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Software selection: a case study of the application of the analytical hierarchical process to the selection of a multimedia authoring system

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Abstract

This paper discusses the multimedia processing environment, the applicability of analytic hierarchy process (AHP) in problem solving, and how AHP can be applied to the selection of multimedia authorizing systems (MAS) in a group decision environment. A MAS selection model is proposed to facilitate the group's decision making in the selection of MAS. Six software engineers, who are technically competent and experienced, participated in our study. They were trained to use AHP and then applied this technique to evaluate three MAS products for adoption decision. The results indicated that AHP offers chances for every participant to fully understand, discuss, and objectively evaluate all MAS products before identifying and selecting the most efficient MAS.

Keywords: Analytic hierarchy processes; Multimedia; Authoring systems; Information systems; Decision making/processes

1. Introduction

Recent advances in compact disk storage, high quality audio, high resolution video, broadband fiber network, and multimedia database technologies have made possible the creation, processing, storage, management, and communication of multimedia information systems (MMISs) [4, 9, 13, 15, 16]. The tools required for developing these interactive MMISs are called multimedia authoring systems (MASs). MASs are centralized, stand-alone development tools that support different hardware devices and file formats, thus, providing an effective means of conveying information, such as graphics, text, sound, animation, and video data types. In the last few years, the MAS tool market has undergone a remarkable change. The number of tools has increased significantly and prices have declined dramatically. Many of these tools were developed to fit different user needs and were designed to execute on a variety of hardware platforms. Owing to the complexity of the product and profusion of alternatives, a systematic process of selection can be formidable and expensive. However, the impact of bad decision can be high not only in monetary terms but in terms of its impact on management attitude.

To further complicate the situation, selecting the best MAS product may not be the responsibility of a

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single individual, for group decision making is commonplace in most organizations. A group approach to software selection decision offers many benefits, including improved overall decision quality and decision-making effectiveness. Still, the process of appraising MAS or any other IT investment may be a political process as the decision touches on the diverse interest of many people and groups. Clearly, software selection is not a well-defined or structured decision problem. The presence of multiple criteria (both managerial and technical) and the involvement of multiple decision-makers will expand decisions from one to many several dimensions, thus, increasing the complexity of the solution process. It seems obvious that we cannot solve the selection problem simply by grinding through a mathematical model or computer algorithm. We need new approaches, which could handle multi-criteria decision-making problems of choice and prioritization, to support these types of complex and unstructured selection problems.

During the past two decades, there has been a steady growth in the number of multiple criteria decision making (MCDM) methods for assisting decision making with multiple objectives. These MCDM methods allow decision makers to evaluate various competing alternative courses of action to achieve a certain goal. Among these MCMD models, the analytic hierarchy process (AHP) is one of the most widely discussed methods. This paper makes an attempt to bring AHP and multimedia together by making the MAS decision structure explicit and by quantifying preferences based on the decision structure. This formal decision analysis allows decision makers in a group setting to rank order the MAS products based on the results of a quantitative analysis. It is hoped that this case illustration will demonstrate the value of AHP in resolving MCDM problem, especially in group decision settings.

2. Background of analytic hierarchy process in supporting group decision

The AHP, which is a theory of measurement for dealing with quantifiable and intangible criteria, has emerged as an important approach to multi-criteria decision-making problems of choice and prioritization. The application of AHP ranges from investment risk to resource allocation and organization planning [22] in fields, such as economics, politics, marketing, sociology, and management [1, 23]. Although the principles underlying AHP for decision support have been the subject of extensive debate (e.g. [3, 5, 20, 21]), it is argued that AHP has several advantages including ease of use and over-specification of judgment [3], built-in consistency tests [12], use of appropriate measurement scales [8], and applicability in the elicitation of utility functions [11].

In this study, a case example was presented to illustrate how the AHP technique was applied to solve a MAS selection problem. The rationale for choosing AHP, despite the controversy of its rigidity, is that this approach is well suited to group decision making and offers numerous benefits as a synthesizing mechanism in group decisions. Dyer and Forman [9] commented that AHP, when used in a group setting, can (1) accommodate both tangibles and intangibles, individual values and share values in the group decision process, (2) help structure a group decision so that the discussion centers on objectives rather than on alternatives, (3) allow discussion to continue until all available and pertinent information has been considered and a consensus choice of the alternative most likely to achieve the organization's stated objectives is achieved. Bard and Souskin [2] also stated that "From the standpoint of consensus building, the AHP provides an accessible data format and a logical means of synthesizing judgment. The consequences of individual responses are easily traced through the computations and can be quickly revised when the situation warrants."

The AHP usually involves three stages of problem solving: decomposition; comparative judgments; and synthesis of priorities. The decomposition principle calls for the construction of a hierarchical network to represent a decision problem, with the top representing overall objectives and the lower levels representing criteria, subcriteria, and alternatives. With the comparative judgments, users are required to set up a comparison matrix at each hierarchy by comparing pairs of criteria or subcriteria. A scale of values ranging from 1 (indifference) to 9 (extreme preference) are used for expressing users preference. At the end, synthesis of priorities is conducted to calculate a composite weight for each alternative based on preferences derived from the comparison matrix. These three stages (or the following more specific procedures), once completed, would allow decision makers to obtain a relative standing, on a ratio scale, of the alternatives to be evaluated. The following list provides a brief summary of all processes involved in AHP application:

1. Formulate the decision hierarchy by specifying a hierarchy of interrelated decision elements.
2. Collect input data by performing a pairwise comparison of the decision elements.
3. Estimate the relative weights of decision elements by using an eigenvalue method.
4. Aggregate the relative weights up the hierarchy to obtain a composite weight which represents the decision maker's opinion of the relative importance of each decision alternative.

The AHP procedures are applicable to individual and group decision settings. In a group setting, many methods can be used to accommodate the views and judgments of group participants in the priority setting process. In a common objective context where all participants share the same objectives, there are four ways for setting the priorities: consensus; vote or compromise; geometric mean of the individuals' judgment; and separate models or players [6]. *Consensus* refers to the achievement of consensus of group participants in constructing the hierarchy and making judgments. If consensus cannot be obtained, the group may choose to *vote or compromise* on a judgment. If a consensus cannot be achieved and the group is unwilling to vote or to compromise, then *a geometric mean* (average) of the individuals' judgments can be calculated. If a group has significantly different objectives and cannot meet to discuss the decision, then each group member can make judgment separately, based either on *separate models or players*. If it is based on separate models, then each group member enters their judgment into a separate model, which will then be averaged. However, if it is based on separate players, then a combined model is set up with each 'player' evaluating those factors in their part of the combined model.

3. Illustration: the MAS environment

The MAS development environment consists of several components: workstations; storage devices; multimedia tools; multimedia database management systems; and network connectivity.

3.1. Workstations

The MAS operating environment needs workstations capable of handling multimedia efficiently. This suggests that the workstation should provide high processing power, possibly equipped with one or more programmable video co-processors. These video co-processors can efficiently manage the screen display memory, screen refresh, and prioritization of memory accessed by the CPU. Additionally, audio and math co-processors can be important components of a multimedia workstation for supporting the processing of compressed audio signals and for performing complex calculations.

3.2. Storage devices

The MAS environment must provide easy, rapid access to a large library of media. Therefore, an optical disk 'juke-box' will be necessary to provide concurrent access to multiple still-image, audio, and video files for multimedia production. Since the storage requirements of these files are extremely high, the MAS environment should adopt compression software to compress/decompress multimedia data with minimal image degradation and reduced load time. The Streamer tape system and the Bernoulli hard drive may also be used for off-line storage of the multimedia data files.

3.3. Multimedia tools

When using a MAS, the author must have ready access to devices, such as scanners, voice synthesizers, video recorders and players, and animation tools. Currently, there are a variety of commercially available multimedia tools and new ones are appearing on the scene. However, many of these tools are difficult to use, not compatible with other tools, and/or highly inefficient because of extremely long access times. Therefore, in selecting a MAS one must consider the efficiency of existing multimedia tools, as well as their compatibility with other tools, to determine the possibility of integrating these tools with the MAS being evaluated. In addition, the MAS must include provisions for a communications package to enable access to tools which are stored at alternate sites.

3.4. Data management systems

A data base management system (DBMS) is definitely needed to manage and control the retrieval, processing, storage, and communication of multimedia data. However, most of the currently available DBMSs are not capable of handling multimedia data and interfacing with other graphical or voice storage systems. Obviously, a multimedia DBMS is needed in the MAS environment to assure that multimedia, especially in the context of a multi-user environment, can be appropriately handled.

3.5. Network connectivity

The ideal environment for a MAS is to have all development workstations fully interconnected through a client-server based local area network. This allows all multimedia files to be accessible by all workstations. A MAS environment requires a wider bandwidth to support multimedia communications than is needed for traditional voice and data communications. The designated network must utilize broadband communication technologies (e.g. broadband coaxial or fiber optic cables) to achieve a satisfactory data transmission rate, speed, and quality.

4. Research method

The study took place in a computer service company that specializes in providing computer solutions to their customers. In the past, this company has been very successful in providing a range of services in the design and implementation of information systems, information technology consulting, and IT-enabled business process reengineering consulting. Due to the recent expansion of its multimedia unit within the software development division, the company is considering the acquisition of some MASs to support its software engineers in developing more efficient multimedia systems. Instead of picking the MASs based on benchmark reports or vendors' brochures, the company would like an objective evaluation framework be established to guide the selection process. The supervisor of the multimedia unit approached one of the authors for solution and we recommended a trial of AHP.

Six individuals from the company's multimedia unit, who have an average of nine years systems design and development experience, participated in the study. Three MAS products were considered for adoption. Two meetings were conducted to resolve their selection decision with AHP. At the first meeting, the group was introduced to the AHP methodology and established the AHP decision hierarchy needed to evaluate the MASs. This meeting lasted for 2 hours, with most time devoted to the discussion of the details, strengths, and limitations of AHP. The decision hierarchical, with its associated criteria and attributes, was formulated, modified, and accepted within a short time. The second meeting took place three days after the first meeting. At the beginning of the second meeting, the participants were given a chance to review and revise the decision hierarchy, but no modification was suggested nor made. The discussion then moved on to assigning values to the individual matrix elements. When each individual completed the evaluation, their responses were read aloud to ascertain the level of agreement. After each round of discussion, the participants were allowed to revise their evaluations to better reflect their level of agreement on the issues. The second meeting took the participants more than 4 hours to prioritize the three MAS products with the use of *Expert Choice* (a PC product that supports the various stages of the AHP procedure).

5. Discussion of MAS Selection with AHP

5.1. Decision hierarchy formulation

The decision group formulated the AHP decision hierarchy for the selection structure of MAS products during the first meeting. This hierarchy classified all decision criteria and variables into four levels as depicted in Fig. 1. At the highest level (level 1) of the hierarchy is a set of objectives that are to be fulfilled when choosing a MAS. These objectives can be classified into technical objectives and managerial objectives. The technical objectives are those objectives that are concerned with the hardware and software features of a MAS which must be met in

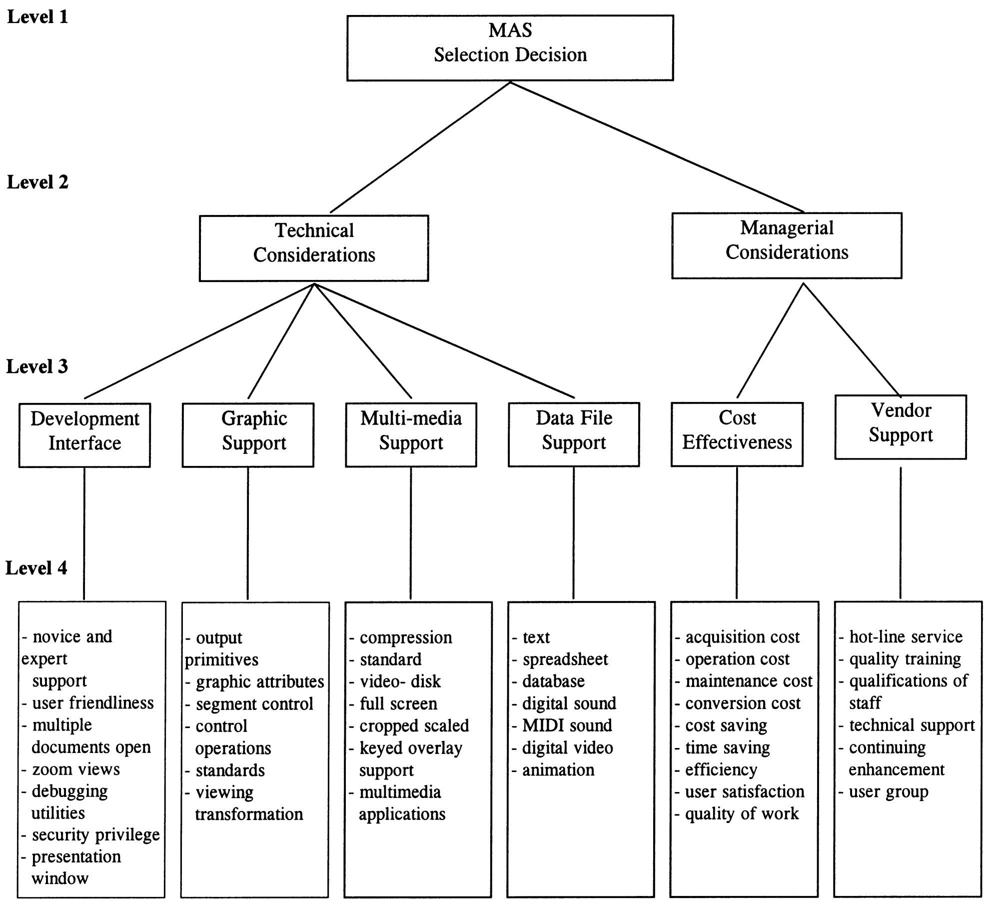

Fig. 1. MAS selection model.

order to have an acceptable MAS. The management objectives are those objectives that are concerned with the cost and administration features of a MAS which fulfills the decision maker's goals in obtaining a MAS. The technical and managerial objectives constitute the second level of the MAS selection hierarchy.

The third level measures the performance of MAS products based on their technical capabilities and their ability to fulfill managerial expectations. According to the evaluations conducted by Poor [14] and Robinson [17], the technical capabilities of a MAS can be divided into four major areas: development interfaces; graphics; multi-media data support; and data file support. As for managerial expectations, research studies (such as [24]) have indicated that cost effectiveness and vendor support were important factors.

At the lowest level (level 4) are the detailed MAS features or primitives that can be used to compare the products and judge their performance. At this level of detail, the technical superiority of products can be more precisely and objectively compared. Following is a detail discussion of the primitives:

5.1.1. Development interface

MASs come in many different flavors. Most of them are system-oriented with a higher level user interface for nonprogrammers. For experienced system developers who need to write complex instructions, MAS also provides scripting languages, which are similar to traditional languages such as C or Pascal but specialized for creating applications.

Ideally, a MAS should be user-friendly, meaning the novice user should be able to operate the software effectively without external documentation. This is possible with a well-designed hierarchy of on-line help messages and clear, meaningful error messages. Full-screen editing of input, multiple document access, debugging utilities, security privileges, and presentation windows are useful user interface support. Although extensive help (such as prompts and menus) is beneficial to the novice, they are annoying to the expert user. Therefore, a good MAS should have at least two levels of user support—a novice and an expert mode.

5.1.2. Graphics

A good graphics module should provide users with a variety of features—output primitives, attributes, viewing transformation, segment control, control operations, and standards [10]—for creating and manipulating pictures. *Output primitives*, the basic building blocks for pictures, include character strings and geometric entities, such as points, straight lines, polygons, and circles. *Attributes* are the properties of the output primitives which include intensity and color specifications, line styles, text styles, animation, transition effect, and area-filling patterns. *Viewing transformations* are used to specify the view that is to be presented and the portion of the output display area that is to be used. When a picture is divided into component parts (segments), there should be segment operations to control the creation, deletion, and transformation of segments. Additionally, the graphic component of a MAS should contain *control operations* to perform a number of housekeeping tasks, such as screen clearing and parameter initiation. The graphic attributes should follow graphic *standards*, which makes it possible to migrate graphs to different types of hardware systems and to be used in different implementations and applications.

5.1.3. Multimedia data support

Video and audio compression technology is a key enabling technology for multimedia. The ability of MASs to interface with the compressed digital files and to perform storage, retrieval, manipulation, and transmission functions is a key concern in MAS selection. To date, there are no standards established for compressing all of the media types. However, the compression standards for image (JPEG and JPIG) and video (MPEG) exist and are important to the implementation of multimedia applications [7]. A good MAS needs to be able to manage dynamic data types and compress audio and video information to appropriate levels before it is stored on disk.

5.1.4. Data file support

A feature that distinguishes the better MAS products is data file support and management. A MAS must support and manage the information available in a variety of digital media, with effective capabilities to integrate them. In addition to being able to manipulate text, spreadsheet, and database files, a good MAS should also have the capability to support users' needs to retrieve and/or modify part of a document, image, audio, or video files. Obviously, a good MAS must provide a level of performance that is acceptable for the application, even when large files are associated with audio, images, and video.

5.1.5. Cost effectiveness

Evaluating the relative costs and benefits of various MASs is quite complex, since a number of related components must be considered. For MAS costs, the first component is acquisition cost, which varies greatly from package to package. Additionally, the annual operation and maintenance cost for MASs can also easily run ca. 30% of the initial acquisition fee. To add to the confusion, some vendors may even charge users for documentation support, training, consultation, and on-line help. Unfortunately, evolution to a MAS development environment is not without cost. MAS adopters must also consider the conversion cost from the current environment to the state-of-the-art multimedia platform. It is possible that current software and hardware needs to be adapted to conform to the new processing architecture. Thus, alternative MAS products must be evaluated cautiously to determine their explicit and implicit costs.

Researchers and practitioners agree that if the right MAS is chosen to support multimedia application development, the immediate contributions would be a saving in cost, reduction in job time, and improvement in employee performance. However, different MASs offer different features and technical capabilities, which directly affect the reliability and efficiency of the developed software (in terms of CPU, I/O, and storage). Consequently, the selected MAS will influence the satisfaction of users and the quality of work they perform.

5.1.6. Vendor support

The quality of ongoing vendor support is of major importance in MAS selection. Important indicators of reliable and resourceful vendors include: a consulting and hot-line service; the quality and flexibility of training; the qualifications of staff; and the presence of an active technical support program and group. Endorsement and evaluations from current users can be helpful and revealing. Additionally, the existence of an organized user group for the product can also be a valuable resource. It could provide organized feedback to the vendor, thus, encouraging corrections and updates to their systems.

5.2. Pairwise comparisons

Before the performance of pairwise comparisons, all members of the group were given an instruction on how to conduct the comparison among the elements (*alternatives*) with respect to the immediately preceding element (*criterion*) in the hierarchy. Their judgment of the importance of one alternative over another can be made subjectively and converted to a numerical value using a scale of 1–9 where 1 denotes equal importance and 9 denotes the highest degree of favoritism [18, 19]. Table 1 lists the possible judgments and their respective numerical values.

The numerical values representing the judgments of the comparisons are arranged in a matrix for further calculations. Notationally, the comparison matrix A for comparing n elements is $A = [a_{ij}]$ (where $a_{ji} = 1/a_{ij}$, $a_{ii} = 1$, $1 \leq i \leq n$, and $1 \leq j \leq n$). To illustrate the nature of comparison, a simpler model (Fig. 2) was formulated for comparison. In Table 2 (which represents the evaluation of member 1 of the group), *development interface*, *graphics support*, *multimedia support*, *data file support*, *cost effectiveness analysis*, and *vendor support* represent the alternatives; while *selection decision* represents the criterion. The main diagonal is always all ones. Notice the reciprocals across the diagonal. That is, (*development interface, graphics support*) is 3 while (*graphics support*, *development interface*) is 1/3.

The group members adopted a bottom-up approach in their pairwise comparison. In other words, the

Table 1
Pairwise comparison judgments between element X and element Y

Judgment	Values
X is equally preferred to Y	1
X is equally to moderately preferred over Y	2
X is moderately preferred over Y	3
X is moderately to strongly preferred over Y	4
X is strongly preferred over Y	5
X is strongly to very strongly preferred over Y	6
X is very strongly preferred over Y	7
X is very strongly to extremely preferred over Y	8
X is extremely preferred over Y	9

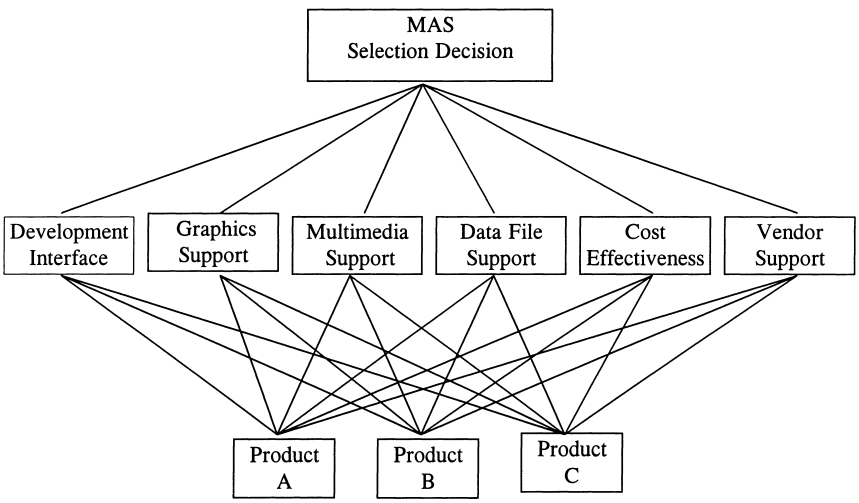

Fig. 2. Abbreviated hierarchy.

Table 2
Pairwise comparison matrix for selection decision

Selection decision	Development interface	Graphics support	Multi-media support	Data file support	Cost effectiveness	Vendor support
Development interface	1	1/3	1/4	1/3	5	7
Graphics support	3	1	1/3	1/4	5	6
Multi-media support	4	3	1	2	7	8
Data file support	3	4	1/2	1	6	8
Cost effectiveness	1/5	1/5	1/7	1/6	1	5
Vendor support	1/7	1/6	1/8	1/8	1/5	1

alternatives are first compared with respect to each attribute; next, a comparison is made among the attributes with respect to the criteria; and finally, the criteria at level 2 are compared among themselves. All the pairwise comparison results were recorded on a sheet of paper, which was used later for group discussion. The comparison process for the entire decision hierarchy took ca. 30 min to complete, intervened with a few questions in the process. After that, the group members started to read aloud and discuss their responses, trying to achieve an agreement among their evaluations. After each round of discussion, the participants were allowed to revise their evaluations to better reflect their perception and understanding on the issues. In the meeting, although participants have difficulties getting consensus on several judgments, sufficient agreement emerged to permit the averaging of results. The discussion lasted for ca. 2 h before the group moved to the next step.

5.3. Decision weights calculation

The third step is to input group member's comparison matrix to *Expert Choice* and calculate the relative weights for the alternative elements with respect to the criterion element by using this AHP software. The relative weights are found by applying a two step process. First, we sum each column and then divide each column entry by its respective column sum. The resulting matrix is called a normalized matrix, which is defined as:

$$A' = [a'_{ij}] \quad \text{where } a'_{ij} = a_{ij} / \sum_{k=1}^{n} a_{ik} \text{ for } 1 \le i \le n,$$

and $1 \le j \le n$.

Table 3 gives the normalized matrix for the matrix in Table 2. Second, we calculate the average value in each row of the normalized matrix to obtain the relative weights or eigen vector, which is determined by:

$$W = [w_k] \quad \text{where } w_k = \sum_{i=1}^{n} a'_{ij} / n \text{ for } 1 \le j \le n,$$

and $1 \le k \le n$.

The relative weights for *selection decision* in Table 3, after calculation, are found to be: *development interface* = 0.1208, *graphics support* = 0.1606, *multi-*

Table 3
Normalized matrix of Table 2

Selection decision	Development interface	Graphic support	Multi-media support	Data file support	Cost effectiveness	Vendor support	Relative weights
Development interface	0.0881	0.0383	0.1063	0.0853	0.2066	0.2000	0.1208
Graphics support	0.2645	0.1149	0.1417	0.0645	0.2066	0.1714	0.1606
Multi-media support	0.3527	0.3448	0.4255	0.5168	0.2893	0.2286	0.3596
Data file support	0.2645	0.4598	0.2127	0.2583	0.2479	0.2286	0.2786
Cost effectiveness	0.0176	0.0230	0.0607	0.0432	0.0413	0.1429	0.0548
Vendor support	0.0126	0.0192	0.0531	0.0322	0.0083	0.0285	0.0256

Table 4
Importance (relative weights) of variables in influencing final MAS selection

Selection decision	Member 1	Member 2	Member 3	Member 4	Member 5	Member 6
Development interface	0.1208 (4)	0.2035 (3)	0.1674 (4)	0.1508 (3)	0.1871 (3)	0.1891 (4)
Graphics support	0.1606 (3)	0.1586 (4)	0.1908 (3)	0.1301 (4)	0.1429 (4)	0.2107 (3)
Multi-media support	0.3596 (1)	0.2983 (1)	0.2718 (1)	0.2871 (1)	0.3012 (1)	0.2803 (1)
Data file support	0.2786 (2)	0.2245 (2)	0.2510 (2)	0.2018 (2)	0.2791 (2)	0.2208 (2)
Cost effectiveness	0.0548 (5)	0.0857 (5)	0.1069 (5)	0.1204 (5)	0.0291 (6)	0.0601 (5)
Vendor support	0.0256 (6)	0.0294 (6)	0.0121 (6)	0.1098 (6)	0.0606 (5)	0.0390 (6)

Numbers in parenthesis are rank order of importance.

Table 5
Summary of results for AHP analysis

Alternative	Member 1	Member 2	Member 3	Member 4	Member 5	Member 6	Geometric mean
Product A	0.3583 (2)	0.4291 (1)	0.3621 (2)	0.3987 (2)	0.3784 (2)	0.3409 (1)	0.3895 (2)
Product B	0.4107 (1)	0.3851 (2)	0.4712 (1)	0.4106 (1)	0.3981 (1)	0.3975 (2)	0.4472 (1)
Product C	0.2310 (3)	0.1858 (3)	0.1667 (3)	0.1907 (3)	0.2235 (3)	0.2616 (3)	0.1633 (3)

Numbers in parenthesis are rank order of importance.

media support = 0.3596, *data file support* = 0.2786, *cost effectiveness analysis* = 0.0548, and *vendor support* = 0.0256.

We repeat this process for each matrix and associate the relative weights with the branch of the hierarchy that connects the criterion with the alternatives. Thus, each line connecting any two elements in the hierarchy has a relative weight associated with it.

5.4. Weight aggregation

Once all the relative weights have been calculated, a composite weight, c_d, for each decision choice, d, is determined. This is accomplished by aggregating the weights over the hierarchy for each decision choice. To do this, we multiply the weights along the path from the top of the hierarchy down to a decision choice, and then sum those products over all the different pathways to that decision choice. The result is a single weight value for each decision choice. Notationally, the composite weights, C, is given by

$$C = [c_d] \text{ for } 1 \leq d \leq n$$

where $c_d = \sum_{t=1}^{nt} w_t * \prod_{l=1}^{nl-1} w_l$, nt is the number of terminal nodes in the hierarchy for alternative d, nl the number of levels in the hierarchy, t denotes a leaf node in the hierarchy corresponding to the alternative d, and the sequence t, $nl-1$, $nl-2$,. . .,1 denotes a path in the hierarchy from the alternative d to the root.

The composite weights for member 1, along with other members, are depicted in Table 4. At this stage, the group members were allowed another opportunity to discuss their results, trying to justify their selection based on prior evaluations. Although there were still arguments on some minor issues, the group participants agreed the AHP rankings did represent their decisions on MAS selection. Hence, the geometric mean was calculated by averaging the group's individual responses at each point of comparison to form a composite matrix, which was then used to obtain the relative and composite weights in the usual manner. The calculated geometric mean of the group is also illustrated in Table 5, indicating Product B was their first choice, trailed by Products A and C.

6. Discussion of results

Throughout the evaluation process, all group members were given the opportunity to re-examine the pairwise comparison, calculated weights, and the final results derived from their initial and subsequent responses. They are requested to assess the results and check the reasonableness of the rankings until they are completely satisfied with the outcomes. The output presented in our tables represent the final judgement of the group. Obviously, these tables were the results of many debates, persuasions, and discussions. These activities, in fact, contributed significantly to the identification of sources that caused inconsistency of members' evaluation, clarification of attributes and criteria that possibly caused misunderstanding, and facilitation of the exchange of information and knowledge significant to resolving findings that were counterintuitive. All members of the decision group agreed that AHP has offered them a chance to objectively discuss, evaluate, and select the MAS that they genuinely desired.

Assessing the relative weights depicted in Table 4 reveals that group members are pretty consistent with the rankings of decision variables in selecting their MAS. They believed that multimedia support of MAS was the most significant factor in affecting their MAS decision, trailed by data file support. Interestingly, all group members, except one, believed that vendor support was the least important variable influencing their MAS choice. The possible reason is that MAS software, like other application software, is not very technical and hard to use. Additionally, all our participants are technically competent and experienced software engineers. They do not need to rely on vendors to resolve their programming and usage problems. In our study, we also found cost effectiveness factor relatively unimportant in determining MAS selection, possibly due to the technical, non-managerial background of our participants. The group member that assigned the highest weight to cost effectiveness factor, who happened to be also the one giving the highest weight to vendor support factor, is found to be the supervisor of the group. This finding indicates that management normally will weight managerial factors (such as cost effectiveness and vendor support) heavier than non-management members.

In general, all members are very consistent with their choices, especially the most and least influential variables. The only inconsistency was found in interface and graphics variables, which was split among the participants. To the participants, these two variables are the least important technical variables, but more important as compared to management variables. However, they cannot reach a consensus on which factor should have heavier weight in influencing MAS decision. If we scrutiny the relative weights assigned by the group members, we can found that the weight difference, applicable to all members, is only between 0.02 to 0.05, implying all members have come very close to an agreement.

An analysis of the results shown in Table 5 also indicates that the group members have almost reached a consensus in their final MAS selection. Their results show that Product C is unanimously found to be inferior to Products A and B. Only two group members found Product A to be better than Product B, even after rounds of subsequent discussions on the weights and final results. Although this member's preference ranking on the first and second products differ from the rest of the group, the composite weights of these two products are very compatible. Therefore, we believe our group has achieved sufficient agreement to permit the use of geometric mean to average the group's preference without obscuring the differences of individual opinions.

7. Limitations

From the standpoint of consensus building, the AHP methodology is an excellent technique as it provides a structured and logical means of synthesizing judgement. It allows every topic or factor relevant to the decision to be discussed in turn, rather than drifting from topic to topic. Unfortunately, it is also this AHP strength that reinforces discussants to address some factors many times and others not at all. In our experiment, individual group members with expertise relative to a specific factor were found to be very active discussants. However, the same group of people had became very passive when they dealt with foreign topics. The consequences of these different topic reactions could lead to some factors being discussed thoroughly, but with other topics neglected completely. Due to this reason, our group members have overlooked some important software criteria that should have been discussed and evaluated. For example, the evaluation framework did not include the performance factor, which would be significant in illustrating the capability of a MAS in different processing environment, such as PC, mainframe, network, and workstation platforms. To avoid such problem, it is suggested that a comprehensive evaluation criteria, probably reviewed by more people, should be prepared prior to the group meeting. In this way, the group members would be ensured of a better decision, without worrying about the completeness of their evaluation process.

In our experiment, we only focused on the impact of using the AHP methodology in resolving a MCDM problem. We did not interpret the result of our MAS selection decision in the context of other MCDM techniques. However, it would be interesting to compare the selection decision using alternative formulations of MCDM methods, including multiple objective linear programming (MOLP), weighted sum model (WSM), and multicriterion Q analysis (MCQA). It would also be interesting to see how a matched control group, not using AHP, would have solved the same selection problem.

8. Summary

The evaluation and selection of a MAS are important parts of multimedia development projects. The objective of this paper was to provide a systematic process to sort through the hype of MAS products by applying a decision analysis model, AHP, to evaluate each MAS product quantitatively in a group setting. This AHP technique allows an evaluator to quantify the relative importance of elements at each level and to calculate the composite relative weights for each product alternative. Three MAS products were chosen to demonstrate how AHP was applied and led to the selection of the product consistent with the maximization of the underlying technical and managerial expectations of all the evaluators within a group environment.

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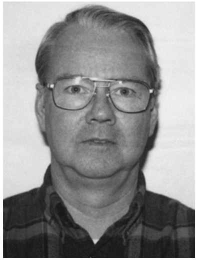

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