EXSANTOL

Experience Santos container Terminal Operations & Logistics

Logistics Node

Santos Container Terminal

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Request to develop a logistics plan for extending an existing port facility located in Santos, Brazil, Atlantic Ocean; it is necessary to address setting of logistics processes and design of port plant as well as its configuration and equipment design; the plant is titled EXSANTOL a Container Terminal,.

The EXSANTOL Terminal project is divided into four main phases: development, ramp-up with initial reduced productivity (Lo-O about 12 months), full productiviy (RO for at least 18 months) plus an eventual optional phase of high productivity (Hi-O may be destined to endure); the terminal will work 24 / 365 (daily, 24 hours a day) on regular oceanic ships (see Fig. 1) with approximately 50% of 5000 transported TEUs to be unloaded and the same to be loaded in the analyzed plant; such flows are characterized by the values and compositions shown in table I, where import means the flow of containers (fig.1b) from international shipping lines within the region while the opposite is intended for exports.

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The expected final layout for EXSANTOL (see Figure 2) includes a 1500 meters dock with 20 meters of draft, a railway terminal with 8 parallel tracks, a gate with 40 opening doors that provides trucks access to the terminal from the network road; these trucks are intended to be loaded/unloaded directly into the yard (square stock).

The configuration and the type of the expected flows for the EXSANTOL (i.e. balanced imports and exports, reduced rate of transhipment from ship to ship) provides a desired level of extra handling (for accessing to containers locked in the storage by others non-handling) that is 15% in the case of vertical access means (i.e. transtainer loaders) use and 30% in the case of cranes with front access (i.e. reach stacker). For the portainer times, the extra activities (i.e. hold opening) are assumed to be included in the auxiliary phases computed in the average operational time of the crane (i.e. as average around two hours for each ship mooring on the dock).

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All import and export flows provide storage in the storage areas of the yard; in this regard it is expected that the average time spent by the containers in the terminal is about 15 days with a standard deviation of 40 hours. The handling process of the containers will be carried out on the quay by cranes portainer (PT, Fig.3); it is expected to use Wheel transtainer (WT, Fig.3b) on the yard, while on the rail terminal rail transtainer (RT, fig.3c) will be used. It is hypothesized a connection between the vectors originally based on washers (or drive trailer - TT fig.3d). The crane models available to equip the terminals are characterized by the data reported in Table II. It is assumed also to consider the possible use of cranes such as reach stackers (SR, Figure 3e) to manage peaks, emergencies and / or special practices.

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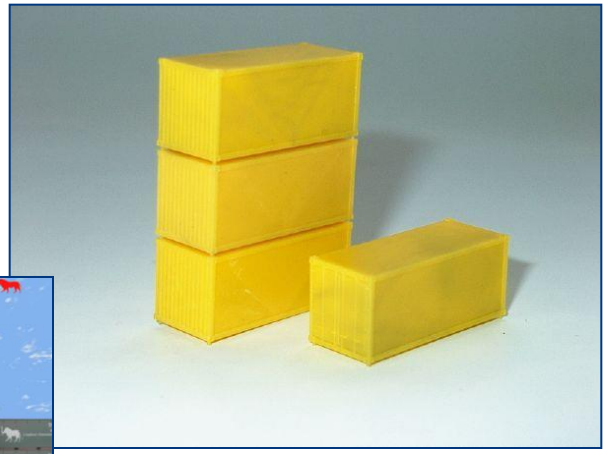
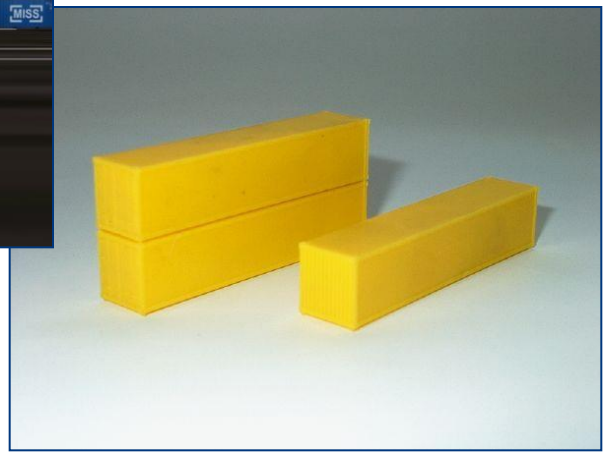
Container: TEU & FEU

Container 20' feets

A	6.08 m
B	2.50 m
C	2.50 m

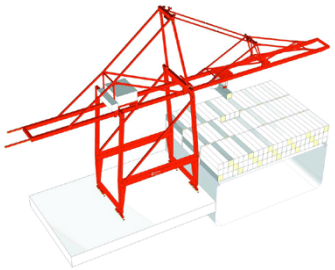




Container 40' feets

A	12.16 m
B	2.50 m
C	2.50 m

Crane: Portainer



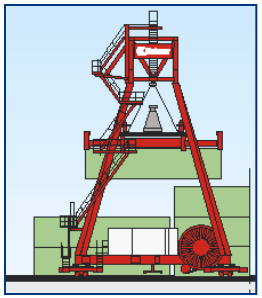
The Portainers (known also as gantry cranes, ship-to-shore cranes) are operating from the Dock to load and unload the ships

Crane: Wheel Transtainer

Transtainers are the cranes operating on big blocks of containers on the Yard or on Rail Terminal for handling containers from the ground to vehicles, trucks, or flat-cars of trains.

Transtainers can be wheeled or rail mounted

Crane: Transtainer railroad



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Transtainers can be wheeled or rail mounted

Truks

Trucks are used in several terminals for moving containers among the different areas

Reach Stacker

A **Reach Stacker** is a flexible handling solution for operating in a small terminal or a medium sized port

Straddle Carrier

A **Straddle Carrier** is an handling device in use in some port terminals for moving and stacking standard containers.

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Terminal - Location

Terminal - Layout

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Il collegamento tra Banchina e Piazzale, cosi` come quello tra piazzale e terminal ferroviario, avverra` tramite Ralle (motrice e rimorchio) o con gru quali reach stacker o straddle Carrier.
Il collegamento tra Navi e feeder Ship per operazioni sia di import che di export avviene anch'esso direttamente tramite Ralle (motrice e rimorchio) o con gru quali reach stacker o straddle Carrier che collegano le portainer coinvolte con le portacontainer in questione.
Il terminal in esame dispone di spazi dedicati alla movimentazione di contenitori particolari (i.e. merci pericolose) capaci di soddisfare le esigenze previste.

Zona DK: Operazioni Banchina
Zona DS: Yard / Area Stoccaggio
Zona DR: Terminal Ferroviario

Direttrici e Mezzi Handling Flussi:

Import

From Ship To Feeder Ship
Nave ⇒ DK ⇒ DS ⇒ DK ⇒ Nave
PT+ Collegamento + WT
WT+ Collegamento + PT

From Ship To Train
Nave. ⇒ DK ⇒ DS ⇒ DR ⇒ Treno
PT+ Collegamento + WT +
WT+ Collegamento + RT

From Ship To Truck
Nave ⇒ DK ⇒ DS ⇒ Camion Est.
PT+ Collegamento + WT +
WT

Export

From Feeder Ship to Ship
Nave ⇒ DK ⇒ DS ⇒ DK ⇒ Nave
PT+ Collegamento + WT
WT+ Collegamento + PT

From Train to Ship
Treno ⇒ DR ⇒ DS ⇒ DK ⇒ Nave
RT + Collegamento + WT +
WT + Collegamento + PT

From Truck To Ship
Camion Est. ⇒ DS ⇒ DK ⇒ Nave
WT +
WT + Collegamento + PT

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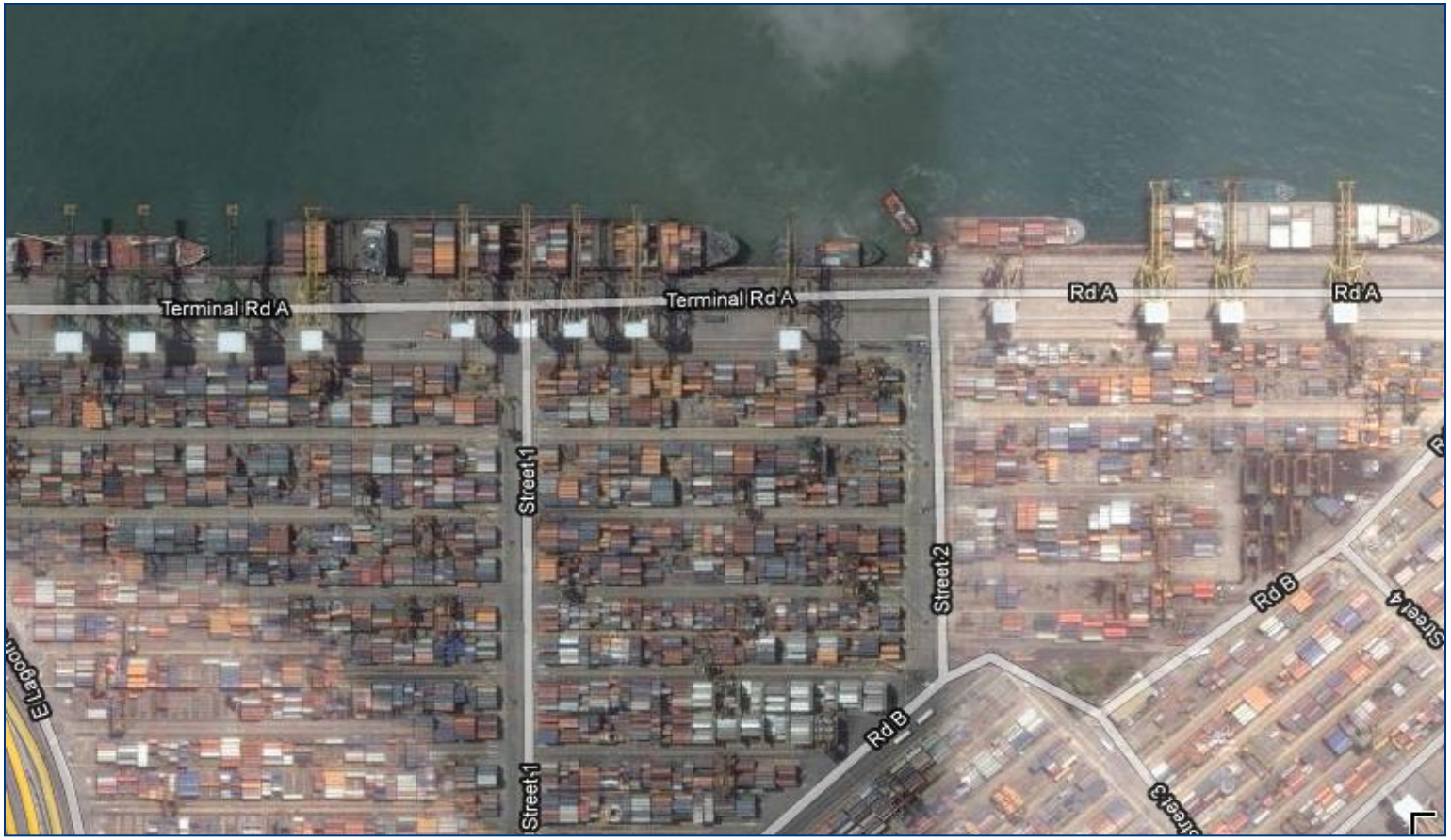
Transhipment



Feeder Ships in our Exercise

- Capacity 1000 TEU
- Length 150 m
- Braccia (numero gru banchina massime 2)

Reference Oceanic Ships in our Case

- Capacity 5’000 TEU
- Lenght 300 m
- Width 35 m
- Draft 9 m
- Braccia Max 5

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TABLE I - Scenarios

- Lo - O Low Productivity
- R - O Medium Productivity
- Hi - O Hight Productivity

Tabella I - Scenari		Durata	Flusso Totale	Suddivisione Flusso Totale		Flusso	Suddivisione Flusso Import			Flusso	Suddivisione Flusso Export		
ID	Descrizione	[mesi]	[TEU/anno]	40' /year	20' /year	Import/Totale	to Train	to Truck	to feeder Ship	Exportt/Totale	from Train	from Truck	from feeder Ship
R	Realizzazione Terminal	TBD	--	--	--	--	--	--	--	--	--	--	--
Lo-O	Operativita' Ridotta Iniziale	12	500,000	200,000	100,000	50%	70%	20%	10%	50%	70%	20%	10%
R-O	Operativita' a Regime Regolare	≥18	1,000,000	400,000	200,000	50%	70%	20%	10%	50%	70%	20%	10%
Hi-O	Operativita' ad Alto Regime	TBD	1,500,000	600,000	300,000	50%	70%	20%	10%	50%	70%	20%	10%

TBD: Da Definirsi — TEU Transport Equivalent Unit = 1 Contenitore da 20 piedi — 40'/year flusso contenitori annui da 40 piedi — 20'/year contenitori annui da 20 piedi

Feeder Ship: navi destinate al traffico di transhipment diretto da nave locale (feeder ship da circa 1000 TEU) a navi di riferimento (circa 4500 TEU) e viceversa

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TABLE II - Equipments

Tabella II - Equipaggiamenti		Portata	Container Impilabili	Velocita' Spostamento	Produttivita' Operativa	MTBF	MTTR	Tempi Servizio Non Produttivi	Costo Acquisto	Costo Operativo Orario	Costo Manutenzione	Tempo Fornitura (Acquisto e Inst.)
ID	Descrizione	[kg]		[m/s]	Contenitori/h	[ore]	[ore]	[ore/anno]	[kEuro]	[Euro/h]	[kEuro/anno]	[mesi]
PT-1	Portainer - Gru Banchina	80,000	5	0.75	25	242.4	12.1	400	5,000.00	64.32	100.00	12
PT-2	Portainer - Gru Banchina	50,000	5	0.75	25	245.3	18.2	75	4,000.00	52.91	80.00	12
PT-3	Portainer - Gru Banchina	46,000	5	0.50	22	60.4	16.2	680	1,800.00	27.79	216.00	0
WT-1	Transtainer Gommata - Piazzale	46,000	5	2.20	25	192.4	18.3	920	1,200.00	20.95	48.00	12
WT-2	Transtainer Gommata - Piazzale	46,000	5	2.20	22	112.9	20.4	920	1,000.00	18.66	120.00	12
RT-1	Transtainer su Rotaia - Rail Terminal	50,000	5	1.00	25	200.8	16	548	1,500.00	24.37	48.00	6
RT-2	Transtainer su Rotaia - Rail Terminal	50,000	5	1.00	22	119.1	16.3	548	1,300.00	22.09	156.00	6
TT-1	Motrice e Rimorchio	45,000	-	15.00	-	188.1	4.8	600	150.00	8.96	6.00	2
TT-2	Motrice e Rimorchio	45,000	-	15.00	-	180.7	12.4	600	70.00	8.05	5.60	1
TT-3	Motrice e Rimorchio	45,000	-	12.00	-	75.5	12.1	600	20.00	7.47	2.40	0
RS-1	Reach Stacker	46,000	5	7.00	20	114.2	14.4	730	300.00	10.67	24.00	2
CS-1	Straddle Carrier	50,000	4	9.00	25	100.3	13.2	850	500.00	12.95	40.00	3

Nel Terminal in Esame si Ipotizza di movimentare Contenitori di peso non superiore alle 45 tonnellate

Tutte le gru di Banchina hanno uno sbraccio superiore ai 44 m sul lato mare e tutte le gru di piazzale sono compatibili con i disegni di layout e le capienze di stoccaggio dichiarate nello schema di layout

Il Numero di container impilabili rappresenta la capacita' dell'equipaggiamento di stoccare un certo numero di container in pile

La velocita' di spostamento e' quella per far traslare il mezzo nel suo assieme, mentre la produttivita' operativa rappresenta il numero di movimentazioni orarie possibili con detto sistema di handling

MTBF: Mean Time Between Failures (intervallo fra due guasti), MTTR Mean Time to Repair (durata riparazioni)

I tempi di Servizio non Produttivi rappresentano un tempo nel quale i sistemi sono attivi, ma non possono essere impiegati in quanto occupati da procedure specifiche (i.e. rifornimento, cambio turno etc.)

Il Costo operativo orario e' comprensivo del costo del personale e di tutti i costi diretti operativi (i.e.consumi energetici); il costo di manutenzione rappresenta il totale annuo complessivo

I tempi di Fornitura rappresentano il tempo trascorso tra l'ordine ed il poter disporre del sistema operativo nell'impianto (i.e. montato, installato e collaudato)

Si considerino comunque 12 mesi dall'inizio del progetto come tempo minimo per le prime installazione al fine di considerare le altre opere in corso di realizzazione (i.e banchine, piazzali etc.)

Si noti che i mezzi PT-3 sono mezzi di recupero disponibili in sole 2 unita', non e' possibile acquisirne altre

TABLE III – Set up Costs

Tabella III - Costi Iniziali e di Gestione Parti Impianto		
Terminal Initial Investment (Dock, Yard, Rail Term.)	80,000.00	kEuro
Overheads and General Costs	3,000.00	kEuro/anno
Control Room Operative Costs	1,200.00	kEuro/anno
Gate Operative Costs	640.00	kEuro/anno
Yard Operative Costs	512.00	kEuro/anno
Rail Terminal Operative Costs	512.00	kEuro/anno
Ship Operation Operative Costs	256.00	kEuro/anno

TABLE IV – Fees

Tabella IV - Tariffe Medie				
Tipo Flusso	Tipologia Direttiva	Tariffa 20 piedi	40 piedi	
Import	from Ship to Truck	92.60	110.40	Euro/Contenitore
Import	from Ship to Train	80.80	90.80	Euro/Contenitore
Import	from Ship to Ship	80.00	80.00	Euro/Contenitore
Export	from Truck to Ship	92.60	110.40	Euro/Contenitore
Export	from Train to Ship	80.80	90.80	Euro/Contenitore
Export	from Ship to Ship	80.00	80.00	Euro/Contenitore

TABLE V – Scenarios Improvements

Tabella V - Sviluppo Scenari	
Scenario	Probabilita' Attesa dello Scenario
Ipotesi:12 Mesi Lo-O, 18 Mesi R-O seguiti poi da Hi-O a regime	60%
Ipotesi:12 Mesi Lo-O seguiti poi da R-O a regime	20%
Ipotesi:12 Mesi Lo-O, 36 Mesi R-O seguiti poi da Hi-O a regime	20%

EXSANTOL - Question A

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A. *Verify that the storable quantity in the different yard areas (45,000 TEUs available in total, Figure 1) is compliant with the three different scenarios flows with the current assumption of containers dwell time and by ensuring a 10% lower risk of saturating over 75% of the spaces. Eventually assess the enhancement to be implemented*

EXSANTOL - Question B

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B. *For the scenarios Lo-O, R-O and Hi-O, size the vectors number and type (PT, WT, RT, TT, RS) in order to ensure the annual flows requirements. It is also required, since the end of the 6th month from operations starting point, to complete in less than 48 hours, the process of loading / unloading of a reference ship (by considering your total including the 2 additional hours due to carious set up operations), even if there is a damaged quay cranes. Since the operative 6th month it will be possible to load and unload four reference trains (40 containers to be handled for each train) in parallel in less than 4 hours (considering also the 30 addditional minutes due to the staff operations for each train preparation)*

EXSANTOL - Question C

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C. *Define the processes and the related total costs for imports and exports of each container type in the R-O scenario based on the data summarized in Table III and the set equipments (considering both the operating cost per hour as well as the vectors maintenance and mortgage costs).*

D. *Determine the configuration set to above the maximum annual handling capacity and the minimum time required for loading / unloading for the reference ship with 5000 TEUs in optimal conditions (a single ship at the dock) by considering the configuration at the previous point*

EXSANTOL - Question D

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E. *Let's assume to use the proposed tariff in the Table IV and to can count on a first government funding of 150 MEuro to be amortizated in 20 years to 2% annual straight-line basis, to evaluate a configuration and an acquisition plan of the equipments and a develment plan of the terminal in oredr to cope the various scenarios within the temporal development of the initiative (assume that Hi-O takes over after 18 months from the operational starting point) maximizing the return on investment. Reproduce on this hypothesis a timetable (Gantt chart or Milestone) with the dates of installation of equipment and prepare a chart showing the cash flow of the plant project.*

EXSANTOL - Question E

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F. *Based on the previous hypothesis and considering the experts assessment about possible critical development scenarios (see Table V), define the expected average value in term of revenue during the first ten years, prepare a synthetic contingency plan to face the different risks*

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Up to You to Handle the Problem

References

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