AN INTEGRATED APPROACH TO MANAGING LOCAL CONTAINER TRAFFIC GROWTH IN THE LONG BEACH –LOS ANGELES PORT COMPLEX, PHASE II

STRATEGIC IMPLICATIONS BASED UPON QUALITATIVE AND QUANTITATIVE STAKEHOLDER DATA OF PROPOSED IMPLEMENTATION OF TRANSPORTATION SYSTEMS MEASURES INCLUDING EXTENDED GATE HOURS OF OPERATION AT MARINE TERMINALS TO IMPROVE REGIONAL GOODS MOVEMENT BY INCREASING THROUGHPUT VELOCITY AND MOBILITY

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December 31, 2001

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Abstract

In this seminal effort the authors have interweaved both quantitative and qualitative economics and social science analytical techniques, original survey data, and modern supply chain management theory into a systemic view of the stakeholder implications in terms of costs, benefits, tradeoffs and impacts on aggregate throughput and regional mobility and traffic congestion from changes in best practices in the form of extended gate hours of operation by the fourteen privately-operated marine terminals comprising the Long Beach-Los Angeles port complex.

The report utilizes microeconomic economic break-even analysis to describe the economic private and social costs and benefits, validated with stakeholder workshop input likely to result from the implementation of an extended gate hours of operation for marine terminals regime upon terminal throughput velocity and regional mobility over time. The concept of throughput velocity is utilized as an original benchmark measurement of comparative terminal operating efficiency in a capacity constrained operating environment combining traditional temporal dimension of dwell time (average time spent on terminal by individual container) with spatial dimension of throughput per acre thereby allowing accurate performance comparison of terminals independent of size or geographic (transshipment, entrepot) and operating conditions.

Based on the survey data, and other qualitative stakeholder data, the authors suggest the implementation of a time-phased throughput redistribution strategy involving:

(1) initial maximization of current first shift operations on a terminal specific basis through the use of flexible shift hours and start times, prioritization of gate transactions, and introduction of a community based appointment and scheduling system to coordinate truck dispatch with gate transactions;

(2) followed by the gradual adoption of extended gate hours in the form of limited service gates using weekend and second and hoot shift gates designed to flush

import and export containers structured to synchronize marine vessel arrival and departures with gate hours of operation.

The strategy is intended to achieve the broad goals of redistribution of overall current and future port containers volumes set forth in 2001 Port of Los Angeles- Port of Long Beach Transportation Study and regional analysis incorporated in I-710 Major Corridor Study requiring the implementation of transportation systems measures such as extended gate hours to maximize use of exiting highway capacity as a necessary prerequisite to major infrastructure funding.

Finally, the authors recommend the incorporation of economic cost benefit analysis, queuing and game theory, and emerging artificial intelligence based simulation and modeling as a means of benchmarking both the performance of marine terminals in increasing throughput velocity, and progress at regular intervals in meeting the long term strategic objectives of an extended gate hours of operation regime in the aggregate.

Table of Contents

Cover page
Disclaimer ii
Abstract ii
Table of contents iii
List of Figures v
List of Tables vi
Disclosure viii
Acknowledgments viii
1.0 Background and statement of the problem: leading indicators of port generated regional traffic congestion 1
1.1 Regional goods movement flows and growth trends in volume of regional truck traffic 1
1.2 Diminishing port land area requiring maximum terminal throughput 3
1.3 Modal distribution of port container volume 5
1.4 Temporal and spatial dimensions of port generated truck traffic movement 7
1.5 Marine and gate operations conflicts 17
1.6 Best practices-transportation systems measures: extended gate hours of operation 23
2.0 Phase II two dimensional research approach 24
2.1 Combined qualitative and quantitative analytical methodology 25
2.2 Stakeholder search for solutions Third Annual Third Annual Intentional Longshore and Warehouse (ILWU) Town Hall and Industry Forum, January 31 and February 15, 2001 25
2.3 First Stakeholder Workshop: "Improving the Regional Goods Movement Supply Chain Through Extended Marine Terminal Gate Hours of Operation in Southern California analysis of stakeholder implications 27

2.4 Second Industry Stakeholder workshop on the "Use of Technology to Improve Goods in Southern California", November 29, 2001 31
2.5 Phase II study quantitative analytical approach 32
2.6 Best practices goal of extended gate hours implementation and shift redistribution 33
2.7 Building a conceptual framework for extended gate hours of operation: the case for extended gate hours of operation; the trucking perspective 34
3.0 Qualitative and quantitative research methodology 37
3.1 Marine terminal survey instrument design 37
3.2 Key metrics for transportation systems management measures: system parameters and components (Congestion factor analysis) 40
3.2.1 Marine operations. 40
3.2.1.1 Marine operations weekly shift distribution 40
3.2.1.2 Marine hours of operation by labor shift 41
3.2.2 Modal throughput distribution 41
3.2.3 Gate hours of operation 42
3.2 3.1 Normal terminal gate hours of operation 42
3.2.3.2. Average gate moves per shift distribution 43
3.2.3 Gate transaction distribution 44
3.2.3.1 Selective distribution of gate transactions 46
3.2.4 Labor scheduling flexibility 46
3.2.4.1 Flexible gate hours of operation 46
3.2.4.2 Gang size dispatch 47
3.2.4.3 Flexible start hours 47
3.2.5. Container yard throughput benchmarking 48
3.2.5.1 Average dwell time 48
3.2.5.2 Average dwell time per transaction distribution 49
3.2.5.3 Demurrage charges 49
3.2.5.4 Average free time 50
3.2.5.5 Empty container storage charges 50
3.2.5.6 Out of port container interchange 51
3.2.5.7 Differential pricing 51
3.2.6. Information technology 51
3.2.6.1 Optical character reading (OCR) at terminal gate 52
3.2.6.2 Automatic equipment identification (AEI) 52
3.2.6.3 Electronic data interchange (EDI) 52
3.2.6.4 Scheduling/appointment system 55
3.2.7 Extended gate hours of operation 55
4.0. Stakeholder implications of extended gate hours 56
4.1. Qualitative stakeholder implications data 56
5.0. Break-even and cost-benefit analysis of marine terminal extended gate hours 60
5.1. Cost-benefit analytical framework for extended gate hours 61
5.2 Marine terminal cost implications for unsubscribed services and incremental break-even variable cost structure 62
5.3 Cost benefit analytical framework for analysis of extended gate hours of operations 70
6.0. Framework for extended gate hours regime 71

6.1. Long term goals of extended hours regime and modal distribution mix 72
6.2. Preliminary steps toward transitional regime 73
6.3. Phased approach toward extended gate hours 73
6.4. Synchronization of marine and gate operations 74
6.5. Changes in existing supply chain management practices 74
6.6. Complementary role of information technology 75
7.0 Implementation: The next steps 75
7.1. Public policy need to validate timing and benchmark performance . 75
7.2 Performance benchmarking key to successful strategic implementation 76
7.3 Application of economic game theory to marine terminal queuing 77
7.4 Terminal space and freeway capacity as common property resource 77
7.5 Cooperative versus non-cooperative games 78
7.6 Application of queuing game theory elements to extended gate hours 79
7.7 Recommended future analytical approach 82
8.0 Setting a collective course towards a 7/24 Hour Solution: Findings, Conclusions, Recommendations and Next Steps 84
8.1 Research findings and conclusions 84
8.1.1 On this basis the following key findings, conclusions, and inferences from data and observations may be drawn 84
8.2 Recommendations and Next Steps 85
8.2.1 Required industry near term initiatives: supporting process and information infrastructure 85
8.2.2 Required near term research initiatives: analytical framework 85
8.2.3 Required joint industry and research initiatives: best practices planning 86
8.2.4 Required industry research support: documentation 86
8.2.5 Required joint industry and research initiatives: strategic modeling 87
8.2.6 Required long term joint industry and research initiatives: performance evaluation and measurement 88

Appendix A Marine Terminal Baseline Survey instrument A-1
Appendix B Extended Gate Hours Stakeholder Implications Matrix B-1
References R-1
Glossary
Index

List of Figures

Figure 1 I-710 Corridor Study Work Chart 29
Figure 2 Political and Policy Ramifications of Doing Nothing in the I-710 Corridor 30
Figure 3 Elements of queuing systems 79

List of Tables

Table 1: Annual Combined Rates of Growth in Container Traffic in the Ports of Los Angeles and Long Beach, 1990-2000 1
Table 2: Comparative Rates of Growth the Ports of Los Angeles and Long Beach, and the National Average, 1990-2000 2
Table 3: Market Share of Container Traffic the Ports of Los Angeles and Long Beach, and the National Average, 1990-2000 2
Table 4: Port of Long Beach and Los Angeles Marine Terminals (1999) throughput per acre and throughput velocity 5
Table 5: Port truck traffic spatial distribution 8
Table 6: Monthly Aggregate Daily Inbound and Outbound Truck Trips for Fourteen Container Terminals (Including Full, Empty, Chassis and Bobtail 9
Table 7: Total Inbound/Outbound Container Truck Traffic Distribution 10
Table 8A: Total AM/PM Hours Weekly Truck Trip Distribution Comparison 10
Table 8B: Total AM/PM Hours Daily Gate Count Distribution 11
Table 8C: Total Peak-non Peak Hour Daily Gate Count Distribution 12
Table 9: Total Inbound/Outbound Weekly AM/PM Peak Gate Transactions 12
Comparative Rates of Growth in the Ports of Los Angeles and Long Beach and the National Average, 1990-2000.
Table 10:Total Aggregate Terminal Weekly Gate Transaction Distribution 13
Table 11A: Aggregate Container Terminal Inbound Weekly Transactions Distribution (AM Peak Hours) 14
Table 11B: Aggregate Container Terminal Outbound Weekly Transactions Distribution (AM Peak Hours) 15
Table 11C: Aggregate Container Terminal Inbound Weekly Transactions Distribution (PM Peak Hours) 16
Table 11D: Aggregate Container Terminal Outbound Weekly Transactions Distribution (PM Peak Hours) 17
Table 12: Average weekly distribution of container vessel arrivals and departures 18
Table 13 A/B: Average container vessel turnaround times 19/20
Table 14A: Selected Aggregate AM Peak Hourly Distribution of Gate Activity 21
Table 14B: Selected Aggregate PM Peak Hourly Distribution of Gate Activity 22
Table 15: Average weekly shift distribution of vessel loading/unloading 40
Table 16: Marine hours of operation by labor shift 41
Table 17: Modal distribution terminal throughput 41
Table 18: Normal terminal gate hours of operation and corresponding labor shift 42
Table 19: Gate moves per shift distribution 43
Table 20: Gate transactions distribution 44
Table 21: Selective distribution of gate transactions 46
Table 22: Flexible time scheduling of longshore labor 46
Table 23: Gang size dispatch utilization 47
Table 24: Flexible start hours and meal hours utilization 47
Table 25: Rationale for use of flex start hours and meal hours work 47
Table 26: CY work performed in conjunction with flex gates and extended shift gates 47
Table 27: Average dwell time for a container at terminal 48

Table 28: Average dwell time distribution per transaction type 49
Table 29: Tariff demurrage charges assessment on inbound containers 49
Table 30: Average free time for a container by shipper size 50
Table 31: Assessment of charges for empty container storage at terminal 50
Table 32: Use of out of port container interchange 51
Table 33: Differential price by percentage of base tariff your terminal charge for container pickup and exchange by shift 51
Table 34: OCR capability at the gates for container and/or chassis identification 52
Table 35: Automatic Equipment identification of containers and chassis 52
Table 36: EDI/Telecommunications platform capability and real time telecommunication of container/shipping data 52
Table 37: Electronic Data Interchange (EDI) technology for data sharing 53
Table 38: Scope of EDI system data at terminal 53
Table 39: EDI system characteristics 53
Table 40: System container pickup and exchange scheduling with shippers and consignees capability 54
Table 41: EDI System receipt of electronic delivery orders 54
Table 42: Use of Internet based truck scheduling and appointment system for access by trucking company dispatchers and independent drivers 55
Table 43: Internet based truck scheduling and appointment system at your terminal and truck driver positive identification system 55
Table 44: Extended gate hours of operation 55
Table 45A/B: Incremental operating cost of a full service gate at normal manning level at your terminal by category (long shore, clerk, walking boss) under the applicable collective bargaining agreements 63/64
Table 46: Incremental break-even cost of a full service gate expressed in dollars and number of containers by shift 64
Table 47: Required manning levels by category (long shore, clerk, walking boss) under applicable collective bargaining agreements for a full service gate by shift 66
Table 48: Incremental break even cost of a limited service gate 67
Table 49: Required manning level by category (long shore, clerk, walking boss) under applicable collective bargaining agreements for a limited service gate by shift 68
Table 50: Assuming 501-800 gate moves per shift under normal weekday yard/gate working operations, specify the percentage of additional staffing requirements at your terminal in order to accommodate full service gates extended terminal gate hours on the second shift, hoot shift, and weekends 69
Table 51: Break event analysis in number of containers based upon average tariff fee per container gate transaction 70
Table 52A/B: 2020 Extended Gate Hours Throughput Redistribution Analysis Scenarios 72

Disclosure

This research project report was funded by a grant from the Department of Transportation through the Center for Metropolitan Transportation Studies (METRANS) under a cooperative agreement between the University of Southern California and California State University, Long Beach (CSULB). The principal investigator was Dr. Joseph P. Magaddino, Chair, Department of Economics, CSULB in collaboration with Dr. Lawrence G. Mallon, Director of Research, Center for International Trade and Transportation (CITT) CSULB. The grant amount was $34,934.00. The project title is An Integrated Approach to Managing Local Container Traffic Growth in the Long Beach –Los Angeles Port Complex, Phase II as part of a series of monographs on benchmarking elements of the Southern California regional supply chain. The report fulfills the project deliverable requirement for the Phase II project.

Acknowledgements

The authors wish to acknowledge the contributions of each of the enumerated participants in the two CITT sponsored workshops designed to obtain stakeholder validated qualitative data for this report. The authors also wish to thank each of the respondents on behalf of the fourteen marine terminals comprising the Los Angeles-Long Beach port complex, the Terminal Operators Committee of the Los Angeles Steamship Association (LASA) for their endorsement of this project, and Jay Winter, Executive Director LASA, Kerry Cartwright, Assistant Director of Planning, Port of Long Beach, Captain Manny Aschmeyer of the Los Angeles –Long Beach Marine Exchange, and Mike Shanks of ITS terminals, for their invaluable assistance in this research project. Finally, the authors wish to acknowledge the exemplary efforts of Muhammad K. Nisar, Graduate Research Assistant, for his efforts in producing the tables and graphs depicted in the report.

1.0 Background and statement of the problem: contributors and leading indicators of terminal bottlenecks and port generated traffic congestion

1.1 Regional goods movement flows and growth trends in volume of truck traffic

The Los Angeles-Long Beach port complex, the gateway to the Pacific Rim, is the nation's largest ocean freight hub and its busiest container port complex. The twin ports of the San Pedro Bay are comprised of fourteen individually gated terminals. From a commercial perspective, they serve as crucial node in the regional supply chain and, from a transportation planning perspective, are designated as an Intermodal Corridor of Economic Significance (ICES).

In 2000, the combined ports handled 9.5 million twenty-foot equivalent units (TEUs). The vast majority of containers or boxes are forty feet in length implying that 4.75 million full containers were handled. Each container is handled twice as it is recycled as an empty under an interchange arrangement between the carriers. This translates into 9.5 million one-way movements by road or intermodal rail (itself frequently including local drayage) within the region and its transportation infrastructure.

The growth in the activity of the combined ports has been impressive. As Table 1 indicates throughout the latter part of the 1990s much of this growth was at double-digit levels. Since this period was one of rapid economic expansion, it is important to compare the rates of growth in the combined ports with that of the nation. Table 2 provides such a comparison.

Table 1
Annual Combined Rates of Growth in Container Traffic
in the Ports of Los Angeles and Long Beach, 1990-2000.

Year	Rate of Growth
1990	3.7
1991	1.1
1992	8.2
1993	6.8
1994	15.8
1995	6.0
1996	6.5
1997	12.4
1998	15.6
1999	10.2
2000	15.1

Throughout this decade, in almost every year the rate of growth in the combined Ports exceeded that of the national average. This reflects the shifting of trading patterns over the last forty years. As recently as 1960, international trade was dominated by trade between North American and the European Community. With the shift in balance from the North Atlantic to the North Pacific (particularly eastbound) trade routes, the importance of the trading partners based on the Pacific Rim has been the driving force behind the rapid growth and emerging importance of these ports to the national economy now accounting for 7% of gross domestic product.

Table 2
Comparative Rates of Growth in the Ports of Los Angeles and Long Beach and National Average, 1990-2000.

Year	Twin Ports	USA
1990	3.7	1.6
1991	1.1	6.7
1992	8.2	6.2
1993	6.8	8.2
1994	15.8	8.8
1995	6.0	9.7
1996	6.5	1.2
1997	12.4	8.5
1998	15.6	6.9
1999	10.2	6.9
2000	15.1	13.2

As shown in Table 3, the Ports of Los Angeles and Long Beach's market share is thirty percent of all container traffic in the nation. The rapid rate of growth in container traffic easily eclipsed the Mercer Management/DRI (MMDRI) forecasted growth of 6.2%. The MMDRI forecast serves as the basis for the 2020 Seaport Plan and much of the regional economic and infrastructure planning has been based on this lower rate of growth. Even taking the MMDRI forecast of 6.2% annual growth from 2000-2020, and applying this forecast to the current levels, forecasted aggregate throughput is 28 million TEU or 14 million containers moving through the combined ports by the year 2020. This is a tripling of current volume. [1]

Table 3
Market Share of Container Traffic
by the Ports of Los Angeles and Long Beach, 1990-2000.

Year	Share
1990	24.7
1991	23.4
1992	23.9
1993	23.6
1994	25.1
1995	24.2
1996	25.5
1997	26.4
1998	28.6
1999	29.4
2000	29.9

[1] San Pedro Bay Ports Log Term Cargo Forecast, Mercer Management Consulting, Inc., October, 1998

As a consequence of this unanticipated growth, port generated traffic has emerged as a major contributor to regional congestion. For many years, aggregate truck traffic as a percentage of total traffic volume has hovered around the 3-4% mark along the I-710 corridor serving Long Beach and the main gateway to the combined ports. Truck traffic volume is currently 10%, and on some major freeways as much a 15% of vehicular traffic volume and growing. As a result, CALTRANS and other regional planning agencies have recently begun to look at passenger car equivalency factors and heavy-duty truck-load factors in calculating the impact upon regional mobility. Additionally, the traffic volume of trucks adversely impact operational capabilities as well as creating a differentially higher demand upon roadway maintenance and construction cost than passenger vehicle loads.

CALTRANS recognizing the importance of goods movement in the functioning of the economy and for planning purposes requires that implementation goals include:

- Goods movement being given full and appropriate consideration in the planning, design, development, operation, maintenance, and funding of the State's transportation system at the State, regional and local level;
- Improving intermodal access and connections between airports, seaports, border crossings, and rail, truck and intermodal terminals;
- Reducing physical, operating and regulatory constraints to full capacity utilization;
- Inclusion of Goods Movement in Programming Guidelines as part of the SB 45 and State Transportation Improvement Plan ("STIP") for implementation by the California Transportation Commission and Metropolitan Planning Organizations (MPOs).

1.2. Diminishing port land area requiring maximum terminal throughput

The combined ports have accommodated this rapid growth through increasing land area available for terminal operations. However, the era of potential port land expansion is coming to an end and increasing throughput velocity must accommodate future growth through better or more intensive utilization of land, adoption of best operating practices, and the application of information technology. Other collaborative studies underway are intended to assist marine terminals in increasing throughput velocity.

Many factors contribute to terminal throughput velocity, which is measured by the average dwell time (average time spent by a container at the terminal) x throughput per acre. These include lack of standardization in technology and operations, failure to adopt best practices and operating procedures, inefficient work practices, sub-optimal use of information technology, and the inefficient practice of granting substantial free (warehouse) time for customer containers at marine terminals before demurrage and other surcharges for late pickup are imposed upon shippers and consignees. Studies are underway involving remedial actions addressing many of these impediments to increased throughput velocity in the spatial dimension.

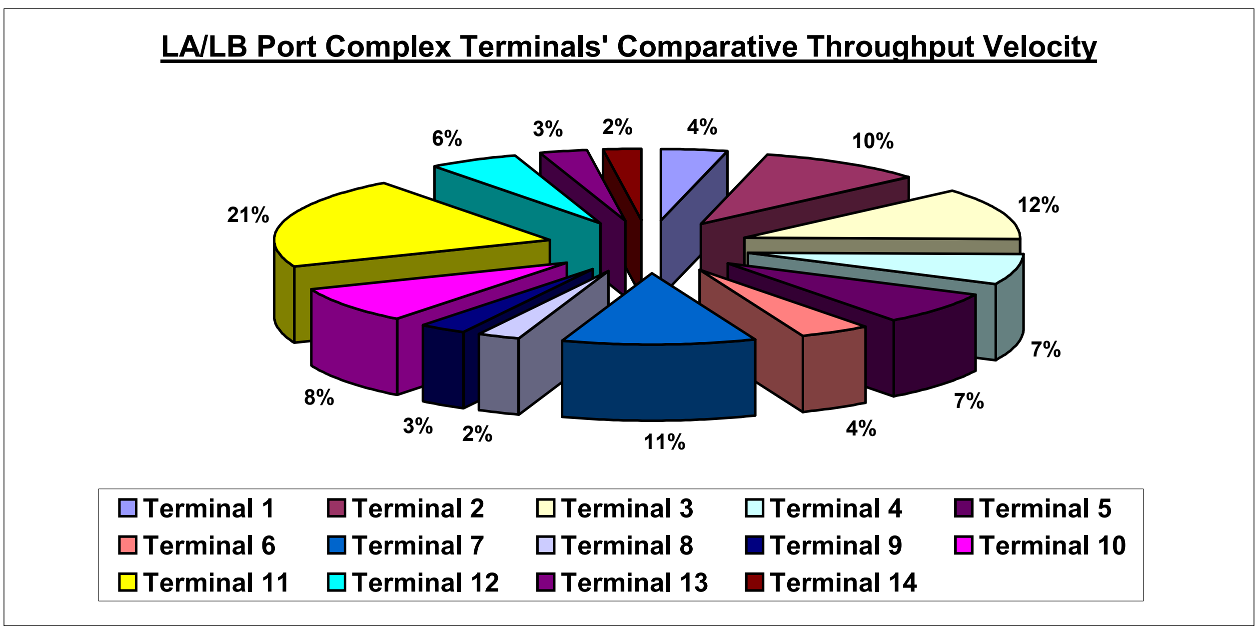
Data assembled by the ports suggests that one component of terminal throughput velocity, throughput per acre, has nearly doubled despite double-digit growth from approximately 3,000 TEUs per acre in 1990 to 5,500 TEUs in 2000. By way of comparison Hong King and Singapore's generate 12,000 TEUs per acre, which reflects their status as major transshipment facilities. When land was less of a constraint, carrier-shipper agreements provided free dwell times, which allowed shippers to store containers at the terminal. As the land constraint becomes binding, this practice hampers terminal operations. Terminal demurrage charges averaging 11-14 days have not been reduced, except for intermodal rail shipments, over the same period.

In the face of diminishing land capacity, throughput per acre is a rough indicator of efficiency in the use of land, although not necessarily a measure of efficient use of other resources. Throughput per acre can be affected by factors not within the control of terminal operators. For example, transshipment ports such as Hong Kong and Singapore have much higher levels of throughput per acre than the Twin Ports. Similarly, the imbalance of inbound and outbound traffic causes a repositioning of equipment that affects throughput. As the land constraint becomes binding, terminal operators increasingly switch from wheeled chassis operations to decked operations. Decked operations oftentimes increase dwell time and reduce throughput. Traditionally, terminals have measured dwell time as the number of days that an individual container, whether an import, export, or empty, spends on average in the terminal. This then serves as an approximate measure of efficiency in the use of three dimensional unit space.

The authors have elected to combine these metrics to provide a new indicator of terminal efficiency, that we call throughput velocity. Throughput velocity is the number of TEUs per acre per month multiplied by average dwell time (for import, export, and empty containers). We use this as a measurement of efficiency in the use of overall resources across the twin dimensions of time and space in the conduct of terminal operations independent of terminal size and geographic configuration.

Table 4
Determination of LA/LB Port Complex Marine Terminals' Comparative Throughput Velocity

Terminal	Monthly Throughput	Acreage	Throughput/Acre	Dwell Time for Decked Containers	Dwell Time for Wheeled Containers	Average Dwell Time	Throughput Velocity
Terminal 1	47963	170	282.14	7.00	3.00	5.00	1410.70
Terminal 2	40798	58.90	692.67	7.00	3.00	5.00	3463.35
Terminal 3	62874	75	838.32	7.00	3.00	5.00	4191.60
Terminal 4	51583	100	515.83	7.00	3.00	5.00	2579.15
Terminal 5	49430	95	520.32	7.00	3.00	5.00	2601.60
Terminal 6	39063	123	317.59	7.00	3.00	5.00	1587.95
Terminal 7	88404	110	803.67	7.00	3.00	5.00	4018.35
Terminal 8	19179	107	179.24	7.00	3.00	5.00	896.20
Terminal 9	27242	130	209.55	7.00	3.00	5.00	1047.75
Terminal 10	73646	125	589.17	7.00	3.00	5.00	2945.85
Terminal 11	136566	91	1500.73	7.00	3.00	5.00	7503.65
Terminal 12	63531	160	397.07	7.00	3.00	5.00	1985.35
Terminal 13	29867	162	184.36	7.00	3.00	5.00	921.80
Terminal 14	43550	261	166.86	7.00	3.00	5.00	834.30



1.3. Modal distribution of port container volume: a critical component of regional mobility

The modal distribution of container-terminal throughput as well as its origin and destination has a profound impact upon roadway use and regional mobility. Commodity flow survey data, as of 1997, reveal that trucks transported 81% of all outbound freight originating in Southern California, an average distance of 288 miles. Intermodal rail transported 19% of outbound freight, an average distance of 1,525 miles, which represents an arc from Los Angeles to Chicago, Illinois or Houston, Texas.[2] Customs data reveals that almost fifty per cent of imports and exports originate within five hundred miles of the combined port complex.

In a 1999 report to Congress, the US Maritime Administration stated that "[t]he Ports of Long Beach and Los Angeles handle 20,000 truck movements and 30 train movements per day, these movements are expected to reach 50,000 truck and 100 train movements per day by 2020."[3] More current data indicate that the combined ports generate approximately 34,000 truck trips per day. If freight growth forecasts prove accurate, the number of daily truck trips could exceed 50,000 by 2010, and reach 92,000 by the year 2020.[4] Once again, the dramatic growth in port activity combined with a relatively conservative forecast of this growth strongly suggest that the levels of predicted traffic will be met in 2010, a full 10 years earlier than planned

Regional rail tonnage is likewise expected to increase threefold, from 91 million tons in 1995 to 309 million tons in 2020. The Alameda Corridor grade separation project is expected to enter service in April 2002. The Alameda Corridor should alleviate some growth related congestion between the port area and the downtown intermodal rail yards. It is hoped that as much as one half of the aggregate throughput volume can be channeled through the Alameda Corridor. In reality, the most efficient on dock rail terminals handle less than thirty per cent of their volume by intermodal rail and the remainder by local drayage to warehousing, distribution, transdocking and intermodal rail facilities

If 30% of the anticipated growth in cargo is moved by rail, this implies that of the 14 million containers that will pass through the port as early as 2010, 10 million will travel by truck or 10 million total container movements including the transportation of empty containers to and from the ports. This translates into a daily average (dividing by 292 working days per year) of almost 92,000 container trips per day by the year 2010!

A recent Port of Long Beach/Los Angeles Transportation Study [5] estimates that at most 30-35% of all containers that move through the ports will be transported by rail to inland destinations via on-dock or off-dock rail yards by the year 2020. This is consistent with the current ratio of containers handled by rail and major trends in logistics planning among large shippers. These trends are predicated upon vendor-managed inventory, cross-docking, and related logistics practices, which are geared toward greater reliance upon road versus rail, especially in the movement of time sensitive cargo.

Dual constraints are at work here to limit future modal distribution. One is the inherent limitation in the availability and use of on dock rail by marine terminals (traditionally competing with terminal storage capacity) notwithstanding the trend toward larger terminals of 300 acres

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[2] Forecast of Freight Mode Share in Southern California Region (1995-2020), Southern California Association of Governments

[3] U.S. Maritime Administration, An Assessment of the U.S. Marine Transportation System: A Report to Congress September 1999

[4] Draft Southern California Freight Management Study, Metropolitan Transit Authority, December, 2001

[5] Ports of Long Beach/Los Angeles Transportation Study, June, 2001

versus the current 100 acre size. The other is the fact that inland rail capacity may be constrained to accommodate sixty per cent of anticipated future rail growth.

Hence, even though the Alameda Corridor may expedite rail traffic from the fourteen marine terminals to the three primary intermodal rail yards (the Intermodal Container Transfer Facility (UP), UP East Los Angeles Facility, and the BNSF Hobart Yard), it may have little or no effect in diverting that portion of current and anticipated local drayage to rail yards to greater use of on dock or near dock rail. In addition, besides the ICTF there are no rail staging areas within the port complex for forming double stack unit trains

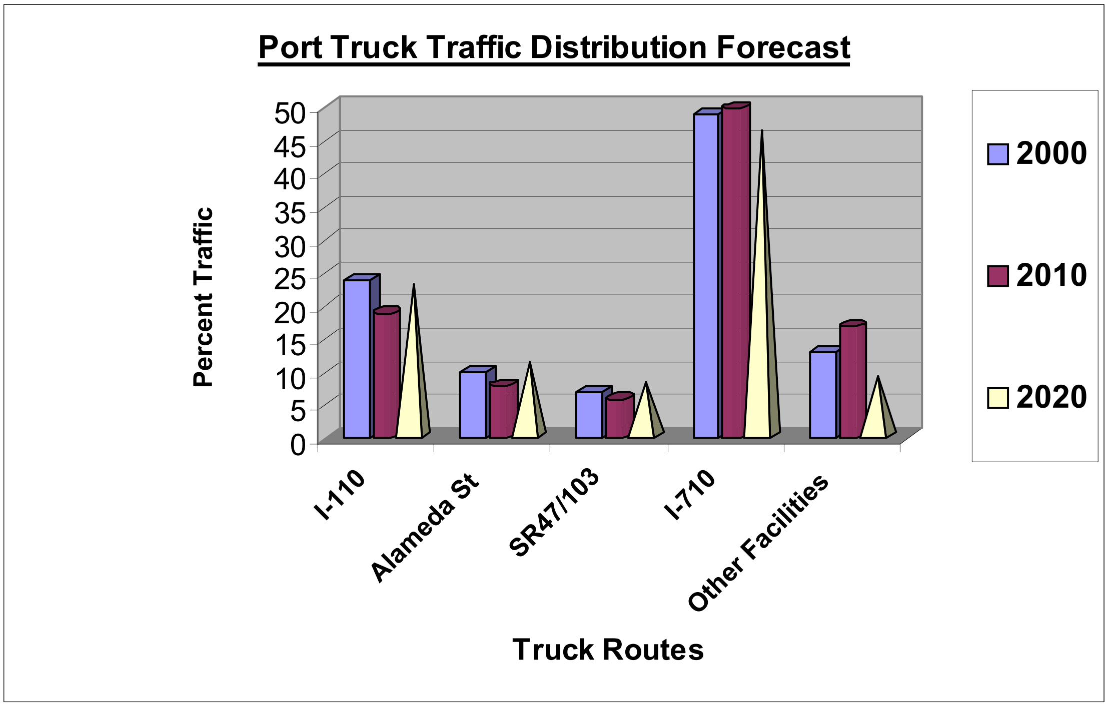
Moreover, from a shippers perspective, it may not realistic to expect them in the interest of expediting the movement of throughput between the ports and the rail yards to both pay anticipated toll charges for the use of the Alameda Corridor passed on by the carriers, and to demand, and potentially have to pay for through increased transportation charges costs incurred by terminals to offset limitations in on-dock rail capacity or by rail carriers to alleviate intermodal rail yard capacity shortfalls. Recent growth in transloading by large shippers using inland drayage to offload to over the road 53-foot trailers may likewise be irreversible. Therefore the goals of any more than a 65-35% modal distribution for the fourteen terminals may be unrealistic and only serve to put greater pressure on the adoption of measures to manage terminal truck traffic to meet future throughput demand and to maintain regional mobility.

1.4 Temporal and spatial dimensions of port generated truck traffic movements: anatomy of port generated congestion

Southern California regional mobility is critically affected by the geographical and institutional structure of the Los Angeles-Long Beach port complex. In addition to the two independent ports, operated as departments of separate municipalities, the overall volume of container trade growth is handled by fourteen independent privately operated terminals under lease agreement with one or the other of the ports.

The geographic configuration of the combined port complex is such that all fourteen terminals are served by only two major freeways, the I-710 either directly connected to most Long Beach container terminals or via the Gerald Desmond Bridge to Los Angeles container terminals located on Terminal Island, or the alternate I-110 connected to Terminal Island by the constricted SR 47 Vincent Thomas Bridge. A third route using State route SR 47/103 links Terminal Island with arterial streets rung parallel to the I-710. Other POLA terminals located landward of Terminal Island are served by Alameda Street.

Table 5
Port truck traffic spatial distribution



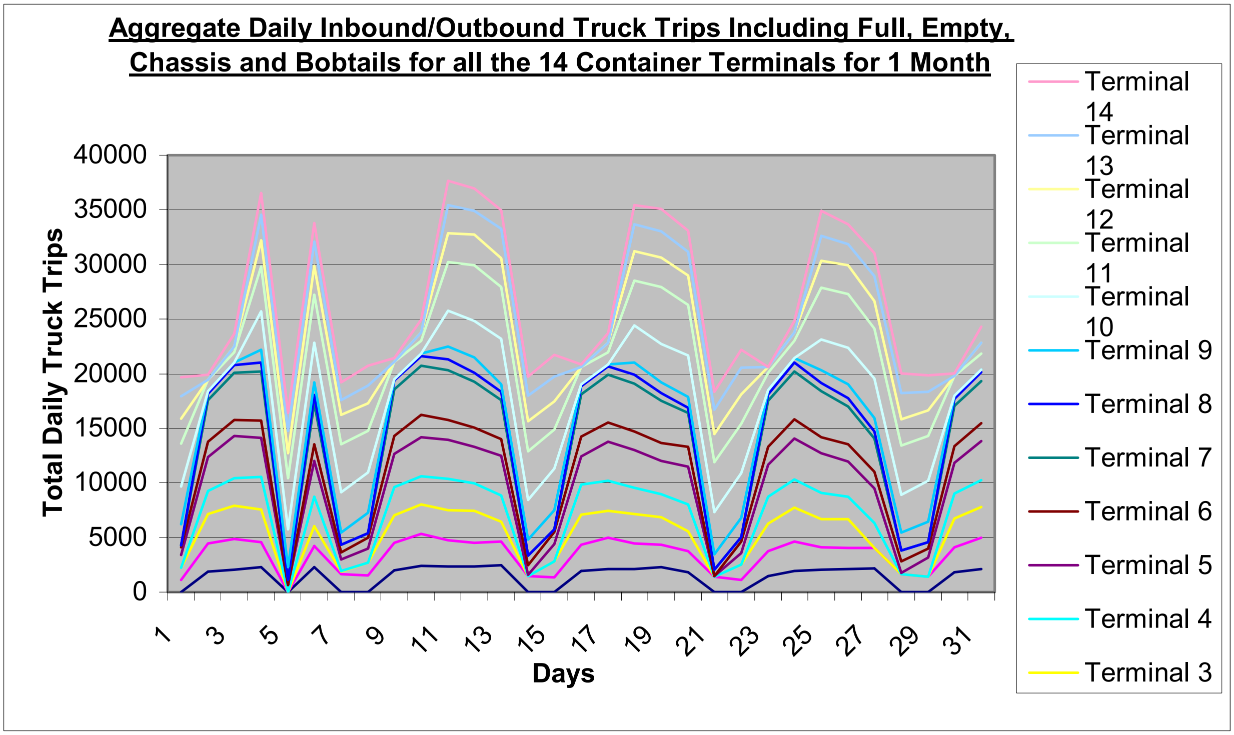
Source: Ports of Long Beach/Los Angeles Transportation Study, June, 2001

Current and projected distribution of port generated truck traffic from the Ports Transportation Study reveals little, if any, potential changes in truck traffic likely in 2010 and 2020. Truck routing decisions are made by individual truck drivers based upon the distribution and frequency of origins and destinations of inbound and outbound freight. The Transportation Study revealed that 65% of container terminal truck trips have origins and destinations within twenty miles of the ports bounded by the SR 60 on the north, I-110 on the west and the I-605 on the east, suggesting that rail is a poor substitute for truck transport.

Truck routing decisions are made by individual truck drivers based upon the distribution and frequency of origins and destinations of inbound and outbound freight. The Transportation Study revealed that 65% of container terminal truck trips have origins and destinations within twenty miles of the ports bounded by the SR 60 on the north, I-110 on the west and the I-605 on the east.

The data presented in this report indicate that, in contrast to marine (vessel) operations, marine terminal gate operations are largely an 8:00 A.M. to 5:00 P.M. Monday through Friday operation. Such is the anomaly between traditional 24/7 marine hours of operations to accommodate ships schedules and asset deployment, and gate hours of operation in a world in which the carrier is the customer and the shipper /consignee is the carrier's customer not the terminal's. The incentive faced by ocean carriers is to minimize the amount of time in port to off-load or load cargo in order to maximize the use of their vessels as transports. Terminal operators, on the other hand, have a strong economic incentive to meet the desires of the ocean carriers since they are the terminals clients. Oftentimes lost in these exchanges is the incentive to minimize dwell time or throughput velocity. Our survey data, however, suggests that these practices, which have been in place for over sixty years, may be changing in response to external pressures and market forces.

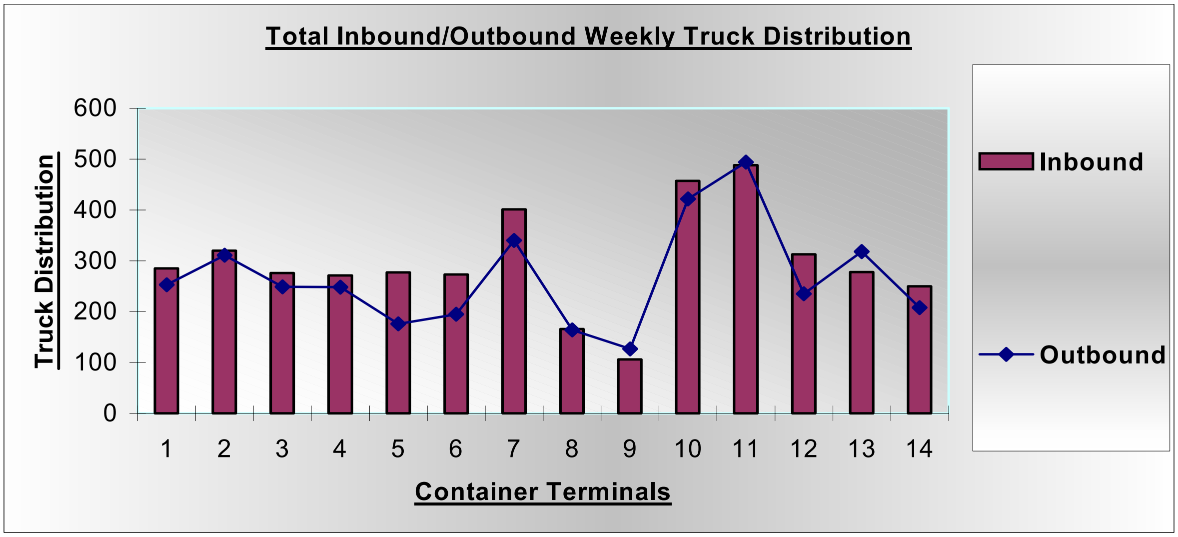
Table 6
Monthly Aggregate Daily Inbound and Outbound Truck Trips
for Fourteen Container Terminals
(Including Full, Empty, Chassis and Bobtail)



A review of the above table reveals that a wide range of diversity exists among the 14 terminals in the aggregate daily volume of truck trips on a monthly distribution basis, and a similar wide pattern of variance exists for each terminal as between various days of the week reflecting a weekly cyclical pattern repeated in the aggregate over a monthly period when all types of transactions are taken into combined consideration. This data suggests that a one-size-fits all incremental approach to the adoption of transportation systems measures such as extended terminal gate hours of operation may not be appropriate and more terminal specific measures likely to more effective in improving both throughput velocity and regional mobility. At the same time it suggests that in the aggregate there are similar daily and weekly patterns and cycles upon which a throughput optimization model could be based.

A similar weekly inbound/outbound weekly aggregate truck traffic distribution comparison for all fourteen terminals including all transaction types (full, empty, chassis and bobtail) demonstrates the weekly pattern and cycle of variability of inbound and outbound gate activity among all terminals and the individual inbound/outbound pattern of activity and relative contribution and distribution for each terminal.

Table 7
Total Inbound/Outbound Container Weekly Traffic Distribution
(including full, empty, chassis and bobtail)



The next series of tables demonstrate aggregate total truck traffic distribution among the fourteen terminals as between AM and PM hours on a weekly and daily basis for selected days, and as between peak and non-peak hours. Although not Tuesday representative of a peak day for most terminals for inbound traffic and Wednesday generally a slack day for most terminals after inbound moves have peaked on Tuesday and before outbound moves peak on Thursday into Friday.

Table 8A
Total AM/PM Hours Weekly Truck Trip Distribution Comparison

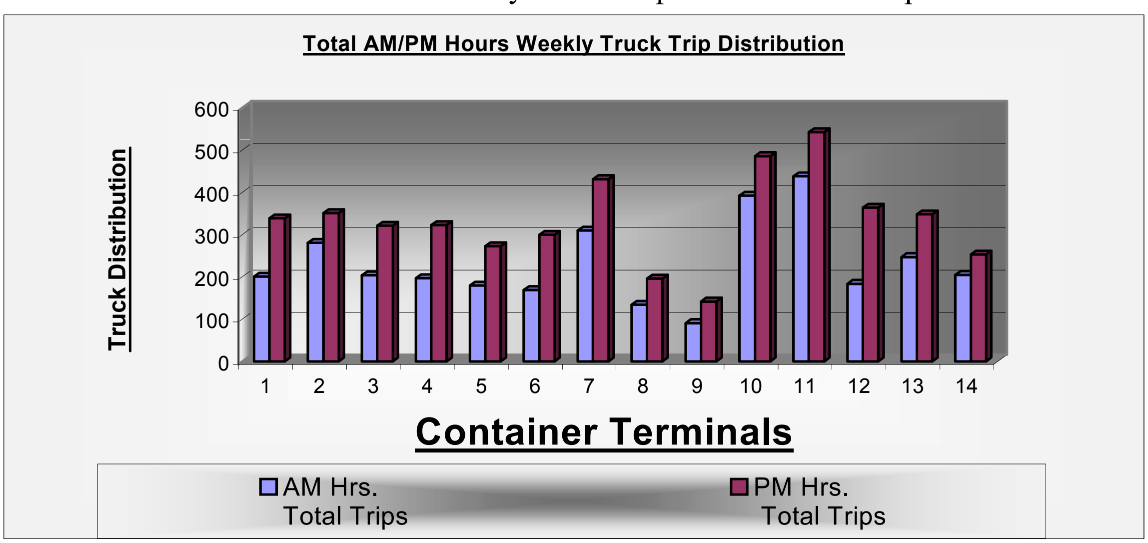


Table 8A demonstrates the relative variation in total weekly truck trip temporal distribution between AM and PM hours for each of the fourteen terminals. Trip distribution data reveals a consistently greater total number of trips reported by drivers during PM hours across all fourteen terminals on a weekly basis.

Table 8B
Total AM/PM Daily Gate Count Distribution
(Tuesday Verses Wednesday)

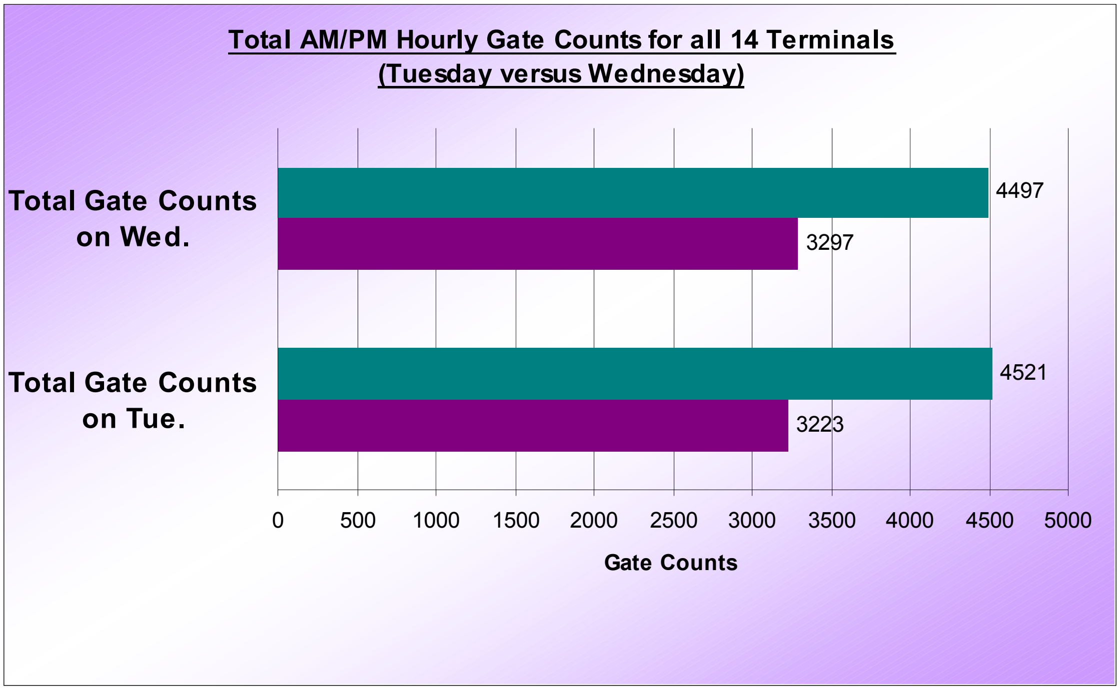


Table 8B demonstrates the AM/PM total gate count distribution for all terminals for Tuesday and Wednesday revealing the same consistent pattern of daily truck activity in the PM hours over the AM but little distinction in the number of total trips reported as between the two days.

Table 8C
Total Peak Hour/Non-Peak Hour Daily Gate Count Distribution
(Tuesday Verses Wednesday)

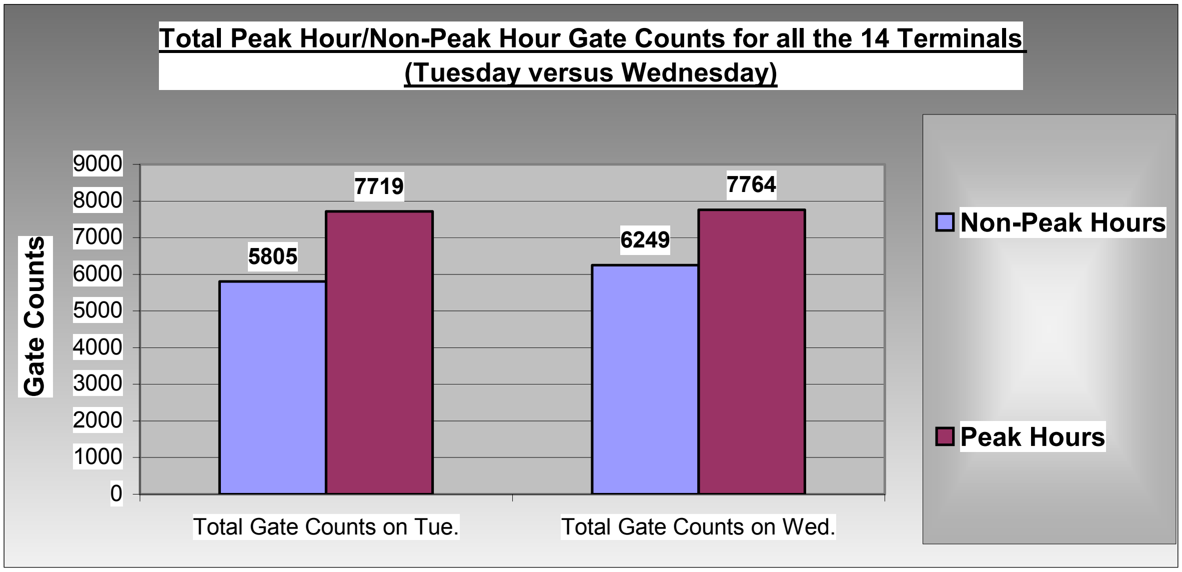


Table 8C reveals the peak concentration of truck traffic distribution among the fourteen terminals on a daily basis.

Table 9
Total Inbound/Outbound Weekly AM/PM Peak Gate Transactions

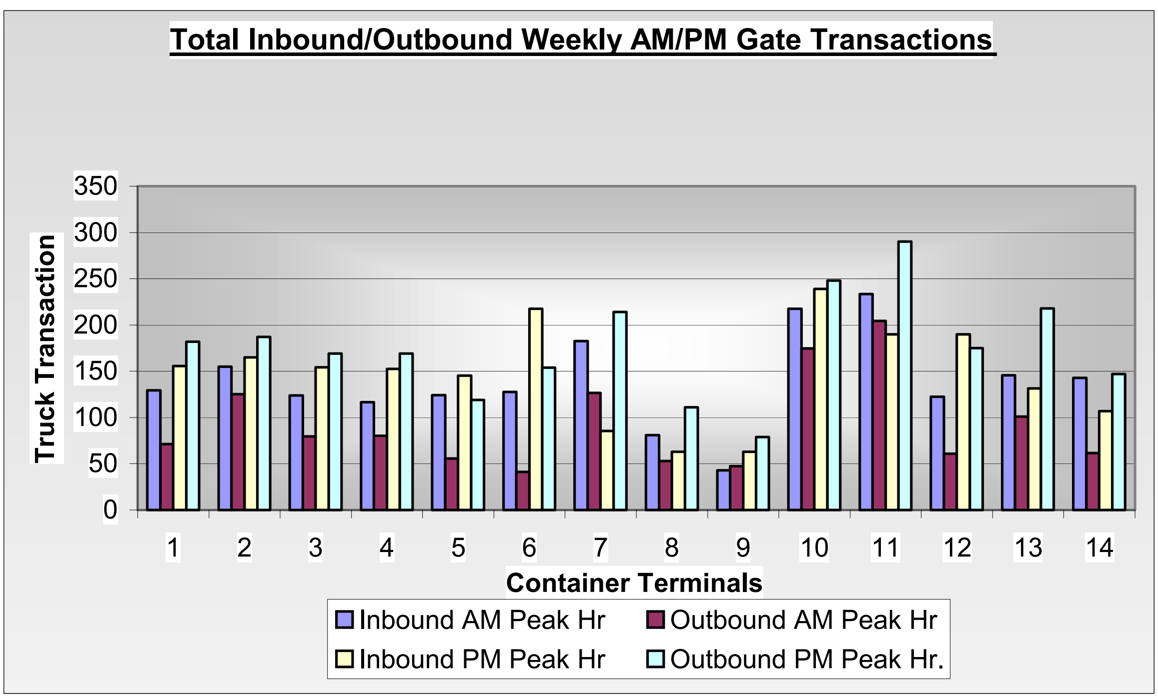


Table 9 further highlights peak gate activity concentration data revealing the pattern and the relative distribution of weekly inbound PM gate peak transactions over inbound AM peak, and even wider variation between outbound PM peak over AM outbound peak gate transactions at the fourteen terminals.

Table 10
Total Aggregate Terminal Weekly Gate Transaction Distribution

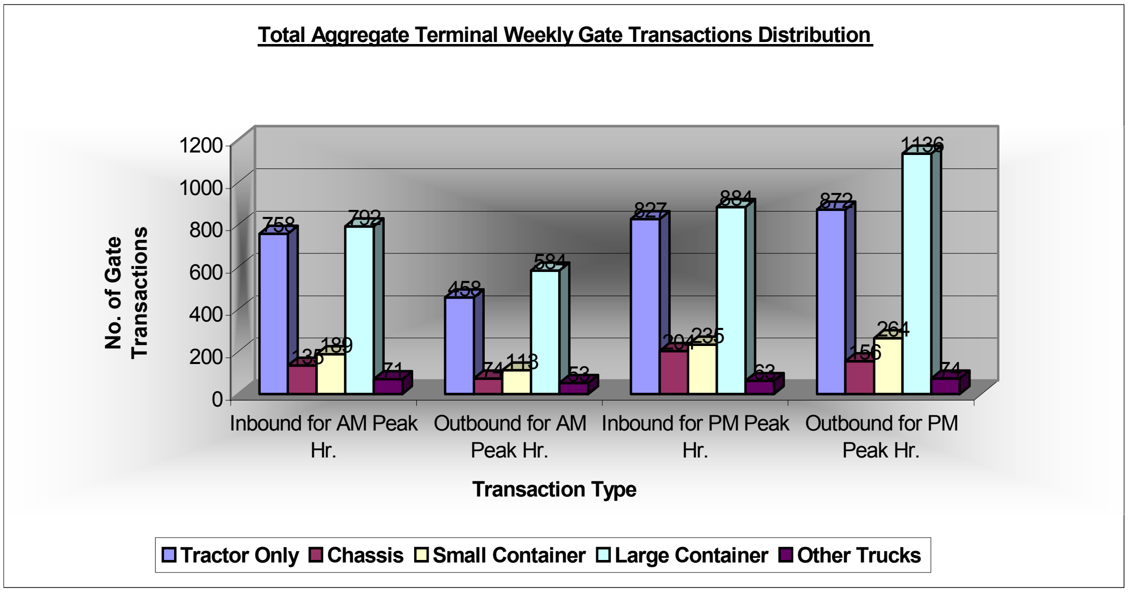


Table 10 uses aggregate data from all fourteen terminals to reveal the relative distribution of forty foot containers, twenty foot containers, empty chassis, bobtail, and other truck inbound and outbound transactions during AM PM peak hours.

Tables 11 A-D breakdown that transactional distribution analysis for all fourteen terminals into inbound AM and PM and outbound AM and PM purposes.

Table 11A
Aggregate Terminal Inbound Weekly Transactions Distribution
(AM Peak Hours)

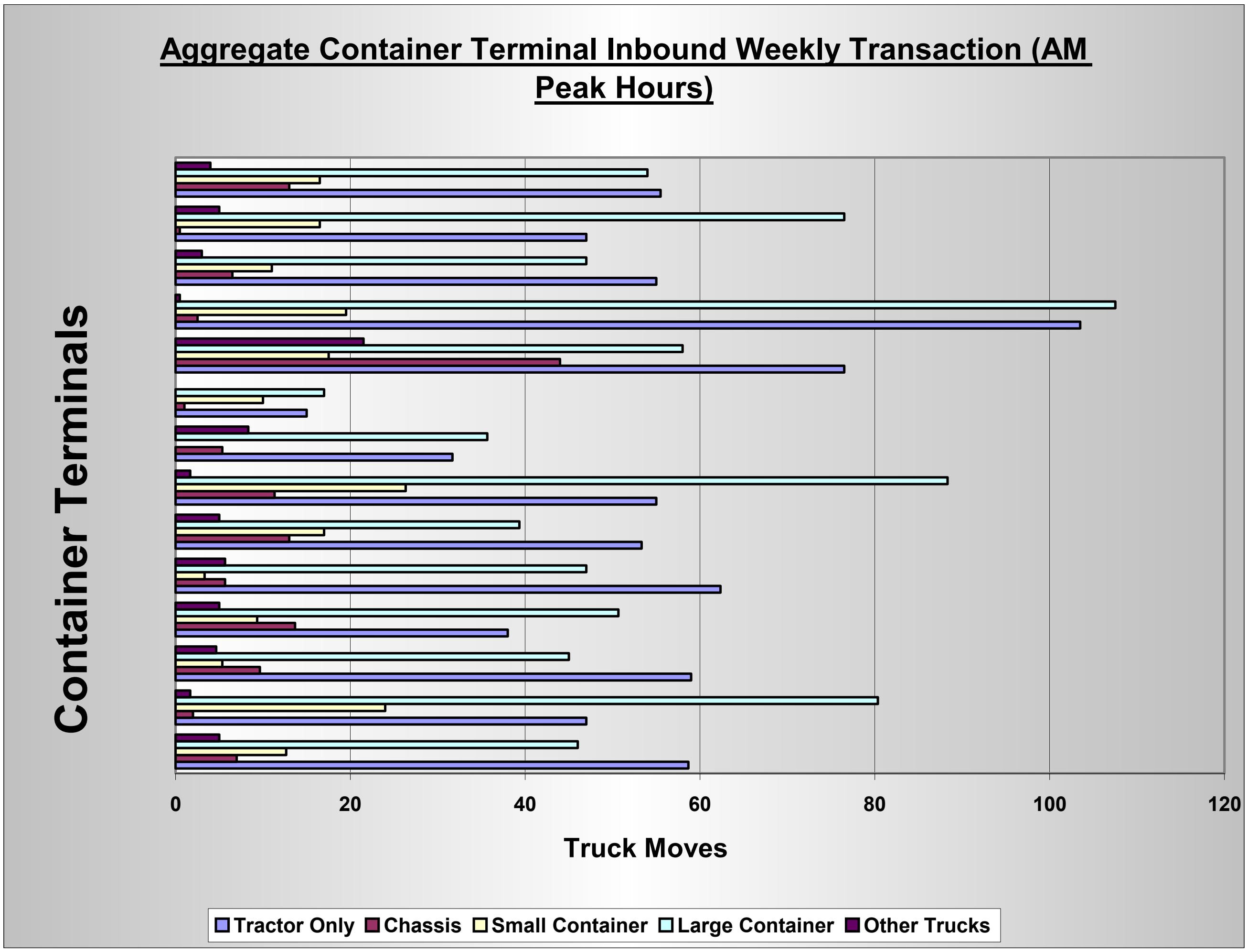


Table 11B
Aggregate Container Terminal Outbound Weekly Transactions Distribution
(AM Peak Hours)

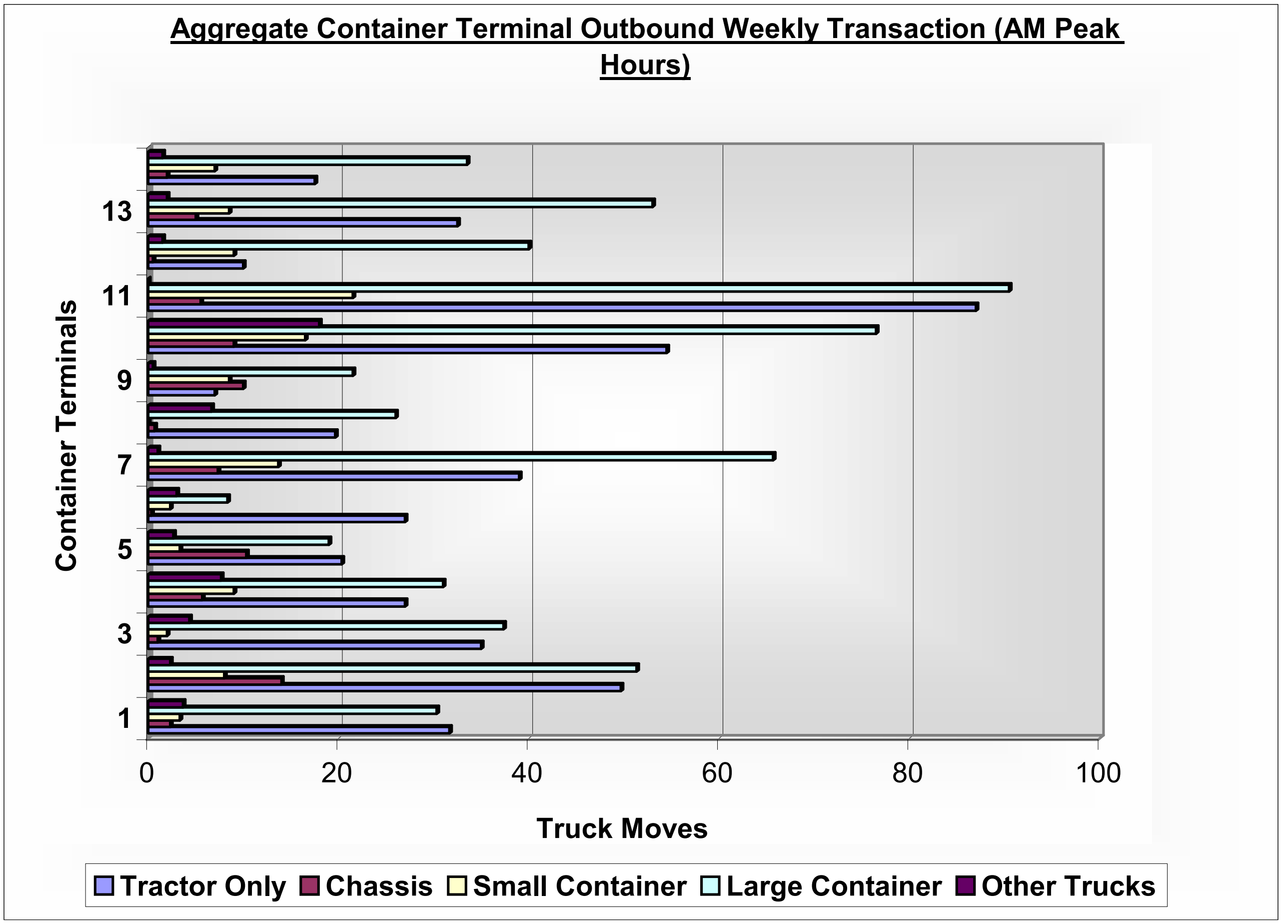


Table 11C
Aggregate Container Terminal Inbound Weekly Transactions Distribution
(PM Peak Hours)

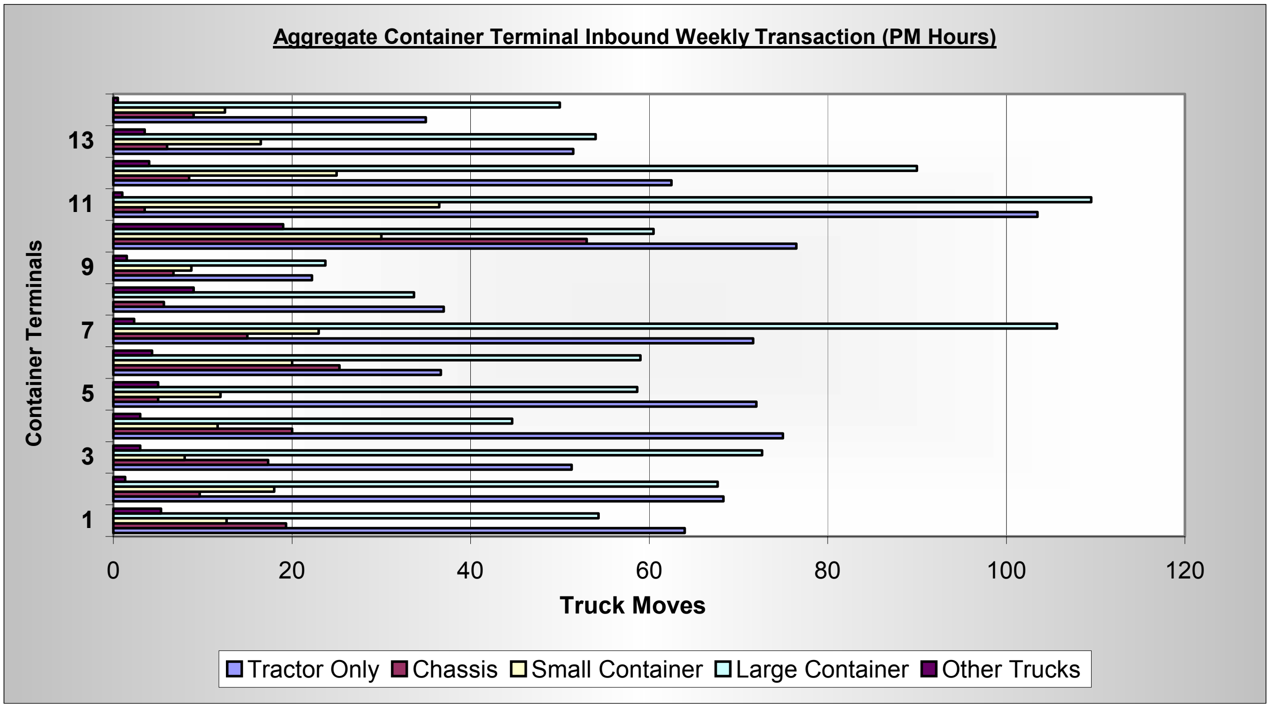
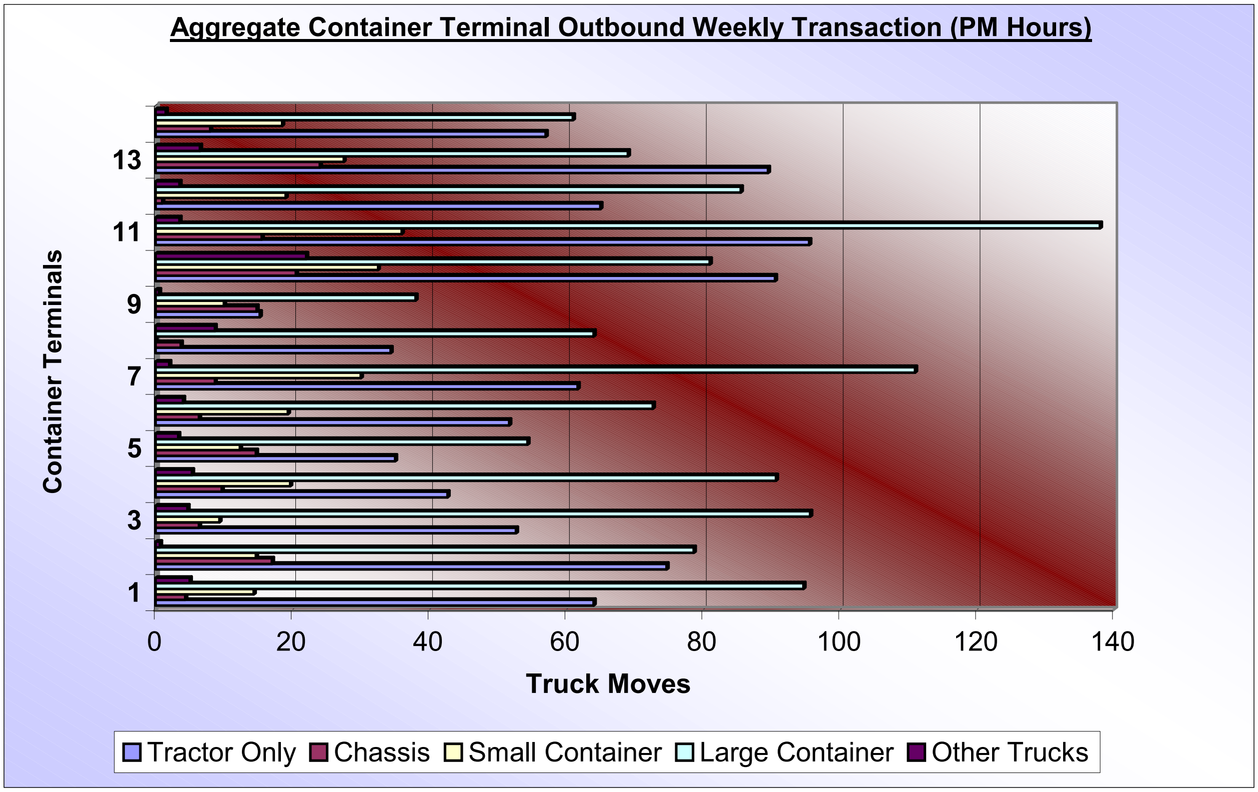


Table 11D
Aggregate Container Terminal Outbound Weekly Transactions Distribution
(PM Peak Hours)



The series of tables demonstrates the transaction composition among tractor only (bobtail), chassis, small (20 foot) container, large (40 foot) container, and other trucks movements weekly distribution during peak AM and PM hours. This data reveals not only the temporal concentration of truck traffic within peak hours, but also the combination of various transactions, including bobtails and empties, that add to congestion and could either be redirected toward non-peak hours or made subject to a queuing arrangement and other transactions, e.g. full container delivery or empty return and full container pickup, be accorded queuing priority.

1.5 Marine (vessel) and gate operations conflicts

Aggregate weekly vessel arrival and departure data from the Los Angeles-Long Beach Marine Exchange suggests that container vessel arrivals with inbound import freight occur with greater frequency on Saturday, Thursday, Monday and Tuesday, and departures with outbound export freight occur more frequently on Fridays, Mondays and Tuesdays suggesting a pattern that could be more closely synchronized with terminal gate hours on a terminal by terminal basis. In addition, most MEGA ships (over 7,000 TEU's) arrivals with the potential for greatest stress on terminal operations and regional mobility are likely (and fortunately) to occur on weekends.

Table 12
Average weekly distribution of container vessel arrivals and departures

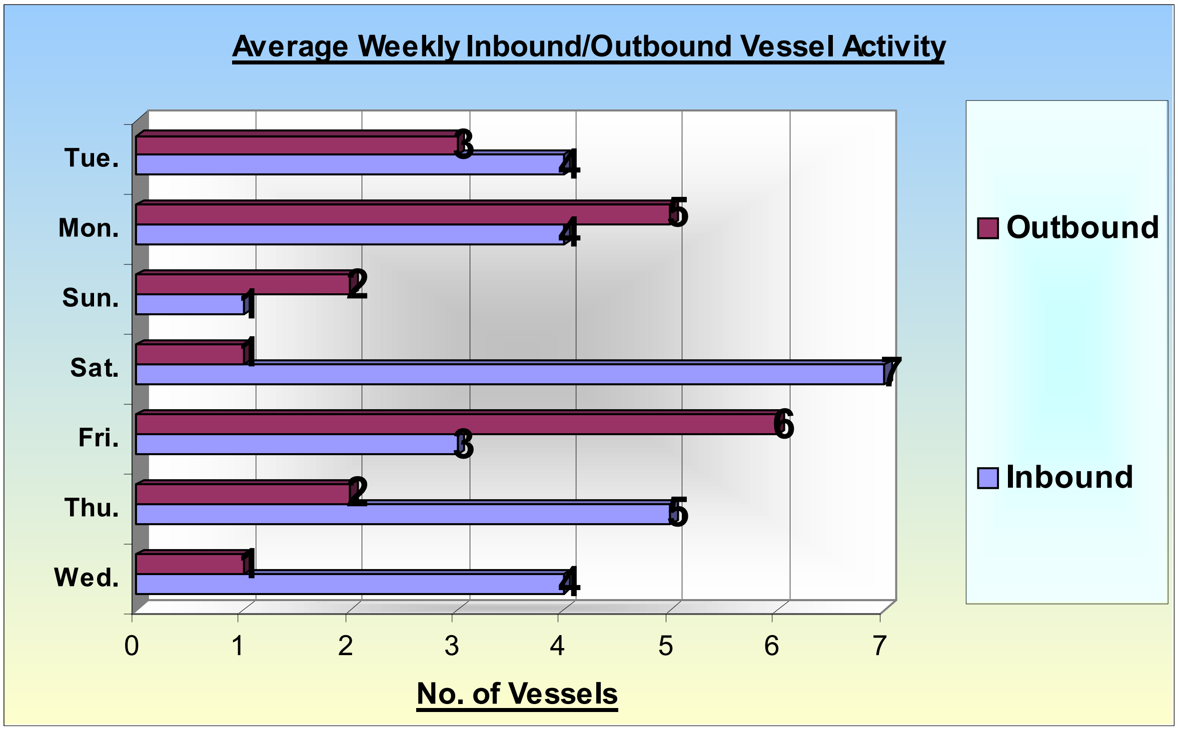
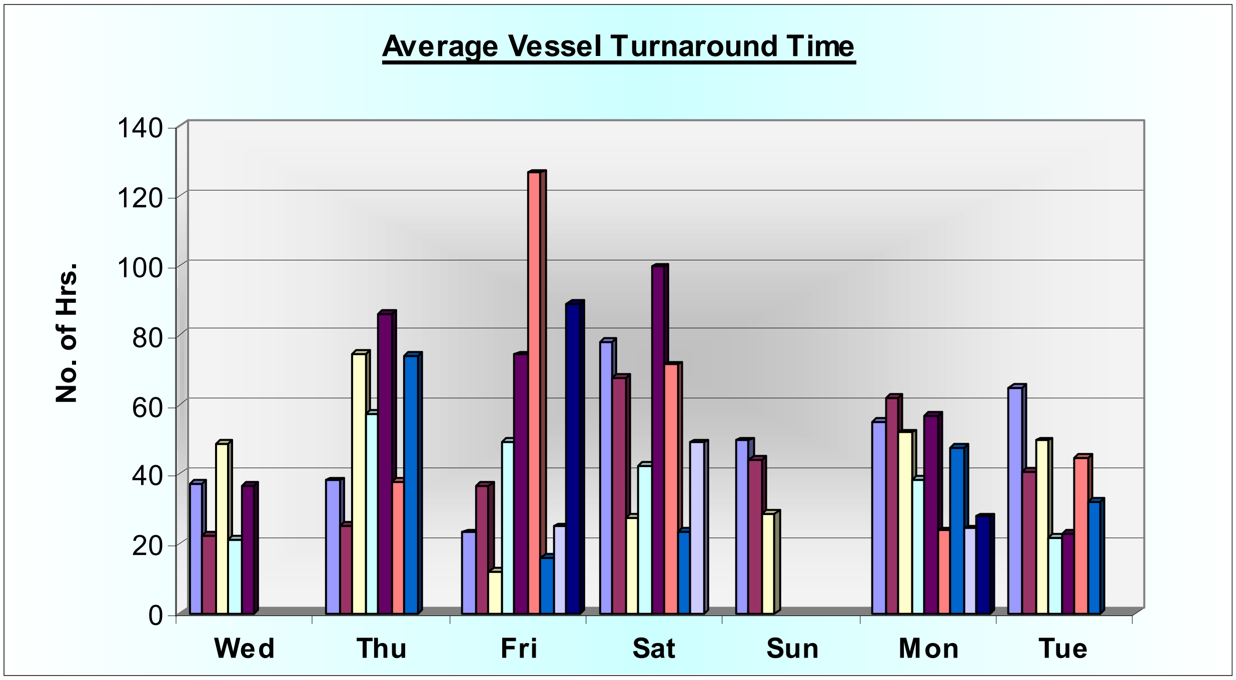


Table 13A
Average Vessel Turnaround Time

No. of Vessels	Arrival Day	Arrival Date	Arrival Time	Departure Date	Departure Time	Hours In Port
1	Wed	8/1/2001	05:05	8/2/2001	18:30	37.42
2	Wed	8/1/2001	05:45	8/2/2001	04:00	22.25
3	Wed	8/1/2001	13:35	8/3/2001	14:30	48.92
4	Wed	8/1/2001	13:20	8/2/2001	10:35	21.25
5	Wed	8/1/2001	05:10	8/2/2001	17:40	36.5
6	Thu	8/2/2001	04:40	8/3/2001	18:50	38.17
7	Thu	8/2/2001	12:55	8/3/2001	02:00	25.08
8	Thu	8/2/2001	16:10	8/5/2001	18:40	74.5
9	Thu	8/2/2001	10:55	8/4/2001	20:20	57.42
10	Thu	8/2/2001	05:15	8/5/2001	19:25	86.17
11	Thu	8/2/2001	05:05	8/3/2001	19:00	37.92
12	Thu	8/2/2001	05:10	8/5/2001	07:10	74
13	Fri	8/3/2001	06:40	8/4/2001	05:50	23.17
14	Fri	8/3/2001	06:10	8/4/2001	18:45	36.58
15	Fri	8/3/2001	05:15	8/3/2001	17:10	11.92
16	Fri	8/3/2001	06:25	8/5/2001	07:35	49.17
17	Fri	8/3/2001	15:05	8/6/2001	17:25	74.34
18	Fri	8/3/2001	12:40	8/8/2001	19:10	126.5
19	Fri	8/3/2001	10:10	8/4/2001	02:05	15.92
20	Fri	8/3/2001	15:15	8/4/2001	16:15	25
21	Fri	8/3/2001	15:00	8/7/2001	07:55	88.92
22	Sat	8/4/2001	14:40	8/7/2001	20:50	78.17
23	Sat	8/4/2001	15:20	8/7/2001	10:55	67.58
24	Sat	8/4/2001	06:55	8/6/2001	06:20	27.42
25	Sat	8/4/2001	14:00	8/6/2001	08:25	42.42
26	Sat	8/4/2001	04:40	8/8/2001	08:10	99.5
27	Sat	8/4/2001	05:10	8/7/2001	04:40	71.5
28	Sat	8/4/2001	05:35	8/5/2001	04:55	23.34
29	Sat	8/4/2001	16:30	8/6/2001	17:35	49.08
30	Sun	8/5/2001	05:25	8/7/2001	07:05	49.67
31	Sun	8/5/2001	21:30	8/7/2001	17:45	44.25
32	Sun	8/5/2001	15:05	8/6/2001	19:40	28.58
33	Mon	8/6/2001	05:20	8/8/2001	12:35	55.25
34	Mon	8/6/2001	15:00	8/9/2001	04:50	61.83
35	Mon	8/6/2001	16:05	8/8/2001	20:00	51.92
36	Mon	8/6/2001	16:30	8/8/2001	07:00	38.5
37	Mon	8/6/2001	05:25	8/8/2001	14:15	56.83
38	Mon	8/6/2001	15:25	8/7/2001	14:35	23.83
39	Mon	8/6/2001	06:15	8/8/2001	05:55	47.5
40	Mon	8/6/2001	08:40	8/7/2001	09:05	24.42
41	Mon	8/6/2001	15:35	8/7/2001	19:20	27.75
42	Tue	8/7/2001	06:05	8/9/2001	22:45	64.67
43	Tue	8/7/2001	16:50	8/9/2001	08:55	40.83
44	Tue	8/7/2001	05:25	8/9/2001	07:05	49.67
45	Tue	8/7/2001	05:20	8/8/2001	02:25	21.83
46	Tue	8/7/2001	01:20	8/8/2001	12:20	23
47	Tue	8/7/2001	14:05	8/9/2001	11:00	44.92
48	Tue	8/7/2001	11:50	8/8/2001	19:50	32

Table 13B
Average vessel turnaround time



Correlation of vessel arrival and departure data for vessels arriving and departing over a one-week span in August, 2000 revealed a wide disparity in average turnaround times from lows averaging around twenty-four hours to median data in the 36-48 hour range and highs averaging in the 72-96 hours range with an occasional weekend turnaround of 96-120 hours at the extreme end.

These prevailing patterns of arrival and departure cycles of marine activity suggest the adoption of an affirmative strategy by individual terminals to maximize existing capacity with the goal of efficiency (combined with Mega ships arrivals mostly on weekends) of the goal of flushing terminals of full containers at the beginning of week on Monday and Tuesday in order to prepare for the cycle of outbound full containers on Thursday and Friday, the major vessel departure days. Wednesday appears to be the slack day and could be utilized for empty container interchange, receipt of outbound containers and necessary container yard maintenance and repositioning operations.

Table 14A
Selected Aggregate AM Peak Hourly Distribution of Gate Activity

Terminals	Time (7:00-8:00 A.M.)			Time (8:00-9:00 A.M.)		
	Mon.	Tue.	Wed.	Mon.	Tue.	Wed.
1	51	118	162	182	208	212
2	165	163	104	273	295	273
3	110	106	152	248	174	188
4	76	86	150	173	229	189
5	73	108	130	183	187	169
6	83	74	103	189	157	158
7	218	270	250	242	332	354
8	62	43	69	102	151	149
9		34	44		84	97
10		263	264		408	376
11		329	474		402	459
12		116	143		161	206
13		76	127		213	280
14		66	41		222	187

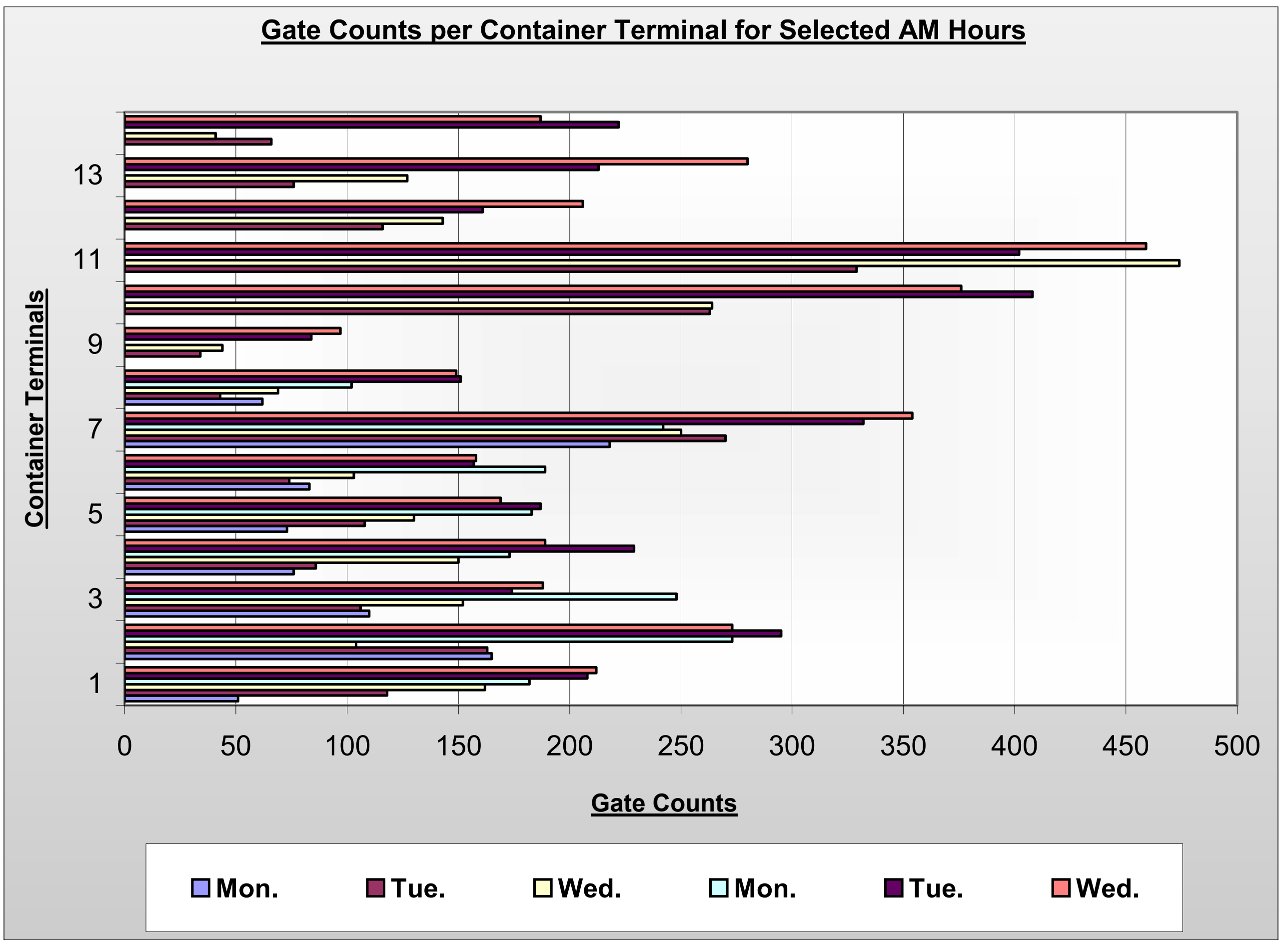
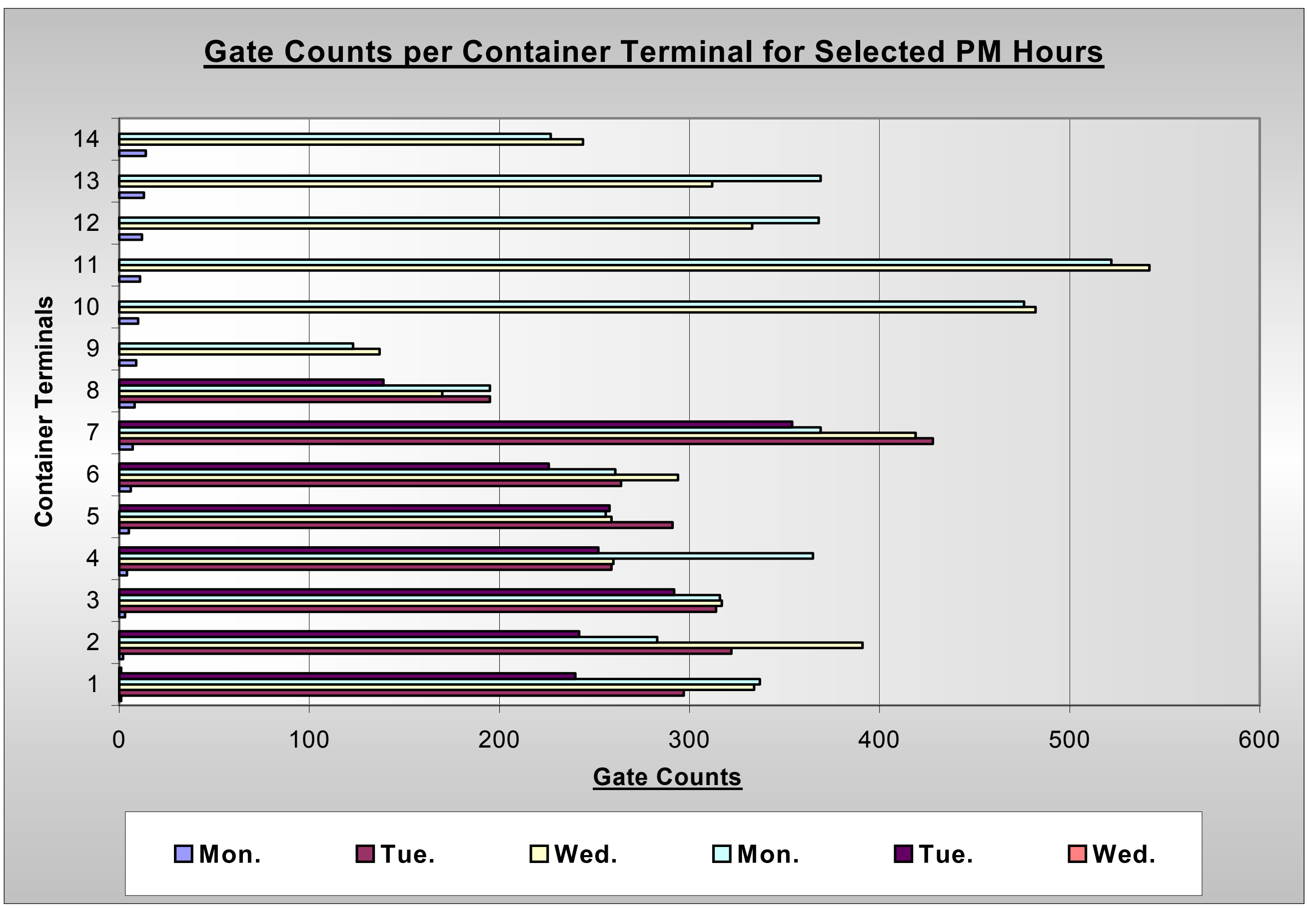


Table 14B
Selected Aggregate PM Peak Hourly Distribution of Gate Activity

Terminals	Time (1:30-2:30 P.M.)			Time (2:30-3:30 P.M.)		
	Mon.	**Tue.**	**Wed.**	**Mon.**	**Tue.**	**Wed.**
1	297	334	337	240	300	255
2	322	391	283	242	305	227
3	314	317	316	292	240	263
4	259	260	365	252	304	335
5	291	259	256	258	247	254
6	264	294	261	226	271	263
7	428	419	369	354	395	393
8	195	170	195	139	139	171
9		137	123		93	146
10		482	476		431	410
11		542	522		483	464
12		333	368		306	359
13		312	369		216	290
14		244	227		223	206



Additional data reveal the extent of the further concentration of truck traffic during Mondays and Tuesdays, the busiest days of the week for terminals engaged in marine operations. Ironically, according to the data Wednesday is a slack day for both marine and gates operations suggesting this be factored into any gate optimization effort.

The dictates of competing marine and gate or rail operations are such that those operations are not conducted concurrently, and when they are, it is not typically the most efficient of operations. There are many factors that contribute to terminal throughput velocity measured by the average dwell time (average time spent by a container at the terminal) x throughput per acre.

However, the most efficient terminal is still limited by infrastructure bottlenecks beyond the terminal boundaries, and the more efficient a terminal may be during peak hours, it is releasing its throughput onto regional highways at peak hours adversely affecting overall mobility while adding to existing congestion. It is the authors hypothesis that these goals and performance indicators are not mutually exclusive.

Major freeways serving the combined ports are already at capacity measured on a Caltrans derived level of service (LOS) scale of A-F1-F4 in which F4 represents continual gridlock, and are currently handling 34,000 truck movements per day. These may in turn increase to 80,000 truck movements per day. Major infrastructure improvements including I-710 freeway expansion are more than ten years off in the future. However, a condition of planning and funding these infrastructure improvements among competing projects is that all available demand management measures have been considered and adopted at the local level. This would include extended gate hours at marine terminal facilities.

The composition and distribution of local traffic flows is likewise changing along with regional growth patterns. Traditional statistical freight flow analysis supplemented by periodic spot sampling estimated truck movement component to be 3-4% of total traffic volume. That percentage composition number is now in excess of ten per cent for freeways serving the ports and the rate of growth for freight movement exceeds that of passenger vehicles. Along with this increased growth is a greater frequency, magnitude, and occurrence of random sig alerts, truck-POV accidents, and disproportionate personally injury, loss of life, and property damage all contributing to greater loss of mobility in terms of three dimensional space, increased conflict, and perceived congestion among other highway users. The I-710 has the highest proportion of truck related accidents in Southern California at 31%, and truck related at fault collisions at 16%. This growing perception carries over into arterial roadways and growing hostility toward truck movement, parking, and location of warehousing and distribution facilities in neighboring and inland municipalities alike.

1.6 Best practices-Transportation system measures: Extended gate hours of operation

All of the foregoing indicators and component factors contribute in large measure to port generated traffic congestion with adverse impact upon regional mobility. All of these factors point in the direction of either the voluntary adoption of a combination of best practices by individual terminals or the imposition of a mandatory requirement under existing lease agreements or by regulatory authority for an extended gate hours of operation regime –or its equivalent—on a phased in basis to redistribute the volume of gate transactions at the fourteen marine terminals comprising the port complex. Such a future regime as evidenced in the assumptions behind the combined Transportation Study, and the Major Corridor Study to follow, now appears inevitable.

However, in contrast to the passenger movement sector, efficient freight movement requires substantial investment by both the public and private sectors in the creation of a regional supply chain. In that public-private partnership context, the necessity for adoption of best practices by the private sector is mirrored in the analysis and economic justification of transportation infrastructure improvements by public sector. Both are mutually dependent elements of a Statewide goods movement strategy.

Port leases with marine terminals all contain best practices clauses, which if not adhered to can result in unilateral lease termination by the port. More recently, the Port of Los Angeles has built into the Pier 400 project leases with Maersk-Sealand best practices clauses with financial incentives to the use of best practices and technology to increase throughput volume and velocity.

Future public investment on the order of 3-4 billion dollars, including the Alameda Corridor, and related rail grade separation projects, I-710 improvements, and potential I-60 dedicated truck lane improvements, not counting additional billions of dollars in port related improvements are all predicated upon the efficient use of marine terminal facilities as part of the regional supply chain and surface transportation infrastructure. In turn, hundreds of millions of dollars in private sector investment in marine facilities, and private warehousing and distribution improvements are likewise dependent upon the efficient operation of those terminals and the efficient management of the transportation infrastructure for the benefit of all users, including freight movement.

Extended gate hours only makes economic sense when combined with reciprocal commitment to extended hours of operation by all entities in the regional supply chain including shippers, consignees, trucking dispatch, warehousing and distribution centers.

With multiple indicators pointing in the direction of marine terminals as growing bottlenecks in the regional supply chain, and the concurrent need for consideration of transportation systems measures or best practices, including extended gate hours of operation as a surrogate, the Phase II study inevitably focused upon the need to reconcile improvement of throughput velocity with regional mobility as interconnected and not mutually exclusive goals.

2.0 Phase II Research Approach

This report is part of a multi-phased research effort intended to improve regional mobility through the adoption of an integrated approach of managing local container traffic growth in the Los Angeles-Long Beach port complex. As part of this strategy, Phase I had a twofold purpose:

(1) assist in the formulation and implementation of a Statewide goods movement strategy where freight movement projects are evaluated using similar criteria and based upon freight specific performance metrics; and

(2) analyze the impact and effectiveness of the adoption of "best practices", and public and private infrastructure improvements, through the use of appropriate benchmarking metrics

2.1 Combined qualitative and quantitative analytical methodology

In Phase II, the researchers pursued a nontraditional methodology designed to elicit both stakeholder participation and provision of data, much of it proprietary, on which to base the analysis. This approach is well grounded in supply chain analysis and logistics as a discrete science. Supply chain management has been a collaborative exercise incorporating a combination of multidimensional community outreach, conventional data collection, research and analysis. The research direction is influenced by the receptivity of the stakeholder community and the pace of research dictated by stakeholder involvement, input, provision of proprietary data, and ultimately support

A key component of the collaborative stakeholder strategy was to cross-leverage research and technology transfer workshops as data gathering and validation tools. This stakeholder oriented approach built upon the Phase I experience. The support and involvement of California Trucking Association (CTA) in providing direction and invaluable truck wait time data at marine terminals and the documentation of the extent and effects of terminal backups on regional mobility, safety, air quality as well as other criteria was instrumental in guiding the development of a coherent transportation policy. In the absence of empirical evidence and analysis, the public policy debate is oftentimes relegated to a discussion of perceptions and anecdotal evidence.

The Phase II approach, while planned, nonetheless evolved in response to stakeholder input and guidance during a series of collaborative events conducted over the course of 2001. The effort began with a series of in-depth interviews with representatives of several marine terminals, including Long Beach Container Terminal and Hanjin Marine Terminal, who have had relevant experience with extended gate hours of operation. The purpose of these meetings was to brief the respondents on the research purpose and scope as well as to validate appropriate terminal specific performance metrics and determine the availability of proprietary data.

2.2 Stakeholder search for solutions: Third Annual Third Annual Intentional Longshore and Warehouse (ILWU) Town Hall and Industry Forum, January 31 and February 15, 2001

The Center for International Trade and Transportation (CITT) at California State University Long Beach (CSULB) held its Third Annual Intentional Longshore and Warehouse (ILWU) Town Hall and Industry Forum on January 31 and February 15, 2001. The two-part Town Hall-Industry Forum set the research course, scope and methodology. This event set the tone and direction by challenging and eliciting stakeholder involvement. This was done by getting the parties to recognize that the future growth of the ports could no longer be supported through port expansion, since little or no developable land is available as the ports are nearly built-out.

To support future growth each and every marine terminal, and every other stakeholder along the regional supply chain will have to adopt "best practices" to increase throughput velocity, as measured by throughput per acre (evening out the disparity in terminal size) and decrease dwell time (measured in the average time a given container spends on the marine terminal). Dwell time encompasses both tariff and terminal demurrage, and corresponding free time, and is a key component of throughput velocity. The Center for International Trade and Transportation (CITT) at California State University Long Beach (CSULB) under whose auspices as part of METRANS this study was conducted held its Third Annual Intentional Longshore and Warehouse (ILWU) Town Hall and Industry Forum on January 31 and February 15, 2001 respectively.

The Town Hall event entitled "Solutions: Perspectives on the Future of Goods Movement in the Southern California Region" established a framework in which each stakeholder groups proposed a range of solutions aimed at increasing both terminal throughput and improving mobility and relieving congestion. This and subsequent stakeholder events would facilitate the dialogue and influence the course and speed of the project. The research would document the aggregate supply chain stakeholder implications, tradeoffs and impacts of consensus solutions proposed by the industry. The proposed solutions encompassed both the adoption and proliferation of industry best practices across the fourteen marine terminals and long term infrastructure improvement planning.

The Town Hall event defined the process and technology elements of best practices/transportation management measures and identified necessary infrastructure improvements as well as the required lead time frames for their planning, funding and construction. The overall effort combined elements of both applied transportation research and technology transfer in the form of an industry and labor education strategy.

The strategy's goal is to assist regional supply chain stakeholders in identifying bottlenecks, fostering collaborative planning, undertaking applied research to identify and quantify costs and benefits, and assist stakeholders in reducing uncertainty. Defining and adopting "best practices" measures, which increase throughput velocity, will improve the regional supply chain, and increase the utilization of the regions resources, both private and public. In turn, the voluntary adoption of best practices by industry stakeholders fulfills the prerequisite for undertaking complementary regional transportation infrastructure investments by metropolitan planning agencies seeking the greatest return on public investment of tax dollars. Benchmarking of both best practices and infrastructure investments will analyze the efficiency of both types of expenditures from an economic perspective.

During these hosted events, approximately forty best practices and infrastructure based solutions to alleviate port related regional traffic congestion generated were presented by various regional supply chain stakeholders, including organized labor, marine terminal operators, inland drayage, shippers, municipalities and transportation planning agencies, and port authorities. The CITT research staff is preparing an evaluation of proposed solutions to be for a test of stakeholder implications and validated in a series of industry workshops. These workshops will culminate in an industry summit conference, in which an overall action plan and implementation timetable will be adopted.

The solutions presented included:

- adding more terminal gates (with 46 additional gates currently being added by both ports by 2003);
- shortening dwell time for containers by reducing free time from 7 to 5 days and increasing demurrage charges;
- extending terminal gate hours; virtual or off-dock container yards and out-of-port interchange;
- instituting driver ID cards/appointment system and wireless EDI/data communications (emodal) to speed gate transactions;
- expansion of on/near dock rail to accommodate up to 50% of intermodal movements of containers (up from the current 25% share) coinciding with the opening of the Alameda Corridor project connecting the ports to downtown Los Angeles intermodal rail yards.

Implementation of the near term transportation system management measures would satisfy the requirements of the I-710 Major Corridor Study to exhaust all demand reduction measures before major funding would be forthcoming for I-710 improvements at least a decade away in the State Transportation Improvement Plan (STIP) financed by highway taxes

Every stakeholder group endorsed the rapid implementation of a combination of extended container terminal gate hours, truck driver identification system, and an appointment scheduling system as the most potentially effective near term strategy for increasing terminal throughput velocity. These measures serve to spread the effort across multiple labor shifts, days of the week, and combining shipper participation in receiving hours of operation commitments, and coordinated gate and marine operations so as to perform both activities most efficiently over the course of time.

One marine terminal operator promised to provide proprietary before and after data that purport to demonstrate the cost-effectiveness of adopting this combination of best practices. Unfortunately, following an internal reorganization of the affected entity the offer to provide the necessary data for further analysis was rescinded necessitating a reevaluation of the project timetable and sequence of events.

2.3 First Stakeholder Workshop: "Improving the Regional Goods Movement Supply Chain Through Extended Marine Terminal Gate Hours of Operation in Southern California" analysis of stakeholder implications

To assist in this effort a METRANS funded workshop with input for the CITT Policy and Steering Committee, was planned as a means to elicit and evaluate the stakeholder implications of extended gate hours, one of only several proposed solutions endorsed by every major stakeholder group.

The research staff determined to continue its focus upon extended gate hours but to explore stakeholder implications of this, the centerpiece combined transportation systems management (TSM) and best practices measure while simultaneously seeking alternate sources of research data both original and secondary.

To assist in the qualitative research effort, a METRANS funded workshop with input from the CITT Policy and Steering Committee was planned as a means to elicit and evaluate the stakeholder implications of extended gate hours, one of only several proposed solutions endorsed by every major stakeholder group. The research staff determined to continue its focus upon extended gate hours but to explore stakeholder implications of this, the centerpiece combined transportation systems management (TSM) and best practices measure. At the same time, we sought alternate sources of research data, either original or secondary sources

On May 30, 2001, CITT hosted the first in a series of industry stakeholder workshops on "Improving the Regional Goods Movement Supply Chain Through Extended Marine Terminal Gate Hours of Operation in Southern California". This workshop focused the "best practices" proposed solutions identified in the two part town hall open industry forum earlier in the year.

The workshop was designed to be a qualitative exercise in a cooperative coalition building environment, with individual working groups comprised of a broad cross section of stakeholders bringing their individual perspective to:

(1) Identify the implications (tradeoffs, impacts, costs and benefits) of extended gate hours of operation for marine terminals

(2) Build coalitions in a collaborative environment to identify win-win strategies to build bridges and overcome barriers to implementation of the core concept.

At the workshop, presentations were made by representatives of the prime contractor on the CALTRANS/Los Angeles County Metropolitan Transportation Authority (LACMTA) I 710 Major Corridor Study and by the Port of Long Beach on its then pending POLB-POLA Transportation Study.

Figure 1
I-710 Corridor Study Work Chart

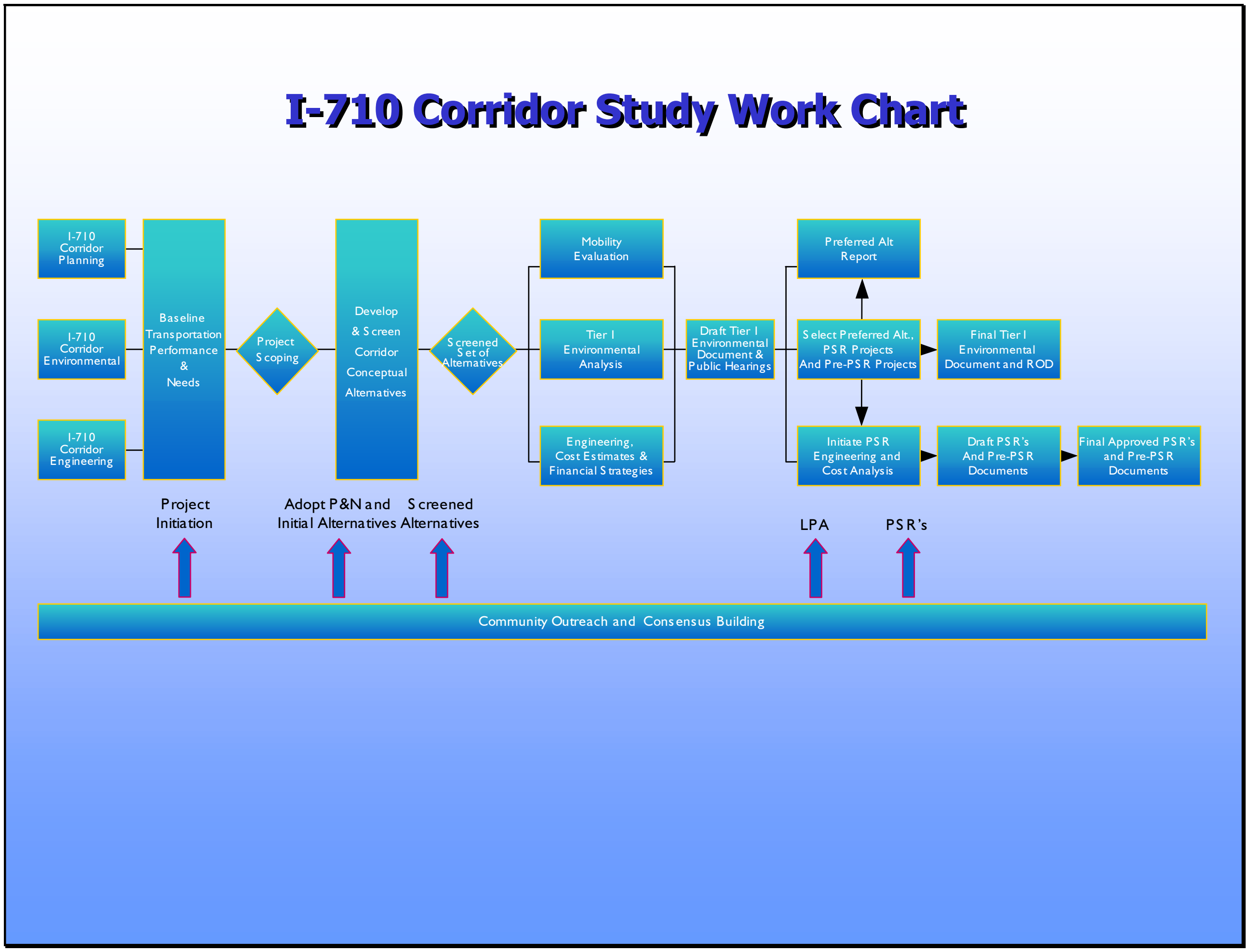


Figure 2
Political and Policy Ramifications of Doing on I-710 Corridor

The significance of these presentations was the convergent views of both port and major infrastructure planners concerning the necessity for the adoption of extended gate hours of operation as both best practices and a pre-requisite to infrastructure investment funding. This included:

(1) confirmation from port planers that terminal throughput redistribution predicated upon adoption of extended gate hours was a key component of future port planning in combination with major infrastructure improvements, principally among those being a multi billion dollar I-710 modernization project, and

(2) reaffirmation from transportation planners that the implementation of extended gate hours had independent significance as a necessary transportation management planning prerequisite to be satisfied prior to the commitment of necessary infrastructure funding as well as a consensus best practices to increase capacity without physical expansion to meet necessary throughput requirements to meet future demand in the form of anticipated volumes of container cargo moving though the ports.

The workshop provide a wealth of data on the first and higher order implications of extended gate hours of operation for eight distinct groups of stakeholders both positive and negative with some degree of rank ordering, probability of occurrence, and mitigating measures.

Capturing and sorting this data for analytical purposes proved daunting but also intellectually rewarding, combining new social research, focus group, and facilitation tools to the transportation industry evaluation of freight management measures.

Following the workshop, after publication of the joint port Transportation Study in June, 2001, the research staff gained access to supporting data including gate moves by terminal (with the terminal's identity withheld), aggregate peak gate data, and origin and destination data for truck movements on which the Transportation Study was based.

After the implications data was captured in a database for evaluation purposes, a follow up briefing of workshop participants was held on August 29, 2001. As a result of this effort, a coalition of local trucking interests was stimulated to take it upon themselves to identify broad parameters of what an extended gate hour regime incorporating terminal specific versions –and interim demonstration project—might look like. In addition, the research staff n prepared a comprehensive marine terminal operations survey instrument that was disseminated to all fifteen operating terminals in the combined ports. The survey was designed to elicit cost of operations in dollars and required throughput levels by shift to justify economically extended gate operations.

The cost implications of extending gate hours from the current concentration on the first shift to redistribution over three shifts and days of the week are profound. The data provides the starting point for design of a cost effective scheduling and appointment system that takes into consideration the cost implications of implementation to marine terminals. The survey data revealed various scenarios for optimizing terminal operations to increase throughput velocity through scheduling marine, yard and gate operations so as to avoid operational conflicts

The feedback from the professionally facilitated event was so extensive that a separate follow up briefing analyzing the results was held for the benefit of the participants on August 29, 2001.

2.4 Second Industry Stakeholder workshop on the "Use of Technology to Improve Goods Movement in Southern California", November 29, 2001 to assess the role of information technology in freight operations and regional mobility.

The other common element of a long-term collaborative strategy that maximizes and reconciles the public infrastructure investment benchmarking and private sector throughput velocity goals of best practices is in transit visibility. This has both a data sharing and a physical tracking component. This element is also the prerequisite for simultaneously fulfilling the needs of Federal, State and local inspection agencies in terms of port security, positively matching Customs and commercial data with the contents of shipping containers along the supply chain from origin to destination.

For this purpose a second CITT sponsored Industry Stakeholder workshop on the Use of Technology to Improve Goods Movement in Southern California workshop, including stakeholder implications of information technology (IT) and intelligent transportation systems (ITS), was held on November 29, 2001. In contrast, this workshop focused on the technology elements of the proposed solutions to improved terminal throughput velocity and regional mobility identified in the two-part town hall-open industry forum earlier in the year. The third and final workshop in the series is slated for early in 2002.

The workshop focused upon three categories of information technology to improve both terminal throughput velocity and regional mobility in terms of freight movement:

(1) In transit visibility based upon automatic equipment identification (AEI) of containers, chassis, tractors etc and data sharing through Electronic Data Interchange (EDI);

(2) Inspection technology for the non-intrusive examination of containers, over the road trailers and rail cars and positive personnel identification through biometrics; and

(3) Intelligent transportation systems in the form of the Ports Automatic Traffic Management and Information System to include terminal gate queue detection cameras at all container terminals, closed circuit television (CCTV) surveillance at terminal gates and key roadway locations, and changeable message signage (CMS) at gate exits linked to the State DOT Traveler Information System, and emodal, a community based dispatching and data interchange system.

In contrast to the first workshop format, this workshop incorporated background presentations by experts on applicable information technologies from marine, aviation, trucking, rail and warehousing to improve throughput velocity and in transit visibility at marine terminals from both an operator and a shipper supply chain management perspective, as well as a summary of CITT research into the role of inspection technology in improving security without adversely affecting throughput velocity.

The participants then broke out into two facilitated working groups to discuss the presentations injecting their own experience to the discussion. At the conclusion of the general discussion session, each participant voted on candidate technologies in each of the three major subject areas ranking them in order of their likely prophylactic impact upon throughput velocity and regional mobility.

2.5 Phase II study quantitative analytical approach

The study approach was to complement the Phase I research which documented uncompensated wait times for truck drivers at the fourteen major terminals during regular gate hours between 8:00 A.M. to 5 P.M. Monday through Friday coinciding with the first of three daily labor shifts at most marine terminals in the ports of Los Angeles-Long Beach. The daily work schedule oriented toward marine or vessel operations with a longstanding 7/24 operating schedule built upon vessel operating schedules to maximize asset utilization includes two primary eight hour shifts (First Shift 8:00 A.M.-5:00 P.M. and Second Shift 6:00 P.M.-2:00 A.M.), and a "hoot" or night shift from 3:00 A.M. to 8:00 A.M.) with reduced staffing levels and services under Coastwide collective bargaining agreements dating back 75 years. In addition there are daily "break" periods at 10:00 A.M. and 3:00 P.M. and one hour lunch and dinner breaks. During breaks terminal gates are closed or "flexed". Flex gates process trucks in and out but there are no yard operations to pull containers for pickup. In addition, flex gates do not typically process trucks at maximum capacity.

Phase II would follow the earlier phase on to the marine terminals, the next leg in the regional supply chain, and as a means of assessing the costs, benefits and implications of extended gate hours of operation would:

(1) benchmark gate (and lane) utilization by labor shift with data collected by the ports of Los Angeles-Long Beach as part of their combined Transportation study;

(2) analyze origin and destination data for local drayage from which cycle times (number of trips per day based upon distance, driving, wait and various transaction times based upon terminal data) may be inferred; and

(3) begin the process in combination with other factors such as vessel arrivals and departures of describing the parameters of a driver appointment/scheduling system to optimize throughput velocity for eventual demonstration project design involving participating trucking forms, terminals, shippers, and a community based communication and electronic data interchange forum.

The more subjective stakeholder implications of extended gate hours captured in the earlier workshop would be integrated into the study analysis to identify and where possible permit internalizing of costs, benefits and externalities associated with implementation of extended gate hours.

Finally, marine terminal surveys could be formulated to provide inter alia cost data as the basis for determining break even points in both dollars and throughput levels coinciding with shift hours at the terminals.

2.6 Best practices goal of extended gate hours implementation and shift redistribution

The proposal for voluntary adoption of extended marine terminal gate hours operation represents a nearly consensus recommendation by supply chain industry stakeholders as a means of increasing throughput capacity to meet the growing volume of container movements and as a means of reducing terminal and road congestion. Across the board, implementation of extended gate hours is already assumed by port and regional transportation agency planners. This sets the stage for a redistribution of gate movements from almost exclusive reliance on the first shift to second and third shifts.

Staggering truck traffic around the clock reduces truck movements from point of origin to terminal destination and return, referred to as “cycles,” queuing or “wait time” at terminals and “turn time” within terminals. Currently, compressing these movements to daylight or peak hours inevitably contributes to reduced truck and terminal efficiency with attendant traffic gridlock, air pollution, and additional demands on physical infrastructure. Discussion of extended gate hours is customarily limited to dedicated truck gates and does not encompass intermodal movement of containers by rail from the terminal to inland point of origin or destination.

2.7 Building a conceptual framework for extended gate hours of operation: the case for extended gate hours of operation; the trucking perspective

The case for extended gate hours was made at a California Trucking Association (CTA) sponsored workshop held on August 17, 2001 in which the 25 largest intermodal carriers representing the drayage community were present.

The CITT first workshop stimulated a California Trucking Association (CTA) initiative to promote extended gate hours by optimizing certain days of the week and shifts for gate operations from a drayage perspective to minimize off-terminal congestion and wait times. This data in combination with vessel arrival and departure and yard operations original survey, and supplied gate movement data is anticipated to provide the necessary inputs for the formulation of a queuing model in the form of a scheduling plan for terminal consideration. This would set the stage in identifying the necessary elements to define the parameters of a demonstration project as the next logical step from a collaborative supply chain management perspective based upon alternative scenarios for a combined community based appointment scheduling system (particularly for first shift pickups) transitioning into a terminal specific extended hours of operation optimization strategy built around a common set of variables for terminal gates.

At the workshop the anticipated regional congestion relief, mobility, safety, air quality improvement, energy conservation, and throughput velocity benefits from extended gate hours of operation were summarized as:

(1) Congestion reduction at marine terminal gates, inside marine terminals (reducing conflict with terminal operations) and inside the port complex;

(2) Congestion reduction on freeways and arterial streets during peak hours; and

(3) Reduced aggregate volume (and proportional rate of reduction in growth) of trucks at peak commuter hours leading to fewer passenger vehicle /truck related accidents;

(4) Improved air quality by moving more freight with shorter wait (and idle) times requiring fewer truck movements and less energy consumption; and

(5) Increased terminal throughput volume and regional goods movement efficiency.

Trucking company representatives noted limitations in prior experience with extended gate hours including limited receiving ours by shippers, need for consistency, adequate notification, and fewer restrictions on types of transactions during extended gate hours such as restricted gates for wheeled loads to a single carrier, empties, flips, or grounded operations, and use of secondary lines inside terminals.

Fundamental limitations for truck driver participation under both the current and any modified regime include no compensation for wait time and USDOT hours of service limitation to ten hours per day for highway safety reasons.

The participants identified specific terminals as candidates for extended hours of operation to alleviate congestion and wait times:

(1) Maersk-Sealand Terminal, Pier J Berth 266 and Pier G Berth 228, Port of Long Beach;

(2) ITS Marine Terminal, Berth 234, Port of Los Angeles

(3) Evergreen Marine Terminal, Berth 233, Port of Los Angeles;

(4) Yang Ming Marine Terminal, Berth 126, Port of Los Angeles; and

(5) NYK Yusen Marine Terminal, Berth 214, Port of Los Angeles.

In addition, at the CITT workshops representatives of several carriers and truckers express concern over anticipated additional congestion likely to occur early in 2002 on Seaside Avenue following the opening of the Pier 400 Maersk Sealand project in the Port of Los Angeles combining truck traffic associated with the Long Beach Pier A Hanjin and F Long Beach Container Terminal and the APL Global Gateway Terminal absent the adoption of voluntary measures such as extended hours of operation by various terminals.

The participants at the CTA workshop began to describe the components and operating parameters of an extended gate hours regime.

As a key component, they recommended a community system communications platform be based upon emodal or an equivalent communications platform based upon a universal protocol (e.g. EDIFACT) including shippers, truckers and terminal operators.

In terms of operating parameters, they advocated a system that synchronizes the cargo flow of vessel arrivals and departures and marine operations with gate operations. This would incorporate vessel arrivals with a greater frequency on weekends with extended gate hours on Monday and Tuesday for import arrivals, and corresponding extended gate hours on Thursday and Friday to accommodate export cargo flows.

Assuming Monday and Tuesday import vessel arrivals, they favored extended Hoot shift gates on Tuesday and Wednesday. They also favored a Sunday first shift gate. Last in order of priority, they preferred second shift night gates on Monday and Tuesday nights.

For the long term, they envisioned moving toward adding a second shift truck dispatch. For that reason they preferred a gradual migration toward an extended 4:00 A.M. Hoot gate opening to a 10:00 P.M. second shift closing for gate operations Monday through Friday. This schedule should include seamless gate openings through brakes and meal times, and incorporate flexible scheduling of gate and labor start times permissible under current collective bargaining agreements. To accommodate this schedule they recommended changes in shift times for gate operations to reflect a 6:00 A.M. –2:00 P.M. first shift, 2:00-10:00 P.M. second shift, and a 10:00 P.M.-6:00 A.M. Hoot shift.

For planning purposes the ports of Los Angeles-Long Beach have set goals based upon the recently released the Ports of LB/LA Transportation Study released in June, 2001 in terms of both on dock rail utilization and optimal distribution of gate movements across labor shifts.

These goals include a projected thirty per cent utilization of on/near dock rail of total throughput volume (despite terminal improvements to create fifty per cent future rail throughput capacity in comparison to a high of 28% by more efficient terminals today) and for truck movements alternative distribution patterns that factored in expanded gates, implementation of maximum equipment efficiency measures such as street turns, of dock empty container interchange etc., and still set concrete goals in terms of shift distribution between first shift day/second shift night/and third shift hoot of 60/20/20 by the year 2010, and 40/40/20 by the year 2020.

Both goals set high expectations in terms of adoption of best practices across the board by all terminals independent of size and current mix of truck-intermodal rail throughput volume.

In turn, these goals will inevitably find their way into the Caltrans/Los Angeles County Metropolitan Transportation Authority (LACMTA) I 710 Major Corridor Study (MCS) is expected to be completed in 2003. However, the Regional Planning System and Preferred alternative analyses, which will dictate study alternatives and study area, are currently underway.

The preliminary regional analysis to be incorporated in that study utilizes level of service (LOS) benchmarking corresponding to average speeds utilized by Caltrans. The mobility evaluation portion of the study process is next in project planning sequence. Adhering to planning and funding criteria under Federal and State law, the MCA has already preliminarily concluded that" Little Infrastructure Funding (is likely) without Best Efforts At Transportation Systems Measures" or changes in operational practices to wring most (capacity) out of existing transportation facilities and reduce peaking of traffic.

In comparing several future transportation planning scenarios, the Transportation Study has identified a combination of I-710 improvements at a projected cost of $2 billion along with additional redistribution of container terminal gate movements throughout the day (and also additional weekend gate movements) as the preferred alternative. However, even the combined implementation of these best practices measures and infrastructure improvements may only achieve LOS E levels of service mobility despite anticipated reduction in port bobtails (tractor only), empty chassis and containers movements of 30-50% being partially offset by increases in overall movements.

The Transportation Study concludes that "Given the expected cost of the (transportation) improvements that will be needed for the I 701 ($2 billion +), the scarcity and uncertainty of public funds, and the lengthy timeframe required for development/implementation which is estimated between seven and ten years (assuming funding is obtained), transportation management strategies (Transportation System Measures) such as extended hours for all entities in the supply chain is absolutely necessary. This is absolutely necessary to ensure efficient mobility for all users of the transportation system (and not just for truck drivers) and to ensure the overall economic of Southern California, the State and the nation. This assertion is affirmed by the results of the 2020 Alternative I analysis, which indicated that even with the spreading of truck traffic throughout the day, the I-710 would be deficient. If nothing is done, adequate mobility for all freeway users would be difficult to achieve.”. Executive Summary at p XXVI.

The Transportation Study also indicated it is unlikely that assuming the origins and destinations for local truck traffic so not radically change, the alternative routing distribution of local trucks calling at the 14 terminals primarily dependent upon the I-710 freeway is unlikely to change with the passage of time and expected increases in volume through the year 2020.

3.0 Qualitative and quantitative research methodology

Two distinctly different research methodologies were employed in this benchmarking effort. The qualitative approach involved an effort in collaborative supply chain management based upon voluntary participation among industry stakeholders during a series of sponsored industry open forums and closed workshops by invitation under the overall guidance of the CITT Policy and Steering Committee.

The second, more traditional quantitative element (more akin to the Phase I effort), involved data analysis of industry supplied data originally collected for another purpose. This data was supplemented survey data. The two efforts were interrelated in that the forum and workshops identified data gaps, which were then addressed in the survey questionnaire. As the trust level in the process and degree of commitment of workshop participants increased, necessary data proved forthcoming.

As previously indicated, the moderated two-part town hall and industry forum and two facilitated stakeholder workshops were designed to elicit stakeholder involvement in the process of collaborative supply chain management. In particular, the first workshop was designed to capture non-quantitative data concerning the implications of extended gate hours for all stakeholders in the regional supply chain to be supplemented by survey data incorporating cost elements and operational considerations.

3.1 Marine terminal survey instrument design

The Marine Terminal Baseline Survey Questionnaire is Exhibit A in this report. The primary focus was to develop a baseline survey instrument that would operate as a sub-module to an overall Regional Supply Chain Simulation Model (RSCSM). The RSCSM would permit simulation of regional goods movement as part of an end-to-end global supply chain from vessel arrival, marine terminal operations, inland drayage, warehousing and distribution, intermodal rail and over-the-road trucking to ultimate origin and destination.

The first module of that overall effort was the Year 2000 Supply Chain Mapping Survey of the top 200 shippers and consignees using the combined ports of Los Angeles-Long Beach based upon U.S. Customs import and export data. In addition to the terminal survey data, the future data set will encompass local origin and destination data and GIS components, including transportation infrastructure layout and warehousing and distribution locations from regional planning agencies and other sources.

Anticipating the eventual need for both existing data from other sources and original data collection from marine terminal operators, CITT staff conducted briefings of the Terminal Operators Committee of the Los Angeles Steamship Association (LASA) in December, 2000 and January, 2001 in order to secure the endorsement of the organization before approaching the ports of Los Angeles-Long Beach and the Pacific Maritime Association (PMA) to utilize existing data gathered from the terminal operators, or to collect original confidential data from individual terminal operators. Assistance was provided by representatives of several terminal operators in the preparation of the final survey instrument particularly in organization, formatting and phrasing of individual questions so as to elicit necessary data elements for analysis purposes.

As the final survey instrument design evolved, it was designed to provide a static footprint of each terminal, physical layout (berths, storage capacity, on near dock rail staging capacity, gate capacity and layout) and a dynamic portrait of every performance metric for marine, terminal and gate operations for modeling and simulation purposes.

That model once fully operational will permit CIT research staff to conduct simulations such as forecasting future capacity utilization levels and modal distribution mix usage of the Alameda Corridor project, and benchmarking the performance of best practices/transportation system measures such as the adoption of extended gate hours of operation by marine terminals, or the implementation of information technology (IT) or intelligent transportation systems (ITS) technology in terms of relieving congestion and improving regional mobility and improving throughput velocity.

The survey instrument is comprised of four sections:

(1) Terminal identification, security, and institutional profile;
(2) Terminal physical and operational profile;
(3) Terminal operating profile; and
(4) Potential changes in terminal operations, technology, and layout.

Section 1 contains basic terminal identification data, security related information, and most importantly, institutional profile reflecting ocean carrier and terminal operator ownership and contractual relationships.

Section 2 consists of four data elements:

(a) physical layout and power profile, including facilities layout, storage capacity, acreage and expansion potential, and spatial functional allocation and configuration;
(b) terminal gate and lane configuration, including truck queuing capacity;
(c) terminal equipment profile, including containers and chassis ownership, carrier ownership and utilization, chassis inspection, on dock or off dock container and chassis maintenance and repair facility, individual versus steamship alliance equipment ownership patterns, and facility equipment inventory such as transtainers (UTR's); and
(d) intermodal rail facilities profile including on/near dock rail capacity, rail car maintenance and repair capability, and rail staging location.

Section 3 consists of four data elements:

(a) terminal workforce and equipment operations profile, including gate hours of operation and shift distribution, workforce structure, marine operations shift distribution, use of flexible workforce scheduling and gang dispatch, and container yard terminal operations work shift distribution;
(b) terminal performance profile benchmarking metrics, including estimated and actual monthly throughput, average container dwell times, average free time, average demurrage charges per container, average gate moves, and gate moves per lane and shift, average truck turn time, average truck wait time, average container lift per hour, model distribution of container throughput volume;
(c) marine operations profile including marine hours of operation, and vessel arrival and departure schedule by carrier and alliance; and
(d) gate operations profile including gate distribution, appointment and scheduling system, door to door service distribution, demurrage charges assessment, empty container storage charges, shift pricing differential, off dock container interchange, maintenance and repair, or off dock container yard operation, truck movement origin and destination distribution data.

Section 4 consists of three data elements:

(a) potential economic costs of changes in gate hours operations including incremental costs of operations of full and limited service gates by shift reflected in dollars, manning requirements, and break even costs in dollars and container throughput volume, and incremental staffing requirements;
(b) potential changes in terminal layout including anticipated shift from wheeled to grounded operations, future mega ship operations, terminal expansion plans, and additional gates;
(c) potential changes in technology, including use of automatic equipment identification, telecommunication, electronic data interchange, delivery orders, demurrage payments, truck scheduling and appointment, IT history, or anticipated of dock relocation of terminal functions.

The individual surveys were pre-completed incorporating publicly available information from port websites, annual reports and emodal community based websites. They were directed to members of the Terminal Operators Committee of the Los Angeles Steamship Association as respondents on behalf of the individual terminals. After the events of September 11, 2001, the draft survey was reviewed by the Safety and Security Subcommittee of the California Marine Transportation System Advisory Council (CALMITSAC) for which CITT provide Secretariat services. The survey was also reviewed by the Coast Guard Captain of the Port as a benchmarking tool for port facility security purposes, and eventual vulnerability assessment and incident simulation and modeling purposes. The survey received the endorsement of both the advisory council and the COTP.

3.2 Key metrics for transportation systems management measures: system parameters and components (Congestion factor analysis)

The survey instrument was constructed to map the major marine terminal system parameters or boundaries, marine, terminal and gate operations, and the major variable resource elements (assuming land capacity to be fixed), including labor and variable costs, and capital investment in technology that are available to construct a more efficient model of terminal operations that maximizes throughput and at the same time results in the least negative cost externalities in the form of congestion and loss of regional mobility.

3.2.1 Marine operations

Daily and weekly distribution of marine operations, including arrivals and departures, for the average terminal are revealed in survey data reflecting the labor shift distribution. As expected on the basis of anecdotal evidence, in the table below in contrast to gate operations vessel unloading and unloading is conducted on both the first (8-6) and second (6-11) labor shifts with no activity occurring on the hoot (11-6) shift with Sunday operations common, and a consistent ebb and flow pattern reflected in vessel arrivals in the early part of the week (Sunday, Monday, Tuesday) and vessel departures concentrated in the latter part of the week in this instance on Thursday.

3.2.1.1 Marine operations weekly shift distribution

Table 15
Average weekly shift distribution of vessel loading/unloading

		1st Shift (Mon-Fri)			**2nd Shift (Mon-Fri)**			**Hoot Shift (Mon-Fri)**			**1st Shift Weekend/ Holidays)**			**2nd Shift Weekend/ Holidays)**			**Hoot Shift (Weekend/ Holidays)**		
		% for Terminals			**% for Terminals**			**% for Terminals**			**% for Terminals**			**% for Terminals**			**% for Terminals**		
		1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Sat	Load																		
	Unload																		
Sun	Load	20			50						10	800		50	300				
	Unload	80			50						90	400		50	330				
Mon	Load	10			80							450			0				
	Unload	30	500		20	500						350			250				
Tue	Load	50	200			500													
	Unload	50	200			250													
Wed	Load	0	200		20	200													
	Unload	100	300		80	100													
Thu	Load	80	400		100														
	Unload	20	180																
Fri	Load		100																
	Unload		200			100													

3.2.1.2 Marine hours of operation by shift

Table 16
Marine hours of operation by labor shift

Shift	No. of Hrs for Different Terminals		
	Terminal 1	Terminal 2	Terminal 3
(Mon-Fri) 1st Shift	8	8	8
(Mon-Fri) 2nd Shift	8	8	8
(Mon-Fri) Hoot Shift			
(Weekend/Holidays) 1st Shift	8	8	8
(Weekend/Holidays) 2nd Shift	8	8	8
(Weekend/Holidays) Hoot Shift			

The same weekly labor distribution is reflected in response to the survey question based upon marine hours of operation.

3.2.2. Modal throughput distribution

Table 17
Modal distribution terminal throughput

Modes	%		
	Terminal 1	Terminal 2	Terminal 3
Rail (including Short/line haul)	15	15	28
Local drayage to rail yards	35	35	-
Local drayage to broker warehouse, Consignees, Distribution Centers	50	50	-

Perhaps no single metric will be more indicative of the relationship between the future contribution of the fourteen marine terminals to regional congestion than in the percentage modal distribution of aggregate container throughput. Conversely, no other single indicator best illustrates the challenges posed by the use of infrastructure improvements, such as the Alameda Corridor, seeking to improve regional mobility by increasing the modal distribution of 85% local drayage-15% intermodal rail to an approximately even distribution by providing more on dock rail and encouraging marine terminals to make greater us of such facilities while at the same time weaning shippers (as little outbound movement will be affected) away from local drayage to intermodal rail yards thereby hopefully reducing the number of trucks calling at marine terminals waiting in queues and using local roadways.

Given the approximately even origin and destination of freight movement through the combined port complex, greater use of on dock rail in and of itself will not resolve the congestion by product of continued port growth, but it will make it easier to attain the shift distribution goals set forth in the Transportation Study designed to redistribute truck traffic movement around the clock from predominantly daytime operations.

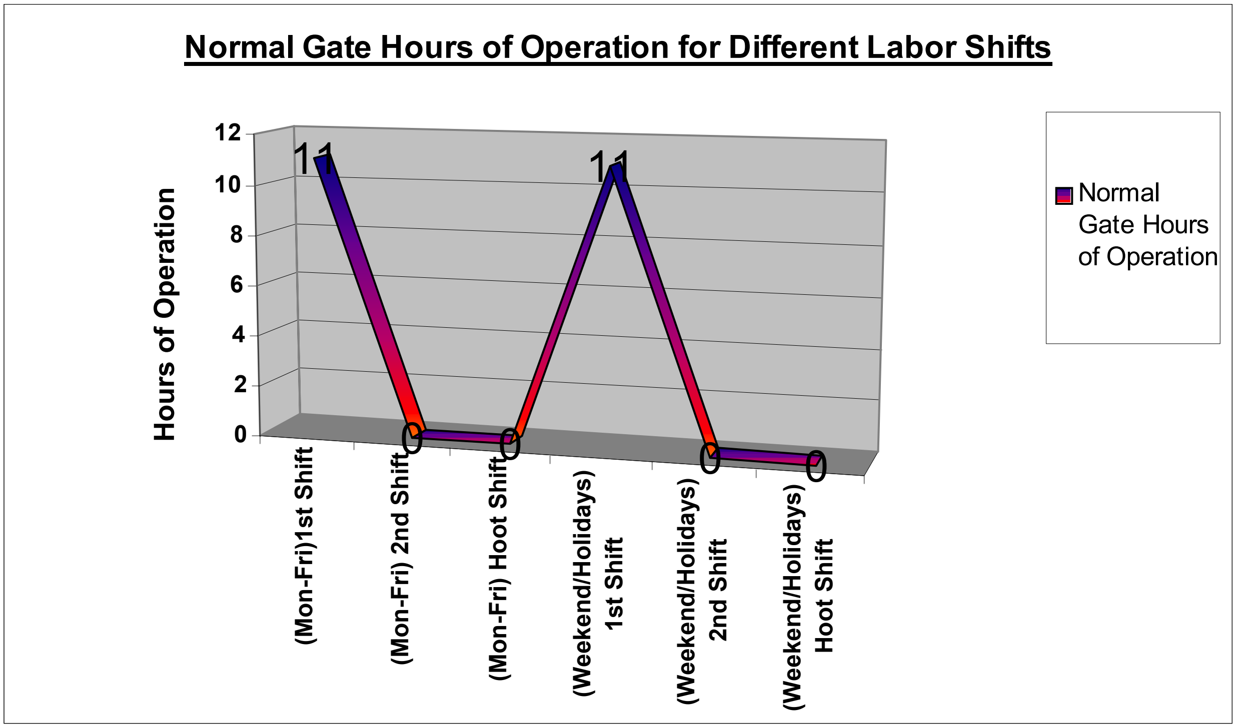
3.2.3. Gate hours of operation

3.2.3.1 Normal gate hours of operation

Published marine terminal gate hours of operation from publicly available sources including port summaries and the emodal website confirms that 8:00 A.M-4:30 P.M. represents standard gate hours of operation for most marine terminals. The limited survey data tells a different story.

Table 18

Normal terminal gate hours of operation and corresponding labor shift



Survey data reflecting existing use of extended gate hours in the form of flex gates permitted under current coastwide collective bargaining agreements is an encouraging first step toward greater collaborative efforts to extend terminal gate hours of operation within the existing cost structure. Use of nine and one half to eleven hours of first shift operation with presumably full service gates permit early pickups and deliveries of full containers and seamless operation before the first shift normally begins at 8:00 AM and after normal closing as early as 4:30 PM with a frequent dead meal period until 6:00 PM when gates may sometimes reopen.

Under current cost structures dictated by labor agreements albeit with some flexibility while reflecting a labor shift differential, further redistribution of throughput through extended gate hours of operation will require a review of current three shift operations, and the imposition of either allocated terminal access for trucks based upon priorities of gate transactions as a private regulatory model, or a premium pricing policy for day or other shift transactions based upon market considerations.

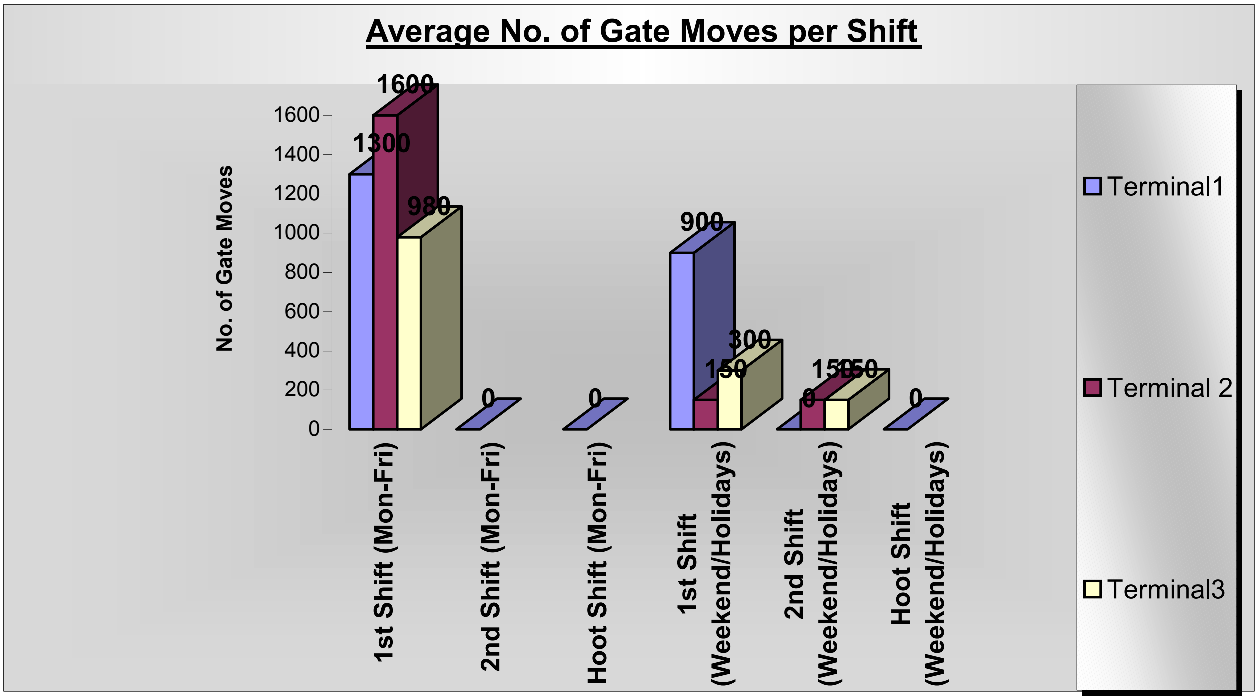
Any such strategy must begin with an affirmative effort to manage and maximize first shift activity through the use of extended first shift beginning and end times, queuing preference through physical separation of non-priority from priority transactions, and the adoption of a scheduling and appointment system to manage the flow of gate transactions.

This can be followed by an incremental approach to the adoption of extended gate hours beginning for cost reasons with greater use of limited service gates on second and hoot shifts, adoption of a shift differential premium, or congestion pricing reflected in the terminal tariff, and corresponding shipper financial or volume commitments, or the expanded use of the priority appointment and scheduling regime that optimizes use of day gates and relegates non-priority or unscheduled transactions to after hours operation.

3.2.3.2 Average gate moves per shift distribution

Table 19
Gate moves per shift distribution

Shifts	**Average Moves**		
	Terminal1	**Terminal 2**	**Terminal3**
1st Shift (Mon-Fri)	1300	1600	980
2nd Shift (Mon-Fri)	x		
Hoot Shift (Mon-Fri)	x		
1st Shift (Weekend/Holidays)	900	150	300
2nd Shift (Weekend/Holidays)	x	150	150
Hoot Shift (Weekend/Holidays)	x		

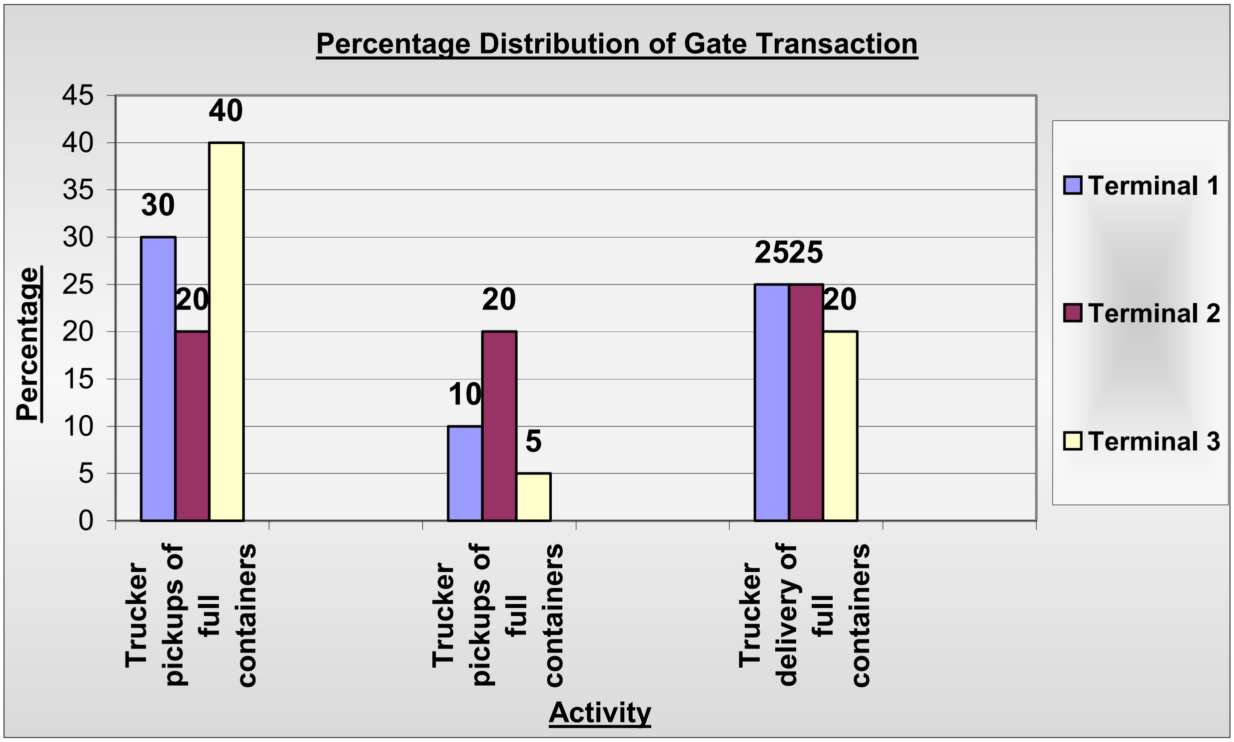


In contrast to the daily and weekly distribution of vessel activity, gate moves per shift distribution reveals the aggregate concentration of gate activity of all kinds on the first shift on weekdays, and a growing trend toward providing a limited or full service gate on weekends (principally Sundays) supporting the inference that a terminal flushing strategy for gate hours of operation synchronized with the ebb and flow of marine operations shows considerable promise as an efficiency measure.

3.2.3 Gate transaction distribution

Table 20
Gate transactions distribution

Activity	% for Terminals		
	1	2	3
Trucker pickups of full containers	30	20	40
Trucker pickups of full containers with empty container delivery	10	20	5
Trucker delivery of full containers	25	25	20
Trucker delivery of full containers with empty container pickup	10	15	5
Empty delivery	10	10	22
Empty container pickup	15	10	8



Gate transactions distribution data demonstrates the current percentage distribution of gate transactions without regard to priority or the use of scheduling, cost or other incentives/disincentives to relieve current recurring gate congestion. From a single terminal perspective under current conditions of carrier ownership or alliance interchange of containers, the pickup or delivery of a full in exchange for an empty container is an efficient transaction and should be accorded priority although it requires a full service gate to inspect returning empties and other clerical supporting services.

Other equipment management best practices solutions identified in the Town Hall and Industry Forum are available to both improve throughput and improve mobility. As individual terminals opt for off-dock container yards to offload non-priority activities, such as container storage and repair; or carriers permit out of port interchange of containers; or the industry collectively moves toward a "gray box" or pool of interchangeable containers (as it has for chassis); then pickups and deliveries of full containers without empties may be just as efficient as an on terminal exchange.

However, pickup and delivery of empty containers clearly is a non-priority activity and this 20-25% of current gate activity could easily be moved to off peak hours thereby contributing to greater efficiency without significant cost impact.

3.2.3.1 Selective distribution of gate transactions

Table 21
Selective distribution of gate transactions

Activity	% for terminals		
	1	2	3
Truck pickups by bobtails	25%		
Trucker delivery by bobtails	25%		
Truck pickups by truckers with own chassis or chassis in possession upon arrival at the terminal	<5%		
Truck delivery by truckers with own chassis or chassis in possession upon arrival at the terminal with chassis interchange out of terminal	<5%		

Similarly, tractor only (bobtail) pickups and deliveries reflecting as much as fifty per cent of gate transaction activity in the aggregate may be an indicator of absence of priority in gate access, inefficiency in scheduling although the length of queues may not be as great as in the case of empty container pickups and deliveries.

3.2.4.0 Labor scheduling flexibility

Under current coastwide collective bargaining agreements flexible start times and gate hours of operation, and gang versus individual dispatch appear to afford the most flexibility in implementing and extended gate hours regime at marine terminals.

3.2.4.1Flexible gate hours of operation time scheduling

Table 22
Flexible time scheduling of long shore labor

	Terminal 1	Terminal 2	Terminal 3
Vessel staging			
Vessel lashing/unlashing	X		
Rail staging and intermodal movement			
Extended gate hours	X 7 AM start / 11 hour day	X	
Other: (Specify)			
None of the above			

Consistent with anecdotal evidence, several of the survey respondents indicated that they had utilized flexible scheduling and start hours for the purpose of extending normal gate hours of operation.

3.2.4.2 Gang size dispatch

Table 23
Gang size (as distinguished from individual) dispatch utilization

	Terminal 1	Terminal 2	Terminal 3
Vessel staging			
Vessel lashing/unlashing	X		
Rail staging and intermodal movement			
Extended gate hours	X	X	
Other: (Specify)			
None of the above			

Similarly, a surprising number of respondents indicated that they had utilized gang size dispatch for the same purpose.

3.2.4.3 Flexible hours

Table 24
Flexible start hours and meal hours utilization

	Flex start Hrs. for Terminals			Meal Hrs. for Terminals		
	1	2	3	1	2	3
Yes	X	X		X	X	
No						

Table 25
Rationale for use of flex start hours and meal hours work

Terminals	Flex start Hrs	Meal Hrs
1	Ability to pay gate clerks 12 hrs originally. Now to maintain service and no need for 2nd shift.	Same
2		
3		

A related concept to flexible start hours is the custom and practice of closing or restricting gate access during meal or break hours. Several respondents indicated that flexible gate hours included not only early start or closing times to take advantage of linger first shift operations, but also continuous gate operation during staggered meal and break times.

Table 26
CY work performed in conjunction with flex gates and extended shift gates

Extended Shift Gates	Flex Gates
Rec/del emptys to/from ground	Rec/del emptys to/from ground
Stack/unstuck chassis	Stack/unstuck chassis
Transtainer delivery	Delivery 0800-1800
Empty yard	

One of the attributes of a full service gate is the availability of personnel for the performance of container yard work during flexible gates such as retrieval of empty containers, use of transtainers etc. Respondents indicated in most instances these functions were performed during extended first shift operations.

Two additional practices that increase gate efficiency were likewise revealed in the survey data. One is the trend toward use of "kitchen" gates in which gate receiving functions, container/chassis inspection, equipment interchange report (EIR) preparation, booking number verification etc are done in one controlled location frequently using remote surveillance cameras in lieu of physical inspection and verification.

The other is the frequent practice of flushing mini-land bridge containers in high volume concentration to intermodal rail yards by local drayage en masse on second and hoot shifts for large shippers/consignees with the carrier charging the shipper directly (rather than shifting those costs to the terminal operator) and incorporating additional labor charges and trucking charges for a house trucker in its service agreement with those shippers. This represents a precedent potential model for a differential cost structure to support the implementation of an extended gate hours regime with shipper, terminal operator, and trucker collaboration.

3.2.5 Container yard throughput benchmarking

3.2.5.1 Average dwell time

Survey data indicated that average dwell time data varies widely among terminals, has a seasonal component in terms of variability, and is particularly evident in relation to empty containers in comparison with import and export containers.

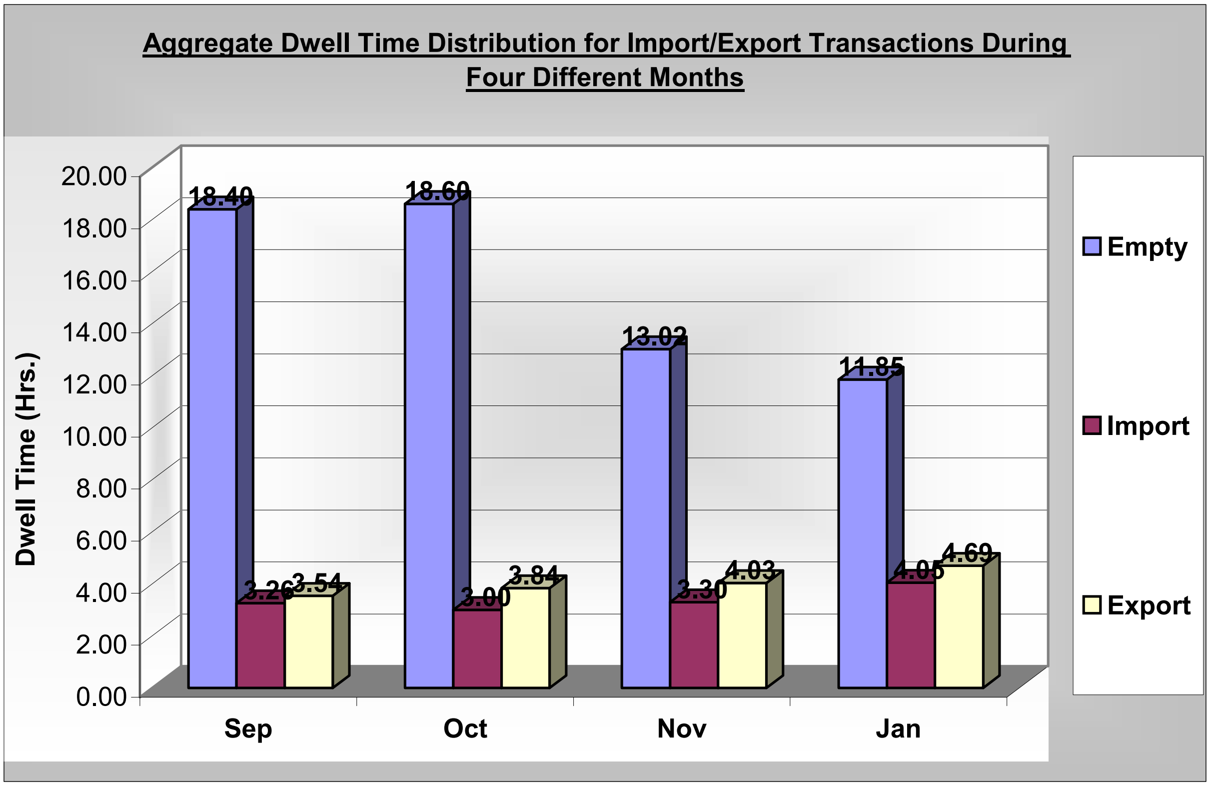
Table 27
Average dwell time for a container at terminal

Service	**Dwell Time**		
	Terminal 1	**Terminal 2**	**Terminal 3**
Standard deck service	3	3	7
Premium wheeled service	1	2	3
Premium on-dock rail service	1		-
Premium near-dock rail service	-	-	-

Survey data demonstrated a clear distinction between average dwell time in relation to deck as distinguished from wheeled operations and on dock rail service.

3.2.5.2 Average dwell time per transaction distribution

Table 28
Dwell time seasonal variation for imports, exports and empties



Survey data for dwell times for empty containers highlight the common practice of carriers contractually imposing unlimited free empty container storage on their affiliate terminal operators without incurring storage charges thereby contributing to terminal congestion and inefficiency on a continual basis.

3.2.5.3 Demurrage charges

Table 29
Tariff demurrage charges assessment on inbound containers

Days	Terminals		
	1	2	3
1-2 days			
3-5days			
6-10 days	X		
11-14 days		X	
More than 14 days			X

While port demurrage charges are required by tariff to be assessed against containers left on the terminal after five days, frequently carriers agree contractually to absorb such costs, as well as terminal tariff imposed demurrage charges for as long as 11-14 days. Survey data confirmed the widespread existence of this practice which also adds to terminal congestion and inefficiency and is past on in the form of a hidden "congestion tax" for the resulting bottleneck on other shippers and stakeholders in the regional supply chain.

3.2.5.4 Average free time

Table 30
Average free time for a container by shipper size

Size	Terminals		
	1	2	3
Large	5	6	5
Small	5	6	5

Survey data revealed a disparity between the average free time afforded large and small shippers in comparison to previous data supplied by shippers and consignees which tended to coincide with the number of days of demurrage charges incurred but not ultimately paid in many instances.

3.2.5.5 Empty container charges

Table 31
Assessment of charges for empty container storage at terminal

	Terminals		
	1	2	3
Yes	X		
No		X	X

(a) If so, on what basis?

Terminal 1	Formula of empty inventory compared to vessel throughput
Terminal 2	Per contract w/carrier
Terminal 3	Per contract w/carrier

Most survey respondents indicated that it was not their practice to charge carriers for empty container storage. However, some terminal operators do in fact levy such charges on wither a per diem or a formula based on vessel throughput.

3.2.5.6 Out of port container interchange

Table 32
Out of port container interchange

Off terminal interchange of empty import/export containers	
Off dock container storage	
Street turns	
Virtual container yard	
Other: (Specify)	No carrier controlled

None of the respondents surveyed indicated that they participated in out of port interchange arrangements in which empty containers are interchanged and reused without requiring physical return to the terminal and the completion of an equipment interchange report as recommended by the local trucking companies. Their collective response was that such arrangements must be agreed to by the container owners, carriers or leasing companies.

3.2.5.7 Differential shift pricing

Table 33
Differential price by percentage of base tariff your terminal charge for container pickup and exchange by shift

Shift	**Price Differential for Terminals**		
	Terminal 1	**Terminal 2**	**Terminal 3**
1st Shift (Mon-Fri)	N/A	Same	N/A
2nd Shift (Mon-Fri)		.20	
Hoot Shift (Mon-Fri)			
1st Shift (Weekend/Holidays)		Same .50	
2nd Shift (Weekend/Holidays)		.50	
Hoot Shift (Weekend/Holidays)			
No differential pricing			

The survey responses revealed that differential shift pricing has begun to be implemented by several terminals in direct response to the cost recovery issue raised in the context of extended gate hours of operation.

3.2.6 Information technology: terminal use of IT for in transit visibility

As the second workshop discussed infra demonstrated, the use of information technology is revolutionizing the global supply chain, and the hallmark of this revolution is in transit visibility in both data and physical freight movement terms.

3.2.6.1 OCR at terminal gate

Table 34
OCR capability at the gates for container and/or chassis identification

	Terminals		
	1	**2**	**3**
Yes	X		
No		X	X

Relatively few terminals responding have incorporated optical character reader systems to expedite gate operations.

3.2.6.2 AEI

Table 35
Automatic Equipment identification of containers and chassis

Technology	**Terminal 1**	**Terminal 2**	**Terminal 3**
Radio frequency identification (RFID)	X	X	X
Global positioning system (GPS)	X		X
Other: (Specify)			

In contrast, most terminals surveyed have adopted one or more forms of automatic equipment identification for tracking and identifying containers and chassis while on the terminal itself to improve in transit visibility in the physical dimension.

3.2.6.3 EDI/communications

Table 36
EDI/Telecommunications platform capability and real time telecommunication of container/shipping data

Technology	**Terminal 1**	**Terminal 2**	**Terminal 3**
Local area network (LAN)	X		X
Satellite	X		
Cellular	X		
Internet	X	X	X
Other: (Specify)	X EDI and direct access		

Most terminals surveyed utilize electronic data interchange (EDI) utilizing a variety of local area network (LAN), satellite, cellular, and web based EDI platforms.

Table 37
Electronic Data Interchange (EDI) technology for data sharing

	Terminal 1	Terminal 2	Terminal 3
Carrier and terminal	X	X	X
Carrier and shippers	X	X	X
Carrier and rail	X	X	X
Carrier and trucking OTR or PUD	X		
Terminal and freight forwarders			
Terminal and customs brokers	X		X
Terminal and U.S. customs services	X	X	X
Other: (Specify)	Emodal		
Do not use EDI			

Respondent terminals share data via EDI with carriers, shippers, rail, and customs brokers but rarely with truckers either over the road or local drayage, and not as frequently with U.S. Customs directly.

Table 38
Scope of EDI system data at terminal

	Terminal 1	Terminal 2	Terminal 3
U.S. Customs entry and clearance data	X	X	X
Other agency reporting data	X	X	X
Import and export manifest	X	X	X
Shippers export declaration	X	X	X
Automated enforcement system (AES) data	X		X
Other: (Specify)	History		

The range of data incorporated in terminal EDI systems runs the entire gamut of import and export trade documentation.

Table 39
EDI system characteristics

	Terminal 1	Terminal 2	Terminal 3
Web based	X	X	X
XML language oriented	X		
Encrypted	X	X	X
Other: (Specify)	GEIS		

The most common EDI platform among survey respondents is web based and encrypted.

Table 40
System container pickup and exchange scheduling with shippers and consignees capability

	Terminals		
	1	**2**	**3**
Yes			
No	X	X	X

(a) If not, is it capable of doing so?

	Terminals		
	1	**2**	**3**
Yes	X		
No		X	X

Most respondents indicated that their EDI system did not have the capability to incorporate pickup and scheduling information with shippers and consignees, and if it does have this capability, it is not currently utilized.

Table 41
EDI System receipt of electronic delivery orders or electronic demurrage payments

	Terminals		
	1	**2**	**3**
Yes			X
No	X	X	

(a) If not, when do you plan to implement such a system: (Check one)

	Terminal 1	**Terminal 2**	**Terminal 3**
Less than 1 year			
1-3 years	X		
More than 3 years			
No current plans			

Most respondents provided the same response when queried as to whether their system had the capability of incorporating electronic delivery orders or demurrage payments.

3.2.6.4 Scheduling/appointment system

Table 42
Use of Internet based truck scheduling and appointment system for access by trucking company dispatchers and independent drivers

Time Period	Implemented			Planned		
	Terminal 1	Terminal 2	Terminal 3	Terminal 1	Terminal 2	Terminal 3
Less than one year	X					
One to three years				X		
More than three years						
Not sure of						
No planning						

Surprisingly, some respondents have already implemented a truck scheduling and appointment system in advance of any such system being implemented on a port or community wide basis.

Table 43
Internet based truck scheduling and appointment system at your terminal and truck driver positive identification system

	Terminals		
	1	2	3
Yes	X		
No		X	X

For those terminals responding in the affirmative to having implemented a scheduling and appointment system, to data the system has not incorporated a positive driver identification feature.

3.2.7 Extended gate hours of operation

Table 44
Extended gate hours of operation

	Terminal 1	Terminal 2	Terminal 3
Extended gate hours of operation	X	X	X
An appointment system for trucks for container pickup	X		
Driver identification cards	X	X	

Virtually every respondent terminal indicated either experience or the intention to implement an extended gate hours of operation independently or in combination with a scheduling and appointment system for trucks and driver positive identification (in one instance in combination with facial recognition technology) as pat of a strategy of improving efficiency and throughput.

4.0 Stakeholder implications of extended gate hours of operation as traffic systems management measures

The terminal metrics tell only half the story. For this reason the authors sought the assistance of stakeholders in order to augment the survey data and provide a qualitative dimension to the analysis of the supply chain management implications of prospective marine terminal implementation of extended gate hours of operation in terms of achieving the twin objectives of improving throughput velocity as a measure of terminal efficiency and regional mobility at the same time.

4.1 Qualitative stakeholder implications data

For that reason with the concurrence of the CITT Policy and Steering Committee, the first in the series of CITT sponsored invitation only closed workshops aligned with the research effort entitled "Improving the Supply Chain Through Extended Hours of Operation in Southern California" was held on May 30, 2001 in Long Beach.

Invited participants included:

(1) Audrey Adams, Director Field Operations, U.S Customs Service;
(2) Joel D. Anderson, Executive V.P. California Trucking Association;
(3) Rose H. Bauss, National Manager Toyota Motor Sales;
(4) Michelle Boden, Vice President K Line;
(5) Mike Brown, Chief, California Highway Patrol Southern Division;
(6) Kerry Cartwright, Manager of Transportation Planning Port of Long Beach and a GLS certificate holder;
(7) Roger Clark, President Williams Clark Company (Customs Brokers);
(8) John Drew, President/CEO Devine Peters Intermodal;
(9) Doug Falling, Chief Deputy CALTRANS District 7;
(10) Norman Fassler-Katz , Senior Consultant to the Select Committee on California Ports;
(11) Thomas Harrison, President ILWU Local 63 Marine Clerks;
(12) George Kuvakas, President INWU Local 94 Walking Bosses;
(13) Allen Lawrence, Chair California Transportation Commission;
(14) David Levinsohn, Vice President Parsons Brinckerhoff (Prime Contractor for the I-701 MCS);
(15) Lawrence G. Mallon, Esq. CITT Rapporteur;
(16) lan McCorke, Maersk-Sealand;
(17) Bob Orpin, Director of Planning and Development, City of Santa Fe Springs; (18) Ramone Ponce de Leon, President ILWU Local 13;
(19) Richard Powers, Gateway Cities Partnership Inc;
(20) Enrico Salvo, Founder/CEO Carmichael International Service;
(21) Sue Smith, Business Manager IKEA Wholesale West 5555 E. Jurepa Street Ontario CA 91761; and
(22) Jack E. Suite Coast Director, Pacific Maritime Association.

Collectively, the participants included representatives from eleven major stakeholder groups with an interest in identifying the implications (costs, benefits, impacts, tradeoffs) of extended marine terminal gate hours of operation. These include"

(1) Truckers
(2) Shippers/consignees
(3) General public/consumers
(4) Organized labor
(5) Marine terminals
(6) Customs Brokers
(7) California Highway Patrol (CHP)
(8) U.S. Customs
(9) Carriers
(10) Caltrans
(11) Municipalities

Each stakeholder had a distinct representative interest in improving regional supply chain throughput velocity and mobility.

The primary purpose of the facilitated workshop was to capture these likely implications beyond the capacity of any one or even group of stakeholders to identify, measure their frequency of reference if not likely occurrence in the collective opinion of the group—and to predict the likely outcomes measured in second, third and even fourth order implications from the implementation of one representative solution as a surrogate for many others.

An added bonus was the ability to capture the relationships between implications in a rough data base, together representing a mosaic picture and map of the likely tradeoffs to be encountered among classes of stakeholders from the implementation of one or more transportation system management measures as required before funding of a major new infrastructure improvement under the State Transportation Plan (STIP). Further analysis of the second and higher order implications identified would yield insights into their relative importance and likely strategies directed toward bridging barriers to successful implementation of such measures.

The assembled group having adopted the core concept of extended gate hours, after an abbreviated demonstration of the Implications Wheel, the facilitators unveiled a list of key first order implications based upon prior telephonic interviews with the participants subject likewise to a rapid validation by the group in attendance. Two admonitions were given to the group in spurring their individual and collective imagination in identifying implications of the core concept.

First, CITT representatives stressed that the individuals were invited to participate as individual experts based upon their own experience and were not expected to represent formal stakeholders as decision makers in exercising their judgment or providing their opinions. By and large to the immense credit and freed from institutional and organizational constraints they did just that. Second, the facilitators stressed that the purpose of the exercise was to identify implications that might from what comes to mind without immediately assigning probabilities (although later in the exercise weighting by assigning values to second and third order implications by teams rather than individually 0—and the frequency of reference of first order implications-- more than compensated for any inherent data errors).

In a preliminary session with CITT staff, fourteen operative assumptions were adopted and subsequently validated by the participants as the basic framework for the implications subsequently identified. These included:

(1) Assumed continued double digit growth;
(2) Dayside operations are currently maximized;
(3) Some terminals are currently using extended gate operations;
(4) There is a lack of industry standardization in technology;
(5) There are currently fifteen operating terminals;
(6) Improvement of I-710 is under planning review but is likely a decade away from construction;
(7) Three quarters of current truck traffic utilizes the I-710 and it is anticipated that some percentage of this will shift to the Alameda Corridor;
(8) Truckers average less than three cycles per day;
(9) I-710 improvement is limited by physical constraints;
(10) Truck traffic on the I-710 is the largest in the State in absolute terms and as a percentage of total vehicle movements;
(11) Local drayage is not subject to California Highway Patrol highway inspection;
(12) Thirty five per cent of all truck related accident are as a result of breakdowns;
(13) If ports cannot accommodate continued container growth, freight diversion to other ports will occur; and
(14) The current energy crisis will not be resolved before extended gate hours is fully implemented.

After some discussion and minor amendment all 14 preliminary assumptions were adopted by the participants.

In the first individual round of discussion, in all 43 first order implications were identified with eight considered major in order of frequency of reference (in and of itself revealing likely data end points) identified:

In the first round of discussion, 43 first order implications were identified. Of the 43, eight were considered major in order of frequency of reference. They were:

- Surrounding communities using the most highly impacted highways and train routes may become angry at the increased traffic (at all hours);
- (Extended hours) may cause all stakeholders to create a more collaborative process;
- Unions may expect to renegotiate their contracts with terminals;
- City councils in surrounding communities may not allow truck traffic on second or third shifts;

- There may be a demand for customs inspectors to be available 24/7;
- Terminals may experience additional costs for added shifts;
- Extended hours may decrease current congestion; and
- Land may be used for logistics rather than manufacturing.

Those implications are captured in a series of schematics presented as Exhibit “B” to this study aggregated by stakeholder group as with other data collected to preserve anonymity and confidentiality. Through the series of schematics, the reader can follow the first and subsequent order of implications, distinguish between those which are positive or negative, and attribute individual implications to a particular stakeholder group.

After a short break the remainder of the morning session the group broke into subgroups in which individuals from various stakeholder communities were intentionally dispersed. These heterogeneous subgroups then proceeded to complete the second and third order implications of the major first order implications.

Following this exercise the subgroups reformed into stakeholder groups to validate and prioritize the send and third order implications by required unanimous vote of each stakeholder group ranking their most positive and negative implications for each first order implications. This two-part exercise consumed the remainder of the extended morning session. The degree of interest was palpable and contagious. The demonstrated individual and group involvement and commitment was self-evident.

The overall distribution of second and third order implications was revealing. Municipal government credited three positive and seven negative implications. Their priorities emphasized physical concentration of truck movements in few cities would nevertheless apparently overshadow the demonstrated overall positive benefits of temporal distribution.

Trucking industry stakeholders were predominantly positive with seven positive implications to five negative ones. They were the greatest subscribers to the theory that all stakeholders would be ultimately be compelled to adopt a more collaborative process from the implementation of extended gate hours of operation.

General public stakeholders were even more positive by a two to one margin of six to three projecting greater regional economic, social, and environmental benefits for extended hours in the big picture.

Shippers were the most prolific tallying nineteen negative and eleven positive benefits offering a skeptical view of local special interests ultimately negating the benefits of a greater collaborative process, as well as expressing an overall level of confidence in the ability of the other stakeholders to improve the current situation by themselves.

Organized labor was predominantly positive by a margin of seven to four of the overall benefits in congestion relief and the potential for greater group collaboration equally skeptical of the actions of municipal government to allow the process to unfold.

Customs brokers were equally negative and circumspect by a margin of five to four. However, even their negative implications offered a bridge to ultimate resolution through a consistent emphasis on the need for greater public and stakeholder education and awareness as the most effective strategy to achieve ultimate success.

Terminal operators were marginally positive by a measure of six to five favoring a collaborative process, equally skeptical of the motivations of municipal government, understandably cost-conscious but cautiously optimistic that adoption of new methods may ultimately be rewarded by new business opportunities.

The California Highway Patrol was prolific noting nine positive and fifteen negative benefits with the potential to occur from extended gate hours emphasizing a potential redistribution of residential and highway safety events as likely occurrences.

U.S Customs was overwhelmingly favorable by a margin of nine to five nevertheless emphasizing that additional government resources would be needed –adding to an existing shortfall in inspectors—and raising the possibility that additional contraband could slip through an already thinly stretched customs perimeter.

Ocean carriers were almost evenly divided by a margin of eight to seven expressing cost considerations balanced against a clear recognition of the need for and likely benefits resulting from changes in shift hours, operating hours and introduction of new technology.

CALTRANS was the most markedly negative stakeholder by a four to one margin of eight to two citing few benefits aside from decreased truck-POV interaction and reciting a litany of crime, community conflict and other social impacts likely to occur unclear as to whether extended operating hours are adopted or not.

5.0 Break-even and cost-benefit analysis of marine terminal extended gate hours of operation

The workshop suggested the need to devise an analytical framework to reflect the costs and benefits, both quantitative and qualitative, in order to estimate the cost-effectiveness of extending terminal gate hours of operation. Extension of gate hours has the potential to improve throughput velocity while ameliorating the negative costs of adverse health and safety, environmental, and related transportation costs from truck congestion during peak hours on freeways and arterial roads. However, terminal operators complained that further analysis was required in order to analyze the additional costs associated with extended gate operations and whether under the existing cost structure the terminals would be able to cover the incremental costs of extended gate operations.

Two such economic methodologies are applicable to this situation. At the firm level, break-even analysis looks at the incremental costs and revenues associated with the extension of gate hours. Cost-benefit analysis extends beyond the firm to address issues that are external to the firm. The congestion costs and related measures of health and safety are spillover costs associated with level of activities of the ports.

5.1 Cost of extended operating hours break-even analysis

Break-even analysis is the use of a simple formula to determine the sales or volume level in units at which a business neither incurs a loss nor makes a profit, or in this case, whether the incremental cost of extended gate hours is equal or less than the incremental revenue from added container volume of pickups and deliveries.

Fixed costs are those expense items that generally do not change, regardless of unit volume. Examples of fixed costs include general administrative expenses, rent, depreciation, utilities, telephone, property tax, and the like. Variable costs are those that change with the unit level of output. Generally, these costs increase with increased production or sales because they are directly involved in either making the product or making the sale. Examples of variable costs for manufacturing firms include direct materials and direct labor. In retail firms, variable costs include the cost of goods, sales commissions, and so forth**.**

- Typically, service businesses like marine terminals do not have large variable costs, except for labor. These firms are characterized by large investments in capital equipment, and output can be increased (or redistributed) by adding on units of labor, in the case of extended gate hour, by adding on an additional shift.

- Figure 5 is a graphical picture of break-even analysis. For simplicity, it is assumed that revenues and costs are linear. At levels of output beyond breakeven, firms earn accounting profits and at levels below breakeven, firms incur accounting losses. Since breakeven analysis ignores the issue of rate of return on invested capital, it is not a correct determination of the output level that is consistent with the maximization of profits. Nonetheless, break-even analysis is a rough approximation of the behavior of a firm.
- Terminal operators, confronted with a choice to extend gate hours, balance the added or incremental cost, associated with such a move, against the added benefits. In this context, break-even analysis flushes out some of the economic issues which terminal operators must address in determining their overall profitability.

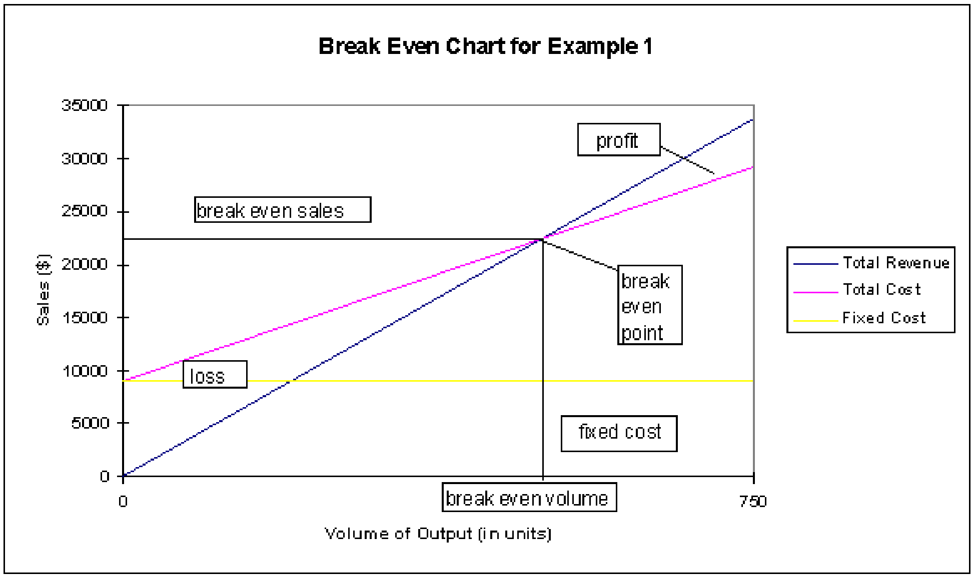


Figure 5 Break-even cost analysis

5.2 Marine terminal cost implications for unsubscribed services and incremental break- even variable cost structure

The survey included a series of questions intend to identify the average range of variable unit cost structure for marine terminals by shift, and for full or limited service gate operations. The survey also attempted to quantify the attendant manning levels (labor cost) by category, and breakeven points in revenue dollars and container volume at tariff rates by day of the week and labor shift in order to develop a cost picture of the impact of extended gate hours from the terminal perspective.

Table 45A
Incremental operating cost structure of a full service gate at normal manning level at a terminal by category (long shore, clerk, walking boss) under applicable collective bargaining agreements.

All on wheeled basis	**Cost**			**All on decked basis**	**Cost**		
	Terminal 1	**Terminal 2**	**Terminal 3**		**Terminal 1**	**Terminal 2**	**Terminal 3**
Receipt of 200 full containers and delivery of 200 full containers	$5082	$2100	$6000	Receipt of 200 full containers and Delivery of 200 full containers	N/a	$12100	$13900
Delivery of 200 full containers and Receipt of 200 full containers	5082	2100	7500	Delivery of 200 full containers and Receipt of 200 full containers	N/a	12100	18000
Receipt of 400 full containers and delivery of 400 full containers	6080	4200	8300	Receipt of 400 full containers and delivery of 400 full containers	N/a	24200	21000
Delivery of 400 full containers and Receipt of 400 full containers	6080	4200	9800	Delivery of 400 full containers and Receipt of 400 full containers	N/a	24200	24200

The first table demonstrates the dramatic effect in required revenue dollars to break even of spreading fixed and variable costs over 400 container gate transactions in comparison to 200 gate moves. It also reflects the overall reduced cost structure of decked in comparison to wheeled operations at time when increased throughput volume is pushing space constrained terminals in the direction of a shift to away from wheeled operations on pre-positioned chassis in favor of decked operations requiring additional moves in order to flush out the terminal of newly arrived inbound containers.

Table 45B
Incremental operating unit cost structure of a full service gate at normal manning level at a terminal by category (long shore, clerk, walking boss)

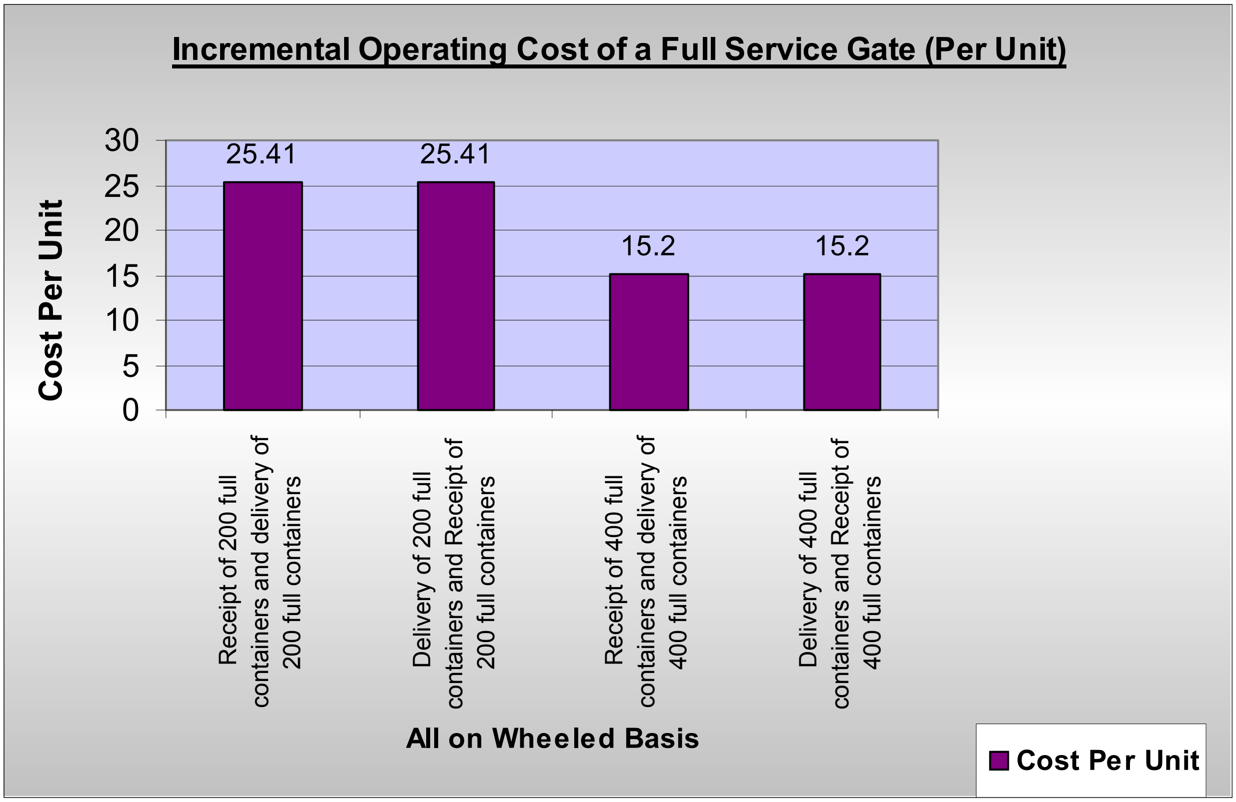


Table 45B graphically illustrates the dramatic difference in break-even costs as a function of volume bases upon declining unit costs for a full service gate at a representative terminal.

Table 46
Incremental break-even cost of a full service gate expressed in dollars and number of containers by shift

Full Service Gate Cost **(Dollars)** For Terminals				Full Service Gate Cost **(Containers)** For Terminals			
	1	**2**	**3**		**1**	**2**	**3**
By 1st Shift (Mon-Fri)	15,500	27,500	16,000	By 1st Shift (Mon-Fri)	500	1581	500
By 2nd Shift (Mon-Fri)	0			By 2nd Shift (mon-Fri)	0		
By Hoot Shift (Mon-Fri)	0			By Hoot Shift (Mon-Fri)	0		
By 1st Shift (Weekend/holidays)	2,750	16,000	16,000	By 1st Shift (Weekend/holidays)	150	300	300
By 2nd Shift (Weekend/holidays)	0			By 2nd Shift (Weekend/holidays)	0		
By hoot Shift (Weekend/holidays)	0			By hoot Shift (Weekend/holidays)	0		

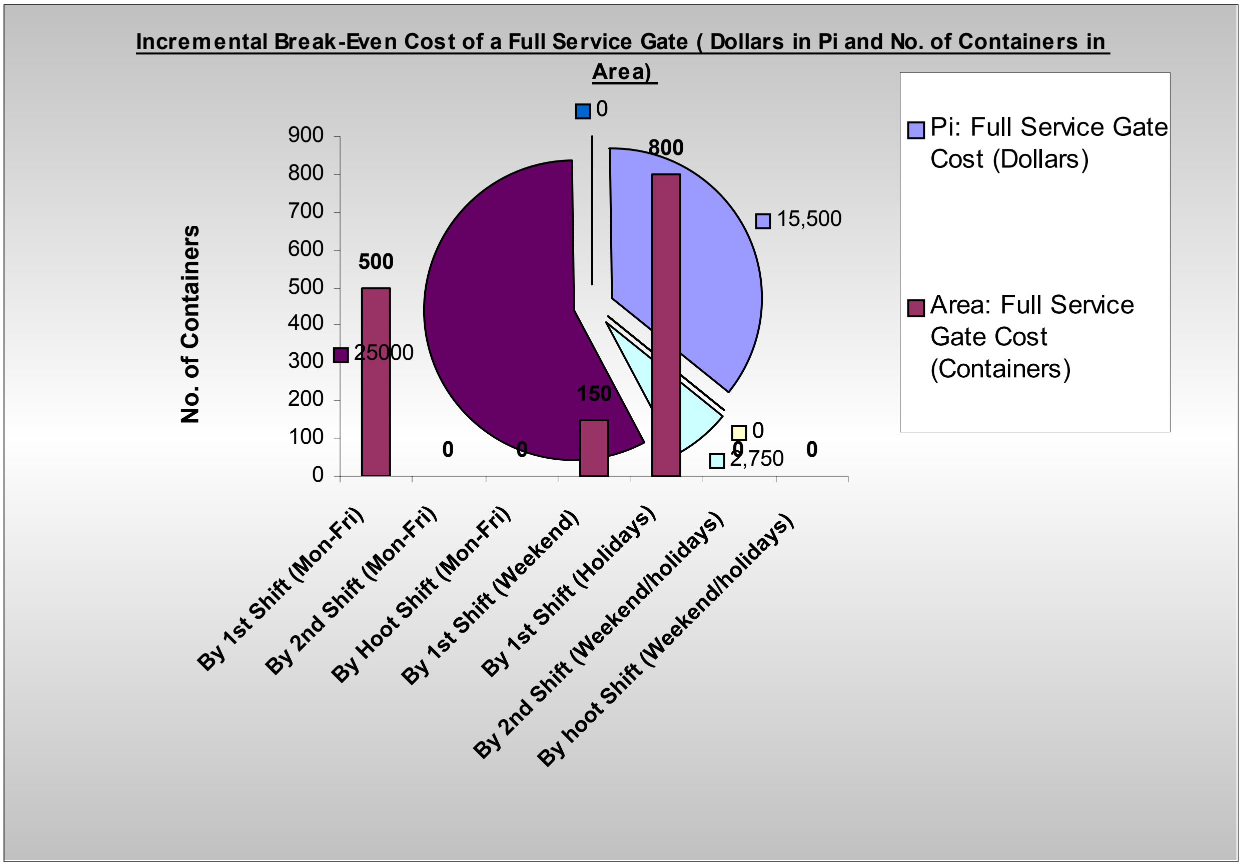
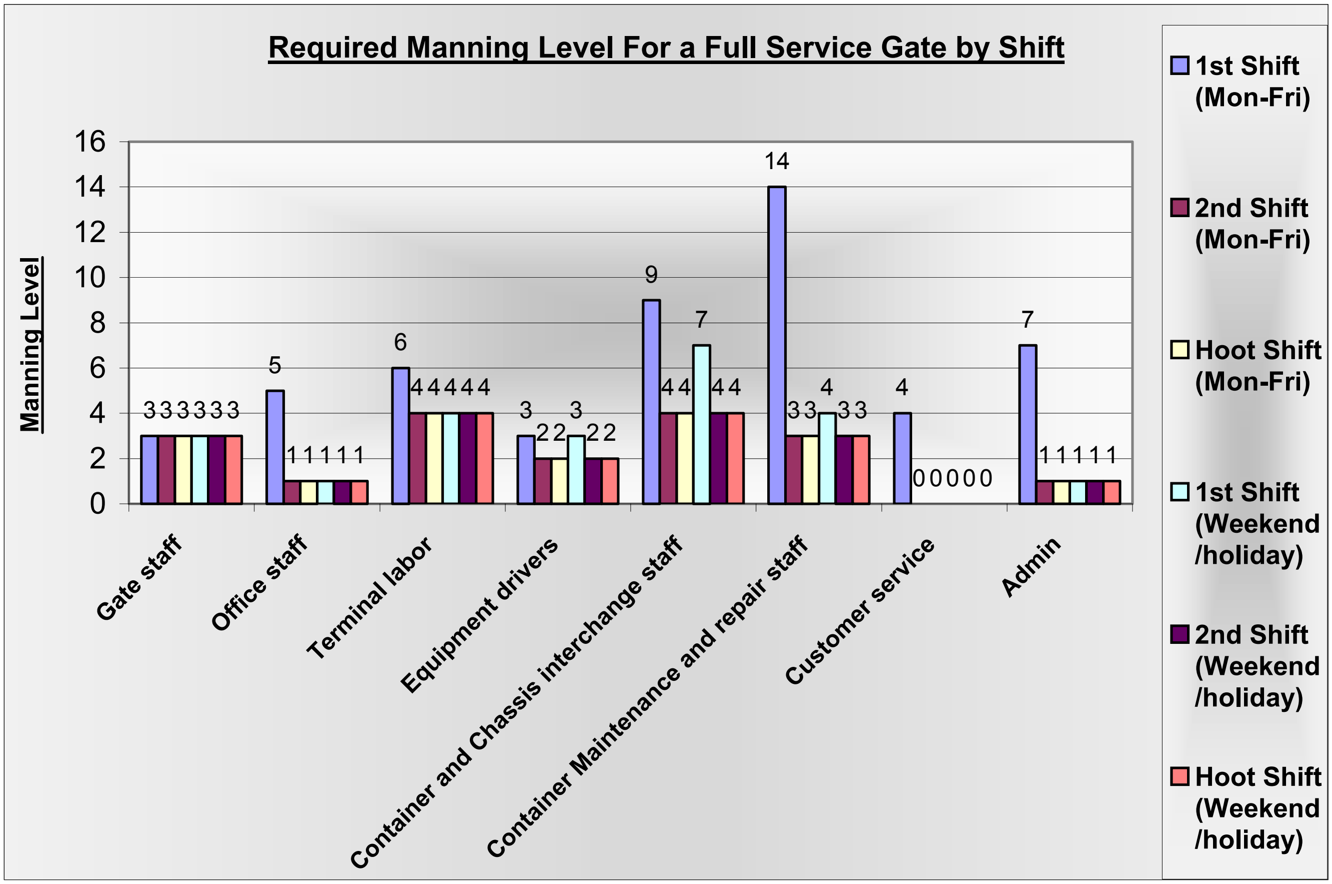


Table 46 demonstrates the wide cost variability between different terminals in maintaining a full service first shift gate on weekdays versus weekends and holidays. Differences in unit costs (and manning levels) account for the difference in break-even volume in the number of containers required to recover costs for weekday and weekend gates. On average, there does not appear to be a dramatic difference in variable cost structure or required volume to break even by adding a weekend gate to help flush out terminals from Sunday arrivals. It is unfortunate that data was unavailable to compare a weekend hoot gate with a corresponding day shift.

Table 47
Required manning levels by category (long shore, clerk, walking boss) under applicable collective bargaining agreements for a full service gate by shift



Since labor cost is the principal component of the break even analysis, it is interesting to see in Table 47 the wide variation in required manning complement for a full service gate by first shift on a weekday versus a first shift on weekends and the limited range of variability in required manning levels as between second and hoot shifts on weekdays and all three shifts on weekends and holidays. This is significant in terms of the lower required manning levels for all other shifts but the first shift on weekdays since labor cost is the primary component of variable cost for extended gate hours of operation.

Even allowing for shift-differential pay rates and for weekend work, this limited data suggests that the breakeven points for second and hoot shifts, on both weekdays and weekends and first shifts on weekends, may not be a significant impediment to spreading container throughput more evenly than under the current practice.

Table 48
Incremental break-even cost of a limited service gate
expressed in dollars and number of containers by hour or by shift

Limited Service Gate Cost **(Dollars)**				Limited Service Gate Cost **(Containers)**			
	Terminals				Terminals		
	1	**2**	**3**		**1**	**2**	**3**
By 1st Shift (Mon-Fri)	10,700	650	3800	By 1st Shift (Mon-Fri)	500	300	
By 2nd Shift (Mon-Fri)	4,200	750	4400	By 2nd Shift (Mon-Fri)	135	300	
By Hoot Shift (Mon-Fri)	3,500	650		By Hoot Shift (Mon-Fri)	135		
By 1st Shift (Weekend/holidays)	4,600	16000	4800	By 1st Shift (Weekend/holidays)	150	650	300
By 2nd Shift (Weekend/holidays)	4,600	4800		By 2nd Shift (Weekend/holidays)	150	300	
By hoot Shift (Weekend/holidays)	3,750			By hoot Shift (Weekend/holidays)	150		

Table 48 illustrates the wide variation in breakeven cost structure of providing a limited service gate, in dollars and in container volume, as between terminals by shift on weekdays, and on weekends and holidays. The variable cost structure is dramatically different by both shift (in particular first shift) and as between weekday and weekends. In comparison to the data contained in Table 42, the breakeven volumes required for a limited service gate are significantly less than required for a full service gate.

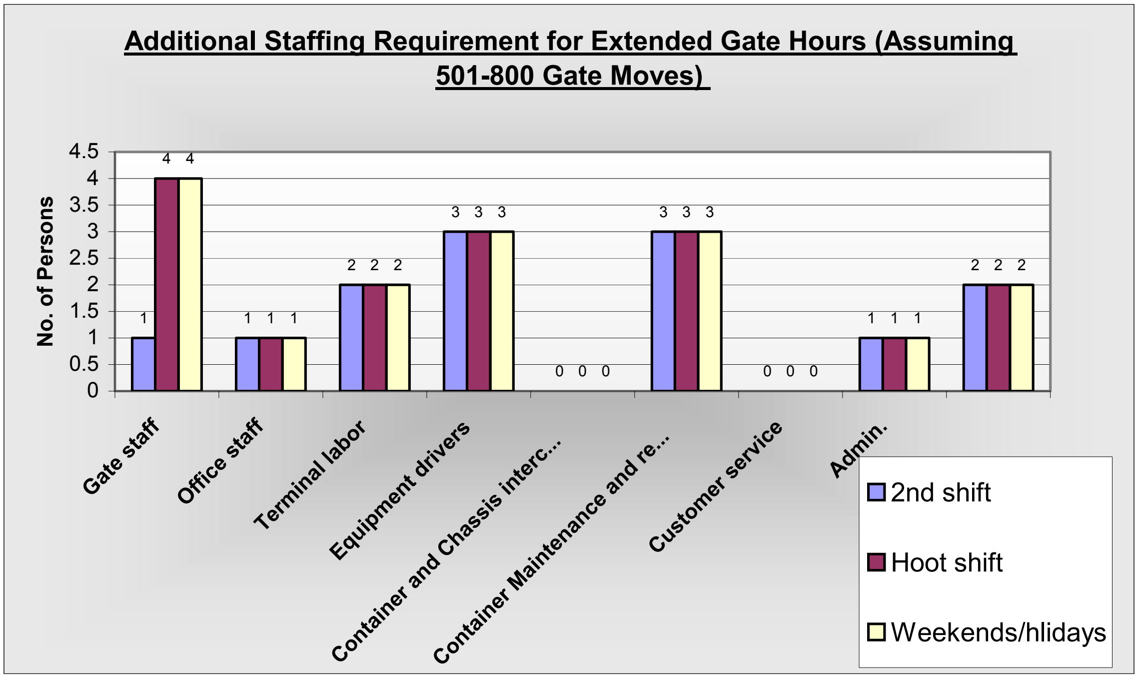
Anecdotal evidence based upon truck driver comments complain suggests that limited service gates do not afford the same level of terminal services (terminal labor, equipment drivers, maintenance and repair, and customer service and administrative personnel) associated with full service gates). However, the significant difference in variable cost structure suggests their utility for certain types of operations e.g. mini land bridge for few high volume customers, empty returns, bobtail pickups and deliveries etc as a model for a phased in strategy for implementing extended gate hours.

Table 49
Required manning level by category (long shore, clerk, walking boss) under applicable collective bargaining agreements for a limited service gate by shift

Limited Service Gate Labor Category	**Manning Level By Shift**																	
	1st Shift (Mon-Fri)			2nd Shift (Mon-Fri)			Hoot Shift (Mon-Fri)			1st Shift (Weekend/holiday)			2dt Shift (Weekend/holiday)			Hoot Shift (Weekend/holiday)		
	Terminals			**Terminals**			**Terminals**			**Terminals**			**Terminals**			**Terminals**		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Gate staff	2	1		2			2			2	2		2			2		
Office staff	6	2		1			1			1	6		1			1		
Terminal labor	2	0		2			2			2	2		2			2		
Equipment drivers	2	0		2			2			2	2		2			2		
Container and Chassis interchange staff	4	4		3			3			3	5		3			3		
Container Maintenance and repair staff	4	0		2			2			2	4		2			2		
Customer service	4	1		0			0			0	4		0			0		
Admin	7	0		1			1			1	1		1			1		
Other: (Specify)security	2	0		2			2			2	2		2			2		

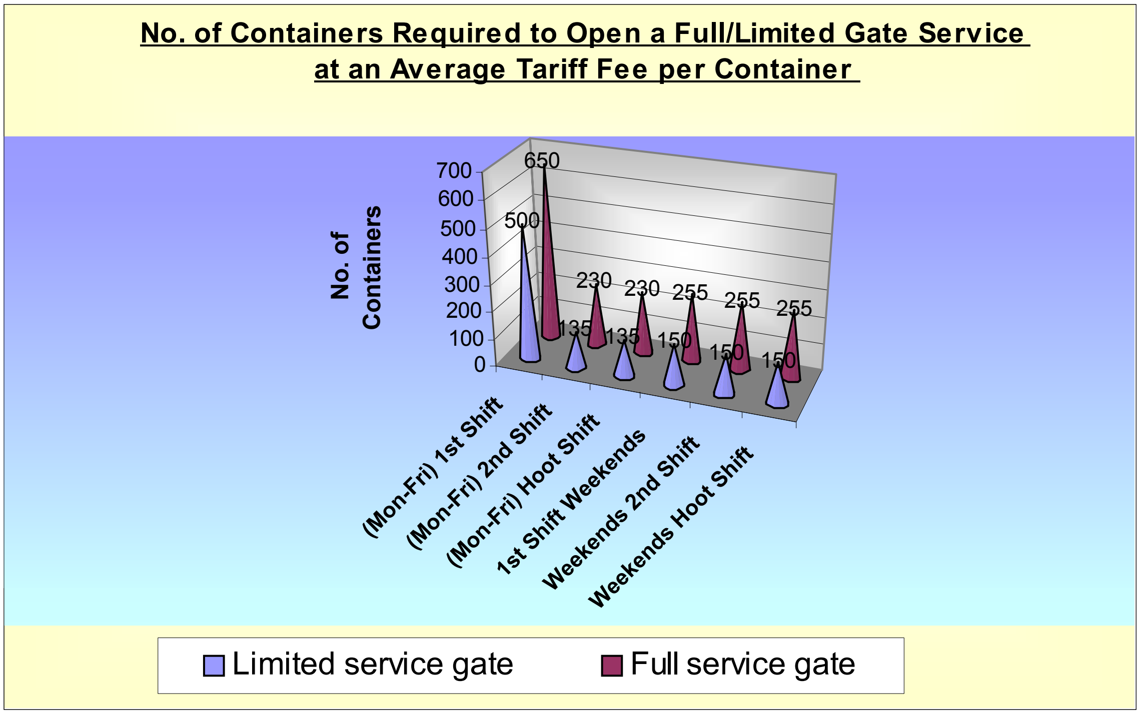
The above table demonstrates the significant differences between the required manning levels for full service versus limited service gates. However, in contrast to the wide variability in full service gate complements, the required manning levels for a limited service gate appear to be relatively uniform among shifts, and on weekdays versus weekends.

Table 50
Assuming 501-800 gate moves per shift under normal weekday yard/gate working operations, specify the percentage of additional staffing requirements at your terminal in order to accommodate full service gates extended terminal gate hours on the second shift, hoot shift, and weekends:



The responses in the above table reflect, in both relative and absolute terms, the additional manning requirements necessary to implement a full service gate, on the second and hoot shift, on weekdays, and on weekends and holidays. This data is consistent with that contained in Table 44. There is not a dramatic difference in required manning levels for second and hoot shifts on either weekdays or weekends. Since a number of respondents indicated that they are already using flexible gate hours (on the first shift, or using weekend first shift gates), this limited data suggests that required manning levels may not a great cost impact upon the use of second, hoot, and weekend gates, and thus variable costs, as the qualitative workshop data originally suggested.

Table 51
Break event analysis in number of containers based upon average tariff fee per container gate transaction



Finally, the above table based upon number of containers required to break even in the operation of a limited or full service gate by shift, summarizes the wide variability in break even volume for first shift gate operations and that required for all other shifts, second or hoot, on weekdays and on weekends. At the same time it illustrates the uniformly lower breakeven volume required for all other shifts, and the substantially lower break even volume required for limited as distinguished from full service gates suggesting the initial reliance upon limited service gates in designing an extended hours of operation regime for marine terminals based upon cost structure.

5.3 Cost benefit analytical framework for analysis of extended gate hours of operations

In contrast to breakeven analysis which is helpful in designing a terminal specific data, cost-benefit analysis (CBA) is an analytical tool that encompasses the full range of costs and benefits, including social costs and benefits, involved in the he introduction of extended gate hours to all stakeholders in the community.

Absent the availability of relevant cost and benefit data from additional surveys of various stakeholders, including truck drivers and empirical data gathering at the terminal level, no attempt will be made to undertake a cost-benefit analysis of extended gate hours within the scope of this report. However, cost-benefits analysis does provide a framework to evaluate all of the private and social costs and benefits of extended gate hours of operations for the stakeholder community.

CBA is a technique for comparatively assessing the (monetary) costs and benefits of an activity or project over a relevant time period. Measuring the costs and benefits of projects allows one to calculate the relevant rate of return associated private or public investment. These projects may be infrastructure such as harbor dredging or highways, or can be changes in process or business practices such as extended gate hours of operation or the provision of training and workforce development programs for longshore labor in the use and application of information technology.

The idea of this economic decision making analytical method originated with Jules Dupuit, a French engineer in1848. The British economist, Alfred Marshall, formalize the concepts that are the foundation of CBA. The practical development and application of CBA to public and private investment decisions came as a result of the impetus provided by the Rivers and Harbors Act of 1936. This Act and its successors require that the U.S. Army Corps of Engineers (USACE) carry out projects for the improvement of the waterway system when the total benefits of a project to whomsoever they accrue exceed the total costs of that project.

Consider the consensus proposal for extended marine terminal gate hours of operation in terms of prospective costs and benefits:

- Private Costs include additional labor and operating costs for marine terminals operators, trucking establishments and warehousing and distributional centers
- External costs include increased off hours noise in municipalities and effects on property values
- Private benefits include increased throughput velocity in terms of finite capacity utilization over time, reduced wait times for truck drivers and an increase regional supply chain efficiency
- External benefits include increased mobility measured in time savings for passenger vehicles and fewer truck-POV accidents, and fewer air quality related health impacts

Clearly, additional empirical data would be necessary to undertake a cost benefit study. However, cost-benefits analysis does provide a framework to identify the relevant cost and benefits at a conceptual level, regardless of the difficulty or elusiveness of measuring non-market activities.

6.0 Framework for extended hours regime: components and parameters

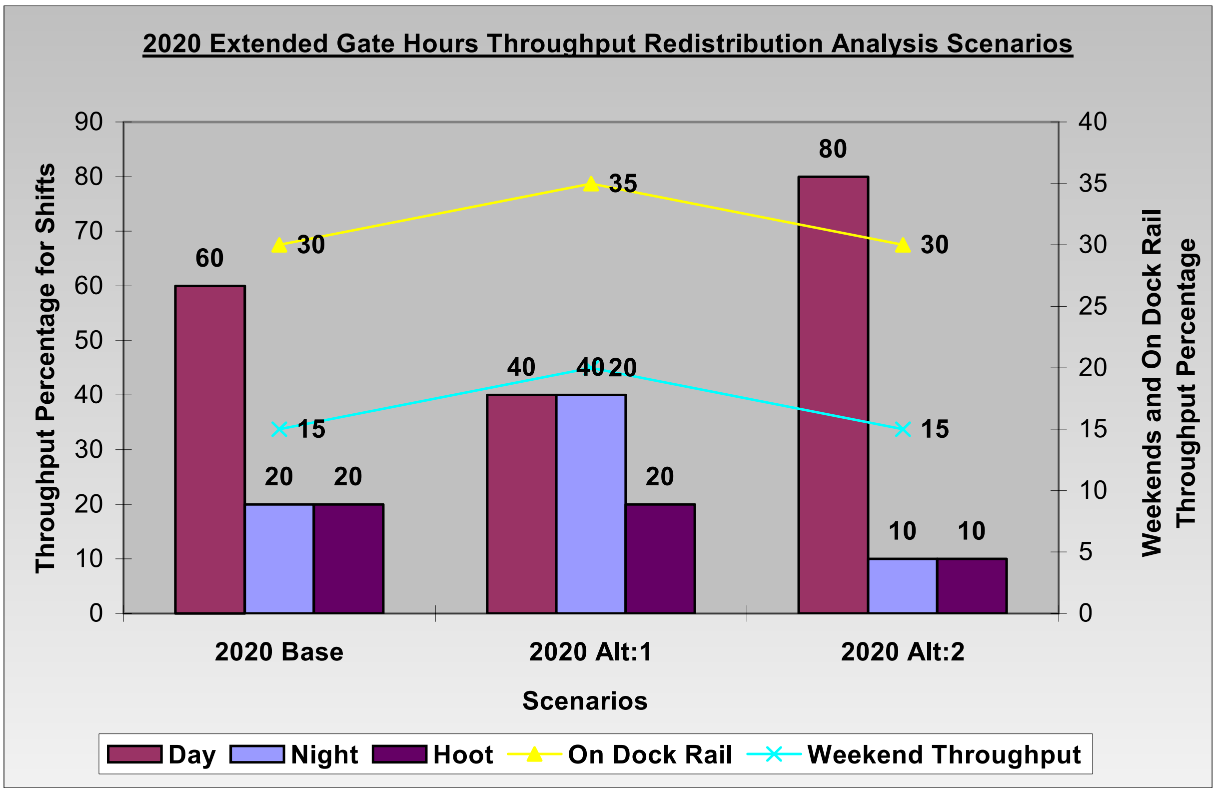
Analysis of all of the foregoing qualitative and quantitative data suggest a broad framework for implementing a time-phased approach to extended gate hours of operation regime with the dual objective of improving individual terminal throughput velocity, and in the aggregate, regional mobility, and the need for benchmarking to evaluate and measure performance along the way toward accomplishing the long term goals in terms of modal and shift redistribution of current and future volumes of terminal throughput set forth in the Transportation Study and the I-710 Major Corridor Study.

6.1 Long term goals extended hours and modal distribution mix

Table 52
2020 Extended Gate Hours Throughput Redistribution Analysis Scenarios

Scenario	On Dock Rail	Weekend Throughput	Shift Percentages		
			Day	Night	Hoot
2020 Base	30	15	60	20	20
2020 Alt:1	35	20	40	40	20
2020 Alt:2	30	15	80	10	10

Source: Ports of Long Beach/Los Angeles Transportation Study, June, 2001



The aggregate long term goals of modal and shift redistribution of current and future throughput volume for an extended hours regime are set forth in the ports Transportation Study to be applied among all fourteen terminals. Incorporation of these goals in the I-710 Major Corridor Study will have the added effect of identifying extended gate hours of operation as a viable transportation system measure required as a prerequisite to major infrastructure project funding. These aggregate goals must be translated into an overall strategic model to optimize throughput volume from each of the fourteen terminals, and in the aggregate.

Under current conditions and system limitations, the on-dock rail goal may be difficult to reach. Yet, the Alameda Corridor project has been built and financed on the premise of drawing away inland drayage to the intermodal rail yards in favor of greater use of on-dock rail. The alternative is even greater truck traffic at the fourteen terminals. Ultimately it may prove easier for marine terminal operators to extend gate hours to maximize throughput velocity in light of finite land capacity. In the future, as in the past, the modal distribution may be determined more by geography, supply chain management practices of shippers and consignees, and the economics of competing surface transportation sectors including over the road (OTR) trucking, intermodal rail, and local pickup and delivery (PUD) drayage.

With aggregate long term goals in mind, the survey cost data collected suggest a phased or trial approach to redistribute a certain percentage of current and future increases in throughput volume allocated on a terminal-by- terminal basis with benchmarking at selected intervals perhaps every five years culminating in the 2010 and 2020 timeframes in the Transportation Study.

6.2 Preliminary steps toward a transitional regime already underway within the port community

The survey data collected suggests the inevitable process of change has already begun in the form of extended first shift gates on weekdays. Terminals are moving from shifts from nine and one half to eleven hours, which is permitted under current coastwide collective bargaining agreements. The survey data also showed that a number of respondents already utilize gang size dispatch, flexible start hours, meal times, and breaks collectively facilitating extended gate hours on first shift operations.

What is evolving is a low risk transitional regime that seeks to maximize full utilization of the existing first shift operation on weekdays by extending the first shift vertically in a temporal sense. The next logical step is to extend first shift operations through a terminal specific or community-wide appointment and scheduling system combined with a driver identification system, greater use of dedicated lanes differentiated by transaction (e.g. empties or bobtails only), or prioritization of gate transactions. All of these initiatives are intended to maximize overall transactions volume within current first shift capacity limits, and prioritize individual transactions during AM and particularly PM peak hours of gate operation.

Use of queuing models on a terminal specific or community wide basis harmonizing the activities of several terminals, particularly high capacity ones, would further maximize existing capacity within corresponding first shift operations.

6.3 Phased in approach toward extended gate hours likely

Again the survey data suggests the next logical phase in the evolution of an extended gate hours of operation regime on the path toward eventual 24/7 operation with an aggregate throughput proportionate redistribution approaching that of the Transportation Study scenarios. Variable labor cost data collected suggested that limited service gates appear to require lower unit volume levels of containers for second and hoot shifts, and on weekends and can be utilized in combination with existing flexible gates on the first shift on weekdays, and Sunday gates to create momentum toward an extended gate hours regime with shippers participation and reciprocal commitments.

6.4 Synchronization of marine and gate operations as long term strategy

Over the longer term, the data suggests that synchronization of marine and gate operations, optimizing the weekly flow of marine operations with gate hours of operation offers the greatest potential for achieving twin goals of increasing throughput velocity and regional mobility. This approach suggested by the data is designed to process import containers coinciding with vessel arrivals early in the week shifting to export operations later in the week coinciding with vessel departures, coordinating truck dispatch and prioritizing gate operations accordingly. Adoption of this approach on a terminal specific basis appears could alleviate much of the port and terminal generated truck congestion during AM and PM peak hours on the limited number of major access routes to the port complex.

The aggregate weekly marine activity data provided by the Los Angeles-Long Beach Marine Exchange tends to corroborate the weekly cycle of vessel arrivals and departures suggested by anecdotal evidence from terminals and truckers.

A terminal-by-terminal pattern of standard operations could be established with the objective of accelerating throughput velocity by scheduling gate hours to continually flush terminals of inbound import containers coinciding with vessel arrivals on Sundays, Mondays and Tuesdays. Beginning with Sunday first, second and hoot shift gates and continuing with additional second and hoot shift gates on Mondays and Tuesdays. Wednesday is a traditional slack day and could be used for non-priority pickups in the AM and priority deliveries of outbound export containers for vessel departures on Thursday and Friday along with additional gates open on the second and hoot shifts on Wednesday and Thursday as necessary to flush out outbound containers in preparation for the next weekly cycle. The mini- land bridge example of scheduling extended second and hoot shift limited service gates for large customers with warehousing and distribution centers and current extended receiving hours is a precedent and promising first step in this regard.

6.5 Changes in existing supply chain management practices necessary

However, in order for any extended gate hours regime to succeed in redistributing freight flows to maximize throughput velocity, certain current practices must change. Shippers and consignees cannot continue to have it both ways in terms of negotiating extended free time or demurrage free warehousing at marine terminals. Their own warehouse and distribution facilities could not operate under similar artificial constraints. The result is a private cost of inefficiency that is absorbed in the supply chain in the form of a congestion tax that becomes a negative social cost when it contributes to increased congestion and reduced regional mobility. In addition, terminal operators cannot afford to provide free empty container storage for individual carrier or alliance owned containers at marine terminals measured in extended dwell times and degradation of terminal throughput velocity.

6.6 Complementary role of information technology in improving in transit visibility, throughput velocity and regional mobility

The second workshop demonstrated the positive correlation between adoption of information technology and in transit visibility with a positive impact upon throughput velocity and regional mobility. The experience of terminal operators with current technology suggests that the optimal regime, one which combines high reliability and desired interoperability with shipper, trucker, and intermodal rail stakeholders, remains somewhat elusive.

In particular, the role of third party community based portals such as emodal can provide the necessary electronic data interchange platform to share data concerning cargo clearances, issue booking orders, match containers and drivers, and schedule pickup and delivery windows at marine terminals**.**

The survey data was encouraging in terms of the growing utilization of automatic equipment identification (AEI) used in terminals and at gates, along with the use of optical character recognition (OCR) and kitchen gates at some terminals, as a means of expediting gate transactions, a contributing factor in terminal queues and wait times.

The workshop also demonstrated a positive role for complementary intelligent transportation system (ITS) measures within and outside the port complex such as intelligent signage on gateways, real time web based traffic reports and remote video cameras providing real time queue information, and infrastructure improvements that segregate passenger vehicles from increasing truck volumes on some corridors such as the I-710 and I-60 also hold considerable promise of improving regional mobility particularly in light of the ten year lead time before major I-710 improvements can be funded and completed.

7.0. Next steps: Benchmarking an extended gate hours of operation regime

The consensus recommendation of the Town Hall-Industry Forum for extended gate hours is clearly validated by stakeholder qualitative data from the closed first CITT workshop, analysis of original survey data, and is consistent with the assumptions made in the ports' Transportation Study and MCS Regional Analysis. The consensus, from these various sources, is that implementation of an extended gate hours of operation by marine terminals regime over time is critically necessary and achievable. Extended gate hours are a required prerequisite to major infrastructure investment funding for the I-710 corridor. Additionally, extended gate hours is viewed in this study as a best practice to increase throughput velocity, improve the regional goods movement supply chain efficiency, and enhance regional mobility through congestion reduction.

7.1 Public policy need to validate pace and benchmark performance of transition toward extended gate hours regime in the interest of economic efficiency

The ports' Transportation Study and Caltrans MCS regional analyses portray the future requirements and likely impacts upon regional mobility from adoption of extended gate hours operation by all fourteen marine terminals**.** Cost benefit analysis can validate the aggregate private and social costs and benefits likely to result from the implementation of an extended gate hours of operation regime. In turn, each terminal can seek to optimize its own redistribution of throughput volume using break-even analysis and the application of various queuing models.

The key to successful implementation on a phased basis and measurement of progress toward the goals set forth in the various analyses will be benchmarking performance by individual terminals measured in terms of throughput velocity, and aggregate impacts upon regional mobility measured in level of service performance on the I-710 corridor and other gateways to the port complex

7.2 Performance benchmarking key to successful strategic implementation

Performance benchmarking is a systematic approach to identify and implement an optimum configuration of a system. A benchmark allows the analyst to make comparisons between the current system and a modified system or a theoretical model for simulation purposes. Benchmarking involves measuring the values and parameters of a system i.e., the metrics. Looking at a marine terminal through the prism of the terminal survey, we can examine its configuration, capacity, dynamic flow processes, and costs on which to base the benchmarking performance evaluation

Benchmarking typically includes four types of activities:

(1) Research and planning;
(2) Data and information collection from the system;
(3) Data analysis; and
(4) Implementation or simulation to improve the system.

The data analysis suggests the next logical analytical steps to implement benchmarking performance evaluation through either systems modeling based upon detailed process data collection over a period of time on a terminal specific basis or simulations based upon certain assumptions about the terminal system. The former would most logically be undertaken at the individual or joint request of a terminal or terminals seeking to maximize throughput velocity. The CITT research staff has begun to develop a Regional Supply Chain Simulation Model to benchmark and measure the performance of best practices, or process changes in the aggregate, and major infrastructure improvements on regional supply chain efficiency and mobility**.**

At the same times, we are seeing emerging new analytical research tools that may be applied to the regional goods movement model, terminal input/output, and modal distribution sub-models based upon the use of artificial intelligence. These research tools are adapted from advanced DOD logistics planning based upon object modeling, ontologies, and collaborative agents that could be put in place to continuously benchmark the performance of the enter regional supply chain on a real time basis to ensure optimal performance

7.3 The incentive problem in the marine terminal truck queue dilemma

There is no element in economic analysis that is more pervasive than individual responses to incentives. Typically, these incentives guide economic agents to utilize resources in an efficient manner. However, the underlying assumption of these models is that all resources are priced. When resources aren't priced inefficiencies arise. While these inefficiencies may be solved by market forces, oftentimes government must play a role in assigning property rights or making economic agents aware of external costs.

Such is the case of the truck queue dilemma. Since all agents are acting independently, truckers will typically line up at the terminal's gate in the early morning. Their primary desire is to pick up their container, deliver it and then return to the queue since their income is determined by the number of delivers and not driving time. Terminal operators, on the other hand, receive their pay from ocean carriers to load and unload vessels. They have no direct incentive to facilitate the objectives of the trucker in reducing waiting and turnaround time. For example, as port activity dramatically increased we witnessed continued movement away from wheeled operations to decked operation within the terminals. Wheeled operations typically reduce the time needed to load a truck.

Moving to a decked operation increases the cost to trucker who now waits for the container to be located and loaded onto a chassis. Since the terminals are primarily concerned with the loading and unloading of vessels a decked operation makes sense as it provides a high level of service to the terminals primary customer, ocean carriers. As the terminals become increasingly congested with containers, there is a greater incentive to flush out the containers to make more room for incoming or out-bound freight

7.4 Terminal space and freeway capacity as common property resources

In the case of the ports, one important resource that is not priced is our freeways and roads. The failure to price roads and freeways yields congestion, which, in turn, reduces regional mobility. While there are examples of roadway pricing, much of the focus has been on passenger rather than goods movement. The congestion on the roadways leading into and out of the port reflects a strategy that imposes significant external costs on the region. Under the current regime, a driver selects the time to arrive at a terminal during normal hours of operation that may be 8:00 AM to 4:30 PM Monday-Friday. As a result, the bulk of drivers arrive during peak periods frequently in response to a shipper request without regard to terminal delays. This behavior is referred to in game theory as a "non-cooperative" solution, in which each person maximizes their own rewards regardless of the outcome or results for others.

Alternatively, it is in the power of the authority (the terminal, in this case) to prevent this inefficiency by the simple expedient of not respecting the queue. If the marine gate clerks were to ignore the queue and, let us say, pass out lots for order of service at the time of each truck arrival, there would be no point for anybody to stand in line. More importantly, there would be no effort wasted by queuing. Because of continued growth in container volumes, we may have finally reached a point where the participants in the game are ready for a new set of rules.

7.5 Cooperative versus non-cooperative games

There are at least two possible kinds of rational strategies in non-constant sum games such as the terminal queue. One is a non-cooperative solution in which each person maximizes his or her own rewards regardless of the results for others (and only the first several truckers to join the queue benefit under this approach), and a cooperative solution in which the strategies of the participants are coordinated so as to attain the best result for the whole group. Cooperative games are the basis for collaborative supply chain management strategies played out along the end-to-end supply chain among groups of participants and stakeholders.

In cooperative games, a group of players who commit themselves to coordinate their strategies is called a coalition. In game theory what the members of the coalition get, after all the bribes, side payments, and quid pro quos have cleared, is called an allocation or imputation. From anecdotal data these side bar arrangements have made the current regime work up until this now (such as through mini-land bridge coordinated container moves) for some shippers, terminals, and truckers on the waterfront, getting by from year to year, as throughput demand increases.

Examples drawn from the CITT stakeholder workshops and the survey data collected illustrate the message that the rules of the game are changing. Namely, a realignment of players in the form of customers and servers is already underway. Under the current regime there is no incentive for truck drivers to do anything different than they do now which is to all arrive during the narrow AM and PM peak gate week day hours of operation for all 14 marine terminals.

The predictable result is what is called a dominant strategy equilibrium which makes everyone is worse-off. However, if as the rules of the game begin to change, we can begin to move towards an improved and moiré efficient allocation of resources. We do this by imposing market discipline based market incentives or disincentives such as the use of tolls, auctions, differential shift pricing, tariff regulatory controls such as preferential or priority gate or lane access during peak hours, or through the imposition of a scheduling and appointment system on drivers. The gross payoffs to the terminal operator as supplier are negative, because introduction of the scheduling system is a cost item to the terminal operator, and the benefits to the trucker as user are the payment they get from the shipper, minus that cost.

The elements of such a regime are already in place. The data from marine terminals gathered for this study suggests that many of the elements are already in place, and many of what has been termed as best practices have been tried by some terminals with limited degrees of success to date. The major barriers to across the board implementation include the Prisoner's Dilemma or first cause paradox in which in a highly competitive environment, in the short term the first player to innovate must take risks, inevitably encounters resistance, incurs added costs, uncertainty, and unanticipated consequences, and other players benefit in the short term at the innovator's expense. Therefore, no one wants to be the first cause or the innovator.

7.6 Application of queuing game theory to marine terminal system operations

In terms of queuing game theory, the marine terminal is a single server (or collection of servers e.g. berths, cranes, gates) with multiple customers, carrier/Alliance/vessels, trucks, rail and shippers/consignees, representing a fundamental change from the traditional carrier as the terminal's customer (although still contractually or more often institutionally linked).

Figure 3 shows the elements of a single queue queuing system.

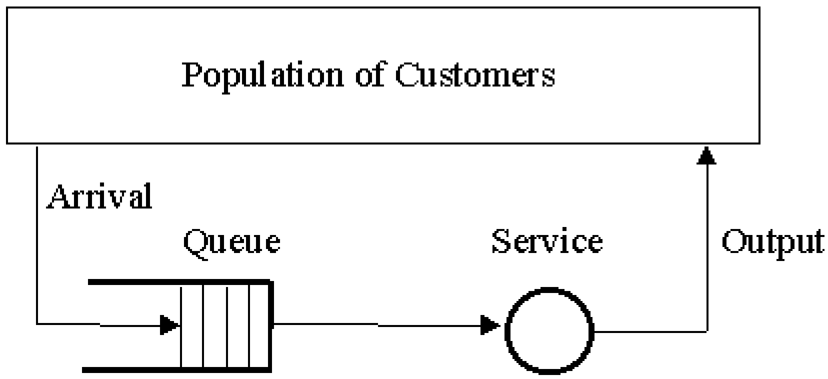


Figure 1

Elements of Queuing Systems

Figure 5

Market design involves creating a venue for buyers and sellers and a format for transactions analogous to the design of the auction markets for radio frequency spectrum licenses, spot markets for electric power, and labor market clearinghouses. The principal design task is to create a centralized market clearinghouse that will compete effectively for participants with the inefficient alternative of decentralized bilateral contracting. Today that is embodied in the tracking of cargo clearances by fax and shipper notice to the trucking company to pick up an individual shipment, or delivery under a booking order, without regard to any parties other than the two contracting parties, the trucking firm and the shipper.

The first step in creating such a market –as distinguished from individual terminal initiative to date--has already been taken with the introduction of emodal and its Marine Terminal Corporation (MTC) counterpart. Both create a community based third party communications platform or portal to link shippers, carriers, customs brokers, and terminal operators using universal data protocols such as EDIFACT and xml language and web based for ease of access.

The next step is to form a coalition, beginning with a few terminals with symmetrical congestion problem elements (common access routes, gate proximity, vessel arrival and departure schedule) based on the long term strategy towards an extended gate hours regime, which matches or synchronizes vessel arrivals/departures with a truck appointment system to reduce terminal congestion. Vessel arrival and departure data seem to corroborate the CTA workshop approach of attempting to "flush" the import inbound containers which primarily arrive on Sunday, Monday and Tuesday, on Monday, Tuesday, and Wednesday AM. Conversely, outbound export containers should optimally arrive Wednesday PM to be "flushed" out on board departing vessels on Thursday and Friday.

The queuing model then can be built utilizing empirical data for each terminal based upon its vessel arrival and departure volume and distribution, throughput demand forecast, terminal storage capacity, gate configuration, and modal distribution. The dynamic nature of an optimal marine terminal queuing model requires balancing many temporal variables to be optimized including: gate operating hours (including flex gates already used by some terminals from the data collected), shift times (including flex times), throughput distribution over peak and slack days of the week (including import containers on Monday and Tuesday, and export containers on Thursday and Friday), fluctuating weekly distribution, and peak versus average monthly throughput distribution.

The supply chain management objective of the application of queuing game theory must be to eliminate bottlenecks in the marine terminal that overflow beyond the gates, creating negative externalities such as traffic congestion and pollution and adversely affect regional mobility. Under this approach the current terminal practices and processes constituting negative cost externalities must be identified, quantified, internalized, and eventually eliminated to restore supply chain efficiency.

This should include:

(1) reduction in free time equivalent to free warehousing for full containers on marine terminals negotiated between carriers and shippers imposing congestion costs upon terminal operators thereby reducing average dwell time for import and export containers;

(2) internalizing the negative cost externalities of storage of full containers by further reduction in both port tariff demurrage from five days to three days before and as a best practices throughput velocity element in current lease agreements, and by eliminating the practice of crediting demurrage charges against other revenues at volume break points, and increasing terminal tariff demurrage charges and the number of days of free demurrage accorded shippers likewise;

(3) terminal tariff assessment of empty container storage charges on carriers (by terminal lease requirement, if necessary) to internalize negative cost externality of free warehousing of empty containers, thereby reducing empty container dwell times;

(4) maximize/rationalize current queuing capacity through the adoption of a priority allocation system in the form of a queuing discipline to maximize throughput during current day time first shift gate hours (a scarce commodity) particularly during AM and PM weekday peak periods, including priority gate/lane access to chassis/empty

container return and full container pickup and reverse (versus bobtails, empty returns only), deferral of certain gate transactions to off -peak hours, or institution of appointment and scheduling system with two hour time windows;

(5) incorporate supply and demand equilibrium based market pricing regime by establishing a terminal tariff based differential pricing scheme that charges premium for gate access during peak periods;

(6) carrier internalization of gate queue negative cost externality of uncompensated truck drier wait time (trucker paid by load) in through bills of lading/door to door service and air pollution and congestion costs;

(7) time-phased incremental extension of gate operating hours through use of flexible gates/shift times to stretch AM-PM peak to non–peak hours e.g. 7 AM opening, and shifting 1:30-3:30 PM peak to later with extended hours from 5:00 PM to 7:00 or 8:00 PM close (9 ½ -11 hour daytime gate hours);

(8) use of Monday-Tuesday hoot or Sunday weekend shifts to flush import containers; and

(9) adjust gate/shift hours to redistribute weekly throughput to flush out terminals to synchronize with ebb and flow of vessel arrivals/departures e.g. maximize Monday-Tuesday-Wednesday AM gate import transactions from Sunday-Monday-Tuesday vessel arrivals, and Wednesday PM-Thursday gate export transactions for Thursday-Friday vessel departures (like tide tables) utilizing Wednesday, a slack day for marine operations, as a swing day for gate and terminal repositioning activities.

As the Second Stakeholder Workshop demonstrated, information technology (IT) and intelligent transportation systems (ITS) will play a significant complementary role to the adoption of best practices, such as extended gate hours of operation, as workforce multipliers to meet future terminal throughput demand.

The primary benefit of proliferation of information technology in the marine terminal environment is through improving in transit visibility or transparency as between the physical movement of containerized freight and the flow/interchange of data critical to the timely movement of containers through the terminals and the regional supply chain.

From the survey data, a number of terminals have some form of Automatic Equipment Identification (AEI), principally in the form of optical character reading (OCR) technology, at terminal gates permitting positive matching of containers and chassis, and delivery/pickup by booking order, and potentially the institution of a driver identification card system, positive matching of container and driver as well.

A number of terminals also utilize one form or another of terminal radio frequency identification (RFID) system to locate empty and full containers and chassis while on the terminal (with varying degrees of precision and accuracy) augmenting truck pickup and delivery queuing distribution of service turn time operations. Most of the terminals have also adopted a port community based communications platform such as emodal/MTC for data interchange on vessel arrivals, Customs clearances, and potentially driver ID, truck dispatch and booking number coordination transitioning into an appointment and scheduling system.

Workshop II identified the need for a global port interface/community data interchange among marine clerks to improve standardization and productivity, and eliminate operator introduced errors, at each of the marine terminals, which could be extended to include truck dispatch, shippers/consignees using a minimal number of common data elements and based upon a universal data interchange protocol (e.g. EDIFACT).

Ultimately, as a new paradigm evolves through collaborative means toward a cooperative queuing game based regime, the issue of who pays for the incremental cost of extended gate hours of operation on a terminal-by-terminal basis. The simple illustrations provided have suggested some approaches to the range of solutions that maximize and redistribute payout among stakeholders including terminal operators, truckers, and shippers/consignees

The survey data collected illustrates the average incremental break-even costs in both dollars and number of containers for a limited or full service gate on the second, hoot or weekend shifts. Data suggests that several terminals have experimented with differential pricing among shifts.

The differential pricing may be skewed in the direction of charging full incremental cost per container on second or hoot shift operations. It may be that shippers may be willing to pay differential premium price discrimination for off non-peak hours with no wait times or required appointment. However, the differential pricing, from the perspective of regional mobility, suggests lower off-peak and higher peak-hour pricing to reduce congestion costs.

Alternatively, an appointment /scheduling system could either operate a as a standalone mechanism to allocate scarce resources i.e., AM-PM peak hour gate transactions or could easily be converted into a commodity by overlaying an auction similar to the on-line spot market for energy and allowing the market and supply-demand equilibrium to set the price for peak transactions. In between these alternatives each terminal tariff could merely establish peak off-peak rates for truck pickups and deliveries based upon full cost recovery

7.7 Recommended future analytical approach

In this Phase of our regional supply chain benchmarking we have incorporated a qualitative analysis of proposed changes in process in the form of transportation systems management measures represented by proposals for extended gate ours of operation of marine terminals in order to meet the dual objectives of maximizing throughput velocity and at the same time improving regional mobility. We have combined this with a descriptive analysis of stakeholder implications of those proposed changes on the current regional supply chain along with anecdotal evidence and observations to support those implications.

On the basis of marine terminal survey data we have developed a limited quantitative database to be supplemented through stochastic probability analysis where the collected data is insufficient for drawing conclusions and inferences on the state of the current system and the implications of proposed changes or the substitution of a modified system.

On this basis the next sequential and transitional elements of a terminal throughput optimization plan and strategy toward an extended gate hours of operation regime to maximize aggregate marine terminal throughput in the combined port complex would include the following:

(1) Performance of an overall community wide cost-benefit analysis of an extended gate hours of operation regime for all fourteen marine terminals;

(2) Develop marine terminal queuing theory modeling and simulation;

(3) Run queuing model testing and validation and scenario simulations;

(4) Multi-terminal demonstration project planning and design based upon queuing model scenarios;

(5) Demonstration project implementation and data collection:

(6) Benchmarking analysis of demonstration project data;

(7) Draft implementation plan incorporating recommendations for changes in current stakeholder (port, carrier, terminal, trucker, shipper/consignee, State and municipal policies and incentives to encourage adoption and implementation of long term strategy for phased implementation of extended hours of operation and related practices by marine terminals; and

(8) Develop artificial intelligence based long term real time benchmarking performance evaluation model for extended gate hours regime

Additional terminal specific data collection is necessary to support a quantitative approach to developing a terminal queuing model that prioritizes gate moves within the current or flexed first shift, and by day of week synchronizing marine and terminal operations by terminal linked to an appointment/ scheduling system incorporating premium differential terminal tariff pricing structure for first, second and hoot operations to offset incremental costs to individual terminals.

Terminal data suggests incremental process changes are already underway. These include:

(1) 9 ½-11 hour first shift extended gate hours, including meals and breaks;

(2) weekend vessel arrivals with no gate hours, all yard work on second shift during the week, prioritized gate moves on first shift with no marine or yard work, and no queue lines.

8.0 Setting a collective course towards a 7/24 Hour Solution: Findings, Conclusions, Recommendations and Next Steps

8.1 Research findings and conclusions

This second phase of our regional supply chain benchmarking project provides a qualitative and limited quantitative analysis of proposed process changes in marine terminal operations in the form of proposals for extended gate hours of operation. This approach serves as the basis for evaluating the economic and social benefits and supply chain implications of their adoption as recommended best practices in order to meet the dual objectives of maximizing throughput velocity, and at the same time improving regional mobility by relieving regional congestion through the displacement of some portion of port generated truck traffic to non-peak hours corresponding to alternate labor shifts for terminal gate operations.

The qualitative analysis is based upon a workshop focus group designed to identify and rank order first and higher order stakeholder supply chain implications of the proposed changes to operating practices on the current regional supply chain along with anecdotal evidence and observations to support those implications. Seminal marine terminal survey data from a cross-section of terminal operators was obtained to provide a limited quantitative database upon which to apply break-even analysis to evaluate the likely economic impacts associated with changes in operating practices as the basis for drawing conclusions and inferences on the feasibility of their adoption by marine terminals and resulting impacts upon regional mobility and supply chain efficiency.

8.1.1 On this basis the following key findings, conclusions, and inferences from data and observations may be drawn:

- Broad Stakeholder Support for Extended Gate Hours. There exists broad stakeholder support and perceived social benefit across all elements of the regional supply chain for adoption of extended gate hours of operation by marine terminals as a non-structural solution to relieving congestion from port generated truck traffic and improving regional mobility.
- Infrastructure Improvement Planning Assumes Extended Gate Hours. Every planning option under consideration in the Major Infrastructure Study for the I-710 Improvement Project assumes the voluntary implementation of transportation systems measures including extended gate hours of operation to maximize use of current freeway system capacity as a necessary pre-condition to economic justification for public infrastructure investment.
- Environmental and Quality of Life Concerns. Stakeholders are properly concerned about the social costs and externalities in the form of environmental and quality of life impacts of both growing congestion and extended gate hours of operation upon surrounding and distant communities from displacement of truck traffic to off-peak hours.
- Reciprocal Requirements. Implementation of extended gate hours will require corresponding changes in shipper and receiver practices associated with truck dispatch

and receiving hours, and municipal approval in the form of conditional use permits for night operations in affected communities.

- Associated Direct Costs of Extended Gate Hours. There are associated direct and indirect costs associated with extended gate hours of operation that must be absorbed and amortized across throughput volume in the form of incremental labor costs at marine terminals, local drayage (further constrained by Federal regulations as to maximum works hours), shipper and receiver warehouse hours of operation, and additional customs and other inspection costs.
- Labor Work Rules Flexibility. Sufficient flexibility exits under current labor work rules to permit implementation of extended gate hours of operation on a phased basis beginning with extended first shift operations and continuous gate operation during meals and breaks extending to second and third shift operations over time.
- Current Terminal Operating Experience. Current terminal operating practices include coordinated mini-landbridge operations on second and third shifts involving terminal labor, marine terminal operators, shippers, and shippers/receivers that serve as a model for across the board extended shift operations.
- Break-even Cost Analysis. On the basis of marine terminal provided cost data, the incremental break even cost of operation for second and third shift operation at applicable labor rates and manning levels is cost-effective at projected distribution of throughput volume.

8.2 Recommendations and Next Steps

8.2.1 Required industry near term initiatives: supporting process and information infrastructure

- Collaborative effort needed. The stakeholders were unanimous in recommending that a more collaborative process was needed in order to implement an extended gate hours of operation for marine terminals regime that included terminal operators, organized labor, shippers and receivers, trucking and warehousing, regional planning agencies and municipalities in that effort.

- Communications and scheduling portal. A community based web portal, such as emodal Scheduler or MTC Voyager, or an equivalent open architecture, is necessary to provide a platform for coordinating truck dispatch, shipment information, marine terminal container pickup availability, and shipper and warehouse receiving availability in support of extended gate hours of operation.

8.2.2 Required near term research initiatives: analytical framework

- Formulation of Terminal Throughput Optimization Model Based Upon Queuing Theory. Applying economic queuing game theory we have identified the values and parameters of a static or dynamic queuing model that can be applied to simulate the various server operations performed by a typical marine terminal.

The objective is to maximize gate movements per shift coordinated with marine and terminal operations with minimum truck wait queues and regional traffic congestion consistent with traffic management redistribution mobility goals. Each terminal, or group of terminals sharing common arterial connectors (such as Maersk-Sealand, American President Lines and Hanjin), should adopt a queuing model to harmonize terminal and gate hours of operation and optimize throughput and relieve terminal generated truck congestion over a 24/7 three shift operation encompassing import, export and empty container movements.

8.2.3 Required joint industry and research initiatives: best practices planning

- Throughput Optimization Plan and Strategy. Joint industry and research initiatives are necessary in order to take the next steps in developing a sequential and transitional elements of a terminal throughput optimization plan and strategy toward implementing an extended gate hours of operation regime to maximize aggregate marine terminal throughput in the combined port complex. These would include the following:

(1) Performance of an overall community wide cost-benefit analysis of an extended gate hours of operation regime for all fourteen marine terminals;

(2) Develop marine terminal queuing theory modeling and simulation;

(3) Run queuing model testing and validation and scenario simulations;

(4) Multi-terminal demonstration project planning and design based upon queuing model scenarios;

(5) Demonstration project implementation and data collection:

(6) Benchmarking analysis of demonstration project data;

(7) Draft implementation plan incorporating recommendations for changes in current stakeholder (port, carrier, terminal, trucker, shipper/consignee, State and municipal policies and incentives to encourage adoption and implementation of long term strategy for phased implementation of extended hours of operation and related practices by marine terminals; and

(8) Develop artificial intelligence based long term real time benchmarking performance evaluation model for extended gate hours regime

8.2.4 Required industry research support: documentation

- Terminal Specific Data Collection Requirements. Additional terminal specific data collection is necessary to support a quantitative approach to developing a terminal queuing model that prioritizes gate moves within the current or flexed first shift, and by day of week synchronizing marine and terminal operations by terminal linked to an appointment/ scheduling system incorporating premium differential terminal tariff pricing structure for first, second and hoot operations to offset incremental costs to individual terminals.

Terminal data suggests incremental process changes necessary to implement such a system are already underway. These include:

(1) 9 ½-11 hour first shift extended gate hours, including meals and breaks;

(2) weekend vessel arrivals with no gate hours, all yard work on second shift during the week, prioritized gate moves on first shift with no marine or yard work, and no queue lines.

8.2.5 Required joint industry and research initiatives: strategic modeling

- Formulation of Terminal Specific Queuing Optimization Model. The next step is the development of terminal specific queuing models to maximize throughput velocity individually and in the aggregate across the temporal spectrum. The objectives of any terminal specific queuing optimization model must be to:

  (1) Maximize and redistribute current freight flow volume within peak and non-peak hours under current shift structure, modify, and eventually extend gate hours of operation based upon laws of supply and demand equilibrium; and

  (2) Synchronize marine and gate hours of operations and freight flows to flush terminals of import and export containers based upon vessel arrival and departure schedule for each terminal;

  (3) Demonstrate Paretian efficiency by amortizing/allocating unsubscribed costs of additional gate hours of operation over throughput volume;

  (4) Incorporate principals of queuing or dispatch discipline to queue through:

    (a) spatial segregation/separation of gate transactions (empties, full, bobtail, chassis) through use of priority gates/lanes, or relocation (off dock/terminal container yard storage or interchange; alternatively, encourage virtual gates, out of port interchange/street turns (out of port interchange of export bookings) verified by scheduling system;

    (b) temporal allocation (scheduling/appointment), flex scheduling, extended hours of operation;

    (c) differential market driven tariff terminal pricing structure as between first and second and hoot shifts based upon incremental cost differential between shifts; and

    (d) driver positive identification (biometrics) linking driver to appt/scheduling system;

(5) Phased-in shift to extended gate hours of operation on a terminal specific basis incorporating:

(a) flexible shift scheduling extended first shift e.g 9 ½-11 hours, w/gates open during meals/breaks:

(b) hoot shift pickup and returns only, or unscheduled pickups/returns;

(c) shift restructuring/specialization e.g. marine operations shift to weekends and second or hoot shifts, terminal operations (M&R, spotting) shift to second shift, and gate moves only during only during first shift

(6) Extended receiving hours initiative using shipper/consignee origin and destination data to determine volume, priorities, and need to obtain shipper participation, modify local ordinances e.g. intermodal rail facilities operate on 7/24 schedule combine with a shipper/consignee commitment through PSA's, confidential service agreements, demurrage tie-in incentives;

(7) Statutory authorization for a transportation systems management measures program, combining local ordinance review/consistency compliance linked to State STIP project eligibility to promote extended receiving hours.

8.2.6 Required long term joint industry and research initiatives: performance evaluation and measurement

- Benchmarking Performance Evaluation of Throughput Optimization Model Using Artificial Intelligence. The proof and validation of any model and plan is in the execution. A proposed benchmarking performance evaluation matrix should be developed defining the object models, ontology, and collaborative agents for a modified gate hours of operation terminal queue optimization model would include:

(1) aggregate truck movement shift redistribution for all terminals:

(2) aggregate truck movement routing redistribution during 1st shift, I-710, I-110, SR 47/113, Alameda St matched to origin and destination (emodal scheduler):

(3) maximum gate moves/hr/shift/day per terminal:

(4) regional mobility indicator: aggregate truck traffic proportional reduction during peak hours and measured in corresponding level of service (LOS) improvement for I-710; and

(5) supply chain velocity per terminal measured in reduction in free time/demurrage and empty container dwell time for imports, exports and empties.