Technological model for application of mobile technology in the process of highway transportation of imported sulfur

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Abstract: - This article presents the definition of a model for application of mobile technology in Ports. The work has been developed in the context of the use of mobile devices for automation of the processes of loading and logistics of highway transportation from the port to the importer. The term mobile technology is employed to define equipment, communication means and software engineering that permit to extend the computing support beyond the existing infra-structure limits.

Keywords: - Mobility, Logistics, Transportation, Automation, Terminal

1 Introduction

The official landmark of the launching of Porto de Santos is February 2nd, 1892, when the then Companhia Docas de Santos – CDS, delivered to the world navigation the first 260 m of docks, in the area, still currently called Valongo.

Since then, the port has not stopped expanding, crossing all cycles of economic growth of the country, appearance and disappearance of types of cargo, until it reached the current period of wide use of containers.

In 1980, with the end of the legal period of concession of exploitation of the port by Companhia Docas de Santos, the Federal Government created Companhia Docas do Estado de São Paulo – CODESP, a mixed economy company, whose major capital belongs to the Union.

Currently, Porto de Santos, moves, per year, over 60 million tons of miscellaneous cargos. With 12 km of docks, between the two margins of the estuary of Santos, the port entered a new phase of exploitation, as a consequence of Law No. 8.630/93, with the leasing of areas and facilities to the private initiatives, upon public bidding procedures.

The Porto de Santos, located in the municipality of Santos, in the State of São Paulo, is the main Brazilian port, leader in the movement of containers. The system of terrestrial accesses to the port is formed by Anchieta and Imigrantes highways and by Ferroban and MRS railways.

Today, it is Latin America’s largest Port, occupying the 39th world ranking of movement of container cargos.

The Port of Santos has two divisions according to specific laws, the first one called Organized Port and the second one called Terminals Without Commercial Exploitation.

According to MT Ordinance No. 94, of 2/15/95 (Official Gazette of the Union of 2/17/95), the area of the Organized port of Santos, in the State of São Paulo is constituted by:

a) terrestrial port facilities existing on the right margin of the estuary formed by the isles of São Vicente and Santo Amaro, from Ponta da Praia to Alamo, and, on the left margin, from the Isle of Barnabé to the opening of Santo Amaro, covering all docks, quays, bridges, piers for anchorage and mooring, warehouses, yards, buildings in general, internal highway and railway circulation and, further, the land along these marginal strips and in their surroundings, belonging to the Union, whether incorporated or not to the assets of the Porto de Santos, or under its cost and responsibility, also including the Hydroelectric Power Plant of Itatinga and the strip of domain of its transmission lines;

b) protection infra-structure and waterway access, such as anchorage areas, maneuvering basin, access channel up to parallel 23°24'48"S and areas adjacent to it up to the margins to the terrestrial facilities of the organized port, as defined in item “a” above, existing or that may

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be constructed and kept by the Management of the Port or by other entity of the public authorities.

FACILITIES

Specialized terminals:
- **TECON**: terminal for containers, located in the left margin of the port, with an area of 350,000 m², dock of 510 m and 13 m deep. It permits simultaneous docking of three ships. It has three warehouses representing 1,530 m² and yards with a total of 198,450 m², and it may operate 140,000 TEU per year.
- **TERMAG**: terminal for solid bulks products (fertilizers, sulfur) also in the left margin, it uses docks of 567 m with two anchorable piers of 283.5 m and 17.5 m deep. It has six warehouses for 30,000 t each.
- **COAL**: installed in Sabóó, it has an area of 10,8000 m² and capacity for 50,000 t.
- **LIQUID BULK PRODUCTS**: in Alamoa, on the right margin of the estuary, with a dock of 631 m and depth of 11 m. It is connected to the Isle of Barnabé, on the left margin – with 341 m of dock and 10 m deep, through two submarine channels.
- **RO-RO**: the port offers six beds, two of which in Sabóó, two near the warehouse yard 35, one in the dock of warehouse 29 and one in the dock of the future warehouse 37.

The work at issue has been made with the purpose of applying mobility technologies in the logistical process of highway transportation of imported sulfur, aiming at optimizing the operations and carrying out a reduction in costs.

Terminals for Solid Bulk (Sulfur) FOSFERTIL

Port Terminal for private mixed use, outside the organized port of Santos and subject to the customs of the Federal Revenue Service.

The terminal considered as “Private Use Port Facility” [1] with an area of 545,411 m², started its operations on 07/28/1969.

Capacity of reception:
- 500 tonnes/hour of Amonia;
- 1,200 tonnes/hour of solid bulk products.

Storage capacity:
- 20,000 tonnes of Amonia at -33º C;
- 60,000 tonnes of fertilizers in a closed warehouse;
- 60,000 tonnes outdoors.

The Fosfertil Maritime Terminal is one of the world’s largest terminals for unloading of sulfur and fertilizers, which permits agility in the unloading of inputs and products. Its capacity of moving products - ammonia and solid bulk products – is of 2.3 millions tonnes per year.

Its unloader permits to receive, in an hour, 1,200 tonnes of solid bulk products. The equipment manufactured in Germany and assembled in the terminal itself, is the only one in the entire South America.

In solid bulk products, the TUF is qualified to unload 12 thousand tones/day of sulfur and 10 thousand tones/day of fertilizer; it also unloads ammonia direct to a tank with capacity for 20 thousand tonnes, at a negative temperature of 33º C.

It is comprised by a pier of 177 meters long and 11 meters deep, which permits the anchorage of ships with total weight of up to 55 thousand tones, depending on the ship. It also has a railway modal, with mixed gauge, that connects the terminal to the external railway grid, permitting the direct access to all other units and to the companies clients. The local operates with a wagon loading system – a network of conveyers that take the product from the unloader to the funnels, where it is placed in a train.

The programming of the whole logistics of the Terminal is performed by the Supply and Logistics Management of Fosfertil.

The Fosfertil Maritime Terminal received the Statement of Compliance with the principles of ISPS Code - International Code for Protection of Ships and Port Facilities. From the 132 port facilities throughout Brazil verified this year by Conportos, only 17 managed to obtain such Statement.

SULFUR – Applications:

Sulfur is a natural product, solid and with at room temperature, of yellow color and with a characteristic smell. It can be extracted from sulfur mines drilled in long depths; from metals that have sulfur as impurity or further by the recovery of acid gases from petroleum. Petrobrás produces about 7 % of the sulfur demanded by the Brazilian market and trades, through Petrobrás Distribuidora, sulfur in three different ways. With traces of hydrocarbons or hydrogen sulfides in a spread form, which are: cattle raising sulfur, used as food complement to cattle; the ventilated sulfur, used in the vulcanization of rubber and tires and the industrial sulfur, for application in industrial segments.

Sulfur is an extremely necessary basic raw material, widely used in agriculture, consuming (53.0%) of the production, followed by chemical...
industries (47.0%). The consumption is directly related to the production of sulfuric acid, which, in turn, is destined from 70 to 80.0% for the production of phosphoric acid and fertilizers. Other important consuming sectors are: industries in the production of inorganic pigments, cellulose paper, rubber, manufacture of carbon bisulphate, explosive and cosmetics. [2]

According to data from the Mineral Commodity Summaries, the reserves of sulfur represent sulfur associated with natural gas, petroleum, metallic copper sulfides, lead, zinc, molybdenum and iron, as a native element in the depositions in deformed sedimentary rocks neighboring saline domes, in volcanic depositions (resulting from the sublimation of sulfuric vapors or magmatic origin) and bituminous sandstones. In sulfates (gypsite and anhydrite) the resources are unlimited, and may be obtained through an industrial process. About 600 billion tonnes are quantified in coal, bituminous shale and schist rich in organic matter, but are still anti-economic, except for Brazil.

In Brazil, the official reserves of sulfur contained in the zinc sulfides of Paracatu (MG) and in the copper, cobalt and nickel sulfides of Fortaleza de Minas (MG). Resources are further known of 3.6 million tonnes of native sulfur in sedimentary deposits in Sergipe and 48 million tonnes of sulfur, present in bituminous shale of the Formation of Irati in Basin of Paraná river that covers the States of São Paulo, Paraná, Santa Catarina, Rio Grande do Sul and Goiás. Petrobrás – Petróleo Brasileiro S/A produces sulfur from these shale in the municipality of S. Mateus do Sul (PR).

In 1999, the world production of Sulfur presented a decrease as much as 3.3% in relation to 1998. In relation to the largest producers of sulfur, there has been no significant changes in the international scenario. The largest world producers are: USA (19.7%), Canada (16.9%), China (10.7%) and Russia (8.0%), respectively. Although Brazilian reserves present volumes higher than those of Japan and France, its production is still not much relevant. [3]

Due to the changes in the internal market, such as higher demand of the agricultural sector for fertilizers and the reduction in the national production of raw sulfur, Brazil continues depending on the import of sulfur, both as an input for fertilizers and as raw material. The variation of the import of over 23.9%, comparing June 2007 to June 2008, represents a high index of participation in the balance of payment and in the GDP. [4]

2 Formulation of the Problem
This section describes the process of import, internation and release of the imported good. In this study we are going to analyze the process of import of Sulfur performed by a terminal for solid bulk.

The import company needs to prepare a series of documents as well as to follow a process from the arrival of the good at the port of Santos up to its arrival at the yard of the company.

After the purchase and shipment of the good, the company needs to prepare the internation and release of the good and for that purpose a series of documents is necessary:
- Documentation of the purchasing company;
- International documents;
- Documents for the Federal Revenue, Health Authorities, Phytosanitary;
- Fees;
- And others.

After the arrival of the good at the terminal of the port of Santos, the next step is to wait for its release. In this case, two situations may occur:
- DI – Released
  In this case, the good may go to the yard and follow directly to Fosfertil (importing company).
- DI – Not Released
  In this case, the Terminal cannot deliver the product, but it may unload in the yard of the port, if there is space.

The next step is the pick up of the good from the yard. This process may be made in two ways: by highway or railway. Our study contemplates the highway transportation.

For the pick up of the goods, the following documents are necessary:
- DI (TAX AUTHORITIES)
- Designate a Carrier
- The Carrier must be registered with the terminal and have the OC (Loading Order) document.
- Number of DI, name of the ship, etc.
- After loading it has to go out with a weighing ticket plus the NF up to the destination.

The Planning of pick up of the Cargo is the responsibility of the importer, which contracts the Carrier and starts to be in charge of the execution of the services, from the pick up of the product up to its delivery to the destination (owner of the good, importer) and informs the carrier how many tonnes/day the carrier must move.

The carrier is in charge of organizing the Logistics of the trucks (arrival and leaver) of the port.
When the ship is docked, there must be no delay, which causes high costs. The trucks must be on the right place on the right time.

During the process of entry of the documents and their follow-up, the importing company contracts dispatching agents to perform the bureaucratic process and inform the progress of the release process. This communication between the purchaser and the dispatching agent is critical, as it takes human resources that could be better used, and the carrier depends on the information on the release of the cargo to efficiently perform its planning, either of the transportation to the terminal or to the importer.

Most of the time, the following communication means are used between the company, the transporter and the dispatching agent, to follow up the release and leave of the good.

- Telephone (Fixed, Mobile)
- Radio (Nextel)
- Others (Fax, e-mail)

These means are subject to the availability of the system, covering area and communication failure by lack of a method for control of the information flow causing delays in the release and transportation of the good that will consequently generate costs for the storage of the good at the terminal yard, delays in the transportation, etc.

The carrier is informed about the availability of the cargo already released and ready to be picked up, information which is obtained by the purchaser through the dispatching agent and relayed to the carrier. This, in turn, finds difficulties to mobilize the necessary available fleet, at that time, which results in contractual penalties and increasing costs.

The purpose it to propose a system where information about the transportation of the product may be fed in its several steps, from the arrival of the good at the port to its delivery to its purchaser (importer).

**3 Solution of the Problem**

The proposed solution falls on the logistical optimization and monitoring of the process of cargo pick up from the port in trucks.

The introduction of mobile communication may be largely useful for all agents of the process, concentrating the information about a certain cargo and one single base, where the importer, the dispatching agent and the carrier may communicate through a interface using WEB/WA (Wireless Application Protocol) technology. This is a low cost provenly effectively and safe solution.

The agents that will use the solution are: importer, dispatching agent, carrier and truck driver.

The figure below illustrates the solution in a macro way:
3.3 Dispatching agent

The dispatching agent views the prediction of transportation, dates and place, preparing its planning. The system does not provide any integration with the governmental systems used by the dispatching agent, both for reasons for technical unfeasibility and because it deviates from the purpose of the solution.

As long as the cargos are been released, the dispatching agent marks in the system the transportation order, which, in turn, is automatically sent to the cell phone of the pre-registered truck drivers for that unloading.

3.4 Drivers

After positive signal by the dispatching agent, the truck driver receives the transportation order in his/her cell phone with the descriptions of each operation and confirms at every step of the process, informing to the system every transportation performed.

As long as the databases are been fed, the importer may follow up where its cargo is in real time, planning production and keeping control on the logistics.

4 Mobility system

The figures below illustrate the screen of the truck drivers cell phones.

Fig. 1 – The truck driver enters the system with his/her identification.
Fig. 2 – The truck driver confirms his/her information and those of his/her truck.

Fig. 3 – The truck driver views his/her corresponding transportation orders.

Fig. 4 – The truck driver views details of a transportation order.

Fig. 5 – The truck driver confirms the transportation or indicates that there has been any problem (return).
4.1 Expected Results

With the implementation of the solution described above, it is estimated that Fosfértil, as well as the contracted carrier, obtain expressive gains in productivity, reliability in the information available in the system, real time follow-up of the transportation scheduled and performed, possible problems faced by the carrier, elimination of delays in released cargos, reduction of costs and better control of the logistics employed in transportation. Fosfértil may still, based on the information contained in the system, performs a double-check in its production system distribution logistics for the manufactured products.

5 Conclusion

The model proposed for terrestrial transportation of sulfur for Fosfértil follows strict principles of dimensioning and compliance with the functional needs required by the unload process of the Port of Santos.

The results indicate that real savings of resources, both physical and human may be obtained, and it is possible to provide a higher agility in the process of transportation and manufacture, besides assuring higher reliance on the information obtained, both because the capacity to work with real time information and by reason of security and authenticity thereof.

The capacity of integrating to the already existing systems, as well as its flexibility in terms of adapting to new systems and its scalability, may be a distinguishing factor in mobile applications.

We highlight the innovative aspect of the proposed solution, once it was worked out focused on the convergence of different technologies and protocols, and the adoption of mobility as a decisive factor in the success of the transportation of sulfur from the Port of Santos.

The proposed system is also conceived to meet the future needs of the process, such as the inclusion of new procedures, adoption of new codes and methods.

The proposed system may also be extended to the automation of services provided by Fosfértil in its maritime terminal.

The dimensioning of the solution is a challenging issue, that demands a careful study based on actual situations, characterization of users and virtually realistic simulations that shall permit to determine the best configurations and possible bottlenecks of the system.

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[1] Private Port Facility: the one exploited by a public or private legal entity, within or outside the area of the port, used in the movement of passengers or in the movement of storage of goods, intended to or coming from waterway transportation. (Wording given by Law No. 11.314 of 2006). Source: Presidency of the Republic – Civil Department – Sub-chief Office for Legal Affairs. Law No. 8.630, of February 25, 1993. Available at: http://www.planalto.gov.br/ccivil_03/Leis/L8630.htm Accessed on August 29, 2008

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