A SYSTEM DYNAMICS SIMULATION APPROACH TO CONTAINER TERMINAL MANAGEMENT

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A SYSTEM DYNAMICS SIMULATION APPROACH TO CONTAINER TERMINAL MANAGEMENT

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By

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ABSTRAK

Terminal kontena beroperasi di persekitaran yang dinamik dan penuh persaingan di mana setiap terminal kontena sentiasa mencari jalan untuk meningkatkan daya saing masing-masing. Salah satu daya saing adalah kebolehan untuk mengendalikan kapal kontena dalam masa yang tersingkat. Tetapi, kebolehan ini amat bergantung kepada keefisienan seluruh operasi terminal kontena itu sendiri. Pengurusan, pembuatan keputusan serta operasi dermaga dan gudang penyimpanan sementara yang cekap adalah sangat penting untuk memastikan keseluruhan terminal kontena beroperasi dengan efisien. Operasi dalaman sesebuah terminal kontena adalah sangat komplex dan rumit, ini menyebabkan perancangan dan pengurusan dermaga serta gudang penyimpanan sementara adalah mencabar. Penyelidikan ini mengaplikasikan kaedah simulasi sistem dinamik untuk memodelkan hubungan serta interaksi di antara operasi di dermaga dengan operasi di gedung penyimpanan sementara. Daripada model sistem dinamik ini, didapati faktor kelajuan kren dermaga memindahkan kontena dan jarak perjalanan *Prime Movers* di antara dermaga dan gudang penyimpanan sementara memainkan peranan yang penting ke atas kadar penggunaan dermaga. Selain daripada itu, model sistem dinamik ini juga boleh digunakan dalam pengurusan kapasiti menerusi experimentasi seperti menguji apakah impak terhadap operasi terminal kontena jika berlakunya pertambahan pada jumlah kontena yang dikendalikan, bilangan kapal yang berlabuh serta peningkatan pada saiz kapal kontena. Penyelidikan ini menyumbang dalam menghubungkan jurang di antara literatur melalui pembinaan sebuah model yang berupaya untuk memodelkan hubungan dan interaksi di antara operasi di dermaga dan operasi di gedung penyimpanan sementara; dan pada masa yang sama berupaya untuk menggabungkan isu-isu di peringkat operasi dan strategik. Selain daripada itu, penyelidikan ini juga memanfaatkan pihak pengurus terminal kontena menerusi pembinaan *Microworlds*. *Microworlds* berupaya untuk membantu pengurus terminal kontena dalam aspek pengurusan dan pembuatan keputusan serta berfungsi sebagai alat pembelajaran di mana pengurus terminal kontena boleh mendalami serta memahami kekompleksitian operasi dalaman sesebuah terminal kontena.

ABSTRACT

The container terminal operates under a competitive and dynamic environment where every container terminal continuously seeks to secure a competitive advantage. One of the competitive advantages is the ability to turnaround vessels within the shortest time period. However, this ability very much depends on the overall efficiency of the container terminal operations itself. The planning, decision making and operation of the berth and container yard are crucial in order to ensure the whole container terminal operates in an efficient and timely manner. However, due to the complexity of the container terminal operation, decision making and planning in the berth and yard subsystems are very challenging. This research presents the application of system dynamics simulation into capturing the relationship and interdependency between the berth and yard operation. The system dynamics model reveals that both quay crane moves and prime mover traveling distances have an impact on the berth occupancy rate. Besides that, the system dynamics model also provides capacity planning by allowing the experimentation of the impact on the increase in container throughput, vessel arrival and vessel size on the container terminal operation. This research contributes at bridging the gap between the literatures by developing a model that is capable of capturing the relationship and interdependency between the berth and yard operation as well as incorporating both operational and strategic level issues at the container terminal. This research also benefits the container terminal management through the development of Microworlds. Microworlds is capable of aiding terminal managers on planning and decision making as well as serving as a learning tool where the managers can gain insight to the complexity of the terminal operations.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter starts with the introduction on the current phenomena of the global container terminal industry; followed by a brief review on the history of containers. Problems faced by modern container terminals are presented next followed by a discussion on the container terminal industry in Malaysia as well as the background of the case study container terminal. The major motivation on why this research was conducted and the objectives of this research are presented subsequently. The choice of method used to conduct this research and the assumptions of the developed model are also discussed in detail in the later section of this chapter. This chapter finally briefly summarizes the organization of this thesis.

1.2 Introduction to Container Terminal

The market environment in which container terminals operate is changing rapidly due to globalization and the adoption of containerization since late 1960's. Container terminals have evolved from being simply loading and unloading points to serving as crucial hubs in an industrial center. Today, a container terminal acts as an interface between production and consumption centers, eliminating the discontinuity between sea and land transport (Moglia and Sanguineri, 2003), thus integrating the entire supply chain.

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