THE USE OF THE ANALYTIC HIERARCHY PROCESS IN THE SELECTION OF PARTICIPANTS FOR A TELECOMMUTING PILOT PROJECT

Rex Karsten
College of Business Administration, University of Northern Iowa, Cedar Falls, IA 50614

Timothy Garvin
Division of Business, Wayne State College, Wayne, NE 68787

Abstract

While many organizations have already implemented telecommuting as a workplace option, many others may be reluctant to make a full-scale commitment to this still relatively new approach. There are many individual, organizational, and environmental issues driving organizations to consider telecommuting. The pilot project approach to exploring and responding to telecommuting problems and opportunities offers the opportunity for organizational learning, while minimizing organizational risks. Decision support tools, in particular the Analytical Hierarchy Process, can provide necessary and valuable assistance in the identification and selection of telecommuting pilot project participants. A hypothetical telecommuting example demonstrates the applicability and usefulness of the Analytical Hierarchy Process to pilot project decisions.

Introduction

The concept of telecommuting has evolved over the past two decades to the point where many organizations now view telecommuting as a potential, viable alternative to traditional office-based work settings [14]. Several factors drive telecommuting issues. Emergent technologies are making work arrangements which were once impossible both convenient and economically viable. A variety of other factors, such as employee preferences and availability, cost, customer service, and environmental concerns have stimulated in telecommuting opportunities.

SIGCPR/ SIGMIS '96, Denver Colorado USA
© 1996 ACM 0-89791-782-0/96/04..$3.50

While many organizations have already implemented telecommuting solutions, many others have taken a more cautious, "wait and see" approach, preferring to let others navigate and chart the still relatively unknown "waters" of remote work.

Most would agree, however, that the factors driving the issue, and the availability of enabling technologies, have reached "critical mass", compelling competitive organizations to actively explore telecommuting options. A logical and prudent first step for organizations reluctant to make a full-blown commitment to telecommuting, but eager to explore the opportunity, is to begin with a pilot project. The are several advantages to the pilot project approach. Pilot projects generally involve reduced financial risk and make the disruption of critical technological and non-technological business systems less likely. The pilot project approach, however, still provides an opportunity for organizational learning that can be profitably transferred, if warranted, to a broader organizational implementation effort.

Ensuring a successful telecommuting pilot project requires the accurate identification and selection of appropriate organizational sub-unit candidates to be considered for participation in the project. The concept of organizational sub-unit in this regard is orthogonal to the organization. Depending on the organization, sub-unit might be variously defined as an entire subsidiary organization, a major department, a small group of workers, or even a single individual.

Such decisions naturally involve multiple alternatives and multiple decision criteria. Some of the criteria to be used in the decisions will be quantifiable, while others may be subjective or qualitative in nature. Additionally, such decisions may be made by groups or selected individuals. A means of decision support which addresses the above factors, assist the decision maker(s) in identifying alternatives and criteria, structuring the problem, eliciting the decision makers' preferences, managing the cognitive complexity of the problem, and that provides an overall ranking of the decision alternatives would seem to be a necessary and valuable tool.

Many authors have suggested numerous factors that should be considered when deciding telecommuting issues. While noting that hunches and guesswork are not sufficient, few suggest a process technique for evaluating these factors [12]. The purpose of this paper is to propose the use of the Analytic Hierarchy Process, originally developed by Thomas Saaty [8], to support organizational decision maker(s) in the identification and selection of participants for a telecommuting pilot project. The Analytic Hierarchy Process (AHP) has the ability to provide decision support in the manner described previously. In addition, the AHP has been well-tested and shown to be helpful in many other decision settings involving identification and selection tasks [15].

This paper briefly discusses telecommuting, its emergence as an issue, and the drivers/enablers which have elevated it to importance. The case for the use of a pilot telecommuting project and the considerations in justifying such a pilot project to management are explored in brief form as well. Common criteria which might play a role in the candidate identification and selection process are presented and discussed. The AHP is explained in general terms, justification for its application to telecommuting is provided, and the application of the AHP to an example pilot project participant selection problem is developed and illustrated. Considerations for the use of AHP in these types of problems are offered and possible directions for future research are presented.

Telecommuting as an Emerging Organizational Issue

Telecommuting is a growing trend which has shown itself worthy of serious consideration by its growth, by organizational struggles to define and accommodate it, and by society's attempt to deal with it [5][7].

There are many entwined reasons why telecommuting is under serious consideration by many organizations, and already in use by many others. From an employee perspective, the issue may driven by the personal preferences, obligations or quality of worklife issues [5]. From an organizational viewpoint, firms may find telecommuting to be a means to establish a "virtual presence" in new markets, to address human resource issues, or to improve customer service. Economic considerations are logical drivers in telecommuting decisions, as firms anticipate the savings in physical infrastructure investments and a variety of productivity improvements promised by telecommuting advocates [14].

Highly visible and available technological enablers of telecommuting are also driving telecommuting to the forefront of organizational consideration. The personal computing, networking, and groupware have changed our thinking about where computing can and should take place, and how workers are connected [6]. Corresponding advances in telecommunications technologies promise to make remote work an increasingly reliable and productive option.

In addition, we have moved towards an economy based on service, information, and intelligence rather than one based upon the production of tangible goods. In short, the nature of work itself has evolved in a direction that makes it more amenable to telecommuting. Coincidentally, the current popularity of the Internet has provided many individuals the opportunity to function in extended electronic environments, encouraging a heightened awareness of telecommuting possibilities.

Finally, larger, societal concerns also encourage organizations to explore the viability of telecommuting. For example, telecommuting is increasingly seen as a means of reducing travel and the associated pollution, congestion, noise and social problems [11].

While the potential advantages of telecommuting are alluring, the actual costs and benefits of a telecommuting project are likely to be difficult to quantify and justify for firms with little or no experience with the concept.

The Case for the Use of Telecommuting Pilot Projects

There are many reasons why an organization might opt to pursue a telecommuting pilot project rather than a full-scale implementation of telecommuting. First, an organization may not be able to afford a full-scale project. In spite of decreasing telecommunications costs, the resource investment is likely be quite sizeable in terms of financial, technological, time, and related commitments. Second, full-scale implementation efforts tend to have disastrous organizational and career consequences for those in charge when they fail, making a conservative decision makers reluctant to commit. Third, an organization may be reluctant to commit to full-scale implementation because of the difficulty in determining if it has the skills and resources necessary to successfully pursue such a novel alternative. Fourth, a lack of support for telecommuting by more traditional, upper-level management [11], may preclude securing a commitment to full-scale implementation. Finally, given the constant emergence of new technologies and popular calls for management restructuring, there may be a natural organizational reluctance to completely commit to yet another new approach to the workplace.

On the other hand, there are a number of reasons which support the use of a pilot telecommuting project. Pilot projects are an obvious way to reduce some of the risks or to overcome the barriers mentioned above. Moreover, there are additional justifications that support the pilot project alternative. As mentioned earlier, it provides the opportunity for learning and exploration which may eventually be incorporated into decisions involving full-scale implementation. Second, the pilot project can often address immediate needs in a more timely fashion than the full-scale approach. For example, a key employee has a legitimate, unexpected need to stay at home to care for a dependent, or unanticipated demand for the organization's products and services necessitates the addition of a sizeable number of workers before sufficient office space can be constructed. Third, the pilot project can be used to empower, motivate, and reward workers in certain key areas that impact productivity and improve customer service. Fourth, the pilot project can be a tool that permits management to address seasonal, business-cyclical, and similar fluctuations without making substantial capital investments. Finally, as an investigatory tool, the telecommuting pilot project can be used as a catalyst for planned and unplanned organizational change.

Based on the preceding discussion, it follows that many organizations would logically elect the pilot project approach as a means of exploring telecommuting options. The challenges then posed for company decision makers are to identify and select from candidate organizational sub-units the actual participants in the pilot project.

Obviously, many decision criteria could be employed in the pilot project candidate identification and selection process. The key consideration is that the organization, via its decision maker(s), must define its own criteria in the context of the problem at hand and the conditions prevalent at the time the decision is being made. Several examples of criteria are discussed here. They are not intended to be complete or prescriptive, but simply to represent some of the more common types of criteria that organizations are likely to consider.

It is useful to dichotomize the criteria which surround the telecommuting pilot project candidate identification and selection process as internal criteria and external criteria on the basis of locus of establishment of each criterion. Internal criteria established by the organization might include cost, technological capabilities (with respect to telecommuting and related activities), the degree of management acceptance and support, congruence with organizational needs and objectives, employee readiness, and the very nature of the work itself.

Those criteria established by entities or forces external to the organization should also be considered in the pilot project decision. For example, these might include the customers' perception and acceptance of telecommuted work, the actions of competitors, the market's/customer's perception of how the product or service should be delivered, and the availability of the technological infrastructure components which are external to the organization, yet necessary to support the telecommuting pilot project. Other considerations might include the degree of geographic dispersion of customers and/or employees, the degree of homogeneity of markets/customers, the turbulence of the relevant business environment, the time-based or place-based competitive pressures on the function proposed for telecommuting, and the amenability of the pilot market to telecommuted work.

Justification for the Use of the AHP

The AHP has all the features necessary to support the telecommuting pilot project decision. The AHP permits the incorporation of both objective, quantifiable data and the more subjective, qualitative data into the decision process [8]. It also facilitates support for all of Simon's [10] phases of the decision making process; intelligence, design, and choice. It can be used with an individual (unitary) decision maker or can be employed with groups [8] and thus used to draw all stakeholders into the decision process. The AHP provides a means of conceptualizing and communicating the problem which permits the building of shared vision. It also offers a means for dealing with the cognitive complexity which is so often attendant to problems with multiple decision criteria for which multiple decision alternatives must be considered.

A general description of the AHP process is beneficial at this juncture. The steps described here will be illustrated with a hypothetical example later in this paper. The approach is based upon several major activities. First, a problem hierarchy is constructed showing the overall goal of the decision at the highest level, the decision criteria at the next lower level, and the subcriteria (if any) and all decision alternatives replicated under each criterion at the lowest levels of the hierarchy.

Second, pairwise preferences are elicited from the decision maker and captured in matrix form. The unique essence of the AHP is displayed in this step as the complexity of a multicriteria and multi-decision-alternative problem is reduced to a series of simple pairwise comparisons. Decision makers can much more readily express a preference of one alternative versus another alternative if their are only two alternatives being compared with each other at a time and in the context of only one decision criterion at a time. This offers a far less daunting task than comparing all decision alternatives with respect to all criteria simultaneously. There are many ways to elicit the preferences from the decision maker, but the nine-point scale proposed by Saaty [8] as shown in Table 1 is most commonly used. The values elicited are documented in a pairwise comparison matrix showing each alternative compared to each other alternative.

Table 1: Pairwise Comparison Scale for AHP Preferences.

Decision Makers Collective Judgment of Preference: (expressed as the preference of the first alternative in the pairwise comparison relative to the second alternative in the pairwise comparison)

PREFERENCE	VALUE
Extremely Preferred	9
Very Strongly to Extremely Preferred	8
Very Strongly Preferred	7
Strongly to Very Strongly Preferred	6
Strongly Preferred	5
Moderately to Strongly Preferred	4
Moderately Preferred	3
Equally to Moderately Preferred	2
Equally Preferred	1

The elicitation of pairwise preferences is an interactive process and is usually performed by an AHP-trained and (usually) decision-neutral facilitator. It may seem at first that this step would involve a cumbersome number of comparisons, but two things work in the AHP's favor to make elicitation a reasonable process. It is obvious that any alternative compared against itself will be equally preferable to itself and thus receive a value of "1" if Saaty's verbal scale is being used. It should also be noted that if alternative A is three time preferable to B, then conversely B must be one-third as preferable as A with respect to the same criterion. The values of one which are formed when an alternative is equally preferable to itself form the main diagonal (from upper left to lower right) of the pairwise preference matrix. The facilitator must then only elicit either the values above or the values below that main diagonal as the mirroring entries in the other half of the matrix will always be the reciprocals of those values.

Each decision alternative is compared with each other decision alternative in the relative isolation of the context of one decision criterion at a time. This process is repeated for each decision criterion in the decision problem. This yields a within-criterion pairwise preference matrix for each of the decision criteria. The pairwise comparison process is then applied at the next higher level of the hierarchy, this time being used to elicit preferences or perceived importance of each decision criterion with respect to each other decision criterion. This yields a single between-criterion comparison matrix for the problem.

As each pairwise comparison matrix is elicited, it is checked for consistency in reasoning through the calculation of a consistency index and consistency ratio. Saaty [8][9] recognized that perfect consistency was not always possible or desirable, so he established a threshold of a value of .10 for the consistency ratio as being acceptable. Any pairwise preference matrix with a critical ratio of .10 or less is acceptable for use in further steps of the AHP. If the critical ratio exceeds .10, the facilitator must interactively engage the decision maker in resolving the causes of inconsistency. The pairwise preference matrix is then modified to reflect the resolution and rechecked for acceptable levels of consistency.

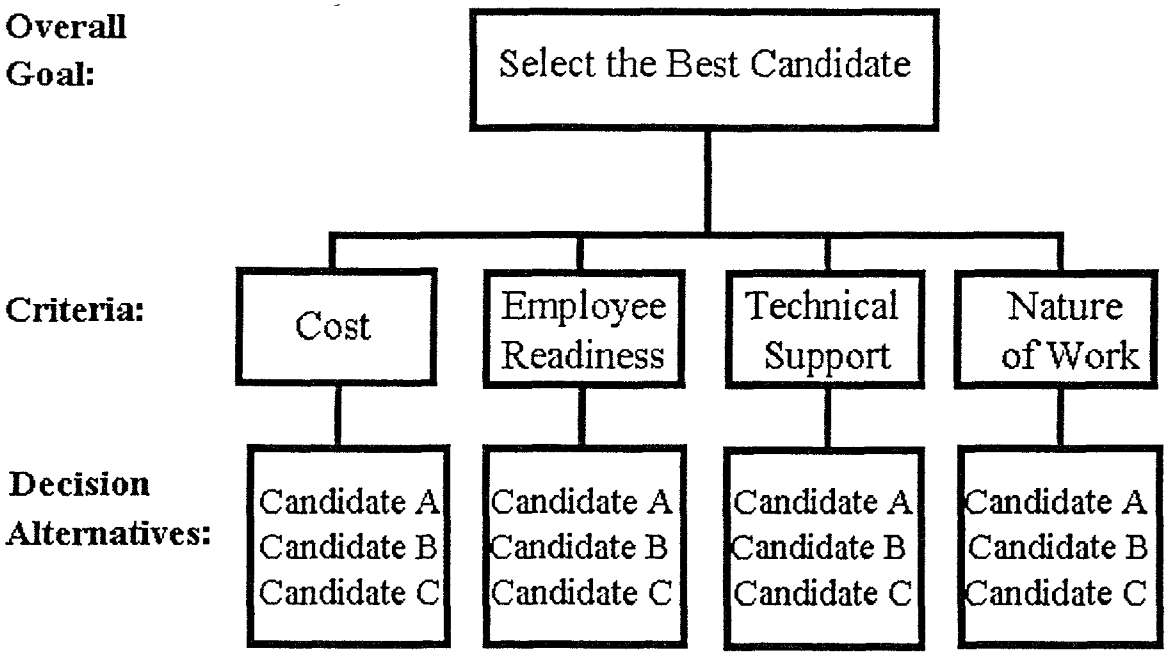
The third major step in the AHP is a process called synthesization in which the within-criterion matrices are mathematically merged with the between-criteria matrix to yield an overall prioritization of the decision alternatives in light of the decision maker's elicited preferences. For small problems where consistency is not a problem, the approximation method illustrated in Cook and Russell [3] may be appropriate. For problems requiring more accurate solution or for those which are larger in scope, the right eigen vector method is more appropriate [8], although more sophisticated. As a matter of practicality, most AHP decision making today is supported by computer software packages specifically designed for the task [13]. One popular package for AHP is Expert Choice [4]. Expert Choice provides support for building hierarchy diagrams, elicitation of preferences (more than one elicitation technique is supported), performing the AHP calculations, conveying the results, and performing sensitivity analysis.

A Hypothetical Example of AHP Applied to Telecommuting Pilot Project Candidate Selection

A hypothetical example of the use of the AHP in the selection of a candidate organizational sub-unit from among several candidates for the purpose of participating in a telecommuting pilot project will serve to illustrate the benefits of using such a tool as AHP. It will also serve to demonstrate how well AHP supports similar selection tasks. For sake of clarity, the example will purposely be limited to four decision criteria and three decision alternatives (three candidate organizational sub-units). Please note again that the criteria presented in this example are intended to be illustrative rather than prescriptive in nature. While we have included decision criteria that are fairly common to the problem, firms that attempt to use the AHP for such decisions must identify the criteria which are

Figure 1

The Problem Hierarchy



important and relevant with respect to their own particular organization and situation at the time the decision is to be made. Similarly, the pairwise preferences presented in the example are intended only to facilitate the illustration of the AHP and are not meant to be prescriptive. Each organization must elicit its own expression of preferences from its decision makers at the time the model is applied.

Assume that an organization with many functionally diverse departments has decided to pursue the exploration of telecommuting by selecting one department to participate in a pilot project of that nature. This constitutes the overall goal of the decision. The organization has identified three of its departments as being worthy of further consideration for this project and has labeled those departments as Candidate A, Candidate B, and Candidate C, respectively. Assume for the sake of the example that it is the responsibility of a single decision maker to select the department to participate from among these three candidates. (The AHP permits incorporation of preferences from multiple decision makers through the calculation of the geometric mean of elicited preferences. See Saaty [9].) Further assume that the manager in charge of the selection process has identified four decision criteria to be used in making the decision. The first criterion is that of COST. Differences in the locations of the candidates, the number of individuals involved in each, and scope of operations of each would create considerable cost differences between candidates.

The second criterion is that of EMPLOYEE READINESS. Employees in some of the candidate departments might be qualified and anxious to participate in the telecommuting pilot project, while those in other departments may not be as prepared and committed. This criterion will reflect the decision maker's perception of each department's overall level of employee readiness.

The third criterion is the degree of TECHNICAL SUPPORT. This criterion reflects the decision maker's perception of the suitability and availability of existing hardware, software, telecommunications capabilities, and supporting expertise in each department. Again, considerable differences between the candidates may be perceived.

The fourth and final criterion is the NATURE OF WORK. This criterion reflects the perceived degree to which the tasks performed within the selected candidate department are compatible to telecommuting. The nature and necessity of customer or coworker interaction, the degree to which the work can be transmitted and performed remotely, security considerations, and several other factors are likely to differentiate candidate subunits.

Given these hypothetical, necessary ingredients for the construction of the problem hierarchy, the application of the AHP begins with development of that hierarchy. The overall goal of the decision—to select the best candidate for the telecommuting pilot project from those available—is incorporated at the highest level of the hierarchy. The decision criteria are listed at the next lower level of the hierarchy. The three candidate departments (A, B, and C) are replicated under each individual criterion at the next lower level. The example problem hierarchy is shown in Figure 1.

The AHP then proceeds to the elicitation of preferences from the decision maker. Using the scale presented previously in Table 1, the AHP facilitator leads the decision maker through a series of pairwise comparisons of the decision alternatives. These comparisons are conducted one criterion at a time. For example, the first preference elicited might be done so with the following question: "With respect to the criterion of COST only, which of the verbal preferences from the scale would best describe your preference for Candidate A as compared to Candidate B?" The questioning then would precede to do the same thing with Candidate A being compared to Candidate C, then B to C. An example of the pairwise comparison matrix for the COST criterion is provide in Figure 2.

Figure 2: An example of a pairwise comparison matrix for three decision alternatives* with respect to one decision criterion.

Criterion: Cost

CANDIDATE	A	B	C
A	1	1/5	1/6
B	5	1	1/2
C	6	2	1

PRIORITY VALUES:	
A	.082
B	.343
C	.575
CONSISTENCY INDEX	.015
CONSISTENCY RATIO	.025

*** The decision alternatives in this example are the candidate organizational subunits which are simply designated as A, B, and C.**

Note that any candidate when compared with itself should, logically speaking, be equally preferable to itself and thus the main diagonal values are all values of 1 from Saaty's scale. Elicitation of only three of the remaining six (non-main-diagonal) elements in the matrix is necessary since the elements on one side of the main diagonal are the reciprocals of the corresponding mirror image positions in the matrix on the other side of the main diagonal. For example, knowing that Candidate A is 7 times more preferred than Candidate B also tells us that Candidate B is one-seventh as preferable as Candidate A. Thus if planned carefully, only three elicitations are necessary to construct this matrix.

Once the preferences for this matrix are elicited and the pairwise preference matrix constructed, the right eigen vector method is applied to the matrix to yield the relative priority of each of the decision alternatives. A consistency index and consistency ratio are calculated for the matrix. If the consistency ratio is a value below .10, then the relative priorities may be considered useful. In Figure 2, with respect to the COST criterion, Candidate C is the most preferred (or alternatively - the lowest cost), Candidate B is a distant second, while Candidate A is the least preferable. Note that the consistency ratio is well below the .10 threshold of acceptability. If that ratio had exceeded the threshold, the AHP facilitator would engage the decision maker in additional questioning to point out and assist in resolving inconsistencies in the preferences which had already been expressed. The resulting pairwise matrix would have then been subjected to the same steps as the original matrix.

The process of performing these within-criterion comparisons of the decision alternatives is repeated until an acceptable (in terms of internal consistency) pairwise preference matrix has been generated for all decision alternatives within each decision criterion. The results of this elicitation process and the corresponding relative priorities and consistency indicators are shown for each of the criteria in this hypothetical example in Figure 3. Note that each meets the consistency requirements. Also note that no one Candidate is dominant across all criteria. Candidate C is the most preferred with respect to COST. Candidate B wins out when it comes to EMPLOYEE READINESS and TECH SUPPORT. Candidate A is a strong winner with respect to the NATURE OF WORK criterion.

Once all the within-criterion matrices are complete, the attention turns to elicitation and calculation of the between-criteria preferences. This occurs at the next higher level of the problem hierarchy and is intended to capture and display the relative importance or preference of each criterion from among the decision criteria. Since their are four decision criteria, a four-by-four matrix must be constructed. This is shown in Figure 4. The process described for the within-criterion comparison of decision alternatives is now applied in a similar fashion at this level.

Figure 3: Individual pairwise comparison matrices for three decision alternatives compared in the context of a single decision criterion.

CRITERION: **Cost**

Candidate:	A	B	C
A	1	1/5	1/6
B	5	1	1/2
C	6	2	1

Priority Values:

A	.082
B	.343
C	.575

Consistency Index: .015
Consistency Ratio: .025

CRITERION: **Employee Readiness**

Candidate:	A	B	C
A	1	1/2	3
B	2	1	4
C	1/3	1/4	1

Priority Values

A	.320
B	.557
C	.123

Consistency Index: .009
Consistency Ratio: .016

CRITERION: **Technical Support**

Candidate:	A	B	C
A	1	1/2	6
B	2	1	7
C	1/6	1/7	1

Priority Values:

A	.350
B	.580
C	.070

Consistency Index: .016
Consistency Ratio: .028

CRITERION: **Nature of Work**

Candidate:	A	B	C
A	1	3	4
B	1/3	1	3
C	1/4	1/3	1

Priority Values

A	.608
B	.272
C	.120

Consistency Index: .037
Consistency Ratio: .064

Note that a minimum of six preferences must be elicited from the decision maker to complete this matrix. In our hypothetical example, the criterion of COST is the recipient of the highest ranking, followed by NATURE OF WORK, then TECHNICAL SUPPORT, and finally EMPLOYEE READINESS. In this example, note that a high degree of consistency (indicated by a low consistency ratio value) is evident in this particular matrix.

The within-criterion matrices are then merged with the between-criteria matrix from the next higher level in the process called synthesization. This process yields an overall ranking of the decision alternatives being considered for selection. In essence, the preference expressed for each decision alternative with respect to an individual criterion is weighted by the overall relative importance assigned to that criterion by the decision maker. The synthesization process then combines all of this data and produces as its output the relative overall rankings of the decision alternatives. This is illustrated in Figure 5.

Discussion

In the example provided here, it is interesting to note that even though the criterion of COST was assigned great importance by the decision-maker and Candidate C was the clearly superior candidate with respect to COST, Candidate C did not emerge as the top choice. That honor was reserved for Candidate B which demonstrated a more consistent preference position across all of the criteria by being the preferred choice with respect to EMPLOYEE READINESS and TECHNICAL SUPPORT and being in the second position with respect to COST and NATURE of WORK. Candidate C ranked a close second, followed by Candidate A in a somewhat more distant third position.

The closeness of the relative preference rankings for Candidates B and C is perhaps close enough to justify further study through the use of sensitivity analysis. Most AHP software packages, such as Expert Choice, provide sensitivity analysis capabilities.

Figure 4: Pairwise comparison matrix for the four decision criteria.

	Cost	Employee Readiness	Technical Support	Nature of Work
Cost	1	7	5	2
Employee Readiness	1/7	1	1/2	1/4
Technical Support	1/5	2	1	1/3
Nature of Work	1/2	4	3	1

Priority Values:

Cost	.532
Employee Readiness	.068
Technical Support	.112
Nature of Work	.288

Figure 5: Synthesization process results and overall prioritization of decision alternatives.

	Cost	Employee Readiness	Technical Support	Nature of Work
Candidate A	.082	.320	.350	.608
Candidate B	.343	.557	.580	.272
Candidate C	.575	.123	.070	.120
Overall Criteria Relative Priorities	.532	.068	.112	.288

Overall Rankings of the Three Candidates

Candidate A	.280	Least Preferred
Candidate B	.364	Most Preferred
Candidate C	.357	Second in Preference

If more than one candidate was needed, then the top two candidates in the ranking of the decision alternatives could be chosen. In the hypothetical example provided here, the candidates had already been identified. The AHP could be used on all potential candidates (assuming a reasonable number of them) as a front-end screening to provide a list of finalist candidates that would be subjected to a more rigorous analysis. Saaty (1980) recommends that the number of decision alternatives and the number of decision criteria be held to ten or less each and under no circumstances be allowed to exceed twenty for either. In this hypothetical example too, the four decision criteria had already been identified. The AHP could be used earlier in the process as well to identify the important criteria to be used in the decision from among a larger list of possible criteria. The AHP could also be applied on the back-end of this example in numerous ways. One obvious use of the AHP in that regard would be to use it to select individuals from within the chosen department to be the first to be permitted to telecommute. Yet another use might be to inform the process of formulating telecommuting policy, especially with respect to both employer and employee conceptions and expectations concerning remote work.

It should also be noted that some of the criteria identified in the hypothetical example were of a highly quantitative nature (COST for example) while others were of a more qualitative nature (such as NATURE OF WORK) and all of the criteria could have conceivably contained a mixture of both quantitative and qualitative facets. Sometimes criteria can be defined so precisely that the problem gets out of hand due to the number of criteria. At other times a criterion may be so nebulous or ambiguous that expression of preference is difficult. Sometimes the mixture of the precise and the imprecise can create situations which give rise to claims of unfair bias inherent in the decision process. The use of the AHP by a facilitator with a basic awareness of possible intentional and unintentional problems and biases that can arise may provide an opportunity to address and/or ameliorate the misconceptions and or inconsistent thinking evidenced by potential participants.

Directions for Future Research

Other problems within the telecommuting and virtual workplace realms are fertile ground for the application of the AHP. For example, the AHP could assist in defining company policy concerning where, or when, employees perform remote work. Another area with future research potential is the marriage of the AHP with other management science techniques. One possibly productive union would be to employ the AHP in conjunction with Zero-One Goal Programming (ZOGP). The application of a ZOGP-AHP approach to selection problems would permit the incorporation of decision maker preferences involving multiple alternatives and multiple criteria into a framework that could simultaneously consider real-world constraints impacting attainment of those preferences.

Conclusion

This paper has discussed the emergence of telecommuting as an organizational issue to be dealt with and the factors which are driving that emergence. It has proposed the use of a pilot project as a prudent tactic for organizations wishing to explore telecommuting. It has identified some common criteria that might be used in the identification and selection of organizational sub-units to participate in a telecommuting pilot project.

Via a hypothetical example, this paper has also demonstrated the applicability and value of a decision support tool, specifically the Analytic Hierarchy Process, in making telecommuting-related decisions involving multiple alternatives, and multiple (and often incommensurate) decision criteria.

References

[1] Arden, L. *The Work-At-Home Sourcebook*, 5th Ed., Live Oak Publications, Boulder, CO, 1994.

[2] Christensen, K.E. *The New Era of Home-Based Work*, Westview Press, Boulder, CO, 1988.

[3] Cook, T.M., and Russell, R.A. *Introduction to Management Science*, 5th Ed., Prentice Hall, Englewood Cliffs, NJ, 1993.

[4] Expert Choice, Inc. *Expert Choice Version 9.0 for Windows (AHP software)*, Expert Choice, Inc. 4922 Ellsworth Avenue Pittsburgh, PA, 1994.

[5] Hequet, M. "How Telecommuting Transforms Work," *Training*, November, 1994, pp. 56-61.

[6] Laudon, K.C. and Laudon, J.P. *Management Information Systems: Organization and Technology*, MacMillan, 1994.

[7] Lozano, B. *The Invisible Workforce: Transforming American Business with Outside and Home-Based Workers*, The Press, New York, 1989.

[8] Saaty, T. L. *The Analytic Hierarchy Process*, McGraw-Hill, New York, 1980.

[9] Saaty, Thomas L. *Decision Making for Leaders*, Lifetime Learning Publications, Belmont, CA, 1982.

[10] Simon, Herbert A. *The New Science of Management Decisions*, Harper & Row, New York, 1960.

[11] *Smart Valley Telecommuting Guide*, World Wide Web document, URL:http://smartone.svi.org:80/PROJECTS/TCOMMUTE/TCGUIDE, October 16, 1995.

[12] *Training*, "Selecting Remote Workers and Managers" October, 1985, pp. 112-114.

[13] Turban, E. and Meredith, J. *Fundamentals of Management Science*, 5th Ed., Irwin, Homewood, IL, 1991.

[14] Young, J.A., "The Advantages of Telecommuting," *Management Review*, July, 1991, pp. 19-21.

[15] Zahedi, F. "The Analytic Hierarchy Process—A Survey of the Method and Its Applications," *Interfaces*, July-August, 1986, pp. 96-108.