

A CONTINGENCY FRAMEWORK FOR ANALYSING SUPPLY CHAIN
PERFORMANCE

MURIATI BINTI MUKHTAR

A thesis submitted in fulfilment of the
requirements for the award of the degree of
Doctor of Philosophy

Faculty of Mechanical Engineering
Universiti Teknologi Malaysia

NOVEMBER 2006

DEDICATION

To Osman, Fikri, Shukri and Sakinah

ACKNOWLEDGEMENTS

In the name of Allah, Most Gracious, Most Merciful. I thank Allah for granting me the courage to embark on the research that culminates in this thesis and the strength and perseverance I needed to complete it.

There are so many people to acknowledge and such a limited space to do it in. First of all my heartfelt thanks and gratitude to my esteemed supervisors Professor Dr Awaluddin Mohamed Shaharoun and Professor Dr. Mohd Shariff Nabi Baksh for their encouragement, guidance and patience. Without their continuous support and motivation, this thesis would not have been a reality as it is presented here.

I must also acknowledge Universiti Kebangsaan Malaysia (UKM) for funding my PhD study. A special note of thanks goes to my colleagues, administrators and staff at the Fakulti Teknologi dan Sains Maklumat, UKM for the assistance meted out to me on several occasions.

I would also like to acknowledge some special people who had assisted me in this research. A special thank you to my friend and colleague, Marini who has helped me on numerous occasions. Without her philanthropic gestures this thesis might not have been completed. The same goes to Dr. Abdul Rahman Abdullah who is always so concerned about my progress. Doing this PhD would have been lonelier if not for the camaraderie provided by my fellow postgraduates Nor Ajian, Marini, Salha, Norly and Yazrina. Thank you all for the lively discussions and useful tips.

Lastly I would like to thank my family for being there for me. I am grateful to my parents Hj. Mukhtar Hj. Abdul Rahim and Hajjah Atikah Abdullah for their prayers and moral support. I am also deeply indebted to my sisters and in-laws who had to do their share of baby- sitting for me on various occasions. A special token of appreciation goes to my husband, Osman for believing in me and for putting up with my absent mindedness. To my children, Fikri, Shukri and Sakinah, thank you for being my inspiration.

ABSTRACT

The activities, processes and relationships that fall under the supply chain label are central to industrial modernity. As supply chains are now competing against supply chains, it is vital that they are managed effectively so as to enhance their performance. An examination of the literature on supply chain analysis reveals that it can be viewed from two separate perspectives. The first is the decisional perspective that prescribes to the premise that different decisional variables or factors lead to different performance levels. The second perspective centers on the fact that there is no one best way to manage all supply chains and different supply chains have to be managed differently. The literature also reveals that several different methodologies are employed in looking at those issues and their effects on supply chain performance. Because of the multiple issues involved and the lack of a common methodology in supply chain analysis, the literature paints an almost confusing picture of the subject. Thus, the purpose of this study is to investigate and develop a general framework that could be used as a platform to investigate or analyze the performance of supply chains whilst at the same time incorporating the characteristics of the two perspectives of supply chain analysis that was mentioned earlier. In order to achieve this, an extensive literature review and case study analysis was done. This leads to the coining of new concepts like the supply chain structure, which is made up of the physical variables, relationship variables and spatial variables, and contextual variables for supply chains. These new concepts formed the elements of the proposed contingency framework for supply chain analysis. This framework is based on two guiding principles. One is that different supply chain structures will give rise to different supply chain performances and the other is that there is an interaction between the supply chain structure variables and the contingent variables, which in turn will affect supply chain performance. A purely conceptual framework, though useful in its own right, would have been of limited use especially to practitioners. Thus the applicability of the contingency framework in analyzing supply chains is demonstrated via simulation. The simulation results confirm the hypothesis that different supply chain structures exhibited different performances. The proposed contingency framework could serve as a theoretical base for further research into supply chain analysis, which would give more insight into the dynamics of a supply chain.

ABSTRAK

Aktiviti, proses serta hubungan antara organisasi yang tercakup di bawah tajuk rantai bekalan adalah penting bagi kementerian perindustrian. Dalam keadaan di mana rantai bekalan bersaing dengan suatu rantai bekalan yang lain, pengurusan yang cekap adalah penting supaya prestasi mereka boleh dipertingkatkan. Tinjauan literatur dalam bidang analisis rantai bekalan menunjukkan yang ia boleh dilihat dari dua perspektif yang berbeza. Yang pertama adalah perpektif keputusan di mana berbagai faktor atau pembolehubah keputusan akan mengakibatkan tahap prestasi yang berbeza bagi sesuatu rantai bekalan. Perspektif kedua pula berkisar kepada fakta yang menyatakan bahawa, tidak wujud hanya satu cara paling baik untuk mengurus semua rantai bekalan, malah, rantai bekalan yang berbeza perlu diurus dengan cara yang berbeza. Tinjauan literatur juga menyerlahkan kewujudan pelbagai metodologi dalam menangani isu-isu yang berkaitan dengan analisis rantai bekalan. Kewujudan pelbagai isu dan ketiadaan suatu metodologi sepunya dalam analisis rantai bekalan menyebabkan bidang ini tampak kompleks. Tujuan kajian ini adalah untuk menyelidik dan membentuk suatu kerangka am yang boleh digunakan sebagai platform bagi mengkaji dan menganalisis prestasi sesuatu rantai bekalan dan pada waktu yang sama berupaya untuk merangkumi ciri-ciri dari kedua-dua perspektif dalam analisis rantai bekalan seperti yang telah disebut di atas. Untuk merealisasikan perkara ini satu tinjauan literatur yang mendalam dan analisis kajian kes telah dilakukan. Ini telah menghasilkan beberapa konsep baru seperti struktur rantai bekalan, yang ditakrifkan sebagai gabungan pemboleh ubah fizikal, pemboleh ubah hubungan, dan pembolehubah ruang, serta pembolehubah konteks untuk rantai bekalan. Konsep ini membentuk unsur penting dalam kerangka kontingensi untuk analisis rantai bekalan yang dicadangkan. Kerangka ini adalah berdasarkan kepada dua prinsip utama. Yang pertama adalah prinsip yang menyatakan bahawa struktur rantai bekalan yang berbeza akan menghasilkan prestasi yang berbeza sementara prinsip kedua pula menyatakan yang interaksi antara pembolehubah struktur rantai bekalan dan pembolehubah kontigen atau konteks akan memberi kesan kepada prestasi rantai bekalan. Keberkesanan sesuatu kerangka konsep yang dibina sudah tentulah terhadap seandainya penggunaannya dalam menganalisis rantai bekalan tidak dapat ditunjukkan. Oleh itu, dalam kajian ini, kebolegunaan kerangka kontingensi ini telah ditunjukkan melalui simulasi. Hasil dari simulasi yang dijalankan, didapati bahawa struktur rantai bekalan yang berbeza menunjukkan prestasi yang berbeza. Ini sekali gus mengesahkan hipotesis yang didapati dari kerangka kontingensi tersebut. Kerangka kontingensi yang dicadangkan dalam tesis ini boleh menjadi asas teori bagi memungkinkan penyelidikan yang lebih mendalam dalam analisis rantai bekalan yang sekali gus akan memberi pandangan yang berguna dalam dinamik rantai bekalan.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENTS	iv
	ABSTRACT	v
	TABLE OF CONTENTS	vi
	LIST OF TABLES	xi
	LIST OF FIGURES	xiii
	LIST OF ABBREVIATIONS	xv
	LIST OF APPENDICES	xvi
1	INTRODUCTION	1
	1.1 Background of the Problem	1
	1.2 Definition of Terms	3
	1.3 Statement of the Problem	3
	1.4 Purpose of the Research	4
	1.5 Objectives	4
	1.6 Scope and Key Assumptions	5
	1.7 Importance of Research	5
	1.8 Research Methodology	6
	1.9 Research Contributions	7

1.10	Organization of the Thesis	9
1.11	Summary	10
2	LITERATURE REVIEW	11
2.1	Introduction	11
2.2	Evolution of the Supply Chain	12
2.3	The Framework for Literature Review	15
2.4	The Decisional Paradigm	19
	2.4.1 Strategic Models	21
	2.4.1.1 Buyer-supplier Relationships	22
	2.4.1.2 Physical Layout	33
	2.4.1.3 Other Factors	35
	2.4.2 Operational Models	36
	2.4.3 Strategic-Operational Models	40
	2.4.3.1 Buyer-Supplier Relationships and Various Operational Variables	40
	2.4.3.2 Physical Layout and Various Operational Variables	41
2.5	The Structural Paradigm	44
	2.5.1 Contingency Theory	47
	2.5.2 Supply Chain Structure	49
2.6	Review of Methodologies	52
	2.6.1 Modelling Issues	59
	2.6.2 Industrial Dynamics Modelling and Simulation	61
2.7	Supply Chain Performance	62
	2.7.1 Performance Measures	62
	2.7.2 Measurement Systems	63
2.8	Conclusions of Literature Review	67

3	RESEARCH METHODOLOGY	71
3.1	Introduction	71
3.2	Overview of Methodology	71
3.3	Determination of the Factors (Phase One)	74
	3.3.1 Role of the Literature	74
	3.3.2 Case Study	75
3.4	Relationship between the Factors (Phase Two)	78
3.5	Application and Testing of Framework	79
	3.5.1 Steps in Simulation Study	81
3.6	Summary	83
4	THE CONTINGENCY FRAMEWORK	85
4.1	Introduction	85
4.2	An Overview of the Investigation	85
4.3	Identification and Classification of Factors	87
	4.3.1 Literature Revisited: Identification of Factors	87
	4.3.2 Literature Revisited: Classification of Factors	89
	4.3.3 Case Studies	91
	4.3.4 Supply Chain Structure	92
4.4	Positing the Contingency Framework	100
	4.4.1 Contingency in the Literature	100
	4.4.2 The Contingency Framework	101
4.5	Discussion of Results	104
4.6	Summary	105

5	APPLYING THE CONTINGENCY FRAMEWORK	107
5.1	Introduction	107
5.2	An Overview of the Investigation	108
5.3	The Supply Chain Structures Simulation Framework (SCSSF)	110
	5.3.1 Literature Revisited	110
	5.3.2 Positing the Framework	111
5.4	Modelling and Simulation	114
	5.4.1 Case Studies and the Hypothetical Supply Chain	114
	5.4.2 Modelling and Simulating the supply chain structures	116
	5.4.2.1 Modelling Relationships-The Relationship Constructs	117
	5.4.2.2 Conceptual Models for the Supply Chain Structures	120
	5.4.2.3 The Models in Arena	123
	5.4.3 Simulation Results	129
5.5	Discussion of Simulation Results	141
5.6	Summary	141
6	DISCUSSIONS	143
6.1	Introduction	143
6.2	Summary of the Research	143
6.3	Research Findings	145

6.3.1	The Variables	145
6.3.2	The Contingency Framework	148
6.3.3	The Simulation Study	151
6.3.4	Taxonomy for the Literature	156
6.3.5	Overall Comparisons with Previous Research	156
6.4	Limitations of the Study	158
6.5	Research Implications and Practical Implications	159
6.5.1	Implications for Research	159
6.5.2	Implications for Practice	160
6.6	Summary	161
7	CONCLUSIONS	162
7.1	Introduction	162
7.2	Conclusions of the research	162
7.3	Research Contributions	163
7.3.1	General Contributions	163
7.3.2	Specific Contributions	164
7.4	Recommendations for Further Research	166
7.5	Closing Note	169
	REFERENCES	170
	APPENDICES	189

LIST OF TABLES

TABLE NO.	TITLE	PAGE
1.1	Definition of terms	3
2.1	Phase 1 Evolution of production and operation management activities	13
2.2	Phase 2 Evolution of production and operation management activities	14
2.3	Phase 3 Evolution of production and operation management activities	14
2.4	Characteristics of the content paradigms	16
2.5	Decisional issues for the strategic model	22
2.6	Central issues in buyer-supplier relationships research in supply chains.	24
2.7	Operational decision factors	37
2.8	Various uses of the term supply chain structure	51
2.9	Review of papers for the different modelling methodologies	53
2.10	Research Issues in supply chain analysis	69
3.1	Research questions and methods.	74
4.1	Factors that affects decision-making in supply chains	88
4.2	Examples of relational behaviours	98

4.3	Summary of interactions between the variables	103
4.4	Brief description of results	105
5.1	Model parameters (time in hours) and assumptions	125
5.2	Summary of the values of the respective performance measures	130
5.3	Performance measurement means for the arms length structures	135
5.4	Statistical comparisons between the arms length structures via PAN	136
5.5	Performance measurement means for the arms length and true collaboration structures.	137
5.6	Summary of statistical comparisons between the arms length structure and true collaboration structure via PAN	137
5.7	Performance measurement means for the collaborative structures.	138
5.8	Summary of statistical comparisons between the collaborative structures via PAN	139
5.9	Performance measurement means for all structures	140
5.10	Summary of statistical comparisons between the structures via PAN	140
6.1	Examples of research hypotheses generated by the contingency framework.	150
6.2	General comparison between previous research and the author's research	157

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	Phases of development of the proposed contingency framework	6
1.2	Summary of main research contributions	8
1.3	The layout of the chapters in the thesis	10
2.1	Framework for the literature review	15
2.2	Classification of research issues in supply chain analysis	18
2.3	Forms of supply chain decisions	19
2.4	Different types of models in the decisional paradigm	20
2.5	Conceptual research methods (adapted from Meredith,1993)	55
2.6	Position of papers under the content-methodology Framework	58
2.7	A selection of measures for the supply chain balanced scorecard framework (adapted from Brewer and Speh, 2000)	66
3.1	Phases of research	72
3.2	Phase One Methodology	77
3.3	Phase Two Methodology	78
3.4	Applying the Framework	79
3.5	Case study and simulation methodology	80
4.1	An overview of the investigation	86
4.2	Example of a mapping of the physical variables of a supply chain (Lambert et al., 1998)	93

4.3	Triangular matrix representation of a door product company's supply chain	94
4.4	Relationship profiles	97
4.5	Triangular matrix representation of the relationship structure	99
4.6	The contingency framework	103
5.1	An overview of the investigation	109
5.2	Details of the mapping module in the SCSSF.	111
5.3	Details of the evaluation module in SCSSF	112
5.4	Supply Chain Structures Simulation Framework	113
5.5	Schematic View of the Hypothetical Supply Chain	114
5.6	The six supply chain structures	116
5.7	Relationship constructs	119
5.8	Results of simulation in PAN	131
5.9	Performance of each supply chain structure with respect to each performance measure	132
5.10	Bar charts for performance comparisons between the supply chain structures for each performance measure	133
5.11	Histogram representation for performance comparison between the supply chain structures with respect to each performance measure	134
6.1	The contingency framework	148
6.2	Relationship profiles	152
6.3	Flow Chart for the supply chain structures simulation framework	155
7.1	New paradigms	168

LIST OF ABBREVIATIONS

AL	Arms length
BDAL	Buyer dominated arms length
BDC	Buyer dominated collaboration
EDI	Electronic data interchange
JIT	Just in time
OM	Operations Management
PAN	Process Analyzer
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference Model
SCSSF	Supply chain structures simulation framework
SDAL	Supplier dominated arms length
SDC	Supplier dominated collaboration
TC	True collaboration

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A1	Case study questionnaire	189
A2	Summary of case study results	196
B1	Flow charts for the basic arms-length structure	200
B2	Flow charts for the buyer dominated arms length structure.	204
B3	Flow charts for the supplier dominated arms-length structure	208
B4	Flow charts for the true collaboration structure.	213
B5	Flow charts for the buyer dominated collaboration structure.	217
B6	Flow charts for the supplier dominated collaboration structure.	221
B7	Common model assumptions and processes representations in Arena.	225
B8	Arena modules for the Basic Arms Length Structure.	236
B9	Arena modules for the Buyer Dominated Arms Length Structure.	239
B10	Arena modules for the Supplier Dominated Arms Length Structure.	242

B11	Arena modules for the true collaboration structure	246
B12	Arena Modules for the Buyer Dominated Collaboration Structure.	249
B13	Arena Modules for the Supplier Dominated Collaboration Structure.	252
B14	Box and Whisker Charts: Comparing the Arms Length Structures.	255
B15	Box and Whisker charts: Comparing the Basic Arms Length Structure and the true Collaboration Structure	259
B16	Box and Whisker charts: Comparing the collaborative structures.	263
B17	Box and Whisker charts: Comparing all structures.	267

CHAPTER 1

INTRODUCTION

1.1. Background of the Problem

A supply chain is a network of facilities and activities involved in delivering a product from raw materials through to the customer. It is concerned with planning, coordinating and controlling material, parts and finished goods from the suppliers to the customer. It involves two distinct flows through the organization that is, material and information (Stevens, 1989). In the early days of discussion about supply chain management the spotlight was primarily centred on management of the supply chain within a single company. The traditional view of supply chain management according to Spekman *et al.*(1998) is to leverage the supply chain to achieve the lowest initial purchase prices while assuring supply. Typical characteristics of this type of management are multiple partners; partner evaluation based on purchase price; cost based information bases; arm's length negotiations; formal short- term contracts; and centralized purchasing.

Today's focus of supply chain management, however, is one of cross-company planning and implementation. Under this new paradigm, supply chain management is redefined as a process for designing, developing, optimising and managing the internal and external components of the supply system, including material supply, transforming materials and distributing finished products or services to customers, that is consistent with overall objectives and strategies. This new way of managing the supply chain will link all partners in the chain including departments within an organization and the external partners including suppliers, carriers, third party companies and information

system providers. The partners all work together to make the whole supply chain competitive (Lummus and Vokurka, 1999).

Since competitive advantage is now defined in terms of supply chains instead of single companies, it is imperative that supply chain analysis are continually analysed so as to improve its performance hence increasing its competitiveness. The importance of supply chain analysis or supply chain management is proven by the large amount of research in the area. An excursion into the literature on supply chain analysis reveals that it is a multi faceted area of research reflected by the multi issues discussed and the various different methodologies adopted. However, it was shown that the literature can be viewed via a taxonomy based on content and methodology (Croom *et al.*, 2000).

On finer scrutiny, it will be shown in Chapter 2 that the content itself can be separated into two perspectives or paradigms. The first is the decisional perspective that prescribes to the premise that different decisions lead to different supply chain performance levels. The second perspective centres on the fact that there is no one best way to manage all supply chains and supply chain performance is contingent upon various factors. Although each perspective, separately, are effective in explaining and analysing the different issues that arose in supply chain analysis, each on its own presents an incomplete analysis of supply chains. This is due to the fact that (as will be shown in the review of the literature in Chapter 2, Table 2.10) each perspective concentrates only on certain factors and ignore others. In order to obtain a more complete picture of supply chain performance and supply chain dynamics, an encompassing framework that incorporates the features of both paradigms is deemed necessary. This framework will be the underlying methodology for supply chain analysis.

1.2 Definition of terms

Definitions to some terms that are regularly referred to in the thesis are given in Table 1.1.

Table 1.1: Definition of terms

Term	Definition
Contingency Framework	A framework that is based on the contingency theory, which is an approach to the study of organizational behaviour in which explanations are given as to how contingent factors such as technology, the external environment and culture influence the design and functioning of organizations.
Supply Chain Performance	Supply chain performance comprises the actual output or results of a supply chain as measured against its intended goals and objectives.
Supply chain analysis	A careful examination of the supply chain with the objective of evaluating its behaviour and performance via suitable qualitative and/or quantitative techniques.

1.3 Statement of the Problem

Supply chain analysis is important especially in this era of globalisation where supply chains compete with each other. To analyse a supply chain is to determine its current performance and to find ways to improve future performance. There are several ways to analyse supply chains as will be attested by the abundant literature on supply chain analysis and management. However these approaches seems inadequate because it fails to incorporate and combine important relevant factors such as the various types of buyer-supplier relationships, the supply chain structure concept and the contingency

behaviour of supply chains into an encompassing framework. As such supply chain analysis done via existing methods will provide a fragmented and an incomplete picture of the supply chain dynamics and performance. Hence, this study will therefore investigate and develop a general framework that could be used as a platform to analyse the performance of supply chains.

1.4 Purpose of Research

The purpose of the research is to develop a framework for supply chain analysis that unifies two different approaches to supply chain analysis found in the literature. The framework will take into consideration the decisional factors of the decisional paradigm, the structural factors from the structural paradigm and the contingency effect exhibited by supply chains.

1.5 Objectives

The objectives of this research are as follows:

- (i) To identify and classify the factors that affect supply chain performance. This will involve the development and formalization of the supply chain structure concept and the contingency variables.
- (ii) To develop a contingency based framework that will serve as a methodology for analysing the performance of supply chains. This involves the determination of the relationships between the factors uncovered in (i).
- (iii) To investigate the applicability of the developed framework on the performance of supply chains, through the use of modelling and simulation.

1.6 Scope and Key Assumptions.

This study is limited to the following:

- (i) The research is conceptual in nature. This means that it relies heavily on existing literature. It is via the literature that the components of the supply chain structure variables and contextual variables are identified and conceptualised. This is consistent with the conceptual modelling approach adopted in Meredith (1993) and Wacker (1998).
- (ii) Although equally applicable to other types of supply chains, the focus of this research is on manufacturing supply chains.
- (iii) To provide focus on the strategic and structural issues the supply chain, models developed are at a high level of abstraction and are not at the machine level of detail.
- (iv) The structural input to the simulation studies is based on limited case studies on local automotive supply chains. The operational input however, is based on a published hypothetical situation (Closs *et al.*, 1998).

The main assumptions of this research are related to the simulation modelling and analysis which is carried out using the simulation package ARENA 5.0 and its separate application *Pan Analyzer*. These are explained in Chapter 3 and Chapter 5 of the thesis.

1.7 Importance of Research

The research is important and significant both from the theoretical and practical standpoints. The rationale and motivation for this research can be summarised as follows:

- (i) Supply chain analysis has attracted researchers from many different domains each utilising a particular methodology and paradigm in examining and solving problems. The boundaries created by the type of methodology and paradigm employed painted a fragmented picture of supply chain dynamics and performance. This makes comparison between studies and generalizations of results difficult and inaccurate. Since

the contingency based framework is an encompassing framework that combines different paradigms in supply chain analysis and incorporate various factors important to the analysis of supply chain performance, it thus presents the researchers and practitioners alike with a common tool that can facilitate comparisons and generalizations between studies as mentioned earlier.

(ii) The lack of a theoretical base to the area of supply chain management has been highlighted by New (1997). Without a sound theoretical base, the field of supply chain management will reduce to a passing fad (Chandra and Kumar, 2000). Thus, this research is timely and relevant as it provides new theoretical descriptions, in terms of the contingency framework and its components. Furthermore, this can become a basis for other theoretical developments in the field of supply chain analysis and management.

1.8 Research Methodology

This section briefly introduces the research methodology. The details however, are presented in Chapter 3. The proposed contingency framework for supply chain analysis was developed via three phases as illustrated in Figure 1.1.

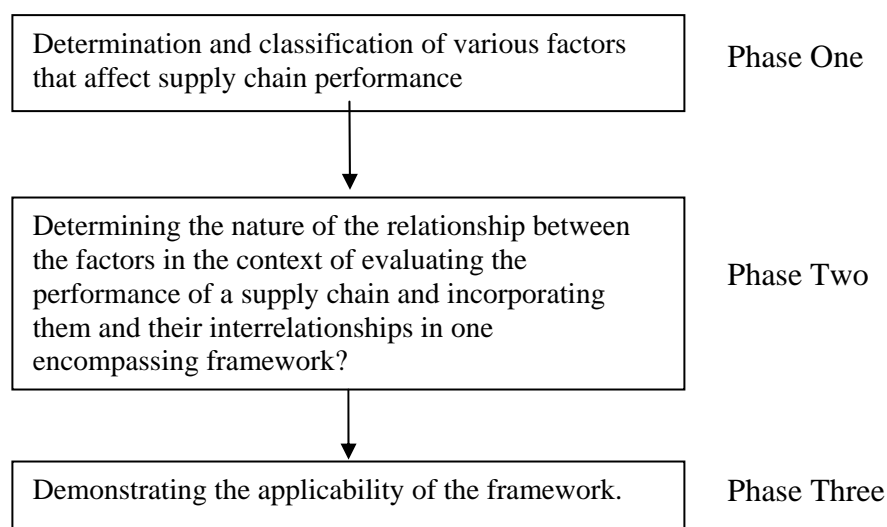


Figure 1.1: Phases of development of the proposed contingency framework

This research is largely theoretical in nature. It thus follows, in the first part, the theory building concepts found in the operations management literature of which supply chain management is a part. In phase one of the research, a critical review of the literature on supply chains is done. This is achieved via a framework that is based on the content and methodology taxonomy. The literature reveals that there are two different paradigms in supply chain analysis and that several decisional and structural factors affect supply chain performance. Using conceptual analysis a classification of these decision variables was done. It led to the supply chain structure concept and the contingency variables.

Phase two of the research is concerned with discovering the interrelationships between the variables discovered in Phase One and supply chain performance. Here, the literature reveals that there is no “one size fits all method” to analyse or manage supply chains. This fact points to a contingency framework for supply chain analysis based on the theory developed in organizational studies. This phase resulted in the proposed contingency framework for supply chain analysis.

The third and final phase of the research is the proof of concept. It demonstrates the credibility and applicability of the framework. This is done by embedding simulation into the supply chain structures simulation framework. Here it is shown that different supply chain structures characterized by different relationship profiles exhibit different levels of performance.

1.9 Research Contributions

The different and sometimes divergent approaches in analysing supply chains and the concept of different styles for different supply chains provided the impetus for this research. Figure 1.2 highlights the main contribution of this research in the form of a hierarchy of contributions. In seeking a holistic paradigm that combines the different approaches to supply chain analysis resulted in the main contribution, which is the contingency framework. This framework provides a systematic and rigorous approach

to effectively analyse supply chains. One of the main components of the framework is the newly formed supply chain structure concept, which is made up of the physical structure variables, the relationship structure variables and the spatial structure variables. The framework incorporates the interactions between the contextual variables, the supply chain structure variables and supply chain performance. The proof of concept and the applicability of the framework are handled via the supply chain structure simulation framework, which is another research contribution. Other specific contributions are the relationship profiles and relationship constructs which are related to the modelling and simulation considerations of the framework. Details of the contributions are given in Chapter 7.

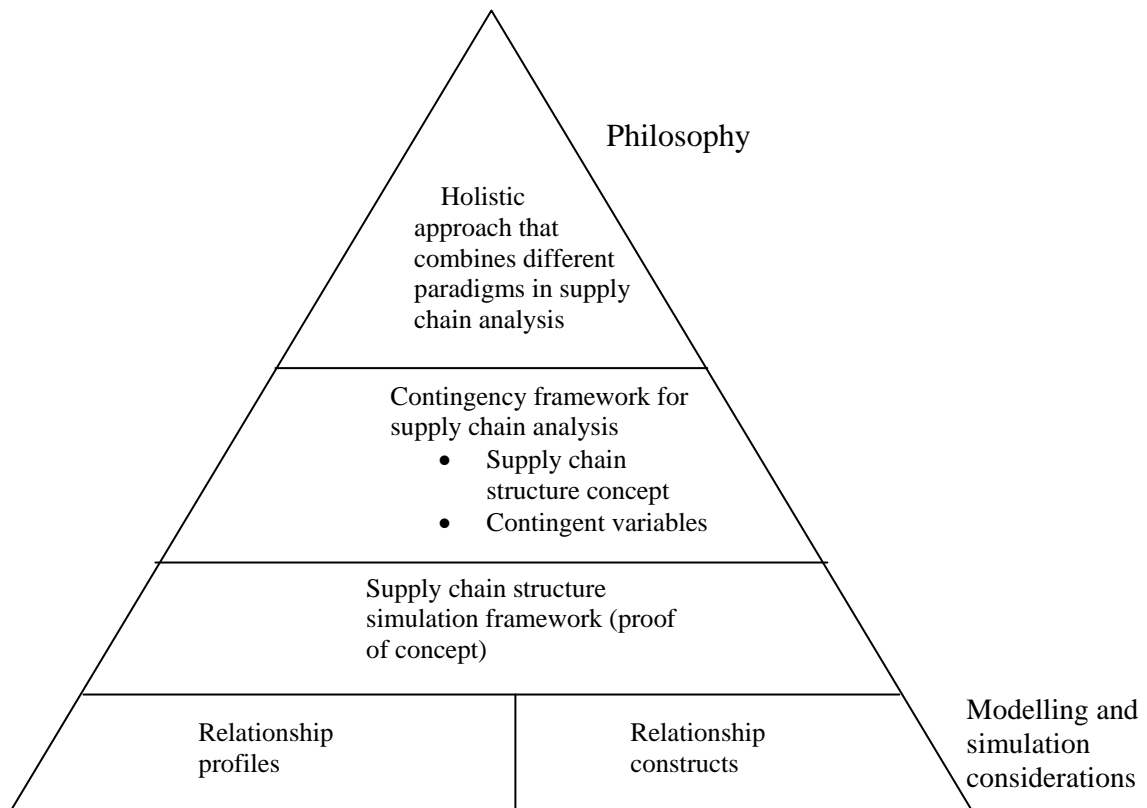


Figure 1.2: Summary of main research contributions

1.10 Organization of the Thesis

This thesis consists of seven chapters as shown in Figure 1.3. Chapter 1 serves as an essential introduction to the research. Chapter 2 presents the review of the relevant literature that leads to the formulation of this thesis. Chapter 3 describes the chosen methodology and the rationale behind its choice. Chapter 4 describes the research main contribution that is, the contingency framework. In this chapter the components of the framework are presented. The concept of supply chain structure with respect to the overall contingent framework is developed and explained. The relevance and novelty of the framework is highlighted. Chapter 5 describes the modelling approaches, the simulation models and analysis done in ARENA used in showing the credibility and applicability of the framework. In light of the results presented in Chapter 3 and 4, Chapter 6 provides the overall discussion of the research findings. Chapter 7 concludes the thesis with lists of contributions, conclusions and suggestions for further research.

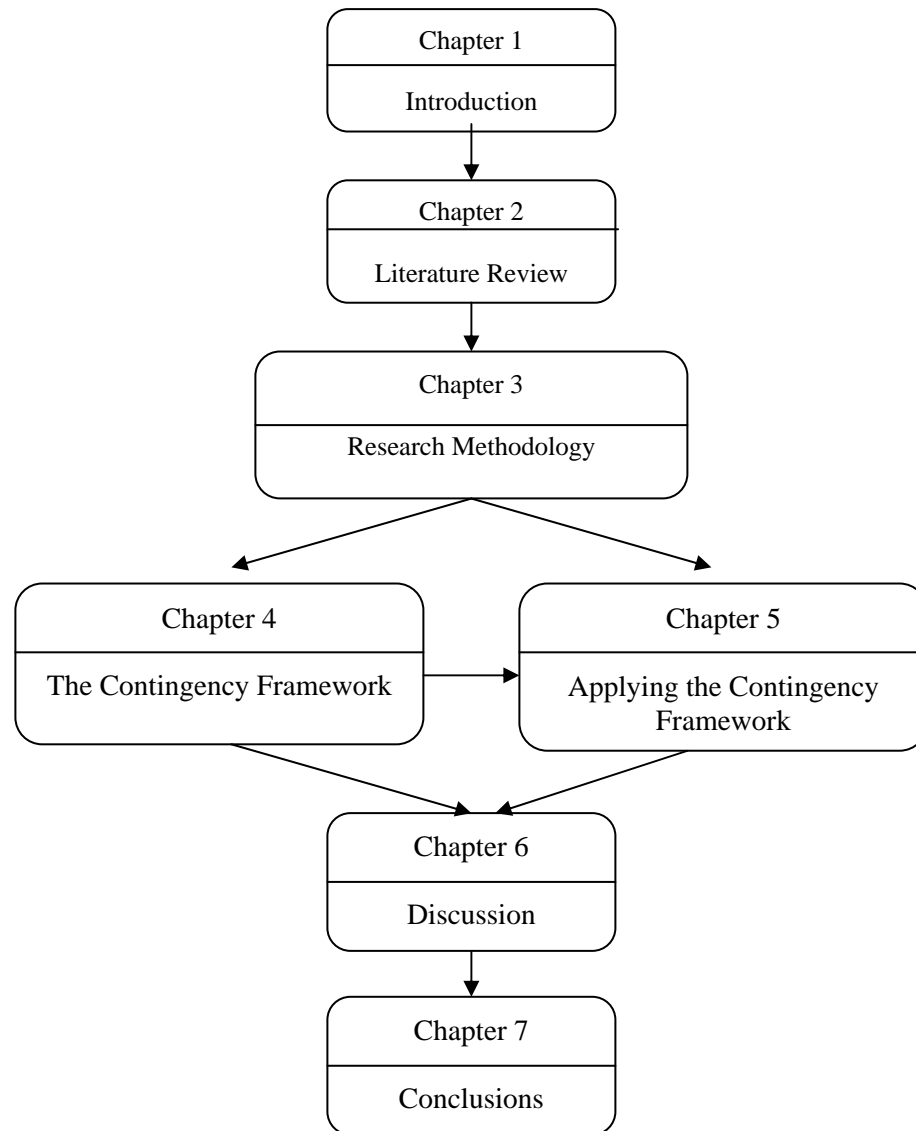


Figure 1.3: The layout of the chapters in the thesis.

1.11 Summary

This chapter has provided the foundation of the thesis. It has introduced the research problem and described the motivations for the research. The research methodology is also briefly described. A list of research contributions is also given. The organization of the thesis is also outlined.

REFERENCES

- Angerhofer, B.J. and Angelides, M.C. (2000). Systems Dynamics Modelling in Supply Chain Management: Research Review. *Proceedings of the 2000 Winter Simulation Conference*. 10-13 December, Wyndham Palace Resort and Spa, Disneyworld, Orlando, Florida, USA: ACM, 342-351.
- Archibald, G., Karabakal, N. and Karlsson, P. (1999). Supply chain vs supply chain: Using Simulation to Compete Beyond the Four Walls. *Proceedings of the 1999 Winter Simulation Conference*. 5-8 December, Phoenix, Arizona, USA: ACM, 1207-1214.
- Bäckstrand, J. and Säfssten, K. (2005). Review of Supply Chain Collaboration Levels and Types. *Proceedings of the International Conference on Operations and Supply Chain Management*. 15-17 December, Bali, Indonesia: Dept. of Industrial Eng. Sepuluh Nopember Institute of Technology, M15-M23.
- Bagchi, S., Buckley, S.J., Ettl, M. and Lin, G.Y. (1998). Experience Using the IBM Supply Chain Simulator. *Proceedings of the 1998 Winter Simulation Conference*. 13-16 December, Washington DC, USA: ACM, 1387-1394.
- Banks, J., Jain, S., Buckley, S. and Lendermann, P. (2002). Panel Session: Opportunities for Simulation in Supply Chain Management. *Proceedings of the 2002 Winter Simulation Conference*. 8-11 December, San Diego, CA, USA: ACM, 1652-1658.
- Beamon, B. (1998). Supply Chain Design and Analysis: Models and Methods. *Int. J. Production Economics*. 55 (1998): 281-294.
- Beamon, B. (1999). Measuring Supply Chain Performance. *International Journal of Operations & Production Management*. 19 (3): 275-292.

- Beamon, B. M. and Chen, V. C. P. (2001). Performance Analysis of Conjoined Supply Chains. *International Journal of Production Research*. 39 (14): 3195-3218.
- Bensaou, M. (1997). Inter organizational Cooperation: The Role of Information Technology, an Empirical Comparison of U.S. and Japanese Supplier Relations. *Information Systems Research*. 8 (2):107-124.
- Bensaou, M. (1999). Portfolios of Buyer-Supplier Relationships. *Sloan Management Review*.40 (4): 35-44.
- Berry, D., Towill, D. R. and Wadsley, N. (1994). Supply Chain Management in the Electronics Products Industry. *International Journal of Physical Distribution & Logistics Management*. 24 (10): 20-32.
- Bhaskaran, S. (1998). Simulation Analysis of a Manufacturing Supply Chain. *Decision Sciences*. 29 (3): 633- 657.
- Billington, C., Callioni, G., Crane, B. and Ruark, J.D. (2004). Accelerating the Profitability of Hewlett-Packard's Supply Chains. *Interfaces*. 34(1): 59-72.
- Bowman, B. (1998). IBM's new supply-chain simulator. *World Trade*. 11(2): 56-58.
- Brewer, P.C. and Speh, T.W. (2000). Using the Balanced Scorecard to Measure Supply Chain Performance. *Journal of Business Logistics*. 21(1): 75-93.
- Brown, R. G., (1963). *Smoothing, Forecasting and Prediction of Discrete Time Series*. Englewood Cliffs, N.J, USA: Prentice Hall.
- Burnes, B. (1996). No Such Thing as ...a "One Best Way" to Manage Organizational Change. *Management Decision*. 34 (10): 11-18.

- Catalan, M. and Kotzab, H. (2003). Assessing the Responsiveness in the Danish Mobile Phone Supply Chain. *International Journal of Physical Distribution & Logistics Management*. 33 (8): 668-685
- Chandra, C. and Kumar, S. (2000). Supply Chain Management in Theory and Practice: A Passing Fad or a Fundamental Change? *Industrial Management & Data Systems*. 100 (3): 100-114.
- Chang, Y. and Makatsoris, H. (2001). Supply Chain Modelling using Simulation. *Int. J. of Simulation*. 2(1): 24-30.
- Chase, R. B. and Zhang, A. (1998). Operations Management: Internationalization and Interdisciplinary Integration. *International Journal of Operations & Production Management*. 18 (7): 663-667.
- Childerhouse, P. and Towill, D. (2000). Engineering Supply Chains to Match Customer Requirements. *Logistics Information Management*. 13(6): 337-345.
- Chow, G., Heaver, T. D. and Henriksson, L. E. (1995). Strategy, Structure and Performance: A Framework for Logistics Research. *Logistics and Transportation Review*. 31 (4): 285- 308.
- Christiaanse, E. and Kumar, K. (2000). ICT-enabled Coordination of Dynamic Supply Webs. *International Journal of Physical Distribution & Logistics Management*. 30 (3/4): 268 – 285
- Christopher, M. (2000). *Logistics and Supply Chain Management*. Second Edition. First Indian Reprint. New Delhi, India: Pitman Publishing.

- Christopher, M. and Towill, D. R. (2000). Supply Chain Migration from lean and Functional to Agile and Customised. *Supply Chain Management: An International Journal*. 5(4): 206-213.
- Christy D. P. and Grout, J. R. (1994). Safeguarding Supply Chain Relationships. *Int. J. Production Economics*. 36 (1994): 233-242.
- Closs, D.J., Roath, A.S., Goldsby, T.J., Eckert, J.A. and Swartz, S.M. (1998). An Empirical Comparison of Anticipatory and Response-based Supply Chain Strategies. *International Journal of Logistics Management*. 9(2): 21-34.
- Cohen, M. A. and Lee, H. L. (1988). Strategic Analysis of Integrated Production-Distribution Systems: Models and Methods. *Operations Research*. 36 (2), March-April: 216-228.
- Cohen, M.A. (2000). Supply Chain Research in the Age of eBusiness. Invited speaker presentation at the 2000 NSF Design and Manufacturing Research Conference, 3-6 January. <http://www.engr.washington.edu/epp/nsf/overview/cohen.pdf>: 1-28.
- Cooper, M. C., Ellram, L. M., Gardner, J. T. and Hanks, A. M. (1997). Meshing Multiple Alliances. *Journal of Business Logistics*. 18 (1): 67-89.
- Corbett, C. J., Blackburn, J. D. and van Wassenhove, L. N. (1999). Case Study Partnerships to Improve Supply Chains. *Sloan Management Review*. Summer 1999: 71-82.
- Cox, A. (1999). Power, Value and Supply Chain Management. *Supply Chain Management: An International Journal*. 4 (4): 167-175.
- Cox, A. (2001a). The Power Perspective in Procurement and Supply Management. *Journal of Supply Chain Management*. 37 (2): 4- 7.

Cox, A. (2001b). Managing with Power: Strategies for Improving Value Appropriation from Supply Relationships. *Journal of Supply Chain Management*. 37 (2): 42-47.

Cox, A., Sanderson, J. and Watson, G. (2001). Supply Chains and Power Regimes: Toward an Analytic Framework for Managing Extended Networks of Buyer and Supplier Relationships. *Journal of Supply Chain Management*. 37(2): 28-35.

Croom, S., Romano, P. and Giannakis, M. (2000). Supply Chain Management: An Analytical Framework for Critical Literature Review. *European Journal of Purchasing & Supply Management*. 6 (2000): 67-83.

da Silveira, G.J.C. and Cagliano, R. (2006). The relationship between interorganizational information systems and operations performance. *International Journal of Operations and Production Management*. 26(3): 232-253.

Davis, T. (1993). Effective Supply Chain Management. *Sloan Management Review*. Summer 1993: 35-46.

Disney, S. M., Naim, M. M. and Towill, D. R. (1997). Dynamic Simulation Modelling for Lean Logistics. *International Journal of Physical Distribution & Logistics Management*. 27(3/4): 174-196.

Duclos, L.K., Vokurka, R.J. and Lummus, R.R. (2003). A Conceptual Model of Supply Chain Flexibility. *Industrial Management and Data Systems*. 103 (6):446-456.

Dutta, A. and Roy, R. (2003). Effects of Information Feedback Loops on Supply Chain Performance. *Proceedings of the 4th ACM Conference on Electronic Commerce*. Poster Session: 270-271.

- Ellram, L. M. (1991). Supply Chain Management The Industrial Organisation Perspective. *International Journal of Physical Distribution & Logistics Management*. 21 (1): 13-22.
- Erenguc, S. S., Simpson, N. C. and Vakharia, A. J. (1999). Integrated Production/ Distribution Planning in Supply Chains: An Invited Review. *European Journal of Operational Research*. 115 (1999): 219- 236.
- Ernst, R. and Kamrad, B. (2000). Evaluation of Supply Chain Structures through Modularization and Postponement. *European Journal of Operational Research*. 124(2000): 495-510.
- Filippini, R. (1997). Operations Management Research: Some Reflections on Evolution, Models and Empirical Studies in OM. *International Journal of Operations & Productions Management*. 17 (7): 655-670.
- Fisher, M. L. (1997). What is the Right Supply Chain for Your Product? *Harvard Business Review*. March-April 1997: 105-116.
- Franks, J. (2000). Supply Chain Innovation. *Work Study*. 49 (4): 152-155.
- Frohlich, M. T. and Westbrook, R. (2001). Arcs of Integration: An International Study of Supply Chain Strategies. *Journal of Operations Management*. 19 (2001): 185-200.
- Galbraith, J. (1977). *Organization Design*. Reading, Massachusetts, USA: Addison-Wesley.
- Ganeshan, R. and Harrison, T.P. (1995). An Introduction to Supply Chain Management. *Online Paper at http://lcm.csa.iisc.ernet.in/scm/supply_chain_intro.html*. 4 pages.

- Ganeshan, R. (1999). Managing Supply Chain Inventories: A Multiple Retailer, One Warehouse, Multiple Supplier Model. *Int. J. Production Economics*. 59 (1999): 341-354.
- Gavirneni, S. (2001). Benefits of co-operation in a production distribution environment. *European Journal of Operational Research*. 130 (2001): 612-622.
- Garg, A. (1999). An Application of Designing Products and Processes for Supply Chain Management. *IIE Transactions*. 31 (1999): 417-429.
- Giannoccaro, I. and Pontrandolfo, P. (2001). Models for Supply Chain Management: A Taxonomy. *Proceedings of the Twelfth Annual Conference of the Production and Operations Management Society, POM-2001*. March 30- April 2, Orlando, Florida USA, POMS: 1-16.
- Graves, S.C. and Willems, S.P. (2005). Optimizing the Supply Chain Configuration for New Products. *Management Science*. 51(8): 1165-1181.
- Griffiths, J., James, R., and Kempson, J. (2000). Focusing Customer Demand through Manufacturing Supply Chains by the Use of Customer Focused Cells: An Appraisal. *Int. J. Production Economics*. 2000: 111-120.
- Gules, H. K., Burgess, T. F. and Lynch, J. E. (1997). The Evolution of Buyer-Supplier Relationships in the Automotive Industries of Emerging European Economies: The case of Turkey. *European Journal of Purchasing & Supply Management*. 3 (4): 209-219.
- Hagelaar, G. J. L. F. and van der Vorst, J. G. A. J. (2002). Environmental Supply Chain Management: Using Life Cycle Assessment to Structure Supply Chains. *International Food and Agribusiness Management Review*. 4:399-412.

- Hammant, J., Disney, S. M., Childerhouse, P. and Naim, M. M. (1999). Modelling the Consequences of a Strategic Supply Chain Initiative of an Automotive Aftermarket Operation. *International Journal of Physical Distribution & Logistics Management*. 29 (9): 535-550.
- Harland, C. (1997). Supply Chain Operational Performance Roles. *Integrated Manufacturing Systems*. 8 (2): 70-78.
- Hieta, S. (1998). Supply chain simulation with LOGSIM-SIMULATOR. *Proceedings of the 1998 Winter Simulation Conference*. 13-16 December, Washington DC, USA: ACM, 323-326.
- Hines, P., Lamming, R., Jones, D. and Rich, N. (2000). *Value Stream Management Strategy and Excellence in the Supply Chain*. Great Britain: Prentice Hall.
- Hogarth, R.M. and Makridakis, S., (1981). Forecasting and Planning : An Evaluation. *Management Science*. 49 (2): 115-131.
- Hoyt, J. and Huq, F. (2000). From Arms-Length to Collaborative Relationships in the Supply Chain an Evolutionary Process. *International Journal of Physical Distribution & Logistics Management*. 30 (9): 750-764.
- Ingalls, R.G. (1998). The Value of Simulation in Modeling Supply Chains. *Proceedings of the 1998 Winter Simulation Conference*. 13-16 December, Washington DC, USA: ACM, 1371-1375.
- Ingalls, R.G. and Kasales, C. (1999). CSCAT: The COMPAQ Supply Chain Analysis tool. *Proceedings of the 1999 Winter Simulation Conference*. 5-8 December, Phoenix, Arizona, USA: ACM, 1201-1206.

- Jain, S., Lim, C. C., Gan, B.P. and Low, Y.H. (1999). Criticality of Detailed Modeling in Semiconductor Supply Chain Simulation. *Proceedings of the 1999 Winter Simulation Conference*. 5-8 December, Phoenix, Arizona, USA: ACM, 888-896.
- Jain, S., Collins, L.M., Workman, R.W. and Ervin, E.C. (2001). Development of a High Level Supply Chain Simulation Model. *Proceedings of the 2001 Winter Simulation Conference*. 9-12 December, Arlington, VA, USA: IEEE, 1129-1137.
- Johnsen, R. E. and Ford, D. (2001). Asymmetrical and Symmetrical Customer-Supplier Relationships: A Typology. *Proceedings of the 10th Annual IPSERA Conference 2001*. 8-11 April, Jonkoping, Sweden: 497-508.
- Jordan, E. and Tricker, B. (1995). Information Strategy: Alignment with Organizational Structure. *Journal of Strategic Information Systems*.4 (4): 357-382
- Kahn, K.B. (1996). Interdepartmental Integration: A Definition with Implications for Product Development Performance. *J. Prod. Innov. Management*. 13: 137-151.
- [Kaplan, R. S.](#) and [Norton, D.P. \(1992\).](#) The Balanced Scorecard - Measures that Drive Performance. [Harvard Business Review](#). 70(1): 71- 79.
- Kelton, W. D., Sadowski, R. P and Sadowski, D. A. (2002). *Simulation with Arena*. Second Edition. New York, USA.: McGraw-Hill.
- Kim, K.K and Umanath, N. S. (1999). An Empirical Investigation of Electronic Integration in a Supply Channel Relationship. *Proceedings of the 20th International Conference on Information Systems*. Charlotte, North Carolina, United States. ACM: 546 - 551
- Kim, B. (2000). Coordinating an Innovation in Supply Chain Management. *European Journal of Operational Research*. 123 (2000): 568-584.

- Kraft, K. L., Puia, G. M. and Hage, J. (1995). Structural Contingency Theory Revisited: Main Effects versus Interactions in Child's National Study of Manufacturing and Service Sectors. *Canadian Journal of Administrative Science*. 12(3): 182- 194.
- Kumar, K. and Christiaanse, E. (1999). From Static Supply Chains to Dynamic Supply Webs: Principles for Radical Redesign in the Age of Information. *Proceedings of the 20th International Conference on Information Systems*. Charlotte, North Carolina, United States: ACM, 300-306
- Lambert, D. M., Cooper, M. C. and Pagh, J. D. (1998). Supply Chain Management: Implementation Issues and Research Opportunities. *International Journal of Logistics Management*. 9 (2): 1-19.
- Lambert, D.M., Knemeyer, A.M. and Gardner, J.T. (2004). Supply Chain Partnerships: Model Validation and Implementation. *Journal of Business Logistics*. 25(2):21-42.
- Lamming, R. (2000). Japanese Supply Chain Relationships in Recession. *Long Range Planning*. 33 (2000): 757-778.
- Lamming, R., Johnsen, T., Zheng, J. and Harland, C. (2000). An Initial Classification of Supply Networks. *International Journal of Operations and Production Management*. 20 (6): 675-691.
- Law ,A.M. and Kelton, W.D. (1991). *Simulation Modeling and Analysis*. Second Edition. Singapore: McGraw-Hill International Editions, Industrial Engineering Series.
- Lawrence, P. R. and Lorsch, J. W. (1969). *Organization and Environment*. Homewood, Illinois, USA: Richard D. Irwin, Inc.

- Lee, H. L. and Billington, C. (1992). Managing Supply Chain Inventory: Pitfalls and Opportunities. *Sloan Management Review*. Spring 1992: 65-73.
- Lee, H. L. and Whang, S. (2000). Information Sharing in a Supply Chain. *Int. J. Manufacturing Technology*. 1 (1): 79-93.
- Lewis, M.W. (1998). Iterative Triangulation: A Theory Development Process Using Existing Case Studies. *Journal of Operations Management*. 16 (1998): 455-469.
- Lewis, I. and Talalayevsky, A. (2004). Improving the Interorganizational Supply Chain through Optimization of Information Flows. *The Journal of Enterprise Information Management*. 17 (3): 229-237.
- Li, D. and O'Brien, C. (1999). Integrated Decision Modelling of Supply Chain Efficiency. *Int. J. Production Economics*. 59 (1999): 147-157.
- Lumms, R. R. and Vokurka, R. J. (1999). Defining Supply Chain Management: A Historical Perspective and Practical Guidelines. *Industrial Management and Data Systems*. 99 (1): 11-17.
- Maloni, M. J. and Benton, W. C. (1997). Supply Chain Partnerships: Opportunities for Operations Research. *European Journal of Operational Research*. 101(1997): 419-429.
- Maloni, M. and Benton, W.C. (2000). Power Influences in the Supply Chain. *Journal of Business Logistics*. 21 (1): 49-73.
- Maruta, T., Yoshitomo, I., Komoda, N. (1999). Simulation Tool of Supply Chain Model with Various Structure and Decision Making Processes. *Proceedings of the 1999 IEEE Conference on Emerging Technologies and Factory Automation (EFTA'99)*. 18-21 Oct. Barcelona, Spain: IEEE, 1443-1449.

- Masella, C. and Rangone, A. (2000). A Contingent Approach to the design of Vendor Selection Systems for Different Types of Co-operative Customer/Supplier Relationships. *International Journal of Operations & Production Management*. 20 (1): 70-84.
- McIvor, R. Humphreys, P. and McCurry, L. (2003). Electronic Commerce: Supporting Collaboration in the Supply Chain? *Journal of Materials Processing Technology*. 139 (2003): 147–152
- Melnyk, S.A. and Swink, M.A. (2001). Value Driven Operations Management: An Integrated Modular Approach.
<http://coursesbus.msu.edu/materials/1006/readings/supply-chain-final.pdf>. 1/2/2002: 1-50.
- Meredith, J. (1993). Theory Building Through Conceptual Methods. *International Journal of Operations and Production Management*. 13 (5): 3-11.
- Meredith, J. (1998). Building Operations Management Theory Through Case and Field Research. *Journal of Operations Management*. 16 (1998):441-454.
- Merkuryev, Y.A., Petuhova, J.J., Van Landegham, R. and Vansteenkiste, S. (2002). Simulation-based Analysis of the Bullwhip Effect under Different Information Sharing Strategies. *Proceedings of the 14th European Simulation Symposium*. 23-26 Oct., Dresden, Germany: SCS-Europe BVBA, 294-299.
- Mintzberg (1979). *The Structuring of Organizations*. New York, NY, USA: Prentice-Hall.
- Mitra, K. (1997). Postponement and Speculation in Exchange Relationships: A transaction cost Approach. Online paper at
<http://www.sbaer.ucs.edu/Research/1997/SMA/97sma018.txt> 09/08/02

- Moon, Seong-Am. (2004). The Relationships among Manufacturer Product Strategy, Supply Chain Structure and Supply Chain Inventory. *Asia Pacific Journal of Marketing and Logistics*. 16 (2): 20-45
- Morgan, J. (1997). Integrated Supply Chains, How to Make Them Work. *Purchasing*. May 22, 1997: 32-37.
- Morgan, C. (2004). Structure, Speed and Salience: Performance Measurement in the Supply Chain. *Business Process Management Journal*. 10 (5): 522-536
- Morash, E. A. and Clinton, S. R. (1997). The Role of Transportation Capabilities in International Supply Chain Management. *Transportation Journal*. 36 (3): 5-17.
- Mudambi, R. and Helper, S. (1998). The 'Close but Adversarial' Model of Supplier Relations in the U. S. Auto Industry. *Strategic Management Journal*. 19: 775-792.
- Munson, C.L., Rosenblatt, C. L. and Rosenblatt, Z. (2000). The Use and Abuse of Power in Supply Chains. *IEEE Engineering Management Review*. 28 (2): 81-91.
- Neely, A., Gregory, M. and Platts, K. (1995). Performance Measurement System Design A Literature Review and Research Agenda. *International Journal of Operations & Production Management*. 15 (4): 80-116.
- New, S. J. (1997). The Scope of Supply Chain Management Research. *Supply Chain Management*. 2 (1): 15-22.
- New, S. J. (1996). A Framework for Analysing Supply Chain Improvement. *International Journal of Operations & Production Management*. 16 (4): 19-34.

- Olsen, R. F. and Ellram, L. M. (1997). Buyer-Supplier Relationships: Alternative Research Approaches. *European Journal of Purchasing and Supply Management*. 3 (4): 221-231.
- Pagh, J. D. and Cooper, M. C. (1998). Supply Chain Postponement and Speculation Strategies: How to Choose the Right Strategies. *Journal of Business Logistics*. 19 (2): 13- 33.
- Pannirselvam, G. P., Ferguson, L. A., Ash, R. C. and Siferd, S. P. (1999). Operations Management Research: An Update for the 1990s. *Journal of Operations Management*. 18 (1999): 95-112.
- Patterson, J. L., Forker, L. B. and Hanna, J. B. (1999). Supply Chain Consortia: The Rise of Transcendental Buyer-Supplier Relationships. *European Journal of Purchasing and Supply Management*. 5 (1999) : 85-93.
- Petrovic, D., Roy, R. and Petrovic, R. (1998). Modelling and Simulation of a Supply Chain in an Uncertain Environment. *European Journal of Operational Research*. 109 (1998): 299-309.
- Petrovic, D., Roy, R. and Petrovic, R. (1999). Supply Chain Modelling Using Fuzzy Sets. *Int. J. Production Economics*. 59 (1999): 443-453.
- Petrovic, D. (2001). Simulation of Supply Chain Behaviour and Performance in an Uncertain Environment. *Int. J. Production Economics*. 71 (2001): 429-438.
- Phillips, J. M., Liu, B. S. and Costello, T. G. (1998). A Balance Theory Perspective of Triadic Supply Chain Relationships. *Journal of Marketing Theory and Practice*. 6(4): 78-91.

- Pilling, B.K. and Zhang,L. (1992). Cooperative Exchange: Rewards and Risks. *International Journal of Purchasing and Materials Management*. Spring 1992: 2-9.
- Rali Mohd Nor. (2001). Supplier Development in the Malaysian Automotive Industry: Current Practices, Outcomes and Issues. NPC Online Publications: 1-29.
- Sabri, E. H. and Beamon, B. M. (2000). A Multi-Objective Approach to Simultaneous Strategic and Operational Planning in Supply Chain Design. *Omega*. 28 (2000): 581-598.
- Sadowski, D. and Bapat, V. (1999). The ARENA Product Family: Enterprise Modeling Solutions. *Proceedings of the 1999 Winter Simulation Conference*. 5-8 December, Phoenix, Arizona, USA: ACM, 159-166.
- Sahay, B.S. (2003). Understanding Trust in Supply Chain Relationships. *Industrial Management and Data Systems*. 103 (8): 553-563
- Sargent, R. G. (1998). Verification and Validation of Simulation Models. *Proceedings of the 1998 Winter Simulation Conference*. 13-16 December, Washington DC, USA: IEEE, 121-130.
- Scott,C. and Westbrook,R. (1991). New Strategic Tools for Supply Chain Management. *International Journal of Physical Distribution & Logistics Management*. 21 (1): 23-33.
- Schmenner, R. W. and Swink, M. L. (1998). On Theory in Operations Management. *Journal of Operations Management*. 17 (1998): 97-113.
- Shah, R., Goldstein, S.M. and Ward, P.T. (2002). Aligning Supply Chain Management Characteristics and Interorganizational Information System Types: An Exploratory Study. *IEEE Transactions on Engineering Management*. 49 (3): 282-292

- Simpson, M., Sykes, G. and Abdullah, A. (1998). Case Study: Transitory JIT at Proton Cars, Malaysia. *International Journal of Physical Distribution & Logistics Management*. 28 (2): 121-142.
- Spekman, R. E., Kamauff Jr., J. W and Myhr, N. (1998). An Empirical Investigation into Supply Chain Management, a Perspective on Partnerships. *International Journal of Physical Distribution & Logistics Management*. 28 (8): 630-650.
- Stevens, G. C. (1989). Integrating the Supply Chain. *International J. of Physical Distribution and Material Management*. 19 (8): 3-8.
- Stewart, G. (1995). Supply Chain Performance Benchmarking Study Reveals Keys to Supply Chain Excellence. *Logistics Information Management*. 8(2): 38-44.
- Stock, G.N., Greis, N.P. and Kasarda, J.D. (1998). Logistics, Strategy and Structure, a Conceptual Framework. *International Journal of Operations & Production Management*. 18 (1): 37-52.
- Stock, G.N., Greis, N.P. and Kasarda, J.D. (2000). Enterprise Logistics and Supply Chain Structure: The Role of Fit. *Journal of Operations Management*. 18 (2000): 531-547.
- Stonebraker, P.W. and Afifi, R. (2004). Toward a Contingency Theory of Supply Chains. *Management Decision*. 42(9): 1131-1144.
- Tang, J. E., Shee, D. Y. and Tang, T. (2001). A Conceptual Model for Interactive Buyer-Supplier Relationship in Electronic Commerce. *International Journal of Information Management*. 21 (2001): 49-68.
- Thomas, D. J. and Griffin, P. M. (1996). Coordinated Supply Chain Management. *European Journal of Operational Research*. 94 (1996): 1-15.

- Thonemann, U. W. and Bradley, J. R. (2002). The Effect of Product Variety on Supply-Chain Performance. *European Journal of Operational Research*. 143 (3): 548-569.
- Towill, D. R., Naim, M. M. and Wikner, J. (1992). Industrial Dynamics Simulation Models in the Design of Supply Chains. *International Journal of Physical Distribution and Logistics Management*. 22 (5): 3-13.
- Towill, D. R. (1996). Industrial Dynamics Modelling of Supply Chains. *International Journal of Physical Distribution & Logistics Management*. 26 (2): 23-42.
- Towill, D. R. (2000). A Route Map for Substantially Improving Supply Chain Dynamics. *Int. J. Manufacturing Technology and Management*. 1(1): 94-112.
- Trienekens, J. H. and Beulens, A. J. M. (2001). Views on Inter-Enterprise Relationships. *Production Planning and Control*. 12 (5): 466-477.
- van Hoek, R. I. (1998). "Measuring the Unmeasurable" – Measuring and Improving Performance in the Supply Chain. *Supply Chain Management*. 3 (4): 187-192.
- van Hoek, R. I. (2001). The rediscovery of Postponement a literature review and directions for research. *Journal of Operations Management*. 19 (2001): 161-184
- van der Vorst, J.G.A.J. (2000). Effective food supply chains; generating, modeling and evaluating supply chain scenarios. PhD Thesis, Wageningen University, The Netherlands.
- van der Vorst, J.G.A.J., Beulens, A.J.M., De Wit, W. and Van Beek, P. (1998). Supply Chain Management in Food Chains: Improving Performance by Reducing Uncertainty. *Int. Trans. Operational Research*. 5 (6): 487-499.

- van der Vorst, J.G.A.J., Beulens, A.J.M. and Van Beek, P. (2000). Modeling and Simulating Multi-Echelon Food Systems. *European Journal of Operational Research* 122(2000): 354-366.
- van der Zee, D.J. and Van der Vorst, J.G.A.J. (2005). A Modelling Framework for Supply Chain Simulation: Opportunities for Improved Decision Making. *Decision Sciences*. 36(1): 65-96.
- van der Vorst, J.G.A.J., Tromp, S. and van der Zee, D.J. (2005). A Simulation Environment for the Redesign of Food Supply Chain Networks: Modeling Quality Controlled Logistics. *Proceedings of the 2005 Winter Simulation Conference*. December 4-7, 2005. Orlando, FL, USA: IEEE, 1658-1667.
- Vickery, S., Calantone, R. and Droge, C. (1999a). Supply Chain Flexibility: An Empirical Study. *The Journal of Supply Chain Management*. Summer 1999: 16-24.
- Vickery, S., Droge, C. and Germain, R. (1999b). The Relationship between Product Customization and Organization Structure. *Journal of Operations Management*. 17 (1999): 377-391.
- Wacker, J.G. (1998). A Definition of Theory: Research Guidelines for Different Theory-Building Research Methods in Operations Management. *Journal of Operations Management*. 16 (1998). 361-385.
- Welty, B. and Becerra-Fernandez, I. (2001). Managing trust and commitment in collaborative supply chain relationships. *Communications of the ACM*. 44 (6):67-73
- Wikner, J., Towill, D.R. and Naim, M. (1991). Smoothing Supply Chain Dynamics. *International Journal of Production Economics*. 22 (3): 231-248.

- Wyland, B., Buxton, K. and Fuqua, B. (2000). Simulating the Supply Chain. *IIE Solutions*. 32 (1): 37-42.
- Wu, Z. and Choi, T.Y. (2005). Supplier-supplier Relationships in the Buyer-Supplier Triad: Building Theories from Eight Case Studies. *Journal of Operations Management*. 24 (1): 27-52.
- Xu, K., Dong, Y. and Evers, P. T. (2001). Towards Better Coordination of the Supply Chain. *Transportation Research Part E*. 37 (2001): 35-54.
- Yu, Z., Yan, H. and Cheng, E. T. C. (2001). Benefits of Information Sharing with Supply Chain Partnerships. *Industrial Management & Data Systems*. 101 (3): 114-119.
- Ziggers, G. W. and Trienekens, J. (1999). Quality Assurance in Food and Agribusiness Supply Chains: Developing Successful Partnerships. *Int. J. Production Economics*. 60-61 (1999): 271-279.