

CONTAINER TERMINAL PLANNING TOWARDS OPTIMIZING SUPPLY CHAINS LOGISTICS

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Abstract

Supply chains need competitive and efficient container port terminals that are up to the challenge of the dynamic cargo flows passing through them. Consequently, port terminal planning and its associated engineering strategies are the tools that let them achieving high operational competitiveness and leadership for any possible complex situation on land and on water side.

Furthermore, it is important to stress that each container terminal presents restrictions due to the geography where it is located. These site conditions can either influence the available operational areas or the connections to the hinterland resulting in potential inefficiencies for the supply chains that they support.

Thereafter, the following analysis focuses on solutions developed by container terminals located on the riverbanks of the City of Buenos Aires and its neighbouring Dock Sud, both located upstream of the River Plate estuary in Argentina.

This paper elaborates on how port terminal planning is implemented in a practical way, and under complex scenarios, to develop efficient operational management strategies towards designing all logistic processes and cargo flows from the containerships to the delivery out of the terminal and on the other way around. To summarise, it can be concluded that appropriate port terminal planning allows the integration of various value-added services to enable a container terminal to be developed as a multimodal operations platform serving and optimising supply chains logistics that cross it.

1. THE CONNECTION BETWEEN THE TERMINAL AND THE SUPPLY CHAINS LOGISTICS

Everyday thousands of merchandising cross a port terminal through the supply chains that they belong to. Nowadays, the competition is between the supply chains and not the products like it used to be. So if a company wants to be competitive and remain in the world markets it is necessary to have dynamics flows in this supply chains.

Although the ports are one node in this process it is important to give a full support to the chain and guarantee efficiencies avoiding scraps. The ports play a major role being the interface between the waterside and the hinterland transport.

To make this possible, it is required to have a productive business model in the terminal. The main activity that aloud this, is the planning engineering strategies in the yard.

Therefore, having an efficient design of the planning strategies permit that this flows of containers movements stay in the yard the shortest time and goes to the vessel, trucks or train as soon as possible. With this, it is obtained a dynamic model that impact on the speed of the supply chains.

The port terminal should emphasise to develop as a multimodal operations platform giving in this way support to the supply chains. Thus the terminal helps optimizing part of the supply chains logistics.

Working in this develop allow the terminal to add-value to the products and this gives to the region the possibility to develop their economies in short, medium and long-term. This integration is useful not only for the market but also for the society too. Gives the possibility to develop in long-term better life conditions to its.

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2. MAKING A CONTAINER TERMINAL A CASE OF SUCCESS

Ports terminal main mission is to be as efficient as possible and having high levels of production. What this means is to have the best combination of the production factors, being efficient with the machines, workers, customers, suppliers and environment. Hence, the terminal have to agree with individual demands of each stakeholder. Are part of this, the shareholders, workers, customers, suppliers, residents, government and unions. This topics made the terminal to work in develop planning strategies to optimize times and spaces; is part of the business to operate the vessel in a productive way and fulfill the indicators between the terminal and the shipping company. The strategies must go with production quay and yard indicators. Having and adequate layout design allow a good optimization of the space and aid to order the containers distribution in the yard.

To focus on operational excellence it is necessary to know the production capacity of each process involve. This means to balance the system capacity and avoid bottlenecks. Bigger ships generates a demand concentration, and the planning design engineering strategies should remove peaks and transform in an equal demand. The system is made by the customer demand, the gates, yard and berth capacity, the human and the equipment resources, all together for a certain service level.

Besides, hundreds of customers go through the terminal every day to pick up the import container and the empty ones to consolidate products, and leave the full containers for the exportation process.

Making all this process possible and in an efficiently way reach the terminal to have a competitive business model and put it at the vanguard. With these engineering solutions takes the region to better market economies.

3. KNOWING THE SCENARIO RESTRICTIONS WHERE THE STRATEGIES ARE APPLIED

Since 1700 different areas bordering Buenos Aires City where used as a port. The later develop of the city was always concentrated here, all the connections to other parts of the country where made by train or wagon from here. Port terminal final design was made by Eng. Luis A. Huergo on the riverbanks of Buenos Aires City and afterwards it was created the terminal in the neighbouring Dock Sud. It is important to mention the first restriction that appears here, the original quay design by Huergo is used nowadays. This consist in a finger piers design that were useful for the cargo vessel, but now for the containers ones brings restrictions to administrate the cranes and the services². Dock Sud port terminal doesn't have this restriction, because it was conceive in a period were the containers vessels exists and it was design with side continuous berths. Although, in returns, a quay of a chemical industry operates in front of it restricting the breath of the vessels that the terminal can attended.



Figure 1: Buenos Aires and Dock Sud Port Terminals plan

² Nowadays the Government Port Administrations had present the new construction design plan with side continuous berths.

Actually, different industries that used the port are located in a radius of 80 km, the bigger part (80%) of the origin-destination of the products belongs for this distance. That's made ports terminal that in certain time slots the truck congestion increase. This situation put the terminals in a complicated place, because they can't develop in another place and have to give a high service to all the parts. Here is concentrated the industry and the logistics centres that serves all the country.

Current restrictions that makes planning engineering a big solution

- Depth restrictions: Currently the River Plate presents an available draft of 34 feet (using tidal windows) and where navigational channels must be permanently dredged. This aspect limit the quantity (Q) that a vessel can transport and it wouldn't be possible to take to the market more than the maximus number that the vessel can support with this depth.
- Breadth of the channel: the Access Channel to Buenos Aires Port is 100 m of breadth. The operative dimension that Buenos Aires Port terminals are design for is a New Panama Vessel, with a capacity of 12,500 TEU and 366 x 49 x 15, 2 meters -these vessels enter the port but not complete, as indicated in the previous paragraph-

Bottom of the channel: two of the biggest ships that arrive to the port can't navigate in one way or another the channel. Prefecture³ only allows for security and safety one type of this vessel at a time. This made that if the terminal has to attend more than one service one ship will wait in the common area until the other cross the channel. Just from the 27, 5 km from La Plata to Buenos Aires two New Panama Vessel can transit at the same time.

Another problem is that the passengers vessels use the same channel to navigate, and they have exclusiveness of channel, so this increase the cost of ship waiting to be attended.

- Customs times: approximately the 40% of the exportations must be scan and control because of Customs' Office regulation, while in many parts of the world, like Chile, USA, the percentage is the 5%. This made to attend the freight with all the resources preventing to roll it to another vessel and increase the cost of the product for the customer. In addition, all the documents that must be present to evacuate the containers impact in the flows of the terminal because if the trucks congestion.
- The existence of 2 common areas to take trailer: this made more expensive the vessel cost, so the final impact will be in supply chain. The first part begin when the vessel arrives to Recalada Pilot Station, here a coast-pilot takes control up to La Plata where another coast-pilot finish the navigation. It takes 8 hours from Recalada to La Plata waiting area and 3 more navigation hours from La Plata to Buenos Aires Port.

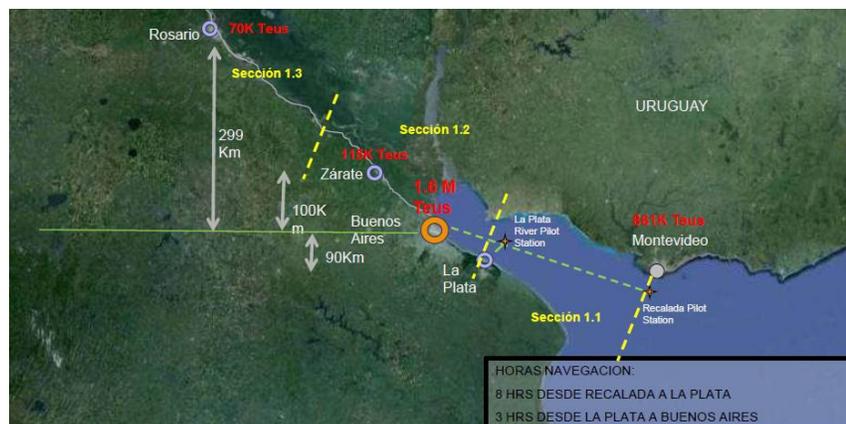


Figure 2: Map of the sections to take trailer and TEUs capacity of the terminals in the zone

³ In Argentina, Prefecture is the militarized police force that governs navigation, both in rivers and seas.

- Empty administration: in the total TEUs movements of Buenos Aires Port the 50% belongs to importations and the other 50% to exportations, but the 40% are products and the other 10% empty containers. So this makes the terminal to prepare a place in the yard for the evacuation, taking space for the full ones.
- Distance of the waiting area: when the ships arrives the waiting area is situated at 26 NM (48 km). The impact of this is that when a terminal couldn't attend more vessels, the finalization of one generate operational bumps. When it finish and leave the terminal, this has to wait up to the other ship begins navigation.
- Union force: the topic affect because in Buenos Aires Port live together more than five different forces. This made that any decision that has to be done must reach an agreement with each representative.
- Hinterland: Buenos Aires Port connexions have several problems to be cross. Even though the biggest part of the cargo distance is near the port, the saturation of the roadways, the lack of railways and the trucks condition made a considerable increase of speed in the supply chain. Therefore, the Port Terminal should take part on this to aid the supply chains.⁴
- Weather conditions: in the last times, a new meteorological phenomenon has appeared. The historical changes of atmospheric pressure that produce winds has increased because of the Climate Change, so now they get unpredictable: the fronts changes quickly and strong winds appear suddenly. This generates a dangerous operation with all the parts of the terminal. The equipment stops the work and the vessel could cut the mooring line. In this cases, the containers take down levels in the stowage to prevent risks.
- Goods production: It's important to note that Argentina mainly exports products suitable for 20-foot containers (bulk cargo of high density), while it imports manufactured products in 40-foot containers, which generates an imbalance between the demanded and offered containers.
- Trains connections: Although in the past there were railway branches that served the port, for decades they had get deteriorated and are used eventually. The government is carrying out works to replace the railway in the port. As consequence, not even have been developed the twin container train system.

4. FUNDAMENTAL PLANNING PILLARS TO GET THE HIGHEST BUSINESS PRODUCTIVITY

Consequently, the different strategies that are used to let an efficiency and productive model will be develop. It should be point out, that the key to have successful strategies is the plan's flexibility design. This suggests the need to consider continuous changes and to reply in a dynamic way, with this the model will guarantee an impact on the supply chain speed. If a change of plans happen a quickly solution appear.

Make planning process possible it's need the support of a software; for this work it was used Navis (N4), but there are other ones that can be used too.

The first thing that will be design in the yard is the layout, the strategy should consider some parameters like: yard blocks to segregate importations, exportations, throughputs and transhipments containers, reefers power points, over dimension and IMDG containers, trucks garage and not in use machines. Then the information processing will allow to know exportations quantities per ports destinations by vessel services, getting this obtains an order in the yard.

EMPTY CONTAINERS STRATEGIES

From the moment that an empty container is returned begins the supply chains organization. It's important to administrate the trucks flow that will be in the hinterland. To make this possible it's necessary the design of a web organiser to let customers choose a time slot to return the container. With this tool the terminal design the truck flow per hour. Besides, in the system can be added the line and the container type that will be given back. Empty container web administration, allow to the planning area take decision about the available space in the yard, for example to know how many space you will need to put reefers, 20' foot or 40' foot containers units. Buenos Aires Port have a relationship for 20'

⁴ The new truck roadway construction had begun, this way is parallel to the port and the main purpose is to remove trucks from the city.

and 40' containers of 1:4. Meaning that per 1 x 20' container its reception 4 x 40' containers. As a result, the yard design should include more space for this type of container, this information is get from the analysing of the vessel discharge and the lack to fill exportations of add-value goods.

Once the trucks get in to the verification area, a qualify inspector classifies the container type, this mean to know if it's or not: a reinforced, a food grade, standard, damage or special one. In the moment is charged in the system and process between the software and the gate decides the yard place to go. A part of this containers will go the empty exportation area near the vessel charges and the other segregate by type to deliver to customers. Having containers type in order allow a quick answer when a trucks goes to the terminal and pick up empty containers.

Another important part in the process is the administration of reefers containers, these type have to be check and ready for the moment that they are pick up. A failed container could imply dead freight costs or loosing customer time when these are consolidate and doesn't work. In all these cases the impact is directly in the supply chains.

Sometimes the container terminal is the bridge between the customers and the shipping company, this means that the terminal should administrate the stocks and give a warehouse system. Thus, all the improvements given from the port terminal to the process will impact directly in the customers and as a consequence directly in the supply chains speeds.

EXPORT CONTAINER STRATEGIES

As mention above, the first strategy that will be design is where and how many containers should be found. It's important to segregate by service and then by destination port. Having this planning design helps to optimize the vessel charge and to make as dynamic as possible.

The vessel planning doesn't depends on the port terminal, it comes design from the maritime company, some consideration can be change, but these defines that the terminal have to take this information and change into efficient business process. An important aspect is that the vessel charge by destination port. Depending on the volume of each port, the design shouldn't be close, if these is open to other yards blocks, at the charge moment it will let have a productive flow, optimizing the process. The resources gets a better use and have less no-operative time.

Small volume ports can share stowages, because their impact in the process is less than big ports, and space limitations is a very common aspect. However, the flexibility need, makes sometimes to put a container in a wrong stowage avoiding trucks contestation, what it consider here it make a later housekeeping.

When the customers begins the container exportation process first it important for the port terminal to have a coordination system, where they can choose a slot-time to enter to the terminal. This aids the terminal to balance flows with the client demand, affording to have an efficient combination of the productive factors, it will not receive more clients than the process can supply. The benefices here are not only for the terminal but also for the customers, the truck will not have delays, so it will attended more process for them, for example taking more containers per day optimizing the trip and of course the uses fuel.

Another two important parts that needs planning strategies are the VGM process and the scanner one. By international regulations all the charge have to be weight, the information should be process and sheltered giving traceability to the process. The item mention above defines the place to put the balance (it's recommended near the gate-in) doesn't intercede with the other port flows. Other part, is the scanner, customs indicates what containers shall done the process. Here the impact is very high because in Argentina around the 40% of the charge must be scan, in other countries of the region like Chile or Brazil the percentage is around the 5%, this gives as result the place to located the scanner to prevent damage the efficiencies of other process. All this information obtain for the mention process is shield by the software and in case of need avoid doing two times the same process, in other words increases efficiency and let the container loading in the service hire preventing the possibility of losing the vessel.

The last part but not least, is in what yard blocks the terminal will receive the exportations containers. The best strategies, indicate that should be in the blocks near the gates-in, because the flow will be more dynamic with the trucks and will not interrupt with the vessel discharge process. Part of the yard

blocks flexibility is for example to use it for empty export containers in case that are not allow the empty yard blocks.

Therefore, using this engineering strategies will give as result efficiencies in the model.

IMPORT CONTAINER STRATEGIES

Once the discharged is processed -this items depends on the maritime agency and gives the information to the port terminal- begins the strategies used for this parts. It should be taken as considerations the discharge of over dimension and IMDG container, the terminal will have the information of quantities of 20´ and 40´ containers, to size the yard allocations need. Importations containers should use yard blocks near the quay, to reduce the truck time from the discharge up to the time to the stowage. Here happens a combinations of yard blocks, the strategy will use a combination of the terminal sites thus avoiding congestions, and other yard blocks wouldn't be used because they will destiny to the import delivery customers. The combination given have to support both process at the same time, the discharge and the delivery of full containers. Having clashing process generates inefficiencies that affect not only the terminals productivity but also the vessel one. And this is one of the factor that's differentiates a terminal from another giving a successful business model.

A strategy used here is to respect the combination discharge plan with the vessel service and the yards blocks, this gives a better combination for the limit dates that the containers should be deliver and the operation of the vessel. Depending the operation in the terminal a daily quantity it's define for the delivery process, having this parts in time-slots provides an optimum resources combination.

Over dimension containers should be discharge in yard blocks far away from the principal process yard blocks, because the charge of its need special equipment, more time and appropriate trucks accompanied by a delivery in a minor time-slot.

5. FINAL CONSIDERATIONS FOR AN EFFICIENT PORT TERMINAL

All these individual strategies gives as result efficiencies on the different process. But definitely all the improvements given to the system impact directly in all the logistics of it, thus the supply chains get highly benefited, reducing death-times and getting dynamics flows helping without doubt to have competitive supply chains. The terminal is a main node for it, so given support, having operational excellence gives not only the business model but also in all the process that go thought it.

World fleet by principal vessel type, 1980–2017:

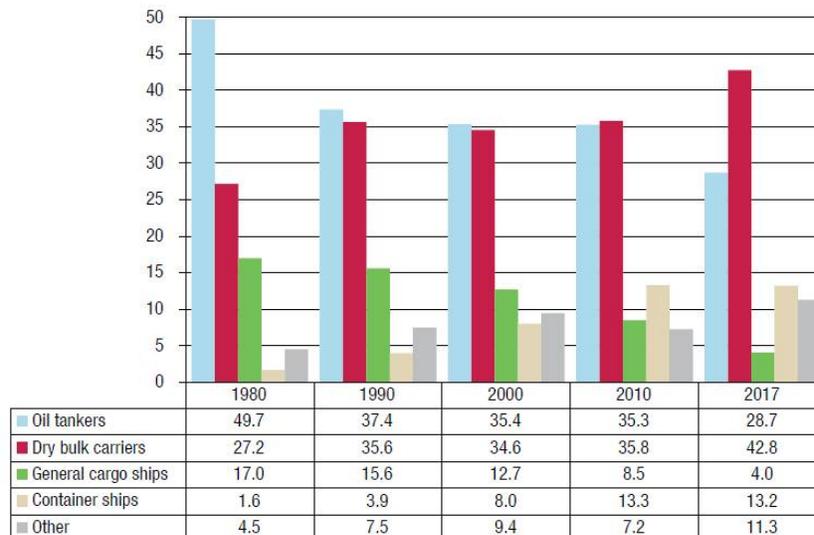


Figure 4: UNCTAD secretariat calculations, based on data from Clarksons Research and the Review of Maritime Transport

Density map of container ship movements:

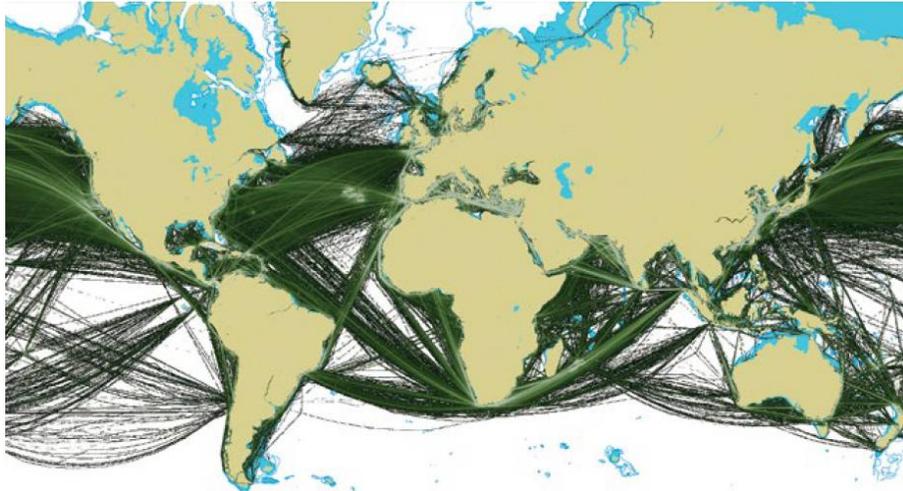


Figure 5: Prepared for UNCTAD by Marine Traffic. Data depict container ship movements in 2016

What is shown in the pictures before is the increasing container vessel trend, this is very important because when the port terminal can't give a quick answer to infrastructure situations having design planning strategies gives the opportunity to optimise all the resources, including the utilization of the yard.

Each year, more goods use containers to be transport, so more supplies chains cross the ports terminals, giving the responsibility to made dynamic process avoiding death-times and inefficiencies.

KEY ASPECTS TO CONSIDER

- A. Demand get concentrate in bigger ships, increasing stress port terminal situation, to prevent process clashing it's necessary to flat the demand. For avoid variability process it should be work in:
 - Having vessel berth windows.
 - Having a coordination system with appointment hour for empty, import and export containers.
 - Having expected connections with the parts of the logistics chains.
- B. It should be calculated the capacities of each process to balance the working charge.
- C. The tack time and the cycle of it should be well-known for the port terminal.
- D. Simulations tools could be used to get better process and efficiencies.
- E. Develop clear performance indicators to know the weak links and the bottlenecks of each process.
- F. Have dynamic information flows with the stockholders.
- G. Having decisions at the last moment.
- H. Work with a resources pool to optimize them.

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