Proceedings of the 3rd Annual
IEEE Conference on Automation Science and Engineering
Scottsdale, AZ, USA, Sept 22-25, 2007

A Decision Framework for Location Selection in Global Supply Chains

N. Viswanadham and S. Kameshwaran

Abstract— **The supply chain decision problems are becoming more complex with the globalization of businesses that spatially span across several international borders. One such strategic decision problem is the location selection problem, which determines an optimal location to build a new facility. This requires multicriteria evaluation of N alternate locations with respect to M location attributes. In this paper we develop a generic framework that can aid the decision maker in identifying and grouping the M attributes into an hierarchy for location selection in global supply chains. An hierarchical structuring is proposed with four fundamental criteria: product/process value chain, economic & political integration, resources & management, and connecting technologies. These are integral to many global business activities and the generic sub-criteria for the above are identified. This aids the decision maker to identify and group the M location attributes as a multilevel hierarchical tree. This structuring facilitates the use of analytic hierarchy process to synthesize the information about the M attributes along with the decision maker's preferences, to evaluate the locations. We illustrate the applicability of the framework using a stylized example of locating a Biotech R&D center in Asia.**

I. INTRODUCTION

A global supply chain spans several countries and regions of the globe. Trade liberalization (European Union, NAFTA) and information technology have accelerated the growth of global supply chains, whereby a firm can invest and trade across national borders. Firms could trade across national borders either by intra-firm-trade (foreign direct investment (FDI)) or arms-length-trade (foreign outsourcing). FDI includes corporate activities such as building plants or subsidiaries in foreign countries. The decision of location for the intended subsidiary is an important strategic decision problem. Traditionally called as the *location selection* or *site selection* problem, this had been studied by economic geographers since the dawn of industrialization era [1]. Globalization has not only made this problem more prevalent and important, but also has added more flavors to it. At the industry level, location decisions are not pertained only to traditional manufacturing plants and warehouses, but also to service sectors like R&D facilities, call centers, ITeS, BPO, etc. Further, this problem need to be solved at the national level to select a country for investment and at the subnational level to select a location within the country.

The paper is motivated by the location of a single facility *i.e.* to find an optimal location from a given finite set of alternate locations using multicriteria decision analysis. This problem is different from the classical *facility location problem* [2], which is an optimization problem. In this paper, we are concerned with the multicriteria evaluation of N alternate locations based on M location attributes. We develop a generic framework that can be used by the decision maker for location selection problems in global supply chains irrespective of the industry and type of investment. It is obvious that every location selection problem is unique in the requirements of the investing firm and the intended business activity. However, they all share certain generic characteristics and in this paper we identify and formalize these characteristics. We propose an hierarchical structuring, called as the PERC model, to homogeneously cluster the M location attributes under appropriate criteria. Following this analysis stage is the synthesis, where the weights for the attributes and the criteria are first elicited from the decision maker using the above hierarchical clusters. This is then combined with the information about the N locations for the M attributes to arrive at the final ranking. For this stage, we recommend the use of *analytic hierarchy process* (AHP), though in principle other multicriteria decision techniques like *multiattribute utility theory* can be used. We illustrate the applicability of the framework using an hypothetical biotech firm that intends to locate its R&D activity in Asia.

The paper is structured as follows. Section II briefly reviews the literature related to location selection studied by different disciplines. The PERC model used for the analysis stage of the decision framework is explained in Section III. Section IV presents a stylized case study of locating a biotech R&D in Asia using the proposed framework. Final notes and conclusions are drawn in Section V.

II. RELATED LITERATURE

The location choice problem has been studied with varying assumptions and perspectives by different disciplines like economic geography, management science, and international business. Location-production models [3] are the earliest analytical models, which analyze the production behavior of an individual stylized firm in relation to the spatial economic costs like labour prices, land costs, transportation costs, and telecommunication costs.

The regional science community use the term *economies of agglomeration* to describe the benefits that firms obtain when locating near each other. It is related to the idea of economies of scales and network effects, in that the more related firms that are clustered together, the lower the production cost and the greater the market. Several studies show that the agglomeration economies are dominant factors in the location choice [4], [5]. The Dunning's eclectic OLI

N. Viswanadham is the Executive Director of the Centre for Global Logistics and Manufacturing Strategies, Indian School of Business, Hyderabad 500032, India N_Viswanadham@isb.edu

S. Kameshwaran is a researcher at the Centre for Global Logistics and Manufacturing Strategies, Indian School of Business, Hyderabad 500032, India Kameshwaran_S@isb.edu

(ownership, location, and internalization) [6] framework is the widely accepted model for the study of MNC location decision in the international business literature [7]. However, the above models are not prescriptive and do not aid the DM in location decision.

Multiattribute decision analysis has been widely used as prescriptive decision models. A linear additive MAUT based location evaluation was used to locate a manufacturing facility in [8]. AHP has been used extensively for a wide variety of location problems: generic plant location [9]; overseas plant location [10]; industrial plant location [11]; international location decisions [12]. All the above models followed the two stage analysis-synthesis framework: developing the hierarchical structure of criteria followed by the use of a multicriteria technique (AHP/MAUT).

In real world industrial location decisions, location consultants aid the firms for expansion or investment or relocation. For a detailed exposure on industrial location selection process with real world cases, see [13]. Many popular location consultants listed by Global Direct Investment Solutions[1] use the multicriteria technique of directly assigning weights and scores (say in a scale of one to ten), and combining them in a linear additive fashion to get a final rank. The above brief survey is intended to provide an overview of the location selection problem studied from different perspectives. For a more expository review, see [14] and references therein.

III. Hierarchical Structuring Using the PERC Model

The multicriteria evaluation can be formalized in two steps: arranging the criteria into a hierarchy (analysis) and then measuring how well the alternatives perform on each criterion (synthesis) [15]. The analysis starts with the identification of *criteria* and *attributes*. We use the word *criteria* to refer to objectives or directions along which the DM seeks better performance from the alternatives. The performance is measured in terms of *attributes*. There is little work in any area of multiple criteria decision making to advise on how hierarchies should be constructed and what makes a good hierarchical representation [16], except for broad guidelines [17], [18]. This analysis phase is generally under the control of the DM and there are many different ways one can cluster and form a hierarchy of criteria.

Different hierarchical clustering were proposed in literature and used by location consultants [9]–[12], [19], [20]. To complement and extend these efforts, we propose here the PERC model [21], which is an abstract higher level model that consists of the following four fundamental criteria: *roduct/process value chain*, *economic and political integration*, *resources and management*, and *connecting technologies*. The sub-criteria under each of the above are shown in Table I. There would be uncertainties in any kind of business investment. Those that could be leveraged for growth are *opportunities* and those that would affect the firm negatively are *risks*. Their certain counterparts are *benefits* and *costs*, respectively. They are explained in detail in the following.

[1]http://www.gdi-solutions.com/profsvcs/lists/location_consultants.htm

1) Product/Process Value Chain: The investment is intended for some business process like manufacturing a product or providing a service. This criterion is about the value chain dimension of the intended subsidiary. It is not about the entire global supply or value chain, but the part confined to the location. It is concerned about the forward and backward linkages, supply and demand (market conditions), agglomeration economies (competing and complementing businesses) and business process innovation (adapting to local markets, creating new business opportunities). The important sub-criteria considered are the supply-demand and the agglomeration. The traditional supply-demand factors are enhanced in global supply chains in terms of cheap supplies, local demand, and potential for market growth. However, deviations and disruptions in demand and supply can result is costly discrepancies elsewhere in the global scenario. Similarly, stronger agglomeration economies and cluster effects provide many benefits and opportunities and also pose major risks. The presence of related businesses in the location reduces supply costs and provides huge demands. It also enables knowledge sharing and collaboration to make the business process efficient but knowledge spill-over could result in IP violations. Ignorance of domain knowledge will be an added advantage of the locals with added expertise due to knowledge spill-over. The agglomeration, on the other hand, can help in business process innovations by leveraging the global expertise to meet local demands. The DM, hence have to take into account the above conflicting factors to arrive at an optimal location decision.

2) Economic and Political Integration: The economic and political factors play an important role in global supply chains. This criterion include taxes (income, sales, trade, import, export), regulatory framework (labor, environmental, legal), trade agreements, government incentives and subsidies, political stability, and living conditions. The obvious benefits of incentives, subsidies, and trade agreements also come with a great pool of risks like anti-dumping, voluntary export restrictions, and breach of promises. Once the investments are made, the bargaining powers of the firms are lost and are dependent on the functioning of the government. The exposure of the firm's information while applying for incentives is another risk encountered commonly in practice [13]. The indirect influences of the government like terrorism and crime are other sources of risk. The regulatory framework is another major sub-criterion that is government dependent. Many studies have indicated that rules and regulations are seen as an hinderance by firms [22]. The bureaucratic framework results in unproductive delays and non-transparent functioning leads to corruption. Finally, the intangible attributes living conditions and public attitude also have subtle effects on location selection.

3) Resources and Management: The third criterion covers the resources and the management of resources. The resources include human (skilled and unskilled), natural (raw materials, land, coast line), utilities (water, electricity), and also financial (loans, banks, venture capitalists). Management of resources is an important sub-criterion that is overlooked.

TABLE I
FUNDAMENTAL CRITERIA AND SUB-CRITERIA OF PERC MODEL.

Fundamental Criteria	Sub-criteria
1. **P**roduct/Process value chain	suppliers, markets and demand, agglomeration economies and clusters, knowledge sharing and collaboration;
2. **E**conomic & political integration	economic policies, trade facilitations, laws & regulations, financial inducements and incentives, political factors, living conditions;
3. **R**esources and management	human resources (skilled workforce), financial resources (loans, investors), utilities and industry inputs (land, water, power, educational and training institutes), management services (legal, marketing, business consulting, financial planning);
4. **C**onnecting technologies	transport (rail, road, air, sea), information and communication technologies (Internet, wireless, landline, data);

Many global business operations largely depend on resource management skills like global sourcing, global marketing, research and training institutions, legal services, human resource training, and financial planning. The resource management complements with the resources and sometimes can compensate when the resources are not available.

4) Connecting Technologies: The final criteria is about how a firm connects to the external world using the transport and network infrastructure. The inbound and outbound flow of materials, manpower, information, and data are considered in this criterion. The obvious attributes include availability of sea ports, air posts, railways, road ways, freight forward costs, lead time, network readiness, IT connectivity, mobile networks, postal and courier system, IT enabled services, etc. The other network components due to globalization are customs clearance and quality tracking systems. International logistics flows are substantially more complex with more documentation like commercial invoices and customs paperwork. Hence, locations that employ automated trade documentation are advantageous. The four fundamental criteria of the PERC model are integral to many global investments and hence can be used for varying decisions like locating manufacturing facility, warehouse, call centers, and R&D facilities. It is a top-down approach by starting with the fundamental criteria first and then identifying the suitable sub-criteria and the attributes. The PERC model only suggests what can be included under a criterion. Some of the attributes are interrelated. For example, the benefit high labor availability is a mathematical inverse of labour cost. The DM should make sure that such related attributes are not included to avoid double counting. The lack of a step-by-step cookbook procedure is an obvious outcome of its genericness, though the Table I can be used as look-up tables by the practitioners.

IV. EXAMPLE: LOCATION OF A BIOTECH R&D FACILITY IN ASIA

In this section, we illustrate the proposed methodology using a simplistic stylized location selection problem faced by a global biotech firm. The problem is to locate a R&D facility in Asia. The following is not an in depth analysis, which is beyond the scope of this paper. The locations selection is done at two levels: first at the national level to choose the country and then at the subnational level to choose the location within the country. Though it is a general practice in the industry to address this problem at above two levels, directly evaluating the cities is also not uncommon.

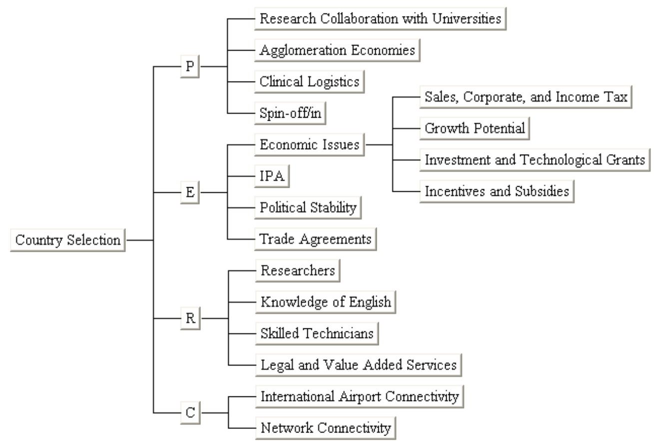

Fig. 1. PERC based Hierarchical Structuring for National Location Selection

A. National Location Selection

The investing firm has decided upon a greenfield investment for an R&D facility in one of the following countries in Asis: China, India, and Singapore. These countries are the top three in Asia-Pacific that received highest amount of FDI in R&D for the year 2005 (India 48%, China 29%, Singapore 8%), according to the global investment location database of IBM Plant Location International. A study conducted by OCO Consulting[2], showed that the following motives drove the investments in the biotech sector: skilled workforce availability, government support, finance incentives or taxes or funding, universities or researchers, regulations or business climate, industry cluster, domestic market growth potential, technology or innovation, infrastructure and logistics, and ICT infrastructure. Figure 1 shows the hierarchical structuring developed using the PERC model based on the above motives.

To evaluate the locations, two numerical entities are required: *weights* and *scores*. The relative importance of the location attributes (as perceived by the DM based on the firm's objectives and constraints) are denoted using the weights. The scores, on the other hand, rates the performance of a location for each of the attributes. The total score for a location is then obtained by combining the weights and the scores in some mathematically acceptable way, which depends on how the weights and scores are represented and obtained. For the synthesis phase, we used the analytic

[2]http://www.ococonsulting.com

TABLE II

THE FUNDAMENTAL SCALE USED IN AHP FOR PAIRWISE COMPARISON

Scale	Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective
3	Moderate importance of one over another	Experience and judgment strongly favor one factor over another
5	Essential or strong importance	Experience and judgement strongly favor one factor over another
7	Very strong importance	An activity is strongly favored and its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one factor over another is of tile highest possible order of affirmation
2,4,6,8	Intermediate values between the two adjacent judgments	When compromise is needed
Reciprocals	If factor **F1** has one of the above numbers assigned to it when compared with factor **F2**, then **F2** has the reciprocal value when compared with **F1**	

hierarchy process (AHP) [23], though in principle one can also use multi-attribute utility theory [17]. Given the problem in a hierarchical structure, AHP determines the scores and weights (both are called as *priorities*) using pairwise comparisons of sibling nodes under each parent node. The priorities are obtained for each set of siblings separately. For example, the attribute *Researchers* is a measurable entity for the countries China, India, and Singapore. The scores (or priorities in AHP parlance) of these countries for attribute *Researchers* is obtained by pairwise comparison, as shown in Table III. The countries are compared pairwise and a numeric value is given, which represents the *ratio* of preference between the two factors. A matrix of pairwise comparisons is constructed by reference to the semantic scale and 1-9 numeric scale, shown in Table II. The diagonal entries are obviously 1, due to the equal importance of comparing the same country with itself. India is assigned a scale of 2 over China, which is an intermediate value between 1 (equal importance) and 3 (moderate importance). Accordingly, China's measure over India in terms of researchers is the reciprocal 1/2. India has a very strong importance (scale 7) over Singapore in terms of researchers.

Let A denote the matrix with scales assigned through pairwise comparisons. A is a positive, ratio matrix with $a_{ij} = 1/a_{ji}$. The priorities of the factors p is the normalized eigenvector associated with the largest eigenvalue of A. It is obtained by solving the following set of linear equations: $Aw = \lambda_{\max}p$. The normalized eigenvector p denotes the scores of the three countries for the attribute *Researchers*. It should be noted that one can further sub-divide *Researchers* into number of doctorates, post-doctorates, research publications, patents, etc to obtain more authentic and accurate measures. The measure obtained in this paper were based on subjective judgement using information about the three countries from the WWW.

The derivation of weights for the criteria and sub-criteria are also obtained using the pairwise comparison. The criteria at the same level (siblings) are compared with respect to their parent criterion. For example, the criteria *International airport connectivity* and *Network connectivity* are compared with respect to their parent criterion *Connecting technologies*. The four fundamental criteria P, E, R, and C are compared with the overall goal of selecting the country. The derivation of weights for the fundamental criteria is shown in Table IV. The weights and scores for the remaining

TABLE III

DERIVATION OF SCORES FOR 'RESEARCHERS'

	China	**India**	**Singapore**	*Scores*
China	1	1/2	4	0.315
India	2	1	7	0.603
Singapore	1/4	1/7	1	0.082

TABLE IV

DERIVATION OF WEIGHTS FOR THE FUNDAMENTAL CRITERIA

	P	**E**	**R**	**C**	*Weights*
P	1	1/3	1/5	3	0.122
E	3	1	1/4	3	0.222
R	5	4	1	6	0.590
C	1/3	1/3	1/6	1	0.066

attributes and criteria were determined in the same fashion (Table V). The final score for a location is obtained through multilinear superposition of weights and scores. First the linear combination of scores with the corresponding weights is obtained for attributes that have the same parent criterion. This becomes the score for that criterion. This is repeated for all attributes and all criteria at each level, till the goal node is reached, which gives the final consolidated score for the location. For this synthesis part, Expert Choice software that implements AHP was used. The final ranking of the countries based on our subjective judgement were: India (0.504), China (0.259), and Singapore (0.237). With India chosen as the destination for FDI, selection of a city within India is the next problem to be solved.

B. Subnational Location Selection

Given the natural resources and the skilled workforce, India has identified its potential in biotechnology nearly two decades ago. Several state governments are making conscious efforts to create a conducive environment to attract entrepreneurs to set up their units and leverage on the vast talent pool and rich biodiversities in the respective states. As a result, India will have at least 20 biotech parks in the next few years. The biotech parks in the following five cities are considered for investment: Bangalore, Chennai, Hyderabad, Lucknow, and Pune.

The hierarchical structuring for the subnational location selection is shown in Figure 2. Attributes like IP issues and trade agreements that are uniform across the country were not considered. Factors like waste handling and regulatory framework were not considered as they were taken care

TABLE V

SCORES AND WEIGHTS FOR THE COUNTRY SELECTION

RESEARCH COLLABORATION

	China	India	Singapore	*Scores*
China		1/3	3	0.258
India			5	0.637
Singapore				0.105

CLINICAL LOGISTICS

	China	India	Singapore	*Scores*
China		1/2	4	0.333
India			5	0.570
Singapore				0.097

SALES, CORPORATE, AND INCOME TAX

	China	India	Singapore	*Scores*
China		3	1/2	0.300
India			1/6	0.100
Singapore				0.600

INVESTMENT AND TECHNOLOGICAL GRANTS

	China	India	Singapore	*Scores*
China		1/3	1/6	0.100
India			1/2	0.300
Singapore				0.600

IPA

	China	India	Singapore	*Scores*
China		1/2	1/5	0.106
India			1/7	0.150
Singapore				0.744

TRADE AGREEMENTS

	China	India	Singapore	*Scores*
China		1/2	2	0.286
India			4	0.571
Singapore				0.143

SKILLED TECHNICIANS

	China	India	Singapore	*Scores*
China		1/2	5	0.326
India			8	0.604
Singapore				0.070

SKILLED TECHNICIANS

	China	India	Singapore	*Scores*
China		1	2	0.400
India			2	0.400
Singapore				0.200

ECONOMIC ISSUES

	Tax	G. P.	I. T. G.	I. & S.	*Weights*
Tax		5	7	3	0.591
Growth			4	3	0.225
I. T. Grants				1/2	0.062
Inc. & Subs.					0.122

ECONOMIC & POLITICAL INTEGRATION

	E. I.	IPA	P. S.	T. A.	*Weights*
Eco. Issues		1/2	7	7	0.408
IPA			5	3	0.433
Pol. Sta.				1/2	0.060
Trade Ags.					0.099

AGGLOMERATION ECONOMIES

	China	India	Singapore	*Scores*
China		1	4	0.444
India			4	0.444
Singapore				0.111

SPIN-OFF/IN

	China	India	Singapore	*Scores*
China		1/2	1/5	0.122
India			1/3	0.230
Singapore				0.648

GROWTH POTENTIAL

	China	India	Singapore	*Scores*
China		1/2	5	0.333
India			7	0.592
Singapore				0.075

INCENTIVES AND SUBSIDIES

	China	India	Singapore	*Scores*
China		1/2	1/4	0.143
India			1/2	0.286
Singapore				0.571

POLITICAL STABILITY

	China	India	Singapore	*Scores*
China		1/2	3	0.320
India			4	0.558
Singapore				0.122

KNOWLEDGE OF ENGLISH

	China	India	Singapore	*Scores*
China		1/9	1/5	0.060
India			4	0.709
Singapore				0.231

LEGAL AND VALUE ADDED SERVICES

	China	India	Singapore	*Scores*
China		1/3	1/5	0.109
India			1/2	0.309
Singapore				0.582

NETWORK CONNECTIVITY

	China	India	Singapore	*Scores*
China		1/2	1/2	0.2
India			1	0.4
Singapore				0.4

PRODUCT/PROCESS VALUE CHAIN

	R. C.	A. E.	C. L.	Spin off/in	*Weights*
Res. Coll.		3	4	9	0.557
Agg. Eco			3	7	0.279
Cli. Log.				3	0.119
Spin off/in					0.046

RESOURCES & MANAGEMENT

	Res.	K. Eng.	S. Tech.	Ser.	*Weights*
Researchers		5	3	8	0.591
Know. English			1/2	3	0.134
Skill. Tech.				3	0.213
Services					0.062

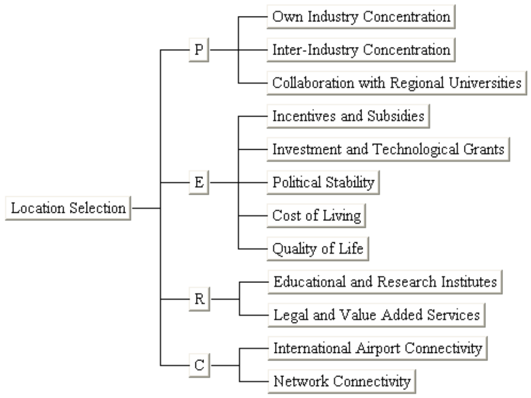

Fig. 2. PERC based Hierarchical Structuring for Subnational Location Selection

by the biotech parks. The information and data about the locations for the above factors were obtained from the WWW. The weights and scores were obtained by pairwise comparison. For the sake of brevity, we have not presented the detailed derivation of weights and scores. The final ranking of cities based on our subjective evaluation were: Bangalore (0.368), Hyderabad (0.217), Lucknow (0.217), Pune (0.126), and Chennai (0.073). This simple example illustrated the practical application of the proposed framework. One can also perform a more detailed study by creating different PERC based hierarchies for each of the benefits, opportunities, costs, and risks and synthesize them to evaluate the locations.

V. Final Notes

In this paper we developed a generic decision framework for aiding the location selection process in global supply chains. The attributes that influence the location selection have evolved with the businesses operating as a single firm to a part of a global supply chain. Location analysis from different studies were complemented and extended to include the global business scenario. Further the methodology is generic and can be used for many new age business processes like BPO and ITeS, which are not as intensively studied as location of manufacturing plants.

The proposed decision methodology for multicriteria evaluation of locations can also be used for measuring investment climate, market attractiveness, and FDI attractiveness. All the above inherently evaluate locations (countries, regions, cities) with respect different factors depending on the industry. The methodology can also be used by economic development agencies to evaluate locations. For example, the evaluation of the host location with its competing locations can be used the economic development agency to identify directions along which developments need to be carried out. Sensitivity analysis in AHP can aid in determining the level of improvement required for certain criteria in order to attract investments. Governments can also use the methodology to identify the next tier of cities that are potential investment locations. A more detailed analysis could be carried out by developing hierarchical structures using the PERC model individually for benefits, opportunities, costs, and risks. This will also help in measuring risk indexes and also in obtaining benefit/cost ratios.

References

[1] R. Hayter, *The Dynamics of Industrial Location: The Factory, the Firm and the Production System*. Chichester: John Wiley and Sons, 1997.
[2] Z. Drezner and H. W. Hamacher, Eds., *Facility Location: Applications and theory*. Berlin: Springer-Verlag, 2002.
[3] P. McCann, "Classical and neoclassical location-production models," in *Industrial Location Economics*, P. McCann, Ed. Cheltenham, UK: Edward Elgar, 2002.
[4] K. Head, J. Ries, and D. Swenson, "Agglomeration benefits and location choice: Evidence from japanese manufacturing investment in the United States," *Journal of International Economics*, vol. 38, pp. 223–247, May 1995.
[5] S. Barrios, H. Gorg, and E. Strobl, "Multinationals' location choice, agglomeration economies, and public incentives," *International Regional Science Review*, vol. 29, pp. 81–107, 2006.
[6] J. H. Dunning, *Explaining International Production*. London: Unwin Hyman, 1988.
[7] R. Mudambi, "The MNE investment location decision: Some empirical evidence," *Managerial and Decision Economics*, vol. 16, pp. 249–257, 1995.
[8] C. Jungthirapanich and C. O. Benjamin, "A knowledge-based decision support system for locating a manufacturing facility," *IIE Transactions*, vol. 27, pp. 789–799, 1995.
[9] J. Yang and H. Lee, "An AHP decision model for facility location selection," *Facilities*, vol. 15, no. 9/10, pp. 241–254, 1997.
[10] S. Yurimoto and T. Masui, "Design of a decision support system for overseas plant location in the EC," *International Journal of Production Economics*, vol. 41, pp. 411–418, 1995.
[11] P. Alberto, "The logistics of industrial location decisions: An application of the analytic hierarchy process methodology," *International Journal of Logistics: Research and Applications*, vol. 3, no. 3, pp. 273–289, 2000.
[12] W. Atthirawong, "A framework for international location decision-making in manufacturing using the analytical hierarchy process approach," PhD Thesis, School of Mechanical, Materials, Manufacturing Engineering and Management, University of Nottingham, UK, 2002.
[13] M. Meirler, *Location Location Location: A Plant Location and Site Selection Guide*. New York: Wiley, 2006.
[14] C. H. Yang, "Identifying and testing the decision making factors related to key industries choice of location," PhD Thesis, Faculty of Commerce and Management, Griffith University, Brisbane, 2004.
[15] D. L. Olson, *Decision Aids for Selection Problems*. New York: Springer, 1996.
[16] V. Belton, "A comparison of the analytic hierarchy process and a simple multi-attribute value function," *European journal of Operational Research*, vol. 26, pp. 7–21, 1986.
[17] R. Keeney and H. Raiffa, *Decisions with Multiple Objectives: Preference and Value Tradeoffs*. New York: Wiley, 1976.
[18] R. Keeney, *Value-Focused Thinking: A Path to Creative Decisionmaking*. Cambridge, Massachusetts: Harvard University Press, 1992.
[19] G. Jones and H. Davis, "National culture and innovation: implications for locating global R&D operations," *Management International Review*, vol. 40, no. 1, pp. 11–39, 2000.
[20] IBM, "Investment strategies and location benchmarking study," Oxford Intelligence," Location benchmarking analysis, February 2004.
[21] N. Viswanadham, "Global manufacturing and service strategies," Indian School of Business," Term 5 Course Lecture Notes, 2006.
[22] World Bank, "A better investment for everyone," World Bank," World Development Report, 2005.
[23] T. L. Saaty, *The analytic hierarchy process*. New York: McGraw-Hill, 1980.