

**THE IMPACT OF BUILD-TO-ORDER SUPPLY CHAIN ON THE  
ENERGY EFFICIENCY AND LOW CARBON FOOTPRINT:  
MEDIATING EFFECT OF SUPPLY CHAIN RESPONSIVENESS**

**ARKYADEEP CHOWDHURY**

**Research report in partial fulfilment of the requirements for the**

**Degree of Master of Business Administration**

**Universiti Sains Malaysia**

**2014**

## **ACKNOWLEDGEMENT**

I would like to start off by acknowledging the person who has played the most crucial part in this paper namely my supervisor, Dr. Yudi Fernando. This paper would not have been possible without his incessant guidance, help and support. His constant informed and knowledgeable assistance has paved the path for this research. We were able to produce this research paper with ease owing to his constant help and push. Thus I would like to extend my sincere gratitude to him for being the backbone of this entire research paper and without his help this paper would not have been a success.

I would also like to thank my friends, colleagues and my respected professors for aiding me with their valuable feedback and helping me in any way possible without the blink of an eye. Thus I would like to thank them for their help and support and their ever so supportive word of encouragement.

I would also like to give my warmest regards to the respondents who have contributed to this research as this paper would not have been successful without their valued opinion. They have played a key role in this research paper and I would like to pass my sincere gratitude to them.

Lastly I would like to thank my ever so supporting and encouraging parents for their constant show of support and for the words of encouragement which makes even the tough days that much easier to tackle.

## TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENT.....	ii
TABLE OF CONTENTS.....	iii
LIST OF TABLES.....	vi
LIST OF FIGURES.....	viii
ABSTRAK.....	ix
ABSTRACT.....	x
CHAPTER 1 INTRODUCTION.....	1
1.0 Introduction.....	1
1.1 Background of the Study.....	1
1.2 Problem Statement.....	5
1.3 Research Questions.....	10
1.4 Research Objectives.....	10
1.5 Research Scope.....	11
1.6 Significance of the Study.....	12
1.7 Definition of Key Terms.....	17
1.8 Structure of the Remaining Chapters.....	19
CHAPTER 2 LITERATURE REVIEW.....	21
2.0 Introduction.....	21
2.1 Overview of Manufacturing Industry in Malaysia.....	21
2.2 Supply Chain Management (SCM).....	24
2.3 Manufacturing Supply Chain.....	25
2.4 Build-To-Order Supply Chains (BTSC).....	27
2.5 Supply Chain Responsiveness (SCR).....	35
2.6 Review of Relevant Theory.....	40
2.7 Literature Review of Variables.....	46
2.8 Theoretical Framework.....	60

2.9 Hypothesis Development.....	62
2.10 Summary.....	72
<b>CHAPTER 3 METHODOLOGY.....</b>	<b>74</b>
3.0 Introduction.....	74
3.1 Research Design.....	74
3.2 Data Collection Method.....	77
3.3 Survey Instrument.....	78
3.4 Questionnaire Design.....	80
3.5 Independent Variable.....	81
3.6 Mediating Variable.....	84
3.7 Dependent Variables.....	87
3.8 Pilot Study.....	89
3.9 Data Analysis.....	90
3.10 Summary.....	98
<b>CHAPTER 4 RESULTS.....</b>	<b>99</b>
4.0 Introduction.....	99
4.1 Response Rate.....	99
4.2 Descriptive Analysis.....	100
4.3 Construct Validity.....	112
4.4 Reliability.....	123
4.5 Common Method Bias.....	124
4.6 Hypothesis Testing.....	127
4.7 Mediating Effect: Supply Chain Responsiveness (SCR).....	139
4.8 Stone-Geisser's ( $Q^2$ ).....	141
4.9 Analysis of Goodness of Fit.....	143
4.10 Control Variables.....	144
4.11 Summary.....	145
<b>CHAPTER 5 DISCUSSIONS AND CONCLUSIONS.....</b>	<b>149</b>
5.0 Introduction.....	149
5.1 Recapitulation of the Study Findings.....	149
5.2 Discussion.....	152

5.3 Implications.....	164
5.4 Limitations.....	168
5.5 Future Research.....	169
5.6 Conclusion.....	171
REFERENCES.....	175
APPENDIX A – QUESTIONNAIRE.....	193
APPENDIX B – PLS ALGORITHM REPORT.....	205
APPENDIX C – PLS BOOTSTRAPPING REPORT.....	208
APPENDIX D – PLS BLINDFOLDING REPORT.....	212
APPENDIX E – IBM SPSS STATISTICS REPORT.....	213

## LIST OF TABLES

	Page	
Table 3.1	List of sectors covered in the population	77
Table 3.2	Summary of the Questionnaire's Sections	79
Table 3.3	Sources of the independent variable	81
Table 3.4	Sources of the mediator variable	85
Table 3.5	Sources of the dependent variable	87
Table 3.6	Cronbach's alpha values of variables	90
Table 4.1	Organization Profile	105
Table 4.2	Respondent's Profiles	111
Table 4.3	Factor Loadings and Cross Loadings	113
Table 4.4	Result of Measurement Model	115
Table 4.5	Summary Result of the Model Construct	117
Table 4.6	Discriminant Validity of the Constructs	119
Table 4.7	Result of Reliability	123
Table 4.8	Total Variance Explained	124
Table 4.9	Path Coefficients and Hypothesis Testing for the Independent Variables and the Mediating Variables	127
Table 4.10	Path Coefficients and Hypothesis Testing for the Mediating Variables and the Dependent Variables	132
Table 4.11	Path Coefficients and Hypothesis Testing for the Independent Variables and the Dependent Variables	135
Table 4.12	t-values for Different Relationships	140

Table 4.13	Summary of Cross Validated Redundancy	141
Table 4.14	Path Coefficients and t-values for Control Variables	144
Table 4.15	Summary of Hypothesis Testing	145
Table 4.16	Summary of Hypothesis Testing for Mediator	147



## LIST OF FIGURES

	Page
Figure 2.1 The conceptual decision model for BTSC	31
Figure 2.2 Differences between traditional and BTO supply chains	32
Figure 2.3 Relationship between flexibility and responsiveness	39
Figure 2.4 Theoretical Framework	61
Figure 4.1 PLS Model	120
Figure 4.2 PLS Model with Loadings	121
Figure 4.3 PLS Model after Removing Items showing Loadings	122
Figure 4.4 PLS Model after Bootstrapping	138
Figure 4.5 PLS Model for $Q^2$	142

## ABSTRAK

Kepentingan menggabungkan praktis 'energy efficiency' dan 'low carbon footprint' di Malaysia adalah suatu topik yang sering dibincangkan. Pelaksanaan 'build to order supply chain management' adalah Amat penting untuk mencapai tahap energy efficient Dan low carbon footprint. Pembentangan ini bertujuan untuk mengkaji kesan build to order supply chain atas aktiviti yang terlibat dengan energy efficiency Dan low carbon footprint. Supply chain responsiveness digunakan sebagai pembolehubah mediator dalam perbincangan ini. Selepas mengkaji Kertas kerja yang dibentangkan sebelum ini, komponen build to order supply chain ditetapkan sebagai production systems, process modularity, supplier integration Dan IT/IS integration untuk Pembentangan ini. Untuk supply chain responsiveness, komponennya terdiri daripada operations systems responsiveness, logistics process responsiveness Dan supplier network responsiveness. Rangka kerja Pembentangan ini dianalisis menggunakan PLS. Teori Asas yang digunakan untuk menyokong Pembentangan ini adalah knowledge based theory. Penelitian diedarkan kepada 152 organisasi di Malaysia yang berurusan dalam bidang pengilangan Dan pemrosesan, manufacturing. Organisasi ini juga mesti mengamalkan build to order supply chain dalam operasi mereka. Keputusan yang diperoleh daripada analisis yang dilaksanakan menunjukkan bahawa IT/IS integration adalah komponen build to order yang paling penting. Ini Kerana komponen ini menunjukkan kesan yang paling penting ke atas pembolehubah mediating dan dependent. Logistics process responsiveness dan supplier network responsiveness adalah dua komponen paling penting untuk supply chain responsiveness Kerana dua komponen itu menunjukkan kesan yang penting ke atas pembolehubah dependent. Memandangkan batasan yang dihadapi, Pembentangan ini menyediakan practitioners dengan pedoman untuk memperbaiki inisiatif 'energy efficiency Dan low carbon footprint yang diadakan. Pembentangan ini berakhir dengan rekomendasi untuk kajian dalam topik ini untuk masa Depan.

## **ABSTRACT**

The importance of incorporating Energy Efficient and Low Carbon Footprint practices in Malaysia is a topic which cannot be neglected. The implementation of Build-To-Order Supply Chain Management is of vital importance in order to achieve the Energy Efficient and Low Carbon Footprint standards. This study was developed in order to test the impact of Build-To-Order Supply Chain on the Energy Efficiency and the Low Carbon Footprint initiatives taking Supply Chain Responsiveness as the mediating variable for this study. After careful study on the literature and previous work, the driver of Build-To-Order Supply Chain were taken to be as Production Systems, Process Modularity, Supplier Integration and IT/ IS Integration in this study. Similarly, the drivers of Supply Chain Responsiveness are Operations System Responsiveness, Logistics Process Responsiveness and Supplier Network Responsiveness. This framework was tested using the Partial Least Squares Structural Equation Modelling (PLS – SEM). The major theory used to guide and support this framework is the knowledge-based theory. This study was aided by conducting a survey on 152 organizations in Malaysia which were strictly from the manufacturing industry. It was also essential to this study that these organizations had already adopted the Build-To-Order Supply Chain in their operations. The results obtained after testing the raw data inferred that IT/ IS Integration was the most significant driver amongst the other drivers of Build-To-Order Supply Chain as it had the most significant effect on the mediating and the dependent variables. Logistics Process Responsiveness and the Supplier Network Responsiveness were the most important drivers of the Supply Chain Responsiveness in having a significant effect on the dependent variables. Considering the limitations in this study, this study manages to provide the practitioners with the important guidelines in order for them to improve their Energy Efficiency and Low Carbon Footprint initiatives. This study concludes with some future recommendations for research in this area.

## LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
BTO	Build-To-Order
BTSC	Build-To-Order Supply Chain
BTSCM	Build-To-Order Supply Chain Management
CFA	Common Factor Analysis
CTO	Configure To Order
CTS	Carbon Trust Standard
EE	Energy Efficiency
EMAS	The Eco-Management and Audit Scheme
EPC	Electronic Product Codes
ERP	Enterprise Resource Planning
FSC	Forest Stewardship Council
ITI	IT/ IS Integration
KBV	Knowledge-Based View
KM	Knowledge Management
LCF	Low Carbon Footprint
LPR	Logistics Process Responsiveness
MATRADE	Malaysian External Trade Development Corporation
MOO	Multi-Objective Optimization
MTS	Made To Stock
OSR	Operations System Responsiveness
PLS	Partial Least Squares
PM	Process Modularity
PS	Production Systems
RBV	Resource-Based View
RFID	Radio Frequency Identification
SC	Supply Chain
SCC	Supply Chain Collaboration
SCM	Supply Chain Management
SCR	Supply Chain Responsiveness
SEM	Structural Equation Modelling
SI	Supplier Integration
SNR	Supplier Network Responsiveness
TCT	Transaction Cost Theory
TSCM	Traditional Supply Chain Management
WCM	World Class Manufacturing

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.0 Introduction**

In this chapter, a brief overview of the entire chapter will be first presented. This study will first look at the background of the research study which will be followed by the problem statement. The focus of the study then shifts to the research questions and the research objectives. That will be followed by the scope of the study and then followed by the significance of the study in terms of the theoretical, practical as well as the social implications. This chapter is concluded by the definition of the key terms and a summary of the chapter to follow. Thus this chapter will provide an overall overview of the paper.

#### **1.1 Background of the Study**

This study focuses on the impact of the build-to-order supply chain (BTSC) on the energy efficiency as well as the low carbon footprint of an organization. It is noteworthy to mention that this study uses Supply Chain Responsiveness (SCR) as the mediating variable. Build-To-Order can be described as the capability of an organization to build customized products within a short period of time upon the receipt of spontaneous orders. This is done without any forecasts, inventory or the delay in the purchasing (Gunasekaran & Ngai, 2005). Post this the products are directly shipped to the individual customers or to the retail stores and dealers. It may also be a response to the assemblers “pull signal” which is the signal necessitating

the need for the parts for the purpose of assembly. The suppliers on the other hand may use Build-To-Order in order to respond to the pull signals which are the main element when it comes to the manufacturing.

In today's environment, the supply chains are increasingly moving towards a Build-To-Order (BTO) environment as opposed to a Made to Stock (MTS) in order to gain competitive advantage. In the BTO environments, products and delivery times are closely tied to customer specifications with a corresponding reduction in finished goods inventory holding costs (Prasad, Tatab, & Madan, 2005). The supply chain integrates the suppliers' suppliers to the customers' customers. The cooperation and collaboration of upstream and downstream entities allows chain partners to run the most cost-effective operation, and in the meantime it can quickly respond to the variety of consumer demands (Lin & Wang, 2011). To gain such an advantage is not easy. BTO supply chains tend to be much more complicated to manage (Easton and Moodie, 1999) given the limited levels of stocks within the network and shorter lead-times. Ensuring responsiveness to customer needs requires product, process and volume flexibility across the entire value chain (Holweg and Pil, 2001). Building to order enables manufacturers to better respond to the market conditions. The time lost between changes in customer preferences and product-mix disappears, and customer demand can be both anticipated and shaped by the sales system (Gunasekaran & Ngai, 2009). BTO strategy has the purpose and objective of providing custom-made (often modularized) products on a mass-scale. The strategy coordinates and integrates a variety of related processes and systems to accomplish this objective. These typically include order customization, customized/ modular production, and expedited delivery (Christensena, Germainb, & Birou, 2005).

Firms in the twenty-first century are grappling with a constantly changing world. Three supply chain trends in particular are converging to create an increasingly complex business environment: a move towards green initiatives, the utilization of lean processes, and globalization (Stolze, Tate and Ueltschy, 2009). In this study we have focused on the move of the supply chain trends towards green initiatives along with energy efficiency initiatives. Green supply chain strategies refer to efforts to minimize the negative impact of firms and their supply chains on the natural environment. In the wake of concerns regarding climate change, pollution, and non-renewable resource constraints, firms are heeding stakeholder demands regarding corporate citizenship behaviour and performance (Sarkis, 2001). A green supply chain focus requires working with suppliers and customers, analysis of internal operations and processes, environmental considerations in the product development process, and extended stewardship across products' life-cycles (Corbett and Klassen, 2006).

Supply chain management is recognized as a major element of competitive strategy to enhance the productivity as well as the profitability of an organization (Gunasekaran, Patel, & McGaughey, 2004), the initiatives in implementing energy efficiency within an organization is also able to ensure sustainability of a business and assist in increasing both the financial as well as the operational performance. Energy efficiency is playing an important role in achieving the goals of sustainable development in Malaysia as it had been recognized by Malaysia many years ago (Asia-Pacific Economic Cooperation [APEC], 2011). The government of Malaysia is actively promoting and improving energy efficiency at both the supply as well as the demand side as it has been recognized as one of the conditions to ensure

sustainability of energy supplies since the 7th Malaysian Plan (1996-2000), and industrial, commercial and residential are encouraged to implement energy efficiency initiatives as part of helping in reducing overall global warming (Tan, Suhaida & Leong, 2011). Thus energy efficiency is a key variable in our study and we check the impact of the build-to-order supply chain on the energy efficiency.

The other important variable in this study is the low carbon footprint. There is growing consensus that carbon emission (emissions of carbon dioxide and other greenhouse gases), if left unchecked will lead to major changes in the earth's climate system. Governments are under growing pressure to enact legislation to curb the amount of these emissions (Benjafaar et al., 2013). Firms worldwide, responding to the threat of such legislation or to concerns raised by their own consumers or shareholders, are undertaking initiatives to reduce their carbon footprint. However, these initiatives have focused for the most part on reducing emissions due to the physical processes involved. For example, firms are replacing energy inefficient equipment and facilities, redesigning products and packaging, finding less polluting sources of energy, or instituting energy savings programs. While there is clearly value in such efforts, they tend to overlook a potentially significant source of emissions, one that is driven by business practices and operational policies. For example, determining how frequently supply deliveries are made could be as important in mitigating carbon emissions as the energy efficiency of the vehicles used to make these deliveries. In fact, one could argue that many of the popular business practices, such as just-in-time manufacturing and lean production, which favour frequent deliveries with less than truckload shipments, small production runs, and multiple regional warehouses, could have as much of an impact on the carbon



footprint of a firm as the energy efficiency of individual units deployed in production or distribution. Similarly, decisions that a firm makes regarding where to locate facilities, from which suppliers to source, and what mode of transportation to use can significantly affect its carbon footprint. Hence to reiterate, this study will be analysing the impact of the BTSC on the energy efficiency as well the low carbon footprint productions of an organization.

## **1.2 Problem Statement**

The BTSC strategy has recently been used by many researchers as well as the practitioners and it has been successfully implemented in many companies including Dell computers, BMW as well as Compaq (Gunasekaran, 2005). There has been a lot of literature written on the importance of the BTSC strategy and this clearly indicates the growing importance of the strategy in today's business. This strategy can greatly improve the competitiveness of any known organization. This strategy aims at personalization for the customers which means that they will cater to the specific needs of the customers in order to meet their satisfaction. Thus there is customization in the product itself to cater to the different and the unique needs of the customers. Thus, the requirements of each individual customer are met through leveraging the advantages of information technology as well as outsourcing.

The basic strategies for implementing Build-to-Order are supply chain simplification, concurrent design of versatile products and flexible processes, the mass customization of variety, and the development of a spontaneous supply chain. Build to order can actually build products on-demand at less cost than mass produced

batches, if "cost" is computed as total cost. Therefore, total cost measurements should also be part of this process. Although supply chain management is a much discussed topic today, most implementations fail to apply the basic lessons of Industrial Engineering 101: "Simplify before automating or computerizing." (Gunasekaran & Ngai, 2005). The simplification steps for supply chain management are standardization, automatic resupply techniques, and rationalization of the product line to eliminate or outsource the unusual. The goal of supply chain simplification is to drastically reduce the variety of parts and raw materials to the point where these materials can be procured spontaneously by automatic and pull-based resupply techniques. Reducing the part and material variety will also shrink the vendor base, further simplifying the supply chain (Gunasekaran & Ngai, 2005).

In market conditions of increasing levels of product variety and customisation, the ability to respond to customer orders in a timely fashion can provide a critical competitive advantage (Reichhart and Holweg, 2007). More recently, the discussion of mass customised products (Lampel and Mintzberg, 1996) has shifted the discussion beyond the simple provision of product variety towards individually customised products. While these customer-driven or build-to-order (BTO) strategies have been implemented in the personal computer sector, with Dell being the most prominent example (Kapusinski et al., 2004), complex manufacturing operations, such as automotive, have been slower in adopting these strategies (Hertz et al., 2001). The increasing importance of BTO supply chains results from two developments: first, the number of product variants has been increasing across most industries, such as consumer electronics (Catalan and Kotzab, 2003), fashion and

sportswear (Fisher et al., 1994), and automobiles (Holweg and Pil, 2004). Second, time has become a factor in competitiveness as customers are increasingly reluctant to accept long lead-times for products and services (Bower and Hout, 1988). The former development creates severe operational problems for traditional make-to-forecast or push” strategies, as firms require large amounts of finished goods inventories to ensure customers find the specifications they are looking for. While BTO strategies can help overcome the first hurdle, existing auto supply chains are not sufficiently responsive to deal with the second development; impatient customers.

Given the changing business conditions faced by most manufacturing organisations, flexibility has become a critical component of supply chain support for BTO initiatives (Coronado & Lyons, 2007). Inherent in BTSC strategy is the need to integrate the entire supply chain from upstream suppliers through downstream order and delivery processes (Christensena, Germainb, & Birou, 2005). An organisation would want a supplier that provides the buyer with the needed flexibility to appropriately adjust their supply process as demand conditions change. According to them the underlying assumption of a good supply chain is that buyers and suppliers are willing to accommodate the uncertainties and variations in each other’s businesses (Das & Abdel-Malek, 2003). The issues of supplier integration and the management of planning and forecast information are closely connected. The tight level of integration can cause problems where plans – that are overly optimistic on volume levels – are effectively communicated yet not what the market subsequently requires (Miemczyk & Howard, 2008). Until recent times, researchers have not paid

sufficient attention to the study of flexibility in supply chains and on how that flexibility affects BTO capabilities (Coronado & Lyons, 2007).

Across industry sectors, the concept of responsiveness has been receiving increasing attention in the operations management literature, and has been advanced as one of the key themes in recent supply chain research. However, this study regards supply chain responsiveness (SCR) not as an operations paradigm in its own right, but rather as a concept that can implicitly rest at the core of various operations strategies, such as lean thinking (Womack and Jones, 1996), agility (Goldman and Nagel, 1993) and more recently, BTO supply chain management (Gunasekaran and Ngai, 2005). Responsiveness thus is a crucial aspect of BTO supply chains, yet not one that is confined to them (Christopher, 2000). This study argues that the importance of responsiveness in today's industry settings.

Energy Efficiency is a key factor in this study. The industrial sector uses more energy than any other end-use sectors, currently consuming about 37% of the world's total delivered energy. Energy is consumed in the industrial sector by a diverse group of industries including manufacturing, agriculture, mining, and construction and for a wide range of activities, such as processing and assembly, space conditioning, and lighting (Abdelaziz, Saidur, & Mekhilef, 2011). BTSC has attracted scholars' attention because of its ability to improve energy efficiency and reduction of energy intensity. This is essential for manufacturing industry to overcome the environmental challenges and increasing dependence on energy. An industrial sector uses more energy than any other end-use sectors and currently this sector is consuming about

37% of the world's total delivered energy (Abdelaziz, Saidur, & Mekhilef, 2011). Unfortunately business leaders and most of the entrepreneurs do not appear to have the aptitude, knowledge and dynamism required to tackle technology-related problems such as energy efficiency (Nagesha & Balachandra, 1978). Hence this study focuses on the energy efficiency of an organization and examines the impact of BTSC on the energy efficiency of an organization.

In today's world, all the organizations want to ensure that they have a green supply chain. For example, green strategies focus on waste reduction. This study focuses on the green initiatives and measures the low carbon footprint. Low carbon footprint refers to the harmful gases which are emitted during the process of production one such being carbon dioxide. This is one of the reasons for the global warming which is taking place in the world. Organizations are adapting to using green techniques in their operations. A company which indulges in the build-to-order supply chain management will have to ensure that all the suppliers in the supply chain adapt to the same norms that they do in order for the entire process of producing the product to be green. In the Malaysian context, it is seen that companies that indulge in the built-to-order supply chain initiatives find it tough to implement the green strategies. These firms have a lot of suppliers in their supply chain and it is tough for all the firms to indulge in the green initiatives. Some suppliers do not indulge in these practices which in turn affects the firm's green initiatives. Thus in order to produce a product worthy of being called green, the entire supply chain will have to ensure that they have a low carbon footprint.

### **1.3 Research Questions**

The research questions are thus formulated in order to accomplish the research objectives:

- 1 What is the impact of build-to-order supply chain management on the supply chain responsiveness?
- 2 What is the impact of build-to-order supply chain management on the energy efficiency?
- 3 What is the impact of build-to-order supply chain management on the low carbon footprint?
- 4 What is the impact of supply chain responsiveness on the energy efficiency?
- 5 What is the impact of supply chain responsiveness on the low carbon footprint?
- 6 Does supply chain responsiveness mediate the relationship between build-to-order supply chain management and energy efficiency?
- 7 Does supply chain responsiveness mediate the relationship between build-to-order supply chain management and low carbon footprint?

### **1.4 Research Objectives**

After careful examination of the literature, this study identifies the major objectives. The focus of this study is the energy efficiency and the low carbon footprint initiatives taken by a firm in a build-to-order environment. Supply chain responsiveness is an important dimension in this study as it affects the supply chain behaviour and this variable has been identified as the mediating variable in this study. In other words, this study aims at identifying the impact of the build-to-order supply chain on the energy efficiency as well as the low carbon footprint coupled

with the mediating effect of the supply chain responsiveness. To summarize, following are the objectives which this study examines and investigates into:

- 1 To examine the relationship between build-to-order supply chain management and supply chain responsiveness.
- 2 To investigate the relationship between build-to-order supply chain management and energy efficiency.
- 3 To investigate the relationship between build-to-order supply chain management and low carbon footprint.
- 4 To investigate the relationship between supply chain responsiveness and energy efficiency.
- 5 To examine the relationship between supply chain responsiveness and low carbon footprint.
- 6 To examine supply chain responsiveness as mediating on the relationship between build-to-order supply chain management and energy efficiency.
- 7 To examine supply chain responsiveness as mediating on the relationship between build-to-order supply chain management and low carbon footprint.

### **1.5 Research Scope**

The research scope includes the limitations as well as the delimitations in order to conduct the research. This study has chosen the manufacturing industry for this research. The major focus of the study is on the energy efficiency and the low carbon footprint. This study examines the impact of the build-to-order supply chain on the energy efficiency and the low carbon footprint of an organization. However, this study chose the feedback of the companies which do indulge in the build-to-order

type of production. This study focuses on the manufacturing industry with majority of the respondents being from the electronics, computer hardware and the automotive sectors as these sectors employ the build-to-order strategy more than any other sector. These sectors are the sectors which involve in build-to-order more than any other sectors. Hence our focus has been mostly on these sectors and majority of the feedback for our research have come from these sectors.

## **1.6 Significance of the Study**

This research is among the earliest study which focuses on the BTSC specifically due to the lack of empirical survey study which has been conducted in this area, and previous studies have neglected the exploration of BTSC in Malaysia. Thus this study is a relatively new topic and has not been explored before especially the impact of the BTSC on the carbon efficient productions using the mediation of supply chain responsiveness. Previous literature are mostly in the form of a case study with very few having done a quantitative survey research. In this study focus will be on how carbon efficient productions are being affected by the organizations which involve the BTO practise. This study will also show us how the BTSC affect the supply chain responsiveness which in turn affects the carbon efficient productions.

### **1.6.1 Theoretical Contribution**

BTSC has been emerging as a major operation strategy for improving organizational competitiveness. In the past few years, a number of articles on BTSC have appeared in operation management and production management academic journals, trade



magazines, and the website. A very few articles discuss details of the design and operations of BTSC. Most discuss the experiences of Dell, BMW, Compaq, and Gateway. Nevertheless, the experiences would be very valuable for companies that aim to develop BTSC. However, most companies are not yet prepared to completely disseminate the success behind their BTSC.

This research identifies the determinants of the BTSC along with the determinants of the supply chain responsiveness. A review of the literature available on BTSC and on experiences of lean and agile manufacturers was useful in developing a framework for BTSC. Although the literature survey is not exhaustive, it serves as a comprehensive base for understanding and developing a framework for BTSC. Using this framework and with the help of a self-administered questionnaire, analysis of the data has been made in order to come to empirical conclusions. Thus this study provides results after testing the framework and can be a base for future researches in this field. This study focuses on the entire manufacturing industry as this is the major industry which indulges in the BTSCM.

### **1.6.2 Practical Contribution**

This study focuses on the BTSC along with the Carbon-efficient productions. It can help in creating awareness about the same as the importance of BTSC cannot be neglected especially when the manufacturing organizations in the world are trying to adapt to this in order to satisfy the customers. Customer loyalty is a major issue in today's world as there are many options available to the consumer. Thus the organizations want to provide the customers with specialized and customized

products in order to ensure that they are happy. Thus the BTO is very important as it focuses on the direct needs of the customer. This study focuses on the BTSC along with its dimension and can serve as a good guide for the business practitioners who are a part of the BTSC in Malaysia.

Malaysia is fairly new to the idea and concept of BTSC. Very few of these many local companies actually indulge in the practising of the BTO. Hence the concept is fairly new and there is a basic lack of understanding on the same. The world is slowly focusing on the importance of the carbon-efficient productions and this plays a major dimension in today's world as well. Especially BTSC has been emerging as a major operation strategy for improving organizational competitiveness. Thus, clearer understanding of the concept of build-to-order supply chain can be achieved through this study in order to advance the industry in question. As the competitions become more and more intense, the role of the supply chains become ever so important. This study is important in order to assess and investigate the level of the built-to-order supply chain implementation and the impact it has on the firm's ability to produce carbon-efficient products. An efficient and effective supply chain is important management is being recognized as important in both the financial as well as the non-financial performance of an organization within a supply chain. This study hence discusses the implications of the findings in the very last chapter. The organizations which indulge in the practise of BTSC will greatly benefit from this study and can use this to enhance their effectiveness and in order to be more carbon-efficient. This study will help to show the importance of the BTSC as well as the importance of producing carbon-efficient products. The practitioners can use these findings in order to align their BTSC and to get an insight into the effective usage of

the resources in order to be more efficient. They can also use their technology in a more effective way in order to perform better, and to realize the ways in which they can improve their performance. Thus the entire industry can benefit from the same. The organizations of this industry could also benefit by being more cost effective and be more environmentally friendly which would ultimately lead to them having a more customer or brand loyalty.

Due to the result of globalization, the suppliers have understood the roles of the supply chain and have learned to maintain good relations with each of their business partners in the supply chain in order to achieve targets and enhance organizational performances. Besides, the industry can better enhance their competitiveness, increase effectiveness, and reduce cost of their operations. When effectiveness increases and the cost reduce, the economy of the country will boost. With the increased efficiency, Malaysia can look to perform better in terms of the global market and seek to be good competitors to their neighbouring countries such as Thailand and Singapore.

Thus this research is of high importance as it highlights the importance of the build-to-order supply chains and it showcases the high importance of the supply chain responsiveness as well. This study can be used to enhance the performance of the firm and seek to be more customers' demand oriented as they are the ones buying the product. This is the practical importance of the research.

### **1.6.3 Social Contribution**

This study contributes in many ways but the major implication lies in its social contribution. This is because the build-to-order is more customers oriented and it seeks to fulfil the customer demand. Hence this study directly contributes to the society at large. BTSC talks about how a product is customized according to the need of the customer and this in turn makes the customer happy as the customer gets exactly what he ordered for. Besides this study focuses on the impact BTSC has on the carbon-efficient production. In today's world, the customers are more attracted towards green products which can only be produced by using green production techniques. There are many environmental concerns which rise daily and everybody wants to be environmentally friendly. Thus the importance of a green product cannot be highlighted enough. This study specifically focuses on the impact it has on the energy efficiency as well as the carbon footprint.

Hence this research can be used by the organizations in order to make their supply chain more environmentally friendly. Thus embracing the low carbon economy will ensure the security of the economic as well as the environmental future of the nation and this study can also be used by the government in order to formulate policies which will lead towards a much greener environment.

Thus, to summarize, this study has a lot of implications and the inferences drawn favour the economy towards a greener environment and the use of built-to-order can save the cost and can help in fulfilling the customer's wants. Thus a built-to-order business which is green is the way to go as it keeps the best interest of everyone and

a firm specializing can also manage their own cost in order to increase their benefits. These are the major contributions of the study.

## **1.7 Definition of Key Terms**

In order to have a clear understanding of the concepts used in the discussion in this study, the definitions of the key terms that will be used throughout the study are as follows:

### **1.7.1 Supply Chain (SC)**

Ganeshaan and Harrison (1995) have described supply chain as:

“a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers, which exist in both service and the manufacturing organizations, although the complexity of the chain may vary greatly from the industry to industry and firm to firm...”

### **1.7.2 Supply Chain Management (SCM)**

Mentzer, DeWitt, Keebler, Min, Nix, Smith and Zacharia (2001) have defined SCM as:

“...the systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across

businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole...”

### **1.7.3 Build-To-Order (BTO)**

Gunasekaran (2005) has defined BTO as:

“...a value chain that activates the processes of building the products based on individual customer requirements and by leveraging information technology and strategic alliances with partnering firms for required components and support services such as logistics. The aim in BTO is to meet the demands of individual customers with a short lead time and minimum inventory and production costs along the value chain”

### **1.7.4 Build-To-Order Supply Chain (BTSC)**

Gunasekaran and Ngai (2005) has defined BTO as:

“the system that produces goods and services based on individual customer requirements in a timely and cost competitive manner by leveraging global outsourcing, the application of information technology and through the standardization of components and delayed product differentiation strategies”  
(Gunasekaran and Ngai, 2005).

### **1.7.5 Supply Chain Responsiveness**

Gunasekaran et al. (2007) has defined supply chain responsiveness as:

“A network of firms that is capable of creating wealth to its stakeholders in a competitive environment by reacting quickly and cost effectively to changing market requirements.”

### **1.7.6 Energy Efficiency**

Malaysia Energy Centre [MEC] (2009) has been defined Energy Efficiency (EE) as:

“...the efficient use of energy in a manner that utilizes less energy for producing the same output...”

### **1.7.7 Low Carbon Footprint**

Grub & Ellis (2007) has been defined Carbon Footprint as:

"...a measure of the amount of carbon dioxide emitted through the combustion of fossil fuels. In the case of a business organization, it is the amount of CO<sub>2</sub> emitted either directly or indirectly as a result of its everyday operations. It also might reflect the fossil energy represented in a product or commodity reaching market."

## **1.8 Structure of the Remaining Chapters**

This chapter has given an overview of the study along with its major contributions.

The following chapters will be more in depth and it comprises the heart of the

research. Chapter 2 presents the literature review which deals with the previous studies done in the fields of SC, BTSC, SCR as well as the carbon-efficient production. This chapter also concludes with the theoretical framework and the hypothesis development.

Chapter 3 will comprise of the research methodology which was adopted in order to conduct this research. This includes the population and sample, the data collection and the instruments used for the survey. The chapter following that will present the findings of the research along with the analysis of the study. It is concluded with the results for the hypothesis testing in the study. Finally, the last chapter in this study, Chapter 5 discusses the study's implication, recommendation as well as the conclusion.



## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

This chapter will cover the topics which are related to the study. It will discuss in details the researches which have been done previously and will also discuss in details the ideas, concepts and the theories which have been used in this study as well. Thus a comprehensive overview of the literature has been provided.

#### **2.1 Overview of Manufacturing Industry in Malaysia**

Manufacturing operations is one of the prime strategic functions of any business. Whether or not manufacturing operations achieves its strategic potential and contributes to the competitive position of a business depends entirely on how it is managed (Kasul and Motwani, 1995). Globalization, shortening product life cycles, increasingly sophisticated consumers, increasing labour costs and volatility in input prices has created an environment where manufacturers must be flexible, adaptive, responsive and innovative (Sohal et al., 1999). It is within the design and execution of manufacturing activities that most impact on the strategic objectives of quality, cost, delivery and flexibility can be made (Kochhar et al., 1997 cited in Davies and Kochhar, 2000). Global competition stresses the firm's ability to innovate and to capture global levels of manufacturing efficiency (Rockart and Short, 1989).

Hayes and Wheelwright (1985) cited in Flynn et al. (1997) used the term “world class manufacturer” to describe organizations which achieved a global competitive advantage through the use of their manufacturing capabilities as a strategic weapon. They cited a number of critical practices, including development of workforce, developing a technically competent management group, competing through quality, stimulating worker participation and investing in state-of-the art equipment and facilities. World-class manufacturing (WCM) companies are those companies which continuously outperform the industry’s global best practice and which know their customers and suppliers, their competitors’ performance capabilities and their own strengths and weaknesses.

Generally, it is assumed that for companies to compete globally, they should emulate the practices of successful companies. Camp (1989) defined best practices as those that will lead to superior performance. Thus, best practice is associated with higher performance levels (Davies and Kochhar, 2002). Superior operating performance will in turn lead to superior business performance and competitiveness (Voss et al., 2002). Therefore, companies are required to adopt WCM practices to be the best, either in the design and quality of the products, capability and standing of the organization, minimum manufacturing cost, the ability to continuously produce new products at a faster rate than your nearest competitor and achieving customer satisfaction with the services provided (Schoenberger, 1987).

Even though achieving world-class is a common aim among manufacturers, Hanson et al. (1994) and Schonberger (1996) concludes that few manufacturers are achieving

this status and many are failing to even get started in the race. Voss and Blackmon (1996) in examining the manufacturing practices in the UK and Germany found the degree to which their adoption and use is affected by national background. Companies should be able to measure, compare and evaluate the performance of an existing process, product or service against that recognized as best practices through benchmarking. Benchmarking can indicate not only what is possible but also how it is done. Benchmarking can be regarded as the most powerful tool for assessing industrial competitiveness and for triggering the change process in companies striving for world-class performance. Benchmarking is important as there is no blueprint for survival in the global marketplace, but clear patterns emerge when one examines practices of world-class manufacturers. Fernandez et al. (2001) summarized benchmarking as a process that facilitates learning and understanding of the organization and its processes. It enables organizations to identify the key processes that need improvement, and to search for applicable solutions from the best in class.

The competition in the marketplace is getting fiercer nowadays due to globalization. Furthermore, the global financial crisis that occurred in the period 2007-2008 had forced companies to increase their competitiveness for business survival (Choo, Mat and Al-Omari, 2013). Consequently, employee engagement has emerged as the most discussed topic among top management over the globe in this decade, since it is an important element for business survival and success. And Malaysia, with its highly educated workforce, is no exception. Previous research has demonstrated the relationship of employee engagement with positive work outcomes, such as low attrition, high performance, and positive business results (Hallberg and Schaufeli,

2006). Findings from BlessingWhite (2005), State of Employee Engagement research report showed a clear correlation between engagement and employee retention, with 85 percent of engaged employees indicating that they planned to stay with their current employer. Ramsey and Finney (2006) also found that engaged employees may be more likely to commit to staying with their current organization. However, Robinson et al. (2004, p. 1) commented that “engagement is big in the HR consultancy market, yet there is a dearth of academic research in this area”. Likewise, Saks (2006) commented that there is a lack of research on employee engagement in academic literature. In a nutshell, there seems to be knowledge gap in employee engagement, which drives the need for more empirical research in this area.

## **2.2 Supply Chain Management (SCM)**

The role of supply chain management is crucial in today’s world to the companies. It is pivotal for all the companies to adapt this strategy in order to survive in the global competitive market. The global nature of the markets and the competition has forced many companies to revisit their operations strategy. Companies have moved from a centralized operation to a decentralized operation in order to take advantage of the available resources and to be closer to their markets. Consistent with this, firms have undergone many numerous changes in terms of the strategies, operation and the tactics with the aim of meeting the changing requirements of the market. Currently, companies have to compete based on many multiple competitive performance objectives such as quality, price, responsiveness, flexibility and dependability (Gunasekaran and Ngai, 2004). Thus in order to sustain in the intensified global