HANDLED BY:
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TERMINAL GINZA

CONTAINER TERMINAL CAPACITY ANALYSIS REPORT

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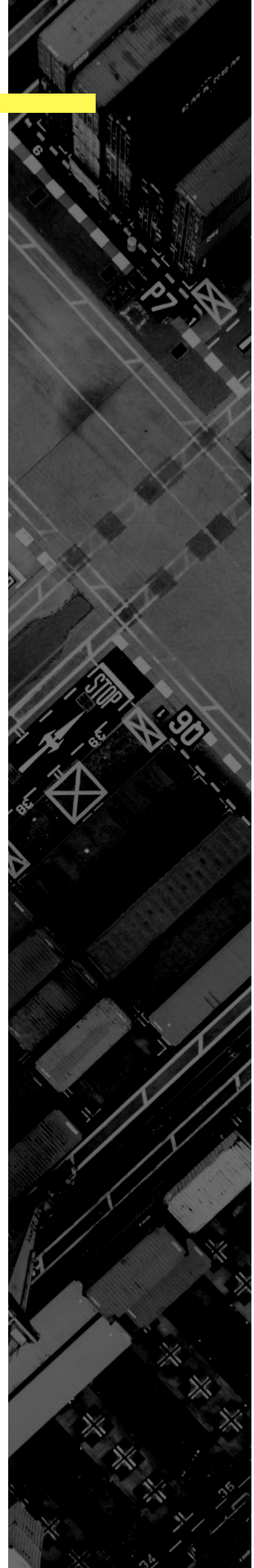


EXECUTIVE SUMMARY

The container terminal serves the need of moving containers through multiple transportation infrastructures. It functions as intermodal terminal where containers are transferred between ship and truck or train. The overall performance for a container terminal requires sufficient physical capacity and sustainable operational capacity. Because the terminal operation is a consolidation of multiple subsidiary systems that are integrated with some operation conflicts, a single dysfunctional facility can limit the overall capacity of the terminal. In order to mitigate the conflicts and accommodate the continuing growth in containers volume, terminal operators attempt to develop capacity planning strategy. So that, a model can simulate the complex container terminal operations for terminal capacity planning. In regard to the potential development and expansion of terminal Ginza, which is one of the existing terminals that located in the US Gulf Coast, this paper evaluates the correlation between terminal characteristics and terminal performance through structural equation modeling. We are going to assess the capacity of the existing facilities of terminal Ginza and propose the possible measures and strategies for terminal capacity improvement over the 20-years period.

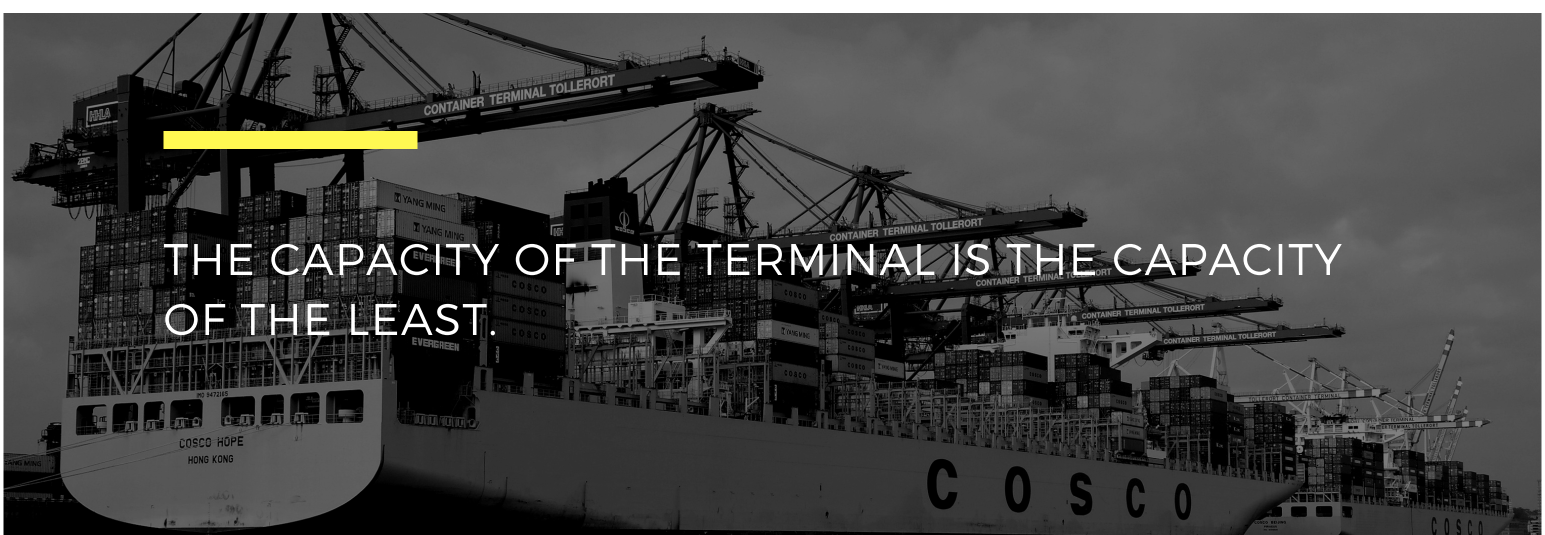
INTRODUCTION

Maritime transport has developed to serve several purposes. E-commerce and fast economic growth in developing countries have led to increase in global demand for fast, low cost, and reliable overseas shipping services. Since, containerization has proven the efficiency and simplicity in handling different types of cargo, the demand for container terminals has significantly increased. According to Matthew Heins, the beginning of containerization was in 1950 and it was prominent in two infrastructures, trucking and the railroad which established system of domestic containers (p.1). Hence the containers of the railroads were not sufficient to accommodate high global demand; instead the shipping lines revamped and adopted containerization strategy which ultimately led to the worldwide standardization of the container. Today, container terminals play an important role in global trading and international business by linking local markets around the world.

The container terminal serves the need of moving containers through multiple transportation infrastructures. It functions as intermodal terminal where containers are transferred between ship and truck or train. Like any other modes of transportation, container terminals function under multiple operational objectives. A container moves through many horizontal and vertical transportation cycles so that the terminal operation is considered to be an intricate set of container-handling processes. Therefore, the efficiency of terminal operation can be optimized by utilizing each link in the container handling cycle. Although it is very difficult to

fully optimize the terminal operations because of conflict of the individual subsystems, optimizing overall performance of the entire terminal over time is achievable.

The overall performance for a container terminal requires sufficient physical capacity and sustainable operational capacity. The physical capacity is constrained by the basic infrastructure of the terminal such as size of the container yard or the number of ship-to-shore cranes. In order to accommodate the continuing growth in containers volume, terminal operators attempt to develop capacity planning strategy. As well the terminal operator works to enhance the operations for an existing terminal configuration (fixed terminal layout and set of equipment) to manage the massive growth in container traffic. Because the individual subsystems interactions can limit the handling capability of terminal, the operators manage the system to deploy efficiency in handling and stacking. The two approaches identify the benefit-impacts of new resources or operation improvement, so it helps the decision-makers to evaluate and manage the risks. In regard to the potential development and expansion of terminal Ginza, which is one of the existing terminals that located in the US Gulf Coast, this paper evaluates the correlation between terminal characteristics and terminal performance through structural equation modeling. We are going to assess the capacity of the existing facilities of terminal Ginza and propose the possible measures and strategies for terminal capacity improvement over the 20-years period.



CURRENT PHYSICAL AND OPERATION CHARACTERISTICS OF TERMINAL

There are many factors that shape the terminal performance. It also can classify as controlled and uncontrolled factors. While the influence of location, and market-oriented factors are extremely hard to predict, operators can take advances in-terminal controlled components such as infrastructure, handling equipment, operating time and IT system to improve the productivity of the terminal. The overall performance of the terminal is usually expressed throughput the annual throughput. Although the terminal throughput might not be the most accurate indicator to assess the terminal performance, it indicates the percentage of utilization in the terminal. Indeed, the terminal throughput is restrained by the efficiency and effectiveness of containers' routes within the terminal, considering input and output rate. Also, hinterland transport has essential role to route the containers out of the port and the terminal have to secure capacity and maintain flexibility of hinterland transport to guarantee streamlining cargo transport. To analyze the physical characteristics and the performance of terminal Ginza, the terminal operations break into four major subsystems represent the underlying operations. This report focuses on capacity indicators that are both available and reliable which demonstrate relative capacities rather than absolutes.

Berth

A berth is the front gate to moor and secure a vessel at the terminal, therefore, the depth and length of the channel approve determine the type of served vessels. Also, having more cranes means less time for loading/offloading and higher annual container throughput capacity.

The current wharf has three berths with total length of 3600 feet which can accommodate three vessels at the same time. while the main channel access to the wharf has Mean Low Water (MLW) depth of 45 feet and width of 2,650 feet, the port plans maximize the channel depth to reach 53 feet, so Post Pananmax vessels can be served by August 2018. In addition, landside infrastructure must be compatible with the vessel type and size. For instance, the number and handling capacity of ship-to-shore gantry cranes indicate (STS) the shoreside capacity. Currently, the terminal has 11 STS gantry cranes serving the terminal's vessels operations. Four of with are Post-Panamax, three Panamax and four of the 50 ft gauge cranes with average gross move per crane-hour is 28.5 lifts under three-eight hours working shifts on three days and two-eight hours working shifts on two days. The port does not plan to expand the working schedule over the weekend any time soon. However, the port will replace the old 50 ft gauge cranes by Post-Panamax cranes to serve larger vessels By July 2018.

Container Yard

Container yard provides fixability in handling and storing cargo by increasing the channel capability which links seaside to landside. Handling systems, yard sizes and crane characteristics are the main factors that identify the capacity of the operation. At the present, 80% of the terminal throughput moves through the container yard. To facilitate the streaming of cargo between gantry crane and storage yard, there are 74 in-terminal tractor/chassis to support the horizontal transport. Besides that, the container yard uses 27 Rubber Tire Gantry (RTGs) cranes of 1-over-6 staking capacity, so that the average handling capacity for each RTG crane is 18 containers per hour. In fact, it's impossible to utilize all the RTG crane move since 50%, 25%, and 25% of the terminal handled containers are import cargo, expert cargo, and empty boxes, respectively. While the storage yard covers 100 acre of total terminal area, the terminal has 3650 ground slots (TEUs) for storage of all kind of containers with static capacity of 11680 TEUs. It should be noted that there are 4, 5 and 7 Days dwell time for each of import, export cargo and empty containers.

Intermodal Yard

The terminal rail yard is associated with 20% of the total terminal throughput. There is only single track at the rail terminal that facilitates train loading and offloading. Because of the inadequate length of the track, the train loading/offloading process accomplished by breaking the train into shorter strings of railcars, storing them at the storage track, and then consolidate them to a full train with capacity of 250 TEU. This process takes about one hour and half, while loading the entire train requires eight working hours. Two RTGs are used to handle the containers to/from the train cars with a capacity of 20 containers per crane-hour. Currently, the terminal rail yard is operated under two eight-hours shifts during weekdays and one shift at the weekend.

Gate

The gate is the front entrance to terminal facility. The capacity of the gate is essential for terminal overall performance and any congestion at the gate will reflect on the container yard operation. The terminal has 6 inbound lanes and 6 outbound lanes with capability of processing 120 moves per hour. The gate house is equipped with security system including three weigh-in-motion scales on the out-bound, and OCP camera portals on each in-bound lane. There is one chassis express lane are provided for each of the inbound and the outbound, and two Vehicle and Cargo Inspection System (VACIS) lanes are placed on the left side of the gate for the outbound lanes. To enhance the gate performance and satisfy the increasing demand, the gate operates under two eight-hours shift from Monday till Friday and can be expended to hoot shift if needed in the future.

Terminal Overall

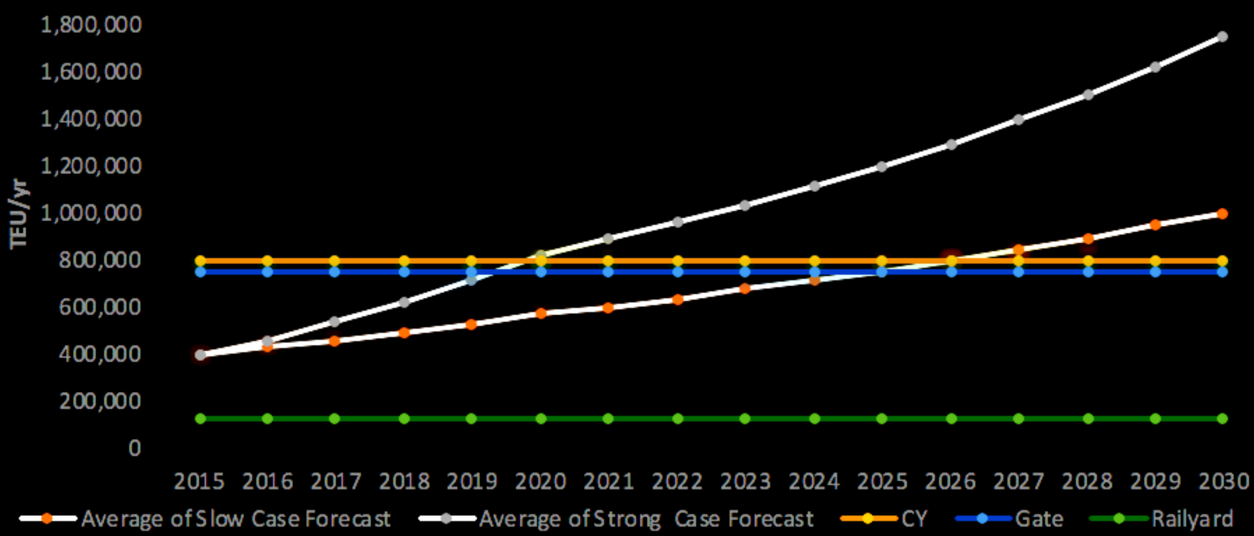
The terminal rail yard is associated with 20% of the total terminal throughput. There is only single track at the rail terminal that facilitates train loading and offloading. Because of the inadequate length of the track, the train loading/offloading process accomplished by breaking the train into shorter strings of railcars, storing them at the storage track, and then consolidate them to a full train with capacity of 250 TEU. This process takes about one hour and half, while loading the entire train requires eight working hours. Two RTGs are used to handle the containers to/from the train cars with a capacity of 20 containers per crane-hour. Currently, the terminal rail yard is operated under two eight-hours shifts during weekdays and one shift at the weekend.

EXISTING CAPACITY ASSESSMENT

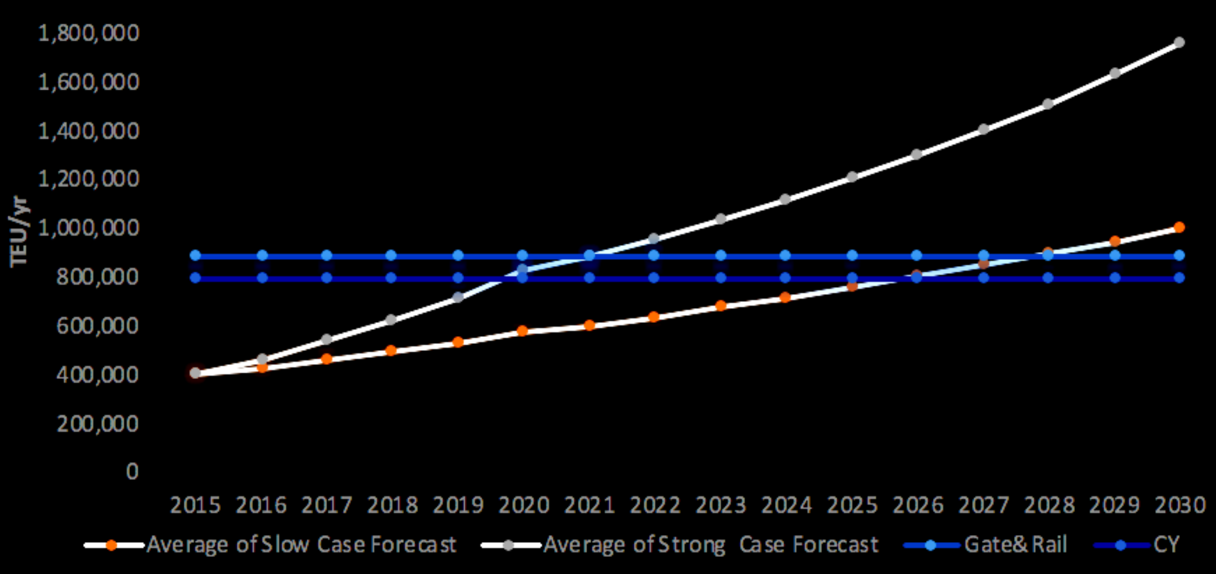
The capacity of the terminal is the capacity of the least. Because the terminal operation is a consolidation of multiple subsidiary systems that are integrated with some operation conflicts, a single dysfunctional facility can limit the overall capacity of the terminal. For instance, utilizing the STS crane to move more containers per hour can cause congestion in the container yard if the staking process is insufficient. Therefore, a separate assessment for each individual facility in the terminal is needed to ascertain the cause of capacity resource deficiency. There are several approaches to evaluate the facility operations, and it mostly provisioned by the objectives of the study. As noted previously, terminal Ginza is seeking to evaluate the existing capacity of terminal to set the base line for future developments, if needed, to accommodate the future demand.

In order to provide accountable and reliable measures, the analytical model is based on current operation performance considering the peak periods, dwell time, and inflation rate. Due to the complexity of container handling cycle, building a mathematical model for the whole terminal operation would be very difficult to achieve. So that, this report relies on single aspect models of one component of the terminal at a time. In another words, the model is divided into four underlying specific models which sum up the major terminal operations under four categories. By calculating the capacity of Berth, Container Yard (CY), Intermodal Yard (IY), and the gate, taking into account the current inputs, the model can identify the bottleneck effect on the terminal capacity.

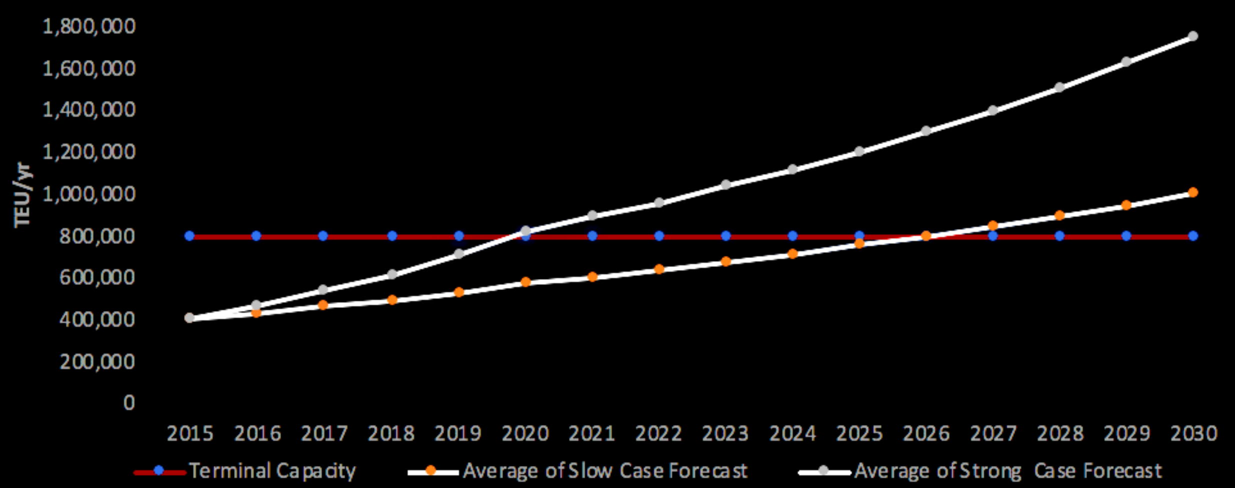
Fundamentally, the containers are handled through two cycles. The first cycle goes from STS crane to CY by one of the horizontal tractors the terminal has. Therefore, the capacity of the STS cranes, CY, and the horizontal transportations are strongly affiliated with the performance of the first handling cycle. While the second cycle starts by the terminal gate where a truck picks the container from CY then turn back to the gate, the efficiency of gate and the capacity of CY are the measurement parameters. For the first cycle, the capacity of berth is calculated by knowing the number of working cranes, the crane productivity, the number of work shifts. Under the current condition, the berth can handle 2,565,469 TEU each year.This determines efficiency of the first link of the cycle.



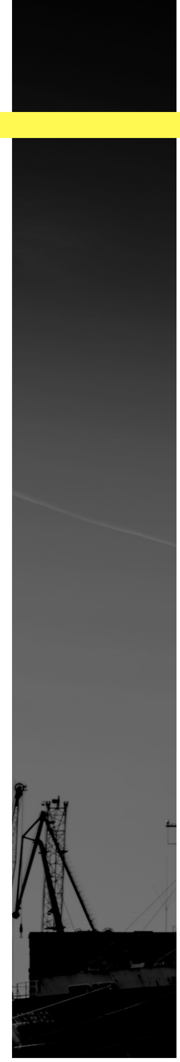
Next the containers are being convey using terminal chassis or tractors. Unfortunately, there is no adequate information about truck turn time between the quay and the CY or IY. By Assuming that the truck turn time is the average of the time required for single and dual-transactions, which is 20 and 40 minutes, respectively. The approximated operation capacity of the horizontal transportation equals the number of in-terminal tractors multiplied by truck turn time which shows the capability of moving 252 TEU per hour and 1,345,701 TEU in total over a year to either container yard or the rail yard.
Both of the rail and container yards considered to be a temporary storage till the containers transport out of the terminal by a train or a truck. At the most common practices, the limited rail yard capacity does not constrain overall terminal capacity; however, unsatisfied demand by the rail yard will be forwarded to the container yard then to the gate which can put more pressure over the second handling cycle.
The terminal yard operation can load 566 trains every year with total capacity of 127,286 TEU by the help of 2 RTGs cranes with maximum practical capacity of 307,749 TEU per year. On the other side, 80% of the total throughputs goes through the container yard, so 27 RTGs with maximum practical capacity of 3,399,223 TEU per year and 826 TEU each working hour facilitate the containers stacking. The maximum practical capacity for RTGSs were obtained knowing the number of working RTGs and its handling capacity per hour.



Although MPC of RTGs is merely high, the container yard capacity is limited by the static capacity of yard. The static capacity refers to number of boxes handled in any given time considering total ground slots and the average stacking high. Since, the static capacity for the container yard is 11680 TEU per net acres, the dynamic capacity appears to be 886,011 TEU per year. The annual turnover time for each type of cargo was incorporated in calculating the dynamic capacity by including 5 holidays, working shifts, and containers dwell time.
Lastly, the second cycle ends by processing the container through gate where a truck picks the container from CY then drive back to the gate. Having weigh-in-motion scales, OCP camera portals, and other security systems, the gate can process 120 transactions per hour. Since, there are 12 lanes serve gate operation, the total handled containers are 797,410 TEU over the course of a year. Although the gate operation has the lowest throughput rate, the terminal throughputs measure through adding up the gate and rail operational capacities. By comparing the capacity of the four facilities, the capacity of the CY, followed by the gate capacity, will be the first constrain that limits the total throughputs for the terminal at the year of 2020.



PROPOSED IMPROVEMENT ACTION PLAN AND SCHEDULE



The market demand is increasing, and the terminal is going to benefit from the strong future container flows. 400,000 containers were the total throughput for the terminal at the year of 2015. Terminal demand forecasts indicate an annual slow growth rate at the LG terminal facility of approximately 4.5% while the strong growth rate is 9.46% between 2016 and 2020, reaching 568,800 TEUs and 824,300 TEUs, in 2020. After ten years, the expected demand will be around 1.754 million TEUs for a strong market and 1.0015 million TEUs if there is less demand. The terminal is planning in the short term to enhance the terminal operation by delivering several developments to the facilities. In one hand, the berth developments, including dredging the channel and placing two STS Post-Panamax cranes, is going to be finish by the end of 2018. On the other hand, the gate operation will be extended to include hoot shift when it's needed.

Improvement Approach and Strategy

The future planning aims at minimizing capital investments and operation expenses while maximizing productivity to accommodate uncertain market demand. The model takes two approaches to improve the storage capacity and optimize the terminal operation. First, by expanding and developing new physical-structures which will insure the flexibility and the efficiency of the system. Indeed, any new facility development will consider the strong growth forecast, so the facility capacity can be unitized for scalable period before it's saturated.

Non-physical approach can be obtained by improve operation productivity and efficiency by, increasing storage density, expanding operation hours, improving internal traffic flow and upgrading IT system. Also, the hourly performance for berth will be considered in the process of optimization other variables that affect the first cycle for the container.

Possible Capacity Improvement Options and Timeline

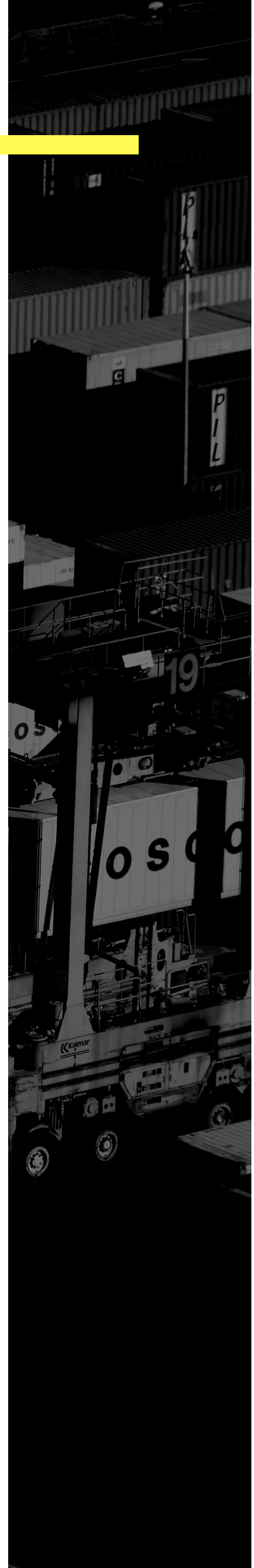
The container yard is the bottleneck in the terminal operation. Therefore, the terminal maximum capacity will reach the break point by 2020 when the terminal capacity is merely can sustain the high demand. To prevent any deficiency in the system, the precautionary plans are noted as following:

Berth

Currently, the berth has sufficient handlining capacity with over 2 million moves per year. While the process of replacing the old 50 ft cranes with Post-panama crane might affect the berth operation in the short term, a better optimization to functional berths at the time of construction is required. Overall, adding two Post-panama cranes, which costs about 19 million dollars, won't increase the total berth moves, but it allows the terminal to serve bigger vessels. The construction expected to end by 2018.

.Rail Yard

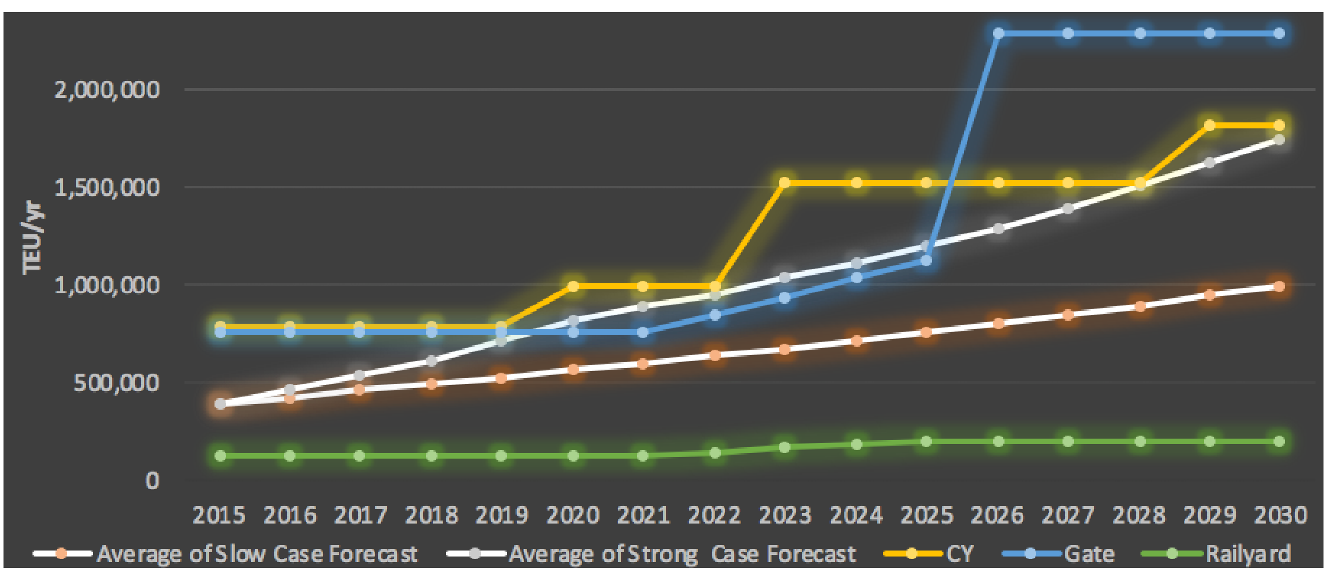
Since only 20% of the terminal throughput passes through the rail yard, the rail yard capacity can reach critical level in 2019. Because the current capacity for the rail yard is 127,286 TEU per year and the strong growth rate indicates 700,000 TEU total throughputs, unhandled containers will put more pressure on the gate operation.



Therefore, there are two ways to mitigate the issue. First, by reducing the time for loading and off-loading the train either by utilizing the RTG crane moves or increasing the working shifts gradually to include the weekend. Secondly, by raising the number of loaded trains everyday by increasing the working power. The terminal can only determine the adequate number of train trips per day based on track availability and other uncontrolled factors. If the rail operation extended into three shift and 6 work days, the rail capacity can reach 208,286 TEU/year by 2025. Overall, the terminal should optimize the rail operation before the year of 2022 and there is no such a need for new infrastructure.

Container Yard

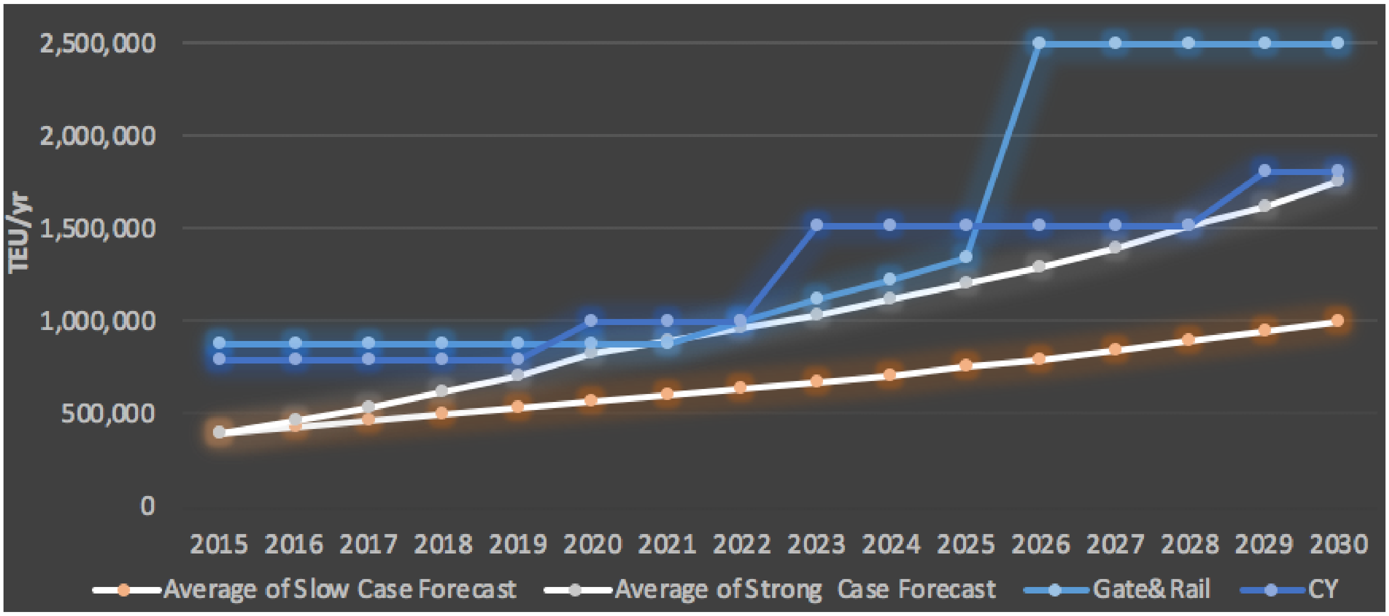
27 RGT cranes are capable of storing 11680 TEU per acre with average stacking high 3.2 TEU. Also, the yard cranes provide fast handlining rate and it can stack high up to 6 TEU. However, the peak demand will exceed the dynamic capacity for container yard in 2020. An additional storage should be put to work before 2021, so it maintains the terminal operation. There are 20 acre off-set depot that are devoted for terminal storage development, developing the 20 acres using RTG system will utilize the land almost up to 500 TEU per storage acre. Deploying new storage yard will that can be used to stack empty containers which add a capacity of 525,165 TEU to the total container yard capacity.



While the propose construction is under the implementation, the terminal should seek increasing the stacking capacity steadily from 2020 until the construction is finished. Increasing the average stacking high up to 4 containers will add about 150,000 TEU to the total yearly capacity operation. The last needed development for the container yard is going to be in 2029. Therefore, increasing the storage capacity by replacing Roll-in Roll-out yard and the empty lot into a container yard. Developing the 20 acres using Straddle Carrier system will utilize the land almost up to 385 TEU per storage acre. Also, the system will require the terminal to acquire 5-7 Straddle Carriers that are typically able to do 8 cycles per hours. Deploying new SC yard will add a capacity of 300,000 TEU to the container yard and sustain the future demand.

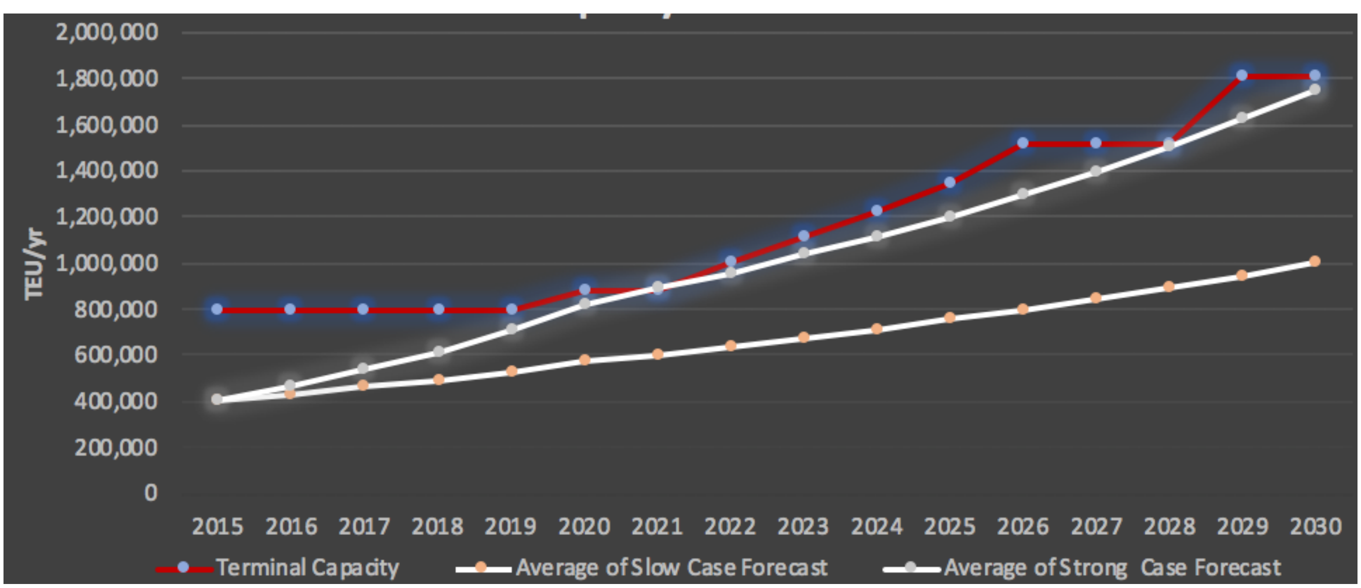
Gate

the development for gate operation will be optimized twice over time. By 2022, the gate operation will be limited to 830,000 TEU per year in which the terminal capacity is constrained by the same value. The short-term strategy is adding hoot shift to the work schedule which will add about 400,000 TEU to the total gate capacity but it increases the operation cost overtime. Automated gate system is a long-term strategy that can significantly improve the gate performance which can exceed 2 million TEU per year. Installing automated gate system will demand less labor force, and better rate for truck turn rate. The terminal should prepare to implement the system by 2026 or instead it can make early investment in which the terminal does not need to upgrade the gate operation over two periods.



Horizontal Transportation

The horizontal movements between the berth and container yard or the rail yard are crucial to optimize the facility equipment in the best way. Currently, transportation channel can handle 252 TEU each hour and move it either to CY or IY. Because there is growth in demand overtime, more handling equipment are must-have. There are five SC, which can move 28 teu/hour-crane, will be serving the new yard plus it can facilitate train loading and offloading if needed. Also, on-dock rail can significantly improve the horizontal transportation and relieve some of the pressure on the gate. Overall, the total horizontal capacity will reach 392 TEU/hour which is about 75% of the STS productivity.



CONCLUSION

Based on the data provided by the terminal operator the results showed that there is still available space to be utilized at a static level and also room for more improvement at a dynamic level. The proposed improvements will accommodate the future growth over the next 20 years. Also, the model simulates the complex container terminal operations for terminal capacity planning. Although the model recommends the year for implementation of any improvement, the improvements of the operation, which does not require any capital investments, can be reassessed each year and matched with the existing demand. The flexibility of the operational implementations leads to better land utilization and better allocation for the terminal resources. On the other hand, capital investment in new facilities in the terminal is essential to increase the terminal capacity over time. Since the container yard serves as an exchange channel between the berth and the gate or the rail, the CY capacity should not be affected while deploying the new developments. Overall the proposed measures enable the decision-makers, the state, port authorities or port operators, to make strategic decisions regarding investment priorities in the modern global turbulent business environment.

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