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Simulating port logistics operations using 3D visualization technology

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Ports are one of the transportation logistic components crucial to the support of international trade and economic growth. In 2006, the United States business logistics costs were $1,305 billion. Increasing at an average annual rate of 16%, the Port of Savannah has been America's fastest-growing port since 2001. The port of Savannah is the largest single container terminal in North America, and handled more than 2.3 million twenty-foot equivalent units (TEU) in 2007. This rapid growth has created a need for a cost-effective means to explore and evaluate port operational changes that could be made to improve productivity. This paper presents a low-level, detailed, 3D simulation model that was developed to simulate the Port of Savannah's berth operation and evaluation the productivity.

3D animation can aid simulation processing in the following areas: verification and validation, understanding of results, communication of results, securing buy-in from nonbelievers, and achieving credibility for the simulation (Rohrer, 2000). One of the values of using 3D visualization in this study is to provide better visibility on the operation flow for identifying the processes to be improved. For example, the idle quay crane can be easily identified visually in a 3D simulation.

The actual layout, traffic management, and operation flow in Berth 8 of the Port of Savannah were used to develop a detailed 3D container-terminal simulation model as shown in Figure 1. Two cases were designed to study the impact of increasing crane speed and to identify any additional resources needed. The first case was to increase the quay crane design speed from 30 moves/hour to 50 moves/hour, while other parameters, including the number of Jockey trucks, remained the same. The results show that the individual quay crane utilization does not reach the design speed of 50 moves/hour, but instead attains an actual speed of 34 moves/hour. The quay crane idle and the reason for it, such as insufficient Jockey trucks and rubber tyred gantry (RTG) capacity, is easily traced and identified by the simulation model. The second case was to study the appropriate number of Jockey trucks needed for the quay crane speed increase. To focus on analyzing the number of Jockey trucks, we assumed that there was sufficient RTG capacity in the yard to handle the increased number of Jockey trucks. Using the simulation, a relationship between the number of Jockey trucks and berth productivity was established. This information can be used for evaluating the return on investment.

These case studies have demonstrated the capability and feasibility of quantitatively evaluating the impact of the increase of quay crane capacity on berth productivity using the developed 3D simulation model. One of the values of using 3D visualization in this study is to provide better visibility on the operation flow for identifying the detailed processes to be improved. For example, the quay crane idle time can be clearly seen and tracked in a 3D visualization environment. In addition, the optimum number of Jockey trucks can also be determined using the simulation model. This simulation is valuable for identifying potential risks before implementing costly changes to port operations. It can be used for exploring and evaluating alternatives for improving berth productivity. With the developed simulation model, different alternatives can be effectively evaluated before their costly implementation thereby minimizing potential risk.

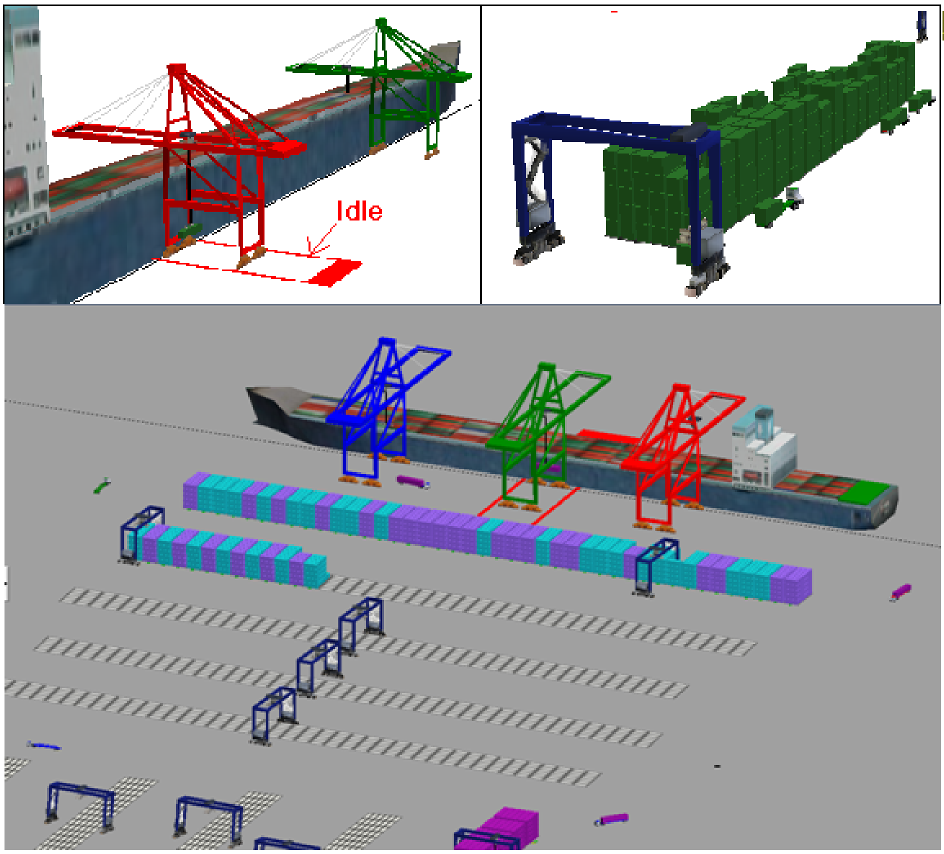

Figure 1, Detailed 3D container-terminal simulation model

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