# AN INTEGRATED STOCHASTIC-FUZZY METHOD FOR SUPPLY CHAIN LEANNESS EVALUATION IN IRANIAN AUTOMOTIVE SMALL AND MEDIUM ENTEPRISES

FARZAD BEHROUZI

UNIVERSITI TEKNOLOGI MALAYSIA

# AN INTEGRATED STOCHASTIC-FUZZY METHOD FOR SUPPLY CHAIN LEANNESS EVALUATION IN IRANIAN AUTOMOTIVE SMALL AND MEDIUM ENTERPRISES

FARZAD BEHROUZI

A thesis submitted in fulfilment of the
requirements for the award of the degree of
Doctor of Philosophy (Mechanical Engineering)

Faculty of Mechanical Engineering
Universiti Teknologi Malaysia

JULY 2013

*Especially dedicated to Aba Saleh Al-Mahdi (a.s)*

## ACKNOWLEDGEMENT

First, I thank Allah for granting me perseverance, strength, and guidance to complete this thesis. Without the abundant grace of Allah, the start and completion of this work was not possible.

I would like to express my sincere thanks and deep gratitude to my supervisor, Dr. Wong Kuan Yew for his guidance, critics, and encouragement during this research. I am also very thankful to my co-supervisor (external co-supervisor), Professor Dr. Azizollah Memariani for his guidance, advices and motivation. I must also acknowledge Professor Dr. Mostafa Kazemi for valuable guidance and help during his stay at Universiti Teknologi Malaysia (UTM) and especially for providing data from the second case study.

I am also indebted to Universiti Teknologi Malaysia (UTM) for financial support. Librarians and staff at UTM also deserve special thanks for their useful assistance and help throughout this research. Unfortunately, it is not possible to list all of them in this limited space.

I would also like to express my deepest gratitude to my parents for their support and encouragement during my life and this research. Without their continued support and interest, I was not at this point. I wish also to express my appreciation to my mother-in-law and father-in-law for their support and encouragement. At the end, I would like to especially thank my devoted wife, Negar, whose love and patience supported me during our life in Malaysia.

I hope Allah give his infinite mercy and reward to all of you.

## ABSTRACT

In today’s competitive markets, companies have realized that there is an urgent need to improve the performance of the whole supply chain of which they are members. A measure of leanness is needed to provide decision support information such as the current leanness level, the progress of lean supply chain implementation, and the extent of potential improvements in the supply chain. In spite of the vast amount of studies on lean concepts and related tools and techniques, the evaluation of lean situation (leanness) is less investigated especially in a supply chain. In order to fill this gap, this research was carried out to systematically quantify the leanness of Small and Medium Enterprises' (SMEs) supply chain in the automotive industry with regard to stochastic and fuzzy uncertainties in performance measures. Particularly, four performance categories (quality, cost, delivery and reliability, and flexibility) along with 28 related metrics were developed as surrogates for leanness. These were achieved through a questionnaire survey, using experts' knowledge and experience from SMEs in the automotive industry in Iran. Factor analysis along with principal component analysis was used to validate the measures and metrics. Validity and reliability tests were consequently conducted. Following this, a stochastic-fuzzy method was developed to evaluate and predict the leanness of supply chain. The probability function of the total leanness was identified and different leanness situations were consequently evaluated and predicted. A total leanness index was also provided and connected to fuzzy sets (linguistic terms) to evaluate the current leanness level. The developed method was consequently tested and evaluated by using two case studies, and some management actions were suggested based on different values of leanness level. From the evaluation, it was found that the proposed method is applicable and easy to use. In addition, it was found that SMEs in Iran's automotive industry need to be given more attention in order to enhance their leanness level. This study contributes to expand the knowledge on supply chain leanness measurement and provides practical guidelines for manufacturing SMEs in the automotive industry to evaluate, predict, and improve the leanness of their supply chain using an integrated stochastic-fuzzy method.

# ABSTRAK

Dalam pasaran yang kompetitif hari ini, banyak syarikat telah menyedari bahawa terdapat keperluan segera untuk memperbaiki prestasi rantai bekalan keseluruhan yang mana mereka adalah ahli. Dengan adanya pengeluaran ramping, rantai bekalan ramping boleh dianggap sebagai satu strategi menang-menang untuk semua ahli daripada pembekal yang pertama kepada pelanggan yang terakhir untuk mencapai nilai yang lebih. Satu ukuran kerampingan diperlukan untuk menyediakan maklumat sokongan keputusan seperti tahap kerampingan semasa, kemajuan perlaksanaan rantai bekalan ramping, dan tahap potensi penambahbaikan dalam rantai bekalan. Walaupun terdapat banyak kajian ke atas konsep ramping dan alat-alat dan teknik-teknik yang berkaitan, penilaian keadaan ramping (kerampingan) kurang disiasat terutamanya dalam rantai bekalan. Untuk mengisi jurang ini, kajian ini telah dijalankan untuk mengukur secara sistematik kerampingan rantai bekalan syarikat kecil dan sederhana dalam industri automotif dengan mengambil kira ketidaktentuan stokastik dan kabur dalam ukuran prestasi. Khususnya, empat kategori prestasi (kualiti, kos, penghantaran dan kebolehpercayaan, dan fleksibiliti) bersama-sama dengan 28 metrik yang berkaitan telah dibangunkan sebagai pengukur untuk kerampingan. Hasil ini diperolehi melalui soal selidik, menggunakan pengetahuan dan pengalaman pakar dari syarikat kecil dan sederhana dalam industri automotif di Iran. Analisis faktor bersama-sama dengan analisis komponen utama telah digunakan untuk mengesahkan semua faktor dan metrik. Ujian kesahihan dan kebolehpercayaan kemudiannya dijalankan. Berikutan ini, satu kaedah stokastik-kabur telah dibangunkan untuk menilai dan meramal kerampingan rantai bekalan. Fungsi kebarangkalian jumlah kerampingan telah dikenalpasti dan situasi kerampingan yang berbeza telah dinilai dan diramalkan. Satu indeks jumlah kerampingan juga dihasilkan dan dikaitkan dengan set kabur (terma linguistik) untuk menilai tahap kerampingan semasa. Seterusnya, kaedah ini telah diuji dan dinilai dengan menggunakan dua kajian kes, dan beberapa tindakan pengurusan telah dicadangkan berdasarkan nilai tahap kerampingan yang berbeza. Penilaian ini mendapati bahawa kaedah yang dicadangkan adalah terpakai dan mudah untuk digunakan. Di samping itu, ia mendapati bahawa syarikat kecil dan sederhana dalam industri automotif di Iran perlu menerima perhatian yang lebih untuk meningkatkan tahap kerampingan. Kajian ini menyumbang untuk mengembangkan pengetahuan dalam pengukuran kerampingan rantai bekalan dan menyediakan garis panduan praktikal untuk syarikat kecil dan sederhana pembuatan dalam industri automotif untuk menilai, meramal, dan memperbaiki kerampingan rantai bekalan mereka menggunakan kaedah integrasi stokastik-kabur.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# CHAPTER 1

# INTRODUCTION

## 1.1 An Overview

This chapter is about the basic philosophies behind this research. It explains the background of this study that includes lean supply chain (LSC) management, related performance measures, and current measurement approaches. The problem statement which provides a basis for this research is then formulated. Following this, the research objectives, scope, questions, and significance of the research are presented. Next, the structure of the thesis is outlined to provide a better illustration of the thesis contents. Finally, this chapter ends with conclusions.

## 1.2 Background of the Study

Customer satisfaction, nowadays, is one of the most important challenges for which companies have focused on. Flexibility, on-time delivery, quality, competitive price, and service level are some dimensions of customer satisfaction, all related to supply chain management (Johansson *et al.*, 1993). Inventory reduction, improved delivery performance, shorter product development cycle, superior quality, high flexibility, and competitive costs are some potential benefits of a LSC (Fawcett *et al*., 2008; Daugherty *et al*., 2005).

On the other hand, waste reduction and continuous improvement techniques, known as lean concepts, help practitioners and managers to pursue perfection. Combining these two management systems, a new concept has been created named lean supply chain management. Many successful cases from various industries have demonstrated the effectiveness of LSC (Plenert, 2007; Manrodt *et al.*, 2008; Husby and Swartwood, 2009).

Lean organizations focus on continuous improvement of quality, cost, delivery, and flexibility by trying to eliminate waste, create smooth flow, and increase the velocity of the system's ability to comply with customer requirements. Lean production is a western translation of the Toyota Production System (TPS), which was developed by the Japanese carmaker and most famously studied in the book entitled "Machine That Changed the World" by Womack (1996).

Ohno (1988) introduced the lean production principles in TPS that helped Toyota to overcome difficult times since World War II. In an environment lacking of resources, TPS was developed to survive with the minimum amount of resources.

As globalization has forced organizations to become more competitive, lean principles have been expanded to cover all sections across the whole supply chain, and Toyota's discoveries have resulted in massive revolutions in the business environment. Consequently, the willingness to create value for customers has motivated managers to think about eliminating non-value-added activities all over the supply chain from the start to the end. The primary goal of lean manufacturing is delivering more value to the customer. It will be achieved through eliminating all kinds of wastes from the organization's processes to meet customer's requirements. The LSC concept is built on the broader goal of providing value to the customer by optimizing the performance of the supply chain as a system (Phelps *et al.*, 2003).

The objective of a LSC is increasing productivity through applying lean tools and techniques into the whole supply chain in order to eliminate wastes and make it effective and efficient enough to satisfy the customer (Srinivasan, 2004). Various

methods and tools have been developed to identify and eliminate wastes. For example, Value stream mapping (VSM) as a graphical tool was developed by Rother and Shook (1998) to visually identify improvement opportunities within processes. It has become one of the most important tools to find non-value-added activities in a business environment, and enables organizations to become more efficient and effective in supporting continuous improvement.

VSM starts by identifying the current processes include both value-added and non-value-added activities. By gathering and analyzing the data on the map, the wasteful activities will be obvious. This is the current state VSM. The current state map will be used as a guide to identify what should be changed in the process to simplify it or to make it more productive. Defining the targets and removing all the wastes, the future state mapping will be obtained. Having these two maps, the practitioners have to develop and utilize tools and techniques to move from current state to the future state.

Wee and Wu (2009) followed a four-step problem solving process to demonstrate how a LSC affects product cost and quality. They presented how VSM helps a LSC to identify potential opportunities for continuous improvement and eliminate wastes. Eight identified wastes in TPS are overproduction, over processing, waiting, excess inventory, transportation, movement, defects, underutilized employee creativity, and the biggest one being overproduction (Monden, 1998; Liker, 2004).

Lean performance metrics are developed to track improvements. After implementing lean tools and techniques, it is important to evaluate the leanness situation. Although it is important that a group of lean metrics can simultaneously evaluate the effectiveness of the lean initiatives of supply chain, but existing lean assessment metrics usually evaluate the performance of a fraction of the overall leanness (Wan and Chen, 2006). In other words, an integrated measure of supply chain leanness is absent in the literature. By establishing a set of lean metrics for a supply chain, managers can track the improvement in each specific area and build an accurate image of the overall leanness. As a result, measuring supply chain leanness

will help practitioners and managers to know where a supply chain is in the lean journey.

Measurement is a significant key to manage improvement. A comprehensive measure of leanness is needed to provide decision support information such as the current leanness level, the progress of LSC implementation, and the extent of potential improvements in a supply chain. While the efficiency and effectiveness of supply chain activities are continuously improved by lean tools and techniques, a quantitative measure of the leanness level of supply chain to determine the probability of different leanness levels and support the improvements has not been developed. In addition, there is a lack on leanness measurement with an integrated single unit-less index. Without an integrated leanness measure, the leanness level of the current situation is unknown, and the improvement of leanness in supply chain cannot be tracked.

## 1.3 Problem Statement

Applying lean principles to a supply chain will create a LSC. In this context, the progress and effectiveness of lean implementation in a supply chain are the major concerns for managers and decision makers to know how lean the current supply chain is, and how it can become leaner.

Researchers have proposed several tools and techniques to reduce wastes and enhance the leanness of supply chain. The question, “how supply chain can become leaner” has been answered by these lean tools and techniques. However, the existing literature does not provide an explicit indication on “how lean a supply chain is”, or what is the probability of having a specific lean level. The current methods to measure the leanness of supply chain have some deficiencies such as unable to address stochastic variables, need sufficient data of previous periods, lack of integrating stochastic and fuzzy uncertainties when measuring leanness, and require external benchmarking (Wan and Chen, 2006; Mikko and Ilkka, 2009).

To overcome the limitations of previous studies, a method to evaluate the leanness level of supply chain needs to be developed. The leanness measurement method should be able to measure and unify various metrics into a single index. In addition, it should be able to address deterministic and stochastic metrics. To compare the current leanness level of each metric with a target, an ideal leanness level needs to be identified. As a result, practitioners and managers can evaluate the leanness level by comparing the current leanness level against the leanness target without doing external benchmarking. Consequently, the leanness evaluation method should lead to improvement actions that can enhance the total leanness of supply chain in order to be successful in the competitive market.

## 1.4 Research Objectives

The main objective of this research is to develop a method to evaluate the leanness of supply chain and presenting it through a single unit-less index which can be interpreted both linguistically and probabilistically. It will raise the awareness of supply chain practitioners about leanness levels and set targets to reach in the future state. In more detail, the objectives are as listed below.

- **To determine a set of key metrics that affect the leanness of supply chain:**

By doing an intensive literature review and conducting a survey, the key leanness metrics of supply chain performance will be identified, grouped, and validated.

- **To develop a method with a final single unit-less index to evaluate the leanness of supply chain:**

To develop a method in order to quantify the leanness level of a supply chain, and provide an integrated single index in order to find “how lean the supply chain is” and “what is the probability of having a specific lean level”. The method should provide insights to analyze and identify the potential opportunities in different areas

in order to help the supply chain practitioners to improve the current performance level towards the leanness target.

## 1.5 Research Scope

The scope of this research is limited to manufacturing SMEs in the automotive industry in Iran. The manufacturing SMEs along with their suppliers and customers are considered as a chain. The distributor is supposed to be the manufacturer since SMEs can directly distribute their products to the large companies as their customers (Teng, 2012). Leanness metrics will be extracted from the literature and then they will be filtered by experts. Consequently, a method will be developed to measure the leanness level of supply chain by using the selected metrics.

## 1.6 Research Questions

Questions to which this study tries to answer are as listed below:

1. What are the key performance measures and metrics to consider when measuring the leanness of SMEs' supply chain in automotive industry of Iran?
2. How to develop a method in order to quantify and analyze the leanness level of supply chain, and provide an integrated single index?

## 1.7 Significance of the Research

This research can be useful for SMEs by presenting a leanness measurement method to inform the decision makers “how lean their supply chain is” and “what are the probabilities of different leanness levels”. Based on the results, the practitioners are able to set some goals and measure them periodically. Removing wastes, cutting

cost, improving delivery, reducing cycle time, and enhancing quality are some beneficial goals that could be established after such an evaluation. In addition, this study will provide a beneficial method to identify the most important metrics in the area of LSC which can be useful for SMEs in the automotive industry.

From theoretical aspect, this study will develop a measurement method which is able to integrate qualitative and quantitative variables as well as deterministic and probabilistic metrics into a single unit-less index which is a challenge in leanness assessment. It is also able to unify the metrics with different scales and units.

## 1.8 Structure of the Thesis

This thesis is arranged into seven chapters. Chapter 1 is an introduction to the research as aforementioned. The background, problem statement, objectives, scope, questions, and significance of the research are all explained in this chapter. Chapter 2 is an extensive review of literature on related topics, concepts, and issues. Previous works and researches along with individual frameworks, methods, and models are described in this chapter, and critical discussions are consequently provided. Chapter 3 will explain the research methodology, and all steps for conducting the research are described. The mathematical tools (i.e. fuzzy set theory, beta distribution, and central limit theorem) applied to this research are also explained in this chapter.

Chapter 4 will discuss the identification of LSC performance measures and metrics which are used in the measurement method. The survey, the method of extracting measures and metrics, and their validity and reliability will be explained in this chapter. Chapter 5 is assigned to the development of a stochastic-fuzzy method for supply chain leanness evaluation. Chapter 6 deals with the evaluation of the developed method by conducting two case studies from the automotive industry in Iran. Finally, Chapter 7 provides conclusions and recommendations for future studies on LSC performance measurement.

# REFERENCES


Aamadi, A. (2002). *Mathematic and Statistic*. Tehran: Tehran Universities Publications Centres.

AberdeenGroup Incorporation (2006). Boston, Massachusetts <http://www.aberdeen.com> site accessed on November, 2010.

Adams, S. M., Sarkis, J. and Liles, D. (1995). The development of strategic performance metrics. *Engineering Management Journal*. 7(1), 24-33.

Afsharipour, A., Afshari, A. and Amin, S, L. (2006). *E-procurement in automotive supply chain of Iran*. Master Thesis. Lulea University of Technology.

Agarwal, A., Shankar, R. and Tiwari, M.K. (2005). Modeling the metrics of lean, agile and leagile supply chain: An ANP-based approach. *European Journal of Operational Research*. 17(3), 211-225.

Akhbari, b. (2007). *Predicting intention to adopt internationalization linkages: a study in Iranian automotive industry supply chain in a B2B environment.* Master Thesis. Lulea University of Technology.

Aladwani, A. M. and Palvia, P. C. (2002). Developing and validating an instrument for measuring user-perceived web quality. *Information and Management*. 39(1), 467-476.

Allway, M. and Corbett, S. (2002). Shifting to lean service: stealing a page from manufacturers' playbooks. *Journal of Organizational Excellence*. 21(2), 45-54.

Anvari, M. R. A., Nayeri, M. D., and Razavi, S. M. (2011). How to Measure Supply Chain Performance: case study. *International Review of Business Research Papers*. 7(2), 230-244.

APICS Group (2004). The development and adoption of lean principles in supply chain management. www.apics.org. (accessed on March, 2010).

Arbos, L. C. (2002). Design of a rapid response and high efficiency service by lean

production principles: Methodology and evaluation of variability of performance. *International Journal of Production Economics*. 80, 169-183.

Arumugam, V. C. (2011). Critical success factors of total quality management and their impact on performance of Iranian automotive industry: a theoretical approach. *European Journal of Economics, Finance and Administrative Sciences.* 33, 25-41.

Ayers, James. B. (2001). *Handbook of supply chain management*. Boca Raton, Florida: St. Lucie Press/APICS.

Azzone, G., Maseela, C. and Bertele, U. (1991). Design of performance measures for time based companies. *International Journal of Operations & Productions Management*. 11(3), 77-85.

Babbie, E. R. (2004). *The Practice of Social Research.* (10th ed.). Belmont, CA: Thomson/Wadsworth.

Barclay, D., Thompson, R., and Higgins, C. (1995). The partial least squares (PLS) approach to causal modeling: personal computer adoption and use as an illustration. *Technology Studies. 2*(2), 285-309.

Bayou, M.E., de-Korvin, A. (2008). Measuring the leanness of manufacturing systems: A case study of Ford Motor Company and General Motors. *Journal of Engineering Technology Management*. 25, 287-304.

Beamon, B. M. (1998). Supply chain design and analysis: models and methods. *International Journal of Production Economics*. 55, 281–294.

Beamon, B. M. (1996). Performance measures in supply chain management. *Proceedings of the Agile and Intelligent Manufacturing Symposium*, Rensselaer Polytechnic Institute.

Beamon, B.M. (1999). Measuring supply chain performance. International Journal of Operations & Production Management. 19(3), 275-292.

Behrouzi, F. and Wong, K.Y. (2011). Lean performance evaluation of manufacturing systems: a dynamic and innovative approach. *Procedia Computer Science.* 3, 388-395.

Bell, R.A. and Morey, R.C. (1995). Increasing the efficiency of corporate travel management through macro benchmarking. *Journal of Travel Research*. 33(3), 11-20.

Bernard, R.R.S. (2005). *The benchmarking process: empirical evidences from small and medium sized enterprises*. Ph.D. Thesis. University Of Montreal, Canada.

Bernardes, E.S., and Hanna, M.D. (2008). A theoretical review of flexibility, agility and responsiveness in the operations management literature. *International Journal of Operations & Production Management*. 29(1), 30-53.

Berry, D., Towill, D.R. and Wadsley, N. (1994). Supply chain management in the electronics product industry. *International Journal of Physical Distribution & Logistics Management*. 24(10), 20-32.

Bhagwat, R. and Sharma, M. K. (2007). Performance measurement of supply chain management using the analytical hierarchy process. *Computers in Industry*. 18(8), 666–680.

Bigliardi, B. and Bottani, E. (2010). Performance measurement in the food supply chain: a balanced scorecard approach. *Facilities*. 28(5), 249-260.

Bojadziev,G. and Bojadziev, M. (2007). *Fuzzy Logic for Business, Finance, and Management*. (2nd ed.). Singapore: World Scientific Publishing.

Bozdogan, K. (2002). Lean Supplier Networks. Massachusetts Institute of Technology.

Brace, I. (2004). *Questionnaire Design: How to Plan, Structure and Write Survey Material for Effective Market Research.* London: Kogan Page.

Brewer, P. C. and Speh, T. W. (2000). Using the balanced scorecard to measure supply chain performance. *Journal of Business Logistics*. 21(1), 75-92.

Brown, M.G. (1996). *Keeping Score: Using the Right Metrics to Drive World-Class Performance*. NY: Quality Resources.

Brown, C. B., Collins, T. R., and McCombs, E. L. (2006). Transformation from batch to lean manufacturing: the performance issues. *Engineering Management Journal.*18(2), 3-13.

Bullinger, H.J., Ku¨hner, M. and Hoof, A.V. (2002). Analysing supply chain performance using a balanced measurement method. *International Journal of Production Research*. 40(15), 3533-3543.

Burke, B. G. (1995). *An evolutionary process model for the effective design and implementation of formal benchmarking*. Master Thesis. Carleton University,

Canada.

Bury, K. (1999). *Statistical Distributions in Engineering*. Cambridge, UK: Cambridge University Press.

Buxton, M. and Jutras, C. (2006). AberdeenGroup. www.aberdeen.com. (accessed on December, 2009).

Camp, R. (1992). Learning from the best leads to superior performance. *Journal of Business Strategy*. 13(3), 3-6.

Carreira, B. (2005). *Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Waste and Maximizing Profits.* New York: AMACOM.

Chae, B. (2009). Developing key performance indicators for supply chain: an industry perspective. *International Journal of Supply Chain Management*. 14(6), 422-428.

Chan, F. T. S. (2003). Performance measurement in a supply chain. *International Journal of Advanced Manufacturing Technology*.21, 534–548.

Chan, F. and Qi, H.J. (2003). An innovative performance measurement method for supply chain management. *Supply Chain Management: An international journal*. 8(3), 209-223.

Chan, F., Qi, H.J., Chan, H.K., Lau, H. and Ip, R. (2003). A conceptual model of performance measurement for supply chains. *Management Decision*. 41(7), 635-642.

Charnes, A. and Cooper, W.W. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*. 2(6), 429-444.

Chen, Z., Huang, G.H., and Chakma, A. (2003). Hybrid fuzzy-stochastic modeling approach for assessing environmental risks at contaminated groundwater system. *Journal of Environmental Engineering*. 129(1), 79-88.

Chen, I. J. and Paulraj, A. (2004). Towards a theory of supply chain management: the constructs and measurements. *Journal of Operations Management.* 22(2), 119–150.

Cho, D. W., Lee, Y. H., Ahn, S. H. and Hwang, M. K (2012). A framework for measuring the performance of service supply chain management. *Computers & Industrial Engineering.* 62(3), 801-818.

Chopra, S. and Meindl, P. (2007). *Supply Chain Management: Strategy, Planning &*

*Operations*. (3rd ed.). Pearson Education International, N. J.: Prentice Hall.

Christopher, M. (1992). *Logistics and Supply Chain Management*. London: Pitman Publishing.

Christopher, M. (1994). Logistics and Supply Chain Management. Richard D. Irwin, Financial Times, New York.

Christopher, M. and Towill, D. (2000). Supply chain migration from lean and functional to agile and customized. *Supply Chain Management: An International Journal*. 5(4), 206-213.

Chuang-Stein, C. (2001). Some issues concerning the normalization of laboratory data based on reference ranges. *Drug Information Journal.* 35, 153-156.

Cohen, S and Roussel, J. (2005). *Strategic Supply Chain Management: The Five Disciplines for Top Performance*. NY: McGraw-Hill.

Collier, D.A. and Storbeck, J.E. (1993). A data envelopment approach to benchmarking in the telecommunications industry. Working paper, Ohio State Faculty of Management Science, Ohio State University, Columbus.

Cook, T.D. and Campbell, D.T. (1979). *Quasi-Experimentation: Design and analysis issues for field settings.* Houghton Mifflin Company: USA.

Cooper, W.W., Seiford, L.M., and Tone, K. (2000). Data Envelopment Analysis. Boston: Kluwer Academic Publishers.

Cousins, P.D., Lawson, B. and Squire, B. (2006). Supply chain management: theory and practice-the emergence of an academic discipline. *International Journal of Operations & Production Mnagement*. 26(7), 697-702.

Croom, S., Romano, P. and Giannakis, M. (2000). Supply chain management: an analytical framework for critical literature review. *European Journal of Purchasing & Supply Managemen*. 6, 67-83.

Cudney, E., Elrod, C. (2011). A comparative analysis of integrating lean concepts into supply chain management in manufacturing and service industries. *International Journal of Lean Six Sigma*. 2(1), 5-22.

Davis, T. (1993). Effective supply chain management. Sloan Management Review. 35-46.

Detty, R. B. and Yingling, J. C. (2000). Quantifying benefits of conversion to lean

manufacturing with discrete event simulation: a case study. *International Journal of Production Research*. 38(2), 429-445.

Dixon, J.R., Nanni, A.J. and Vollman, T.E. (1990). The New Performance Challenge: Measuring Operations for World Calls Competition. Dow Jones/Irwin, Homewood, IL.

Doolen, T.L. and Hacker, M.E. (2005). A review of lean assessment in organizations: an exploratory study of lean practices by electronics manufacturers. *Journal of Manufacturing Systems.* 24(1), 55-67.

Drickhamer, D. (2003). Lean laggards. *Industry Week*. 252(10), 72.

Drucker, P.F. (1999). Knowledge worker productivity: the biggest challenge. *California Management Review*. 41(2), 79-94.

Eccles, R.G. (1991). The performance measurement manifesto. *Harvard Business Review*. No. January-February, 131-137.

Ellis, E. (2006). Made In Iran. *Fortune Magazine*, 154(6). 12 September 2006. <http://money.cnn.com/magazines/fortune/fortune_archive/2006/09/18/8386173/index.htm?section=money_latest> site accessed on January 2010.

Ellram, L.M. (1991). Supply chain management: the industrial organization perspective. *International Journal of Physical Distribution and Logistics Management*. 21(1), 13-22.

Elmuti, D., Kathawala, Y. and Lloyed, S. (1997). The benchmarking process: assessing its value and limitations. *Industrial Management*. 12-19.

Emiliani, M. L. (2000). Supporting small businesses in their transition to lean production. *Supply Chain Management: An International Journal*. 5(2), 66-705.

Farrell, M.J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*. 120(3), 253-290.

Fasanghari, M., Roudsari, F. H. and Chaharsooghi, S. K. (2008). Assessing the impact of information technology on supply chain management. *World Applied Sciences Journl.* 4(1), 87-93.

Fathian, M., Akhavan, P. and Hoorali, M. (2008). E-readiness assessment of non-profit ICT SMEs in a developing country: The case of Iran. *Technovation*. 28(9). 578-590.

Fawcett, S.E., Magnan, G.M. and McCarter, M.W. (2008). Benefits, barriers, and

bridges to effective supply chain management. *International Journal of Supply Chain Management*. 13(1), 35-48.

Fayez, Mohamed (2005). *An automated methodology for a comprehensive definition of the supply chain using generic ontological components*. Ph.D Thesis. University of Central Florida, Orlando.

Fisher, M. (1997). *What is the Right Supply Chain for Your Product?*. Harvard Business Review. 75(2), 105-116.

Flynn, B. B., Sakakibara, S., Schroeder, R. G., Bates, K.A. and Flynn, E.J. (1990). Empirical research methods in operations management. *Journal of operations management*. 9(2), 250-284.

Fullerton, R.R, McWatters, C.S. and Fawson, C. (2003). An examination of the relationship between JIT and financial performance. *Journal of Operations Management.* 21, 383-404.

Fullerton, R.R and Wempe, W.F. (2008). Lean manufacturing, non-financial performance measures, and financial performance. *International Journal of Operations & Production Management*. 29(3), 214-240.

Gefen, D., and Straub, D. (2005). A practical guide to factorial validity using PLS-GRAPH: tutorial and annotated example. *Communications of the Association for Information Systems. 16*, 91-109.

Gillyard, A. E. (2003). *The relationships among supply chain characteristics, logistics and manufacturing strategies, and performance*. Ph.D. Thesis. Ohio State University, USA.

Gilmour, P. (1998). Benchmarking supply chain operations. *Benchmarking for Quality Management & Technology*. 5(4), 283-290.

Gonzalez, L. (2006). Performance Measurement Using Systems Dynamics in an SME. Ph.D. Thesis. University of Alberta, Canada.

Goodpasture , J. (2004). *Quantitative Methods in Project Management*. US: J. Ross.

Gopal, P. R. C. and Thakkar, J. (2012). A review on supply chain performance measures and metrics: 2000-2011. *International Journal of Productivity and Performance Management*. 61(5), 518-547.

Gunasekaran, A., Patel, C. and Tirtirogulu, E. (2001). Performance measures and metrics in supply chain environment. *International Journal of Operations &*

*Production Management*. 21(1/2), 71-87.

Gunasekaran, A., Patel, C. and McGaughey, R. (2004). A framework for supply chain performance improvement. *International Journal of Production Economics*. 87(3), 333-347.

Gurumurthy, A. And Kodali, R. (2009). Application of benchmarking for assessing the lean manufacturing implementation. *Benchmarking: An International Journal*. 16(2), 274-308.

Hair, J. F., Anderson, R. E., Tatham, R. L. and Black, W. C. (1992). *Multivariate data analysis with readings*. (3rd ed.). New York: Macmillan.

Hatcher, L. (1994). *A Step-by-step Approach to Using the SAS system for Factor Analysis and Structural Equation Modeling*. Cary, NC: SAS institute, Inc.

Hausman, W.H. (2002). *Supply Chain Performance Metrics*. Management Science and Engineering Department, Stanford University, Dordrecht: Kluwer Academic Publishers.

Herron, C. and Braiden, P. M. (2006). A methodology for developing sustainable quantifiable productivity improvement in manufacturing companies. *International Journal of Production Economics.* 104, 143-153.

Hines, T. (2004). *Supply Chain Strategies: Customer-Driven and Customer-Focused*. Oxford, UK: Elsevier Butterwirth-Heinemann.

Ho, R. (2006). *Handbook of univariate and multivariate data analysis and interpretation with SPSS*. Chapman & Hall/CRC, Taylor&Francis Group, US.

Howardell, d. (2004). ACA group. www.theacagroup.com/leanarticle.htm (accessed on June, 2009).

Humphreys, P., Huang, G. and Cadden, T. (2005). A web-based supplier evaluation tool for the product development process. *Industrial Management & Data Systems*. 105(2), 147-63.

Husby, P.C. and Swartwood, D. (2009). *Fix your supply chain: How to create a sustainable lean improvement roadmap*. NY: CRC Press, Taylor & Fransis Group.

Ip, W. H., Chan, S. L. and Lam, C. Y. (2011). Modeling supply chain performance and stability. *Industrial Management & Data Systems.*111(8), 1332-1354.

ISIPO: Iran Small Industries & Industrial Parks Organization (2009). <http://www.iraniec.ir/Site.aspx?ParTree=13181311> Site access on August,

2009.

Iyaniwura, O. and Osoba, A.M. (1983). Measuring Productivity; Conceptual and Statistical Problems: Improvement of Statistics" in Osoba A.M. Productivity in Nigeria. *Proceedings of a National Conference NISER*, Ibadan.

Iyer, A.V. (2009). *Toyota supply chain management: A strategic approach to the principles of Toyota's renowed system*. USA: McGraw-Hill.

Jaklic, J., Trkman, P., Groznik, A., Stemberger, M.I. (2006). Enhancing lean supply chain maturity with business process management. *Journal of Information and Organizational Sciences.* 30 (2), 205-223.

Jilani, T.A., and Burney, S.M.A. (2018). Multivariate stochastic fuzzy forecasting models. *Expert Systems with Applications*. 35, 691-700.

Jin, H. (2008). *Collaborative decision making in modern supply chains*. Ph.D. Thesis. University of Kentucky, US.

Johansson, H.J., McHugh, P., Pendlebury, A.J. and Wheeler, W.A. (1993). *Business Process Reengineering: Breakpoint Strategies for Market Dominance*. Chichester, UK: Wiley.

Johnson, D. E. (1998). *Applied Multivariate Methods for Data Analysis.* Pacific Grove. CA: Duxbury Press.

Johnson, N.L., Kotz, S. and Balakrishnan, N. (1995). *Continuous Univariate Distributions 2.* ($2^{nd}$ ed.). New York: Wiley.

Johnson, H.T. and Kaplan, R.S. (1987). *Relevance Lost: The Rise and Fall of Management Accounting.* Boston, MA: Harvard Business School Press.

Jones, T.C. and Riley, D.W. (1985). Using inventory for competitive advantage through supply chain management. *International Journal of Physical Distribution and Materials Management*. 15(5), 16-26.

Jordan, J,A. and Michel, F.J. (2001). *The Lean Company: Making the Right Choices*. Dearbom, MI: Society of Manufacturing Engineers.

Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement. 20,* 141-151.

Kamath, N.B. and Roy, R. (2007). Capacity augmentation of a supply chain for a short lifecycle product: a system dynamics framework. *European Journal of Operational Research*. 179(2), 334-351.

Kaplan, R.S. and Norton, D.P. (1992). *The balance score card; measures that drive performance*. Harvard Business Review, 71-9.

Karlin, J. N. (2004). *Defining the lean logistics learning enterprise: Examples from TOYOTA's North American supply chain*. Ph.D. Thesis. University of Michigan, US.

Karlsson, C. and Ahlstrom, P. (1996). Assessing changes towards lean production. *International Journal of Operations & Production Management*. 16(2), 24-41.

Karvanen, J. (2003). The statistical basis of laboratory data normalization. *Drug Information Journal*. 37, 101-107.

Kazemi, M.R., Hassanzadeh, R., Mahdavi, I., and Pargar, F. (2013). Applying fuzzy stochastic programming for multi-product multi-time period production planning. *Journal of Industrial and Production Engineering*. 30(2), 132-147.

Keebler, J. S., Manrodt, K. B, Durtsche, D. A. and Ledyard, D. M. (1999). *Keeping SCORE: Measuring the Business Value of Logistics in the Supply Chain*. Oak Brook, IL: Council of Logistics Management.

Keebler, J.S. and Plank, R.E. (2009). Logistics performance measurement in the supply chain: a benchmark. *International Journal of Benchmarking*. 16(6), 785-798.

Kentel, E., and Aral, M.M (2005). 2D Monte Carlo versus 2D fuzzy Monte Carlo health risk assessment. *Stochastic Environmental Research and Risk Assessment (SERRA)*. 19(1), 86-96.

Kleijnen, J.P.C. and Smits, M.T. (2003). Performance metrics in supply chain management. The Journal of the Operational Research Society. 54(5), 507-514.

Kochan, T., Lansbury, R. and MacDuffie, J.P. (1997). *After Lean Production*. Ithaca, NY: Cornell University Press.

Kojima, S. and Kaplinsky, R. (2004). The use of a lean production index in explaining the transition to global competitiveness: the auto components sector in South Africa. *Technovation*. 24, 199-206.

Kopczak, L.R. (1997). Logistics partnership and supply chain restructuring: survey results from the US computer industry. *Production and Operations Management*. 6(3), 226-247.

Kumar, P.R. and Ravi V. (2007). Bankruptcy prediction in banks and firms via statistical and intelligent techniques–a review. *European Journal of Operational Research.* 180(1), 1-28

Kuruppalil, Z. (2007). *Leanness and agility in job shops: A framework for a survey instrument developed using the Delphi method*. Ph.D. Thesis. India State University, Terre Haute, India.

Lambert, D.M. and Cooper, M.C. (2000). Issues in supply chain management. *Industrial Marketing Management*. 29(1), 65-83.

Lambert, D.M. and Pohlen, T.L. (2001). Supply chain metrics. *The International Journal of Logistics Management*. 12(1), 1-17.

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.

Lander, E. (2007). *Implementing Toyota-style systems in high variability environments.* Ph.D. Thesis. University of Michigan, US.

Lapide, L. (2006). MIT's SC2020 Project: The essence of excellence. *Supply Chain Management Review.* 10(3), 18-24.

Lee, H. and Billington, C. (1992). Managing supply chain inventory: pitfalls and opportunities. *Sloan Management Review.* 33(3), 65-73.

Lee, G. L. and Oakes, I. K. (1996). Templates for change with supply chain rationalisation. *International Journal of Operations and Production Management*. 16(2), 197-209.

Lewis, M. A. (2000). Lean production and sustainable competitive advantage. *International Journal of Operations & Production Management.* 20(8), 959-978.

Liker, J.K. (2004). *The Toyota Way*. NY: McGraw-Hill.

Loewenthal, K.M. (2001). *An Introduction to Psychological Tests and Scales*. (2nd ed.). East Sussex: Psychology Press.

Malhotra, N. K. and Birks, D. F. (2006). Marketing Research: An Applied Approach. (2nd ed.). Harlow-England: Prentice Hall.

Manrodt, K.B., Abott, J. and Vitasek, K. (2005). Understanding the Lean Supply Chain: Beginning the Journey. Report on Lean Practices in the Supply Chain, APICS. www.apics.org. (accessed on July, 2010).

Manrodt, K.B., Abott, J. and Vitasek, K. (2008). Lean practices in the supply chain. Report on Lean Practices in the Supply Chain, APICS, www.apics.org. (accessed on July, 2010).

Manzouri, M., Ab Rahman, M. N., and Arshad, H. (2011). Problematic issues in implementation of supply chain management in Iranian automotive industries. *Proceeding of the International Conference on Environment Science and Engineering*. Singapore, 8, 304-307.

Martin, j. w. (2007). *Lean six sigma for supply chain management: The 10-step solution process*. USA: McGraw-Hill.

Maskell, B.H. and Baggaley, B. (2004). *Practical Lean Accounting: A Proven System for Measuring and Managing the Lean Enterprise*. NY: Productivity Press.

Maskell, B. (1989). Performance measures for world class manufacturing. *Management Accounting*. 67(5), 32-33.

Mason-Jones, R, Naylor, B. and Towill, D. (2000). Engineering the Leagile Supply Chain. *International Journal of Agile Management Systems*. 2(1), 54-61.

McKee, R. and Ross, D. (2005). From Lean Manufacturing to Lean Supply Chain: A Foundation for Change. Intentia. www.lawson.com. (accessed on May, 2010).

Medori, D. and Steeple, D. (2000). A framework for auditing and enhancing performance measurement systems. *International Journal of Operations & Production Management*. 20(5), 520-33.

Melnyk, S.A. and Stewart, D.M. (2002). *Metrics and the Supply Chain: An Exploratory Study*. The Education and Research Foundation, APICS.

Mentzer, J. T., DeWitt, W., Keebler, J. S., Soonhoong M., Nix, N. W., Smith, C. D. and Zacharia, Z. G. (2001). Defining Supply Chain Management. *Journal of Business Logistics*. 22(2), 1-25.

Mikko, J. K. and Ilkka, A. K. (2009). Evaluation of the lean level assessment methods. *European Operations Management Association, 16th International Annual EurOMA Conference,* Göteborg.

Mohaghar, A. and Ghasemi, R. (2011). A conceptual model for supply chain relations quality and supply chain performance by structural equation modeling: a case study in the Iranian automotive industry. *European Journal*

*of Social Sciences*. 21(3), 456-470.

Mohammed, I.R., Shankar, R. and Banwet, D.K. (2008). Creating flex-lean-agile value chain by outsourcing: An ISM-based interventional roadmap. *Business Process Management Journal*. 14(3), 338-389.

Moitra, S. D. (1990). Skewness and the beta distribution. *Journal of the Operational Research Society*. 41, 953-961.

Momeni, M., Monavarian, A., Shaabani, E. And Ghasemi, R. (2011). A conceptual model for knowledge management process capabilities and core competencies by SEM: the case of Iranian automotive industry. *European Journal of Social Sciences.* 22( 4), 473-489

Monden, Y. (1998). Toyota Production System: An Integrated Approach to Just-In-Time. (3rd ed.) Norcross, GA: Engineering & Management Press.

Moore, K.A. (2001). *Value mapping framework involving stakeholders for supply chain improvement when implementing information technology projects*. Ph.D. Thesis. University of Central Florida, Orlando, Florida.

Moore, N. (1987). *How to do Research*. (2nd ed.). Library Association, London.

Morgan, M. G. and Henrion, M. (1990). *Uncertainty: A Guide to Dealing with Uncertainty in Quantitatice Risk and Policy Analysis*. Cambridge: Cambridge University Press.

Mousavi, S.M., Jolai, F., and Tavakkoli-Moghaddam, R. (2011). A fuzzy stochastic multi-attribute group decision-making approach for selection problems. *Group Decision and Negotiation.* 22(2), 207-233.

Narasimhan, R., Swink, M. and Kim, S.W. (2006). Disentangling leanness and agility: an empirical investigation. *Journal of Operations Management*. 24(1), 440-457.

Naylor, J. B., Naim, M.M. and Berry,D. (1999). Leagility: Integrating the Lean and Agile Manufacturing Paradigms in the Total Supply Chain. *International Journal of Production Economics*. 62(1), 107-118.

Neely, A., Bourne, M. and Kennerly, M. (2000). Performance measurement system design. *International Journal of Operations & Productions Management*. 20(10), 1119-1145.

Neely, A., Gregory, M. and Platts, K. (2005). Performance measurement system

design. *International Journal of Operations & Production Management*. 25(12), 1228-1263.

Ngai, E.W.T., Cheng, T.C.E. and Ho, S.S.M. (2004). Critical success factors of ebbased supply chain management systems: An exploratory study. *Production Planning and Control*. 15, 622-630.

Nicholas, J.M. (2004). *Project Management for Business and Engineering.* (2nd ed.). Burlington. MA, Elsevier, Butterworth-Heinemann.

Nicoll, A.D. (1994). Integrating logistics strategies. *Proceeding of the Annual International Conference of American Production and Inventory Control Society*, 590-594.

Norhayati, Z. (2009). *Structural Analysis of Total Quality Management, ISO/TS16949 and Organizational Performance in Malaysian and Thailand Automotive Industry*. Ph.D. Thesis, Universiti Teknologi Malaysia.

Nunnally, J. (1967). *Psychometric Theory*. New York: McGraw-Hill.

Nunnally, J. C. (1978). *Psychometric Theory*. (2nd ed.). New York: McGraw-Hill.

Nunnally, J. C. and Bernstein, I. H. (1994). *Psychometric Theory.* (3rd ed.). New York: McGraw-Hill.

Oeij, P.R.A., De Looze, M.P., Ten Have, K., Van Rhijn, J.W. and Kuijt-Evers, L.F.M. (2011). Developing the organization's productivity strategy in various sectors of industry. *International Journal of Productivity and Performance Management.* 61 (1), 93-109.

Ohno, T. (1988). *Toyota Production System*. Portland, Oregon, US: Productivity Press.

Oliver, R. K. and Webber, M.D. (1992). *Supply Chain Management: Logistics catches up with strategy*. Outlook, reprinted in Christopher, M.G. (1992), Logistics: the Startegic Issues. London, UK: Chapman and Hall.

Olugu, E. U. And Wong, K. Y. (2012). An expert fuzzy rule-based system for closed-loop supply chain performance assessment in the automotive industry. *Expert Systems with Applications*. 39. 375-384.

Pallant J. (2011). *SPSS Survival Manual: A step by step guide to data analysis using SPSS*. (4th ed.). Crows Nest: Allen & Unwin.

Phelps, T. (2004). Building a lean supply chain. *Journal of Society of Manufacturing Engineers,* www.findarticles.com/p/articles/mi_qa3618.htm. (accessed on

May 2009).

Phelps, T., Hoenes, T. and Smith, M. (2003). *Developing Lean Supply Chains: A Guidebook*. Altarum Institute, The Boeing Company, and Messier-Dowty Inc.

Plenert, G. (2007). *Reinventing Lean: Introducing Lean Management into the Supply Chain*. Oxford OX2 8DP, UK: Linacre House, Jordan Hill.

Rahman, S., Laosirihongthong, T. and Sohal, A. S. (2010). Impact of lean strategy on operational performance: a study of Thai manufacturing companies. *Journal of Manufacturing Technology Management*. 21(7), 839-852.

Rasch, S. (2004). *Lean manufacturing practices at small and medium-sized U.S. parts suppliers-Does it work?*. New York: Productivity Press.

Rasli, A. (2006). *Data analysis and interpretation: A handbook for postgraduate social sciences.* Penerbit Universiti Teknologi Malaysia, Johor, Malaysia.

Ray, C.D., Zuo, X., Michael, J.H. and Wiedenbeck, J.K. (2006). The lean index: operational lean metrics for the wood products industry. *Wood and Fiber Science*. 38(2), 238-55.

Ross, D.F. (2003). *Introduction to e-Supply Chain Management: Engaging Technology to Build Market-Winning Business Partnerships*. Boca Raton, FL: St Lucie Press.

Ross, S.M. (2004). *Introduction to Probability and Statistics for Engineers and Scientists.* Elsevier Academic Press. Burlington, MA, US

Rother, M. and Shook, J. (1998). Learning to See–Value Stream Mapping to Add Value and Eliminate Muda. Cambridge: The Lean Enterprise Institute.

Russell, R. and Taylor, B. (2006). *Operations Management: Quality and Competitiveness in a Global Environment*. (5th ed.). N. J: Wiley.

Rutkauskas, J. and Paulaviciene, E. (2005). Concept of productivity in service sector. *Engineering Economics*, 3(43), 29-34.

Saad, M. and Patel, B. (2006). An investigation of supply chain performance measurement in the A87 automotive sector. *Benchmarking: An International Journal*. 13(1/2), 36-53.

Sakakibara, S., Flynn, B.B., Schroeder, R.G. and Morris, W.T. (1997). The impact of just-in-time manufacturing and its infrastructure on manufacturing performance, *Management Science*, 43(9), 1246-1257.

Samani, M.B., Attafar, A., Khouzani, N. K. (2011). A conceptual model for Iran's car industry customers' loyalty. *Proceeding of the 2nd International Conference on Business and Economic Research*, 790-797.

Sambasivan, M., Nandan, T. and Mohamed, Z.A. (2009). Consolidation of performance measures in a supply chain environment. *Journal of Enterprise Information Management*. 22(6), 660-689.

Santoso, T., Ahmed, S., Goetschalcks, M., and Shapiro, A. (2005). A stochastic programming approach for supply chain network design under uncertainty. *European Journal of Operational Research*. 167, 96-115.

Schonsleben, P. (2004). *Integral Logistics Management: Planning and Control of Comprehensive Supply Chains*. Auerbach Publications, Boca Raton, FL.

Schwab, D. P. (1980). Construct validity in organizational behaviour. *Research Organizational Behaviour*. 2(1), 3-43.

Seth, D., Seth, N. and Goel, D. (2007). Application of value stream mapping (VSM) for minimization of wastes in the processing side of supply chain of cottonseed oil industry in Indian context. *Journal of Manufacturing Technology Management*. 19(4), 529-550.

Shah, R., Ward, P. (2003). Lean manufacturing: context, practice bundles, and performance. *Journal of Operations Management*. 21, 129–149.

Simchi-Levi, D., P. Kaminsky, *et al*. (2003). *Designing and Managing the Supply Chain*. (2nd ed.). New York: McGraw-Hill.

Singh, B., Garg, S.K. and Sharma, S.K. (2010). Development of index for measuring leanness: study of an Indian auto component industry. *Journal of Measuring Business Excellence*. 14 (2), 46-53.

Slack, N. (1983). Flexibility as a manufacturing objective. *International Journal of Operations & Production Management*. 3 (3), 4-13.

Soni, G. and Kodali, R. (2010). Internal benchmarking for assessment of supply chain performance. *Benchmarking: An International Journal*. 17(1), 44-76.

Soriano-Meier, H. and Forrester, P.L. (2002). A model for evaluating the degree of leanness of manufacturing firms. *Journal of Integrated Manufacturing Systems*. 13(2), 104-109.

Spendolini, M. J. (1992). The Benchmarking Process. *Compensation Benefits*

*Review*, 5(24), 21-29.

Srinivasan, M. M. (2004). *Streamlined: 14 Principles for Building and Managing the Lean Supply Chain.* Madison, OH: Thompson.

Srinivasaraghavan, J. and Allada, V. (2006). Application of mahalanobis distance as a lean assessment metric. *International Journal of Advanced Manufacturing Technology*. 29, 1159-1168.

Steinlicht, C. L. (2010). *Lean Production and the Organizational Life Cycle: A Survey of Lean Tool Effectiveness in Young and Mature Organizations*. Ph.D. Thesis, Capella University.

Stewart, G. (1995). Supply chain Performance Benchmarking Study Reveals Keys to Supply Chain Excellence. *Logistics Information Management*. 8(2), 38-44.

Stewart, G. (1997). Supply-chain operations reference model (SCOR): the first cross-industry framework for integrated supply chain management. *Logistics Information Management*. 10(2), 62-7.

Stone, K. (2012). Four decades of lean: a systematic literature review. *International Journal of Lean Six Sigma*. 3(2), 112-132.

Sueyoshi, T. (1999). DEA-discriminant analysis in the view of goal programming. *European Journal of Operational Research*. 115(3), 564-582.

Supply Chain Council. (2005). www.supply-chain.org (accessed on May, 2009).

Supply-Chain Council. (2006). Supply chain operations reference model version 8.0. www.supply-chain.org (accessed on 16 July 2010).

Tabachnick, B. G. and Fidell, L. S (2007). *Using Multivariate Statistics.* ($5^{th}$ ed.). Boston: Pearson Education.

Tangen, S. (2005). Demystifying productivity and performance. *International Journal of Productivity and Performance Management*. 54(1), 34-46.

Tapping, D. (2006). *The Lean Pocket Guide XL – Tools for the Elimination of Waste*, Kindle ed., Kindle Book, New York, NY.

Teng, Z. (2012). Research on abroad direct distribution alliance strategy for Chinese garment foreign trade SMEs surviving in the recession. *International Journal of Business Administration*. 3(6), 41-44.

Thakkar, J., Kanda, A. And Deshmukh, S. G. (2009). Supply chain performance measurement framework for small and medium scale enterprises. *Benchmarking: An Internationa Journal.* 16 (5), 702-723.

Theeranuphattana, A. and Tang, J. C. S. (2008). A conceptual model of performance measurement for supply chains alternative consideration. *Journal of Manufacturing Technology Management.* 19(1), 125-148.

Upton, D.M. (1995). What really makes factories flexible?. *Harvard Business Review.* 73(4), 74-84.

Vose, D. (2008). *Risk Analysis – A quantitative Guide*. (3rd ed.). Chichester, UK: Wiley.

Wan, H. (2006). *Measuring Leanness of Manufacturing Systems and Identifying Leanness Target by Considering Agility*. Ph.D. Thesis, Virginia Polytechnic Institute and State University.

Wan, H., and Chen, F. (2006). An Application of Slacks-Based Measure on Quantifying Leanness. *Proceeding of 2007 Annual Industrial Engineering Research Conference*, May 20-24, Orlando, Florida.

Wan, H., Chen, F. and Rivera, L. (2007). Leanness Score of Value Stream Maps. *Proceedings of 2007 Industrial Engineering Research Conference*, Atlanta, GA, USA.

Wee, H.M. and Wu, S. (2009). Lean supply chain and its effect on product cost and quality: a case study on Ford Motor Company. *Supply Chain Management: An International Journal*. 14(5), 335–341.

William, L. (2003). Office kaizen: transforming office operations into a strategic competitive advantage. American Society for Quality, Milwaukee, Wisconsin.

Wincel, P.J. (2004). *Lean Supply Chain Management: A Handbook for Strategic Procurement*. NY: The Free Press.

Womack, J. P. and Jones, D. T. (1996*). Lean Thinking: Banish Waste and Create Wealth in Your Corporation*. NY: Simon and Schuster.

Womack, J. P., Jones, D. T. and Roos, D. (1990). *The machine that changed the world*. NY: Harper Perennial.

Wong, W.P. and Wong, K.Y. (2007). Supply chain performance measurement system using DEA modeling. *Journal of Industrial Management & Data Systems*. 107(3), 361-381.

Wong, W.P. and Wong, K.Y. (2008). A review on benchmarking of supply chain

performance measures. *International Journal of Benchmarking*. 15(1), 25-51.

Yasin, M. M. (2002). The theory and practice of benchmarking: then and now. *Benchmarking: An International Journal*. 9(3), 217-243.

Yin, R.K. (1994). *Case Study Research: Design and Methods.* (2nd ed.). Sage Publications, London.

Zadeh, L.A. (1978). Pruf-meaning representation language for natural language. *International Journal of Man-Machine Studies.* 10, 395–460.

Zadeh, L. A. (1975). The Concept of Linguistic Variable and Its Approximate Reasoning, Part I. *Information Science*. 8, 199-249.

Zadeh, L.A. (1965). Fuzzy Sets. *Information and Control*. 8, 338-353.

Zairi, M. and Hutton, R. (1995). Benchmarking: a process-driven tool for quality improvement. *TQM Magazine*. 7(3), 35-40.

Zakuan, N. (2009). *Structural analysis of total quality management, ISO/TS16949 and organizational performance in Malaysia and Thailand automotive industry*. Ph.D Thesis. Universiti Teknologi Malaysia, Skudai.

Zhang, Q., Vonderembse, M.A., and Lim, J.S. (2003). Manufacturing flexibility: defining and analyzing relationships among competence, capability, and customer satisfaction. *Journal of Operations Management*. 21(2), 173-191.