A Collaborative Coordination System based on Supply Chain Management Concepts for a Maritime Port Logistics Chain

Rosa G. González Ramírez

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Research Lines

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6. A Collaborative Platform System for coordinating inland flows: VBS
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Research Lines
We are a research group conformed by researchers and consultants from the School of Industrial Engineering, with solid practical and theoretical knowledge in Supply Chain Management, Operations Research and our main focus is the analysis and solution to complex problems arising in the industry of logistics services, intermodal transport, trade facilitation and collaborative platform information systems.

We collaborate with public and private enterprises, logistic communities, gremmial associations, Regional Council of Logistics as well as national and international research groups.

We are currently developing R&D projects funding from different institutions of the Chilean Government: FONDEF, CORFO INNOVA R+D, FIC (Innovation and Competitiveness Funding) based on the requirements of the Port Logistics Community of San Antonio (COLSA)

Website (under construction)  
www.nodologistico.cl
+Research Lines

**Port Community of San Antonio, COLSA**

- Strategic Plan and Governance support (2010-2012)
- Foundation (2013)

**Infrastructure Committee**
- Analysis of current infrastructure requirements
- Support for a proposal USTDA for a feasibility study of the corridor SCL-SAI (multimodal)

**Logistics Committee**
- Vehicle Booking System design
- Fleet Matching Tool design
- Traceability Platform
- Business Process Analysis of import and export logistic chains
- DSS for yard allocation problem (storage space for containers)

**Environmental and Social Integration Committee**
- Local supplier development: Market Place B2B Platform
- Social Responsibility
- Port/City relationships

Port Community of Arica
1 Introduction
a) International Transport, Logistics and Cargo Distribution Concepts

- International Cargo Transport takes place at an intercontinental and regional scope.
- It is subject to geopolitical considerations: control, competition and cooperation.
- There exists a fragmentation of production systems and an expansion of global world trade.
- There exists multinational and domestical enterprises in the globalization scenario.
- There is an increasing level of integration among production, distribution and consumption.
- An efficient management of this integration at a world scale is the labor of logistics and the container is the main element of intermodality.
Physically, international trade requires a “transport chain,” which is a series of logistical activities that organizes modes and terminals, such as railway, maritime, and road transportation systems for continuity along the supply chain. The port, particularly the container terminal, has become an important trade and logistics platform whose level of activity not only reflects the intensity of infrastructure utilization, but also the logistical capabilities to support its operations. (Rodrigué, 2012).
Introduction

Maritime Shipping Transport: A matter of size

- World transport accounted 16 millions of TEUs in 2011.
- 5 Shipping lines represent 40% of the world transport capacity.
- Top 20 companies grewed 12,5% between 2010-2011.

- Container traffic represented 22% in 2011 in the world traffic.
- The inventory of containers in the world is estimated in 30 millions TEUs.
- In 2010, 293 container ships were manufactured.
- 20% have a capacity greater or equal to 10,000 TEUs.
Ports: Consolidation of the GTOs

- Top 10 GTOs transferred 210 MM TEUs, with a 45% participation.
- To 2016, it is expected that port industry transfer more than 840 MM TEUS.
- On average, transhipment per container in 2010 was 19 times.

- DPW, the third world wide stevedor, is expecting to have a capacity of 100 millions TEUs/year in 2020 (growing twice of capacity).
Introduction

Ports: a Latam GTO

- SAAM has business related to ports, tugs and logistics.
- US$641 MM income in 2011
- Growing plans 2012-2016 aim to invest in ports around US$2,400 MM

According to UNCTAD in the *Review of Maritime Transport 2011*, Latam will concentrate in 2020 a port investment of 12 billion dollars
LATAM Background
2011

- Latin American and Caribbean ports have seen a remarkable growth of the containerized traffic handled with the development and expansion of port infrastructure.

- Latam and Caribbean countries represented 7.3% of world container traffic in 2011. Along with China, the region represented the highest increasing rate 2010/2011, with 13.9%.

- Even tough North American ports transferred the highest volumes, increasing rate 2005/2010 was relatively low, while Latam and Caribbean ports represented 88% of the increasing rate for the continent.

- There exists 143 commercial ports in the region that transfer 41.3 millions of TEUs in 2011.

- Four countries explain 53% of the regional traffic (Brazil, Panama, Mexico and Chile).

- The main transhipment ports are from Panama (Colón and Balboa), and the main port of national cargo was Santos (Brasil).

Sources: IADB; Rodrigue, (2012)
+Latam Background

Source: IADB Rodrigue, 2012
2012

- However, according to CEPAL, in 2012, Latam/Caribbean ports faced a deceleration (4.3% increasing rate, compared to a 15% in 2010 and 13% in 2011).

- Argentina and Jamaica presented decreasing rates 2012/2011 (-10.5%, -35%), while Chile, Panama and Brazil registered a low increasing rate (1.2%, 3.4%, 3.6%).

- Peru, Colombia, Mexico, Costa Rica, Venezuela and Dominican Republic show an increasing rate (9.9%, 18.2%, 13.9%, 15%, 17.6%, 18.4%).

- The Port of Callao, Cartagena and Buenaventura, Lázaro Cárdenas, Manzanillo and Veracruz, Limon Moin, Cabello and Caucedo were the most dynamic ports.

- Chilean more important ports are the Port of San Antonio (13 position at the ranking Cepal 2012) and the Port of Valparaíso (15 position).

Source: Ranking Cepal 2012
Logistics and transport Performance improvement is a key element:

- ↓ Commercial and end product costs
- ↑ Competitiveness
- ↑ New Markets
- ↑ Investment
- ↑ Productivity
- ↑ Economic development
Latam/Caribbean ports challenges include:

- Acquisitions and development of port technology
- Coordinated port-city development
- Trade facilitation, including Customs improvements, human resources development and international cooperation
- Better hinterland coordination. Inland transport has achieved a more significant role and is a key element in terms of total logistics costs.

Source: IADB; Rodrigue, (2012)
3 Port Logistics Chain and basic concepts
Classification of Ports according to utilization

- Public Use
- Private Use
- Multipurpose
- Specialized
- Single-Operated
- Multi-Operated

Classification of Ports according to cargo

- Container Terminal
- Break-bulk Terminal
- Bulk Terminal

Ref. Rodrigue, 2009
Main Stakeholders

- Exporter and Importer Company
- Inland transport operator: road and rail *(Flow of the network)*
- Maritime transport operator: Shipping lines, shipping agents.
- Port terminal (maritime, air, dry port, border entry and transfer stations) *(Node of the network)*
- Shipping companies (maritime, air, international land transport operators) *(Flow of the network)*
- Empty container parks, Primary Warehouses, Cargo Freight Stations, etc. *(Node of the network)*
- Freight Forwarders
- Custom Agents
- Customs (origin and destiny)
- Banks
- Inspection Organisms: Quarantine and Agricultural Inspectors (and others)
+Port Logistics Chain

Centralized Logistics Model

Descentralized Logistics Model

Hybrid Logistics Model
1. International Trade Facilitator
2. A Stage of the transport chains (mode-terminals)
3. Component of the physical distribution of international logistic chains

Source: IADB; Rodrigue, (2012)
SCM is “a set of approaches that efficiently integrate suppliers, manufacturers, warehouses and stores for planning, implementing and controlling of the materials and information flows from origin to the point of destination, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements.” (Simchi-Levy et al. 2003).

SCM for a PORT LOGISTICS CHAIN can be defined as follows: “The Management of a Port Logistics Chain promotes the efficient integration and coordination of public and private stakeholders for planning, implementing and controlling the flow of maritime and ground transport, cargo and information flow (service orders and documentation of international trade) from origin to the point of destination (hinterland, foreland) in an efficient and effective way, in order to minimize system wide costs while satisfying service level requirements of importers and exporters (agility and predictability)”.

Source: Ascencio & González-Ramírez (working paper submitted to JART)
Port Terminal Operations
The following graph presents the number of published work related to “containers handling” in the literature, where it can be observed up to 6,292 articles in this area.
Port terminals consist of three main areas: the gate, yard and quay.

Steenken et al. (2008)
Operational decisions in a Container Terminal

Ref.: Bierwirth, Meisel, 2009.
Hierarchical structure of operational decisions for seaside and some landside operations at a Container Terminal

+ Port Terminal Operations

Seaside Operations
The yard allocation problem consists on the assignment of storage space to incoming containers at the yard of a Container Terminal. We have flows of import and export containers at the yard: Gate, Quay, CFS and within the yard itself.

The container storage area of a port yard is constituted by blocks which are divided into Bays, Rows and Tiers according to BAROTI system. A slot is defined as a BAROTI coordinate in which is assigned a TEU (*Twenty-Foot Equivalent Unit*):
Yard Allocation Problem
Assignment of space to containers can lead to relocations of containers when they are retrieved either to be loaded to a ship or dispatched to external trucks.
+ Yard Allocation Problem

1 1 2
1 2 2
1 2 2
Yard Allocation Problem
The following parameters are defined:

$S = \{1, \ldots, I\} \subseteq S$, set of segregations.

$B = \{1, \ldots, b\} \subseteq B$, set of blocks of the yard terminal.

$T = \{1, \ldots, T\} \subseteq T$, set of non-homogeneous planning horizon periods.

$CR \subseteq S$, set of segregations of reefer containers

$CI \subseteq S$, set of segregations of IMO containers.

$C40 \subseteq S$, set of segregations of 40’ containers.

$IMPO \subseteq S$, set of import containers.

$EXPO \subseteq S$, set of export containers.

$BR \subseteq B$, set of blocks of the yard for reefer containers.

$BI \subseteq B$, set of blocks for IMO containers

$de_{ij}$, distance between block $j$ and the berth for loading/unloading operations of containers of segregation $i$

$d_{jl}$, distance between blocks $j$ and $l$

$A$, location of the warehouse where consolidation and unconsolidation operations are performed.

$R$, location of the export ruma

$M$ big cost imposed to the usage of additional internal trucks measured in terms of distance
Yard Allocation Problem

\( CAP_j \), storage capacity at block \( j \) measured in TEUs

\( CantB_j \), number of bays of block \( j \)

\( CapB_j \), capacity of a bay of block \( j \), measured in TEUs.

\( O^t_i \), supply of containers of segregation \( i \) in period \( t \). (incoming)

\( D^t_i \), demand of containers of segregation \( i \) in period \( t \). (outgoing)

\( r^t_i \), length (seconds) of period \( t \).

\( K \), number of internal trucks.

\( v \), average speed of internal trucks.

\( desc^t_{ij} \), number of containers to be unconsolidated of segregation \( i \) from block \( j \) in the planning shift \( l \): \( \{t=1,..,4\} \)

\( cons^t_i \), number of consolidated containers of segregation \( i \) in period \( t \).

\( P_i \), 1 if the segregation corresponds to containers of 20 foot, and 2 in case it is of 40 foot.

\( RE^t_i \), number of containers of segregation \( i \) that are moved from ruma-export to the stacking area in \( t \). (it is important to point out that for \( t=1,..,4 \) are decision variables and parameters for \( t=5,..,12 \)).

\( Re^t_i \), number of containers of segregation \( i \) that are moved from ruma-export to the stacking area in the planning shift \( l \): \( \{t=1,..,4\} \)
The decision variables are:

- $X_{ij}^t$, number of containers of segregation $i$ to be assigned in block $j$ in period $t$.
- $k_i^t$, number of additional internal trucks required in period $t$.
- $FS_{ij}^t$, number of containers of segregation $i$ outgoing from block $j$ in period $t$.
- $FE_{ij}^t$, number of containers of segregation $i$ incoming to block $j$ in period $t$.
- $CONS_{ij}^t$, number of consolidated containers incoming to block $j$ in period $t$.
- $DESC_{ij}^t$, number of containers to be unconsolidated of segregation $i$ from block $j$ in shift $I$.
- $RE_{ij}^t$, number of containers from ruma-export of segregation $i$ incoming to block $j$ (stacking) in period $t$.
- $y_{ij}^t$, 1 if containers of segregation $i$ are assigned to block $j$ in period $t$.
- $u_{ijl}^t$, 1 if containers of segregation $i$ are assigned to block $j$ and block $l$ during period $t$ or consecutive periods.
Yard Allocation Problem

Cargo Freight Station for packing/unpacking containers
**Yard Allocation Problem**

Minimize:

\[
\sum_{t=0}^{4} \sum_{i \in S} \sum_{j \in B} \sum_{l \in B} u_{ijl} \cdot d_{jl} + \sum_{t \in T} M \cdot k^t
\]  

(1)

Locates containers of same segregation as close as possible and minimize the number of additional trucks

**Constraint 1:**

\[
x_{ij}^t \leq y_{ij}^t \cdot CAP_j
\]

\[
\forall i \in S, \forall j \in B, \forall t = 0, \ldots, 4
\]

(2)

Capacity constraints and activates auxiliary variable \(u\) if containers of the same segregation are assigned to different locations

**Equality 1:**

\[
u_{ijl}^t \geq y_{ij}^t + y_{il}^t - 1
\]

\[
\forall i \in S; \forall j, l \in B, j \neq l; \forall t = 0, \ldots, 4
\]

(3)

Balance Flow for supply and demand of inbound and outbound containers

\[
\sum_{j \in B} F_{ij}^t = O_i^t
\]

\[
\forall i \in S, \forall t \in T
\]

(4)

Balance Flow for consolidation and unconsolidation flows of containers

\[
\sum_{j \in B} F_{i}^t = D_i^t
\]

\[
\forall i \in S, \forall t \in T
\]

(5)

\[
\sum_{t=1}^{4} DESC_{ij}^t = desc_{ij}^t
\]

\[
\forall i \in S, \forall j \in B_i
\]

(6)

Balance Flow for movements of containers within the yard

\[
\sum_{j \in B} CONS_{ij}^t = cons_{i}^t
\]

\[
\forall i \in S, \forall t \in T
\]

(7)

\[
\sum_{t=1}^{4} RE_i^t = Re_i^t
\]

\[
\forall i \in S
\]

(8)

\[
\sum_{j \in B} RE_{ij}^t = RE_i^t
\]

\[
\forall i \in S, \forall t \in T
\]

(9)
### Yard Allocation Problem

\[ \sum_{j \in B} \left( \sum_{i \in EXPO} \left( d_{ij} \cdot FS_{ij}^t + d_{Aj} \cdot CONS_{ij}^t + d_{Rj} \cdot RE_i^t \right) \right) + \sum_{i \in IMPO} \left( d_{ij} \cdot FE_{ij}^t + d_{jA} \cdot DESC_{ij}^t \right) \] \[ \leq K + k^t \quad \forall t \in T \] \hspace{1cm} (10)

\[ x_{ij}^t = x_{ij}^{t-1} + FE_{ij}^t + CONS_{ij}^t + RE_{ij}^t - FS_{ij}^t - DESC_{ij}^t \quad \forall i \in S, \ \forall j \in B, \ \forall t \in T \] \hspace{1cm} (11)

\[ \sum_{i \in S} p_i x_{ij}^t \leq Cap_j \quad \forall j \in B, \ \forall t \in T \] \hspace{1cm} (12)

\[ \sum_{i \in CR} FE_{ij}^t = 0 \quad \forall j \in (B - BR), \ \forall t = 1,...,T \] \hspace{1cm} (13)

\[ \sum_{i \in CI} FE_{ij}^t = 0 \quad \forall j \in (B - BI), \ \forall t = 1,...,T \] \hspace{1cm} (14)

\[ x_{ij}^t, FE_{ij}^t, FS_{ij}^t, k_t \geq 0 \quad \forall i \in S, \ \forall j \in B, \ \forall t \in T \] \hspace{1cm} (15)

\[ ye_{ij}^t, u_{ijl}^t \in \{0,1\} \quad \forall i \in S, \ \forall j, l \in B / j \neq l, \ \forall t = 1,...,T \]
Landside Operations

- Quay Crane
- Vessel
- Stack with RMG
- Vehicles
- Trucks, Train
Landside Operations

- Due to the natural complexity of operations at a port system, there exists huge variability in the different stages of the port logistics chain, and a huge variability on the inbound and outbound containers flows at the terminal. Variability and inefficiencies have impacts on total land costs, that could be incremented up to 85-115% (according to a study performed by PUCV).
- **Operational and documental costs account for around 10%** of the total landed costs. However, extra-costs and inefficiencies could increase these costs up to 30% of total logistic costs.
- Currently, ports are facing huge congestion at the access and within the port terminal occur, generating long waiting times and inefficiencies for transport operators when picking-up or delivering cargo, who pay for the inefficiencies of the entire port logistics chain.
Logistics industry does not operate 24x7
Port Logistics Chain

+ Landside Operations

Triangulization or Street Turn

Roundtrip

Label:
- Truck with full container
- Truck with empty container
- Empty Truck
- Load/Unload of container

Consignee Warehouse 1
Carrier Operations Base
Empty Container Depot
Gate
Consignee Warehouse 2
Stack Containers
5

Current Situation Port of San Antonio
CHILEAN WORLD TRADE STATISTICS

In 2011, International Trade accounted US$147.343 millions, with an increasing rate of 19%, (26% for imports and 15% for exports).

- **Exports**
  - Mining products: 62% (US$ 50.049 millions)
  - Others: 38% (US$ 30.879 millions)
    - Fruit: US$4.549 millions
    - Fishing: US$3.566 millions
    - Cellulose: US$2.861 millions
    - Wood and manufacturing: US$2.174 millions
    - Beverages and alcoholics: US$1.729 millions
    - Meat: US$ 847 millions

- **Imports**
  - 56% America, 28% Asia and 15% Europe
  - Fuels: 23% (US$15.425 millions)
  - Non-Fuels: 77% (US$ 50.990 millions)
The Port of San Antonio is the main port of Chile, along with Valparaiso. The port of San Antonio transfers around 17 MM Ton, and is located at the Central Regional of Chile, being the closest terminal to Santiago city (100 kms). Its hinterland is composed by the macro-zone central-south and MERCOSUR (mainly Argentina). It has 4 terminals. Panul Port is a break bulk terminal for solid bulk. STI is the main container terminal. Central Port has been recently given in concession and currently transfers general cargo, however, it is actually investing to renew infrastructure capacity. Terquim Port is a liquid break bulk cargo. The port operates with shipping liners as MAERSK, CSAV, NYK, CCNI, among others.
**Current Situation**

**Port of San Antonio**

**PORT SYSTEM**
- Port Authority: Empresa Portuaria de San Antonio
- 4 Terminal Operators Concessioners:
  * 2 Container and General Cargo Terminals: STI (SAAM Group), PCE (Matte Group)
  * 2 Break-Bulk Terminals: Panul (solid bulk, Graneles Chile and Vial Group), Terquim (liquid bulk)

**Volume transfers:**
- 17 million tons / 1.1 millions TEU (2012)
- 200,000 Ro-Ro (automoviles)
- 2.5 millions tons bulk cargo

**Main Logistics Chain**
- 30% Empty Containers (7 Empty Parks)
- 20% Container Freight Station (CFS) for consolidating and unconsolidating cargo at the terminal
- 50% Full Containers (Impo/Expo)
  - Rail 10% / Road 90%
  - 60% is cargo transported to/from a radio of 120 kms from the port
  - 40% is cargo transported to/from a radio of 250 kms from the port
Current Situation
Port of San Antonio

Arrivals vs Gate Utilization. Case: DP World and Patricks Sydney

- There exists a better distribution of inland flows throughout the day.
- There exists a higher utilization of the night shift.
Current Situation
Port of San Antonio

Arrival Patterns at San Antonio International Terminal (STI) 2011
Current Situation
Port of San Antonio

- 10% of the trips to STI are empty
- 9% of the trips to collect an empty trip between 2 cities are empty
- 40% of the trips to pickup a full container at SAI are empty
- 12% of the export trips do not have a next service
- 23% of the trucks that deliver an empty container do not have a next service
Current Situation
Port of San Antonio

Waiting Times Imports

Waiting Times Exports
Current Situation
Port of San Antonio

Waiting Times

Importación
238 [camiones/dia]

Exports
1000 [camiones/dia]

Waiting Times

Dest. Est. Espera

3.37 [hrs.]
3.16 [hrs.]
4.16 [hrs.]
5.99 [hrs.]
0.27 [hrs.]
0.33 [hrs.]
0.30 [hrs.]
0.00 [hrs.]
Actualidad

Taco infernal de mil camiones dejó escoba en el Nuevo Acceso

Choferes estuvieron hasta 15 horas en la fila de 3 kilómetros que iba desde STI hasta el cruce de Cartagena.

No es una caravana ni se trata de un cortejo fúnebre. Lo que ayer había en San Antonio era un taco infernal que llegó a sumar mil camiones que intentaban llegar a cargar o descargar en San Antonio Terminal Internacional (STI).

Así, en el Nuevo Acceso quedó la grande. Con la montaña de camiones atascados, cuyos choferes llegaron al lugar la noche del miércoles y ayer a las 17 horas seguían pegados.

LARGÍSIMO

El taco de ayer es uno de los más largos vistos en San Antonio. Este dolor de cabeza comenzó en el ingreso sur del puerto de San Antonio y terminaba en el cruce de Cartagena. Alcanzando tres kilómetros, trayecto en que los vehículos de carga estaban en doble filas.
Actualidad

Taco infernal dejó escoba

Choferes estuvieron hasta 15 horas en la fila de 3 kilómetros que iba desde el Port of San Antonio hasta el cruce de Cartagena.

Monica Jacuquim Escobar.
monica@fernanda.com

No en una caravana ni se trataba de un cortejo funerario. Lo que ayer había en San Antonio era un taco infernal que llegó a sumar mil camiones que intentaban llegar a cargar o descargar en San Antonio Terminal Internacional (STI).

Así, en el Nuevo Acesso quedó la granora, con las montoneras de camiones atascados, cuyos choferes llegaron al lugar la noche del miércoles y ayer a las 17 horas seguidas pegados, ya no necesitan restricción. "Yo llevo carne, está refrigerada se me sigue perdiendo, por eso necesito que se encurra rápido", explicó.

LARGÚSIMO

El taco de ayer es un de los más largos visto en San Antonio. Este deslizar de camiones llenaba en el ingreso del puerto de San Antonio y terminaba en el cruce de Cartagena, alcanzando tres kilómetros, trayecto en que los vehículos de carga estaban en doble fila.

El taco llegó hasta el cruce de Cartagena.
At least there are 4 places of waiting times, that could account up to 3 days for a weekend or holiday.

- Low productivity of the transport chain reducing competitiveness and imposing bad conditions for drivers.
- There could exist other waiting times: weighing, tolls, waiting for authorization and cleaning procedures of empty containers, waiting for permission of overloaded cargo, etc.
Current Situation
Port of San Antonio=

- Loaded at the Port
- Travel to Santiago
- Drop-off empty container
- Returns to the carrier's base

\[ t_{\text{waiting 1}} + t_{\text{Travel 1}} + t_{\text{Travel 2}} + t_{\text{Waiting 4}} = t_{\text{Total}} \]

- At least there are 4 places of waiting times, that could account up to 3 days for a weekend or holiday.
- Low productivity of the transport chain reducing competitiveness and imposing bad conditions for drivers.
- There could exist other waiting times: weighing, tolls, waiting for authorization and cleaning procedures of empty containers, waiting for permission of overloaded cargo, etc.
Collaborative Platform for landside coordination: VBS
A Vehicle Booking System (VBS) is a collaborative platform for coordinating inland flows to and from a port terminal for picking up and delivering cargo, both by road or rail transport.

The basic principles of a VBS are:
- Provide anticipated information with the aim to balance supply and demand at the port terminal and achieve a better gate utilization.
- Provide service level standards for landside operations: truck turnaround times (TTT).
- Define business rules for the users, which include a penalty system.
- Implementation of a tactical demand and capacity planning at the port terminals.
- The existence of a Port Community Institution with a well-defined governance and structure.

Source: Engineers Australia Transport Panel 2012
A review on VBS

- Congestion issues at maritime ports in California, U.S., led to regulatory efforts to reduce freight traffic impacts and the California Assembly Bill (AB) 2650 became law in 2002 for regulating truck queuing at the Ports of Los Angeles, Long Beach and Oakland (Giuliano & O’Brien, 2007).

- The VBS implemented at these ports is the first reference of this kind of systems and is currently operated by e-modal company, with more than 16 terminals of California, 6 terminals of Oklahoma and 30 terminals of Florida, Portland, New Jersey, Washington, Virginia, Texas, Philadelphia, and Oregon in United States.

- A more recent experience is related to the Australian ports strategies performed to mitigate congestion and improve the performance of landside operations. Australian ports have implemented a Vehicle Booking System for coordinating pickup and drop-off truck flows, which is currently operated by 1-Stop organization since 2005.

- After implementing the VBS for the terminals, a Vehicle Notification System for the empty container parks was also implemented, operated by Containerchain.
+ VBS: OpenGate

Figure 1.5 Sydney: Landside of container terminal size of task indicators

1,8 MM Teus

Figure 1.6 Sydney: adjusted vehicle booking system usage

Legend
- Berths
- Berth number
- Berth (future)
- Principal freight rail paths
- Principal freight rail paths (future)
- Principal roads
- Principal roads (future)
- Selected access roads
- Terminal gatehouse
- Other
**OpenGate** is a Vehicle Booking System that supports coordination of trucks to the terminal, allowing the implementation of standard service levels for landside operations.

**INTERNAL USER** (STEEVEDOR)

"Upload" and "manage" slots per time window for the gate and each type of task.

**EXTERNAL USER**

"Manage" its booking and "coordinate" its logistics, avoiding long waiting times, receiving a standard service level at the port terminal.

**PORT AUTHORITY USER**

"Monitor" the performance of the users according to the standard service level established.
**Impact Assessment VBS**

**Performance Indicators**

- **Quality of Service**
  - Average Waiting Times of Trucks at the Gate

- **Congestion Levels**
  - Truck Queuing Behavior: Maximum Queue length on peak hours

**Experimental Design**

- **F1**— Truck Arrival Patterns
- **F2**— Operating Capacity
- **F3**— Segmentation of Lanes
- **F4**— Booking Levels

- Truck arrival patterns correspond to a Non Stationary Poisson Process.
- The arrivals of trucks with full containers increase from Monday to Friday prior to shift change (8:00; 15:30 and 00:00 hours) and Thursday and Friday present the highest concentration of arrivals. 44% of Full Containers (FCL) are reefer and 56% are dry. These percentages vary according to the fruit export season.
- The arrival rate of empty containers is significantly less than full containers. However, the intensity of these arrivals was relatively uniform for all shifts.
• The current (booking level at 0%) weekly average waiting time is 27.1 min for peak hours. When the current situation is optimized to improve the use and segmentation of lanes, weekly average waiting times are reduced by 31%, reaching 18.7 min on average.

• Waiting times for carriers without appointment remain quite closer to current levels, in order to encourage the use of the appointment system. On a week basis, average waiting times for carriers with appointment are reduced by 63%, 65% and 78%, for scenarios with 15%, 40% and 100% of TAS use, respectively. While the average waiting time for carriers without appointment increase by 8% for the 15% scenario, and decreases 6% for the 40% scenario.

•
Conclusions and current research
Conclusions and current research

- International trade for emerging countries is a key element for economical and social development.

- Emerging countries as Latam/Caribbean are increasing their participation in world trade, with a deceleration in 2012.

- Infrastructure developments and process improvement based on IT are crucial for the ports, in order to face the current challenges imposed by these trends and the increasing size of the ships with lower frequencies but requiring higher number of containers to transfer.

- VBS is a relatively new topic in the container terminal operations research literature, however several studies have been reported with emphasis on case studies. Previous research have shown the importance of considering local conditions of a terminal when designing a VBS, given the differences on operation.

- A Port Community with a governance and structure that allows the discussion of business rules for the implementation of a VBS is absolutely a key element for collaborative solutions.

- We are about to implement a real pilot at the Port of San Antonio with a control group of transport operators and the utilization of a recently implemented truck center.

- An important research avenue is to measure the impacts of a VBS on yard stacking operations.

- A DSS to support capacity planning at the port is needed in order to obtain the maximum benefits from a VBS and increase yard equipment productivity and minimize service times.
References

References


