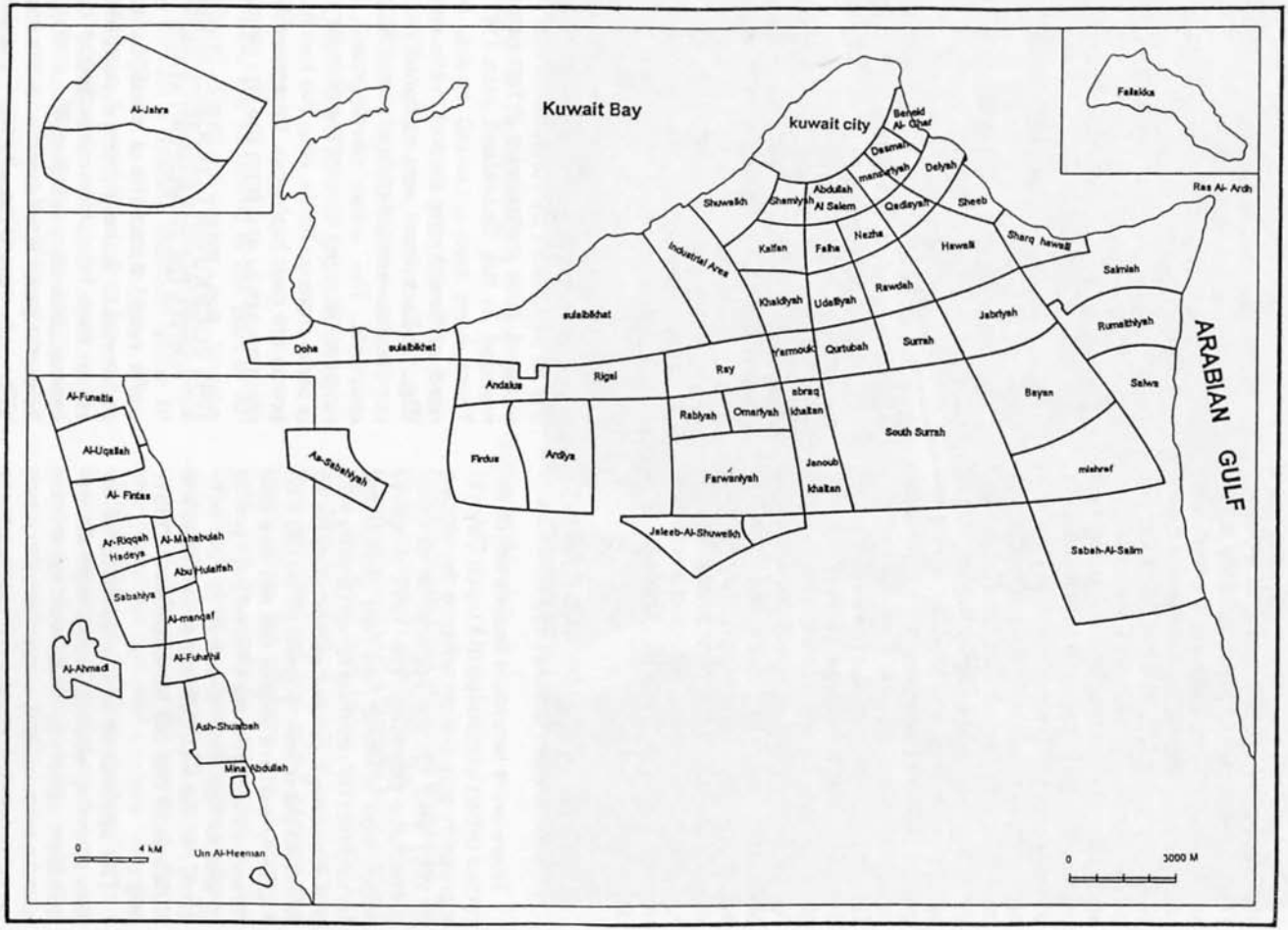

FIGURE 4. Road system and blocks in Kuwait city.

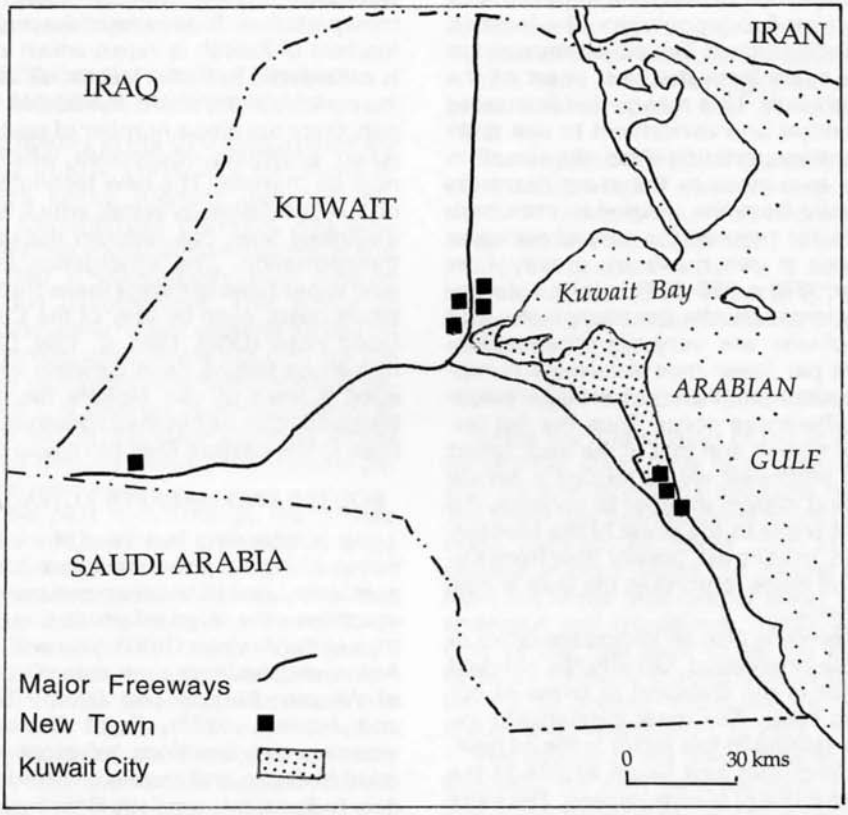

FIGURE 5. The location of Kuwait and new town development.

peated armed conflicts (i.e. 1961, 1973 and 1990). Such tensions continuously threatened the internal security of Kuwait. The threat to oil depots and pipelines was made clear in the 1990–1991 Iraqi invasion of Kuwait. Clearly oil pipelines from Kuwait crossing foreign soil to the eastern Mediterranean would be in jeopardy should future conflicts occur. Thus, the future of Kuwait which is based on oil would not be secure. Economically and strategically it is logical for Kuwait to use tankers for its oil transportation. The issue has been escalated since the "Al Baath" Regime emerged which is a product of socialism and a contrast to Kuwait's accepted government which is a Sheikdom or rule through a constitutional monarchy.

Armed conflicts have great geopolitical and physical impact on oil transportation in general. The factor became clear during 1967 and 1973 Arab-Israeli conflicts. The Iraqi pipelines were cut off and their oil refineries on the Syrian Mediterranean coast were damaged. The Saudi Arabian, TransArabian Pipeline (TAP) which ends at the Mediterranean coast in Lebanon was also cut off during these conflicts. The Iran-Iraq war illustrated that tankers are safer than pipelines. Thus, it is more convenient and more secure for Kuwait to ship its oil via the Arabian Gulf and avoid hostile relations. Kuwait is a marine state located at the head of Arabian Gulf, which provides the country with a significant coastline to the east and arid conditions to the west. These contrasting conditions encourage the use of marine transportation through the Gulf instead of pipelines to the west.

Another factor encouraging the use of oil is related to topography. The location and distribution of Kuwaiti oil sources are a few miles from the west coast of the Arabian Gulf. This means that it is more economical and convenient to use tankers for transportation. Also, the elevation of the area close to the coast descends gradually from the interior to the coast. This factor reduces the cost of pumping oil since it can move by gravity flow (Fisher, 1978 p. 253–254). In terms of pipeline orientation, the flat topography and right-of-way are very significant. Flow factors per linear mile determine pumping pressures unless some major elevation differences occur. Thus the flat terrain of Kuwait and that of the Iraqi desert to the northwest would require a double pumping system in order to continue the flow of crude to the coast of the Mediterranean. In contrast, gravity flow from Kuwaiti oil fields to ports in the Gulf is cost effective.

Distance is also an important factor in pipeline orientation. Usually the shortest distance is the cheapest in terms of operating costs. The most outstanding example related to this factor is the oil pipelines from Iraq and Saudi Arabia to the eastern coast of Mediterranean. The extra 100 to 200 miles of pipelines, secured a saving of more than 4,000 miles of tanker transport via the Arabian Gulf to Europe. The 1,200 mile TAP was built because it was cheaper to transport oil by pipeline rather than by tankers around the Arabian Peninsula and through the Suez Canal, a journey of 3,500 miles. Like Kuwait, the Saudi Arabian of oil fields are close to the west coast of the Arabian Gulf. In spite of the greater distance around the Arabian Peninsula to the Mediterranean, several factors encourage Kuwait to utilize tankers.

Pipeline maintenance is very expensive. Expenses include physical upkeep as well as taxes, insurance, and security. Security of pipelines demands continuous protection for two reasons. Firstly the extremely hot weather which leads to fires and secondly, areas of unstable political conditions.

The location of new oil markets have stimulated Kuwait to use tankers for transportation. Today one of the major oil markets of Kuwait is Japan which in turn is considered to be the largest oil importing country in the world. In addition to Japan, there are also a number of southeast Asian emerging economies which are new oil markets. The new technology of oil transportation by water, which will be discussed later, has reduced the cost of transportation. The emergence of the new super-tankers means lower transportation costs, even by way of the Cape of Good Hope (Odel, 1963, p. 159). Clearly numerous factors have logically encouraged Kuwait to use tankers for its oil transportation rather than construct pipelines to the eastern Mediterranean coast.

ROUTES AND MARKETS KUWAIT OIL

An outstanding feature of the international oil trade is the economic interdependence created between two groups of countries—the large oil producing countries of the Arabian Gulf region and North Africa, and the large consuming countries of Western Europe and Japan. (Schurr and Homan, 1971). From Kuwait oil moves in two directions: principally eastward to Japan and southward around Africa, to Europe (especially Britain and the Netherlands) and the United States. These two areas, Japan and Western Europe (especially Britain and Holland) are the major markets for Kuwait oil. The United States, the world's largest oil market is a relatively modest player in the oil trade with Kuwait. The U.S. is the world's largest oil consumer as well as the largest producer, providing about 80 per cent of its consumption from domestic sources, with the remainder originating mainly elsewhere in the western hemisphere. Five of the seven major international oil companies which constitute the main commercial link between the oil exporting and importing countries are United States corporations. They explore, produce, transport, refine and market the major portion of the world's oil supply in international trade. Japan and east Asia consume about 40 per cent of Kuwait oil. The other 60 percent of oil is divided among Western European markets, the

other markets in the world and for the domestic consumption.

DEVELOPMENT OF THE KUWAITI MARITIME SHIPPING FLEET

The history of the oil transportation according to KOC (1970) is a testimony of Kuwait's policy towards national economic development activities. The government has encouraged oil shipping and supported it consistently with parallel economic development. This policy of generous government support for the oil transporting company is not only for the general economic development of the nation but it is also an important policy in the context of the state planning aimed towards gaining control over natural petroleum resources.

In the past two decades the private sector in Kuwait has invested a large amount of capital in shipping. It was the business community that made the first initiative with the formation, in 1957, of the "Kuwait Oil Tanker Company" (KOTC). The initial capital was $20 million in 1968. In 1959 the first tanker, (*Kazimah*) was built by Sasebo Heavy Industries in Japan. At 49,000 dead weight tons (dwt) it was one of the world's biggest vessels. Two identical ships followed *Warbah* and *Al Sabbirah,* each of 60,000 dwt built by the Sasebo Company, and in 1959 the same firm constructed the first very large crude carrier (VLCC), *Arabiyah* displacing 208,000 dwt.

In 1970 two VLCC *Al Funtas* and *Al Badiahm,* each of 208,000 dwt were added to the fleet and four years later a mammoth ultra crude carrier (VLCC) of 361,000 dwt, *Al-Andalus,* was ordered from the Astano shipyard in Spain to give the KOTC fleet a total of 1,154,000 dwt. More ships, however, were on order. By the end of 1976, three more vessels had joined the fleet; two new super tankers, one of 407,000 dwt and the other of 400,000 dwt built by Mitsubishi. A third 328,000 dwt-vessel was constructed by the Chantier de la Ciatat in France.

By June, 1977, a 261 dwt tanker was built by Sasebo. In acquiring this latest VLCC, the total loading capacity of the company's tanker fleet exceeded 2.2 million dwt. By the end of 1977 the company added the first of the four gas transporting tanker with a capacity of 71,000 cubic meters each. The remaining three tankers joined the company fleet in 1978 and 1979.

The impact of OPEC on the technology of oil transportation was very clear. (Rouhani, 1971). Many countries had ordered larger tankers especially VLLC in order to improve transport costs. As a member Kuwait had benefited from OPEC especially after the nationalization of Kuwait's oil industry in 1975.

CONCLUSION AND FUTURE OUTLOOK

Since the first closing of the Suez Canal in 1956, ships have been outgrowing and outnumbering the available berths. The trend has been towards much larger, more mechanized docks built at river mouths or even jutting out several miles from the shore into deeper water (Alexanderson and Nordstrom, 1963). At the time of the first Suez crisis the largest tankers coming to Europe were in 28,000-ton to 32,000-ton dead weight range (Ewart and Fullard, 1971, p. 257).

The closure of the Suez Canal in 1956, although for only four months, meant that ships were forced to sail around the Cape of Good Hope. To maintain the same rate of delivery as before, each ship needed to carry larger loads. This sparked an increase in size of ships, particularly of bulk carriers and tankers. With the closure of the Suez Canal again in 1967, this time apparently for good, the trend to much larger ships had accelerated. The increase in the size of ships and the introduction of a unit load system such as containerization, meant that port authorities had to provide new and innovated ways to accommodate the new shipping technologies.

The exceptionally deep water required by the largest tankers (e.g. 100-foot draughts) has resulted in oil refineries of transshipment terminals migrating even farther offshore from traditional dock areas. In an increasing number of cases, offshore mooring buoys or jetties were constructed, sometimes several miles from the shore. The concept of such terminals

at sea has given a further boost by the increasing size of carriers. Before the advent of deep-water ports and offshore terminals, large tankers had to discharge part of their cargo into smaller tankers (Ewart and Fullard, 1972; p. 37). To keep dockside costs to a minimum, the capacity of oil pumping facilities had risen ten fold, from a few hundred tons per hour after World War II to several thousand tons per hour in the 1970s. To save expensive dredging costs, long jetties were constructed into deep water. In Kuwait, for example an artificial island has been constructed 10 miles offshore where the water is nearly 100-feet deep. Kuwait has also built new ports such as Mina Abdullah to the south of Al-Ahmadi port. A new terminal will be built facing this new port 12 miles offshore.

The largest tankers now carry more oil than can be stored in a typical refinery. To avoid the cost of reconstructing new, higher capacity refineries a new distribution method was created. In 1968, Gulf Oil opened a European oil depot—a million ton transshipment terminal at Bantry Bay, Ireland. Here the largest tankers could be moored in 100 feet of water and discharge their cargo into onshore storage tanks. Smaller tankers of up to about 100,000 dwt load and sail to smaller-capacity refineries and ports via the relatively shallow waters in northern Europe.

Although over 90 percent of tanker cargoes consist of oil, there is a growing tendency to send other liquids to sea in tankers (Norton, 1971). Chemicals, molasses, and even liquefied gas are now conveyed in tankers. World trade in chemicals is increasing about 40 percent faster than ordinary trade. The capacity of chemical tankers has doubled in the past few years to 1.5 million tons. Chemical tankers usually have a number of isolated compartments in which various liquid cargoes (including oil) can be stored.

Most projections of future shipping have seen a steady evolution rather than a revolution, of current ship types. Ships are now being designed for specific purposes, and the dominant types are the tanker, bulk carrier and container vessel. Their average size and their total number will continue to grow steadily.

Many technical advances in shipping to be sure will occur. As with aircraft, there will doubtless be a continuing trend towards stronger, yet lighter materials in shipbuilding. The use of aluminum instead of steel for superstructures is a good example. Some naval vessels now have been built with plastic hulls, which makes them exceptionally light, protects them from corrosion and reduces the need for protective coats of paint. An additional advantage of plastic for military vessels is that it is nonmagnetic.

Innovative developments in ocean transportation technology—primarily during the last decade, have affected not only shipping operations, but terminals, feeder interfaces, shipping management ship financing, and a large number of subsidiary industries. The large increase in the unit size of ships has introduced major changes in structural configuration and hull design. Since 1940, for example, the size of tankers has more than doubled every 10 years (Frankel and Marcus, 1973, p. 65). The newest category is that of a mammoth vessel, which is over 350,000 dwt. Total orders jumped from seven in mid-1972 to twenty-two by the year's end. Some of the new vessels will be designed, with relatively shallow draughts. The record size set by Shell's 533,000 dwt now under construction had already been surpassed by Globitik's letter of intent for a 706,000 tonnes. Shell Oil had also considered ordering more ships up to 650,000 dwt (Rifai, 1974; p. 141). The prospect of a one or two million ton tanker has become increasingly more feasible.

On the other hand, at the beginning of the second half of 1990, Kuwait had concluded the long-term socio-economic development plan (1990–2015) which was in part directed to future urban structure; it had also fulfilled a five-year development plan (1990–1995). Those two main development plans were not implemented because of the Iraq invasion of Kuwait (August 1990 to February 1991) (Ministry of Planning, 1995 p. 125–129). Estimates of the size of economic damage suggest a figure ranging between $200–300 billion according to early studies by the authorities and other organizations.

The year 1990 began with a maximum production of oil 2.9 million barrels/day. However, the average production in the first half of that year dropped nearly 50 per cent to 1.5 million barrels/day. Kuwait also produces natural gas and liquid propane gas. Its natural gas reserve was estimated at 1.32 trillion cubic meters at the end of 1989. The country also has an advanced petrochemical industry that manufactures fertilizers, chlorine, salt, sodium hydroxide, acids, hydrogen, distilled water, melamine, resin and polyester.

The dependence on oil is clear. At the same time however, the resource has resulted in geopolitical strife. Saudi Arabia has elected to use the TAP and tankers to export its oil resources. In contrast Kuwait's sensitive political circumstances, have encouraged the country to invest in coastal and offshore facilities and oil tankers to move its oil. The remarkable growth in tankers and emerging markets in east and southeast Asia suggest that this decision does have a logical foundation.

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