FREIGHT EFFICIENCY & COMPETITIVENESS PHASE I

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FREIGHT EFFICIENCY & COMPETITIVENESS PHASE I

FINAL REPORT

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16. ABSTRACT

The Freight Efficiency and Competitiveness Study provides a comprehensive look at the freight delivery supply chain of major industries in the Central Puget Sound region. The study pinpoints areas of inefficiency in the freight delivery system and provides data to support the creation of a strategic investment plan for Washington State's freight transportation system.

The report is organized into four sections,

1. Introduction and Executive Summary;
2. Overview of Target Supply Chains;
3. Issues, Constraints and Potential Remedies Based on Freight Interviews;
4. Constraints, Opportunities and Recommendations.

The research and analysis for this project included in depth interviews with key freight personnel in Washington State, industry research, and market analysis. These methods allowed a better understanding of the freight and supply chain issues of each industry. From this, the study was able to identify and quantify bottlenecks and deficiencies in the existing transportation system.

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SECTION 1
INTRODUCTION AND EXECUTIVE SUMMARY

INTRODUCTION

The purpose of the Freight Efficiency and Competitiveness Study is to provide a comprehensive look at the freight delivery supply chain of major manufacturing industries in the Central Puget Sound region. The goal of the study is to pinpoint areas of inefficiency in the freight transfer system and to provide data to support a strategic plan for Washington State's freight transportation system.

This requires a thorough understanding of *who* is using the freight system, *what* things they value most in a delivery system, and *where* the largest inefficiencies in the system exist. In order to gather this information, this study followed an industry outreach process that focused on three major manufacturing supply chains in the Central Puget Sound region: building and construction, processed foods, and aerospace.

This report is organized into four sections, of which this chapter is the first. The chapters include:

1. **Introduction and Executive Summary:** Outlines the key findings, and conclusions of the study.

2. **Overview of Target Supply Chain Sectors:** Introduces the three study industries, their role in the regional economy, and their relationship to study goals.

3. **Issues, Constraints, and Potential Remedies Based on Freight Interviews:** Synthesizes the outreach process and information gained through the process.

4. **Specific Constraints, Opportunities, and Recommendations:** Recommends specific actions that WSDOT and potential partners can pursue.

SUMMARY OF FINDINGS

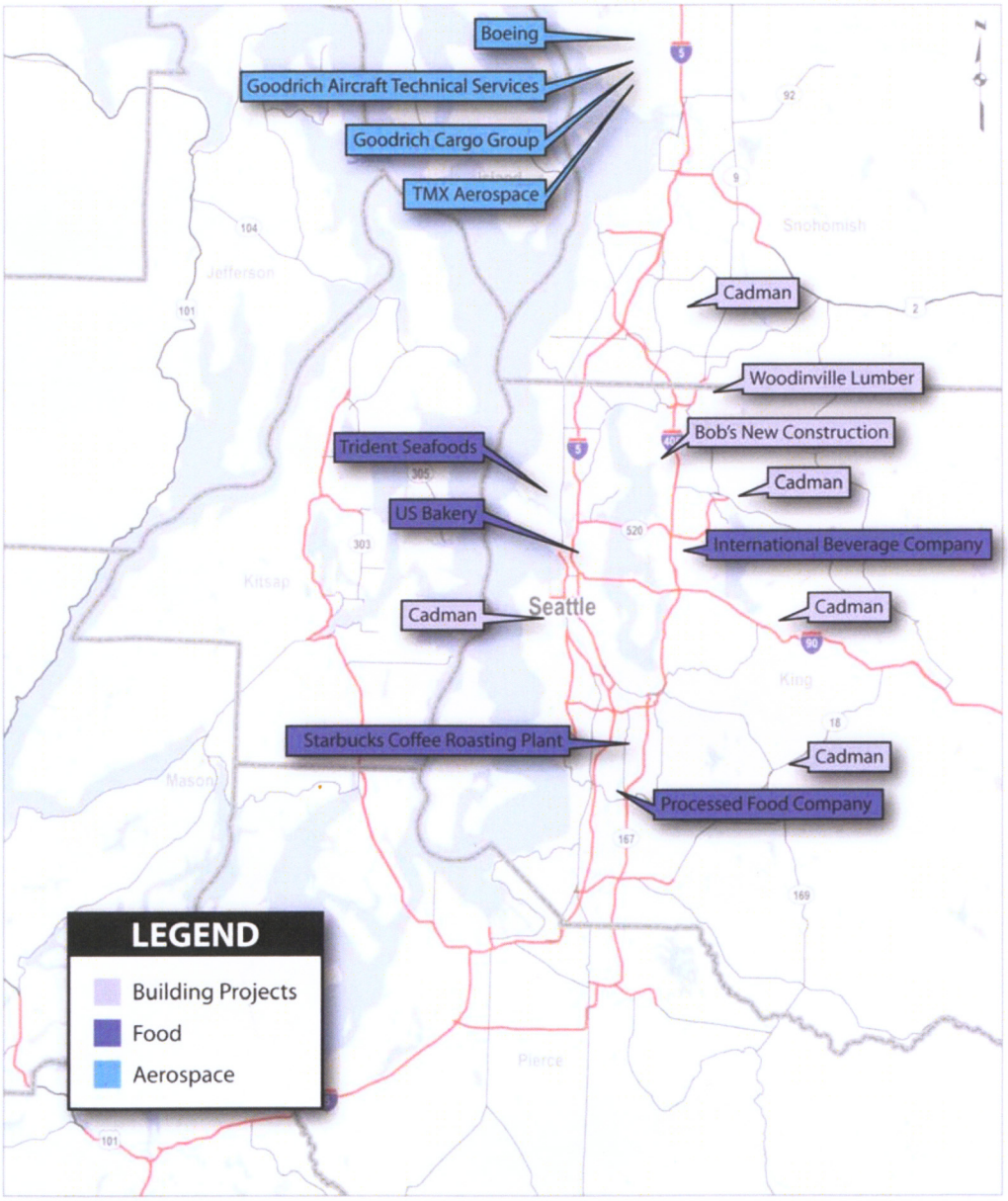
Exhibit 1 shows the name and location of the businesses that were interviewed for this study, as well their respective industrial sector. This map also shows the major highways that these businesses reported using most in their everyday business activities. Detailed interview summaries are provided for each business in the Appendix.

The following key findings are discussed in detail in the main body of the report. In general terms, they include the following insights:

- Most of the Puget Sound regions' industrial activity is located in the area from Seattle south to Pierce County, with concentrations in the Green River Valley (the region which includes the cities of Kent, Auburn, Renton, Tukwila, and parts of Sumner in Pierce County).

Exhibit 1
Manufacturing Locations of Companies Interviewed

WSDOT FREIGHT EFFICIENCY + COMPETITIVENESS, PHASE 1



Source: Stakeholder Interviews 2006

MANUFACTURING LOCATIONS OF COMPANIES INTERVIEWED
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- Freight-intensive operations (industrial and warehouse) development is growing further to the south, with most of the growth occurring from Tacoma south to Lewis County.
- Trucks are the most relied-upon mode for local and regional shipping needs.
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- Trucks are the most relied-upon mode for local and regional shipping needs.
- Every company in the Puget Sound Region is dependent on the same highway network, with several sections being relied on by almost every industry.
    - I-5 from Everett in the north to Lewis County in the south
    - I-405 through Bellevue
    - SR 167 – at the I-405 interchange and at the I-5 & Port of Tacoma interchange
    - I-90 over Snoqualmie Pass
- Businesses have had to adapt to local congestion in similar ways:
    - Adding satellite distribution locations to shorten trips in the region.
    - Investing in additional trucks and hiring additional drivers to deliver proportionately less volume. One company indicated that their transportation fleet has doubled in the last few years, despite volume growth of only 20 percent.
    - Investing in new technologies, routing, GPS, mapping and/or communication devices to counteract traffic-related issues and delays.
    - Adding inventory to compensate for unreliable transportation system. Five of the businesses interviewed have increased inventories by 5 to 20 percent to compensate for transportation inefficiencies.
    - Making operational changes, such as extending operating hours, paying overtime, using alternative delivery modes, staging delivery vehicles at driver/employee homes, pre-palletizing/consolidation of loads to reduce driver dwell time, early carrier arrival to ensure on-time pick-up/delivery, pre-staging/pre-loading trucks, and redundant scheduling.
    - Accessing the WSDOT traffic web site to assist in routing trucks.
- There is little to no redundancy in the primary regional freight corridors.
- There is a constant shortage of qualified truck drivers in the Puget Sound region.
- It is difficult to access local ports due to congestion at the port gates.
- Growth in the urban areas has resulted in increased parking restrictions and reduction of truck staging and maneuvering facilities.
- Certain policy issues inhibit and negatively affect freight movements: flatbed trucks cannot use HOV lanes, noise restrictions prevent extending delivery times to many construction sites, restrictions and permit requirements imposed by the City of Seattle limit construction traffic to off-peak hours, and design standards for trucking corridors vary widely between governmental agencies.

Recommended Actions

The conclusions of this report are meant to help direct freight finance and planning decisions during future Washington State Department of Transportation strategic plans. To this end, it was deemed most useful to divide recommendations into two categories, "Priority" and "Other." Within these two categories, they are further divided into operational improvements, capital improvements, and policy recommendations.

PRIORITY ACTIONS

The manufacturing industry in the Central Puget Sound region would benefit most from the following high priority actions to improve freight movement. These recommendations are based on the findings of the targeted industry surveys and the technical expertise of the consulting team. The projects are directed at improving mobility for the industrial and manufacturing businesses located within the Central Puget Sound region. Two of the actions listed below are operational measures that can be implemented in the short-term. The others are longer-term capital improvements.

1. Expand WSDOT's Web-based traffic flow map to provide better traffic flow information and camera coverage in the urban area as well as to expand the network beyond the current limits. Some of these locations are already in the capital budget, including:
   - I-5 between Federal Way and Tacoma
   - SR 516 between I-5 and SR 167

   Other locations are recommended, including:
   - I-5 south to Lewis County (and perhaps through Centralia)
   - I-5 north of Everett through Skagit County (includes remaining two-lane section in Mount Vernon in preparation for additional congestion that could occur in 2010 for the Vancouver Olympics)
   - SR 167 south of Auburn
   - I-90 between Issaquah and North Bend
   - SR 18 (adding cameras)
   - SR 169 near I-405

2. Increase incident response along major freight corridors, and expand hours to include midday. Major corridors include:
   - I-5 from Seattle to Lakewood
   - SR 167 from Renton to Puyallup
   - SR 599 from 1st Avenue S. Bridge to I-5
   - I-90 from Seattle to Issaquah

   Some of these are already in the capital budget, including:
   - Funding for one additional patrol in the south end of I-405 during peak traffic congestion (including the SR 167 interchange)
   - Funding for two additional patrols during peak traffic congestion on Highway 18 and in south King County

3. Complete missing links on major freight routes to improve connectivity and reliability for freight. The highest priority freight routes to improve the reliability for Central Puget Sound manufacturing are:
   - SR 167 from I-5 to SR 161, with a direct connection between SR 167 and I-5. The extension was proposed to be funded in past iterations of the Regional Transportation Investment District (RTID); however, the interchange with I-5 was not funded. In order for this project to serve regional freight needs between the

customers and manufacturing centers, a connection between I-5 and SR 167 is needed.

- SR 509 from S. 188th Street to I-5. This project was proposed to be funded in past iterations of the RTID. This project will benefit freight by creating a parallel route to I-5 that connects from Seattle's Duwamish Industrial Area to the Kent Valley. In addition to relieving congestion on this critical section of I-5, the SR 509 project will also provide an alternate route to improve the reliability of the entire system.

4. Increase capacity along major freight routes. These include:
    - I-5 from Mercer Street to the Boeing Access Road. Capacity increases may be possible by improving the ramp weave-merge section between the West Seattle Freeway and I-90 and by reconfiguring ramp access to and from downtown Seattle. There is no concept or funding for potential improvements in this section.
    - SR 167 from I-405 to Sumner. HOV and ramp improvements are proposed as part of the SR 167 Corridor project. Partial funding for this project has been provided by the "Nickel Account," with the remaining funds proposed in past iterations of the RTID.

OTHER FREIGHT PROJECTS

There are many other projects that would enhance freight mobility for industrial and manufacturing businesses in the State of Washington. The list below is also based on the targeted industrial sector surveys. These are listed below by type of project: Operational, Infrastructure, and Policy.

Operational

1. Reduce disincentives to delivering at night (from 7:00 P.M. to 7:00 A.M.) to relieve daytime congestion on the roadways and improve efficiency of delivery.

2. Consider incentive programs, such as PierPass in Los Angeles/Long Beach, that would shift Port truck traffic to nighttime hours.

3. Allow trucks to bypass ramp meters at locations with high truck volumes and steep grades or short merge lengths.

Infrastructure

4. Replace failing infrastructure that, if lost, would dramatically affect capacity on the major freight routes of I-5 and I-405. This includes replacing the Alaskan Way Viaduct and SR 520 Bridge. Funding for these projects is expected to be from a mix of local, state, and federal funding options.

5. Improve I-90 to reduce weather-related closures and increase capacity over Snoqualmie Summit. This project has been funded out of the 2005 Transportation Partnership Account.

6. Complete planned major truck linkages to the Port of Seattle and Port of Tacoma. Specific projects include:
    - SR 519 Phase 2
    - Spokane Street Viaduct Project (widening and ramp improvements are currently unfunded)
    - East Marginal Way Grade-Separation Project (funded)
    - Lincoln Avenue Grade-Separation Project (partially funded, currently in design)
    - Port of Tacoma Road Interchange Improvements (being considered as part of I-5 mainline improvements through Fife.)
7. Increase capacity on I-5 from Fife to Fort Lewis. A portion of the project–from Port of Tacoma Road to Pacific Avenue in Tacoma–is proposed as part of an "Add HOV Lanes" project, which received partial funding from the 2005 Transportation Partnership Account and was fully funded in past iterations of the RTID proposal. A separate project being constructed as part of the I-5/SR 16 interchange improvements would extend the HOV lanes to SR 16. An extension further south is not yet funded.

8. If additional HOT lane or other managed lane programs are implemented, infrastructure improvements such as direct access ramps that would improve truck access into the lanes should be considered.

Policy

9. Establish state-wide standards for regional trucking corridors (e.g., lane widths, turning radii, etc.) and prevent local municipalities from superseding state-defined standards.

10. Create a direct funding stream for improvements to arterial truck routes that provide access to I-5, I-405, SR 167, SR 99, and SR 18. This funding mechanism could use the existing State's Freight and Goods Transportation System (FGTS) Classifications for "T-1" and "T-2" routes.

11. Update FGTS route maps on an annual basis. Ensure continuity in the route classifications between jurisdictions. Updates could be performed as part of regional Metropolitan Planning Organization (MPO) 10-year planning processes. These maps are currently updated every two years by the state, but could benefit from a yearly update.

12. Consider reducing tolls (e.g., on Tacoma Narrows Bridge) for trucks that move at night.

13. Increase driver training programs. Work with Homeland Security to increase the pool of drivers eligible to move restricted commodities.

14. Consider programs that would reduce cost to individual driver-owners, such as insurance pools and shared maintenance programs.

The results of this study confirm that the highway network is essential to businesses in this state since the vast majority of goods are moved by truck. Improvements that benefit truck movements will help the Washington State economy.

SECTION 2
OVERVIEW OF TARGET SUPPLY CHAIN SECTORS

INTRODUCTION

This section of the report summarizes the three manufacturing sectors in the Central Puget Sound region whose supply chains are evaluated as part of this study. It introduces the three industries, documents their role in the regional and state economies, and suggests how this information guided the following stages of this study.

SELECTION OF STUDY INDUSTRIES

Since Washington has a rich diversity of industries that generate freight demand, it is important to focus on the dynamics for specific industries that are important to the regional and state economy. Therefore, this study targets three key supply chain segments that offer the best insight into the freight competitiveness and efficiencies of the manufacturing in the Central Puget Sound area.

The selection of these target industries was guided by several factors, including previous studies such as the *Washington Transportation Plan Update: Freight Report 2005* (WTP)[1], consultation with a freight advisory committee, an economic comparison of industries within the Central Puget Sound, and discussions with regional freight experts. The three industries selected for further analysis in this report are:

1) Building and construction
2) Processed Food
3) Aerospace

The following are descriptions of each of the industry sectors.

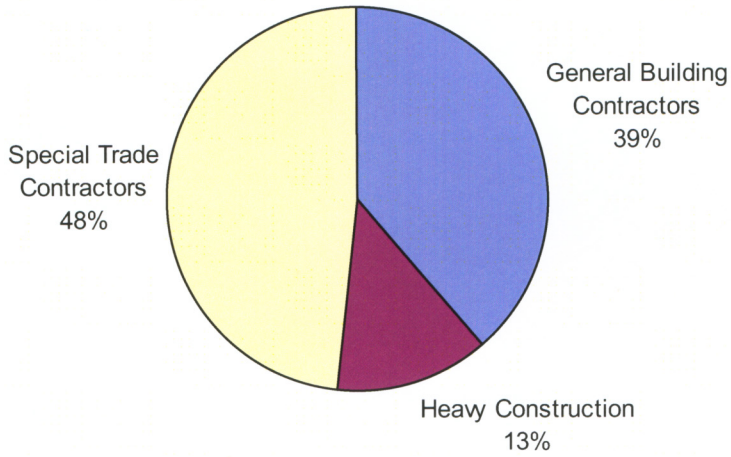
BUILDING AND CONSTRUCTION INDUSTRY

Production Output Value

The building and construction industry is a major industry in Washington State and the Central Puget Sound region. In 2004, statewide construction gross business revenues were roughly $30 billion.[2] As shown in Exhibit 2, these revenues were almost half (48 percent) from special trade contractors (including plumbers and electrical contractors), 39 percent from general building contractors, and 13 percent from heavy construction. A total of $843 million in wood products for construction were exported in 2004, the state's fourth greatest export by value.[3]

[1] http://www.wsdot.wa.gov/freight/images/WTP_FreightUpdate.pdf
[2] Washington State Department of Revenue. *Quarterly Business Review Calendar Year, 2004. Table 1: Total Gross Business Income Statewide by Industry (SIC)*
[3] Washington State Office of Trade and Economic Development

EXHIBIT 2
GROSS INCOME COMPOSITION BY KEY BUILDING AND CONSTRUCTION SECTOR (STATEWIDE): 2004[4]



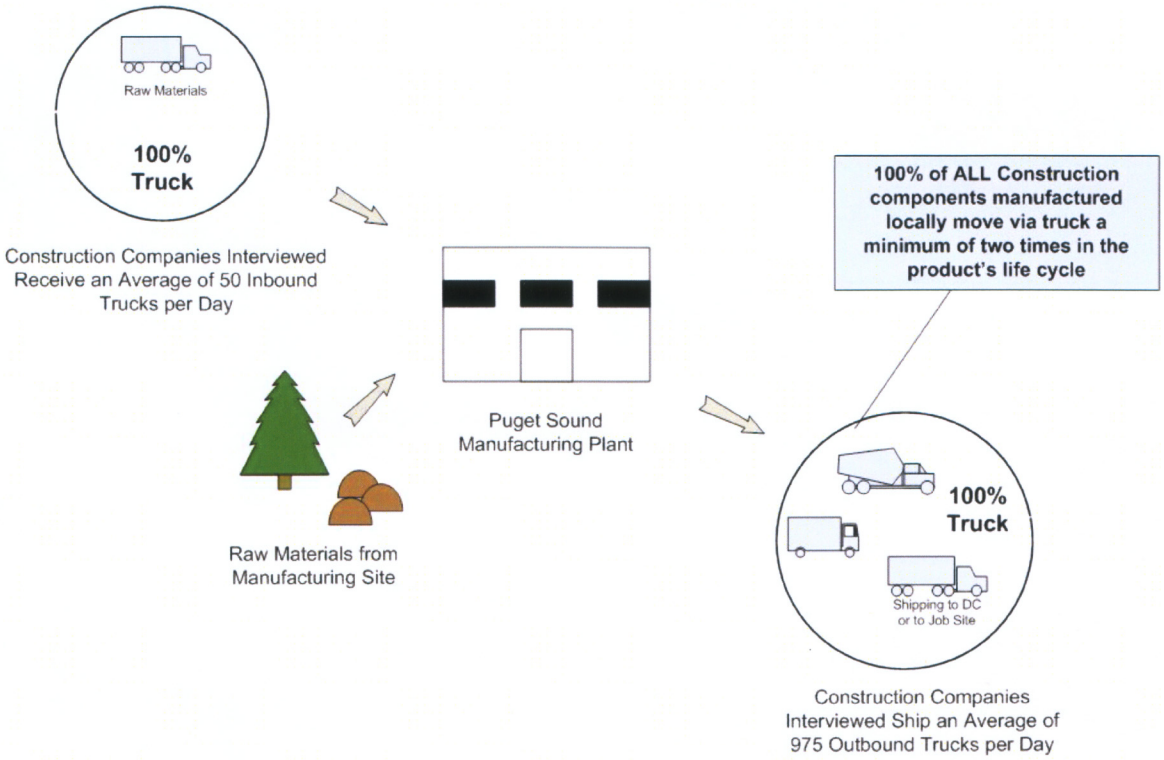
Employment
A combined 88,410 people were employed in the building and construction industry in the Central Puget Sound area in 2004,[5] a number that represents 5.7 percent of total regional employment. Of these, 56,075 were employed as specialty contractors, 22,269 were employed as general contractors, and 10,066 as heavy construction workers. This accounts for some $2.2 billion dollars in wages generated in the Central Puget Sound region alone; $1.6 billion of this was generated by special trade contractors. These estimates do not include employment in the secondary and tertiary industries supported by the construction and building industry.

Summary of the Typical Building and Construction Industry Supply Chain Structure
Most of the construction industry firms surveyed for this study manage or support the construction of large single-family residential housing developments. It included The Quadrant Corporation, along with secondary suppliers for lumber, furnace, and concrete.

Exhibit 3 shows a typical supply chain for a construction-related manufacturing business. Raw materials, such as sand, gravel, or trees, are mined or harvested at mostly rural sites, trucked to a manufacturing facility (mill or plant) and processed with materials such as fly ash or additives which also arrive via truck. After manufacturing or value-added processing, 100 percent of goods are shipped via truck to a distribution facility or construction site.

[4] Washington State Department of Revenue. *Quarterly Business Review Calendar Year, 2004. Table 1: Total Gross Business Income Statewide by Industry (SIC)*
[5] Workforce Explorer, Washington: http://www.workforceexplorer.com/

EXHIBIT 3
SUPPLY CHAIN FLOW DIAGRAM: CONSTRUCTION INDUSTRY



The average number of receipts and shipments per day reflects data provided by the companies interviewed. Concrete is actually the most time-sensitive product shipped by any company that was part of this study, with a useful shelf life of approximately 90 minutes. Traffic congestion and the associated delay can cause an entire load of product to be rendered unusable.

Secondary and Tertiary Suppliers

The Central Puget Sound area, like many growing urban areas, has developed a flourishing construction industry. This can be attributed to factors such as the strong local demand and well-developed local supply of raw materials and manufactured products. The building industry represents supply chains that are domestically and regionally focused, primarily based on the relative abundance of rich natural resources in the Pacific Northwest. This sector provides insight into a supply chain structure that is locally and regionally based. Secondary and tertiary industries have evolved to supply the building and construction industry, including suppliers of concrete, asphalt, wood, and steel. Examples of these secondary and tertiary suppliers are shown in Exhibit 4.

EXHIBIT 4
SAMPLE LISTING OF BUILDING AND CONSTRUCTION INDUSTRY SECONDARY AND TERTIARY SUPPLIERS

Secondary Industries	Products	Tertiary Industries	Products
Window suppliers	Windows, doors, other glass structures	Raw material providers	Glass, special glass
Asphalt	Hot asphaltic concrete materials, including paving, crack sealing, and resurfacing products	Raw material providers	Crude oils, recycled asphalt
Finished wood	Walls, floors, other wooden construction	Raw material providers	Lumber
Cement	Foundations, retaining walls, revetments	Raw material providers	Sand, gravel, crushed stone
Steel products	Structural elements, including platforms, pipes, etc.	Raw material providers	Steel
Electrical systems	Lighting systems and remodeling	Raw material providers	Electrical switches, wiring

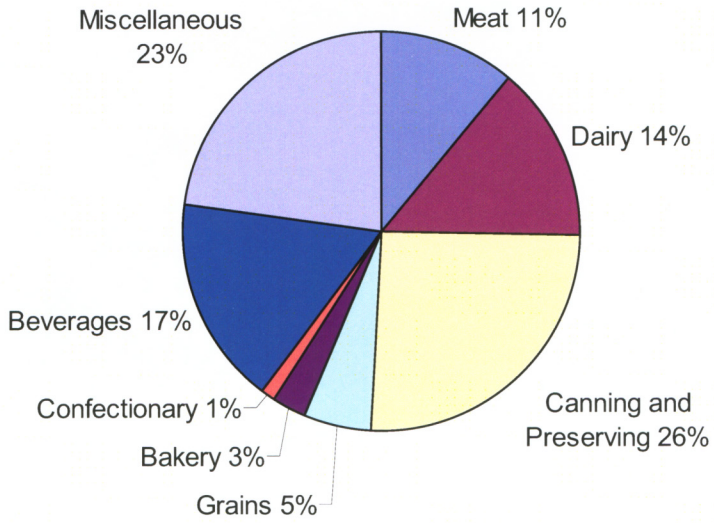
THE PROCESSED FOOD INDUSTRY

Production Output Value

Washington State's food processing sector is the second largest manufacturing industry in the state. Major processed foods exported from Washington State include dairy products, seafood, and bottled beverages. Together, processed foods account for about 11 percent of the total value of the manufacturing output in Washington State, with almost $12 billion in annual revenues in 2004[6]. Exhibit 5 shows the gross business income of the major food processing categories in the state, with canning and preserving, beverages, dairy, and meat as the largest categories at 26 percent, 17 percent, 14 percent, and 11 percent of the respective total gross income share.

[6] Washington State Department of Revenue. *Quarterly Business Review Calendar Year, 2004. Table 1: Total Gross Business Income Statewide by Industry (SIC)*

EXHIBIT 5
PROCESSED FOOD STATEWIDE GROSS INCOME COMPOSITION: 2004[7]



Employment

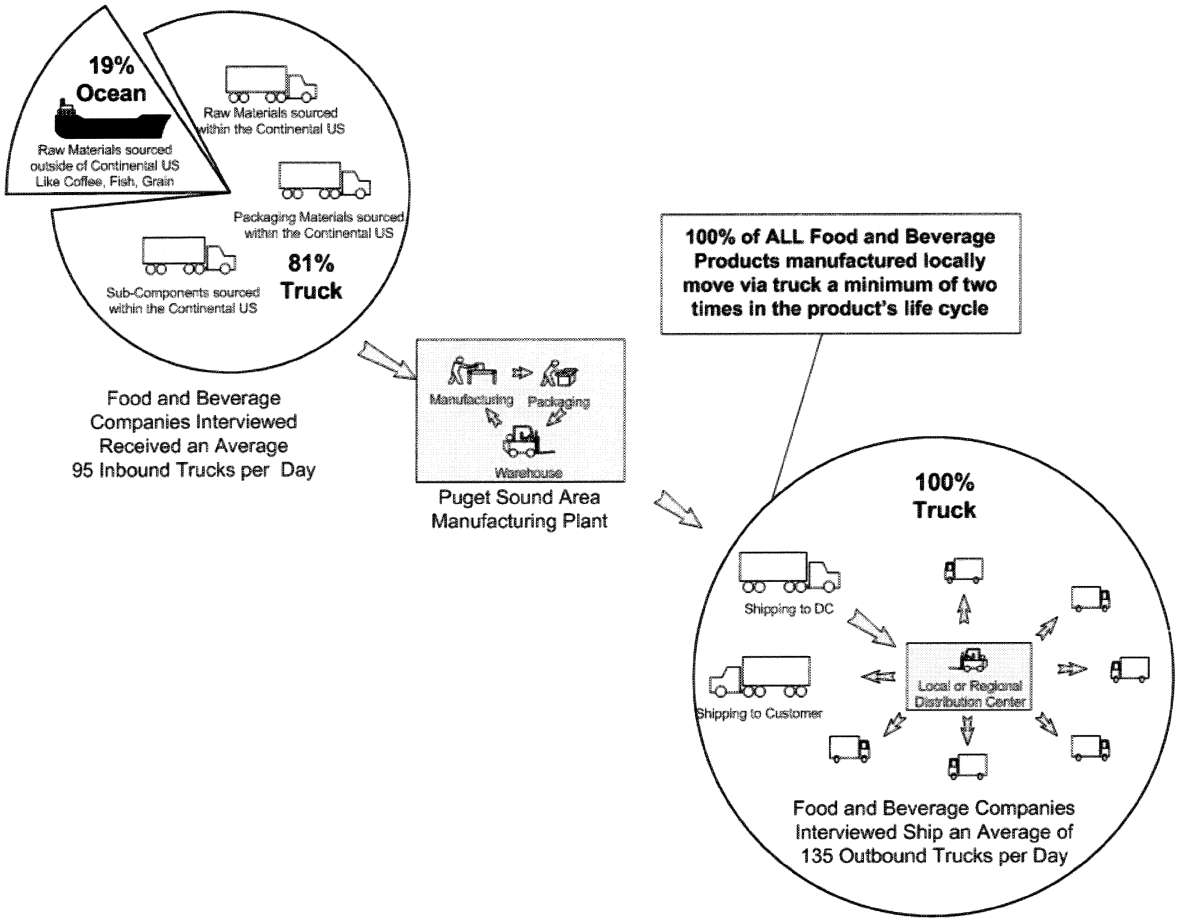
An estimated 40,000 workers[8] are involved in the cleaning, preparation, sterilization, and packaging of beverages and food in Washington State, representing 1.5 percent of all people employed in the state.[9] In the Central Puget Sound region, about 16,000 people are employed in the manufacturing of food and beverages, with a total wage income of about $680 million dollars.[10] These numbers do not include employees working in secondary and tertiary industries that support the processed food industry.

Summary of the Typical Processed Food Supply Chain Structure

Exhibit 6 depicts a typical supply chain in the food and beverage manufacturing industry, as developed from data provided by companies interviewed as part of this study. Food and beverage companies in the Puget Sound region source their materials from local, national, and international suppliers. Most of the goods manufactured in the area are shipped to local destinations, but significant shipments to national and international customers occur on a daily basis.

[7] Washington State Department of Revenue. *Quarterly Business Review Calendar Year, 2004. Table 1: Total Gross Business Income Statewide by Industry (SIC)*
[8] http://www.cityofseattle.net/tda/industry/agriculture.htm
[9] http://stats.bls.gov/eag/eag.wa.htm
[10] http://workforceemployer.com

EXHIBIT 6
SUPPLY CHAIN FLOW DIAGRAM: FOOD INDUSTRY



Items arriving via ocean freight are almost exclusively raw materials, such as coffee, seafood, or grain, sourced from other countries. The majority of the remaining inbound materials are for packaging and come from the immediate area or from within the contiguous United States. This type of inbound freight predominantly moves by truck. Other items arriving by truck include raw materials such as flour, fresh/frozen meat products, sweeteners, syrups, flour, and baking ingredients. Packaging and ingredients are sourced globally, processed and packaged, then distributed to predominantly local markets. Over 85 percent of outbound volume is delivered to customers within the Pacific Northwest.

Secondary and Tertiary Suppliers

The processed food sector provides insight into a supply chain structure that is more regionally and nationally focused, due primarily to the perishable nature of the products. Secondary suppliers to the processed food industry include companies involved in conveying, filling, sealing, cutting, sterilizing, and packaging. They also include companies that supply the raw foods that go into the processed foods, including grains, sugars, meats, etc. Tertiary suppliers

typically produce the materials used by the secondary suppliers, including things such as plastics, metals, glass, refrigeration devices, etc. A sample of the secondary and tertiary suppliers to the processed food industry are listed in Exhibit 7.

EXHIBIT 7
PROCESSED FOOD INDUSTRY SECONDARY AND TERTIARY SUPPLIERS

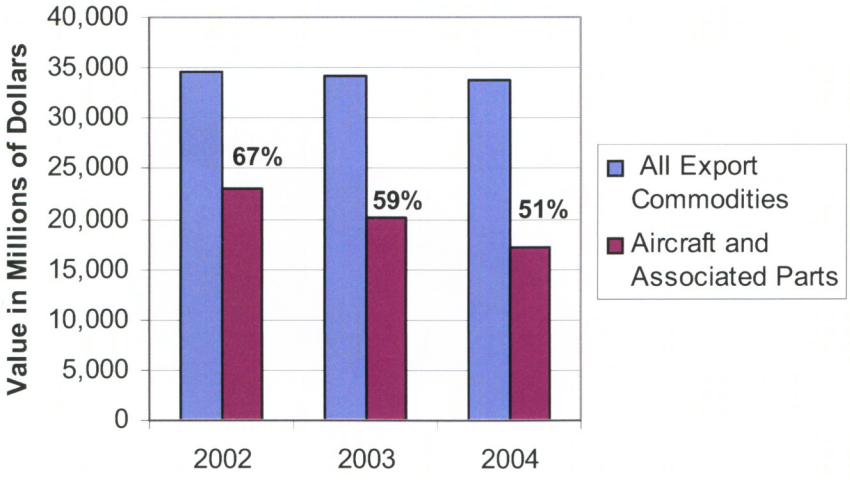
Secondary Industries	Products	Tertiary Industries	Products
Conveyer manufacturers	Conveyer belts	Raw material providers	Plastics, textiles, metals, cables, other conveyer belt raw materials.
Refrigeration and freezer components	Linear freezers, flat product freezers, flash coolers, IQF freezers, cooler equipment, and spiral freezers	Raw material providers	Metals, glass, plastics, refrigeration devices and parts
Sterilizers	Rotary pressure sterilizers, hydrostatics, small lab sterilizers, high capacity batch retort systems	Raw material providers	Metals, plastics, rubber sealants
Dry material handlers	Bin dumpers, mixers, bins, blenders, tanks, vibrating weigh-filling systems	Raw material providers	Motors, plastics, metals
Fillers	Fill & seal machines, liquid filling machines	Raw material providers	Metals, plastics, rubber sealants, etc.
Cutters	Cutting/size-reduction machines, portion control equipment, presses, ultrasonic cutting	Raw material providers	Blades, metals, plastics, etc.
Closers	Can sealers, closing machines, fill & seal machines	Raw material providers	Metals, plastics, rubber sealants, etc.
Raw food suppliers	Agricultural products, liquids, sugars and other raw foods	Raw material providers	Metals, plastics, rubber sealants, etc.

AEROSPACE INDUSTRY

Production Output Value

The aerospace sector is the largest manufacturing industry in Washington State. Combined sales of aircraft and associated parts accounted for over 24 percent of the total value of the manufactured output in Washington State, with almost $25 billion in annual revenues in 2004.[11] It is also the state's leading export industry. As shown in Exhibit 8, the industry has been responsible for at least 51 percent of the state's total export value for at least the past three years.[12]

EXHIBIT 8
AEROSPACE INDUSTRY'S ROLE IN WASHINGTON'S EXPORTS



Employment

In 2003, the industry employed approximately 70,000 people in the region, with total wages of almost $5 billion dollars.[13] Current estimates predict that the number employed in aerospace will increase over the next few years, up to approximately 75,000-78,000 in 2006.[14] These numbers do not include people working in the secondary or tertiary supply industries.

Summary of the Typical Aerospace Supply Chain Structure

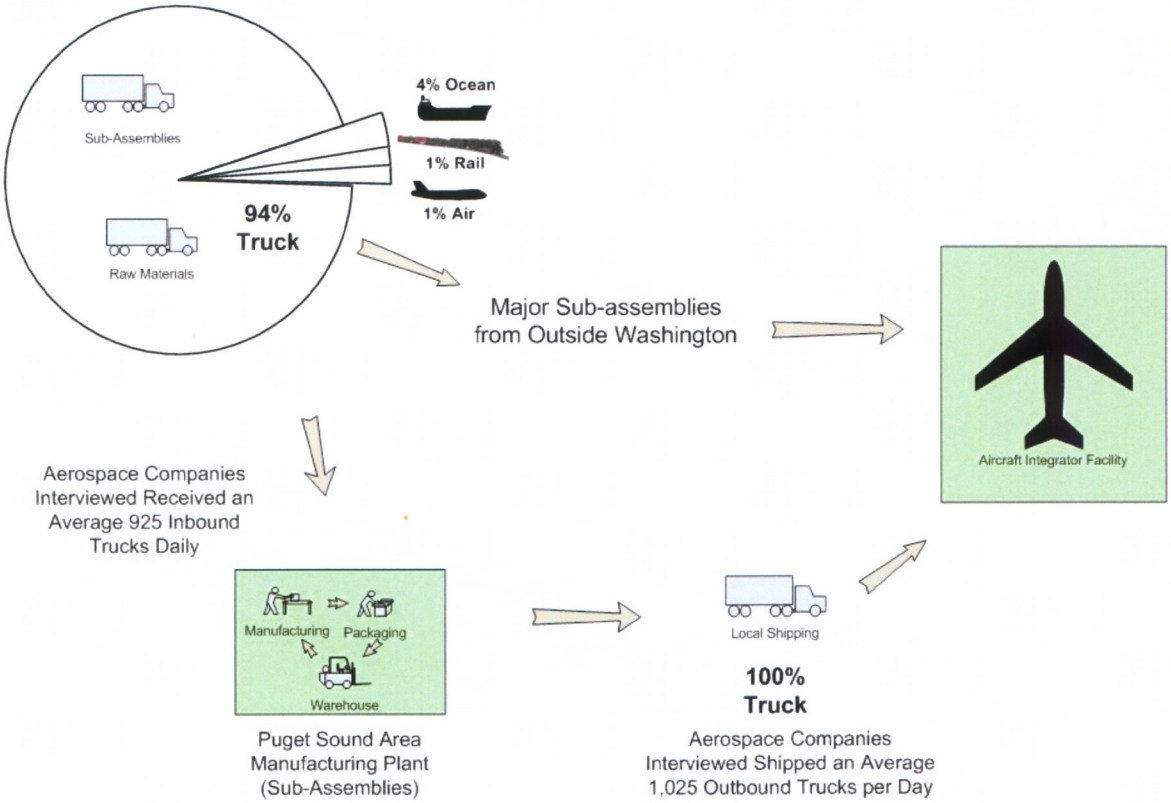
For this report, the aerospace industry was confined to the manufacture and repair of commercial aircraft. This included Boeing, the major aerospace manufacturing company in the

[11] Washington State Department of Revenue. *Quarterly Business Review Calendar Year, 2004. Table 1: Total Gross Business Income Statewide by Industry (SIC)*
[12] Washington State Office of Trade and Economic Development, http://www.cted.wa.gov
[13] http://www.workforceexplorer.com
[14] *Aerospace: Cyclical Comeback with Hopes to Slow Structural Declining.* Alex Roubinchtein. Retrieved from http://www.workforceexplorer.com/article.asp

Central Puget Sound region, as well as secondary and tertiary suppliers to Boeing, including TMX (aluminum and sheet metals) and Goodrich (cargo restraint and conveyance products).

The aerospace industry has the most complex and far-reaching supply chain of the three studied in this report, as depicted in Exhibit 9. As a key industry in the State of Washington, the aerospace industry involves both local companies that manufacture parts and sub-assemblies for the aircraft integrator, as well as the aircraft integrator itself.

EXHIBIT 9
SUPPLY CHAIN FLOW DIAGRAM: AEROSPACE INDUSTRY COMMERCIAL AIRCRAFT PRODUCTION



Sub-assembly component manufacturers interviewed receive an average of 925 inbound trucks daily. Sub-assemblies manufactured outside the region (i.e., fuselages, engines) are shipped directly to the aircraft integrator facility. The majority of raw materials in and out of regional sub-assemblies arrive via truck. Puget Sound region sub-assembly manufacturers ship an average of 1,025 trucks each day to the aircraft integrator facility. All finished product (a completed plane) is flown from the integrator facility to the customer.

As many components used in the assembly of aircraft are now manufactured outside the state, and even outside the United States, the amount of time it takes to move an item to or from a local manufacturer to Boeing using local highways or surface roads is less significant than for other industries with a more local focus. As a component of Total Delivered Cost (TDC) (a concept that will be explained further in Section 4 of this report), freight is a minor component of the cost of a multi-million dollar aircraft. Still, the sheer volume of trucks used to move goods in the area in support of local manufacturing operations is significant.

Secondary and Tertiary Suppliers

The aerospace industry has a very complex system of suppliers, as is typical for most large manufacturers with an extensive global supplier base. Therefore, the aerospace sector is a good proxy for evaluating the efficiencies and competitiveness of a global manufacturing supply chain structure. Exhibit 10 lists a sampling of secondary and tertiary suppliers that are likely to work in the Central Puget Sound's aerospace industry. Secondary suppliers to the aerospace industry include companies involved in engineering, technology, manufacturing, and systems integration. Tertiary suppliers typically produce the materials used by the secondary suppliers, including finished metals, electronic wiring, and other raw materials.

Exhibit 10
Aerospace Industry Secondary and Tertiary Suppliers (Sample)

Secondary Industries	Products	Tertiary Industries	Products
Aircraft component manufacturers	Window frames, wing spars, engine pylon assemblies, bulkheads, airframe structural components, landing gear, tail skid assemblies, Access doors, etc.	Raw material providers	Glass, metals, plastics, rubber
Specialized metal manufacturers	APU bellows, insulation blankets, ECS ducts, starter ducts, vapor seals, anti-ice rings, stainless steel rings	Raw material providers	High temperature and high-strength steel and other specialized metals
Hydraulic systems engineering specialists	Hydraulic power generating systems and associated pumps, motor pumps, and couplings	Raw material providers	Metals, glass, circuits
Electrical and mechanical systems	Electronic controls, crew information systems, data management systems, flight control systems, navigation and supply systems	Raw material providers	Electronic components
Mechanical systems providers	Engine systems, landing gear and door actuation, propellers, electromechanical actuation	Raw material providers	Plastics, metals, rubber
Engine components	Rotating and static engine components	Raw material providers	Metals, individual engine components

Summary

These three industries, the aerospace industry, the processed food industry, and the building and construction industry, serve as case studies for further analysis of manufacturing supply chains in the Central Puget Sound region. All three industries are of great regional prominence, and all have tremendous impacts on the regional and state economic activity.

SECTION 3
ISSUES, CONSTRAINTS, AND POTENTIAL REMEDIES BASED ON FREIGHT INTERVIEWS

INTRODUCTION

The purpose of this section is to summarize the information gathered through the interview process. The survey was conducted as an effort to better understand the freight supply chain and transportation issues faced by the three sectors targeted for this study:

1. Building and Construction
2. Processed Food
3. Aerospace

A copy of this survey document is included as Appendix A. The survey was developed in order to identify and quantify bottlenecks and deficiencies in the existing transportation system that affect the respective supply chains.

This section is organized around the following topics:

1. **Profile of Businesses, Industry Sectors, and Supply Chain Types:** Describes the industries that were included for this study and groups them into supply chain types.

2. **Industry Coping Strategies and Supply Chain Innovations:** Describes how the surveyed companies have adapted to cope with the negative effects of traffic congestion in the region.

3. **Transportation Issues:** Summarizes specific operational, infrastructure, and policy issues that emerged during the interviews.

4. **Response to Transportation Investment:** Presents a methodology for determining how businesses in Washington may respond to investments in the transportation system.

5. **Potential Solutions:** Summarizes ideas for potential solutions raised by interviewed businesses.

PROFILE OF BUSINESSES, INDUSTRIAL SECTORS, AND SUPPLY CHAIN TYPES

Representatives from thirteen companies in the three targeted sectors, along with one freight hauling firm, were surveyed in person for this study. Several follow-up surveys by telephone were also performed to finalize the surveys. Individual company interviews are summarized and presented in Appendix C. Representatives from the following businesses, along with Carlile Transportation Systems, were interviewed:

Aerospace Industry
- Boeing Corporation
- Goodrich Aircraft Technical Services
- Goodrich Cargo Group
- TMX Aerospace

Processed Foods Industry
- US Bakery (Franz)
- Trident Seafoods
- Starbucks Coffee Company
- A processed food company
- An international beverage company

Building/Construction Industry
- Quadrant Corporation
- Cadman, Inc.
- Woodinville Lumber
- Bob's New Construction

The companies analyzed in this study range from those that are locally owned and operated to those that are national or global in scope. Without regard to company size, the analysis focused on the inbound and outbound transportation requirements within the Puget Sound region. In the case of national or global companies, the decision was made to focus solely on the operations of the facility or plant located within the Puget Sound region. This approach allowed for a more full assessment of the relationships between the freight delivery system of each industry and the transportation facilities within WSDOT's purview.

The following criteria were developed to classify the industries into categories for further analysis. All results are summarized in a table titled "Supply Chain Summary" in Appendix B.

MARKET AREA

This refers to the geographic area where the goods and services of each company are distributed or sold. The market area was divided into three broad categories:

- **Local:** Includes the Puget Sound region.
- **Regional/National:** Includes other states and regions within the United States and Canada.
- **Global/International:** Includes locations anywhere in the world.

DEPENDENCE ON TRANSPORTATION NETWORK

This explains the emphasis on a local, regional, or global transportation system as it relates to the freight movement of each company. As before, this classification focuses on the local plant or facility of each company, and does not extrapolate to the national or international facilities of any company.

- **Local:** Includes the transportation system that services only the Puget Sound region.
- **Regional/National:** Includes the transportation system that services areas beyond the local Puget Sound region, including other northwestern states and western Canadian provinces.
- **Global/International:** Includes the transportation system that services locations anywhere in the world.

OTHER FACTORS

Several other characteristics of each company's supply chain were examined as part of this analysis:

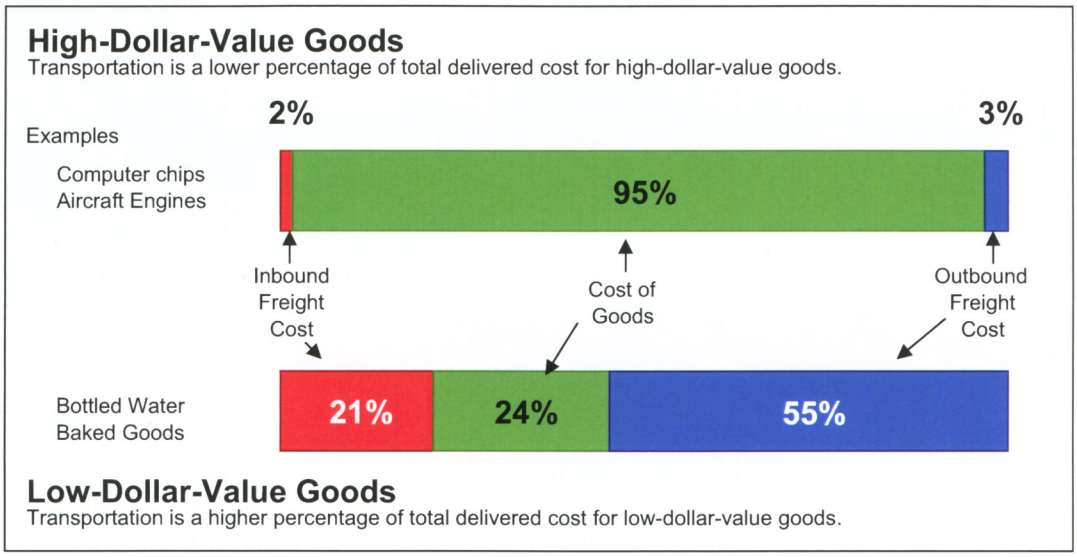
- **Complexity:** Within the scope of this study, no causal relationship was identified between the complexity of a company's supply chain and its dependence on the Puget Sound transportation infrastructure. Further, the size or reach (local market vs. global market) had no bearing on the complexity or sophistication of the company's handling of freight.

- **Number of Truck Trips per Week:** Reliance on trucks was the common supply chain denominator across all industries studied. The majority of goods entering the Puget Sound region will travel by truck at least twice during the product life cycle. Therefore, part of the criteria included an estimate of the average number of truck trips generated by each company in a typical week. The number included both inbound and outbound shipments. The companies interviewed generate an estimated 19,000 truck trips per week, or an average of 3,000–4,000 truck trips per business day. Truck movements include the following:
    - Vendor or supplier to plant or distribution center
    - Port or docks to plant or distribution center
    - Airport to plant or distribution center
    - Plant to distribution center
    - Plant to customer
    - Distribution center to customer

- **Travel Mode:** This category indicates all modes of travel the company uses in its supply chain, including truck, rail, ocean, and air.

- **Cost of Goods:** Business behavior is driven by business income. The study found that when Central Puget Sound manufacturing companies manufacture low-cost products (e.g., bread), high transportation costs can severely affect net business income. For high-cost products, transportation costs represent a lower proportion of the total cost of goods. This relationship is shown in Exhibit 11.

EXHIBIT 11
RELATIVE IMPORTANCE OF TRANSPORTATION COSTS



INDUSTRY COPING STRATEGIES AND SUPPLY CHAIN INNOVATIONS

The interviews revealed many common themes among the businesses surveyed, including how they cope with transportation issues. The overarching themes that emerged are summarized below.

SUPPLY CHAIN FOCUS AND LOCAL CONGESTION

While the issue of local traffic congestion came up regularly, the relative importance, attention, and urgency accorded to it varied across the surveyed companies. The businesses that have locally focused supply chains have the largest reliance on the local highway network. For them, nearly 100 percent of their material inputs and finished products are received and distributed by trucks in the Puget Sound region. Therefore, local traffic congestion rose to the top as a dominant issue affecting the reliability, cost, efficiency, and productivity of their supply chain. For example, the Woodinville Lumber yard serves as the main facility for all of Woodinville Lumber's receiving, repackaging, and re-distribution of lumber. Lumber arrives, by truck, from mills all over the Pacific Northwest and Canada. It is then repackaged in the Woodinville facility, loaded onto another truck, and taken to local job sites. Congestion and load-limit

restrictions on local highways affect all inbound and outbound movements for these more locally-based supply chains.

Another company reported that in 2001, a round trip from Bellevue to Tacoma took an average of 90 minutes; at the time of the survey (2005) it was common for the same trip to take between 120 to 150 minutes. Businesses that move most of their products within the local region are more affected by these increases in local congestion than businesses that use local highways for just a portion of a long-distance trip. Companies compensate for the additional congestion by paying drivers overtime, purchasing additional trucks, and hiring more drivers. All of these compensation measures add substantially to the cost of doing business in the Puget Sound region.

Even businesses with global supply chains such as Boeing can be challenged by local congestion. There is a difference in how local congestion is viewed by Boeing, specifically as it relates to the parts of the supply chain it directly controls, and the parts of the supply chain that are controlled by its global system of suppliers. Although Boeing has a global reach and transportation requirements, the aspects of the business it directly manages rely almost entirely on the local infrastructure system. As an integrator, Boeing depends on a large group of suppliers to supply raw materials and component parts for aircraft assembly. Large multinational firms manufacture, fabricate, and assemble large component parts (for example the whole engine, the entire landing gear, etc.), and Boeing assembles the final aircraft. The bulk of the activities directly controlled by Boeing are local, from manufacturing to fabrication to assembly. Moreover, as a rule, Boeing assumes control of the bulk of the locally based transport of parts, even providing local transport service for its suppliers. Therefore, the share of supply trips it directly controls is predominantly local, making transportation systems a key priority.

ADAPTATIONS TO COPE WITH LOCAL CONGESTION

All businesses interviewed have had to make changes to increase transportation efficiencies. All of these changes add costs for the businesses. Ranked according to the relative cost of implementation, one or more of the following coping strategies have been adopted by the surveyed businesses:

1. **Investment in warehouses or satellite facilities:** Firms have added satellite distribution locations to serve the same geographic area previously served by one facility. This response is most evident among carriers that provide trucking services. Carriers that are located south of Seattle, towards Tacoma, are finding it more difficult to provide reliable same-day service to customers located to the north of Seattle, and on the east side. Some carriers are supplementing ground service with air shuttle services (such as DHL or FedEx) to improve service and reliability. At least two businesses interviewed invested in or expect to invest in additional facilities to compensate for traffic congestion and the growing migration to the south of manufacturing/distribution facilities.

2. **Increasing the size/capacity of the truck fleet**: Five companies indicated that congestion and Puget Sound infrastructure issues are the main reasons for investing in additional trucks and hiring additional drivers to deliver proportionately fewer goods. Several companies cited examples of typical transit times doubling between the north

and south ends of the Puget Sound in the past five years. One company indicated that their transportation fleet has *doubled* in the last few years, despite volume growth of only 20 percent. Another business indicated that it requires 30 percent more equipment and drivers to compensate for area congestion. This business estimates the additional cost of this labor and equipment at $300,000 per year. Similarly, the international beverage company interviewed estimates that transportation efficiency is declining at a rate of 15 percent to 20 percent annually. It expects to pay more overtime and add additional trucks and drivers to compensate. Bob's New Construction invested in larger trucks to facilitate making larger drops to a construction site, thereby reducing total trips. Another business dedicated two vehicles and drivers to handle critical delivery requests.

3. **IT/communication investments**: Five companies indicated they invested in routing, GPS, mapping, and/or communication devices to counteract traffic-related issues and delays. Bob's New Construction has installed communication devices on all trucks to assist in communicating traffic-related issues. Bob's has also installed GPS devices in its fleet to track movement and measure dwell time. U.S. Bakery has invested in route optimization software as well as GPS systems. They continually review the WSDOT traffic website and communicate with drivers to reroute trucks around traffic issues. Communication devices are commonly used to increase communication among drivers and dispatchers to alert others to congestion along routes.

4. **Increased inventory investment**: Companies are holding additional inventory due to unpredictable delays and congestion. Five of the businesses interviewed have invested an incremental 5-20 percent of total inventory to compensate for transportation-related delays. Both the processed food and international beverage company indicated their respective inventories were inflated 15-20 percent to compensate for transportation inefficiencies.

5. **Operational changes:** The majority of businesses interviewed (8) indicated that they have made one or more significant operational changes to compensate for Puget Sound congestion issues. Changes included:
   - Extending operating hours
   - Paying overtime
   - Using alternative delivery modes
   - Staging delivery vehicles at driver/employee homes
   - Pre-palletizing/consolidating loads to reduce driver dwell time
   - Early carrier arrival to ensure on-time pick-up and delivery
   - Pre-staging/pre-loading trucks
   - Redundant scheduling

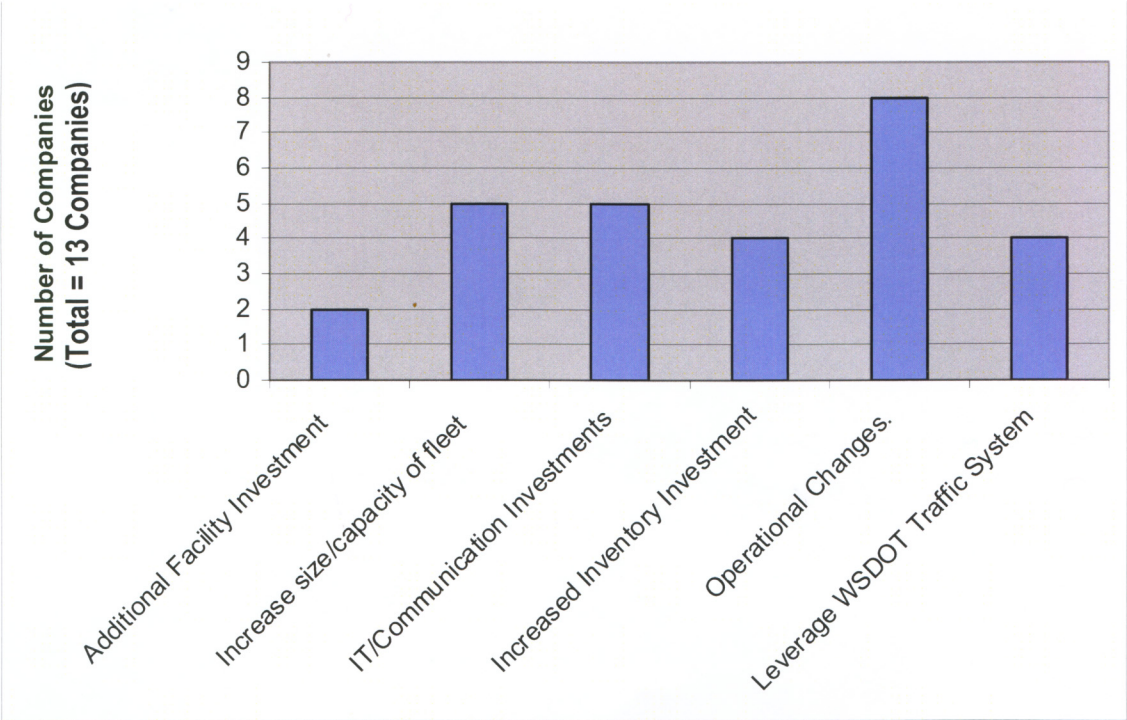
   All of these companies have adjusted operating hours in response to congestion-related issues. Bob's New Construction sends drivers home with loaded trucks for the next day's delivery to avoid employee commute as well as outbound delivery issues. After determining that peak congestion was eroding transportation efficiency by over 20 percent, U.S. Bakery converted the majority of its routes to off-peak schedules. Efficiency on those routes improved 7-10 percent, causing the company to conclude that

congestion issues are not limited to peak periods. Other changes include streamlining loading/unloading operations to minimize the truck wait times at the site/plant. This includes changes such as pre-staging loads so they are ready when the truck arrives, loading trucks the night before so they are ready to leave when the morning shift begins, and using automated loading systems.

6. **Leverage WSDOT traffic system**: Four companies regularly access the WSDOT traffic web site to assist in routing trucks. However, at least one company indicated they were often aware of traffic issues before they were reported by WSDOT.

Exhibit 12 summarizes the number of surveyed businesses that has used each of the coping strategies described above. As shown, 8 out of the 13 businesses reported making operational changes to cope with traffic congestion. The next most frequently used strategies were increased fleet size and investments in information technologies.

EXHIBIT 12
STRATEGIES USED TO COPE WITH LOCAL CONGESTION



Many of the companies included in the interviews have been able to maintain fluid operations by implementing these strategies even though congestion has increased substantially in recent years. However, there is concern that they have squeezed almost all of the inefficiencies out of their systems and it will be difficult to compensate for future increases in congestion.

EFFECT OF LAND USE PATTERNS AND GROWTH

Several interviewees observed that more industrial businesses, distribution centers, and customers are moving south of Seattle to Pierce, Thurston, and even Lewis counties. Because of traffic congestion, it is nearly impossible to serve the entire region from a single site. Therefore, the current growth trends are likely to result in two distinct market areas in the Puget Sound region: one south of Seattle and another north of Seattle. Those businesses that do not split the market and create satellite service centers may need to constrain their market size.

The growth of truck-intensive land uses in the South Puget Sound area and in Lewis County will increase the pressure on the existing freeway system and interchanges that serve these areas. South of SR 512 in Pierce County, there is only one major freeway corridor–I-5. The lack of an alternative route to this single freeway link will degrade the reliability of the freight transportation system. This link will be susceptible to delays caused by an incident or construction.

LACK OF REDUNDANCY IN FRIEGHT CORRIDORS

Beyond the immediate central Puget Sound region, all truck movements use I-5 and I-90, and neither freeway has an alternate. I-90 is problematic at all times for freight shipping because it may be closed by bad weather, avalanches, and as recently experienced, rock slides. Highway 2 over Stevens Pass is not a good alternative for interstate truck trips because of the challenging grades, two-lane configuration, and lack of connectivity with other interstate highways. Trucks experience congestion on I-5 through Lewis County (where it is two lanes in each direction), from Olympia to Everett, and through Skagit County (where it is also two lanes in each direction). I-405 provides a bypass around the worst section of I-5 through Central Seattle, but I-405 can also be extremely congested. In addition, while Highways 167 and 509 are important north-south freight routes, they do not currently connect directly to I-5 south of the Seattle, thereby minimizing their role in providing an alternate north-south route.

RELIANCE ON TRUCKING FOR INTERSTATE TRANSPORT

Most businesses interviewed use trucks to ship the majority of their materials, because trucks are generally faster than shipping by rail. For example, most components from the Midwest and East Coast are trucked to Goodrich Aircraft Technical Services, which takes five to seven days. None of these components are shipped by rail, which takes seven to ten days, plus an additional one to two days for intermodal transfer and local drayage on either end. Those requiring faster delivery are shipped by air or express carrier such as UPS, Fedex or DHL.

CHRONIC SHORTAGE OF QUALIFIED DRIVERS

Fuel costs and new qualification regulations are making it very difficult to convince truckers to move to the Puget Sound region. As a result, equipment utilization is not optimal. One trucking operation with 2,500 trucks will routinely have almost 100 trucks out of service because of this shortage of drivers.

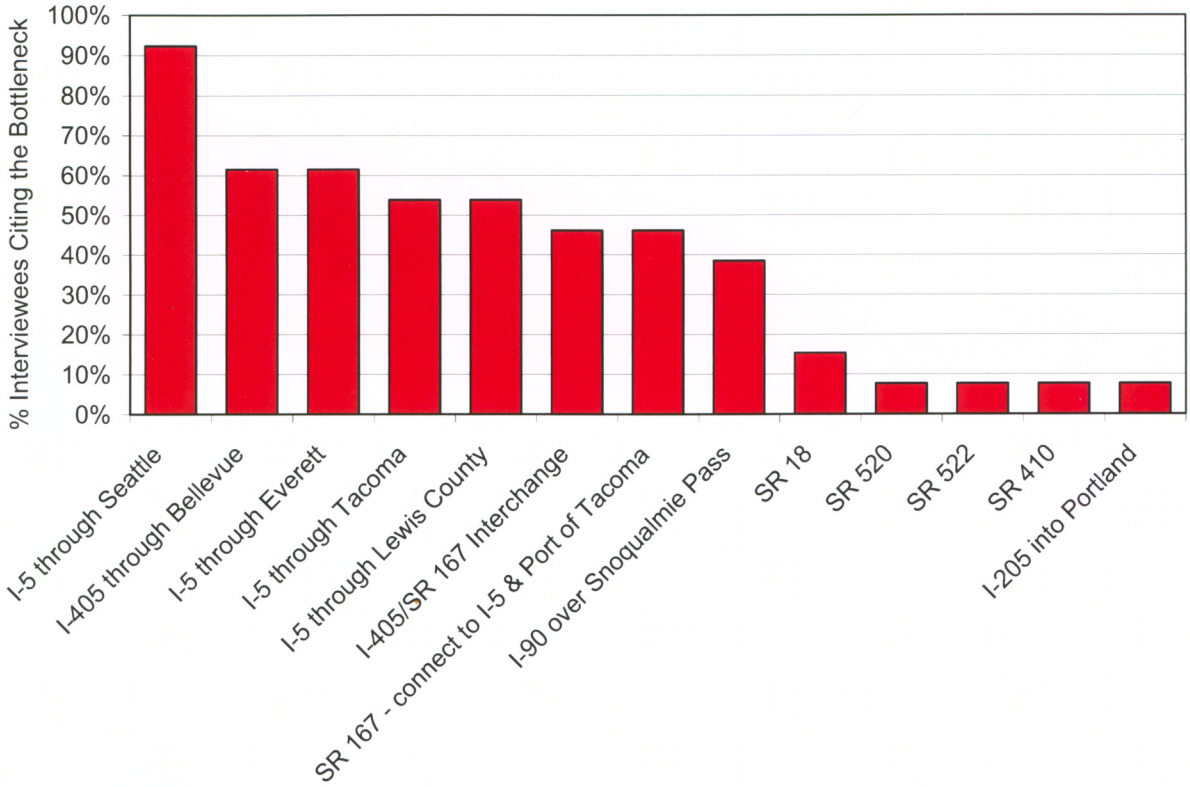
FREIGHT BUSINESS SUPPORT FOR TRANSIT INVESTMENTS

Several company representatives stated their support for light rail or other mass transit systems for commuters since it would remove trips from the highway system.

Transportation Issues

Businesses representatives were asked about transportation issues that are their top priorities to address, as well as the corridors where congestion most affects their business. Exhibit 13 lists these corridors in the order most frequently named (e.g., the first corridor was named by the most company representatives).

Exhibit 13
Worst Highway Freight Corridor Bottlenecks Based on Industry Interviews



A map showing the location of these freight bottlenecks is included in Section 4 of this report (Exhibit 18, p. 4-8). Specific comments related to transportation operations, infrastructure, and policies were also recorded. These are listed below.

OPERATIONS

- Increased parking restrictions and reduction of truck staging and maneuvering facilities in the urban areas has caused trucks to be staged off site until space is available for loading or unloading. This is inefficient for most companies and adds to the cost of business.

INFRASTRUCTURE

- I-5 lacks a single lane that flows directly through Seattle without requiring a lane change. This creates a major bottleneck and increases the potential for accidents as trucks must merge through this section.
- It is difficult to access local ports due to congestion at the port gates and because railroads block at-grade crossings near the ports. Specific locations that were mentioned include:
    - Port of Tacoma
        - I-5 and 54th Street interchange
        - I-5 and Port of Tacoma Way interchange
        - Taylor Way and Hwy 509 intersection
    - Port of Seattle
        - West Seattle Bridge
        - Spokane Street
        - Royal Brougham Way
        - Michigan Avenue
- Major arterial connections between freeways and industrial areas should be improved. One of the major arterials mentioned is Mercer Street in Seattle, which is affected by congestion and indirect routing for trucks.
- Closing the Alaskan Way Viaduct while rebuilding it would have a significant financial burden on the Maritime Cluster businesses located on Elliott Bay and Seattle's Ship Canal.

POLICY

- Flatbed trucks cannot use HOV lanes, even with the required number of occupants.
- Noise restrictions prevent extending delivery times to many construction sites. This prevents construction-related businesses from increasing efficiencies by extending shipping hours.
- Restrictions and permit requirements imposed by the City of Seattle to limit construction traffic to off-peak hours have substantially increased the cost of construction in downtown Seattle. Some of these restrictions have been part of the bus tunnel closure plan, and are expected to be removed with the re-opening of the tunnel.
- There is a lack of consistent design standards for trucking corridors among various governmental agencies (i.e., city vs. state).

RESPONSE TO TRANSPORTATION INVESTMENT

In addition to identifying potential solutions, it is important to understand the degree to which businesses respond to investment. The information in Appendix B presents a fundamental economic principle that businesses organize their supply chains in response to their market focus (proximity to customers and suppliers) and the availability of transportation (in addition to many other factors). Using these two factors as criteria—market area and dependence on the local roadway system—the companies interviewed were classified in a basic framework, specifically based on how their supply chains are structured, that outlines their anticipated responses to investments. In addition, the data were used to determine the relative return on

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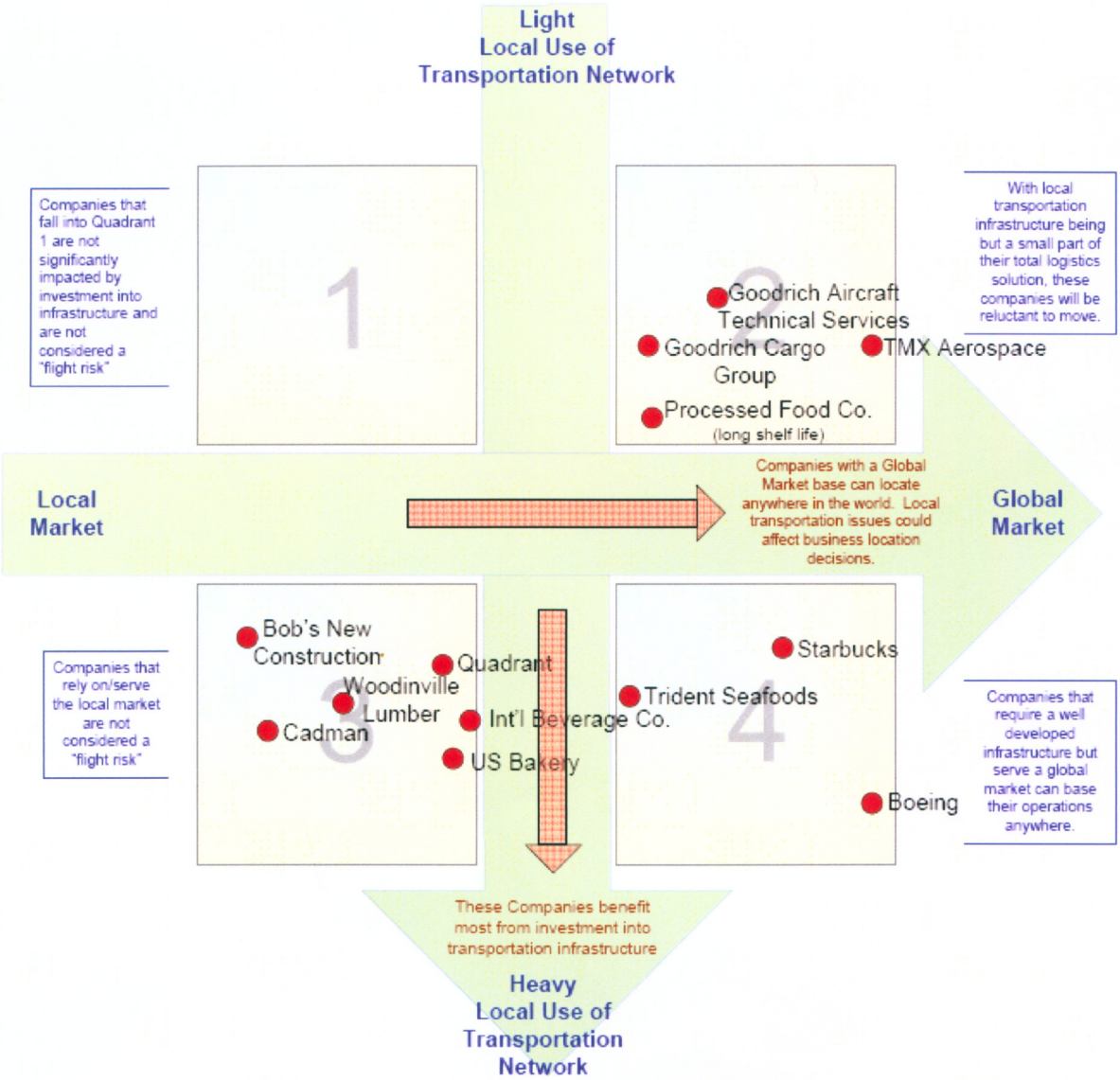
transportation investments and policies. The companies were categorized according to their market focus relative to their dependence on the local transportation system, as shown in Exhibit 14, and as described in more detail below.

EXHIBIT 14
BUSINESS CLASSIFICATION
MARKET AREA VS. DEPENDENCE ON LOCAL TRANSPORTATION SYSTEM



The companies were classified across two axes. The horizontal axis is an interpretation of the target company's proximity to market, specifically local market versus global market. For example, locally based companies whose markets are completely local were graded to the left of the horizontal axis. Those whose markets are global were graded to the right of the horizontal axis. The vertical axis is an interpretation of the importance placed by the target company on

the local transportation system versus regional or global systems. The local operations which had a strong focus on local transportation were graded toward the top of the vertical axis, and those with a more global focus on transportation were graded toward the lower end of the axis.

Sector 1 (upper left corner) had no representative companies in this study. However, the types of companies that might meet this profile are local retail companies or malls that have an entirely local market, and that generate relatively few truck trips. Bellevue Square or other local retail malls would fit this profile. Local transportation investments and/or policy changes would have a minor benefit to these types of companies.

Sector 2 (upper right corner) reflects companies that have a global market, but have a low dependence on the local transportation system. These companies are located in the region because some of their customers or suppliers are located locally. Examples include large suppliers that have a global market but also have a local presence to support Boeing. The local transportation system represents a very small part of their overall global supply chain. Disruptions and inefficiencies in the local system do not have a major impact on their overall global supply chain. Moreover, they tend to have a highly sophisticated dispatch and routing system to overcome local congestion. These companies will continue to cope with local congestion, and it has a relatively small effect on their business operations. Their elasticity in response to local transportation investments or policies, or the lack thereof, is likely to be low, relative to other factors such as market access.

Sector 3 (lower left corner) reflects companies with a local or regional market focus that are highly dependent on the local transportation system. Because they are dependent on the local market, they are unlikely to move to another region due to increased congestion or other local transportation issues. However, as congestion continues to increase their transportation costs, their profits will decline. At worst, some companies may not survive. These types of companies are very dependent on local transportation, and have a relatively high elasticity in response to transportation investment, or the lack thereof. They will essentially go out of business before relocating because of transportation issues in the logistics supply chain.

Sector 4 (lower right corner) reflects companies that have locally based operations for reasons other than the local transportation system or local market. Because they have a global market focus, they have a broader range of choice in terms of location. Some of these companies may be heavily invested in the region or choose to remain in the region for a variety of other reasons. An example is Boeing. While a large portion of its supply chain is outsourced, Boeing controls the bulk of the transportation related to locally based operations, including fabrication of major components and final assembly of aircraft. Therefore the local transportation system factors significantly into the portions of the supply chain it controls. This type of company is highly elastic to local transportation investments and policies, or the lack thereof.

Based on the broad range of results and perspectives from this research, this classification system could be applied for any business in terms of anticipating the response to freight transportation investments.

POTENTIAL SOLUTIONS

Business representatives were asked for their ideas about potential transportation solutions. Suggestions voiced during the interviews are listed below. Many of these were repeated by several businesses:

1. Expand the primary highway system to provide alternative routes and/or additional lanes.
2. Set aside truck lanes along key regional corridors to provide redundancy and improve reliability of the freight system.
3. Improve regional and national rail service. Suggested improvements include providing an integrated rail system that allows seamless accounting of shipments; improving loading/off loading in the rail yards; expanding equipment to support efficient handling of small loads; and using an Integrated Information Systems infrastructure to measure on-time delivery (similar to the airlines).
4. Implement toll facilities for truck use if they increase the capacity for freight. Companies will adapt to include tolls in transportation pricing. If it decreases travel time and increases reliability, tolled facilities could even reduce the overall transportation costs for some businesses.
5. Improve the ability to stage trucks in urban areas where local agencies want to impose parking and loading restrictions, either through policy changes or additional trucking facilities.
6. Expand the area covered by WSDOT's traffic web site to include areas north and south of King County and additional highways.
7. Improve cycle times through the seaports.
8. Consider daytime incident management along major corridors, in addition to peak-hour response.
9. Establish state-wide standards for regional trucking corridors (e.g., lane widths, turning radius, etc.) and prevent local municipalities from superseding state-defined standards.
10. Allow trucks to use HOV lanes regardless of the number of occupants.
11. Encourage local retailers to accommodate off-hour deliveries (from 6:00 P.M. to 3:00 A.M.) to relieve daytime congestion on the roadways and improve efficiency of delivery.
12. Review logistics infrastructure between the seaports and the rail heads to identify and reduce congestion points between the two systems.

SECTION 4
SPECIFIC CONSTRAINTS, OPPORTUNITIES, & RECOMMENDATIONS

INTRODUCTION

This section of the report outlines the constraints and opportunities for improving the reliability, cost, and competitiveness of the targeted supply chains, as well as recommendations for specific actions that WSDOT and potential partners could pursue. It follows a three-step outline:

1. **Discuss performance measures** that are important to each of these supply chains.
2. **Show truck concentrations** and their relationship to transportation system constraints.
3. **Recommend actions** to address transportation system constraints.

The recommendations are presented as priority actions and other actions, and are further grouped into three categories:

- Operational
- Infrastructure
- Policy

A specific set of constraints/opportunity pairs are outlined for each of these categories. Most of these are drawn from the previous section. A determination was made not to bring in outside sources (i.e., truck trip data, congestion data, etc.) as this goes beyond the scope and intent of this report.

SUPPLY CHAIN PERFORMANCE MEASURES

In order to determine deficiencies in the freight delivery system, it is vital to know what performance measures are most important to the users. A major goal of this study was to determine which performance measures matter the most to major Puget Sound manufacturers. Throughout the interview process, two overriding performance measures became clear:

- Total Delivered Cost (TDC)
- Transportation system performance and reliability

TOTAL DELIVERED COST

Manufacturing companies typically employ a standard metric termed "Total Delivered Cost" (TDC) to gauge their competitiveness in the marketplace or to track their own efficiencies and efforts to improve. Each company has a different sensitivity to fluctuations in transportation costs. Increased transportation costs could be catastrophic for one company and not be noticed by another due to the relative contribution of transportation costs to TDC.

As stated in Section 3 of this report, our study found that when companies manufacture products that have a high "cost of goods," the relative transportation costs are low and thus less important. An example is an aircraft component. Conversely, companies with a low "cost of goods," like a bakery, are very sensitive to rising transportation costs (see Exhibit 11, p. 3-4).

Because of this, each company will address and leverage opportunities differently, based on management ability, worker skills, technical knowledge, availability of resources, and company infrastructure. Transportation costs are a common denominator in this equation for all manufacturing companies in the Central Puget Sound region. Improving the transportation infrastructure within the Puget Sound region would positively impact all area companies.

Each company interviewed has a certain number of variables that they can control or influence in order to improve their transportation costs or efficiencies. These improvements generally come as a result of innovation, experience, use of technology, or employment of additional resources. Each company's response to its challenges followed a generally defined decision tree that could be summarized as follows:

- Meet the needs of the business–this is the primary driver
- Minimize costs/use of resources
- Seek additional information to facilitate further adaptations and coping strategies
- Seek additional resources
- Evaluate alternate locations

As one might expect, each company attempts to solve its problems differently, striving for the best fit for its own requirements.

Nonetheless, regardless of the relative effect of transportation costs, companies strive to minimize their costs in order to remain competitive. This includes reducing transportation costs wherever possible. One of the key contributing factors that affect transportation cost is the reliability of the transportation system itself. While companies have control over some factors that influence transportation costs, they do not have influence over the transportation system's reliability. For example, they can negotiate lower transportation costs with their suppliers, they can choose lower cost nodes, or they can locate closer to their markets to reduce transportation costs. However, locally based manufacturers do not control the reliability of the transportation system.

Transportation system reliability, or performance, can affect transportation costs, and hence total delivery costs in a variety of ways.

- **Increased Equipment and Operating Costs:** Increased congestion in the highway system increases travel time, forcing companies to buy more equipment and hire more drivers.
- **Increased Inventory Costs:** A reduction in reliability forces companies to hold more inventory. Some companies interviewed have resorted to Just-In-Case (JIC) inventory management practices whereby they hold extra stock/inventory to cover for deliveries that do not meet production schedules. Some businesses interviewed have invested an incremental 5-20 percent of total inventory to compensate for transportation-related delays.
- **Satellite Operations:** Due to increased congestion and increased trip times, some businesses have been forced to split their market areas and have built smaller satellite operations to serve the split markets. This increases the cost of providing services.

- **Invest in Technology:** In order to make better routing decisions to avoid congestion and to make up for a longer trip times, companies are investing in expensive technology innovations.

Given that transportation system performance is a factor that influences total delivery cost and is outside of the control of the locally based industries, it is important that this study provide further insight into transportation system performance.

TRANSPORT SYSTEM PERFORMANCE AND RELIABILITY

The key finding of this study is that the target supply chains rely significantly on the highway system. The local and regional highway systems play a dominant role in supporting the target supply chains. However, the local and regional highway systems also present the most significant challenge to the reliability of the target supply chains.

Based on the interviews, congestion and reliability along the Puget Sound region's highway system has led to a deterioration in highway travel times. Some of the interviewees concluded that the average truck trip time has increased by between 30 percent and 50 percent over the past three to five years. Moreover, interviewees stated that the highway system in general is more unpredictable, specifically during peak hour periods. This assertion is further supported by results from the 2001 Central Puget Sound Urban Freeway Network Usage and Performance study, conducted by the Washington State Transportation Center (TRAC). Exhibit 15 identifies regional roadways with significant variances in average trip times during the average AM Peak, Midday and PM Peak weekday travel periods. While the data are somewhat dated (2001), and are not for the entire highway system, it does support the assertions by the supply chain interviewees that travel times on the highway system are unpredictable. The data indicate that the AM peak, PM peak, and Midday peak periods are all unreliable, with the PM peak being perhaps the worst of the three.

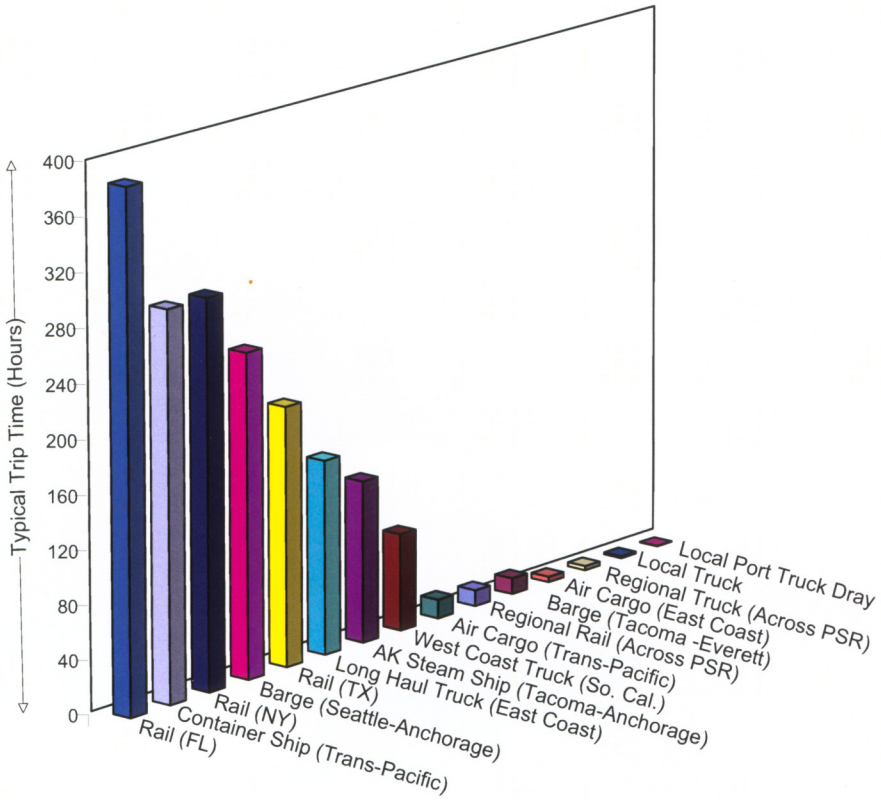
EXHIBIT 15
ROADWAY SEGMENTS WITH HIGH TRIP TIME VARIANCE

Freeway	Segment	Direction	Variance (Greater than 40%)		
			AM Peak	Noon	PM Peak
I-5	Everett to Seattle	South	55%	50%	41%
		North			45%
	Sea-Tac to Seattle CBD	South			48%
		North		44%	47%
I-90	Issaquah to Seattle CBD	West	48%		65%
		East			57%
I-405	231st Street SE to Bellevue CBD	South	41%		
		North			46%
	Tukwila to Bellevue CBD	South		41%	46%
		North			
SR-167	Auburn to Renton	South			81%
		North	47%		

Large trip time variances on the highway system have significant implications for the target freight supply chains. A disproportionately high number of trips for the target supply chains occur on the highway system. Almost every shipment for a Puget Sound-based supply chain has at least two segments or "legs" that occur on the region's highway system. Therefore, highway travel time reliability impacts every supply chain shipment. Second, highway mode segments are the most sensitive to variance, compared to any other mode segment along the supply chain. To understand this point, it is important to first compare the typical trip times for the various modal segments.

Exhibit 16 shows that the typical trip time varies significantly for each of the different mode segments across the supply chain. For example, the typical travel time for an airplane component shipped by rail from a supplier in Florida is sixteen days. A shipment by ocean container from Asia takes ten to twelve days. On the other extreme, a local highway trip can be an hour or less. These typical trip times are factored into the supply chain decision process. Therefore, the length of the trip time does not necessarily impact the supply chain as long as the trip time is constant. Variance in trip time is much more of an impact to the supply chain.

EXHIBIT 16
THE TYPICAL TRIP TIMES BY MODE



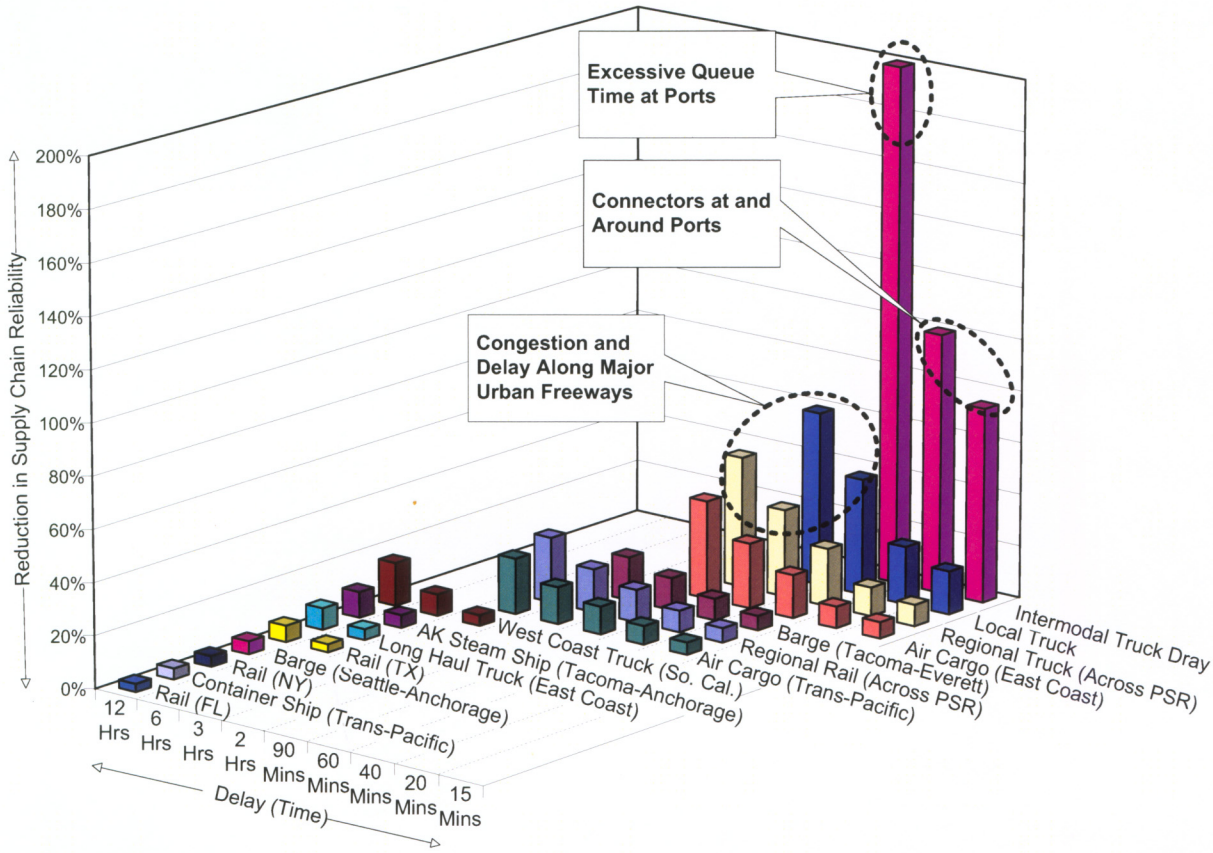
Source: Trip times based on industry interviews.

The modal segments that have the longer typical trip times offer supply chain managers the flexibility to factor in extra time to accommodate delay that may occur along the trip. The longer the trip time, the greater the opportunity for including extra time to account for delays.

Conversely, because of the shorter time and distance traveled on the highway system, any amount of delay results in a significant level of variance. Truck trips tend to be faster and require a greater deal of precision in terms of managing on-time reliability.

Exhibit 17 compares the impact of delay on the various modal segments of the supply chain. It illustrates the impact of a representative range of delay times and the impacts on trip variance.

EXHIBIT 17
IMPACT OF DELAY ON SUPPLY CHAIN RELIABILITY (BY MODE)



Source: Trip times and delay based on industry interviews.

The key conclusion that can be drawn from the graph is that a relatively small amount of delay has a far more significant impact on highway-based trips than trips by other modes such as rail or ship. For instance, a 40-minute delay results in a 22 percent variance for a delivery traveling across the Puget Sound region, a 44 percent variance for a locally based delivery, and a 200 percent variance for a short trip from the Port of Seattle to the Kent valley. However, a 40-

minute delay has less impact on the variance of a marine shipment or rail shipment. The scheduled delivery window for a marine shipment is typically within a 24-hour target period.

Marine shipping line schedules target a general day of the week, as opposed to a specific hour within a specific day. In order for an occurrence in delay along a marine modal segment to even affect the reliability of the supply chain, it has to approach a delay period of 24 hours or more. On the other hand, the delivery window for truck shipment is measured in minutes and hours, not days. Delays measured in minutes can have a significant impact on supply chain reliability.

The findings from the 2001 TRAC study cited earlier further support the assertion that the deteriorating reliability in the Puget Sound region's highway system has the most significant impacts on the target supply chains. Based on the TRAC study, there are several highway segments with trip variances in the 40 percent to 60 percent range, and as high as 80 percent. As shown Exhibit 16 above, highway congestion and delay reduce supply chain reliability within a similar range (40 percent to 60 percent). Delay occurring along arterial connectors reduces the reliability of port-related truck trips by as much as 80 percent to 100 percent. Excessive queuing times for trucks at port gates can reduce supply chain reliability by up to 200 percent. In general, however, port-related truck trips are a disproportionately smaller share of overall truck trips.

Truck Concentrations and System Constraints

Having established that highway systems reliability is the leading issue for industries that rely on locally based transportation, it is important to provide insight about where potential solutions may have the greatest impact, currently and in the future. This kind of insight is important for agencies that provide transportation infrastructure, such as WSDOT. With a limited amount of resources and capital, it is important to invest freight-specific resources where they are likely to have the greatest effect.

FREIGHT ACTIVITY CENTERS

One method by which to gauge the most vital links in the freight delivery system is to determine the major freight "activity centers." Activity centers will be the major production and attraction sites for all truck trips, and therefore the links between activity centers are often the most vital to the transportation system as a whole. Activity centers investigated in this study fall into the following categories:

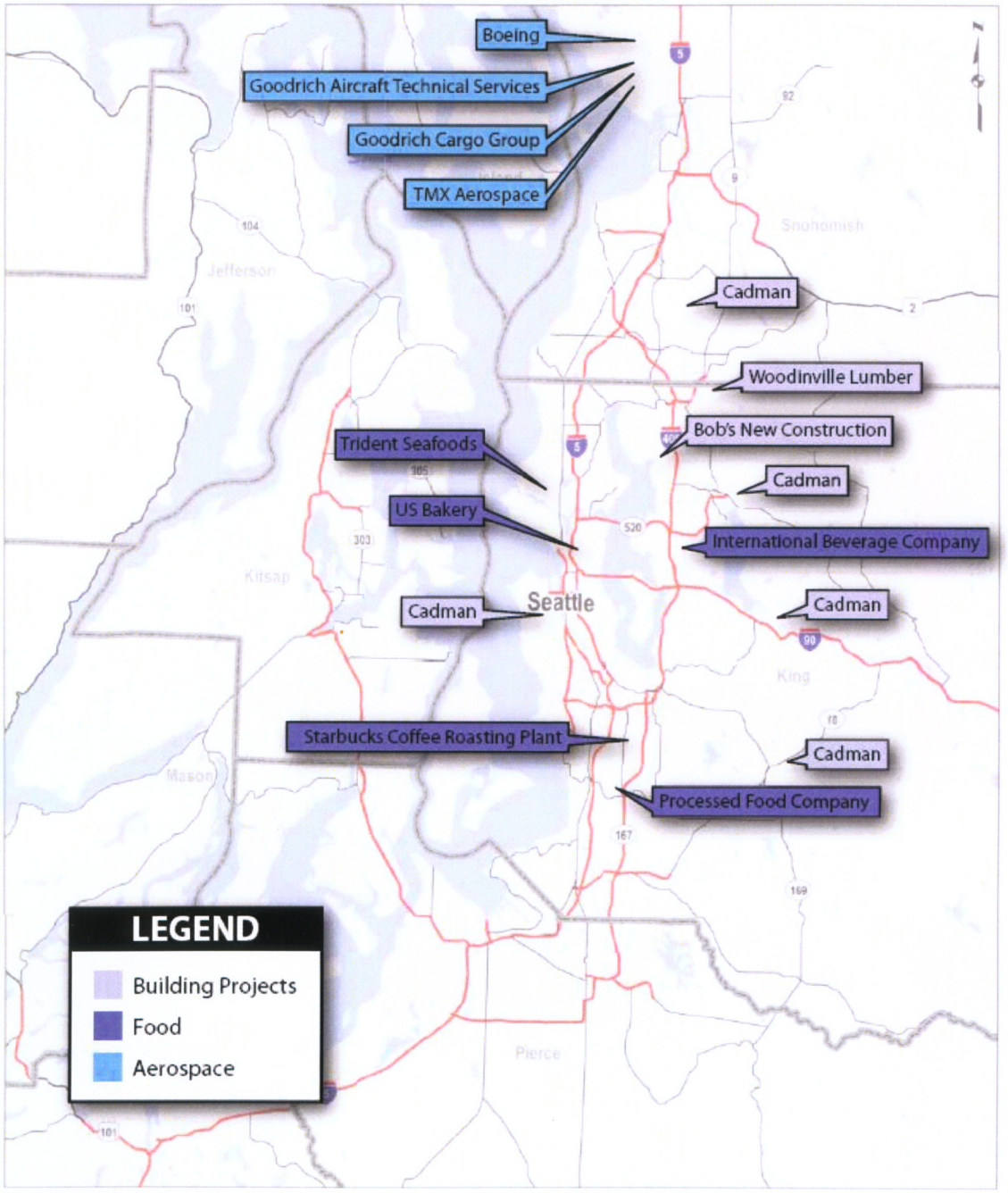
- Entry ports into the region
- Central distribution centers
- Manufacturing locations
- Packaging and bottling facilities
- End users (work site, factory, shipping point, or vendor)

The interview process undertaken for this study was an effort to fairly assess the important transportation links to major Puget Sound regional industries. Therefore, specific questions about the major activity centers were asked, as well as specific questions about perceived sections of bottlenecks and congestion along Puget Sound roadways. The results of these questions reveal which segments of roadway are vital to major industries in the region.

Major Manufacturing Centers

Exhibit 18 shows the geographical distribution of the companies interviewed in this effort. This includes the major manufacturers in the processed food industry, the building and construction industry, and the aerospace industry. It also includes the secondary and tertiary suppliers that were included in the interview process.

EXHIBIT 18
PUGET SOUND MANUFACTURING LOCATIONS OF COMPANIES INTERVIEWED



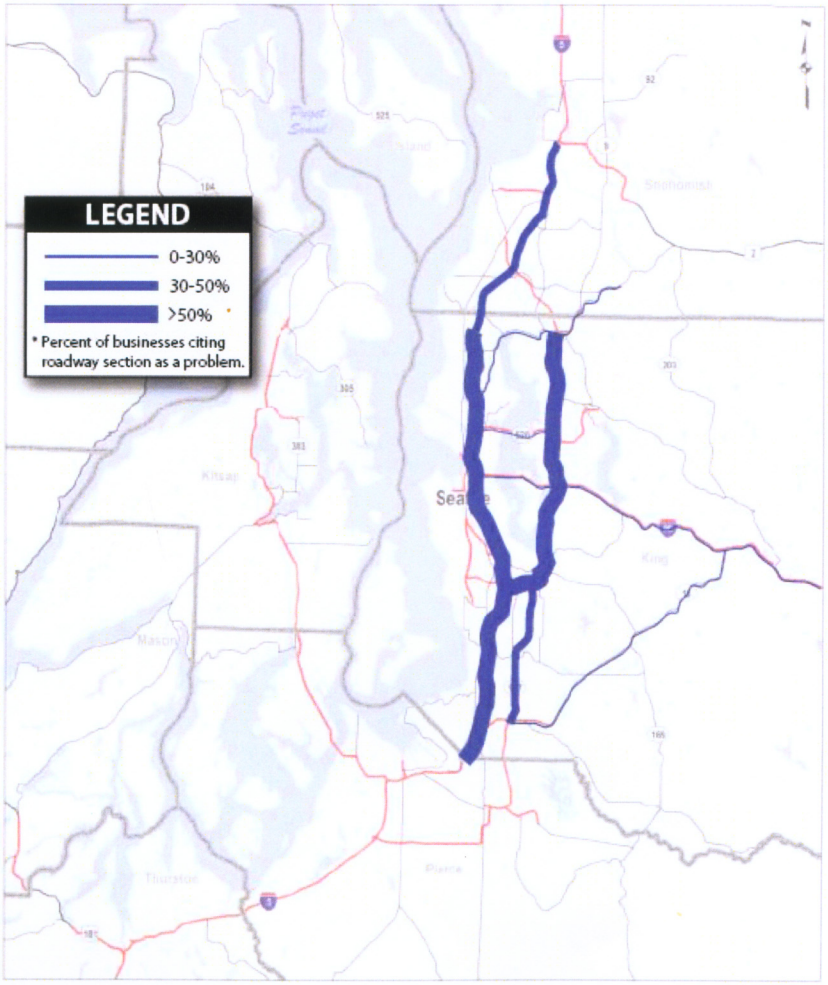
Source: Stakeholder Interviews 2006

The companies interviewed represent a fairly even distribution of industries throughout the Puget Sound region, extending as far north as Everett and as far south as Kent. For those companies clustered around Seattle, there is a fairly even distribution west of Lake Washington (along I-5) and east of Lake Washington (along I-405). There are also some companies along the SR 520, the SR 18, and the I-90 corridors.

Links with High Truck Movements

The physical location of the interviewed companies provides some indication of critical transportation links for inbound and outbound shipments. The locations indicate that the companies are clustered around the major links identified above, in particular the north-south I-5 and I-405 corridors. The interview process corroborated this impression of critical links. When asked to describe the "worst bottleneck" affecting their business (i.e., the segments that each company would most like to improve), over 90 percent mentioned I-5 and over 60 percent mentioned I-405. Exhibit 19 graphically depicts the proportion of the respondents who identified a particular roadway segment. The exact percentages can be found in Exhibit 12 (p. 3-9) of this report.

EXHIBIT 19
HIGHWAY FREIGHT CORRIDOR BOTTLENECKS



Source: Interviews with Puget Sound Region Industries, 2006

EXISTING AND FUTURE PUGET SOUND REGION INDUSTRIAL AND WAREHOUSE SPACE

Though existing freight activity centers were determined in part from industry interviews, it was also deemed necessary to research the square footages of warehouse and industrial space in the Puget Sound region. The purpose of this analysis was to identify trends that point to future concentrations in freight activity. Therefore, research was conducted as to the amount of space devoted to "Existing" warehouse and industrial space as well as that "Under Construction." The data used for this analysis were available for specific geographic areas, namely the Northend, Seattle, Eastside, Tacoma, and Southend markets, as noted in the following sections and depicted in Exhibits 20 and 21 below.

EXISTING DISTRIBUTION

As shown in Exhibit 20 on p. 4-10, the distribution of existing space devoted to industrial uses favors the Southend of Puget Sound and Seattle markets, with 38 percent and 23 percent, respectively, of the existing market. Tacoma and the Northend each have about 16 percent of the existing market, and the Eastside has about 7 percent. This supports the fact that much of the region's freight moves between activity centers in the Southend and Seattle, with additional movements between Tacoma and the Northend.

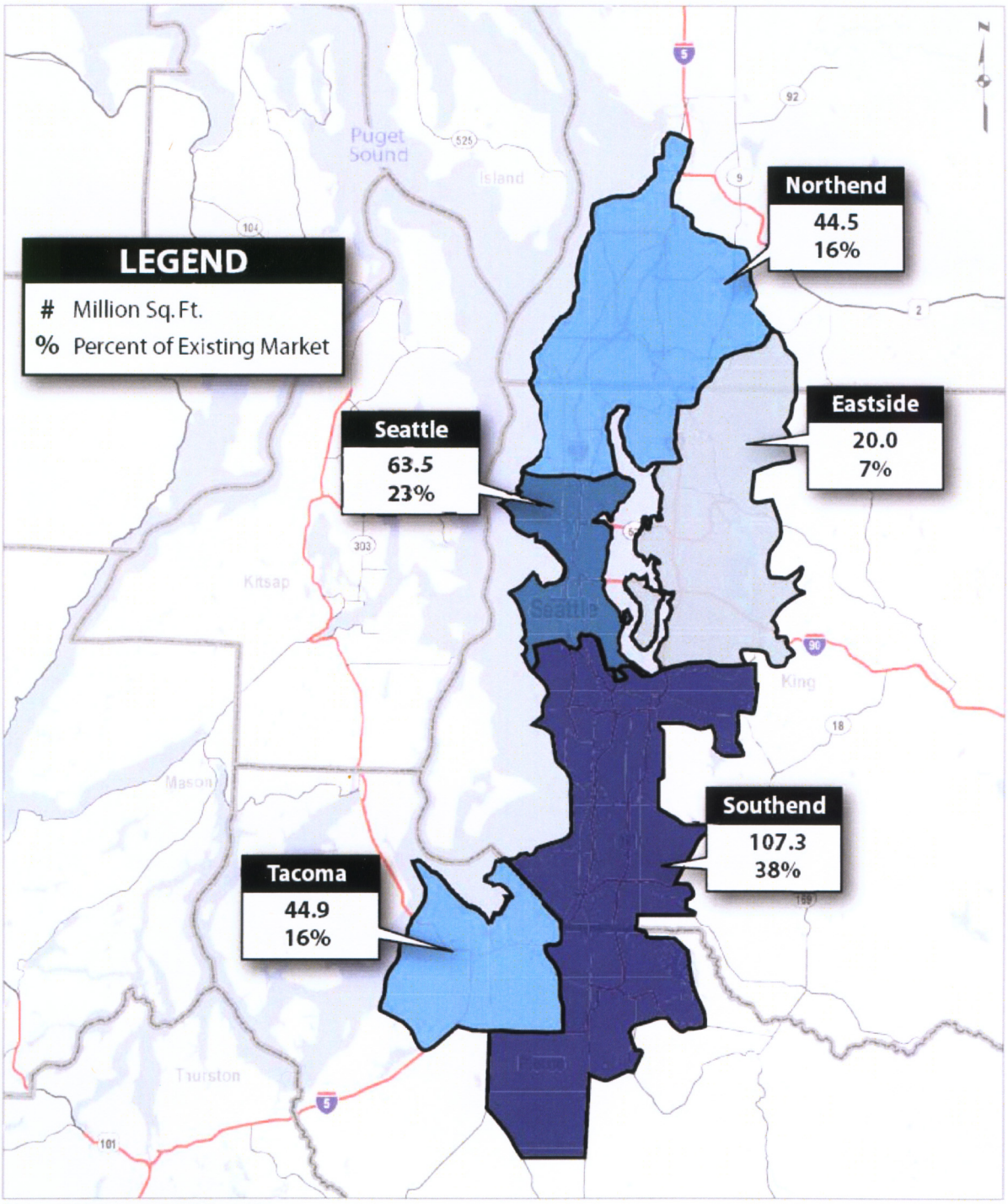
FUTURE DISTRIBUTION

Another input for determining critical roadway links is identifying where future activity centers will be. With this information, it may be possible to anticipate growth with enough certainty to implement infrastructure improvements to support the growth in a timely manner. For this reason, this study researched future expansion trends of warehouse and industrial space. Specifically, market data indicate that slightly over 3.8 million square feet is permitted and under construction as of 2005 (see Exhibit 21 on p. 4-11).

The key finding from the data is that there is a significant shift towards the markets south of Seattle. In fact, 65 percent of the 3.8 million square feet under construction is in Tacoma, with an additional 26 percent in the Southend. This represents 91 percent of all new space under construction. The Eastside will see a 6 percent increase in space, with the Northend seeing the remaining 3 percent. No new industrial or warehouse space is under construction in Seattle. This is likely due to the high cost of land in Seattle, and the availability of existing warehouse space there.

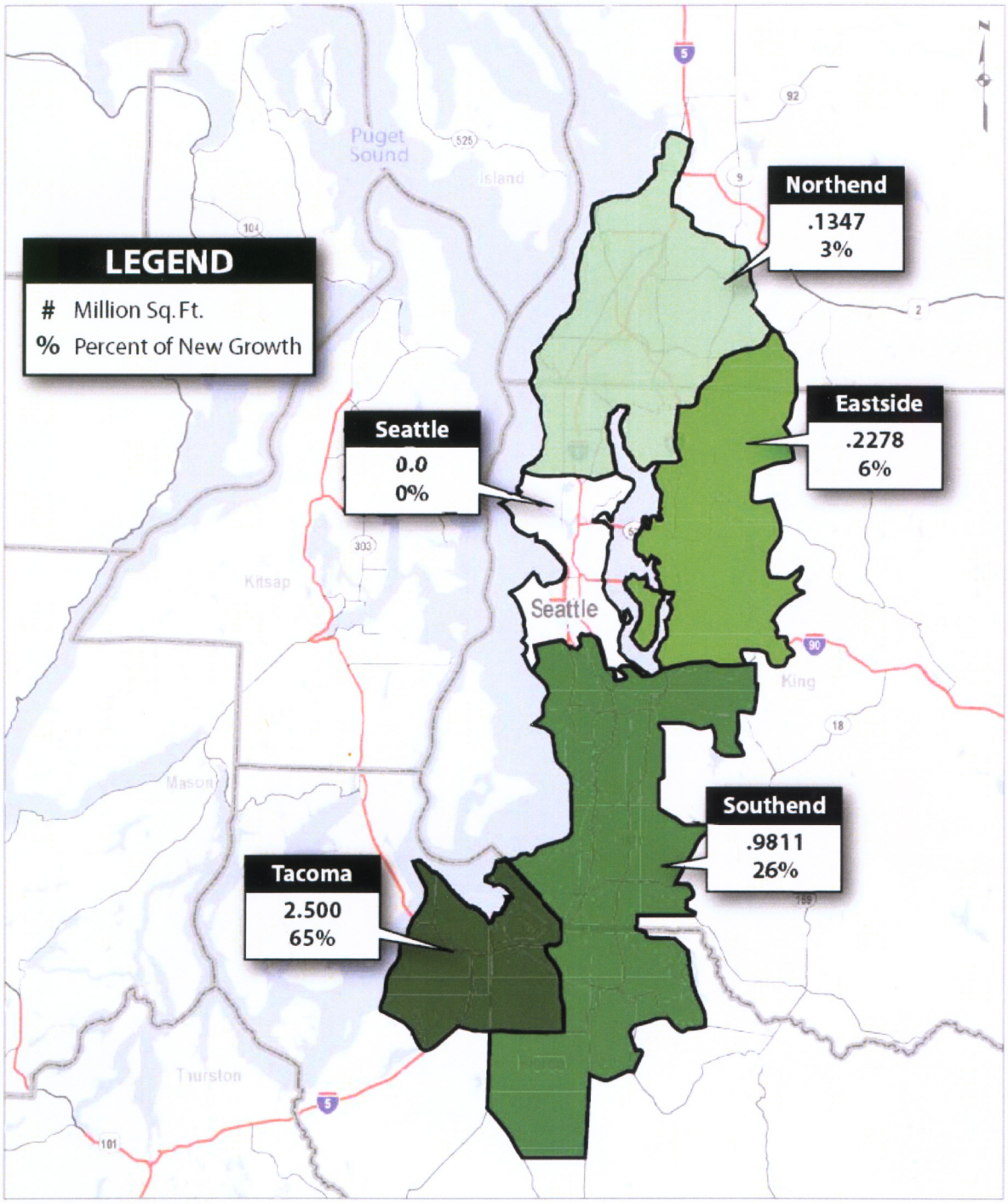
This analysis of future industrial and warehouse space illustrates a distinct move south, away from Seattle and towards the areas of Kent, Auburn, Federal Way, and Tacoma. For this reason, the conclusions of this report emphasize the infrastructure that feeds these southern regions. The findings of this review are reflected in the "Priority" recommendations made later in this report.

Exhibit 20
Existing Industrial/Warehouse Space (2005)



Source: COSTAR Group, Inc. COSTAR Industrial Report, Year-end 2005- Seattle/Puget Sound

Exhibit 21
Industrial/Warehouse Space Under Construction (2005)



Source: COSTAR Group, Inc. COSTAR Industrial Report, Year-end 2005- Seattle/Puget Sound

RECOMMENDED ACTIONS

The conclusions of this report are meant to help direct freight finance and planning decisions during future Washington State Department of Transportation strategic plans. To this end, it was deemed most useful to divide recommendations into two categories, "Priority" and "Other." Within these two categories, they are further divided into operational improvements, capital improvements, and policy recommendations.

PRIORITY ACTIONS

The manufacturing industry in the Central Puget Sound region would benefit most from the following high priority actions to improve freight movements. These recommendations are based on the findings of the targeted industry surveys and on the technical expertise of the consulting team. The projects are directed at improving mobility for the industrial and manufacturing businesses located within the Central Puget Sound region. Two of the actions listed below are operational measures that can be implemented in the short-term. The others are longer-term capital improvements.

1. Expand WSDOT's Web-based traffic flow map to provide better traffic flow information and camera coverage in the urban area as well as to expand the network beyond the current limits. Some of these locations are already in the capital budget, including:
   - I-5 between Federal Way and Tacoma
   - SR 516 between I-5 and SR 167

   Other locations are recommended, including:
   - I-5 south to Lewis County (and perhaps through Centralia)
   - I-5 north of Everett through Skagit County (includes remaining two-lane section in Mount Vernon in preparation for additional congestion that could occur in 2010 for the Vancouver Olympics)
   - SR 167 south of Auburn
   - I-90 between Issaquah and North Bend
   - SR 18 (adding cameras)
   - SR 169 near I-405

2. Increase incident response along major freight corridors, and expand hours to include midday. Major corridors include:
   - I-5 from Seattle to Lakewood
   - SR 167 from Renton to Puyallup
   - SR 599 from 1st Avenue S Bridge to I-5
   - I-90 from Seattle to Issaquah

   Some of these are already included in the capital budget, including:
   - Funding for one additional patrol in the south end of I-405 during peak traffic congestion (including the SR 167 interchange)
   - Funding for two additional patrols during peak traffic congestion on Highway 18 and in south King County

3. Complete missing links on missing freight routes to improve connectivity and reliability for freight. The highest priority freight routes to improve the reliability for Central Puget Sound manufacturing are:
    - SR 167 from I-5 to SR 161, with a direct connection between SR 167 and I-5. The extension was proposed to be funded in past iterations of the Regional Transportation Investment District (RTID); however, the interchange with I-5 was not funded. In order for this project to serve regional freight needs between the customers and manufacturing centers, a connection to SR 167 is needed.
    - SR 509 from S. 188th Street to I-5. This project was proposed to be funded in past iterations of the RTID. This project will benefit freight by creating a parallel route to I-5 that connects from Seattle's Duwamish Industrial Area to the Kent Valley. In addition to relieving congestion on this critical section of I-5, the SR 509 project will also provide an alternate route to improve the reliability of the entire system.

4. Increase capacity along major freight routes. These include
    - I-5 from Mercer Street to the Boeing Access Road. Capacity increases may be possible by improving the ramp weave-merge section between the West Seattle Freeway and I-90 and by reconfiguring ramp access to and from downtown Seattle. There is no concept or funding for potential improvements in this section.
    - SR 167 from I-405 to Sumner. HOV and ramp improvements are proposed as part of the SR 167 Corridor project. Partial funding for this project has been provided by the "Nickel Account" with the remaining funds proposed in past iterations of the Regional Transportation Improvement District (RTID).

OTHER FREIGHT PROJECTS

There are many other projects that would enhance freight mobility for industrial and manufacturing businesses in the State of Washington. The list below is also based on the targeted industrial sector surveys. These are listed below by type of project: Operational, Infrastructure, and Policy.

Operational

1. Reduce disincentives to delivering at night (from 7:00 P.M. to 7:00 A.M.) to relieve daytime congestion on the roadways and improve efficiency of delivery.

2. Consider incentive programs, such as PierPass in Los Angeles/Long Beach, that would shift Port truck traffic to nighttime hours.

3. Allow trucks to bypass ramp meters at locations with high truck volumes and steep grades or short merge lengths.

Infrastructure

4. Replace failing infrastructure that, if lost, would dramatically affect capacity on the major freight routes of I-5 and I-405. This includes replacing the Alaskan Way Viaduct and SR 520 Bridge. Funding for these projects is expected to be from a mix of local, state, and federal funding options.

5. Improve I-90 to reduce weather-related closures and increase capacity over Snoqualmie Summit. This project has been funded out of the 2005 Transportation Partnership Account.

6. Complete planned major truck linkages to the Port of Seattle and Port of Tacoma. Specific projects include:
   - SR 519 Phase 2
   - Spokane Street Viaduct Project (widening and ramp improvements are currently unfunded)
   - East Marginal Way Grade-Separation Project (funded)
   - Lincoln Avenue Grade-Separation Project (partially funded, currently in design)
   - Port of Tacoma Road Interchange Improvements (being considered as part of I-5 mainline improvements through Fife.)

7. Increase capacity on I-5 from Fife to Fort Lewis. A portion of the project–from Port of Tacoma Road to Pacific Avenue in Tacoma–is proposed as part of an "Add HOV Lanes" project, which received partial funding from the 2005 Transportation Partnership Account and was fully funded in past iterations of the RTID proposal. A separate project being constructed as part of the I-5/SR 16 interchange improvements would extend the HOV lanes to SR 16. An extension further south is not yet funded.

8. If additional HOT lane or other managed lane programs are implemented, infrastructure improvements such as direct access ramps that would improve truck access into the lanes should be considered.

Policy

9. Establish state-wide standards for regional trucking corridors (e.g., lane widths, turning radii, etc.) and prevent local municipalities from superseding state-defined standards.

10. Create a direct funding stream for improvements to arterial truck routes that provide access to I-5, I-405, SR 167, SR 99, and SR 18. This funding mechanism could use the existing State's Freight and Goods Transportation System (FGTS) Classifications for "T-1" and "T-2" routes.

11. Update FGTS route maps on an annual basis. Ensure continuity in the route classifications between jurisdictions. These maps are currently updated every two years by the state, but could benefit from a yearly update.

12. Consider reducing tolls (e.g., on Tacoma Narrows Bridge) for trucks that move at night.

13. Increase driver training programs. Work with Homeland Security to increase the pool of drivers eligible to move restricted commodities.

14. Consider programs that would reduce cost to individual driver-owners, such as insurance pools and shared maintenance programs.

SUMMARY

All companies surveyed found the use of the Puget Sound area transportation infrastructure challenging. In addition, all companies surveyed are experiencing increased costs related to transportation. Those costs are growing at a faster rate than volumes and revenue. Finally, each company responds to the challenge in different ways, but they all use similar criteria or guidelines when formulating a response to transportation challenges.

As a result of the study and through the many interviews conducted with supply chain personnel and management of the sample companies, it became apparent that some of the possible solutions to the challenges faced by these companies were either unrealistic (i.e., solutions that were outside their sphere of influence or ability to control) or they could not be completed in a time frame that would meet their short-term needs.

Additional infrastructure (e.g., expanded interstate highways, transportation corridors, alternate routes, and toll ways) to remedy key bottlenecks or capacity issues are already in the planning stages in many instances. Although commonly cited as being most beneficial, these solutions are both expensive and time-consuming.

Each company surveyed, and by inference most manufacturing companies in the region, has logistic solutions that are unique to it alone. This is driven by the many variables in the components of the TDC for each product manufactured. What is important to one company may not be as important to another company. The resources available to solve a particular problem are likely to be allocated differently in individual companies, or the relative cost of transportation to the cost of goods may be so high as to demand more immediate or aggressive solutions.

The team found that, given sufficient information, each company is developing its own ways to cope. Just as each company employs all its resources, skills, experience, and technology to best meet the objectives of business and does so in a way that is different from its competitors, these companies can continue to find ways to overcome the challenges and costs of their supply chains.

PREPARED FOR THE

Washington State
Department of Transportation

IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

FREIGHT EFFICIENCY & COMPETITIVENESS PHASE I

APPENDICES

JUNE 2006

PREPARED BY

WILBUR SMITH ASSOCIATES
HEFFRON TRANSPORTATION
NOHBELL GROUP
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APPENDIX A
SURVEY FORM

This appendix contains the survey form used for this study. The survey form was used as a template to help guide the interview process. Upon request, a copy of the survey was provided to the interviewee to help prepare and collect the data for the interview.

Washington State
Department of Transportation

FREIGHT COMPETITIVENESS & EFFICIENCY SURVEY

Pre-Interview Questionnaire

(To Provide Interviewee with Sample Questions)

Purpose of Interview:

1. Provide background information about company logistics patterns in the Puget Sound region.
2. Identify bottlenecks or deficiencies in the current transportation system of the Region that hampers business operations.
3. Identify performance measures (i.e. time, operating costs) for each segment of the supply chain.

Data to be gathered includes:

1. Overall commodities moving to and from the region
2. Daily, weekly, or seasonal peaks in either outbound or inbound shipments
3. Major market destinations for inbound and outbound shipments
4. Greatest obstacles due to transportation infrastructure in achieving efficient supply chain management.

Organization of Questionnaire:

1. Background – 3 questions
2. Inbound transportation – 8 questions
3. Outbound transportation – 8 questions
4. Supply chain segmentation – 9 questions
5. Overall transportation/logistics – 5 questions

Washington State
Department of Transportation

FREIGHT COMPETITIVENESS & EFFICIENCY SURVEY

INTERVIEWER: _____

DATE: _____

Company Name: _____

Location/Address: _____

Contact: _____ Title: _____

Phone: _____ e-mail: _____

Background

1. How many full time employees does your company employ in the Puget Sound region? Please check the one applicable to your firm **(optional)**

   a. ___ Under 100 b. ___ 100-300 c. ___ OVER 300

2. How long has this operation been at its current location? _____years.

3. What are typical hours of operation for your facility?

   a. Daytime only from _____ a.m. to _____ p.m.

   b. Day / Evening from _____ a.m. to _____ p.m.

   c. ____ 24 hours a day

ENGINEERS PLANNERS ECONOMISTS
Wilbur Smith Associates

Inbound Transportation

4. What are the primary products (by volume) that you receive at your location?:

   a _____ *b* _____

   c _____ *d* _____

5. What are the primary origins of these products? Countries, states, cities (if within WA).

   a _____ *b* _____

   c _____ *d* _____

6. Who exercises control over in-bound transportation decisions? (Use % if more than 1).

   a. _____Your company b. _____ Customers c._____ 3rd party

7. Approximately how many in-bound shipments does your company receive **weekly**?

   a. _____ truck b. _____rail/IMX c. _____ express/air

   e. _____ other: _____

8. Of the truck shipments above, what % are on own trucks and what % are on hired trucks?

   _____ own truck _____for hire truck

9. Do your in-bounds experience daily, weekly or season peaks?

   _____ Yes a. Peak day hours: _____
   _____ No b. Peak days each week: _____
   c. Peak months each year: _____

10. What would you consider to be the most crucial factors influencing your inbound transportation arrangements: (please rank order **the top 3** with 1=highest priority)

    a. _____ On-time/JIT b. _____ Trans. Cost c. _____ Loss/damage
    d. _____ Lower Invent/material e. _____ Equipment availability
    f. _____ Range of integrated services g. _____ Other:_____

11. If "On-time Performance" is one of the critical factors influencing your inbound transportation criteria, indicate what defines on-time relative to the appointed time:

    _____ 15 min. _____ 30 min _____ 1 hour _____ day _____ Other

Outbound Transportation

12. What are the primary products (by volume) that you ship from your location?:

a _____ *b* _____

c _____ *d* _____

13. What are the primary destinations for these products? Countries, states, cities (if within WA).

a _____ *b* _____

c _____ *d* _____

14. Who exercises control over out-bound transportation decisions? (Use % if more than 1).

a. _____Your company b. _____ Customers c._____ 3rd party

15. Approximately how many out-bound shipments does your company receive **weekly**?

a. _____ truck b. _____rail/IMX c. _____ express/air

e. _____ other: _____

16. Of the truck shipments above, what % are on own trucks and what % are on hired trucks?

_____ own truck _____for hire truck

17. Do your out-bounds experience daily, weekly or season peaks?

_____ Yes a. Peak day hours: _____

_____ No b. Peak days each week: _____

c. Peak months each year: _____

18. What would you consider to be the most crucial factors influencing your out-bound transportation arrangements: (please rank order **the top 3** with 1=highest priority)

a. _____ On-time/JIT b. _____ Trans. Cost c. _____ Loss/damage
d. _____ Lower Invent/material e. _____ Equipment availability
f. _____ Range of integrated services g. _____ Other:_____

19. If "On-time Performance" is one of the critical factors influencing your out-bound transportation criteria, indicate what defines on-time relative to the appointed time:

_____ 15 min. _____ 30 min _____ 1 hour _____ day _____ Other

Supply Chain Segmentation

Purpose of the following sets of questions is to broadly segment your overall supply chain, to determine which segments are most sensitive to key performance measures. Specifically, which segments are most prone to materials build-up/bottlenecking, most sensitive to level of service/time/delay, and which have the highest transport costs. And why.

20. **Sensitivity to material ownership:** Which three supply chain segments have the highest share of inventory/material ownership?

Supply Chain Segment 1: a. Material/Product:_____

b. Origin: _____ Dest: _____

c. Mode (circle one): Rail Truck Ship Barge Air d. Routing: _____

e. Where does inventory build-up (circle one): Supplier Plant DC Along line haul

f. Share of total inventory/material cost_____

g. Top factors that influence inventory levels?: % Contribution

_____ _____

_____ _____

h. How does materials build-up along this segment impact your overall operation:

_____

Supply Chain Segment 2: a. Material/Product:_____

b. Origin: _____ Dest: _____

c. Mode (circle one): Rail Truck Ship Barge Air d. Routing: _____

e. Where does inventory build-up (circle one): Supplier Plant DC Along line haul

f. Share of total inventory/material cost_____

g. Top factors that influence inventory levels?: % Contribution

_____ _____

_____ _____

h. How does materials build-up along this segment impact your overall operation:

_____

Supply Chain Segment 3: a. Material/Product:_____

b. Origin: _____ Dest: _____

c. Mode (circle one): Rail Truck Ship Barge Air d. Routing: _____

e. Where does inventory build-up (circle one): Supplier Plant DC Along line haul

f. Share of total inventory/material cost_____

g. Top factors that influence inventory levels?: % Contribution

_____ _____

_____ _____

h. How does materials build-up along this segment impact your overall operation:

_____

21. **Sensitivity to level of service/time**: Which three supply chain segments have the greatest variance in level of service/time?

Supply Chain Segment 1: a. Material/Product:_____

b. Origin: _____ Dest: _____

c. Mode (circle one): Rail Truck Ship Barge Air d. Routing: _____

e. Where dwelling/delay occurs (circle one): Supplier Plant DC Along line haul

f. Share of total supply chain/process time _____

g. Top factors that influence delay/dwell: % Contribution

_____ _____

_____ _____

h. How do delays/dwell time along this segment impact your overall operation:

_____

Supply Chain Segment 2: a. Material/Product:_____

b. Origin: _____ Dest: _____

c. Mode (circle one): Rail Truck Ship Barge Air d. Routing: _____

e. Where dwelling/delay occurs (circle one): Supplier Plant DC Along line haul

f. Share of total supply chain/process time _____

g. Top factors that influence delay/dwell: % Contribution

_____ _____

_____ _____

h. How do delays/dwell time along this segment impact your overall operation:

_____

Supply Chain Segment 3: a. Material/Product:_____

b. Origin: _____ Dest: _____

c. Mode (circle one): Rail Truck Ship Barge Air d. Routing: _____

e. Where dwelling/delay occurs (circle one): Supplier Plant DC Along line haul

f. Share of total supply chain/process time _____

g. Top factors that influence delay/dwell: % Contribution

_____ _____

_____ _____

h. How do delays/dwell time along this segment impact your overall operation:

_____

22. **Sensitivity to transportation costs**: Which supply chain segments represent the highest transportation costs as a share of overall supply chain transportation costs?

Supply Chain Segment 1: a. Material/Product:_____

b. Origin: _____ Dest: _____

c. Mode (circle one): Rail Truck Ship Barge Air d. Routing: _____

e. Where is cost allocated (circle one): Supplier Plant DC Along line haul

f. Share of total supply chain transport cost _____

g. Top factors that influence transport cost: % Contribution

_____ _____

_____ _____

h. How do transport costs along this segment impact your overall operation:

_____

Supply Chain Segment 2: a. Material/Product:_____

b. Origin: _____ Dest: _____

c. Mode (circle one): Rail Truck Ship Barge Air d. Routing: _____

e. Where is cost allocated (circle one): Supplier Plant DC Along line haul

f. Share of total supply chain transport cost _____

g. Top factors that influence transport cost: % Contribution

_____ _____

_____ _____

h. How do transport costs along this segment impact your overall operation:

_____

Supply Chain Segment 3: a. Material/Product:_____

b. Origin: _____ Dest: _____

c. Mode (circle one): Rail Truck Ship Barge Air d. Routing: _____

e. Where is cost allocated (circle one): Supplier Plant DC Along line haul

f. Share of total supply chain transport cost _____

g. Top factors that influence transport cost: % Contribution

_____ _____

_____ _____

h. How do transport costs along this segment impact your overall operation:

_____

Overall Transportation/Logistics Management

23. What is the greatest challenge your currently face in meeting your company's transportation / logistics needs?

_____

_____

_____

24. From a business perspective, what do you feel is the weakest link in the transportation services currently available in the Puget Sound Region?

_____

_____

_____

25a. Which modes of transportation would you most like to see improved in the transportation system of the Puget Sound Region?

_____

_____

25b. What part of the transportation system would you fix? And how?

_____

_____

26. Do you currently collaborate with any other companies for any parts of your supply chain (e.g. warehousing, transportation, etc). If so, how?

_____

_____

27a. What type of supply chain management software do you use, and is it able to provide real-time information about products in transit? _____

27b. Does it provide real time information about traffic tie ups, congestion at terminals, etc. – Would such information be useful? _____

27b. Are there any circumstances under which you would be willing to share information with public agencies (e.g. information about traffic conditions, etc). _____

APPENDIX B
SUPPLY CHAIN SUMMARY

Firm	Market Area			Dependence on Local Transportation Network			Complexity			# Truck Trips/Week	Travel Mode			
	Local	Reg/Nat	Global	Local	Reg/Nat	Global	Simple	Involved	Complex		Truck	Rail	Ship	Air
Building Industry														
Cadman	●			●			●			1200-3000	●			
Woodinville Lumber Yard		●		●	▨		●			600-800	●			
Bob's New Construction	●			●				●		250-300	●			
Quadrant	●			●				●		2050 - 4100 (Sum of Above)	●			
Processed Foods Industry														
U.S. Bakery		●		▨	▨		●			350-1000	●		●	
An International Beverage Company		●		▨	▨			●		300-400	●			
Trident		●		●	▨		●			200-400	●		●	●
A Processed Food Company		●		●	▨			●		60-80	●	●	●	
Starbucks			●	▨	▨	▨			●	1200-1700	●	●	●	
Aerospace Industry														
Goodrich ATS			●	●	▨	●			●	100-1600	●			●
Goodrich Cargo			●	●	▨	●		●			●			●
Boeing			●	●	▨	●			●	400-600	●	●	●	●
TMX			●	●	▨	●			●	9000	●	●	●	●

● Lowest Percentage of Dependence
▨ Medium Percentage of Dependence
● Highest Percentage of Dependence

APPENDIX C
INDUSTRY INTERVIEW SUMMARIES

INTERVIEW SUMMARIES ATTACHED:

1. Quadrant Homes, Bob's New Construction, and Woodinville Lumber
2. Bob's New Construction Warehouse
3. Woodinville Lumber Yard
4. Cadman, Inc.
5. International Beverage Company (name withheld)
6. Processed Food Company (name withheld)
7. Starbucks Coffee Company
8. Trident Seafoods
9. United States Bakery (Franz)
10. Boeing Corporation
11. Goodrich Aircraft Technical Services
12. Goodrich Cargo Group
13. TMX Aerospace
14. Carlile Transportation Systems

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH QUADRANT HOMES, BOB'S NEW CONSTRUCTION, AND WOODINVILLE LUMBER

INTERVIEW DATE: NOVEMBER 7, 2005

INTERVIEWERS: TOM JONES AND SOPHIE HARTSHORN

ATTENDEES

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SUMMARY OF BUSINESS OPERATIONS

Quadrant

Quadrant is the number-one single-family home builder in the Puget Sound region, averaging 15,000-18,000 new homes every year for the past 5 years. They employ about 200 people in their Bellevue offices, with an additional 50 sales agents out in the field.

Quadrant works on a what they call an "evenflow" system, where each home is completed on a very aggressive set schedule. In general, at any point in time there are:

- 6 new homes started each day
- Over 300 homes sold but not started
- 60 homes sold but not released for construction
- Over 300 homes in process
- A 6-week backlog of homes

In general, this system appears to be one that is reliable and efficient.

Woodinville Lumber

Woodinville Lumber (WL) is the primary supplier of floor joists, walls, trusses and pre-manufactured framing panels for Quadrant homes. All materials used in the Puget Sound region are distributed out of a large Central Distribution site (CD) in Woodinville. This site is approximately 18 acres in size, and is used to store several day's worth of inventory.

A smaller distribution and truss manufacturing facility exists in Burlington, Washington, but this site only sees about 15 percent of all revenue (and a corresponding amount of the volume of lumber). Together, the two sites employ about 500 people. Since Quadrant homes is one of the largest clients of WL, the service area of WL tends to grow geographically and volumetrically similar to Quadrant.

Bob's New Construction

Bob's New Construction (BNC) distributes and installs furnaces, air coolers, water heaters, and all associated parts and craftsmanship into the majority of Quadrant Homes. They are headquartered in Kirkland, with additional locations in Tacoma and Burlington that are operationally similar to the Kirkland site. These remote sites exist in order to serve the expanding Quadrant Homes market in these two regions. All sites are large enough to hold a backlog of inventory, and also to serve as a staging area for unloading and loading trucks. BNC employs 158 employees, and owns its own fleet of 118 trucks.

INBOUND TRANSPORTATION

Quadrant

Quadrant relies on many products to complete homes, including:

1. Lumber (wood)
2. Sheet rock
3. Concrete
4. Dirt

Numerous other products, including sinks, furnaces, panels, etc., are also needed to complete a house. In all cases, Quadrant asks the supplier to bring each product directly to the jobsite. Quadrant Homes therefore does not directly oversee any inbound or outbound shipments.

Woodinville Lumber

The Woodinville CD site receives roughly 40 truckloads of bulk lumber products each day. The lumber is trucked directly from mills located primarily in the Pacific Northwest and Canada. The plant repackages the wood into bundles that are per home/per job site, and sends it out to the individual jobs sites. WL uses both its own fleet of trucks and private carriers on its inbound trips. Most of these trucks move along the I-5 corridor.

Bob's New Construction

BNC receives five to six truckloads a day into each of its three sites. The inbound materials include:

1. **Sheet Metal:** arrives on 45-foot trucks from a wholesaler in Fife each evening
2. **Furnaces:** arrive on trucks from Kent at a rate of 1 truck every other night
3. **Insulation:** arrives on trucks from sheet metal supplier in Fife at the rate of one to two per day
4. **Water Heaters:** arrive on trucks from Tacoma and Kirkland once or twice a week

BNC Warehouses are staffed 24 hours a day, seven days a week.

Outbound Transportation

Woodinville Lumber

WL uses a fleet of 25 trucks to take the repackaged lumber from its CD site to the individual job sites. After offloading the wood, the trucks return to the Woodinville CD site in order to pick up a new load. Each of the trucks completes three to four round-trips per day between CD and jobsite.

Lumber deliveries to job site used to take place between the hours of 7:00 A.M. and 4:00 P.M. During the last few years, the time needed for deliveries has increased, causing the delivery hours to expand to 5:00 A.M. and as late as 8:00 P.M. The longest hours are during the summer months, in order to take advantage of extended daylight.

Quadrant's aggressive timeframe means that WL must deliver all necessary lumber products to each site in a 10-day delivery schedule. This usually requires four to five deliveries to each site or home. The size of the loads is limited by what can be carried on a single truck with trailer, and also by increasingly small building lots with limited on-site staging areas.

Bob's New Construction

BNC outbound deliveries begin at 4:00 A.M. and last until late afternoon. If everything goes perfectly, each home/job site requires 8 visits:

1. Lay house out
2. Rough it out day one
3. Rough it out day two
4. Second delivery
5. Inspection
6. Gas pipe installation
7. Water heater and furnace

8. Trim

It is important to note that only half of these visits originate at the BNC warehouses. Trips made by employees to the job sites begin at their homes, since they generally bring the work trucks home with them at the end of the day. Out of 158 employees, generally half of these will start their day from places dispersed though out the Puget Sound region. BNC has furnished maps to illustrate where their employees live.

Risk management has caused BNC to install GPS units in each of its trucks. This helps to track the amount of miles driven, and to control the use and movement of BNC-owned trucks.

BNC offered the following information about its fleet:

1. All trucks drive about 153,333 miles/month total
2. That breaks down to about 1,291 mile/month/vehicle

SUPPLY CHAIN SEGMENTATION

Woodinville Lumber

WL is seeing its time and costs of shipping increase every year. This is due to:

1. Increasing fuel costs
2. Increasing time lost to congestion
3. Increasing geographic spread of market

The inefficiencies caused by these three factors are passed on to Quadrant, and ultimately on to the consumer.

WL has responded to these factors by:

1. Increasing delivery hours from eight or nine to 12 hours per day
2. **Doubling the number of trucks used**, although **volumes have only increased 20 percent** in the last few years.
3. Assembling more and more parts off-site and trucking them to the job site.
4. Increasing the size of the shipments by using larger trucks and adding trailers (thus saving fuel by taking fewer trips).

Though WL says that "most" of the roadway network is problematic, its biggest problems are on:

1. I-405
2. SR 167

Bob's New Construction

BNC is struggling with the same challenges as WL:

1. Increasing fuel costs
2. Increasing time lost to congestion
3. Increasing geographic spread of market

The inefficiencies caused by these three factors are passed on to Quadrant, and ultimately on to the consumer.

Between January and September, fuel prices rose $1.02 per gallon. This worked out to an additional $16,614 in fuel costs.

Though BNC says that "most" of the roadway network is problematic, it's biggest problems are on:

1. I-405
2. SR 167
3. SR 410
4. SR 18
5. I-5

Policy Issues

Woodinville Lumber
WL occasional suffers inefficiencies in its freight delivery system during morning delivery of large loads on I-5. Regulations on this highway prohibit the moving of oversize vehicles south of Burlington on I-5 until after 9:00 A.M.

Bob's New Construction
BNC is experimenting internally with ways to counteract productivity lost to congestion. It is working with new loading/unloading technologies, longer hours, and more efficient warehousing in order to make up some of the time lost to congestion.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH BOB'S NEW CONSTRUCTION WAREHOUSE

INTERVIEW DATE: DECEMBER 16, 2005

INTERVIEWER: SOPHIE HARTSHORN

ATTENDEES

Patrick Beulke
Bob's New Construction Safety Fleet Project and Cell Phone Communications Manager
206-378-6734

This was a follow up interview to the Quadrant/Woodinville Lumber meeting of 11/7/2005. It involved the Yard Manager at Bob's New Construction, one of the major suppliers of furnaces, water heaters, and other HVAC equipment to Quadrant Homebuilders. It was conducted in order to get a better understanding of the truck movements and schedules of a major second-tier construction company in the Puget Sound region.

SUMMARY OF BUSINESS OPERATIONS

Bob's New Construction (BNC) is one of the largest suppliers of residential HVAC equipment in the Pacific Northwest. It owns a fleet of 115 vehicles, of which 90 percent are cargo vans and about 10 percent are flatbed trucks. BNC is a major supplier to Quadrant Homes, which accounts for about 25-35 percent of all BNC business.

BNC has three warehouse locations, in Burlington, Tacoma, and Kirkland. These three warehouse locations collectively serve an area that is bordered by Canada to the north, Olympia to the south, North Bend to the east, and the Pacific Ocean to the west. Each warehouse serves its local market segment. In general, each warehouse exists for three purposes:

1. Receive vendor shipments of water heaters, coolers, etc.
2. Store parts as inventory so that "several days' worth" are always on hand
3. Serve as a distribution point to carry materials from warehouse to job site

As is evidenced by the above language, BNC does not operate on "just-in-time" (JIT) inventory. The warehouses are kept stocked with a good amount of inventory.

INBOUND TRANSPORTATION

BNC receives vendor deliveries into its three warehouses between the hours of 6:30 and 7:00 A.M. It is estimated that 4-10 trucks make drops at each warehouse during this time period. Other things to note about the vendor deliveries include:

- BNC employees do not help with the unloading of vendor trucks.
- Gensco, a major vendor, actually has a full-time employee in the BNC warehouse to oversee delivery, unloading, and warehousing of Gensco products.
- Since JIT inventory is not kept at BNC, congestion is not really an issue for these inbound shipments. There is never a situation where delay causes a part to be missing or out of stock.

OUTBOUND TRANSPORTATION

BNC outbound shipments consist of the BNC fleet of cargo vans and flatbed trucks leaving each of the warehouses and traveling out to job sites. This occurs every Monday, Wednesday, and Friday. The vehicles in the fleet are driven by employees, who take the vans home and drive directly to the job site on the second day. This minimizes the time lost to travel between warehouse and jobsite. It also decreases the amount of usable parking needed at each warehouse. Other outbound shipment facts include:

1. Between 5:00 and 6:00 A.M. on Monday, Wednesday, and Friday, 15-40 empty trucks enter each warehouse location.
2. Each truck/van comes in empty except for returned parts and garbage.
3. The load time is therefore quite short, about 35 minutes average per truck.
4. Drivers are not fined for slow delivery; however, very fast drivers are rewarded. Rewards are usually monthly and take the form of a $50 gift certificate or something akin to that.
5. Eight vans can be loaded at one time; fewer flatbed trucks can be loaded simultaneously.

INNOVATIONS/ADAPTATIONS

BNC's major innovation to fight the time lost to congestion is a "2nd Day Delivery" system. In essence, this system streamlines the amount of time lost to driving by streamlining the delivery of forgotten, broken, or incorrect parts. 2nd Day Delivery operates like this:

- A truck at a job site realizes that it has an incorrect, broken, or wrong part after pickup and delivery on Monday.
- Instead of turning around on Tuesday and driving back to the warehouse, the truck instead faxes the warehouse with a description of the issue.
- The warehouse organizes all the parts and loads them onto a single truck (one operates north of I-90, one operates south of I-90).
- The truck leaves the warehouse at 4:00 A.M. the next day, delivering all of the parts to the correct worksites, and saving each individual driver from having to make a journey.

They have also done the following to combat time lost to travel/congestion:

- Changed delivery start time from 6:00 A.M. to 5:00 A.M., in order to make one delivery before the morning rush.
- Equipped each driver with a walkie-talkie to keep in touch with other drives and discuss problemmatic traffic points.

- Equipped each truck with a GPS unit. This is done to track the movements of the trucks and to record the unloading/dwell time at each warehouse or job site.
- Developed efficiency gains in the yard, such as streamlining the loading and unloading process, and being more creative so that turn-around time for trucks is shorter.
- Loaded the night before in order to get the earliest trucks on the road ASAP in the morning.

Infrastructure Issues

Most BNC shipments are north-south, traveling on roads in the Olympia-to-Canada corridor. Therefore, 520 or I-90 are not counted as problematic. Instead, the worst infrastructure issues are:

- I-5, especially near Everett and up to Route 2
- I-405, especially northbound through the S-curves
- 167 to Tacoma

Policy Issues

BNC does not notice many ramifications of policy issues on its truck movements. The one policy it mentioned is that HOV lanes do not accept flatbed trucks.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH WOODINVILLE LUMBER YARD

INTERVIEW DATE: NOVEMBER 22, 2005

INTERVIEWER: SOPHIE HARTSHORN

ATTENDEES

Eric Conklin
Woodinville Lumber Yard Manager
425-766-2993

This was a follow up interview to the Quadrant/Woodinville Lumber meeting of 11/7/2005. It involved the Yard Manager at Woodinville Lumber, one of the major suppliers of lumber to Quadrant Homebuilders. It was conducted in order to get a better understanding of the truck movements and schedules of a major lumber company in the Puget Sound region.

This interview also clarified that the Woodinville Lumber Truss plant has a separate set of trucking issues due to the high volume of oversize loads.

SUMMARY OF BUSINESS OPERATIONS

The Woodinville umber yard serves as the main facility for all of Woodinville Lumber's receiving, repackaging, and re-distribution of lumber. Lumber arrives, by truck, from mills all over the Pacific Northwest and Canada. It is then repackaged in the Woodinville facility, loaded onto another truck, and taken to the job sites.

INBOUND TRANSPORTATION

The Woodinville lumber yard receives 10-12 inbound truck shipments per day into the Woodinville facility. Roughly half of these trucks come from within the Puget Sound region. The other half comes from locations within British Columbia, Canada. Receiving hours at the yard are from 6:00 A.M. to 2:30 P.M. Later deliveries, up to 7:00 P.M., are possible by limited appointment only. The vast majority of inbound shipments use independent carriers not affiliated with Woodinville Lumber.

The following apply to shipments received from Canada:

- The deliveries are set by appointment, at the rate of one per hour. There is no fine levied in the event of a missed delivery appointment.
- Every effort is made to unload trucks as soon as they are brought in.
- Three to four times a month, a truck is delayed at the border. Most trucks use Blaine border crossing.
- Increasingly, trucks are arriving at odd hours outside of their appointment time. For example, many times trucks will arrive at 6:00 A.M., even though their appointment is not until 10:00 A.M. If possible, these trucks are accommodated. However, they are occasionally asked to circle around for a few hours until the yard can accommodate them. In addition, there is a two-truck "waiting area" in the yard. The costs for these delays are borne by the carrier.
- It takes about 15 minutes to half an hour to unload the truck and get it back on the road.

Outbound Transportation

The Woodinville lumber yard owns 12 trucks dedicated to outbound shipments. These 12 trucks are responsible for 99 percent of the outbound shipments from the yard. The outbound shipments occur between the hours of 5:00 A.M. and 5:00 P.M. daily.

The following apply to shipments leaving the lumber yard:

- The majority of outbound shipments go south, towards Dupont, Puyallup, etc.
- About 35-40 trucks leave the plant each day. This means that each of the 12 trucks is completing three to four trips per day.
- GPS units are installed on each truck. This was done in order to:
  - Manage driver productivity
  - Keep a log file of truck movements in the event of a reported accident or report of property damage due to trucks (i.e., a rock breaking a windshield)
  - Track turnaround times and look at the length of stops
- Two truck types are used for outbound shipments. The two types have slightly different loading and unloading characteristics.
  - Tractor trailers
    - Have a one-hour average turnaround time. This represents the time for the driver to return to the yard, take a break, and reload with lumber before leaving the yard fully loaded.
    - Carry a forklift to make deliveries at job sites.
    - Take about 45 minutes at each jobsite in order to get forklift off, unload lumber, and reload forklift.
    - Try to visit three job sites per trip.
  - 10-wheeled flatbeds
    - Have a 50minute average turnaround time at the lumber yard.
    - Take about 20 minutes to unload lumber at each jobsite.
    - Try to visit two to three job sites per trip.

INNOVATIONS/ADAPTATIONS

Woodinville lumber yard has undergone several adaptations and innovations to try and cut time from the overall delivery process. These adaptations have been in three main categories:

1. Decreasing time lost in loading/unloading and other "dwell" time
2. Increasing hours of operation to try and combat increasing congestion
3. Incorporating traffic management devices

More specifically, they have done the following:

- Changed delivery start time from 6:00 A.M. to 5:00 A.M., in order to make one delivery before the morning rush.
- Installed traffic gauges on all trucks, so truckers can see upcoming congestion/safety concerns.
- Increased the amount of traffic monitoring and feedback to drivers (including DOT camera monitoring)
- Developed their own dispatch and traffic monitoring system, operated by two people.
- Developed efficiency gains in the yard, such as streamlining the loading and unloading process, and being more creative so that turnaround time for trucks is shorter.

INFRASTRUCTURE ISSUES

Most of the Woodinville lumber shipments are north-south, either from Canada and points north, or en route to places such as Puyallup or Dupont. Therefore, the worst infrastructure issues are:

- I-5, especially southbound in the morning
- I-405, both directions, most of the day after 5:45 A.M.

POLICY ISSUES

Time restrictions on oversize loads are a concern, particularly the rule that no oversize trucks may move on I-5 until after 9:00 A.M. This problem is exacerbated on the day before holidays, (such as December 23); when all oversized loads must be off the freeway by noon.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH CADMAN, INC.

INTERVIEW DATE: SEPTEMBER 29, 2005

INTERVIEWER: MARNI C. HEFFRON, P.E., P.T.O.E.

ATTENDEE

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SUMMARY OF BUSINESS OPERATIONS

Cadman, Inc., has two primary lines of business: ready-mix (concrete) and aggregate. This interview focused on the ready-mix line of business because of its time-sensitive delivery needs.

Cadman employs about 320 people in the Puget Sound region, about 200 of which work in the ready-mix division. Cadman has facilities located in:

- Seattle's Duwamish Industrial Area (on East Marginal Way)
- Issaquah (co-located with the Lakeside Industries)
- Bellevue (a satellite site that is available when needed for large commercial projects)
- Redmond (on Union Hill Road)
- Black Diamond (on SR 169 at Green Valley Road)
- Mill Creek (on SR 527)
- Monroe (near the prison)

These sites are shown on Exhibit C-1. Of these sites, Seattle and Issaquah produce the highest volume of ready-mix. The interview focused on these sites.

EXHIBIT C - 1
SITE LOCATIONS FOR CADMAN READY - MIX

The typical hours of operation for the Seattle and Issaquah sites are 5:00 A.M. to 6:00 P.M., although both are permitted for 24-hour, 7-day per week operations. More night-time activity occurs from the Seattle site. Noise considerations affect night-time operations in Issaquah because of the site's proximity to residential areas.

INBOUND TRANSPORTATION

Four ingredients are used to create ready-mix concrete:

1. Aggregate (a mixture of sand and gravel)
2. Cement
3. Fly ash
4. Additives (one or more depending on the application).

Different modes and sources are used for each of these materials depending on the site where the ready-mix is made. The origin and mode of transport for the Seattle and Issaquah site are shown in Exhibit C-2:

EXHIBIT C-2
ORIGIN AND MODE OF TRANSPORT FOR READY-MIX INGREDIENTS TO SEATTLE AND ISSAQUAH SITES

	Origin and Method of Transport to:	
Material	**Seattle Site**	**Issaquah Site**
Aggregate	Gravel barged from Dupont, Washington Sand from Canada. Average of about 1½ barges per week.	75% of material comes directly from site; 25% (course material) is trucked from North Bend. Average of 10 to 20 loads trucked from North Bend per day for concrete mixing. (Additional trucks bring course material to Lakeside Paving for asphalt).
Cement	Barged from Canada. Average of about 1½ barges per week.	Trucked from the Seattle site. Average of about 5 to 6 truck loads per day.
Fly ash	Trucked from Centralia. Average of about 2 truck loads per day.	Trucked from Centralia. Average of about 1½ truckloads per day.
Additives	Trucked from South Seattle. About 2 trucks per month.	Trucked from South Seattle. About 2 trucks per month.

Most of the aggregate deliveries are made by Cadman-owned trucks when they are available. Sometimes these deliveries are made by contract haulers. The inbound fly ash and additives are delivered by hired trucks. All inbound truck deliveries are controlled and scheduled by Cadman.

The Seattle and Issaquah sites have on-site storage that would allow production of up to three days' worth of ready-mix. Deliveries generally occur daily to restock the supply. The most crucial factor influencing inbound transportation arrangements is noise restrictions at their sites (or supply sites) that prohibit loading and unloading during certain times of the day. While this is not a critical issue at the Seattle site, it does affect most of the other sites in Cadman's system. For this reason, most deliveries are scheduled to occur during daytime hours, but avoiding the peak commute periods. The trucks being used to haul aggregate and cement to the facility general make multiple trips during the day, spaced out over time; therefore, there is no peak time of day when truck movements are highest.

OUTBOUND TRANSPORTATION

Ready-mix concrete is the only product that is shipped out of Cadman's facilities. Once mixed, concrete must be poured within 2½ hours, and Cadman's goal is to have trucks unload within 90 minutes of leaving the plant. The market area for each site is set to provide about 20-minute travel times between the site and the customer, which is approximately a 10-mile radius in the urban areas and slightly larger in the rural areas (e.g., from the Black Diamond or Monroe sites).

The customer sets the requirements for outbound flow. Cadman will request information about a concrete pour's start time and the desired volume per hour (which is often dictated by the equipment and construction personnel at a site) to determine the spacing of trucks leaving the plant. For example, a customer might request 60 yards per hour. Each truck can carry about 10 yards each, so they will be set to arrive every 10 minutes.

Cadman has 22 concrete-mixing trucks in Seattle, and each can haul about four loads per day. This relates to a weekly volume of about 400 to 450 loads per week. There are 25 trucks at the Issaquah site, and the weekly volume is about the same as Seattle's. There are peaks in the ready-mix business which follow the peak construction seasons. During a peak month, each site's volume might increase to about 500 truckloads per week. The increase is generally accomodated through longer work days (since the fleet size remains the same). All of the concrete mixer trucks are owned and operated by Cadman.

The most crucial factor influencing the outbound transportation arrangements is **on-time delivery.** Concrete is a perishable commodity and has a very short shelf life (90 to 150 minutes after the truck has been loaded). Therefore, it is highly susceptible to congestion-related or unexpected delays. Cadman's on-time performance is measured from 15-minutes early to dead on-time to the delivery schedule predicted for the customer. With the use of sophisticated dispatch software, very few loads are lost because the product is delivered past its viability deadline. Most losses occur because of jobsite delays, but with pumping technology at the jobsites, this has also become less frequent. An unusable load is trucked to a facility that makes concrete-waste products such as ecology blocks. The value of a lost load is about $75 to $80 per yard, or about $800 per truck.

Cadman uses sophisticated supply management software (called *Command Series*, which is used by the vast majority of ready-mix companies worldwide) that tracks each customer's truck demand, pour rates, turn times, and expected travel time. They have GPS transponders in all of their trucks that track through a screen in the dispatch software. They can access this information as needed.

The dispatch system estimates travel times, but those are generally an average during off-peak hours. It does not account for unexpected delays. While they do use the WSDOT web sites to track congestion, they have found that their own radio communication is more reliable and timely (they know about congestion before the WSDOT web site does). All of their truck drivers know the best alternative routes in their market area.

Supply Chain Segmentation

Because it is a perishable product, the end product—ready-mix concrete—and its delivery to the customer is the element of the supply chain that has the highest share of material ownership, is most susceptible to variations in level of service, and has the highest transportation costs. All of the transportation of this product is performed in Cadman-owned concrete mixer trucks. Any inventory of this material is also held in the trucks, since that is where it is made.

The only other element of the supply chain that is subject to variance are the barge shipments of cement that arrive at Cadman's plant on the Duwamish River from Canada. The Seattle facility has on-site storage for approximately 5,000 tons of cement. This is about a 3-day supply of materials. They closely track and coordinate the barge shipments to make sure that the supply does not run low. The barge loading used to be susceptible to tide fluctuations because they did not have the needed depth. They recently dredged the dock area, which has relieved this issue. The dredging required a lengthy permitting process.

In terms of transportation costs, about 25 percent of the cost of ready-mix is related to delivery—70 percent of which is labor, 20 percent for truck maintenance, and a combined 10 percent for fuel, insurance, etc. They are able to pass on the recent fuel-cost increases through the indexed fuel surcharge.

Current turn times (the number of loads a truck can deliver in a day) are about the same as they were several years ago because the pour rates have improved substantially (primarily related to the fact that most large projects now use pump equipment). Further improvements in pour rates are not expected, so congestion will likely affect turn times in the future. Their primary advantage is the fact that they have multiple locations from which to make deliveries.

Infrastructure Issues

Unpredictable delay is the greatest challenge facing the transportation system. Key corridors and locations where Cadman experiences the most delay (and unpredictability) are:

- I-5 through downtown Seattle
- I-405/SR 167 interchange
- I-405 through downtown Bellevue
- SR 522 inbound from Monroe
- I-405/SR 522 interchange

Policy Issues

A new policy enacted by the City of Seattle concurrent with the closure of the downtown Seattle Bus Tunnel has severely restricted concrete deliveries to the downtown core. The new system requires a permit for all daytime truck activity in the downtown core. No trucks are allowed between 6:00 and 9:00 A.M. and between 3:00 and 7:00 P.M., unless an exception is granted by Seattle Department of Transportation (SDOT). For large construction projects that

need concrete, this essentially limits the delivery times to between 9:00 A.M. and about 2:00 P.M. (to exit before the restriction is imposed). Most projects in the downtown core do not have construction occur at night because of noise restrictions.

The permit to access the downtown core is $150 per truck per month per jobsite. The permits are required for the number of trucks that could be circulating in the downtown core for a single project at any one time. For example, one project might need 100 yards per hour, which would require about 15 trucks cycling for that job, eight of which could be in the downtown restricted zone at any one time. The City would then require the company to purchase eight permits (which can then be copied and put into all 15 trucks.) For large projects, this equates to about an extra $0.50 to $0.75 per yard of concrete. For small projects such as a street utility patch that might require only four yards of concrete, the company would require a one-day permit for $20 plus the time involved in getting the permit. This could add about $30 to the cost for four yards.

Cadman is currently providing concrete for the WaMu Tower on Second Avenue. Had the permit system been in place for that project, it could have added another $75,000 to the project costs in permit fees alone.

Cadman will pass on the costs of the permits to the general contractor, who in turn will pass it on to the owner. The cost of the permit is secondary to the additional cost related to extended schedules. The time restrictions imposed could double the time needed to complete concrete work on a large downtown project. The additional schedule time and financial carrying costs could exceed tens of millions of dollars for high-value projects. This could affect decisions to develop projects in the downtown core.

Nighttime pours are not a good option since most of these would require waivers of the noise ordinances. Also, with unionized labor (in both the concrete truck and on the construction site), nighttime construction costs a premium in labor. This in unlike most truck deliveries that require only a receiving clerk to accept a delivery. Concrete must have the construction crew on site to place the material.

Cadman understands the afternoon peak hour restrictions. However, on some streets, the morning congestion has not been an issue with the buses out of the tunnel. SDOT should review the traffic conditions in the morning to determine if exceptions could be made to the 6:00 to 9:00 A.M. restriction in some areas.

Potential Actions

1. Review local policies to make sure they have adequately assessed the economic consequences of time restrictions for construction vehicles. Determine if morning peak period restrictions are necessary based on congestion.
2. Address chokepoints that result in unpredictable delays.
3. Consider daytime incident management along major corridors, not just during the commuter peak hours.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH DISTRIBUTION DIVISION OF AN INTERNATIONAL BEVERAGE COMPANY

INTERVIEW DATE: NOVEMBER 22, 2005

INTERVIEWER: TIM DUFFY

ATTENDEE

Director Northwest Logistics, Bellevue, Washington

SUMMARY OF BUSINESS OPERATIONS

Please note: This company did not give permission to reference their name directly in the public version of this study.

SUBJECT-COMPANY is the distribution arm of an international beverage company. SUBJECT-COMPANY operates 431 facilities throughout North America and Western Europe, generating over $18 billion in revenues. The Northwest division of SUBJECT-COMPANY is located in Bellevue, Washington, and is the focus of this interview.

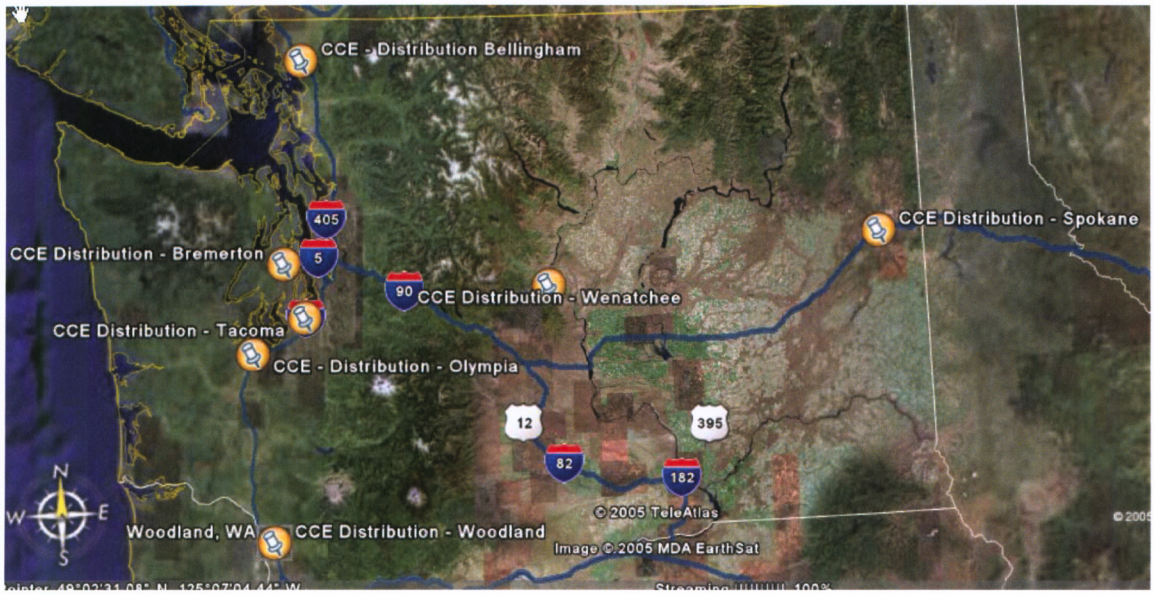
Employing over 300 people in the Puget Sound area, SUBJECT-COMPANY-Northwest operates 24 hours a day producing Name brand beverages at their bottling plant located in Bellevue, Washington. Once produced, product is shipped to distribution centers throughout Washington and several points outside the state. From the distribution centers, finished product is shipped to the point of sale at supermarkets, convenience stores, and other retailers within the immediate market areas.

In addition to their Bellevue bottling plant and distribution center, SUBJECT-COMPANY-Northwest has distribution facilities located in the following areas within Washington State:

- Bellingham
- Marysville
- Tacoma
- Bremerton
- Olympia
- Woodland
- Wenatchee
- Spokane

These sites are shown in Exhibit C-3.

EXHIBIT C-3
SUBJECT-COMPANY-NORTHWEST DISTRIBUTION FACILITIES



The bottling plant operates 24 hours per day, five to seven days per week based on seasonality. The plant typically operates seven days per week, May to September. SUBJECT-COMPANY-Northwest has a fleet of seven trucks operating 16-24 hours per day delivering full goods to the distribution centers. Inbound raw material transportation is arranged and controlled by outside vendors.

Distribution centers typically operate Monday through Friday, 24 hours per day. Larger distribution centers (Tacoma, Bellevue, and Spokane) also operate on Saturdays. Each distribution center has between 10 and 60 trucks delivering 20 to 120 routes per day, five to six days per week. On a typical day, the Bellevue facility alone has 67 trucks utilizing the Puget Sound transportation infrastructure.

INBOUND TRANSPORTATION

The bottling plant receives over 200 inbound shipments each week. The primary components that make up Name brand finished product include empty cans or bottles, liquid sweetener, liquefied gasses, concentrate, and packaging materials. (Please see Exhibit C-4). Peak inbound hours are from 8:00 A.M. to 5:00 P.M. each day. Peak days of the week are Monday and Friday, peak months are May through September. The shipping vendors control 90 percent of the inbound transportation. SUBJECT-COMPANY picks up approximately 10 percent of inbound shipments using company owned trucks.

EXHIBIT C-4
INBOUND PRODUCT CATEGORIES (SORTED BY VOLUME)

Product Category	Point(s) of Origin	Mode	Target Inventory On-Hand
Empty Cans/Bottles	Kent, Olympia	Truck	2 Hours
Liquid Sweetener & Liquefied Gasses	Fife	Tanker Truck	24 Hours
Concentrates	Texas	Truck	3 days
Packaging Materials	California	Truck	7 Days

The bottling plant has limited storage capacity. Raw material inventory supply on-hand ranges from two hours for empty cans and bottles to seven days for packaging materials. Since SUBJECT-COMPANY runs with limited raw material inventory on-hand, inbound on-time delivery is critical. Vendors are expected to meet scheduled appointments within a 15-minute window. A delay of inbound product could result in line down time, increased labor cost, and lost sales downstream.

SUBJECT-COMPANY estimates current inventories are inflated 20 percent to compensate for infrastructure-related transportation delays. Because the bottling operation is so dependent on on-time delivery of raw materials, SUBJECT-COMPANY suppliers have compensated for the Puget Sound area congestion by arriving early and waiting for scheduled delivery times, increasing overall transportation costs.

OUTBOUND TRANSPORTATION

From the bottling plant, SUBJECT-COMPANY ships 145-180 truckloads of full goods each week, primarily Name brand beverages, to distribution centers located in the Puget Sound area, eastern Washington and several points outside the state. Puget Sound area distribution centers are located within 90 miles of the bottling plant. SUBJECT-COMPANY ships 90 percent of outbound shipments using company-owned and -controlled trucks.

Storage capacity at the distribution centers is limited to a seven-day supply. Demand and supply variability require the distribution centers to depend on daily plant deliveries to fulfill current orders. As a result, on-time delivery is one of the most crucial factors in arranging outbound transportation from the bottling facility. Deliveries are expected to arrive within one hour of a scheduled appointment.

SUBJECT-COMPANY distribution centers ship product to the point of sale at supermarkets, convenience stores, and other retailers in their respective market areas. Typically, deliveries are made within 31 miles of the distribution center. Each distribution center has a fleet of trucks delivering routes within their market area. Small facilities have a fleet of 10 trucks operating at least 16 hours per day, five days per week. Bellevue, the largest distribution facility, has 60 trucks delivering 120 routes per day, five to six days per week.

SUPPLY CHAIN SEGMENTATION

Full goods (those that have completed production) is the element of the supply chain that has the highest share of transportation cost, is subject to the greatest variance in service level, and represents one of the highest shares of material ownership. The majority of full goods shipments are performed using SUBJECT-COMPANY trucks. Full goods are produced 24 hours daily, five to seven days per week, and shipped out at a rate of 30-40 trucks per day from the Bellevue bottling plant.

Empty cans and bottles represent the other segment of the supply chain that is subject to variability. With only a two-hour supply of inventory on hand, on-time delivery of this component is critical. Delayed shipments result in line downtime and increased labor costs. Suppliers ship product early to minimize the risk of missing a delivery appointment, resulting in increased transportation costs and underutilized equipment.

Due to congestion in the Puget Sound area, SUBJECT-COMPANY has experienced significant transportation efficiency declines at both the bottling plant and the distribution centers. Transportation efficiency is deteriorating at a rate of 15-20 percent annually. In 2001, a round trip to Tacoma from the Bellevue bottling plant took 90 minutes, compared with 120-150 minutes today. SUBJECT-COMPANY compensates for the deteriorating infrastructure by paying driver overtime and/or purchasing additional trucks and hiring more drivers.

INFRASTRUCTURE ISSUES

The Puget Sound highway capacity, particularly I-405, Highway 167, and Highway 520, has not kept pace with the commercial and population growth in the region. Since 2001, SUBJECT-COMPANY transportation efficiency has declined 15-20 percent annually due to congestion on area highways. As congestion increases, the likelihood of unpredictable delays (i.e., accidents, merging issues etc.) increases. Area congestion has made it impossible for SUBJECT-COMPANY to achieve their goal of keeping transportation costs flat through productivity improvements, despite increasing fuel, labor, and contract carrier costs.

SUBJECT-COMPANY is challenged by the overtaxed Puget Sound highway system at the bottling plant as well as at each of the five Puget Sound area distribution centers.

POTENTIAL ACTIONS

- Expand the highway system to provide alternative routes and/or additional lanes or raised roadways.
- Take pressure off existing highway infrastructure by building a light rail system for commuter activity that is comprehensive, inexpensive, and user-friendly.
- Preserve the ability for fleets to license their fleets to 105,000lbs GVW to allow for the continued ability to take advantage of larger payloads and fewer trips.
- Encourage local retailers to accommodate off-hour deliveries (from 6:00 P.M. to 3:00 A.M.) to relieve daytime congestion on the roadways.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH DISTRIBUTION DIVISION OF A PROCESSED FOOD COMPANY

INTERVIEW DATE: NOVEMBER 10, 2005

INTERVIEWER: TIM DUFFY

ATTENDEE

Director, Logistics, Kent, Washington

SUMMARY OF BUSINESS OPERATIONS

Please note: This company did not give permission to reference their name directly in the public version of this study.

SUBJECT-COMPANY is a family-owned and -operated processed food company that has been operating in the Puget Sound area for over 85 years. SUBJECT-COMPANY manufactures over 400 products under various brands. Because they are a tightly held company, certain data, including sales volume information, is not released to the public.

SUBJECT-COMPANY manufactures product in four locations: Kent, Washington; Airport Way, Seattle; Rainier Avenue, Seattle; and Albany, Oregon. All finished goods are consolidated and shipped from their distribution center attached to the Kent manufacturing facility.

Raw materials are sourced domestically and internationally. Meat is imported from Brazil, shipped ocean freight to the port of New Jersey, railed to Tacoma, and trucked to the plants. Packaging film is sourced from Asia and corrugated packaging is sourced locally mostly from Kent, Washington. SUBJECT-COMPANY also sources spices from California.

SUBJECT-COMPANY receives approximately 53 trucks of material each week. Inbound volume generally does not have a peak period. Volume has limited variability across the week, month, or year. November through February tend to be the slowest months.

On average, SUBJECT-COMPANY ships 290 orders each week. The majority of shipments are less-than-truck-load (LTL) orders. An estimated 15 orders per week are full truck load. SUBJECT-COMPANY ships primarily shelf-stable product to markets across the country. About 50 percent of out-state volume leaves via I-90 and 50 percent via I-5.

Transportation costs, on-time delivery, and damage are the top three factors influencing inbound and outbound freight decisions. Inbound and outbound on-time performance is based on a 30-minute delivery window.

Inbound Transportation

Components used in SUBJECT-COMPANY 's manufacturing process are primarily processed meat, packaging film, corrugate packaging, and spices (see Exhibit C-5). SUBJECT-COMPANY controls the transportation decisions for about one-half of the inbound volume. Transportation for imported packaging film and meat is controlled by a third-party freight forwarder. Inbound corrugate transportation is controlled by SUBJECT-COMPANY using hired trucks for 75 percent of the volume and company-owned trucks for the balance. Company-owned trucks are also used to shuttle finished goods to the distribution center. Cost is the primary factor influencing inbound transportation decisions.

Exhibit C-5
Inbound Product Categories (Sorted by Volume)

Product Category	Point(s) of Origin	Weekly Volume (Truckloads)
Corrugate	Seattle/Kent	26
Processed Meat	Brazil via the Port of New Jersey	12
Packaging Film	Asia via the Port of Seattle	12
Spices	California	Unknown

Outbound Transportation

Finished goods produced at the SUBJECT-COMPANY processing facilities are consolidated and shipped from the Kent distribution center. Although SUBJECT-COMPANY does not experience significant peaks and valleys in their demand curve, the highest outbound volume period is between April and August. Daily volume peaks between 2:00 and 5:00 P.M.

SUBJECT-COMPANY ships processed meat products, primarily jerky, to retailers and other food service establishments across the country. The majority of shipments are LTL. Approximately 274 LTL orders per week are consolidated and shipped on roughly 15 hired trucks. In addition, SUBJECT-COMPANY ships approximately 15 full truck load orders each week. Out-of-state demand leaves the Kent area via I-5 and I-90 equally.

Supply Chain Segmentation

There are three segments of the supply chain most susceptible to variance that are critical to SUBJECT-COMPANY's ability to effectively meet customer demand while maintaining profitability: finished goods, inbound meat, and local packaging supply.

Finished Goods

Finished goods is the segment of the supply chain that has the highest share of material ownership (50 percent), represents the highest share of total transportation costs (50 percent), and is susceptible to variance in transportation-related service levels. SUBJECT-COMPANY controls all outbound shipments leveraging multiple LTL carriers.

SUBJECT-COMPANY customers maintain limited inventory in their systems. A typical order is comprised of two to three pallets and weighs 850 pounds. SUBJECT-COMPANY maintains a 1-2-week inventory balance. Any service variation in the supply chain has an immediate impact on customer service levels and SUBJECT-COMPANY's profitability.

Inbound Meat

Meat is imported from Brazil, shipped ocean freight to the port of New Jersey, railed to Tacoma, and trucked to the plants. Thirty percent of inventory is invested in processed meat. Processed meat also consumes 30 percent of the total transportation budget. Delays occur at both the outbound and inbound ports. Rail service is unpredictable. Shipments can sit at any one of several points along the rail line. The last mile from Tacoma to the plants takes increasingly greater amounts of time due to traffic congestion in the Puget Sound area.

Packaging Materials

Packaging film is imported mostly from Asia and received through the Port of Seattle. Corrugate is sourced locally and delivered by the vendors or picked up using SUBJECT-COMPANY trucks. SUBJECT-COMPANY controls the timing of all corrugate deliveries. Packaging materials represent 20 percent of total transportation costs. Vendor production delays and port congestion are the primary factors causing service issues for packaging film.

SUBJECT-COMPANY estimates 15 percent of current inventory levels, or $1-2 million, is in place to buffer transportation-related service issues. Causes of supply chain variability include:

- Local traffic congestion; affecting both interplant transfers, outbound to customers, and

inbound product from the ports, rail yards, and local vendors.
- Limited LTL capacity drives up costs, causes service variability
- Fuel surcharges
- Rail service levels and capacity issues
- Port of Seattle and Port of New Jersey congestion/capacity issues.

INFRASTRUCTURE ISSUES/POSSIBLE ACTIONS

On-time delivery at a reasonable cost, of LTL and FTL shipments, has been identified as one of one of SUBJECT-COMPANY's greatest transportation challenges. SUBJECT-COMPANY associates this challenge with the lack of competitive carriers in the Puget Sound area and the lack of a viable rail alternative with consistent service for LTL or FTL service.

SUBJECT-COMPANY would like to see significant investment in improving rail service regionally and across the country. Improvements include:

- An integrated rail system that allows seamless accounting of shipments
- Improved, measurable loading/off-loading in the rail yards;
- Expand equipment to support the efficient handling of LTL loads
- Integrated Information Systems infrastructure to measure on-time delivery (similar to the airlines)

Congestion on the I-5 and I-90 corridors is a significant contributor to increasing transportation costs and delivery delays particularly between SUBJECT-COMPANY facilities. Travel time between facilities has increased significantly over the past five years. Specific data were not provided.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH STARBUCKS COFFEE COMPANY

INTERVIEW DATE: OCTOBER 31, 2005

INTERVIEWER: TIM DUFFY

ATTENDEE

Brent Denniston, Director, Transportation
Starbucks Coffee Company
2401 Utah Avenue South
Seattle, WA 98102
206-318-7950
e-mail: bdennist@starbucks.com

SUMMARY OF BUSINESS OPERATIONS

Starbucks Coffee Company purchases and roasts over 200 million pounds of whole bean coffee and sells it along with related food, beverages, and merchandise primarily through its company-operated retail stores. Starbucks' company-owned and -licensed stores currently exceed 10,000 locations worldwide. Starbucks also sells whole bean and ground coffee as well as other coffee-related food and beverages through grocery and institutional channels. Starbucks has strategic alliances with many highly visible brands and organizations, including Pepsi-Cola Company, Dreyer's Grand Ice Cream, Kraft Foods Inc., CARE, Conservation International, Johnson Development Corporation, and many other hotel, food service, technology, communications, retail, and financial institutions.

Starbucks has domestic roasting plants and distribution centers in Kent, Washington, Renton,Washington, York, Pennsylvania, and Carson Valley, Nevada. Starbucks also leverages third-party fulfillment houses to distribute dairy, perishable foods, paper, and ready-to-drink beverages.

Due to space constraints and/or product shelf life, stores require a relatively high frequency of deliveries. Product is distributed to company stores through one of four channels.

- Roasting plant shipments
- Third-party dry goods distribution service
- Third-party perishable delivery service
- Vendor direct delivery

Roasting Plant Shipments

Roasted coffee, merchandise, packaged foods, and store supplies are shipped one to three times weekly via less-than-truck-load (LTL) contract carrier. Shipments are scheduled to arrive within a predetermined four-hour window between 6:00 A.M. and 2:00 P.M. Stores plan labor around scheduled arrival times. If product arrives outside the scheduled window, the store incurs incremental labor, and the product typically sits in an area that impedes either customer or employee flow.

Third-Party Dry Goods Distribution Service

Paper supplies (cups, lids, napkins, etc.), dry bar condiments, and ready-to-drink beverages are delivered through a third party delivery service one to two times each week.

Third-Party Perishable Delivery Service

Depending on store location, dairy, pastry, and beverage components are shipped nightly through a third-party carrier. Product is dropped at the store between 10:00 P.M. and 5:00 A.M. by drivers that are secured with store keys and security information. Daily orders are maintained by each store. Product is checked in as part of the daily store opening process.

Vendor Direct Delivery

Stores located in rural areas rely on local delivery services or vendors to supply dairy and other fresh products.

All inbound and outbound deliveries are executed using contract carriers or third-party fulfillment houses. However, Starbucks controls the timing of all logistical movements.

Because of its size and presence in the Puget Sound area, this interview focused primarily on the Kent roasting and distribution facility. To a lesser extent, the interview focused on the Renton facility and Puget Sound third-party fulfillment houses. The Kent facility operates from 6:00 A.M. to 6:00 P.M., Monday through Friday. Schedule varies during peak shipping periods in October/November.

Starbucks Puget Sound area locations include:

- Roasting and Distribution Facility – Kent, Washington
- Seattle's Best Distribution – Renton, Washington
- Corporate Headquarters – Seattle, Washington
- Third Party Consolidated Distribution Facility – Kent, Washington
- Third Party Paper/RTD Distribution Facilities – Seattle, Tacoma, Everett

Inbound Transportation

Starbucks receives 71 containers of green coffee each week into the Puget Sound area, primarily from Latin America, North Africa, and Indonesia. Green coffee receiving peaks between April and July, coinciding with the harvest seasons. 80 percent of coffee import

shipments arrive via rail in Tacoma (majority) and Seattle from the ports of Long Beach, Los Angeles, and Oakland. 10 percent of coffee import shipments arrive via rail in Portland. The last 10 percent arrive in a variety of ways. Coffee is then trucked from the respective railhead to the roasting plant. Coffee is received and stored at or near the roasting plants until required for production. Starbucks also receives 15 ocean containers each week of other materials, primarily finished goods. Merchandise receiving peaks in the August/September period in preparation for the holiday season. Merchandise is sourced primarily from China and, to a lesser extent from Switzerland, Thailand, and Korea. Beverage components are sourced from Japan.

Starbucks receives an estimated 58 truck loads and 200 LTL shipments of domestically sourced merchandise, packaged foods, packaging materials, and supplies each week across the Puget Sound. Starbucks also receives two containers of domestically sourced beverage components weekly via rail.

Exhibit C-6
Puget Sound Weekly Inbound Receipts

Product Category	Primary Origin	Full Containers	Less than Container
Green Coffee	Central America, North Africa, Indonesia, South America and Germany	71 – Ocean	
Merchandise, Materials, Packaged Food	China, Switzerland, Thailand, Korea, Japan	15 – Ocean	
Merchandise, Packaged Foods, Packaging Materials, Store Supplies	Continental US & Asia (LCL Long Beach Port)	58 – Truck	200 – Truck
Beverage Components	MI, OR, IL, BC, CA	2 – Rail	

Starbucks controls 100 percent of inbound transportation. They are currently conducting a pilot to outsource inbound transportation management with a third-party logistics (3PL) firm.

Starbucks experiences two distinct inbound peaks: April to July for green coffee, and August to September for merchandise.

Although this interview did not focus on store deliveries, Puget Sound area stores combined receive an estimated 1200-1400 inbound deliveries each week.

On-time delivery, transportation cost, and minimal inventory investment are the top three criteria for measuring logistics performance. On-time delivery of seasonal merchandise is particularly critical. Transportation cost is the most crucial factor related to the receipt of green coffee due to the large volumes imported annually.

Outbound Transportation

The Kent distribution facility supplies coffee, merchandise, and other supplies to over 1900 stores located throughout Washington, British Columbia, Oregon, and portions of California. Approximately 1800 LTL shipments originate from the Kent and Renton facilities (primarily Kent). Many parcel and express shipments originate from these facilities each week. Starbucks also ships approximately 20 truck loads every week to specialty sales and grocery customers.

Store shipments are picked by geography and loaded on an LTL carrier for routing and delivery. Approximately one-half of all product shipped by weight from the Kent and Renton facilities is roasted coffee. The balance of product shipped includes retail supplies and merchandise.

On-time delivery is the most crucial factor in measuring outbound transportation performance. Deliveries are made at every store during a pre-determined four-hour window between 6:00 A.M. and 2:00 P.M. Labor is scheduled specifically to receive and stock inbound product. Delays in delivery cost stores incremental labor and interrupts business flow if the delivery sits in the store during high volume periods.

Supply Chain Segmentation

Receipt of green coffee represents the segment of the supply chain that has the highest share of material ownership. Limited rail head capacity hinders Starbucks' ability to mitigate fluctuations in inbound transportation costs and service. Lack of direct service from Latin American ports to Seattle and Tacoma require coffee to be routed through the ports of Long Beach, Los Angeles, and Oakland, shipped to the Portland, Tacoma, and Seattle railheads via rail, and subsequently shipped over the road to Seattle, causing Starbucks to incur additional handling costs as well as service and cost variability caused by port and traffic congestion. Rail congestion limits flexibility and requires extended lead-times for merchandise imported from Europe.

Outbound transportation to the stores is the element of the supply chain that has the highest transportation costs and is most sensitive to variations in service level. Stores have a specific delivery window and receive product one to three times each week. Product scheduled for delivery is often promotionally based and is part of an overall marketing campaign. On-time performance is measured within 15 minutes of the delivery window. Starbucks' has attempted to mitigate rising fuel costs through improved efficiencies; however, their efforts have been hindered by increased Puget Sound congestion. Congestion limits the number of stops a route driver can make in a set period of time.

Infrastructure Issues

During an average week, Starbucks has an estimated 500 trucks using the Puget Sound transportation infrastructure. Issues include traffic congestion, local freeway connections, local and national rail capacity issues, and the inability to receive less-than-container load (LCL) loads into a Washington port.

National and local rail capacity issues hinder Starbucks' ability to reduce transportation costs by an estimated $200,000 annually. Containers originating from Latin America must be routed through the ports of Long Beach, Los Angeles, and Oakland, shipped via rail to the Portland, Tacoma, and Seattle railheads, and then trucked to Seattle. It is not uncommon for a container to take 15 days to clear the Port of Long Beach and arrive in Seattle. Railhead congestion regularly results in delays to coffee and merchandise deliveries. Starbucks builds in additional lead time to compensate for expected railhead inefficiencies. Local railhead congestion has also forced Starbucks to terminate a number of Asia-to-U.S. East Coast shipments in Seattle and, instead, ship the product over-the-road to make up lost time.

Traffic congestion in the Puget Sound area increases overall costs of Starbucks' transportation. Starbucks supplies over 200 locations in the Puget Sound area, representing 1200-1400 deliveries each week. Route efficiencies are directly impacted by area traffic conditions. Specific areas of concern include Highway 167, I-405, and I-5.

Potential Actions

Identify bottlenecks and invest in infrastructure that will reduce cycle times through the port terminals.

Review logistics infrastructure between the Puget Sound Ports and the rail heads to identify and reduce congestion points between the two systems.

Create incentives, invest in rail infrastructure to relieve capacity constraints and improve transit times along the West Coast.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH TRIDENT SEAFOODS

INTERVIEW DATE: OCTOBER 27, 2005

INTERVIEWER: MIKE SIEGMUND, TIM DUFFY

ATTENDEE

Ron Hildebrandt, Chief Logistics Officer, Trident Seafoods
Trident Seafoods
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SUMMARY OF BUSINESS CLUSTER

Trident Seafoods is the largest vertically-integrated harvester, processor, and marketer of frozen seafood products in the country. Founded in 1973, Trident is a privately held corporation operating offshore processors and shore-side plants throughout Alaska and the Pacific Northwest.

Trident is one of the largest companies identified as part of Seattle's Maritime Cluster. This cluster is comprised of fishing, ship building/repair, marine construction, seafood processing, water transportation, marine goods/service, and cold storage companies. According to the City of Seattle Office of Economic Development, the combined sales of this cluster exceeded $4 billion in 2002 and employed over 45,000 across King County.

SUMMARY OF BUSINESS OPERATIONS

Trident harvests and processes over 100 million pounds of seafood annually. Ninety-five percent of raw materials (seafood) are caught off the Alaskan coast and, to a lesser extent, the coastline of the Pacific Northwest. Seafood is processed, cubed, and frozen in bulk form in one of twelve on- or off-shore bulk processing facilities primarily located in or off the coast of Alaska. In addition, Trident has three salmon canning facilities located in Alaska. Once processed, bulk product is either exported or shipped to secondary processing facilities and converted to consumer-ready finished goods.

Trident experiences both demand and supply seasonality. Supply seasonality is driven by the pollack fishing seasons, January to May and July to October. The harvests peak in March and August respectively. Demand seasonality peaks during the Lenten months between February and April.

Trident employs over 5,000 people, with approximately 650 people in the Puget Sound region. In season, Trident supplies the personnel and living essentials to staff and support remote and at-sea operations in Alaska. Approximately 4,000 people are dispatched to Alaskan operations via Seattle annually. Trident estimates they are Alaska Airlines' single largest customer.

The majority of bulk product harvested in the Pacific is shipped into the Puget Sound area for secondary processing. Trident owns and operates three ships that shuttle bulk product in 1,000-ton increments from Alaska every 10 days during the fishing seasons: January to May and July to October. An inbound shipment of bulk, processed seafood requires 50 containers and must be unloaded within 30 hours. A crew of 200 people supports the logistics on a single boat. An unloading delay of 1 day costs Trident $20,000 or $833 per hour per boat.

Bulk product is shuttled from the port to Western Washington secondary processing facilities based on planned production or space availability. Trident operates a hub-and-spoke processing/distribution model in the Puget Sound area. Bulk seafood is converted into approximately 2,500 different consumer-ready finished goods in one of four facilities. It is then shipped to and consolidated at the Seattle Pier 91 facility for distribution across the country. Some full truck load orders are shipped direct from processing facilities; however, the majority of outbound shipments (95 percent) originate from Pier 91. Sixty percent of outbound shipments leave the state via I-90 and 40 percent leave via I-5.

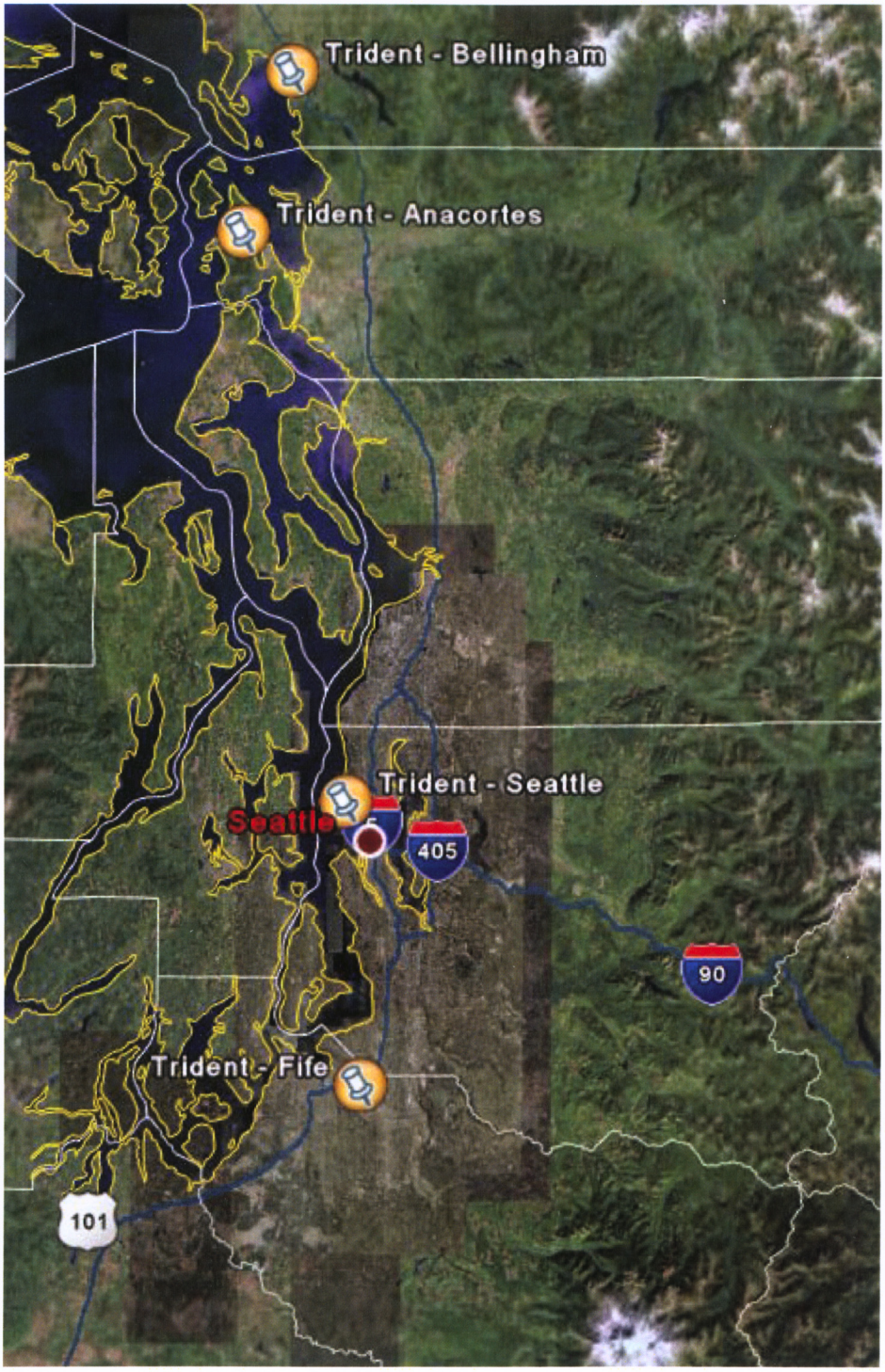
Puget Sound secondary processing facilities are located in:

- Bellingham
- Anacortes
- Seattle Pier 91 (secondary processing and main distribution hub)
- Fife

Trident also has a labeling facility located in Kent. In Alaska, salmon is processed into unlabelled cans and shipped to Kent for labeling, then distributed to customers.

This interview focused primarily on the secondary processing facilities located in Western Washington.

Exhibit C-7
Trident Puget Sound Locations:



INBOUND TRANSPORTATION

The secondary processing facilities receive four primary ingredients: bulk, processed seafood; packaging materials; breading; and oil. Bulk, processed seafood represents the majority of inbound activity. It is shipped into the Puget Sound throughout the year and peaks during the pollack seasons, January to May and July to October. Peak months are March and August respectively. Exhibit C-8 depicts the annual container volume for each of the four primary ingredients used at Trident secondary processing facilities.

EXHIBIT C-8
PUGET SOUND SECONDARY PROCESSING INBOUND VOLUMES

Ingredient	Primary Origin	Annual Container Equivalents
Bulk Seafood	Alaska – Private Boats	1,200
Packaging	Olympia - Truck	700
Breading & Oil	Midwest - Truck	200
Sugar (For Surimi Processing)	Indiana - Truck	200
Brite Stack (Cans)	Alaska – Boat/Truck	450
Finished Goods (Transfers from other facilities)	Truck	20M Pounds 450 FCE*

* FCE = full container equivalent

Once processed, Trident consolidates finished goods for distribution at the Pier 91 distribution center. An estimated 450 containers are shuttled from the other secondary processing facilities to Pier 91. A small portion (five to ten percent) of finished goods is shipped full-truck-load (FTL) direct from the secondary processing facilities.

In the peak season, Trident receives 150 containers of bulk frozen product from their Alaskan processing facilities via three company-owned vessels every 10 days. Each ship must be unloaded within 30 hours of arrival. This places a significant strain on port as well as container capacity, particularly when Trident is competing for reefer container capacity during the West Coast and Chilean Cherry seasons (spring-early summer) and the Christmas tree season when such containers are spread across the country for the holidays.

Once bulk seafood is transferred to a container, it is shuttled to the secondary processing facilities and stored until required for production. Trident positions bulk seafood among its various facilities based on forecasted production and/or available temperature-controlled

space. Trident uses several local carriers, including Horizon Lines, Coastal Transportation, Northland, and Sampson. They also use their own fleet of trucks.
The majority of packaging materials are trucked from Olympia by vendor-controlled shippers. Trident receives an estimated 700 truckloads of packaging annually.

Approximately 200 truckloads of breading and oil are received annually from the Midwest. Another 200 truckloads of sugar are received to support surimi processing. An estimated 450 containers each year of unlabelled canned salmon are received through the port into the Kent labeling facility. The canned salmon is labeled and shipped to customers across the country.

One of the biggest challenges with inbound transportation is congestion at the Port of Seattle. With limited staging capacity, trucks often back up and create congestion at the freeway access points. A delay in unloading of a single vessel can cost Trident almost $1,000 per hour.

Trident balances raw material product mix between facilities requiring transfers up and down the I-5 corridor. In addition, the majority of finished goods are shuttled to the Seattle Pier 91 distribution facility. Trident estimates they are carrying a minimum of five percent incremental inventory in each location to compensate for congestion issues on the I-5 corridor and access-related issues between the Maritime Cluster and I-5.

Trident has limited interest in using rail as a modal option because of service concerns. Their perception of rail service is that it is bad and getting worse.

Outbound Transportation

Trident packages, markets, and ships approximately 2,500 finished goods. The shelf-life for each finished good is between 90 and 180 days. The majority of finished goods are stored in, and shipped from, an 800,000 cubic foot frozen distribution center at the Seattle Pier 91 processing facility.

On average, Trident ships 1.2 million frozen pounds each week, mostly from the Pier 91 distribution facility. Approximately 60 percent of outbound shipments leave the Puget Sound via I-90 and 40 percent via I-5. The majority of shipments are less-than-truck load (LTL). The typical order consists of 35 items and weighs 4,200 pounds. Including FTL orders, the average order weighs 8,800 pounds. Thursday and Friday are peak days, with an estimated outbound volume of 66 trucks each day. Trident's customers expect product to ship on Thursday or Friday to ensure product will arrive by the following week in time to support weekend sales demand. Due to the price point of inventory and space constraints, customers are not interested in receiving product any sooner than required for the weekend business. If product is not shipped by Thursday/Friday, it must be expedited to the customer, most often using air freight. Outbound shipments Monday through Wednesday average 15 trucks each day. Due to shelf life issues and distribution-related costs, Trident has concluded that opening distribution facilities closer to their markets cannot be justified. Trident estimates inventory would increase 35 percent to support a single additional downstream facility. Generally, any interruption in the supply chain is handled by using temperature-controlled air freight.

In an effort to mitigate the Puget Sound infrastructure issues, Trident has investigated relocation of the Pier 91 operations south of Tacoma. Estimated cost to relocate is $30 million. Trident does not expect to implement such a plan since moving would remove them from significant industry support within the maritime cluster.

Supply Chain Segmentation

While each element of Trident's supply chain is sensitive to transportation-related variation, two key segments are critical to their operation and have the greatest potential implications to their profitability: inbound receipt of bulk seafood and consolidation/shipping of finished goods.

Due to the service expectations set by the customer and the hub-and-spoke configuration of Trident's distribution model, finished goods handling represents the segment of the supply chain that has the highest share of material ownership, is most susceptible to variations in service, and has the highest transportation cost. Transfers from secondary processing facilities to Pier 91 are controlled by Trident and executed using local transport firms or Trident-owned and -operated trucks. All outbound shipments are controlled by Trident using outside LTL trucking firms. Trident estimates inventories are inflated five percent to anticipate Puget Sound logistical issues.

Inbound bulk seafood is the other segment of the supply chain most susceptible to variation. The seafood industry is inherently seasonal. In season, Trident ships 150 containers of bulk product into the Puget Sound ports every 10 days. Trident competes for container capacity with other seasonal industries (fruit harvests, export) that peak during the pollack seasons. Ships are expected to turn within 30 hours. Trident estimates unloading delays cost an estimated $833 per hour. Truck staging capacity at the port is limited, causing congestion at the freeway entrance and exit points.

INFRASTRUCTURE ISSUES

Accessibility to I-5 and unpredictable traffic congestion in the Puget Sound area represent the greatest challenges Trident faces with Puget Sound transportation infrastructure. Specific issues include but are not limited to:

- Highway 99 lacks a direct link to I-5 north of Spokane Street.
- The current design of I-5 lacks a single lane that flows directly through Seattle without requiring a lane change. This increases the chance of congestion, accidents, etc.
- Lack of port staging capacity at the terminals hinders Trident's ability to efficiently turn their inbound containers.
- As similarly stated in the City of Seattle study of the Maritime Cluster, Trident experiences huge delays navigating to and from the port due to congestion at the access

points to the Seattle port and harbor. Because the grades of roads and railways are not separated in the downtown area, significant delays occur every day.

Trident Seafoods, in conjunction with the Maritime Cluster, have identified the Alaska Way Viaduct as central to their collective businesses. Closing the viaduct while rebuilding or replacing it would place a significant financial burden on their enterprises. They would like to see the viaduct repaired in place and access to and from the Maritime Cluster improved.

Access to rail service, competitive pricing, and predictable service levels combined eliminate rail as a possible mode of transportation for Trident.

Policy Issues

Trident noted the lack of consistency over the governance of trucking corridors. They would like the state to establish standards for truck route design (lane widths, turning area, etc.) and prevent local municipalities from superseding state-defined design requirements.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH UNITED STATES BAKERY (FRANZ)

INTERVIEW DATE: DECEMBER 8, 2005

INTERVIEWER: MICHAEL SIEGMUND, TIM DUFFY

ATTENDEE

Rosalie Delaurenti, Shipping & Transportation Manager
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SUMMARY OF BUSINESS OPERATIONS

United States Bakery/Franz Family Bakeries, headquartered in Portland, Oregon, is a family-owned and -operated business serving the Northwest since 1906. They manufacture and market a full range of bakery products. Their market reach extends across all of Oregon and Washington as well as northern California and parts of Idaho, Montana, and Alaska. Sales channels include grocery, restaurant, food service, and institutional customers. U.S. Bakery operates a hub-and-spoke distribution model, with multiple bakeries and distribution hubs to meet customer demands. The largest bakery operation in the Northwest, U.S. Bakery operates two bakeries in the Seattle area and multiple distribution hubs employing over 900 people in the Puget Sound area alone.

BAKERY LOCATIONS INCLUDE:

- Weller Street – Seattle
- 6th Ave – Seattle
- Spokane – Washington
- Eugene – Oregon
- Portland – Oregon
- McMinnville – Oregon

Distribution/Transfer hubs include:

- 6th Ave – Seattle
- Bremerton – Auto Way
- Bremerton – Perry Ave
- Port Angeles
- East Kirkland
- George Washington
- South Tukwila
- Kent
- Tacoma
- Parkland
- Olympia
- Aberdeen
- Lynnwood
- Everett
- Mount Vernon
- Bellingham
- Portland, OR
- Clackamus, OR

This interview focused on the Weller Street bakery and distribution center, which services the central Puget Sound area.

The primary components used in the manufacturing process at the Weller Street facility include flour, miscellaneous bakery ingredients (i.e., yeast), sugar, and packaging materials. The majority of materials and ingredients are received daily and inventoried for "just-in-time" (JIT) usage. Product produced at the Weller Street facility is consolidated with finished goods sourced from other bakery locations and shipped to Northwest distribution hubs.

Product is expected to reach U.S. Bakery customers within 24-48 hours of manufacture.

INBOUND TRANSPORTATION

U.S. Bakery's Weller Street facility in Seattle's Duwamish Industrial Area operates 24 hours per day, seven days per week. Peak hours are between 8:00 A.M. and 4:30 P.M. daily. Weekly volumes are based on annual averages. U.S. Bakery experiences significant spikes during the summer months. The Weller Street facility receives approximately 10 trucks each day of finished product from bakeries in Spokane and Portland/Eugene for distribution to area markets.

In addition, the Weller Street facility receives approximately six trucks each day of ingredients and packaging. Materials include flour, miscellaneous bakery ingredients (i.e., yeast), sugar, and packaging. Points of origin are primarily Montana, California, Kansas, and Wisconsin. Because the production lines are scheduled based on inbound arrivals, on-time delivery of inbound product is the most crucial factor influencing inbound transportation arrangements, followed by cost and equipment availability. Inbound shipments are expected to arrive within one hour of scheduled appointments.

Inbound logistics are controlled and scheduled by the Weller Street facility. Hired trucks are contracted and scheduled to deliver an estimated 30 truck loads of ingredients and materials each week. Using company trucks, the Weller Street facility also controls the shipment and receipt of approximately 50 loads of finished goods originating from the other U.S. Bakery manufacturing locations each week.

The Weller Street facility is ideally located with convenient access to both I-5 and I-90. However, due to city zoning changes and parking restrictions, staging and maneuvering transportation equipment in the area around the plant has become increasingly challenging. Trucks are required to be staged "off-site" until space is available for loading or unloading.

Outbound Transportation

The Weller Street facility manufactures baked goods, consolidates them with product sourced from other bakeries, and transports them to distribution hubs for local delivery to U.S. Bakery customers. Twenty eight routes are scheduled daily, delivering product to 18 distribution hubs five to six days per week. The majority of the distribution hubs are located within the Puget Sound area.

The Weller Street facility ships between 250 and 300 truckloads each week. Although the focus of this interview was limited to Weller Street operations, it is important to note that U.S. Bakery operates 228 daily routes, originating from the distribution hubs, delivering bakery product to their customers. On any given day, U.S. Bakery could have over 400 trucks on the road across the Puget Sound area.

U.S. Bakery owns a fleet of 36 transport/trailers, which originate from the Weller Street location. Outbound product is shipped using these trucks, giving U.S. Bakery complete control of outbound shipments.

Because baked goods are perishable, very little inventory is held in the supply chain. As a result, the two most crucial factors influencing outbound transportation arrangements are on-time delivery and total transportation cost. Any interruption in the supply chain typically costs U.S. Bakery in discounted or lost sales and increased labor costs.

In 2001, several transport route deliveries were made during the day. U.S. Bakery determined route efficiency had declined 20 percent over time due to traffic-related delays and inefficiency. To compensate for the increase in costs, the majority of transport route deliveries were scheduled during off peak hours between 7:00 P.M. and 7:00 A.M. Route efficiency improved 7-10 percent as

a result of the scheduling change. While delivering during off-peak hours proved more efficient, U.S. Bakery found that traffic-related inefficiencies are not limited to peak traffic hours.

Infrastructure Issues

Unpredictable traffic congestion represents one of the greatest challenges to U.S. Bakery in controlling transportation costs. U.S. Bakery locations are strategically placed along the I-5 corridor. Congestion along the I-5 corridor has steadily increased over the past several years. A delivery between the Weller Street facility and Tacoma took less than 2 hours 10 years ago, compared with more than 4 hours today.

In response to the growing transportation challenges related to area congestion, U.S. Bakery has initiated an effort to measure route efficiency based on average cost per minute of operation for each route. In addition, U.S. Bakery is evaluating route optimization software to assist in reducing overall transportation costs.

U.S. Bakery also monitors WSDOT's traffic web site for congestion information to assist in rerouting transportation.

Policy Issues

Recent parking and zoning changes as well as increased development near the Weller Street location have increased the overall cost of routing trucks into or out of the facility. Trucks have to be staged far off site while waiting to load or unload. This increases the overall cost of operating at its current location due to transportation dwell times and delivery delays.

Possible Actions

- Create commerce-only lanes to expedite freight delivery in the Puget Sound area. HOV lanes are underutilized.
- Expand Highway 18 to four lanes each way to create a by-pass for commercial traffic between Everett and Fife, reducing overall traffic on the I-5 corridor.
- Evaluate the key main interchanges to improve traffic flow. (i.e., I-405 North to 167 interchange keeps traffic moving)
- Assist U.S. Bakery with finding a solution to truck staging around the Weller Street facility that balances community needs with efficient operation of the business.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH BOEING CORP.

INTERVIEW DATE: OCTOBER 4, 2005

INTERVIEWER: ARNO HART AND SOPHIE HARTSHORN

ATTENDEES

Elizabeth Warner, Manager, Boeing Local Government Relations
Tal Evanger, Director of Boeing Puget Sound Licensed Transportation Supply Chain Services
Jack Dove, Manager- Boeing Enterprise Traffic Management Spares Distribution Center- Sea Tac Supply Chain Services
Beverly Clark, Boeing Shared Services Communication

SUMMARY OF BUSINESS OPERATIONS

Boeing is the largest maker of aircraft in the nation. Though its corporate headquarters are located in Chicago, it has major plant operations throughout much of the Puget Sound region. There are two main business lines at Boeing–the Integrated Defense Systems (IDS) Group (which is responsible for about 15 percent of all Boeing freight moved in the Puget Sound area) and Boeing Commercial Aviation (BCA) (which is responsible for about 85 percent of all Boeing freight moved in the Puget Sound area). The remainder of this summary focuses on the BCA operations in the Pacific Northwest.

Overall Production Philosophy and Supply Chain Vulnerability
Boeing's production/service goal is to be able to provide a finished airplane to a customer within 6 months of their first contact with Boeing. For that reason, BCA is increasingly farming out to suppliers and emerging into the role of integrator–integrating the aircraft at the final stages. This increased focus on outsourcing has a significant effect on the impact/role of the Puget Sound transportation on the overall supply chain. The opinions about the effect of transportation congestion vary between Boeing and its suppliers. Boeing is responsible for most of the local transport moves between Puget Sound manufacturing plants, and is more reliant and vulnerable to congestion and delay on the local transportation system than its supplies, many of whom make longer-distance moves to the region. Boeing has adopted the concepts of the LEAN manufacturing process methodology–which is a philosophy of

production that aims to minimize all resources (including time) used by cutting out unnecessary steps and processes, which means there is very little room for variance.

Overall Production Hierarchy

In its simplest form, Boeing's complex supply chain can be boiled down to those functions that Boeing performs, and those performed by suppliers. The higher up the production hierarchy you look, the more Boeing is visible. Boeing manages the entire assembly process. It fabricates only some of the segments that are used to assemble the planes; more of the fabricated segments are being outsourced. The parts and components that go into the fabrication are almost entirely outsourced.

Boeing ships a tremendous quantity of material into and through the Puget Sound region. Much of this movement is accomplished by its private truck fleet of 240 vehicles and drivers. This fleet is diversified and ranges from small trucks (for moving electronics and other small parts) up to very large flat bed haulers (for moving fuselages or other large, heavy items). Approximately 85 percent of all freight moved in the Puget Sound region is for BCA, and 15 percent is for IDS.

Inbound Transportation

Boeing first takes responsibility for goods as they enter the Puget Sound region. Usually, these goods are being shipped from Tier I and II suppliers, who can be from anywhere in the world. The largest single supply chain is from California, though there is also considerable freight traffic from the East Coast ports (and therefore Europe and other international destinations), the Midwest, and other points within Washington State.

- 300-500 truckloads inbound weekly, 50 percent by Boeing's own fleet
- 30-60 rail/interposal shipments
- 1,000-5,000 inbound express/air shipments weekly
- 100-300 ocean containers weekly
- Daily peak is 6 A.M. to 6 P.M., but open 24 hours
- On-time service is #1 priority, lowering inventory cost is #2, transport cost is #3
- Defines on-time within a one day window.

Assembly

Final assembly occurs at facilities in Renton (narrow-body aircraft–window aisles only) and Everett (wide-body–middle aisle along with window aisles). Final assembled planes are delivered out of Boeing and Paine fields.

Fabrication

This is the stage where major parts that go into the assembly process are fabricated. Wings, fuselage, wires/tubes, landing gear, seats, galley, engines, lavatory, and electronics are all major parts that are fabricated prior to shipment to the assembly plants. Boeing fabricates the wings, fuselage, wires/tubes, and landing gear. The rest of the fabrication parts are outsourced to

suppliers. It is noted that the BUYER is responsible for furnishing these fabricated parts to the assembly plant.

Boeing also has an "Emergent Manufacturing" plant in Auburn. If something is damaged, incomplete, or late, the Auburn plant can manufacture almost anything that is needed. The transportation choice depends on product (for example, if it is tubes, they will go by van to Everett or Renton).

- **Wings**
  - Fabricated locally by Boeing in Auburn and Frederickson (large parts like wing skins and spars). Large parts are forged mainly from steel, titanium, aluminum, and composites. Raw materials are forged into custom-sized ingots at the source and delivered to Boeing, mostly by flatbed truck, except aluminum by rail from California Rail spurs from Auburn and Fredrickson provide mobility. (See interview with TMX which supplies raw materials.)
  - All of the small parts and components are outsourced, and are shipped (mostly from California) in small quantities known as "less-than-truckload" (LTL). The shipments are generally received and consolidated at a non-Boeing warehouse before being sent to Boeing.
  - Fabricated wing parts move from fabrication to assembly plant by truck.

- **Fuselage**
  - Fabricated in Wichita, Kansas and shipped by rail to assembly plant
  - Rail is extremely vital

- **Wires and Tubing**
  - Wires and tubes come in a wide range of sizes and configurations and are fabricated in Auburn. Used for conveyance of power, water, fuel, fluids, air, and exhaust, they are fabricated locally. Raw materials (wire, copper, titanium, and plastic) come from all over the U.S.
  - Raw materials are brought into the Auburn plant and cut to the right length.
  - Tubes are made of titanium and used for fuel from the wings to the engines, exhaust, air, etc. Some are made in Spokane and trucked to the Auburn plant.
  - Fabricated parts are trucked (small) into the assembly plant on demand (three truck loads per plane). Trucks roll directly onto the assembly floor (roll-on/roll-off) next to the aircraft being assembled.

- **Engines**
  - Engines are 90 percent complete when they arrive at the Boeing plant. The Boeing plant finishes them, by installing electronic components, tubes, fans, etc.
  - The largest suppliers of engines are located in the United Kingdom; some come from Ohio, and some from Connecticut.
  - Engines are trucked to Boeing one or two at a time as an oversized flatbed delivery.

- Deliveries need oversize permits and have to follow time restrictions levied by states. For example, oversized loads are not allowed on I-5 South of Burlington until after 9 A.M. on weekdays. Therefore, deliveries can take longer since oversize loads can only be on the highway for a few hours per day.
- 777 engines come in at SeaTac and are loaded on flatbeds for the final delivery leg.
- Engines leave SeaTac by flatbed truck and go to either Renton or Everett for final integration into the aircraft.

- **Lavatories**
  - Lavatories are trucked in from Woodinville on local, semi-crated vehicles. They are complete when they arrive at Renton/Everett and ready to roll into place on the aircraft.
  - They are made of fiberglass/plastics/steel.

- **Galleys**
  - They are brought by container ship from Amsterdam to East Coast ports, then trucked across the U.S. to the Everett or Renton assembly plants.
  - They come fully assembled to Boeing and roll into place.

- **Landing Gear**
  - Boeing makes the majority of these in Portland, and then delivers them by truck to the Puget Sound region. Raw materials are trucked into Portland from tertiary suppliers, most of which are based in California.
  - The components for the landing gear are trucked to Goodrich fabrication plant near Seattle. Fabricated landing gear is trucked to assembly plant.
  - They rely on hydraulics, tires, and titanium.

- **Seats**
  - Seats are shipped from France on container ships that arrive at East Coast ports and are trucked across the country to Renton or Everett.
  - Trucks are used because of the time savings they provide.

- **Electronics**
  - Electronics consist of fabricated radio/communications and navigation systems.
  - Most are locally made and rely on smaller vehicles, which does not pose a big logistics issue.
  - Most are made in Auburn, where large trucks bring the raw materials. Finished products go by small truck or van to the assembly plant.

Parts and Components

Parts and components that are inbound to Boeing's fabrication plants and to those run by its suppliers in the region rarely direct ship by full truck load (TL). Instead, they are trucked (by LTL service) to locally based staging areas (warehouses/distributions centers) from around the region and the country (California, the Midwest, and some from the East Coast).

Outbound Transportation

Assembled Aircraft

- Final assembled aircraft are delivered at Boeing Field and Paine Field. Customers fly the aircraft home from there.

Return Tooling

- 100 truckloads outbound weekly, 65 percent by Boeing's own fleet
- 30+ rail/intermodal shipments
- 500-2,000 outbound express/air shipments weekly
- 45+ ocean containers weekly
- Daily peak is 6 A.M. to 6 P.M., but open 24 hours
- Transport cost is #1; lowering inventory cost is #2; range of integrated services is #3.

Key Supply Chain Segments

- **Wings and Spars:** Trucked from Frederickson to Renton and Everett
- **Seats and Tracks:** From France to Renton and Everett via ocean and truck and some air
- **Repairs/Emergent:** From SDC/Renton/Everett to worldwide via truck and some air
- **Fuselage:** From Wichita to Renton/Everett via rail (6 days); Boeing takes ownership when they leave Wichita
- **Fan Cowlings:** From Wichita to Renton/Everett via truck and some air
- **Landing Gear:** From Everett to Renton/Everett via truck
- **Landing Gear Components (and other Portland components):** From Portland to Everett via truck; 2 years ago round trip took 9 hours and now it takes 10-12 hours, bordering on the truck driver hours-of-service restriction
- **Engines:** From Connecticut (Pratt), Ohio (GE), the United Kingdom (Rolls, other) to Renton/Everett via truck and some air

Infrastructure Issues

In general, Boeing controls the flow of goods only within the Puget Sound region, and therefore is primarily concerned with the movement of trucks on the roadway network. Unpredictable delay is the greatest challenge facing the transportation system in the Puget Sound region. Key corridors and locations where Boeing experiences the most delay (and unpredictability) include all the major corridors in the region:

- I-5 through downtown Seattle
- I-405/SR 167 interchange
- I-90

POLICY ISSUES

- Boeing uses trucks for most of its shipping within the nation and also within the Puget Sound region. This is chiefly because of the time savings provided by trucks.
- A well-functioning highway system is the most important transportation feature in the Puget Sound region.
    - The movement of fabricated parts between key plants is sensitive to time variance from congestion on the major corridors; however, these shipments tend to be scheduled (flexibility in delivery). These also tend to have higher incidence of permit requirements (oversize).
    - The movement of parts and components is impacted by highway in two ways. First, the long-haul inbound trip to local staging points is prone to congestion on I-5 and I-90, resulting in higher sensitivity to hours of operations window. Second, delivery from warehouse to fabricating plant (Boeing and local third party suppliers) tends to be on short notice, with tighter delivery windows, and prone to trip variance on local haul, hence impacting performance within delivery window. Hours of service not an issue.
- Rail deliveries from the California and East Coast ports are the second most important element.
- Boeing recognizes that an integrated, multi-modal, appropriate capacity system using many corridors is important: a system that does not support any one corridor to the detriment of another and has adequate redundancy.
- Boeing believes that set-aside truck capacity along key corridors is a critical path toward ensuring redundancy. Toll facilities can be a valid part of the transportation system. Boeing is willing to pay their fair share for toll facilities or other user-financed projects, but does not think that they should be asked to pay more than their fair share.
- Fuel costs, congestion, and surcharge for roads (on top of taxes) are making it very difficult to convince truckers to move to the Puget Sound region; this results in a constant shortage of qualified truckers to move goods in the region.
- Boeing thinks the WTP plan does not give enough support to freight mobility and fails to recognize that much of it needs to be on trucks. Boeing certainly supports transit, but clearly cannot use it for freight delivery.
- Boeing is trying to reduce the number of people moving between sites, as they realize that it is just as logistically challenging as moving freight.
- Boeing needs to obtain permits prior to shipping oversize items such as engines or wing spans and has to follow time restrictions levied by states. This means that some shipments can take many days to complete, with much time wasted as drivers sit in the trucks, unable to use the roadways.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH GOODRICH AIRCRAFT TECHNICAL SERVICES

INTERVIEW DATE: NOVEMBER 22, 2005

INTERVIEWER: ARNO HART AND SOPHIE HARTSHORN

ATTENDEES

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SUMMARY OF BUSINESS OPERATIONS

Goodrich is headquartered in Charlotte, North Carolina, and is a pure aerospace industry supplier, focusing almost exclusively on aerospace. It employs 20,000 worldwide, most of these involved in Original Equipment Manufacturing (OEM) for the aerospace industry. A small segment focuses on aftermarket services such as Aircraft Technical Services (ATS), which does maintenance and repair.

Goodrich manufacturing includes the following three segments, each of which has 8-10 business lines:

1. **Engines:** including the aero-structure and cargo divisions. Goodrich does not make engines, only parts that go into making engines. They are therefore a second/third tier supplier to makers of engines that go to Boeing and others.
2. **Airframes:** including the landing gear and the ATS group (for maintenance and overhaul of airplanes). Goodrich does not build airframes, only parts of airframes. They are therefore a first tier supplier to builders of airframes, including Boeing.
3. **Electronics:** including sensors and all accompanying parts. Goodrich is a second/third tier supplier.

This interview was a two-in-one with the **Cargo** group and an overview of the **ATS** group, both of which are in the **Airframes** section. This is a summary of the **ATS** part of the interview. The

interview also included an overview of the **ATS** group. The **ATS** group is responsible for both routine maintenance and repair of airplanes (they do Category C and D checks, which occur once a year or more (A and B checks are more frequent), including all mechanical, structural, and electronic systems. The group is a service provider, not a manufacturer, and customers are commercial airlines, not Boeing. Their facility is at Paine Field, and customers fly their aircraft in for maintenance. Peak maintenance seasons are during the months that immediately follow peak commercial travel seasons. They handle all parts that are needed for aircraft maintenance and repair, from any given OEM supplier used by the customer (and not just parts produced by other Goodrich groups). The turnaround time for performing such services is very tight; it is not unheard-of to have 15-minute supplier turnaround windows. Therefore, just-in-time (JIT) delivery of parts is extremely important to the ATS group. In addition, the ATS group carries a large inventory of parts that may be needed for maintenance and repair, and carries larger inventories than the OEM counterparts within Goodrich.

Though Boeing is cited as the largest client to both the **Cargo** products and **ATS** services, Goodrich products and services are used by many other major airlines and carriers throughout the world.

Inbound Transportation

- Customers make transportation decisions 70 percent of the time.
- 50-800 truckloads are inbound to the Everett facility each week. Of these:
    - 4 percent use the Goodrich private fleet
    - 96 percent use for-hire, public trucks
- Goodrich receives from 1,000-3,500 inbound shipments of express/air shipments weekly (using DHL, UPS, and Fedex). Many of these shipments are carrying parts that were initially sent out from the ATS division to be repaired at sites around the nation.
- Demand is seasonal and peaks immediately after high travel seasons, when airlines service aircraft.
- ATS receives shipments of parts from all over the world.
- Inbound shipments are dominantly 2nd day air/express through UPS, Fedex, and DHL into SeaTac International Airport. This reflects the time-sensitive nature of the deliveries and the fact that the maintenance schedule of the airplanes is very tight.
- Some shipments are flown into Paine field in Everett (not many).
- Overland shipments are all by truck from the Midwest and East Coast, taking 5-7 days. Goodrich does not use rail for any shipments.
- On-time performance is the top priority, followed by cost, for shipping. It is estimated that a 15-minute criterion is used to judge "on-time performance."
- ATS is encouraged to hold an inventory to prevent service and maintenance delays. This is accomplished by using facilities in Paine field and at the Cargo systems facility in Everett:
    - Four 25,000 square foot facilities in Everett
    - Five 25,000 square foot hangers at Paine field

Outbound Transportation

- Aircraft that have been maintained or repaired in the Everett facility are flown out of Paine Field.
- Other primary outbound shipments are of aircraft tooling and aircraft parts.
- The destinations for these products vary—they are worldwide in scope.
- 50-800 truckloads leave the Everett facility each week. Of these:
    - 4 percent use the Goodrich private fleet
    - 96 percent use for-hire, public trucks
- Goodrich sends out from 1,000-3,500 outbound express/air shipments per day (using DHL, UPS, and Fedex).

Supply Chain Issues

Because it is entirely JIT focused, the ATS group has three key supply chain issues. The first is that its supply chain is globally rather than locally based. Suppliers are predominantly based in the Midwest and East Coast. Because they provide a quick turnaround service (days, not weeks or months), freight velocity is key. The time it takes to ship parts (2 days for express and 5-7 days by truck) seriously cuts into their service turnaround time. Therefore, they cannot afford road or air cargo delays.

Another key issue is that the ATS group does not have any systems redundancy for its main east-west roadway supply corridor. As is pointed out below, the only viable roadway connection is I-90 (see details below). This lack of redundancy causes the ATS group to carry more inventory than its OEM counterparts within Goodrich.

Growing traffic congestion is the leading supply chain issue for local trips. Since on-time performance must fall within a 15-minute window, on-time variability is expected to increase as congestion continues to grow.

Infrastructure Issues

Because a majority of Goodrich shipments for the ATS group arrive from locations in the Midwest and East Coast, the single biggest concern of Goodrich is I-90. I-90 is problematic at all times for freight shipping, particularly across Snoqualmie Pass. The situation has been exacerbated recently with lane closures through the pass. Highway 2 does not serve as an alternative to I-90, because its challenging topography is not conducive to truck travel.

I-5 is also a big issue, not specifically any location or bottleneck, but more from an overall systems congestion standpoint. The lack of an alternative option can make it difficult to meet a tight delivery window.

Overall Comments

While the interview was able to add to the picture of the overall strategic role played by the freeway system for serving high-service truck freight, but the group was not very forthcoming with information and insight regarding cost implications and other economic information. The company did not wish to share this information with the public sector.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH GOODRICH AIRCRAFT CARGO GROUP

INTERVIEW DATE: NOVEMBER 22, 2005

INTERVIEWER: ARNO HART AND SOPHIE HARTSHORN

ATTENDEES

Bill Major
Goodrich Corporation Cargo Systems
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Everett, WA 98203
(425) 407-1191
bill.major@goodrich.com

SUMMARY OF BUSINESS OPERATIONS

Goodrich is headquartered in Charlotte, North Carolina, and is a pure aerospace industry supplier, focusing almost exclusively on aerospace. It employs 20,000 worldwide, most of these involved in Original Equipment Manufacturing (OEM) for the aerospace industry. A small segment focuses on aftermarket services such as Aircraft Technical Services (ATS) which does maintenance and repair.

Goodrich manufacturing includes the following three segments, each of which has 8-10 business lines:

1. **Engines:** including the aero-structure and cargo divisions. Goodrich does not make engines, only parts that go into making engines. Therefore, it is a second/third tier supplier to makers of engines that go to Boeing and others.
2. **Airframes:** including the landing gear and the ATS group (for maintenance and overhaul of airplanes). Goodrich does not build airframes, only parts of airframes. It is therefore a first tier supplier to builders of airframes, including Boeing.
3. **Electronics:** including sensors and all accompanying parts. It is a second/third tier supplier.

This interview was a two-in-one with the **Cargo** group and an overview of the **ATS** group, both of which are in the **Airframes** section. This is a summary of the **Cargo** part of the interview.

The Cargo group includes all cargo handling systems and everything involved with the conveyance, guidance, and restraint of cargo within the aircraft, typically wide-bodied aircraft (those that have at least one middle aisle in addition to window aisles). The group is based in North Dakota, where it supplies a variety of customers including Boeing. It ships direct from North Dakota to the Boeing plant in Everett. The Cargo facility in Everett is not a manufacturing or staging/assembly facility. It is primarily a testing, customer service, and research facility. Therefore, it is not as affected by "just-in-time" (JIT) delivery, or by delays due to weather or congestion. No inventory is held at the Everett facility; Boeing holds the inventory at its plant. Shipments come to Boeing's Everett plant, since this is where Boeing makes its wide-body aircraft (narrow-body in Kent), and cargo is more common in wide-body aircraft.

While Boeing is cited as the largest client to the Cargo group, it has a broad range of customers worldwide.

Inbound Transportation

- Most parts ship directly to Boeing in Everett, from North Dakota.
- Shipments are almost exclusively trucked.
    - Takes 24-36 hours
    - Wooden crates on flatbed
- The Cargo group does not perform any manufacturing in the Pacific Northwest. There are therefore no staging areas in the region; instead, all assembled parts are trucked from the North Dakota manufacturing site. Parts are integrated into the aircraft by Boeing.
- Trucking is exclusively for-hire.

Outbound Transportation

- None.

Supply Chain Issues

The Cargo group does not foresee any significant supply chain issues. Because Boeing's production process is fairly well-scheduled, the Cargo group has significant advanced notice to schedule deliveries and to anticipate any potential traffic delays.

Infrastructure Issues

A majority of Goodrich shipments for the Cargo group arrive from their headquarters in North Dakota; therefore, shipments come inbound from the east on I-90. As in the case with the ATS group, the lack of east-west highway systems redundancy (Highway 2 not an option) is an issue.

There is no significant movement within the Puget Sound region for the Cargo group, except for express deliveries from SEATAC. The service providers tend to mange this well.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH TMX AEROSPACE

INTERVIEW DATE: NOVEMBER 18, 2005

INTERVIEWER: ARNO HART

ATTENDEES

George Waara
Operations Manager
TMX Corporation
20425 72nd Ave S, Suite 400
Kent, WA 98032
253-239-5712

SUMMARY OF BUSINESS OPERATIONS

TMX supplies all of the raw material aluminum, titanium, and other metals (plates, sheets and extruded product) for Boeing and its suppliers in the region and throughout the world. It operates mostly a ship-and-store service, but also performs some value-added, customized packaging. Overall, TMX supplies the raw ingredients for more aircraft than any other provider nation-wide.

TMX has 5 locations in the United States:

- Santa Fe Springs, California
- Wichita, Kansas
- Wallingford, Connecticut
- San Antonio, Texas
- Kent/Auburn, Washington
    - Pacific Northwest location (opened eight years ago) to service Boeing and suppliers locally (within a 50-mile radius)
    - North-south orientation on I-5 corridor, from Monroe (30 percent) north to Tacoma (70 percent) south
    - 5 years ago, 80 percent local and 20 percent U.S./global
    - In 2005, 60 percent local and 40 percent U.S./global
    - Shipping is becoming more far-flung in nature as Boeing sources out more to suppliers

Inbound Transportation

Domestic Inbounds (70 percent)

100 percent supplier (or outsourced) delivery to TMX

- TMX does not tightly control these movements since on-time delivery is not crucial.
- Mostly truck (flatbed)
    - 4000 loads weekly
    - Arizona: 20 percent – three days' transit
    - California: 10 percent — three days' transit
    - Iowa: 45 percent (including Eastern Washington) – three days' transit time
    - Eastern Washington: 45 percent (including Iowa) - five hours' transit time
- 40 express/air shipments weekly

International Inbounds (30 percent)

Primarily shipped from Europe (75 percent) and Russia (25 percent)

- Ocean to Port of New York/New Jersey (PONY/NJ)
    - 20-day voyage
    - Two days' transit
- Intermodal rail to Seattle
    - Five to seven days transit time

Outbound Transportation

Local Trucking (60 percent)

TMX handles almost all of the outbound shipments:

- 5,000 truck shipments weekly
- 100 air/express
- 10 percent customer pickup, 60 percent own trucking, 30 percent for-hire
    - On-time delivery is most important, so they want to control delivery internally

Have developed a very reliable delivery schedule:

- 99 percent on time in 2004
    - One-hour delivery window
- 93 percent in 2005, but this drop was not due to congestion but commodity shortage
    - Chinese consumption of metals
    - Decrease in mill capacity
- Drivers make two turns a day
    - Morning (scheduled two to four days out) - 75 percent of volume
        - Three-hour line haul turn with multiple drops
        - 50 percent time queuing and unloading
        - 50 percent en route

    - Afternoon (for same-day emergent needs) - 25 percent of volume
        - Two-hour line haul turn with multiple drops
        - 25 percent time queuing and unloading
        - 75 percent en route
- Although turns likely took less time in the past, traffic congestion impact is only anecdotal. Increase in the number of orders may be the biggest reason for increased time.
- Traffic is pretty much "tribal knowledge" and plan around it

Long Distance Transport (40 percent)

- Overseas: 15 percent (five percent Asia, ten percent Europe)
    - Freight forwarder handles all shipments
    - 90 percent ocean
        - One-fourth through Port of Houston (container on truck or rail)
        - One-fourth through PONY/NJ (container on truck or rail)
        - One-fourth through Port of Los Angeles/Long Beach (flatbed truck, containerized in California)
        - One-fourth through Port of Seattle (container on truck)

- U.S. - 85 percent (California, Florida, New Jersey, Kansas, Texas, Arizona, and Utah)
    - For-hire, mostly flatbeds

Inventory Turnover

- 65 percent: 1.5 times a week
- 20 percent: once every five to six weeks
- 15 percent: every five to six days

SUPPLY CHAIN ISSUES

- **Inbound Over-the-Road from the East:** Shipments are vulnerable to delay at the pass on I-90
    - At least once a year, drivers are stuck for several days

- **Local Shipments:** Drivers know the traffic patterns and tendencies, but have to work hard at it
    - Local roads are the weakest link for local deliveries.
    - They have an issue with mill drivers that do not have sophisticated tracking systems.
        - Raw materials (low value)
        - Suppliers buy transportation on a lowest-contract-bid basis
        - Not getting the best service

Infrastructure Issues

Key corridors and locations where TMX experiences the most delay (and unpredictability) include all the major corridors in the region, especially:

- I-5 through downtown Seattle
- I-90 at Snoqualmie

Policy Issues

- Despite their good on-time performance, local congestion is the weakest link in the transportation system.
    - Recommend establishment of truck only lane and/or allow trucks to use existing HOV lanes.

INTERVIEW SUMMARY

PROJECT: FREIGHT EFFICIENCY & COMPETITIVENESS PHASE 1

SUBJECT: INTERVIEW WITH CARLILE TRANSPORTATION SYSTEMS

INTERVIEW DATE: NOVEMBER 19, 2005

INTERVIEWER: ARNO HART

ATTENDEES

Linda Leary, Vice President of Sales
Mike Walls, Dispatch Supervisor

SUMMARY OF BUSINESS OPERATIONS

Carlile is an asset-based motor carrier headquartered in Anchorage, Alaska. The company provides a full range of services including less-than-truckload (LTL), full truck load (TL), heavy haul, liquid, third-party logistics (3PL), etc. Their focus is on the Alaska market, and the bulk of their business is in Alaska. In 1984, they expanded their businesses to provide full service transportation from the Pacific Northwest to Alaska.

They have at least one other operation that runs an overland service between Houston, Edmonton, and Fairbanks (targeted at the petroleum industry with trucks that carry oil field supplies from Houston to Fairbanks). This operation runs teams of drivers in both directions, a trip that takes 5-7 days, one way. Loads are mostly inbound to Alaska. Prices are based on both directions to cover the cost of the empty return haul.

This interview was conducted with the overall manager and the traffic manager at the Kent facility. The Kent operation is in the process of being relocated to the Port of Tacoma. While the primary business focus is on trucking, they are planning to diversify into rail (they have a rail spur into the Tacoma facility) and direct barge (their new site in Tacoma has barge access), although the latter is not a certainty given the existence of competitive barge services.

The Kent operation offers services over two main trade lanes. The main lane is waterborne between the Ports of Tacoma/Seattle and Alaska, and the second lane is an overland service by truck between Seattle and Anchorage/Fairbanks.

Seattle-Alaska Waterborne Lane
In general, approximately 2,200 trailers/containers ship from Seattle to Alaska each week. Carlile handles 15 percent of that market. This is the dominant service for the company (90 percent of its volume out of the Pacific Northwest). They use steamship service out of the Port of Tacoma and barge service out of the Port of Seattle. The Tacoma service has a 5-day transit time, and the Seattle service has a 10-day transit time.

Seattle-Fairbanks/Anchorage Over-the-Road
This service complements air cargo service between Seattle and Fairbanks/Anchorage. This service provides an alternative to regular airline cargo service that is approaching capacity due to air mail, tourists and seafood. They provide refrigerated service.

INBOUND TRANSPORTATION

Seattle-Alaska Waterborne Lane
The inbound volumes are split 50/50 between TL and LTL.

- **TL:** Approximately 75 inbound loads weekly. TL goes directly to marine dock.
  - Pickup dwell time at customer location is 45-60 minutes.
- **LTL:** The LTL loads come to the cross dock truck facility, where they are consolidated with other loads. Loads are built over 2-3 days between sailings.
  - Sail times are at midnight, cutoff is at 11 P.M. Therefore LTL loads have to be at bay by 5 P.M., noon for freeze/chill.
  - Does not offer storage (transit), typically priced in/out same day.
  - Pickup transit time at customer location is 15-20 minutes (not significant).
- **LTL Local Market Splits:**
  - North Seattle/Kent Market
    - 75 percent of inbounds
    - 2.5 hour turn time (1.5 hours 3-5 years ago)
  - Everett Market
    - 3.5 hour turns
  - Olympia Market
    - 1.5 hour turns
  - Portland Market
    - 7.5 hour turns
    - Leave Seattle before 5 A.M. to miss traffic
    - Must leave Portland by 2 P.M. in order to meet window
    - Planning to open a Portland depot to build loads there and truck direct to port. Hot seat trucks run day and night

Seattle-Fairbanks/Anchorage Over-the-Road
Customers are in the Seattle area, Southern California, Chicago, and Portland – almost exclusively inbound traffic. Shippers route shipments to them on an ad-hoc basis (not typically scheduled) as the need arises (i.e., if they cannot find space on air lift). They also pick up from

80 percent of the LTL service customers in the greater Seattle area. 80 percent of this local LTL is between Kent and North Seattle. Pickups in Portland are handled as TL.

Outbound Transportation

Seattle-Alaska Waterborne Lane

Carlile moves about 150 loads a week over the water.

- 90 percent of the outbound moves are through the Port of Tacoma
  - 95 percent is roll-on/roll-off (Ro/Ro) trailer chassis by steamship
  - 5 percent is container on chassis by steamship
  - 5 days transit
- 10 percent through Port of Seattle
  - Container on chassis by barge
  - 10 days transit

Seattle-Fairbanks/Anchorage Over-the-Road

They run seven days a week, using 53' tractor-trailer combinations. The trip takes 52 hours. Volume ranges from 10-20 loads per week.

Key Supply Chain Segments/Issues

Seattle-Alaska Waterborne Lane

There are two overall segments to this supply chain: the local pickup and the long-haul lane.

- **Long-Haul:** The waterborne segment is not something they control, and no issues were identified. However, access to the Ports of Tacoma and Seattle were identified as key issues to this supply chain segment. Note, though, that once they open their Port of Tacoma facility, the issue of access translates into a local pickup issue.
- **Local Pickup:** As with the over-the-road service, the critical aspect of this segment is the 11 P.M. cutoff to meet the midnight sail time. The LTL loads have to be at the cross dock by 5 P.M. to give enough time to build full trailer loads. Those that miss the cutoffs sail out on the next available sailing. While the ocean lane is not as service-critical as the over-the-road service (perishables), responsibility for a missed sailing lies with the hauler since they pick up at the client. The routes that cause the greatest incidence of delay are I-5, SR 167, I-405, and I-205 (for shipments from Portland).

Seattle-Fairbanks/Anchorage Over-the-Road

There are two overall parts to this supply chain: the local pickup and the long-haul lane.

- **Long Haul:** This is a fairly cut-and-dried service with no real significant supply chain issues. Because of the length of the haul, there is built-in flexibility to make up for lost time, particularly that caused by Seattle congestion.
- **Local Pickup:** The critical aspect of this segment is the midnight cutoff to meet the long-haul departure cutoff. Local congestion has an impact on the reliability of this service. Missing the cutoff means that delivery to Fairbanks/Anchorage is delayed by a day (cannot make up a day on the long-haul segment). This affects the quality of

service to the customer; again, this is a high-service segment given the time-sensitivity/perishable shelf life of the shipped goods.

INFRASTRUCTURE ISSUES

Seattle-Alaska Waterborne Lane

The dominant infrastructure issues identified are in two areas:

- Access directly to the ports, particularly the Port of Tacoma
  - The interchange at I-5 and 54th Street
  - The interchange at I-5 and Port of Tacoma Rd
  - The intersection between Taylor Way and Hwy 509
- The main north-south corridors
  - The completion of the SR 167 extension to Port of Tacoma was cited as a key opportunity to improve north-south mobility
  - I-5 needs additional capacity from the Port of Seattle to Chehalis/Lacey (see warehouse trends in next section)
  - Additional capacity is needed along I-5 north of Seattle toward Bellingham
- Local congestion affects the cost of local supply chain by adding the need for additional equipment and drivers
  - Need 30 percent more equipment and drivers
  - Translates to $300,000 per year
  - Given that they handle 15 percent of the Seattle/Alaska market, the overall cost of local congestion to this overall supply chain is $2,000,000 per year

Seattle-Fairbanks/Anchorage Over-the-Road

For the long-haul segment of this service, the key infrastructure issue is the I-5 route through Seattle. However, this is only a very small segment of the supply chain, and they have schedule redundancy to make up for delays. For the local pickup segment of this service, the key infrastructure issues are the main north-south freeway corridors between Kent and North Seattle. There is no systems redundancy (alternate north-south routes) or schedule redundancy to make up for delays.

POLICIES & TRENDS

Trend toward Migration of Warehouse/Distribution Densities

From the perspective of this carrier (and perhaps others) a key trend that should be a factor in future freight transport policy is the continued migration of freight-intensive activities toward the south (Kent and south to Chehalis).

- Currently, the key freight customer market centers from north to south are (rank in size):
  - Everett (3)
  - Seattle (1)
  - Tacoma/Kent (2)
  - 75 percent of the market is in #1 and #2.

- The market is evolving toward:
  - Everett (3)
  - Seattle (2)
  - Tacoma/Kent (1)
  - Lacey/Chehalis (4)

This is forcing the carriers to rethink their market service strategies in a variety of ways:

- Their market is moving further south, so the carriers themselves are moving their operations south, either by relocating further south or setting up satellite operations further south.
- At the same time, the market around Everett is also expected to continue growing, spreading the linear reach of the market even further. Carriers therefore have to split their operations to serve the larger (longer) market reach.
- With carriers focusing further south, the markets to the north (Everett, etc.) are becoming less serviceable from a single location (in the south).
- This emerging market split between the north and the south is the result of the Seattle bottleneck. The lack of north-south highway capacity through downtown Seattle creates a bottleneck, and increases turnaround times. This, coupled with a longer distance, has caused carriers to split the market service areas.
- The implications of this are higher transport costs and lower service levels for customers, specifically in the northern market, since it is and will continue to be the smaller relative market. This has implications for major customers expanding their northern operations, such as Boeing.
- As the Puget Sound market continues to spread south, Portland begins to fall into the overall market reach, placing further emphasis on increasing service levels toward the south. With a southern location, carriers are able to increase their local LTL/cross-dock market reach to Portland.

From an investment policy standpoint, this trend points to the need to strengthen policies toward advancing north-south highway freight capacity, specifically in advance of market saturation. Some specific freight policies mentioned included:

- Set aside highway capacity for trucks, or
- Use of HOV lanes by trucks.
- While the use of pricing was discussed, it was not viewed in a positive light. However, it was noted that the carrier industry is sophisticated enough to make pricing decisions. In other words, they would not avoid a specific alternative route that is tolled solely on the basis that it is tolled. They have pricing models that can determine whether the tolled alternative provides benefits greater or less than the additional toll price. If the benefits are greater, they will use the tolled facility.