The economic feasibility and future benefits of the Kra Canal project

by Peter Rush

The following economic feasibility study of a canal through the Isthmus of Kra in southern Thailand is an updated and abridged version of a study presented to a seminar on "The Economic Feasibility of the Kra Canal," conducted by the Fusion Energy Foundation and Executive Intelligence Review *in Bangkok on March 19, 1984.*

While the justification for building the Kra Canal goes beyond mere financial considerations, it is expected that the canal will more than pay for itself within 10-20 years of its completion under the more favorable options, or in up to 30 or 35 years under less favorable circumstances of total cost and higher interest charges. Compared to projects of comparable relative cost and magnitude during the past century, this payback period is quite modest, even if it is longer than the customary term of commercial bank loans today. The estimates of the financial feasibility of the canal are derived from three principal groups of parameters:

1) estimates of the excavation and construction costs;

2) estimates of the financing costs at various rates of interest;

3) estimates of the expected level of trade, and the level of canal revenues that can be generated from this trade.

Based on several alternative sets of estimates for different sized canals and different interest rates, financial breakeven conditions and dates were calculated. For this study, only direct canal revenues were included, even though revenues from the associated harbor and industrial projects will provide additional revenues applicable against amortization of the accumulated debt incurred in construction of the canal. The calculations show that for the more expensive options, the revenues in the first few years after construction will be below the interest charges on the debt. Therefore, we calculated both the point at which toll revenues "catch up" to interest payments, as well as the point at which the entire debt will be paid off.

The excavation and construction costs of the canal are taken from the "Preliminary Survey Report on the Kra Canal Complex" prepared in September 1973 by the Tippetts-Abbett-McCarthy-Stratton (TAMS) Consulting Engineers firm of New York and the Robert R. Nathan Associates, Inc. Consulting Economists firm of Washington, D.C., and including contributions by the Hudson Institute of Croton, New York and the Lawrence Livermore Labs of Berkeley, California. The total construction costs of the canal in the TAMS study were put in 1984 constant dollars by multiplying the mid-1973 costs by the rate of inflation indicated by the U.S. Bureau of Reclamation canal and channel construction index, and adjusting this to allow for inflation and breakthroughs in construction technology. The adjusted 1984 constant dollar costs for the canal, which will be built to accommodate ships with 500,000, 300,000 or 250,000 ton deadweight ton capacity are shown in **Table 1.**

Table 1
What different sizes of canals will cost to construct

Canal size (dwt)	Canal type (lanes)	Method of Construct.	Original Cost* (bn US$ 1973)	Cost** (bn US$ 1984)
500,000	2	convent.	11.12	22.48
	2	nuclear	6.22	12.57
	1	convent.	5.65	11.42
	1	nuclear	3.54	7.16
300,000	2	convent.	8.90***	17.99
	2	nuclear	4.80***	9.70
	1	convent.	4.55***	9.20
	1	nuclear	2.89***	5.84
250,000	2	convent.	8.35	16.88
	2	nuclear	4.45	9.00
	1	convent.	4.27	8.63
	1	nuclear	2.73	5.52

* From the TAMS study.
** The TAMS figures multiplied by 2.246 and .9.
***Interpolated from 250,000 and 500,000 ton canal costs.

Financing of the canal is expected to come from four principal sources: the so-called multilateral lending agencies such as the World Bank and the Asian development Bank; the export-import banks of the developed countries whose firms will participate in the construction; the commercial banks; and interested governments, including the United States and Japan, and Thailand itself.

In terms of the multilateral banks, Thailand does not qualify for preferential loans that "fourth world" poorest countries do, and hence is subject to a strict quota, so it is not expected that more than a small proportion of the financing will come from this source. The primary government funding source is expected to the respective export-import banks of the United States, Europe, Japan, and countries such as Korea which will extend loans at relatively favorable terms to finance all or most of the foreign exchange portion of construction contracts to firms of the respective countries. Based on whatever portion of the total construction costs these two classes of loans will cover, the commercial banks will be invited to finance the remainder of the costs. It is anticipated that the commercial bank portion will be 50% or less. However, as commercial bank loans today average in the seven-to-eight-year range, with occasional longer terms, the structure of the total financing package will establish the commercial loans as the first ones to be repaid, with the export-import and multilateral bank loans to be paid only afterward, as these loans can be made on a much longer-term basis.

It is expected as well that the United States and Japan will wish to make a $1 billion contribution each to the Canal Authority, either as a straight grant or as an interest-free loan, not to be repaid until all other obligations are discharged. To Japan, the value of the canal will be immediate in economic terms; to the United States, it represents the strategic value of securing the long-term economic growth and stability of the Southeast Asian region and the optimal way of preventing Soviet subversion of the region. It is also possible that the Thai government will participate, up to the $1 billion level, perhaps in the form of 8-12 annual payments of $85 million to $125 million. Such participation may or may not be possible or desirable.

The financing of the canal project will employ a tiering process of loans, as is common practice with such development projects. The initial loans will not be disbursed all at once, but only as needed. Plus, the first years of the project, that is, the construction phase, will be concomitant with a grace period on both the principal and interest of the loans, in which period the interest will be capitalized. Repayment of the principal plus the capitalized interest will start with the first year of the canal's operation, paid out of the tolls charged, net of operating expenses.

The prevailing interest rate is the dominant parameter affecting the overall cost and time of repayment of the total loan package. For purposes of this study, several different interest-rate levels were explored.

Trade patterns and projections

In order to project likely revenues realizable from operation of the canal, a picture of the recent past trade patterns through the Straits of Malacca was required, as a basis for projecting likely patterns in the future. An effort to measure this had been made by Robert Nathan Associates for the original study referred to above for the early 1970s, but trade patterns have changed so much that no simple scaling of their figures could be employed to update their results. In particular, their figures for the petroleum trade were calculated before the 1973 oil crisis. On the other side, the growth of manufactured exports by Japan, Korea, and Taiwan has increased the general cargo trade way beyond the pre-1973 calculations.

Consequently, United Nations figures were used to compare volume (in tons) of cargo transported through the Straits in 1970 and 1980. The results appear in **Table 2.**

Since 1980, petroleum imports have actually fallen, while manufactured exports have continued to grow, although somewhat more slowly than previously. Our estimates, assuming a period of general economic recovery, project that total petroleum trade in 1985 would be 255 million tons, 200 million to Japan and 55 million tons to other importers. Bulk cargoes were estimated at 90 million tons, including 25 mil-

Table 2
Asian trade volume has grown utilizing the Straits of Malacca,* 1970-1980
(million tons)

	1970	1980	Annual % Change
Eastbound trade:			
Total	263.9	342.5	2.6%
Petroleum	217.5	284.5	2.7%
Bulk cargo	40.5	50.6	2.2%
General cargo	6.0	8.0	2.9%
Westbound trade:			
Total	19.2	62.4	12.3%
Bulk cargo	11.5	29.7	9.9%
General cargo	7.7	31.7	15.1%
Two-way trade:			
Total	283.0	403.9	3.6%
Bulk cargo	52.1	80.4	4.4%
General cargo	13.7	39.7	11.2%

*The available figures utilized for this table showed trade to and from the major seacoasts of the world which permitted a relatively accurate assessment of which trade must have utilized the Straits of Malacca. In the unfortunate absence of any direct figures on trade or ship traffic through the Straits, such indirect measures as the one used provide the only basis for estimating this traffic.

Source: *Maritime Transport Study, Commodity Trade (By Sea) Statistics*, 1970 and 1980, Statistical Papers, Series D, Statistical Office of the United Nations lion tons of iron ore exported by India to Japan. General cargoes were assumed to have risen to 50 million tons.

We show these figures only from 2000 on because the canal itself would not be ready until the late 1990s or early 2000s. It was assumed that all petroleum and bulk cargoes will use the canal, as they will have no reason to prefer Singapore and the Straits, while 70% of the general cargo will prefer the canal, the remaining 30% using Singapore as their primary port of call. This 70% was increased by 1% yearly to 90% by 2020. This scenario envisions therefore a slower, but continued growth for Singapore, as well as a rapid growth through the canal.

Revenue calculations

Calculations of expected revenues were based on the estimated cost savings to ships not having to use the Straits of Malacca. According to the figures in the TAMS study, the canal will save at least one full day of steaming time for ships now using the Straits of Malacca (two days for Bangkok, somewhat more than one day for Indochina). Average ship operating costs were converted to estimates of cost per day per ton carried, from which total revenues were figured using the tonnage figures in **Table 3**. It was also assumed that profit of 20% was also realizable. Seventy-five percent of the resulting cost plus profit saved/earned was assumed to be the toll chargeable by the canal.

During the 1970s, a series of serious accidents resulting in oil spills occurred in the Straits of Malacca. While subsequent safety measures have reduced the incidence of accidents, the growth of trade envisioned in this study is likely to bring congestion in the Straits to a serious level by 2000. At that point, it is expected that the larger tankers will be required to use the much longer route through the Straits of Sunda or Lombok. The Sunda Straits add at least one more day to the travel time through Malacca, and Lombok almost two. It was therefore assumed that for tankers, a savings of two days could be assumed as the basis for a toll structure.

The average price of several sizes and types of ships, as compiled by the U.S Maritime Administration, was used to estimate the per ton costs of one day saved at sea, as presented in **Table 4**.

Revenues from the canal were calculated to be about $275 million in constant 1984 dollars in 1997, the earlier date the canal might open, $335 million in 2000, $461 million in 2005, $650 million in 2010, $1,390 million in 2020 and $2,730 million in 2030.

While only direct canal tolls were included in this study, it should be pointed out that other sources of revenue will augment the total funds countable against amortization requirements. The port to be developed at Songkla, on the eastern terminus of the canal, which will not only provide all the obvious services of bunkering, ship repair, etc., and serve as a transshipment point for the entire region, but which will be the gateway to a major industrial complex, will generate revenues net of its own operating and amortization costs, the excess reverting to the Canal Authority. And the industrial complex itself will generate revenues, in the form of rents and leases for the land, which will also be paid to the Canal Authority.

A review of **Table 1** shows that the options considered fall into roughly five price ranges. The most expensive canal is the two-lane conventional 500,000 dwt capacity option, at over $20 billion. The next is the two-lane conventional 300,000 and 250,000 dwt option, about $4 billion cheaper in the $17-18 billion range. Third is the 500,000 dwt two-lane nuclear and one-lane conventional option, at around $12 billion. Fourth is the 300,000 and 250,000 dwt two-lane nuclear and one-lane conventional options, and the 500,000 dwt one-lane nuclear alternative, in the $7-10 billion range, and the cheapest are the 300,000 and 250,000 dwt one-lane

Table 3
Trade through Kra Canal projected 2000-2020
(million tons)

	Petroleum		Bulk	General	
	To Japan	To Others	Commod.	Cargo	Total
2000	360	200	135	144	839
2005	418	294	172	249	1,133
2010	499	432	220	428	1,579
2015	561	635	281	733	2,210
2020	651	934	359	1,250	3,194

Source: own elaboration: Japan's oil imports are assumed to rise at 3% per annum, and other countries' at 8%, bulk shipments through the Canal are expected to rise at 5%, and general cargo shipments at 10%.

Table 4
Daily ship operating costs at sea, 1983

	Tonnage	Daily operating cost
Medium-sized tanker	85,000 dwt*	$25,727
Large-sized tanker	265,000 dwt	$49,751
Small bulk carrier	25,000 dwt	$12,482
Large bulk carrier	50,000 dwt	$21,726
Small containership	12,000 dwt	$15,296
Large containership	42,000 dwt	$32,990

*dead weight tons

Source: U.S. Maritime Administration, Office of Ship Operating Costs, memorandum on ship operating costs.

nuclear construction options which cost $5-6 billion.

The one-lane alternatives were not considered attractive because, while much smaller at present, the east to west general cargo trade is the most dynamic, and is expected to continue to be so for the indefinite future. Since a one-lane canal would necessarily go from west to east to accommodate the oil traffic, the added cost of the two-lane options would more than pay for itself over time by the added traffic of this east to west general cargo. Also, the original 500,000 dwt alternatives were considered by TAMS at a time when tankers in the 400,000-500,000 range were foreseen as the wave of the future. Now, only one in that range is still operating, and 300,000 tons is the effective limit. Therefore, the 500,000 dwt size now seems unnecessary, and therefore incurring the added costs will serve no revenue function. The 300,000 option was added to the TAMS options to ensure capturing all of the tanker traffic. The alternatives examined in some detail were therefore the two-lane alternatives in the two smaller sizes.

For the more expensive of these options, the conventional construction, a period of 30 years was calculated for "payback," that is, the date at which revenues would complete paying off the entire principal accumulated in construction and subsequent capitalization of other costs, at a 2.5% rate of interest, assuming 1984 constant dollars. It would take seven years for canal revenues to catch up to interest payments (that is, at a "breakeven" point at which total outstanding debt would stop rising). At 1.5% interest, the canal would "break even" immediately, and reach payback in 26-27 years. For the nuclear construction alternatives, "breakeven" is also reached immediately, but payback occurs in 23 years with 2.5% interest, and in 20 years with 1.5%.

Wider benefits of the canal

A report attached to the original TAMS study prepared by the late Dr. Willard Libby of the Lawrence Livermore Laboratory makes clear the benefits of building an industrial park in the zone on either side of the Kra Canal. At minimum, the region of the Kra Canal Zone should be provided the following facilities:

1) A major deep-water offshore harbor and port facility, most likely on the Pacific side at Songkla, with the possibility for a second port on the Indian Ocean side sometime in the next century as needed;

2) Berthing, loading, unloading, repair, and transshipment facilities for all sized ships, including for the 300,000 dwt tankers and the new 50,000 to 100,000 ton container and bulk ships;

3) Protected "inner" harbors through use of dikes, breakwaters, reclaimed land for container ships, mixed cargo, barges, and specialized vessels;

4) Secondary, tertiary, and quaternary canals for industrial sites

Dravo Corporation

Pipes for water intake at a nuclear power project in the Philippines. The Kra Canal will boost Thailand's nuclear industry.

from the primary canal to facilitate efficient interface of the industrial complexes with the ships passing to and through the canal;

5) Piping and pumping systems for crude petroleum and for petroleum products from ships to refinery and back for export, as well as from refinery north and south to Thailand and Malaysia, respectively;

6) Construction of a major oil refinery center on the model of Rotterdam and Singapore;

7) Large compartmentalized concrete reservoirs as an integral part of offshore facilities, serving possibly as the foundation
location for all piping systems;

8) Nuclear-explosion-created deep underground storage cavities of from 1-5 million cubic meters for storage of petroleum, toxic effluents, and wastes from shore industries;

9) Large (1,000-megawatt-size) nuclear power facilities for pumping stations and to provide cheap industrial power to shore facilities. The nuclear power facilities could use the surrounding waters as a heat sink or coolant;

10) The development of heavy industries such as steel and other metals, to utilize the cost benefits of cheap water transport of the large bulk cargoes to and from the factories;

11) An industrial park, including food processing, metallurgy, machine-tool making, machinery-making, etc.;

12) Construction of new towns and cities, rail spurs, hotels, airports, residential areas, commercial facilities, water taxis, etc. By 2020, this zone could support a population of 3-5 million citizens, double the present population of Singapore.