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Simulating new logistics system of Le Havre Port

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Abstract: This paper presents a prospective study of the new logistics in Le Havre Port. The future container traffic transfer between maritime terminals and the multimodal terminal acting as a hub is simulated under a multi-paradigm simulation tool. Several scenarios and management rules were tested. The integrated optimization module is used to calibrate different values of simulation parameters. Simulation results are reported and classified as performance indicators. These enable decision makers to have an idea of potential possibilities, difficulties and alternative improvements of the future logistic system.

Keywords: Simulation, logistics, terminal, multimodal, container, optimization, performance.

1. INTRODUCTION

Maritime transport is the main vector of international trade with over 80% market share. This sector development knew an exponential growth since the introduction of container in the mid 50s of the last century. The container standardization and the arrival of huge vessels have revolutionized global trade. As a result, the ships size enlargement increased the need for more space in the storage areas in Maritime Terminals (MT). This staggering growth imposes on the port authorities more efficiency and punctuality. To cope with the increasing competition with northern ports and to strengthen its offer of land transportation which became the battlefield of the maritime ports, the Le Havre port, the first French port in container traffic, developed a new logistic system consisting of a an intermediate Multimodal Terminal (MMT) serving as a hub for consolidating traffic with its hinterland.

To make a prospective evaluation of this future logistics, we designed and developed a multi-paradigm simulation model for the new logistics system in Le Havre Port. The remainder of this paper is organized as follows: the next section presents a brief overview of related works in the literature. Section 3 sets the current and future logistics systems; it shows the innovative interest of the new logistics for maritime terminals. The simulation scenario is detailed in Section 4. We present management rules implemented in simulation model in Section 5. We report and discuss the results in Section 6 and we conclude with some remarks and perspectives in the last section.

2. RELATED WORKS

Scientific literature related to topics modeling/simulation is much discussed from a statistical point of view. However, articles concerned with the simulation in port logistics are relatively scarce. The simulation can provide realistic estimations and evaluations of different scenarios such as management rules, design resources, etc. (Belmokhtar et al. 2010). Having already proven its efficiency in the world of industry (Law and Kelton, 1991), it aims to help decision makers make important decisions in logistics, design or investment following the results of a simulation scenarios. It is a perfect tool to test and analyze different port logistics planning. Furthermore, the simulation can be used to size a system, improve the use of equipment and also demonstrate the potential for the installation of new equipment (Na and Shinozuka, 2009). Simulation based approaches allow the modeling of dynamic situations of a company, with different degrees of constraints and different policies (Persson and Araldi, 2009). A typical application of simulation in a maritime context can be found in (Hartmann, 2005) in which the author developed a simulation model based on configuration of storage area and scheduling of AGVs

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(Automated Guided Vehicle). He compared the performance of the new configuration with the old one without the AGVs. The simulation was also used by (Zeng and Yang, 2009) for scheduling handling operations in container terminals. Discrete event simulation models are frequently used for terminal containers management. This approach is used to evaluate possible future growth of container flows in (Parola and Sciomachen, 2005). In (Cortés et al., 2007), the authors used Arena simulation software to test several scenarios in Seville Port, the unique inland port in south Spain. Recently, A., Benghalia et al. (2012), proposed a simulation model using FLEXIM CT for containers transfer in Le Havre seaport. For our knowledge, this is the first paper to model, simulate and study the new logistic system of Le Havre port with the multimodal terminal.

3. LE HAVRE PORT LOGITICS

3.1 Le Havre Port

Le Havre port has a privileged location in the northwest of Europe and is connected to a rich hinterland (Paris Basin, French and European market) by road, river and rail. This strategic position makes the port of Le Havre the first French port for external trade and gives it a European vocation, in particular as a transshipment and feeder port. It is the first port in France in terms of container traffic with over 2.5 million TEUs (Twenty Equivalent Units) in 2013.

3.2 Current logistics system

On the road mode, the trucks pick up containers directly from one of the maritime terminals, ATL (Atlantic), TDF (Terminal De France), TPO (Terminal Porte Océane) or TNMSC terminals (Terminal de Normandie Mediterranean Shipping Company).

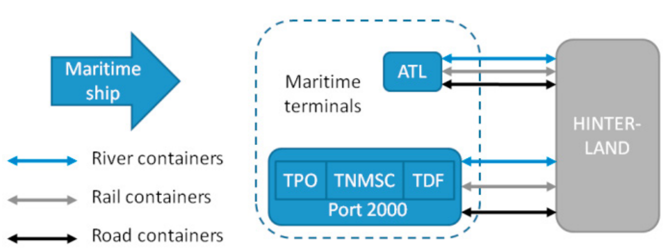

Fig. 1. Current logistics system

For waterway mode, a part of this traffic is also transferred directly from the maritime terminals to barges and some containers are handled at the terminal of Europe (such the current hub for barges), and transferred via rail shuttle to terminals in Port 2000 (TPO, TNMSC, TDF). For rail, containers are handled on wagons distributed in advance in maritime terminals and the wagons are collected together on a rail beam and finally, the wagons can be towed by a locomotive on the national rail network.

The current logistic system (Fig. 1) raises several problems. Especially it creates waiting times for trucks that make queues in front of the maritime terminals. In addition, this situation causes a cross flow between the road and the railroads and induces more environmental externalities due to heavy use of trucks. Another problem is saturation of the limited storage yard for maritime terminals. . Furthermore, the rail transfer between Europe and Port 2000 terminals is using a special procedure, blocking roadways and using a lot of human resources. To improve this situation and to promote consolidated modes, the port of Le Havre has invested in new infrastructures, especially in building a new Multimodal Terminal (MMT) to strengthen consolidated land transport and to fluidize the transfer with its hinterland.

3.3 Future logistics system

With the construction of the new multimodal platform, a rail shuttle system will allow the transfer of containers to the multimodal terminal where they will be positioned on freight trains or barges and then transferred to the hinterland. The new logistics scheme (Fig. 2) does not anticipate any changes to the road mode. However, multimodal terminal use promotes modal shift and limits trucks number which arrive directly in maritime terminals.

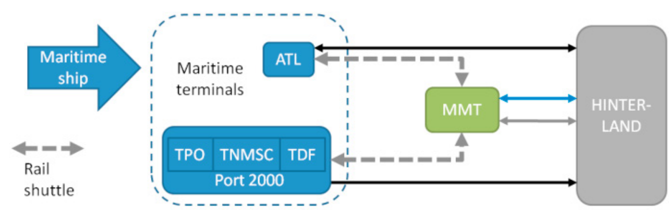

Fig. 2. Future logistics system

The Multimodal Terminal is designed to receive containers by rail shuttle from maritime terminals. It includes spaces and handling equipment for the transfer of containers on barges and trains and with a possible temporary storage. This new terminal was sized for traffic of 200,000 containers per year. It includes a rail yard, a river yard and a set of electrified tracks forming a rail beam for receiving trains (Fig. 3).

The rail yard is composed of 8 rail tracks spanned by portal cranes able to handle more than 1,000 TEU (Twenty-foot Equivalent Unit) per day with possibility of direct departure of trains and buffers for short temporary storage of containers. In this yard we have possibility to rapid rail-rail transshipment from shuttles (from maritime terminals) to freight trains and vice versa, this enables benefits from economy of scale from consolidating containers and possibility to stock containers in buffers to relieve the stockyard of maritime terminals.

The river yard is composed of a fluvial quay with 400 m in length, allowing the realization of two berths, 2 gantry cranes of 400 m, 4 rail tracks under cranes and a storage area for containers. This yard allows possibility to rapid rail-river transshipment from shuttles (from maritime terminals) to