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FLEET MANAGEMENT MATHEMATICAL PROGRAMMING MODEL FOR ROUTING AND SCHEDULING AN OCEAN TRANSPORTATION PETROLEUM PROBLEM

Key Words

Oil Tanker Routing and Scheduling; Integer Programming; Kuwait Petroleum Corporation.

Abstract

This paper investigates a mathematical programming model for the routing and scheduling of oil tankers in a maritime transportation system. A literature survey on seaborne transportation systems indicates a noticeable scarcity of research on ship routing and scheduling problems. The size and complexity of a typical ship routing and scheduling problem are the primary reasons that have resulted in the scarcity of research in this area. This research effort is focused on the Kuwait Petroleum Corporation (KPC) oil tanker routing and scheduling problem. This problem is of great economic importance to the state of Kuwait, whose economy has been to a large extent dominated by the oil sector, and hence any improvement in the present ad-hoc scheduling procedure has the potential for significant savings. An integer linear programming model for the KPC problem is constructed, wherein most of the essential operational attributes are represented. The integer programming model attempts to maximally utilize the KPC owned vessels, decides on the (optimal) number and types of chartered vessels needed along with the owned vessels to satisfy total demand. The mathematical model can be utilized for the routing and scheduling of vessels as well as for planning, managing and negotiating purposes.

Introduction

Sea transportation is one of the major transportation modes in the world. Data compiled by Ronen (1993) from Lloyd's Register (1991) indicates that over one year, the world merchant fleets increased by 12.4 million gross tons. The world fleet is made up

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of 80,030 ships (each over 100 gross tons) of different types (Ronen, 1993). The world seaborne trade achieved an increase of 16% in 1991 over 1981 and the distance weighted trade grew by 11% in 1990 over 1981 (Ronen, 1993). These facts highlight the reliance of the world economy on seaborne trade and hence emphasize the need for efficient and reliable maritime transportation systems. Routing and scheduling of ships requires the most elaborate and significant level of planning of fleet management in any maritime transportation system. In this process one should properly assign shipments to vessels and decide on the route a vessel should take. Furthermore, one needs to efficiently determine ship size, ship speed, shipment size, fleet size, number of time-chartered vessels, number of spot-chartered vessels, whether it is lucrative to perform a spot-charter for another operator, and so on. Efficient routing and scheduling of ships has the potential of enormous savings in the total fleet operation costs. This is true, especially when taking into account the facts that a typical ship in a merchant fleet usually costs millions of US dollars and the daily operating costs of a ship amounts to tens of thousands of US dollars (Ronen, 1983,1993).

In spite of the vital role of routing and scheduling ships in any maritime transportation system, ship routing and scheduling problems have not attracted adequate attention of researchers in the past. The complexity of a typical ship routing and scheduling problem, and the high degree of uncertainty involved in ship operations, have tremendously contributed to the scarcity of research in this area. In contrast, vehicle routing and scheduling problems have been extensively examined in the literature Bodin *et al* (1983). In fact, the routing and scheduling of vehicles is deemed to be a major success story, mainly because of efficient modeling and implementation and the close connection between theory and practice (Assad, 1988). Unlike the airline industry, which is seriously looking forward to enhancing its operational efficiency and rationalizing its planning decisions further (Assad, 1980), the ocean shipping industry is conservative and reluctant to adopt new ideas. As a matter of fact, most of the existing quantitative models were developed in vertically integrated organizations wherein ocean shipping is only one aspect of the business (Ronen, 1983).

Water transportation is of special importance to many oil importing and exporting countries in the world, where ships mainly move oil and its related products. For the United States, for example, which is the world's largest energy consumer, seaborne petroleum imports are a necessary lifeline to the oil deposits of the Middle East, East Asia, and Latin America (Warf, 1989). Many countries, for instance the Arabian Gulf countries, own fleets of oil tankers. The daily operational cost of a typical oil tanker amounts to tens of thousands of dollars. Therefore, the efficient utilization of such a tanker becomes necessary.

In general, this paper is intended to highlight the importance of routing and scheduling of ships in any maritime transportation system. The principal thrust of the research effort is focused on the Kuwait Petroleum Corporation (KPC) oil tanker scheduling problem. This problem is of great economic significance to the state of Kuwait, which is a small country having a massive oil reserve amounting to about 77 billion barrels of recoverable oil. The amount of reserve Kuwait has is second only to Saudi Arabia, which has the largest reserve in the world. Kuwait is a major exporting member of OPEC and the Kuwaiti economy has been traditionally dominated to a large extent, by the oil sector, which provides well over 80% of Kuwait's national revenues. Kuwait Oil Tanker (KOT) owns 35 crude oil and refined product carriers, making it the largest tanker company in an OPEC country (Background Notes 1995 and the World Economic Fact book 1994,1995). Kuwait markets its products in Europe, the United States, Japan, and other countries in the world. The delivery of oil and its related products to customers is mainly undertaken by KOT, which is a branch of KPC. This study is concerned with building a systematic scheduling scheme model and algorithms for KPC that can economically enhance its existing ad-hoc manual scheduling procedure. Certainly, any improvement in the existing scheduling scheme has the potential for significant savings.

KPC Oil Tanker Scheduling Problem

In this section, some information about KPC is presented and then a precise statement of the KPC oil tanker scheduling problem is given.

KPC is an integrated oil company that enjoys international recognition in the petroleum industry. It is the top company of the Kuwaiti government's operations in the petroleum sector. KPC incorporates a number of companies: Kuwait Oil Company (KOC), Kuwait National Petroleum Company (KNPC), Petrochemical Industries Company (PIC), Kuwait Oil Tanker Company (KOT), and Kuwait Foreign Petroleum Exploration Company (KFPEC). KOC is in charge of producing oil and gas, and KNPC is in charge of refining oil and promoting domestic sales. PIC handles the production of ammonia and urea, and KOT handles the transportation of oil and its related products from Kuwait to different parts of the world. KOT owns 35 crude oil and refined carriers, making it the largest Tanker Company in the Organization of Petroleum Exporting Countries (OPEC). KFPEC is an investing company with several concessions in developing countries. KPC mainly markets its products in North America, Europe and Japan (Background Notes, 1995).

Crude oil and a number of refined oil-related products are to be shipped from three ports in Kuwait to customers located in Europe, North America and Japan. Deliveries of cargoes are undertaken either by KPC or by other shipping companies, according to contracts agreed upon by KPC and other shipping companies. A shipment not undertaken by KPC has no impact on the scheduling process of KPC's fleet of vessels, where assuring the delivery according to a specified time frame is the responsibility of the shipping company. Nevertheless, such shipments may impose some restrictions on the loading ports in Kuwait. The decision of whether to use KPC's fleet or to use another shipping company for a given product is made by KPC.

Two classes of vessels are considered. The first is the fleet of vessels controlled by KPC and the second are the vessels that are leased (time-chartered vessels). Each voyage has a single origin (loading port) and a single destination (discharging port). Each cargo is a full shipload and is characterized by its type (oil, refined products, etc.), loading port, loading date, discharging port and discharging date. Two routes are available for tankers. A tanker may be routed either through the Suez Canal, where canal dues are required, or around the Cape of Good Hope, making a much longer voyage. Some tankers (such as super tankers) cannot pass through the Suez Canal and therefore must go around the Cape of Good Hope. Furthermore, certain tankers are not permitted to enter certain ports or may be unavailable for scheduling during part of the planning horizon.

Since Kuwait is a member of OPEC, a predetermined exporting quota is assigned to it (usually 1.5 - 2.0 million barrels per day). In case this quota changes, KPC has to react accordingly to adjust for this change. If the quota increases, KPC may need to expand the existing controlled fleet or resort to time chartering. If the quota decreases, KPC may want to reduce the size of its fleet.

The problem elements of KPC are presented as follows:

The Operation

* KPC-owned vessels.
* KPC-leased vessels (time chartered vessels).
* Shipping crude oil and refined products from three ports in Kuwait to Europe, North America, Japan, and some other countries.
* Several discharging ports.
* No return cargoes.
* Shipments on a recurrent basis.

The Vessels

* Each vessel is characterized by its size (capacity), speed, and the capability to carry different types of cargo.
* Super tankers and some fully loaded vessels (not necessarily super tankers) cannot pass through the Suez Canal.
* Dues incurred on vessels passing through the Suez Canal.
* A vessel may not be available during part of the planning horizon.

The Ports

* Three loading ports in Kuwait.
* Discharging duration for each port.
* Port dues.
* Port restrictions.

The Shipments

* A shipment may consist of crude oil or refined oil-related products.
* Each shipment is a full shipload.
* A shipment is characterized by its type (crude oil or other oil related products), revenue, size, origin (loading port), destination (discharging port), loading date, and discharge date.

The Costs

* Daily cost of controlled vessels (KPC-owned vessels and time chartered vessels).
* Bunker fuel.
* Auxiliary systems fuel.
* Port entry charges and Canal dues.

According to the above problem description an integer programming model is introduced in the next section to tackle the KPC's fleet scheduling problem.

Model Construction

Introduction

Ship scheduling problems have attracted moderate attention in the published literature. Ronen (1983, 1993) provides a comprehensive review of ship routing and scheduling problems and models. These papers also highlights the difficulties associated with ship routing problems that have resulted in the noticeable scarcity of research in this area. The KPC problem presented above has similarities to the problem investigated by Brown *et al* (1987). They investigated a crude oil tanker-scheduling problem faced by a major oil company to ship crude oil from the Middle East to Europe and North America. They generated the complete set of feasible schedules in a column generation framework, along with the schedules' costs, and modeled the problem as an elastic set-partitioning problem. The KPC model developed in this paper differs from the model of Brown *et al*, (1987) in that it incorporates the processes of constructing and selecting feasible schedules within the model itself rather than separately generating the schedules. Furthermore, we consider two classes of vessels. The company-owned vessels and the vessels that are available for time chartering. Accordingly, the model formulated in this paper is designed to be utilized for the routing and scheduling of vessels as well as for providing KPC with insightful information as to the number and types of vessels to be chartered in order to satisfy the overall demand.

Ships of various characteristics (either owned by KPC or available for chartering) are considered in the operation. These characteristics include ship capacity, ship speed, capability of a ship to carry certain products, applicability of a ship to traverse a certain route, etc. Accordingly, we partition ships into different classes based on these characteristics, and hence ships that belong to the same class are assumed to have identical characteristics. We further assume that ships of the same class have identical operating costs and chartering expenses (if any). It is also assumed that a vessel can carry at most one product at a given leg. Speed of ships of the same type is fixed and hence ships of the same type assigned to the same route should operate at the same speed. Times in ports per voyage on a given route are the same for all ships of the same type. Delays caused by waiting and sailing in canals and restricted waters in general are also the same for all the ships of the same type. Consequently, total voyage time is identical for ships of the same type in a given route.

Next we will give a list of notation that has been used in the developed mathematical model in the following section.

$d = 1,..,D$: destination (port), where D represents the total number of destinations.

$p = 1,..,P$: product, where P represents the total number of products to be considered in the problem.

H = time horizon considered in the problem.

$r = 1,..,4$: the available routes from Kuwait to customers. These routes are given as follows:

$r = 1$: Kuwait → Suez Canal → Destination → Suez Canal → Kuwait

$r = 2$: Kuwait → Cape of Good Hope → Destination → Suez Canal → Kuwait

r = 3: Kuwait → Suez Canal → Destination → Cape of Good Hope → Kuwait

r = 4: Kuwait → Cape of Good Hope → Destination → Cape of Good Hope → Kuwait

t = vessel type, where T represent the total number of vessel types.

Q_t = number of company-owned vessels of type t.

CT_t = number of vessels of type t that are available for chartering. Note, the practitioner will determine the available CT_t.

MT_t = the required maintenance time for a ship of type t. We assume that this maintenance time is known a priori.

$L_{t,s,d,p,r}$ = a leg representing a ship s of type t carrying product p to destination d by traversing route r.

$t_{t,d,p,r}$ = the time required to complete the leg $L_{t,s,d,p,r}$ It is assumed that time incorporated the loading time in Kuwait, the time required to traverse route r, and the unloading time at destination d.

$C_{t,d,p,r}$ = the cost associated with the $L_{t,s,d,p,r}$ (i.e., ships of the same type have identical operational costs). The operational costs of a given leg (for both the company-owned and the chartered vessels) includes the following:

a) daily running cost.

b) fuel costs (propulsion fuel, generator fuel), auxiliary system fuel, and bunker fuel.

c) port charges and canal fees.

$\$_{t,s}$ = chartering expenses of a ship s of type t. (i.e., all ships of the same type have identical chartering costs).

$D_{d,p}$ = the total demand of product p at destination d.

N_t = total number of ships of type t (Q_t + CT_t).

Ω_t = Ship capacity of type t.

$\lambda^+_{d,p}$ = the allowable over-supply percentage of the product p at destination d.

$\lambda^-_{d,p}$ = the allowable under-supply percentage of the product p at destination d.

Problem Formulation

As discussed earlier, the controlled fleet is composed of two classes of vessels: company-owned vessels and chartered vessels. Our main objective is to satisfy overall demands of various products at minimal cost. Since vessels are chartered for millions of US dollars, it is more lucrative to maximally utilize the company-owned vessels (i.e., to satisfy as much demand as possible by the company-owned vessels at minimum cost), and then, we need to efficiently decide on the number and types of vessels to be chartered. Therefore, one optimization problem is considered for ocean transport petroleum (OTP) consisting of : (i) the company-owned vessels problem; and (ii) the Leased (chartered) vessels problem. The OTP deals with the maximal utilization of company-owned vessels. Usually demands can not be satisfied using only company-owned vessels, hence the company must resort to chartering to satisfy the demands that are not met by the company-owned vessels.

Let us consider $X_{t,s,d,p,r}$ be integer variable representing the total number of legs of the type $L_{t,s,d,p,r}$ for the company-owned vessels and the chartered vessels, respectively.

Let $Z_{t,s}$ be an integer variable representing the chartered ship s of type t. Note that this variable is bounded above by the total number of ships of type t that are available for chartering which is given by CT_t.

We now present problems OTP as follows:

OTP:

Minimize $\sum_{t=1}^{T} \sum_{s=1}^{N_t} \sum_{d=1}^{D} \sum_{p=1}^{P} \sum_{r=1}^{4} C_{t,d,p,r} X_{t,s,d,p,r} + \sum_{t=1}^{T} \sum_{s=1}^{N_t} \$_{t,s} Z_{t,s}$

Subject to

$$(C_1) \quad \sum_{t=1}^{T} \sum_{t=1}^{T} \sum_{t=1}^{T} t_{\bar{t},d,p,r} X_{\bar{t},\bar{s},d,p,r} \leq (H - MT_t) Z_{\bar{t},\bar{s}}$$

$$\text{for } \bar{t} = 1, .., T \text{ and } \bar{s} = 1, .., N_t$$

$$\forall Z_{t,s} = 1 \text{ if } Z_{t,s} \in \{1, ..., Q_t\}$$

$$\forall Z_{t,s} \in \{0, 1\} \text{ if } Z_{t,s} \in \{Q_{t+1,...,}N_t\}$$

$$(C_2) \quad \sum_{t=1}^{T} \sum_{s=1}^{O_t} \sum_{r=1}^{4} \Omega_1 X_{t,s,\bar{d},\bar{p},r} \leq D_{\bar{d},\bar{p}} \lambda^{+}_{d,p} \quad \text{for } \bar{d} = 1, .., D \text{ and } \bar{p} = 1, .., P$$

$$(C_3) \quad \sum_{t=1}^{T} \sum_{s=1}^{O_t} \sum_{r=1}^{4} \Omega_t X_{t,s,\bar{d},\bar{p},r} \geq D_{\bar{d},\bar{p}} \lambda^{-}_{d,p} \quad \text{for } \bar{d} = 1, .., D \text{ and } \bar{p} = 1, .., P$$

$$X_{t,s,d,p,r} \in \{0, 1\}$$

The objective function of problem OTP is composed of two terms. The first term gives the total operational costs of all selected legs for the company-owned ships. The second term of the objective function along with constraint (C1) reflects the desirability of maximal utilization of the company-owned vessels and minimum usage's of charted vessels. This is accomplished by satisfying as much demands of various products as possible via the company-owned vessels. For all $\$_{t,s} \in \{1, ..., Q_t\}$ are set to a low value where $\$_{t,s} \in \{Q_{t+1}, ..., N_t\}$ are set to a high value. Constraints (C2) and (C3) insures that the total demand of product p at destination d is satisfied. However, the dynamic nature of the problem and the desire to utilize the total ship capacity allows some percentage ($\lambda^{+}_{d,p}$ and $\lambda^{-}_{d,p}$) flexibility in over or under supply of product p at destination d , therefore, constraint (C_2) and (C_3) are multiplied by the percentage allowable change.

The term (H-MT_t) in constraint (C_1) gives the total availability of a company-owned ship of type t in terms of days. In other words, the total time usage of a company-owned ship of type t cannot exceed (H-MT_t) days during the time horizon H. Accordingly, constraint (C_1) assures that the total time required to complete all selected legs of a company-owned ship of type t does not exceed the maximum time availability (H-MT_t), and also a maximum utilization of chartered vessels at minimum number. The practical usage's of the model solution will be discussed next.

Use of the Model as a Planning Tools

A model solution can be used to analyze any aspect of the shipping operation. The general method is to rerun the model with different values for the various parameters. In this fashion, the computer model simulates the behavior of the fleet and indicates the various direct and indirect effects of alternative policies to the users. Experiments can be made before the planning horizon, or analyses of revised situations can be made during the planning horizon. The following are some examples of these uses:

i) Straightforward running of the model OTP can be used to help determine the best route and carrying product of the company vessels, and the number of vessels of each type needed for the planning horizon respectively.

ii) The model is useful in determining the effects of unexpected occurrences such as accident, unusual weather conditions and port delays. Policies can be established for compensating for these occurrences. For example, the lying up or delays of a vessel is simulated by changing its availability (MT_t) during that period of the planning horizon.

iii) Determine the size of the ship to be chartered and the degree of its utilization in certain routes.

vi) The effect of buying or selling a vessel can be determined. Estimates for essential characteristics of the new vessels or charted ones to replace the sold one, such as carrying capacity and speed can be used to establish the coefficient values of $X_{t,s,d,p,r}$. The model can then be run with the inclusion of the projected vessels and the resulting patterns can be observed.

v) The effects of making improvements to the company owned vessels could be evaluated. These improvements must be quantified in terms of the numerical value of the Lt,s,d,p,r 's, and the model can be rerun with the projected values.

Solution Approach

To test the model capability we generated a small problem of two ship types and two ships of each type. Type I and II has a capacity of 300,000 and 400,000 tons respectively. Assume KPC produces 2 products and uses two routes for its two customers. The number of ships of each type available for hiring is two. The table below represents the customer order per product and traveling time from source to customer.

	Product 1 (Tons)	*Product 2 (Tons)*	*Route 1 (Days)*	*Route 2 (Days)*
Customer 1	1300000	600000	2	3
Customer 2	800000	700000	4	5

The total variables and constraints in the above problem is 32 and 12 respectively. The percentage gab between the lower bound and the integer solution was less than 2%. Therefore the above formulation generates a tight lower bound which will reduce the search time for the integer solution by any commercial package.

In all computer runs of the above model, the solutions have been sensitive to the ship specifications. The larger and faster vessels are most selected by the model. This was true in spite of the fact that a significant number of ports have limited docking facilities for larger vessels to enter. It is conceivable that when certain vessels are more efficient than other vessels for particular routes, but less efficient for other routes, also the quantity of the product requirement at destination plays a significant role in the route. Therefore, the slack (surplus) may exist in more than one vessel. In that case, one may attempt to determine the effect of prohibiting the use of specific vessels, or adjust the demand as a multiple of ship capacity. A computationally efficient method of doing this is to rerun the model with appropriate right-hand sides and variable coefficients of constraint C_2 and C_3.

If, as is frequently the case, several vessels are essentially identical in speed, capacity, and so on, then these boats can be thought of as simply one boat equal to the total of its capacity. This decreases the necessary data preparation and computer time.

The solution generated from the model can be rounded to obtain an integer solution, this heuristic approach requires less computational effort and generates a near optimal solution. Due to the complexity of the problem, the heuristic algorithm is not straightforward. Since all the shipments must be assigned, and all ports must be visited, therefore, the rounded variables need to be checked for feasibility. If one of the constraints is violated by the rounded integer solution, a balance between ship capacity and demand is implemented to meet the restriction. This balance procedure needs to be introduced carefully and not deviate much from the original constraint. Another procedure is to absorb the imbalance in the equation by the slack variable, and then a set of slack variables is grouped as a full shipload.

An optimal solution can be obtained by an exact solution procedure. Since ships may have differing capacities and the number of vessels entering discharging ports is not known in advance, and, therefore, most tools used for the vehicle routing problem are not applicable to this problem context. The structure of the problem provides the key to the optimal solution. Full enumeration of all schedules is not necessary since some ships, products and ports can not be combined. Furthermore, the generalized transportation problem will solve a small size problem using a branch and bound method. The problem could be simplified further if the demand constraints are relaxed in a lagrangean fashion. The relaxed problem will be solved as a generalized assignment problem, which requires less computational effort to compute the sub-problem using a branch and bound method.

The solution techniques, which have been presented above, demonstrated many profound advantages for analysis. For one thing, it provides a systematic framework in which a very large number of details can be accommodated. For example, the effect of the demand structure constraints on ship loads were easily handled within the linear programming input data. The system also keeps track of all the various voyages and ports calls that are involved. Even if it were only a bookkeeping device, the program would be very useful. The important thing, however, is that it permitted us to view the problem from a system basis. Thus ships were optimized, not with respect to a few specific voyages or ports, but rather as part of the overall system of ships, ports, voyages and product flows. Finally, the sensitivity analysis is able to explore the variations by uncertainties that have to be considered when dealing with future time periods.

Concluding Remarks

We have reviewed the relevant work on sea transportation and briefly described the practical background of this topic. Our objectives and assumptions for the present research have been presented. A model for the optimization of the deployment of oil tankers composed of both owned and chartered vessels has been developed.

Few authors have realized the importance of the medium term ship scheduling problem, and this study is a comprehensive effort to address the problem while taking into account many realistic aspects of the problem that have not be treated in earlier research. Even a slight modification to the existing scheduling will result in large savings.

Various elements can be combined for the solution of the problem. Loss of ships' time due to port congestion can be included in the cost of port entrance and thus accounted for. The cost function incorporates demurrage charges for the ships that are not used as well as the cost of unloading time of the ships that are used. Thus, scheduling decisions may be made on the basis of all fleet related costs and not only sailing costs.

The algorithms used in this research can be used in the practical situation and are easily modified to provide several good schedules to suit the needs of the planner. Data requirements for solving the problem are moderate and should be available within the shipping organization.

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الملخص

نموذج رياضي لإدارة ناقلات النفط
باستخدام أساليب النقل والجدولة

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يتناول موضوع البحث استخدام النماذج الرياضية لإدارة ناقلات النفط وجدولة الناقلات لنقل النفط ومواده المشتقة من الدول المصدرة إلى العملاء. ولتلبية الطلب على مواد النفط الخام ومشتقاته تلجأ الدول المصدرة إلى استخدام الناقلات كوسيلة لنقل المنتج، وهذه الناقلات إما أن تكون مملوكة أو مستأجرة للشركة. ومن هذا المنطلق أصبحت عملية الجدولة بين الملكية والاستئجار لنقل المنتج عملية شاقة ومعقدة وذات تكلفة عالية. ومن ثم أصبح استخدام النموذج الرياضي المقترح في هذه الدراسة أمر ضروري لتخفيض تكاليف النقل والتخطيط المستقبلي. إضافة إلى ذلك يزود النمؤذج لمتخذي القرار أداة لمعرفة الأيام المثلى لتفريغ الشحنة ووسيلة معرفة الطرق المتعددة للنقل والجدولة.

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مجلة دراسات الخليج والجزيرة العربية

مجلة فصلية محكمة

تصدر عن جامعة الكويت ـ مجلس النشر العلمي

رئيس التحرير :

أ.د. أمل يوسف العذبي الصباح

مجلة علمية فصلية محكمة تصدر أربعة أعداد في السنة ، بالإضافة إلى اصدارات خاصة في المناسبات .

- صدر العدد الأول منها في يناير ١٩٧٥ .
- تعنى المجلة بنشر :

ـ البحوث والدراسات المتعلقة بشئون منطقة الخليج والجزيرة العربية السياسية والاقتصادية والاجتماعية والثقافية والعلمية .... الخ .

- مراجعات الكتب العربية والأجنبية المهتمة بمنطقة الخليج والجزيرة العربية .

ـ تقارير عن أهم الندوات التي تعقد في داخل الكويت وخارجها بالإضافة إلى البيبلوجرافيا بالعربية والانجليزية .

- صدر عن المجلة :

أ ـ مجموعة من المنشورات المتخصصة .

ب ـ مجموعة من الاصدارات الخاصة المتعلقة بمنطقة الخليج والجزيرة العربية .

ج ـ سلسلة كتب وثائق الخليج والجزيرة العربية من ١٩٧٥ ـ ١٩٨٢ .

د ـ عقد الندوات التي تهم المنطقة أو المساهمة فيها واصدارها في كتب .

الاشتراك السنوي :

أ ـ داخل الكويت : ٣ د.ك للأفراد ـ ١٥ د.ك للمؤسسات .

ب ـ الدول العربية : ٤ د.ك للأفراد ـ ١٥ د.ك للمؤسسات .

ج ـ الدول الأجنبية : ١٥ دولار للأفراد ـ ٦٠ دولار للمؤسسات .

المقـــر :

جامعة الكويت ـ الشويخ

مبنى مجلس النشر العلمي

هاتف ٤٨٣٣٧٠٥

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بدالة : ٤٨٤٦٨٤٣ / ٤٠٦٦

٤٨٤١٥٣٨ / ٤٠٦٧

فاكس : ٤٨٣٣٧٠٤

جميع المراسلات توجه باسم رئيس التحرير على العنوان الآتي :

ص.ب : ١٣٠٧٣ ـ الخالدية ـ الكويت ـ الرمز البريدي ٧٢٤٥١