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THE USE OF SPECIAL TECHNICAL EQUIPMENT ACCORDING PROFILING TERMINALS TO INCREASE THE PERFORMANCE OF OPERATIONS IN THE SEAPORT OF DURRES, ALBANIA

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Abstract

This paper studies the profiling of terminals in Durres port- Albania aiming at improvement of the performance of the operations and avoiding bottleneck through the defining of special technical handling equipment. The paper presents the port infrastructure, the layout of the quay sides and their back off yards, as well as the access channel and port basin. It also represents the condidions of existing handling equipment and the equipment used for cargo transfer from pier to their storing yards and beyond to their final destinations. Determination of special technical equipment required by terminals is based on the traffic forecast, passengers and ships that will call the port of Durres, and operational procedures. The paper argues that the identification of requirements for special technical handling equipments adapted according to the profiling of terminals bring good management of terminal capacity and improves the performance of

operations. These predictions are a tool to be used for the design of appropriate policies and strategies for the commercial orientation and good management of increased port traffic, by guaranteeing security and reduction of negative impacts on the environment.

Keywords: Port infrastructure, technical handling equipments, operational procedures, performance of terminals, port traffic

INTRODUCTION

Overview of Durres Port and criteria for performance of terminals

The port of Durres is the main port of Albania. Its operational infrastructure consists of 11 berths with depths alongside ranging from 7.5÷11.5 m. Main products handled at the port are general cargo, cereals, containers, ferries and minerals. Being the main gateway to Albania and being positioned at the entrance of the Adriatic, the port of Durres has a strong strategic position. It offers a gateway to corridor VIIII, in particular to the neighboring countries of Kosovo and Macedonia.

In view of the transformation of the port of Durres into a landlord port, its applied terminals, these are dedicated to the handling and storage of particular types of cargoes that are compatible with each other. The terminals are:

- General cargo and cereals terminal berth length required 600–900 m; storage: open air, warehouses and silo complex (cereals)
- Container terminal: berth length required 600 m; area required 15–25 hectares
- Ferry and cruise terminal: 8 berths; parking area 5-10 hectares
- Dirty dry bulk terminal: berth length required 1 berth of 240 m; area for storage about 2 hectares; connection with rail

Figure 1. Aerial view of the port of Durres

Port is characterized by the location of the container terminal at the western side of the basin and the location of the dirty dry bulk at the eastern side of the basin. With this plan the “clean” harbor activities are located close to the city of Durres and the “dirty” activities are located as far as possible away from the city of Durres. The development of terminals based on these principles:

• Demand for port services as indicated in traffic forecast
• All cargo is to be handled in the Port of Durres
• Required terminal infrastructure
• Vessel size

Existing basin can be established in accordance with international standards of safety with a reasonable investment. Based on this improved configuration of basin is determine the type of vessels to allow access to the port: of container the maximum possible vessel size is limited to 1700 TEU; dry bulk: the maximum possible vessel has a capacity of about 30.000 DWT.

Completion of certain performance levels in certain categories of operational activities typically include measures of productivity and service quality such as:

• Number of moves or tonnage handled between the ship-to-shore inter face per hour at berth
• Number of moves per gantry crane per hour or tonnage handled per crane per hour
• Number of moves made or tonnage handled per meters of quay per year
• Vessel turnaround time service quality index
• Truck turnaround service quality index
• Train turnaround service quality index (when and where applicable)

To measure how well are used the facilities often include minimum values measures of productivity, which vary for different port terminal types, for the two following assets:

• N° of moves or tonnage handled per meter of berth length
• N° of TEU or tonnage handled per square meter of terminal area

GENERAL CARGO AND CEREALS TERMINAL

General cargo *Marine operations*: Presently, a vessel needs to wait at anchorage until all customs procedures are fulfilled, including the payment of customs duties. It is clear that this procedure generates substantial waiting times of the vessel, and consequent demurrage charges. It is strongly recommended that the whole port area is transformed into a customs bonded area.

Traffic: General cargo arrives in the port of Durres with ferries (Ro-Ro: Roll-on/Roll-off) as well as with conventional general cargo vessels (Lo-Lo: Lift-on/Lift-off).

Quay handling: Non containerized general cargo is mainly handled at berths 1-4, located along the western breakwater of the port. From the port statistics it could be derived that the handling rate is about 115 tons per hour per vessel.

Storage: Non containerized general cargo is practically all handled via direct operations. Trucks are parked alongside the vessel and the cargo is immediately loaded on the truck for expedition to the hinterland or for exports (such as tiles).

Expedition to/Reception from the hinterland: Non-containerized cargo is done by truck.

Table 1. General cargo vessel traffic at the port of Durres

Indicator	Unit	Year 2012	2013	2014 (first 6 months)
Vessels	Number	835	731	272
Tonnage	Tonnes	954.989	934.281	346.885
Parcel size	Tonnes/Vessel	1.144	1.278	1.275
Average vessel capacity	DWT	1.636	1.731	1.786
Parcel size capacity		70%	74%	71%

Table 2. Quay operations for general cargo handling

	Unit	Year 2012	2013	2014 (first 6 months)
Traffic	Tonnes	1.366.449	1.265.342	485.877
Handling time	Hours	12.296	10.386	4.269
Handling rate	Tonnes/Hour	111	122	114

Cereals *Traffic*: Cereal imports have been fluctuating between 300.000 and 400.000 tons during the last 5 years.

Quay handling: Cereals are unloaded from the vessels by means of grab cranes Fantuzzi. These grab cranes discharge the grains into 5 steel large hoppers (sometimes referred to as silos) installed on the quay.

Storage: Cereals are handled via direct operations, thus eliminating the need for storage. There are 5 hoppers installed on the quays, each one with a capacity of around 300 tons, giving a total buffer of 1500 tons. With the improvement of the grain handling techniques through pneumatic equipments, this operation will be a relatively clean one, resulting in less pollution for the platform and the environment at large.

Expedition to / Reception from the hinterland The grain is further expedited to the hinterland by trucks that are loaded beneath the hoppers.

Determination of necessary equipment

General cargo will be loaded and off-loaded by means of mobile cranes. At the terminal, the cargo will be transported with Forklift Trucks (FLT's). Considering the condition of the loading cranes and FLT's, has been foreseen need of new equipment: 4 new mobile 5 tons cranes and 18 FLT's at the beginning and later 4 FLT's others. This should be enough for the projected traffic of about 1.2 million tons up to the 2030. For the determination of the required number of quay cranes, the following assumptions have been made: 15 cycles per hour; 5 ton per cycle; 365 days per year; 20 non workable days per year; 21 working hours per day; maximum occupancy per crane: 80%; and for the determination of the required number of FLT's, the following assumptions have been made: time per cycle vessel - storage v.v.: 15 minutes; 1 ton per cycle. This will be done at the time the unloading of cereals will be relocated from berth 5 to berth 4, the new equipment will consist of one vacuvator with a capacity of 250 t/h. Cereals can be handled via direct unloading (directly into trucks), but in case storage is required, a set of silos can be erected. In order to minimize visual hindrance, the height of the silos should be limited to about 10 m maximum.

Container Terminal

Marine operations Presently, container vessels are exempt of the obligation to handle all customs procedures before berthing.

Traffic Container traffic has been increasing rapidly. Most of the export containers are empties. Recently the export of chrome ore in containers has took off.

Quay handling Durres port handles Ro-Ro containers as well as Lo-Lo containers. The Ro-Ro containers arrive on chassis by ferry, and they are then trucked to the hinterland. Lo-Lo containers are presently handled at berth 6, with a berth length available for container handling of about 135 m (between fences). During the last 1.5 years the handling rate at the berths is about 9 boxes per hour per vessel. Normally, a mobile crane should be able to move about 15 boxes per hour. The slow rate achieved in the Port of Durres is probably to be attributed to the fact that the mobile crane used is actually too heavy for efficient container handling.

Horizontal transport between quay and storage Loading and unloading is done using 2 reach stackers. After deposit of the container on the quay, this is picked up by the reach stacker and transported to the storage yard where it is deposited in its final position with tractor trailer combinations.

Storage The total area within the fence is about 3.3 hectares. Assuming a stacking density of about 500 TEU per hectare with reach stacker operations, the available area has a capacity to store about 1500 TEU. With an averaged well time of 10 days, the area would be enough for an

annual throughput of about 50 thousand TEU. The yard has a limited number of reefer slots available.

Expedition to/Reception from the hinterland the reach stackers are used to load the import containers on trucks (or to off-load incase of export). Most full import containers are stripped at their final destination.

Storage area requirements An important issue for the planning of any container terminal is the available storage space. In the port of Durres this issue is particularly relevant, as the total storage area is relatively limited. The required storage capacity is expressed in TEU (twenty foot equivalent units), and distinction is made between capacity required for full containers and for empty containers. The reasons for this distinction are that:

• The average dwell time of empty containers is considerably longer than for full containers,

• The empty containers can be block-stacked – i.e. in large blocks of say 10÷20 containers wide

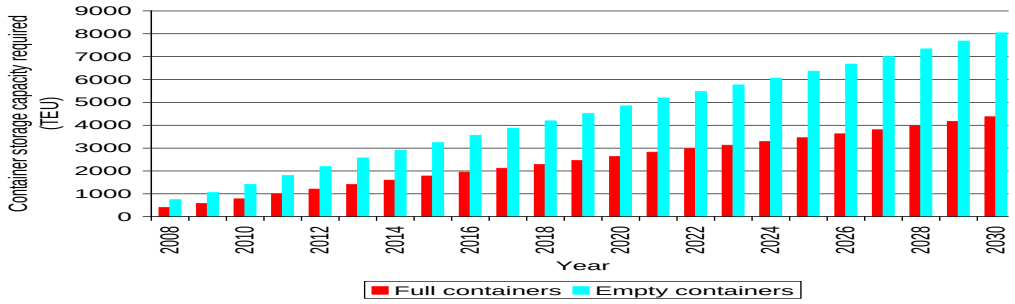
Due to the longer dwell time, the empty containers are positioned further away from the quays, and they can even be stored in a separate empty container storage yard, outside the container terminal. The storage requirements are determined on the basis of 350 operational days per year, and on following assumptions regarding dwell time: full import containers: 7 days; full export containers: 5 days; empty containers: 14 days. Dwell time refers to the total time that the container remains in the container yard (between unloading and expedition to the hinterland or v.v.) is a critical factor in the determination of the capacity of a container terminal. High dwell times, above 5-6 days, should be avoided, as they adversely affect the yard operations. The assumed dwell times are in line with observations in other terminals, but the consultant recommends that the dwell time of containers is closely monitored.

Operational system Distinction is made between ship-to-shore handling and yard operations.

Table 3. Quay operations for container handling

	Unit	2012	2013	2014 (first 6 months)
Traffic	Boxes	11.902	15.977	8.740
Handling time	Hours	2.575	1.765	997
Handling rate	Boxes/Hour	4.6	9.1	8.8

Figure 2. Capacity forecast required for container storage



Ship-to-shore handling

In principle there are 3 possibilities for the quay equipment of a container terminal:

• No quay equipment, all containers are handled with ships gear: The advantage is that no investment in cranes is required. Disadvantages are that only geared vessels can call at the container terminal. More and more container vessels, especially the larger ones, are delivered without own cranes. Further, the handling rates when using ships gear are lower than what can be achieved with quay cranes. In view of the limitations, this solution is not considered any further for the Port of Durres

• Ship-to-shore gantry cranes (rail mounted): This is the standard solution applied in the larger container terminals in the world. Gantry cranes can achieve the highest handling rate (over 30 boxes per hour per crane). Their capacity is typically in the order of 100 000 boxes per year. The main disadvantage is that these cranes are dedicated to container handling, and that they are not flexible to handle other cargoes. Furthermore, they require that the quay is provided with heavy crane rails (standard span: around 30m), often supported on piles.

• Mobile container cranes: Mobile container cranes, of size and dimensions adapted to container handling, are good solution for many smaller to medium sized container terminals. They are supported by rubber tires, and in operation they are supported by 4 retractable spuds. Although the handling rate will be below that of gantry cranes, the performance of mobile cranes should not be underestimated. Largely depending on the skills of the crane operator, handling rates between 20 and 25 boxes per hour can be achieved with this type of crane.

Container yard operations

For the handling of containers in the container yard, there are in principle 4 alternatives:

Reach stackers (RS); Straddle carriers (SC); Rubber Tired Gantries (RTG), in combination with tractor/trailer; Rail Mounted Gantries (RMG), in combination with tractor/trailer

Table 4 Table below presents a comparative overview of the 4 alternative systems for the container yard.

Table 4. Comparative overview of the 4 alternative systems.

	RS	SC	RTG	RMG
Stacking density	-	0	0/+	+
Investment	+	0	0/+	-
Operational costs	0	-	+	0
Pavement requirements	-/0	+	0/+	-
Overall Evaluation for Durres port	-	-/0	+	-/0

- = lower than average performance

0 = medium performance

+ = better than average performance

Recommends the combination of Rubber Tired Gantry cranes in combination with tractor/trailer for the following reasons:

• Reach stackers are often applied in the first phases of a small container terminal. It is the system presently in use at the Durres container terminal. The advantage is that they are very flexible – they can be used to pick up the container from the berth, transport it to the yard and stack it. It does not require any highly skilled operators, and also maintenance is relatively simple. Further, the investment cost is limited (around 350 thousand euro). Main disadvantages are that they tend to destroy the terminal pavement (the axle load of a loaded reach stacker is comparable to the wheel load of a Boeing 747 on the tarmac when landing), and that the practical stacking density is limited to around 400TEU per hectare (albeit an important improvement compared to forklift trucks).

• Straddle carriers are very flexible in operations, and require only a limited investment. Straddle carriers are often used in medium size and large terminals. Straddle carrier system is labor efficient and enables high crane productivity, because an effective buffer zone is created under the ship-to-shore crane. This makes it possible for the ship-to-shore cranes to operate at maximum efficiency thus maximizing vessel productivity. A straddle carrier system gives high selectivity because of a relatively low stacking height. This is also the disadvantage, namely the limited stacking density of around 500 TEU per hectare. Disadvantages are further that they require a large number of skilled drivers and that they generally require intensive maintenance.

• Rubber Tired Gantries are often applied in large to very large terminals, and also in smaller terminals where the available space is limited. Stacking up to 7 containers wide and 6+1 high, they can achieve very high stacking density of up to 1000 TEU per hectare. They operate in

combination with tractor/trailer combinations. Maintenance requirements are low and special workshops for RTG cranes are normally not needed.

• Rail Mounted Gantries (RMG) are bridge cranes, supported by rails. They can span many rows of containers stacked into one block, and therefore can achieve the highest stacking densities of over 1000 TEU per hectare. They are often used in large rail operations as several tracks can be covered simultaneously. With cantilevered RMG cranes road truck traffic can be easily separated from the rail operations. RMG cranes are normally dedicated to a specific area, as they cannot be moved long distances, for example between rail and yard operations. The main disadvantage of RMG's is that they are inflexible.

Especially in view of the high stacking density of the RTG, and taking into account the limited storage available in the Port of Durres, recommends the application of Rubber Tired Gantries for the Durres container terminal. In addition to the RTG's, the Consultant recommends to deploy also a reach stacker (to benefit from its flexibility), and empty container handlers (side lifters for the block stacking of empty containers.

Capacity The total capacity of the fully developed container terminal depends on many factors, but can be estimated at around 500 thousand TEU

Cement and clinker terminal

The option of combining the cement and clinker is selected as they require an infrastructure and similar installations. Both products are for export, so do not require any installation as heavy cranes. Both products can be transported freely via a jetty. Imported coal, so it requires firing heavy machinery, making a combination with cement or clinker. On the other hand, cranes used for unloading of coal can also be used for loading of minerals.

Traffic Until last year, Albania depended on imports for the provision of cement.

Quay handling Imports are being handled by mobile Siwertell screw un-loaders.

Storage Behind berth no10 a shed is installed for the storage of cement, together with a bunker and a bagging installation.

Expedition to/Reception from the hinterland Cement in bulk is transported by means of specialized trucks.

Minerals *Traffic* In the past Albania was the 3rd exporter world wide of chrome ore. Minerals are the main export product of Albania through the port of Durres. Albania is reported to have substantial reserves of these minerals still, and a further increase of exports is to be taken into account. An increase in the dimensions of ships entering the port.

Quay handling Most of the minerals are transported from the hinterland in bulk, by railway. The wagons dump the minerals on a dedicated field in the north-eastern corner of the port area. At

present, the minerals are then loaded on to dump trucks, which take the goods to the other side of the port. Finally the minerals are loaded on to the vessel by two 15 ton grab cranes installed on the quay at a rate of about 200 tons per vessel per hour (about 20 cycles per hour x 5 tons /cycle x 2cranes/vessel).

An interesting evolution that took up recently is the export of chrome ore in 20 ft containers. Although the transport of bulk minerals in containers is not very common, there is a rationale behind this: the port of Durres mainly imports full containers, and nearly all containers are returned empty. Filling up these empty containers with export produce helps balancing the container flows, and it is a cheap way of getting them to the international markets (e.g. to countries that mainly export full containers, such as China)

Storage Minerals arriving by rail are dumped on a plot in the north-eastern corner of the port, adjacent to the rail and just south of the oil tank farm.

Expedition to / Reception from the hinterland Most of the minerals arrive from the hinterland in bulk by railway.

Table 5. Characteristics of dry bulk vessels for the export of chrome from Albania

Indicator	Unit	Year 2012	2013	2014 (first 6 months)
Vessels	Number	50	42	21
Tonnage	Tonnes	102.562	200.897	175.629
Parcel size	Tonnes/Vessel	2.051	4.783	8.363
Average vessel capacity	DWT	2.656	6.961	12.181
Parcel size capacity		77%	69%	69%

Table 6. Quay operations for chrome loading

	Unit	Year 2012	2013	2014 (first 6 months)
Traffic	Tonnes	102.562	200.897	175.629
Handling time	Hours	1.536	1.393	900
Handling rate	Tonnes/Hour	67	144	195

Determination of necessary equipment

Clinker and cement are products that are easily conveyable (with a pneumatic system or with conveyor belts), and can therefore be handled across a jetty. They do not require the immediate adjacency of a large back-up area as would be the case for, for example, scrap or minerals.

The capacity of the cement and clinker jetty is estimated at around 4 million tons per year (depending on vessel sizes and on operational efficiency)

The minerals and coal terminal is located behind berth 10 and 11. Considering the condition of the terminal area and the berths, rehabilitation works are foreseen. In addition, the terminal area

will be extended seawards. This new area will be reclaimed with the dredged material from the channel and basin. The capacity of the minerals and coal terminal depends largely on the nature of the materials to be handled, but can be estimated roughly at around 3 million tons per annum.

Table 7. Identification of equipment requirements

Port of Durres Authority														
Identification of Equipment Requirements														
			1	2	3	4	5	6	7	8	9	10	11	
	Length	(m)	178,5	292,2		173,8	235,9	265	202,9	202,9	125,5	249,7	173	
	Dredged Depth	(m)	7,35	7,35		7,1	7,9	9,85	8,5	7,7		7,3	11	
	Design Load	t/m^2	4	4		4	4	4	4	4	4	4	4	
Equipment	**Type of Cargo**		G/C	G/C	Service	G/C	Grain/GC	Container	Bulk	Bulk	Ferry	Bulk	Bulk	Total
Cranes												under rehabilitation		
S/S Rail Cranes	(available)		2	2		3	5		2			3		17
S/S Mobile Harbour Cranes	(available)							2						2
Grabs							grain grabs		ore/coal	grabs		grabs (to be determined)		
Spreaders								3						3
Pallet Gear			2	2		3								7
Pallet Cages	for bananas					3								3
Pallets			200	200		300		200						900
Forklift Trucks														
Forklift Trucks 3 t			1	2			3	4						10
Forklift Trucks 5 t			3	5		6	6							20
Forklift Trucks 10 t														0
Forklift Trucks 15 t			1	2		1	1							5
Forklift Trucks 20 t														0
Forklift Trucks 25 t				1		1								2
Forklift Trucks >25 t				1		1								2
Truck/Trailers														
Head Trucks			2	2		3	3	8			2			20
Flat Bed Trailer			4	4		6	3				4			21
Container Trailer (bath tube)								12						12
Container Lifting Equipment														
Reachstacker								4						4
Toploader								3						3
Bulk Handling Equipment														
Shovel Loader									3					3
Bob Cats							2		4					6
Hoppers Movable							2							2

CONCLUSIONS

- To improve the existing port capacity in order to positively respond to greater demand of the market, and making it possible for bigger ships to access the port is necessary use specialized equipment in order to cut down the cargo handling time and increasing the utility rate of the berth.
- The specialization of the terminals to handle the cargo of the same natyre (Durres port is a multipurpose port) resulting in the usage of the specialized equipments. These

equipments are used in an effective way, thus bringing the improvement of the operations management.

- In this era of globalization era, port has to face the challange of redefining its finctional role in order to be part of the global supply chain through the optimization of port procedures. Terminals shoud offer high speed operations in order to avoid quay congestion, which would create a bottleneck in the port.

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