The Key Successful Factors for Distribution Bases Positioning in Global Logistics Management -- Taiwan's Perspective

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Abstract

Distribution Bases (DB) positioning is an important decision in enterprise's Global Logistics Management (GLM). This article applied the Fuzzy Analytic Hierarchy Process (FAHP) to extract the Key Successful Factors (KSFs) for enterprise's DB positioning. Finally, this article suggested five KSFs as: 1.National Safety Degree, 2.Distribution Ability, 3.Information System Integration Degree, 4.Operational Risk Management Ability, and 5.Financial Risk Management Ability.

Keywords: Distribution Bases, Global Logistics Management, Key Successful Factor, Fuzzy Analytic Hierarchy Process.

KSF for Distribution Bases Positioning in Global Logistics Management -- Taiwan's Perspective

I. INTRODUCTION

Distribution means to marketing and carrying products from makers to customers. For a Multi-National Enterprise (MNE), "Distribution" always means to carrying products to other countries through its Distribution Channel. Therefore, MNE have to setting Distribution Facilities, called "Distribution Bases (DB)" in this article, under its International logistics plan. Since DBs are cross to the customers, DB positioning is an important decision in enterprise's Global Logistics Management (GLM).

There are three definitions for distribution in American Marketing Association (AMA): 1. (economic definition) A study of how factors of production are priced in the market place, i.e., the de-termination of rents, wages, interest, and profits. 2. (marketing definition) The marketing and carrying of products to consumers. 3. (business definition) The extent of market coverage.[1]

In Wikipedia, (Product) Distribution is one of the four elements of the marketing mix. An organization or set of organizations involved in the process of making a product or service available for use or consumption by a consumer or business user.[2]

Enterprise has to design the Distribution Channel under its Distribution Strategy [Kotler and Armstrong, 2008]. Simchi-Levi et al. [2000] suggested three kind of the outbound distribution strategies in supply chain, there are: direct shipment, warehousing, and cross-docking.

Anderson et al. [1997] pointed out that the technological change, marketplace demands, aggressive global competition, and workplace and population demographics are the key factors affecting modern distribution channels.

Distribution Channel is a system or relationships among businesses that participate in the process of buying and selling products and services [Bowersox et al., 2002]. For choose the Distribution Channel, Huff [1964] developed a model in which the attraction of a site is proportional to the size of the retail center and inversely proportional to the customers' distance from the site. This model has been extended to incorporate not only size of retail site, but also image. These models are extensions of the Multiplicative Competitive Interaction model. Logistics-related optimization models have also been developed for warehouse locations and inventory management. Jaffe and Yi [2007] developed a model to analyzing the length of Distribution Channel in China, and found that the drivers of channel length are economic development, consumption, consumer mobility/outreach, urbanization and

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[1] AMA Dictionary, http://www.marketingpower.com/_layouts/Dictionary.aspx, reference date: 2011/12/21.

[2] http://en.wikipedia.org/wiki/Distribution_(business) , reference date: 2012/2/11.

government policy. Paksoy et al. [2012] applied the Fuzzy Analytic Hierarchy Process and hierarchical fuzzy TOPSIS to study the Organizational strategy development in distribution channel management.

Cheng [2010] defined the Distribution as the process for products from seller to buyer. Cheng [2010] defined the Channel as a network which composed of Middlemen (for example: agents, wholesalers, and retailers) among sellers and buyers. For DB activities, in Cheng [2010], there are many dynamic flows: physical flow, ownership flow, negotiation flow, promotion flow, information flow, and money flow.

Distribution Center (DC) is an important facility for DB. A distribution center for a set of products is a warehouse or other specializedbuilding, often with refrigeration or air conditioning, which is stocked with products (goods) to be redistributed to retailers, to wholesalers, or directly to consumers. Distribution centers are the foundation of a supply network, as they allow a single location to stock a vast number of products.[3]

Lu [2003] found four attributes of distribution centers were considered as important or very important by shippers: cargo safety, cargo tracing, tracking, inland transportation, and customs clearance.

Oum and Park [2004] found that there are not a single MNE in their sample have established a highly consolidated distribution center that can serve the entire Asian market. Oum and Park explained as: although current overwhelming trend of globalization forces MNEs to consolidate warehouses and distribution centers located in each country into a fewer distribution centers that serve a much wider geographic areas, there still exist some opposing pressures such as differences in local customer preferences and government stipulations.

There are many papers investigated the location problem for Distribution Bases. Li and Liu [2011] applied the fuzzy neural network model for logistics distribution center location problem. Li et al. [2011] applied the rough sets and objective fuzzy decision theory to solve the distribution center location problem.

Wu [2008] applied the Simple Analysis of Related System (SARS) and Quantitative SWOT methods to study the key index for the Notebook computer DC. Chang [2010] applied the Particle Swarm Optimization (PSO) algorithm to compute the two-stage supply chain distribution problem. Chang [2011] applied the dynamic programming algorithm and local swap techniques to study the Large-scale Distribution Network, and developed a graphical user interface (GUI) system and the proposed system demonstrates its practical usefulness.

This article tried to extract the Key Successful Factors (KSFs) for select the location in MNE's DB positioning. And this article applied the Fuzzy Analytic Hierarchy Process (FAHP) method to accomplish this study. The corresponsive importance among the KSF raised was

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[3] http://en.wikipedia.org/wiki/Distribution_center , reference date: 2012/2/11.

clarified via the cautious professional questionnaire joined with a solid data analysis and FAHP ranking.

The issue of KSF was first proposed by Daniel [1961] who mentioned that most of the successful enterprises possess three to six fundamental factors. A company who was desirous to be successful was required to be excellent in those essentialities.

II. QUESTIONNAIRE DESIGN

Refer to the FAHP's methodology, the questionnaire was designed as 4 levels hierarchy including 2 main-dimensions, 10 sub-dimensions, and 43 variables. The structure showed as Figure 1, and brief described in the next sub-sections.

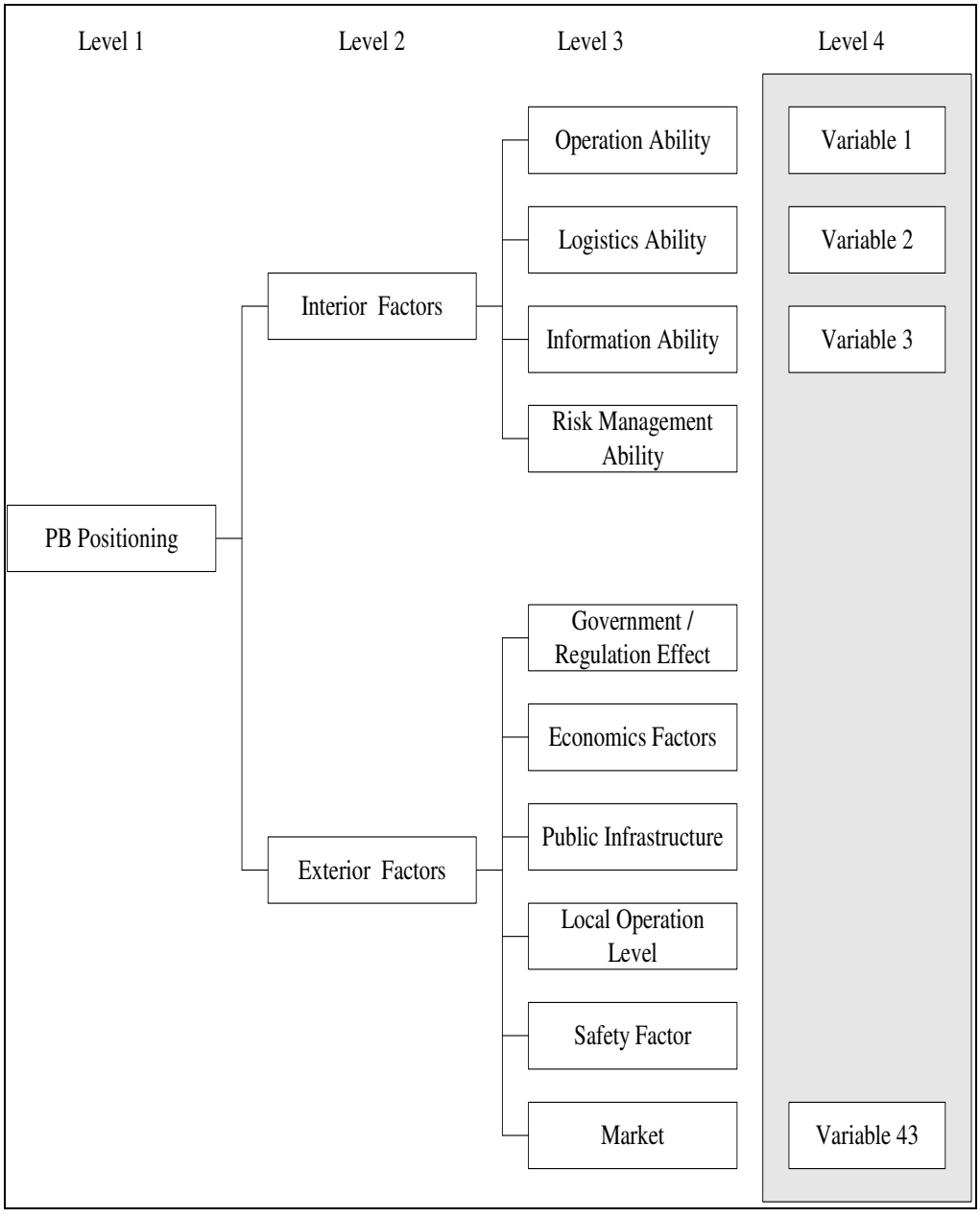

Figure 1. the Questionnaire Structure

2.1 Level 2 Description

The Level 2 dimension including 2 items: Interior Factors and Exterior Factors. The description showed as Table 1.

Table 1. Level 2 Dimension Description

Item	Definition
Interior Factors	means the distinctive abilities for the enterprise
Exterior Factors	means the exterior factors that must face for enterprise operation

2.2 Level 3-1 Description

The Level 3-1 was the sub-dimension for the "Interior Factors" which includes 4 items: Operation Ability, Logistics Ability, Information Ability, and Risk Management Ability. The description showed as Table 2.

Table 2 Level 3-1 Dimension Descriptions

Dimension	Variable	Literature
Operation Ability	Product Development Ability	Hill [2006]
	Production Ability	Simchi-Levi et al. [2000]
	Market Development Ability	Flint [2004]
	Human Resource	Stock and Lambert [2001]
	Response Ability	Chopra and Meindl [2007]
Logistics Ability	Supplier Stability	Handfield and Nichols [2005]
	Dealers/ Agents Stability	Handfield and Nichols [2005]
	Inventory Visibility	Bowersox et al. [2002]
	Distribution Ability	Handfield and Nichols [2005]
	Green Logistics Ability	Dornier et al. [1998]
Information Ability	Electronicalizational Level	Turban et al. [2000]
	Information System Integration Degree	Simchi-Levi et al. [2000]
	Information System Implementation Degree	Copper and Zumd [1990]
Risk Management Ability	Financial Risk Management Ability	Frazelle [2002]
	Operational Risk Management Ability	Bowersox et al. [2002]

2.3 Level 3-2 Description

The Level 3-2 was the sub-dimension for the "Exterior Factors" which includes 6 items: Government/ Regulations Effect, Economic Factors, Public Infrastructures, Local Operation Level, Safety Factor, and Market. The description showed as Table 3.

Table 3 Level 3-2 Dimension Descriptions

Dimension	Variable	Literature
Government/ Regulations Effect	Government Efficiency	[4]
	Home Country Policy	[5]
	Host Country Policy	[6]

[4] http://www.imd.ch/research/centers/wcc/index.cfm, reference date:2009/3/20.
[5] http://tw.news.yahoo.com/article/url/d/a/091219/17/1x8q0.html, reference date: 2009/12/19.

Dimension	Variable	Literature
	Government Stability	[7]
	Legal Advanced Degree	Hill [2006]
Economic Factors	Exchange Rate Stability	Stock and Lambert [2001]
	Interest Rate Stability	[8]
	Economic Growth Rate	Stock and Lambert [2001]
	Foreign Exchange Reserves	[9], [10]
	Exporting Amount	Hill [2006]
	Importing Amount	
	Taxation Level	Hill [2006]
	Incentive Measures	[11]
Public Infrastructures	Land Acquirability	
	Harbor Container Thoughput	[12], [13]
	Customhouse Efficiency	Simchi-Levi et al. [2000]
	Harbor Facility Perfect Degree	
	Infrastructure Index	[14]
Local Operation Level	Laborer Quality	Cullen and Parboteeah [2005]
	National Incomes	Hill [2006]
	Business Efficiency	[15]
Safety Factor	National Safety Degree	[16]
	Geographical Safety Degree	[17], [18], [19]
Market	Market population	[20], [21], [22]
	Market land area	Dornier et al. [1998]
	Market Acceptance Degree	Cullen and Parboteeah [2005]
	Market Competitive Degree	Porter [1985]
	Globalization Index	[23]

III. DATA ANALYSIS

[6] http://tw.stock.yahoo.com/news_content/url/d/a/091217/3/1tbbn.html, reference date: 2009/12/17.
[7] http://tw.news.yahoo.com/article/url/d/a/081127/78/1a5t5.html, reference date: 2008/11/27.
[8] http://tw.news.yahoo.com/article/url/d/a/100108/5/1yfbw.html, reference date: 2010/1/8.
[9] http://tw.news.yahoo.com/article/url/d/a/090203/1/1duhl.html, reference date: 2009/2/3.
[10] http://tw.news.yahoo.com/article/url/d/a/090904/52/1qhcw.html, reference date: 2009/9/4.
[11] http://www.ccicsonline.net/ccics/images/news/20030617_2.doc, reference date: 2003/6/17.
[12] http://tw.news.yahoo.com/article/url/d/a/100126/5/1zh4h.html, reference date: 2010/1/26.
[13] http://tw.news.yahoo.com/article/url/d/a/100125/5/1ze3h.html, reference date: 2010/1/25.
[14] http://www.imd.ch/research/centers/wcc/index.cfm, reference date:2009/3/20.
[15] http://www.imd.ch/research/centers/wcc/index.cfm, reference date:2009/3/20.
[16] http://tw.news.yahoo.com/article/url/d/a/091104/78/1ua0s.html, reference date: 2009/11/4.
[17] http://en.wikipedia.org/wiki/2004_Indian_Ocean_earthquake, reference date: 2010/1/13.
[18] There were five scientists presented a paper during the 18th Caribbean Geological Conference in March 2008 in Santo Domingo, Dominican Republic, warned of Haiti earthquake risk. http://www.cnn.com/2010/TECH/science/01/12/caribbean.earthquakes/index.html, reference date: 2010/1/13. This shows sometimes such calamity can be warned for enterprise's operation.
[19] Widespread destruction from Japan earthquake, tsunamis, http://edition.cnn.com/2011/WORLD/asiapcf/03/11/japan.quake/index.html#, 2011/3/12.
[20] http://en.wikipedia.org/wiki/ASEAN%E2%80%93China_Free_Trade_Area, reference date: 2010/1/11.
[21] http://en.wikipedia.org/wiki/European_Union, reference date: 2010/1/11.
[22] http://en.wikipedia.org/wiki/NAFTA, reference date: 2010/1/11.
[23] http://www.kof.ethz.ch, reference date: 2009/3/20.

In Section 3, this article describes the sampling plan and displays the computation results for FAHP.

3.1 Sample Description

This article proposed the FAHP's questionnaire by chosen 14 experts from many MNEs. These experts includes 2 R&D managers, 2 finical managers, 2 accounting managers, 1 production manager, 2 marketing managers, 1 risk manager, 2 trade managers, 1 personnel manager, and 1 information manager.

3.2 The Computation Technology for FAHP

This article applied FAHP method to compute the index values for KSF.

According to the AHP level structure, the questionnaire was designed as four levels: the goal, the dimensions, the sub-dimensions, and the criteria. Every factor belonging to different levels was evaluated by the expert scholars, and the results were regarded as the reference of KSF.

Based on the AHP analysis, the variables were compared in pairs. The relative importance between two variables, from low to high, and was ranked into five ranks: the number (1) for equal important, (3) for slightly important, (5) for very important, (7) for extremely important, and (9) for absolutely important. And, there are rank (2), (4), (6), and (8) in between each ranks accordingly.

This article applied the FAHP as the analysis methodology. Based on the notion of fuzzy sets, instead of crisp value, the interval value was provided for filling the questionnaires in the pair comparison.

The FAHP method is developed as following steps:

Step 1: Construct the analysis levels, including the dimensions and variables in Figure 1, there are four levels in the FAHP construction.

Step 2: Build the triangular fuzzy number for each variable, denoted by $\tilde{A} = (a, b, c)$ which a is the minimum value among all tester, b is the average value, and c is the maximum value.

Step 3: Build the Pair-Wise Compare Matrix for each levels.

The results of pair-wise compare are stored in a matrix called the Pair-Wise Compare Matrix, as formula (1):

$$A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1m} \\ 1/a_{12} & 1 & \cdots & a_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1m} & 1/a_{2m} & \cdots & 1 \end{bmatrix} \qquad (1)$$

Step 4: Consistency Test.

In order to evaluate the consistency for decision-makers, it has to take the Consistency Test into the Pair-Wise Compare Matrix. There are two indexes for the Consistency Test:

C.I. (Consistency Index) and C.R. (Consistency Ratio), and individual mention as formula (2) and formula (3).

$$\text{C.I.}=\frac{\lambda_{\max}-m}{m-1} \qquad (2)$$

$\forall\ \lambda_{\max}$ = the maximum eigenvalue

m = number of decision factors

If C.I.=0, it means the full- consistency. And Saaty [1980] was suggested that $\text{C.I.} \le 0.1$ are allowable deviation range.

$$\text{C.R.}=\frac{\text{C.I.}}{\text{R.I.}} \qquad (3)$$

$\forall$ R.I.=Random Index

Saaty [1980] was also suggested that the $\text{C.R.} \le 0.1$, and is represented deviation range for the weight judgment in the Pair-Wise Compare Matrix is allowable, that is, it conform the consistency.

Step 5: Compute the Weights for each levels.

After the computation for each level's weight values, then compute the whole hierarchy's weight value. It is computed by multiplication of each level's weight values.

In the computation processes, this article applied the Fuzzy Expected Value (FEV) method for de-fuzzification. For a triangular fuzzy number $\tilde{A}=(a,\ b,\ c)$, the FEV is as formula (4) [Heilpern, 1992]:

$$FEV\left(\tilde{A}\right)=\frac{1}{4}(a+2b+c) \qquad (4)$$

3.3 Computation

The Consistency Test showed as Table 4. And the weight values for Level 3 are computed as Table 5. And the final FAHP values for the whole hierarchy are computed as Table 6.

Table 4 The Consistency Test

Level	Dimension	The Consistency Test
2	Production Base Positioning	C.I.=0; C.R.=0
3	Interior Factors	C.I.=0.012767; C.R.=0.014185
	Exterior Factors	C.I.=0.03454; C.R.=0.027855
4	Operation Ability	C.I.=0.039025; C.R.=0.034844
	Logistics Ability	C.I.=0.0093; C.R.=0.008304
	Information Ability	C.I.=0.01085; C.R.=0.018707
	Risk Management Ability	C.I.=0; C.R.=0
	Government / Regulations Effect	C.I.=0.0402; C.R.=0.035893
	Economic Factors	C.I.=0.021029; C.R.=0.014914

Level	Dimension	The Consistency Test
	Public Infrastructures	C.I.=0.0191; C.R.=0.017054
	Local Operation Level	C.I.=0.0123; C.R.=0.021207
	Safety Factor	C.I.=0; C.R.=0
	Market	C.I.=0.048; C.R.=0.042857

Table 5 The weight values for Level 3

Level 3 Dimension	Weight	Ranking
Logistics Ability	0.2926	1
Operation Ability	0.2729	2
Market	0.2135	3
Information Ability	0.1825	4
Government / Regulations Effect	0.1719	5
Risk Management Ability	0.1669	6
Public Infrastructures	0.1612	7
Safety Factor	0.1550	8
Economic Factors	0.1526	9
Local Operation Level	0.1429	10

Table 6 The final FAHP values

Level 4 Variables	FAHP	Ranking
National Safety Degree	0.0742	1
Distribution Ability	0.0523	2
Information System Integration Degree	0.0446	3
Operational Risk Management Ability	0.0426	4
Financial Risk Management Ability	0.0400	5
Response Ability	0.0340	6
Electronicalizational Level	0.0317	7
Inventory Visibility	0.0315	8
Human Resource	0.0313	9
Market Development Ability	0.0304	10

Note: Table 6 only listed the first 10 variables.

IV. CONCLUSIONS

As the Table 4 shown, all the C.I. values and the C.R. values are all small or equal than 0.1. By Saaty's suggestion [1980], the questionnaire conform the consistency.

In the dimensions level, Table 5 appeals that the Logistics Ability is the most important dimension for the DB's decision, and the following four factors are: Operation Ability, then Market, Information Ability, and Government / Regulations Effect.

Finally, as the computed results in Table 6, this article suggests five KSFs for DB Positioning in GLM as: 1. National Safety Degree, 2. Distribution Ability, 3. Information System Integration Degree, 4. Operational Risk Management Ability, and 5. Financial Risk Management Ability.

REFERENCES

1. Anderson, E., Day, G. S., and Rangan, V. K. "Strategic Channel Design," *Sloan Management Review* (38:4) 1997, pp:59-69.
2. Bowersox, D. J., Closs, D. J., and Cooper, M. B. *Supply Chain Logistics Management*, 1st Ed., McGraw-Hill, NY, 2002.
3. Chang, M. Y. "*Using Particle Swarm Optimization for Two-Stage Supply Chain Distribution Problem*," The Master Thesis for Institute of Industrial Engineering and Management, Yuan Ze University, 2010.
4. Chang, Y. C. "*Capacitated Facility Location with Application to Large-scale Distribution Network Design*," The Master Thesis for Institute of Industrial Engineering and Industrial Management, National Tsing Hua University, 2011.
5. Cheng, K. F. *Marketing Management Theory and Applications*, 4th ed., Future Career Publishing Corporation, Taipei City, 2010.
6. Chopra, S. and Meindl, P. *Supply Chain Management: Strategy, Planning, and Operation*, 3rd Ed., Pearson Education, NJ., 2007.
7. Copper, R. B. and Zumd R. W. "Information Technology Implementation Approach", *Management Science* (36:2) 1990, pp:123-139.
8. Cullen, J. B. and Parboteeah, K. P. *Multinational Management: A Strategic Approach*, Cengage Learning, KY., 2005.
9. Daniel, R. D., "Management information crisis," *Harvard Business Review* (39:5) 1961, pp.111-121.
10. Dornier, P. P., Ernst, R., Fender, M., and Kouvelis, P. *Global Operations and Logistics: Text and Cases*, John Wiley & Sons, Inc., Hoboken, NJ., 1998.
11. Flint, D. J. "Strategic Marketing in Global Supply Chains: Four challenges", *Industrial Marketing Management* (33), 2004, pp.45–50.
12. Frazelle, E. H. *Logistics and Supply Chain Management*, 1st Ed., McGraw-Hill, NY., 2002.
13. Handfield, R. B. and Nichols, E. L. ,Jr. *Introduction to Supply Chain Management*, Prentice Hall, NJ., 2005.
14. Heilpern S. "The Expected Value of a Fuzzy Number", *Fuzzy Sets and Systems* (47), 1992, pp:81-86.

15. Hill, C. W. L. *International Business-- Competing in the Global Marketplace*, 6th Ed., 2006.
16. Huff, D. L. "Defining and Estimating a Trading Area," *Journal of Marketing* (28: 3) 1964, pp:34-38.
17. Jaffe, E. D. and Yi, L. "What are the Drivers of Channel Length? Distribution Reform in The People's Republic of China," *International Business Review* (16) 2007, pp:474–493.
18. Kotler, P. and Armstrong, G.. *Principles of Marketing*, 12th ed., Pearson Education, NJ., 2008.
19. Li, S., Chan, F. T. S., and Chung, S. H. "A Study of Distribution Center location based on the Rough Sets and Interactive Multi-objective Fuzzy Decision Theory," *Robotics and Computer-Integrated Manufacturing* (27) 2011, pp:426–433.
20. Li, Y. and Liu, Y. "The Application of Fuzzy Neural Network in Distribution Center Location," *Energy Procedia* (13) 2011, pp:6458-6463.
21. Lu, C. S. "Market Segment Evaluation and International Distribution Centers," *Transportation Research Part E* (39) 2003, pp:49-60.
22. Oum, T. H. and Park, J. H. " Multinational Firms' Location Preference for Regional Distribution Centers: focus on the Northeast Asian Region," *Transportation Research Part E* (40) 2004, PP:101-121.
23. Paksoy, T., Pehlivan, N. Y., and Kahraman, C. "Organizational Strategy Development in Distribution Channel Management using Fuzzy AHP and Hierarchical Fuzzy TOPSIS," *Expert Systems with Applications* (39) 2012, PP:2822–2841.
24. Porter, M. E. *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, NY., 1985.
25. Saaty, T. L. *The Analytic Hierarchy Process*, McGraw-Hill, NY., 1980.
26. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E. *Designing and Managing the Supply Chain: Concepts, Strategies, and Case studies*, McGraw-Hill, NY., 2000.
27. Stock, J. R. and Lambert, D. M. *Strategic Logistics Management*, 4th Ed., McGraw-Hill, NY., 2001.
28. Turban, E., Lee, J., King, D., and Chung, H. M. *Electronic Commerce-- A Managerial Perspective*, 1st Ed., Prentice Hall, NJ., 2000.
29. Wu, Y. C. "*The Competitive Posture of Notebook PC Distribution Centers Near Manufacturer -- A case Study of Airfreight from Northeast Asia to United States*," The Master Thesis for Institute of Harbor and River Engineering, National Taiwan Ocean University, 2008.

全球運籌管理配銷基地設立關鍵成功因素--台灣觀點

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摘要

配銷基地(Distribution Bases, DB)的設立，對於企業全球運籌管理(Global Logistics Management, GLM)而言，是一項重要的工作。本研究應用模糊階層分析法(Fuzzy Analytic Hierarchy Process, FAHP)分析全球企業對於其配銷基地選定的關鍵成功因素(Key Successful Factors, KSF)。最後提出全球企業配銷基地設立的關鍵成功因素為：1.國家安全程度、2.配銷能力、3.資訊系統整合能力、4.營運風險管理能力、及5.財務風險管理能力。

關鍵詞：配銷基地、全球運籌管理、關鍵成功因素、模糊階層分析法