UNIVERSITI PUTRA MALAYSIA

MODELLING AN INVENTORY MANAGEMENT SYSTEM USING A SYSTEM DYNAMIC APPROACH

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FK 2010 91

MODELLING AN INVENTORY MANAGEMENT SYSTEM USING A SYSTEM DYNAMIC APPROACH

By

LEILA TAVANGAR

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

December 2010

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To my beloved family,

My husband, Abbas

My son, Hesam

And my parents.

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

MODELLING AN INVENTORY MANAGEMENT SYSTEM USING A SYSTEM DYNAMIC APPROACH

By

LEILA TAVANGAR

December 2010

Chairman: Faieza bt. Abdul Aziz, PhD

Faculty: Engineering

System Dynamics (SD) is a methodology for analyzing complex systems and problems with the aid of computer simulation software. It provides a common foundation that can be applied to understand and influence how things change over the time especially in very complex systems.

Inventory is one of the most visible and tangible aspects of business. Managing any manufacturing firm inventories is one of the fundamental issues to the managers. High-level inventories have both cost and benefits to the firm and having the right amount of inventory is a critical aspect. The performance of a supply chain influences the overall performance of a firm. Looking at the whole supply chain is more efficient to study the inventories. A supply chain by nature is a complex system. Parameters like new technologies, intricacy of products, and integrated supply chains enhance this complexity. Based on the problems of supply chain management and the capabilities of system dynamics in modelling complex systems, SD modelling approach was selected for this research.

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This thesis focuses on inventories of a Nuts and Bolts manufacturing firm supply chain in Iran. Piche Setareh Yazd (PSY) is a downstream of steel industry and all the changes in steel industry affects its supply chain. Moreover, other factors such as inflation, international sanctions and some domestic issues influence the PSY's supply chain. All these factors in addition to the natural complexity of a supply chain make the PSY's supply chain a good candidate for SD modelling. The model of PSY's supply chain system developed using the system dynamics methodology. VENSIM DSS software was used for simulation of the model.

The developed model was tested for usefulness, validity, and robustness with different standard tests. The tests results showed that the developed model structure is robust in different conditions and is not sensitive to the change of model parameters. Therefore, it can represent a true behaviour of the PSY's supply chain under different scenarios. This research demonstrated that SD approach is a proper tool for modelling and simulating a complex supply chain system in an instable environment. Using SD approach to model a supply chain management system could improve the understanding of managers about the true behaviour of inventories and help them to make their decisions more confidently and correctly.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

PERMODELAN SISTEM PENGURUSAN INVENTORI MENGGUNAKAN PEN DEKATAN DINAMIK SISTEM

Oleh

LEILA TAVANGAR

Disember 2010

Chairman: Faieza bt. Abdul Aziz, PhD

Faculty: Kejuruteraan

Sistem Dinamik merupakan satu kaedah untuk menganalisis sistem dan masalah yang rumit dengan bantuan perisian simulasi komputer. Ia menyediakan satu asas umum yang boleh digunakan untuk memahami dan mempengaruhi bagaimana sesuatu perkara berubah berdasarkan perubahan masa terutama dalam sistem yang sangat rumit. Persediaan merupakan salah satu aspek yang paling terlihat dan nyata dari perniagaan. Mengurusakan persediaan syarikat perkilangan apapun adalah salah satu masalah mendasar bagi pengurus.

Pencapaian Pengurusan Rangkaian Bekalan mempengaruhi prestasi keseluruhan sesebuah firma. Pada dasarnya, rangkaian bekalan sememangnya sistem yang rumit. Parameter seperti teknologi baru, produk yang kompleks serta rangkaian bekalan yang bersepadu menambahkan lagi kerumitan sistem ini. Berdasarkan masalah-masalah pengurusan rangkaian bekalan dan kemampuan sistem dinamik untuk

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memodelkan sistem yang rumit, pendekatan permodelan sistem dinamik telah dipilih bagi kajian ini.

Model rangakaian bekalan di sebuah firma pembuatan bolt dan nut iaitu Piche Setareh Yazd (PSY) di Iran telah dibangunkan menggunakan kaedah sistem dinamik. Tesis ini memfokuskan kepada masalah rangkaian bekalan di PSY.. Firma ini merupakan salah satu cabang kepada industri keluli dan sebarang perubahan di dalam industri keluli akan mempengaruhi rangkaian bekalannnya. Tambahan pula, faktor – faktor lain seperti inflasi, sekatan antarabangsa dan beberapa isu tempatan mempengaruhi rangkaian bekalan PSY. Kesemua faktor ini serta kerumitan rangkaian bekalan yang sedia ada menjadikan rangkaian bekalan PSY calon yang bersesuaian untuk dijadikan model Sistem Dinamik. Simulasi model tersebut dilakukan menggunakan perisian VENSIM DSS.

Model yang dibangunkan telah menjalani beberapa ujian untuk kegunaan dan faedah-faedahnya, keberkesanan dan kekuatannya. Keputusan terhadap ujian-ujian tersebut menunjukkan bahawa struktur model yang dibangunkan adalah teguh dalam pelbagai keadaan dan tidak sensitif terhadap perubahan parameter model menjadikan ia sesuai untuk mewakili sifat sebenar rangkaian bekalan PSY dalam situasi yang berbeza-beza. Kajian ini membuktikan bahawa pendekatan Sistem Dinamik merupakan alat yang sesuai untuk permodelan dan simulasi sistem rangkaian bekalan yang rumit di dalam keadaan yang tidak stabil. Dengan menggunakan pendekatan Sistem Dinamik untuk memodelkan sesebuah sistem

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pengurusan rangkaian bekalan boleh meningkatkan kefahaman para pengurus mengenai sifat sebenar inventori dan membantu mereka membuat keputusan dengan lebih yakin dan tepat.

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ACKNOWLEDGEMENT

This thesis was made possible by the generosity of many people and I wish to genuinely thank them all.

First, I would like to thank the supervisor of my studies Dr. Faieza bt. Abdul Aziz for the time and effort she have devoted to supporting me throughout the creation of this thesis. I am also deeply indebted to Professor Dr. Rosnah Mohd. Yusuff for her suggestions and constructive remarks throughout this work. Their insightful suggestions and helpful guidance in academic research are deeply appreciated.

I am thankful to my unseen friend Banafsheh Behzad for her suggestions in selecting my thesis subject.

I wish to express my special thanks to Mr. Barzegari, Mrs. Hadjihoseini, and all people from PSY for their cooperation and help in collecting data for my research.

I wish to express my heartfelt gratitude to my parents, Rasoul Tavangar and Safa Khanom Modaghegh for all the love and unconditional support they have given me.

I want also express my warmest thanks to my parents-in-law, Hossein Abhaji and Fatemeh Ansari for their love and support.

Last but not least, I wish to sincerely thank my husband, Abbas Abhaji who not only was my best friend and partner in life but also was the only reason for me to go forward and start my masters. His unconditional support and encouragement enabled me to go through all the problems during this study. I want to thank -deep in my heart- my lovely son, Hesam Abhaji for his love, patience and understanding.

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I certify that an Examination Committee has met on to conduct the final examination of **LEILA TAVANGAR** on her **Master** thesis entitled "**A SYSTEM DYNAMICS APPROACH TO MODELLING AN INVENTORY MANAGEMENT SYSTEM**" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously and is not concurrently submitted for any other degree at University Putra Malaysia or other institutions.

LEILA TAVANGAR

Date: 10 December 2010

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