Panama Canal Commission Long Term Transportation Forecast

Comisión del Canal de Panamá Pronóstico del Transporte a Largo Plazo

ICF Kaiser International Inc.

18 de agosto de 1997

Resumen Ejecutivo

Panama Canal Commission
Long Term Transportation Forecast

Prepared for:

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EXECUTIVE SUMMARY

The Panama Canal Commission (PCC) selected ICF Kaiser International (ICF Kaiser) to carry out a long term projection of cargo flows through the Canal, an analysis of the types and sizes of the vessels that will likely carry the cargo, the number of Canal transits implied by the projected growth in trade volumes, and the implications for Canal capacity expansion. ICF Kaiser has been involved in Canal cargo projections over the last year, and the individuals who carried out this work have been involved in various aspects of Canal cargo forecasting for the last ten years.

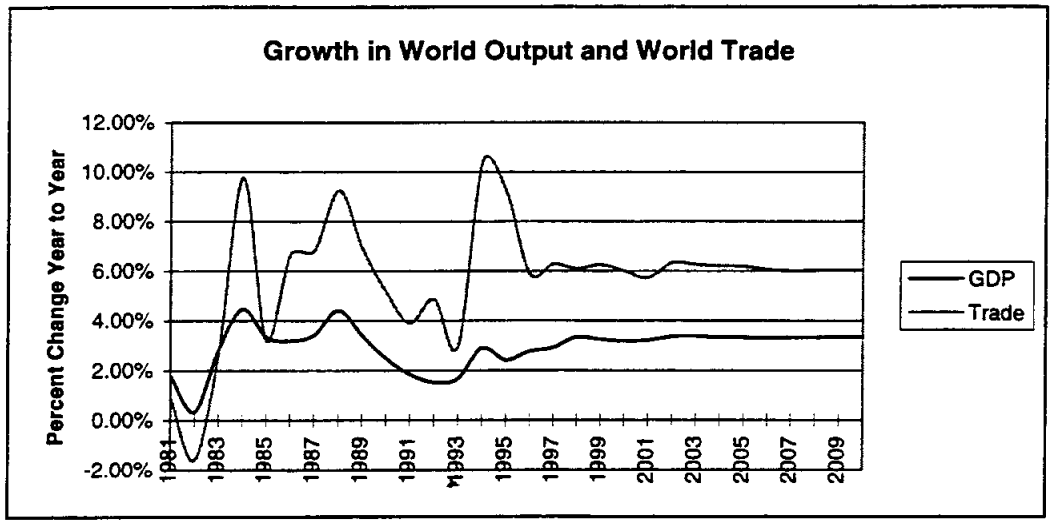
MACROECONOMIC AND TRADE OUTLOOK

The macroeconomic outlook for the world's industrialized and developing nations drives international trade. In turn, the international trade outlook drives the forecast of Canal cargo volumes and transits, coupled with other factors that are detailed in the report.

Through the 1980s and 1990s, worldwide growth in output and GDP has averaged between 3% and 4%. Trade in manufactured products grew at a rate of between 6% and 7.5% (1980 through 1995). This relationship of trade to real GDP growth is due to the impact of a steady decline in barriers to entry and gradual acceptance of American views on free and open access to markets, which promotes more rapid economic growth.

International trade generally grows faster than real economic output, as shown in the chart below.

Chart ES-1: Growth in World Output and World Trade



This relationship of trade to real GDP is assumed to hold throughout the forecast period. As in this chart, real GDP growth will stabilize in the forecast shown here, and, at the same time, total international trade will also stabilize. While rolling recessions in more advanced nations and in Latin America have led to extreme volatility in trade growth along major trade lanes in the past, a more stable macroeconomic climate in the latter part of the 1990's should lead to a more stable and predictable growth in total world trade and along major world trade lanes. The reasons why international trade should, at least over the next several years, remain strong and grow at a more steady rate along major trade lanes, include the following:

- Recoveries underway in Europe and Japan
- Relatively strong growth in most of the emerging markets of Asia and Latin America
- Fewer tariffs and other barriers to trade
- The internationalization of world production.

Liner trade is expected to grow even faster than total world trade, as has been the case historically. Overall, world trade in containerized cargo has averaged 6 percent per year historically, and, as shown in the table below, the growth in total TEUs trade has been even faster, as containerization penetration continues to occur in fast-growing markets.

Table ES-1: Growth in World Trade in TEUs

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Pacific-North America	5.4%	4.7%	1.9%	9.3%	5.5%	6.0%	5.4%	5.2%	5.6%	5.8%
Asia-Latin America	19.5%	13.3%	8.3%	22.1%	8.3%	9.0%	9.0%	8.3%	8.3%	8.3%
North Atlantic	-3.4%	1.4%	0.0%	17.8%	6.5%	5.1%	5.3%	5.3%	4.4%	4.6%
Europe-Latin America	10.4%	10.8%	8.4%	16.8%	6.9%	7.0%	7.6%	7.1%	7.1%	7.3%
Europe-Asia Pacific	9.5%	5.5%	13.0%	5.5%	9.5%	6.8%	6.6%	6.4%	7.0%	7.3%
North America-Latin America	8.3%	5.2%	6.8%	10.7%	10.3%	5.8%	6.6%	6.2%	6.1%	6.6%
Intra-Asia Pacific	17.2%	12.7%	9.2%	14.8%	10.6%	8.5%	9.0%	8.8%	9.0%	9.0%
Intra-Latin America	19.8%	28.9%	19.2%	16.0%	9.8%	9.4%	10.9%	9.7%	9.0%	9.2%
Total by Major Routes	**8.6%**	**7.4%**	**6.8%**	**11.9%**	**8.3%**	**6.9%**	**7.1%**	**6.8%**	**7.0%**	**7.2%**

There are a number of strong reasons why containerized trade is expected to continue to grow faster than total world trade in the forecast:

- Containerized trade has remained relatively robust despite the difficulties experienced over the first part of this decade in some of the key trading nations.
- Containerized cargo is likely to continue to grow in importance in value and volume terms. As more countries adopt open markets, increased

specialization into higher value products is encouraged. The increased competition for market share promotes increased international exchange.

- International trade in manufactures, which tend to be containerized, appears to be less sensitive to economic downturns than more traditional trade. With few alternatives and with the continued substitution of foreign for domestic production, there was only a limited decline in imports of containerized cargoes into both Europe and Japan despite economic stagnation in these economies in the mid-1990's.

For dry bulk and tanker trades throughout the world, the forecast calls for continued steady growth but at a rate that is less than for liner trades. This is shown in the following table.

Table ES-2: World Growth in Dry Bulk and Tanker Trade

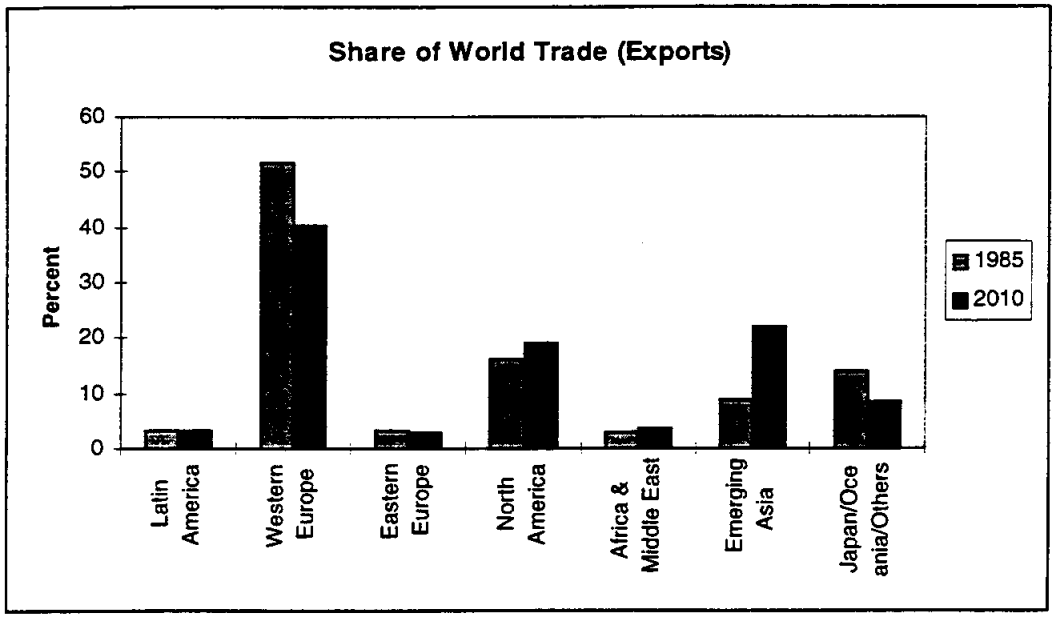
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Pacific-North America	-1%	-3%	-1%	0%	15%	0%	3%	3%	3%	3%
Asia-Latin America	17%	1%	8%	5%	6%	7%	5%	5%	5%	5%
North Atlantic	-3%	3%	-8%	10%	8%	3%	3%	3%	3%	3%
Europe-Latin America	7%	4%	3%	4%	3%	3%	3%	3%	3%	3%
Europe-Asia Pacific	21%	10%	5%	2%	1%	4%	2%	3%	4%	4%
North America-Latin America	-1%	7%	10%	9%	4%	1%	5%	6%	6%	6%
Intra-Asia Pacific	16%	7%	6%	-6%	4%	7%	5%	6%	6%	6%
Intra-Latin America	19%	16%	11%	16%	10%	10%	7%	6%	6%	7%
Total by Major Routes	**7%**	**5%**	**4%**	**3%**	**6%**	**4%**	**4%**	**5%**	**5%**	**5%**

The growth in emerging Asia, both in terms of economic growth and trade growth, has outpaced the rest of the world and is expected to continue to do so. In 1985 Asia's share was 8.8%, it had risen to 14.2% by 1990 and to nearly 18% by 1995, and is expected to reach 22% by 2010. Asia's share of world production was just 5.4% in 1985 and by 2010 is forecast to reach over 17%. This is a three fold increase in market share consistent with its new, and more important place in the world.

Similarly, Latin America's importance to the world will also increase but at a rate that is well below the rate of growth achieved by Emerging Asia. In 1985, Latin America's share of industry-wide sales and exports was quite similar at about 3.4% of world output or world trade. This share barely increases in the forecast. While output grows slightly to 4.3% in 2010, Latin America's export share remains fixed at 3.4%. Eastern Europe's share continues to decline as does Europe's share.

These shifts in trade share can be seen in the chart below.

Chart ES-2: Share of World Trade (Exports)



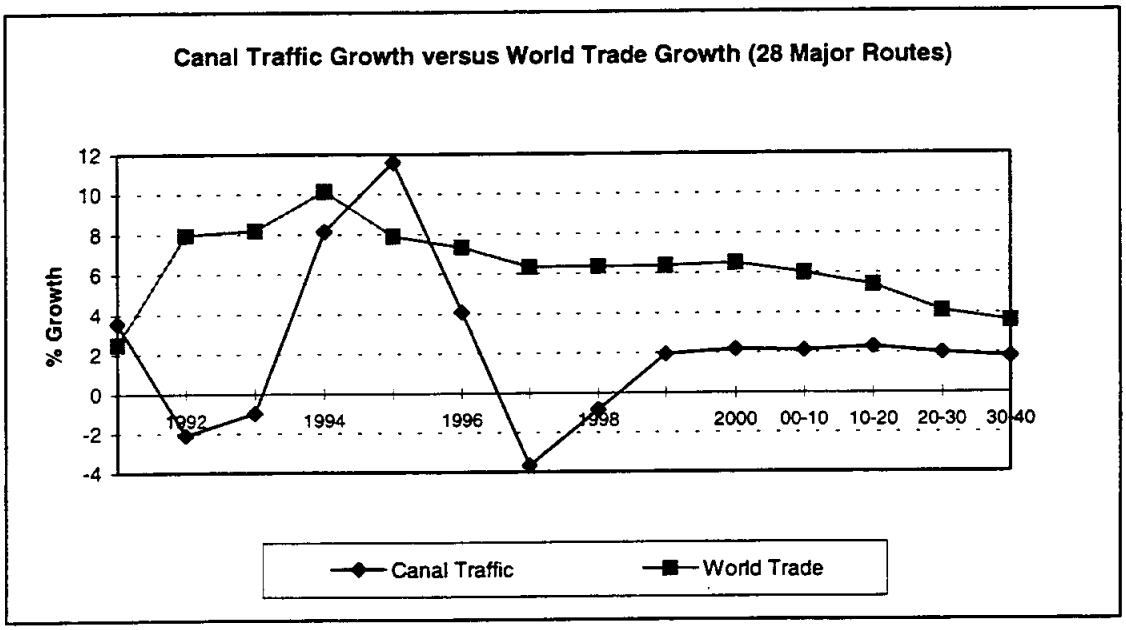
The 28 major PCC routes used in projecting Canal traffic volumes do not include some of the fastest growing trade lanes in the long term such as the fast-growing trade within the Asia market itself. The potential for growing trade between Europe and an emerging Africa is also excluded. The fastest growing trade among the 28 remains the US to Asia which continues to grow at about 5%. Canada to Europe also grows at close to this rate. Some small volume trades such as South Africa East to Central America, which potentially can transit the Canal, are also growing rapidly (5.3% in 2020-30 and 4.7% over the 2030-40 time frame). However, the model forecasts a slowing of the growth in the Asia to South America East trade. This route grew from a low base over the 1990-2000 period at 14% per year; the forecast call for slowing to 7% in the next decade and then to 5.4% and 3% in the succeeding decades. A similar pattern of slowing growth from the 1990's can be observed in the US trade with South America West, US with Central America, and South America East to South America West. This route, however remains a key trade growing in importance. Even in 2040, we estimate that it will be growing at a rate that is about half of 1% above the rate for the aggregate of the 28 routes.

Because of the variation in the projected growth in individual trade lanes, it is important to avoid predicting Canal tonnage as a fixed percentage of total world trade. Instead, the route-specific and commodity-specific approach yields a more realistic picture of the dynamics of international trade.

PANAMA CANAL TRAFFIC FORECAST

Canal traffic growth has been tied closely to the strong growth in world trade. However, Canal volume is limited by physical limits on lock capacity. Delays at the Canal can reroute some traffic. Moreover much of world trade growth has been on routes that are non-Canal routes (as mentioned above) As the chart below illustrates, growth through the Canal is limited both by the size of the locks and the pattern of the trade.

Chart ES-3: Panama Canal Traffic Growth versus World Trade Growth (28 Major Routes)

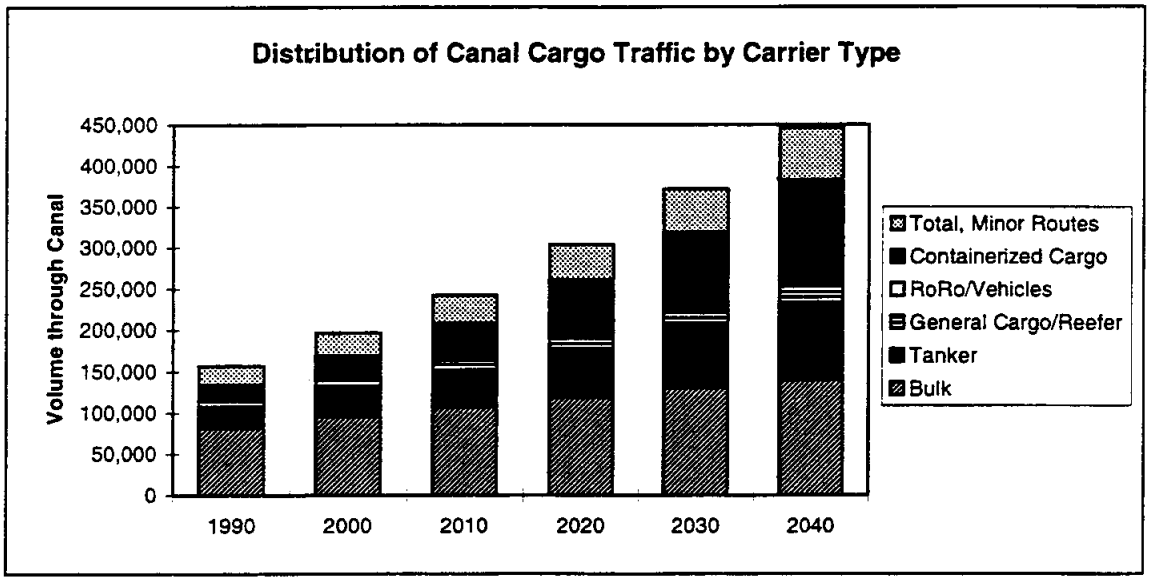


In 1997 the drop can be attributed to a steep decline in sales of American corn and grains to China as well as to the increase in tolls. The growth peaks in 1995 after the trough caused by the US recession. What is clear is that Canal traffic is tied more closely to some key bulk commodities even if revenues are tied closely to liner trade, automobile carriers, and passenger cruise ships (36% of total Canal tolls in 1996).

The long term forecast calls for a steady 2% growth the decades from 2000 to 2040, assuming that the Canal has sufficient capacity to accommodate the cargo. Overall volume through the Canal, without impediments due to limits on available capacity, would more than double from 198 million long tons (1996) to over 440 million long tons (2040). This growth in cargo is considerably lower than the growth in world trade and reflects the general diversion that has occurred in PCC "potential" cargoes to alternative transportation options – from land-bridge for higher-value US bound cargoes, to the growing penetration of air transport in some trades.

The mix of cargo passing through the Canal is expected to change, more or less in line with expected shifts in trading patterns, sourcing patterns, and the trend to further containerization of a broader array of cargo types. As shown in the chart below, a higher proportion of the traffic will be concentrated in containers.

Chart ES-4: Distribution of Canal Cargo Traffic by Carrier type



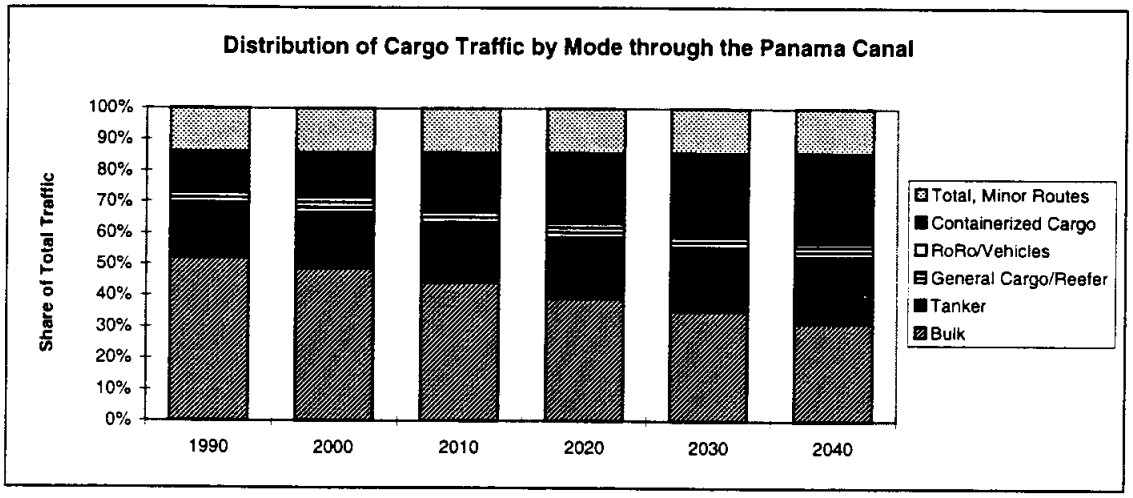
The growth in these cargo segments over the full forecast period can be seen in the table below in thousands of long tons. It is clear that the major shift is from dry bulk to containerized cargoes, with liquid bulks also gaining some share of the total.

Table ES-3: Canal Traffic by Cargo Type (thousands of long tons and % of total)

Cargo Type	1997 / % of Total		2040 / % of Total	
Dry Bulk	95,187	50%	139,581	30%
Tanker	34,574	18%	91,523	20%
General Cargo/Reefer	9,233	5%	22,435	5%
Ro/Ro	1,382	1%	2,881	1%
Containerized	23,488	12%	126,839	27%

The shares of total traffic shown in this table are depicted in the chart below for the intervening years. The trend toward greater share of containerized cargo is clear.

Chart ES-5: Distribution of Cargo Traffic by Mode Through the Panama Canal



As overall traffic grows, there will be some adjustments in the traffic by route. On some of the routes where trade is destined for more developed regions, e.g. US and Europe, the long term growth in traffic through the Canal will be reduced from current growth rates. The strong growth on other major routes reflects mainly the strong growth in routes to emerging markets in Asia. In cases where most of the mature routes show a decline in real rates of growth in the long-term, there will likely emerge stronger growth in some of the less important bilateral flows. The seven most important PCC routes accounted for 58% of the traffic through the Canal in 1990, but by 2040 we expect that these same seven routes will only account for about 43% of the total traffic through the Canal. Some of these other routes that are growing quickly and will continue to grow in the future include US East Coast to South America West Coast, Europe to South America West Coast, and South America East Coast to US West Coast.

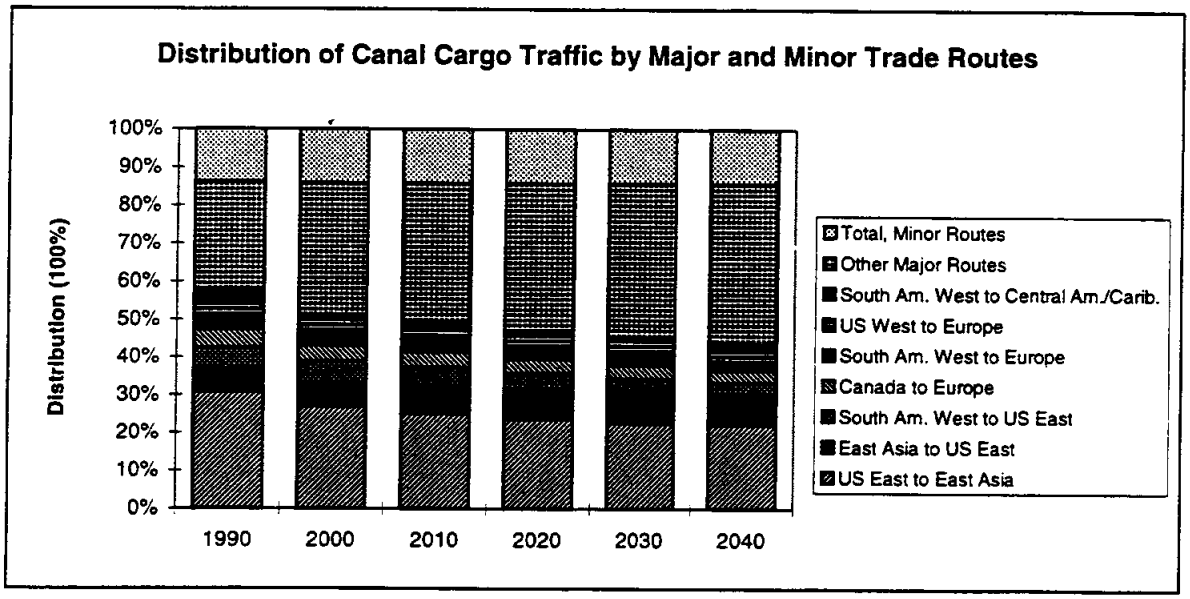
The table below shows some of the major routes, the long tons on the route, and the share of total Canal traffic for 1997 and for 2040.

Table ES-4: Canal Traffic by Major Route (thousands of long tons and % of total)

Major Route	1997 / % of Total		2040 / % of Total	
US East to East Asia	51,151	27%	99,482	22%
East Asia to US East	11,849	6%	35,351	8%
S. Amer West to US East	11,738	6%	14,037	3%
US East to S & SE Asia	8,062	4%	34,967	8%
US East to S. Amer West	7,482	4%	34,333	8%

More details of the route structure and how it is forecast to change by the year 2040 are shown in the chart below. Here, is it clear that the US East to East Asia route will decrease in significance, and other major routes grow faster and as some of the routes shown in the table grow in importance.

Chart ES-6: Distribution of Canal Cargo Traffic by Major & Minor Trade Routes



IMPLICATIONS FOR THE CANAL

The growth in world trade will add potentially more than 250 million tons to the market that could be served by the Canal over the next 43 years. This amount is more than double the nearly 200 million tons that is currently passing through the Canal (1996). About 450 million tons could pass through the Canal in 2040 based on the international economic and trade projections for the Canal assumed in this analysis. *This is not unreasonable when put into the perspective of the historical growth of the Canal traffic. The volume of cargo grew from 7.1 million long tons in 1917 to 49.7 million in 1957, a seven fold increase over 40 years. The next 40 years to 1997 saw nearly a four fold increase.*

Over the period 1990-1996, volume through the Canal rose by 40,000 tons while the number of voyages increased by 1,518. The Canal's throughput and its ability to handle larger volumes has stemmed from :

- Steady *growth in average tonnage* of the ships
- Steady increase in the *utilization* of most ship types.

These factors also affect directly the number of transits of vessels through the Canal.

ICF Kaiser developed a vessel utilization model to help in the translation of cargo volumes to Canal transits. This model, based on sampling of actual PCC data (10,000 transits) and on ship characteristics data, predicts vessel utilization on each Canal route and incorporates the trends in vessel sizes that are predicted as part of this study. In short, the forecast calls for larger vessels and more slightly higher rates of vessel utilization; therefore, transits are not likely to increase at the same rate as Canal trade volumes.

Canal transits can be analyzed by:

- Commodity (29 PCC definitions)
- Route (PCC defined: 28 primary ones, 144 in total)
- Ship type (7 primary ship types; 60 combinations of type and size) over time.

In the past, there has been no year when total transits through the Canal exceeded 15,000 laden and unladen voyages.

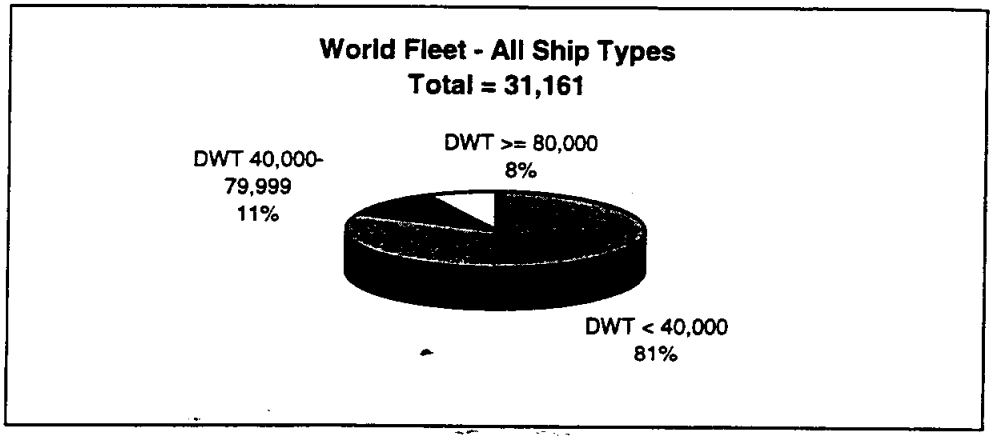
MARITIME INDUSTRY

The Current World Fleet

The development of the world fleet is an important factor for the future of the Panama Canal. ICF Kaiser consultants reviewed the composition of the current world fleet and order book in terms of size and type of vessel, in order to determine the portion of vessels that could potentially use the Canal.

The current world fleet is shown below by dead weight category.

Chart ES-7: World Fleet – All Ship Types

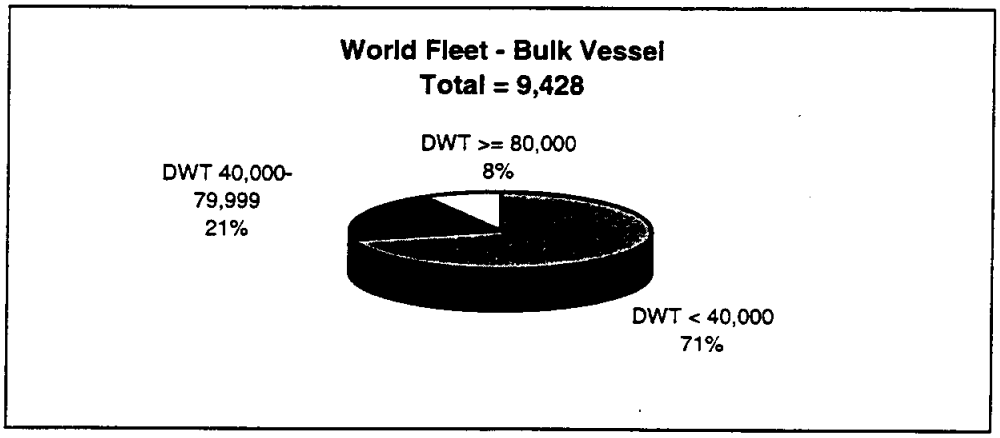


Remarkably, 92 percent of the active world fleet and order book is below 80,000 tons deadweight. Of this, fully 81 percent is below 40,000 DWT. There is a strong case here for suggesting that the physical configuration of the Panama Canal today is sufficient for the physical dimensions of the current world fleet.

Each of the three principal ship types (bulk vessels, tankers, container ships) in the current world fleet is shown below by size category.

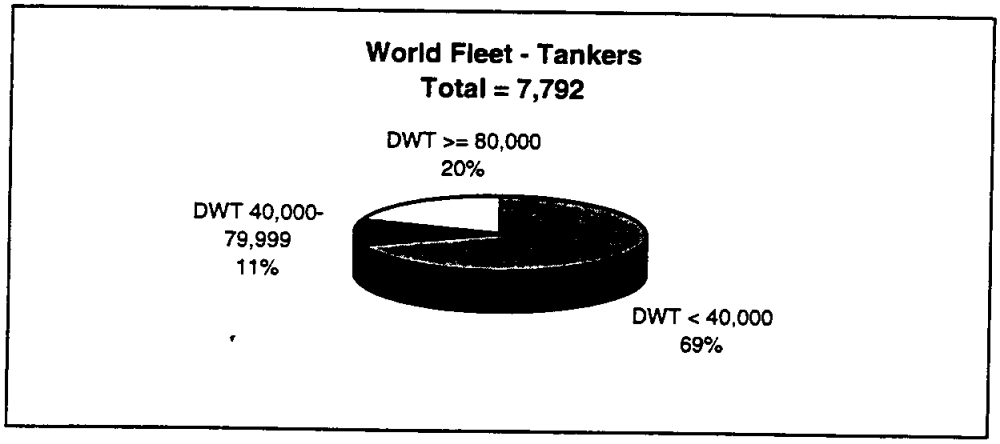
The dry bulk fleet mirrors the distribution of the overall world fleet, with 92 percent below 80,000 DWT although a higher proportion of the vessels are in the 40-79,999 tonnage range. The majority of the larger size bulk vessels trade on routes that are not typically within the Panama Canal routing.

Chart ES-8: World Fleet – Bulk Vessel



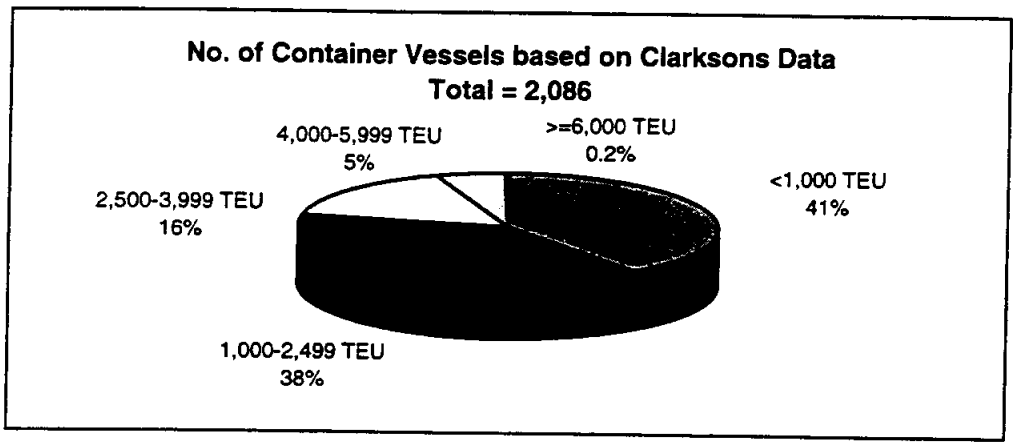
The tanker fleet has 80 percent below 80,000 DWT and a smaller proportion of the fleet below 40,000 tons. This is commensurate with the global distribution of supply and demand for crude oil which is on routes that are not constrained by the Panama Canal.

Chart ES-9: World Fleet – Tankers



The world container fleet (Chart III-4) is predominantly below 50,000 tons. It has been only in recent years that the vessel sizes have moved beyond the 50,000 DWT mark.

Chart ES-10: World Fleet – Container Vessels



Today, only slightly more than 5% of the container fleet is above 4,000 TEU. It should be noted that although this ratio is increasing, fully 95% (or more) of the fleet is within the constraints of the Panama Canal.

The Future World Fleet and Canal Transits

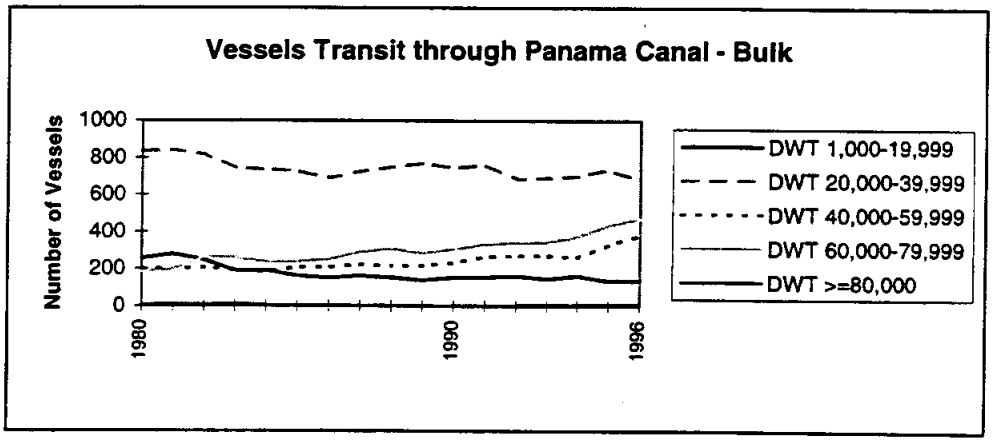
Using statistical evidence available from PCC data, Lloyd's, Clarksons Research, and Fairplay, a relationship was created of increasing vessel size over time based on historical evidence.

The global container vessel fleet will continue to grow in average size with the additional capacity benefiting the shippers moving their cargo on these larger ships. The expected proportion of large ships, in the 4,000+ TEU range, in the next building cycle (2005-2010) will be higher than in the current fleet. This will come as a result of the industry restructuring taking place today, with fewer carriers and greater rationalization through vessel sharing. This restructuring has already led to larger ships being introduced (greater capacity, but little, if any growth in voyages) on the European - Asian, Europe - India and transpacific trade.

ICF Kaiser analyzed the size distribution of the vessels transiting the Canal (Chart III-9). The discussion that follows considers the distribution of the actual vessels but it does not constitute a transit count. Twelve percent of the global fleet, or 3,849 individual commercial cargo vessels, were identified as using the Canal during 1996. Over time, the size of vessels transiting the Canal has increased, particularly since 1990, in line with the distribution of the world fleet. During 1996, transits of vessels under 40,000 DWT represented 71 percent of the total, a figure not significantly different from the global fleet distribution (81 percent). The trend of increasing vessel sizes is likely to continue over time at a relatively slow pace.

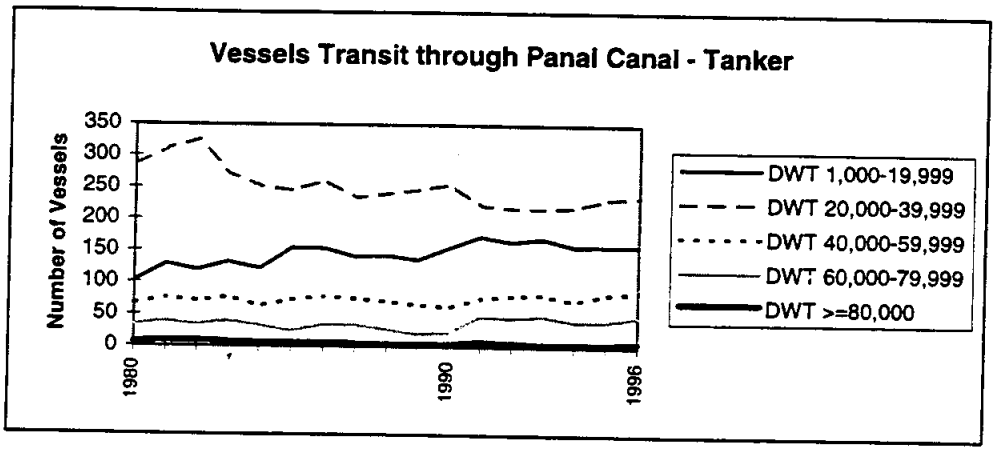
The distribution of bulk ships is very indicative of the trend toward larger ships transiting the Canal, particularly from 1990 onwards, mirrored by a decline of the smallest size range. During 1996, 49% of the transits were by vessels below 40,000 DWT. Some 18% of the world dry bulk fleet transited the Canal during this period.

Chart ES-11: Vessels Transit through Panama Canal – Bulk



The trend towards larger ships is also clearly indicated by the tanker size profile below. Tanker transits are dominated by local traffic within the immediate geographic region given that only 537 vessels were identified in 1996 representing only 7% of the world fleet. Of these, fully 74 percent were below 40,000 DWT.

Chart ES-12: Vessels Transit through Panama Canal – Tanker



The trend toward increasing vessel size is dramatically apparent for container ships, with the sharp increase in the proportion in the 40-60,000 DWT range. In 1996, a total of 346 container vessels were identified, representing 16% of the total world fleet. Of these, 62% were below 40,000 DWT and 36 % were in the 40-60,000 DWT range.

The conclusion that can be drawn from the above analysis is that there is a discernible trend towards larger vessels transiting the Panama Canal; however, this trend will not create a larger pool of vessels that cannot pass through the Canal. Rather, it is indicative of ship operators' finding opportunities to maximize their cargo loads and to achieve better economies of scale. The world fleet remains predominately a "Panamax " capable fleet.

The pressure for greater Canal transit capacity will be one of transit volumes rather than outsize vessels.

Ship Size and Utilization - Allowing for Growth

In order to provide a realistic measure of transits we allow for changing ship size and for growth in ship utilization of the larger ships. Of course shifts from smaller vessels to larger occur and smaller ships may be eliminated in the competitive environment.

To develop a better future forecast we need to assume that these adjustments will continue to take place. As ship size and utilization increase, the number of transits needed to carry the same cargo is reduced. The rate of growth of transits varies depending upon the route. Based on historical data and expected trends in ship size, the following assumptions were made in the Canal transit model (table below).

Table ES-5: Average Utilization and DWT by Ship Type

Average Utilization by Ship Type													
	1980	1990	2000	2010	2020	2030	2040	%80-90	%90-00	%00-10	%10-20	%20-30	%30-40
Bulk	0.75	0.81	0.80	0.80	0.80	0.81	0.81	0.9%	-0.1%	0.0%	0.0%	0.0%	0.0%
Container	0.45	0.50	0.49	0.52	0.54	0.55	0.55	1.1%	-0.1%	0.6%	0.3%	0.1%	0.1%
General Cargo	0.50	0.51	0.54	0.58	0.63	0.67	0.68	0.2%	0.5%	0.8%	0.8%	0.6%	0.1%
Tanker	0.84	0.80	0.77	0.79	0.81	0.81	0.82	-0.5%	-0.3%	0.2%	0.2%	0.1%	0.0%
RoRo	0.32	0.43	0.55	0.61	0.64	0.66	0.67	2.9%	2.6%	1.1%	0.5%	0.3%	0.2%
Reefer	0.36	0.30	0.31	0.31	0.31	0.31	0.32	-1.9%	0.5%	0.0%	0.1%	0.0%	0.1%
Vehicle	0.26	0.26	0.24	0.24	0.24	0.23	0.23	0.0%	-0.9%	0.1%	-0.1%	0.0%	0.0%
Average DWT by Ship Type													
	1980	1990	2000	2010	2020	2030	2040	%80-90	%90-00	%00-10	%10-20	%20-30	%30-40
Bulk	33,737	37,852	44,575	53,886	63,278	67,188	68,867	12.2%	17.8%	20.9%	17.4%	6.2%	2.5%
Container	21,995	32,827	36,579	40,513	43,654	45,012	46,452	49.2%	11.4%	10.8%	7.8%	3.1%	3.2%
General Cargo	10,635	12,402	13,334	14,648	15,853	16,741	17,469	16.6%	7.5%	9.9%	8.2%	5.6%	4.3%
Tanker	36,626	31,351	37,427	45,106	53,159	59,679	65,972	-14.4%	19.4%	20.5%	17.9%	12.3%	10.5%
RoRo	14,116	16,370	20,915	23,784	24,685	26,153	28,188	16.0%	27.8%	13.7%	3.8%	5.9%	7.8%
Reefer	6,426	7,628	8,698	9,477	10,357	11,156	11,715	18.7%	14.0%	9.0%	9.3%	7.7%	5.0%
Vehicle	14,468	14,270	15,203	15,990	16,787	16,640	16,554	-1.4%	6.5%	5.2%	5.0%	-0.9%	-0.5%

As more ships reach their theoretical maximums for DWT and utilization, the aggregate rate of change declines. By 2040, for example, the average bulk carrier moving through the Canal would have to be 69,000 DWT which is less than the 80,000 maximum. It reflects, however, the fact that there will be many vessels that are at 80,000 now moving through the Canal. A similar pattern is apparent for all other vessel types. Utilization rates are more limited and cannot grow as fast as DWT.

CANAL TRANSIT PROJECTIONS

To assess the feasibility of the present Canal carrying increasing volumes of cargoes, we have used the demand forecasts with a detailed model, developed from PCC traffic flow data, to measure the number of vessel transits associated with this demand.

From the statistics received from the Panama Canal Commission, transit data are available for three major categories of vessels. These are:

1. Laden commercial cargo vessels
2. Ballast commercial cargo vessels
3. Others, including passenger, naval, yachts, supply, barges, etc.

Transits by these categories make up the full count of transits that need to be considered for a full capacity assessment. In the analysis carried out here, however, the

focus has been on translating the projected volume of trade into transits of laden commercial cargo vessels and a factor for the ballast transits based on the historical ratio.

Three different forecasts of commercial cargo vessel transits were developed:

1. A ***baseline forecast*** that assumes that the current rate of growth in ship size and ship utilization continues up to a maximum size (Panamax size) and a maximum ship utilization of 90%
2. An ***alternative (#1)*** that allows for ship growth for bulk and oil carriers to reach a maximum of 120,000 DWTs
3. An ***alternative (#2)*** which is a completely unconstrained forecast allowing ship size to grow in line with the historical trend but without limits.

The first two forecasts place limits on ship size by function (the *baseline* and *Alternative #1*); ship size is allowed to grow unimpeded by any constraints in the third forecast.

In each of these forecasts, the consultants assume that the growth rate of transits by ship type and by route is at the rate of growth observed historically by the Panama Canal and that the maximum ship utilization achievable is 90%.

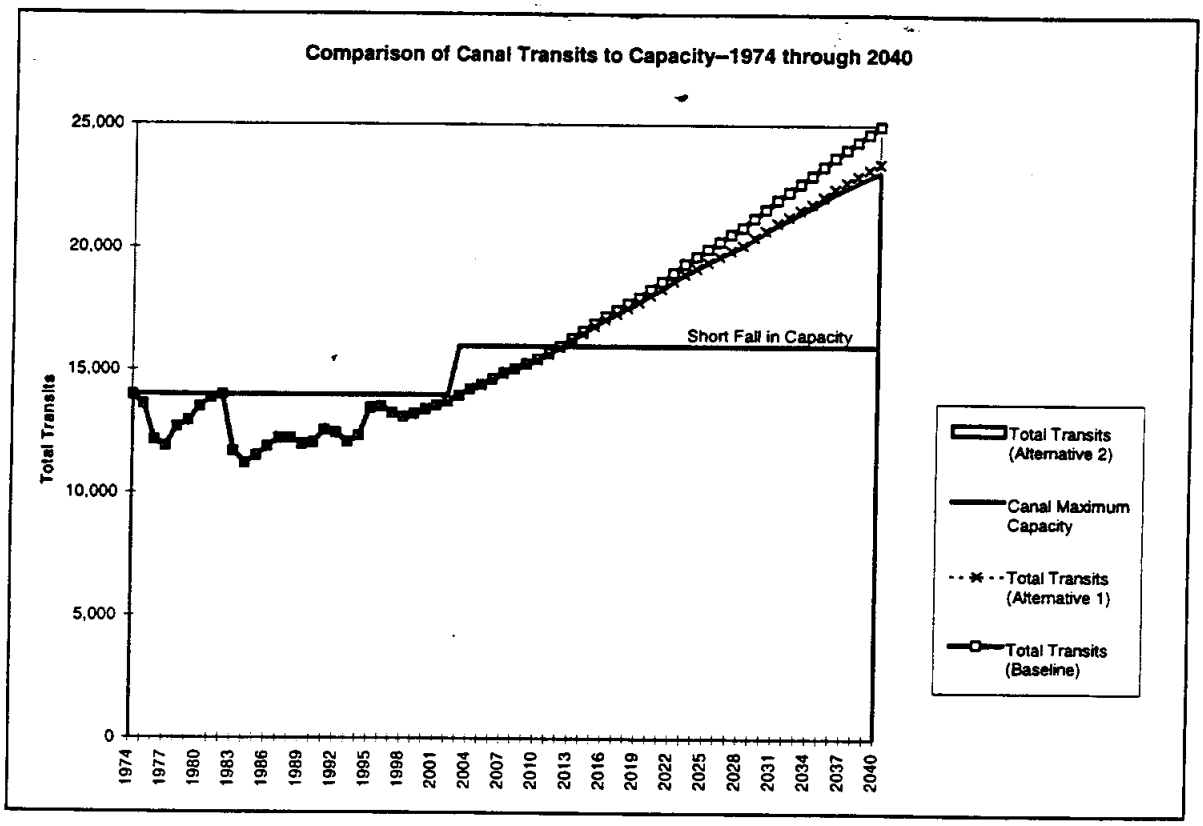
The chart below shows the potential transits through the Canal assuming that ship size and weight are allowed to grow to specific maximum size and weight classes.

Transits through the Canal reflect the average size allowed for ships passing through the Canal. When size is not a constraint, then the natural migration toward larger ships will permit a greater volume of cargo to pass through the Canal, since the number of transits needed will be less. The number of transits is reduced by allowing for larger sized ships to pass through the Canal, but the Canal would remain constrained under any circumstances without the addition of a third set of locks.

Comparing the Baseline forecast, in which ships remain below Panamax size, with the forecast in which the Canal's locks are widened, lengthened, and deepened to accommodate unconstrained growth in ship sizes (Alternative 2), the unconstrained alternative produces 1,877 fewer transits in 2040 than in the Baseline (see Table ES-6 below) or 5 transits per day. Stated differently, the constrained Baseline actually produces more transits per day. However, it is extremely important to note that under all three forecasts, the Canal is short of sufficient capacity in the long term to meet demand without a third set of locks.

The following Table ES-6 compares all three forecasts by 5-year increments in terms of commercial transits, average deadweight per transit, and the number of transits per day.

Chart ES-13: Comparison of Canal Transits to Capacity – 1974 through 2040



Missed Opportunities

A failure to increase Canal capacity after 2010 will force a significant amount of the "potential" Canal traffic to alternative routes. The chart below shows the lost opportunity associated with this trade as a share of total potential Canal trade volume. For the baseline case, assuming no change in Canal capacity, this lost share reaches over 35 percent of potential Canal trade. Chart ES-14 shows this same pattern in terms of volume of trade (long tons).[1]

Alternatively, lost cargo through the Canal in tonnage terms can be seen in Chart ES-15. In this chart, in the Baseline forecast, in the year 2040, more than 200 million tons of potential Canal cargo will not use the Canal. Again, Table ES-6 shows the three forecasts compared in terms of commercial vessel transits, tons per laden transit, average DWT per laden transit, and the daily average number of transits in 5-year increments.

[1] Potential trade lost is measured by taking the average tons per laden voyage and the maximum number of laden voyages (a share of the maximum number of total transits up to the assumed limit through 2002 (14,000) and after 2002 (16,000).

Chart ES-14: Missed Opportunity – Share of Total Potential Traffic Lost Due to Capacity Limits

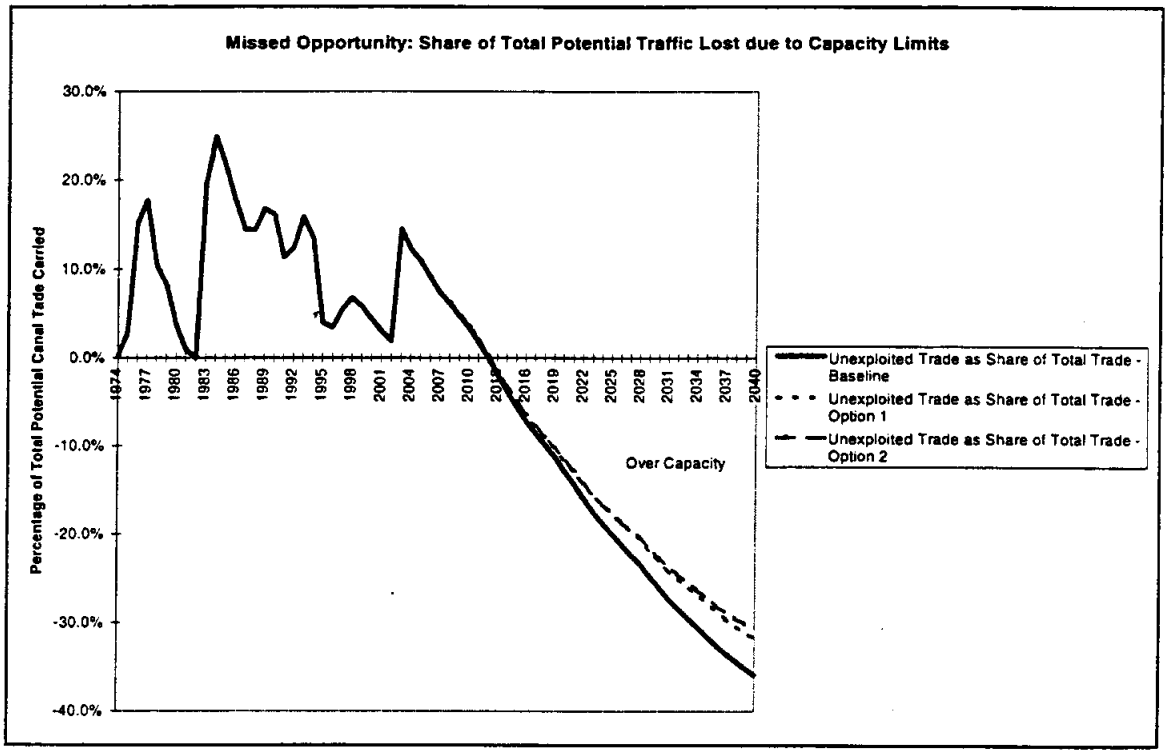


Chart ES-15: Capacity Constraints on Canal Traffic

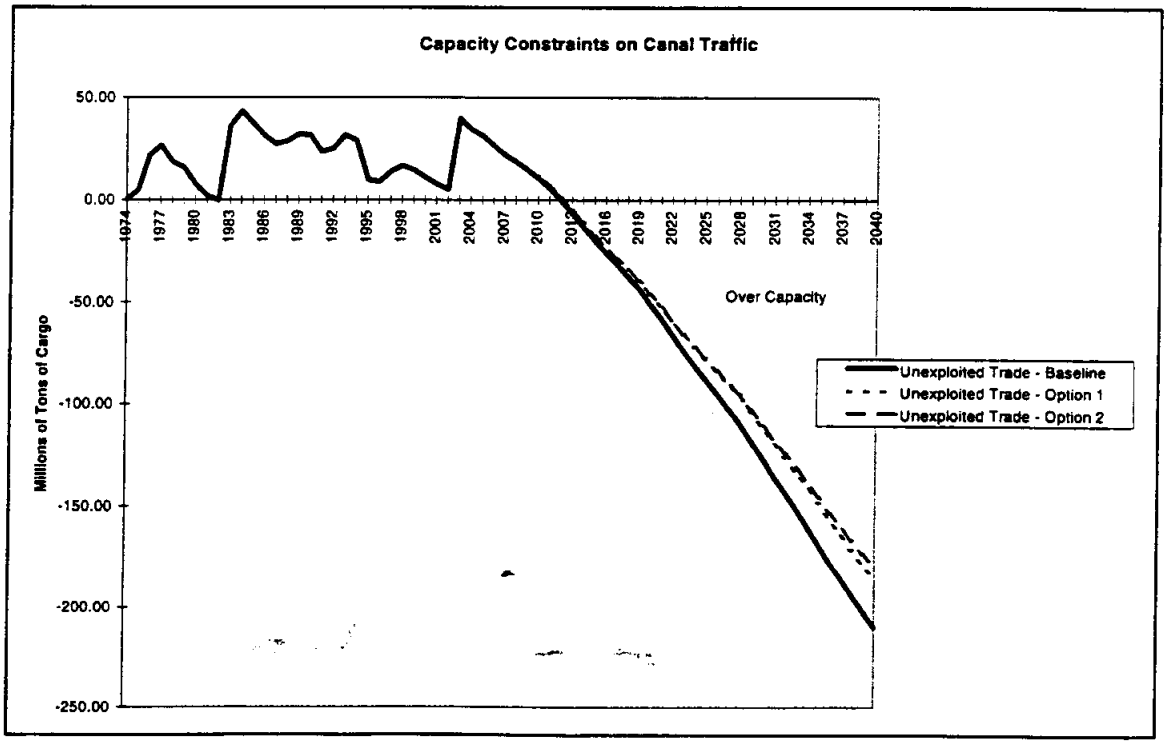


Table ES-6: Commercial Transit Forecasts for the Baseline, Alternatives 1 and 2

Baseline	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Total Cargo ('000 Long Tons)	190,303	197,067	218,846	242,435	272,522	304,030	337,103	371,870	409,333	446,278
Total Commercial Transits	**13,459**	**13,413**	**14,420**	**15,477**	**16,937**	**18,338**	**19,971**	**21,597**	**23,329**	**24,971**
Laden Transits	10,435	10,246	11,015	11,823	12,938	14,008	15,256	16,498	17,821	19,075
Ballast Transits	3,024	3,167	3,405	3,654	3,999	4,330	4,715	5,099	5,508	5,896
Other Transits	1,272									
Total Transits	14,731									
Tons per Laden Transit	18,237	19,234	19,868	20,505	21,064	21,704	22,096	22,540	22,969	23,396
Average DWT per Laden Transit	26,377	29,210	31,179	33,222	35,076	36,869	38,031	38,769	39,456	40,197
Daily Average Number of Commercial Transits	37	37	40	42	46	50	55	59	64	68

Option 1	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Total Cargo ('000 Long Tons)	190,303	197,067	218,846	242,435	272,522	304,030	337,103	371,870	409,333	446,278
Total Commercial Transits	**13,459**	**13,413**	**14,409**	**15,437**	**16,826**	**18,092**	**19,430**	**20,741**	**22,109**	**23,448**
Laden Transits	10,435	10,246	11,007	11,792	12,853	13,820	14,842	15,844	16,889	17,912
Ballast Transits	3,024	3,167	3,402	3,645	3,973	4,272	4,588	4,897	5,220	5,536
Number of Transits vs. Baseline	0	0	-10	-41	-111	-246	-542	-856	-1,220	-1,522
Tons per Laden Transit	18,237	19,234	19,882	20,559	21,203	21,999	22,713	23,471	24,237	24,915
Average DWT per Laden Transit	26,377	29,317	31,903	34,800	37,852	41,077	44,492	47,350	49,919	51,866
Daily Average Number of Commercial Transits	37	37	39	42	46	50	53	57	61	64

Option 2	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Total Cargo ('000 Long Tons)	190,303	197,067	218,846	242,435	272,522	304,030	337,103	371,870	409,333	446,278
Total Commercial Transits	**13,459**	**13,413**	**14,409**	**15,437**	**16,826**	**18,088**	**19,403**	**20,665**	**21,948**	**23,094**
Laden Transits	10,435	10,246	11,007	11,792	12,853	13,817	14,822	15,786	16,766	17,641
Ballast Transits	3,024	3,167	3,402	3,645	3,973	4,271	4,581	4,879	5,182	5,453
Number of Transits vs. Baseline	0	0	-10	-41	-111	-250	-568	-932	-1,381	-1,877
Tons per Laden Transit	18,237	19,234	19,882	20,559	21,203	22,004	22,743	23,557	24,414	25,298
Average DWT per Laden Transit	26,377	29,317	31,903	34,800	37,852	41,233	45,194	49,477	54,176	59,403
Daily Average Number of Commercial Transits	37	37	39	42	46	50	53	57	60	63

RISK AND UNCERTAINTY ISSUES

Risk and uncertainty are major factors when considering a forecast for a period of over 40 years covering world trade in commodities that are driven by the following:

- Consumer demand in the case of the major bulk items,
- Weather in two different continents (origin, destination),
- Changes in the size distribution of the world fleet.

Itemized below are the key elements of uncertainty that one needs to bear in mind, particularly when looking into the period after 2015.

1. World trade has been expanding rapidly as globalization and free trade has have progressed. In this forecast, economic growth has been assumed to remain robust over this period. Economic disturbances in the world could disrupt these patterns of trade, or, alternatively, technologies may replace trade in finished manufactures (a major category of Canal revenue). Worldwide conventions on Greenhouse Gases may limit trade in coal products, and droughts could force countries to block exports of grains. The long term forecasts are in fact relatively conservative, but with a sustained growth over 40 years on a trend line basis, there is inevitably a significant upswing. The risk and effects of recessions will certainly play a role but cannot reliably be forecast.

2. The world fleet today, and for the next five to ten years will almost certainly be made up of vessels that are predominantly in sizes that are capable of transiting the Panama Canal. Over 90 percent of the current fleet is in this category. The current order book, port physical constraints, and commercial practices in the bulk trades all indicate that there is no reason to expect profile to change over medium term. On the other hand, the closure of the Suez Canal in 1973 led to a surge in the growth of tankers and bulk carriers reaching as much as 300,000 DWT, targeted at by-passing the Suez Canal; therefore it is reasonable to consider the idea that a Panama Canal without physical constraints might stimulate the building of larger vessels. The scenario would be that perhaps the world fleet might shift up in size with more "Cape-size" vessels being added to the bulk and tanker fleet. Container ships on the long-haul routes are increasingly over 5,000 TEU, and there are indications that 8,000 TEU ships will appear early in the next century. Due to port draft restrictions, these ships will be longer and wider than current ships.

3. The assumption of continued migration from smaller to larger ships, even though based on observed trends by ship type and by route, may be too conservative. A more rapid shift from smaller to larger ships may reduce transits during the earlier part of the period 2010 through 2040 to a point where the number of transits recorded is less than Canal capacity with the third set of locks. An unconstrained Canal may encourage this change in ship economics just as a constrained Canal may be self

limiting with fewer ships showing up to transit, if they perceive the risks of extended wait times are higher.

4. New players will develop and new routes will be established that by-pass the Canal. New, faster, larger ships will be developed that make these alternative routes superior compared to passage through the Canal. This risk is greater, however, if the Canal is fully utilized, as it likely will be by 2010, and the risk is less if additional capacity is available. For example, trade growth via the Panama Canal grows below the average trade growth for the partner countries. This may well be partly due to the perception of capacity constraints, and, as a result, by-pass options are utilized. Conversely, if in the future there is a perception that there are no physical constraints, then growth of traffic, and hence transits, may be more rapid than indicated in the forecasts.

5. The transit forecasts do not take into account the effect of a successful "Hub' port at either end of the Panama Canal linked by a double track, double stack railroad and a major highway. Depending upon the cost variables of the three different modes of transportation (water, rail, road), there is a significant risk that up to 2000 transits annually might be lost due to intermodal transfers between the Atlantic and Pacific ports.

6. U.S. grain exports to Asia make significant use of the Mississippi River and the Port of New Orleans. Exports through the Pacific Northwest are determined by the rail cost and the availability of sufficient grain elevators. Any significant change in these determinants will have a marked effect on port choice as the PNW has deeper draft ports and freight charges are cheaper.

7. The actual number of ships may be considerably greater if the size migration slows. Canal traffic would be more constrained, but the volume of cargo moving through the Canal would be less. The value of cargoes on these smaller ships would be lower and ship operating costs higher, reducing the potential "rent" earned by the Canal on the new locks.

CONCLUSIONS

Without adding additional capacity, in the post 2010 environment the Canal will find itself unable to meet the demand of the market place for transit of the Isthmus.

Specific conclusions follow:

1. By 2010, assuming only a modest 2 percent per year growth in Canal traffic (nearly 4% less than corresponding growth in world trade), the Canal will be out of capacity, even assuming that an additional 2000 ship transits per year are allowed after 2002 with the widening of the Gaillard Cut. This conclusion is based on a fairly conservative approach to ship management and assumes that ship owners continue to shift cargoes from smaller to larger vessels in response to rising demand and that capacity on existing ships reaches a maximum of 80 percent for some categories.

2. The average cargo per transit will likely grow at a slower rate than the number of required transits due to changes in the mix of traffic through the Canal. The faster growing intra-Latin American routes use smaller ships which increase demand on the Canal's resources without allowing additional volumes of cargo through the Canal. This changing mix is most apparent after 2010.

3. Assuming that ship size is not limited by current Panamax dimensions or by the proposed dimensions of the third set of locks, the net impact is not that significant in terms of reducing the number of transits. This result is due to the fact that the majority of ships that currently do and will likely in the future transit the canal are smaller ones.

Size of the post-Panamax fleet is less important in determining if a third set of locks is needed than is the overall traffic demand.

The financial viability of adding additional capacity will depend upon a number of factors, not the least of which is the variability of traffic projections through the Canal. For this reason, additional studies including the use of Monte Carlo type simulation tools and quantifying various global scenarios, may be necessary to insure that the risks associated with the expenditure do not outweigh the benefits to Panama and the world.