
**WEB-BASED SUPPLY CHAIN MANAGEMENT USING
AGENT BASED APPROACH**

A thesis submitted to the Graduate School in partial
fulfillment of the requirements for the degree
Master of Science Intelligence System(IS)
Universiti Utara Malaysia

By

Siti Mazura Che Doi



JABATAN HAL EHWAL AKADEMIK
(Department of Academic Affairs)
Universiti Utara Malaysia

PERAKUAN KERJA KERTAS PROJEK
(Certificate of Project Paper)

Saya, yang bertandatangan, memperakukan bahawa
(I, the undersigned, certify that)

SITI MAZURA CHE DOI

calon untuk Ijazah
(candidate for the degree of)

MSc. (INTELLIGENCE SYSTEM)

telah mengemukakan kertas projek yang bertajuk
(has presented his/her project paper of the following title)

WEB-BASED SUPPLY CHAIN MANAGEMENT
USING AGENT BASED APPROACH


seperti yang tercatat di muka surat tajuk dan kulit kertas projek
(as it appears on the title page and front cover of project paper)

bahawa kertas projek tersebut boleh diterima dari segi bentuk serta kandungan dan meliputi bidang ilmu dengan memuaskan.
(that the project paper acceptable in form and content, and that a satisfactory knowledge of the filed is covered by the project paper).

Nama Penyelia Utama

(Name of Main Supervisor) : PUAN NORITA MD. NORAWI


Tandatangan
(Signature)

:  Tarikh (Date): 28/3/04

Nama Penyelia Kedua

(Name of 2nd Supervisor) : CIK NOORAINI YUSOFF

Tandatangan
(Signature)

:  Tarikh (Date): 28/3/2004

PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirements for a postgraduate degree from Universiti Utara Malaysia, I agree that the University Library may make it freely available for inspection. I further agree that permission for copying of this thesis in any manner, in whole or in part, for scholarly purposes may be granted by my supervisor(s) or, in their absence, by the Dean of the Graduate School. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to Universiti Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Requests for permission to copy or to make other use of materials in this thesis, in whole or in part should be addressed to:

Dean of Graduate School

Universiti Utara Malaysia

06010 UUM Sintok

Kedah Darul Aman

ABSTRACT

(Bahasa Melayu)

Penulisan kertas kajian ini adalah bertujuan untuk membuktikan kesesuaian penggunaan teknologi agen dalam menyelesaikan masalah kekurangan koordinasi dalam pengurusan rangkaian pembekal. Tanpa koordinasi yang baik, kawalan jualan dan inventori tidak dapat diselaraskan secara teratur. Justeru, peningkatan mutu sistem pengurusan rangkaian pembekal adalah penting bagi meningkatkan persaingan kedudukan dan keuntungan. Teknologi agen merupakan teknologi terpilih dalam membangunkan koordinasi yang sesuai dan dinamik bagi entiti teragih dalam pengurusan rangkaian pembekal. Agen secara berdikari melakukan pelbagai koordinasi dan pengambilalihan tugas daripada penggunanya untuk setiap hari. Kelebihan penggunaan agen dalam pengurusan rangkaian pembekal berasaskan web adalah kawalan inventori dan pemesanan pembelian barangan secara automatik seperti yang dilaksanakan dalam prototaip.

ABSTRACT

(English)

The objective of this paper is to demonstrate the feasibility of agent technology to solve the problem on the lack of coordination within the supply chain members. Without proper coordination, sales and inventory control will not be synchronized accordingly. Improving Supply Chain Management System (SCM) is very important for increasing competitive position and profitability. Agent technology is the preferable technology for enabling a flexible and dynamic coordination of spatially distributed entities in SCM. This technology changes the metaphor for human computer interaction from direct manipulation by the user to indirect management through agent processes. Agent can autonomously perform a lot of coordination and everyday tasks on behalf of their users. The advantages of web-based SCM using agent technology are automated inventory control and purchase order as demonstrated by the prototype.

ACKNOWLEDGMENTS

I am so thankful to Allah for giving me the courage and strength to complete this project. There are lots of efforts and supports that have been given by many people, whether individuals or organizations in completing this report.

First of all, I would like to thank and extend my warmest appreciation to University Utara Malaysia and its staff especially those from Faculty of Information Technology for making my studies meaningful. I also wish to thank the Zsa Zsa Beauty Care in Sungai Buluh that allowing me to use their data for this study. My deepest gratitude to my dedicated supervisors; Mrs. Norita Md. Norwawi and Miss Nooraini Yusoff , for giving me guidance and full supports in completing this project.

I wish to thank for all their advice, interest and valuable to my beloved best friend, Muziah Muhammad. To all my friends that have been helping and supporting me throughout the entire duration of this semester, thank you for your kindness. They are Sue, Liza, Tengku, Helmi, Fizlin and Lida and many others that I could not mentioned here.

Finally, not forgetting my beloved parents, Mr. Che Doi B. Jusoh and Mrs. Kiah bt Mat. Thank you for your `doa` in your prayers.

TABLE OF CONTENTS

PERMISSION TO USE	i
ABSTRACT (BAHASA MELAYU)	ii
ABSTRACT (ENGLISH)	iii
ACKNOWLEDGEMENTS	iv
LIST OF TABLES	v
LIST OF FIGURES	vi
LIST OF ABBREVIATIONS	vii
CHAPTER 1: INTRODUCTION	
1.1 Overview of The Study	1
1.2 Problem Statement	5
1.3 Objectives	6
1.4 Significance of The Project	6
1.5 Scope of The Study	7
1.6 Organization of The Report	8
1.7 Summary	9
CHAPTER 2: LITERATURE REVIEW	
2.1 Agent Technology	10

2.2	Agent in Supply Chain Management (SCM)	16
2.3	Summary	24

CHAPTER 3: METHODOLOGY

3.1	Methodology Phases	25
3.1.1	Construct A Conceptual Model	25
3.1.2	Develop A System Architecture	25
3.1.3	Analyze And Design The System	26
3.1.4	Build The System	26
3.1.5	Observe And Evaluate The System	27
3.2	Summary	27

CHAPTER 4 : RESULT

4.1	Result	28
4.1.2	The SCM Architecture	29
4.1.2	The Agent Based SCM System Architecture	30
4.1.3	Application of Agent UML Representation	31
4.1.4	Interaction Model	37
4.1.5	Prototype Implementation	40
4.1.6	Summary of Result	48
4.2	Discussion On Agent Characteristics	49
4.2.1	Summary of Agent Characteristics	52
4.3	Summary	52

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1	Conclusion	53
5.2	Limitation	54
5.3	Recommendation	55
5.4	Summary	56

BIBLIOGRAPHY	57
--------------	----

APPENDIXS

Appendix A: User Manual

Appendix B: Flow Chart

Appendix C: Site Map

LIST OF TABLE

Table 1.1:	Related Work On Agent In SCM	17
Table 3.1:	Development Environment	26
Table 4.1:	The Stock Before User Chooses To Buy The Product	42
Table 4.2:	The Stock After User Chooses To Buy The Product	44
Table 4.3:	The Stock Before User Chooses To Buy The Product	45
Table 4.4:	The Stock After User Chooses To Buy The Product	46
Table 4.5:	The Agents Action	49

LIST OF FIGURE

Figure 1.1:	Supply Chain Network (Swaminathan <i>Et AL.</i> , 1998)	2
Figure 1.2:	Retailer Relationship And Process	8
Figure 2.1:	Model of Agent-Based Web SCM System	20
Figure 3.1:	Development Environment	26
Figure 3.2:	Summary of Research Methodology	27
Figure 4.1:	SCM System Architecture	29
Figure 4.2:	The Architecture of Agent Based SCM System	30
Figure 4.3:	Use Case Diagram	32
Figure 4.4:	Protocol Diagram	33
Figure 4.5:	Statechart Diagram For Agent Customer	35
Figure 4.6:	Statechart For Retailer Agent	36
Figure 4.7:	Statechart For Supplier Agent	36
Figure 4.8:	Social Interaction Method For Sales Processing	38
Figure 4.9:	Social Interaction Method For Order Processing	39
Figure 4.10:	Social Interaction Method For Inventory Management	39
Figure 4.11:	Pseudo Code For Alert Message	41
Figure 4.12:	Decision Tree For Alert Message	41
Figure 4.13:	The Customer Page	43
Figure 4.14:	No Alert Message	44
Figure 4.15:	The Customer Page	46
Figure 4.16:	Alert Message On Retailer Page	47
Figure 4.17:	Alert Message On Supplier Page	48
Figure 4.18:	The Reactive Agent Page	50
Figure 4.19:	Agent Interaction	51
Figure 4.20:	Agent For Proactive Characteristics	51

LIST OF ABBREVIATIONS

AUML	-	Agent Unified Modeling Language
CASA	-	Collaborative Agent System Architecture
CPN	-	Coloured Petri Net
DSS	-	Decision Support System
ISCM	-	Integrated Supply Chain Management
MAS	-	Multi Agent System
OS	-	Operating System
PC	-	Personal Computer
PDA _s	-	Personal Digital Assistants
SCM	-	Supply Chain Management
UML	-	Unified Modeling Language
XOR	-	Exclusive Or

Chapter 1

Introduction

This chapter presents the overview of the Supply Chain Management (SCM) and intelligent agent. The problem definition, objective of study, contribution and scope of the project are also discussed.

1.1 Overview Of The Study

Supply chain management (SCM) is the integrated administration of goods and service from supply side, including the logistics and services from the supply side, the logistics and operations components of the value chain, through the transformation process and distributed process and distributed channel to the customer. In other words, supply chain is a network of suppliers, factories, warehouses, distribution centers and retailers, through which raw materials are acquired, transformed, produced and delivered to the customer (Swaminathan *et al.*, 1998).

The focus of supply chain management has been shifted from production efficiency to customer and partnership synchronization approaches. To implement this strategic shift requires high level collaboration between the supply chain partner. Agent technology

The contents of
the thesis is for
internal user
only

BIBLIOGRAPHY

- Anderson, D. L. & Lee, H. (1999). Synchronized supply chains: the new frontier, Volume 1. <http://www.ascet.com/documents.asp?d_ID=198>(July 2003)
- Agre, P. E. & Chapman, D. (1987). "Pengi: An Implementation of a Theory of Activity". *Proceeding of 6th National Conference on Artificial Intelligence, San Mateo, CA: Morgan Kaufmann.*
- Brooks, R. A. (1986). "A Robust Layered Control System for a Mobile Robot". *IEEE J Robotics and Automation*, 2 (1), pp.14-23.
- Chen, Y., Peng, Y., Finin, T., Labrou, Y., Cost, S., Chu, B., Yao, J. Sun, R. & Wilhelm, B. (1999). A Negotiation-Based Multi-Agent System For Supply Chain Management. *Proceedings of the Agents'99 Workshop "Agent-Based Decision-Support for Managing the Internet-Enabled Supply-Chain"*.
- Chopra, S. & Meindl, P. (2001). *Supply Chain Management: Strategy, Planning, and Operations*. Prentice Hall College.
- Fox, M. S., Chionglo, J. F. & Barbuceanu, M. (1993). The Integrated Supply Chain Management System. *Internal Report, Dept. of Industrial Engineering, University of Toronto.*
- Gupta, A. & Agarwal, R. K. (2001). Supply Chain Agent Decision Aid System(SCADAS). *Proceedings of the 2001 winter Simulation Conference.*

- Huget M. P. (2002). An Application of Agent UML to Supply Chain Management. *Technical Report ULCS-02-015 Dept. Of Computer Science, University of Liverpool.*
- Jennings, N. R., Faratin, P., Johnson, M. J., O'Brien, P. & Wiegand, M. E. (1996). ADEPT : Using intelligent agents to manage business processes. *Proceedings of the First International Conference on Practical Applications of Intelligent Agents and Multi-Agents.*
- Jennings, N. R. & Wooldridge, M. (1996). Software agents, *IEEE Review*, pp. 17-20.
- Jennings, N. R. & Wooldridge, M. (1998). Applications of intelligent agents, *In Agent Technology: Foundations, Applications, and Markets, Berlin, Springer Verlag*, pp.1-27.
- Jennings, N., Sycara, K. & Wooldridge, M. (1998). A Roadmap for Agent Research and Development. *Autonomous Agents and Multiagent Systems 1 (1)*, pp. 7-38.
- Jensen, J. (2001). Citing Internet sources.
<http://www.firstmonday.dk/issues/issue2_3/jansen/> (15 April, 2003).
- Jensen, B. (2001). A Multi-agent System For Sales Order Processing. *Journal of ACM Press, New York*, 12(3), pp. 32-42.
- Kalakota, R. & Robinson, M. (2001). e-Business 2.0: Roadmap for Success, USA: Addison-Wesley.
- Kim, K., Paulson, C. P., & Petrie, C. J., (2000). Agent-based Electronics Markets for Project Supply Chain Coordination. *The AAAI-2000 Workshop on Knowledge-based Electronic Markets, Monday, July 31, Austin TX, USA.*

- Mario, V & Marco C. (2002). Commitments for Agent-Based Supply Chain Management, *ACM SIGecom Exchanges*, 3(1), pp. 23-45.
- Maes, P. (1991). *Designing Autonomous Agents: Theory and Practice from Biology to Engineering and Back*, London: The MIT press.
- Maes, P. (1994). Agents that Reduce Work and Information Overload. *Communications of the ACM*, 37 (7), pp. 31-40
- Min, J. U. & Bjournsson, H. C., (2001). Agent-Based Supply Chain Management Automation, *Working Paper* No. 453.
- Ong, K. L. & Ng, W. K., (1998). A Survey of Multi-Agent Interaction Techniques and Protocols. Technical Report #CAIS-TR04-98, School of Applied Science, Nanyang Tecnological University, Singapore.
- Papazoglou, M. P. (2001). Agent-oriented Technology in Support of E-Business. *Communications of the ACM*, 44(4), pp. 71-78.
- Schoder, D. & Eymann, T. (2000). Technical Opinions: The Real Challenges of Mobile Agents, *Communications of the ACM*, 43(6), pp. 111-112.
- Shen, W., Ulieru, M. & Norrie, D. (1999). Implementing The Internet Enabled Supply Chain Through A Collaborative Agent System. *Agents'99 Workshop on Agent Based Decision-Support for Managing the Internet-Enabled Supply-Chain*, Seattle, WA.
- Shen, W. & Norrie, D. H. (1998). *An Agent-Based Approach for Manufacturing Enterprise Integration and Supply Chain Management*, G. Jacucci, et al (eds.), *Globalization of Manufacturing in the Digital Communications Era of the 21st Century: Innovation, Agility, and the Virtual Enterprise*, Kluwer Academic Publishers.

- Shavlik, J. & Eliassi-Rad, T., (1998). Building Intelligent Agents for Web-based tasks: A Theory-Refinement Approach, *Proceedings of the CONALD Workshop on learning from Text and the Web*.
- Swaminathan J. M., Smitch S. F. & Sadeh N. M. (1998). Modeling Supply Chain Dynamics: A multi Agent Approach, *Communication of the ACM*. 29(3), pp. 609.
- Tveit, A. (2001). A survey of agents oriented Software engineering. *Proceedings of 1st NTNU Computer Science Graduate student conference, Trondheim Norway, May. 2001*. < <http://www.csgsc.org> > (15 June, 2003).
- Umeda, S. & Jones, A. (1998). *A Simulation-Based BPR Support System For Supply Chain Management, Re-Engineering in Action: The Quest for World Class Excellence*. : <<http://www.mel.nist.gov/msidlibrary/summary/pubs98.htm>> (25 April, 2003).
- Wang, H., Mylopoulos, J. & Liao, S., (2002), Intelligent Agents and Financial Risk Monitoring Systems, *Communication of the ACM Journal*, 45(3), pp.83-88.
- Wooldridge, M., Jennings, N. R. & Kinny D. (2000). The Gaia methodology for agent-oriented analysis and design. *Autonomous Agents and Multi-Agent Systems*, 3(3), pp. 285-312.
- Yan, G. ng, W.K & Lim, E. P. (1995). Toolkits for a distributed, Agent-Based Web commerce System. *Proceedings of the international Ifip working Conference on Trends in Distributed Systems For Electronic Commerce(TrEC'98), Hamburg, Germany*.
- Yuan, Y., Liang, T. P., & Zhang, J. J., (2001). Using Agent Technology to Support Supply Chain Management: Potentials and Challenge. DeGroote School of Business Working Paper No. 453, October.