Intelligent Transportation System as a part of Seaport Terminal Management System

Caio F. Fontana, Fabio Papa, Claudio L. Marte, Leopoldo R. Yoshioka and Cledson Akio Sakurai

***Abstract*—**the article presents the possible technological models that can be used in port terminals to support offshore oil platforms, as this type of platform demand specific requirements for operation, plus the need for speed and efficiency. Port terminals play an important role in connecting transition between the unit and shipping and land transport must be efficient and fast in their services to reach productivity levels compatible, since the expected increase in cargo handling. Information technology and communication can help computerize the operation processes of the terminal, by introducing concepts of monitoring and management, and the introduction of devices that can collect information in real time and thus reduce time and improve quality in services. A point of attention is that the port terminal consists of various activities and operational procedures that are interconnected, so that the applied technology requires great efficiency, because a failure in one component affects the entire value chain.

***Keywords*—**Offshore terminals, Processes, Management, Monitoring, Trucks.

I. Introduction

THE expansion of the platform offshore oil drilling in the world, and especially in Brazil, bring new challenges on technical and logistical issues. In Brazil the oil is under a layer of salt, where the oil is anywhere between 2,000 to 7,000 meters under the sea and the variety of geographical formations like: shale, calcium carbonate and others, before there are thousands of meters of salt [1]. The logistical support to meet operational needs of each platform has become a challenge for researchers, where primarily covers the activities of storage, unification, loading and unloading of goods on ships, ground transportation and shipping. Also considering that the new oil is approximately 200 kilometer from seaport terminals in Brazil (figure 1).

To get this operational control it is necessary some technologies that will support to make decisions and control the operation. The technologies composed of systems, hardware, software and equipment will collect several information of terminals and necessities of offshore platforms and with the human, this technologies can manage the all operation. The operations is composed of trucks that bring the goods to the seaport terminals, the boats that carry the goods and bring the oil and the helicopter that carrying the professionals for offshore platform. This paper consider only the boats that carry the goods to the offshore platform, but the main parameters to manage this operation are: available trucks, schedule, load storage, equipment, available boats and destination. In a simple description, the system will be able to acquire the information, integrate data correctly assess available resources and manage the whole operational process from the arrival of the material at the seaport terminal to final destination which is the offshore platform.

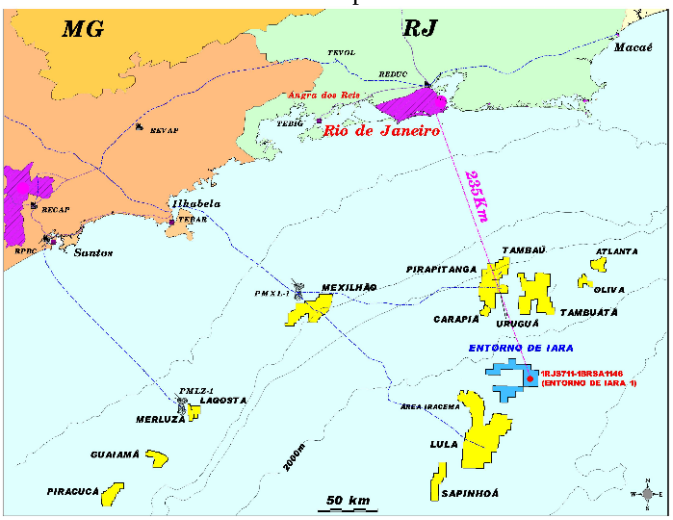

Fig. 1: Distance of new offshore platform

II. Methodology of Work

The methodology used in the project began with the accomplishment of the survey and understanding of the the operational procedures of a seaport terminal to meet the activities of offshore platforms, from this point was studied technologies that could facilitate and enhance the operational procedures of the terminal. With these two points was possible to describe the technical specification of material and human resources needed to meet the port terminal. Lastly, it will start the implementation of the system and the collection of information concerning the operation of checking whether the aims were met.

The assessment and understanding of the port terminal was initiated through a survey to understand the objectives and procedures for the seaport terminal. This research aimed to generate knowledge for practical application and directed to the solution of specific problems and local interests. The research was conducted predominantly qualitative, through the understanding of the relationship between reality and needs, so a study was conducted exploratory, descriptive and explanatory. One can consider this as being descriptive, which aims to describe the characteristics of a given population or phenomenon or establishing relationships between variables, and in this project we adopted the study case format. The study

case involves a thorough and exhaustive study of one or a few objects in a way that allows its broad and detailed knowledge .

This work has enabled a shift in thinking about the need for improvements in operating processes, being that they were obtained through interviews and meetings with those involved in processes, in addition the visits to Imbetiba Offshore Terminal in Brazil and Louisiana Offshore Terminal in the United States of America.

From the documents of the current scenario mapping and analysis of the data collected was identified business processes, operational procedures, existing systems, strengths and weaknesses, needs and operational bottleneck.

Considering the mapping of processes have been proposed adjustments in these business processes and operational procedures and with evaluation of available technology, the project has defined a number of solutions that promote better functioning of the terminal, and the definition of indicators and control rules for monitoring and management of the terminal.

This paper present a part of result of project, so the paper present a brief of requirement necessaries for Terminal Management System that uses Intelligent Transportation Systems to solve several problems identified at seaport terminal.

III. Importance of Logistic for Offshore Platform

Logistics is one of the strategic activities of any company, it should ensure the movement of raw materials and products with security risk and cost effective operations. The first to explore oil in Gulf of Mexico created the term “offshore logistics" to indicate support activities oil rigs lying in the sea. [2]

Logistical support land and sea to ensure the movement of people and materials for marine units within the established indicators and the appropriate cost is a necessity for any company that operates in this area. [2] Furthermore, the logistics support is responsible for removing these bases from the sea, and solid waste materials unusable in order to be given the correct final destination. To justify the importance of logistics in offshore oil and gas, we can mention that the timeliness of project wells depends largely on the effectiveness of logistics support, because the value of its charter and a probe can reach $ 500,000 by day. Additionally each exploratory probe has a calendar year, so it is necessary to define the use in advance .

The Terminal Offshore Logistics provides all types inputs , products and services to support operations in offshore platforms , such as: provision of drilling fluids , cement , pipes , fuel, water and food for the crew . The platforms have all the demands of a small town, isolated in the middle of the sea. The various services, materials and work teams necessary for the smooth operation of offshore platforms that require support vessels of transport that will carry these requests.

The main supply terminal offshore consisting of : water , diesel , ranch , feeding tubes drilling and production , drilling fluid , bulk supply of barite and cement, wooden boxes with equipment and supplies (for example : rope , oxygen cylinder , acetylene cylinder, freon gas, steel cable reel, coil polypropylene, etc.), providing acid, besides sending professional offshore platform. Should consider other activities such as towing, recovery and anchor fire and oil spills . To meet the demand need support vessels, helicopters , boats and a territorial basis with all necessary infrastructure to receive the trucks that bring the warehouses inputs and outputs required for operation of the offshore platform.

A. Offshore Terminals

The offshore terminals or seaport terminal are the point of loading and unloading of products and inputs and each terminal has the infrastructure needed to service vessels. The pre-boarding is an activity of modal land where cargo is inspected and checked at this point are several points such as breakdowns of charges, packaging and destination of the material. If there is non-compliance during the inspection process, the material will not be unloaded from the truck and the owner is triggered to make corrections. If this is not possible, the truck with the material returns to its source. However, if the charge is within the desired patterns, it is downloaded and sent to the pre-loading zone.

The materials lying in wait for the pre -shipment scheduling transportation to allocate them in a vessel that will take it to the destination. The materials to be transported by sea bases, and use, must return to earth, so-called reverse logistics. Reverse logistics is the return of materials, waste or tailings these units, proposing the assignment or proper disposal.

Among the elements of reverse logistics stands out tools and equipment, reusable, waste and tailings. Among the highlights are the waste generated in the platform that should be brought to the correct treatment in land, thus ensuring environmental requirements. The material returned is stored in the area called retro-port, which aims to store the material until it is removed returned to the correct destination. This material also returned is inspected by a professional before taking it to the area retro-port. For example, in the case of chemicals, there is an appropriate area according to the rules for storage.

This area should have containment barriers against leakage protection, waterproof floor so that the product does not migrate into the soil and contaminate the product and leaks in the vacuum system. The logistical support to units of drilling or production, some floating and furniture installed in the open ocean. By air, using helicopters to transport personnel and small loads, on an urgent basis. By sea concentrates more specific work units to support maritime operations, transportation of materials essential for work and life at sea. Support vessels that perform tasks such as transport between bases and terrestrial platforms. His presence is remarkable since the preliminary studies of geology for the removal and closure of wells. Created especially for the transport of cargo destined to the facilities of the offshore oil industry, has basic features geared to optimize its operation. In summary, this ship has tanks for liquid bulk, refrigerated foods and suitable for the transport of deck cargo in general. It requires sufficient capacity to deal with it, so stay close to the platforms for cranes to embark and disembark the materials with relative safety, even under harsh environment. The evolution of the concept of craft supplies , new features were developed to meet specific needs , such as readiness to rescue cases resulted from accidents , firefighting , well stimulation , supporting

activities diving equipment towing and anchor handling . Process offshore terminal can be divided into six processes:

- **Process receiving terrestrial** refers to the load which reaches through the modal ground;
- **Verification process** refers to loads that are handled (classified and separated) before embarking on offshore units ;
- **Boarding process** consists of sending cargo from the verification process for offshore terminals;
- **Reverse logistics process** consists of the cargo arriving to the terminal via the modal sea or air from offshore terminals;
- **Separation process** consists in separation and sorting of cargo from the reverse logistics process;
- **Submission process** consists of sending cargo overland cargo from the reverse logistics process.

B. Transportation Requirements

The transportation requirements is the document that initiates the process of transporting materials, this document is issued to request the necessary material. The whole process operating in offshore terminal starts from this document, which registers all logistical movements and interactions. The document contains information about source and destination, in addition the applicant informs the estimated date and time and the fields that determine the expectation of the candidate in relation to transport. The document must contain the following information: description of the material, dimensions, weight, quantity, unit value, place of origin, destination, modal transport, requestor, deadline for compliance. The document may or may not be unified. If a set of application transport is unified with the number of transports is automatically generated by the system of management of a new document to characterize a set of application transport that was unified for transportation.

IV. Evaluation of Offshore Terminals

During this project two terminal was evaluated, these terminals are located in Brazil and USA.

A. USA Offshore Terminal

The Edison Chouest Offshore (ECO) was founded in Galliano, Louisiana, USA, in 1960, and today is the most advanced outside the company and the fastest growing in the world. The business of ECO Core is the charter of vessels. The ECO is the largest private sector in the world and has the youngest fleet. But, moreover, creates the design, construction and operation of vessels, is present in 13 countries, has more than 170 logistics support vessels, has five construction sites and also have 10 bases logistical support which operates the brand 70 % share of the Gulf of Mexico and four of them in Brazil. As support bases offshore, has a base in the Gulf of Mexico, in the town of Galliano in Louisiana, this terminal the ship enters an aft deck structure where the loads are stored with equipment called a crane, which is used to move loads the ship to the terminal and vice versa. Port located in the southern state of Louisiana and known to be the main connection with the exploration and production of oil in the Gulf of Mexico. Currently, there are 18 anchor points covered, enabling the work, regardless of weather, with 37 cranes with scales to determine the weight of cargo handled. Loads weighing more than 50 tons are discovered moves in the specified location using a crane. The trucks are capable of carrying loads directly from the patio to the dock.

A. Brazil Offshore Terminal

The Imbetiba Terminal located in Macaé/RJ has three piers and six berths, handles an average of 49,020 tons of deck cargo per month, its operation is continuous, 24 hours a day and 7 days a week. This is the main port of logistic terminal in Brazil and operates vessels that provide service in the Campos Basin. 2012 data revealed that the port Imbetiba (Macaé) responded to 139 vessels logistical support offshore.Com its three pillars 90 feet in length are sent equipment, supplies and other materials intended for platforms and support vessels are unloaded coming from production units. Port of Imbetiba records an average of 440 dockings per month and is considered the busiest terminal in the oil industry in the world. In other regions such as the Gulf of Mexico and the Black Sea, the volumes are transported by more than one terminal.

V. Terminal Management System

This item describes the business model of the Terminal Management System (TMS), which defines the system and its corresponding module. The modules proposed in this document aims to optimize and streamline movements, determining which equipment must be allocated to execute a move and in what order the movement should be performed.

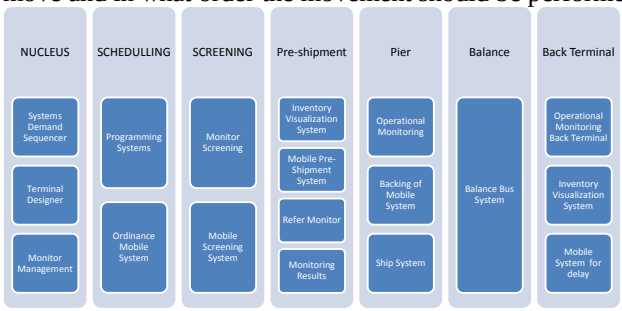

Fig. 2: Terminal Management System

The assignment of equipment and choose the best storage site must be done in real time execution taking into account the dynamic nature of the operations, often because changes occur that require immediate overhaul of the whole or a part of the movement, by inserting computational intelligence enabling:

- Optimization of cargo movement time;
- Decrease the queues of trucks;
- Optimization of occupancy rates of equipment;
- Optimization of the arrangement of the load in the courtyard;
- Improved occupancy rates of the vessels;
- Increased productivity of the terminal;

- The efficient and effective management of the terminal;
- electronic exchange of data between different actors;
- Planning of operational activities;
- Management based on historical data.

The terminal management system and the respective modules are shown in Figure 2.

A. Nucleus

The Nucleus is the centering of information using mathematical algorithms to determine the best solution for each movement in order to minimize the time and the increase of internal controls the operations.

- Demands Sequencer System:The purpose of this tool is to create demand for cargo handling. The system, to identify the need to move a cargo terminal, uses a mathematical algorithm to choose which equipment must perform the move according to the rules of court and attributes, the type of load and type of operation, determining the best sequence operation. It is for the system to establish the fate of the cargo and send the instructions to move it from equipment and vehicles, creating a sequence of handling claims;
- Terminal Designer: To locate a cargo terminal must be create a mapping for the normalization of load distribution. In this module, you will design the terminal configuration, indicating the points of access in and out of trucks and storage in the terminal positions. Another feature of this module is the master of the storage attributes, where the user must register area by unique rules, restrictions or preferences regarding attributes load controlled by the system, creating areas for dockings for special loads such as refrigerators require electrical connection, dangerous goods, cargo or with excessive weight or size. Based on this information, the system can suggest the best storage locations for each cargo handled;
- Monitor Management: The module will be used to visualize the productivity rates of the various operational areas of the terminal.

B. Schedulling

The scheduling system arrival of trucks is a tool able to generate the information necessary for the operational planning of the terminal.

- Programming Systems: Without the programming module, the truck arrival process at the terminal has a strong trend and statistical independence between random events. This system must be supported by a simulation tool, so you can analyze the processes of sorting and screening to determine the maximum number of calls to determine, by type of service, the amount of vehicles that receive the terminal in a time interval that is, its ability to function. The main objective of the scheduling system is to decrease the likelihood of logistical problems and create an organization in traffic flow.
- Ordinance Mobile System: Sector employees concierge should check the documentation of the truck on his arrival, the information must be identical to those recorded in the scheduling system. The number of protocol schedule printed in possession of the truck, which has a bar code is read to confirm the information from the driver, truck, load and time. The system identifies the destination of the truck and announces the arrival of the same sector.

C. Screening

The screening module allows entry of trucks into the terminal and monitor waiting times of trucks in the area of screening.

- Monitor Screening: This module is used to monitor the total waiting time of vehicles in the screening and provide information needed to allow the same input terminal;
- Mobile Screening System: This module will interact with the monitor module pre-shipment, monitor and sequencer retroporto demands, showing for the fiscal year to sort the list of activities to be performed, recording the time and compliance therewith, or to report problems. Through the activity log will be possible to collect information for the calculation of productivity statistics and alerts operational problems;

D. Pre-Shipment

The pre-shipment module manages the demands of handling equipment for pre-boarding, hours of operation of the equipment and load inventory:

- Inventory Visualization System: The module will enable, through the graphics option, seeing Load inventory on the defined layout designer. This tool allows you to monitor real-time inventory, sorting by color charges under the title chosen by the user (eg, boarding vessels, type of operation, length of stay, dangerous cargo, supplier, etc.). You can apply filters on the current stock, allowing flexibility in the location of loads in stock. Another feature of the tool is to provide critical information such as terminal areas of occupation or calculate the occupancy rate in all future programming information and attractions planned;
- Operational monitoring Pre-shipment: In this module, the controller will monitor pre-shipment equipment and the demands of the pre-boarding;
- Mobile Pre-Shipment System: This module will interact with the monitor module pre-shipment terminal monitor and sequencer demands back, showing the speaker to the list of activities to be performed, recording the time and compliance, monitoring or reporting problems. Through the activity log will be possible to collect information for the calculation of productivity statistics and alerts operational problems, both equipment and vehicles;
- Refer Monitor: Tool to monitor the temperature of refrigerated containers, notify the supplier and charge the pre-boarding alarms generated by the tool and record the history of readings of each container.

- Monitoring Results: The functionality of this module is to provide information of incidents recorded for the loads, with the option to view pictures and send them to the vendor.

E. Pier

The Pier module manages the demands of handling equipment to the pier, hours of operation of the equipment and plan to board the ship:

- Operational Monitoring Pier: In this module the driver's side will monitor the equipment and the demands of the hull. Another feature of this module is to provide information of RT released for shipment to the technical information of the vessel using a graphical tool that allows a view of the ship's deck and RT released, the user must select the RT for shipment, each system choice RT should check that the sum of the weight and volume of TA is consistent with the maximum capacity of the ship at the end of this operation the ship's manifest must be generated;
- Backing of Mobile System: This module will interact with the side of the monitor module and demands the sequencer, showing the speaker to the list of activities to be performed, recording the time and compliance, monitoring or reporting problems. Through the activity log will be possible to collect information for the calculation of productivity statistics and alerts operational problems, both equipment and vehicles.
- Ship System: This module will interact with the side of the monitor module and demands the sequencer, showing loads captain to be allowed. The master will determine how best to discharge RT, the creation of the plan for the disposal of the ship and will better define the order of RT boarding, creating board the plane.

F. Balance

Seeking greater control of operations, the scales of the road should incorporate digital technology and information systems to be integrated control, so that the records are weighing, dispensing data entry resulting from such automated measurements:

- Balance Bus System: The equilibrium road sensor is installed to monitor the entry and exit of the vehicle on the weighing platform and a module for capturing the weight of the vehicle. Analyzing these data, the system can check whether there was any irregularity in the position of the vehicle on the platform or in your entry and exit. It permits to count the number of axles on the weighing platform and count the axles coming out at the end of the weighing and the direction the vehicle is traveling, thus determining the actual weight of the load.

G. Back Terminal

Module to manage the demands of handling equipment back to the terminal, operating times of the equipment and load inventory:

- Operational Monitoring Back Terminal: In this module, the controller will monitor the equipment of seaport and demands;
- Inventory Visualization System: The system will, by graphics option, seeing Load inventory on the defined layout designer. This tool allows you to monitor real-time inventory, sorting by color charges under the caption chosen by the user (eg, boarding vessels, type of operation, length of stay, dangerous cargo, suppliers, etc.);
- Mobile System for Delay: This module will interact with the monitor module pre-shipment, monitor and demands delay sequencer, showing the speaker to the list of activities to be performed, recording the time and compliance, monitoring or reporting problems. Through the activity log will be possible to collect information for the calculation of productivity statistics and alerts operational problems, both equipment and vehicles.

H. Information Flow

The monitoring systems permit the user have all information provider by modules to generate new demand. The information flow can verify the need for a new demand and to establish the fate of the cargo and send the instructions to move it to all equipment and vehicles, creating a new demand for movement. The types of requirements are:

- Operations at the gate.
- Handling operations at the terminal.
- Boarding operation.
- Weighing operations.
- Discharge operation.

VI. Conclusion

Technological advances allowed defining a system with high processing power and storage, and rely on communication channels high performance. These automation system processes and decisions in cargo handling enables the efficient support logistics for offshore terminals.

It is hoped that the implementation of the modules savings in human and material resources, and provide greater flexibility in the processes of cargo handling and ensure greater reliance on information obtained and decisions taken.

The work allows to increase the knowledge in logistics operation for offshore terminals and it is estimated the following gains:

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- Reduction of wait trucks in 50%;
- Reduction of total time between input and output in 30%
- Reduction of total time taken to move the ship in 45%
- Reduction of total time of the discharge vessel in 30%.

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