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Article *in* Supply Chain Management · September 2008

DOI: 10.1108/13598540810905697

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Research paper

Applying the analytic hierarchy process to the offshore outsourcing location decision

Linda Boardman Liu
School of Management, Boston University, Boston, Massachusetts, USA

Paul Berger
Bentley College, Waltham, Massachusetts, USA, and

Amy Zeng and Arthur Gerstenfeld
Worcester Polytechnic Institute, Worcester, Massachusetts, USA

Abstract

Purpose – The purpose of this paper is to show that there is a wealth of academic literature that qualitatively examines the outsourcing and offshoring from a go/no go perspective. The paper examines the complex "where to outsource" question by applying a quantitative approach called Analytic Hierarchy Process (AHP).

Design/methodology/approach – The authors examine a *Fortune* 500 company's real-world decision about where to outsource and summarize the current selection process employed by the company. We then apply our AHP model to the company's decision and compare the results.

Findings – There are four major findings: the location selection decision is a component of the outsource supplier selection decision; the AHP model effectively manages the complexity of the decision making process, incorporating all decision criteria harmoniously; a method such as AHP, which is able to incorporate both qualitative and quantitative criteria into evaluations, would streamline the decision-making process; and the AHP process allows firms to look at a portfolio of choices and determine which firms are basically equal in qualifications.

Research limitations/implications – The research implies that: (AHP may be more applicable in these areas by providing a rigorous framework for assessment of qualitative and quantitative factors together; and AHP offers substantial flexibility to accommodate the variety and quantity of decision criteria set forth by the firm.

Practical implications – As firms are more active in pursuing opportunities in global markets, identifying the right offshoring location is critical. The selection process is complex, involving a set of qualitative and quantitative factors and requiring rigorous and careful analysis. Therefore, a scientific method that not only offers flexibility and simplicity, but also simultaneously accommodates a wide variety of decision criteria is invaluable. The research demonstrates that AHP provides these benefits and is an effective technique for analyzing the where-to-outsource decision.

Originality/value – The extensive literature review suggests that the majority of the existing works focus on analyzing the go/no-go decision using a qualitative approach. This paper applies the AHP method to the "where to outsource" question to demonstrate one quantitative approach to this complex decision. Additionally, the paper provides a detailed description of how the AHP method is implemented in analyzing the decision by using a Fortune 500 company's data and information as an example.

Keywords Outsourcing, Decision making, Analytical hierarchy process

Paper type Case study

Introduction

Outsourcing is the practice of using a supplier rather than in-house employees to perform a function. This practice will most likely continue and potentially increase as firms look to consolidate and focus on their core business activities (Fill and Visser, 2000) while outsourcing support or non-core functions to firms that have the appropriate expertise. In addition, the globalization of many industries creates additional pressures to offshore: outsourcing to locations outside the domestic market served by the firm. India, for example, has developed significant expertise in IT development, boasting 40 percent of the top-rated software development firms in the world (King, 2005). Other areas of the world also welcome offshored USA work, with Asia, Latin America, South America, and European countries all seizing a piece of this economically valuable opportunity (see, for example, Vestring *et al.*, 2005; Venkatraman, 2004; King, 2005; Swenson, 2004; Swenson, 2005). Offshoring is a growing phenomenon in a wide variety of industries. Few industries are exempt: manufacturing, information technology, and service operations all experience offshoring.

Business practitioners recognize that offshoring is one of the many tools in their toolkit to design and manage their

The current issue and full text archive of this journal is available at **www.emeraldinsight.com/1359-8546.htm**

Supply Chain Management: An International Journal
13/6 (2008) 435–449
 [ISSN 1359-8546]
[DOI 13598540810905697]

Supply Chain Management: An International Journal
Volume 13 · Number 6 · 2008 · 435–449

business and potentially has a place in most strategic plans. Although there is a wealth of academic literature examining outsourcing and offshoring, it generally addresses the decision whether or not to outsource: the go/no go choice. This paper applies the Analytic Hierarchy Process (AHP) to the "where to outsource" question in an effort to demonstrate one quantitative approach to this complex decision. After a review of both outsourcing decision-making and analytic hierarchy process literature, the proposed AHP model will be applied to the location selection decision of a "Fortune 50" company (i.e. a company that is one of the top 50 largest firms in the Fortune 500) offshoring a customer-serving call center. Finally, extensions and other applications of the model will be discussed.

Literature review

Outsourcing and offshoring

Enabled by a global economy and competition for low-cost expertise, a wide array of jobs are being outsourced outside the USA. Offshoring is "the practice among USA and European companies of migrating business processes oversees to India, the Philippines, Ireland, China, and elsewhere to lower costs without significantly sacrificing quality." (Venkatraman, 2004) These types of geography-related changes in labor and economic markets are nothing new. Transportation capabilities and related infrastructure development of the 20th century enabled this trend to decentralize the functions performed by a firm (Venkatraman, 2004). The later emergence of global capital markets pressed this trend further; now, with global skills married to global infrastructure, offshoring is readily accessible and manageable for most firms. Even small start-up firms "go global" in order to leverage cost effectiveness with regional functional competence (Thomas, 2005).

Yet another perspective views outsourcing as a strategic decision (Teng *et al.*, 1995). The decision to outsource cannot be viewed as a decision to outsource a single project or job, but should be viewed as a decision to outsource an entire function for the long term, a business arrangement that could last years. Prahalad and Hamel (1990) define core competencies as the capabilities that provide broad market access, deliver significant customer benefits, and are difficult for competitors to copy. Quinn and Hilmer describe the outsourcing decision as a competitive choice made when a firm concentrates on its core competencies and strategically outsources other functions to suppliers that can perform those functions better (Quinn and Hilmer, 1994). Teng *et al.*'s empirical study of strategic factors considered in the yes/no decision making for IT outsourcing identifies information quality, support quality, and the strategic role of IT to the firm as decision factors. Another empirical study in the outsourcing literature by Krause *et al.* (2001) examines purchasing decision-making across manufacturing industries and links purchasing competitive priorities to operations competitive priorities, i.e. cost, quality, delivery, flexibility, and innovation; suggesting that purchasing decision making is aligned with operations priorities. Tracey and Tan (2001) conducted an empirical study of manufacturing firms to understand what relationships exist among supplier selection criteria, supplier involvement in product design, customer satisfaction and firm performance. The study showed that unit price as a selection criterion did not have a significant effect on customer satisfaction or firm performance; selection based on quality, reliability, and performance criteria however did have a significant positive impact on customer satisfaction and firm performance. Beaumont and Sohal (2004) conducted a study of Australian firms and the outsourcing decision that examined the level of and reasons for outsourcing. They found that the strongest reasons for outsourcing were access to skills, cost reduction, gaining flexibility, and performance improvement.

Another view of the outsourcing decision evaluates what function in the firm's process should be outsourced, specifically upstream or downstream functions (where upstream and downstream are indicative of the order sequence of the tasks) in the process (Sridhar and Balachandran, 1997). Here, the decision model differentiates between internal and external suppliers based on informational attributes such as access to information, amount of information, and control of information. The model indicates that firms tend to outsource the upstream tasks and have employees perform the downstream tasks. Apte and Mason (1995) examine the global disaggregation of information-intensive activities in terms of global insourcing versus global outsourcing. They formulate a set of strategic criteria to determine what activities can be globally disaggregated; these criteria include information intensity, need for customer contact, need for physical presence, and cultural feasibility.

Beulen *et al.* (2005) conducted three case studies to examine the risks associated with offshoring. They identify five critical risk categories associated with offshoring IT infrastructure management: rotating onshore resources, infrastructure, knowledge transfer, geopolitical risk, and contract length. This research suggests that selection criteria should consider strategies to mitigate these risks. In their qualitative research of outsourcing, Harland *et al.* (2005) conducted a Delphi study to understand the risks and rewards of outsourcing at the firm, industry, and national levels. Based on the results, the authors formulated a strategic-level conceptual framework for understanding outsourcing that includes policy, strategy, decision making, outcomes, structures, and inter-firm relationships.

Outsourcing strategies are complex and may have significant impact on a firm's success. The primary objective is to minimize risk and maximize value to the firm. Costs that need to be considered include market price, set up cost, monitoring/coordinating, and switching costs (as a contingency for the future). Decision making is rooted in transaction cost theory and considers certain risks such as changing the boundary of the firm, uncertainty of supplier performance, opportunistic bargaining, supplier incompetence, and loss of control over the activity (Ngwenyama and Bryson, 1999). In their paper the authors develop models to compare single supplier and multi supplier strategies.

Much of the academic literature of the last decade on outsourcing/offshoring considers information technology functions. This does not limit the literature's applicability to other functions that can be offshored – cost, capability, management control, and other decision criteria considered in these articles are equally applicable to other service and manufacturing operations.

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Outsourcing decision models

A number of decision frameworks appear in academic literature to support the outsourcing decision-making process. Outsourcing is often strictly a comparative cost decision, driven by the firm's goal to maximize profitability. For some outsourcing endeavors, such as information technology (IT) outsourcing, the type of work should also be considered (Grover and Teng, 1993). Their decision-tree model differentiates IT work into two categories, the systems level and the impact level. The model is not quantified, but does provide insight into the go/no go outsourcing decision. Another analytic model designed to support the go/no go outsourcing decision considers several criteria in the decision process, including the context of the function that is being considered for outsourcing, the overall strategy and structure of the outsourcer firm, and total costs associated with outsourcing (Fill and Visser, 2000). Anderson and Parker (2002) develop a model to evaluate the make-or-buy decision with consideration of two learning curves that affect component costs and integration costs. Cánez *et al.* (2000) formulate a framework for the make-or-buy decision based upon research with both academics and industry experts; they identify factors for consideration in the areas of technology and manufacturing processes, production cost, supply chain management, support systems, and performance measures. The framework is illustrated through three case studies. Vyas and Woodside's empirical study of 18 plant purchasing agreements reveals a pattern of behavior of five general processes that steadily narrows the supplier field: identification, qualification, bid solicitation, bid evaluation, and bid selection (Vyas and Woodside, 1994).

A decision support model that draws on operations research techniques considers supplier selection and negotiation (Weber *et al.*, 2000). This paper has a "partnership pyramid" that identifies five stages of the supplier selection: analyze the decision environment, identify options, evaluate/compare options, negotiate, and form partnerships. The paper outlines a multi-objective programming model that aids in supplier selection. Vokurka *et al.* (1996) formulate a prototype expert system to support the supplier selection decision and demonstrate applicability of the system by applying it to a manufacturing case study.

Yang and Huang develop an application of the Analytic Hierarchy Process to support the outsourcing decision based on five factors: management, strategy, economics, technology, and quality (Yang and Huang, 2000). This model addresses the question of whether to outsource; it does not consider where to outsource.

Where to outsource

A large pool of academic literature has addressed the outsourcing decision from two perspectives: one focuses on the selection factors; the other examines the supplier's internal capabilities. Few efforts, however, (based on the authors' searches of management-literature indexes using keywords including "operations and outsourcing", "operations and offshoring", "outsourcing and offshore", and "operations and supplier selection") have considered the supplier's location as the core selection criterion. In particular, the authors were not able to find any quantitatively-oriented decision-support models that address the specific "where to outsource" location question. This paper aims to focus on the "location" and associated factors as the key selection criteria and develop a quantitatively-oriented decision-support model to address the "where to outsource" decision.

In evaluating offshore locations for USA-based firms, countries where English fluency is common and political risk is low should be given priority, as should countries that have recognized superior skills in certain functional areas (King, 2005). Vestring *et al.* (2005) make the argument that the country choice when offshoring should be portfolio-tized, as "every country presents a different mix of strengths and weaknesses". They identify several factors to consider that include operating costs, regulatory environment, domestic markets, engineering talent, political stability, currency fluctuations, facility costs, infrastructure, and language skills. Smith *et al.* (1996) developed a conceptual framework for choosing offshore outsourcing location at a strategic level. The framework considers the relationship between project requirements, location resources, and environmental considerations. Handfield's study of 97 USA manufacturing firms identifies a set of criteria for evaluating international suppliers that includes quality, cost, trust, product and process technology, product modification capabilities, delivery, schedule reaction, and lead time (Handfield, 1994).

In two empirical studies of offshoring activity where the offshore country is the unit of analysis, Swenson (2004) utilizes data from the US Overseas Assembly Program and demonstrates that country costs are considered by firm's engaging in offshoring, and that sunk costs (such as entry costs) are also a factor in the offshore decision. In the second study, the author shows that a country's share of USA assembly work increases when its production costs decrease, or when other country's production costs increase (Swenson, 2005).

When evaluating country location for offshored work, a number of criteria could be considered. Each location selection decision would need to consider a subset of factors as appropriate, depending on the function being outsourced. For example, manufacturing would be less concerned with the rank-and-file employees' ability to speak conversational English than would an IT support call center. A taxonomy of five decision categories and examples of various criteria in these categories is provided in Table I.

The analytic hierarchy process

The Analytic Hierarchy Process (AHP) is a decision-making process that breaks complex problems down into levels of decision criteria that can be managed more readily. The AHP synthesizes information and evaluates decision criteria in a way that enables the use of both "real" data (such as actual labor costs) and qualitative evaluations of factors (such as infrastructure capability) in one model. Input to the model is in the form of paired comparisons between elements. The output of the AHP process is a ratio scale "score" that allows for comparisons between choices and gives insight into their relative merits (Saaty and Kearns, 1985). Saaty proposes that there are three parts of problem solving: decomposing the problem into manageable components, comparative evaluations of the decision criteria, and synthesis of priorities. Comparison takes place at each level of the hierarchy, and occurs on several dimensions (Saaty, 1986). In the most basic two-level AHP model, these two dimensions are the relative importance of the decision criteria included in the model and the relative performance of each alternative

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Table I Offshoring decision categories

Category	Examples
Costs	Set up costs, monitoring/coordinating costs, switching costs (Ngwenyama and Bryson, 1999), (Swenson, 2004) Production costs (Swenson, 2005) Trend in labor costs (Vestring *et al.*, 2005) Travel costs for USA based management Tariffs Taxes
Culture/language	Alignment of culture between USA and offshore location (Apte and Mason, 1995) English-speaking fluency (King, 2005) English as an official language Hiring and selection practices
Economic/political	Type of economy in offshore location (agricultural, industrial, service-based) Political stability (Vestring *et al.*, 2005) Currency stability (Vestring *et al.*, 2005)
Infrastructure	Maturity of transportation system Maintenance of roads/airports/railway Communications systems (Venkatraman, 2004) Power systems
Expertise/viability	Median level of education Access to related education Country experience in type of function Skilled workers (Venkatraman, 2004), (Beaumont and Sohal, 2004) Amount of management oversight required Prior experience in outsourced function (Bahli and Rivard, 2005)

against the criteria. Measurement scales should be appropriate to the article being measured. AHP, in its utilization of ratio scale numbers that retain their relative proportionality regardless of normalization, ensures measurements are valid and have intrinsic relativity to each other. (Saaty, 1989).

The AHP process has been applied in a variety of decision-making and analytic arenas. Partovi *et al.* (1989) discusses applicability of the AHP process to a wide variety of operations management problems and decision frames as the AHP model is often able to satisfy the complexity of operations management problems without oversimplification. The authors identify several applications of AHP including supplier selection, facility location, forecasting adjustments, technology selection, product design, plant layout, maintenance scheduling, and logistics carrier. Hafeez *et al.* (2002) utilize an AHP model to identify a firm's core competencies using both quantitative and qualitative input. Nydick and Hill (1992) propose an AHP application for supplier selection as well, citing AHP as a good tool to enable consideration of, and resolution to, the inherent conflicts between decision criteria, i.e. cost and quality. A selected set of recent applications of the AHP method to management and supplier selection decisions is given in Table II.

The AHP model is an excellent fit to support decision-making when selecting an offshore location. It incorporates both qualitative and quantitative decision factors and addresses the need to consider a variety of criteria in a variety of dimensions. AHP readily combines real data (such as cost) and subjective judgment (such as risk considerations).

Application of AHP to outsourcing location selection

Corporate personnel involved in making these offshoring decisions recognize the complexity and importance of the selection. To support the decision-making process, decision makers develop various support tools and processes. Although somewhat detailed, these systems use a fairly straightforward rating and ranking system in order to provide a basis for comparison between choices. To provide insight into the use of AHP in support of the offshoring location decision, we provide a prototype example based on a recent real-world offshoring decision.

This firm was selected based on several criteria. The firm in question had a formalized decision process in place for supplier evaluation and selection; we would be able to compare the outcome of the existing process with the AHP model. Secondly, the decision makers were familiar with selecting suppliers, but were novices at selecting an offshore location, providing an opportunity to access their un-tested criteria and concerns. Interestingly, the decision makers described their task as selecting a location for an off-shore work center, with "where to put it" as the primary concern. Finally, the decision makers were willing and able to provide extensive data in support of the offshoring decision. We began by conducting a review of their current decision making process and analyzed the decision support data. We conducted phone interviews with the lead decision maker (not the senior member of the team but the individual ultimately responsible for managing the process) to understand the decision makers' goals, issues, and concerns. We then developed the AHP model using the decision criteria.

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Table II Selected recent applications of AHP in operations management/supplier selection

Selected studies by authors	Major research
Putrus, 1992	Proposed an AHP model to support the "whether to outsource" decision for IS functions based on company objectives and measures of success
Mohanty and Deshmukh, 1993	Formulated a theoretical AHP model supporting supplier selection for materials management using price, quality, delivery, and service
Berger and Holtzman, 1997	Applied the AHP model to direct marketing decision making, where the objective is to maximize profit with the consideration of a multi-level decision hierarchy
Barbarosoglu and Yazgac, 1997	Proposed an AHP application to select a supplier for Turkish industry, formulating a five-level hierarchy that incorporates a wide variety of "nested" decision criteria
Yahya and Kingsman, 1999	Applied the AHP process in a case study to select participants for an entrepreneur development program that identified wooden furniture manufacturers as potential suppliers to Malaysian government entities
Masella and Rangone, 2000	Formulated four theoretical AHP models to support supplier selection depending on the duration of the supplier relationship (short-term v. long-term) and nature of the activities (logistic or strategic) considering both performance and infrastructural measures as selection criteria
Udo, 2000	Formulated a theoretical AHP model to determine if a function will be outsourced, managed by in-house IT, or managed by the end user departments based on five decision criteria
Akarte *et al.*, 2001	Prototype AHP application in manufacturing for supplier selection using 18 sub-criteria grouped in 4 criteria
Kahraman *et al.*, 2003	Conducted a survey of Turkish businesses to determine decision criteria used in supplier selection, and then proposed an AHP model to support the decision based on four broad selection criteria
Chan and Chan, 2004	Developed a four-level AHP model to support the supplier selection decision using cost, delivery, flexibility, innovation, quality, and service as high-level criteria
Yurdakul and Ic, 2004	Developed a multi-level AHP model for evaluating credit risk based on financial and non-financial criteria
Liu and Liu, 2005	Developed a 4-level decision model that considers interdependence among decision criteria by applying the Analytic Network Process (extension of AHP) to select a logistics service provider
Liu and Liu, 2005	Utilized the Yahya and Kingsman supplier selection decision to illustrate an extension of AHP that incorporated a voting mechanism to establish the criteria weights
Yoon and Im, 2005	Developed and applied an AHP model to evaluate IT outsourcing satisfaction based on consulting service satisfaction, customer supporting service satisfaction, and performance satisfaction

Finally, we extended the model to address the issues raised in our interviews.

A "*Fortune* 50" company (i.e. a company that is one of the top 50 largest firms in the *Fortune* 500) determined that it would outsource a new customer support call center. In the initial assessment of the center's requirements and associated operating costs, it also determined that the center would likely need to be placed in an offshore location in order to satisfy total cost requirements. The company has a process currently in place to guide this decision-making, as mapped in Figure 1. The first part of their selection process is to identify possible suppliers, issue a Request for Proposal (RFP), and respond to supplier inquiries for clarification on the RFP requirements. Any clarifying information shared with one supplier is shared with all suppliers to ensure fairness. The RFP is returned to the firm in a standardized format as specified in the RFP document. The firm decision makers then evaluate the responses. From this universe of suppliers, a subset is selected to deliver formalized presentations to the firm. Following the presentations, remote observations of the supplier's current call centers are conducted. Next, the decision makers conduct site visits to the suppliers' offshore locations. A final total cost quote is solicited, and the winning supplier is selected. At each stage in the process, there is the potential to narrow the candidate pool by eliminating firms. In practice, this process takes approximately six months from developing the initial statement of work to selecting the supplier.

Current decision-making process

When selecting an offshore outsourcing location, the company takes into consideration a myriad of factors that are both quantitative and qualitative. The choice of offshore location is a part of the overall supplier evaluation process. In this instance, offshore suppliers are evaluated in three broad areas: Technical Capability (the ability to perform the specific work functions required), Experience (the supplier's previous experience in the functional area), and Offshore Capability (the supplier's ability to satisfy various off-shore specific requirements). The specific criteria used by this firm in each of these decision areas are identified in Table III (for detailed definitions of the criteria, see the Appendix.)

The firm uses a spreadsheet-based rating and ranking methodology. Each decision criterion is assigned a weight to reflect the importance of the criterion and each decision criterion is rated on an ordinal scale (ultimately treated as an interval scale). The firm has established and defined scales for

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Figure 1 Supplier selection process

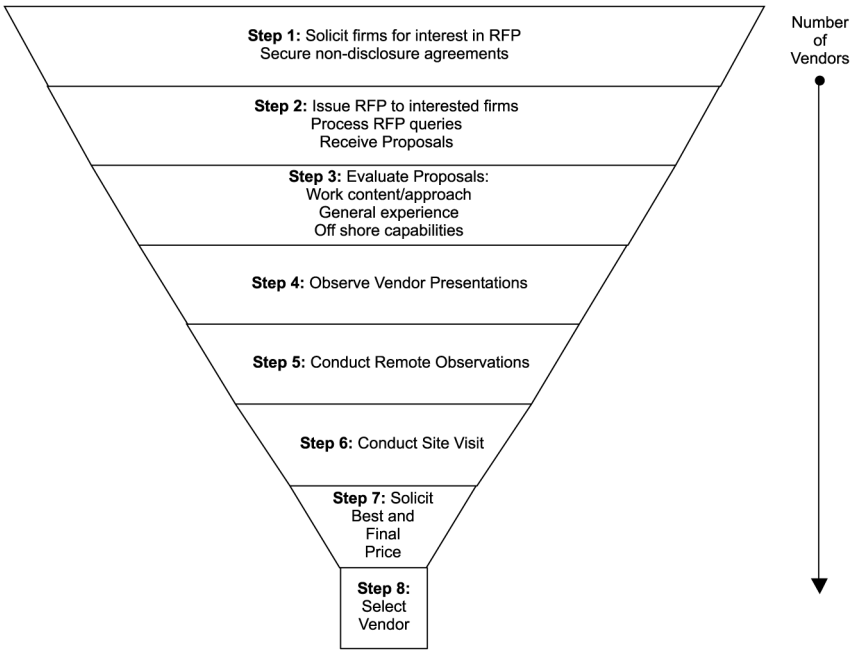

Table III Decision criteria

Technical capability criteria (26 criteria)	Experience criteria (14 criteria)	Off shore capability criteria (11 criteria)
Functional services	Background	International infrastructure
Operations support environment	Call center experience	Language skills
Operational reports	Ownership diversity classification	Facility security
Operational monitoring	Financial strength	Client data security
Performance standards	References	Employee termination process
Escalations and transfers	Facilities	Hiring – background checks
End-user outbound calls	Internet site evaluation	Hiring – criminal check
Forecast management	Client scale	Hiring – drug screening
Call volumes	Professional associations	Lodging security assessment
Volume variations	Certifications/awards	Expatriate compound/accommodations
Client-provided training	Employee relations	Environs risk/security assessment
Telecommunications	Attrition	
Training	Organized labor relations	
Remedial training	Emergency planning	
Knowledge and skills		
Products		
Desktop equipment		
Desktop access		
Periodic reviews		
Incentives		
Mean call duration		
Quality management		
Employee churn		
One contact		
Schedule		
Customer satisfaction		

both rating and weighting criteria. The rating is multiplied by the weight to create a criterion score. Table IV provides the scales and weights used in the rating of each criterion. The individual scores of each criterion are summed to provide a score for the respective decision dimension (Technical Capability, Experience, Off-shore Capability).

The three scores (one per decision criterion) are combined to yield two composite scores. The first composite score

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Table IV Rating and weight scales

Rating scale definitions		Weight scale definitions	
0	No answer provided	1	Not required but adds value
1	Does not meet requirements	3	Important requirement
2	Meets some requirements	5	Critical requirement
3	Meets most requirements		
4	Meets all requirements		
5	Exceeds requirements		

combines Technical Capability and Experience, the second combines Technical Capability and Off-shore Capability. For this composite scoring, Technical Capability is weighted at 60 percent in each combined score; Experience and Off-shore Capability are each weighted at 40 percent of their respective composite score. Composite "meets all" scores are calculated for comparison purposes (using the weight for each criterion and a rating of 4: meets all requirements). Based on the actual composite scores, eight suppliers were selected to move onto the next selection phase. The output of this rating/ranking process is displayed in Table V. The eight suppliers selected to move on to the next phase are shaded. These suppliers were selected based on rank-ordering the output of the Technical Capability/Experience score, and then checking to ensure that the Technical Capability/Off-Shore score did not indicate that the supplier should be excluded. Canada-2, for example, was the 2nd ranked location in Technical Capability/Experience, and was ranked 12th in Technical Capability/Off-shore. In spite of this relatively low Off-Shore rating, the location was moved onto the next phase. The location ranked 7th (India-3) was bypassed and replaced with the 12th rated supplier (Philippines-4). This substitution was a subjective choice based on the decision maker's prior experience with the suppliers.

The literature suggests factors that should be considered when selecting an offshore outsourcing location; earlier we formulated a list of possible factors as well. In comparing those criteria with the factors actually incorporated in the decision-making process, we see that this firm is most concerned with language conversational fluency (Language Skills), hiring and selection practices (Hiring – Background Checks, Criminal Check, Drug Screening, Termination Process), and communications system (International Infrastructure). Interestingly, of the eleven criteria in the Off-shore Capability matrix, five address security issues (Facility Security, Client Data Security, Environs Risk/ Security Assessment, Lodging Security Assessment, Expatriate Compound/Accommodations) that we did not consider up front. Clearly, safety and regional stability issues are priorities for this firm.

Application of the analytic hierarchical process

We now use the AHP to replace the rating and ranking system during the initial evaluation process (step 3 in the supplier selection process). As the firm had already completed the decision-making process and selected a supplier, the following AHP example utilizes the same ratings and weights used in the firm's decision-making process. The original rankings can then be compared to the AHP output. As noted, we assume that the firm has already decided to offshore the given function and that the specific scale and scope of the undertaking is known (i.e. the type of work, the volume of work, and so on).

AHP process

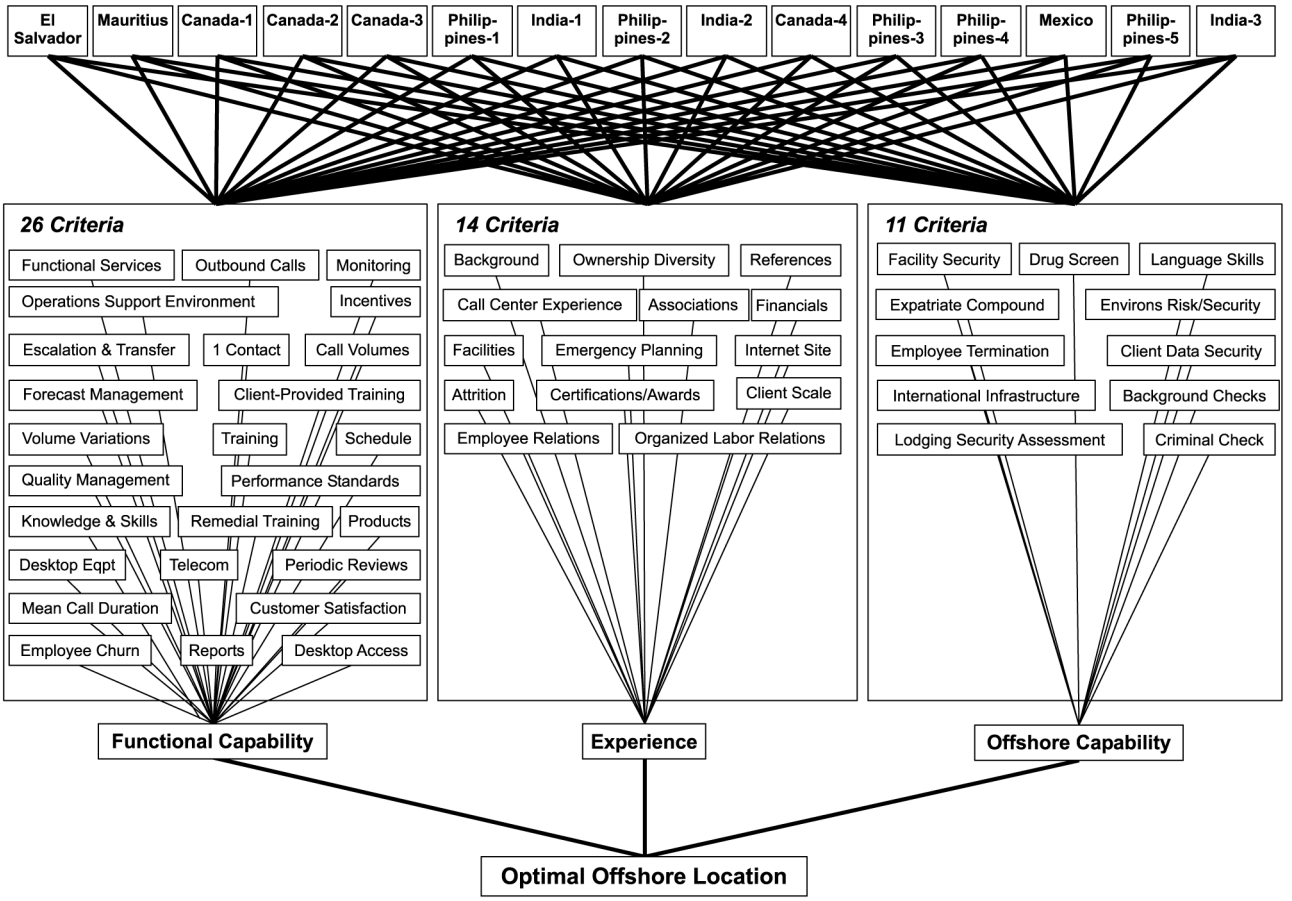
Figure 2 shows the hierarchy of the actual offshore supplier selection process for our "Fortune 50" company. The goal, shown in the output level of the model, is to select the optimal offshore location. The aggregate criteria that are considered in this decision are just above the location selection: Technical Capability, Experience, Off-shore Capability. The sub-criteria

Table V Composite scores

	Technical capability	Experience	Technical/experience composite score	Rank	Off-shore capability	Technical/off-shore composite score	Rank
Meets all weighted	384	184	304		164	296	
Mexico	*318*	*165*	*256.8*	*1*	134	244.4	1
Canada-2	*321*	*158*	*255.8*	*2*	0	192.6	12
Canada-1	*313*	*159*	*251.4*	*3*	136	242.2	2
El Salvador	*303*	*163*	*247*	*4*	125	231.8	3
Canada-4	*295*	*163*	*242.2*	*5*	112	221.8	7
India-2	*297*	*131*	*230.6*	*6*	117	225	4
India-3	293	136	230.2	7	119	223.4	6
Philippines-1	*276*	*161*	*230*	*8*	134	219.2	8
Mauritius	278	155	228.8	9	106	209.2	9
Canada-3	280	145	226	10	0	168	13
Philippines-5	288	131	225.2	11	128	224	5
Philippines-4	*261*	*162*	*221.4*	*12*	125	206.6	10
India-1	253	156	214.2	13	129	203.4	11
Philippines-3	74	146	102.8	14	118	91.6	14
Philippines-2	0	106	42.4	15	90	36	15

Note: The text in italics shows the eight suppliers selected to move on to the next phase. These suppliers were selected based on rank-ordering the output of the Technical Capability/Experience score, and then checking to ensure that the Technical Capability/Off-Shore score did not indicate that the supplier should be excluded

Figure 2 AHP offshore location selection hierarchy



that are included in each of the aggregate criteria appear above. At the top of the diagram are the 15 off-shore locations considered and evaluated for each of the sub-criteria.

In AHP, the decision maker takes each criterion and compares each pair of options against each other with respect to that criterion. Here, for example, considering the criterion, Operational Monitoring, the decision maker would compare each location against each of the other locations with respect to their relative Operational Monitoring capabilities. In general, these comparisons can utilize actual measurements (such as cost or distance) or qualitative judgments. If not using "real" comparative data, Saaty formulated a 9-point comparative scale for qualitative pair-wise evaluations. The scale is described in Table VI, using El Salvador and Mauritius as examples, with the even scale values representing intermediate values between the two adjacent scale values. (Saaty and Kearns, 1985) An application of AHP that used a 5-point rating scale (ranging from outstanding to poor) mapped the 5 categories onto the odd values of the 9-point comparative scale, where "outstanding" mapped to 1 and "poor" mapped to 9 (Chan and Chan, 2004).

In this example, we will use the ratings that the decision maker actually assigned to each decision criterion for each supplier as if they were actual (i.e. quantitative) measurements. For example, if El Salvador is rated a 4 (meets requirements), and Mauritius is also rated a 4, then the scale value assigned in the matrix is 1, indicating that they are equal in their capabilities ($4/4 = 1$). This initial comparison matrix for Operational Monitoring appears in Table VII. By definition, the main diagonal cells are all equal to 1 as they are the rating of a location compared to itself. The shaded cells are calculated using the rating scores, row divided by column. To complete the matrix, the remaining cells (i, j) are each calculated as the reciprocal of the value in shaded cell (j, i), the reverse comparison of the two locations. Consider row (i) Canada-1 and column (j) Mauritius. This cell value (1.33) is the reciprocal of the calculated cell value (rating value 3/rating value $4 = 0.75$) that compared the ratings of row (i) Mauritius and column (j) Canada-1. This yields a complete matrix of pair-wise comparisons.

This matrix is then normalized to produce a vector of the local priorities. Saaty offers a variety of approaches for formulating this priority vector, including normalizing the column elements (dividing each value by its column total) and then averaging each row (Saaty and Kearns, 1985). This approach is the most straightforward and is used in this application.

Table VIII provides the normalized matrix and priority vector. Note that the priority vector (extreme right column of the table) adds to 1. This allows for relative comparisons between the components under consideration. Also note that the cell values are constant within each row; this is a result of using the assigned ratings as if they were actual

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Table VI AHP pair-wise scale values

Scale value	Definition	Case descriptive example
1	Equal importance	The two supplier firms demonstrate equal call monitoring capability
2		
3	Moderate importance of one over the other	El Salvador has moderately better call monitoring capability than Mauritius
4		
5	Essential or strong importance of one over the other	El Salvador has better call monitoring capability than Mauritius
6		
7	Demonstrated importance of one over the other	El Salvador has demonstrably better call monitoring capability than Mauritius
8		
9	Extreme importance of one over the other.	El Salvador has extremely better call monitoring capability than Mauritius

measurements. When using pair-wise comparisons between criterion, this constancy will, in general, NOT be the case.

In addition, we can calculate a consistency index as an indicator of the consistency of the pair-wise ratings (Saaty, 1980). A consistency index (although, as a higher index value indicates inconsistency, this might be more accurately called an "inconsistency index") below 0.10 is considered acceptable; in this application, the consistency index is virtually zero (0.0003). Of course, as we have used the firm's ratings as actual measures rather than pair-wise comparisons, we expected a very low (indicating very consistent) consistency index value. Hence, it is indicated that there is a strong degree of consistency among the pair-wise ratings.

Recall that the criteria were assigned relative weights (Table III) by the decision makers. These weights were used to synthesize the various criteria in each hierarchy, again treating the weights as if they were actual measures. In the first overall score, Technical Capability was weighted at 60 percent and Experience at 40 percent. In the second overall score, Technical Capability was again weighted 60 percent and Off-shore Capability was weighted 40 percent. A criterion priority vector is calculated in the same manner as the individual elements priority vectors (Table IX).

Note that, in our case of fifteen potential suppliers, twenty-six 15 × 15 matrices were constructed with the ratings of the criteria considered in the Functional Capability hierarchy; fourteen 15 × 15 matrices were constructed with the Experience criteria ratings and eleven 15 × 15 matrices were constructed with the Off-shore Capability ratings. To facilitate computation of the AHP model, ratings of "0" (no answer provided), were changed to ratings of "1" (does not meet requirements). In the initial Technical Performance hierarchy, the "1" rating was never used and there were 47 instances of a "0" rating in the Technical Performance hierarchy; these "0" ratings were changed to a "1". There were two locations that were not evaluated under the Off-shore Capability hierarchy; again, ratings of "1" were substituted. None of these changes affected the rank position of the locations under the firm's decision analysis model. Table X provides the synthesis output vectors of the three hierarchies. To combine the three hierarchies, we again return to the actual comparisons used in the firm's rating and ranking model.

Recall that the firm combined the rankings based on a weighting system (Table IX). To synthesize the aggregate criteria into global priorities, we used the relative weights of these ratings setting Experience and Off-shore Capability equal to each other, and Technical Capability 50 percent more important than the other two criteria hierarchies. Table XI provides the synthesis of the three hierarchies (yielding weights of 3/7, 2/7, 2/7) and global priorities, as well as the overall AHP output vector.

Based on the AHP output, we can see that the best location (as indicated by the highest value in the AHP output vector) is Mexico, followed closely by Canada-1. The least desirable locations are Philippines-2 and Philippines-3, with Canada-3 not far behind. When compared to the firm's rankings (based on its current process), the AHP output changes the rank position of several locations. However, six of the top eight selections stayed the same, and, if we count Philippines-4 as among the original top 8 (it was 12th, but moved up to 8th by the company, based on "qualitative" reasons), we have seven of the eight top choices remaining the same. Mexico was ranked first in both cases.

Discussion

Putting aside the specific rankings produced (which, actually, were somewhat similar), the AHP output appears at first glance to mirror the type of weighted rating and ranking system already in place for location selection, in that it yields a rank-ordered list of locations. A deeper review demonstrates, however, that the AHP model provides results that can be applied more readily to support the decision making process. The AHP output has a relational scale; the ranking system currently in place does not. The value of this is the ability to discern real differences between locations and in being able to understand the trade-offs between criteria. One example can be seen by comparing India-1 and India-2. Comparing their ratings in the current ranking system, they are ranked 13th and 6th, respectively, with rating scores of 214.2 and 230.6. With over a 16 point difference in their scores, it appears that India-2 is "a lot better" than India-1. The AHP output vector, however, by considering the various criteria ratings and weights, yields a very similar value for both locations (.0687 and .0681), indicating that these two locations are fairly close in overall suitability, and, while they are ranked similarly, 9th and 11th, in fact, India-1 is, overall, slightly superior.

Another interesting point to consider is that cost was not part of the location selection process until the final step. As described in the taxonomy in Table I, there are a wide variety of cost components that can be incorporated into the location selection process. In a conscious effort to ensure that locations are evaluated based on all criteria, not just "best cost," the firm's current process does not consider cost until the final round of evaluations (step 7). The decision maker, however, would have preferred to include costs in the initial evaluation

Table VII Operational monitoring comparison matrix

Rating score (j) (i)		3 El Salvador	3 Mauritius	4 Canada-1	4 Canada-2	3 Canada-3	4 Philippines-1	4 India-1	1 Philippines-2	4 India-2	3 Canada-4	3 Philippines-3	4 Philippines-4	4 Mexico	3 Philippines-5	2 India-3
3	El Salvador	1.00	1.00	0.75	0.75	1.00	0.75	0.75	3.00	0.75	1.00	1.00	0.75	0.75	1.00	1.50
3	Mauritius	*1.00*	1.00	0.75	0.75	1.00	0.75	0.75	3.00	0.75	1.00	1.00	0.75	0.75	1.00	1.50
4	Canada-1	*1.33*	*1.33*	1.00	1.00	1.33	1.00	1.00	4.00	1.00	1.33	1.33	1.00	1.00	1.33	2.00
4	Canada-2	*1.33*	*1.33*	*1.00*	1.00	1.33	1.00	1.00	4.00	1.00	1.33	1.33	1.00	1.00	1.33	2.00
3	Canada-3	*1.00*	*1.00*	*0.75*	*0.75*	1.00	0.75	0.75	3.00	0.75	1.00	1.00	0.75	0.75	1.00	1.50
4	Philippines-1	*1.33*	*1.33*	*1.00*	*1.00*	*1.33*	1.00	1.00	4.00	1.00	1.33	1.33	1.00	1.00	1.33	2.00
4	India-1	*1.33*	*1.33*	*1.00*	*1.00*	*1.33*	*1.00*	1.00	4.00	1.00	1.33	1.33	1.00	1.00	1.33	2.00
1	Philippines-2	*0.33*	*0.33*	*0.25*	*0.25*	*0.33*	*0.25*	*0.25*	1.00	0.25	0.33	0.33	0.25	0.25	0.33	0.50
4	India-2	*1.33*	*1.33*	*1.00*	*1.00*	*1.33*	*1.00*	*1.00*	*4.00*	1.00	1.33	1.33	1.00	1.00	1.33	2.00
3	Canada-4	*1.00*	*1.00*	*0.75*	*0.75*	*1.00*	*0.75*	*0.75*	*3.00*	*0.75*	1.00	1.00	0.75	0.75	1.00	1.50
3	Philippines-3	*1.00*	*1.00*	*0.75*	*0.75*	*1.00*	*0.75*	*0.75*	*3.00*	*0.75*	*1.00*	1.00	0.75	0.75	1.00	1.50
4	Philippines-4	*1.33*	*1.33*	*1.00*	*1.00*	*1.33*	*1.00*	*1.00*	*4.00*	*1.00*	*1.33*	*1.33*	1.00	1.00	1.33	2.00
4	Mexico	*1.33*	*1.33*	*1.00*	*1.00*	*1.33*	*1.00*	*1.00*	*4.00*	*1.00*	*1.33*	*1.33*	*1.00*	1.00	1.33	2.00
3	Philippines-5	*1.00*	*1.00*	*0.75*	*0.75*	*1.00*	*0.75*	*0.75*	*3.00*	*0.75*	*1.00*	*1.00*	*0.75*	*0.75*	1.00	1.50
2	India-3	*0.67*	*0.67*	*0.50*	*0.50*	*0.67*	*0.50*	*0.50*	*2.00*	*0.50*	*0.67*	*0.67*	*0.50*	*0.50*	*0.67*	*1.00*

Note: The figures in italic are calculated using the rating scores, row divided by column

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Table VIII Operational monitoring normalized matrix and priority vector

	Normalized matrix															
	El Salvador	Mauritius	Canada-1	Canada-2	Canada-3	Philippines-1	India-1	Philippines-2	India-2	Canada-4	Philippines-3	Philippines-4	Mexico	Philippines-5	India-3	Priority vector
El Salvador	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
Mauritius	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
Canada-1	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
Canada-2	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
Canada-3	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
Philippines-1	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
India-1	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
Philippines-2	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
India-2	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
Canada-4	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
Philippines-3	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
Philippines-4	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
Mexico	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
Philippines-5	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
India-3	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041

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Table IX Criteria comparison matrix and priority vector

		Criteria matrix			Normalized matrix			
Score		60% Technical capability	40% Experience	40% Off-shore capability	Technical capability	Experience	Off-shore capability	Priority vector
	Technical capability	1.000	1.500	1.500	0.429	0.429	0.429	0.429
40%	Experience	*0.667*	1.000	1.000	0.286	0.286	0.286	0.286
40%	Off-shore capability	*0.667*	*1.000*	1.000	0.286	0.286	0.286	0.286

Note: The figures in italic are calculated using the rating scores, row divided by column

Table X AHP hierarchy priority vectors

	Technical capability	Experience	Off-shore capability
El Salvador	0.0757	0.0732	0.0766
Mauritius	0.0694	0.0700	0.0645
Canada-1	0.0778	0.0715	0.0822
Canada-2	0.0798	0.0713	0.0221
Canada-3	0.0705	0.0647	0.0221
Philippines-1	0.0677	0.0723	0.0817
India-1	0.0622	0.0684	0.0788
Philippines-2	0.0241	0.0463	0.0548
India-2	0.0736	0.0571	0.0711
Canada-4	0.0737	0.0743	0.0677
Philippines-3	0.0358	0.0646	0.0713
Philippines-4	0.0651	0.0725	0.0754
Mexico	0.0790	0.0740	0.0819
Philippines-5	0.0722	0.0595	0.0776
India-3	0.0735	0.0602	0.0722
Column total	1.0000	1.0000	1.0000

step (step 3). To support this process, we have re-run the AHP model adding in contract cost as a fourth criterion. We used actual contract costs in the criteria matrix, and assumed that cost would be of equal importance to Experience and Off-shore Capability. Table XII provides the output of this model. AHP readily incorporates contract cost as a component criterion of the decision-making process, but while leading to some major difference in rank order (e.g., Canada-1 from 2nd to 8th), it does not become the controlling factor. Of the top 8 in the rank order without considering cost, 6 remain in the top 8 when cost is considered in the evaluation. Perhaps adding cost into the first evaluations would have narrowed the field of finalists more effectively, in spite of the company's "fear" that cost would dominate the decision making process. And, as noted above, AHP easily accommodates cost as simply one more criterion.

AHP allows for global synthesis of the complete decision making criteria. In the firm's current method, a composite score for Technical Capability and Experience is the "final score" and is calibrated against a second composite score, Technical Capability and Off-shore Capability. If a top candidate in the first score had a very low score in the second, it may be passed over. Rather than use this litmus test approach, which is inherently imprecise and vague, AHP incorporates the Off-shore Capability criteria with the other criteria in an explicit way. The company's weighted ranking and rating system's output was not viewed as a 'real score' that demonstrated actual differences in the locations as demonstrated by the decision makers willingness to modify the list that moved onto the next round; application of the AHP model described with it's scaled output would potentially reduce that type of subjective decision making.

Table XI Overall model synthesis and output vector

	Global synthesis			AHP
	Technical capability	Experience	Off-shore capability	Output vector
El Salvador	0.0325	0.0209	0.0219	0.0753
Mauritius	0.0298	0.0200	0.0184	0.0682
Canada-1	0.0333	0.0204	0.0235	0.0772
Canada-2	0.0342	0.0204	0.0063	0.0609
Canada-3	0.0302	0.0185	0.0063	0.0550
Philippines-1	0.0290	0.0206	0.0234	0.0730
India-1	0.0267	0.0195	0.0225	0.0687
Philippines-2	0.0103	0.0132	0.0156	0.0392
India-2	0.0315	0.0163	0.0203	0.0681
Canada-4	0.0316	0.0212	0.0193	0.0721
Philippines-3	0.0153	0.0185	0.0204	0.0542
Philippines-4	0.0279	0.0207	0.0215	0.0701
Mexico	0.0339	0.0211	0.0234	0.0784
Philippines-5	0.0309	0.0170	0.0222	0.0701
India-3	0.0315	0.0172	0.0206	0.0693
Total				1.0000

Table XII AHP with cost included as a criteria

Location	Overall rating	Rank
India-2	0.0786	1
Mexico	0.0769	2
India-1	0.0753	3
Philippines-4	0.0748	4
Philippines-1	0.0741	5
El Salvador	0.0734	6
India-3	0.0728	7
Canada-1	0.0707	8
Mauritius	0.0683	9
Philippines-5	0.0669	10
Canada-4	0.0659	11
Canada-2	0.0576	12
Canada-3	0.0545	13
Philippines-2	0.0458	14
Philippines-3	0.0444	15

The firm's current method is designed to be systematic and objective. It is interesting that they specifically exclude operating cost (the most objective component of the analysis) from this initial assessment. Perhaps a method such as AHP, that is able to incorporate both qualitative and quantitative criteria evaluations, would streamline the decision-making process. As the location selection process continues to subsequent steps, with a smaller candidate pool and more subjective evaluation (such as the supplier presentation and site visits), AHP may be more applicable in those areas by providing a rigorous framework for assessment of qualitative factors.

Conclusion

The AHP process allows firms to look at a portfolio of choices and determine which firms are basically equal in qualifications. As the final choice of location and supplier in this example resulted in three locations being selected, a way to assemble a portfolio of choices that considers all factors is needed. For firms that are building or extending off-shore capabilities, this AHP model provides a meaningful way to create a portfolio of locations. The AHP ratio-scale output provides relevant, relative assessments that readily translate to selection of a portfolio of locations. One approach to creating a portfolio of locations would be to select the top-tiered locations from the AHP vector (for example the first quartile). Another approach would be to modify the global priorities values to fit the various operations being off-shored, as well as the individual firm's key priorities. Perhaps cost would be weighted most highly for back-office operations, language would be the priority for customer-contact operations, and experience would take center stage for technical support.

Many companies employ a weighted ranking and rating system as a means for analyzing supplier decisions; as demonstrated here the application of a more structured, objective, scaled output system such as the AHP model reduces the possibility of subjective "off book" decision making. As discussed earlier, a variety of decision criteria for location selection are proposed in previous outsourcing and offshoring literature but no quantitative analysis is performed. The criteria used in this case indicate that perhaps these theories do not mirror actual practice. Empirical research that seeks to understand what the decision criteria utilized actually are, and how they are evaluated in the offshore location decision-making process, would be a natural extension of this paper.

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Supply Chain Management: An International Journal
Volume 13 · Number 6 · 2008 · 435–449

Appendix. Decision criteria with definitions

Table AI

	Criteria	Definition
Technical capability	Functional services	Provide support services to install/uninstall software and services for client's end users, manage and resolve support requests
	Operations support environment	Provide support to the operating environment i.e. DSL lab environment, operations calls, use of VOL trouble tickets system, dedicated training facilities
	Operational reports	Ability to provide management reports to client
	Operational monitoring	Ability to perform ongoing monitoring of agents
	Performance standards	Provide support to end users within client defined performance objectives including service level, speed of answer, call duration, and so on
	Escalations and transfers	Ability to adhere to established methodology for handling customer service escalations and/or transfer calls
	End-user outbound calls	Ability to adhere to established methodology for handling calls back to customers
	Forecast management	Ability to respond to forecasted volumes within proscribed timeframe with a staffing plan
	Call volumes	Ability to handle full range of projected call volumes
	Volume variations	Ability to handle increases/decreases in call volumes as well as changes to call categories
	Client-provided training	Ability of incorporating client-provided training technology
	Telecommunications	Type of telecommunications infrastructure
	Training	Methodology for new hire and ongoing agent training
	Remedial training	Ability and methodology to identify requirement for and conduct agent remedial training
	Knowledge and skills	Ability to secure agents with required technical knowledge and skills
	Products	Ability to support product portfolio
	Desktop equipment	Adherence to technical specifications for desktop equipment
	Desktop access	Adherence to limiting desktop access to peripherals or storage medium
	Periodic reviews	Methodology for conducting periodic performance reviews
	Incentives	Methodology for managing performance incentives
	Mean call duration	Methodology for managing mean call duration
	Quality management	Methodology for managing quality
	Employee churn	Methodology for managing employee churn
	One contact	Methodology for managing towards resolving all customer requests in one contact experience
	Schedule	Methodology for managing employee adherence to work schedules
	Customer satisfaction	Methodology for managing to end-user customer satisfaction rating objectives
Experience	Background	Supplier background
	Call center experience	Supplier experience in call center services
	Ownership diversity classification	Diverse ownership/management (women/minority)
	Financial strength	Financial strength of supplier firm
	References	Professional references
	Facilities	Type of supplier facilities
	Internet site evaluation	Firm has an active, robust internet presence
	Client scale	Relative scale of prior clients
	Professional associations	Supplier involvement in relevant professional associations
	Certifications/awards	Supplier holds relevant certifications (i.e. ISO 9000, Deming)
	Employee relations	Supplier demonstrates strong relationship with employees
	Attrition	Supplier has appropriate employee attrition rates
	Organized labor relations	Supplier has appropriate relationship with Union (if present)
	Emergency planning	Supplier demonstrates appropriate disaster recovery plan
Off shore capability	International infrastructure	Location and quality of infrastructure connecting USA to offshore site
	Language skills	Supplier demonstrates process to ensure conversational language quality and minimize speaking accent
	Facility security	Supplier demonstrates robust physical security plan
	Client data security	Supplier adheres to client data security protocols
	Employee termination process	Supplier adheres to data access requirements when an employee is terminated
	Hiring – background checks	Supplier conducts background checks when hiring employees
	Hiring – criminal check	Supplier conducts criminal checks when hiring employees
	Hiring – drug screening	Supplier conducts drug screening when hiring employees
	Environs risk/security assessment	Risk/security assessment of facility location and surrounding environs
	Lodging security assessment	Risk/security assessment of hotel/compound locations and other relevant sites
	Expatriate compound/accommodations	Supplier provides a compound for visiting/working expatriates

Corresponding author

Linda Boardman Liu can be contacted at: lbliu@bu.edu