

**National Cooperative Freight Research Program  
Project 14 – Truck Drayage Practices**

**Task 3: Literature Review Appendix - Annotated Bibliography**

**Draft of March 1, 2009**

The following annotated bibliography is intended to assist interested readers locate sources that are related to drayage. A good number of these sources were not referred to in the literature review because they do not directly deal with *seaport* drayage. The provided annotations are either abstracts of papers or executive summaries of project reports. To keep this bibliography to a reasonable length, some abstracts and summaries were truncated. For easy reference, the sources are grouped into the following subject areas.

- Drayage operations and characteristics
- Extraneous factors affecting drayage operations
- Environmental impact of drayage activities
- Clean truck program
- Issues surrounding drayage drivers
- Terminal management strategies to improve drayage operations
- Empirical initiatives
- International initiatives

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The opinions and conclusions expressed or implied in the report are those of the research agency. They are not necessarily those of the Transportation Research Board, The National Academies, or the Research and Innovative Technology Administration.

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## DRAYAGE OPERATIONS AND CHARACTERISTICS

Title	1. State-of-the Art of Freight Forecasting Modeling: Lessons Learned and the Road Ahead
Author(s)	Joseph Y.J. Chow, Amelia C. Regan
Publication date	2009
Summary	This paper reports on current freight forecasting models used inside and outside the U.S. The study first classifies available models into seven classes, and describes important modeling concepts and case studies applying these models. The study summarizes primary independent variables (inputs) and outputs for these freight models in order to help understand the current status of freight forecast modeling. In addition, the research found that a common characteristic of the case studies shows that freight modeling is not always done as a single project at one point in time nor do the most successful studies rely on a single class of models. Due to resource constraints or evolving freight needs, public agencies can opt to stage their freight model development or combine and remove portions of certain classes as they see fit. The paper concludes by discussing three types of hybrid models involving commodity supply chains, urban logistics tours, and economic tours which are considered for the future modeling trends.

Title	2. Estimating an origin-destination table for US imports of waterborne containerized freight
Author(s)	Levine B., Nozick L., Jones D.
Publication date	2009
Summary	Containerized freight imports into the US are growing at an average of 10% per year. This traffic is concentrated at a small number of US seaports. It is therefore important to have an accurate understanding of the flow of containers from their origin country through these seaports to their final destination. This paper develops an optimization model to estimate route flows and a corresponding multi-modal origin-destination table for containers by synthesizing data on international trade and railcar movements with a gravity model for the demand of container traffic. This analysis provides insights into the balance of rail and truck inland transportation from each port.

Title	3. Modeling Marine Container, Terminal Gate Congestion, Truck Waiting Cost, and Optimization
Author(s)	Chang Qian Guan, Rongfang (Rachel) Liu
Publication date	November 15, 2008
Summary	This paper applies a multi-server queuing model to analyze marine terminal gate congestion and quantify truck waiting cost. An optimization model is developed to minimize gate system cost. The model is tested using data from field observations. A case study is applied to analyze gate congestion behavior and truck waiting cost. Model sensitivity is discussed. The results indicate that truck waiting cost at marine terminal gates is an issue that needs to be addressed. With optimization, the truck waiting cost can be drastically reduced. Several congestion mitigation alternatives can be derived from the optimization model; a truck appointment system seems to be the most viable way to reduce gate congestion and increase system efficiency.

Title	4. Operational Development of Marine Highways to serve the Pacific Coast
Author(s)	Matthew P. Tedesco
Publication date	November 12, 2008
Summary	<p>This paper examines market volumes, service times, vessel characteristics, and economics for marine highways serving the Pacific Coast. This work was performed under contract to the Center for Commercial Deployment of Transportation Technologies (CCDOTT). Market volumes were assessed for routes of interest, filtering for cargo that would be eligible for marine highways service based on drayage distance and other factors. Sufficient daily truckload volumes exist in the northern to southern California route to justify marine highways with multiple daily sailings of vessels of 450 to 700 trailer capacity, should service times and economics prove to be competitive enough to divert cargo. Market volumes in the California to Pacific Northwest route are sufficient for daily sailings of smaller vessels of approximately 150 to 200 trailer capacity. A door-to-door supply chain perspective was maintained, and discrete event simulation was used to assess service times and required vessel speeds. The resulting voyage analysis served as input to both parametric analysis of vessel characteristics and economic analysis of marine highways considering all maritime and landside cost elements associated with door to door movement of trailers. It was concluded that current truck rates are not high enough for marine highways to compete on the basis of cost in short next-day turnaround markets such as northern to southern California. Marine highways are viable for longer routes such as California to the Pacific Northwest, where truck rates are higher and both distance and trucking hours of service regulations permit vessels to be time competitive at lower speeds.</p>

Title	5. Mining the Sources of Delay for Dray Trucks at Container Terminals
Author(s)	Nathan Huynh, Nathan Hutson
Publication date	2008
Summary	<p>This paper develops a methodology for examining the sources of delay for dray trucks at container terminals in order to isolate the causes of abnormally high truck turn time. It is motivated by the need of port authorities and terminal operators to develop specialized solutions to reduce turn time based on the terminal-specific causes. While many ports have taken steps to improve the general level of service for trucks, such as establishing chassis pools and extending gate hours, fewer have performed the transaction-level analysis required to determine why a certain subset of operations are significantly higher than the average, thereby hindering the overall level of service. After isolating which steps in the truck transaction process are problematic, terminals can select and deploy a range of the technological or organizational countermeasures to address the problem. This study draws upon a database of truck activity from the Port of Houston. Due to the large number of gate transactions and potential factors that could contribute to high truck turn time, a data mining technique is employed. Specifically, a decision tree technique is explored and described in this paper. The results indicate that import transactions that required chassis tend to have high truck turn time because truckers need to find a matching chassis. This paper demonstrates how decision trees can be used by port authorities and terminal operators to gain insight to their operations without</p>

	the need to perform exhaustive data analysis.
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Title	6. Drayage Activity in Texas
Author(s)	Robert Harrison, Nathan Hutson, Jolanda Prozzi, Jason West, Juan Gonzalez, John McCray
Publication date	October, 2007
Summary	The following report chronicles the first year's findings of project 0-5684. The report characterizes Texas drayage activity while focusing principally on activity occurring at the Port of Houston Barbours Cut Container Terminal, the UP and BNSF rail yards located in Houston and the border Ports of Laredo and McAllen. The seaport drayage component of the report draws upon information gained from interviews with dray managers and drivers as well as a database of truck activity provided by the Port of Houston. Patterns of delay at the port are broken into processing times that accrue outside and inside the port gates. The rail section describes the Pearland, Englewood, and Settegast yards in Houston. The border analysis relies on interviews with brokers and analysts in describing the emerging patterns of drayage.

Title	7. Container Volume and Truck Trip Generations at Marine Container Terminals - A Behavioral Analysis
Author(s)	Chang Qian Guan, Rongfang (Rachel) Liu
Publication date	July 31, 2007
Summary	<p>As world container continues to grow, the issue of infrastructure improvement and expansion becomes an urgent one. Unlike some of the major ports that the majority of their containers are transshipment cargo, U.S. Ports, on the contrary, are mostly not transshipment ports. The Port of New York/New Jersey has 80% of their cargo distributed locally. The tremendous truck trips generated at marine container terminals have a direct bearing on the local highways and arterial roads. Anticipating the completion of Panama Canal expansion by 2015, the Port is expected to have much larger size of containerships, the issue of land access becomes more pronounced.</p> <p>The first part of the series is to analyze vessel container traffic pattern, terminal gate transactions and truck trip patterns. The analysis is based on a data obtained from a marine container terminal in the Port of New York/New Jersey. First, it confirms the fact that the Port has a severe imbalance of trade; a ratio of such imbalance is calculated. It identifies an interesting ratio between vessel container volume and truck trips to the terminal. In addition, it also indicates a trend that large portion of empty containers are left behind. Lastly, it provides a clear picture of the behavioral patterns of vessel container activities, gate transactions, and truck trip generations.</p>

Title	8. Analysis of the efficiency of urban commercial vehicle tours: Data collection, methodology, and policy implications
Author(s)	Miguel Andres Figliozzi
Publication date	2007



Summary	<p>The emphasis of this research is on the analysis of commercial vehicle tours. Tours are disaggregated by their routing constraints. The generation of vehicle kilometers traveled (VKT) by tour type is analytically modeled and analyzed. The relative influence of the number of stops per tour, tour duration, and time window constraints on VKT is discussed using an analytical framework. Multistop tours are shown to generate more VKT than direct deliveries even for equal payloads.</p> <p>Intuition about the impacts of network/logistics changes and policy implications on VKT is derived. Implications for the calibration of trip generation and distribution models are discussed. In the tour model, it is proven that the percentage of empty trips has no correlation with the efficiency of the tours regarding VKT generation. The shape of trip length distributions (TLD) is discussed. It is shown that the average trip length and the TLD shape are strongly dependent on the tour type, distance from the depot/distribution center to the service area, density of stops, and number of stops per tour. Implications for data collection needs are analyzed.</p>
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Title	9. Minimizing Energy and Environmental Impacts of Intermodal Freight Transport: Development and Application of a Geospatial Routing Tool
Author(s)	James J. Winebrake, James J. Corbett, Aaron Falzarano, J. Scott Hawker, Karl Korfmacher, Sai Ketha, Steve Zilora
Publication date	2007
Summary	<p>This paper presents an energy and environmental network analysis model to explore tradeoffs associated with freight transport. The geospatial model uses an intermodal network built by the authors to connect various modes (rail, road, water) via intermodal terminals. Routes along the network are characterized not only by temporal and distance attributes, but also by cost attributes, energy attributes, and emissions attributes (including emissions of carbon dioxide, particulate matter, sulfur oxides, volatile organic compounds, and oxides of nitrogen). Decision makers can use the model to explore tradeoffs among alternative route selection across different modal combinations, and to identify optimal routes for objectives that feature energy and environmental parameters (e.g., minimize carbon dioxide emissions). The model is demonstrated with three case of freight transport along the U.S. Eastern seaboard.</p>

Title	10. Impacts of time of day pricing on travel behavior: general findings from the port authority of New York and New Jersey's initiative
Author(s)	J. Holguín-Veras, Q. Wang, N. Xu, K. Ozbay, J. C. Zorrilla
Publication date	July 15, 2006
Summary	<p>The Port Authority of New York and New Jersey implemented a time of day pricing initiative in March 2001. This initiative provided a discount on off-peak tolls on its facilities. Peak toll rates are effective on weekdays from 6-9 AM and 4-7 PM, as well as on weekends from Noon to 8 PM. These crossings carry average daily eastbound traffic of 352,000 vehicles, or more than 126 million eastbound vehicles in 2004. This is, by far, the largest application of road pricing in the United States.</p> <p>Following the implementation of the new pricing structure, the Federal Highway Administration decided to sponsor a multi-year research project aimed at studying the behavioral impacts produced by the time of day pricing initiative. The research project focuses on three main areas: user impacts, traffic impacts, and institutional</p>

	analyses. This paper discusses the key findings pertaining to the impacts produced by the time of day pricing initiative on the behavior of both passenger and commercial vehicle traffic. It was found that 7.4% of passenger trips and 19.3% of truck trips (20.2% if increasing shipping charges are included) changed behavior due to the time of day pricing initiative.
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Title	11. An Optimization Approach for Planning Daily Drayage Operations
Author(s)	Yetkin Ileri, Mokhtar Bazaraa, Ted Gifford, George Nemhauser, Joel Sokol, Erick Wikum
Publication date	2006
Summary	Daily drayage operations involve moving loaded or empty equipment between customer locations and rail ramps. The research's goal is to minimize the cost of daily drayage operations in a region on a given day. Drayage orders are generally pickup and delivery requests with time windows. The repositioning of empty equipment may also be required in order to facilitate loaded movements. The drayage orders are satisfied by a heterogeneous fleet of drivers. Driver routes must satisfy various operational constraints. The authors present an optimization methodology for finding cost-effective schedules for regional daily drayage operations. The core of the formulation is a set partitioning model whose columns represent routes. Routes are added to the formulation by column generation. The authors show numerical results for real-world data which demonstrate that their methodology produces low cost solutions in a reasonably short time.

Title	12. Characteristics of Drayage Operations at the Port of Houston
Author(s)	Harrison Hutson, West Wilke
Publication date	2006
Summary	Port drayage, defined as a truck pickup from or delivery to a seaport with both the trip origin and destination in the same urban area, is a critical yet comparatively understudied link in the intermodal supply chain. Because port dray trucks operate primarily in urban environments, they have a significant impact on congestion and air quality. The primary goal of this paper is to identify dray industry characteristics at the Port of Houston Authority (POHA) in order to help planners prepare for continually increasing container volumes while keeping in mind the twin needs of maintaining profitability and reducing societal costs. The paper reports the results of interviews with dray managers and a survey of 103 port drivers at the Port of Houston Barbours Cut container terminal on demographics, working conditions, truck characteristics, route characteristics and port operations. The results of the study are then compared against the existing literature, most of which comes from the Los Angeles area. Substantial variation is shown in the age and mileage of trucks. While only a minority of drivers was unsatisfied with overall terminal efficiency, many had suggestions on ways in which efficiency could be improved. The industry is found to be relatively stable despite the increasing demands placed by high container growth rates. Lastly, the paper examines methods in which the dray fleet could be modernized through air quality improvement grants.

Title	13. Impact of Commercial Vehicle Tour Types on Vehicle Kilometers Traveled in
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	Urban Areas
Author(s)	Miguel Andres Figliozi
Publication date	2006
Summary	<p>The emphasis of this research is on the analysis of commercial vehicle tours. Tours are disaggregated by their routing constraints. The generation of Vehicle Kilometers Traveled (VKT) by tour type is analytically modeled and analyzed.</p> <p>The relative influence of the number of stops per tour, tour duration, and time window constraints on VKT is discussed using an analytical framework. Multistop tours are proven to generate more VKT than direct deliveries even for equal payloads. Intuition about the impacts of network changes and policy implications on VKT is derived. Implications for the calibration of trip generation and distribution models are discussed. It is proved that the percentage of empty trips has no correlation with the efficiency of the tours regarding VKT generation. The shape of Trip Length Distributions (TLD) is discussed. It is shown that the average trip length and the TLD shape are strongly dependent on the tour type, distance from the depot/distribution center to the service area, density of stops, and number of stops per tour. Implications for data collection needs are analyzed. Data and indicators that are needed to estimate and forecast truck VKT are proposed.</p>

Title	14. Planning Container Drayage Operations at Congested Seaports
Author(s)	Namboothiri Rajeev
Publication date	2006
Summary	<p>The dissertation considers daily operations management for a fleet of trucks providing container pickup and delivery service to a port. Truck congestion at access points for ports may lead to serious inefficiencies in drayage operations, and the resultant cost impact to the intermodal supply chain can be significant. Recognizing that port congestion is likely to continue to be a major problem for drayage operations given the growing volume of international containerized trade, this research seeks to develop optimization approaches for maximizing the productivity of drayage firms operating at congested seaports. Specifically, the dissertation addresses two daily drayage routing and scheduling problems.</p>

Title	15. The impacts of time of day pricing on the behavior of freight carriers in a congested urban area: Implications to road pricing
Author(s)	Jose' Holgu'N-Veras, Qian Wang, Ning Xu, Kaan Ozbay, Mecit Cetin, John Polimeni
Publication date	December 16, 2005
Summary	<p>This paper describes the key findings from a major research project aimed at assessing the impacts of the Port Authority of New York and New Jersey's time of day pricing initiative on the behavior of commercial carriers. The paper, believed by the authors to be the first comprehensive study on the subject, highlights key implications for road pricing policy.</p> <p>One of the most interesting findings is that carriers respond to time of day pricing by implementing multi-dimensional responses involving Productivity increases, Cost transfers, and Change in facility usage. This implies a more nuanced response than suggested by micro-economic theory, which would only predict a change in facility usage. In fact, no carrier was found to have responded by implementing only</p>

	changes in facility usage, which leads to the authors to believe that this is a last resort alternative.
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Title	16. The Period Vehicle Routing Problem with Service Choice
Author(s)	P. Francis, K. Smilowitz, M. Tzur
Publication date	October 11, 2005
Summary	<p>The period vehicle routing problem (PVRP) is a variation of the classic vehicle routing problem in which delivery routes are constructed for a period of time (for example, multiple days). In this paper, the authors consider a variation of the PVRP in which service frequency is a decision of the model, referring to this problem as the PVRP with service choice (PVRP-SC).</p> <p>The authors explore modeling issues that arise when service choice is introduced and suggest efficient solution methods. Contributions are made both in modeling this new variation of the PVRP and in introducing an exact solution method for the PVRP-SC. In addition, this research proposes a heuristic variation of the exact method to be used for larger problem instances. Computational tests show that adding service choice can improve system efficiency and customer service. Finally, the authors also present general insights on the impact of node distribution on the value of service choice.</p>

Title	17. Multi-resource routing with flexible tasks: an application in drayage operations
Author	Karen Smilowitz
Publication date	September, 2005
Summary	<p>This paper introduces an application of a Multi-Resource Routing Problem (MRRP) in drayage operations. Drayage involves the movement of loaded and empty equipment between rail yards, shippers, consignees and equipment yards. The problem of routing and scheduling drayage movements is modeled as an MRRP with flexible tasks, since the origins and destinations of some movements can be chosen from a set of possible nodes. The complexities added by routing choice are studied, along with the impact of these complexities on problem formulation. The solution approach developed to solve this problem includes column generation embedded in a branch and bound framework. Using this approach, efficient operating plans are designed to coordinate independent drayage operations in Chicago.</p>

Title	18. Methodologies for Reducing Truck Turn Time at Marine Container Terminals
Author(s)	Nathan N. Huynh, C. Michael Walton
Publication date	May, 2005
Summary	<p>This research investigates the two measures terminal operators are taking to reduce their terminals' truck turn time. The first measure is investing in additional yard cranes to facilitate the handling of containers. To this end, this research seeks to assist terminal operators in deciding whether or not to make the investment. Statistical and simulation methodologies are developed to better understand the availability of yard cranes versus truck turn time. The second measure is implementing a truck appointment system to regulate the number of trucks into the terminal. To this end, this research seeks to assist terminal operators in evaluating the consequences of limiting truck arrivals into the terminals. In addition, this research develops a methodology to assist terminal operators in implementing the</p>

	truck appointment system, should they decided to have one.
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Title	19. Evaluation of two modeling methods for generating heavy-truck trips at an intermodal facility by using vessel freight data
Author(s)	Sarvareddy P., Al-Deek H., Klodzinski J., Anagnostopoulos G.
Publication date	2005
Summary	A methodology for building a truck trip generation model by use of artificial neural networks from vessel freight data has been developed and successfully applied to five Florida seaports. The backpropagation neural network (BPNN) algorithm was used in the design. Although the methodology was sound, a new model had to be developed for each of these intermodal facilities. Lead and lag variables were necessary input variables for most models to account for commodities stored on port property before export or pickup after import. Other modeling techniques were researched, and a fully recurrent neural network (FRNN) trained by the real-time recurrent learning algorithm was selected to develop a model for Port Canaveral and compare with a BPNN model. FRNN is dynamic in nature and was found to relate to the storage time of the commodities to truck trip generation. A developed Port Canaveral BPNN model was successfully validated at the 95% confidence level with collected field data. It was applied to conduct a short-term forecast of the port's truck traffic for 5 years.

Title	20. North American container port capacity: A literature review
Author(s)	Maloni, Michael Jackson, Eric C.
Publication date	2005
Summary	International marine container volumes have surged over the last several decades, but North American ports and their supporting container distribution networks have struggled to increase capacity to match this expansion. This article seeks to review and organize existing container network capacity literature into a taxonomy based on the interrelated stakeholders of container flows. The article first establishes the industry capacity situation, then examines research of capacity influences from stakeholders, including port authorities, terminal operators, longshore labor, shippers, railroads, drayage carriers, intermediaries, ocean carriers, governments, and local communities. Ultimately, the article attempts to establish the urgency of container network capacity problems and identify areas needing further research.

Title	21. Vehicle Routing Problem with Time Windows, Part I: Route Construction and Local Search Algorithms; Part II: Metaheuristics
Author(s)	Olli Bräysy, Michel Gendreau.
Publication date	2005
Summary	This paper presents a survey of the research on the vehicle routing problem with time windows (VRPTW). The VRPTW can be described as the problem of designing least cost routes from one depot to a set of geographically scattered points. The routes must be designed in such a way that each point is visited only once by exactly one vehicle within a given time interval, all routes start and end at the depot, and the total demands of all points on one particular route must not exceed the capacity of the vehicle. Both traditional heuristic route construction methods and recent

	local search algorithms are examined. The basic features of each method are described, and experimental results for Solomon's benchmark test problems are presented and analyzed. Moreover, the authors discuss how heuristic methods should be evaluated and propose using the concept of Pareto optimality in the comparison of different heuristic approaches. The metaheuristic methods are described in the second part of this article.
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Title	22. A Study of Drayage at the Ports of Los Angeles and Long Beach
Author(s)	Kristen Monaco, Lisa Grobar
Publication date	December 15, 2004
Summary	The goal of this research is to provide insight into the port drayage industry, by providing detailed information on both the drivers and the firms. Three sources of data are used, all of which were collected specifically for this study. The first source is a comprehensive data set of the wages and worklives of 175 port drivers. This data is used to examine the socioeconomic characteristics of this workforce as well as to examine pay and safety issues.

Title	23. A set partitioning heuristic for local drayage routing under time-dependent port delay
Author(s)	Namboothiri R., Erera A.L.
Publication date	2004
Summary	This paper considers operations management for a fleet of trucks providing container pickup and delivery service (drayage) to a port. Truck congestion at ports may lead to serious inefficiencies in drayage operations. To mitigate the negative effects of congestion, this research develops a drayage operations optimization model that incorporates a known, time-dependent congestion delay model at the port. The model determines pickup and delivery sequences for trucks with minimum total travel time, including the waiting time accessing the port due to congestion. In this paper, the authors consider both exact and heuristic solution approaches for this difficult optimization problem. Finally, the authors use the framework to develop an understanding of the potential impact of congestion delays on drayage operations, and the value of planning with accurate delay information.

Title	24. Development of a java applet for generating truck trips from freight data
Author(s)	Klodzinski J., Ai-Daraiseh A., Georgiopoulos M., Ai-Deek H.M.
Publication date	2004
Summary	As freight transportation becomes a more significant concern, the ability to estimate accurately truck trips generated by freight activity at an intermodal facility is important for transportation engineering and planning. Truck trip generation models that used vessel freight data were developed by the University of Central Florida Transportation Systems Institute and have been statistically proved to determine accurately the number of trucks generated at a seaport. To apply these previously developed models more efficiently, a Java applet was developed to execute a selected artificial neural network (ANN) port model and a trainable ANN port model. This applet provides the user with an easy-to-understand interface for entering data and executing models. The two models developed were the Port

	<p>Everglades ANN model and a hybrid of the Port Everglades model that allowed the user to retrain the ANN model before execution for desired data. Although the trainable model requires additional retraining with new data, the added complexity comes with the benefit of producing a network with a higher degree of accuracy. This applet equips the user with two models and therefore has expanded the capabilities of the previously limited Port Everglades ANN truck trip generation model. The developed Java applet can be expanded to include more ANN models and thus more flexibility, depending on the type of freight data available. This successful adaptation of the ANN model into a Java applet sets the foundation for further applications.</p>
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Title	25. Methodology for modeling a road network with high truck volumes generated by vessel freight activity from an intermodal facility
Author(s)	Klodzinski J., Al-Deek H.M.
Publication date	2004
Summary	<p>An innovative methodology has been developed for analyzing freight movement on local road networks by merging previously developed truck trip generation models using artificial neural networks (ANNs) and a microscopic network simulation model. Through computer simulation, this methodology comprehensively analyzes a seaport considered a special generator of heavy truck traffic and an adjacent road network that includes identified intermodal routes that connect to a seaport. Truck traffic from the seaport is initially modeled with ANNs using vessel freight activity at the seaport. These ANN models have been incorporated into the methodology to provide accurate truck and total traffic volumes for modeling the networks. This methodology was successfully tested with two network microscopic simulation models. Transferability was successfully tested with two seaports with different characteristics. Three months of field data from each port and selected locations on the networks were used in calibration and validation. Both models were successfully validated and showed no statistically significant difference between the field and model output data. This methodology can be used to evaluate local port networks to manage traffic efficiently during heavy congestion or investigate forecasted port growth. These networks can also be used for information technology applications such as incident management or alternative route choice. The ability to develop a network that includes significant truck volumes generated by freight activity is a useful tool especially for engineers and planners involved in intermodal transportation analysis.</p>

Title	26. Dynamic Optimization of Cargo Movement by Trucks in Metropolitan Areas with Adjacent Ports
Author(s)	Ioannou P., Chassiakos A., Julia H., Unglaub R. Metrans
Publication date	2002
Summary	<p>Today, in the trucking industry, dispatchers perform the tasks of cargo assignment, and driver scheduling. The growing number of containers processed at marine centers and the increasing traffic congestion in metropolitan areas adjacent to marine ports, necessitates the investigation of more efficient and reliable ways to handle the increasing cargo traffic. In this report, it is shown that the problem of container movement by trucks can be modeled as a "multi-Traveling Salesmen</p>



	Problems with Time Windows” (m-TSPTW). A two-phase exact algorithm based on dynamic programming is proposed that will find the best routes for a fleet of trucks. Since the m-TSPTW problem is Nondeterministic Polynomial (NP) hard, the computational time for large size problems becomes very high. For the case of medium to large size problems, the authors develop two computationally feasible methods: 1) a hybrid methodology consisting of dynamic programming in conjunction with genetic algorithms, and 2) a heuristic insertion method. Furthermore, since the cargo movement in a traffic network is a dynamic problem, the authors use the heuristic insertion method to add newly arriving customers to the set of customers with advanced requests. Computational results demonstrate the efficiency of the hybrid method for static problems and the insertion method for the dynamic ones.
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Title	27. An Integrated Approach to Managing Local Container Traffic Growth in the Long Beach/Los Angeles Port Complex Phase II
Author(s)	Mallon L, Magaddino J.
Publication date	2001
Summary	Building upon Phase I interim research and analysis, this research proposal furthers this effort in two key aspects. First, it overlays a decision making framework and process applying the principles of global supply chain management to the resolution of real time port capacity constraints involving University faculty, research assistants, and industry representatives directly in this effort. Secondly, it builds capacity and experience within the University faculty and students, and the METRANS community, engaged in the applied research process and educational experience which will pay long term dividends as these students enter their professional careers in the transportation industry.

Title	28. Multi-zone dispatching in truckload trucking
Author(s)	G.Don Taylor, Gary L. Whicker, John S. Usher
Publication date	August 31, 2000
Summary	This paper examines the use of multi-zone dispatching alternatives in truckload trucking using simulation methods and historical freight data of continental scale supplied by J.B. Hunt Transport, Inc. After introducing the concept of zone dispatching, several alternative operational configurations are presented. Simulation results indicate that multi-zone dispatching works best when zone boundaries are configured to minimize, to the extent possible, the freight imbalance between the zones

Title	29. Mixed global and local assignment algorithms for quasi-dynamic local truckload trucking operations with strict time windows
Author(s)	Regan AC, Jagannathan S, Wang XB
Publication date	2000
Summary	Examined are the trade-offs associated with local and global, but myopic, assignment heuristics for local truckload trucking operations such as those associated with drayage operations near intermodal facilities. These operations involve a combination of loads that are known at the beginning of the day and those



	that arrive dynamically throughout the day. Some of the dynamically arriving loads are revenue-generating moves, and others are trailer, chassis, or container repositioning moves. Because a significant fraction of the day's loads are known a priori, dispatchers would like to be able to construct schedules for the day and then to make minor changes to these schedules as the day progresses. The efficiency of an operation in which new loads are added to or appended to schedules constructed at the start of the day versus one in which the whole system is reoptimized several times during the day is examined. The reoptimization method does not seek to preserve current schedules, but the local optimization techniques do. Solutions were examined with a geographic information system-based simulation model developed for this purpose.
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Title	30. Using weigh-in-motion data to calibrate trade-derived estimates of Mexican trade truck volumes in Texas
Author(s)	Figliozzi MA, Harrison R, McCray JP
Publication date	2000
Summary	Weigh-in-motion (WIM) sites are being installed along many highway corridors that carry international trade trucks. Estimating the numbers of trucks carrying international commodities currently relies on manipulating and adjusting trade databases. The variety of vehicle classification data measured at WIM sites provides a rich source of data with which to enhance this adjustment process. Previous WIM border data have focused on port-of-entry truck traffic axle loads, which are heavily influenced by drayage operations. Examined is how WIM data collected at ports of entry and on truck corridors can be used in the determination of standardized truck volumes (termed equivalent trade trucks or ETT) on international highway corridors. Data from the Texas-Mexico border are used to determine ETT North American Free Trade Agreement volumes.

Title	31. Algorithms and strategies for dynamic carrier fleet operations: applications to local trucking operations
Author(s)	Jian Yang, Patrick Jaillet, Hani S. Mahmassani
Publication date	July, 1998
Summary	The authors present a rolling horizon framework for the dynamic assignment and sequencing of trucks to jobs consisting of picking up and delivering full truckloads when requests for service arise on a continuous basis. A mathematical formulation of the problem faced at each stage is presented; its solution allows for the dynamic reassignment of trucks to loads, including diversion to a new load of a truck already en-route to pick up another load, as well as for the dynamic resequencing of the order in which loads are to be served, as new loads arrive and conditions unfold. Loads have associated time windows for pickup and delivery, and the objective function includes explicit penalty cost for not serving a particular load. A solution algorithm is presented and implemented, and computational results are presented, yielding insight into various operational trade-offs in dynamic fleet operations. Because applicability of the solution algorithm is at present limited to relatively small problems, and given the stochastic dynamic nature of these systems, numerical experiments are performed to compare the quality of the solution

	obtained using this approach to the performance of simpler and less computationally demanding local rules.
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Title	32. Network Economies of Scale in Short Haul Truckload Operations
Author(s)	W. Thomas Walker
Publication date	1992
Summary	This paper quantifies the significant economies of scale that are present in a short haul truckload drayage market through the application of a minimum cost scheduling algorithm to actual shipments. This technique offers a useful alternative to the econometric methods used to estimate cost curves for various categories of trucking operations in the past. These econometric methods have suffered from a variety of methodological and data problems which have lead to conflicting conclusions with regard to economies of scale in trucking.

## ENVIRONMENTAL IMPACT OF DRAYAGE ACTIVITIES

Title	1. Assessment of CO2 Emissions for Intermodal Freight Transport Systems and Truck-Only System: A Case Study of the Western-Eastern Europe Corridor
Author(s)	Nam Seok Kim, Bert Van Wee
Publication date	January, 2009
Summary	Intermodal freight transportation systems in the EU are regarded to be more environmentally friendly than truck-only freight systems, particularly for long-distance haulage based on vessel (short sea or inland waterway) or rail and in terms of CO2 emissions. This research aims to examine whether the intermodal freight system really does emit less CO2 than its road-based counterpart. Based on a conceptualisation of intermodal and truck-only systems, the simplified formulations for assessing CO2 emission are presented for seven different scenarios. Specifically, three different intermodal configurations are studied, the effect of two different rail power options are also examined, and finally for electric rail four different electricity generation scenarios are reviewed. The numerical formulation is consistently applied to an area where three freight systems are competing: A Western- Eastern Europe Corridor between Rotterdam, the Netherlands collecting freights from Belgium, Luxemburg, and France and Gdansk, Poland distributing them to Estonia and Latvia.

Title	2. Environmental Impacts of a Major Freight Corridor: A study of the I-710 in California
Author(s)	Gunwoo Lee, Soyoung (Iris) You, Stephen G. Ritchie, Jean-Daniel Saphores, Mana Sangkapichai R. Jayakrishnan
Publication date	2009
Summary	The objective of this paper is to explore a new approach to estimating vehicle emission impacts of freight corridor operations related to the port area, particularly those associated with heavy duty diesel trucks. The approach involves use of a microscopic traffic simulation model to capture detailed vehicle trajectories and congestion effects (ultimately including the effects of Intelligent Transportation System strategies), emissions modeling, and modeling the spatial dispersion of pollutants in the corridor, to facilitate estimation of the health and environmental

	<p>justice impacts of freight corridor operations. In this paper the authors focus on operation of the I-710 freeway in the Alameda Corridor, leading from the SPBP area for about 20 miles toward Los Angeles. In a parallel effort the authors are also studying rail operations in the same corridor. In the future both the rail and highway elements will be combined to form an integrated, overall assessment of air quality impacts in the corridor. In this paper, seven scenarios were evaluated in addition to the 2005 Base Scenario: replacement of the current fleet of port heavy duty diesel trucks with zero emission trucks (25%, 50%, and 100% of port trucks), elimination of port heavy duty diesel truck trips (25%, 50%, and 100% reductions) that would correspond to shifting more containers to other modes such as rail, and implementation of a truck restricted-lane on I-710 preventing trucks from using the left most lanes. The results show that fleet replacement with cleaner trucks yields the most emission reductions both quantitatively and spatially.</p>
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Title	3. Local Seaport Initiatives Driving International Policy - Eliminating the Effects of Air Pollution and Drawing Up "Green Prints" for Responsible Growth
Author(s)	Geraldine Knatz
Publication date	2009
Summary	<p>Despite the global nature of goods movement in the 21st century, it became apparent—at least in Southern California—that the nation's two largest ports needed to forge their own clean air solutions in the absence of more stringent regulatory standards from policy-making bodies. For those individuals who live or work near the Los Angeles docks or the transportation corridors leading to the docks, solutions could not come soon enough.</p> <p>The San Pedro Bay Ports Clean Air Action Plan (CAAP), an initiative promulgated jointly in November 2006 by the Los Angeles and Long Beach Harbor Commissions, is the "green print" for a sea change in emission reduction efforts that ports and shipping interests worldwide will pursue in the decade ahead. The landmark emission plan at the massive two-port complex aims to reduce harmful emissions from all port-related sources-ships, trucks, trains, harbor craft, and cargo-handling equipment-45% or more by 2012.</p>

Title	4. Comparison of technological and operational strategies to reduce trucking emissions in Southern California
Author(s)	Facanha, C., Ang-Olson, J.
Publication date	2008
Summary	<p>This study compares the cost-effectiveness and the emission reduction potential from selected trucking strategies in Southern California. The Ports of Los Angeles and Long Beach will have to accommodate substantial traffic growth in the next decades because of Asia Pacific corridor trade growth. Not only will California have to improve capacity and avoid gridlock, but it will also have to develop strategies that reduce emissions from goods movement. The Southern California Association of Governments and other agencies are developing major plans for goods movement infrastructure investments as well as technological and operational strategies that account for environmental performance. Beside future improvements in trucking emissions due to new emission standards, additional trucking strategies are evaluated in this analysis. They include truck replacement,</p>

	truck repowering and truck retrofit with particulate matter control devices, and two operational strategies - a virtual container yard and an expanded incident management program that tackles incidents involving heavy-duty diesel trucks.
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Title	5. Diesel truck traffic in low-income and minority communities adjacent to ports environmental justice implications of near-roadway land use conflicts
Author(s)	Houston, D., Krudysz, M., Winer, A.
Publication date	2008
Summary	Container traffic at the Ports of Los Angeles and Long Beach, California, has tripled in the past 15 years, resulting in massive port-related heavy-duty diesel truck (HDDT) traffic on surface streets in the low-income and minority communities of Wilmington and western Long Beach adjacent to the ports. In response to the limitations of existing data on the volumes of HDDTs on surface streets, this study used direct video measurements of surface street traffic at 11 intersection's and line segments in these communities to document port-related truck traffic traveling to and from intermodal facilities, truck service sites, local amenities, and regional goods movement roadways. The volumes of HDDTs often reached 400 to 600/h for several hours immediately upwind of sensitive land uses, such as schools, open-field parks, and residences. Diurnal truck traffic patterns on surface streets varied by intersection, local conditions, and passenger car commute patterns. Given the documented health and environmental consequences of HDDT emissions, the results raise serious public health concerns for the inhabitants who reside, work, attend school, or recreate in close proximity to roadways with HDDT traffic in these communities adjacent to ports. This paper discusses the environmental justice implications of truck-related land use conflicts and current planning and emission control strategies to mitigate the local air pollution impacts of increasing port-related truck traffic in these low-income, minority communities.

Title	6. Comparative Evaluation of Infrastructure Strategies to Reduce Emissions from Intermodal Freight Movement in Southern California
Author(s)	Jeffrey Ang-Olson, Cristiano Facanha
Publication date	15 November, 2007
Summary	This paper evaluates five major infrastructure projects that could substantially reduce emissions from intermodal goods movement in Southern California: On-dock railroad expansion, Near-dock railroad expansion, Mainline railroad capacity expansion and grade separation, Electrification of the Alameda Corridor, and Electrification of the entire regional railroad mainlines. Given the importance of Southern California as a gateway for international trade, need for expansion of the capacity of the region's good movement system, and the contribution of goods movement to the region's serious air quality problems, it is important to understand the emissions impacts of major goods movement infrastructure projects. This study finds that all five infrastructure projects can reduce a significant amount of emissions. Electrification of the entire mainline railroad system would achieve by far the largest emission reductions, eliminating more than 7,500 tons of NOx and 234 tons of PM2.5 emissions annually. Mainline capacity expansion would achieve the next largest reductions. Alameda corridor electrification is the most cost-effective of the five strategies at \$15,000 per ton of NOx and \$485,000 per ton of PM2.5,

	followed by on-dock rail expansion.
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Title	7. Heavy-Duty Vehicle Chassis Dynamometer Testing for Emissions Inventory, Air Quality Modeling, Source Apportionment and Air Toxics Emissions Inventory
Author(s)	Nigel N. Clark, Mridul Gautam, W. Scott Wayne, Donald W. Lyons, Gregory Thompson, Barbara Zielinska
Publication date	August, 2007
Summary	This study discusses Program E-55/59 which had the objective of acquiring regulated emissions measurements (for the whole test fleet) and non-regulated emissions measurements (on a subset of the test fleet) from in-use trucks with the objective of improving the emissions inventory in California.

Title	8. Goods Movement air emissions inventory at the port of Houston
Author(s)	Starcrest Consulting Group, LLC
Publication date	2007
Summary	<p>The Port of Houston Authority (PHA), in conjunction with the Texas Natural Resource Conservation Commission (now Texas Commission on Environmental Quality, TCEQ) commissioned Starcrest to prepare one of the first port-specific emissions inventories, the <i>Houston-Galveston Area Vessel Emissions Inventory</i> (HGA VEI) for 1997 (publication in 2000).</p> <p>This Goods Movement Air Emissions Inventory (GM EI) is intended to update the PHA-related commercial marine vessel components of the HGA VEI, and add heavyduty trucks and locomotives source categories. Emissions for cargo handling equipment, developed under a separate effort, are also included.</p>

Title	9. Estimating extended idling emissions of heavy-duty diesel trucks in Texas
Author(s)	Zietsman J., Perkinson D.G.
Publication date	2005
Summary	<p>Long-haul truck drivers idle their vehicles to operate heating systems and air conditioners, generate electricity, charge the vehicles' batteries, and warm up the engines. This type of idling, which often occurs over extended periods and could be a significant source of emissions, is expected to increase because of the U.S. Department of Transportation's latest rule mandating that truck drivers rest 10 h for every 14 h of driving. The emissions associated with this type of discretionary idling occurring at the beginning and end of trips are not included in emissions inventories and can be an important contributor to the overall mobile source emissions. There is, therefore, a need to develop a procedure that would yield accurate estimates of extended truck idling emissions. This study developed such a methodology by using a nonattainment area in Texas as a pilot study. On the basis of interviews and observations made at generators such as truck stops, public rest areas, industries, ports, and intermodal facilities, a model was developed to perform the emissions estimates. The procedure was applied to the remaining metropolitan areas in Texas. It was found that extended truck idling emissions were a major source of mobile source emissions, resulting in emissions of more than 30 tons per day of oxides of nitrogen and more than 0.8 ton per day of particulate matter in Texas metropolitan areas. Although these emissions represent less than 4% of the overall on-road mobile source emissions, they are important in assisting nonattainment areas to</p>

	reach conformity.
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## CLEAN TRUCK PROGRAM

Title	1. Drayage Fleets Add Clean Trucks
Author(s)	Traffic World
Publication date	December 15, 2008
Summary	<p>Clean trucks are arriving in larger numbers on the West Coast. Daimler Trucks North America last week delivered 132 natural gas-fueled trucks to California Cartage and another 100 tractors to the ports of Los Angeles and Long Beach.</p> <p>In addition, retailer J. C. Penney and PDS Trucking, a subsidiary of Pacer Distribution Services, received more than 20 new Kenworth T-800 tractors that will replace aging diesel trucks currently in use by independent owner-operators in Pacer's port network. The Pacer trucks are part of a program to make JCPenney's fleet 100 percent compliant by early 2009, well ahead of the ports' deadline.</p>

Title	2. Program Produces Lots of Concessions, Few Scrapped Trucks
Author(s)	The Cunningham Report
Publication date	December 13, 2008
Summary	<p>One measure of the Port of Long Beach and Port of Los Angeles clean truck programs is whether the ports finally have a handle on what kinds of trucks are frequenting their terminals and how much pollution those trucks emit.</p> <p>By that standard, the program is a smashing success. Less than three months after the launch, the two ports have 16,340 trucks fully registered in their Drayage Truck Registry. That number approximates the 16,800 trucks believed to be frequent and semi-frequent callers to the ports.</p> <p>Another measure is whether there are fewer dirty trucks on the road. By that standard, success has eluded the ports. Under the two ports' grant program, only five older trucks have been scrapped and replaced by 2007 U.S. EPA compliant models. Eight more have been scrapped under a Port of Los Angeles-only buyback program that pays \$5,000 per truck, for a total of 13 trucks destroyed so far. Another 30 trucks are waiting to be scrapped under the buyback program, although the Port of Los Angeles has yet to contract with a scrapping company for its alternative program.</p>

Title	3. FMC Action Likely Delays Port Truck Program
Author(s)	Journal Of Commerce
Publication date	September 15, 2008
Summary	<p>This articles discusses the action taken by the Federal Maritime Commission (FMC) which is likely to delay the Oct. 1 start of controversial plans to regulate the port drayage market at Los Angeles and Long Beach. The commission voted 2-1 in a recent meeting to request additional information from the ports about the working agreement that underpins their clean-trucks programs. The FMC said it acted "because it has serious concerns about potentially unreasonable increases in transportation costs or decreases in transportation services" under the agreement.</p>

Title	4. Crossroads for drayage
Author(s)	Bill Mongelluzzo
Publication date	January 7, 2008
Summary	<p>This article discusses the effort by the Teamsters to organize harbor truck drivers at U.S. ports</p> <p>The vehicle to achieve the Teamsters' goal was the Clean Air Action Plan that the ports of Los Angeles and Long Beach adopted late in 2007. A key part of the plan required the approximately 16,000 trucks that call regularly at the ports to be replaced by 2007 model-year vehicles or their equivalent within five years. The goal is to reduce air pollution from trucks by 80 percent. Controversy arose when the ports, at the urging of the Teamsters, included a requirement that would restrict harbor trucking to companies to secure special operating licenses and agree to hire only employee drivers instead of owner-operators.</p>

Title	5. U.S. Container Ports and Air Pollution: A Perfect Storm
Author(s)	James S. Cannon
Publication date	2008
Summary	<p>This study by Energy Futures, Inc., examines the actions underway to reduce air pollution at the 10 largest container ports in the U.S. The goal is to identify the specific environmental problems at each port, the development status of pollution control strategies, and the opportunities for alternative fuels and advanced technologies to play a critical role in reducing air pollution.</p>

Title	6. The clean trucks program: Evaluation of policy impacts on marine terminal operations
Author(s)	Goodchild A., Mohan K.
Publication date	2008
Summary	<p>The Clean Trucks Program is a Clean Air Action Plan initiative currently being adopted by the Ports of Los Angeles and Long Beach. This paper examines each of the Clean Trucks Program's current requirements and estimates the impact on terminal operations. Using terminal operations data supplied by three terminal operating companies, the authors conduct a simple queuing analysis and present a regression model which allows them to consider the potential impact of the policy changes. While the impact at a specific terminal is not estimated in this paper, the authors consider order of magnitude effects. While the program itself does not require terminal operations changes, the program will modestly increase incentives to improve operational efficiency outside the terminal and reduce terminal gate processing time. It will also require technology that could be used for further operational changes. However, that unless gate time improvements are matched with these operational improvements in the terminal, they will only move the delay inside the terminal and not reduce total terminal time. The research considers the impact of the Clean Trucks Program on the Ports of Los Angeles and Long Beach, but similar concerns are driving changes at ports around the globe.</p>

## ISSUES SURROUNDING DRAYAGE DRIVERS



Title	1. Incentivizing Truck Retrofitting in Port Drayage: A Study of Drivers at the Port of Los Angeles and Long Beach - Metrans Project 06-02
Author(s)	Kristen Monaco
Publication date	February, 2008
Summary	Using data from detailed surveys of truck drivers, the wages and working conditions of drivers involved in port drayage were analyzed. Focus as on drivers' willingness to pay for retrofitting and their preferences regarding different truck replacement programs. It was found that drivers are willing to pay a portion of truck retrofitting costs. It was also found that though a grantbased truck replacement program was ranked highest among drivers, they were somewhat polarized on this program; many drivers also ranked this program as their least favorite. A subsidized interest rate program had the most umulative first and second rankings.

Title	2. Study predicts drayage driver shortage due to security rules, growing imports
Author(s)	Watson Rip
Publication date	2008
Summary	This articles growing concerns of shortage of port drayage drivers because of new federal security regulations and a return to growth of freight imports by sea. "There is a concern that many drivers that deem themselves at risk of being rejected are simply not applying for the Transportation Worker Identification Credential," the report from the Tioga Group said. "This could cause a shortage of drivers where illegal immigrants are believed to make up a large part of the driver force." Southern California could lose 22% of its port drayage driver pool because many drivers cannot pass the immigration status check that is part of the process for obtaining the TWIC card that will be required after April 15.

Title	3. A Survey of Dray Drivers at the San Pedro Bay Ports
Author(s)	CGR Associates, Prepared for the Gateway Cities Council of Governments
Publication date	March 26, 2007
Summary	Two surveys were developed, conducted and the results tabulated between January 18th and February 28, 2007. The first was a random survey of Licensed Motor Carriers (LMCs) providing drayage services to the San Pedro Ports of Los Angeles and Long Beach (the Ports). The second was a survey of the Independent Owner Operator driver/truckers (the IOOs) associated with the LMCs randomly selected for the first survey. In total, there were 54 respondents to the LMC survey and 209 to the IOO survey. The 209 IOO respondents were associated with 15 of the 54 LMCs. The 54 LMCs reported they use 1,555 IOOs and have 47 employee drivers as well. Based on the LMC's reported number of container moves, the study estimates they represent approximately 10% of the total annual container moves associated with the two Ports.

Title	4. Los Angeles/Long Beach Harbor Truckers Survey Follow-Up Survey Summary Report - PierPASS OffPeak Program
Author(s)	Fairbank, Maislin, Maullin
Publication date	December, 2006



Summary	<p>PierPass, a not-for-profit company created by marine terminal operators, commissioned a new survey as a follow-up to the survey conducted among truckers serving Los Angeles and Long Beach Harbors between May 18 and 27, 2006. Like that survey, the focus in this latest inquiry was on perceptions of and participation in the OffPeak Program for Los Angeles and Long Beach Harbors. Survey interviews were completed face-to face in either English or Spanish by interviewers intercepting potential respondents at terminal gates and waiting areas. Interviews were conducted during day and evening shifts as well as the Saturday shift. In all, 451 truckers offered their opinions. A standard questionnaire was utilized for all interviews, and the interviews averaged between 10 and 15 minutes per respondent.</p> <p>Findings: A high number of truckers continue to say that they are familiar with the OffPeak Program. The November /December survey reports a six percent drop in familiarity – 77 percent compared to 83 percent in the previous survey -- but this difference may simply be a chance variation related to the intercept interview collection process. In practical terms, as of year-end 2006, a large majority of truckers say they know about the OffPeak Program. Likewise, among those familiar with the Program, positive opinion of the Program prevails over negative opinions on an overall basis by a substantial ratio. Many truckers also continue to attribute personal benefits to the OffPeak Program, including more productivity and higher earnings, as well as work and life style improvements.</p>
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Title	5. Second Survey of Port Driver Attitudes on PierPASS OffPeak Program
Author(s)	John Rozsa
Publication date	March 8, 2006
Summary	<p>This article discusses drivers' attitude toward PierPASS OffPeak Program. The principal benefit promised to drivers from the establishment of PierPASS' OffPeak program was the opportunity to make more turns at less congested night gates. That promise has yet to materialize. This second driver survey showed that drivers who serve night gates are not getting any additional turns. In fact, drivers who work the maximum of four night gates per week make significantly fewer turns than the average. Night gates and Saturday gates continue to be unpopular with drivers. Forty percent refuse to work nights. Forty one percent refuse to work Saturdays. Thirty three percent of drivers who work night gates and 32 percent of those who work Saturday gates say they do so because that is when the loads are available. The most prominent objection continues to be that night and Saturday schedules prevent drivers from being with their families during the hours their families' normal activities are scheduled. Attitudes among drivers toward PierPASS have become more positive than they were in the first survey. However, when adjusted to reflect the impact of extra compensation, drivers are not much more positive toward PierPASS or willing to work nights or Saturdays than they were during the first survey.</p>

Title	6. Wages and Working Conditions of Truck Drivers at the Port of Long Beach
Author(s)	Kristen Monaco
Publication date	2004
Summary	As volumes of imports to the U.S. continue to grow, there is increased pressure on

	<p>terminals, port drayage companies, and shippers to increase throughput at the nation's ports. One key part of this vertical chain is the port drayage driver. At the ports of Los Angeles and Long Beach (which combined are the third largest container port in the world) the vast majority of these drivers are owner operators (drivers who own their own trucks).</p> <p>There is very little known about these drivers. Anecdotal evidence suggests that they possess low levels of education, are often new to the country, and typically earn less than drivers in other segments of trucking. The purpose of this study is to use data from surveys of drivers at the Port of Long Beach to better describe this labor force, with an eye towards examining rates of pay, their worklives, and safety issues.</p> <p>It is important to understand the nature of the work of these drivers. Though most are owner operators, they do not typically operate with their own authority – they contract with harbor drayage companies. Given that these drayage companies typically do not have any employee drivers, they seem to serve as brokers, linking drivers and loads. Port drayage drivers are dispatched by the firms and proceed to the port and the terminal where the load is to be picked up. Though some terminals at the Port of Long Beach have appointment systems it is typical that these are not used (or only used for the first trip of the day). The driver waits for the proper load inside the terminal and is provided this load on a chassis that is typically owned or arranged by the ocean carrier.</p> <p>The driver then leaves the port and delivers the load (typically to a local destination). The nature of this work leads to several questions. First, how is the driver paid? Second, how much of the driver's time is spent waiting? Third, what are the safety issues facing drivers in this segment of the industry?</p>
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Title	7. Owner-operator truck driver earnings and employment: Port Cities and Deregulation
Author(s)	James Peoples, Wayne K. Talley
Publication date	2004
Summary	This chapter tests the hypothesis that ocean transportation deregulation presents owner-operators with greater job opportunities and the opportunity to increase earnings at port cities. The pre- and post-deregulation earnings estimates of owner-operator drivers in the fifty busiest port-cities are compared to estimates for other owner-operators. Earnings findings indicate a statistically significant increase in the relative earnings for port-city owner-operators following deregulation. Employment findings reveal that compared to the pre-deregulation period, a greater share of owner-operator drivers are employed at port cities in the shipping post-deregulation period.

## TERMINAL MANAGEMENT STRATEGIES TO IMPROVE DRAYAGE OPERATION

Title	1. Reducing Truck Turn Times at Marine Terminals with Appointment Scheduling
Author(s)	Nathan Huynh
Publication date	November 15, 2008
Summary	This paper addresses a critical component of the truck appointment systems -

	<p><i>scheduling rules</i>. The goal of this study is to gain an understanding of how the various scheduling rules affect resource utilization and truck turn time in grounded operations. Such understanding could influence terminal operators and appointment service providers to make changes to the current scheduling practice. To this end, it seeks to develop a framework for the evaluation of (1) the performance of various simple appointment-scheduling rules under a variety of operating scenarios, and (2) the major factors affecting the performance of scheduling rules. This study considers two types of appointment scheduling strategies, adopted from the healthcare sector: (1) individual appointment systems (IAS), and (2) block appointment systems (BAS). To determine the effectiveness of the scheduling strategy, this study relies on a simulation model of a container terminal. Simulation is used because it provides for a more realistic representation of the complex terminal operations. In addition, it circumvents the restrictive assumptions of analytical methods. The developed simulation model is constructed using Flexsim CT, the first commercially available "off-the-shelf" simulation tool for container terminals. Experimental results show that there is a clear benefit for a terminal without an appointment system to employ the IAS. Such scheduling system will keep the yard cranes highly utilized while improving the internal yard turn time by about 44%. With the proper <i>spacing</i> between appointments, the IAS can be effective even when a good portion of trucks are walk-ins, no-shows, or late (up to one hour).</p>
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Title	2. Robust scheduling of truck arrivals at marine container terminals
Author(s)	Huynh N., Walton C.M.
Publication date	2008
Summary	<p>The use of a truck appointment system is gaining momentum in the marine container industry. It is used to regulate the number of trucks that can enter the terminal. Terminals employing appointment systems put a cap on the number of trucks that can enter a zone in the yard per time window. Limiting truck arrivals can be beneficial to some extent; however, if the caps are not set properly, it could be detrimental to both the terminal and the truckers. This paper examines the effect of limiting truck arrivals on truck turn time and crane utilization. In addition, it proposes a methodology to assist terminal operators with determining the optimal number of trucks to accept for the appointment system to be effective. The proposed methodology, which is a combination of mathematical formulation and simulation, seeks a solution that is beneficial for both the terminal operator and the trucker. Furthermore, the solution is robust to account for truckers with appointments showing up late or not showing up at all.</p>

Title	3. DrayFLEET: EPA SmartWay Drayage Activity and Emissions Model and Case Studies
Author(s)	The Tioga Group, Inc.
Publication date	2008
Summary	<p>Container drayage is widely recognized as a critical emissions, congestion, and capacity issue for major container ports and rail intermodal terminals. The objective of the project was to develop an emissions and activity model – DrayFLEET – that accurately depicts drayage activity in terms of VMT, emissions, cost, and</p>

	<p>throughput, and can reliably reflect the impact of changing management practices, terminal operations, cargo volume, and diesel truck upgrades.</p> <p>A major objective of the modeling effort was to create a comprehensive picture of port drayage movements. While meeting this objective necessarily increases model size and complexity, comprehensiveness is vital for several reasons. Ports and terminals all fulfill the same basic functions, but do so in several different ways and in many detailed variations. The project team therefore endeavored to create model options for all significant drayage functions at any port complex, even though those model options may be rarely used.</p>
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Title	4. Two-Stage Stochastic Program with Recourse for Analyzing Effect of Demand Uncertainty in Inland-Depots-For-Empty-Containers System
Author(s)	Neha Mittal, Alok Baveja, Sotiris Theofanis
Publication date	2008
Summary	<p>Maritime trade supporting facilities are strategically located and are designed to handle an expected freight volume in the region they serve. However, since freight volumes fluctuate with changes in consumer demand and global economies, the supporting facilities hold a high probability of experiencing these changes in their operating environment. The uncertainty in cost and demand makes it critical for the authorities to design facilities that may effectively respond to the possible randomness in the system.</p> <p>This paper builds upon the authors' earlier work that proposed an 'Inland-Depots-for-Empty-Containers' (IDEC) concept to minimize the total system costs in regional empty container repositioning. In this paper the authors analyze the stochasticity in empty container demand and supply at the network nodes and examine its impact on the IDEC system. The authors develop a two-stage stochastic program with recourse to determine the number and location of inland depots to minimize the expected system costs. The model determines facilities in two stages - stage zero facilities work well under all possible realizations of the future scenarios and stage one facilities are recourse facilities that open later in the future when demand is less ambiguous.</p> <p>The research evaluates the proposed approach by performing a case study based on the port region of New York/New Jersey. Results obtained from a range of scenarios demonstrate greater expected benefit from the proposed approach as compared to the corresponding deterministic or single-stage stochastic models.</p>

Title	5. Investigating the Feasibility of Establishing a Virtual Container Yard to Optimize Empty Container Movement in the NY-NJ Region
Author(s)	Sotirios Theofanis, Maria Boile
Publication date	September, 2007
Summary	<p>A Virtual Container Yard (VCY) is a mean of developing a shared resource information system to match empty equipment needs through the adoption of next generation internet and new technology information platforms. This project examines the feasibility of developing and operating a Virtual Container Yard to serve the freight and maritime community in the NY-NJ region.</p> <p>In this report, an analytical formulation and simulation model developed to evaluate the potential benefits of a VCY under different market conditions is</p>

	presented. Also, financial and economic evaluation, potential funding alternatives and investment recovery strategies to ensure successful development and long term viability of systems' operation, are presented. Finally, a staged application timeline and implementation plan is produced, to cater for an intermediate pilot demonstration phase, necessary to draw experiences leading to proper full-scale application. The project provides for an integrated support product to enhance setting up a Virtual Container Yard system application in the NY-NJ region.
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Title	6. Virtual Container Yard: A Simulation-based Perspective
Author(s)	Janatiraman S., Theofaius Boile, Naniopoulos A.
Publication date	January, 2007
Summary	The tremendous increase in international trade has given rise to a problem of thousands of inefficient empty truck trips to and from the ports in areas such as the NY-NJ region, resulting in unproductive vehicle miles traveled, congestion and other related issues. Using a virtual container yard system as a platform for sharing and providing information among the different port players to make freight logistics more efficient by means of street-turns is increasingly considered as a possible solution. This paper describes a simulation model that captures the essential features of such an implementation, and the results for different scenarios of input parameters, system environments and practical constraints in order to make the system feasible are presented and analyzed. The paper concludes with recommendations to achieve favorable conditions for practical implementation.

Title	7. Boosting Marine Container Terminals Throughput - A Survey of Strategies
Author(s)	Huynh Nathan N.
Publication date	2007
Summary	This paper describes how the economic projections on containerized trade were based on models of the past that did not include countries like China and India. As a result, trade forecasts were way below the actual figures and failed to give ports adequate warning. Even when the forecasts became a reality, ports were slow to react, creating what is now known as port congestion which negatively affected many in the intermodal chain. Marine container terminals all over the U.S. are now playing catch up with ocean carriers in expanding capacity to accommodate the growth in Asian exports. This paper elaborates on some of the strategies terminal operators and shippers are taking to deal with the port congestion problem.

Title	8. Modeling Empty Container Matching Opportunities through a Virtual Container Yard
Author(s)	Boile Maria, Janakiraman Srihari, Theofanis Sotirios, Naniopoulos, Aristotelis
Publication date	2007
Summary	Empty container drayage trips are considered to be a major problem for port metropolitan areas, they add to traffic congestion, increase emissions and are considered to be an inefficient equipment interchange. A Virtual Container Yard (VCY) is an Internet based information sharing platform, aiming at permitting empty container interchange and other processes to take place without moving the container back to the marine terminal or an empty container depot Using a VCY system as a platform for sharing and providing information among the different

	port players (ocean carriers, trucking operators etc.) to make freight logistics more efficient by means of street-turns (direct empty container moves from a consignee to the next consignor) is increasingly considered as a viable solution in reducing empty Vehicle Miles Traveled (VMT) and associated congestion and emissions. This paper describes a modeling approach and a simulation model that captures the process of matching empty containers and the essential features of implementing a VCY. The anticipated benefits from VCY implementation, in terms of VMT reduction and the economic conditions for the successful operation of the system are quantified. The results for different scenarios of input parameters, system environments and practical constraints, in order to make the system feasible, are presented and analyzed. The paper concludes with recommendations to achieve favorable conditions for practical implementation of the system.
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Title	9. Planning local container drayage operations given a port access appointment system
Author(s)	Rajeev Namboothiri, Alan L. Erera
Publication date	2007
Summary	This paper studies the management of a fleet of trucks providing container pickup and delivery service (drayage) to a port with an appointment-based access control system. Responding to growing access congestion and its resultant impacts, many US port terminals have implemented appointment systems, but little is known about the potential impact of such systems on drayage fleet efficiency. To address this knowledge gap, the authors develop a drayage operations planning approach based on an integer programming heuristic that explicitly models a port access control system. The approach determines pickup and delivery sequences for daily drayage operations with minimum transportation cost. The authors use the framework to develop an understanding of the potential productivity impacts of access control systems on drayage firms. Most importantly, the authors find that it is critical for terminal operators to provide enough access capacity for drayage, since vehicle productivity can be increased by 10–24% when total access capacity is increased by 30%. Furthermore, poor (but not unreasonable) selection of access appointment time slots by drayage firms may result in substantial customer service deficiencies, reducing the number of customers that can be served by up to 4% for a fixed level of total access capacity.

Title	10. Reducing port-related truck emissions: The terminal gate appointment system at the Ports of Los Angeles and Long Beach
Author(s)	Genevieve Giuliano, Thomas O'Brien
Publication date	2007
Summary	Growth in international trade and changing patterns of production have resulted in greatly increased volumes of freight traffic in urban areas. Metropolitan areas serving as major nodes within the international trade network are particularly affected. In California, state regulation was imposed on port operations in an effort to mitigate congestion and air pollution associated with increased port-related trade. This paper presents an evaluation of the outcomes of California Assembly Bill (AB) 2650 at the Ports of Los Angeles and Long Beach. The legislation permitted terminals to adopt either gate appointments or off-peak operating hours as a

	means of reducing truck queues at gates. There is no evidence of reduced queuing or transaction times, and hence that AB 2650 did not result in reduced truck emissions.
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Title	11. Regional Repositioning of Empty Containers: Case for Inland Depots
Author(s)	Boile Maria, Theofanis Sotiris, Baveja Alok, Mittal Neha
Publication date	2007
Summary	<p>Regional repositioning of empty containers involves empty container movement between regional importers, marine terminals, depots, and export-customers. This chain movement generates unproductive empty vehicle miles in the region. The problem of empty miles becomes more prominent since empty container depots are located close to the port and customers are inland. Considering the double-digit increase in containerized trade volumes and the persistent trade imbalance that strain existing depot capacities in major import areas, this paper focuses on the optimal location of new container depots and the repositioning of empty containers in a region. It proposes a system of Inland Depots for Empty Containers (IDEC) where new depots would be built closer to customer clusters.</p> <p>An IDEC system can minimize the total system costs (cost of opening new depots plus repositioning cost of empties) and provide additional required capacity. The paper presents a mathematical model of such a system and discusses its feasibility and effectiveness.</p> <p>The proposed system is evaluated for a region based on the New York/New Jersey port region. Results show that by building inland depots, empty vehicle miles traveled and total system cost of repositioning empties are reduced significantly. At the same time, capacity is added to the system that otherwise would experience a shortfall as a result of the increase in trade and the trade imbalance. The authors believe that an IDEC system has a great potential in optimizing regional empty moves.</p>

Title	12. Examination of the Relationship between Real-Time Traffic Information and Market Entry Barrier for Local Delivery Firms - Agent-Based Approach
Author(s)	Kazuya Kawamura, Yandan Lu
Publication date	2007
Summary	<p>This exploratory study use the agent-based model to create a virtual environment in which small and large firms enter into a new market under several different conditions to examine the validity of the hypotheses that in the absence of publicly available traffic information, the competitive advantage of larger companies, resulting from having accurate information on the traffic condition (because they possess greater ability to gather congestion information using their own trucks as probes), can be large enough to prevent smaller companies to enter into a new market for which the pattern of recurring traffic congestion is not well known. Thus, the traffic information system may provide additional benefits that have not been recognized in the past. The output from the simulations runs show that while traffic information system reduces the entry cost, especially for the small firms, the average cost savings over the simulation cycle of 70 time periods is equivalent of 3% of the total cost. Also, the saving in the entry cost is affected by the level of</p>



	congestion and also the variability in the link travel times. Although determining whether the entry cost is large enough to prevent the smaller companies to enter the new market in the real world will require further analyses using the empirical data. However, it is clear that the provision of the publicly available traffic information will improve the odds of entry and survival for the small firms.
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Title	13. An Accurate Monitoring of Truck Waiting and Flow Times at a Terminal in the Los Angeles/Long Beach Ports
Author(s)	Shui F. Lam, Jeho Park, Cheryl Pruitt
Publication date	2007
Summary	The rapid growth in cargo volume at the Los Angeles/Long Beach Twin Ports has led to serious concerns, among others, on port capacity limits, traffic congestions in the surrounding areas and beyond, pollution, etc. A large portion of the operations at the ports involves trucks coming to the terminals for drop off or pick up of containers. Due to the significant impact of these truck traffics on the roadway congestion and air pollution, the need for efficient service for these truck operations cannot be over stated. Numerous projects have been, are being, and will be conducted on policy as well as operational issues of truck drop-offs/pick-ups in these twin ports. Many of these studies require a good understanding of the current state of services at the terminals in this regard. In this project the authors track truck traffic at a specific terminal in the twin ports in an attempt to acquire statistics on truck arrivals, as well as truck waiting and flows at this terminal. The tracking is accomplished using digital photographing technology.

Title	14. Evaluation of the Terminal Gate Appointment System at the Los Angeles/Long Beach Ports
Author(s)	G. Giuliano, S. Hayden, P. Dell'aguila, T. O'Brien
Publication date	2006
Summary	This report presents an evaluation of the terminal gate appointment system at the Los Angeles/Long Beach ports. Implemented in 2002, the appointment system was established in response to California Assembly Bill (AB) 2650. The intent of the legislation was to reduce vehicle emissions and highway emissions by reducing truck queuing at marine terminal gates and distributing truck traffic over a greater period of time throughout the day. The legislation allowed terminals to adopt either gate appointments or off-peak operating hours as a way to avoid fines for truck queues. Based on interviews, field observations, a trucking company survey, and data provided by selected terminals, the authors evaluate the outcomes of their research in three primary areas: 1) implementation and enforcement of AB 2650; 2) the response of the trucking community; and, 3) the impacts of the appointment system on queuing and turn time at the terminals

Title	15. Performance Measure Evaluation of Port Truck Trip Reduction Strategies.
Author(s)	Fischer M., Hicks G., Cartwright K.
Publication date	2006
Summary	The Ports of Long Beach and Los Angeles are the largest container port complex in North America and fifth largest in the world. Growth in U.S. Pacific Rim trade has



	<p>put pressure on the landside transportation systems serving these two ports. In order to address this growth and mitigate environmental impacts, the ports are implementing new operational strategies and infrastructure improvements. Recently, the ports evaluated the prospective performance improvements that an aggressive program of truck trip reduction strategies can achieve. Strategies that have been evaluated include extended gate hours, virtual container yards, expanded on-dock rail facilities, a new near-dock rail intermodal terminal, and an inland rail shuttle service. This paper describes the approach taken to forecast several of the performance measures that were used to evaluate the strategies. These performance measures are change in truck trips generated at the ports, changes in port truck vehicle miles traveled (VMT), changes in weekday port truck traffic by time period on Interstate 710 (the principal access road to the port), and changes in port-related air pollutant emissions.</p>
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Title	16. A Glance at Clean Freight Strategies: Gate Accessibility for Drayage
Author(s)	U.S. EPA SmartWay Program
Publication date	2006
Summary	Improved gate accessibility can increase terminal throughput while reducing time trucks spend idling in queue. This helps trucking companies save fuel while reducing greenhouse gas, nitrogen oxides and particulate matter emissions. Extended gate hours and gate systems improvements could save over \$1,000 in fuel costs and eliminate 5 metric tons of greenhouse gas emissions per truck annually.

Title	17. Cooperative Time Window Generation for Cargo Delivery/Pickup with Applications to Container Terminals
Author(s)	Ioannou P., Chassiakos A., Julia H., Valencia G.
Publication date	2006
Summary	In this report the authors study the appointment window system to manage the flow of trucks in traffic networks and at customers' locations. The system introduces the scheduling of transactions into and out of container terminals and requires that freight carriers deliver/pick-up their cargo within a specific time period. The authors propose a structure and develop an algorithm to generate cooperative time windows. The cooperative time window appointment system is modeled mathematically, and an optimization technique based on insertion method is proposed. Simulation experiments are used to evaluate the efficiency of the algorithm. In this project the authors also developed a software package for simulating terminal operations. The Terminal Simulator is used to study the effects of the time window appointment system on various terminal operations. Based on data collected on truck arrivals, several simulation scenarios are created, which compare the current practices to the case when the time window appointment system is applied. It is seen that when the appointment system is used, the queues at the inbound and outbound gates become smaller, and the import and export yards are serviced more efficiently

Title	18. A Glance at Clean Freight Strategies: Terminal Appointment Systems for Drayage
Author(s)	U.S. EPA SmartWay Program

Publication date	2006
Summary	Implementing an automated terminal appointment system can reduce the length of time a truck spends waiting to be processed at terminal gates. Research suggests that turn times can be reduced by 30 percent, saving over 200 gallons of fuel per truck or about \$500 annually.

Title	19. A Glance at Clean Freight Strategies: Common Chassis Pools for Drayage, U.S.
Author(s)	EPA SmartWay Program
Publication date	2006
Summary	Common Chassis Pools can help trucking companies save fuel and reduce greenhouse gas emissions by minimizing unnecessary truck movements and idling associated with switching chassis. Drayage trucks using pooled chassis could save up to 0.8 gallons per trip, reducing Nitrogen Oxide and Particulate Matter emissions.

Title	20. Assessment of Terminal Gate Appointment System at Ports of Los Angeles and Long Beach
Author(s)	Genevieve Giuliano, Thomas O'Brien, Sara Hayden, Paul Dell'aquila
Publication date	July 28, 2005
Summary	<p>This paper presents an evaluation of the terminal gate appointment system at the Los Angeles/Long Beach ports. The appointment system was implemented in 2002 in response to California Assembly Bill (AB) 2650, which seeks to reduce vehicle emissions and highway congestion by reducing truck queuing at marine terminal gates and distributing truck traffic over a greater period of time throughout the day. The legislation permits terminals to adopt either gate appointments or off-peak operating hours as a means of avoiding fines for truck queues.</p> <p>The authors monitored the appointment system over a 16 month period. The results are based on extended interviews, field observations, a trucking company survey, and data provided by selected terminals. The authors found that 1) use of the appointment system varies greatly and depends upon operating policies of individual terminals; 2) perceptions of the appointment system's effectiveness differ across user groups; 3) there is no evidence that the appointment system has affected queuing at marine terminal gates; 4) while a majority of the terminals at the two ports did implement an appointment system in response to the legislation, most did so in order to avoid paying the high labor costs associated with extending operations to off-peak hours. The study concludes that responses to AB 2650 are largely explained by institutional and contractual relationships that drive port operating practices.</p>

Title	21. Addressing locally a global problem
Author(s)	Boile Maria; Mittal Neha; Golias Michail; Theofanis Sotirios
Publication date	2005
Summary	This paper presents and analyzes the empty marine container accumulation problem. Critical factual documentation is presented and subsequently the empty container logistics are presented in three levels namely global, regional and local with a view to gain accurate insight in the factors affecting accumulation and the complex relationships between players and stakeholders involved. The relative

	merits and limitations of addressing the problem at a regional and local level are critically discussed and analyzed. A conceptual decision making procedure based on empirical goal setting is presented. A decision support tool based on this procedure has been developed and implemented within a GIS framework. A strategic decision perspective applied to the New Jersey region is also presented. The tool has an open architecture and it can cater for algorithm or benchmark rules incorporation to consider external influential factors. The tool, together with a proposed monitoring program could be implemented and tested in the New York – New Jersey region, to gain further insight in the problem and be further developed for broader applicability and more thorough consideration of factors affecting this complex intermodal transportation problem.
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Title	22. Improved Chassis Routing via Use of Tracking Technology and Optimization: A Case Study
Author(s)	Srouf F. J., Newton D., Jensen M.
Publication date	2004
Summary	As new technologies emerge to improve the security of intermodal freight shipments, the benefit of these technologies on freight efficiency must also be examined. The evaluation of a device for tracking the location and status of an intermodal chassis via sensors and use of the Global Positioning System is the topic of this paper. The chassis tracking technology was deployed on a fleet of 54 chassis operating in a single centrally managed chassis pool in the North Eastern United States. The main focus of this study is the impact of the new real-time information on this fleet of chassis. An optimization based mixed integer program was tailored to model chassis routing under the assumption of greater fleet visibility. Using the data from the test fleet, the model was run to simulate varying planning horizons. The results demonstrate that use of optimization in conjunction with real-time information indicates significant savings in bare miles traveled over the miles traveled in actuality - a 69% savings in the best case.

Title	23. Freight Information Real-Time Support for Transport Evaluation Final Report
Author(s)	J. Srouf, J. Kennedy, M. Jensen, C. Mitchell
Publication date	2003
Summary	This report presents the findings of an independent evaluation of the Freight Information Real-time System for Transport (FIRST) intermodal freight ITS prototype system. FIRST is an Internet-based, real-time network that integrates numerous sources of freight location and status into a single, easily navigated Web portal to allow port users to access cargo and Port information to facilitate planning and logistics. This system was designed by the Port Authority of New York and New Jersey, in cooperation with members of the private sector intermodal industry, to meet the operational needs of regional intermodal freight service providers and their customers. FIRST makes information from ocean carriers, terminal operators, rail lines, and trucking companies available to port users. These stakeholders envisioned the FIRST system would help to reduce the truck queues at terminal gates, reduce unnecessary trips by trucks to the port, reduce truck emissions, increase terminal operation efficiencies, and improve the freight transportation system at the Port of New York/New Jersey overall. However, due to a variety of

	internal and external factors, the FIRST system did not gain a significant level of usage over the course of the evaluation period. For this reason the aforementioned benefits did not occur. This evaluation presents some of the factors contributing to the low usage, compares FIRST to similar, yet successful systems, and demonstrates via simulation the benefits that might be realized should the FIRST system incorporate a truck appointment system.
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Title	24. The Logistics of Empty Cargo Containers in the Southern California Region: Are Current International Logistics Practices a Barrier to Rationalizing the Regional Movement of Empty Containers?
Author(s)	Le Dam Hanh P.
Publication date	2003
Summary	<p>This project describes existing logistics practices with respect to empty containers, and considers the economic and institutional circumstances that direct the movement of empty containers within the SCAG region. Building on findings and recommendations presented in the recently concluded Gateway Cities Study [1], this work explores the regional problems posed by empty containers in the context of existing international trading structures and through discussions with international marine carriers.</p> <p>A key objective of this project is to understand the current logistics of empty containers related to the movement of cargo through the ports of Los Angeles and Long Beach. This project will investigate two aspects of the existing logistics system for handling empty containers: (1) the physical movement of empty containers, and (2) institutional arrangements and practices. In order of emphasis, however, the second aspect of this investigation will be the main focus of discussion. Accordingly, this investigation will assess the extent to which current global logistics practices constitute a barrier to rationalizing empty container movements within the study region.</p>

Title	25. Empty Ocean Container Logistics Study
Author(s)	The Tioga Group, Inc.
Publication date	2002
Summary	<p>In a perfectly balanced trading environment, every import container arriving on the West Coast would be filled with an outbound load. Current containerized trade through San Pedro Bay, however, is severely imbalanced, and has markedly increased empty container flows. The problem is exacerbated by the sheer volume of containers moving through a major urban area that already has serious traffic congestion and air quality concerns. Empty containers used for import loads are typically drayed back to marine terminals. Exporters draw a supply of empty containers from the terminals, returning loaded boxes the other way. "Street turns" — reusing import containers for export loads without first returning them to the marine terminal — are regarded by all parties as highly desirable, but hard to achieve. Information systems promise to increase street turns by assisting drayage firms to identify import/export linkages and quickly locate suitable containers for export loads. The development and eventual implementation of a practical, effective empty container logistics plan driven by an Internet-based information system has significant potential to ameliorate the serious empty container problem</p>

	facing Southern California.
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## EMPIRICAL INITIATIVES

Title	1. Framework for Evaluation of System Impacts of Intermodal Terminals using Commodity Flow Data
Author(s)	Chiranjivi Sarma Bhamidipati, Michael Demetsky
Publication date	February 8, 2008
Summary	A framework for evaluation of rail-truck intermodal terminal projects with qualitative and quantitative measures has been established by the authors using public goals and private stakeholder perspective. With the use of a case study, some of these measures have been evaluated. The case study selected for the Project is the proposed freight intermodal terminal at Petersburg, Virginia, conceived by the Norfolk Southern Corporation. This analysis formed a bridge between a region and a corridor based analysis. The key findings of the study are as follows: (a) Evaluation of an intermodal terminal project requires a systematic multi-regional modeling approach; (b) The impacts of an intermodal terminal are region and trade corridor specific; and (c) In cases where estimated intermodal rail drayage forms a small share of the overall truck traffic, the introduction of an intermodal terminal does not have substantial impacts on accessibility, mobility or safety. The study successfully developed models for estimation of impacts, including a two-stage accessibility model for drayage, a truck-rail mode choice model, truck involved crash models, and secondary local freight traffic impact model, mainly using data from the Commonwealth of Virginia.

Title	2. Evaluation of Impacts of Intermodal Terminals on the Highway System
Author(s)	Chiranjivi Sarma Bhamidipati, Michael J Demetsky
Publication date	2008
Summary	Rail-truck intermodal terminals can play a key role in making rail-truck intermodal transportation an effective transportation alternative to long-haul trucking. In order to measure this effectiveness, public and private stakeholders require some qualitative and quantitative methodologies. This paper is based on a study describing a general methodological framework for evaluation of the impacts of intermodal terminals on the transportation system, and applying it to the highway system of Virginia, United States. Apart from incorporating the needs of several agencies into the framework, preliminary models for site-specific evaluation of impacts on mobility, accessibility, safety and economic activities were also developed, which were calibrated using commodity flow, socio-economic and other data for the Commonwealth of Virginia. The results of the application of the evaluation framework on a case study terminal are presented in this paper. The study identified the key steps involved in the assessment of highway system impacts and regional planning of intermodal terminals in Virginia. It is recommended to carry out further research on detailed evaluation in order to provide decision support on the feasibility of public-private shared financing of intermodal terminals.

Title	3. Georgia ports authority intermodal planning
Author(s)	Thomas J.E.A , Nye L.W.B, Tillotson H.W.C

Publication date	2007
Summary	This paper provides a discussion of the overall planning process that was undertaken and the alternatives that were developed which included a combined ICTF facility in the Mason ICTF and/or independent separate facilities. The considerations that entered into the decision included connectivity to existing rails, advantages with regards to labor and equipment at a single facility, and overall costs. The final result was a decision to pursue separate independent facilities in the short-term and a combined facility in the long-term.

Title	4. Shared Intermodal Terminals and the Potential for Improving the Efficiency of Rail-Rail Interchange
Author(s)	Jack Lanigan, John Zumerchik, Jean-Paul Rodrigue
Publication date	2006
Summary	This paper identifies the main inefficiencies of current intermodal rail interchange operations (such as fragmented terminals, unnecessary intercity truck trips, shipment inefficiency, and congestion). It also investigates the concept and potential of shared intermodal facility solutions (multiple railroads concentrate transmodal interchange at one facility), and analyzes governmental and market impediments to the development of shared intermodal facilities. Shared intermodal facilities will bring enormous quantifiable financial, time and energy benefits to shippers and carriers. However, before such facilities can be developed, there is a critical need to gather performance metrics on rail line volume entering the region, the percentage of that volume that is transmodal traffic, and the speed and cost of current interchange. The potential to reduce energy consumption and terminal heavy-duty truck emissions are also explored. Published performance metrics and estimates from field practitioners are used in this preliminary analysis of potential benefits, laying the groundwork for future simulation modeling efforts designed to better quantify these benefits.

Title	5. Assessing the adequacy of America's transportation policies: Lessons from the debate about the role of the railroads in the development of the American West
Author(s)	Cameron Gordon
Publication date	2005
Summary	This paper compares and contrasts two debates about the role of transportation in the American economy. The contemporary policy debate revolves around adequacy of current transportation infrastructure, whether infrastructure investment should be increased and how, and if, congestion should be addressed by public policy. An earlier debate in the economic history field revolved around whether the railroads were "indispensable" to America's economic growth and how the building of a rail network affected the shape of that growth. This paper argues that, in certain ways, the contemporary policy exchange is covering much of the same ground covered by analysts studying the railroads, and that the former can be usefully informed by the latter.

Title	6. Innovative Strategies to Raise Efficiencies along Transportation Corridors and at Multimodal Hubs
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Author(s)	Lyndon B. Johnson
Publication date	2005
Summary	<p>Close to 16 billion tons of freight, with a value of nearly \$11 trillion, were hauled along the United States' transportation network in 2002. But a prospering domestic economy and continued growth in international trade, particularly with Pacific Rim countries, together strain existing network capacity and contribute to the growing congestion witnessed today in many urban areas and along major transportation corridors. The rising costs of energy, new truck driver hours-of-service rules, labor and equipment shortages at ports, railroads, and motor carriers, and increasingly limited federal and state transportation budgets for capital construction projects compound these network problems. The research for this report, conducted for the Congressional Research Service by the LBJ School of Public Affairs, examines public- and private-sector initiatives found in different geographic regions on the United States that are intended to address traffic congestion and improve the capacity and efficiency of the national transportation network. These initiatives fall into three general categories: planning, finance, and specific projects or practices. Each chapter in this book includes a brief overview of transportation planning conducted in key states experiencing heavy volumes of international trade (Florida, Illinois, New York, Texas, and Washington), a description of the primary mechanisms in place to fund transportation infrastructure improvements, and a series of in-depth case studies of innovative projects and practices.</p>

Title	7. Short-haul rail intermodal - Can it compete with trucks?
Author(s)	Resor R.R., Blaze J.R.
Publication date	2004
Summary	<p>Intermodal traffic that is truck trailers or ocean containers handled on special rail equipment, is the fastest-growing segment of rail traffic. Between 1990 and 2000, rail intermodal grew at an annual rate of 4.6 %, which grew at an annual rate of only 1.4 %. However, during the same period, truck tonnage grew at an annual rate of 6.9 %, and air cargo at a rate of 17.9 %. The growing rail intermodal is expected to overtake coal as the single largest source of revenue for freight railroads in the year 2004. But railroad intermodal tonnage is not growing as fast as truck traffic, and market share is consequently falling. This is a problem: with total freight traffic projected to grow 57 % by the year 2020, all the increased traffic will have to be accommodated on the highway network. The introduction of double-stack rail cars in the 1980s dramatically reduced rail haul costs, and it made intermodal traffic competitive at distances of 500 mi or so, whereas previously rail could compete with trucks only at distances of about 750 mi or more. Still, most rail intermodal traffic remains long haul. Three-quarters of all truck tonnage moves distances of less than 500 mi, and rail does not compete in this market. Rail haul costs are developed for a number of short corridors, and it is demonstrated that although double-stack usage has lowered line haul costs, terminal and drayage costs remain high. If these costs can be reduced, rail intermodal can be competitive even in short-distance corridors. Several ways to lower these costs, both by industry initiatives and by public investment, are proposed.</p>



Title	8. Location, design and operation of future Intermodal rail yards: an empirical analysis
Author(s)	West N., K. Kawamura
Publication date	2004
Summary	This paper conducts an assessment of desirable traits, including the location, design, and operation, of Intermodal facilities using the information obtained through structured interviews with key stakeholders in the Chicago area with the knowledge of freight transportation. Both descriptive statistics and qualitative assessment are used to extract the information from the records of the interviews. The study revealed that the push toward bigger facilities, like Logistics Park – Chicago and Global III, and also the outward migration of the rail yards will likely continue because the current standard for desirable Intermodal yards seems to be a minimum area of 300 to 500 acres (120 to 200 hectares) with a minimum length of 7,000 feet (2,100 meters). It is unlikely that a land conversion of such magnitude can happen within the city of Chicago or near-by communities in the foreseeable future. Thus, railroads are most likely to seek locations in rural or semi-rural areas. Also, there seems to be differences of opinion regarding the optimal function and design of future Intermodal facilities depending on the backgrounds of the respondents. The implication for the policy makers and planners is that it is ever more important to facilitate communications among various stakeholders who will be impacted by the location and also the operation of the Intermodal facilities.

Title	9. Review of Technologies Used in Freight Transportation in the New York Metropolitan Region
Author(s)	New York Metropolitan Transportation Council
Publication date	October, 2002
Summary	The objective of this report is to survey and identify the most significant existing and emerging technologies, which affect or could affect the future of freight transportation in the New York Metropolitan Transportation Council (NYMTC) region. This brief orientation does not present detailed technical information which is available from the listed sources of information. Some areas, such as development of new materials or construction systems, are not mentioned and the reader is advised to contact the Transportation Research Board or other sources for such information. This report is expected to be used by transportation stakeholders, government agencies, professional freight transportation organizations and other recipients who want to find condensed information on the development of technology in the areas of communication, design and scientific instrumentation for the freight transportation industry.

Title	10. Strategies for Coordinated Drayage Movements
Author(s)	C. Neuman, K. Smilowitz
Publication date	2002
Summary	The movement of loaded and empty equipment (trailers and containers) between rail yards and shippers/consignees is a costly part of intermodal shipping. These drayage costs are exacerbated by the lack of coordination among parties, including shippers, railroads, trucking companies, and intermodal marketing companies. This paper reports initial findings regarding the design of strategies to coordinate



	drayage movements, with a focus on the Chicago freight interchange, a region unique in its size and complexity of operations. A simple heuristic, used to obtain feasible solutions and provide insight into specialized algorithms, is presented. This research is part of a larger study on Chicago intermodal freight operations.
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Title	11. An analysis of intermodal ramp selection methods
Author(s)	G. Don Taylor, Frank Broadstreet, Timothy S. Meinert, John S. Usher
Publication date	2001
Summary	<p>A key issue affecting the viability and efficacy of intermodal transportation via truck and rail is the operational selection of intermodal ramps. In this paper, two alternatives for ramp selection are examined.</p> <p>Both methods seek to reduce total empty and circuitous miles incurred during intermodal drayage movements. The sensitivity to the ramp group configuration and to freight compatibility is tested to determine the robustness of the findings. The analysis is industrially motivated, using data supplied by J.B. Hunt Transport, Inc. The primary contribution of the paper is in quantifying the performance of the ramp selection methods in various operational settings.</p>

Title	12. A model for medium-term operations planning in an intermodal rail-truck service
Author(s)	Linda K. Nozick, Edward K. Morlok
Publication date	1996
Summary	<p>This paper describes a model developed for medium-term operations planning in an intermodal rail-truck system. It was motivated by the need to redesign such systems to produce (1) more reliable service, (2) multiple service classes, and (3) better equipment and facility utilization.</p> <p>The model is an integer linear program, which is computationally difficult to solve. A heuristic procedure was developed which provides excellent solutions, generally within 1% of the known optimal solution to the relaxed (non-integer) problem. Thus the model and heuristic could be used on large networks. Uses of the model and possible extensions are briefly discussed.</p>

Title	13. Approaches for Improving Drayage in Rail-Truck Intermodal Service
Author(s)	Morlok E.K., L.N. Spasovic
Publication date	August 18, 1994
Summary	<p>Approaches for improving service quality and reducing cost in the highway portion of rail-truck intermodal transportation are discussed. The highway portion – termed drayage – is a major source of service inferiority to the primary competitor – over-the-road trucking. Drayage costs are also very high, and because these do not vary with the length of the intermodal haul, they preclude profitable intermodal service in the shorter domestic freight markets of less than 600 miles where the highest truck volumes are found. In addition, the inferior service quality precludes intermodal from competing for high quality premium traffic. The potential for overcoming these disadvantages through reorganization of the drayage operation and use of centralized drayage operations planning is discussed. Specific changes in the organizational structure of intermodal and in its operating procedures are</p>

	outlined.
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Title	14. Redesigning Rail-Truck Intermodal Drayage Operations for Enhanced Service and Cost Performance.
Author(s)	Morlok E.K., L.N. Spasovic
Publication date	1994
Summary	<p>This paper presents the results of research on redesigning the trucking portion, or drayage, of rail-truck intermodal freight service. Currently, despite its relatively short distance compared to the rail movement, drayage accounts for a large fraction of intermodal origin to destination costs and is a major factor in service quality as perceived by the shipper. This high drayage cost seriously affects the profitability of intermodal service, and also limits the markets in which it can compete with intercity trucking. This paper examines the potential for improving service quality and reducing cost of drayage. The approach used was to examine in detail the current costs and potential for improvement at one intermodal terminal, in a case study type of analysis. The limitation to one terminal was dictated by extreme difficulty and cost of obtaining reasonably good data on actual trailer movements and demands, resulting from the fragmented responsibility for current drayage operations (involving many intermodal retailers and drayage companies). Current costs were estimated using existing drayage prices and discount practices. An optimized drayage operation in which tractor and trailer movements are centrally planned was developed using an integer programming model for tractor and trailer scheduling, with time windows for pick up and delivery. An alternative system design that includes various payment options for drayage was also developed for the centralized drayage operation. The model was then used to compute the cost of each alternative. The results reveal substantial cost savings, of 43% to 63% for the centralized operation over the current operation. The implications for rail-truck intermodal operation are discussed. In addition, possible changes in intermodal organizational and operational procedures that are necessary to achieve the cost savings are also discussed.</p>

Title	15. Using marginal costs to evaluate drayage rates in rail-truck intermodal service
Author(s)	Spasovic L. N., Morlok E. K.
Publication date	1993
Summary	<p>An operations planning model of the highway portion, or drayage, of rail-truck intermodal transport is used to develop pricing guidelines for drayage service. The model, originally developed and used to evaluate the potential of reducing cost and improving service quality of drayage, also generates marginal (incremental) costs of moving loads in the drayage operation. The marginal costs are used to evaluate the efficiency of drayage rates charged by truckers in the current operation as well as rates used in a proposed operation with centralized planning of tractor and trailer movements. The insights gained from this analysis are used to develop guidelines for using marginal costs in the areas of pricing intermodal door-to-door movements, load solicitation, and decisions regarding load acceptance. Application of the model as a decision support tool for assisting intermodal management in developing proper strategies for pricing and marketing of intermodal service is illustrated. The</p>

	need for railroad management to become aware of the characteristics of drayage operation and the systemwide impacts of drayage movements on the cost and thus profitability of intermodal operation is indicated.
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Title	16. Intermodal Marine Container Transportation: Impediments and Opportunities
Author(s)	Schneider S.
Publication date	November, 1992
Summary	As part of its technology policy program, the Maritime Administration of the U.S. Department of Transportation asked the Transportation Research Board to conduct a study to help determine where and how government action might assist in overcoming impediments and fostering efficiency in intermodal marine container transportation, especially through technological or institutional innovation. To conduct the study, the National Research Council convened a TRB committee which subsequently identified and analyzed 10 key issues on which government in the U.S. affects or can affect the intermodal marine container transportation industry. Of these 10 critical issues, the first six are those in which governmental actions are viewed as impediments to technological or organizational innovation and efficiency in intermodal marine container transportation, while the last four issues offer opportunities for government to improve container transportation by playing a facilitating role. The issues are: ship procurement restrictions under the Operating Differential Subsidy (ODS) program; federally imposed ship-manning requirements; military cargo bidding policies; environmental policy conflicts and costs; overweight container trucks; customs clearance procedures; intermodal equipment interchange procedures; cargo liability and responsibility regulation; creation of a federal intermodal coordinating office; and collection and publication of container trade data. This article summarizes the committee's findings with regard to each of these issues.

## INTERNATIONAL INITIATIVES

Title	1. Interaction between Transport, Infrastructure, and Institutional Management: Case Study of a Port Community System
Author(s)	Gustafsson, Inger Karin Marie
Publication date	2009
Summary	This paper is a contribution to an on-going research on how to support high quality information for intermodal transport. The research approach suggests that interaction between the domains of transport, infrastructure and institutional management is one way forward. This kind of interaction needs to be formalised and structured through an interaction infrastructure and, as for any infrastructure, someone needs to be responsible for maintenance and development. The introduction of a port community system in the Port of Gothenburg is used as empirical material, based on in total 54 semi-structured interviews. The research shows that co-operation and sharing of information within the port cluster is far away from the highly integrated supply chain management solutions where contractual agreements support the co-operation. Further the research indicates major gaps in the recognition of each other situation between authorities and the shipping industry. By viewing a port community system as an interaction

	infrastructure, the approach of the Port of Gothenburg stresses the need for interaction between the different domains and the need of a strong initiator and developer.
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Title	2. Impact of Landbridge on Port Market Area – Model Development and Scenario Analysis
Author(s)	Xinchang Wang, Qiang Meng, Lixin Miao, T. F. Fwa
Publication date	2009
Summary	<p>Landbridge as an intermodal freight transport mode seamlessly integrates long-haul rail and short-haul truck services to provide transcontinental delivery of containers which can be alternatively transported by maritime transport mode. To evaluate the impact of the Myanmar-China international landbridge on Shanghai port, this paper first proposes a novel concept of the probability-based port market area to measure the service area of a port by assuming that costs/times of the intermodal freight transport routes are the normal distributed random variables.</p> <p>The analytical expression of the probit-based market area of Shanghai port is then derived for two competing transport routes to Dubai port – one involves the Myanmar-China landbridge, and the other one uses direct port to port maritime link. The probability-based market area curves in terms of transport cost and time of Shanghai port are established for two operational scenarios of the Myanmar-China landbridge: (i) current state of operation, and (ii) a possible future state of operation with efficiency similar to that of US continental landbridge operation. Each of these curves possesses one branch of a hyperbola curve, representing a contour of the impact level of the landbridge on the Shanghai port. Differences of the impact contours of the two scenarios provide an indication of the market area of Shanghai port that will be affected by changes in the efficiency of the landbridge operation.</p>

Title	3. Trade-Off Between CO2 Emissions and Logistics Costs Based on Multiobjective Optimization
Author(s)	Nam Seok Kim, Milan Janic, Bert Van Wee
Publication date	2009
Summary	<p>This paper examines the relationship between the freight transport costs and the Carbon-Dioxide (CO<sub>2</sub>) emissions in given intermodal and truck-only freight networks. When the trade-off, which is represented as the relationship, is changed, the freight mode share and route choice are also updated. In order to show the ever-changing trade-off and mode/route choice, a decision-support tool is developed. The given intermodal freight networks represents different freight combinations (i.e. truck-only system, rail-based intermodal system, short sea based intermodal system). Since CO<sub>2</sub> constraints in logistics markets need to be realized in the near future, a modal shift in freight transport could be expected to reduce the CO<sub>2</sub> emissions within the reasonable cost/time constraints. The technique of multi-objective optimization is used as the core of the decision-support tool for clarifying the relationship. The developed tool is applied to a simplified freight transport network connecting two large European ports – the port of Rotterdam (The Netherlands) and the port of Gdansk (Poland). The initial solution, based on the</p>

	minimization of freight costs, shows that the mode share of freight is local/regional freight transport situations, while the other solutions balanced with CO2 emissions shows that the mode share is changed into intermodal freight system, which is based on the 'Hub-and-Spoke' network. Changing demands and capacities of freight systems, five scenarios are tested in order to examine the impact of mode/route change on the trade-off. The results of scenario analysis show that the trade-off is significantly influenced by demands and capacities of systems.
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Title	4. On route optimization of CTs in container terminal based on pool strategy
Author(s)	Li L., Sun J., Han M.
Publication date	2008
Summary	The container truck is an important factor affecting the efficiency of the container yard in the container terminal. The traditional schedule of container trucks is based on operation queues. The schedule of this paper is based on pool strategy, and loading and unloading containers are operating at the same time. This paper considers transporting time of container trucks and operating time of yard cranes, and constructs math model, targeting the minimum of time about container trucks. Immune and tabu-search algorithm is put forward for solving the model. The results of the experiment prove that pool strategy improves the efficiency of container trucks and yard cranes comparing to operation queues, and then improves the efficiency of the yard.

Title	5. A local search heuristic for the pre- and endhaulage of intermodal container terminals
Author(s)	A. Caris, G.K. Janssens
Publication date	2008
Summary	Pre- and end-haulage of intermodal container terminals involves the pickup or delivery of containers at customer locations. The attractiveness of intermodal transport can be increased by organizing the road segment in the intermodal transport chain more efficiently. In this paper the drayage of containers in the service area of an intermodal terminal is modeled as a Full Truckload Pickup and Delivery Problem with Time Windows (FTPDPTW). A two-phase insertion heuristic is proposed to construct an initial solution. This solution is improved with a local search heuristic based on three neighborhoods. Numerical experiments are described to demonstrate the mechanisms of the heuristics.

Title	6. Competition in the container trucking industry
Author(s)	Rob Konings
Publication date	15 November, 2007
Summary	The functioning of the container trucking industry can be addressed as a paradox: container transport is a booming business and therefore it is also a growth market for road transport, but in spite of this the trucking industry has great difficulties to operate profitable. Increasing competition of the alternative modes, rail and barge, plays a part, but the major explanation for the bad profitability is related to the market structure of the container trucking industry. Its market structure fits to the theoretical model of perfect competition. This model is used to explain and illustrate the behavior in the container trucking industry. In addition, this model is

	used to identify clues to improve the profitability of the sector. Promising strategies include offering added value services and increasing the scale of operation.
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Title	7. Improved modeling and solution methods for the multi-resource routing problem
Author(s)	Francis, Peter, Zhang, Guangming, Smilowitz, Karen
Publication date	August 1, 2007
Summary	This paper presents modeling and solution method improvements for the Multi-Resource Routing Problem (MRRP) with flexible tasks. The MRRP with flexible tasks is used to model routing and scheduling problems for intermodal drayage operations in which two resources (tractors and trailers) perform tasks to transport loaded and empty equipment. Tasks may be either well defined, in which both the origin and the destination of a movement are given, or flexible, in which the origin or the destination is chosen by the model. This paper proposes methods to effectively manage the number of options considered for flexible tasks (either feasible origins for a known destination or feasible destinations for a known origin). This modeling change generates sufficient options to allow for low-cost solutions while maintaining reasonable computational effort. The authors also propose a new solution method that uses randomized route generation. Computational results from test cases show that these changes improve the quality of solutions by at least 5% in the test cases as compared to methods from previous studies.

Title	8. Drayage and Competitiveness of Intermodal Freight Transport
Author(s)	Rob Konings
Publication date	2007
Summary	This paper addresses the importance of the service and cost performance of drayage for the competitiveness of intermodal freight transport. Based on the trip characteristics of drayage operations and their cost structure the possibilities to improve drayage performance are discussed. The major conclusion is that the contribution of drayage to the competitiveness of intermodal transport is not only determined by the performance of drayage operations, but is also strongly effected by characteristics of the terminal service area in terms of number and size of customers and the distribution pattern of the customers. Land use policies could therefore be very effective to create the conditions for competitive intermodal freight transport.

Title	9. An attribute–decision model for cross-border drayage problem
Author(s)	Raymond K. Cheung, Ning Shi, Warren B. Powell C, Hugo P. Simao
Publication date	2007
Summary	Using Hong Kong, the busiest port in the world, as an example, the authors illustrate the challenges and issues in managing drayage activities in hub cities. The study shows that managing cross-border drayage container transportation is a very challenging problem because not only individual resources but also the composites of them need to be managed simultaneously. The problem is further complicated by the regulatory policies which govern the cross-border activities. The authors use an attribute–decision model for this problem and implement an adaptive labeling algorithm to solve it and conduct numerical experiments to evaluate the system

	performances under various regulatory policies. The results show that the benefit gained by relaxing the regulatory policies is significant.
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Title	10. Optimization Model for The Intermodal Routing Problem of International Container Cargos in Korea Using Genetic Algorithms
Author(s)	Young-Tae Chang, Eun-Soo Kim
Publication date	2007
Summary	This paper attempts to optimize intermodal network system in handling container cargoes for capital region in Korea. The authors first analyze current cargo flows in the region then try to find optimal solution in considering total logistics cost, time and risk of handling the cargoes. Integer goal programming is employed as the methodology and genetic algorithm is applied in solving the problem. The authors find that the optimal solution is to use the Port of Incheon to handle the cargoes in the capital region and this strongly suggests that the port should be developed in the near future.

Title	11. Prince Rupert to the Twin Cities: the Potential Value Added of a New Intermodal Freight Service
Author(s)	Richard D. Stewart, Adolph Ojard, Xiubin Wang
Publication date	2006
Summary	This paper examines the potential impact of a new Canadian container port being developed in Prince Rupert, British Columbia on the Minneapolis, St. Paul Minnesota metropolitan region (the Twin Cities). The new Prince Rupert route has potential to serve the Twin Cities through two gateways; Chicago, Illinois and the Twin Ports of Duluth, Minnesota and Superior, Wisconsin. The advantages and disadvantages of using each gateway are discussed. The paper examines on both routes the issues of: transit time, terminal availability, drayage, corridor congestion, asset utilization, interest inventory costs, freight rates, growth potential, circuitry and transloading.

Title	12. Terminal Appointment System Study
Author(s)	Morais P., Lord E.
Publication date	2006
Summary	A study was carried out assessing the impact of terminal gate reservation systems, automation technologies, extended gate hours and other strategies for improving cargo velocity at ports and terminals in order to reduce congestion, delays and GHG emissions. A review of North American container ports highlighted the fact that west coast ports are leaders in environmental legislation and programs, and in the implementation of information and automation technology to enhance terminal productivity. Solutions for improving terminal productivity and reducing congestion are centered on implementing technologies and Internet based cargo information systems. Specific solutions targeting truck idling involve the integration of appointment systems and extended gate hours. Data from case studies show that extended gate hours and gate reservation systems implemented at the Port of Vancouver were effective in reducing truck emissions.



Title	13. Final Report of the Task Force on the Transportation and Industrial relations Issues Related to the Movement of Containers at British Columbia Lower Mainland Ports
Author(s)	Canadian Ministry of Transport, et al.
Publication date	October, 2005
Summary	In the summer of 2005, container truckers shut most road transport to the Vancouver Port Authority and the Fraser River Port Authority. As a result,, the federal and provincial governments appointed a three-person task force to make enquiries into the factors that led to the dispute, and to provide recommendations aimed at avoiding a recurrence while also increasing the efficiency of port operations. This report documents the issues the Task Force reviewed and their final recommendations.