

AHP MODEL FOR OPTIMUM DISTRIBUTION NETWORK SELECTION IN
FOOD INDUSTRY

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ABSTRACT

Efficient supply chain distribution network design must take into account various dimensions of performance and product characteristics. The appropriate choice of distribution network results in customer needs being satisfied at the lowest possible cost. Investigators have recently begun to realize that the decision in the supply chain distribution network design must be driven by an extensive set of performance metrics and the characteristics of the products. In this thesis, cost and service factor performance metrics were regarded as the decision criteria for optimizing supply chain distribution network design. Qualitative and quantitative factors were considered in selecting the optimum delivery network design by using Analytic Hierarchy Process (AHP) methodology. After aggregating the ideas of a group of experts and customers, the selection decision is made. Sensitivity analysis was performed to show the robustness and consistency of the model. The results of the analysis illustrate the model is found to be stable and robust and the ketchup sauce manufacturers can select their suitable and optimum distribution network designs according to this study.

ABSTRAK

Rangkaian penghantaran rangkaian bekalan yang berkesan perlu mengambil kira pelbagai dimensi prestasi dan ciri-ciri produk. Kehendak pelanggan hanya dapat dipenuhi sekiranya pemilihan rangkaian penghantaran bekalan yang betul dilakukan di mana ia dapat membantu di dalam memastikan kos penghantaran yang rendah. Melalui kajian yang pernah dilaksanakan, didapati pemilihan rangkaian penghantaran bekalan perlu berdasarkan kepada metrik prestasi yang ekstensif dan ciri-ciri produk. Di dalam kajian ini, faktor kos dan perkhidmatan digunakan sebagai kriteria pemilihan rangkaian penghantaran bekalan yang paling optimum. Faktor kualitatif dan kuantitatif dimbilkira dengan menggunakan method Proses Analisis Hierarki atau (AHP) di dalam pemilihan rangkaian penghantaran yang optimum. Pemilihan akhir dibuat berdasarkan pandangan sekumpulan pakar dan pelanggan. Analisis sensitiviti digunakan untuk memastikan konsistensi model yang dicadangkan. Daripada analisis yang dijalankan, didapati bahawa model adalah stabil dan konsisten. Hasil kajian ini dapat diaplikasikan oleh pengeluar sos bagi pemilihan rangkaian bekalan penghantaran yang bersesuaian serta paling optimum.

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LIST OF ABBREVIATIONS

AHP	-	Analytic Hierarchy Process
CR	-	Consistency Ratio
CI	-	Consistency Index
DC	-	Distribution Centre
MCDM	-	Multi Criteria Decision Making
RI	-	Random Index
SGMM	-	Simple Geometric Mean Method
UTM	-	Universiti Teknologi Malaysia
WGMM	-	Weighted Geometric Mean Method

LIST OF SYMBOLS

λ_i	-	Weight of each decision maker in WGMM Method
X	-	The set containing the ideas of decision makers
X_i	-	Idea of each decision maker in WGMM Method
C_{ci}	-	Cost factor criteria
C_{si}	-	Service factor criteria
A_i	-	Alternatives of distribution network design
C	-	Cost factor
S	-	Service factor

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Supply chain is a network of facilities, such as suppliers, plants, distributors, warehouses, retailers which performs a set of operations including procurement of components and raw materials, assembling of products, storage and handling of semi finished and finished products, transportation and delivery of products, and so on (Ding *et al.*, 2007).

Distribution refers to the steps taken to move and store a product from the supplier stage to a customer stage in the supply chain. Distribution is a key driver of the overall profitability of a firm because it directly affects both the supply chain cost and the customer experience. Choice of distribution network can achieve supply chain objectives from low cost to high responsiveness. As a result, companies in the same industry often select very different distribution networks (Chopra and Meindl, 2010).

Dell distributes its PCs directly to end consumers, while companies like Hewlett Packard and Compaq distribute through resellers (Magretta, 1998). Dell customers wait several days to get a PC while customers can walk away with an HP or Compaq PC from a reseller. Gateway opened Gateway Country stores where

customers could check out the products and have sales people help them configure a PC that suited their needs. Gateway, however, chose to sell no products at the stores, with all PCs shipped directly from the factory to the customer. In 2001, Gateway closed several of these stores given their poor financial performance. Apple Computers is planning to open retail stores where computers will be sold (Wong, 2001). These PC companies have chosen three different distribution models. How can we evaluate this wide range of distribution choices? Which ones serve the companies and their customers better? This research is more focused on selecting an appropriate distribution network for a specific company which provides customer satisfaction at the lowest cost.

This chapter explains background of the study, problem statement, objectives, scope, significance of the study, the research outline following by conclusion.

1.2 Research Background and Motivation

Effective supply chain distribution network design needs to consider various performance dimensions and product characteristics. It is clearly important to design or redesign a production distribution network based on a comprehensive optimization analysis.

The results obtained by academic researchers have been partially put into practice. Recently, researchers have begun to realize that the decision and integration effort in supply chain design should be driven by a comprehensive set of performance metrics and also product characteristics (Mithun, 2008).

Despite attempts to choose the best delivery network design or combination of design, it is still a major challenge for the decision maker. There is still need to investigate the design/selection of an appropriate supply chain distribution network

design to achieve optimal performance, which is measured using a set of metrics and criteria. Most decision makers make qualitative analysis to design the distribution network. Through their experience and intuition they select a combination of these network designs. But there is no research so far in optimizing the designs objectively so as to make feasible decisions whether it is a single or combination of selections.

Therefore, this research provides a framework and identifying key dimensions along which to evaluate the performance of any distribution network. To achieve this goal it is proposed to use multi-criteria decision-making tool known as analytical hierarchy process (AHP).

1.3 Problem Statement

Production distribution network design is a critical decision that has significant impacts on a supply chain's long-term performances. One of the most important problems in supply chain management is the distribution network design problem system which involves locating production plants and distribution warehouses, and determining the best strategy for distributing the product from the plants to the warehouses and from the warehouses to the customers (Golmohammadi *et al.*, 2009).

Herein, it is considered that the problem of designing a distribution network that involves determining the best strategy for distributing the product from the plants to the warehouses and from the warehouses to the customers.

Hence choosing the best delivery network design or a combination of design is a major challenge for the decision maker. Firms can make many different choices when designing their distribution network. A poor distribution network can hurt the level of service that customers receive while increasing the cost. An inappropriate

network can have significant negative effect on the profitability of the firm. The appropriate choice of distribution network results in customer needs being satisfied at the lowest possible cost (Mithun, 2008).

Therefore, design of distribution network in supply chain needs to focus primarily on the objectives and not just the development of tools used in decision making. This study primarily deals with the design/selection of an appropriate supply chain configuration to achieve optimal performance, which is measured using a set of metrics. Thus, four companies of a consumer product located in Johor, Malaysia are selected for this survey. The best distribution network was selected, results in customer needs being satisfied at the lowest possible cost.

1.4 Objective of the Study

The study aims to select suitable distribution network design based on performance metrics for companies of a consumer product located in Malaysia.

Specific objective associated with this aim is designing a distribution network that the demands of all customers are satisfied with the minimum of transportation and warehousing cost.

1.5 Scope of the Study

This study primarily focuses on identifying appropriate distribution network designs in four ketchup sauce manufacturers who are from the same type of

industries and produce the same product in Malaysia. The scope of this study is determining the suitable distribution network design for this kind of industry.

AHP methodology will be applied which will select the best set of multiple distribution networks to satisfy profitability and customer satisfaction.

1.6 Significant of the Study

As at now, there is no known study in optimizing the designs of distribution network objectively so as to make feasible decisions whether it is a single or combination of selections in Johor. This study attempted to provide more information in optimizing supply chain delivery network design and adopt cost and service factor performance metrics as the decision criteria.

The study could be served as a guide to select the appropriate choice of distribution network from the manufacturer to the end consumer results in customer needs being satisfied at the lowest possible cost and as a reference material to decision makers and future scholars in this area. This is done by presenting better understanding of performance metrics influencing distribution network design which are cost and service factor. Then, it will provide managers with logical framework for selecting the appropriate distribution network given product, competitive and market characteristics. Also the proposed procedure enables managers of similar firms and industries to adjust a combination of network design to eliminate risk and to enhance service quality and profitability.

1.7 Organization of Thesis

This thesis is organized into five chapters. Chapter one introduces the study background and motivation, statement of the research problem, research objectives, research scope and significant of study.

Chapter two reviews relevant research studies on understanding the role of distribution within supply chain and identifies factors that should be considered when designing a distribution network.

Chapter three provides the methodology of the study so that it can be carried out systematically. The major sections of this chapter are research framework and model, questionnaire and choice of optimizing technique.

In chapter four, different parts of data gathering will be described and the results obtained from these parts of data collection are presented.

In the last chapter, the results of the work are provided to show the outcomes of questionnaire and AHP method to the problem. In addition, a brief discussion about the results is presented to give a better understanding. Finally, some recommendations are offered for the future studies that can be done in the area.

1.8 Conclusion

This chapter has described about the introduction to this project. All details about the problems, objective, scope, and significant of the study has been explained. The next chapter, Chapter 2, will present a literature review related to the research.

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