EXAMINING A SOCIAL COST-BENEFIT ANALYSIS OF THE PANAMA CANAL EXPANSION PROJECT

by

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Abstract

Upon completing the construction of the Panama Canal in 1914, maritime vessels sailing between the Atlantic and Pacific Oceans were provided an alternative to navigating the southern tip of South America. While the Canal has exceeded original capacity estimates, the Panama Canal Authority (ACP) in 2006 began planning an expansion of the Canal to meet future demand for Canal services. The ACP enlisted URS Holdings, Inc to do a social cost-benefit analysis of the project: *Economic Adjustment for Social and Environmental Externalities and Final Cost-Benefit Analysis*. This thesis thoroughly examines the contents of the URS analysis and critiques the content and methodology of the study. The URS analysis suffers from a number of problems, including a lack of monetary value for potentially significant social and environmental impacts of the Canal expansion, a failure to distinguish pecuniary versus non-pecuniary externalities, causing the social benefits of the expansion to be grossly overstated, a choice of discount rate which is open to question and assumptions about future prices for using the Canal which make a more positive picture of the private returns from the expansion. Resulting conclusions derived from the URS analysis are therefore affected, limiting the credibility of their analytical conclusions. Although monetary valuations are lacking throughout the analysis, if done incorrectly, the resulting monetary valuation can distort the true value of the impact. For that reason quantitative as well as qualitative valuations of impacts should be retained for analysis.

List of Abbreviations Used

ACP	Autoridad del Canal de Panama – Panama Canal Authority
EIS	Environmental Impact Study
IRR	Internal Rate of Return
NPV	Net Present Value
PCC	Panama Canal Commission

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Chapter 1: Introduction

After centuries of searching for an acceptable passageway, and multiple attempts to build a route traversing the Isthmus, the Panama Canal opened in 1914. While other routes in Panama and various locations throughout the Central American Isthmus had been utilized with varying degrees of success, the opening of the Panama Canal marked the first time that maritime traffic could navigate the Isthmus. The Canal has since grown from primarily being used as a route to shorten the journey between the East and West Coasts of the United States into a vital component of numerous international transportation corridors. As maritime technology has evolved and the composition of goods transported by sea has been altered, the demand for Canal services has changed dramatically. While the largest maritime vessels at the time of construction could transit the lock chambers two at a time, by 2009 over 40 percent of the vessels that transited the Canal were built to the maximum dimensions of the Canal lock (ACP 2009). Due to increasing vessel sizes and demand for Canal services, the Canal capacity under the configuration used since 1914 will soon be met. As a result, the ACP presented a proposal to expand the Canal in 2006.

Although a Canal expansion has been proposed to accommodate increased capacity, the current Canal configuration has proven to be remarkably robust. Approaching from the Atlantic (or Caribbean) vessels enter an approach channel as they transit towards the Gatun Locks. The Gatun Locks, a series of three lock chambers, then raise the vessel to 85 feet (26m) above sea level. From there, vessels exit into the man-made Gatun Lake, which they transit for 33km until they reach the Culebra Cut. After

navigating the 13km long Culebra Cut, vessels enter the Pedro Miguel Locks to descend from 85 feet (26m) to 54 feet (16m). Once completed, vessels enter the man-made Miraflores Lake as they transit towards the Miraflores Locks and the final two lock chambers descending to the Pacific Ocean. While navigation channels have since been deepened and widened, the current Canal configuration, designed and built almost a century ago, has been able to avoid significant modifications throughout its lifespan.

In order to expand capacity and accommodate growing demand for the Panama Canal the ACP presented a detailed proposal of the expansion project in June 2006. The expansion proposal was composed of three integrated components, which will be discussed in-depth in a following chapter. The first component of the expansion proposal is the construction of two new lock facilities: one on the Atlantic side and one on the Pacific side. The lock facilities on both sides employ similar designs and use a series of three lock chambers to raise and lower vessels. The new lock chambers have been designed with dimensions significantly larger than the existing locks in order to accommodate the demand created by larger vessels. The second component of the expansion project is the construction of new access channels to the new locks, and the widening of existing navigation channels. While the new Atlantic access channel will use a significant portion of the excavation undertaken in a previous expansion attempt, the Pacific access channel will be a far more cumbersome process. Constructing a navigation channel connecting the Culebra Cut with the existing sea entrance of the Pacific Ocean requires circumventing both the Pedro Miguel and Miraflores locks. The third integrated component of the Canal expansion project is the deepening and widening

of existing navigation channels and the elevation of Gatun Lake's maximum operating level. The deepening and widening of existing navigation channels will be undertaken in order to accommodate the safe navigation of vessels that can only transit the Canal via the new locks. Additionally, the maximum operating level of Gatun Lake will be raised to accommodate the passage of larger vessels, while also providing the water volume necessary to accommodate additional lock transits.

In addition to presenting a detailed description of how the construction of the project would proceed, the ACP commissioned an independent analysis of the project and the impacts that may occur during and after the expansion process. This document, and the analysis that it presents, will be explored and expanded on throughout the current paper.

Environmental Impact Study (EIS) of the Panama Canal Expansion Project—Third Set of Locks, prepared by URS Holdings, Inc, conducts a thorough review of the literature of all the environmental, social and economic studies and assessments in the Project area and its adjacent areas. The subsequent information obtained from these studies and assessments was compared, and field samples were taken in cases where additional information was necessary. This was done to guarantee a complete analysis of the possible impacts the Project could have and to propose appropriate mitigation and/or compensation measures (URS 2007). The information yielded from the analysis could then be used, where necessary, to mitigate and compensate in an effective and pragmatic manner issues resulting from the expansion project.

When considering whether or not an infrastructure project should be approved, it is vital to conduct a thorough financial, social and environmental analysis of its costs and benefits. Such an analysis will not only provide a discussion of the monetary costs and benefits, but it will also identify both positive and negative externalities. Once identified, they can be used in an economic analysis to determine whether the project is financially and socially advisable.

The objective of the current paper is to conduct a thorough examination of the economic analysis used to evaluate the proposed Panama Canal Expansion Project. While multiple analyses of various depths have been performed on the proposed project, the current paper will expand and explore on the analysis commissioned by the Panama Canal Authority (ACP), and delivered by URS Holdings, Inc. We will begin by exploring the content of the URS analysis, discussing what factors were included, as well as factors that were omitted and the methodology used by URS to conduct the analysis. The discussion will then continue by examining the sensitivity of the statistical conclusions of the analysis.

Chapter 2: Expansion Proposal

The Panama Canal Expansion proposal presented by the Panama Canal Authority (ACP) includes a detailed description of how the expansion will be undertaken, objectives of the expansion project, and alternatives that were considered prior to agreeing to the current expansion proposal. The proposal to expand the capacity of the Panama Canal is composed of three integrated components: (1) construction of two lock facilities; one on the Atlantic side and another on the Pacific side; (2) the excavation of new access channels to the new locks and widening of existing navigation channels; and (3) deepening of existing navigation channels as well as the elevation of Gatun Lake's maximum operating level. While alternatives to the current proposal such as a sea-level canal and two lock lanes of similar dimensions were discussed, neither was considered a viable option. In addition to prohibitive financial and environmental costs, these alternatives failed to fulfill the objectives of the Canal expansion project, as discussed in more detail below.

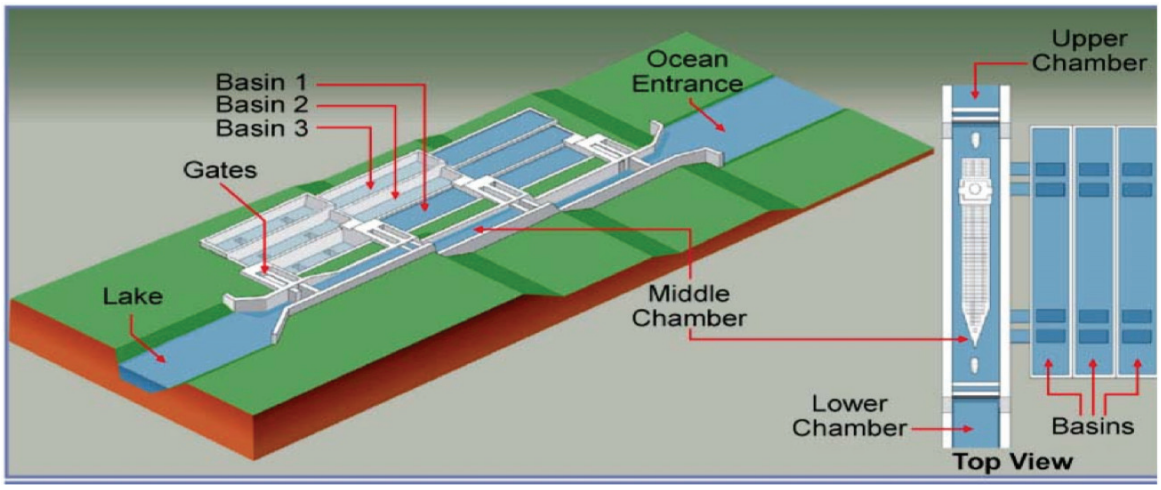

Figure 1: View of proposed lock facility (p. 4, ACP 2006)

The first of the integrated components to expand the Canal's capacity is the construction of two lock facilities; one on the Atlantic side and another on the Pacific side. Due to similar topographical challenges, and in an effort to reduce design costs, similar configurations will be used for the locks on both the Atlantic and Pacific sides (ACP 2006). The new lock facilities are designed to have three consecutive chambers to raise and lower vessels from sea level to the level of Gatun Lake. Each of the new lock chambers will be 427m (1,400') long, by 55m (180') wide, and 18.3m (60') deep (ACP 2006). In order to reduce the amount of water required for vessels to transit the new locks, each of the lock chambers will include three water utilization basins. The decision to construct three basins per chamber was made because it offered the highest yield in construction costs, while having a low impact on lockage times and lock capacity. Constructing the reutilization basins will help to ensure that water requirements for the population and Canal are satisfied.

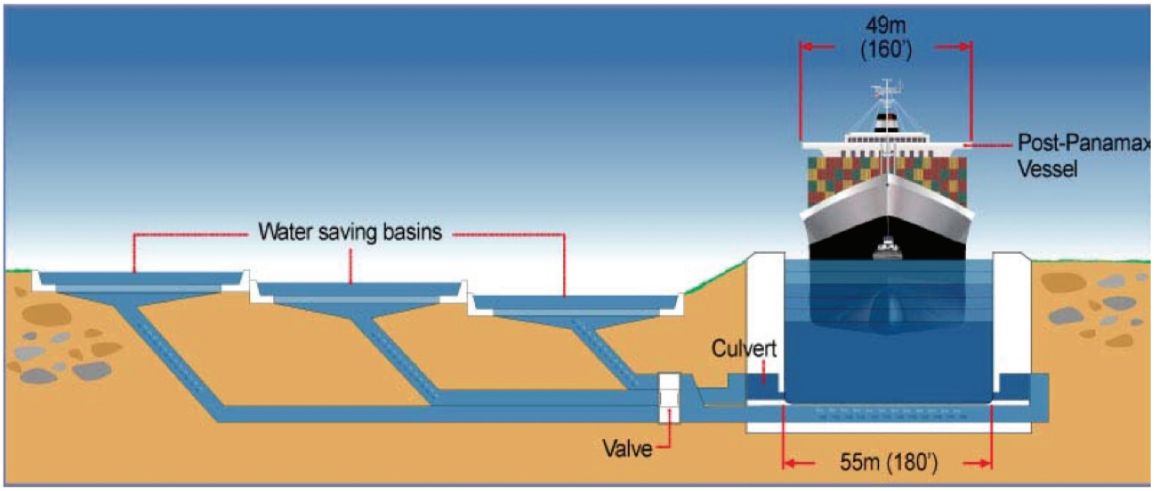

Figure 2: Cross-section of new locks with its water saving basins (p. 4, ACP 2006)

The second of the integrated components required for the Canal expansion project is the excavation of new access channels to the new locks, and widening of existing navigation channels. Providing access to the locks on the Atlantic side will involve the construction of a 3.2 km-long approach channel to connect the new Atlantic locks to the existing sea entrance of the Canal (ACP 2006). Construction of the Atlantic access channel will use a significant portion of the excavation that was undertaken when expansion of the Canal was first pursued before being suspended because of the start of World War II.

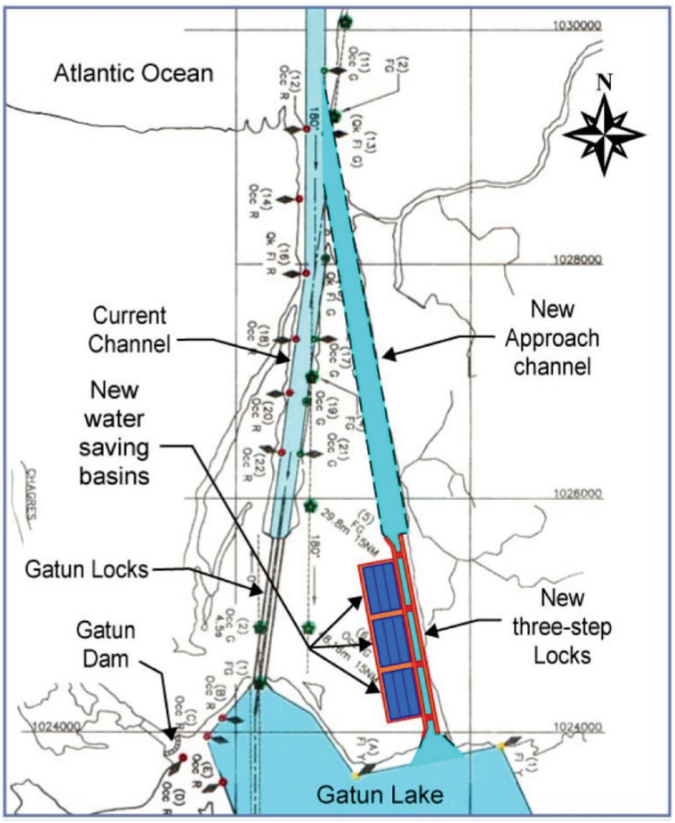

Figure 3: Atlantic Lock Facility with new approach channel (p. 5, ACP 2006)

Excavation of the approach channel for the new Pacific locks will be a far more cumbersome process because the required approach channel is significantly longer than that on the Atlantic side. Constructing a navigation channel connecting the Culebra Cut with the existing sea entrance of the Pacific Ocean requires circumventing both the Pedro Miguel and Miraflores locks. The resulting north access channel will measure 6.2 km

from the Cut to the new locks, and an additional 1.8 km long access channel connecting the new locks to the Pacific Ocean (ACP 2006). Construction of the new Pacific access channels, requiring the excavation of approximately 49 million cubic meters of material, will be executed in four different stages.

The third integrated component of the Canal expansion project is the deepening and widening of existing navigation channels and the elevation of Gatun Lake's maximum operating level. In order to complete this phase of the project dredging existing navigation channels will be undertaken to ensure the safe navigation of vessels that can only transit the Canal via the new locks. These navigation channels will also be widened to accommodate these larger vessels. The maximum operating level of Gatun Lake will not only be raised to accommodate the passage of larger vessels, but will also provide the water volume necessary to accommodate the additional transits.

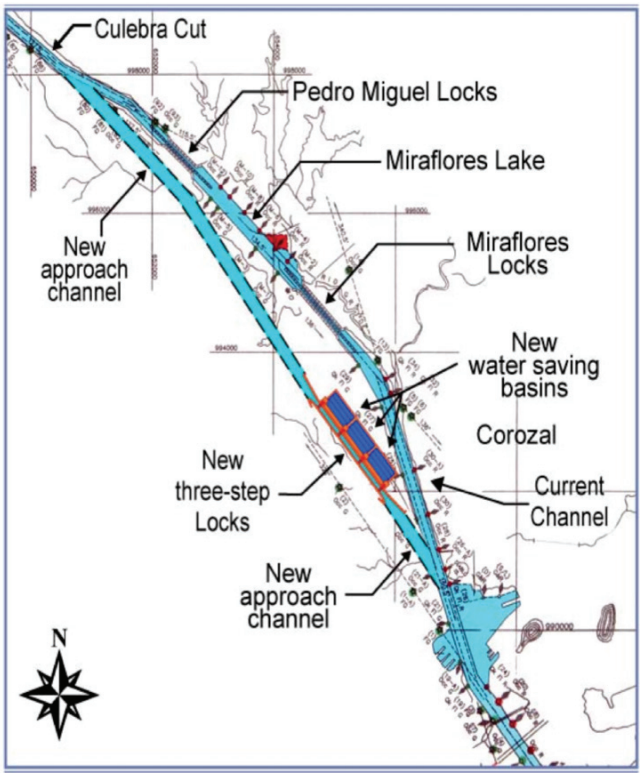

Figure 4: Pacific Lock Facility with new approach channels (p. 6, ACP 2006)

The ACP proposal is also accompanied by four objectives outlining the goals of Canal expansion. The first objective outlined for Canal expansion is to "achieve long-term sustainability and growth for the Canal's contributions to Panamanian society through the payments it makes to the National Treasury" (p. 1, ACP 2006). The doubling of Canal capacity provided by the expansion project will increase operational efficiency and national economic benefits. The increased capacity provided by the investment will also increase Canal revenues, and therefore payments to the National Treasury. Considering the impact of the Panama Canal and its associated services on economic activity in the country, expansion constitutes a fundamental step in the development of the national service cluster.

The second objective outlined in the proposal is to "maintain the Canal's competitiveness as well as the value added by Panama's maritime route to the national economy" (p. 1, ACP 2006). Failure to address the impending capacity shortage will affect the competitiveness of the Canal route, thus strengthening competitors, and promoting the emergence of new competitor routes. Pursuing expansion will prevent the Canal from becoming obsolete for shippers that employ post-Panamax technology and dimensions for transcontinental routes.

The third objective of Canal expansion as stated in the proposal is to "increase the Canal's capacity to capture growing tonnage demand with the appropriate levels of service for each market segment" (p. 1, ACP 2006). Without the expansion project the Canal would not be able to benefit from growing traffic demand. Expanding the Canal

will increase capacity, strengthening the Canal's market share, "particularly in the containerized cargo route between Northeast Asia and the U.S. East Coast" (p. 61, ACP 2006). Failure to meet this growing demand would not only mean that some vessels would be unable to transit the Canal, but that growth capacity will stagnate. Stagnating transit growth would mean that all revenue increases will be dependent on toll increases, creating the risk of driving clients away if not accomopanied by significant service improvements.

The fourth and final objective of the proposal is to, "make the Canal more productive, safe and efficient" (p. 1, ACP 2006). By adding an additional set of locks, while also widening and deepening existing navigation channels, the Canal will be able to expand capacity while accommodating increased usage in a productive and efficient manner.

The proposal also discusses alternatives to the current expansion proposal that were considered. The alternative of constructing a sea-level canal was not pursued for at least two reasons: it would have been very difficult to integrate operation channels, systems and infrastructure with the present Canal, and constructing a sea-level canal would, "generate permanent and irreversible adverse environmental impacts of considerable magnitude, both to land and marine ecosystems, as well as to human populations and activities"(p. 42, ACP 2006).

Constructing two lock lanes similar to those that currently exist was also considered. While this option would sufficiently increase capacity to meet increasing

volume demand, it would not be able to accommodate transits of post-Panamax vessels, and thus it would do little to address the competitiveness of the Canal.

Therefore, it was concluded that the, "concept of two similar three-level lock facilities was the best alternative since the same design may be used for both facilities, which reduce project costs and execution time" (p. 42, ACP 2006). Additionally, from the maintenance standpoint, spare parts inventories can be reduced and standardized as a result of the duplication of the lock design.

Having described the project, we now move on to an examination of the URS evaluation of the proposal.

Chapter 3: "Environmental Impact Study of the Panama Canal Expansion Project—Third Set of Locks"

The ACP commissioned an independent analysis of the project and the impacts expected after the expansion process. This document, and the analysis that it presents, will be explored and summarized in this chapter.

Environmental Impact Study (EIS) of the Panama Canal Expansion Project—Third Set of locks, conducts a review of environmental, social and economic studies and assessments of the Project area. Where information of project impacts was not available, additional information was collected and synthesized by URS for inclusion in the analysis.

Defining the area that will be affected by the project:

The evaluation outlines the areas that will be impacted by the Panama Canal expansion project. Due to the permanent quality of the project, the evaluation suggests that the areas affected by the expansion project will be very similar to those affected by construction of the original Canal. While the project will have an impact throughout the country, the environmental and socioeconomic impacts incorporated into the evaluation cover a relatively small portion of the national territory. The evaluation justifies that the impacts of the expansion will be lesser because it takes place in an area already altered by the construction of the original Canal at the beginning of the 20th century (p. 1, URS 2007).

Describing externalities: Social and Environmental

In addition to conducting an analysis of the costs and benefits of the expansion project, URS also considers the externality effects. For purposes of the analysis, environmental externalities include the environmental costs caused by expansion activities to the natural surroundings within or immediately adjacent to the project site. As described in the URS analysis, environmental externalities include: "contribution to climate change, degradation of the ozone layer, release of toxic substances or pesticides, contribution to the reduction of biodiversity, heating and/or contamination of water, accumulation of residues, noise pollution, and emission of gases that pollute the air" (p. 2, URS 2007).

An examination of the social externalities addresses social conditions that are created due to the expansion project. The conditions largely focus on the impacts that accrue to humans in the project area due to the expansion process. For purposes of the URS analysis, social externalities include: "exploitation, work under precarious conditions, work without proper environmental conditions, displacement of populations, and reduction of cultural diversity among other" (p. 2, URS 2007).

While the Panama Canal is centrally located in the country, it has long served as an economic engine for the country. As a result, the magnitude of the expansion of the Canal will cause impacts throughout Panama. The impacts resulting from the expansion of the Canal will have medium and long-term results because of the role of the Canal Economic System in Panamanian society (p. 34, URS 2007). Due to the reach of impacts

resulting from the expansion, some of the externalities do not have a clear market value, and in some cases, market values are clearly intangible.

Quantitative and qualitative data:

The analysis of the Panama Canal expansion project provided by URS Holdings Inc identifies numerous externalities. Once identified, their compensatory effects were quantified by calculating the adjustment to market prices. Although additional externalities exist, the analysis focused on the following six compensatory effects.

The first of the compensatory effects to be measured in the analysis is the impact, and revenue generated from taxes on diesel, and sales during the expansion process. In order to complete the excavation and construction required for the expansion project heavy machinery running on diesel fuel will log thousands of hours. The expanded demand for diesel fuel, which is taxed by the Panamanian government, created by the project will increase the generation of tax revenues. The expanded demand for other taxable materials used in the construction will similarly increase tax revenue generation. Construction materials acquired directly by the ACP will be exonerated from these taxes according to Panamanian Law (p. 38, URS 2007).

The second social impact measured through the adjustment of market prices is the cost of labour used in the project. While in general the cost of labour appears in the economic evaluation of costs and benefits, worker salaries above or below the reserve

salary[1] are recorded as compensatory effects. Although workers will only accept employment below their reservation wage if insufficient alternative employment options exist, employment above their reservation wage will result in a net social benefit (p. 38, URS 2006). The value of the benefit for workers can be measured by calculating the difference between the actual wage and the reservation wage.

The third impact that can be measured through the adjustment of market prices is the generation of revenue from tradable goods. While the previous externality measure focused on revenue generated during the construction process, increased revenues from tradable goods will only occur once the expansion process has been completed. Since tradable goods entering the country via the Canal pay taxes at the border, the tariffs paid by the importer will be directed to the National Treasury. The resulting increase in revenues becomes a social benefit attributable to the project (p. 38, URS 2007). These benefits will begin to accumulate once the expanded Canal begins operation in 2014.

The fourth compensatory effect measured through the adjustment of market prices is income taxes from foreign businesses. In recent years Panama, and in particular Panama City, has become an international business hub, with growing importance. The country's strategic location, relatively lenient business taxation laws, and services provided by the Panama Canal have improved the attractiveness of Panama as a place for foreign businesses to establish (Johnson 1976). The expansion project will increase Canal capacity while also increasing the services used by vessels transiting the Canal.

[1] Reserve salary or reservation wage refers to the lowest salary a worker would accept to work a particular job.

Therefore, the expansion will increase the payment of income taxes by the foreign business, thus providing an additional benefit to the Panamanian economy (p. 38, URS 2007).

The fifth impact measured through the adjustment of market prices is the gains of enterprises. As previously alluded to, the Panama Canal serves as a major engine for growth in the Panamanian economy. In addition to the Canal providing the service of enabling maritime vessels to pass from the Pacific to Atlantic Oceans, numerous periphery services exist in the country to service vessels and their contents. Increasing Canal capacity will result in a greater demand for Canal related services, thus increasing the social benefit derived from the Canal.

The sixth compensatory effect measured through the adjustment of market prices is taxes paid by local workers. While the wages earned by local workers will be recorded directly as costs and benefits, their income will enable them to purchase goods and services within the Panamanian economy. The provision of jobs for workers involved in the project will increase the purchase of goods and services, ultimately increasing the tax revenues generated. The fifth impact, sales taxes paid by foreign enterprise, is said to increase tax revenues in a similar manner. Foreign workers, in the country to assist in the construction of the project, will spend their income on local goods and services. The increased purchase of these goods and services will increase generation of tax revenue, providing a benefit to the Panamanian society.

While additional positive and negative social and environmental impacts exist, according to URS, those discussed here are among the easiest to quantify through adjustments to market prices. Once the adjustment of market prices has been measured, a quantitative analysis can be conducted to determine whether the expansion project has a positive impact on the well being of the Panamanian society (p. 34, URS 2007). There are, however, instances that the monetary value of social externalities cannot be determined through measuring the adjustment of market prices.

Macroeconomic effects:

The macroeconomic effects of the Panama Canal are felt throughout Panamanian society. In addition to the surplus of Canal transit toll revenues annually deposited into the National Treasury, URS suggests that the existence of the Canal has enabled the prosperity and growth of numerous other associated services throughout the country. Expanding the Canal will not only increase its macroeconomic impact, it will also increase Canal capacity, allowing the Canal to increase revenues generated by transiting vessels. The increase in revenues provided by the expansion will enable new dollars to enter the economy. In particular, the increase in Canal profits will be directed at the National Treasury, enabling the Panamanian government to create and administer additional programs (p. 38, URS 2007). Canal expansion is also expected to have a sustained impact on the gross domestic product (GDP) that according to forecasts will reach 28 billion by the year 2025, whereas without expansion it is expected to increase to 23 billion for the same period (p. 40, URS 2007). Due to the sustained growth, URS suggests that the expansion is also expected to have a significant impact on the proportion

of the population living in conditions of poverty. While figures for 2005 show that approximately 18 percent of the population was below the poverty line, with expansion, forecasts show that the percentage living below the poverty line will decrease to 11 percent by 2025 (p. 40, URS 2007). This corresponds to a reduction by more than 100,000 in the number of persons living below the poverty line. While the primary objective of Canal expansion is to ensure that future demand is met, the macroeconomic effects of Canal expansion will be felt throughout Panamanian society.

Defining a timeline subject to analysis:

The Panama Canal expansion project utilized the aforementioned criteria to select an appropriate timeline for the analysis. The timeline chosen for the analysis was based on the estimated length of time the impacts caused by the construction of the project expected to last. While the impacts will extend beyond the construction phase of the project, they will last less time than the useful life of the project. In order to ensure that these impacts were included in the analysis, while not dissipating them over an excessively long period, 2005 until 2025 was established as the timeline for analysis (p. 3, URS 2007).

Components required for construction of accurate cost benefit analysis (NPV):

Net Value of investment:

The net value for investment in the report provided by URS Holdings Inc. was calculated under two different scenarios. In the first scenario, the net value of the investment was calculated under the assumption that tolls would remain constant over the lifespan of the project. The net value of the investment in the second scenario was calculated under the assumption that tolls would continue their current trend and increase over the lifespan of the project. Under both scenarios, the initial investment in the project was added to the expected costs over the lifespan of the project. The totals produced by this calculation were then subtracted from the expected net benefits of the project to yield the net value of the Panama Canal expansion project.

Expected Net Benefits:

The expected net benefits in the report produced by URS Holdings Inc. were calculated for two different scenarios. In the first scenario the expected net benefits of the expansion project were calculated under the assumption that tolls for the Canal would remain constant. Under this assumption, the expected net benefits were calculated to be $5,078.47 million. The second scenario, in which tolls for Canal transit will increase over the life span of the project, is consistent with recent toll increases. Under this second scenario, the expected net benefits of the project were calculated to be $8,609.96 million.

Expected costs:

While both the net value of investment and expected net benefits of the project were calculated based on two different scenarios, the expected costs remain constant under either scenario. The expected costs used in the calculation of the NPV were calculated to be $3,624.67 million.

Salvage value, if any:

Another important consideration in the calculation of the NPV of the expansion project is to determine salvage value. While there are certain infrastructure projects that contain components that can be salvaged and re-sold, the Panama Canal expansion project does not. Any potential salvage value for the expansion project would be minimal, and as a result was therefore omitted from the analysis.

Determining the useful life of a project:

While the useful life of the Canal is expected to extend into the second half of the twentieth century, the timeline was chosen based on the estimated length of time the impacts caused by construction are estimated to last. As a result, 2007 until 2050 was established as the timeline for analysis (p. 45, URS 2007).

Discount rate:

In order to calculate the NPV of the Panama Canal expansion project a discount rate was constructed by URS Holdings Inc. For the analysis, a 50-50 debt equity ratio was selected to reflect the fact that only half the funds for the project will be borrowed (p.

43, URS 2007). The remaining funds required for Canal expansion will come from the ACP. The first half of the discount rate was calculated using the reference rate of 6.5 percent (which is the yield of the T-bills or U.S. Treasury Bonds) and the inflation rate of two percent (p. 42, URS 2007). Based upon these variables the cost of debt Kd is 1.065/1.02, which equals 1.044118 or 4.4118 percent. Equity, the second half of the discount rate, was calculated using the average profitability of national capital for the period 1993-2004. The rate of 9.9 percent was taken as the opportunity cost of for ACP (p. 43, URS 2007). As a result, the discount rate for the Panama Canal expansion project was obtained through the following operation: dR = 0.5 (4.4118) + 0.5 (9.9) = 7.1559 %. This discount rate is used for all calculations throughout the analysis.

Economic and Social NPV:

Based on the aforementioned criteria for constructing the indicators necessary for economic analysis URS calculated the NPV for the Panama Canal expansion project. In order to provide a more accurate picture of the impact of the project, the NPV for the expanded Canal was calculated under both constant and increasing tolls. Under the constant tolls scenario the sum of benefits between 2007 and 2050 was calculated to be $5,078.47 million while the sum of costs over the same period was calculated to be $3,624.67 million. The resulting NPV of the expanded Canal with constant tolls is $1,452.99 million (p. 45, URS 2007).

Calculation of the NPV with increasing tolls provided an even more favorable conclusion for proponents of the project. Under the increasing tolls scenario the sum of

benefits between 2007 and 2050 was calculated to be $8,609.96 million while the sum of cost remained unchanged at $3,624.67 million. The resulting calculation yielded an NPV for an expanded Canal with increasing tolls of $4,984.47 million (p. 46, URS 2007).

NPV is used to calculate the IRR:

The data employed to calculate the NPV of the expanded Canal was also used to derive the IRR of the project under both constant and increasing tolls. Under the constant tolls scenario an IRR of 9.07 percent was calculated, meaning that the project can withstand a discount rate of up to 9.07 percent without incurring losses (p. 47, URS 2007). Under the increasing tolls scenario the project was found to tolerate a discount rate of up to 12.14 percent, an increase of 3.07 percent from the constant tolls scenario (p. 47, URS 2007).

NPV is used to calculate the B/C R:

The third and final analysis in which the economic indicators were used was the calculation of the B/C R. As with the calculation of both the NPV and the IRR, the B/C R was calculated under both the constant and increasing tolls scenarios. Calculation of the B/C R for the expansion project yields a ratio of $1.69, suggesting that for each dollar invested a return of $0.69 is obtained. Calculation of the B/C R under the increasing tolls scenario improves substantially reaching $2.38, indicating that $1.38 is recovered for every dollar that is invested.

Social NPV and IRR:

In the case of the analysis of the Panama Canal expansion project conducted by URS Holdings Inc the calculation of the social NPV and IRR followed the economic analysis. While the economic evaluation of the project showed satisfactory results, the social evaluation yields results that are even more favorable. While a calculation of the economic NPV of the project with constant tolls yielded a value of $1,452.99 million, the calculation of the social NPV with constant tolls yielded a value of $2,594.40 million. The calculation under increasing tolls yields a similar story as the economic NPV measured $4,984.47 million while the social NPV measured $6,287.09 million.

Increases from the economic to social NPV were consistent with increases from the economic to the social IRR. While a calculation of the economic IRR under the constant tolls scenario yielded that the project could withstand a discount rate of up to 9.07 percent, the social IRR reveals that the expansion project can withstand a discount rate of 11 percent. Calculating the change under increasing tolls reveals a similar increase from 12.14 percent under the economic calculation, to 14.16 percent with calculation of the social IRR.

While each of these three calculations depends on the same information, the results they yield each serve a distinct purpose. Calculating the Net Present Value, Internal Rate of Return and Benefit/Cost Ratio of the project each provide additional insights into the value of the project. An examination of the information yielded from these calculations will be covered as part of a detailed analysis of the URS conclusions and their methodology.

Chapter 4: Analysis of the URS Report

In the previous chapter, the evaluation report on the Panama Canal Expansion project carried out by URS Holdings was summarized. In this chapter, we examine the principal components of the URS analysis to determine:

1. the validity of the arguments made by URS
2. benefits and costs that should be included which are not
3. the sensitivity of the URS results to the errors or omissions identified in 1. and 2.

The fact that URS concludes that the canal expansion project is worthwhile is, in one sense, not surprising. URS was, after all, hired by the Panama Canal Authority (ACP) to do the evaluation and it is the ACP that has proposed the expansion in the first place. On the other hand, the report also presumably is of some importance in convincing the financial backers of the project that it is worth doing and most importantly, that the project will show a rate of return that will allow their loans to ACP to be paid off. In other words, even if URS knew it was expected to produce results to support the project, the financial backers of the project presumably would still require a relatively objective analysis as a means of assuring themselves that their loans were relatively safe and would be repaid. In this regard, however, it is useful to bear in mind that the only assurances that lenders require is that the financial rate of return will allow repayment of the loans. Being satisfied that the social rate of return justifies the project is not of the same degree of concern to the lenders and indeed, may not be of concern at all.

What this means is that exaggerating social benefits and/or underestimating social costs doesn't necessarily matter at all to lenders and certainly, does not matter as much as being assured that the private revenues and costs are properly estimated and taken into account. As will be obvious in the analysis that follows, much of the criticism of the URS report that can be made relates to the treatment of externality effects, both positive and negative, which are very relevant to a social cost-benefit determination, but of no importance to a private cost-benefit analysis.

With the above caveat in mind, this chapter will look at the key assumptions and components of the URS report and analyze them.

Environmental Impacts:

URS begins its analysis of the environmental impacts of the project by noting quite correctly that they "are an integral component of a sound economic analysis." But this statement is qualified when they continue "Whenever possible, they are quantified and included in the economic analysis as costs and benefits of the project." (p. 2, URS 2007) Environmental costs are often not possible, or at least may be very difficult, to quantify. If this means they are excluded from the cost-benefit calculation and if the results fail to note that this omission qualifies the results, then the analysis is deficient. This happens in this case, where environmental costs that are noted, such as loss of carbon capture capability, loss of vegetation, destruction of habitat and contamination of water sources, are then disregarded because they cannot be measured.

Where there are environmental costs and benefits that get measured, there are other problems that arise. For example, URS argues that the project will reduce carbon emissions, thus having a salutary effect on global warming. Although Panama is a signatory of the Kyoto Protocol aimed at fighting global warming, the emissions limits in the framework of the Protocol do not include emissions by international shipping (p. 2, United Nations 1998). The more recent Copenhagen Accord, which endorses and builds upon the Kyoto Protocol, also fails to include emissions limits on international shipping (United Nations 2009). Therefore, under current international arrangements, there is no reason why this reduction in carbon emissions should be relevant to Panama in deciding whether to undertake this project. Not influencing carbon emissions will be no different to Panama's rate of return on this project than reducing carbon emissions. Smaller carbon emissions globally are a good thing; no one is disputing that. But they make no difference to Panama's determination of whether the project is good or bad **for Panama**.

To take another example, URS argues that the relevant time-period for evaluating environmental impacts is "the minimum period it takes the trees of a reforested area to reach maturity" (p. 3, URS 2007). But this assumes that all of the environmental impacts relate in some way to deforestation, which is not the case. In part, this derives from the assumption that the impacts are confined to the land area actually directly affected by the construction phase of the project. Such an assumption is unreasonable. There is a need to consider what some of the other environmental impacts may be. For example, is it possible that the project will change the population density in different parts of the

country and if so, do these changes have implications for water supply and quality, or for sewage disposal?

Is it true that if the expansion does deliver on the predicted economic prosperity for Panamanians, the majority of these benefits will accrue within close proximity of the Canal? In order for individuals to benefit from the newfound economic prosperity, individuals will be required to migrate to the area served by the Canal. In addition to collecting water necessary to transit the isthmus, Gatun Lake provides the drinking water for over half of the national population, including Panama City, while also being the destination of sewage for that same population. The increased demand for water associated with the expansion project will therefore produce uncertain effects on the water source.

Second, although construction of the new access channels and lock facilities will take place adjacent to the existing Canal, expansion will enable a significant increase in Canal transits. An increase in transits will increase the pollutants deposited in the reservoir. While the construction process will produce impacts in a relatively small area, once operation of the expanded Canal has commenced, the effects of increased transits will be felt throughout the watershed. Habitats and vegetation in the watershed, even those located several kilometers from the new lock facilities, will be affected due to the increased usage of Gatun Lake by effluent-emitting vessels. Collectively, these issues that have been given little discussion by URS could also have potential consequences for the Panamanian population that use Gatun Lake as their water source.

The timeline to evaluate the environmental externalities of the project was chosen based on, "the minimum period it takes the trees of a reforested area to reach maturity" (p. 3, URS 2007). Why this timeframe has been chosen is not clear, nor has any attempt been made to justify it. Considering the variety, and magnitude of environmental impacts during both the construction and operations phases, its use as a reference point for the evaluation is questionable. In order to make way for construction of the new lock facilities and access channels, significant areas of terrain, and therefore habitats, will be excavated. The excavation, and permanent transformation, of these areas is necessary for the operation of the Canal. Vegetation lost in these areas will not be reforested. Assuming that a reasonable time frame to evaluate the recovery of these areas is best measured by, "the minimum period it takes trees of a reforested area to reach maturity" is far from reasonable, especially considering 12,000+ TEU containers ships will be the primary users of the transformed area.

In addition to the vegetation lost in the area where construction will take place, it is also reasonable to assume that roads may need to be cut to allow for access to the construction site. The construction of these roads, temporary and permanent, will require that certain tracts of vegetation be removed. It is only once the construction process has been completed that the reforestation of these temporary roads could commence. According to ACP, operation of the expanded Canal will begin in 2014. Hence, the earliest date the reforestation in these areas can begin, given that construction routes will no longer be necessary once operations begin, is 2014. Using 2014 as a reference point,

it is improbable that a reforested area can be re-established during an 11-year period ending in 2025.

Building on the previous example, URS continues by acknowledging that the expansion project will compromise and disrupt habitats while affecting vegetation and some species that are protected locally and/or internationally (p. 5, URS 2007). Although an effort is made to acknowledge the disruption caused by the project, there is little discussion within this section, or elsewhere in the report, that attempts to actually evaluate the consequences of such a disruption. Regardless of the species that will be directly affected by the project, its magnitude will clearly have large and irreversible impacts. In addition to the transformation of natural habitats on the site of the new access channels and lock facilities, the subsequent increase in traffic transiting the Canal, once the project has begun operation, will affect both land and sea bound species throughout the watershed.

Following earlier discussions that failed to produce values for environmental externalities, URS continues by presenting project impacts in the form of an extensive table. The table describes Physical, Biological and Socioeconomic impacts during both the construction and operations phase of the project. These impacts include costs and benefits, in addition to externalities of the project. The table, which fails to provide significant insight or monetary valuations to the discussion, spans almost half of the pages in the report. Consistent with the presentation of numerous non-quantified externalities throughout the report, there are only 30 non-zero values of the 219

descriptions provided in the table. Although an attached legend suggests many of the zero values in the table have been addressed in the budgets of various programs created to mitigate the negative impacts of the expansion project, it is not clear why they have been included as zero values in the one presented. Presenting each externality with its monetary valuation in one section, while presenting the qualitative externalities in another, would have made more sense. Assembling the table(s) in this manner would have assisted in a more sound and coherent presentation of the project externalities.

Of greater concern, is determining **why** so many zero values are presented in the discussion. There are at least two possible reasons to explain why the zero values were included in the analysis, neither of which augments the credibility of the URS report. The first possible explanation is that URS believes the impact, externality or internalized cost or benefit, to be negligible. Although URS acknowledged the existence of numerous impacts, they fail consistently throughout the report to provide monetary valuations. As such, it is possible that URS believes that the impacts without monetary valuations are negligible. The table presented is simply an extension of this practice, repeated numerous times.

The second possibility is that URS was unable to calculate these impacts. As revealed earlier by URS, many of the monetary valuations used in the analysis were retrieved from a document previously commissioned by the ACP. (INDESA 2006) While it is has been repeatedly discussed that establishing a monetary valuation for environmental externalities is by no means a simple task, any discussion of potential

impacts should be accompanied with a monetary valuation. Consistent failure to provide monetary valuations could also suggest that URS was unable to calculate the externalities presented.

A discussion on whether URS was able to calculate the externalities of the project also leads to questions about the source of their data. (INDESA 2006) Throughout the URS document, there is no indication that they conducted any independent calculation of externalities; and every indication that all monetary valuations came from this document prepared by INDESA. There are multiple issues with this approach. The first issue is that if URS has constructed their analysis based on this data, they have done so while failing to present any independent verification regarding the accuracy of the source data. Any subsequent calculations made from inaccurate data will simply magnify the inaccuracies; resulting in a deficient final analysis. Another issue with this approach is that there is no evidence of an attempt to define externalities presented with zero values in the source document. While it is reasonable to expect that data for a cost-benefit analysis must be collected from multiple sources, an accurate and credible analysis requires additional calculations where necessary, as well as independent verification of source data.

Regardless of whether URS has deemed these impacts negligible, or whether they are unable to calculate them, an accurate analysis of the costs and benefits of the project requires also that all externalities be acknowledged. Each externality must be included in some form because their omission will affect the ratio of costs to benefits. Choosing

instead to include a zero value is not an option. In situations where it is not possible to produce a value, it is necessary to say so. The readers of an analysis must be informed of what externalities were not quantified and in what direction their inclusion would influence the final analysis. Regardless of whether the externality can be measured, it must be addressed.

A further examination of the table of impacts reveals that numerous costs that should be quantifiable have been given zero values. While the difficulty of assessing the monetary value of habitat destruction has already been acknowledged, failing to determine a value for more tangible impacts is less defensible. Although numerous additional zero values were presented by URS, examining all of them is beyond the scope of the current discussion. Hence, only some selective examples have been noted at this point.

As a first example, a zero value is given to the cost of stabilizing the soil with appropriate retaining structures: "Stabilize slopes with a history of landslide recurrence" (p. 15, URS 2007), "Stabilize the cuts of new access roads with appropriate retaining structures" (p. 16, URS 2007). While these may appear as little more than an aesthetic landscape feature to the untrained eye, even temporary retaining structures are costly. In addition to the expense of moving soil to prepare for construction, the materials required in the installation of retaining structures, and their shipment, are costly.

A second example is the "Training of personnel specialized in handling fuel and maintaining machinery and equipment" (p.18, URS 2007). Ensuring that all employees have up-to-date training is a fundamental requirement of any construction project, large or small. The cost of training employees can vary significantly depending on course content, duration and number of participants. Regardless of these potential variations, the cost of training is a non-zero value. Obtaining information on these variables would assist in establishing the exact cost of training. Assigning a zero value to these impacts is another example of the failure to calculate easily quantifiable costs.

A third example is in relation to "mark[ing] the footprint area before cutting down the trees to guarantee the area to be felled is exactly the one needed for the proposed works" (p. 22, URS 2007). The first component necessary to accomplish this task are accurate detailed schematics of each area scheduled to be felled. Secondly, the individual(s) interpreting the schematics must be compensated based on their ability, and provided with the appropriate equipment to ensure that their markings correspond with the schematics provided. While on their own these impacts may appear insignificant, they are additional examples of quantifiable costs given a zero value.

Finally, a zero value is assigned to the cost of the "communication process geared to national companies concerning the characteristics and requirements for each construction phase" (p. 25, URS 2007). Further on in the report URS suggests that the cost of "public and community participation", which includes "monthly meetings, publications and information", is valued at $900,000 (p. 35, URS 2007). It is not

obvious, given the similar nature of these two items, why one is valued at zero and the other at almost $1 million dollars.

As a final example, a zero value is assigned to designing and building a stretch of railway track (p. 27, URS 2007). If quantified, of all the zero values that appear in the discussion, the cost of designing and building a railway could prove to be the largest omission. The construction of a section of railway is always a costly undertaking.

It should be emphasized that none of these examples represent externalities. They are all direct expenditures items. Counting them as zero can be justified in an overall contract cost sense if these items are all assumed to be included in the contract price, which they probably are. But the URS report fails to explain this and fails to note why, in this case, these items are even being listed separately as they are in the massive table of costs included in the report. At the risk of being overly cynical, it appears that they are trying to create an impression of an exhaustive list that in practice adds nothing to our understanding of the net benefit of the project.

Social Externalities:

URS suggests that the Panama Canal Expansion Project will cause social externalities due to "the impact of construction activities" (p. 34, URS 2007). The statement is further qualified by suggesting, "construction activities will first affect the neighbouring population in terms of transportation, quality of roads, migration, waste

generation, and other" (p. 34, URS 2007). The issue occurs not with what URS has acknowledged will happen, but with what they quantify for analytical purposes. While the costs of roads and transportation infrastructure are presented, the costs of migration and waste generation are nowhere to be found.

In addition to "the impact of construction activities," URS suggests that social externalities will occur due to the expansion, "in both the medium and long run due to the role of the Canal Economic System in the Panamanian economy" (p. 34, URS 2007). Commonly used when promoting the positive impacts of the Panama Canal on the national economy, a working definition of the Canal Economic System as well as a quantitative evaluation of its estimated impacts are not included in the discussion. An evaluation of social externalities is similar to that of the environmental externalities in that they are often not possible, or at least may be very difficult, to quantify. If their qualitative nature results in them being excluded from the analysis, resulting conclusions may be inaccurate. This happens in this case, where social externalities such as project induced migration, benefits accruing to companies providing port services and the elevation of Gatun Lake among others are noted then disregarded because they cannot be measured.

When the measurement of social costs and benefits occurs, other problems are often revealed. For example, URS argues that the total cost of social externalities of the Canal expansion will total $22,600,000. A closer examination of the quantified social externalities presented by URS reveals that $21,650,000 of the total costs will be directed

towards, “reconditioning, repair, or replacement of infrastructure that may be affected by the project” (p. 34, URS 2007). The problem is that this figure suggests that the summation of all of the other social externalities accruing from expansion is just $950,000, $900,000 of which is allocated for “monthly meetings, publications and information sessions” with the remaining $50,000 being designated for “archaeological rescue” (p. 34, URS 2007). In order to meet the labour demands of the project numerous domestic and foreign workers will be necessary. The migration of the nearly 6,500 workers that will be required at the height of construction will be the equivalent of establishing a medium sized town. The impact of these workers on the social infrastructure, although temporary, will be significant. Failing to include these, and many other social externalities, in the quantified presentation of social costs, is yet another deficiency of the URS analysis.

The pattern of presenting externalities and subsequently failing to produce a monetary valuation carries over to a discussion of positive externalities of the project. “The expansion and deepening of the channels will benefit companies providing port services such as Astilleros Braswell, APSA, and Panama Ports because they will be able to expand their operations during high as well as low tide, increasing their profit margins” (p. 36, URS 2007). While environmental and socioeconomic costs can be notoriously difficult to quantify, the externalities described in this statement by URS fail to fall under either category. Instead, the type of externality presented falls well within the realm where it can be estimated. Each of these three companies, operating ports within the Panama Canal Zone, employs many Panamanians. Although a Chinese

conglomerate owns Panama Ports, earnings generated from international shippers by both Astilleros Braswell and APSA remain in Panama. Any increase in the amount of maritime traffic could then be captured by these companies, and their employees, potentially resulting in a net benefit from the expansion. Once again, however, URS fails to provide a monetary valuation for the gain that could potentially accrue to these companies following completion of the expansion project.

URS also fails to produce a monetary valuation for the externality caused by the change in the elevation of Gatun Lake. When the level of the lake is low, transportation on the lake becomes difficult, because old tree trunks are exposed" (p. 36, URS 2007). First and foremost, the ACP reports that the expansion project will increase the **maximum** operating level of the lake by a mere 0.45m. While this elevation will be significant enough to result in a loss of vegetation and fertile land, the increased water usage required for the locks, as well as seasonal elevation variation, will result in the **minimum** operating level of the lake decreasing by **1.2m** (p. 53, ACP 2006). As a result the benefits accruing to the population that moves in boats on the lake will occur only over a short period of time each year and may be offset entirely when the lake drops below its pre-expansion minimum operating level.

URS introduces the Environmental Management Plan, another chapter from the Environmental Impact Assessment of the Panama Canal Expansion project. They suggest that, "The Environmental Management Plan contains mitigation measures not so much for the repairs themselves, because they are the responsibility of other states

agencies, but… to guarantee road safety and minimize interruptions of vehicular flow to the extent possible" (p. 35, URS 2007). Considering the title, *The Environmental Management Plan (EMP),* it would be expected that the contents would contain mitigation measures as well as protocol to undertake repairs. If these issues are not discussed in the report, it is difficult to understand why URS even mentions the EMP in a discussion of project externalities.

Following a thorough analysis of the evaluation of social and environmental impacts prepared by URS, the objective becomes clear: briefly discuss both positive and negative impacts of the project, while providing a final analysis to support the decision to proceed with the project. While numerous social and environmental externalities, both positive and negative, are presented, few are actually quantified for purposes of the analysis. Many negative externalities are presented and quickly discarded because they are deemed too difficult to quantify, or not quantified because they are included in the budget of another plan designed to deal with issues of that sort.

Distinguishing Pecuniary and Non-Pecuniary Externalities:

There is an important distinction to be made when talking about externalities, between so-called pecuniary and non-pecuniary externalities. The former is essentially a redistribution effect while the latter is a real resource effect. For example, a by-product of a new highway that follows a different route than the existing highway may be to put a gasoline station along the old highway out of business while making profitable a new gas

station on the new highway. These are externalities of the highway change but they effectively cancel out, unless there is some reason to argue that the utility of the old gas station owner counts for more or less than that of the new gas station owner. In other words, a redistribution basically has no real resource impact unless we are prepared to make interpersonal utility comparisons. This is true in the Canal expansion project for a number of items that URS has included in its analysis. These items include tax revenues that they bring into the analysis at several points.

The first item introduced as a positive compensatory effect of the project is "Taxes on Sales, Tariffs, and Tax on Diesel" (p. 37, URS 2007). Following from the description provided, "materials and equipment acquired by contractors shall pay taxes in addition to the taxes established by Panama as tariffs on imported goods" (p. 38, URS 2007). In order to complete the expansion of the Panama Canal, large amounts of construction materials and equipment will be necessary. While local products will be able to meet some of this demand, many of the materials and equipment required for the project will be imported. As these additional materials and equipment enter the country, those not purchased directly by the ACP will be subject to tariffs as well as local taxes. Also subject to taxation is the diesel required by the machinery and equipment necessary to complete the project. It is important to distinguish that there are, in fact, two distinct actions occurring during this process. The first of these two actions occurs as materials and equipment required in the construction of the expansion are imported. As these goods enter the country, they add resources to the national economy. The second of the two actions occurs due to the collection of tax revenues. Examination of project

financing reveals that the ACP must repay in full any financial assistance that has been secured for the expansion project. As a result, the ACP either directly or indirectly covers the taxes collected in this process. Therefore, the net effect of this tax collection will be a redistribution of resources (pecuniary externality).

Further, in the discussion of "Taxes on Sales, Tariffs, and Tax on Diesel", it is suggested that the taxes generated "are considered a benefit to society and the total amount for the entire construction phase will be $983 million" (p. 38, URS 2007). While not only has it already been discussed why this "benefit to society" is in fact a redistribution, the estimated value of tax revenues for the project is difficult to justify. An investigation of taxation rates yields that the Panamanian sales tax rate in 2010 was 5%. Given the estimated cost of the project ($5.25 billion) and a sales tax rate of 5%, $262.5 million in taxes revenues would be generated, **if** the entire value of the project were subject to sales tax. The reality is, however, that the entire value of the project will not be subject to sales taxes. First, and foremost, the projected cost of the expansion includes the cost of labour as well as the cost of materials. Secondly, the materials purchased directly by the ACP will be free from taxes and tariffs according to Panamanian Law (p. 38, URS 2007). Although the expansion project will generate tax revenue, the magnitude will be significantly below that suggested in the URS analysis, and what is collected will be a redistribution of resources (pecuniary externality), rather than a change in real resources.

The second item examined as a compensatory effect of the project, "Income Taxes from Foreign Business", fails for many of the same reasons. Due to the scale and

size of the proposed expansion, foreign businesses will enter the economy to participate in the construction process. Revenue, and subsequent profit, generated by companies participating in the expansion of the Canal will be subject to Panamanian taxation. The level of tax generated from these businesses is independent of whether they are foreign or domestic. However, URS again suggests that revenues generated from the income taxes of foreign businesses are a compensatory effect of the project. As previously demonstrated, the fact that tax revenues collected by the government are directly or indirectly covered by the ACP results in the net effect of this tax collection being a redistribution of resources (pecuniary externality).

The third and fourth items, "Taxes on Sales Paid by Local Workers" (p. 38, URS 2007) and "Sales Taxes Paid by Foreign Workers" (p. 38, URS 2007) are subject to similar criticisms. Regardless of whether workers are foreign or local, their incomes are financed either directly or indirectly by the ACP. The Panamanian government will collect all sales taxes, regardless of whether they are paid by local or foreign workers. The net effect of sales taxes collection in the country will once again be a redistribution of resources (pecuniary externality).

Macroeconomic Effects:

When undertaking an infrastructure project of the magnitude of the Panama Canal Expansion Project, an analysis of its impact on the national economy should also be conducted. An examination of this impact should include acknowledgement that a

project of this nature will impact the national economy with the assistance of a fiscal multiplier. The fiscal multiplier is a ratio of change in national income resulting from a change in government spending. The value of the fiscal multiplier is the same regardless of the project or program causing the change, assuming the leakages associated with different expenditures are the same. When fiscal expenditures, such as those required for the expansion project, lead to increased consumption spending, which then increases income, further increasing consumption, etc, the overall increase in national income can be used to calculate the multiplier effect. But any government expenditure of equal size will produce the same multiplier impact. The point is that the multiple effects of the canal expansion should not be included in the calculation of benefits, because they are the same for all alternative projects as well and in this sense, have no net effect on the determination of how to best spend the government's limited resources.

While the Panama Canal Authority is legally differentiated from the Panamanian Government, it functions within a framework similar to that of other branches of the government: any operating profits are transferred to the National Treasury. As such, it is reasonable to assume that projects undertaken by the ACP generate a multiplier effect, much like that produced by government projects. URS fails to acknowledge this fact, however, and presents the potential national income gains as economic benefits exclusive to the expansion project. "Among the macroeconomic effects brought about by the Canal expansion worth mentioning are sustained growth of the gross domestic product that according to forecasts will reach 28 billion by the year 2025 with the expansion, whereas without the expansion it would only increase to 23 billion for the same period." (p. 40,

URS 2007) However, the existence of the fiscal multiplier suggests that an expenditure of $5.25 billion in the Panamanian economy would have a similar effect on national income regardless of what project(s) utilize the money.

There are also issues concerning the value of the predicted impact of the expansion project on the Panamanian economy. The first issue is a continuation of one that has been discussed at length throughout this analysis. While numerous positive as well as negative externalities are presented by URS, the vast majority of them are not assigned a monetary value. In the absence of monetary valuations, it is difficult to predict the cumulative impact of externalities, as well as how their impact will affect the national economy once the project has been completed. Another issue with the projected economic impact of the project, which will be discussed in further depth later in the analysis, is the time at which the forecasts were calculated. While the report was published in July 2007, it is very probable that the calculations were made several months earlier, and based on even earlier data. Since that time the global economic market has endured a recession, from which it has taken some countries longer than others to recover. The effects of the recession have affected supply and demand for numerous products upon which expanded Canal demand projections were calculated. The turbulent economic environment has also resulted in a variation in interest rates. These demand and interest rate changes that have occurred since 2007 may merit the recalculation of URS' economic forecasts.

URS also uses the potential benefits of the expansion to suggest that the project will play a major role in alleviating poverty. "Due to this sustained growth of the economy for the upcoming years as a result in large part to the expansion… there will be a significant change in the proportion of the population in conditions of poverty." (p. 40, URS 2007) While URS claims the project has poverty alleviating potential, they fail to provide an indication of how the benefits of the project will accrue to the poor. Throughout the URS report, it has become apparent that many of the benefits accruing form the expansion project will be localized to the area directly adjacent to the Canal. Meanwhile, the majority of the population living in conditions of poverty is beyond the area where benefits will accrue. As a result, the poverty alleviating impacts on this population appear to have been exaggerated. At the very least, they need to be better explained before they can be accepted. It is also somewhat inconsistent for URS to claim the poverty effects of the project are extensive and not to try to include them more concretely in the listing of benefits to justify the project.

Net Present Value and Discount Rates:

The comprehensive and accurate evaluation of an infrastructure project requires a thorough review of potential impacts. While a discussion of the costs and benefits examines those impacts directly caused by the project, the presentation of the externalities explores the impacts for which there is no compensation. Once costs, benefits and externalities have been presented, their monetary valuations can then be used to calculate the net impact of the project. One of the most common methods of

calculating the net impact of projects is the so-called Net Present Value (NPV) approach. Calculating the NPV of a project presents the total value of the project if its lifespan is measured in today's prices. If the calculation of the NPV yields a value greater than zero, it is economically and socially advisable. If, however, it yields a value less than zero the project is not advisable. When calculated with an accurate and comprehensive set of variables, the NPV can be a valuable tool in determining whether to proceed with a project.

URS carries out its NPV calculation by looking at six factors: 1) Net Value of the investment; 2) Expected Benefits; 3) Expected costs; 4) Salvage value, should there be any; 5) Useful life of the project; 6) Discount rate. While the calculation of many of these elements has been discussed at length throughout both the URS report and the current analysis, limited attention has been given to the timeline subject to analysis.

Selecting an appropriate timeline for analysis is a fundamental component of constructing an accurate analysis. If the timeline selected is too short, the benefits of the project may be underestimated as they often begin accumulating only after the accumulation of costs has begun. If, however, the timeline selected is too long, the net benefits of the project may be overestimated. Failing to select an appropriate timeline can therefore yield an inaccurate analytical conclusion. As a result, it is necessary to select a timeline that provides sufficient time for benefits to develop, ensuring that an accurate analysis can be constructed.

For the URS analysis, a timeline of 2007 to 2050 was chosen. While URS argued earlier in the report why the timeline for environmental analysis was selected, no such justification was attempted when presenting the timeline used in the calculation of the NPV. Without a justification, it is not clear why URS chooses a timeline for the NPV that is 25 years longer than that used to evaluate the environmental impacts of the project. Neither of these timelines are justified, and each appear to have been selected to maximize the positive results of the evaluation.

In order to calculate the NPV of a project, the construction of a discount rate is required. Without it, the calculation of a cost-benefit analysis is not possible. The vast literature on discount rates, a thorough review of which is beyond the scope of the present analysis, shows sharp debate on the choice of an appropriate discount rate. Even a poll of 50 acknowledged experts conducted by Weitzman (2001) failed to yield a uniform answer when asking: "What real interest rate do you think should be used to discount the (expected) benefits and costs of projects being proposed to mitigate the possible effects of global climate change?" He received responses from 0% to 15%. The construction of discount rates is, therefore, far from straightforward. If an analysis employs a discount rate that is too low, a project can be wrongly approved, whereas too high a discount rate can result in a project being wrongly rejected.

According to Burgess (2010), the appropriate "discount rate should reflect the rate of return forgone in the private sector when resources are withdrawn from the capital market to fund the project" (p. 132, Burgess 2010). The discount rate, consisting of the

weighted average of the marginal rate of productivity of investment in new capital and the marginal rate of time preference, should be constructed reflecting the proportions of funding drawn from investment and consumption, respectively (Burgess 2010). It should also be noted that the discount rate does not depend upon whether the project is undertaken by a public agency or a private firm, because, in either case, the funding for the project has the same economic opportunity cost.

Construction of an appropriate discount rate also requires information on the integration of an economy into the international capital market. In the case of the Panama Canal Expansion Project, this information is required because a significant proportion of the funding will be foreign. The discount rate then becomes a weighted average of the marginal rate of productivity of capital, the consumption rate of interest and the marginal cost of incremental funding from abroad (Burgess 2010). But even this can be a difficult task because the cost of foreign funding "is difficult to estimate because the rate of return that foreign savers demand to provide additional funding may depend upon the country's net indebtedness" (p. 133, Burgess 2010). The relevance of these guidelines becomes more apparent following a discussion of how URS constructed the discount rates for their analysis.

An examination of the discount rate constructed by URS reveals a 50-50 debt equity ratio. While this ratio was chosen because half of the money needed to finance the project will be borrowed from foreign lenders, it fails to discuss the integration of the Panamanian economy into the international capital markets. This is particularly

important due to the amount of funds required from these capital markets in order to complete the project. In lieu of including a measure of market integration URS reveals that "the cost of debt was calculated using the reference rate of 6.5 percent (which is the yield of the T-bills or U.S. Treasury Bonds) and the inflation rate at a conservative two percent… and all seems to indicate that it will remain the same for the mid term" (p. 42, URS 2007). It should also be noted that calculation of the debt ratio fails to "reflect the rate of return forgone in the private sector when resources are withdrawn from the capital market to fund the project" (p. 132, Burgess 2010). A recalculation of the debt ratio should be based on the weighted average of the marginal rate of productivity of investment of new capital as well as the marginal rate of time preference, reflecting the proportions of funding drawn from investment and consumption. A thorough examination also reveals that a recalculation based on current data is necessary to reflect recent changes in the Panamanian, and global, economic environment.

Additional methodological issues are revealed with an examination of the equity ratio used to calculate the discount rate. In order to calculate the equity ratio, 9.9 percent was taken as an opportunity cost because it "is the average profitability of national capital for the period 1993 – 2004" (p. 43, URS 2007). The issue is how the equity ratio was constructed. While calculated using the average profitability of national capital, the equity ratio fails to reflect the rate of return forgone in the private sector when resources are withdrawn from the capital market to fund the project. The discount rate should be constructed reflecting the proportion of funding drawn from both investment and

consumption. Without including both investment and consumption, the discount rate fails to sufficiently consider important economic variables.

The suspect methodology employed yields a discount rate of 7.16% that is then used in the calculation of the net present value of the project. While the calculation of the NPV of the project is a straightforward process, a discount rate that is off by even one or two percent in either direction can significantly affect the outcome of the economic analysis. For example, following the calculation of the Private Economic NPV of the project under the *constant tolls* scenario, URS presents an Internal Rate of Return (IRR) of 9.07 %. The IRR is also the discount rate that would make the net present value of a project equal to zero.

The calculation of the Private Economic NPV of the project under the *increasing* tolls scenario reveals a similar picture. While it is not being suggested that a recalculation of the discount rate would nullify the calculation of a positive NPV, a higher, or for that matter lower, discount rate would have a significant impact on the magnitude of the net benefits of the project. The decision based on the NPV of a project requires that the construction of discount rates be done with diligence.

For the social evaluation, URS calculates the NPV of the project including social indicators. Throughout this analysis there has been significant discussion concerning the presentation of potential social impacts of the project. While some of these impacts have been given values, many of the most significant impacts remain without monetary

valuations. Regardless of the numerous impacts that they have failed to value, URS continues with a calculation of a social NPV. Not surprisingly their inclusion of social impacts in the calculation of the NPV of the project is overwhelmingly positive; with project benefits increasing by over $1,100 (millions) between 2007 and 2050, while suggesting the social costs increase by a mere $51 (millions) over the same period (p. 45, 48, URS 2007). The result is a Social NPV that is even more in favor of the project than the Private Economic NPV, under both the constant and increasing tolls scenarios. The question emerges, with so many zero values for costs, benefits and externalities of the project, why a Social NPV was calculated at all.

The issue, again, is not the private cost benefit analysis of whether to proceed with the project, but rather challenging the social cost-benefit determination. Without even attempting to provide values for countless variables, the URS discussion does little to address serious questions concerning the social and environmental impacts of the Panama Canal Expansion project. Appropriate, and useable, analytical conclusions could only be yielded from these calculations if sufficient effort was directed at producing values for the numerous impacts that were identified yet not given monetary valuations.

Analytical Conclusions:

The fact that URS concludes that the Canal Expansion Project is worthwhile is not surprising. The company that proposed the project in the first place, ACP, did, after all, hire them. On the other hand, the report has presumably been constructed to solicit

financial support, and to show that the project will produce a rate of return sufficient to allow the ACP to repay the loans necessary for the project. Although URS was aware of the results expected from the analysis, the financial backers of the project still require a relatively objective analysis as a means of ensuring that their loans will be relatively safe, and will be repaid. In this regard, URS has provided calculations, however suspect, that the project will in fact produce a financial rate of return necessary to repay the loans.

While calculating a social rate of return for the project may be of importance to some, it may be of little concern, if at all, to lenders. As a result, analysis of the social, as well as environmental, costs and benefits of the project have received limited scrutiny.

URS identifies and discusses numerous environmental impacts of the Canal Expansion project. Although the magnitude of the project will undoubtedly result in significant impacts during both the construction and operations phase of the project, very few of these impacts have been given monetary valuations. In lieu of independently constructing and verifying values for these impacts, the monetary values that do appear have been retrieved from other studies of the area, with little indication of independent verification. The impacts that have been identified, but not given a monetary value, indicate that URS: (1) believes the impact to be negligible or internalized, or (2) that they were unable to calculate the value of the impact.

Similar issues plague the presentation of social externalities. While numerous social impacts are presented, many negative impacts are quickly discarded because they

are deemed: (1) too difficult to quantify, or (2) have not been quantified because they are included in the budget of another plan designed to deal with issues of that sort. Ensuring that all costs, benefits and externalities are addressed is a fundamental component of constructing an accurate and comprehensive analysis.

There are several positive externalities, mainly attributed to increases in tax revenues, which have been identified and given monetary valuations. Upon closer inspection, however, the ACP either directly or indirectly covers these tax revenues. Therefore, rather than introducing new resources into the economy, these taxes simply represent a redistribution of resources.

URS has, quite correctly, suggested that the expansion project will have a significant impact on the Panamanian economy. What they fail to discuss, however, is the fact that due to the fiscal multiplier, any project(s) totaling the same $5.25 billion price tag would have a similar effect on the national economy. Claims of significant poverty alleviation occurring due to the national economic impact of the project fail to discuss how such benefits may be delivered. Claiming that the expansion project will provide an impact unattainable by other project(s) on a similar scale is false.

Although URS identifies and discusses several negative costs, benefits and externalities of the expansion project, they fail to include numerous critical elements required of an accurate social and environmental analysis. Subsequent calculations of Net Present Value under different scenarios are therefore limited by the inadequate data

from which they are constructed. The resulting analytical conclusions are a significant deficiency of the analysis.

Chapter 5: Conclusion

Since opening in 1914, the Panama Canal has served as a vital component in the global trading system. The designs of the original canal and lock facilities have been robust enough to not only meet, but exceed, original traffic and capacity estimates. Recent maritime innovations, and the subsequent increase in vessel sizes, have resulted in numerous vessels being unable to use the Canal. As a result, the Panama Canal Authority (ACP) has proposed and begun expansion of the Canal. The expansion will enable the ACP to increase the volume of traffic and size of vessels capable of transiting the Canal. If accompanied by increased demand for Canal services, the expansion project will also enable the ACP to significantly increase the revenue collected from Canal operations.

Prior to undertaking an infrastructure expansion project, or any project for that matter, it is of the utmost importance to conduct a thorough review of the potential costs and benefits. Reviewing the potential costs and benefits of a project can help to determine whether undertaking the project is a worthwhile venture. The evaluation of financial costs and benefits is a fundamental tool required by project financiers. If the benefits outweigh the costs, it is far more likely that lenders will be repaid, and potentially earn a positive return on their investment. An examination of the Panama Canal expansion project reveals that expanding the Canal should provide the ACP with the resources necessary to repay any financing secured for the project. Once operational, the expanded Canal will not only be able to continue serving the existing traffic, but it will also be able to meet the additional demand created by vessels that had previously been too large to use the Canal.

The comprehensive evaluation of a project also requires that in addition to the financial costs and benefits, the social and environmental impacts be evaluated. While the results of a social and environmental cost-benefit analysis may have little effect, if any, on the private costs and revenues of the project, it will deliver a more complete picture of the potential impacts of a project. The purpose of this paper has been to provide an extensive examination of one such analysis, prepared by URS, Holdings Inc, for the Panama Canal Expansion project.

The analysis of the URS report has revealed significant deficiencies in their analysis of the project. Although they have identified and discussed numerous environmental impacts of the project, URS has failed to assign monetary values to many of them. The failure to provide monetary valuations is true of both positive and negative impacts. A closer evaluation of these variables reveals that many are well within the realm of monetary valuation, and some very similar variables have been given values in other sections of the URS analysis.

It is also important to keep in mind that the nature of many social and environmental impacts are inherently difficult to monetize. Although such impacts can be assigned monetary values, it should be cautioned that their evaluation should also include a qualitative assessment. As discussed throughout this thesis, it can be difficult, although possible, to construct an accurate monetary valuation of social and environmental impacts. Doing so poorly can result in the distortion of the true value of the impact. It is

for that reason that it is important to not abandon qualitative measures when delivering a quantitative assessment of impacts. Evaluating social and environmental impacts qualitatively *or* quantitatively, rather than ensuring *both* methods are used can result in distorting the true impact, and thus fail to deliver an accurate account to be used in a larger analysis.

That said, while the financial viability of the project has not been questioned, this thorough examination has revealed many deficiencies in the URS report. The repeated and consistent failure to provide monetary valuations for both social and environmental impacts reduces the credibility of conclusions by URS. These deficiencies are especially problematic if used by other parties to construct conclusions that employ the URS evaluation of social and environmental impacts of the project. Without an analysis of the project that identifies and provides, or at least attempts to provide, a monetary valuation of as many impacts as possible, it will be difficult to determine the true value of social and environmental impacts caused by the project. Identifying the many deficiencies of the URS report should not, however, be confused as an attack on the *financial* viability of the project

Constructing a report that identifies, while also providing a monetary valuation for, the potential impacts of the Expansion project can be used by political decision makers and the public alike. Such a report can be used as the foundation from which negative, as well as positive, issues of the project can be addressed, and mitigated if necessary.

The environmental impacts of the expansion project are many. In addition to the impacts occurring during the construction process, the additional traffic using the Canal once completed will lead to negative environmental impacts. URS repeatedly identifies environmental impacts of the expansion project, while failing to provide their monetary value. From the loss of vegetation and the destruction of habitats during the construction phase, to the additional effluent emitted by vessels transiting the Canal, URS fails to provide monetary valuations for significant project impacts. Failure to do so severely hinders the ability to construct an accurate social cost benefit analysis. URS also identifies potential *positive* environmental impacts of the project, such as contributing to the reduction of carbon emissions. There is little debate that such a reduction is positive. It is unclear, however, why this has been included at all, given that both the Kyoto Protocol and the Copenhagen Accord, of which Panama is a signatory, exclude emissions by international shipping.

Of greater concern is *why* so many zero values have been included in the analysis of the project. The first possibility is that URS believes these impacts to be negligible. This is a concerning possibility because while URS has taken the opportunity to identify the impact, they have failed to provide a monetary value for it, and thus include it in their final cost benefit calculations. The second possibility is that they were unable to calculate the impacts. The concern here is that there are numerous impacts that have been given zero values in certain areas of the report, while similar impacts have been

assigned monetary values in others. Regardless of the reasoning, the fact that so many zero values are presented does little to augment the credibility of their analysis.

The issues that plague the assessment of environmental impacts carry over to the discussion of social externalities. While numerous externalities are identified, few are given monetary values. The vast majority of the social externalities that are given monetary values, $21,650,000 of a total of $22,600,000, are directed at reconditioning, repairing and replacing infrastructure affected by the project. The migration of nearly 6,500 workers that will be required at the height of the project will be the equivalent to establishing a medium sized town. The impact of this migration on social infrastructure, although temporary, will be significant. Failing to include the monetary value of these and many other social externalities is a significant impediment to an accurate and comprehensive analysis of the expansion project.

Constructing an accurate cost benefit analysis also requires acknowledgment of the distinction between different forms of externalities. Confusing so-called pecuniary and non-pecuniary externalities can be detrimental to any analysis. URS does just that on a number of occasions by suggesting that increases in numerous different forms of tax revenue will increase the amount of resources in the Panamanian economy (non-pecuniary). In reality, however, this tax collection is a redistribution of resources (pecuniary). Suggesting that this increase in tax revenues is a positive impact of the project is misleading, and contributes to a deficient analysis of the project.

Regardless of the size of an infrastructure project, it is also very important to conduct an analysis of its potential impact on the national economy. In URS' attempt to analyze and present these macroeconomic impacts, they fail to acknowledge the influence of the fiscal multiplier. The fiscal multiplier, which is a ratio of change in national income resulting from a change in government spending, affects *all* government projects equally. URS suggests, however, that the macroeconomic effects produced are exclusively due the expansion project. What the fiscal multiplier suggests, however, is that similar macroeconomic effects would occur regardless of the project(s) in the Panamanian economy given a total expenditure of $5.25 billion.

Once URS concludes their examination of the costs and benefits they believe will accrue due to the project, they proceed by calculating their net impact. By selecting the Net Present Value (NPV) approach to calculating the net impact of the project, they are required to select a discount rate. Their approach to this, which involves assuming a 50-50 debt-equity ratio, is done while failing to consider significant considerations that have been shown to affect discount rates. The most significant omissions include the integration of the Panamanian economy into international capital markets and the rate of return forgone in the private sector due to the resources being withdrawn from the capital market to fund the project. Failing to include these, and many other considerations, severely reduces URS' ability to construct an accurate discount rate, and thus calculate a precise Net Present Value for the project.

These criticisms are, however, aimed at the URS analysis, rather than the Expansion project itself. After careful examination, it is apparent that the Panama Canal Expansion project has the potential to have a significant impact on the Panamanian economy. Once the expanded Canal is operational, it could potentially help generate over $1 billion in yearly revenues for the ACP.

As discussed at length, the URS analysis fails to assign a monetary value to numerous environmental and social externalities. Without further analysis, which is beyond the scope of the current discussion, determining the exact value of these impacts is difficult. Although URS fails to provide a monetary value to many of the impacts that it has identified, the expanded Canal is expected to increase the revenue generating potential of the ACP. These additional revenues are turned over to the Panamanian Treasury to be dispersed by the federal government. Regardless of how these additional resources are ultimately dispersed, the Panamanian Government will be endowed with the *opportunity* to address many of the potential impacts that have been identified, regardless of their monetary valuation.

These increased revenues will also provide Panama with *opportunity*, however unlikely, to address some of the numerous social issues that exist throughout the country, such as: poverty, education, health care, etc. Although financial resources may not be sufficient to fully alleviate these issues, profits from the Canal expansion may allow them to be better addressed than would otherwise be the case.

The fact that the expansion project will provide the Panamanian government with the resources necessary to address these issues doesn't mean that they will actually do so. The aforementioned social issues have plagued the country for decades. Over the same period, however, the government has taken significant strides to make the country as attractive as possible to the international business community with numerous tax and banking freedoms for corporations. Assuming the Panamanian government will direct these newfound resources at pressing social issues, while optimistic, cannot be counted on to happen.

While Panama's strategic location has enabled it to become a financial and logistics hub, it has significant social issues that have long gone unaddressed. Although Panama is increasingly integrating into the global economy, the needs of many minorities in the country continue to be marginalized. For instance, the indigenous people of Panama are among the most marginalized people groups in Panama. While approximately one third of the non-indigenous population, or thirty percent of the total population[2] in the country lives in poverty, over 83 percent of the indigenous population[3], or 8.3 percent of the total population, lives below the poverty line (p. 19, Vakis and Lindert 2000). Furthermore, 70 percent of indigenous people cannot satisfy their daily minimum caloric intake requirements (p. 19, Vakis and Lindert 2000). The poverty among the people is worse for those living in indigenous areas where 87 percent of people live in extreme poverty, while less than one quarter of those residing outside indigenous areas live below the extreme poverty line (p. 6, Vakis and Lindert 2000).

[2] Total population of Panama: 2,839,177 (Population and Housing Census 2000)
[3] Indigenous population of Panama: 285,231 (Population and housing Census 2000)

Once completed, the expanded Canal will accommodate increased volumes and traffic flows. As a result, toll revenues will increase significantly, with or without toll increases. The increase in toll revenues will be more than sufficient for lenders whose priority is to be repaid. These revenues can also be used to ensure that social and environmental concerns are addressed. Although URS fails in many instances to accurately assess the potential social and environmental impacts of the project, their analysis has little impact on the financial realities. Additional revenues created by the expansion provide the potential to address previously existing needs throughout the country, as well as those created by the project itself.

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Appendix A: History of the Panama Canal

Since the 1492 commissioning of Christopher Columbus by Isabella I of Spain, the quest for a new passage to the orient has been driven by both politics and commerce. While not the first European to arrive in Panama, Columbus arrived on the Panamanian coast in 1502 (Llacer 2005). In spite of the short duration of his stay, he and his team established that the body of water that lay across the seventy kilometers of mountain ranges and forests would lead to the Orient. Shortly after this conclusion had been reached, "the King of Spain would order Panama's Governor, Pedrarias Davila, to find a passage to the South Sea" (p. 25, Llacer 2005). Although unsuccesful in his attempt to do so, he was able to establish a land route to traverse the isthmus connecting the cities of Nombre de Dios on the Caribbean to Panama City on the Pacific.

It was not until almost three centuries later that the dream of constructing a canal to join the two oceans through the isthmus was revisited. In 1779 King Carlos III of Spain ordered engineers to explore the Panamanian route, as well as a rival route in Nicaragua. (Llacer 2005) Although the engineers identified land routes, it wasn't until 1811 that German-Scientist explorer Alexander von Humboldt proposed a canal to traverse the isthmus (Maurer and Yu 2006). While the proposal of a canal provided the possibility that one day ocean bound vessels might be able to traverse the isthmus, the appropriate resources were unavailable at the scale required for the project. It wasn't until 1876 that sufficient resources became available for the project to become a reality.

The Suez Canal was opened in 1869. Ferdinand de Lesseps who had overseen the design and construction of the canal remained as the president of the Suez Canal Company once the project had been completed. He then turned his attention to building a canal in Panama. In 1876 he was appointed chair of the newly created Societe Civile International du Canal Interoceanique de Darien (Llacer 2005). Lesseps proposed a sea-level canal, similar to the Suez, which was opposed by eminent engineers Eiffel and Lepinay, whose proposals were based upon developing a lock Canal. The French Congress elected to go with De Lesseps' proposal (Llacer 2005).

The topograhy of the proposed Canal passage quickly proved to be prohibitive for a sea-level route. Frequent mudslides required that the walls of the canal be dug at a 22.5 degree angle rather than the planned 45 (p. 8, Maurer and Yu 2006). Ultimately, the French gave up trying to build a sea-level Canal in 1887, "and redesigned their project around a series of locks designed by Alexandre Gustave Eiffel" (p. 9, Maurer and Yu 2006). As construction progressed, the project was unable to generate revenues, and debt for the company continued to mount. The refusal of the French legistaure to suspend the company's debts resulted in their bankruptcy in 1889 (p. 9, Maurer and Yu 2006). While unable to complete the project, the French successfully constructed navigable channels on both the Atlantic and Pacific entrances to the canal. The assets of the bankrupt company were then reoganized under the name of the New Panama Canal Company.

American construction of the Canal:

The French failure to successfully complete the project did little to alter American opinions about the value of an isthmian canal. American governments had long desired the construction of a canal across the Central American Isthmus due to projected economic benefits (Maurer and Yu 2006). Shortly after the failure the Isthmian Canal Commission was created with the objective of successfully completing the Central American Isthmian canal. In addition to exploring the potential of continuing the project that had been initiated by the French, the Commission recommended a Nicaraguan route. The proposal of the alternative route wasn't for technical or political reasons, but rather due to the price demanded by the New Panama Canal Company for it's properties ($109 million) (p. 9, Maurer and Yu 2006). Once Philippe Bunau-Varilla, an engineer under de Lesseps and part owner of the New Company, had been made aware of the financial impediments, he approached the company's management in Paris. He argued that they should lower their price to $40 million because the New Company's concession would expire in 1904, "after which its shareholders would receive nothing for their investments" (p.9, Maurer and Yu 2006). A bill was then presented in the American Senate that would authorize the President to purchase the assets for $40 million if a satisfactory agreement could be reached.

The proposal of the Hay-Herran Treaty exceeded what had been defined as a satifactory agreement, essentially granting all of the American demands. Under the Treaty the U.S. would receive "a six-mile zone within which it could deploy troops with Columbia's consent, construct a canal, and control public health" (p.11, Maurer and Yu

2006). Although approved in the American senate, it was met with significant resistance in Columbia. Ultimately, the Treaty was not ratified but the American government had grown impatient, and was not willing to renegotiate with Columbia. The United States government opted instead to poltically and militarily support a planned uprising led by the Panamanian Independence movement. The leader of the movement, Manuel Amador, met with Bunau-Varilla in New York where details of the support required for Panamanian independence and concessions for the proposed Canal were established (Maurer and Yu 2006). As a part of the proposal a ten-mile wide band around the canal would be conceded to the United States. On November 3, 1903, with the support of the American military, Amador declared independence from Columbia (Maurer and Yu 2006). The major events that led to this date demonstrate that Panama's birth as an independent nation was largely driven by American political and economic interests.

Construction of the Panama Canal was restarted shortly after Panamanian independence, with the Canal quickly becoming the most expensive public works project in American history (Maurer and Yu 2006). "Between 1903 and 1914, the United States spent $302 million on construction. In 2004 dollars, adjusted with the U.S. GDP deflator, the Panama Canal cost $4.4 billion" (p.3, Maurer and Yu 2006).

Nicaraguan Canal:

Throughout the process of designing and constructing the Panama Canal, there had also been interest in constructing a Nicaraguan Canal. While the topographic challenges faced by this potential Nicaraguan route were similar to the Panama canal,

politically the route was more challenging. Rather than dissecting a single country like the Panamanian route, the carribbean side of the proposed Nicaraguan route would follow the San Juan River, shared by Nicaragua and Costa Rica. While the Costa Rican government had consistently opposed any plans for a canal, there were also serious doubts concerning the legitmacy of the Nicaraguan government (Bailey 1936). It was feared that substantial concessions offered by the government could swiftly be overturned in the event of political unrest. American Senator Elihu Root conceded that the Nicaraguan government "did not represent more than a quarter of the people of the country and that it was really maintained in office by the presence of the United States marines" (p. 7, Bailey 1936). This, however, did little to deter other countries interested in the potential route from inquiring as to the feasibility of the project.

Although the Americans began construction on the Panama Canal in late 1903, there was always the disquieting possibility that one of the European or Asian powers might attempt to construct a rival canal through Nicaragua. In spite of the Panama Canal not yet being operational in 1913, the United States established the Chamorrow-Weitzel Treaty to address this possibility. Under the terms of the Treaty the United States would "secure an option on the canal route, together with the privilege of establishing certain naval bases; and Nicaragua in return was to receive a sorely-needed $3,000,000" (p. 3, Bailey 1936). Although the Treaty itself was designed only to provide an *option* on a canal route, rather than delivering specific terms for *constructing* a canal, it revealed the intent of Americans in maintaining a monopoly over a trans-isthmian canal route (p. 3, Bailey 1936).

In 1915, a year after construction of the Panama Canal had been completed, diminishing interest in an alternate route was rejuvenated. A group of Canadian capitalists proposed constructing an Atlantic to Pacific railroad across Nicaragua (p. 6, Bailey 1936). With the proposal concerns were raised that if such an enterprise were completed that it would divert trade from the Panama Canal, and jeopardize monopoly control of the Nicaraguan canal route held by the United States. Ultimately the proposal was abandoned due to a lack of sufficient funding (Bailey 1936).

Following the Canadian proposal, additional attempts to build a Nicaraguan canal were few and far between. The lack of alternatives could largely be attributed to one of two reasons; (1) potential investors lacked sufficient capital necessary to complete such a project, and/or (2) foreign governments did not want to challenge American authority in the region, and potentially provoke war over the proposed route.

In spite of the lack of recent viable proposals to build a Nicaraguan Canal, support for such a route continues to make their voices heard. Proponents argue that from economic, political, and diplomatic point of view this great project would have a stabilizing effect upon Central America. “If a Nicaraguan waterway should be constructed as an international project, shared by the Hispanic American countries, and left unfortified, it would be warmly welcomed” (p.28, Bailey 1936).

Early Canal Operations:

As the canal neared completion the impending impact on the American railroad industry became apparent. The railroads would certainly oppose the impending arrival of a potentially cheaper inter-coastal alternative and "were likley to do whatever they could to defend their dominance of the coast-to-coast freight business" (p. 23, Donovan 2000). The American government wasn't about to subject the prosperity of the canal to a competitive marketplace. The government having invested signicant amounts of resources in the project, "felt compelled to defend the canal's commercial prospects" (p. 23, Donovan 2000). As a result in 1912 the Interstate Commerce Act was ammended with the Panama Canal Act "by specifically prohibiting railroad companies from having any interest in water carriers operating through the Panama Canal, especially if they transported cargoes the railroads might otherwise have carried" (p. 23, Donovan 2000).

The railroads were given an additional measure of relief when the opening of the Canal did not coincide with unrestricted civilian access. Although the Canal informally opened on August 15, 1914, landslides along the Canal route, as well as the First World War, restricted Canal traffic to American military and commercial vessels. As a result, the benefits expected to accrue on both the Atlantic and Pacific coasts failed to develop as quickly as expected. It wasn't until the Canal formally opened in July 1920 that producers began to benefit from a substantial reduction in freight rates (Rockwell 1971).

In the first full year of Canal operations the cost of shipping between the West Coast of the United States and the United Kingdom dropped by 31 percent (Maurer and

Yu 2006), while steamer rates were cut by nearly one half (Rockwell 1971). The shorter Canal route reduced the average steamer time between coasts from seventy days to twenty days (p. 449, Rockwell 1971). The shorter distances not only reduced operating expenses but also interest costs, insurance rates, and other associated charges as factors such as time and risk were reduced closer to that of railroad competition.

It was at this time, especially during the second half of the 1920's, that the greatest impact of economic development attributed to the Canal became evident. The opening of the Canal route provided producers on both coasts with a cheap alternative to transporting their goods by rail. During the first fiscal year of operation the canal accommodated nearly 12 million long tons of cargo, within four years the annual volume transiting the canal had more than doubled, and by 1929 total tonnage approached 31 million long tons (p. 447, Rockwell 1971). One setback during this period, reflecting the impact of the Great depressions, saw shipments decline by almost 50 percent from 1930 to 1933. In 1934, traffic rebounded sharply to 27 million long tons and remianed there until the outbreak of the Second World War (p. 447, Rockwell 1971).

Early proposal for a third set of locks:

The success of the Canal prompted a third set of locks to be considered as early as the mid-1930's. Construction of an additional set of locks would be designed to accommodate the transit of larger commercial vessels and a new class of battleship. The project received Congressional approval in August 1939 and construction began in July 1940. In the Spring of 1942, however, the Navy indefinitely postponed the battleship

construction program, which had become the primary driver to the new locks (p. 389, McBride 1997). Shortly thereafter, when the U.S. entered WWII work on the third set of locks was suspended indefinitely.

Post-war relations between Panama and the U.S.:

After the war, in an era of de-colonization it became increasingly difficult for the United States to justify its involvment in Panama. At the same time military significance of the Canal was diminishing. By the 1960's, the most important warships—nuclear submarines and modern aircraft carriers—were either too large or too vulnerable to make use of the long narrow Canal (Strong 1991). Relations between the two nations deteriorated as U.S. control of the Canal and Canal Zone came into question.

Tensions between the two countries escalated in1958 when groups of students began entering the Canal Zone to display Panamanian flags. Their presence instigated riots in 1958, and again in 1959. These acts of defiance, and subsequent riots, "drew attention to growing Panamanian dissatisfaction with the existing situation" (p.270, Strong 1991). The Eisenhower administration attempted to ease tensions between the two nations with a symbolic concession set to begin in September 1960. Under the arrangement a Panamanian flag was to be flown at a prominent location in the Canal Zone near Panama City. Due to the previous sensitivity surrounding goverance of the Canal and Canal Zone administrators had previously forbidden the flying of either flag at any public building within the zone (Strong 1991).

Attempts to obtain sovereignty over the Canal Zone reached a crucial point on January 9th, 1964 when a group of American students raised the Stars and Stripes outside of their highschool (Strong 1991). Teenagers from Panama City marched into the American controlled Canal Zone to protest the fact that the High School was not also flying the Panamanian flag (McPherson 2002). A dispute between American and Panamanian students over which flag was flown resulted in the tearing of the Panamanian flag. While the dispute seemed trivial, it ignited a crisis within hours and thousands of adults rioted for four days, resulting in the deaths of four American soldiers, twenty-one Panamanians and more than one hundred injuries (McPherson 2002).

Once the American army had restored order in the Canal Zone, irreversible political damage had been done. The incident had resulted in a temporary breakdown in diplomatic relations between the two countries. Eventually, on April 3rd, 1964, tensions subsided sufficiently that the two countries agreed to restore diplomatic relations and began negotiating the eventual return of the Canal and the Canal Zone to Panamanian administration (Llacer 2005). While the framework for a treaty was laid that year, it wasn't until more than a decade later that formal negotiations for return of the Canal and Canal Zone began.

Torrijos-Carter Treaties:

When Jimmy Carter was sworn in as American president on January 20th 1977, it initiated a new era of the U.S. relationship with Panama. Possession of the Canal had been a sensitive issue that previous administrations had almost completely avoided.

During a time in which the failures of Vietnam had become apparent, most were unwilling to consider a further reduction of American power such as conceding the Panama Canal. Carter's presidential campaign tried to avoid making the Canal a major issue stating that he would "not relinquish practical control of the Panama Canal Zone any time in the forseeable future" (p.272, Strong 1991). By the time he had become president-elect however, his opinion on the importance of the issue had changed. After learning more of the 1903 treaty and the recent tensions between the two countries, he used his new found political clout "to correct an injustice" (p.272, Strong 1991).

The process that Carter had initiated with his presidential inauguration was culminated on September 7th 1977 with the signing of the Panama Canal Treaty and the Permanent Neutrality and Operation of the Canal Treaty (Llacer 2005). The Torrijos-Carter Treaties entered into force on October 1st 1979 at which point the Canal and the Canal Zone would fall under joint American-Panamanian adminstration. The most important achievement of the Treaties established that the Canal and Canal Zone would revert to Panamanian control "at noon—Panamanian local time—on December 31st 1999" (p.31, Llacer 2005). The Treaties also outlined the framework necessary to deliver command of the Canal to the jointly administered Panama Canal Commission (PCC), followed by the Panama Canal Authority (ACP) upon reversion to Panamanian control.

Turnover of the Canal:

At noon on December 31st, 1999, the Panama Canal Authorty was given control of the Panama Canal. The ACP was established under Title XIV of the National

Constitution, and was passed into law on June 11, 1997. According to the law, the ACP has the exclusive "charge of the administration, operation, conservation, maintenace, and modernization of the Panama Canal and its related activities" (p.1 Organic Law of June 11 1997). Under the law the ACP would become "a governmental corporation which would allow it to operate as an enterprise rather than a government agency" (p.33, Llacer 2005). The law also charges the ACP with operating the Canal profitably, and making annual payments to the Panama National Treasury… from the monies collected from vessels transiting the Panama Canal" (p.4, Organic Law of June 11 1997). Any plans to develop or expand the Panama Canal must also be approved by the ACP. Soon after the turnover of the Canal, the ACP excercised these duties and began exploring options of how to expand the Canal.

Appendix B: Panama Canal Operations

Since the completion of its construction in 1914, the Panama Canal has served as a vital component of global shipping channels and the Panamanian Economy. Forming the Panama Canal are three sets of locks, two man-made lakes and an artificial valley dissecting the Continental Divide. While substantially shortening the journey between the West and East Coasts of the United States, the Panama Canal also expedites the shipment of products from countries around the world. Improvements such as widening the Culebra Cut and the installation of fluorescent lighting have enabled the Canal to accommodate increases in traffic as the composition of maritime cargo has evolved. In the last two decades, however, the largest maritime vessels have grown beyond what current locks dimensions can accommodate. Due to the inability to accommodate the largest vessels, and maritime navigation time differences, the U.S. intermodal System and Suez Canal have emerged as competitors to the Panama Canal. As alternatives to the Panama Canal have evolved, multiple toll increases, as well as the reversion to Panamanian control of the Canal, have provided the resources necessary to initiate modernization programs in order to accommodate larger vessels.

The Panama Canal, at approximately 80 kilometers long, reduces the journey between the West Coast and the East Coast of the United States by nearly 13,000km (Eriksen 2000). While previous attempts to construct a passage through the Isthmus had been attempted with sea-level canals, the design that has been successfully employed for nearly 100 years involved constructing three sets of locks, two man-made lakes and a channel carved through a mountain range.

As vessels approach the first set of locks, a launch boat delivers the pilots and line-handlers required to guide the ship through the Canal. The job of the pilots is to navigate vessels through the canal by delivering instructions to line-handlers and tug boats. Line-handlers attach cables from locomotives that move on tracks parallel to the lock chambers to assist in the steering of each vessel through the locks. This process is repeated for each of the three sets of locks. Tugboats are used to assist in navigation as vessels enter each set of locks. These measures are taken not only to reduce lockage times, but also help protect transiting vessels from colliding with the lock chambers.

Figure 5: Canal locomotive (Virtual Panama 2010)

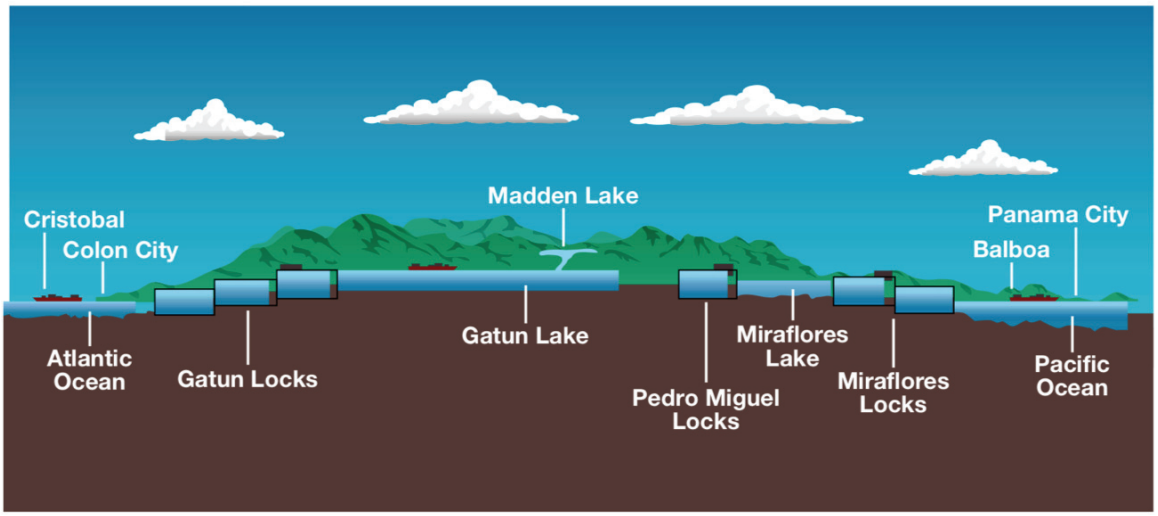

Figure 6: Cross-section of the Panama Canal (p. 28, Rosales 2007)

Approaching the Canal from the Atlantic Ocean, the first part of the journey requires vessels to enter the Gatun locks. The Gatun locks, a series of three lock chambers, raise vessels a total of 85 feet (26m). Passage through the three Gatun lock chambers for a loaded vessel takes approximately 2 hours (Llacer 2005). Rather than mechanically pumping water into the locks, the locks work by using gravity to fill the chambers. The locks are connected to the lakes and oceans through a series of valves that open and close to fill the chambers (Llacer 2005).

Once vessels have completed the ascent provided by the first set of locks, they enter into the man-made Gatun Lake to continue the next 33 km of their journey. Gatun Lake was created by damning the Charges River during construction of the locks from 1907 to 1913. At the time of construction, the Gatun dam was the largest dam in the world and Gatun Lake was the largest man-made lake in the world (Rosales 2007). Upon completing navigation of Gatun Lake, vessels then enter the Culebra Cut for the next 13km of the journey. The Culebra Cut is an artificial valley constructed through the Continental Divide of Panama to join the lake to the Pedro Miguel Locks. Upon completing the transit through the Culebra Cut vessels enter the single chamber

Figure 7: Containership transiting the Culebra Cut (Watt 2010)

Pedro Miguel Locks lowering them 31 feet. Vessels then proceed to the second artificial lake, Miraflores Lake, as they continue their journey towards the Miralfores Locks. The two Miraflores lock chambers then lower vessels the remaining distance to the Pacific Ocean.

Panama Canal Improvements:

The original design of the Canal and its locks has proven to be remarkably robust. In addition to performing regularly scheduled maintenance on the lock gates, significant modifications have only been made once over their lifespan. The lock gates, which had been gear operated since 1914, were converted to hydraulic struts arms in 1998. The change was undertaken to take advantage of updated technologies and lower maintenance costs offered by the hydraulic struts (Llacer 2005).

One amenity that was not foreseen due to the lack of appropriate technology at the time of construction was a lighting system. The installation of fluorescent lighting in 1963 facilitated round-the-clock operations. These bulbs and lighting systems have been modified as new technologies have become available.

The Culbera Cut that serves as an integral link in the Canal, built to accommodate the largest vessels during the era of construction, has not however been able to avoid significant modifications. When the Canal was first opened to traffic, few vessels approached the maximum allowable dimensions of the Canal. In fact, many of the largest vessels at the time of construction were capable of transiting the locks two at a time

(Rosales 2007). The Culebra Cut, built to accommodate these vessels, was 91m wide upon completion. As the dimensions of vessels began to grow, widening of the Cut to 152m in some locations began in the 1930's and 1940's, with the remaining portions completed by 1971 (Llacer 2005). Beginning in the early 1990's, as numerous vessels were being built to the maximum dimensions of the locks, additional widening of the Cut was undertaken.[4] Further widening of the entire Culebra Cut from 152m to at least 192m in straight stretches, and 222m in corners, occurred in order to allow the simultaneous passage of Panamax-size vessels (Llacer 2005). The widening enabled Panamax vessels to pass each other in the Cut for the first time on May 3rd 1999 (Llacer 2005).

Traffic:

Canal traffic has always been a function of global economic and maritime commercial factors. The development of maritime transportation technologies and global trading routes has affected the size of ships and cargo utilizing the Canal. When significant variations in Canal traffic do occur they are most frequently caused by economic fluctuations on global trades routes between countries and trading regions rather than on factors pertaining to Canal operations.

[4] The dimensions of the lock chambers limit the size of ships capable of transiting the Canal to 32.3m at the beam (width), 294.1 m in length and 12 m in draft (p. 44, Eriksen 2000). Ships that are built to the maximum navigable dimensions of the locks are referred to as *Panamax*, while ships exceeding these dimensions are referred to as *Post-Panamax vessels*.

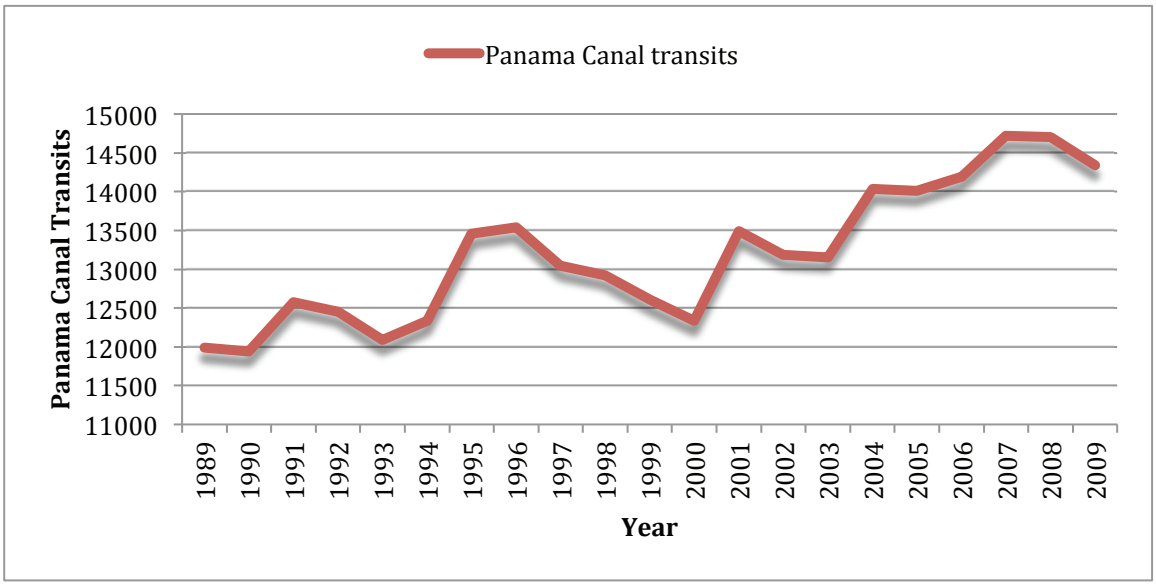

Figure 8: Panama Canal transits per year (1989-2009) (ACP, Llacer 2005)

While transits of the Canal have increased from fewer than 12000 per year in 1989 to over 14000 in 2009, the rate at which increases have occurred has been far from constant. The modest increase in traffic that was experienced in 1991 was offset by the effects of an economic slowdown in the USA and Japan, as well as changes made in the transport of oil, grain and cars (p. 229, Llacer 2005). Canal traffic recovered quickly and by 1996, transits exceeded 13500 transits. Beginning in 1997, the economic recession affecting Asian economies and other major Canal users caused transits to drop by nearly 10% by 2000 (Eriksen 2000). The sharp recovery in 2000 was tempered by a mild economic downturn before experiencing continued transit growth through 2007. The effects of the global recession on transits was mildly reflected in 2008 transit statistics, before greater effects were felt in 2009.

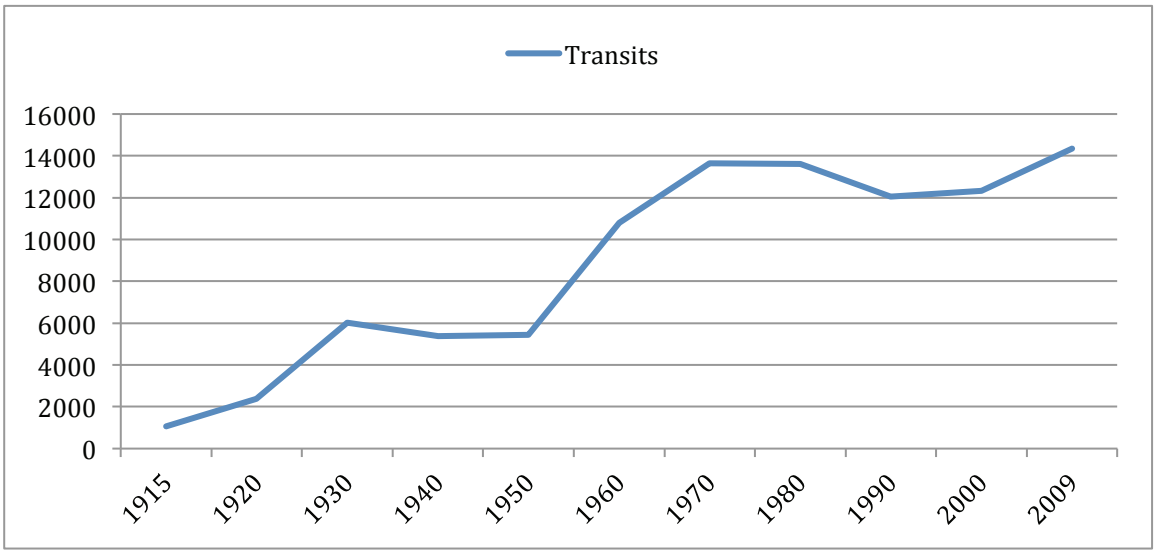

Figure 9: Panama Canal transits by decade (Llacer 2005)

Observing traffic patterns over the entire history of the Canal reveals a similar yet less detailed picture of how usage has changed. During the first two and half decades of operation, Canal traffic increased at a steady rate until the effects of the Great Depression were felt. This increase was largely a result of shippers from both American coasts increasing usage as the cost savings of the canal became evident. The steady increase of Canal transits was halted by 1930 as the effects of the Great Depression were felt. While this reduction in transits reversed during the latter half of the 1930's, the outbreak of the Second World War restricted transit growth throughout the 1940's. Transit growth was restored in the 1950's as maritime technology improved and economies around the world were thriving. The leveling out of transits during the 1970's and into the early 1980's was caused by insufficient Canal capacity to increase transits at the time. The traffic decline of the 1980's was initiated by an economic recession and accentuated by the commissioning of oil pipelines, such as the Panama Oil Pipeline, that reduced the need for oil tankers to traverse the Canal (p.229, Llacer, The Panama Canal: Operations and

Traffic 2005). A more detailed discussion of Canal traffic in the 1990's and 2000's was previously discussed.

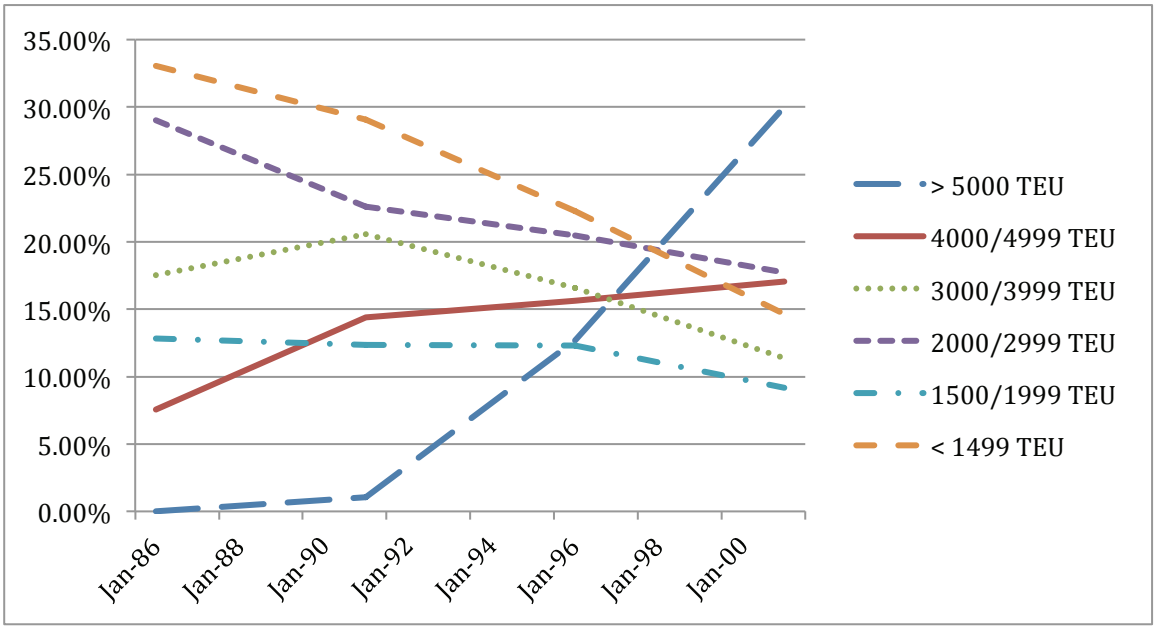

Figure 10: Scale increases in vessel size: Evolution of the world cellular fleet 1991-2006 (Notteboom 2004)

The days of commercial vessels being able to transit two, or more, Panama Canal lock chambers at a time have long since passed. As maritime technologies have improved, and the demand to ship cargo by sea has increased, vessel dimensions have increased. Maritime technological advances have also had a significant impact on the composition of goods shipped by oceangoing vessels. Containerships, currently the most frequent users of the Canal, did not exist in their current form before the 1950's and only began to account for a significant portion of Canal traffic beginning in the 1980's. As container traffic has become increasingly popular, the size of vessels carrying containers has increased significantly to take advantage of economies of scale. As depicted in figure

3, that while vessels of greater than 4000 TEU[5] accounted for less than 10% of the world cellular fleet in 1991, as of 2006 they accounted for nearly 50% of the world cellular fleet. This dramatic growth of the world cellular fleet has corresponded with the growth of Panamax vessels transiting the Canal. While in 1988 Panamax vessels represented one-quarter of transits, by the mid 1990's they accounted for one-third, and by 2009 they accounted for nearly one-half of all Panama Canal Transits (Eriksen 2000, ACP – Annual Report 2009).

The Canal is quickly reaching its maximum capacity and currently accommodates higher traffic volumes than it was designed for (Salin 2010). As long as the composition of high value low volume goods transiting the Canal in containers continues to grow, demand for the canal to accommodate Panamax vessels, and larger, will persist. Capturing this potential growth will not only depend on expansion of the locks to accommodate Post-Panamax vessels which currently move 27 percent of the world's containerized maritime shipments, but also on the service, storage, and handling capabilities of the Canal entrance ports of Balboa and Cristobal (Salin 2010).

Tolls:

The system through which tolls are calculated for vessels transiting the Panama Canal is subject to constant evaluation. Under the original system, established in 1914, tolls were assessed on the basis of net register tons (PC/NRT). This system was based on the belief that taxes, charges and payments for vessels using Canal services should be

[5] Twenty Foot Equivalent Unit – Standard unit of measurement for multimodal containers. The most common length is forty feet, or two TEU's.

directly related to their productive capacity (Llacer 2005). While the Canal was under American control, the first toll increase didn't occur until 1974 (Eriksen 2000). The toll increase was made to ensure that the Canal could continue to operate at a break-even point financially. Subsequent toll increases occurred 8 additional times throughout the duration of American control of the Canal.

Shortly after the Canal was reverted to American control, the Panamanian National Assembly and Alberto Aleman, the Canal administrator at the time, indicated that a fundamental change in the toll structure was necessary (Fuller, Fellin and Eriksen 2000). While the Americans had operated the existing system on a break-even basis, the Panamanians indicated that the Canal would be managed to increase government revenues. A new toll structure was adopted to reflect these ideological changes in October 2002 (Llacer, Panama Canal Management 2005).

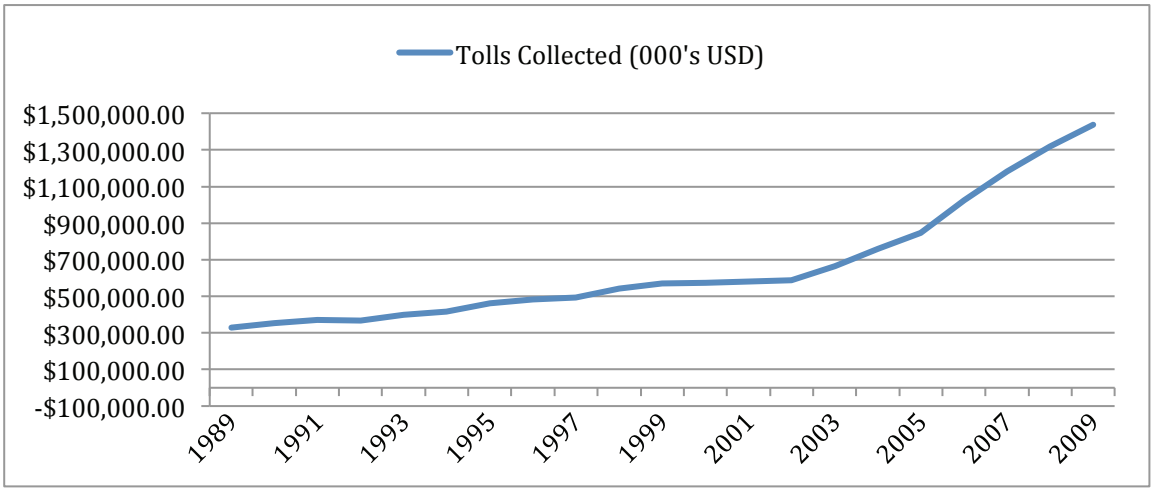

Figure 11: Tolls collected (000's USD) from Panama Canal transits (1989-2009) (ACP, Llacer 2005)

A new toll structure had been in development for some time, although under American control the Canal was slow to adopt any changes. The need for a modified toll structure can be seen when examining data between the Panama Canal and the Suez Canal from 1989. During that year the Suez Canal had 18,190 transits transporting 259.5 million metric tons of cargo while the Panama Canal had 12,234 transits transporting 154 million metric tons of cargo (Llacer 2005). Although these data demonstrate that the Suez Canal was supporting 48% more vessels and 66% more cargo, an examination of the tolls reveals a startling picture. While the Panama Canal collected roughly 330 million dollars in toll revenue, the Suez Canal collected almost four times that amount, at 1300 million dollars (Llacer 2005). Further comparative examination of the results between the two canals reveals that a significant in the toll structure was necessary for the Panama Canal.

The new system was designed in an attempt to differentiate tolls based on vessel type, size, locomotives used and other needs of each vessel. The first change in the new system was to move away from the PC/NRT (net register tonnage) unit of measurement by adopting the PC/UMS (universal measurement system) unit of measurement deemed more capable by the ACP of indicating a vessel's earning space. Rates were established for the first 10,000 PC/UMS, slightly smaller for the next 10,000PC/UMS, and smaller still for the remaining tonnages. Differentiated rates were also established for ships based on the following classifications: containers, general cargo, refrigerated cargo, dry bulk carriers, tankers, roll-on-roll-off ships, passenger ships and others. The application of the new system was a two-step process beginning on October 1st 2002 and then on July 1st

2003 with average increases of 8% and 4.5% respectively (Llacer, Panama Canal Management 2005).

Reversion to Panamanian control has also resulted in changes regarding the procedure that vessels must follow when transiting the Canal. As demand for Canal services has increased so has the necessity for vessels to pre-book their desired transit date, sometimes months in advance. If a vessel arrives in Canal waters, and is not scheduled to transit the Canal that day, it will drop anchor while it waits for its scheduled transit time (Llacer 2005). Once the scheduled transit date does arrive, vessels can only begin their transit once ACP has received full payment for the transit (Eriksen 2000). Along with the new toll structure, these procedures have assisted efforts to increase Canal revenues. Within two years of the new strategy the Canal's contribution to the Panamanian economy doubled, thus encouraging and enabling modernization programs (Llacer 2005).

The contribution of the Canal to the Panamanian economy far exceeds Canal revenues. While historically tolls have accounted for about 9% of Panama's gross domestic product, the impact of the Canal spreads throughout the Panamanian economy as service-oriented industries including storage, ship-repair and bunkering employ thousands of Panamanians (Fuller, Fellin and Eriksen 2000). Programs to modernize and expand the Canal will not only increase toll revenues, but also have a significant effect on Canal related services throughout the Panamanian economy.

Canal Competition:

The growth of volume and traffic transiting the Canal also faces competition from viable transportation alternatives. The first of these competitors, the U.S. Intermodal System, involves vessels navigating the pacific to a West Coast port where goods are then transferred to train and truck to complete the journey to their destination. The second alternative is that presented by the Suez Canal, which allows for the passage of ships larger than the permissible dimensions of the Panama Canal. In order to keep pace with the growing demand for the maritime transportation of goods both of these competitors has been able to provide a viable alternative to the Panama Canal.

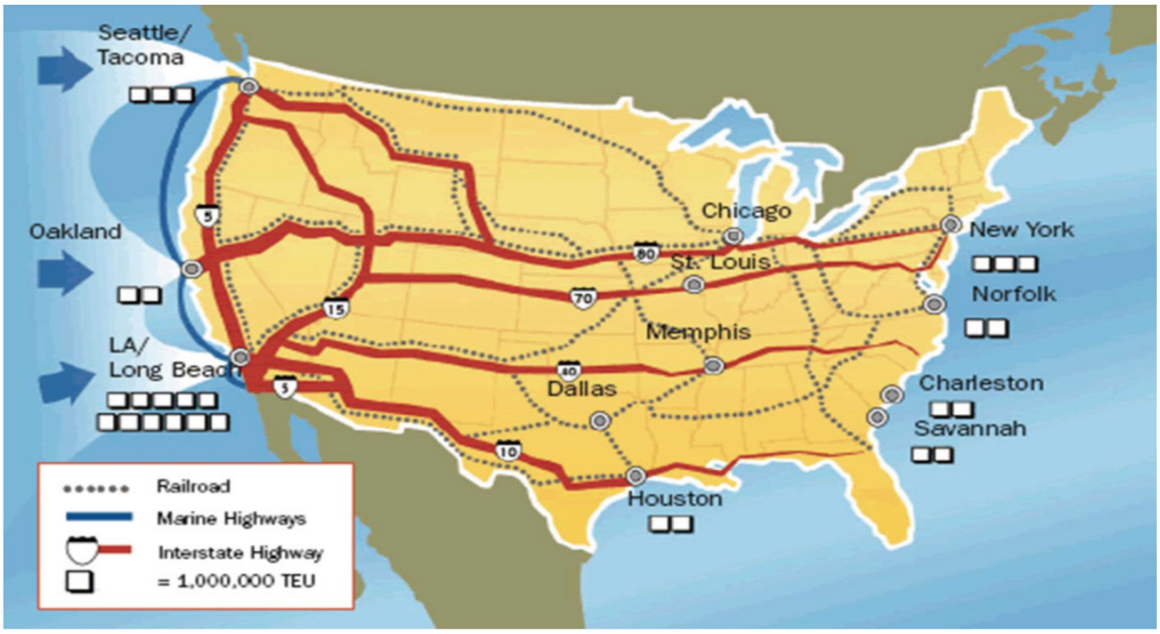

Figure 12: U.S. Intermodal Routes (U.S Department of Transportation 2009)

The U.S. Intermodal Route provides shippers with an alternative to the Panama Canal when transporting goods from the Northeast Asia to the U.S. East Coast. The Route begins with an ocean navigation time of 12.3 days. Goods are then transferred to train and/or truck for the 6-day transit from the West Coast to the East Coast, for a total

transit time from Asia to the East Coast of about 18.3 days, depending on the carrier (Salin 2010). This route is more than three days faster than the 21.6 days required for the maritime navigation provided by the Panama Canal (Salin 2010). Another major advantage of the U.S. Intermodal Route is the opportunity that it offers with economies of scale. As there are no impediments to limit the size of vessels, the Route frequently uses Post-Panamax ships, therefore requiring "only five ships for a weekly service rotation compared with the eight ships required by the Panama Canal route" (p. 7, Salin 2010). This shorter navigation time, and the ability to accommodate larger vessels, has assisted the U.S. Intermodal System becoming the preferred route to the U.S. East Coast, accounting for 75 percent of Asian imports (Salin 2010). The Route does however face potentially significant issues.

For the U.S. Intermodal System to remain competitive in the face of the Panama Canal Expansion, the reliability of ports and railroads must be addressed. In addition to requiring further investment and a more integrated approach, ports and railroads are frequently faced with labour problems (Salin 2010). These labour problems often result in strikes and labour shortages, which end up increasing congestion problems. The system must also work to improve national transportation networks as global trade has put a strain on the U.S. logistics system (Salin 2010). Without addressing labour and infrastructure investment issues the systems will have a reduced ability to remain competitive once the Panama Canal Expansion project has been completed.

The second viable alternative available to Panama Canal users when transporting goods from Northeast Asia to the U.S. East Coast is the Suez Canal. The Suez Canal competes with the Panama Canal by providing users with a shorter navigation time: 21.1 days to transit via the Suez Canal as opposed to 21.6 days via the Panama Canal. The Suez Canal also offers a comparative advantage due to its ability to handle Post-Panamax vessels, allowing shippers to take advantage of increased revenues and greater productivity larger ships provide with economies of scale. Currently however, both the Panama Canal and the transpacific route connecting the U.S. have proven to be more efficient for shipments originating in Northeast Asia (Salin 2010). These routes also minimize the potential threat of piracy off the Coast of Somalia as vessels approach the Suez Canal. As a result, the Asia-Panama Canal-U.S. East Coast route handles 19 percent of Asian imports while Suez Canal route handles just six percent of Asian imports (Salin 2010).

While additional competition to accommodate required traffic volumes are not yet available, significant proposals have been presented, including the expansion of maritime handling facilities in Canada due to the additional transit time savings. “Sea journeys between Shanghai and North America are 68 hours faster through Prince Rupert than through Los Angeles and 32 hours faster through Vancouver than Los Angeles.” (p. 8, Salin 2010) Although these plans remain in the planning stages, if delays and interruptions in Canal traffic persist, and tolls continue to rise rapidly, competitive alternatives to the Panama Canal route will continue to evolve and emerge.

The Panama Canal has served as a vital component in global maritime navigation for nearly 100 years. While transiting the Canal substantially shortens the journey from the West Coast to the East Coast of the United States, the Panama Canal has also emerged as an international transportation corridor. As maritime technology and the composition of products shipped by sea have evolved, demand for Canal services has increased. The increase in demand for Canal services has led to significant improvements to ensure that vessels can be accommodated 24-hours a day. While significant resources have been allocated for these improvements, maritime vessels have evolved to dimensions beyond which the Canal locks can currently accommodate. As a result of the Canal being unable to capture this potential demand, modernization programs to increase the capacity of the canal, including the construction of a third set to accommodate increase traffic and larger vessels, have commenced.