State Auditor's Office Performance Audit

Washington State Ferries: Vessel Construction Costs

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Washington
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State Auditor

Table of Contents

MACIAS CONSULTING GROUP

Special Acknowledgements

An independent Technical Panel of five maritime industry experts was convened throughout this review to provide advisory services. We would like to thank these five individuals for their efforts.

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Executive Summary

Saving money when Washington State Ferries builds new ferries

Washington State Ferries' distinctive white-and-green ferryboats are famous far beyond the ports on Puget Sound where the state owned and operated fleet sails. The 22 boats in the Washington State Ferries (WSF) fleet serve as the state's "marine highways" system, carrying 22 million passengers and 10 million vehicles annually. At any moment, more than half the fleet will be loading, unloading, or sailing – shuttling between 20 terminals in eight counties plus British Columbia. It adds up to one of the busiest ferry operations in the world.

That fleet is aging. The four Steel-Electric class ferries that were suddenly retired in 2007 were 80 years old. Nine other boats in use today are between 40 and 65 years old, and will likely need to be replaced in the next 20 years. WSF's vessels are older than the average age of ferries operating in the United States.

The need to replace these ferries presents WSF and the Washington Legislature with challenges and opportunities. The state must build efficient, safe, and sturdy boats at competitive prices when its budget is already tight and dedicated funding sources for new ferry construction are limited.

WSF has commissioned and completed several new ferry construction contracts in the last 20 years. In the late 1990s, the three Jumbo Mark II ferries were completed. The three-boat Kwa-di Tabil class, carrying 64 vehicles each, is in service already. Two Olympic class vessels that will carry 144 vehicles are under construction. WSF's experience with the construction of these new ferries has led to a perception that WSF's vessels cost more to build than comparable boats built by other operators in the country.

WSF ferries built since 1991, discussed in this report

Class – Passenger/vehicle capacity	Vessel name, year built
Jumbo Mark II – 2,500 / 202	*Tacoma*, 1997
	Wenatchee, 1998
	Puyallup, 1999
Kwa-di Tabil – 750 / 64	*Chetzemoka*, 2010
	Salish, 2011
	Kennewick, 2012
Olympic – 1,500 / 144 under construction	*Tokitae*, spring 2014
	Samish, early 2015

Source: WSF website: Our Fleet.

We wanted to know whether that perception is accurate. And if WSF does pay more for its new ferries than other purchasers, what factors contribute to the higher expenditure and what could WSF do to better control ferry construction costs?

The State Auditor's Office engaged a consultant to conduct this performance audit in order to answer the following questions:

1. How do the construction costs of WSF's ferries compare with those of comparable ferries built elsewhere?
2. What factors affect the cost of constructing ferries and to what extent do those factors affect total construction spending?
3. Does WSF use leading practices to develop, manage, and monitor its ferry construction contracts?

Answer in brief

We found it does cost more to construct a ferry when WSF is the purchaser compared to other ferry purchasers, and that certain regulatory requirements – the Build in Washington laws and the Apprenticeship Act – contribute to these higher costs. While WSF has improved its use of leading practices, we believe there is potential for further reductions in construction costs through the use of additional leading practices. We outline those suggestions in this report.

Scope and Methodology

We collected information on 39 ferries built in the United States by eight U. S. ferry operators, including WSF, in the last 20 years. We adjusted data on all ferry construction costs to 2011 dollars, using the *U.S. Bureau of Labor Statistics, Producer Price Index, Industry data, Series Name: Non-military shipbuilding and repair index*.

We analyzed the data we collected on these 39 ferries to help identify and control for those factors that drive ferry construction costs, such as weight and anticipated service life, and to estimate the additional amount WSF pays to construct its ferries compared to other ferry purchasers.

We also reviewed relevant Washington laws and regulations that affect ferry construction practices, including Build in Washington laws, and elements of the Apprenticeship Act that apply to WSF ferry construction. At our request, Washington's Office of Financial Management (OFM) used its Input-Output economic model to estimate the effect WSF's new vessel construction program has on the state's economy.

Ferry purchasers interviewed during this audit

- Alaska Marine Highway System
- BC Ferries
- North Carolina Department of Transportation
- Pierce County Public Works and Utilities
- San Francisco Water Emergency Transportation Authority
- Staten Island Ferries
- Texas Department of Transportation
- Washington State Ferries
- Woods Hole, Martha's Vineyard & Nantucket Steamship Authority

We also interviewed BC Ferries in British Columbia, Canada. While we did not include their ferries in our construction analysis, because they are built under different laws and requirements, the information BC Ferries provided gave us the perspective of another operator with a large, complex system based in the Pacific Northwest.

In addition, we compared WSF's ferry construction practices to a set of 15 leading practices we developed based on a review of industry literature, construction industry leading practices, interviews with ferry purchasers and shipyards, and the advice of the panel of experts we worked with.

We engaged this independent, five-person technical panel with expertise in maritime industries to review and provide advice on our audit methodology, results, and recommendations.

What we found

WSF's ferries are among the largest and most expensive vessels to build compared to those bought by other ferry operators

WSF's ferries are among the most expensive ferries purchased in the last 20 years compared to the amounts spent by other U.S. ferry operators. Using data we collected from eight ferry purchasers, including WSF, on 39 vessels, we adjusted the total cost to design and build the vessels to 2011 dollars, and found that when comparing by total cost, the six ferries purchased by WSF were among the most expensive. The three Jumbo Mark II ferries (built in the late 1990s and carrying 202 cars) were the three most expensive, and the three Kwa-di Tabil ferries (built most recently and carrying 64 cars) ranked sixth, tenth, and eleventh most expensive.

This is not entirely surprising, given that the Jumbo Mark IIs are among the largest vessels of the 39 ferries. **Exhibit 10** on page 29 of this report provides more detail on the range of differences among the vessels.

WSF spent more when we compared two ferries with comparable designs

To better understand how WSF costs compare to those of another ferry purchaser who built a vessel with a comparable design, we compared the construction costs of the WSF Kwa-di Tabil class ferry *Chetzemoka* to the *Island Home*, built three years earlier by the Woods Hole, Martha's Vineyard & Nantucket Steamship Authority. This comparison is interesting because WSF purchased the license to use the design of the *Island Home* in order to save time and money in constructing the *Chetzemoka*.

WSF was under pressure to build the *Chetzemoka* as quickly as possible to restore ferry service to communities affected by the retirement of the four Steel Electric vessels. Although WSF started from an existing design, the agency made several substantial changes to the design to accommodate changes in regulations and to make the vessel conform to its existing fleet characteristics. In addition, only one shipyard bid on the contract to construct the *Chetzemoka*, and its bid was higher than WSF's estimated construction cost.

The *Chetzemoka* ended up costing almost twice as much as the *Island Home*. The largest cost difference we were able to identify was in the value of change orders between the two vessels – more than $10 million for the *Chetzemoka* and just $624,600 for the *Island Home*. Of the $10 million in change orders issued by WSF, about $6.5 million was spent to expedite the construction schedule and complete the vessel as quickly as possible.

It should also be noted that the construction cost of the third vessel in this class, the *Kennewick*, was much lower. It is close to the amount the *Island Home*'s construction shipyard told us it would cost them to build that ferry today. The lower cost of the *Kennewick* reflects the efficiencies gained when constructing vessels in an uninterrupted series using the same shipyard.

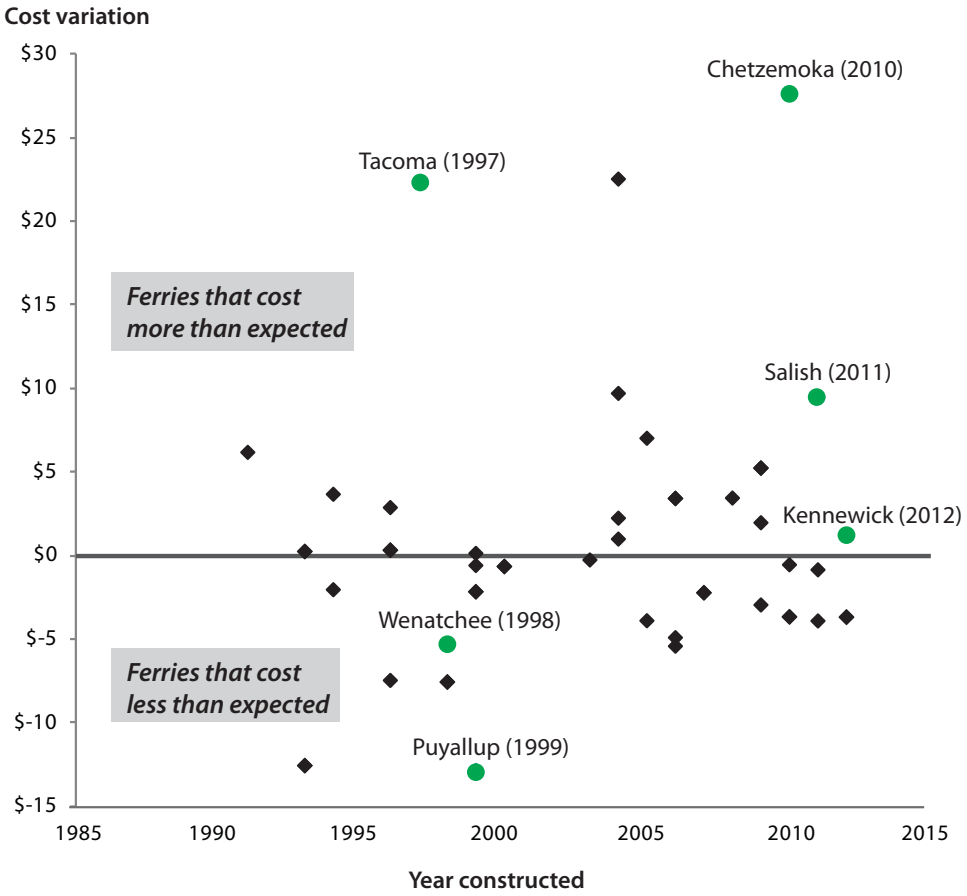
Our analysis takes into account ferry design characteristics

The cost to construct a ferry is largely driven by the design characteristics of the ferry: its size and weight, whether its hull is constructed from steel or aluminum, passenger capacity and amenities, expected service life, and relevant federal safety standards. Our statistical analysis of 39 ferries indicated that WSF's construction costs were higher than most other ferry purchasers even after accounting for vessel design characteristics. **Appendix B** presents a detailed explanation of how we conducted this analysis.

Exhibit 9 illustrates the distribution of ferry construction costs compared to the cost our analysis estimates purchasers would have paid after accounting for the design of these vessels. Icons (circles for WSF ferries, diamonds for other purchasers' ferries) below the $0 line cost less than our analysis estimated, icons above the line cost more than our estimate.

Exhibit 9 - Comparing construction costs of 39 ferries when design characteristics are controlled for in the analysis

Dollars in millions, adjusted to 2011 value.
WSF vessels named (with construction year).



Source: Analysis of ferry purchaser data.

It shows that WSF paid more for four of its six ferries than would be expected given their design compared to other ferry construction projects we reviewed. Based on the results of our statistical analysis, we estimated that WSF's ferries cost as little as $7.5 million and as much as $42.2 million more per ferry when compared to ferries built by other purchasers and after accounting for design differences.

The round WSF icons also illustrate that when ferries are built in a series – as were the Jumbo Marks IIs and the Kwa-di Tabils – the construction cost drops with each ferry built. This reveals the efficiencies gained when vessels are constructed as a class, using the same design, in an uninterrupted series using the same shipyard.

Other factors are affecting total costs to build WSF vessels

Our statistical analysis does not explain why WSF paid more than other purchasers after accounting for differences in vessel design characteristics, which suggests other factors are present that affect WSF's total ferry construction costs. Through our review of state regulations, interviews with officials from WSF, ferry purchasers and shipyards, and our case study comparing the *Chetzemoka* to the *Island Home*, two additional factors emerged:

- The regulatory environment WSF operates in
- The way in which WSF purchases new ferries

We found that two Washington state regulations limit competition on WSF ferry procurements, increasing total construction costs. We also identified opportunities for WSF to strengthen its vessel construction program and potentially achieve cost savings through adopting additional vessel design and construction leading practices, and improving the use of several practices the agency already has in place. The next two sections of the executive summary address these factors.

Regulatory factors limit competition for WSF ferry procurements

WSF officials told us that the laws which require them to build ferries in Washington and to use shipyards with state-approved apprenticeship programs limit the number of shipyards that can compete on their new vessel procurements and contribute to higher construction costs. We found that while Build in Washington laws do limit competition to Washington shipyards, they alone do not completely eliminate competition because the state has more than one shipyard capable of building a WSF ferry. However, the requirement that Washington shipyards must have a state certified apprenticeship program to bid on a WSF ferry construction procurement further restricts competition.

The stated purpose of **Build in Washington** laws is to "employ people, help develop a capable workforce, and create a positive economic benefit" in the state. The Legislature has applied this requirement to all WSF ferries constructed in the last 20 years. It effectively prevents WSF from soliciting bids from out-of-state shipyards. WSF received two bids to construct the Jumbo Mark II class of ferries and only one bid to build the Kwa-di Tabils. As a result, the same shipyard has built the last six ferries for WSF and is building the latest Olympic class vessels as well.

Washington is not alone in applying such laws. One ferry purchaser we interviewed described a similar in-state preference for ferry procurements but also told us it is allowed to reopen bidding to out-of-state shipyards if there was insufficient in-state competition or if the bids received were unreasonably high. They also told us that the possibility of seeking out-of- state bids if the in-state bids were too high had a positive effect on lowering bid amounts on the in-state procurement. Yet even where ferry purchasers may freely solicit bids from any U.S. shipyard, we learned that they experience difficulty in attracting bids because few U.S. shipyards are capable of and interested in building ferries.

Estimated economic impact on the state's economy from constructing WSF vessels in Washington

To understand the economic impacts of requiring WSF ferries to be built in Washington, we asked the state's Office of Financial Management (OFM) to help us estimate the impact of hypothetically spending $150 million to build two ferries over the next two fiscal years, FY2013 and FY2014.

OFM's Input-Output model estimated that $150 million in spending would support an average of 322 jobs and $28 million in wages in the shipbuilding industry over each of the two fiscal years. They also estimated the total economic impact in all sectors of the state's economy would support 1,335 jobs and $90 million in wages over each of the same two fiscal years. In terms of the total impact on the state's economy of our hypothetical $150 million example, OFM estimates it would contribute 2.5 percent to the state's employment growth, and less than one percent to the state's earnings growth over the two-year period.

The state's **Apprenticeship Act**, which the Legislature required WSF to begin following in 2007, was designed to ensure an adequate supply of skilled workers in the construction industry. It applies to all WSDOT public works projects worth more than $2 million, and all other state agency public works projects worth more than $1 million. It requires agencies to ensure that 15 percent of work on these projects is performed by workers enrolled in state-approved apprenticeship programs.

As a result, to bid on WSF ferry construction contracts a shipyard must have a state-approved program in place. This is the case at the shipyard that has completed construction of three WSF ferries built since 2005. Officials at two other Washington shipyards cited the state-approval requirement as a primary barrier to their ability to compete for WSF construction contracts. Officials at one shipyard stated they have repeatedly tried to have their training program approved, but three application attempts have been denied by the state Regulatory Apprenticeship Council. Officials at the other shipyard told us that while they are interested in building ferries for WSF, unless the process for state approval of their apprenticeship program is changed, they would be unlikely to participate in future WSF ferry procurements.

The technical panel questioned the value of imposing this requirement on WSF's ferry construction activities because shipyards typically establish their own training programs to ensure they have the skilled workforce they need. The panel suggested a more common way to ensure a skilled workforce would be to include clauses in the construction contracts that required certified skilled workers are assigned to the project. This places the responsibility on the shipyards to have the skilled workforce needed to successfully bid on projects, effectively ensuring they will have sufficient programs to train and maintain a skilled workforce. However, because the typically high turnover in skilled marine construction workers does not ensure that people trained on one ferry construction project will be available to work on another in the future, the panel questioned whether Washington's apprenticeship program actually maintains a skilled workforce.

We also found that requiring the use of apprentices on 15 percent of the vessel's construction work has an effect on construction costs. The shipyard that constructed the most recent series of ferries for WSF has stated that using apprentices adds about 10 percent to 15 percent to its hourly labor costs due to the amount of supervision required for workers-in-training.

Both of these regulatory requirements limit competition and increase the amount WSF pays to construct new ferries. The Build in Washington laws do limit competition to in-state shipyards, but since there is more than one shipyard capable of building ferries for WSF, these laws alone are not the limiting factor. The laws that stipulate Washington shipyards must have a state-approved apprenticeship program to bid on WSF ferry procurements further restrict competition.

Effectively implementing ferry construction leading practices could reduce WSF vessel construction cost

To determine whether WSF was doing all it could to manage design and construction costs, we assessed how effectively the agency uses relevant leading practices. We conducted independent research of industry literature, and worked with WSF staff and other ferry purchasers, shipyards, and the technical panel to develop a list of 15 leading practices in this area. The table on page 10 shows the full list.

15 Leading practices in ferry construction and their use at WSF

We developed these leading practices based on our review of industry literature, interviews with WSF, ferry purchasers, and shipyards visited during the audit; they were then reviewed by the Technical Panel. We assessed WSF's use of the leading practices and discussed our results with the Technical Panel, which provided the conclusions shown below.

Description of leading practice	What its effective implementation looks like	Is this practice used effectively at WSF? Used effectively	Could be strengthened	Not used
Leading practices WSF uses that add value to the construction process				
1 Use a formal change order process that includes approval criteria.	Change orders reviewed and approved by appropriate level of staff, shared with management as needed, ensures only appropriate changes are approved to the contract.	√		
2 Require the shipyard to provide operational training, standard operating procedures, and spare parts.	Saves purchaser time and expense to develop materials and reduces maintenance costs.	√		
3 Secure the right to own the final as-built design for future reuse.	Owning the design avoids paying reuse or royalty fees if a follow-on vessel is ordered.	√		
4 Owner describes in detail specific needs and preferences.	Ensures clarity within contractor's and owner's organizations regarding the design, construction, and outfitting of the desired finished vessel.	√		
5 Project partners agree to a Project Charter outlining the purpose, goals, and expected outcomes of the project.	Ensures all parties are 'on the same page' and promotes better working relationships.	√		
6 Project Plan fully developed, outlining timelines, personnel/vendor roles and responsibilities, expected duration of the project. Plan is updated throughout project.	Ensures that purchaser and shipyard understand roles and tasks, project goals, and what expectations they must meet.	√		
7 Define responsibility and establish processes to resolve issues in timely manner.	Having a resolution process in place helps reduce the risk of disputes jeopardizing the production schedule.	√		
8 Use a steering committee to review and approve changes.	Ensures appropriate stakeholders are involved in reviewing and approving changes.	√		
Leading practices that WSF uses but could strengthen				
9 Use a formal process to ensure 'lessons learned' activities are completed in a timely way and effectively used on subsequent projects.	*To improve its use of this leading practice, WSF* should establish and use performance metrics to monitor progress based on independent collection of data from all stakeholders.		√	
10 Develop project budgets based on appropriately estimated project costs; do not depend on large contingency amounts.	*To improve its use of this leading practice, WSF* should limit its contingency budgets to no more than 5% of the total. Large contingency amounts undermine the integrity of fixed-price contracts.		√	
11 Use chosen contracting method effectively.	*To improve its use of this leading practice, WSF* should not employ multiple design firms and should consider using one contract to cover vessel design and construction.		√	
Four key leading practices that, if implemented together, offer the best opportunities to reduce costs				
12 Use a fixed price contract.	Fixed-price contracts require the contractor to deliver the project for a set price.		√	
13 Design is complete and reviewed before construction begins.	Helps prevent cost overruns on fixed-price contracts by purchaser not being responsible for changes to an approved design.			√
14 Use an independent owner's representative.	This advocate for the purchaser performs quality oversight, manages the change order process, and ensures project does not depart from the contract.			√
15 Owner places all responsibility on contractor to deliver project quality.	Allows the owner to hold the shipyard accountable for errors and omissions.		√	

We found that WSF already follows many of the 15 industry leading practices on our list. They adopted many of them following the less-than-smooth construction program of its Jumbo Mark II class of ferries in the 1990s. For the Jumbo Mark II project, WSF only had two leading practices in place, and cost overruns totaled $26 million. Following that experience, WSF took steps to improve its ferry construction program before beginning construction of the three Kwa-di Tabil class vessels in 2009, by seeking to address budget overruns, and to solve problems with contractor relationships and quality assurance.

The leading practices that WSF uses effectively are:

- Using a formal process for review and approval of change orders
- Requiring the shipyard to provide operational training, standard operating procedures, and spare parts
- Securing the right to own the final as-built design for future reuse
- Describing in detail its specific needs and preferences in the contract
- Developing a project charter that outlines the purpose, goals, and expected outcomes of the project, and agreeing the charter with all project partners
- Fully developing a project plan that outlines timelines, personnel/vendor roles and responsibilities, and the expected duration of the project; the plan is updated throughout the project
- Establishing a dispute resolution process that partners can use to resolve issues in a timely manner
- Using a steering committee to review and approve changes.

These leading practices focus in large part on clearer communication within WSF and between WSF and the shipyard: they address project expectations and how differences will be resolved, and clarify decision-making processes. As a result, WSF has improved its management and oversight of the construction process since the construction of the Jumbo Mark IIs. WSF staff reported that they had greater success delivering the Kwa-di Tabil class on time and on budget due to these changes.

In addition to implementing these leading practices, WSF has reduced the size of its project teams from 16 people to five, and hired new program managers and staff with capital project financial management experience. Their contributions have helped strengthen program activities and setting expectations that foster a culture of cost savings.

Using additional leading practices could result in further improvements to the Ferry Construction program

Of the remaining seven leading practices, WSF has yet to adopt two of them, and could improve the way they use the other five. The technical panel identified four practices as having, in their opinion, the best potential for reducing overall ferry construction costs.

The panel stressed that these four practices should be implemented as a "suite" to gain the best value from their use, as each depends on the others to be fully effective. They are:

1. **Use a fixed price contract.** WSF currently uses fixed-price contracts. In the case of the *Chetzemoka*, WSF officials told us that they allowed the shipyard to begin construction before the vessel design was complete in order to help maintain its vessel completion schedule. For this and other reasons, they experienced cost overruns which increased total construction costs. WSF plans for change orders by adding a contingency of 10 percent to 20 percent to their ferry construction budgets, which is not in keeping with maintaining a fixed-price contract.
2. **Ensure vessel design is complete and reviewed before construction begins.** In some instances, WSF has allowed the shipyard to start construction before completing vessel design to accommodate the scheduling needs of the shipyard. Starting vessel construction before the design is completed and approved increases the risk that construction will be delayed and that change orders will be needed to cover the cost of unanticipated work.
3. **Use an independent owner's representative** as a third-party intermediary between WSF and its contractors. This practice would remove WSF staff from active management and oversight of the construction contract. The independent owner's representative serves as the primary point of communication between the purchaser and the shipyard, performing quality oversight activities, managing the change-order process, ensuring the project follows the contract requirements, and resolving differences between the two parties. This practice helps the purchaser adhere to a fixed-price contract by removing the temptation to make improvements using change orders during construction.
4. **Place all responsibility for project quality and delivery on the shipyard.** Because WSF currently assumes some of the responsibility for project quality and delivery, the shipyard cannot be held responsible for the related errors and omissions of others. For example, by providing owner-furnished equipment, such as propulsion systems, to the shipyard, WSF accepts some of the risk in these situations. If the shipyard is required to make changes or corrections due to owner-furnished equipment, the additional expense may require a change order and construction costs rise commensurately.

The technical panel stated that these four leading practices, if implemented together, provide the greatest opportunity to reduce WSF's costs to design and construct its ferries.

Strengthening the agency's use of three additional leading practices could offer greater benefits to the program

WSF already uses the remaining three leading practices to some extent. The Technical Panel noted that more effective implementation of the three following practices could strengthen the WSF construction program and potentially provide additional cost savings. They are:

Timely completion and effective use of "lessons learned" activities. WSF conducts lessons learned meetings, but does not have a formal process in place to ensure that all parties participate, suggestions are fully reviewed and communicated, and changes are made on future projects. At the time of our review, WSF had not completed

its lessons learned activities on the Kwa-di Tabil class so it lost an opportunity to incorporate changes into the construction processes of the Olympic class vessels.

Strengthen financial management of construction contracts. We found that WSF did not include the cost of the previously purchased propulsion systems in the total reported cost of the three Kwa-di Tabil class vessels. (See the sidebar on this page for more information about the propulsion systems.)

We also found that WSF adds up to 20 percent to a vessel's budget for contingency. Our Technical Panel stated that a large contingency undermines the integrity of fixed price contracts, and suggested an appropriate amount would be no more than five percent.

Improve use of contracting methods. State law allows WSF to use a modified design-build contracting method for ferry construction. Using this modified design-build contracting method has resulted in WSF employing multiple firms to design its ferries, and different contractors for design and construction. Doing so deprives WSF of the benefit of using a single contractor for vessel design and construction.

When one firm is used for design and construction of a ferry, the purchaser maintains the right to approve the design but is not responsible for coordinating and managing the design team. Once the design is approved by the purchaser, the contractor is responsible for constructing the vessel in accordance with the approved design for the amount agreed to in the contract. The appropriate use of a design-build approach is intended to save time and avoid costly change orders.

Accounting for the cost of the propulsion systems

WSF purchased four propulsion systems in 2001 for the 144-car ferries using federal funds at a cost of $48 million.

To facilitate the construction schedule for the Kwa-da Tabil class vessels and restore ferry service as soon as possible to affected communities, WSF used components from those previously purchased systems on the three Kwa-da Tabil vessels. WSF officials told us they used $3.1 million worth of equipment from the existing propulsion systems on each of the three vessels. That amount is not included in the reported total project cost figures for the Kwa-da Tabil vessels.

WSF officials have told us that the remaining equipment will be used on the 144-car ferries currently under construction, vessels to be constructed in the future, and as spare parts for the 144-car ferries.

Recommendations

The state and WSF have opportunities to reduce the amount spent to construct ferries. We developed our recommendations with guidance from the technical panel of maritime industry experts. We make recommendations to the Legislature that address regulatory barriers to competition for new ferry construction contracts, and recommendations to WSF that will help it continue to improve its vessel construction program.

We recommend that the Legislature address the regulatory barriers that limit competition on WSF vessel procurements by:

1. Allowing WSF to use alternative strategies to encourage competition for its ferry procurements when insufficient interest exists or higher-than-expected bids are received from Washington shipyards. One possible strategy to ensure an adequate level of competition could be to allow WSF to invite out-of-state shipyards to bid on new vessel construction contracts in these instances.

2. Undertake a study of the Apprencticeship Act to identify and resolve potential barriers for prospective applicants, in particular shipyards with established apprenticeship training programs.

We recommend that WSF continue to improve its vessel construction program by determining whether adopting the leading practices and suggestions for improvement provided in this report would result in program improvements and/or cost savings, and implementing those with the greatest potential for benefit to the program.

The four leading practices identified by the technical panel as having the greatest potential for cost savings, especially if implemented together:

- Fully adhering to fixed price contracts for ship design and construction.
- Waiting to start vessel construction until after the design is complete and approved.
- Using an independent owner's representative.
- Shifting all responsibility for project delivery and quality to the shipyard.

The suggested improvements by the Technical Panel to three leading practices WSF currently uses:

- Timely completion and effective use of lessons learned activities.
- Strengthen financial management of construction contracts.
- Improve use of design-build contracting method.

What's Next

We conducted this performance audit under the authority of the state's performance audit law which was enacted in 2005 through the statewide citizen initiative, I-900. The law requires the responsible legislative body to hold a public hearing within 30 days of its publication.

Representatives of the State Auditor's Office will report on this performance audit to the Joint Legislative Audit Review Committee or another legislative committee. Please check the state Legislature's website (**www.leg.wa.gov**) for the exact date, time, and location. The public will have the opportunity to comment at this meeting.

The audited entity and responsible legislative body will decide how to address our recommendations. The State Auditor's Office conducts periodic reports to determine what action was taken in response to the audit. A draft report was provided to WSF and comments provided by agency management were incorporated into this report as appropriate.

Appendix A describes the provisions of Initiative 900 and how the audit addressed these provisions.

Introduction and Background

The State Auditor's Office (SAO) decided to conduct a performance audit to evaluate how well Washington State Ferries (WSF) oversees the building of ferries after concerns surfaced about cost overruns, procurement, and contracting activities. We engaged a consultant to conduct the performance audit and answer the following objectives:

1. How do the construction costs of WSF's ferries compare with those of comparable ferries built elsewhere?
2. What factors affect the cost of constructing ferries and to what extent do those factors impact total construction spending?
3. Does WSF use leading practices to develop, manage and monitor its ferry construction contracts?

This report answers these questions by showing that it costs WSF more to purchase ferries compared to other operators, and that certain regulatory requirements contribute to higher costs. It also describes the many leading practices WSF uses, but notes that WSF could do more to save money on subsequent ferry construction projects.

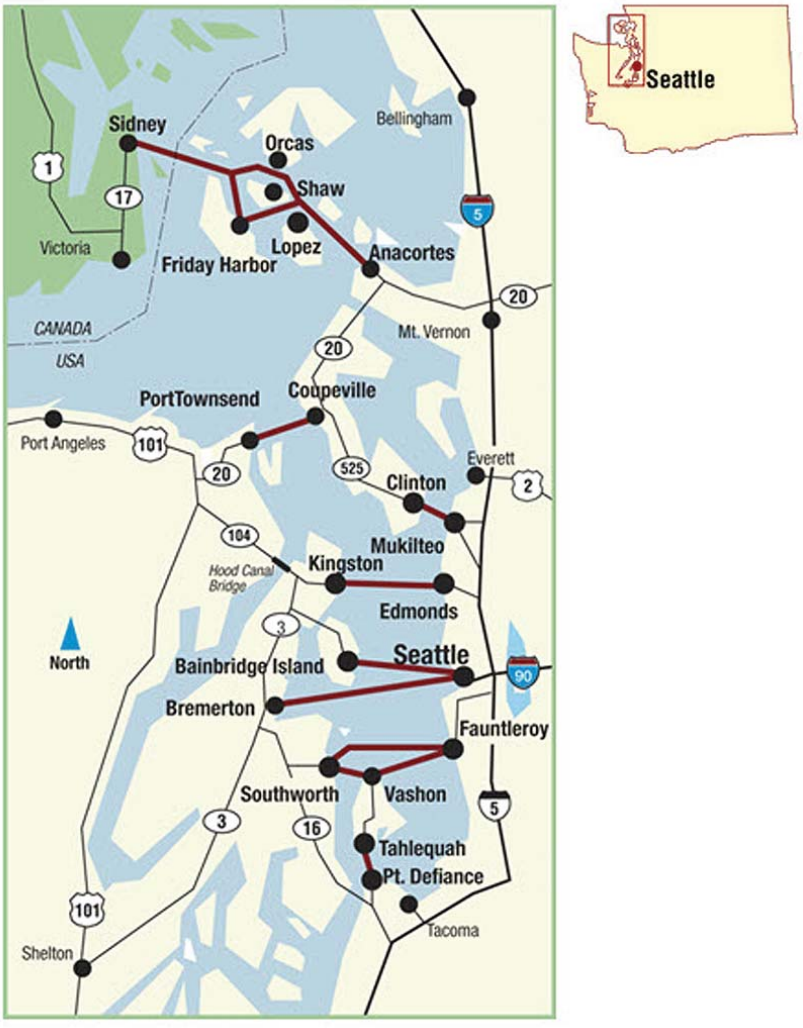
Background

Washington State Ferries is one of the largest ferry system operators in the United States

The U.S. ferry network plays an important role in linking communities of all sizes and providing commuter services in major metropolitan areas on both coasts. The U.S. Department of Transportation's 2010 report, *Highlights of the 2008 National Census of Ferry Operators (NCFO)*, states that in 2007 190 ferry operators in 37 states provided service to an estimated 106 million passengers annually. Across the country, almost 700 active ferries – with a combined capacity to carry as many as 6,000 passengers at a time or as few as two – serve nearly 500 terminals. These vessels sail roughly 350 different route segments covering 7,877 route miles.

WSF, a division of the Washington State Department of Transportation (WSDOT), is one of the largest ferry operations in the U.S. Each year, WSF transports more than 22 million passengers and ten million vehicles on 22 ferries. Eight counties are served on ten routes stretching from Tacoma, Washington, to British Columbia, Canada, as shown on the map in **Exhibit 1**.

Exhibit 1: Washington State Ferries route map.



WSF's fleet of ferries is aging

In 2007, the average ferry operating in the U.S. was 26 years old. In comparison, the average age of WSF's ferries is currently 32 years. In 2007, Transportation Secretary Hammond unexpectedly retired four ferries built in the 1920s, deeming them unsafe to operate. The retirement was unplanned and left one route with temporary service from a ferry rented from Pierce County, the *Steilacoom II*. To replace these ferries and restore service to affected communites, WSF built the Kwa-di Tabil class based on the *Island Home* ferry designed by the Woods Hole, Martha's Vineyard & Nantucket Steamship Authority (Steamship Authority).

In addition to the retired ferries, the current WSF fleet includes nine ferries that, over the next 20 years, will reach or exceed WSF's standard of 60 years of anticipated service life and will need to be replaced. **Appendix C** includes information on WSF's fleet.

Replacing ferries requires planning

When planning to replace ferries, purchasers must make many decisions about what to build, from capacity and ridership to propulsion and vessel design. WSF's 2009 Long Range Transportation Plan calls for the replacement of seven ferries within the next 20 years.

WSF builds and operates double-ended ferries, which have identical bow and stern systems, allowing the ferry to shuttle back and forth between two terminals without having to turn around, as illustrated in **Exhibit 2**.

Exhibit 2: Washington State Ferries' hallmark double-ended ferry design

Source: Washington State Ferries photo.

Such vessels need two propulsion systems, two engines, and two pilot houses. Double-ended ferries are also operated by, among others, the Staten Island Ferry and the North Carolina Department of Transportation's Ferry System. In 2008, BC Ferries put into service three of the largest double-ended ferry vessels in the world.

Beyond vessel shape, other key design decisions derive from the vessel's anticipated operating environment, such as the length of the route, the required passenger or vehicle capacity, the speed needed to meet the schedule requirements, the weather conditions under which it must operate, and the size of the ferry terminals. Terminals are designed to position the ferry for efficient loading and unloading of passengers and vehicles. WSF, like other operators, designs its ferries to accommodate its existing terminals, the needs of its passengers, and the characteristics of the ferry's anticipated operating environment, among other considerations.

Ferries are said to be in the same "class" if they share certain design characteristics, such as length, passenger and vehicle capacities, amenities, horsepower, and number of engines. WSF operates seven classes of vessels (see Appendix C). When substantial design changes are made during construction, subsequent ferries affected by these changes can create a new class or subclass of the original class. WSF incorporates the design changes it makes to the first ferry into subsequent similar ferries and considers them to be in the same class.

Finally, purchasing ferries requires financial planning because replacing a new ferry can represent a sizable public investment of up to $200 million or more, depending on the size and other characteristics of the ferry. In 2000, Washington changed how it funds transportation projects, when the Legislature repealed the Motor Vehicle Excise Tax (MVET) in response to a citizen initiative. WSDOT estimated a loss of more than $9 billion for transportation projects over the past decade due to the repeal of this tax, including $1.2 billion in a dedicated funding stream for the state ferry system and vessel replacement projects. Highway construction projects were later funded by two taxes on gasoline in 2003 and 2005, but no similar funding was designated for ferry construction.

In August 2011, the Washington State Transportation Commission added a system-wide capital surcharge of $.25 to every ticket sold to fund WSF's vessel replacement program; it will help support the construction of new ferries, including the Olympic class boats. The surcharge took effect October 1, 2011. WSF officials said that while this dedicated funding source has helped, it alone is insufficient to pay for the capital costs to replace WSF's aging ferries.

The shipbuilding and ship repair industries are in decline

Although the U.S. ferry network has grown since 1999, domestic shipbuilding and repair industries have not. According to a 2004 U.S. Commission on Ocean Policy report, *An Ocean Blueprint for the 21st Century*, employment within these industries had dropped about 50 percent from 1980 levels and companies had to consolidate to survive. In 2002, there were 24 shipyards in the U.S. capable of building large vessels and only nine actively doing so. These shipyards build not only ferries but also vessels such as barges, research vessels, military vessels, and container ships.

What is true of the U.S. generally is also true regionally. According to the U.S. Maritime Administration's annual Report on Survey of U.S. Shipbuilding and Repair Facilities, the number of major private shipbuilding and repair facilities[1] located on the West Coast dropped between 1991 and 2004, the most recent year for which data is available. The 2004 report identified only 15 such facilities on the West Coast; that number includes six shipyards in Washington – down from eight in 1991.

Laws exist to protect national and local shipbuilding industries

To protect the U.S. shipbuilding industry from foreign competition, the Federal Merchant Marine Act of 1920 (which includes provisions commonly referred to as the Jones Act) requires that vessels carrying passengers or cargo between two U.S. places have their hulls constructed in the U.S.[2] WSF is further bound by requirements in state law that it build its ferries within Washington.

1. The Maritime Administration report defines a major shipbuilding and repair facility "as one that is open and has the capability to construct, drydock, and/or topside repair vessels with a minimum length overall of 122 meters, provided that water depth in the channel to the facility is at least 3.7 meters."
2. Title 46 of United States Code Sections 55102 and 55103. The requirement for hull construction in the United States does not apply to machinery.

In addition to the Build in Washington laws, WSF must adhere to the Apprenticeship and Training Act and other state and federal requirements when building ferries. The Apprenticeship Act requires it to use companies with state-approved training programs. Another state requirement calls for shipyards to have bonds in place to protect the financial investment of WSF. In common with all other ferry purchasers in the U.S., WSF must comply with federal laws, such as requirements regarding the number of lifeboats and standards for the design and construction of the ferry's electrical systems and other components.

Recent history of WSF's New Ferry Construction program

The same shipyard has built the last six WSF ferries, in addition to the two boats currently under construction. As shown in **Exhibit 3** on the following page, the shipyard completed construction on the three Jumbo Mark II class ferries in 1998. In 2001, WSF began designing and planning for new 130-car ferries, but the project was delayed when WSF had to turn its attention to replacing the Steel Electric class ferries. Following this ten-year delay and a change in vessel capacity, the two 144-car ferries known as the Olympic class are now under construction.

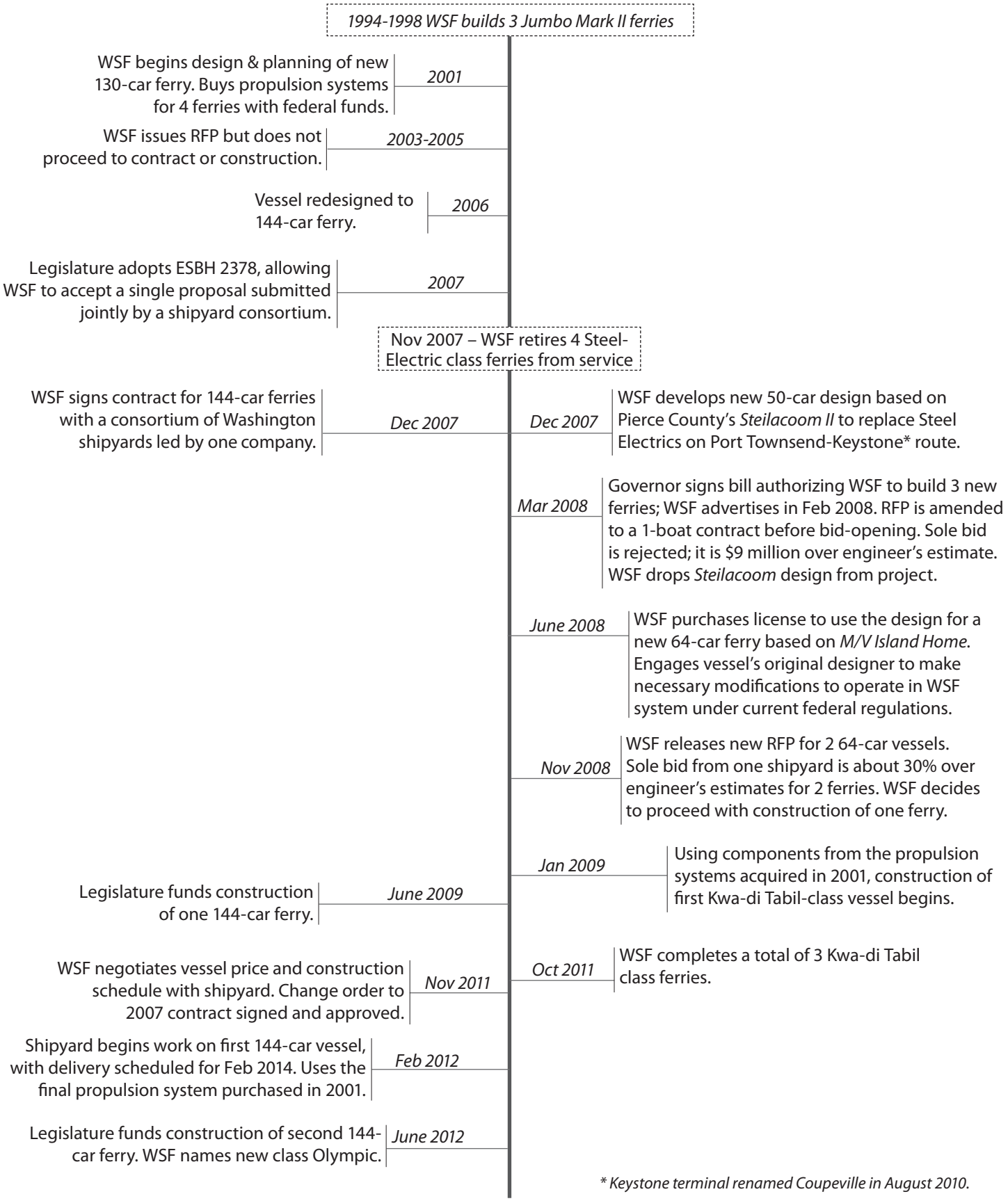
Recent studies identified opportunities to improve WSF's New Ferry Construction program

Since 2000, a number of legislative and state agency-sponsored reports offered guidance to WSF on enhancing operations. In 2000, a Blue Ribbon Commission on Transportation. appointed by Governor Locke and the Legislature, made 18 recommendations to improve the state's transportation system, including suggestions to avoid costly change orders and incorporate the design-build process and its variations into ferry construction projects.

Another three studies examined aspects of WSF planning, operations, and funding, and made recommendations to improve the state's New Ferry Construction program. One of these studies called for improving the process used to procure a new ferry and manage its construction, including improving WSF's capital financing strategies. The report also urged WSF to consider third-party management of new vessel design and construction, and to integrate the design-build process with the pre-design report process in order to expedite vessel design and construction at minimal cost to the state. WSF took action on most of the recommendations within the agency's control, noting that the remainder would likely not be cost beneficial to implement.

In 2010, another study issued by the Passenger Vessel Association (PVA) echoed the concerns of the earlier studies. PVA assembled a national technical panel of ferry system managers to review WSF practices and assess whether they represent best practices within the U.S. ferry industry. The panel recommended that the Legislature allow WSF to bid their vessel construction nationwide because of the high price WSF paid for in-state construction.

Exhibit 3. Chronological history of new ferry construction by WSF



Scope and methodology

How we determined the cost to build a ferry

To determine how construction costs of WSF's vessels compare with those built elsewhere, we collected financial and other project data on 39 ferries that were purchased by eight ferry operators over the last 20 years. They included: Alaska Marine Highway System, North Carolina Department of Transportation, Pierce County Public Works and Utilities, San Francisco Water Emergency Transportation Authority, Staten Island Ferries, Texas Department of Transportation, the Woods Hole, Martha's Vineyard & Nantucket Steamship Authority, and WSF.

BC Ferries, a Canadian ferry operator, participated in this review by sharing information about their recent vessel replacement program activities, but we did not collect construction data because their ferries were purchased and constructed outside the U.S. under different rules and regulations. Other information on how the comparison ferries were selected is described in **Appendix B** of this report.

How we performed the cost analyses

To understand how WSF's cost to construct a ferry compared with those built by other purchasers, we first compared total construction costs. Total construction cost equals all expenditures by the purchaser for designing, building, and outfitting a new ferry, including the shipyard construction contract as well as equipment and shipboard fittings. We also developed a case study to compare construction costs of two ferries with comparable designs: WSF's *Chetzemoka* and the ferry its design was based on, the *Island Home* built by the Steamship Authority.

How we identified the cost drivers

To identify the factors that influence total construction costs, we conducted a multivariate regression analysis. The construction costs and other data collected from eight ferry purchasers, including WSF, served as the source of data for that analysis. We analyzed 22 potential factors to determine the extent of each factor's influence on total construction costs and whether the level of influence was statistically significant. Additional information about the analysis model is provided in Appendix B.

For our cost analysis, we adjusted all amounts to 2011 dollars by applying a producer price index that accounts for changes in raw materials and differences in prevailing wage rates. This index (*the Bureau of Labor Statistics, Producer Price Index Industry data, Series Name: Non-military shipbuilding and repair index*) reflects changes in price over time for items such as steel and wages that affect the price of the finished product sold by the producer – in this case the shipyard. The cost of the raw materials and labor needed to construct the ferry are included in the price paid by the purchaser to the shipyard.

We assembled an independent technical panel of reviewers to provide expertise and feedback on why some factors affected construction costs more than others. We met with officials from WSF to discuss the Build in Washington law and the Apprenticeship Act, and discussed the impact of these laws with representatives from three local shipyards and the Passenger Vessel Association. We also asked Washington's Office of Financial Management to assist us by using ferry construction cost data from WSF in its Input-Output model to estimate the economic impact on the state of WSF's vessel purchases.

How we assessed leading practices implemented by WSF

To determine the extent to which WSF implements leading practices, we developed a list of 15 leading practices through reviewing relevant construction industry literature, and interviews with WSF executive management, project managers, naval architects, and contracting and finance officials. We also analyzed available agency financial reports, contracts, project management reports, and other documentation. Our interviews and analysis focused on WSF's three most recently constructed classes of ferries: the Jumbo Mark II (202 cars), the Kwa-di Tabil (64 cars), and the Olympic (144 cars). We contacted three shipyards and the Attorney General's office to discuss WSF's procurement and contracting activities. We also discussed project management activities with one of the three contacted shipyards.

Throughout this review, we periodically convened the technical panel of maritime industry experts to provide subject matter expertise on areas affecting ferry construction, from procurement and contracting to project close-out. The technical panel provided advice at key stages of the audit covering data collection, analysis, and reporting. They also participated in the development of leading practices. They made recommendations aimed at enhancing the effectiveness of WSF's vessel construction program and scored the potential for cost savings of each practice. More than 60 people contributed to this report.

A draft report was provided to WSF and comments provided by agency management were incorporated into this report as appropriate.

We conducted the audit under the authority of state law (RCW 43.09.470), approved as Initiative 900 by Washington voters in 2005, and in accordance with generally accepted government auditing standards, prescribed by the U.S. Government Accountability Office. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix A describes the provisions of Initiative 900 and how the audit addressed these provisions.

Question 1. How do the construction costs of WSF compare with those of comparable ferries built by other purchasers?

We found that WSF's ferries are among the most expensive purchased in the last 20 years compared to the amounts spent by other operators. This is not surprising given that WSF's vessels are also among the largest ferries built in the U.S, but we also found it to be true when comparing WSF's costs with those of another purchaser for a ferry of comparable design. To better understand if WSF costs are higher than other ferry purchasers, we conducted a statistical analysis to control for design differences in the 39 ferries included in our audit. We found that WSF's construction costs were higher than expected, after accounting for design characteristics, when compared to the construction costs for ferries built by other operators.

WSF's ferries are among the most expensive when comparing total cost

Examining the total cost to build a ferry is an informative but imperfect way to compare WSF to other ferry purchasers in the U.S. because it does not control for differences in vessel size and design. Our statistical analysis does control for those differences, but we did look first at the total cost to purchase each ferry.

The total cost to build a ferry includes the amount paid to the shipyard for construction as well as the purchaser's costs to design the ferry, administer the contract with the shipyard, and commission the ferry for operation. It is important to note that total cost will vary because vessels have different dimensions, weight, carrying capacity (both passengers and vehicles), and speed. To compare the total costs of the 39 ferries in our database, we adjusted all monetary data to 2011 dollars using the *Bureau of Labor Statistics, Producer Price Index Industry data, Series Name: Non-military shipbuilding and repair index*.

Exhibit 4 lists the 12 most expensive ferries in order from most to least expensive.

Exhibit 4 – Top 12 most expensive ferries ranked in order of total cost

Rank	Purchaser	Class (construction order)	Passenger/car capacity	Lightship weight in long tons	Anticipated service life in years
1	WSF	Jumbo Mark II (first)	2,500/202	4,347	60
2	WSF	Jumbo Mark II (second)	2,500/202	4,405	60
3	WSF	Jumbo Mark II (third)	2,500/202	4,346	60
4	Purchaser #1	Single ferry	499/80	6,187	65
5	Purchaser #2	Class A (first)	4,400/30	2,763	35
6	WSF	Kwa-di Tabil (first)	750/64	1,515	60
7	Purchaser #2	Class A (second)	4,400/30	2,763	35
8	Purchaser #2	Class A (third)	4,400/30	2,763	35
9	Purchaser #1	Class B (first)	250/36	492	25
10	WSF	Kwa-di Tabil (second)	750/64	1,524	60
11	WSF	Kwa-di Tabil (third)	750/64	1,524	60
12	Purchaser #1	Class B (second)	250/36	501	25

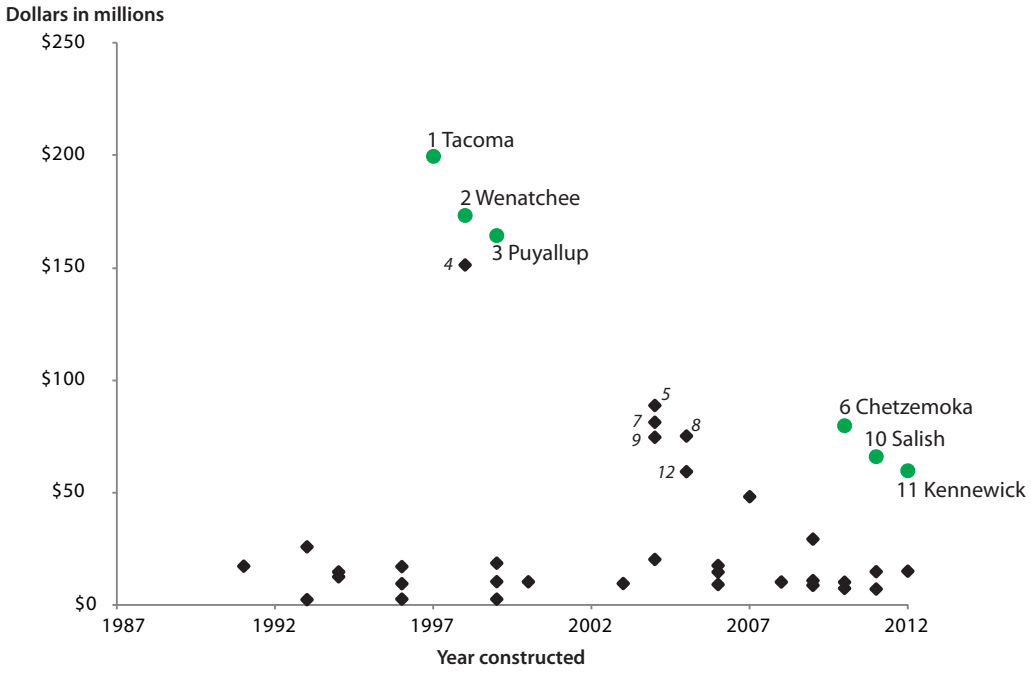
Source: Analysis of ferry purchaser data.

Even when adjusted to 2011 dollars, all six ferries purchased by WSF appear on this list. This is not entirely surprising, given that WSF's three Jumbo Mark II ferries, built in the late 1990s, are among the largest and also the most expensive of the 39. WSF's three most recently built boats, the Kwa-di Tabil class, are smaller than the Jumbo Mark IIs; they ranked sixth, tenth, and eleventh most expensive in total cost.

Exhibit 5 illustrates the total construction cost of all 39 ferries in the analysis, identifying the WSF ferries by name and the other boats in the top 12 list by number.

Exhibit 5 - Total cost to construct 39 ferries

Twelve most expensive ferries numbered from most to least expensive. Individual WSF ferries named. Price at completion, shown in millions, adjusted to 2011 dollars.



Source: Analysis of ferry purchaser data.

The total cost to purchase each of the 39 ferries ranged from about $2.7 million to $200 million depending on the characteristics of the ferry. The average total cost paid by purchasers is $43.6 million and the median total cost is $17.3 million.

WSF spent more when comparing two ferries with comparable designs

Another way to examine spending is to compare the costs of ferries built based on the same general design. This "natural experiment" can provide a unique opportunity to identify differences in expenditures between purchasers. The exhibits in this section illustrate the two vessels we compared in this analysis: the *Island Home* (**Exhibit 6**) and the *Chetzemoka* (**Exhibit 7**). **Exhibit 8** on the next page lists their design characteristics.

Exhibit 6 The *Island Home*

Exhibit 7 The *Chetzemoka*

Members of the technical panel, other industry experts, and other purchasers said that using a pre-existing design should considerably reduce vessel construction costs and be more cost efficient because the preliminary design work needed to begin final production design work – which can take between six months and two years depending on the complexity of the ferry – had already been completed by the other purchaser.

In 2008, WSF decided to purchase the license to use the existing design of the *Island Home* ferry to design and build its new Kwa-di Tabil class after the state opted against building a new vessel based on the Pierce County *Steliacoom II*[3]. The *Chetzemoka* was the first ferry built from the *Island Home* design to replace the sudden and unplanned retirement of the WSF's four Steel Electric class ferries in November 2007. The Steamship Authority had designed the *Island Home* from scratch and built it as a "one-off" to replace a single ferry that was approaching the end of its planned service life. A shipyard on America's Gulf Coast built the *Island Home*.

Exhibit 8 – Design characteristics of WSF's *Chetzemoka* and Steamship Authority's *Island Home*
All amounts are in 2011 adjusted dollars unless otherwise noted.

Characteristic	*Chetzemoka*	*Island Home*
Purchaser	WSF	Steamship Authority
Year built	2010	2007
Final shipyard contract in 2011 dollars	$79,676,538	$43,397,216
Total cost in 2011 dollars	$87,257,536 *a*	$48,464,499 *b*
Cost per pound	$25.71	$13.84
Dollar amount of change orders in unadjusted dollars	$10,887,345	$614,600
Passenger capacity	750	1,200
Vehicle capacity	64	76
Lightship weight in pounds	3,393,600	3,501,120
Registered length	257	235
Anticipated service life	60	40
Horsepower	6,000	6,000
Federal safety regulations *c*	Subchapter H	Subchapter H

a Includes about $3.1 million for the propulsion system that WSF did not report as part of the total cost for the ferry due to accounting activities. The 2011 adjusted total cost without the propulsion system is $83,995,223.
b The shipyard that built the *Island Home* estimated it would cost about $51.5 million to build it today.
c Changes to Subchapter H after construction of *Island Home* added an estimated $1 million to the construction costs of the *Chetzemoka*.

Source: Analysis of ferry purchaser data.

WSF staff gave us three reasons for purchasing the *Island Home* design. First, they expected to reduce the time needed to design and build a new class of ferries by using an existing design. Second, the *Island Home* uses the same propulsion system as the four systems WSF had already purchased and held in storage. This eliminated the additional lead time and funding the agency would have needed to purchase a new propulsion system, which officials said can take up to a year. Third, beyond meeting its requirements for carrying passengers and vehicles, the *Island Home* operates on a route and in a seasonal environment very similar to the route in Puget Sound on which the new ferries would operate.

Despite using an existing design, WSF paid more per pound to design and build the *Chetzemoka* than the Steamship Authority spent per pound on the *Island Home*, as shown in **Exhibit 8**. In 2011 dollars, WSF spent about $26 per pound, a total of about $87 million; the Steamship Authority spent only $14 per pound, a total of about $48 million. WSF'S higher cost per pound is not due to a heavier vessel; the *Chetzemoka*, at 3.4 million pounds, weighs about the same as the *Island Home* at 3.5 million pounds.

It should be noted that WSF and other ferry purchasers cited the price of steel as a driver of the total cost to build a ferry, and that the price of steel has risen in the last 20 years, peaking in 2008, the year that WSF began construction of the *Chetzemoka*.

The third vessel in WSF's Kwa-di Tabil class, the *Kennewick*, cost close to the amount the shipyard that built the *Island Home* said it would cost if they were to build that ferry today.

3. WSF had leased the *Steilacoom II* from Pierce County to operate on the route while WSF designed a permanent replacement ferry. In May 2008, the Governor announced the decision to build the new ferries based on the *Island Home* design instead of the *Steilacoom II*.

WSF officials said the high cost of steel was one cause for the higher cost paid for that vessel, but our comparison accounts for this increase in steel prices through our adjustment of total costs to 2011 dollars with the *Bureau of Labor Statistics Non-Military Shipbuilding Producer Price Index*, which includes the increased cost of steel.

The largest cost difference between the two ferries that we could identify was the result of change orders. WSF placed 29 change orders – each of which can include multiple changes to the project – valued at more than $10 million for the *Chetzemoka* versus 49 change orders valued at $614,600 (in unadjusted dollars) for the *Island Home*. A key difference was the $6.5 million spent by WSF for additional time and materials to maintain the project schedule. WSF officials said that these changes were necessary because the agency's top priority for the project was to build the replacement ferries as quickly as possible to restore service to affected communities.[4] The remaining change orders for both ferries were similar in nature, such as addressing design, piping, and electrical work. The technical panel determined that if WSF had avoided making changes to the original design, the cost of the two ferries would have been closer.

WSF made four major design changes to the *Island Home's* design. The first involved lengthening the ferry so it conformed more closely with WSF'S fleet, an acceptable practice in the view of the technical panel. A second conformity decision called for the removal of the vehicle deck hull doors. This feature prevents water from entering the ferry, protecting vehicles from saltwater spray, but WSF officials said the generally calm waters of Puget Sound do not require closed doors. Officials also said that closed hull designs block the views of passengers sitting in their vehicles. The third major change involved removing the wastewater treatment system used on the *Island Home* to treat sewage for proper disposal into the open waters traveled on the route. Because WSF offloads all of its ferries' sewage while in terminal, WSF officials said the *Chetzemoka* did not need the waste management system.

Finally, WSF made changes to address identified problems in the *Island Home* design, specifically excessive noise from the vibration in the propulsion system. Excessive vibration and noise could lessen customer comfort but also prematurely wear the ferry's equipment, increasing the cost to maintain a ferry over its operational life. Although the shipyard that built the *Island Home* knew about this weakness in the original design, WSF officials rode the *Island Home* prior to purchasing the design and said the vibration was not that readily apparent from the pilot house.

To address potential vibration and noise issues, WSF installed a different type of drive train shaft on the three Kwa-di Tabil ferries than the type used for the *Island Home*. Once the ferries entered service, WSF received customer complaints about the vibration, and WSF staff acknowledged the vibration level was greater than expected. WSF officials have stated that it is common for vibration to occur during acceleration from the dock and stopping, and that it is not a reflection on the safety and integrity of a ferry or its operability. While WSF does not anticipate any long-term consequences from the vibration, it has instituted a monitoring program to assess the need for additional maintenance work resulting from excessive vibration.

WSF officials said these design changes transformed the *Chetzemoka* into a substantially different ferry from the *Island Home* suggesting the two ferries are no longer directly comparable. Further, WSF's officials noted that the anticipated

4. WSF officials said that for the subsequent two ferries in the Kwa-di Tabil class, WSF had another shipyard complete the final outfitting to prevent some of the delays to the production schedule that had occurred during construction of the *Chetzemoka*.

service life for the *Chetzemoka* is 60 years compared to the 40 years by the Steamship Authority. Members of the technical panel said to increase the service life of a ferry requires the use of extra steel weight and installation of redundant systems. However, the *Chetzemoka* and *Island Home* have similar lightship weights, and WSF officials did not identify changes made to extend the service life of the *Chetzemoka* over the *Island Home*.

Before construction began on the *Chetzemoka*, a marine architect working on a ferry replacement study for the state Legislature's Joint Transportation Committee reviewed WSF's proposed changes to the *Island Home* design. The consultant found that the *Island Home* design was a close fit to the operating environment requirements of its operational route, and that WSF's proposed design changes would make the new ferry a "more perfect fit" to a Puget Sound route without compromising the design. The consultant did not examine how these changes would affect the total cost of construction.

It is unclear whether paying more to design and build ferries reduces life cycle costs for WSF.

To assess whether WSF and the taxpayers receive a long-term benefit from spending more to design and build a new ferry requires an analysis of the ferry's life-cycle costs. Life cycle costs are the total of one-time and recurring expenses incurred over the entire life span of the ferry. At our request, WSF calculated the life-cycle costs for the six ferries it has acquired in the last 20 years, and the two Olympic class ferries under construction, as this information was not readily available. However, because we were not able collect the same data from the other ferry purchasers in our study, we could not reach a conclusion about whether paying more to design and build a ferry reduces life cycle costs. The technical panel stated that a thorough understanding of a vessel's life cycle costs is an important consideration when making decisions about when to replace it with a new ferry.

WSF paid more even when accounting for ferry design characteristics

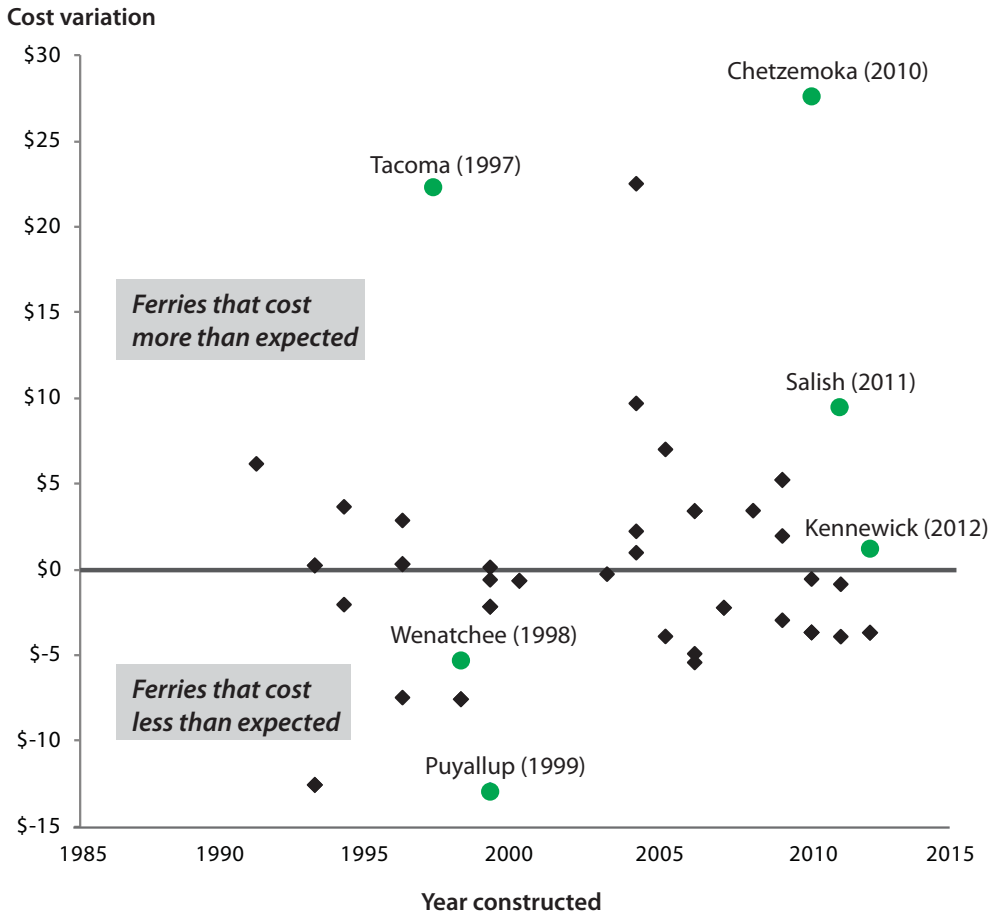
The cost to construct a ferry is largely driven by its design characteristics. Design characteristics refer to things like the size, weight, shape, and carrying capacity of the vessel for passengers and vehicles. It also includes things like whether the vessel hull is made of steel or aluminum and the length of its expected service life. We conducted a statistical analysis to control for differences in design characteristics among the 39 vessels built in the last 20 years.

We found that WSF's construction costs were higher than expected after accounting for design characteristics, when compared to the construction costs for ferries built by other purchasers. This means that there is something related to the unique situation of WSF as the purchaser that increases total construction cost that cannot be otherwise explained by our statistical analysis. The results of our analysis suggest that WSF paid as little as $7.5 million and as much as $42.2 million more per ferry when compared to the amount paid by other ferry purchasers after accounting for design characteristics.

Exhibit 9 illustrates the distribution of ferry construction costs compared to the cost our analysis estimates purchasers would have paid after accounting for the design of these vessels. Icons (circles for WSF ferries, diamonds for other purchasers' ferries) below the $0 line cost less than our analysis estimated, icons above the line cost more than our estimate.

Exhibit 9 - Comparing construction costs of 39 ferries when design characteristics are controlled for in the analysis

Dollars in millions, adjusted to 2011 value.
WSF vessels named (with construction year).



Source: Analysis of ferry purchaser data.

It shows that WSF paid more than the expected amount for four of the six ferries it built in the last 20 years. The round WSF icons also illustrate that when ferries are built in a series – as were the Jumbo Marks IIs and the Kwa-di Tabils – the construction cost drops with each ferry built. This reveals the efficiencies gained when vessels are constructed with as a class, using the same design, in an uninterrupted series using the same shipyard.

A detailed explanation of how we conducted this analysis is included in **Appendix B**.

Design characteristics drive a ferry's total cost

Design characteristics refer to the size, weight, shape, and carrying capacities of a ferry. Purchasers typically make decisions about these characteristics before construction of the ferry begins. Interviews with the eight ferry purchasers identified many factors as influential on cost, such the ferry's capacity to carry both passengers and vehicles, and these were included in our statistical analysis. Our statistical analysis identified several design characteristics that affect the total cost to design and build a new ferry. We discuss the more important factors below. **Appendix B** has more details on the statistical analysis.

The characteristics with the greatest effect on total cost are directly related to a ferry's overall size and weight. Other factors pertain to the number of passengers carried by a ferry and the spaces used to serve those passengers during the trip. The planned operational life of the ferry and the applicable safety standards also drive costs. **Exhibit 10** illustrates some of the design characteristics of the 39 vessels in our study.

Exhibit 10 – Design characteristics of WSF ferries compared to other purchasers

Ferry characteristic	WSF	Other purchasers
Number of ferries	6	33
Configuration	6 double-ended	24 double-ended 9 single-ended
Number with steel hull	6	26
Number with aluminum hull	0	7
Lightship weight in pounds		
Range	3,393,600 - 9,867,200	199,360 - 13,858,880
Median	6,564,320	1,122,240
Horsepower		
Range	6,000 - 13,200	285 - 25,000
Median	9,600	3,000
Passenger capacity		
Range	750 - 2,500	120 - 4,400
Median	1,625	300
Vehicle capacity		
Range	64 - 202	0 - 80
Median	133	40
Anticipated service life		
Range	60	20 - 65
Median	60	30

Source: Analysis of ferry purchaser data.

Overall ferry size and weight

The type of material used to construct the hull of the ferry has the greatest effect on total cost. A ferry with a hull made from steel is less expensive per pound when compared to an aluminum-hulled boat where all other design characteristics, including weight, are identical. A member of the technical panel explained that aluminum is about one-third the weight of steel but can be several times more expensive.

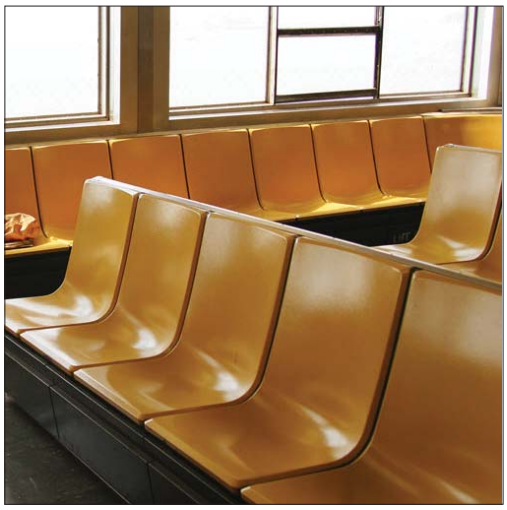
Single versus double-ended construction is also a significant design characteristic that influences total cost. A double-ended ferry is easier to navigate, is less disruptive to other waterway users, and offers faster route times, but the added construction requirements to accomplish its dual functionality makes a double-ended ferry significantly more expensive when all other design characteristics are identical.

Weight also has a significant influence on total cost. For this report, the weight of a ferry is represented by its lightship weight – its weight when complete and ready for operation but empty of people, cargo, and fuel. When all other design characteristics are the same, the heavier the lightship weight, the more the ferry is likely to cost.

Passenger amenities and capacity

Total cost is also driven by passenger capacity and by the quality of passenger amenities – such as bare or upholstered seats, self-service snack vending machines versus staffed food service. Purchasers were asked to rate the level of the passenger amenities to which they build their fleet as either *basic* or *above (comfort or luxury)*. One purchaser said they provided above basic passenger amenities – upholstered and oversized seating, electric outlets, flat-screen televisions – because their route time was several hours and frequently traveled by tourists. Purchasers that choose to provide above-basic passenger amenities increase the total cost of the new ferry. Those ferries that included staffed food service had an increased total cost. Regardless of the quality of amenities, our analysis found that otherwise identical ferries that are designed to carry more passengers cost more. **Exhibit 11** illustrates the "basic" seating of a typical Staten Island Ferries vessel and the "above" comfort seating of WSF's *Salish*.

Exhibit 11 – Basic seating on a Staten Island Ferry vessel (upper photo), more comfortable seats on the WSF *Salish* (lower photo).



Photos: Jake Dobkin and WSF.

Planned operational life of the ferry

The anticipated service life of the ferry influences cost as well. Our analysis found that the longer the purchaser plans to keep the ferry in operation, the greater the total cost. Purchasers reported that they plan to operate steel hull ferries for 40 to 60 years, with proper repair and maintenance; they anticipated a shorter service life of between 20 and 30 years for their aluminum-hull ferries.

Purchasers also told us that regardless of the anticipated service life of the ferry's structure, other components will need to be refurbished or replaced. Engines and other propulsion equipment have a practical life of 30 years while interior refurbishment of seating or passenger amenities might take place every 10 to 12 years.

Federal safety standards

Finally, federal safety standards affect the cost to build a ferry. The requirements, set forth in the United States Code of Federal Regulations, vary by the ferry's overall size, passenger capacity, and planned operating environment. All passenger ferries operating in the U.S. must be inspected by the U.S. Coast Guard (Coast Guard) for compliance with the applicable standards and receive a certificate of inspection that permits them to operate.

For example, a ferry under 100 gross tons (a measure of a ferry's cargo space), carrying fewer than 150 passengers, must meet the safety standards described in Subchapter T, while a larger vessel intended to carry more passengers must comply with the standards in Subchapter H or other specific regulations. The safety regulations include, among others, requirements for the adequate capacity to carry the required number of crew, provision of ample lifesaving equipment, structural protection from fire while in operation, and Coast Guard inspection of the plans for new construction of a ferry.

All WSF ferries are certified by the Coast Guard under Subchapter H for operation in lakes, bays, and sounds. Compared to smaller ferries built to the standards of Subchapter T or K, it costs more to build a new ferry that complies with Subchapter H safety regulations.

Question 2. What factors affect the cost of constructing ferries and to what extent do those factors affect total construction spending?

Our statistical analysis alone did not explain why WSF paid more compared to other ferry purchasers even after accounting for vessel design characteristics. Results from our interviews with WSF, other ferry purchasers, and shipyards; our review of state regulations; and our case study comparing the *Chetzemoka* to the *Island Home*, suggest that something in Washington's regulatory environment and the way WSF buys a new ferry contribute to WSF's higher costs. This section discusses how the regulatory environment WSF operates in affects its ferry construction projects. The next section discusses WSF's use of leading practices to manage the design and construction of its new ferries.

Build in Washington requirements do limit competition to Washington shipyards, but do not eliminate in-state competition.

WSF specifically cited the Build in Washington law as a reason for higher costs because it limits competition to companies with shipbuilding facilities in Washington. The Governor and Legislature have required that all ferries in the Jumbo Mark II, Kwa-di Tabil, and Olympic classes be constructed in Washington. Under Build in Washington, out-of-state builders cannot qualify to compete for the contract unless the company also has an in-state shipyard location. According to state law, the purpose of the requirement is to help sustain the state's shipbuilding and repair industry.

A series of laws, rather than a single law, have served to continuously require WSF to construct new ferries within Washington. In 1993, the laws enabling the construction of the Jumbo Mark II class of ferries contained language that required WSF to incorporate the in-state construction requirement into bid documents. In 2001, legislative changes were made to allow WSF to use a modified request for proposal process and a design-build construction approach; these changes also required WSF to build its ferries in Washington. This version of the build-in-state requirement applies to the Olympic class currently under construction.

In 2008, another law was adopted to require in-state construction if the new ferry carries no more than 100 vehicles, which pertained to the Kwa-di Tabil class. All laws in the series exempt equipment furnished by the state and standard manufactured components, products, and systems from the in-state construction requirement. For more information on the laws requiring in-state construction of new ferries, see **Appendix D**.

For the Kwa-di Tabil class ferries, WSF officials said the state's requirements narrowed the competition to one shipyard. We interviewed two shipyards that did not bid on the procurement; both had experience building passenger ferries and maintain active shipbuilding facilities located on Puget Sound. These in-state shipyards said state requirements other than Build in Washington were their main reasons for not participating in this WSF procurement, in particular the state's requirement for a state-approved training program.

We further examined whether opening competition to out-of-state shipyards would increase the level of competition on WSF procurements. Our analysis showed that it may not necessarily increase the number of bidders who meet all of the state's qualification requirements. Even purchasers who are not subject to a comparable build-in-state requirements reported difficulty in obtaining sufficient competition on their procurements. Purchasers reported, and one shipyard said, that other factors such as the existing and anticipated workload for the shipyard influence the yard's decision to bid or pass on a project. At least two of seven purchasers delayed or cancelled procurements because they did not receive adequate competition. To ensure multiple bid responses and competitive pricing, several buyers reported implementing outreach and marketing activities prior to the procurement.

Another purchaser, who must also comply with an in-state preference similar to Build in Washington, is allowed to reopen bidding to out-of-state shipyards following an unsuccessful price negotiation with an in-state shipyard. WSF officials reported meeting with at least one other Washington shipyard to encourage in-state competition but this company has declined to participate in WSF procurements.

Estimated economic impact on state's economy from constructing WSF vessels in Washington

By requiring WSF to build its ferries in Washington, the Legislature's intent is to bolster the state's economy by supporting its shipbuilding industry. We asked the state's Office of Financial Management (OFM) to help us estimate the impact of hypothetically spending $150 million to build two ferries over the next two fiscal years, FY2013 and FY2014. The data used for the analysis were based on actual expenditures for the first of the Kwa-di Tabil class ferries, the *Chetzemoka*.

OFM's Input-Output Model estimates that $150 million of ferry construction spending on two new ferries would support an average of 322 jobs and $28 million in wages in the shipbuilding industry in each of the two fiscal years. The total economic impact in all sectors of the state's economy is estimated at an average of 1,335 jobs and $90 million in wages in each of the same two years.

What would such a ferry construction project mean to Washington's economy? According to the most recent economic projections by the state's Economic and Revenue Forecast Council, the state will have an average annual gain of 53,605 jobs over the next two fiscal years. In our hypothetical example, $150 million to build two ferries would contribute 2.5 percent to the state's employment growth, and just under 1 percent to the state's earnings growth over the two-year period.

What would the project mean to Washington's shipbuilding industry? The state's Economic and Revenue Forecast Council does not project economic growth by specific industries such as shipbuilding. However, according to the U.S. Commerce Department's Bureau of Labor Statistics, Washington's shipbuilding industry supported 5,130 jobs in 2011, with wages of $282 million. The hypothetical expenditure of $150 million represents about 6 percent of Washington's shipbuilding jobs and 10 percent of wages in the industry, however, the number of new jobs created is not known.

State Apprenticeship Program laws limit competition and likely increase costs to build new ferries

WSF officials told us that compliance with the state's Apprenticeship Act limits competition for their procurements and is another reason for higher construction costs. The Apprenticeship Act is intended to ensure an adequate supply of skilled workers in the construction industry; it was established in response to studies that found population trends are not likely to provide the needed workforce. It requires participating agencies to ensure that 15 percent of the work on state construction projects worth more than $2 million is completed by apprentices participating in a program approved by the Regulatory Apprenticeship Council.

In 2007, the state required WSDOT, including WSF, to comply with the Apprenticeship Act by placing an apprenticeship requirement in its construction contracts. (See **Appendix E** for details.) The law also called for the Transportation Secretary to create and convene an Apprenticeship Utilization Advisory Committee to help guide the department's decision-making in the development, implementation, and administration of the program. Under this program, in order to prequalify and compete for a new ferry construction contract, a shipyard must demonstrate that it has a state-approved training program for its workers that meets state laws. Apprenticeship programs that are not state-approved cannot count toward meeting the requirement.

The apprenticeship program laws have posed a barrier to WSF's ability to attract a sufficient number of prequalified bidders on its ferry construction procurements worth more than $2 million. Other Washington shipyards capable of building new ferries have not pursued bidding on WSF's projects because of this requirement. Two shipyards we interviewed cited the requirement as a primary barrier to their ability to compete for WSF new ferry construction contracts.

Officials from one of these companies said that without changes to the apprenticeship program approval process, they are unlikely to participate in future procurements. Officials from the other company said that despite seeking assistance from the Department of Labor and Industries, their apprenticeship program remains unapproved after three application attempts were denied by the Regulatory Apprenticeship Council. They also told us another hearing is scheduled for October 2012. The sidebar at right discusses how increased competition for the construction of the *Steilacoom II* reduced the cost to build the new ferry by 13 percent.

Pierce County's experience shows competition can affect costs

Pierce County is not subject to either the Build in Washington requirement or the Apprenticeship Act. When it first set out to build the *Steilacoom II*, the County received one bid from a local shipyard, but because the bid was higher than the initial project estimate, the procurement was cancelled.

The county reissued the procurement after actively soliciting interest from other shipyards and adopted a similar bonding requirement to WSF's. The new procurement brought interest from nine shipyards and qualified five shipyards to bid; the winning shipyard's bid was 13 percent lower than the initial bid. The yard has its own training program, albeit not a state-approved one.

Source: Pierce County officials.

In addition to adversely affecting competition, implementing the apprenticeship law increases construction costs. WSF has not estimated the dollar impact on the vessel replacement program due to the apprenticeship program laws, but the shipyard currently constructing the Olympic class told the Senate Transportation Committee in 2011 that compliance adds about 10 percent to 15 percent to its hourly labor costs. Some technical panel members estimated a three-fold increase in labor costs to the purchaser from work performed by apprentices because the shipyard must supervise the apprentice, slowing production. The panel questioned the value of imposing this requirement on WSF because shipyards, especially large ones, usually establish their own apprenticeship training programs to ensure their workers have the necessary expertise to do the work.

Technical panel members further explained that shipyards can have high turnover among trainees because it is difficult work environment. A more common way to ensure a skilled workforce is through contractual requirements that require certified skilled workers are assigned to the project and perform certain tasks.[7] The law states that a key benefit of applying the apprenticeship program to public works projects is that it helps maintain a skilled work force to perform future public projects, which include ferry maintenance and construction activities.

Although the administration of the Apprenticeship Act is entirely outside its control, WSF has attempted to ease some of the requirements. For example, WSF has asked the Legislature to increase the threshold over which the apprenticeship law applies from $2 million to $5 million, estimating that doing so could save $250,000 in capital outlays annually. However, this change would only affect WSF's maintenance and preservation work because new ferry construction contracts cost more than the $5 million limit.

Furthermore, even if the Legislature were to lift the Build in Washington requirement and allow out-of-state shipyards to bid on new vessel procurements, competition for the contracts by in-state shipyards would still be limited because they remain bound by the apprenticeship laws.

Other regulatory factors cited as cost drivers also limit competition but are not unique to WSF

WSF officials reported that the state's bonding requirements contribute to higher costs, explaining they limit the number of shipyards that can compete. Six of the seven other purchasers participating in this review also said the purchaser's bonding requirements is a challenge for some shipyards to meet. All purchasers, including WSF, and the technical panel recognized that bonding requirements protect public agencies' large investments against the risk that the shipyard will fail to deliver the ferry. The technical panel said that bonding requirements limit competition, in particular from smaller shipyards, but they are not usually the determinative reason why a larger shipyard would not prequalify to bid.

WSF has aligned its bonding requirements with project risk by performing a comprehensive risk assessment of its projects to determine the level of financial guarantees necessary. As a result, bonding levels vary from project to project. All seven other purchasers had bonding requirements similar in purpose and form to

7. Members of the technical panel questioned whether the savings from apprenticeship utilization justified the cost of the program; however, WSDOT does not publish performance outcome data on its website to answer this question.

those of WSF. The purchasers participating established varying bond amounts, but two purchasers required a performance bond equal to 100 percent of the contract award. For those shipyards unable to meet the bonding requirement, some purchasers allowed the shipyard to present alternative forms of guarantees. For example, one Washington purchaser asked the state for an exemption to the bond requirements, so that a local shipyard could obtain a guaranteed line of credit from a bonding company or bankers.

Finally, WSF officials also said their costs were higher because the state requires WSF to meet the standards of the federal Americans with Disabilities Act (ADA), even though existing federal maritime guidelines for passenger ferries do not insist on it. Washington's Department of Labor and Industry requires that all state facilities, including ferries, comply with federal ADA requirements.

Bank and bonding company assumptions in the shipbuilding industry

One member of the technical panel explained that bonding companies and banks typically assume that a shipyard will default at some point during the contract and the purchaser will call on the bonding company or bank to pay. The bonding company or bank will often reduce the shipyard's line of credit to prevent the shipyard from becoming over-extended if a default occurs. Bonding companies and banks often require some percentage of personal guarantees from the principals of the shipyard unless the value of the company's land and other assets are considerably more than the value of the construction contract.

WSF officials said that to make its elevators ADA-compliant, they must purchase larger elevators than those typically required for passenger ferries. Other purchasers also reported designing and building their ferries to meet ADA standards beyond federal maritime guidelines. Complying with ADA elevator standards increased WSF's total cost by about $500,000 for the second and third Kwa-di Tabil ferries combined, and about $380,000 for the first ferry in that class.

Although required by Washington state, there are no federal requirements to design and build ferries that comply with the ADA. The United States Access Board, a federal agency, is developing guidelines under the ADA for access to ferries, cruise ships, excursion boats, and other passenger vessels.

Question 3. Does WSF use leading practices to develop, manage, and monitor its ferry construction contracts?

By following more of the leading practices we identified, WSF can do more to reduce costs

WSF established its Vessel Construction Program to plan for and facilitate its vessel replacement activities. The WSF's Assistant Secretary has established three primary goals to: (1) realize cost savings; (2) continue to build an effective partnership with its shipyard; and (3) routinely replace ferries after 60 years of service or at the end of their useful life. Five primary functions comprise WSF's Vessel Construction Program: procurement/contracting, design, construction and project management, project delivery and close-out, and financial management.

Each of these functions have leading practices that can reduce financial, quality, and delivery risks on ferry construction projects when implemented effectively. For this audit, we developed leading practices from our review of industry literature, and through our interviews with officials from WSF, other ferry purchasers, and shipyards that build ferries. Our list of leading practices were reviewed and refined by the technical panel that we engaged to assist us on this audit. These leading practices do not represent industry standards, but do reflect practices commonly known and used in the construction industry.

Given that WSF spends more on new ferry construction projects compared to other purchasers, we assessed WSF's use of these 15 leading practices to identify opportunities for cost savings. Although WSF is not required to implement leading practices, our analysis shows that WSF has more leading practices in place now than it did 20 years ago and uses many of them effectively. However, its use of other practices could be strengthened, and implementation of others evaluated.

WSF uses many leading practices

Before beginning construction of the three Kwa-di Tabil class vessels in 2009, WSF took steps to enhance its ferry construction program. It needed to address contractor relationship issues, budget overruns, and quality assurance problems that occurred on the Jumbo Mark II construction project in the late 1990s. For that project, WSF had only two leading practices in place and cost overruns totaled $26 million.

Now, WSF uses eight of the 15 leading practices we examined. They are:

- Use a formal change order process for review and approval of change orders.
- Require the shipyard to provide operational training, standard operating procedures, and spare parts.
- Secure the right to own the final as-built design for future reuse.
- Owner describes in detail specific needs and preferences.
- Project partners agree to a Project Charter outlining the purpose, goals, and expected outcomes of the project.
- Project Plan fully developed, outlining timelines, personnel/vendor roles and responsibilities, expected duration of the project. Plan is updated throughout project.

- Define responsibility and establish processes to resolve issues in a timely manner.
- Use a steering committee to review and approve changes.

Effective implementation of some of these leading practices has provided greater clarity between WSF and the shipyard on project expectations and resolving differences, and also has improved communication between project partners and within WSF itself. WSF has greatly improved its management and oversight of its construction process since the construction of the Jumbo Mark IIs. WSF staff reported that they are having better success in delivering the Kwa-di Tabil class on time and on budget due to these changes.

In addition to implementing these leading practices, WSF initiated other new vessel construction program changes by reducing the size of project teams from 16 to five people, hiring new project managers and other staff with capital project financial management experience whose contributions have helped strengthen program activities, and setting expectations that foster a culture of cost savings.

Four leading practices, properly used, offer WSF the best potential for cost savings

The technical panel helped us evaluate the remaining seven leading practices. They determined that four practices are interrelated; in the opinion of the panel, if WSF implements them together, these practices offer the best opportunity for cost savings on future projects. The four leading practices that can mitigate cost growth are shown in **Exhibit 12** and discussed in detail on the following pages.

Exhibit 12 – Four leading practices, if implemented effectively, offer WSF the best opportunity for cost savings

Leading practice	Could be strengthened	Not used by WSF
Use a fixed price contract.	√	
Design is complete and reviewed before construction begins.		√
Use an independent owner representative.		√
Owner places all responsibility on contractor to deliver project quality.	√	

Source: Analysis of WSF leading practices.

Use a fixed price contract

The first leading practice is the effective use of fixed price contracts, which require the contractor to deliver a specific project for a set price that covers all the construction work needed to complete the ferry based upon the owner's procurement specification. The technical panel stated that – given ferries are a relatively simple design – a fixed price contract is appropriate provided that a clear scope and defined schedule are agreed upon before the contract is signed. One advantage of a fixed price contract is that it places responsibility on the contractor to develop an accurate price estimate for the project. However, the panel explained that the purchaser must exercise a substantial amount of internal discipline to resist interfering in the shipyard's production process if they are to avoid cost overruns.

Although WSF used a fixed price contract for new ferry construction, they did not do so effectively. We examined how successfully WSF had completed the shipyard's contract within the contract award amount. The results show that WSF exceeded the original contract amount for the vessels in the Kwa-di-Tabil class, by between $1.4 million and $10.9 million, as shown in **Exhibit 13**.

Exhibit 13: Construction contract award to shipyard and total spent to date for WSF ferry construction
All amounts are in unadjusted dollars.

	Kwa-di Tabil Class (64-car) completed			Olympic Class (144-car) under construction	
	Chetzemoka	*Salish*	*Kennewick*	*Tokitae*	*Samish*
Contract award	$65,487,328	$60,000,000	$54,109,000	$115,345,212	$109,424,358
Total paid (to date)	$76,374,673	$63,634,490	$55,546,337	$135,974,649*	$120,366,794*
Amount over contract award	$10,887,345	$3,634,490	$1,437,337	$20,629,437 *estimated*	$10,942,436 *estimated*

* WSF budgeted amounts (contract award amount plus contingency).

Source: Analysis of WSF data.

In total, WSF paid an additional $15.9 million for Kwa-di-Tabil class construction activities with change orders attributing to the cost growth. About 60 percent of the additional costs for the *Chetzemoka* were for time and materials to maintain the project schedule to restore ferry service as quickly as possible to communities affected by the retirement of the Steel Electric class of vessels.

WSF expects cost growth on the first ferry of the Olympic class. Although it is already under construction, WSF included a $20.6 million contingency above the initial contract award of $115.3 million. In an October 2011 Joint Transportation Committee meeting, WSF and its shipyard, in response to a legislative directive to identify cost savings in the Olympic class either in ferry construction and/or long term ferry maintenance or operations, found $426,000 to $638,000 in construction savings by removing or changing certain features, and up to another $326,000 by removing spare parts, tools, and required administrative documents. Unfortunately, these savings come at the expense of a leading practice: *"Require the shipyard to provide ... standard operating procedures, and spare parts."*

Design is complete before construction begins

The second leading practice is to complete and approve the design before beginning construction. Effectively implementing this leading practice prevents cost over-runs on a fixed price contract because the purchaser is not responsible for changes to the ferry's design after it is complete and they have provided final approval.

WSF allowed its shipyard to start construction before design specifications were final and approved on all of its ferry construction projects, explaining that doing so allowed the shipyard to better accommodate its own project scheduling needs. However, in a lessons learned activity for the Kwa-di Tabil class, WSF project managers suggested that completing specifications and drawings before construction starts allows the shipyard to order all equipment, reducing the risk for delay and disruption-of-contract claims by the shipyard. While that is ideal, WSF was somewhat constrained by the accelerated construction schedule and the availability of shipyards for the Kwa-di Tabil ferries.

One ferry purchaser told us they wait to begin construction until the design is fully complete and has been approved by the USCG or by a classing organization because purchasers must comply with all USCG safety regulations in effect at the time the keel is laid. This approach helps prevent unanticipated changes and associated costs to meet USCG standards later. If a purchaser waits until well after the keel is laid to receive formal approval, risks grow that USCG standards may have changed, prompting redesign or construction change orders and additional funds to resolve regulatory issues. That said, one member of the technical panel noted that public agency purchasers, like WSF, will likely incorporate any change in the safety regulations that occur after the keel is laid in the interest of public safety, regardless of whether or not it is required to do so.

Use an independent Owner Representative

In the third leading practice, the ferry purchaser employs an independent owner representative, to serve as a third party intermediary between the buyer and the contractor(s) designing and building the ferry. The role of the owner representative is to:

- Advocate for the purchaser's best interest throughout each phase of the construction project
- Serve as the primary communicator between the contractor and the purchaser
- Perform all project quality oversight activities
- Bridge the gap between the owner and the shipyard on quality expectations
- Manage the change order process when necessary
- Ensure that the project does not depart from the contract.

The hiring of an owner's representative should not increase overall project costs because expenses would be redistributed; lower professional, construction, and administrative costs should result from a more transparent, focused and efficient process. The technical panel stated that using an independent owner's representative could prevent costly change orders or delays in the production process.

WSF does not implement this practice; it had not previously considered doing so because it is a WSDOT-wide practice to use a "strong owner" model of project delivery. The technical panel noted that WSF's change order management process (which has improved since the Jumbo Mark II project) can be handled by an independent owner representative, thereby removing WSF from much of the process and reducing or eliminating the temptation to make changes. Other ferry operators participating in this review explained that because the owner's representative has in-depth understanding of the project specifications for the ferry, those issues which inevitably arise can be initially addressed and resolved without the close involvement of the purchaser.

It also removes the owner from the sometimes adversarial meetings that occur when discussing potential changes. Ferry purchasers in our review told us that they are involved only to provide final change order approval based on the independent recommendation of the representative.

Owner places all responsibility on the contractor to deliver project quality

The fourth leading practice requires the purchaser to place all responsibility for project quality and delivery on the shipyard. Doing so allows the purchaser to reduce its risk. Should the purchaser assume responsibility for quality, the shipyard cannot be held accountable for the errors and omissions caused by others. However, the shipyard will still have to correct such errors, setting the stage for change orders and increased construction costs.

WSF shares some of the responsibility for ensuring the delivery and quality of its new ferries. For example, when WSF has purchased the propulsion equipment for new ferries itself, the agency has also accepted responsibility for testing and delivering the equipment to the Puget Sound area from its storage site in California. For the Kwa-di Tabil class, WSF initiated some time and material change orders to maintain the project schedule and others because owner-furnished equipment did not arrive on schedule. In a lessons learned activity, WSF staff questioned its use and suggested that it be discontinued to prevent project risks and contractor claims. The technical panel suggested the risk of providing owner-furnished equipment can be somewhat mitigated by using contract clauses to hold the shipyard responsible for taking delivery, inspecting, accepting, and storing the equipment. While WSF did include similar clauses in its contract with the shipyard for the Kwa-di Tabil class vessels, they do not cover issues that could arise if the equipment WSF provided was found to be faulty. Furthermore, because WSF had stored this equipment since purchasing it in 2001, they – not the manufacturer – became responsible for for providing fully functional equipment to the shipyard.

Also, WSF conducts its own inspections to ensure project quality. WSF has two full-time inspectors and one back-up inspector of its own assigned to each ferry construction project to oversee the quality of work performed by shipyards. Agency officials explained that a long history of problems meeting project expectations led WSF to accept and welcome increased responsibility for quality.

The technical panel recognizes the purchaser has an incentive to inspect often to ensure quality, but believes that as a result the buyer assumes more responsibility for the quality each time it performs an inspection. Project quality, said the technical panel, should be the sole responsibility of the shipyard. Nearly all the other ferry

purchasers participating in this review relied on classification societies, the USCG, or an independent owner representative to perform inspections to verify shipyard quality. WSF did include clauses in its contract with the shipyard for the Kwa-di Tabil vessles that stated that the presence of WSF inspectors at the yard did not absolve the construction company from its responsibility to deliver a quality project. If WSF decides to use an owner's representative, that person also provides a purchaser's presence for quality assurance matters.

Other leading practices can strengthen WSF's New Ferry Construction Program

WSF does not use the remaining three leading practices as effectively as it could. These leading practices, shown in **Exhibit 14,** are related to lessons learned activities, accurate financial reporting, and effective use of the chosen contracting method.

Exhibit 14 – Leading practices used by WSF that could be strengthened

Leading practices description	Suggested improvement
Use a formal process to ensure lessons learned are completed in a timely way and are effectively used on subsequent projects.	Establish and use performance metrics based on independent collection of data from all stakeholders.
Develop project budgets based on appropriately estimated project costs; do not depend on large contingency amounts.	Large contingencies undermine the integrity of fixed price contract; contingencies should be no more than five percent.
Effectively use the chosen contracting methods.	Minimize the use of multiple design firms, and consider using one contract to cover vessel design and construction.

Source: Analysis of WSF leading practices.

WSF could strengthen its "lessons learned" activities. This leading practice calls for a post-project conversation between stakeholders, discussing how the project went and making agreements on appropriate adjustments for subsequent projects. This helps them avoid repeating past mistakes and leads to the development of even better solutions. Lessons learned activities play a vital role in facilitating program improvement and lowering project costs on future ferry construction projects.

WSF does hold debriefing meetings to identify and convey lessons learned as suggested in WSDOT's lessons learned guidance. However, WSF does not have a formal process in place to ensure that the meetings are independently administered, that all partners participate, and that suggestions are fully reviewed and acted upon.

At the time of our review, WSF had not completed its lessons learned activities on the Kwa-di-Tabil class, losing an opportunity to fully incorporate beneficial changes for the Olympic project already under way. Preliminary suggestions made by WSF staff included:

- Requiring WSF's Master Inspector to attend monthly progress meetings, instead of being on site full-time during the initial construction phase, which could save unnecessary costs.
- Reviewing the administrative deliverables and the way they are submitted to reduce duplicated documentation. Although electronic and CD copies are required, WSF also requires up to three hard copies, indeed up to five in some instances, of 75 reports and forms documenting specifications and layout of the ferry.

To date, WSF has taken action on one preliminary suggestion, by inserting a clause into the Olympic class contract limiting the amount the shipyard can invoice the agency before the end of the biennial year. The sidebar at right shows lessons learned by the other ferry purchasers we interviewed for this study.

The technical panel suggested that lessons learned activities could be strengthened by establishing and monitoring performance metrics, and by providing independent professional facilitation of data collection activities from all stakeholders, including the ferry owner, shipyards, subcontractors, and other partners, to ensure improvement opportunities are not missed.

WSF could strengthen its financial management practices. This leading practice calls for costs to be thoroughly analyzed by staff to ensure they are appropriately estimated and reported; it includes accurately accounting for inflation in the project's budget process and preparing financial reports on a timely basis. Without effective financial management, actual spending can exceed project budgets.

Although WSF has improved the quality of its financial management activities since the Jumbo Mark II project, especially describing in greater detail the nature of project expenditures, the financial reports for the Kwa-di-Tabil class do not accurately reflect all project costs because WSF had not included the cost of the three previously purchased propulsion systems. WSF did separately track the cost of the propulsion equipment used for these vessels, but it is not included in the reported total project cost.

WSF management said that because the propulsion systems were purchased more than 10 years earlier for the construction of the Olympic class, accounting for these costs was reflected in earlier fiscal years. Accounting adjustments could not be performed because the financial accounting periods had long been closed. WSF staff, however, adjust the financial reports to accurately reflect the costs for each new ferry in the Olympic classes. Including these expenditures would better reflect the actual cost to purchase each new ferry.

In addition, we noted WSF depends on the use of contingencies to complete projects on budget. Ferry construction budgets often include multiple contract award amounts for design, construction, and anticipated expenses associated with the entire project, from conceptual design to christening of the vessel.

Other ferry purchasers offer lessons learned

We asked the ferry purchasers in our study what they would do differently in their next ferry purchase. Suggestions that WSF does not currently implement include:

- Using a business case to justify ferry design features
- Using advanced "green" technology
- Having the USCG approve detailed designs before beginning construction
- Waiting until all machinery is delivered to the contractor so that design adjustments could be made before construction begins
- Eliminating observation decks
- Using an owner representative for the design process as well as the construction process
- Moving away from detailed owner specifications
- Using a General Partner that would have responsibility for the entire life cycle of the vessel.

Accounting for the cost of the propulsion systems

WSF purchased four propulsion systems in 2001 for the 144-car ferries using federal funds at a cost of $48 million.

To facilitate the construction schedule for the Kwa-da Tabil class vessels and restore ferry service as soon as possible to affected communities, WSF used components from those previously purchased systems on the three Kwa-da Tabil vessels. WSF officials told us they used $3.1 million worth of equipment from the existing propulsion systems on each of the three vessels. That amount is not included in the reported total project cost figures for the Kwa-da Tabil vessels.

WSF officials have told us that the remaining equipment will be used on the 144-car ferries currently under construction, vessels to be constructed in the future, and as spare parts for the 144-car ferries.

Contingencies are sometimes added to the project's budget to cover unanticipated charges. Some ferry purchasers we visited opted against including contingencies because their goal was to successfully use the base budget and others restricted contingencies to activities that were critical to project completion. For these purchasers, contingencies ranged up to ten percent of the shipyard contract award.

In comparison, WSF set an additional 10 percent of its shipyard contract award as contingency funding for each ferry project. Following its experience with the first ferry in the Kwa-di Tabil class, which was significantly over the contract award amount when it was completed, WSF opted to budget a 20 percent contingency for the first ferry in the Olympic class.

Based on their experience, the technical panel believes that a 20 percent contingency is too high, even for the first ferry in a class, because ferries are relatively simple vessels. Technical Panel members additionally questioned WSF's consistent use of large contingencies for each of the three ferries in the Kwa-di Tabil class. As **Exhibit 15** shows, these large contingency budgets allowed WSF to complete the projects on budget.

Exhibit 15 – WSF performance in completing vessel projects within total project budget factoring in contingencies
All amounts are in unadjusted dollars.

	Kwa-di Tabil Class (64-car) completed			Olympic Class (144-car) under construction	
	*Chetzemoka**	*Salish**	*Kennewick**	*Tokitae*	*Samish*
Total budget	$80,044,448	$72,084,789	$65,819,165	$146,913,057	$132,500,000
Total expenses	$83,641,508	$69,719,279	$61,795,368	–	–
Over/(under) total budget	$3,597,060	($2,365,510)	($4,023,797)	–	–

* Includes $3.1 million in propulsion system costs for each vessel.
Source: Analysis of WSF data.

However, technical panel members said WSF's consistent use of contingencies to cover construction contract overruns undermines the integrity of fixed price contracts, and suggested that an acceptable contingency amount is up to five percent of the estimated cost. A member of the technical panel further noted that a purchaser greatly influences, if not controls, the degree of uncertainty and can generally decline additional expenditures.

WSF could improve the way it conducts its contracting/procurement processes. This leading practice calls for effective use of contracting methods.[8] WSF is required by statute to use design-build contracting for procurement of its vessels. A design build contract awards an entire project, including design, construction, and delivery, to one company. The shipyard is assigned a high level of responsibility for all preliminary design and construction work required to build the ferry, it may hire a designer and other technical experts to complete the work. The purchaser retains the right to approve or reject the proposed preliminary design, but is not responsible for

8. Other contracting methods include General Manager or Construction Manager General Contractor, or Construction Manager at Risk. We discuss design-build methods because it is the contracting method WSF is required to use by the Legislature.

coordinating or managing the design team. Once the purchaser approves the design, the shipyard may begin the construction process. Using the design-build approach can save time and avoid costly change orders.

State law requires WSF to use a modified design-build[9] method for ferry construction, which enables it to share project responsibility with the shipyard. The state adopted the use of design-build in order to reduce the administrative time and expense needed to negotiate and manage multiple contracts in a single project. WSF does not appear to be receiving this benefit from the use of a modified design-build approach because WSF continues to work with multiple contractors instead of just one, which does not relieve WSF of the administrative burden of multiple procurements for the design, construction, and outfitting phases of the project.

For example, WSF hired three design firms for the Olympic class ferries. Agency staff explained that they employed multiple design firms because each had specific experience in designing various components of a ferry. Before 2008, WSF spent more than $8.4 million on the design work for the Olympic class, and the shipyard has spent another $2.8 million on production work developing the construction build-strategy for the project. None of the other ferry purchasers reported hiring more than one design firm for a project.

The technical panel questioned WSF's decision to hire other shipyards to perform final outfitting when it should be the construction shipyard's responsibility, and suggested minimizing the use of multiple design firms. WSF could save time and money on its construction projects if it did not have to conduct other procurements or coordinate the activities of several contractors. However, WSF officials informed us that for the Kwa-di Tabil class, this was done through a competitive bid and resulted in a lower cost than the price quoted to them by the shipyard that constructed the vessels and helped them meet their accelerated project schedule.

9. At the suggestion of a 2001 audit of WSF's procurement process, the Legislature allows it to partner with its shipbuilder on the design of the project. This change was made to promote ownership of the design by the shipbuilder while using WSDOT's expertise in ferry design and operations.

BC Ferries offers an alternative ferry construction program model

BC Ferries is one of the largest and most complex ferry systems in the world, with 25 routes, 47 terminals, and 35 vessels. In 2003, BC Ferries became an independent company. Today it receives an annual fee-for-service to provide service on routes which are not financially self-sustaining. It raises its own capital through bond issues with which it funds asset replacements such as its new vessel replacement program.

Under the new company, BC Ferries restructured its program by establishing goals to operate quality ferries and manage timely delivery of vessels following a history of cost overruns and public criticism over its operations, in particular its past approaches to new ferry construction.

To accomplish program objectives, BC Ferries implemented the following changes:

- Developed criteria for ferry replacement, which is governed by vessel condition and the gap in compliance with Transport Canada regulations.
- Adopted a "functional specification" approach in which ship functionality is specified to vessel constructors rather than specific construction details. This moved construction and cost risk onto the constructors.
- Opened procurements to shipyards outside of British Columbia that had expertise and experience in building ferries.
- Required shipyards to provide it with fixed-price contracts.
- Required shipyards to assume all responsibility for design and construction of the new vessels, including delivery and performance risks.
- Adopted construction contracts with the following features: price de-escalation clauses in design-build contracts, performance guarantees on maneuverability, speed, carrying capacity, and fuel consumption, and warranties above industry standard.
- Imposed contractual requirements to include a right of refusal of the vessel to ensure quality vendors that are willing to stand behind their product submit bids.

BC Ferries attributes the success of its most recent new ferry purchases to their program changes. Three of the company's newest ferries are some of the largest ferries in the world and were delivered on-time and on-budget. BC Ferries management team recently advised that local shipyards are beginning to re-invest in their companies, improving their technical capability to compete on future procurements. This is occurring as a result of a major government shipbuilding program.

For the future, BC Ferries may consider using a "General Partner" approach for vessel construction projects. A company serving in this capacity would have responsibility for the entire life cycle of the vessel. BC Ferries managers explained that because shipyards specialize in hull construction, which comprise less than five percent of total life cycle cost of a ferry, it may make sense to have the shipyard serve as a subcontractor to the General Partner. A General Partner would be responsible for ferry quality throughout the life cycle of the vessel by coordinating all of the construction handling maintenance and repair issues throughout the life cycle of the vessel while BC Ferries could focus on ferry operations.

Conclusions and Recommendations

Although WSF has made achieving cost savings a priority in their Vessel Construction Program, their ability to further reduce costs is limited to what they can control. We acknowledge that WSF had made significant improvements since the construction of the Jumbo Mark II ferries in the late 1990s, but believe there are further opportunities to reduce costs by considering the value of adopting the leading practice suggestions presented in this report.

Ferry construction costs are also impacted by factors that are beyond the control of WSF. We identified two regulatory requirements placed on WSF by the Legislature, which significantly restrict competition on its new ferry procurements and therefore increase vessel construction costs. We found that while the Build in Washington laws have somewhat restricted competition, the requirement that shipyards have a state-approved apprenticeship program to construct ferries for WSF further restricts competition on these procurements. As a result, WSF used the same shipyard to construct the Jumbo Mark II and the Kwa-di Tabil class vessels, and is also using it to construct the first two Olympic class vessels.

WSF does not have the authority to implement other strategies to obtain a better price when competition is lacking, other than to cancel the procurement. Another ferry purchaser we visited, who must also comply with a state preference similar to Build in Washington, is allowed to reopen bidding for competition with out-of-state companies after an unsuccessful price negotiation with an in-state shipyard. This alternative strategy successfully accommodates both the state's desire for construction that helps the local economy and the operator's need for competitive pricing. Based on the lessons learned by another ferry operator, fostering competition may encourage in-state shipyards to reinvest in their workforce and technical capability to ensure that they offer strong competition to out-of-state shipyards.

Recommendations

Opportunities exist for both the state and WSF to reduce the amount spent to construct ferries. Our recommendations were developed with guidance from the technical panel of maritime industry experts. We make recommendations to the Legislature that address regulatory barriers to competition for new ferry construction contracts, and recommendations to WSF that will help it continue to improve its vessel construction program.

We recommend that the Legislature address the regulatory barriers currently in place that limit competition on WSF vessel procurements by:

1. Allowing WSF to use alternative strategies to encourage competition for its ferry procurements when insufficient interest exists or higher-than-expected bids are received from Washington shipyards. One possible strategy to ensure an adequate level of competition could be to allow WSF to invite out-of-state shipyards to bid on new vessel construction contracts in these situations.

2. Undertake a study of the Apprencticeship Act to identify and resolve potential barriers for prospective applicants, in particular shipyards with established apprenticeship training programs.

We recommend that WSF continue to improve its vessel construction program by determining whether adopting the leading practices and suggestions for improvement provided in this report would result in program improvements and/or cost savings, and implementing those with the greatest potential for benefit to the program.

The four leading practices identified by the Technical Panel as having the greatest potential for cost savings, especially if implemented together:

- Fully adhering to fixed price contracts for ship design and construction.
- Waiting to start vessel construction until after the design is complete and approved.
- Using an independent owner's representative.
- Shifting all responsibility for project delivery and quality to the shipyard.

The suggested improvements by the Technical Panel to three leading practices WSF currently uses:

- Timely completion and effective use of lessons learned activities.
- Strengthen financial management of construction contracts.
- Improve use of design-build contracting method.

STATE OF WASHINGTON

December 27, 2012

The Honorable Brian Sonntag
Washington State Auditor
3200 Capital Boulevard
P.O. Box 40021
Olympia, WA 98504-0021

Dear Auditor Sonntag:

Thank you for the opportunity to respond to the State Auditor's (SAO) Performance Audit on *Washington State Ferries: Opportunities to Reduce Vessel Construction Costs*. We reviewed the report and have provided our formal response below.

The Washington State Department of Transportation (WSDOT) appreciates the State Auditor's work. WSDOT continually seeks to improve its effectiveness in delivering projects and programs of the highest quality in a timely and fiscally responsible manner, thus we attached importance to a review to help ensure we provide the taxpayers the highest possible return of value.

We appreciate the report's acknowledgement that WSDOT's Ferries Division has made much progress in its vessel construction program since the Jumbo Mark II class ferries were built in the late 1990's. The State Auditor included the Jumbo Mark IIs and other vessels built as long ago as 1993 to increase the sample size in their analysis. However, it is important for the reader to know that including vessels built in the 1990s in the audit impacts the Auditor's analysis, given the number of changes in regulations over vessel design and construction, as well as changes in the economic environment that impact cost in ways that were not sufficiently addressed in the Auditor's analysis.

We also appreciate that the report reflects that Ferries employs 13 of the 15 leading practices for vessel construction, developed during the audit. This is significant, since the industry has not seen suggested "leading practices" compiled like this in one document before. As WSDOT moves ahead in building the new Olympic class ferries, it is employing lessons learned from building the Kwa-di Tabil class ferries, which is also recognized in the report.

WSDOT continuously reviews its processes to ensure that each tax dollar is wisely spent, so we appreciate recommendations to further enhance its ferry construction program. However, it is

important to understand that given all the factors that influence vessel construction costs, and that significant cost drivers were not consistently addressed in the Auditor's analysis, the audit cannot conclude, or reasonably estimate, how much could be saved by implementing the recommendations. Some additional context on vessel costs follows.

Total Cost of Vessels

The Auditor's report compared the total costs of 39 vessels purchased in the U.S. over the past 20 years, which includes six vessels purchased by Washington State Ferries. The Auditor used 2011 dollars for its total cost comparison; however, this is only a starting point for the analysis. Any comparison of the construction costs of different vessels must consider regional wage differences, regulatory factors, and the cost of a state-certified apprentice program, as well as differences in vessel design and size. All of these factors can have a significant impact on costs. The Auditor's total cost comparisons don't attempt to account for the impact on competition for bids by shipyards and resulting cost from the state's requirements to build state ferries in Washington and for the shipyard to have a state-approved apprenticeship program. These cost comparisons also do not take into account changes in vessel design standards over the years or different design standards based on size of vessels in their audit. Further, total cost comparisons do not address the differences in wage rates nationally, where shipyard labor in Washington is markedly higher than the southern part of the United States where some of the non-WSDOT vessels were built. We explain further the impact of some of the regulatory, design, and economic factors below.

In addition, the total cost comparisons did not take into account that some of the 33 vessels in the comparison could literally be placed on one of WSDOT's ferries and transported across the Puget Sound, given that they are small passenger-only ferries built of aluminum. The Department wants to ensure the comparisons are viewed with these factors in mind and the extremely wide range of vessel sizes included in the Auditor's sample. A small passenger-only ferry weighing 200,000 pounds vs. a 10 million pound Jumbo Mark II ferry does not yield a meaningful comparison.

Vessel Cost Adjusted for Cost Drivers

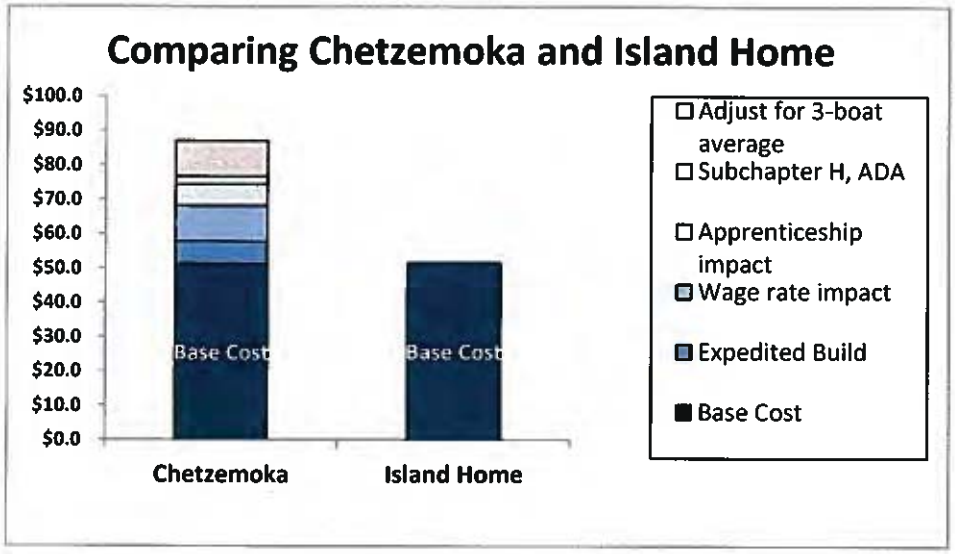
The Audit Report is misleading when it states that Washington State Ferries paid more even when accounting for ferry design characteristics. As stated above, there are many more factors affecting the cost of a vessel than design characteristics. We were not provided a complete set of the data used by SAO in their cost analyses, including a list of all the vessels and vessel characteristics to which the Department's vessels costs were compared. While the Department's response to the statistical analysis is limited, we do appreciate the information on cost analyses the Auditor shared with us and the discussions as we reviewed the draft report. Factors that impacted the Auditor's cost comparisons are addressed below regarding points on the cost to build the Kwa-di Tabil class ferries.

As acknowledged in the audit, laws passed to stimulate the state economy, provide jobs, maintain the supply of skilled workers, and ensure shipbuilder trade training through the required state certified apprentice program contributed to increased WSDOT ferry construction costs. Further, when WSDOT builds a ferry, it is built to provide a sixty-year service life. Building for this life expectancy does increase initial costs; however, when costs are spread over the vessel's service life they are lower than vessels built to an industry standard for most commercial or naval vessels of twenty to thirty years.

As the Auditor began this performance audit, WSDOT informed the audit staff of several crucial factors that influenced the costs of building the Kwa-di Tabil class ferries. A major cost driver was the accelerated construction schedule needed to restore service to several communities where service was disrupted by the sudden retirement of the four Steel Electric ferries. In order to meet the accelerated construction schedule, the contactor joined forces with two other shipyards, creating a shipyard consortium, to ensure the vessel could be delivered in the very aggressive timeframe established by WSDOT and the Legislature. This called for extra shifts at the shipyard to keep the vessel on schedule. Thus, the accelerated schedule came at a cost. In addition, it was necessary to begin construction before all of the required design changes were made. These were not frivolous design changes; they included changes necessary for double-ended operation, meeting new U.S. Coast Guard regulations, and conforming the vessel to ADA requirements.

Another element of the State Auditor's analysis was a comparison of the Department's build of the Chetzemoka to the Island Home Ferry built by the Wood's Hole, Martha's Vineyard & Nantucket Steamship Authority in 2007. Both were based on the same basic design. The Chetzemoka cost exceeded that of the Island Home, but when the comparison is adjusted for cost factors not within the Department's control, the costs were almost identical (see Base Cost in the graph below). Those cost factors, as estimated by WSDOT's Ferries Division, included: 1) the adjustments for amounts spent to expedite the construction of the Kwa-di Tabil vessels ($6.5 million); 2) adjusting for the impact of wage rate differences between Washington and the south where the Island Home was built ($10.5 million); 3) the impact of the apprenticeship requirements ($6 million); 4) the adjustment for differences in the regulations between the two builds that influenced costs at the Department ($2.4 million); and 5) use of an average of the cost of the three vessels of the Kwa-di Tabil Class to reflect efficiencies gained in the program to build the three vessels from this class. ($10.3 million). These factors, taken together, amount to more than $35 million, leaving a base cost comparable to the Island Home.

The Honorable Brian Sonntag, State Auditor
Official WSDOT Response to the SAO Report on: *Washington State Ferries: Opportunities to Reduce Vessel Construction Costs*
December 27, 2012



The three-vessel Kwa-di Tabil project was recognized in 2011 by the American Association of State Highway and Transportation Officials in the "Under Budget, Large Project" category. While the Chetzemoka cost more than planned, the other two vessels in the class came in at a significantly lower cost, resulting in an overall project that came in under budget and ahead of schedule.

We would like to thank you and your staff for the work put into this report. We will address your recommendations to make improvements to our program and work with the Legislature, if requested, as they address your recommendations directed toward considering changes to state law.

Sincerely,

Paula J. Hammond, P.E.
Secretary
WA State Department of Transportation

Stan Marshburn
Director
Office of Financial Management

Attachment

cc's on attached

cc: Marty Loesch, Chief of Staff, Office of the Governor
Fred Olson, Deputy Chief of Staff, Office of the Governor
Kari Burrell, Director, Executive Policy Office, Office of the Governor
Jennifer Ziegler, Director of Legislative & External Affairs, Office of the Governor
Steve Reinmuth, Chief of Staff, WSDOT
David Moseley, Assistant Secretary Ferries, WSDOT
George Capacci, Deputy Chief Ferries Construction & Operations, WSDOT
Jean Baker, Deputy Chief Ferries Administration & Finance, WSDOT
Dillon Auyoung, Director Governmental Relations, WSDOT
Steve Pierce, Director Communications, WSDOT
Steve McKerney, Director Internal Audit Office, WSDOT
Wendy Korthuis-Smith, Director, Accountability & Performance, Office of the Governor
Sheri Sawyer, Performance Audit Liaison, Accountability & Performance, Office of the Governor
Ralph Thomas, Director of Communications, OFM
Robin Rettew, Senior Budget Assistant, OFM

OFFICIAL STATE CABINET AGENCY RESPONSE TO THE PERFORMANCE AUDIT ON WASHINGTON STATE FERRIES: OPPORTUNITIES TO REDUCE VESSEL CONSTRUCTION COSTS

DECEMBER 27, 2012

This coordinated management response to the audit report received on December 19, 2012, is provided by the Washington State Department of Transportation and the Office of Financial Management.

RECOMMENDATION 1: We recommend that the Legislature address the regulatory barriers currently in place that limit competition on WSF vessel procurements by:

A. Allowing WSF to use alternative strategies to encourage competition for its ferry procurements when insufficient interest exists or higher-than-expected bids are received from Washington shipyards. One possible strategy to ensure adequate level of competition would be to allow WSF to invite out-of-state shipyards to bid on new vessel construction contracts in these situations.

RESPONSE

WSDOT agrees that exploring alternatives to the Build in Washington Law may result in shipyard competition to build ferries; however, further studies would be needed to determine if any savings resulting from competition, especially competition outside of Washington, would offset the benefits to the state of a stable shipyard workforce and economic benefits of in-state jobs. WSDOT will follow legislative direction regarding possible revisions to the law.

Action Steps and Time Frame

- Is directed to the Washington State Legislature.

B. Undertake a study of the Apprenticeship Act to identify and resolve potential barriers for prospective applicants, in particular shipyards with established apprenticeship training programs.

RESPONSE

WSDOT recognizes the intent of the required state-certified apprentice program, which is to keep a growing and thriving shipbuilding industry in Washington to help ensure the WSDOT ferry fleet can be maintained and operated for its long service life of 60 years. However, what could be explored is whether the industry's own apprentice programs achieve the same results. Revising the apprenticeship requirements would allow for increased competition within Washington, which may result in lower overall construction costs. WSDOT will follow legislative direction regarding possible revisions to the law. If directed by the Legislature, WSDOT will work with the Office of Financial Management and the Washington State Legislature to explore alternatives to the required apprentice program.

Action Steps and Time Frame

- Is directed to the Washington State Legislature

RECOMMENDATION 2: We recommend that WSF continue to improve its vessel construction program by determining whether adopting the leading practices and suggestions for improvement provided in this report would result in program improvement and/or cost savings, and implementing those with the greatest potential for benefit.

A. The four leading practices identified by the Technical Panel as having the greatest potential for cost savings, especially if implemented together:

- Fully adhering to fixed-price contracts for ship design and construction.
- Waiting to start vessel construction until after the design is complete and regulatory approval is obtained.
- Hiring an independent owner's representative with established expectations.
- Shifting greater responsibility for project delivery and quality to the shipyard.

RESPONSE

The report acknowledged that WSDOT's Ferries Division has made much progress in its vessel construction program since the Jumbo Mark II class ferries were built in the late 1990's. The report also states that Ferries employs 13 of the 15 identified leading practices for vessel construction, either fully or partially. As WSDOT moved ahead in the building of the new Olympic class ferries, it employed three of the four recommended practices having the greatest potential for cost savings as lessons learned from the building of the Kwa-di Tabil class ferries (i.e., fixed price contract, construction after design is complete, and greater responsibility to the shipyard). However, we disagree with the recommended practice of using an independent owner's representative.

WSDOT uses a "strong owner" model of project delivery. We don't believe an independent owner's representative provides a proper level of review, oversight, and control of a large and complex project such as construction of one of our ferry vessels. WSDOT's strong owner practices have resulted in on-time and on-budget projects and avoids the additional costs associated with the owner's representative.

The other practice that is stated by the Auditor as one we do not follow is completing design before construction begins. This did happen on the Chetzemoka in the interest of expediting construction. It is not the case for the new Olympic class vessels. Finally, the audit report states that WSDOT estimates it will likely pay $20.6 million more than the initial contract award of $115.3 million for the first Olympic class ferry. This is not the case. The project is halfway finished and change orders have totaled $434,470. The $20.6 million figure is the total contingency budgeted in the project. A portion of the contingency amount is for potential escalation on steel and copper costs. The first change order was actually a reduction for lower material prices.

Action Steps and Time Frame

- WSDOT has implemented the following identified leading practices in the Olympic class construction program:
  - Fully adhere to fixed-price contracts for ship design and construction

- Waiting to start construction until after design is complete and regulatory approval is obtained. As pointed out during the audit, this practice was not employed for the Chetzemoka in light of the expedited construction schedule in order to restore service to communities affected by the retirement of the Steel Electric class ferries.
- Shifting greater responsibility for the project delivery and quality to the shipyard. Again, the Department took a greater than normal responsibility on the Kwa-di Tabil vessels in order to expedite the construction and restore service to those communities affected by the retirement of the Steel Electric class ferries.

WSDOT will further explore the identified leading practices to hire an independent owner's representative with established expectations. This is not a practice employed by WSDOT in the vessel construction program, as well as the highway construction program. Over the past three decades, WSDOT has opted to have a strong owner presence, which has resulted in on-time and on-budget projects. Ongoing.

B. The suggested improvements by the Technical Panel to three leading practices WSF currently uses:
   - Timely completion and effective use of lessons learned activities.
   - Strengthen financial management of construction contracts.
   - Improve use of contracting methods.

RESPONSE

While WSDOT agrees that use of leading practices could lead to strengthened practices, it is not in agreement with how all 3 practices identified were applied by the Technical Panel.

Timely completion and effective use of lessons learned activities: WSDOT has implemented lessons learned from the Jumbo Mark II construction into the Kwa-di Tabil builds and Kwa-di Tabil lessons learned into the Olympic class vessels currently under construction. However, WSDOT will formalize the lessons learned process in place. By implementing lessons learned from the Kwa-di Tabil builds, WSDOT has adopted practices identified by SAO as leading practices. Formalized lesson learned practices will be completed by January 31, 2013.

Strengthen financial management of construction contracts: WSDOT takes exception to how the SAO applied this leading practice to the Kwa-di Tabil vessel construction program. This recommendation is based on the Technical Panel's lack of understanding of the state government appropriations process, which requires that appropriated funds be tracked and reported in comparison to monies allotted. The Technical Panel felt that we were misrepresenting the project cost because the propulsion systems, purchased under separate contracts in prior reporting periods, were not tracked collectively. WSDOT's financial management meets or exceeds all state-required accounting practices and the Kwa-di Tabil vessels included their cost of the propulsion system purchased in the prior reporting period.

Improve use of contracting methods: Again, WSDOT takes exception to how this leading practice was applied, especially for the Chetzemoka vessel construction. The noted exceptions to the practice resulted from the need to expedite the Chetzemoka vessel construction and restore service to communities after the sudden retirement of the Steel Electric ferries. Detailed design was complete before construction began on the Olympic class ferries. The report also questioned a decision to hire another shipyard to perform final outfitting, which was done to expedite the

construction schedule. This actually resulted in reduced expenditures, as the bid for outfitting resulted in a lower contract than that of the primary contractors.

Action Steps and Time Frame

- WSDOT will continue to use and explore ways to improve upon the identified leading practices. Ongoing.

State Auditor's Office response to Washington State Ferries letter

For this audit, we gathered information on 39 ferries built by eight ferry purchasers within the United States to make our cost comparisons. In its response, the Department raised concerns that our comparisons did not adequately account for the differences between those ferries. As described below, our audit did take into account all the differences that had a strong impact on costs:

- **Our statistical model accounts for 95 percent of the differences in total costs.**

  It's important to note that the "WSF as the purchaser" factor in the statistical model served as a proxy for all those cost drivers that are unique to WSF building ferries, including labor rates in Washington, the Build in Washington laws, and the application of Apprenticeship Act requirements. Although we were not able to determine specific additional cost amounts attributable to those factors, we do explain how the Build in Washington and apprenticeship requirements drive up WSF's construction costs in the report.

  Our statistical analysis (detailed in Appendix B of the report) estimates the additional cost paid by WSF while controlling for differences in design characteristics that are significant cost drivers, such as vessel weight and passenger and vehicle capacity. Our understanding of the factors that affect construction cost was based on our interviews with WSF staff, visits to other ferry purchasers, shipyards that build ferries, and input from the members of our technical panel.

- **To account for 20 years of changes in labor and material costs** that could affect the final price of a new ferry, we also adjusted the cost figures for all 39 ferries to 2011 dollars using the U.S. Bureau of Labor Statistics, Producer Price Index for Non-Military Shipbuilding and Repair. This index is based on actual labor and material costs in the industry across the country over time.

- **Comparing similar ferries.** To help demonstrate the differences in price between similar ferries, we compared the cost to build WSF's *Chetzemoka* ferry with the cost to build the Woods Hole, Martha's Vineyard & Nantucket Steamship Authority's *Island Home*. These vessels are comparable because the design of the *Chetzemoka* is based on the design of the *Island Home*, and both were first vessels built from their designs. Both our audit and the Department's response point out that the *Chetzemoka* was unique, given the need to replace the retired Steel Electric class vessels as quickly as possible.

  However, the Department's cost comparison used the average construction costs for the three Washington ferries built in this class, rather than directly comparing the cost of the two first-built vessels, which we believe to be more appropriate. While we agree with factors cited by WSF to explain the reasons why the *Chetzemoka* cost more, we do not agree with the assumptions they used to calculate the specific cost impact of those factors.

We believe our work was appropriately conducted and fully supports the findings, conclusions, and recommendations presented in the report. In addition, for this particular project, an added layer of assurance was provided by the five members of our maritime industry technical panel. These experts were involved throughout the audit process and advised us on our audit methodology, the interpretation of the audit results, the soundness of our findings and conclusions, and the development of our recommendations. The members of the technical panel reviewed the final draft of the report and concurred with all it contained.

We would like to thank Washington State Ferries and the Washington State Department of Transportation for their full cooperation during this audit.

Appendix A: Initiative 900

Initiative 900, approved by Washington voters in 2005 and enacted into state law in 2006, authorized the State Auditor's Office to conduct independent, comprehensive performance audits of state and local governments.

Specifically, the law directs the Auditor's Office to "review and analyze the economy, efficiency, and effectiveness of the policies, management, fiscal affairs, and operations of state and local governments, agencies, programs, and accounts." Performance audits are to be conducted according to U.S. General Accountability Office government auditing standards.

In addition, the law identifies nine elements that are to be considered within the scope of each performance audit. The State Auditor's Office evaluates the relevance of all nine elements to each audit. The table below indicates which elements are addressed in the audit. Specific issues are discussed in the Results and Recommendations section of this report.

I-900 Element	Addressed in the audit
1. Identification of cost savings	**Yes.** The audit identified key cost drivers in constructing ferries and where implementing leading practices could improve the performance in developing and managing WSF ferry construction contracts ultimately resulting in potential cost savings.
2. Identification of services that can be reduced or eliminated	**No.** The purpose of this audit focused on identifying the cost of constructing ferries and improving the performance of the Ferry Construction Program, not on reducing or eliminating services.
3. Identification of programs or services that can be transferred to the private sector	**No.** The purpose of this audit focused on identifying the cost of constructing ferries and improving the performance of the Ferry Construction Program, not on outsourcing to the private sector.
4. Analysis of gaps or overlaps in programs or services and recommendations to correct gaps or overlaps	**No.** The purpose of this audit focused on identifying the cost of constructing ferries and improving the performance of the Ferry Construction Program, not on gaps or overlaps in programs or services.
5. Feasibility of pooling information technology systems within the department	**No.** The purpose of this audit focused on identifying the cost of constructing ferries and improving the performance of the Ferry Construction Program, not on pooling information systems.
6. Analysis of the roles and functions of the department, and recommendations to change or eliminate departmental roles or functions	**Yes.** The audit identified key personnel and their roles and responsibilities in the Ferry Construction Program and determined where improvements could be made in the program based upon leading industry practices.
7. Recommendations for statutory or regulatory changes that may be necessary for the department to properly carry out its functions	**Yes.** The audit identified how certain statutory requirements are limiting competition within the state of Washington.
8. Analysis of departmental performance, data performance measures, and self-assessment systems	**Yes.** The audit identified how the agency is monitoring the performance of their ferry construction contracts.
9. Identification of best practices	**Yes.** The audit identified leading practices in the construction industry to improve the performance of the Ferry Construction Program.

Appendix B: Scope & Methodology

Overall approach relies on multiple methodologies

We applied six different methodological approaches to address the audit objectives: cost analysis, multivariate statistical analysis, assessment of the regulatory environment related to new ferry construction, gap analysis to assess WSF's use of leading practices, case studies, and input from a technical panel of experts. Using several different methods of data collection and analysis increases the validity of the audit results.

Methodologies used to address audit objectives

Project objective	Methodologies		
1) How do the construction costs of WSF's ferries compare with those of comparable ferries built elsewhere?	Cost analysis	Case studies	Panel of experts
2) What factors affect the cost of constructing ferries, and to what extent do those factors impact total construction spending?	· Multivariate statistical analysis · Assess regulatory environment		
3) Does WSF use leading practices to develop, manage and monitor its ferry construction contracts?	Gap analysis to assess WSF use of leading practices		

How we selected ferry purchasers to interview for this study

Using national databases of ferries and their purchasers compiled by the U.S. Army Corps of Engineers and U.S. Department of Transportation, we identified a list of ferry purchasers for this study based on three criteria.

- First, to ensure that purchase information was more likely to be available, we selected ferry operators who had built a ferry since 1991. Setting a scope of 20 years, instead of 10, increased the efficiency of data collection as well as the likelihood that we would collect data on more than one ferry with each purchaser visit.
- Second, we looked for purchasers who had built at least one ferry over 100 gross tons, to ensure that the study included other large passenger ferries. Purchasers of large ferries were included in this study because WSF officials said that their ferries are relatively larger than other passenger ferries operated in the U.S.
- Third, we looked for purchasers who had used a shipyard in Washington to compare the costs and experiences of WSF to other purchasers.

Fourteen purchasers met preliminary criteria. Five were eliminated, either because they were unlikely to have adequate records or had bought only one ferry. Of those invited to participate in the study, one declined to be interviewed, leaving eight purchasers in the final group.

- Alaska Marine Highway System
- North Carolina Department of Transportation
- Pierce County Public Works and Utilities
- San Francisco Water Emergency Transportation Authority
- Staten Island Ferries
- Texas Department of Transportation
- Washington State Ferries
- Woods Hole, Martha's Vineyard & Nantucket Steamship Authority

We used structured data collection guides to obtain cost data, as well as information about the rules and regulations governing the purchasing, contracting, construction management, and regulatory environment under which the new ferries were bought. Our data collection efforts resulted in a set of 39 ferries built by eight purchasers.

In addition, BC Ferries, a Canadian ferry operator, participated in this review by sharing information about their recent vessel replacement program activities. We did not collect construction data from them because their ferries were purchased and constructed outside the U.S., under different rules and regulations.

Our definition of total cost

For this study, we considered total construction cost as all expenditures by the purchaser for designing, building, and outfitting a new passenger ferry, including but not limited to the shipyard construction contract. **Figure A.1** shows the types of expenses by phase of the project; some types of costs appear in more than one phase, such as labor, materials, construction related services, overhead, and contingencies as charged to the purchaser for the design, construction and delivery of ferries. The technical panel reviewed these cost elements.

Figure A.1 – Typical elements of a project to purchase a new ferry, by project phase

Design	Construction	Other
Research and development	Construction management, including change orders	Owner furnished equipment
Preliminary engineering	Shipyard contract	Litigation support and legal fees
Architectural services	Inspections	Risk contingencies
Technical specifications	Final outfitting	Project management
Licensing agreements	Insurance	Cost management
Regulatory approval	Vessel financing and bonding	
Operations study and needs assessment		

We adjusted costs to constant 2011 dollars

We used a cost adjustment factor from the U.S. Department of Labor's Bureau of Labor Statistics for the shipbuilding industry to adjust our financial information in our analysis to 2011 dollars. The Bureau of Labor Statistics' Producer Price Index (PPI) program measures the average change over time in the selling prices received by domestic producers for their output. We used the PPI for the Ship building and Repair, Non Military Self-Propeller Ships, New Construction series to adjust the cost data for each ferry, based on the year it was built.

How we performed the cost analysis

We wanted to compare the acquisition costs of WSF to other ferry purchasers, and also between different classes of WSF ferries. Following the cost adjustment, we performed the following cost analyses:

- Comparing total construction costs between WSF and other ferry purchasers.
- Comparing the construction cost per pound of the lightship weight for steel-hulled ferries purchased by WSF and by other ferry operators.
- Comparing the construction cost per pound of lightship weight for steel-hulled ferries by length of anticipated service life
- Comparing two ferries with comparable designs; in this case, WSF's costs to build the *Chetzemoka* with the cost to the Steamship Authority to build the *Island Home*.

Comparing total construction costs between purchasers

After comparing the total construction costs for each of the 39 ferries, we ranked them from most to least expensive. To determine if one purchaser had paid more than another for their ferries, we conducted a test of statistical significance comparing the averages of each ferry purchaser with the average of all other purchasers in the dataset. A 95 percent level of statistical significance was used to determine if there is a difference in average total costs.

Comparing cost per pound between purchasers

We divided the total cost by the lightship weight (in pounds) to calculate the cost per pound paid by the purchaser for each ferry. We then compared the results for WSF ferries with those of other operators, using a statistical test for comparison of means. To identify trends, we then compared the construction cost per pound and total construction cost for each of the ferries purchased by WSF. We only included cost per pound in the report for the *Chetzemoka* and *Island Home* comparison.

Evaluating the life cycle costs of WSF's ferries was outside the scope of our audit

A life cycle cost estimate is the total one-time and recurring expenses incurred over the life span of the ferry, including the purchase price and the costs of maintenance and operations. WSF has estimated the life cycle cost for their six most recently completed ferries and the two Olympic class boats currently under construction.

However, because we were unable to collect the same data from the other ferry purchasers in our study, we could not reach a conclusion about whether paying more to design and build a ferry reduces life cycle costs.

How we performed the multivariate statistical analysis

To identify the factors that influence total construction costs, we performed a multivariate weighted least squares regression analysis using a software application called the Statistical Package for Social Sciences (SPSS), using construction costs and other data collected from ferry purchasers.

How we identified primary cost drivers

We relied on information from multiple sources to develop a list of the factors that affect the cost to construct a new ferry. We asked participants to tell us what in their view contributed to the cost of purchasing a new ferry, including WSF officials, the seven other ferry operators, the Technical Panel, shipyards, and the Passenger Vessel Association; we also collected data from them. For proprietary reasons, we did not systematically collect data on shipyard labor rates.

All factors that we could quantify and measure for their influence on total costs were included in the analysis. The technical panel provided input on these factors, for example recommending the use of lightship weight to calculate one of our analyses. For factors that could not be quantified for inclusion in the statistical analysis, the leading practices assessment reviewed their impact on cost. As shown in **Figure A.2**, on the next page, we analyzed 22 potential factors to determine the extent of each factor's influence on total construction costs and whether the level of influence was statistically significant.

Figure A.2: Factors included in the multivariate analysis		
Vessel characteristics	**Operating environment**	**Purchasing characteristics**
Purchaser	Operating environment (purchaser described)	Shipyard located in WA
Lightship weight (pounds)	Route time (+/- 30 minutes)	Number of vessels in contract
Passenger capacity		Days to delivery (contract award to delivery acceptance)
Vehicle capacity		Federal funding received
Hull material type		Dollar amount of change orders
Horsepower		Provided owner-furnished equipment (any)
Double-ended		Vessel construction classed
Anticipated service life		Outsourced project management
Passenger amenities (basic vs. comfort or above)		Number of bids received
Food service amenities (none or self-service vs. staffed)		
Subchapter certification under CFR		

Before we began our analysis, we evaluated the relationship of each potential cost factor to total cost to identify those factors that would likely be drivers of total cost. Factors that have a strong direct relationship with total cost are likely to be significant drivers of total cost. We also assessed the relationship between the cost factors to identify potential issues of multicollinearity, where a strong relationship among the cost factors could diminish the effect of another cost driver on total cost.

The primary purpose of the analysis was to assess what effect the purchaser had on ferry costs while accounting for differences in vessel designs, operating environments, and characteristics of the purchase, such as where the ferry was built. In addition we wanted to identify those factors that drive total cost. Due to multicollinearity, primarily among the design characteristics, and a relatively small dataset of 39 vessels, precise estimates of the effects were difficult to obtain. For example, the 95% confidence interval of the effect of WSF as purchaser ranged from $7.5 million to $42.2 million per ferry. We ran multiple iterations of the model assessing the effects of multicollinearity and settled on those factors suggested by purchasers and our technical panel that had the most robust results. The final results of the weighted least squares regression are shown in Figure A.3 on the next page.

We first ran the statistical analysis to determine if differences in vessel design characteristics most closely correlated with total cost explained all of the differences in total cost among the purchasers. This analysis also included the purchaser-described operating environment and shipyard location, which WSF had identified as cost drivers. The analysis found that differences in the design characteristics and these two factors explained most, but did not account for all, of the differences among WSF and the other purchasers in the total cost.

We next ran the analysis including the remainder of the characteristics of the operating environment and purchasing characteristics, to determine if any of the other operating environment or purchasing characteristics would account for the difference in cost between WSF and the other purchasers. None of these characteristics fully explained the difference in cost among WSF and other purchasers. In addition we ran separate models comparing each purchaser to all other purchasers.

Figure A.3 – Regression results to identify significant drivers of the total cost to acquire a new ferry

Characteristics	Coding	Coefficient	*	Lower bound	Upper bound
Model intercept	–	-$20,284,534.02		-$43,581,193.33	$3,012,125.29
WSF is the purchaser	WSF=1 Other=0	$24,854,363.66	*	$7,540,523.07	$42,168,204.25
Shipyard in WA	WA=1 Other=0	-$20,312,762.95	*	-$31,737,813.32	-$8,887,712.59
Steel hull	Steel=1 Aluminum=0	-$69,685,985.88	*	-$103,886,820.92	-$35,485,150.84
Double ended	Double=1 Single=0	$35,735,928.85	*	$7,492,405.47	$63,979,452.24
Passenger capacity	–	$13,997.14	*	$7,617.10	$20,377.18
Vehicle capacity	–	$151,284.24		-$23,184.63	$325,753.11
Lightship weight pounds	–	$9.96	*	$6.60	$13.31
Anticipated service life	–	$1,564,984.46	*	$796,124.98	$2,333,843.95
Horsepower (hp)	–	$595.02		-$157.04	$1,347.08
Federal safety regulations	Subchp. H=1 Other=0	-$27,560,050.38	*	-$38,767,652.04	-$16,352,448.73
Operates in lakes, bays, or sounds	LBS=1 Other=0	-$3,609,879.17		-$8,826,132.24	$1,606,373.90
Amenities: passenger spaces	Comfort=1 Basic=0	$26,279,513.65	*	$16,103,753.41	$36,455,273.89
Amenities: food service	Staffed=1 Self-serve=0	$27,282,681.76	*	$9,912,023.77	$44,653,339.74

Notes
The regression coefficient (the effect) applies to the category coded 1. For example, steel-hulled ships cost $69.7 million less than aluminum-hulled ships when accounting for other design factors.
Adjusted R-Square = 0.95
95% confidence interval for lower and upper bounds.
*Cost factor statistically significant at p<0.05.

Based on this analysis, we concluded that WSF paid more than most other purchasers for their new ferries. Our final model estimates that WSF paid between $7.5 million and $42.2 million more per ferry. WSF was not the only purchaser to pay more for a new ferry compared to other purchasers: two other purchasers also paid more compared to other purchasers.

As expected, our analysis found that design characteristics related to the overall ferry size and weight had the greatest effect on total costs when accounting for other factors. Ferries with aluminum hulls, double-ended designs, and heavier weight all increased costs. Additional factors that increased costs when accounting for other factors included: longer expected service life, greater passenger capacity, and more comfortable passenger areas and staffed food service.

Two factors acted to decrease total costs when accounting for the other factors. When controlling for design characteristics and WSF as purchaser, ferries built in Washington were less expensive, as were ferries built to Subchapter H safety regulations compared to vessels built under subchapters T or K.

The regression coefficient for Subchapter H is affected by multicollinearity with other design characteristics, primarily light ship weight, and is questionable. Safety regulations address, among other things, adequate capacity to carry the required number of crew, provision of ample lifesaving equipment, and structural protection from fire while in operation – all requirements that increase costs. A separate regression predicting

cost per pound (that is, total costs divided by light ship weight) indicated that Subchapter H regulations increased costs. We retained the Subchapter H standard in the model because, logically, it is important and because it had little impact on the effect of the WSF as purchaser variable.

Multicollinearity among the design characteristics affected the statistical significance of some of the characteristics, for example, vehicle capacity. Lightship weight, passenger and vehicle capacity, horsepower, and hull material are correlated because larger ferries weigh more, carry more cars and passengers, and tend to have steel hulls. We kept these important design characteristics in the model, despite lack of statistical significance. The multicollinearity among the design characteristics had little impact on the coefficient of WSF as purchaser. The WSF as purchaser effect remained strong, positive, and statistically significant in our diagnostic tests of the effects of multicollinearity.

We could not assess the impact of the regulatory environment on WSF's cost to acquire new ferries with the statistical analysis. Because WSF has not built a ferry outside of Washington in the last 20 years, we could not compare costs of WSF ferries built in Washington with those that were not. As a result, we assessed the impact of the regulatory environment separately from the statistical analysis.

Assessing the impact of the regulatory environment on cost, competition, and the economy

We assessed the impact of certain regulations on the cost to design and build a new ferry, in particular how the regulations affect shipyard competition for new ferry construction contracts. Increased competition is believed to reduce the price of a construction contract. We discussed the regulatory environment – in particular, the Build in Washington requirements and the Apprenticeship Act – with WSF officials, as well as three local shipyards and the Passenger Vessel Association.

Finally, the Office of Financial Management (OFM) used data from WSF in its own 2002 Input-Output Model to estimate the economic impact of constructing two ferries in Washington at a proposed total ship-building cost of $150 million. The model captures the so-called "ripple effect" of a project's direct spending on the wider state economy. With help from experts in the industry, we compiled a construction schedule that simulated an actual two-year ship-building project that was conducted in Washington. This analysis assumed the whole project period to be fiscal years 2012-2014. We used the results of this economic analysis to evaluate how much Washington's shipbuilding industry depends on new ferry purchases by WSF.

How we used case studies to illustrate differences and lessons learned

A case study is an intensive examination of a specific individual or decision and typically combines data collection methods such as reviewing written documents, interviews, questionnaires, and observations. A case study comparison highlights the differences, and reasons for the differences, between two or more individual events or decisions. We completed three case study comparisons and one case study, which are presented in various sections of the report.

The first case study comparison illustrates cost differences between two ferries built using comparable designs. We compared total construction costs and cost per pound between WSF's *Chetzemoka* and the Steamship Authority's *Island Home*. We wanted to find out what prompted any substantial cost differences between the two ferries. We interviewed WSF and Steamship Authority officials and reviewed earlier reports on the *Island Home* prepared by the Cedar River Group, which provided information on its technical specifications. This case study is presented in the cost analysis section of the report.

The second case study comparison examined the differences between two purchasers in Washington. Both WSF's *Chetzemoka* and Pierce County's *Steiliacoom II* were built in Washington and operate in Puget Sound. This case study illustrates the impact on competition when two ferries designed for the same operating environment are built under similar (although not identical) regulatory requirements. The results are presented in the discussion of the apprenticeship requirement in the report.

The third case study comparison examines changes in WSF's practices during the acquisition of the Jumbo Mark II, Kwa-di Tabil, and Olympic classes of ferries. The changes in practices and their effect on cost are identified in the leading practices section of the report.

We also completed a case study to illustrate lessons learned from BC Ferries, to see how its construction program differed from WSF's. BC Ferries participated in this review by sharing information about their recent vessel replacement program activities. This Canadian ferry operator had a history of cost overruns on its construction projects in the 1990s. We prepared the case study to contrast WSF's construction program model with the program administered by BC Ferries; the results are presented at the end of the leading practices section.

Assessment of leading practices used by WSF

To determine the extent that WSF uses leading practices, we identified leading practices in five areas: (1) procurement/contracting, (2) ferry design, (3) construction and project management, (4) project delivery and close out activities, and (5) project financial management. We initially identified leading practices from information gathered from the Technical Panel, the Passenger Vessel Association, relevant literature and reports, shipyards, and ferry purchasers. As **Figure A.4** (on the following page) shows, we selected 15 practices for further review that could potentially impact a ferry purchaser's ability to deliver a vessel on time and on budget.

To determine the extent that WSF employed each leading practice, we interviewed executive management, project managers, naval architects, contracting officials, and finance officials, and analyzed available WSF financial reports, contracts, project management reports, and other documents. Our interviews and analysis focused on WSF's three most recently constructed classes of ferries: the Jumbo Mark II, the Kwa-di Tabil and the Olympic. We discussed WSF's procurement and contracting activities with the Attorney General's office and three shipyards. With one of those yards, we also discussed construction and project management activities. We analyzed all the information we gathered to identify gaps in leading practices or leading practices that were not effectively implemented.

The technical panel assessed our analysis and provided feedback, offering recommendations aimed at enhancing the effectiveness of WSF's vessel construction program.

Finally, we assessed WSF's ability to deliver ferries on budget. For this analysis, we compared differences between the contract award for ferry construction and the actual costs incurred to date based on financial and other data provided by WSF.

Figure A.4 – 15 Leading practices reviewed at WSF

Category	Leading practice	Description
Procurement & contracting	Contracting method	Use of Design Build, or Construction Manager General Contractor, or Construction Manager at Risk
	Ongoing support	Requirements for providing operational training, and standard operating procedures including spare parts.
	Proprietary rights	Secures right to own final actual design for future reuse.
Design	Design management	Design is nearly or 100% complete and approved by regulatory agencies before construction starts
	Owner requirements	Owner describes in detail specific needs and preferences to ensure project expectations are met.
Project & construction management	Data management tools	Project charter should be delivered outlining the purpose, goals and expected outcomes of the project.
		Project plan should be developed outlined timelines, personnel/vendor roles and responsibilities, expected duration of the project and updated throughout the project.
	Risk management	Defined responsibility and established processes to resolve issues in timely manner to reduce risk of jeopardizing production schedule
Project delivery	Change order management	Formal change management process in place, including policy for establishing criteria for approving changes.
		Use of steering committee to review and approve change
		Use of independent owner representative to recommend approval/denial of change order.
	Project quality	Owner places all responsibility on contractor to deliver project quality.
Project closure	Lessons learned	Stakeholders discuss positive and negatives of project execution and makes appropriate adjustment for subsequent projects. Formal activities are held to gather knowledge.
Financial management	Detailed and accurate budget	Project should be thoroughly analyzed by budget staff to ensure that all costs are appropriately estimated and that inflation is accurately accounted for in the budget process.
	Market analysis	Monitor market conditions (external factors) that could affect budget from initiation through the life of the project.

How we selected the technical panel of experts

Purpose of the panel

We convened a panel of five maritime industry experts, from various fields of the passenger ferry construction industry, to provide technical and subject matter expertise on areas affecting ferry construction, from procurement and contracting to project close-out. The technical panel provided advisory services at key stages of the audit including data collection, analysis, and reporting. Panel members reviewed and discussed our audit approach and results, and evaluated the opportunities, constraints, and trade-offs of making certain changes to WSF's current ferry construction policies and practices.

Selection of the technical panel

The development of the technical panel began with identifying the fields of expertise needed to evaluate passenger ferry vessel construction costs and practices. These fields include:

Naval architecture	Naval architects design the new vessels.
Maritime regulation	Federal maritime agencies ensure the safety of passengers through the administration of federal maritime regulations.
Vessel contracting and maritime law	Purchasers must contract with shipyards to construct the new vessels with the assistance of experts in contracting and maritime law.
Shipbuilding	Highly specialized shipyards that manage the laborers, acquire the materials and build to the pertinent regulatory standards to construct the new vessels.

We contacted professional organizations representing these fields and asked them to help identify appropriate and available experts to participate on the Technical Panel. If an expert could be identified from the organization's website, we contacted that person first. We also selected panel members who were independent of WSF. For example, experts who had already made public statements regarding the debates surrounding the Build in Washington Law, or who had worked directly for WSF or the Washington State Legislature, were not asked to serve on the panel.

We contacted these associations:

- Naval architecture: Society of Naval Architects and Marine Engineers
- Maritime regulation: USCG and USDOT/Maritime Administration
- Vessel contracting and maritime law: U.S. Maritime Law Association and American Bar Association
- Shipbuilding: Shipbuilders Council of America and the Pacific Coast Shipbuilders Association

We contacted the people each organization recommended, and returned for additional suggestions if the nominated individual did not wish to participate. Potential panelists had to be willing and available to participate in all three scheduled symposia.

The resulting technical panel's five members belong to the following organizations:

- Society of Naval Architects and Marine Engineers
- USDOT/Maritime Administration
- U.S. Maritime Law Association
- American Bar Association
- Pacific Coast Shipbuilders Association

Panel symposia

The technical panel met three times. Each meeting of the technical panel was professionally facilitated by FLT Consulting to ensure that the objectives of each symposium were achieved.

The first one-day symposium was held by teleconference in March 2012. The agenda included reviewing the audit's plan of project work, identifying leading procurement and construction practices, and identifying factors that influence the cost to construct a new ferry. The second one-day symposium, in July 2012, included a tour of WSF's facilities. Panelists were given an opportunity to review and comment on our analysis of construction cost data and to evaluate WSF's contracting and construction management practices. During the third one-day symposium, in September 2012, panelists were able to review the draft of this report, including the draft recommendations, and provide feedback. The panel helped develop strategies that could improve WSF's new vessel construction plan.

The technical panel also reviewed the preliminary draft report. We incorporated their comments and suggestions into the final report, which they also reviewed.

Appendix C: Washington State Ferries Fleet

WSF fleet characteristics

Class	Ship name	Where built	Year		Dimensions		Vehicle capacity	Passenger capacity	Displacement in long tons
			built	rebuilt	length	beam			
Jumbo Mark II	Tacoma	Seattle, WA	1997		460'2"	90'0"	202	2500	6184
	Wenatchee	Seattle, WA	1998		460'2"	90'0"	202	2500	6184
	Puyallup	Seattle, WA	1999		460'2"	90'0"	202	2500	6184
Jumbo	Spokane	Seattle, WA	1972	2004	440'0"	87'0"	188	2000	4859
	Walla Walla	Seattle, WA	1973	2005	44'0"	87'0"	188	2000	4860
Super	Hyak	San Diego, CA	1967		382'2"	73'2"	144	2000	3634
	Kaleetan	San Diego, CA	1967	2005	382'2"	73'2"	144	2000	3634
	Yakima	San Diego, CA	1967	2005	382'2"	73'2"	144	2000	3634
	Elwha	San Diego, CA	1967	1991	382'2"	73'2"	144	1221 SOLAS	3978
Issaquah	Issaquah	Seattle, WA	1979	1989	328'0"	78'8"	124	1200	3310
	Kitsap	Seattle, WA	1980	1992	328'0"	78'8"	124	1200	3310
	Kittias	Seattle, WA	1980	1990	328'0"	78'8"	124	1200	3310
	Cahlamet	Seattle, WA	1981	1993	328'0"	78'8"	124	1200	3310
	Chelan	Seattle, WA	1981	2005	328'0"	78'8"	124	1090 SOLAS	3405
	Sealth	Seattle, WA	1982		328'0"	78'8"	90	1200	3310
Evergreen State	Evergreen State	Seattle, WA	1954	1988	310'0"	73'0"	87	983	2350
	Klahowya	Seattle, WA	1958	1995	310'2"	73'2"	87	800	2413
	Tillikum	Seattle, WA	1959	1994	310'2"	73'2"	87	1200	2413
Kwa-di Tabil	Chetzemoka	Seattle, WA	2010		273'8"	64'0"	64	750	1515*
	Salish	Seattle, WA	2011		273'8"	64'0"	64	750	1515*
	Kennewick	Seattle, WA	2012		273'8"	64'0"	64	750	1515*
Hiyu	Hiyu	Portland, OR	1967		162'0"	63'1"	34	200	621

Notes

* In the Fleet Guide, the source of the ferry characteristics presented in this Appendix, WSF incorrectly reported the approximate lightship weight and not the displacement for the Kwa-di Tabil ferry class. We did not verify the accuracy of the other characteristics.

Long Ton = 2240 lbs. SOLAS is the Safety of Life at Sea Convention.

Source: Washington State Department of Transportation, WSDOT Ferries Division Fleet Guide.

Washington State Ferries Fleet

Jumbo Mark II

Puyallup | Tacoma | Wenatchee

Jumbo Class

Spokane | Walla Walla

Super Class

Elwha | Hyak | Kaleetan | Yakima

Olympic Class

Tokitae

estimated delivery: spring 2014

Samish

estimated delivery: early 2015

Evergreen State

Evergreen State | Klahowya | Tillikum

Issaquah Class

Cathlamet | Chelan | Issaquah | Kitsap
Kittitas | Sealth

Kwa-di Tabil Class

Chetzemoka | Kennewick | Salish

Rhododendron

Retired

Hiyu

These silhouettes show the relative sizes of ferries in WSF's current fleet compared to the Jumbo Mark II, the largest vessel in the fleet.

Source: http://www.wsdot.wa.gov/ferries/vesselwatch/Vessels.aspx

Appendix D: Build in Washington Requirements

The Build in Washington law is not a single statue but a series of requirements placed on the construction of new classes of ferries. A series of laws has applied the Build in Washington requirement to the three classes of WSF's ferries built since 1990: Jumbo Mark II, Kwa-di Tabil and Olympic classes.

This appendix provides the relevant laws for each ferry class.

Jumbo Mark II Class

RCW 47.60.772 Jumbo ferry construction – Bidding documents

The department shall send to any firm that requests it bidding documents specifying the criteria for the jumbo ferry vessels. The bid documents shall include, but not be limited to, the following information: [. . .]

(8) A requirement that the vessels be constructed within the boundaries of the state of Washington except that equipment furnished by the state and components, products, and systems that are standard manufactured items are not subject to the in-state requirement under this subsection. For the purposes of this section, "constructed" means: The fabrication, by the joining together by welding or fastening of all steel parts from which the total vessel is constructed, including, but not limited to, all shell frames, longitudinals, bulkheads, webs, piping runs, wire ways, and ducting. "Constructed" also means the installation of all components and systems, including, but not limited to, equipment and machinery, castings, electrical, electronics, deck covering, lining, paint and joiner work, required by the contract. "Constructed" also means the interconnection of all equipment, machinery, and services, such as piping, wiring, and ducting; [. . .]

[1993 c 493 § 2.]

NOTE: This code was repealed in 2010. See Chapter 283 of the Washington Laws, 2010 [Engrossed Substitute House Bill 3209]

Kwa-di Tabil Class

RCW 47.56.780 New ferry vessel construction for service on routes that require a vessel that carries no more than one hundred motor vehicles — how constructed — warranty work.

(1) The department shall construct one or more new ferry vessels for service on routes that require a vessel that carries no more than one hundred motor vehicles. The department shall include in the procurement of the new vessels a requirement that the vessels be constructed within the boundaries of the state of Washington, except that equipment furnished by the state and components, products, and systems that are standard manufactured items are not subject to the in-state requirement under this subsection.

(2) For purposes of this section, "constructed" means: The fabrication, by the joining together by welding or fastening, of all steel parts from which the total vessel is constructed including, but not limited to, all shell frames, longitudinals, bulkheads, webs, piping runs, wire ways, and ducting. "Constructed" also means (a) the installation of all components and systems including, but not limited to, equipment and machinery, castings, electrical, electronics, deck covering, lining, paint, and joiner work required by the contract and (b) the interconnection of all equipment, machinery, and services, such as piping, wiring, and ducting.

(3) The procurement of the new ferry vessels must also include a requirement that all warranty work on the vessels be performed within the boundaries of the state of Washington, insofar as practicable.

[2008 c 4 § 2.]

Olympic Class

RCW 47.60.810 Design-build ferries- Authorized – Phases defined.

(1) The department may purchase new auto ferries through use of a modified request for proposals process whereby the prevailing shipbuilder and the department engage in a design and build partnership for the design and construction of the auto ferries. The process consists of the three phases described in subsection (2) of this section.

(2) The definitions in this subsection apply throughout RCW 47.60.812 through 47.60.822.

a) "Phase one" means the evaluation and selection of proposers to participate in development of technical proposals in phase two.

b) "Phase two" means the preparation of technical proposals by the selected proposers in consultation with the department.

c) "Phase three" means the submittal and evaluation of bids, the award of the contract to the successful proposer, and the design and construction of the auto ferries.

[2001 c 226 § 4.]

RCW 47.60.814 Design-build ferries — issuance of request for proposals.

Subject to legislative appropriation for the procurement of vessels, the department shall issue a request for proposals to interested parties that must include, at least, the following: [. . .]

(17) A requirement that the vessels be constructed within the boundaries of the state of Washington except that equipment furnished by the state and components, products, and systems that are standard manufactured items are not subject to the in-state requirement under this subsection. For the purposes of this subsection, "constructed" means the fabrication, by the joining together by welding or fastening of all steel parts from which the total vessel is constructed, including, but not limited to, all shell frames, longitudinals, bulkheads, webs, piping runs, wire ways, and ducting. "Constructed" also means the installation of all components and systems, including, but not limited to, equipment and machinery, castings, electrical, electronics, deck covering, lining, paint, and joiner work required by the contract. "Constructed" also means the interconnection of all equipment, machinery, and services, such as piping, wiring, and ducting; [. . .]

[2001 c 226 § 6.]

Appendix E: State Apprenticeship Program Requirements for Public Works

State law requires all public works contracts, including WSF contracts, estimated to cost $2 million or more to include a requirement that no less than 15 percent of the total labor hours on the contract be performed by registered apprentices. The following sections of state law (RCW 39.04.300 through 34.04.320) state the apprenticeship program requirements for public works contracts that apply to WSF's contracts.

A separate section of state law, RCW 49.04.010 through 49.04.910, gives the Director of Labor and Industries responsibility for apprenticeship within the state for federal purposes, and directs the Director to establish an Apprenticeship Council. The Council is authorized to approve apprenticeship programs and establish standards for the program.

RCW 39.04.300 Apprenticeship training programs — purpose.

A well-trained construction trades workforce is critical to the ability of the state of Washington to construct public works. Studies of the state's workforce highlight population trends that, without a concerted effort to offset them, will lead to an inadequate supply of skilled workers in the construction industry. State government regularly constructs public works. The efficient and economical construction of public works projects will be harmed if there is not an ample supply of trained construction workers. Apprenticeship training programs are particularly effective in providing training and experience to individuals seeking to enter or advance in the workforce. By providing for apprenticeship utilization on public works projects, state government can create opportunities for training and experience that will help assure that a trained workforce will be available, including returning veterans, in sufficient numbers in the future for the construction of public works. Furthermore, the state of Washington hereby establishes its intent to assist returning veterans through programs such as the "helmets to hardhats" program, which is administered by the center for military recruitment, assessment, and veterans employment. It is the state's intent to assist returning veterans with apprenticeship placement career opportunities, in order to expedite the transition from military service to the construction workforce.

[2006 c 321 § 1; 2005 c 3 § 1.]

RCW 39.04.320 Apprenticeship training programs — public works contracts — adjustment of specific projects — report and collection of agency data — apprenticeship utilization advisory committee created.

(1)(a) Except as provided in (b) through (d) of this subsection, from January 1, 2005, and thereafter, for all public works estimated to cost one million dollars or more, all specifications shall require that no less than fifteen percent of the labor hours be performed by apprentices.

(b)(i) This section does not apply to contracts advertised for bid before July 1, 2007, for any public works by the department of transportation.

(ii) For contracts advertised for bid on or after July 1, 2007, and before July 1, 2008, for all public works by the department of transportation estimated to cost five million dollars or more, all specifications shall require that no less than ten percent of the labor hours be performed by apprentices.

(iii) For contracts advertised for bid on or after July 1, 2008, and before July 1, 2009, for all public works by the department of transportation estimated to cost three million dollars or more, all specifications shall require that no less than twelve percent of the labor hours be performed by apprentices.

(iv) For contracts advertised for bid on or after July 1, 2009, for all public works by the department of transportation estimated to cost two million dollars or more, all specifications shall require that no less than fifteen percent of the labor hours be performed by apprentices.

(c)(i) This section does not apply to contracts advertised for bid before January 1, 2008, for any public works by a school district, or to any project funded in whole or in part by bond issues approved before July 1, 2007.

(ii) For contracts advertised for bid on or after January 1, 2008, for all public works by a school district estimated to cost three million dollars or more, all specifications shall require that no less than ten percent of the labor hours be performed by apprentices.

(iii) For contracts advertised for bid on or after January 1, 2009, for all public works by a school district estimated to cost two million dollars or more, all specifications shall require that no less than twelve percent of the labor hours be performed by apprentices.

(iv) For contracts advertised for bid on or after January 1, 2010, for all public works by a school district estimated to cost one million dollars or more, all specifications shall require that no less than fifteen percent of the labor hours be performed by apprentices.

(d)(i) For contracts advertised for bid on or after January 1, 2010, for all public works by a four-year institution of higher education estimated to cost three million dollars or more, all specifications must require that no less than ten percent of the labor hours be performed by apprentices.

(ii) For contracts advertised for bid on or after January 1, 2011, for all public works by a four-year institution of higher education estimated to cost two million dollars or more, all specifications must require that no less than twelve percent of the labor hours be performed by apprentices.

(iii) For contracts advertised for bid on or after January 1, 2012, for all public works by a four-year institution of higher education estimated to cost one million dollars or more, all specifications must require that no less than fifteen percent of the labor hours be performed by apprentices.

(2) Awarding entities may adjust the requirements of this section for a specific project for the following reasons:

(a) The demonstrated lack of availability of apprentices in specific geographic areas;

(b) A disproportionately high ratio of material costs to labor hours, which does not make feasible the required minimum levels of apprentice participation;

(c) Participating contractors have demonstrated a good faith effort to comply with the requirements of RCW 39.04.300 and 39.04.310 and this section; or

(d) Other criteria the awarding entity deems appropriate, which are subject to review by the office of the governor.

(3) The secretary of the department of transportation shall adjust the requirements of this section for a specific project for the following reasons:

(a) The demonstrated lack of availability of apprentices in specific geographic areas; or

(b) A disproportionately high ratio of material costs to labor hours, which does not make feasible the required minimum levels of apprentice participation.

(4) This section applies to public works contracts awarded by the state, to public works contracts awarded by school districts, and to public works contracts awarded by state four-year institutions of higher education. However, this section does not apply to contracts awarded by state agencies headed by a separately elected public official.

(5)(a) The *department of general administration must provide information and technical assistance to affected agencies and collect the following data from affected agencies for each project covered by this section:

(i) The name of each apprentice and apprentice registration number;

(ii) The name of each project;

(iii) The dollar value of each project;

(iv) The date of the contractor's notice to proceed;

(v) The number of apprentices and labor hours worked by them, categorized by trade or craft;

(vi) The number of journey level workers and labor hours worked by them, categorized by trade or craft; and

(vii) The number, type, and rationale for the exceptions granted under subsection (2) of this section.

(b) The department of labor and industries shall assist the *department of general administration in providing information and technical assistance.

(6) The secretary of transportation shall establish an apprenticeship utilization advisory committee, which shall include statewide geographic representation and consist of equal numbers of representatives of contractors and labor. The committee must include at least one member representing contractor businesses with less than thirty-five employees. The advisory committee shall meet regularly with the secretary of transportation to discuss implementation of this section by the department of transportation, including development of the process to be used to adjust the requirements of this section for a specific project. The committee shall provide a report to the legislature by January 1, 2008, on the effects of the apprentice labor requirement on transportation projects and on the availability of apprentice labor and programs statewide.

(7) At the request of the senate labor, commerce, research and development committee, the house of representatives commerce and labor committee, or their successor committees, and the governor, the *department of general administration and the department of labor and industries shall compile and summarize the agency data and provide a joint report to both committees. The report shall include recommendations on modifications or improvements to the apprentice utilization program and information on skill shortages in each trade or craft.

Notes:

*Reviser's note: The "department of general administration" was renamed the "department of enterprise services" by 2011 1st sp.s. c 43 § 107.

Rules -- Implementation -- 2009 c 197: "The Washington state apprenticeship and training council shall adopt rules necessary to implement sections 2 and 3 of this act. Rules shall address due process protections for all parties and shall strengthen the accountability for apprenticeship committees approved under chapter 49.04 RCW in enforcing the apprenticeship program standards adopted by the council." [2009 c 197 § 4.]

Effective date -- 2005 c 3: See note following RCW 39.04.300.

[2009 c 197 § 1; 2007 c 437 § 2; 2006 c 321 § 2; 2005 c 3 § 3.]

Appendix F: Glossary

Term	Definition
Breadth	Distance from one side of the ferry to the other side at its widest point.
Change order	The purchaser's written order directing the contactor to make a change in the baseline contract work
Class	Ferries that have similar characteristics such as size or design.
Ferry	A boat or ship used to carry primarily passengers, vehicles, and cargo across a body of water.
Ferry design	A diagram of what the ferry will look like depending on the length of the route, the passenger or vehicle capacity required, speed requirements and the water conditions the craft must deal with.
Ferry terminal	A dock that is specifically built to receive ferries.
Hull	The basic frame or body of a vessel that includes the bottom, sides and decks, but excludes machinery, masts, equipment, etc.
Keel	The keel is the large beam around which the hull of a ship is built. Laying the keel is considered the first step in construction.
Length	Hull length is measured from the point of the bow to the transom measured distance from end to end
Life cycle costs	The full costs from initiation to retirement of a ferry. It includes the purchase price and the costs of maintenance and operations.
Lightship weight	The lightship weight is the weight of a vessel when complete and ready for service, including liquids in machinery systems, but excluding crew, passengers and vehicles, fuel and other consumables, and provisions.
Outfitting	All gear and equipment to be installed on the ferry, such as furniture, lighting, seating, and interior decoration.
Pilot house	A deckhouse for a ship's helmsman containing the steering wheel, compass, and navigating equipment. Also called the wheelhouse.
Propeller	A device with a central hub and surrounding blades, connected to the motor, which moves a vessel through the water.
Propulsion system	The motor system, including engines, that provides the driving force of the ferry.
Transom	The transom is the surface that forms the stern of a vessel.
Vessel operating environment	Characteristics of the route traveled by the ferry, such as number of sailings to be made, route length, anticipated speed required to complete the route, the conditions of the water to be travelled on, gallons of fuel consumed, and the number of passengers and vehicles to be transported.
Vessel ramp	Allows vehicles and cargo to be easily rolled on or off of a ferry without having to use a crane.

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MCG Subject Matter Advisor

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Ferry purchasers interviewed during this audit

- Alaska Marine Highway System
- BC Ferries
- North Carolina Department of Transportation
- Pierce County Public Works and Utilities
- San Francisco Water Emergency Transportation Authority
- Staten Island Ferries
- Texas Department of Transportation
- Woods Hole, Martha's Vineyard & Nantucket Steamship Authority

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