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**EVALUATING THE IMPACTS OF THE PANAMA CANAL
EXPANSION ON TEXAS GULF PORTS**

ROBERT HARRISON AND MANUEL TREVINO

RESEARCH REPORT SWUTC/13/476660-00062-1

SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER
CENTER FOR TRANSPORTATION RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN
AUSTIN, TX 78701

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Abstract

This report covers a four-year period after contractors started work on the third set of locks, which in 2015 will effectively double the size of the ship using the Panama Canal. Many of the impacts linked to the new locks remain unknown (like lock fees, demand, and shipper response) but it has been successfully promoted as an economic stimulus to a number of the larger Gulf and East Coast Atlantic ports. This in turn has generated a number of studies that reported during 2012. This report concentrates on three issues raised in these reports that fit the resources and focus of the original study—statewide planning. Chapter 2 gives a Texas Gulf perspective on the potential impacts of the new locks. Chapter 3 examines a major, yet unresolved, issue facing shippers and steamship companies – offering “direct” versus “hub and spoke” services to ports that may not have the status of true load centers or sufficiently deep access channels. Finally, Chapter 4 provides planning observations and recommendations, which could strengthen Texas statewide multimodal plans over the next 20 years.

Executive Summary

The Panama Canal will, in 2015, be enhanced by a third system of locks able to handle substantially larger ships. In addition, the Government of Panama is investing in a range of shipper facilities and services to increase the utility of the canal to global shippers and customers. The Panama Canal Authority (ACP) and the Panama Government inherited the Canal in 1999 and have successfully negotiated the planning, financing and overseeing of the new lock project and are now promoting the enhanced system as a “game changer” in all-water Asia-Latin America-United States East Coast and Gulf Coast transportation. The report considers how these improvements will impact Gulf ports, particularly deep water ports in Texas. This study discusses the main issues examined during 2012 as the maritime industry, comprising ports, steamship companies, shippers, third party logistic companies, and large customers, indicated the potential scale of change. Chapter 1 provides a brief background to the project and the ancillary services planned by the ACP—supplemented by an Appendix covering the period 2007-2010—and concentrates on three current issues of interest to planners.

Chapter 2 presents a 2012 Texas Gulf perspective on the potential impacts once the new locks are opened. It reflects the wide variety of interest shown by transportation planners in the state when examining the Panama Canal expansion and related economic impacts, especially exports. Ports have to function in three areas; the seaside (channels), the terminals (port) and the landside (modal access). Channels create many challenges in the longer term when Texas and regional demand creates a true “load center” for containerized commodities, and bulk products of all types are routed through the port gateways to support the economy. Terminal needs are typically addressed in the strategic planning of the port and funded through a variety of mechanisms, including partnering with users of terminal operating companies. The landside element, when compared with channels and terminals, is comparatively healthy and working reasonably well. In a recent Texas waterborne trade study, over 40 percent of the projects identified as port improvements were related to highway projects. Moreover, many had already been subject to transportation analysis and entered into the TxDOT transportation improvement process. The question of adequate channels depths and berths remains relatively critical at the time of this report. But, is it essential to have deep channels—some as much as 50 feet—if a Gulf port wishes to service the largest ships—both container and bulk carriers—now entering service? The answer may lie on the economics of transshipment versus direct service, a key element of supply chain design which will be tested in the next five years.

Chapter 3 examines a major, and yet unresolved, issue facing shippers and steamship companies – that of offering direct versus “hub and spoke” services to ports that may not have the status of true load centers (a load center is defined as a port that handles at least 4 million TEU per year) or sufficiently deep access channels. Global supply chains contain transfer points where cargo is loaded, transferred or unloaded, ranging from basic systems moving bulk commodities to more complex ones for containerized freight. Each transfer carries a cost and is not made unless the aggregate benefits to the chain exceed total costs, enabling the chain to be competitive with rivals. Complex transportation systems are still made for rather basic reasons – value, profit margins, reliability and cost. Transshipment ranges from a transfer from one ship to another to unloading the container and adding value to the shipment, for example by consolidating different commodities into a second container for delivery to a specific customer. In certain cases, value activities might include some form of “light” assembly using containerized components from different sources with the finished product then sent by new

containers to the marine port best-suited to the landside network of the customer. The benefit to the local economy where such transfer activities take place can be profound and include direct, indirect and induced employment, typically estimated by input-output models.

Finally, Chapter 4 offers several planning recommendations from the variety of studies reporting in 2012 to assist those updating statewide planning and building a more dynamic and responsive approach to freight supply chains. These include:

- a. Steamship companies currently using the canal are already “running the numbers” of costs – the current intangibles are the global economy, specific regional growth – both imports and exports – and the demand for shipping services that would use the larger canal. Asian and Southeast Asian traffic on carriers that already have 8,000 TEU vessels have begun to deploy them to East Coast gateways that can handle the draft. This strongly suggests that Houston could have several 8,000 TEU services for both imports and exports once it has a 45 ft. channel at the Bayport terminal that uses the new Panama Canal, if regional demand can create a load center. It may also reduce the demand on competing Panama Canal routes.
- b. Drewry consultants have some compelling cost comparisons to show that the West Coast Californian port container growth (linked to the BNSF/UP Transcontinental routes) is vulnerable. This will impact traffic forecasts on Class 1 routes in Texas and IH-10/20 corridors. They calculate that the boundary in favor of West Coast at this moment lies around Dallas. These claims need to be treated carefully since they could alter fuel price increases and competitive responses from the western Class 1 railroad companies. The full trans-continental service of the 1990s has now given way to East Coast port growth supported by the three Western Class 1 railroads.
- c. Gulf port authorities believe they will gain a substantial share of the growth in business using the new locks. A Louisiana DOT research project suggests an 18-20-percent increase for Gulf ports while the Port of Houston estimates a 15-percent growth in annual container volumes in Texas. These numbers should be regarded as estimates subject to revision if related improvements to terminal efficiency and connectivity are not undertaken.
- d. Trade impacts should not be measured only in terms of containers, especially for Texas ports—because state trade is more granulated and diverse. Direct service of bulk, liquids, car carriers and cruise service calls may not be joined by containerships, which might hub in the Caribbean en route to Savannah and Charleston. These are always difficult to estimate because they are unscheduled and data are difficult to collect.
- e. Gulf bulk shipping services should continue to grow from a variety of Texas deep water ports, particularly between Latin and South American markets, based on demand for Gulf exports and non-containerized imports. It is not simply focused on imports and containers. The Panama Canal Authority says that bulk movements—much from Brazil—have stepped into the gap left by the fall in containership passages. Bulk trade flows should be regarded as highly significant for Texas, especially if energy exports (like LNG) grow as predicted in the medium term.
- f. Current analyses are weakened by a lack of data on demand and costs—almost all the arguments are based on the supply-side infrastructure provision. Overall, the Canal expansion should be good for Texas shippers (particularly exports), although the scale of the logistical advantage over other corridors serving the state is incomplete at this

- time. The shift in production from China to Southeast Asia for certain commodity goods has favored a Suez route to U.S. East Coast port terminals. However, this is not likely to impact, in the short/medium term, Gulf ports that remain linked to the Panama Canal for future growth in all-water Asian trade. Texas markets—imports and exports—are served by a large regional cluster of supply chains linking California, Mexico, and Texas Gulf gateways to regional markets by truck and rail landside moves.
- g. Shifts in global production- and transportation-derived services continue and will impact trade patterns in the next decade. The Economist recently produced a Special Report on the global manufacturing and outsourcing, near-sourcing, reshore and moving between low-cost countries. These changes—such as moving assembly from China to Mexico—have direct impacts on transportation supply chains, especially maritime routes and terminal operations for containerized sub-components. This is a significant development for TxDOT since it impacts an area of trade flows not studied in recent years, namely NAFTA trade flows in Texas and the U.S. This may well have a much larger strategic impact on statewide transportation than that from the large Panama Canal, especially in the short- to medium-term DOT planning cycles.

The study agrees with the findings related to port and marine planning of the 2012 Panama Canal Stakeholders Group, which advised TxDOT on the economic impacts of the Panama Canal expansion. TxDOT has created, and is now staffing, a marine division that will integrate port investment programs and landside needs into long-range planning. An advisory group of deep water ports, railroad companies and key waterborne customers has been set up to guide statewide policy and help address legislative initiatives related to international trade. TxDOT is about to begin the update of its statewide transportation plans and more effective support from the port communities can only sharpen and support multimodal plans over the next four years. However, the basic question about Panama Canal impacts on Texas ports remains difficult to estimate in the short to medium term. Skeptics may be correct in arguing that the expansion of the waterway may not strongly influence where trade flows through U.S. ports.

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Acknowledgements

This report is unusual in the SWUTC Region 6 program because it covers a five-year period from 2007 to 2012. The original work plan called for a shorter timespan but the TTI Administrator, Dock Burke, allowed an unfunded extension based on two reasons. First, the Panama Canal extension created a far greater interest in national transportation planning circles than was originally thought, much of it generated by East Coast and Gulf port authorities who predicted substantial benefits from serving the larger ships using the Canal. This, in turn, drew the attention of state and federal agencies that sponsored studies examining various aspects of the investment and the implications for future landside needs at deep water ports. Second, the literature provided the study team with a knowledge bank indicating that more valuable planning material would be gained by waiting until the construction project was safely established and data from the shipping sector began to focus on key transportation needs relevant to state and federal Departments of Transportation. One unexpected benefit of the project extension was to provide preliminary findings to both academic and transportation groups—a key objective of the Region 6 program. These findings were reported in a series of presentations that included:

- 2010/11 UT CE class presentations,
- 2011 LBJ School Policy Research Project
- 2009/10 Summer Intern presentations
- 2012 TxDOT Forum
- 2012 TxDOT Short Course
- 2012 Presentation to the TxDOT Panama Canal Stakeholder Group

This study report therefore concentrates on the 2012-2013 period in the Texas Gulf and offers an insight into some key factors and issues that remain to be answered over the next five years after the Canal project is completed and larger ships begin to use the new facilities.

CTR gratefully acknowledges the understanding shown by the Region 6 TTI management in allowing the extension. Sarah Janak carefully edited and improved the document, while all errors are the responsibility of Robert Harrison.

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Chapter 1. Introduction and Background

The history of the Panama Canal spans over 130 years and includes the early discovery of the narrow isthmus separating two oceans, political shenanigans surrounding the creation of a new nation, the triumph of a project that reflected the best of 18th century industrial age, steam-driven, engineering (not forgetting medical breakthroughs), followed by a long period of control by the United States until its return to Panama in 1999. The early 1900s Canal design included locks which subsequently served the majority of ships entering those world trade routes using the Canal for much of the first two-thirds of the 20th century. Naval architects then cleverly designed ships that could fit the dimensions of the locks (particularly the beam) and so created a new ship class – Panamax. The inadequacy of the Canal system finally became obvious when global containerized and bulk commodity trade grew in the 1980s, fueled by trade liberalization,¹ outsourcing, and the growth of Asian—particularly China—trade which introduced ever more larger ship designs which could not use the Canal routes. The assets inherited in 1999 by the Panama Canal Authority (ACP) and the business model for its success in the 21st century needed change—radical change. It should be noted that the investments needed for this change could never have come through U.S. Canal Zone governance.²

This report deliberately leaves those issues to a range of easily located informative reports and peer reviewed papers published by others.³ It concentrates on reporting what was known in 2012 about the new locks, their impact of trade routes and on planning at those U.S. East Coast and Gulf deep water ports wishing to service the larger ships. It begins, not with current Canal operations and details on the construction of the new locks, but with the business plan developed shortly after Panamanians voted on October 22, 2006, to support the largest bond issue ever made by the country (\$5.2 billion) to make the canal system viable to serve the sizes of ships⁴ entering the post-2000 global shipping market. The study ends in early 2013 with a firm Panama Canal project opening date in 2015, some hundred years after it was first opened. The investment also represents, in the clearest possible manner, the commitment by the Panama government to build a full service system providing a wide variety of operations that support an expanded role for the canal. It is no longer simply a transit land route – like the Suez Canal – but will be a global logistics platform – comprising multiple modes, terminals, service centers and, of course, larger locks. It represents a firm bet to make the canal system more attractive to shippers, customers, and service providers than a waterway route alone and raise the financial contribution it currently makes to the Gross National Product (GNP). Services of all types account for around 80 percent of GNP, and the canal investments will provide long-term support to the transportation elements of that sector.⁵ The opening will also end a period of increasing interest in the impacts of the investment, comprising many academic articles, PowerPoint presentations, maritime conference sessions, state and federal government agency interests and

¹ The role of the General Agreement on Tariffs and Trade (GATT) which became World Trade Organization (WTO) was fundamental to the success of liberalization

² The U.S Government has systematically failed to invested even in its domestic waterway system – see “Americas maritime infrastructure – Crying out for dollars”, The Economist, February 2-8, 2013

³ Appendix 1 provides basic information for readers new to the topic.

⁴ Termed “Post-Panamax,” they covered a range of sizes, mostly increases in the beam, which effectively doubled the capacity of the current Panamax design.

⁵ “Doing Business in Panama 2013” World Bank. <http://www.doingbusiness.org/data/exploreeconomies/panama/>.

actual investments made to serve the larger ships by port authorities on the eastern seaboard of the U.S.

The Panama Canal Authority (ACP) instituted a successful marketing campaign from 2007 to 2012 touting the positive impacts to global shippers and frequently referred to the investment as a “game changer,” a phrase that many U.S. port proponents subsequently adopted as their own mantra for the project. However, it is more likely that the ultimate game changer will be for Panama itself and its potential role as a multi-service global supply chain complex. Figure 1.1 shows some of the terminals on the Canal system while Figure 1.2 details the complementary services which will provide a variety of transportation activities and logistic services to global shippers and their customers. It should be noted that the services extend well beyond those associated with containers since the ACP is trying to offer full-services to all shippers in order to stimulate a range of shipping benefits if the investment is to pay off. There is no doubt that short-term risk has been factored into the Panamanian decision-making although this is related to new demand rather than the ability to service the bonds. ACP and its consultants have always downplayed the initial impact of the new locks on global trade and focused on the medium- to long-term impacts. Although the economic recession of 2009-2011 lowered demand forecasts, the timing of the bond issue was fortuitous as it began when the global recession created a period of lower interest rates that allowed negotiation at attractive rates. Furthermore, the ability of the ACP to use canal revenues to meet the monthly payments met with major approval in world markets. Unlike other transportation investment bonds—those associated with many toll roads, for example—fees from existing traffic more than covered bond repayments,⁶ and in 2010, investment analysts gave the canal bonds an investment grade⁷ rating.

⁶ Personal discussions with Dr. Michael Bomba, Traffic and Revenue Analyst at Alliance Engineering, November 2012.

⁷ Fitch raised it to BBB in 2010. See http://www.thepanamanews.com/pn/v_16/issue_04/economy_02.html

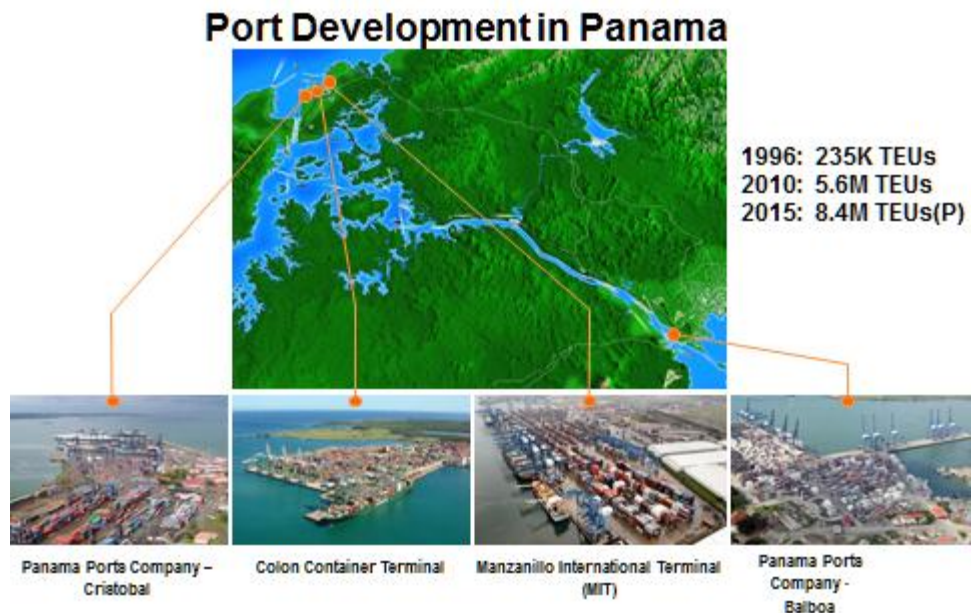


Figure 1.1: Port Terminal Development serving Traffic on the New Panama Canal System
Source: ACP, 2011



Figure 1.2: Logistics Support Services Planned for the Panama Canal
Source: ACP, 2011

Those reviewing the substantial material generated by the project can be forgiven for thinking that the ACP has always been regarded in high esteem. In fact, the literature shows otherwise. The Canal Zone, with the exception of a short period in the early part of World War II⁸, was managed much as a public utility might be—modest maintenance, little increase in efficiency or productivity, and cost-plus pricing. This suited the shipping industry (circa 1940-1975) rather well with predictable, modest fees and adequate service levels. However, throughout the period of American control, there were a series of campaigns to reinstate Panamanian control over the Canal Zone. The Cold War reduced the strategic significance of the Canal to the U.S. and at a time when European nations were relinquishing their influence over nations traditionally governed as colonies, it seemed to many U.S. politicians, particularly Democrats, that the Canal Zone administration was both anachronistic and inappropriate for U.S. foreign policy.

Policy was changed in 1977 when two treaties named after the then leaders of both the U.S. and Panama—Carter and Torrijos— were first signed and subsequently ratified by both governments, to guarantee the Panamanians control of the Panama Canal Zone after 1999. This was not universally welcomed, and until early 2000, critics (admittedly by then in the minority) included those who objected to transferring a strategic asset to a hostile country, and those who judged the Panamanians not competent to operate a facility that facilitated world trade. The ACP strategic planning actions, after 2000, soon put to rest any worries about competence as they immediately implemented a series of projects to raise productivity that included deepening approaches to locks, widening the Gatun Lake channel to allow large ships to facilitate bi-directional flows, and renovating equipment installed at the inception of the canal⁹ in 1914. This was the prelude to the construction of the third set of locks that is now underway and is the subject of the admiration of those involved in global trade. The ACP threw all resources behind the strategic planning needed to build a new business model based on a large canal and associated services serving most of the world’s shipping fleet, particularly the larger, low cost bulk and container ships now entering service.¹⁰

The issue uppermost in planning context when this study began was the project—the cost, schedule, construction problems, commodity demand, shipper response and which countries (or states) and ports would benefit from the lock expansion. Much has now been answered—or sufficient ranges of opinions given—to negate any value in reporting findings that repeat what other studies have now reported. This report therefore concentrates on three current issues. Chapter 2 gives a Texas Gulf perspective on the potential impacts of the new locks at 2012. Chapter 3 examines a major, and yet unresolved, issue facing shippers and steamship companies – that of offering direct versus “hub and spoke” services to ports that may not have the status of true load centers¹¹ or sufficiently deep access channels. Finally, Chapter 4 makes some planning observations and recommendations, which feed into statewide multimodal plans over the next 20

⁸ Dredging and excavating a large lock upgrade began around 1940 based on the strategic imbalance of maritime power favoring the Atlantic ports, but was abandoned after World War II when new strategic centers protected the West Coast. It is noteworthy that the new lock alignment follows much of that started in 1940.

⁹ The author recalls the lock house at Miraflores in 2007, which at that time, still had the original operating brass controls, complete with a working model of lock depths, linked to a system of valves to open the gravity lock systems. Needless to say, these have been replaced, and as of 2012, reside in a visitor museum directly across from the original lock house where tourists can see canal locks operations.

¹⁰ It is now reported that containerships up to 14,000 TEU can use the new locks. *Journal of Commerce*, Jan 7, 2013.

¹¹ In the container sector, a load center is defined as a port that handles at least 4 million TEU per year.

years. Preliminary findings from the research are reported in presentations at Symposia and available on the web for the more diligent reader.

Chapter 2. Panama Canal Impacts on Texas Gulf Ports in 2012

Introduction

Texas ports—both deep and shallow draft—are critical to the success of the Texas economy. Texas has the second largest state economy in terms of the share of state contribution (9% in 2011) to U.S. gross domestic product (GDP) and arguably has the largest transportation system—gateways, corridors, modes and hubs handling maritime trade, NAFTA and the trade that moves across the state to service other regions, for example Asian containerized transcontinental trade moved by Union Pacific (UP) and Burlington Northern Santa Fe (BNSF) between regional hubs and Californian terminals. Texas and Louisiana form one of the twelve Megaregions identified by America 2050 and transportation plays a role in this decision, particularly in the petro-chemical sector, which relies heavily on an efficient multimodal system to move products. In 2011, Texas recorded a \$319 billion value for imports (14% of U.S.) and a \$249 billion value for exports (17% of U.S.) which, when aggregated, exceeds the state of California by over \$50 billion. The influence of the ACP decision to build a third set of locks to service larger ships impacts Texas ports in two ways. The first is based on the likelihood that larger, more efficient ships (see next chapter) will draw competition from current modal corridors to Texas deep water terminals. Current corridors (2012) for containerized Texas imports and exports are shown in Figure 2.1.



Figure 2.1: Competing Global Corridors for Asian-Texas Trade

For the Panama Canal to successfully compete with the other corridors shown in Figure 2.1, it essentially rests on the ability of the Canal to provide a cost-time schedule—for both exports and imports—that is superior to that offered by competitors, for example the Californian ship-rail systems. The figure, though not to scale, shows five competing ship-based multimodal corridor systems and these are now briefly described.

- A. Southern California ports—Los Angeles and Long Beach in particular—built their pre-eminence in container handling in the 1990s on a vibrant estate economy and growing population, their maritime proximity to Asian producers, natural deep water channels, efficient terminals and rail links to the Western Class I transcontinental routes. The latter offered shippers a dual opportunity to serve a large state domestic market while also moving containers competitively to other U.S. major markets like Chicago and Dallas.
- B. The Panama Canal requires 2/3 of a day additional sailing from California prior to entering the canal itself for Asian-Texas imports and further sailing in the Caribbean/Gulf depending on whether the service is direct or transships at a hub port en route. Clearly, the trip distance is longer than traveling through California, but an all-water service can be competitive on cost. The provision of other value-added services at Panama might also induce demand beyond basic ton-miles at sea.
- C. Manzanillo plays an important role in the Mexican domestic system, serving the Mexico City-Guadalajara-Monterrey triangle, but two weaknesses limit its ability to serve Texas. First, it lacks the space to grow terminal capacity efficiently while it is a truck-based port, rather than multimodal rail, since trucks are more efficient than rail when serving the triangle.
- D. Lazaro Cardenas has both space and a naturally deep channel capable of serving the largest containership currently in service. Moreover, it has a premium intermodal service provided by KCS de Mexico (KCSM) which controls a 1500 km (1000 mile) route to Laredo. KCSM has improved both speed and security over the past three years and is growing its container traffic at double digits, though admittedly from a low base.
- E. Asian routes through the Suez Canal have been dominated by European demand, though this is changing. The economies offered by the largest ships entering service are causing steamship companies to extend European services to East coast U.S. ports, notably New York and Norfolk, with the potential to move to Savannah once channels have been deepened. Rail would be used to move containers to Texas over the last leg of the import trip.

Shippers benefit from corridor choice and it is clear that Texas is not dependent on a single corridor, but rather, its economy will benefit from corridor competition from multiple routes based on market forces and non-cost-related needs on the part of the customer.

Statewide Transportation Planning

The second impact of the ACP decision is that traditional statewide planning does not reflect changes in transportation operational systems—which can be both dynamic and short term. Transportation is a derived demand asset-based system, with high entry costs (capital intensive), long life cycles, targeted maintenance and modest profits. It has also remained elusive to traditional statewide planning, which has concentrated, to date at least, on an inventory-derived “stove pipe” approach that has rendered traditional statewide planning increasingly irrelevant. They fail to reflect the growth of transportation logistics—comprising information systems, knowledgeable retail and manufacturing customers—and the dynamic quality of booking modal services based on commodity characteristics, customer preferences and cost in real time. Academic mode choice models may have identified key commodity characteristics like speed, cargo value, inventory costs, security and schedule reliability in a number of ingenious and theoretically interesting ways, but there is simply a current disconnect between multimodal planning, mode choice models, and maritime operations.

Statewide planning and metropolitan planning are often constrained within boundaries that generally form only a part (sometimes a small part) of the system-wide analysis captured by logistics. Shippers must offer connections at key transfer points and be sensitive to all operational costs. An interesting example in the maritime sector is slow steaming. Steamship companies have been hit by overcapacity in recent years and have been able to introduce slow steaming—where speeds fall from 20 knots to 17 knots or lower—and fuel consumption falls by double digits. It seems that many companies are using this technique and the customers have adapted to the 2/3 day longer trip time on key routes.¹² Benefits include fuel cost and lower carbon emissions, and full transit time to customers can sometimes be improved through terminal efficiencies. Systems are dynamic and innovative and shippers prefer choice so the Canal will definitely be subjected to close scrutiny as 2015 approaches and ACP reveals their cost structure.

The Texas economy will benefit from bottleneck improvements to the import-export transportations systems serving its customers and markets. The 1990s focus was on the impacts of the North American Free Trade Agreement (NAFTA) and the economic benefits on the state have been, and remain, considerable. Global trade, much of it unrelated to the Panama Canal, has grown in the first decade of this century and ports will play a major part in the energy boom of the second decade. This could extend into the third decade if the U.S. government permits the widespread exporting of natural gas and supports permits to liquefy the gas, now viewed as abundant, at select Texas ports.^{13,14}

¹² “Why Slow Steaming Makes No Waves,” Peter Tirschwell, 2013 Annual review and Outlook, Journal of Commerce, January 7, 2013

¹³ LNG plants are expensive (\$5 billion) and take time to build (6 years) even when retro-fitted so they will not be numerous. Texas currently expects to have 3 if exporting is allowed. The LNG ships will be able to use the new Panama Canal locks to serve Asian markets.

¹⁴ The government has just agreed (February, 2013) to an export LNG plant permit at the Port of Corpus Christi

2012 Study Reports and Presentations

Three relevant TxDOT-sponsored Panama Canal impact study findings have been selected from many made in 2012. The first was based on a multimodal panel reporting at the TxDOT Transportation Forum, the second a presentation made to TxDOT by the LBJ School team reporting on project 0-6690, and finally the TxDOT Panama Canal Stakeholders Working Group (PCSWG) which first met in June and made their final report in November. These studies were independent in several respects. The SWUTC study had an impact on both, but each took up a different combination of interests. The LBJ School team, for example, looked at the role of Asian and South American trade, while the PCSWG had a wide range of state and regional users and modes, together with trade specialists, providing insight into key sectors.

TxDOT Transportation Forum February 2012

This subject was placed on the 2012 Forum agenda because it seemed that almost all East Coast and Gulf ports were claiming that the Canal impacts could significantly affect trade passing through their gateways if channels could be deepened. This is an exaggeration, but it did seem that every week brought a new claim that port investments in both channels and terminals were needed.

The study reported that Texas ports were, in the short-term, ready for the opening of the new locks and would immediately benefit if steamship companies moved to larger ships. The argument lies in the definition of what constitutes a “larger ship.” The nominal limit for the Panamax¹⁵ containership was 5,500 TEU,¹⁶ but Houston, for example, had already serviced a 7,500 TEU containership. How was that accomplished? The answer lies in the draft of the 7,500 TEU ship and the contents of the boxes it carried. Most consumer goods are light-loaded and this displaces less water than heavy cargo, so the 7,500 TEU ship used the current 45-foot Houston ship channel. However, it would not be able to take 7,500 TEU loaded with typical Texas exports because they are heavier and need additional draft.

In the medium-term, rail connectivity linked to terminals sited on deeper channels than 45-foot should be a TxDOT planning focus even if it means that only one or two sites could be served. Lighter cargo could use the existing channels and depths while the heavier exports focus on the selected terminals with deeper water. Emphasis was made on the unfortunate tendency to focus on containerized imports when discussing international trade. In reality, several commodity categories constitute a portfolio of cargoes that all contribute to the success of the state economy. This was particularly true for the energy sector that was beginning to be positioned, in the minds of many, as a global player for both oil and gas.

In the long-term, some cargo might divert to rival corridors serving Texas, so the net economic effect would be small. In addition, if deepening channels could not be funded, the possibility of using “hubs”¹⁷ at a natural deep water site in Panama or the Caribbean would negate the need to dredge, dispose of material and maintain long channels.¹⁸ The main point the SWUTC report work conveyed was simple: the new locks are going to be open and will be competitive with other routes and though the impacts at first may be modest, the provision of an

¹⁵ The term for a ship that is designed to operationally meet the maximum dimensions of the older locks.

¹⁶ About 2,600 forty-ft. boxes

¹⁷ Transloading ship-to-ship using a terminal that can handle the dimensions of the larger vessel.

¹⁸ Jim Kruse, Director of TTI's Ports and Waterways Group informed the team that some channels might be as long as 12 miles.

improved supply chain route—particularly for Texas exports—would be welcomed by shippers and the logistics sector.

TxDOT Project 0-6690 entitled “Selected 2012-2014 Trade Flows and Texas Gulf Ports: Panama Canal and South American Markets” was awarded to a joint CTR/LBJ and TTI team and was designed to address two major issues in terms of global impacts—Texas ports and the Panama Canal expansion. The first year focused on patterns of global demand that formed the customer base for Texas ports, while the second year examined likely changes in ship size, routes and commodities once the larger locks were opened in early 2015. The LBJ School group presented their preliminary findings in April 24, 2012 to the TxDOT advisors selected by the Research, Technology and Implementation (RTI) office. The presentation was entitled “Panama Canal Expansion: Its Role in U.S.-Asian-South American Trade and Its Potential Impact on the Texas Transportation System.”

The findings first examined the broad markets served by Texas ports (both imports and exports) and developed chapters on trade lanes and trends in trade for both Asia and Latin America. It was done both to give a sense of scale in trade volume and value and to reflect changes in the location of economic activity in each region. As an example, the pre-eminence of China in global trade with the U.S. is impacted by the creation of the Association of Southeastern Asian Nations (ASEAN) which is luring companies away, principally on the basis of good but cheap labor. The south-easterly location alters routing and does, in certain circumstances, favor a Panama Canal all-water service. The same can be asserted for India, though many landside problems at Indian ports also exert a higher transportation cost on commodities traded with Texas.

The team first asked whether Texas ports could easily accommodate the trade volumes associated with the larger ships now entering service and repeated the conclusion reached by many others that almost all current authorized depths limit ship size. Not only is dredging Gulf access channels expensive because of length, the volumes of key traffic—like containers—is limited to Houston and Freeport terminals where there is insufficient volume for the larger ships. Typically, analysts view the volume needed at around 4-5 million TEU annually, which is about half of the amount moved through Houston in 2012. Finally, a number of Texas terminals have chokepoints, or lack rail access, which facilitate multimodal flows and unit train access for coal and grains. Although these challenges can be addressed through multi-year planning and funding, competition for certain funds—dredging, for example—requires comingling of funds from a variety of sources, which limits the likelihood of implementation.

Economic forecasts for the Texas ports were viewed as positive, with Houston and Corpus Christi benefiting from the larger Panama Canal locks, while Beaumont and Brownsville will benefit from growth in Latin American trade. All ports will benefit from global trade growth and a sub-set, including shallow draft ports, will benefit from the energy sector. The study findings were preliminary, but some pointers were offered on the role that TxDOT could play to assist the port community in supporting the growth of the state economy. The first was to focus on highway bottlenecks, particularly bridges and terminal links, which is generally being done by most ports through close collaboration with TxDOT District planning and programming. This would also include evaluating the benefits of overweight corridors at key ports, especially if it reduced truck traffic. The study recommended that TxDOT monitor and support rail investment, especially if it supported export flows. Finally, it suggested that a more effective way of promoting port activities within the statewide transportation planning activities be developed in time for the next update of the effort, due in 2013.

Table 2.1: Preliminary Conclusions of TxDOT Project 0-6690, Report 1

1. Texas economic performance is forecasted to remain strong and benefit Texas ports
2. Energy exploration and production will stimulate import and export demand and could impact Panama Canal flows
3. TxDOT should defer large investments based on benefits from the new locks until there is more clarity in maritime markets
4. TxDOT should monitor market developments as part of its statewide transportation planning

The third conclusion about the relevance of the Panama Canal is based on a two-fold argument. First, the Canal plays a small part in global trade¹⁹ and Texas ports are seeing faster growth in the Latin American trade. Second, the maritime sector is dynamic and will maintain a presence in many all-water routes in its efforts to grow service and retain business. In April 2012, there was no agreement about the timing and magnitude of Canal impacts. Moreover, as ship size grows, they have to call at fewer ports to maintain scale economies. With this in mind, since a number of Caribbean hub ports already service large ships, “hub and spoke” services could be offered to Texas container customers without the need to provide full draft for the ships. In terms of specific regions, manufacturing shifts from China to Southeast Asia and India may make the Suez route—for U.S. East Coast ports—more attractive. Finally, railroads should be expected to take action, in pricing for example, to protect market share in the face of Panama Canal competition.

Interest in the Panama Canal impacts on Texas ports continued through 2012 to the point where it was decided to call all stakeholders to join a working group to advise the state, through TxDOT, to respond. This working group met in six different locations and took testimony and planning information from a wide variety of individuals and entities. The SWUTC study provided a presentation, giving the background or context to the subject, together with some findings from TxDOT project 0-6690. The findings of the Panama Canal Stakeholder meetings are now described.

TxDOT Panama Canal Stakeholder Working Group (PCSWG)

In evidence given to the PCSWG,²⁰ the SWUTC-sponsored study offered the following mid-2012 perspective. First, since ship size is critical in terms of ton-cost, improvements like the Panama Canal locks have the potential to reduce these costs for the range of commodities moving between market pairs. This may benefit Texas exports to Asian markets, both of bulk and agricultural products. The longer-term impacts are more important than the shorter-term, particularly since north-south trade remains critical for Texas ports. In terms of maritime planning, it was suggested that partnering with shippers, deep water ports, railroads and key GIWW users would allow TxDOT to strengthen its understanding of current and changing patterns of demand. As part of this activity, new services for dry bulk, liquid bulk and containers would be monitored. This, in turn, would determine potential constraints that could be the focus of medium-term planning and fall into three groups— channels on the seaside, terminal (port)

¹⁹ Less than 5% by world tonnage in 2011.

²⁰ June 2012

efficiencies and landside connectivity for rail, highway and barge. These could be grouped into short-, medium- and long-term projects that could integrate with the TxDOT highway planning routines and processes.

The Panama Canal Stakeholders Working Group (PCSWG) report was published in November 2012²¹ and its recommendations are summarized in Table 2.2.

Table 2.2: Main Recommendations of the 2012 Panama Canal Stakeholders Group²²

1. TxDOT should remain focused on trade-related transportation improvements
2. TxDOT should formalize freight into transportation planning
3. Plans are needed to increase the use of the Gulf Intracoastal Waterway (GIWW)
4. Texas ports should continue port and terminal improvement plans
5. TxDOT should act as a resource to Texas ports
6. TxDOT should support rail capacity improvements to accommodate growth in imports and exports
7. Develop a “Texas Global Gateway” marketing and information system

The PCSWG provided TxDOT with a wide range of recommendations about maritime activities and gateways, some unrelated to the expansion of the canal. It was well executed, supported by a wide range of transportation and customer modes and services and met at six locations to allow a regional picture to be captured. Table 2.1 shows that few recommendations directly related to the impacts of the new canal locks in Panama itself. Rather, they reminded transportation planners that all freight, modes and gateways need to be efficiently working to provide the state with a competitive system for moving both imports and exports.

TxDOT addressed several recommendations wholly, or in part, by early 2013. The PCSWG team members were invited to stay on and provided strategic responses to issues that might emerge during the new Legislative session. Integrating freight into statewide planning had begun earlier and at least the first steps were made when preparing the request for proposals for the 2013 update of the statewide transportation plan. There is long way to go before statewide planning can reflect patterns derived from logistical analysis but there is a potential for experimenting with changes to the traditional statewide planning format that will eventually produce more accurate planning data. TxDOT recognizes the role of the GIWW and is attempting to determine alternative ways of supporting a program that would make a series of investments to raise system efficiency. Texas ports compete for business with both state and regional ports and each has a portfolio of funding mechanisms that it uses, if they are permitted. However, there are always many more projects than funding, even at the largest ports. The 2008-2010 recession and slow recovery have driven shippers and the maritime industry to seek the lowest cost gateways and they are resistant to higher rates to support new investments, even when they will result in higher productivity levels and lower rates below current levels.

In 2012, TxDOT created a maritime Division to support, and be a resource to, Texas ports and statewide planning. This provides a major opportunity to bring maritime planning into the mainstream of statewide planning, working through the Texas Ports Association and water-

²¹ http://ftp.dot.state.tx.us/pub/txdot-info/panama/final_report.pdf

²² <http://tti.tamu.edu/group/stsc/files/2011/05/Turnbull-12-18-12.pdf>

related entities. The recommendations on rail are sensitive, since rail companies that can access or serve Texas port terminals want to grow business, but not at the expense of rail freight – particularly containerized freight—traveling across the trans-continental systems in which they have invested billions of dollars over the past decade. A related point is that the current rail system has sufficient capacity, for at least the coming decade and perhaps longer. Previous rail analysis suggests that inefficient bottlenecks constrain capacity and these may be site-specific and sometimes in other states.²³ It would be helpful if regional system-wide bottlenecks, including those at Texas ports, could be derived from statewide rail planning analysis and recognized in state freight planning. Finally, the call to form a Texas Global Gateway marketing and information system is interesting but lies outside TxDOT and is better placed in other state agencies. If TxDOT planning activities can be integrated to reflect improvements to port and corridor efficiencies, the logistics industry will respond through their own highly-detailed, dynamic information systems.

This chapter reflects the wide variety of interest shown in the state on the Panama Canal expansion and related economic impacts, especially exports.²⁴ Ports have to function in three areas; the seaside (channels), the terminals (port) and the landside (modal access). It is the first that creates many challenges in the longer term when Texas and regional demand creates a true “load center” for containerized commodities, and bulk products of all types are routed through the port gateways to support the economy. The second is typically addressed in the strategic planning of the port and funded through a variety of mechanisms, including partnering with users of terminal operating companies. The third is comparatively healthy and working reasonably well. In a recent Texas waterborne trade study, over 40 percent of the projects identified as port improvements related to highway projects. Moreover, many had been subject to transportation analysis and entered into the TxDOT transportation improvement process.

The question of adequate channel depths and berths remains relatively critical at the time of this report. But, is it essential to have deep channels—some as much as 50 feet—if a Gulf port wishes to service the largest ships—both container and bulk carriers—now entering service? The answer may lie on the economics of transshipment versus direct service, a key element of supply chain design that will be tested in the next five years, and is examined in the next chapter.

²³ See http://www.camsys.com/pubs/AAR_Nat_%20Rail_Cap_Study.pdf

²⁴ There were at least two other research reports sponsored by MARAD and the DOT, and almost every transportation-related event dealing with trade had a session on the Canal in 2012.

Chapter 3. Route Choice: Transshipment Hubs vs. Direct Service

Global supply chains contain transfer points where cargo is loaded, transferred or unloaded, ranging from basic systems moving bulk commodities to more complex ones for containerized freight. Each transfer carries a cost and is not made unless the aggregate benefits to the chain exceed total costs, enabling the chain to be competitive with rivals. Complex transportation systems are still made for rather basic reasons – value, profit margins, reliability and cost.²⁵ Transshipment ranges from a transfer from one ship to another to unloading the container and adding value to the shipment, for example by consolidating different commodities into a second container for delivery to a specific customer.²⁶ In certain cases, value activities might include some form of “light” assembly using containerized components from different sources with the finished product then sent by new containers to the marine port best-suited to the landside network of the customer. The benefit to the local economy where such transfer activities take place can be profound and include direct, indirect and induced employment, typically estimated by input-output models.

This chapter simplifies what is essentially a dynamic, and at times complex, process for ships using the Panama Canal. It addresses both the demand characteristics of the type of commodity, volume, value and timing, and the supply characteristics of vessel type, size, speed, operating costs and port terminal and delivery costs. It first breaks the commodities into three major groups comprising bulk, break-bulk and containerized freight,²⁷ and examines the potential for transshipment prior to its arrival at a Gulf port for imports and after it is loaded at a Gulf port for exports.

Bulk Commodities

Aside from economies of scale from larger vessels, direct service is favored for most bulk commodities. This is important for many Gulf ports which move substantial volumes—measured by both weight and value—of bulk products, including oil, petroleum products, aggregates and grains across their docks. These commodities will benefit from the expansion of the Panama Canal locks for current routes and strengthen the competitiveness of their shippers to the overall benefit of the Texas and regional economies. Additional costs would be incurred at the port interface if larger ships come into service before improvements to channel and berth dimensions are completed, and therefore will require unloading at buoys linked to underwater pipelines and, in extreme circumstances, lightering. Texas ports, unlike many other terminals, have relatively balanced import and export volumes and both will benefit for bulk commodities coming from, and going to, Asian and Southeast Asian markets.

²⁵ This includes the likelihood, or probability, of the shipment (e.g. container) missing the allotted slot and waiting for the next vessel.

²⁶ Where this takes place at a U.S. distribution center near the deep water port terminal – like Los Angeles – the second container is larger (wider and at 53 ft. often longer, so gaining a productivity edge.

²⁷ This does not include categories like auto carriers, military cargo and liquefied natural gas (LNG) ships but such services are almost always direct to a specific port and rarely transshipped.

Break Bulk Commodities

These are in a category of commodities defined as non-containerized bulk or project cargo, ranging from large sacks of minerals and steel coils to large and heavy pieces of equipment such as electricity generators and large chemical refining fabrications. Historically, all ports handled non-bulk products in this way—unloading items piecemeal or in groups using labor, nets, cranes and dock or ship-based equipment and then warehousing the cargo prior to customs clearance (if needed) and collection by the shipper. Containers have reduced the demand for non-bulk products handled in this way by reducing labor and storage costs and doing so with less damage and higher levels of security. Currently, the break bulk share of Gulf port traffic handled in the traditional way has significantly fallen over the past two decades. Nevertheless, it remains an important and profitable sector of marine trade²⁸ at the Texas deep water ports. Commodities moved include military equipment, oil and refining components, windmills, generators and heavy equipment of all types. There are several reasons for believing that project and break bulk cargo will continue to be important import and export business sectors for Texas deep water port customers. This belief is based on the projected growth in the Texas population—raising energy demand (electricity and gas)—to oil and gas exploration and refining needs to meet state, national and global needs. If demand is trending upward, the replacement of current refining equipment when it reaches the end of its life cycle, together with the need to increase output, will ensure project cargo will remain a strong element of future Texas Gulf deep water port import and export operations.

The enhancement of the Panama Canal, however, will not have a major impact on short- and medium-term breakbulk operations. The fleet comprises ships of two sizes: smaller ships averaging 12,000 dead weight tons (DWT) and large ones in the 25,000-30,000 DWT range. The former can be viewed as “tramp” operations—moving to regions of the world where work is available while the latter run what are essentially “liner” operations—following a fixed port sling or route which offers shippers a schedule they can use to book space and guarantee a delivery date.²⁹ Interviews at the *2011 Breakbulk Americas Conference*³⁰ confirmed that the largest breakbulk ships easily fit into the current locks and, at least for the next decade, operators stated that the market structure will not generate the cargo volumes justifying larger ships with their scale economies. The new locks will create a benefit if other commodities—especially when containerized—are moved through the new locks. This diversion should have a minor but positive impact by reducing wait times at the older locks providing breakbulk shippers with more reliable transit and service times.

Containerized Cargo

Global trade drives demand for all ship-based cargoes but, it is the containerized sector that most interests planners. Containers or boxes allow a wide variety of products to be shipped efficiently across global networks, including landside multi-modal systems. Boxes are moved on regular—often weekly—schedules which can place burdens on landside infrastructure like metropolitan highways. A large, 8,000 TEU post-Panamax ship’s weekly schedule could

²⁸ In 2010, The Port of Houston claimed it was the largest break bulk port in the U.S. and handled 65% of all major project cargo for the nation. See: http://www.portofhouston.com/pdf/pubaffairs/PHAMag_JunJul10.pdf

²⁹ Several breakbulk steamship companies around the world service transiting both the Panama and Suez canals.

³⁰ http://breakbulkevents.com/index.php?section=breakbulk_americas2011

theoretically handle around 800,000 TEU a year if operating a direct service to a single port.³¹ This is a substantial volume for all but the largest U.S. ports— for example the Port of Houston handled a total of around 1.8 million TEU in 2010.³² Planners responsible for terminal operations, truck operations and rail service clearly need to be aware of such developments in their long-range investment forecasts.

The regional market served by Texas Gulf deep water ports will grow as population and economic activity rises, even if strong growth is only present in Texas. Previous research at the Center for Transportation Research (CTR) at The University of Texas at Austin examined the challenges of predicting container volumes moving through the Port of Houston.³³ The most recent CTR work,³⁴ completed after the opening of the new Bayport Terminal, captures both the state demographic growth of the Texas population and the impact of a fully built-out Bayport terminal, but not the impact of the new locks. That number was 4.5 million TEU—well over twice current volume— and seems reasonable given that the terminals could operate longer hours and incentivize dwell and storage times (demurrage) once boxes are cleared for import or accepted for export.

**Box 3.1: Scale Impacts:
Containerships**

The differences on a cost-per-slot basis for an 8,000 TEU ship and a 14,000 TEU ship is more than 20 percent—which is a huge number when you consider the average industry margin per TEU is currently less than \$100.

Gary Ferrulli, 2011

Gulf ports have always had marine trade lanes to the west and east coasts of South America (the latter using the Panama Canal), Europe and more recently Asia, especially China. Containerized volumes (in TEU) are relatively balanced in terms of imports and exports at the Port of Houston, though Gulf ports face competition from other corridors. The most important of these is the transcontinental rail corridors of the Union Pacific (UP) and Burlington Northern-Santa Fe (BNSF) that links Texas to the Southern California port terminals of Los Angeles and Long Beach. These carry well over twice the annual container volumes moved through Texas deep water port terminals. If rail companies and other corridor modes can be expected to react competitively to Panama Canal improvements, what drives the arguments for substantial changes in current market share?

One factor is illustrated in Box 3.1, which provides an example of how economies of scale currently present in the container shipping sector impact costs and, therefore, prices. Large ships, when operated in the most efficient way show impressive levels of cost competitiveness compared to costs of current Panamax ships. Furthermore, over a four-year period beginning in 2008, the number of large containerships ordered, built, and entered into service has already

³¹ In April 7 2011, the MSC Maeva (8089 TEU) became the largest containership to serve the Port of Houston, although it was light-loaded to utilize the 45 ft. Houston channel. It handled 3,000 containers or 6,000 TEU if all were 40-ft.

³² See <http://aapa.files.cms-plus.com/PDFs/WORLD%20PORT%20RANKINGS%202009.pdf>

³³ The Port of Houston dominates Gulf port container volumes and accounted for over 90 percent of the boxes handled by Texas deep water ports in 2011.

³⁴ “An Analysis of the Value of Texas Seaports in an Environment of Increasing Global Trade,” Technical Report 0-5538-1 for the Texas Department of Transportation 2008. See: http://www.utexas.edu/research/ctr/pdf_reports/0_5538_1.pdf

created disequilibrium in the marine market and driven down rates offered to shippers. The “perfect storm” of higher fuel prices, lower global demand, and larger ships has created a wide range of containership sizes operating across the global trade lanes, ranging from 1,500 to 18,000 TEU and providing shippers with attractive opportunities to move product around the world. Why should steamship companies use the larger locks on the Panama Canal and what size of ship will they offer to shippers given the range of sizes available?

A number of key characteristics underpin large containership efficiencies that center on trade lane demand metrics and ship operating costs. The trade lane needs to offer the volume of boxes that can enable the larger ships to reach their design capacity over most of their route. This means that the largest ships call infrequently only at terminals that can generate such volumes that allow them to maintain or exceed a break-even volume of boxes. Larger ships are expensive to operate so port calls are reduced on routes, sometimes to the point of one per continent. Furthermore, such terminals must be able to provide 24/7 service and adequate channel and terminal capacity so that overall service efficiencies are kept at a high level. Currently, terminal call frequency for any route is related to containership size—as ships get larger, the number of calls drops to only those terminals that can load center sufficient box volumes to make the operation profitable. These terminals tend to be served by smaller ships on regional routes that form a “hub and spoke” system, which is used because it provides the lowest total cost to the shipper even though transshipment requires multiple handling of the box.

Gulf ports currently receive containers from both direct and transshipment services—for example the Port of Houston receives containers from Brazil transshipped at Caribbean terminals and has a direct Wal-Mart service from China that traverses the Panama Canal. The latter, by definition, is a Panamax size and that service is a potential candidate for larger ships when the new locks open. The size of the larger ship is not constrained by supply – there is a more than adequate number of post-Panamax ships, many of them relatively new and displaced from Asia-Europe routes by bigger ships too large for new locks now being constructed.³⁵ Instead, the size of ship in the immediate future centers on demand – and the ports on the U.S. Gulf and East Coast that have the customer reach and box volumes that would make it profitable to both shippers and those operating post Panamax ships.

A further key supply constraint is terminal access (particularly draft) at all three elements of the seaside operations namely channel, berth, and turning basin. Some East Coast and Gulf ports need all three improved to service the largest ship likely to provide a direct service, while others may have only the main channel to deepen. Figure 3.1 plots a simple decision tree that offers some insight into the type of ship size and operation that volumes might justify for shippers considering an all-water service to Texas using the Panama Canal. The decision tree comprises four steps, demand, canal fee structure, Texas (or Gulf Coast) port infrastructure and customer base, and finally, transshipment benefits.

³⁵ At 59 meters width, it is too wide for the new locks. See <http://www.worldslargestship.com/>

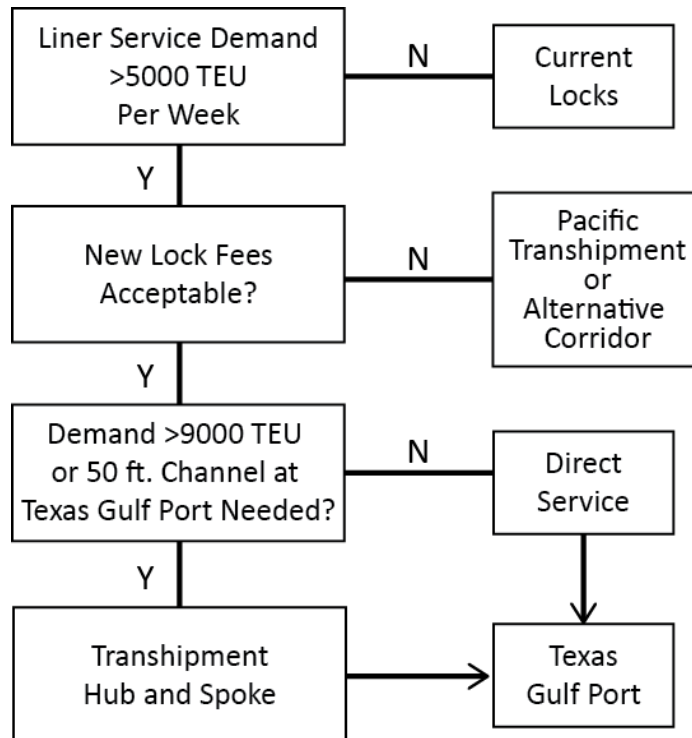


Figure 3.1: Panama Canal Containership Transshipment Decision Tree

This graphic is applicable to both import and export flows on a trade route and are now discussed in more detail.

Demand

Current Panamax ships carry slightly over 5,000 TEU³⁶ in favorable conditions,³⁷ and draft around 40 ft.—the typical minimum draft of most U.S. and Latin American East Coast deep water terminals.³⁸ A competitive liner service³⁹ therefore needs a level of demand that exceeds that figure by a substantial amount. Containership designs have increased in size, relatively rapidly, as naval architects incorporated advances to design and propulsion systems. The larger ships, initially termed “Megaships” began life at around 9,000 TEU and now encompass a wide range of sizes, the largest of which exceeds the capacity of the third set of Panama Canal locks now under construction. The sizes now exceeding Panamax (PM) size can be grouped into four size ranges for the purposes of this study: *Post-Panamax* (PP) in the 5,100-10,000 TEU category, *New-Panamax* (NP) in the 10,001 to 14,500 TEU category, and the *Ultra Large Container Vessel* (ULCV) which exceeds 14,500 TEU and the new canal lock capacity.

³⁶ This is a nominal rating of around 15 metric tons per TEU. If the commodity is light, then a higher number can be carried, if heavier, a lower number. It is for this reason that during 2007-2009, there were many complaints from shippers exporting U.S. products that containerships were leaving booked containers on the dock because the ship had drafted the maximum allowed by the access channel to deep water.

³⁷ Lack of rainfall can reduce canal channel depth and reduce vessel capacity, raising costs.

³⁸ The Port of Houston terminals and the major South Atlantic container terminals channels draft 45 ft. Savannah and Florida have plans to dredge to 50 ft.

³⁹ Liner services for containers call typically once a week—around 50 a year.

Table 3.1: Containership Capacities Relevant to the Panama Canal⁴⁰

Ultra Large Container Vessel (ULCV)	14,501 and higher	With a length of 397 m, a width of 56 m, draft of 15.5 m, and a capacity of over 15,000 TEU, ships of the updated <i>Emma Maersk</i> class are well over the limits of the New Panamax class.
New Panamax (NP)	10,000–14,500	With a beam of 43 m, ships of the <i>COSCO Guangzhou</i> class are much too big to fit through the Panama Canal's old locks, but could easily fit through the new expansion.
Post Panamax (PP)	5,101–10,000	
Panamax (PM)	3,001 – 5,100	Ships of the Bay-class are at the upper limit of the Panamax class, with an overall length of 292.15 m, beam of 32.2 m, and maximum depth of 13.3 m.

Each successive class of containership is more expensive to build, finance, and depreciate but, offer lower cost per TEU if the ship carries sufficient boxes (payload) to keep costs in the most efficient part of the cost curve. Therefore, steamship companies can offer competitive prices, as stated by Ferrulli in Box 3.1, by operating large ships if there is sufficient demand on that trade lane. This is shown in Figure 3.2, which illustrates a theoretical series of cost curves for all four ships identified in Table 3.1.

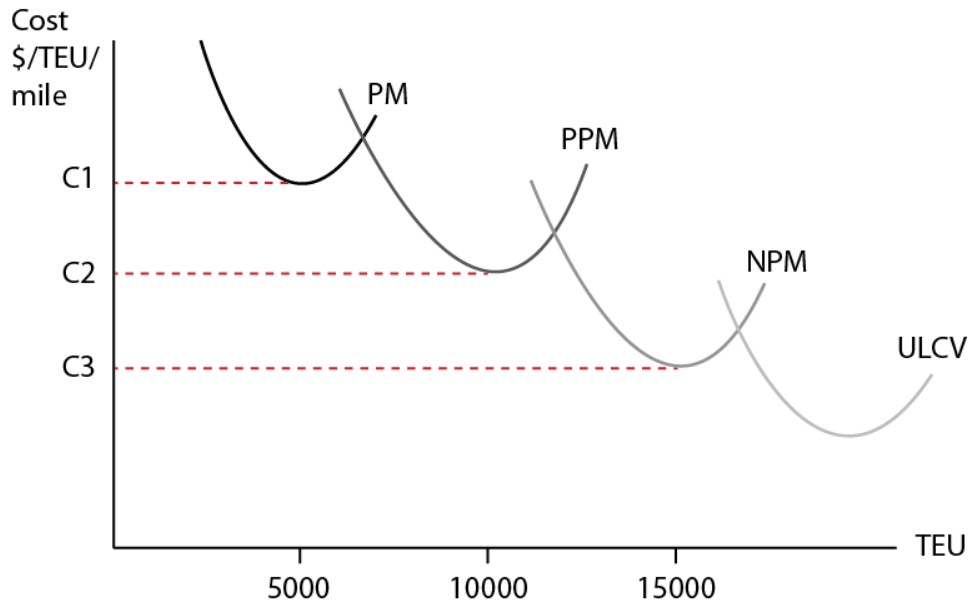


Figure 3.2: Average Cost Curves for Various Containerships

The figure shows designs that optimize TEU/mile costs at 5,000, 10,000, and 15,000 TEU levels with costs of C1, C2, and C3 respectively. The fourth category, ULCV, is too large for the new locks but shows that some global origins and destinations could be serviced by ULCV types sailing longer routes than smaller vessels.⁴¹ The central point being made is that a steamship operator will only move to a larger ship if the demand is sufficient to fully load the ship, in at least one direction. Cost curves also show the dangers of not reaching the designed

⁴⁰ Source: http://en.wikipedia.org/wiki/Container_ship

⁴¹ Cape vs. Suez or Suez vs. Panama Canal, for example.

capacity—costs per TEU/mile rise quickly. If a company commits large ships to a specific trade lane and demand falls, as it did at the start of the recent global recession, steamship companies quickly lose money, so canal users have to incorporate significant risk into their decisions on ship size and routes. This suggests that they will carefully evaluate the efficiencies of using the new locks relative to using other, competitive supply channels.

Panama Canal Lock Fees

Speculation on the economic impacts of the third set of locks began immediately once the bond funding was successfully floated on the capital markets and the construction schedule was seen to be on-time and under budget. Three major milestones had been reached—first the locks were actually being built and would raise capacity to existing canal users, second larger containerships were available to replace the Panamax size, and finally, these ships lowered the cost per TEU mile and so provided shippers with better profit margins. However, a critical fourth factor was absent and makes it difficult to forecast impacts with precision. What will be the fee structure put into place for all passages—old and new locks—when the enhanced canal is open for business?

The fee system used before the canal was returned to Panama administration was determined using a relatively simple “cost plus” method based on actual operating costs. These were comparatively modest given that no fundamental changes to the 1914 design had been undertaken.⁴² The new Panama Canal Authority (ACP) immediately began planning a series of investment programs to raise efficiencies and attract the larger ships that were being introduced on the global trade lanes. Channels were deepened and widened to permit ships to pass at critical sections of the canal. Locks were updated; with special attention paid to the control systems (that had remained virtually unchanged),⁴³ and the electric railed “mules” that stabilize a ship as it passes through each lock system.⁴⁴ The decision to move forward with the new locks needed a Panamanian referendum and a series of analyses were commissioned with a wide range of specialist companies and consultants to estimate both the costs and benefits of the investment.

Critically, ACP does not view the canal in isolation from the Panama economy. Rather, it supports a comprehensive review of economic activities that are linked to canal users from bunkering, transshipment to value-added inland port type services that would move them from U.S. locations but would allow delivery directly from the final port terminal to the customer. In any event, the ACP takes the view that pricing should be market-based while remaining competitive, which is often taken by shippers as raising fees where the opportunity arises. This sensitive issue clearly impacts the bottom line of those decision-makers in the shipping supply chain and if they are unable to meet the new fees, they will move to another trade route or transship at either end of the canal.

Is a Gulf Port 50-foot Channel a Necessity?

The differentials shown in the cost curves in Figure 3.2 assume that the critical issues are demand and ship size. This is a simplification because several factors have to be in place for a smooth transition to larger ships and the failure of any one might deter the adoption. There are at

⁴² Construction of a larger set of third locks started during World War II, but was halted early in the schedule. The 2014 lock design uses sections of the excavation work, so shortening the construction schedule.

⁴³ This rather remarkable life cycle was possible because of the simplicity and ruggedness of the lock water system that was “powered” by gravity.

⁴⁴ The new locks will not utilize this system.

least three groups of limiting factors, namely seaside, port and landside. These are briefly described below.

- Seaside limitations center on the channel dimensions that link deep water to the port facilities, which in the Gulf means crossing a relatively wide continental shelf. In addition, some ports are located on rivers that deposit silt into the basins and deltas. These factors, when combined with hurricanes that further displace sand, make regular dredging a critical feature of East coast and Gulf port access. Unfortunately, the Army Corps of Engineers—who are responsible for dredging—have insufficient funds to keep pace with siltation and a number of channels are less than authorized depth, further limiting access by the larger ships.
- Demand drives ship size—the cost curves show that a lightly-loaded larger vessel is more expensive to run than the smaller vessel and is replaced over certain ranges of volume. If we take the study estimate of 4.5 million TEU per year as representing the entry volume for an efficient “load center,” then even Houston, the largest Gulf container port, is unlikely to reach this figure for a decade.⁴⁵ The projected increases can be serviced by larger post-Panamax ships of the PP class in Table 4.1, which can utilize the current channel depth of 45 ft. for all imports and most exports.
- Caribbean Hub and Spoke decisions can then be made using cost models and shipper needs. To date, these have concentrated on Caribbean deep water terminals in a variety of locations from The Bahamas to Puerto Rico. Naturally, service times and costs increase with transshipment, but it does put boxes on the last leg to their Gulf port on a smaller ship that can utilize current channels. Some simple examples of route distance and time is given in Table 3.2. However, there is one interesting hub and spoke route that has been ignored by many commentators, namely transshipment in Panama to a ship that can use the current channels. The distance would be identical while the time would increase by the time needed to cross-load the cargo, potentially within a 24 hour period in the simplest case. The total cost might actually be less if the volumes are not too large and this case is likely to be investigated by shippers once the fees for the new locks are announced and shipper demand for the Panama Canal locks becomes clearer.

Table 3.2: Direct versus Caribbean Hub and Spoke Service

Route	Nautical Miles	Number of Days
Colon-Houston	1528	4
Colon-Savannah	1563	4
Colon-Bahamas-Houston	2276	7

The issues examined in this chapter will stay with those evaluating the economic impacts of the new Panama Canal locks over the next five years and it is likely that various types of hub and spoke routes will be tested along with direct service for the 45 ft. draft ships—for all types of commodities. These examinations will then form part of the strategic planning of those ports

⁴⁵ TxDOT Technical Report 0-5538-1, “An Analysis of the Value of Texas Seaports in an Environment if Increasing Trade,” (2008) used time series data at Houston and tested several forecasting models which projected 4 million TEU around 2025. www.utexas.edu/research/ctr/pdf_reports/0_5538_1.pdf

wishing to service the largest vessels working the Gulf. Texas statewide planners should be aware of these deliberations when conducting competing multi-modal economic maritime investment evaluations. The next chapter summarizes the study findings and offers some recommendations linked to transportation investments.

Chapter 4. Conclusions and Planning Recommendations

The Panama Canal Authority (ACP) accomplished a fundamental change in how the Panama Canal is managed, operated, and priced, and also took a calculated risk in supporting a vision that went beyond that of simply collecting fees from those using the canal. They have structured a series of complementary investments that support logistical value-added services for those shippers using the canal. Skeptics at each stage of the implementation of the business model have been shown that the ACP is capable of meeting investment targets under budget and understands the global market of producers, shippers and modes. Some cautionary observations are in order, however. First, the Canal traffic is currently a small percentage of global trade—around 5 percent by tonnage. Second, it must compete for traffic on some key routes by carefully tracking the Suez Canal fee structure and pricing policy—it does not have a pure monopoly in any commodity segment. Third, Canal demand is derived from global activity and this is predicted to remain weak in many regions, reducing demand at a time when capacity is being added. Fourth, the maritime sector has been losing money and struggling with over-capacity, so its ability to absorb the new lock fees, when announced, must be recognized in the ACP pricing structure.

The study conclusions and planning recommendations are those developed in 2012 at a time when market conditions were fluid and the U.S. economy was only slowly improving. They are designed to help planners contemplating multimodal improvements at the state-wide level such as TxDOT. The Canal project will be constructed, tested and ready for larger ships in early 2015. Most of the ancillary facilities and services will be operating at that time, meeting the ACP focus of offering a portfolio of logistic services and not simply a canal passage. It will have an impact on Gulf ports and landside transportation systems in Texas by providing shippers with a more competitive route to Asian and Indian markets for both Gulf imports and exports. Forecasts provided by the ACP suggest modest use by large ships as the steamship companies develop operating responses through analysis, trials and customer feedback. Finally, the new Panama Canal facilities and services will help the Texas economy remain competitive in key regions and shipping lanes, particularly bulk and new energy exports like LNG.

Planning recommendations are now provided to assist those updating statewide planning and building a more dynamic and responsive approach to freight supply chains. The topics raised include Asia-Suez Canal versus Asia-Panama Canal large containership services to U.S. East Coast ports, the impact this could have on Asian trade lanes to middle America using California ports, including Texas destinations like the triangular heartland, the importance of efficient non-containerized trade in the Texas economy, the inability to measure transportation and costs for the Panama Canal routes accurately in 2012 since none have been announced, and finally the dynamic quality of changes in global manufacturing which first drove out-sourcing and is now driving decisions on near-sourcing and even re-shoring in the U.S. mainland.

- Steamship companies currently using the canal are already “running the numbers” on costs – the current intangibles are the global economy, specific regional growth – both imports and exports – and the demand for shipping services that would use the larger canal. The Journal of Commerce recently reported, “Most carriers are taking a neutral position on the Panama Routes and (the) Suez will be the place for expansion on the East Coast of the U.S.”⁴⁶ Asian and Southeast Asian traffic on

⁴⁶ Peter Leach, “Where East Meets West”, The Journal of Commerce, 2013, V.14 N.2.

carriers that already have 8,000 TEU vessels will deploy them to East Coast gateways that can handle the draft. The new post-Panamax ships are 30-percent more fuel efficient than older designs of similar size, which can translate to \$40,000 a day in fuel costs. This strongly suggests that Houston could have several 8,000 TEU services (the 45 ft. channel works for this size) using the Panama Canal if regional demand can create a load center.

- Drewry consultants have some compelling cost comparisons to show that the WCCA port container growth (linked to the BNSF/UP Transcontinental routes) is vulnerable. This will impact traffic forecasts on Class I routes in Texas and IH-10/20 corridors. Drewry states “If the Canal Authority succeeds in moving a 13,000 TEU vessel through its new locks, the West Coast ports will be ejected from the Midwest markets entirely.” They calculate that the boundary in favor of West Coast at this moment lies around Dallas. These claims need to be treated carefully since they could alter fuel price increases and competitive responses from the western Class I railroad companies. The full trans-continental service of the 1990s has now given way to East Coast port growth supported by the three Western Class I railroads.
- Gulf port authorities believe they will gain a substantial share of the growth in business using the new locks. A Louisiana DOT research project suggests 18-20-percent increase for Gulf ports while POHA estimates a 15-percent growth in annual container volumes in Texas. These numbers should be regarded as estimates subject to revision—the POHA figure would exceed terminal capacity within a 5-7 year period so a series of related investments—channel maintenance, terminal productivity, and possibly location and landside access improvements for both truck and rail services—may be needed in the coming 5 years to meet this prediction.
- Some analysts doubt that the new locks will substantially divert current U.S. West Coast port traffic in large volumes, particularly via the Panama Canal to East Coast ports north of Savannah. As noted above, a number of East Coast ports are already serving, or are about to serve, 8,000 TEU containerships routed via the Suez Canal. Box 4.1 quotes noted analyst Ted Prince who argues persuasively that only a handful of USEC ports will benefit after the larger Canal enters service. Note; however, that this is directed at containers and not bulk vessels that use most Texas deep water ports and carry much of the export cargoes.

Box 4.1: Panama Canal Expansion Impacts on U.S East Coast Ports

“The Panama Canal expansion is without question an important event in global transportation. The ACP has already been successful in facilitating cargo diversions from the USWC and the canal expansion will ensure that this market share is protected. The canal may also become a driver of transportation and logistics growth in the Caribbean. In all likelihood, whatever cost advantages the canal expansion facilitates for the lines will be passed through to shippers. However, there is a dichotomy in how shippers route cargo. And unless routing cargo through an expanded canal helps shippers substantially improve their overall supply chain costs, they will not greatly increase their usage of all-water service from Asia to the USEC. It is also likely that as the size of container ships in the U.S.-Asia trade increases, carriers will increasingly concentrate vessel calls at fewer USEC ports. It seems clear that the Panama Canal Authority and only a handful of USEC ports will benefit after 2014.”

Source:

http://www.supplychainquarterly.com/topics/Global/201201panama/?utm_medium=email

- Trade impacts should not be measured only in terms of containers, especially for Texas ports—because state trade is more granulated and diverse. Direct service of bulk, liquids, car carriers and cruise service calls may not be joined by containerships, which might hub in the Caribbean en route to Savannah and Charleston. Ro-Ro auto carrier calls have collapsed at Houston—199 calls in 2004, 175 in 2006, and 74 in 2008. The Canal Authority believes they will not reach their previous market size, even when the economy strengthens.
- Gulf bulk shipping services should continue to grow from a variety of Texas deep water ports, particularly between Latin and South American markets, based on demand for Gulf exports and non-containerized imports. It is not simply focused on imports and containers. Canal Authority says that bulk movements—much from Brazil—have stepped into the gap left by the fall in containership passages. Bulk trade flows should be regarded as highly significant for Texas, especially if energy exports (like LNG) grow as predicted in the medium term.
- Current analyses are weakened by a lack of data on demand and costs—almost all the arguments are based on the supply-side infrastructure provision. Overall, the Canal expansion should be good for Texas shippers (particularly exports), although the scale of the logistical advantage over other corridors serving the state is incomplete at this time. The shift in production from China to Southeast Asia for certain commodity goods has favored a Suez route to U.S. East Coast port terminals. However, this is not likely to impact, in the short/medium term, Gulf ports that remain linked to the Panama Canal for future growth in all-water Asian trade. Texas markets—imports and exports—are served by a large regional cluster of supply chains linking California, Mexico and Texas Gulf gateways to regional markets by truck and rail landside moves.

- Shifts in global production- and transportation-derived services continue and will impact trade patterns in the next decade. The Economist recently produced a Special Report⁴⁷ on the global manufacturing and outsourcing, near-sourcing, reshore⁴⁸ and moving between low-cost countries. In North America, several examples were provided of new manufacturing plants and IT centers locating back from Asia to the U.S. or the NAFTA partners Mexico (especially) and Canada. This has direct impacts on the transportation supply chains, especially maritime routes and terminal operations for containerized sub-components. This is a significant development for TxDOT since it impacts an area of trade flows not studied in recent years, namely NAFTA trade flows in Texas and the U.S. This may well have much larger strategic impacts on statewide transportation than that from the large Panama Canal, especially in the short- to medium-term planning cycle.

The study agrees with the findings related to port and marine planning of the 2012 Panama Canal Stakeholders Group, which advised TxDOT on the economic impacts of the Panama Canal expansion. TxDOT has created, and is now staffing, a marine division that will integrate port investment programs and landside needs into long-range planning. An advisory group of deep water ports, railroad companies and key waterborne customers has been set up to guide statewide freight policy and help address legislative initiatives related to international trade. TxDOT is about to begin the update of its statewide transportation plans and more effective support from the port communities can only sharpen and strengthen their multimodal planning over the next four years.

⁴⁷ The Economist, Special Report : “Outsourcing and Offshoring” January 19-25 2013 at Economist.com/specialreports

⁴⁸ Defined as moving new manufacturing/service centers back to the original country of origin.

Appendix A: Panama Canal Impacts: Background and Project Scope 2007-2010⁴⁹

A.1 Canal History

The idea of a waterway connecting the Atlantic and Pacific Oceans goes back to the 16th century, when the first crossing of the Isthmus of Panama was accomplished by Spanish explorer Vasco Nuñez de Balboa in 1513. A precursor to the conception of the Canal was the construction of the Panama Railway across the Isthmus, which took place from 1850 to 1855, running 47 miles from Colón, on the Atlantic Coast, to Panama City on the Pacific. The existence of the railway was the key in selecting the route—then part of Colombia—for the Canal.

The French, shortly after the completion of the Suez Canal in 1869, obtained a concession from the Colombian government to undertake the construction across the Isthmus. At the time, Panama was a province of Colombia. Construction of the sea-level canal (without locks) began on January 1, 1882. The land, which is about 50 miles wide at its narrowest point, represented a much tougher challenge than the constructors could envision. The dense jungle vegetation, the mountains, the heavy rains that caused frequent flooding of the Chagres River, the deep swamp, the heat, and the humidity were only part of the difficulties faced by the constructors. The greater hardship, though, was provided by diseases—malaria and yellow fever were endemic to the Isthmus, and the state of medical knowledge at the time did not include the fact that mosquitoes are the transmitters of such diseases, which resulted in an estimated 22,000 deaths between 1881 and 1889. The first French enterprise folded in 1893, and a second one took over the following year, but ultimately, construction was abandoned altogether, mainly due to disease and financial difficulties in 1899.

The United States, which had been interested in developing a Central American canal, took advantage of the French subsidy at the Isthmus. However, negotiations with Colombia for a concession were unsuccessful. Thus, the U.S., out of their need to construct the Canal, supported Panama's independence movement. Panama declared independence from Colombia on November 3, 1903. A treaty granting the U.S. the Canal's concession in perpetuity was signed, the French equipment and excavations were purchased for \$40 million (USD), and construction was restarted on May 4, 1904. The project called for an elevated canal, with dams and locks, as opposed to the original French concept of a sea-level waterway. This new idea had the advantage of reducing the total excavation volume necessary to accomplish the interoceanic connection. The route from Limón Bay to Panama City was chosen. By that time, it had been discovered that the diseases that had been so detrimental to the workforce of the French venture were transmitted by mosquitoes. Thus, a substantial investment was dedicated to eradicate the insects, and this proved to be a key component of the project that resulted in its eventual success. The Gatun Locks were constructed near the Atlantic Ocean, and the Pedro Miguel Locks and Miraflores Locks close to the Pacific side of the Isthmus. The Canal's construction was completed in 1914, and it formally opened on August 15, 1914.

⁴⁹This Appendix was compiled by Manuel Trevino from material comprising the Panama Canal Authority Website and other sources available in 2009. It is provided for readers who need a primer on the Canal and the attributes of the thirteenth set of locks project. Current updates may be found at <http://www.pancanal.com/eng/>

In 1977, a new treaty was signed between the U.S. and Panama, granting the Panamanians free control of the Canal so long as the Panamanian administration guaranteed the permanent neutrality of the Canal. This led to full Panamanian control effective on December 31, 1999.

A.2 Demand

Since the Canal opened on August 15, 1914, the waterway has provided transit service to more than 815,000 vessels. The Canal has had over 14,000 transits in each of the last 4 fiscal years. In fiscal year 2008, there were 14,702 total transits, accounting for \$1,317 million in tolls, and almost 210 million tons of cargo, representing about 5% of total global maritime trade. Currently, about 30% of the total oceangoing transits are by Panamax-size vessels.

A.3 The Canal's Market Segments

The Panama Canal Authority (ACP) classifies its market into eight segments, depending on the type of cargo and the type of vessels used to transport it, namely:

- 1) Containership segment: all sorts of products, mainly processed and manufactured goods
- 2) Dry bulk segment, moved in dry bulk vessels used for transporting grains as well as minerals or their derivatives; sugar, salt, cement
- 3) Vehicle carrier segment
- 4) Liquid bulk segment: vessels transporting chemical products, fuel, gases and oil derivatives
- 5) Reefer segment: fruit, meat, dairy
- 6) Cruise ship segment: passengers on leisure trips, who see the Canal and Panama as a touristic attraction
- 7) General cargo vessel segment: a variety of products in small lots, serving regional routes
- 8) Miscellaneous vessel segment: fishing boats, navy and research vessels, and dredges and barges

There has been a steady increase in the tonnage going through the Canal for each segment. Historically, the dry and liquid bulk segments have generated most of the Canal's revenues. However, in recent years the containership segment has seen a dramatic increase, to the point of becoming the main driving force of Canal traffic growth (Figure A.1). Containers account for the highest number of transits, highest amount of tolls, as well as for the highest number of TEUs.

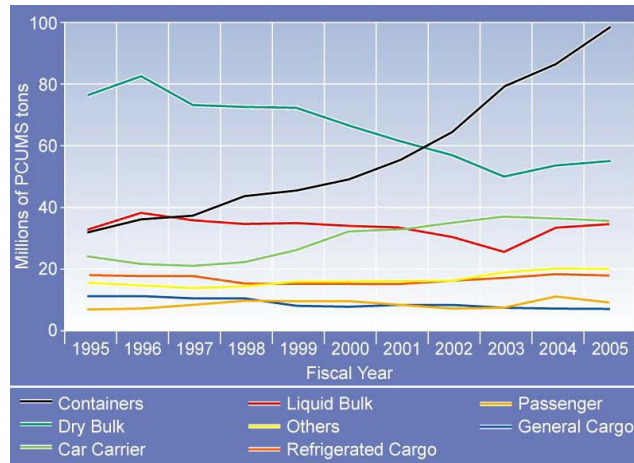


Figure A.1: Historic Tonnage of Market Segments Through the Canal
Source: ACP, 2009

The growth of the containership segment is a result of an increase in the number of transits of this type of vessel through the Canal, but mainly it is a consequence of the increasing size of vessels that the segment uses.

Table A.1 shows the expected growth in traffic through the Panama Canal, both with and without the expansion, projected 20 years into the future.

During fiscal year 2005, the containerized segment moved 98 million tons as measured under the Panama Canal/Universal Measurement System (PC/UMS), i.e., 35% of the total PC/UMS volume passing through the Canal, representing 40% of its revenues. That same year, the dry bulk segment represented 55 million PC/UMS tons and 19% of the revenues, while the vehicle carriers segment accounted for 35 million PC/UMS tons and 11% of the income.

Table A.1: Expected Growth in Tonnage through Panama Canal 2005–2025 (In Millions)

Market Segment	2005 Tons	Year 2025 Tons	
		Without Expansion	With Expansion
Containers	98	185	296
Dry Bulk	55	49	73
Liquid Bulk	34	19	28
Passenger	10	13	19
Car Carrier	36	40	58
Refrigerated Cargo	19	15	22
General Cargo	7	3	4
Other	20	6	8
TOTAL	279	330	508

Source: Panama Canal Authority, 2006

Projections indicate that, in the most probable demand scenario (shown in Table A.1), the Canal's PC/UMS tonnage volume will almost double in the next 20 years, increasing by an average of 3% per year. This scenario is consistent with a 3.5% annual increase of the Canal's tolls that would result in a doubling of present tolls by 2025. The Canal's containerized cargo will increase at an average annual rate of approximately 5.6%, from 98 million PC/UMS tons in 2005 to nearly 296 million in 2025.

Container shipping activities have experienced the highest growth in the larger vessels, especially the ones able to carry 7,000 TEUs or more, which currently do not fit through the Canal.

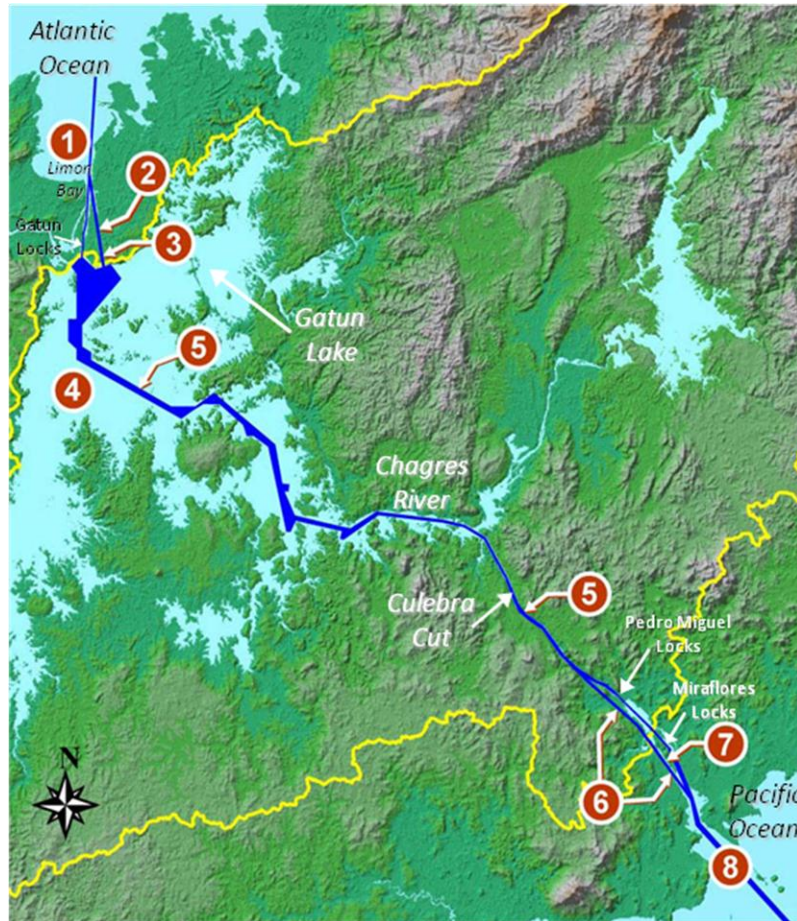
The vehicle carrier and cruise ship segments will have an average annual growth of between 2% and 3% in terms of PC/UMS volume. The dry bulk segment will grow at an average annual rate of approximately 1% during the next 20 years (Table A.1).

A.4 Expansion Project

After almost a century of successful operation, the Canal faces potential problems, related to its physical limitations and the increasing size of cargo ships. The maximum size of ships that can use the canal is determined by the dimensions of the lock chambers (110 ft. by 1050 ft.). As of 2006, more than 45% of the ships using the Canal matched the lock dimensions; these ships are known as Panamax vessels. Many shippers attempting to satisfy the current worldwide trading demands would need to utilize Post-Panamax (larger than allowed by the Canal's lock dimensions) vessels. The Canal's traffic is soon expected to approach its maximum capacity. Additionally, the number of larger (close to Panamax-sized) ships transiting the canal is increasing steadily. Realizing these issues, the ACP has taken action to increase its capacity, by means of the expansion project. The expansion project consists of three major components.

- The construction of two new lock facilities, one on the Atlantic side, and one on the Pacific side.
- The excavation of new access channels to the new locks and the widening of existing channels to accommodate larger ships.
- The deepening of navigation channels and the elevation of Gatun Lake's maximum operating level.

The project is designed to allow for an anticipated growth in traffic from 280 million PC/UMS tons in 2005 to nearly 510 million PC/UMS tons in 2025; the expanded canal will have a maximum sustainable capacity of approximately 600 million PC/UMS tons per year. Figure A.2 shows a map of the Panama Canal with expansion elements noted.



1. Deepening and widening of the Atlantic entrance channel
2. New approach channel for the Atlantic Post-Panamax locks
3. Atlantic Post-Panamax locks with three water-saving basins per lock chamber
4. Raising of the maximum Gatun Lake operating water level
5. Widening and deepening of the navigational channel of the Gatun Lake and the Culebra Cut
6. New approach channel for the Pacific Post-Panamax locks
7. Pacific Post-Panamax locks with three water-saving basins per lock chamber
8. Deepening and widening of the Pacific entrance channel

Figure A.2: Map of the Panama Canal's Expansion Elements
Source: ACP 2007

A.5 New Locks

In its current condition, the Canal has two lock lanes. The expansion will add a third lane, by means of the construction of two lock facilities, one at each end of the Canal—one on the Pacific end, south of the Miraflores Locks (Figure A.3a), and the other one on the Atlantic end, on the east side of the Gatun locks (Figure A.3b).

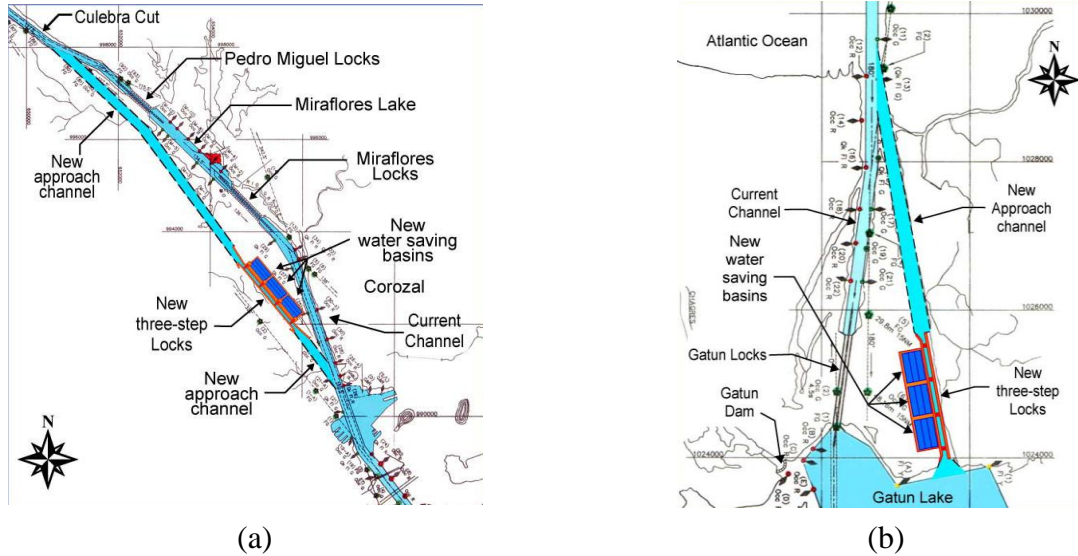


Figure A.3: New Locks Proposed for the (a) Pacific Ocean Side, and (b) Atlantic Ocean Side

Each of the new lock facilities will have three consecutive chambers (Figure A.4), designed to move vessels from sea level to the level of Gatun Lake and back down again. Each chamber will have three lateral water reutilization basins, for a total of nine basins per lock and eighteen basins in total. The new locks and their basins will be filled and emptied by gravity, without the use of pumps.

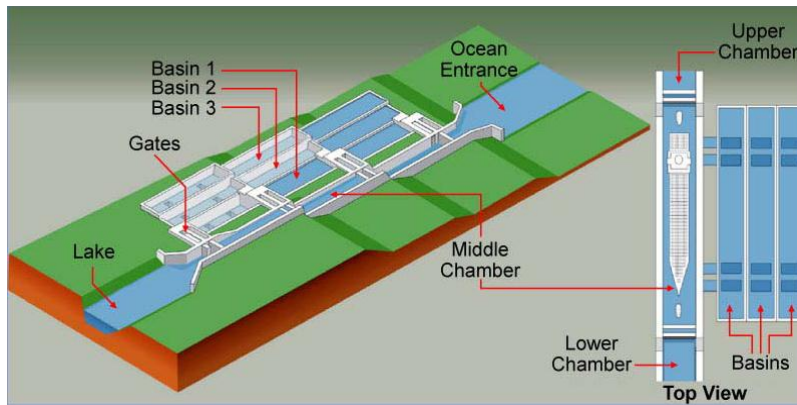


Figure A.4: Schematic of the New Locks Proposed for the Panama Canal Expansion

The new locks and their channels will form a navigation system that will be integrated into the existing locks and channels system, which will continue to operate. The new lock's chambers will be 1,400 ft. (427 m) long, by 180 ft. (55 m) wide, and 60 ft. (18.3 m) deep, which is large enough to allow the traffic of vessels equivalent in size to a ship carrying around 12,000 TEUs. The new locks will use tugboats to position the vessels instead of locomotives.

A.6 Schedule

It is estimated that the new locks could begin operations between fiscal years 2014 and 2015. The proposal to expand the Canal was approved in a national referendum by

approximately 80% on October 22, 2006. Funding availability for project construction was secured in December 2006. Construction of the project started on September 3, 2007, when the first blast took place to expand the Culebra Cut.

The schedule is divided in two main phases: the preconstruction phase and the construction phase. The preconstruction phase includes the development of final designs, physical models, specifications and contracts, contractor pre-certification, and finally, contractor selection. For the locks component of the project, this phase could last between two and three years. Dry excavation and the dredging of channels have already started.

The construction phase includes the simultaneous construction of both lock facilities with their water reutilization basins, dry excavation of the new access channels, and dredging of both new lock access channels and Gatun Lake navigational channels, as well as of the sea entrances. Building the locks will take between five and six years. An illustration of the summarized project schedule is shown in Figure A.5.

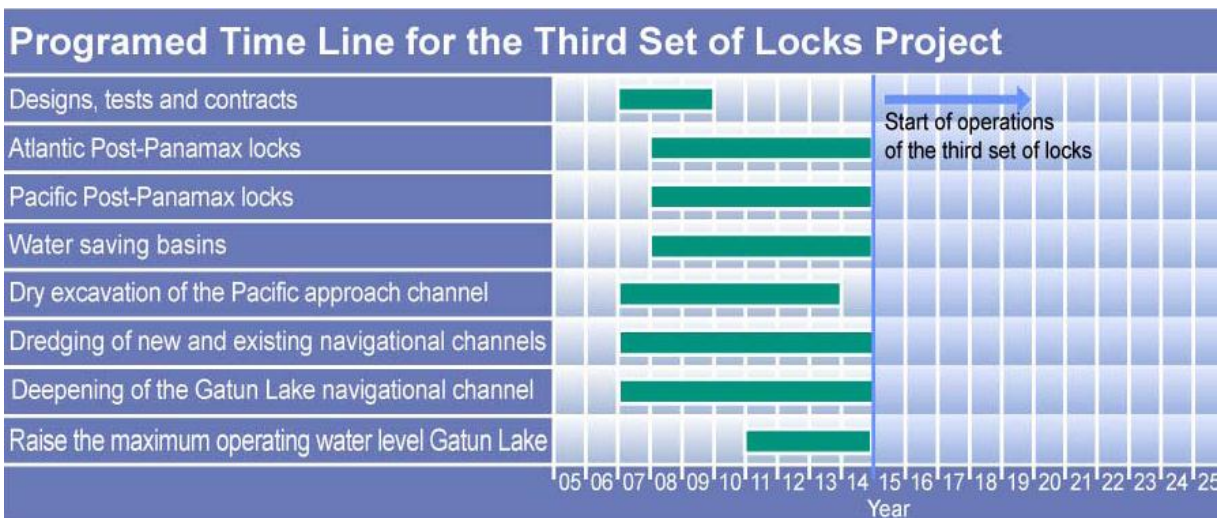


Figure A.5: Panama Canal Expansion Summarized Project Schedule
Source: ACP, 2009

A.7 Estimated Cost

The construction cost of the expansion project is estimated at approximately \$5,250 million (shown in Figure A.6, with a breakdown into the main project components).

Project Components	Investment Estimate*
New Locks	
Atlantic Locks	1,110
Pacific Locks	1,030
Contingency for New Locks**	590
Total for New Locks	2,730
Water Saving Basins	
Atlantic Water Saving Basins	270
Pacific Water Saving Basins	210
Contingency for Water Saving Basins**	140
Total for Water Saving Basins	620
Access Channels for New Locks	
Atlantic Access Channels (Dredging)	70
Pacific Access Channels (Dry Excavation)	400
Pacific Access Channels (Dredging)	180
Contingency for Access Channels**	170
Total for New Locks Access Channels	820
Existing Navigational Channel Improvements	
Deepening and Widening of Atlantic Entrance	30
Widening of the Gatun Lake Channels	90
Deepening and Widening of Pacific Entrance	120
Contingency for Existing Channel Improvements**	50
Total for Navigational Channel Improvements	290
Water Supply Improvements	
Increase the Maximum Level of Gatun Lake to 27.1m (89') PLD	30
Deepening of the Navigational Channels to 9.1m (30') PLD	150
Contingency for Water Supply Improvements**	80
Total for Water Supply Improvements	260
Inflation During the Construction Period***	530
Total Investment	5,250 M*
*Millions of Balboas, rounded to the nearest tenths	
**The contingency includes possible variations for each component	
***Assumes a general inflation of 2% per year above what is included in the contingency	

Figure A.6: Estimated Cost for Canal Expansion Project
Source: ACP, 2009

This estimate includes design, administrative, construction, testing, environmental mitigation, and commissioning costs. Additionally, there is a contingency cost element associated with each component, which covers risks and unforeseen events such as accidents, design changes, price increases, and possible delays, among others. The project's estimated cost also includes the effect of inflation during the construction period. The most important item in the estimate is the cost of constructing the two new lock facilities—one on the Atlantic side and

the other on the Pacific side—with estimated costs of approximately \$1,110 million and \$1,030 million each, plus a \$590 million provision for possible contingencies during their construction. In total, the estimated cost for the new locks, including their water reutilization basins and contingencies, is \$3,350 million. An estimated \$530 million has been considered for inflation during the construction period.

A.8 Financing the Locks and Canal Tariffs

The expansion of the Canal is devised as a self-financing program, and will not burden the country's economy. Furthermore, it is expected that the waterway's contribution to the National Treasury will be maintained, given that the expansion will result in additional revenue. Funds for the expansion project will be obtained through tolls increases. Ultimately, tolls will be the source of all funds to be used for the payment of investments related to the third set of locks and for the repayment of its financing. The ACP has not established a toll schedule for the future; its policy is that the time and amount in which the toll increases will take place will be determined by the project's financing requirements, as well as the operating costs and the competitiveness of the market for the Canal.

The financing of the project will come from a combination of ACP's funds, resulting from toll increases, and external financial sources to cover peaks during construction. Revenue obtained from the Canal's operations once the project is completed will allow for the repayment of external financing in eight years or less, according to ACP's estimations.

The ACP's internal resources are capable of financing at least \$150 million per year throughout the completion of the project. The new project investment program will require average investments in the amount of \$650 million per year. Therefore, the Canal will require approximately \$500 million per year in additional funding to cover program requirements, which will be provided by a combination of additional revenues from the toll increase derived from the pricing policy mentioned, and from credit and financial sources that ACP may obtain in the financial markets. Accordingly, the ACP has increased the tolls since 2007 (Table A.2). As a supplement to the increased tolls, and in order to cover costs during the critical project construction peak in the 2009–2011 periods, it is anticipated that the ACP will need to acquire temporary external financing.

Evidently, the toll increases cannot solely be determined by the needs of the construction project. The combination of additional financing from toll increases and external financing will cover the project costs, but the tolls must take into account the maritime transport market conditions as well as the prevailing financial market conditions, such as interest rates, periods and terms, and financing costs. If higher tolls are implemented, there would be less need for external financing; conversely, if the market dictates that tolls cannot be increased to match the demands of the construction project, there will be a greater need for external financing. In this sense, in accordance with the most conservative policy for increasing tolls of 3.5% per year, the amount of external financing required to cover the project's peak construction period will not exceed \$2,300 million.

On the other end of the toll spectrum, if an 8% yearly increase is applied during the first five years of the project, the need for external financing to cover the peak construction period would be approximately \$1,500 million. Table A.2 presents the tolls increases since 2007.

Table A.2: Panama Canal Tolls

Market Segment		2007			2008			2009					
		Effective 1st of			Effective 1st of			Effective 1st of					
TEU Toll													
Full Containers	Laden	May	54.00		May	63.00		May	72.00				
	Ballast		43.20			50.40			57.60				
On-Deck Container Toll in other vessels	Laden	May	54.00		May	63.00		May	72.00				
Toll per berth													
Passenger Vessels 1/	Laden	October	100.00		October	115.00		October	120.00				
	Ballast		80.00			92.00			96.00				
Tolls per PC/UMS Ton													
		Effective 1st of	1st 10K	2nd 10K	Rest	Effective 1st of	1st 10K	2nd 10K	Rest	Effective 1st of	1st 10K	2nd 10K	Rest
General Cargo	Laden	Jul	3.26	3.19	3.14	May	3.63	3.56	3.50	May	3.90	3.82	3.76
	Ballast		2.59	2.53	2.49		2.88	2.82	2.77		3.10	3.03	2.98
Refrigerated Cargo	Laden	Oct	3.39	3.32	3.26	Oct	3.80	3.72	3.65	Oct	3.80	3.72	3.65
	Ballast		2.69	2.63	2.59		3.01	2.95	2.90		3.01	2.95	2.90
Dry Bulk	Laden	Jul	3.20	3.13	3.08	May	3.50	3.43	3.37	May	3.73	3.65	3.59
	Ballast		2.54	2.48	2.44		2.78	2.72	2.67		2.96	2.90	2.85
Tankers	Laden	Jul	3.29	3.22	3.16	May	3.70	3.63	3.57	May	3.98	3.92	3.85
	Ballast		2.61	2.55	2.51		2.94	2.88	2.83		3.18	3.11	3.05
Vehicle Carriers	Laden	Jul	3.24	3.18	3.12	May	3.60	3.52	3.46	May	3.87	3.79	3.72
	Ballast		2.57	2.52	2.47		2.86	2.80	2.75		3.07	3.01	2.95
Passenger Vessel 2/	Laden	Oct	3.39	3.32	3.26	Oct	3.80	3.72	3.65	Oct	3.95	3.87	3.80
	Ballast		2.69	2.63	2.59		3.01	2.95	2.90		3.14	3.07	3.02
Others	Laden	Jul	3.32	3.25	3.19	May	3.78	3.70	3.64	May	4.12	4.04	3.97
	Ballast		2.63	2.58	2.53		3.00	2.94	2.89		3.27	3.20	3.15
Tolls per Displacement Ton													
Displacement		Jul	1.84		May	2.09		May	2.28				

Notes:

1/ Vessels above 30,000 gross tons (GRT) and whose PC/UMS tonnage divided by maximum passenger capacity (PAX-ITC) ratio is less than or equal to 33, shall pay tolls on a per berth basis. If such ratio is greater than 33, tolls shall be paid on the basis of PC/UMS tonnage. Vessels below or equal to 30,000 GRT shall also pay on the basis of PC/UMS tonnage.

Source: Panama Canal Authority

A.9 Progress

The expansion project started in September 2007 and has progressed steadily ever since. According to the latest press release from the ACP, issued on April 23, 2009, the expansion project is on-time and on-budget. In the press release, the ACP acknowledges that the shipping industry is currently experiencing tough times, due to the prevailing global economic uncertainties, but the ACP continues to monitor trends and make adjustments where necessary to ensure that the progress of the construction is maintained.

Since the project started, the ACP has issued quarterly reports detailing the advancement recorded on the various administrative and financial tasks as well as excavation, dredging and construction of the project. The project development, at the beginning, occurred mainly in the administrative, managerial, and legal areas (contracts), as the project was in the preconstruction phase referenced above. However, as the project has moved into the construction phase, work is already underway in the areas of excavation and dredging.

As in every construction project, and especially in endeavors of this magnitude, there have been some unforeseen difficulties that have caused temporary delays, but the ACP has been prompt to request the contractors that have more resources—personnel and/or equipment—

allocated to specific tasks to make up for the lost time and make sure the project gets back on schedule. A considerable number of contractors are participating in this project, many of them being international companies with numerous resources. And in many instances, the expertise and workforce of individual construction companies is not enough to tackle certain tasks, leading to the creation of numerous consortia that are taking part in tasks such as the excavation, design of the locks and construction of dams.

To date, substantial progress has been made on environmental studies; the excavation of the Pacific Access Channel; dredging of the Gatun Lake; relocation of the Borinquen Highway and the divergence of the Cocoli River; the removal and relocation of electrical utilities, telecommunication lines, water lines, sanitation lines, ducts, and sewers; archaeological works; construction of the Pacific and Atlantic field offices to be used by ACP personnel and consultants; and the dredging of Culebra Cut.

March 2009 signaled a significant milestone for the project, when the ACP received bids from three world-renowned consortia vying to design and build the new locks. The bids are currently being evaluated and a decision will be made in the coming months.

Nevertheless, there have been some setbacks, which have occurred mainly due to inaccurate estimations of the size of the tasks. In such cases, adjustments have been made to the amount of work, resulting in modifications to schedules and budget. However, these have only happened at the level of individual tasks, as the overall schedule, according to the ACP, has kept the opening date as 2014 and the total cost estimate is still \$5.25 billion.

Even though optimism prevails in most of the construction progress reports, the ACP has not been immune to criticism. Most of it pertains to three aspects of the project, namely the following.

- 1) Doubts about the bidding process. The ACP chooses the lowest bids. Critics indicate that once the decisions are made, the contracts are awarded. Then profits are increased through add-ons to the contracts. These add-ons can substantially increase the price of the winning bid. A number of instances of this nature have been reported. Also there have been instances of conflicts of interests occurring between ACP officials and companies being awarded contracts.
- 2) Underestimation of the total cost of the project. Several reviewers reported that the initial budget was a very low estimation of the actual cost, considering the magnitude of the construction endeavor. The purpose of issuing such a widely-optimistic figure was to entice the population to approve the project in the 2006 referendum. Furthermore, if the prices of the individual contracts are being adjusted by add-ons as explained in the previous point, such increases will eventually materialize in a higher total project cost.
- 3) Undertaking the project. Many observers questioned, especially prior to the referendum, whether proceeding with the expansion project was in the best interest of the people of Panama. The argument was that the expansion project originated from other countries' commercial interests, as it was only necessary to satisfy the demands of the shipping companies from abroad, mainly from the U.S., and that it was not going to necessarily benefit the Panamanians as the owners of the Canal.

A.10 Current Canal Operations

Statistics for the second quarter of fiscal year 2009 were recently released. Herein, some relevant figures are compared to those from the second quarter of 2008. Transits through the Canal have remained fairly constant. Vehicle carriers represent the principal segment mostly affected by the economic crisis, but projections already indicate traffic increases for next year.

Total Canal transits slightly decreased 1.4%, to 3,914 transits from 3,971. Transits of larger ships that require greater time and navigation skills to traverse the Canal declined 2.9%, to 1,815 transits from 1,869.

With regard to market segments, general cargo, dry bulk and tanker transits increased, while refrigerated (reefers), container, vehicle carrier and passenger transits decreased.

The Panama Canal/Universal Measurement System (PC/UMS) tonnage remained nearly constant with a slight 3.3% decline to 75.7 million PC/UMS tons from 78.4 million PC/UMS tons.

Utilization of the reservation booking system decreased 15.6%, to 79.56% utilization from 94.31%. Because of this particular statistic, the ACP has announced a temporary modification to the booking system. The temporary measures will take effect on June 1, 2009, and continue through September 30, 2009. These measures consist of two primary components.

- A redefinition of ballast (ships without cargo) for full container vessels transiting the Canal; and
- Modifications to the Reservation System to increase flexibility and reduce fees.

A.10.1 Temporary Redefinition of Ballast for Full Containerships

The new definition of ballast for full container vessels will allow a ship that carries 30% or less of its capacity to be charged the ballast rate of \$57.60 per TEU, \$14.40 less than the \$72 laden (ships with cargo) rate.

A.10.2 Temporary Modifications to the Reservation System

- **Reservation Fee Reduction:** The base reservation price is reduced depending on the vessel size for all segments that use the ACP's Reservation System.
- **Late Arrival Fee Reductions:** Currently, when vessels fail to arrive on-schedule they lose their slot but have the option to pay an additional charge to keep the reservation and transit that same day. The new temporary measure reduces the charges and provides shipping lines with greater flexibility. The percentage reduction varies depending on the vessel's arrival time.
- **Flexibility for Slot Substitutions:** Canal customers will now have 30 days before the date of a vessel's transit to request slot substitutions without additional costs. Previously, customers could make such requests without an additional charge if that request was made at least 60 days prior to the date of transit.