A SYSTEM DYNAMICS APPROACH TO IMPROVE VISIBILITY AND PERFORMANCE IN A SUPPLY CHAIN SYSTEM

A thesis submitted to the College of Arts and Sciences in fulfillment of the requirement for the degree of Master of Science (Decision Science)

Universiti Utara Malaysia

by

CHAN KAH WAI

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ABSTRACT

This research takes an in-depth look into the supply chain system of a semiconductor company. It utilizes a system dynamics tool to detect demand indications and simulate the pipeline inventory. The semiconductor company has been practicing a lot of management principles especially postponement strategies and supply chain management (SCM). The overall performance of the supply chain system has never been measured thoroughly, thus the company is not sure about the effectiveness of its decisions. It is also concerned about the effective implementation of some of the company's policies.

Using a system dynamics approach to simulation modeling, this research aims to build a complete system dynamics model for internal supply chain events (from order to ship-out). The simulation model allows for the investigation and identification of discrepancies between the business policy and actual practice of key events in order to achieve supply chain optimization. The simulation model also allows for comparison and measurement of the effectiveness of various supply chain strategies implemented by the semiconductor company.

This research provides a platform into studies of supply chain systems of semiconductor industry. Its success adds a unique case study on assessing the dynamic relationships of supply chain events in the semiconductor industry using system dynamics technique. The simulation model provides empirical evidence on the effective implementation of various supply chain strategies. System dynamics approach to modeling a supply chain system is shown to be able to try out alternative practices that have high level of complexity.

Keywords: Supply chain, system dynamics and inventory management

ABSTRAK

Kajian ini meneliti secara mendalam sistem rantaian bekalan sebuah syarikat semikonduktor. Kajian ini menggunakan teknik dinamik sistem untuk mengesan isyarat permintaan dan mensimulasikan inventori pengeluaran. Syarikat semikonduktor ini telah melaksanakan pelbagai prinsip pengurusan, terutamanya Strategi Penangguhan dan Pengurusan rantaian bekalan. Prestasi keseluruhan rantaian bekalan syarikat semikonduktor ini tidak pernah diukur dan diperiksa secara menyeluruh. Jadi, syarikat ini tidak pasti tentang keberkesanan keputusan-keputusan yang telah dilaksanakan. Syarikat ini juga prihatin tentang keberkesanan pelaksannaan sesetengah polisi syarikat.

Dengan menggunakan pendekatan dinamik sistem untuk membuat permodelan simulasi, kajian ini dijalankan untuk membina satu model sistem rantaian bekalan berasaskan dinamik sistem yang bermula daripada pesanan sehingga penghantaran. Simulasi ini membolehkan penyiasatan dan pengecaman sama ada wujudnya percanggahan antara penetapan syarikat dan apa yang berlaku sebenarnya. Ia juga memberi peluang untuk mengukur dan membuat perbandingan keberkesanan ke atas beberapa strategi rantaian bekalan yang telah dilancarkan oleh syarikat ini. Dengan ini, syarikat tersebut boleh memperolehi rantaian bekalan yang optima.

Kajian ini juga menjadi wadah kepada kajian-kajian lain dalam sistem rantaian bekalan industri semikonduktor. Ia menambahkan lagi sebuah kes unik dalam pengkajian hubungan-hubungan dinamik sistem rangkaian bekalan industri semikonduktor. Simulasi ini memberi bukti empirik yang kukuh mengenai keberkesanan pelaksanaan strategi-strategi rantaian bekalan. Model simulasi sistem rantaian bekalan mempamerkan kebolehan untuk mencuba cara-cara alternatif yang rumit tanpa risiko.

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List of Abbreviations

SCM	Supply Chain Management
SD	System Dynamics
MRP	Material Requirement Planning
VMI	Vendor Managed Inventory
SFGI	Semi-Finished Goods Inventory
DES	Discrete Event Simulation
PP	Production Policy
PD	Projected Demand
MR	Market Request
PR	Production Response
CW	Warehouse (Main Inventory)
FAC	Factory Actual Closure
WOI	Weeks of Inventory
A&T	Assembly and Test

CHAPTER 1

INTRODUCTION

1.1 Introduction

These days, most of the consumer products that we use, from simple bread to sophisticated computers and mobile phones, are most likely being produced en-masse in factories. They may not even be produced locally. The ability to mass produce has allowed factories to produce at a higher rate, and at the same time, new companies emerged due to the opportunity to mass produce. Total production keeps increasing but the market for a product will be saturated and matured (Inagaki & Kuroda, 2007). Consequently, competition among manufacturers for the limited market drives down price and profitability. The situation is so unfavorable that the threat of extinction has forced many U.S.-based companies to take advantage of low-cost sourcing or tap into emerging consumer markets (Levans, 2002). Some Japanese companies are heavily influenced by the need to source components and material from "lower-cost countries" such as China, as well as emerging sources such as Brazil, Russia and India (Inagaki & Kuroda, 2007).

Some companies choose merger and acquisition (M&A) as a solution to their problems. M&A usually results in a larger organization with better control of the market and reduced cost. M&A is less of a tradition in Japan than in many other countries; but it is becoming more and more common for Japanese companies in a variety of industries to join forces with similarly focused organizations (Inagaki & Kuroda, 2007). Most of these relationships are built from the need for capabilities, resources and skills sharing, thus increasing competence effectively (Svahn & Westerlund, 2007). Many firms have taken bold steps to break down both inter- and intra-firm barriers to form alliances, with the objective of reducing uncertainty and enhancing control of supply and distribution channels (Gunasekaran *et al.*, 2004).

The focus of improvement has gradually shifted away from looking at competitors, but instead on suppliers and distributors, or more precisely, the supply

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