Online Book Offerings at the AMS

Selecting a method to offer
Scholarly publications online

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Abstract

The American Mathematical Society (AMS), a scholarly publisher, has recently decided to make mathematical books freely available from its website. Currently, the AMS makes many of its journals available in an electronic format for researchers. Offering entire books online is a natural extension of their electronic publishing efforts, but it will certainly be a challenge. The scope of this project is very large for an organization of this size, and as such requires careful consideration and planning.

Introduction

Karen Ferreira, one of the authors of this paper, is employed at the AMS as the Director of Electronic Product Development. She has been involved with the AMS' electronic publishing effort since its inception in 1989. Although Ms. Ferreira's group will be involved in the implementation of this project, they are not centrally responsible for it. Karen has been actively communicating with the members of the project team however, not only with respect to her job at AMS, but also in the development of the decision model described in this paper. The project leader in particular is excited about defining objectives and making judgements that will justify the final decision.

The AMS has already made the decision to move forward with the online book project. This paper will examine some of the factors that led to this decision, but will primarily concentrate on the follow-up decision currently before the AMS – selecting a method to offer scholarly books online.

In this paper we explore several aspects of this decision. A thorough definition of the decision is provided. The objectives that the organization ultimately wants to accomplish are identified. The identification of the objectives is accomplished in part by assessing the needs of the various stakeholders in this project. Several alternatives are listed and considered in terms of the objectives each one meets. These factors are then assimilated using decision support

software.   To those involved in the project, the resulting conclusions are surprising though completely justifiable given the process used.

1. The AMS

Before the specifics of the current decision are examined, it is relevant to examine the context in which it takes place. The following excerpt is from some of the American Mathematical Society's (AMS) promotional literature, and describes very well the foundation and history of the Society.

> In 1887, a Columbia University graduate student named Fiske traveled to Cambridge University to visit and study with prominent mathematicians. Inspired by his trip, Fiske wanted to foster a sense of "comradeship among Americans interested in mathematics." In 1888, he returned to New York City, where he and two friends founded what was to become the American Mathematical Society. The Society began holding meetings that served as forums for the mathematical community. As membership in the Society increased, so did the frequency and size of the meetings. Wanting to encourage further interest and support of mathematical research, the Society began publishing the proceedings of these meetings as well as other mathematical books.
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> Carrying on this important tradition today, the AMS remains at the forefront of the mathematics communication through its research conferences, national meetings, print and electronic publishing programs, and science policy activities.
>
> The AMS now has nearly 30,000 individual members, including mathematicians throughout the United States and around the world, and over 500 institutional members. It continues to fulfill its mission with programs that promote mathematical research, increase the awareness of its value to society, and foster excellence in mathematics education.[1]

In addition to understanding the history of the AMS, it is also useful to understand a little about the current culture of the organization. Here is another excerpt from the Society's literature that shows their mission statement.

> The AMS mission statement:
> The AMS, founded in 1888 to further the interest of mathematical research and scholarship, serves the national and international community through its publications, meetings, advocacy, and other programs which:
> - Promote mathematical research, its communication, and uses,
> - Encourage and promote the transmission of mathematical understanding and skills,
> - Support mathematical education at all levels,

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[1] American Mathematical Society, <u>AMS Membership Brochure</u>.(AMSMemb00), n.d.

- Advance the status of the profession of mathematics, encouraging and facilitating full participation of all individuals, and
- Foster an awareness and appreciation of mathematics and its connections to other disciplines and everyday life.[2]

As can be seen, the primary concern of the AMS is to further research in mathematics. To achieve this end, it has continuously offered current research in its journal publications. Recently, the Society has decided to increase its distribution by offering full versions of its books on the Internet.

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[2] American Mathematical Society, Untitled Promotional Brochure, n.d.

2. Books via Internet

The American Mathematical Society is first and foremost a scholarly publisher. In an effort to make mathematical research quickly available to researchers, the division embraced electronic publishing as early as 1990, well before websites or even gopher sites were established. Until now, its electronic publishing efforts have centered on scholarly journals. But with the increasing popularity and maturity of the Internet, the Society is turning its attention toward electronically publishing books.

There are several factors that have been considered in the Society's decision to electronically publish books. These factors are what *initially* led the AMS to approve the current online-book-offering project. The most important factor for this new initiative is a long-term organizational policy. One of the Society's goals is that no book it publishes will ever go out of print. This goal is one of the cornerstones of the AMS' not-for-profit charter. To this end, very short print runs of old books (50-60 years) are accommodated at the Society's printshop. This commitment can be costly for short print runs, but to cease it would be damaging for AMS in terms of their relationship with the mathematical community. Not only are these limited printings expensive, they are also very disruptive to the process of printing new books. It is the belief of the AMS management that making books available from a website will ease this problem. Even after this project has been successfully implemented, some transition time may be required before this project will offer an alternative method to keep all published books in print. Both the authors and the scientific community will need to accept the electronic alternative before hard copy printing can be relaxed.

In addition to maintaining the Society's commitment to keep scholarly books in print, this effort is expected to eventually become a source of revenue for the AMS. Many other publishers

are reporting that making an entire book freely available from a website actually results in additional sales. At this year's annual conference of the Association of American Publishers, Mr. Ryan, a representative of Amazon.com gave a presentation addressing this phenomenon. They had found that people want to browse a book (even electronically) before making a purchase. Publishers believe that making the whole book available is more effective than making only a chapter freely available. After reviewing these findings, AMS management believes that its online offerings will lead to more sales of its hard copy books, and thus will generate more revenue.

Another factor that led to AMS' decision was the Society's reputation for being an "e-savvy" organization. The Society has continued to be a technological leader in the scientific community with its electronic journals program. Not only are the completed journals made available electronically, each article submitted to the journal is made available electronically prior to the release of the journal issue in which it is contained. This further speeds up the process of making information available for continuing research by other members of the mathematical community. The Society has also initiated several agreements with other scholastic publishers to provide web links between literature of different sources. This effort goes beyond simply making the articles available online, it provides a new means for users to draw upon the cumulative wealth of existing research, without the limitations of any one website.

All of these factors led AMS's management to decide to offer its publications on the website. But once the decision to make books freely available from its website had been made, research was still required to find the best technological method to use.

3. Potential Solutions

AMS management has assigned a team from its publication division to select alternative solutions to this project. The team consists of individuals from various departments within the Publications Division:

- Upper management - to communicate the goals for the project and act as the steering committee

- Technical production staff - skills will be required to

    - determine the objectives for the project

    - determine the options for consideration

    - price the options

    - assess the options

- other production staff for implementation of a quality product

- electronic product development to deploy the product on the website

- Acquisitions - to determine which selection of books will be most effective for the initial implementation

- Marketing - to determine the appropriate marketing strategy

- Promotions - to implement the marketing plan

The skills of all of these team members will be needed if this project is to be successful.

The project team has been working on this problem for a few months. To date, the team has discussed the marketing strategy, determined the alternatives to consider, and begun developing cost estimates.

At this point, four possible alternative technologies for implementing the online book offering have been identified. They are:

1. scan at 600dpi

2. scan at 300dpi

3. re-key the contents of the book

4. work from existing electronic files

Another alternative was initially considered, but quickly discarded. That alternative was to scan each work into a computer, and then translate the scan to a text file by using optical character recognition (OCR). The project team reviewed the OCR software currently on the market, and decided that the software would not work for much of the text that contains mathematical formulas. Many of these formulas contain subscripts, superscripts, and symbols that the software would incorrectly interpret. Due to these problems, the alternative of scanning with OCR was discarded early in the life of the project.

Each of the current four alternatives has positive and negative factors (pros and cons) to consider. The options will be explained below and the most significant factors mentioned.

1. Scan at 600 DPI

This option involves hiring a vendor to scan the data from an existing hardcopy of the book. Locating a hardcopy is not generally a problem. Once scanned, the vendor will deliver Adobe Acrobat (PDF) files to the Society. These will then be posted on the website. Considerations for this alternative include:

- Low quality – Scanning of the books will result in actual pictures of the pages from the hard copy book. These pictures will be inserted into a PDF file, which is of lesser quality than actually having a text document.

- Large file size – The pictures that make up the PDF files will result in relatively large files. This can be problematic for people wishing to download the file.

- Less functionality – Because the PDF files are not actual text, options for future growth will be limited.

- Cost – Scanning in the documents requires much less work than other alternatives.

2. Scan at 300 DPI

This option is very similar to the 600 DPI option. The two important areas that are different from the previous alternative are:

- File size – Scanning at 300 DPI will result in smaller files than scanning at 600DPI

- Quality – Due to less precision in the scanning process, visual quality will suffer

3. Re-key the contents of the book

This option involves sending a hardcopy of the book to an out-sourced vendor. The vendor will physically type every word of the book into a text file, which will then be copied into a PDF file. Considerations for this alternative include:

- Quality - The resulting document would have a very high level of visual quality.

- File size – Files would be much smaller than those resulting from the scanning options.

- Functionality – Because the file would contain actual text, there is much more flexibility for increasing functionality at a later date.

- Cost – physically retyping so many books could be very expensive.

4. Work from existing electronic files

To use this alternative, archived electronic files that were used in the making of hard copy books would need to be restored. Until recently, the production department would obtain the output from those files and often do paste-up work (handwork) on the printed output before the product was sent out to be printed. The result is that the Society has files that do not match the printed output. This alternative involves comparing the contents of the electronic files with the printed output. This alternative will have similar results to the "Re-Keying" alternative, except for:

- Labor - This work would have to be accomplished with in-house staff. Outsourcing is not an option.

- Cost – This alternative appears to cost less than "Re-Keying", but more than either of the scanning options.

Regardless which of these four alternatives is selected for implementation, there are several costs which are fixed across all options. Such costs will not be discussed in detail in this paper. They include project overhead, website design, development of a limited search environment, hardware needs, testing, ongoing maintenance, and support. The initial effort will involve making 6 books available on the Society's website. The total number of pages (which will affect cost) is 2724.

There are other differences in the strengths and weaknesses in each of these four potential solutions. To more fully understand the ramifications of selecting one alternative over another and to help define the objectives for this decision, it is helpful to consider the impact this project will have on the stakeholders.

4. Stakeholders

Clearly, the AMS has a large stake in the success of this project. In an effort to ensure this success, the appropriate objectives for the decision must be defined and the alternatives weighed against them. In order to determine the objectives, which are so central to this process, an examination of the stakeholders and their needs is necessary. This process facilitated the identification of the objectives used in the decision model.

The stakeholders were defined as:

- Publisher – AMS

- Customers

- Authors

Each has its own set of expectations to be considered. Not all objectives identified for the stakeholders will be included in the decision model discussed further in this paper. Some expectations were considered earlier when the business model for this program was developed.

Publisher - AMS

The publisher, AMS, looks at this venture as both a contribution toward furthering mathematical research and as a potential money-making venture. Making books freely available online will allow more access to the scholarly information. In this way, the Society will be viewed as contributing to mathematical research. At the same time, the publisher is looking at accounts where such an effort actually resulted in more sales of the hard copy books. This is a very attractive finding for the publisher.

In addition, this effort will allow the Society to further solidify their image as an e-savvy organization. This public image began as early as 1989, when the AMS first established its

electronic presence. Of the other mathematical associations and similar academic societies, few were as quick as the AMS to embrace the information revolution. But at the current time there are many e-savvy organizations, and it is difficult to find an opportunity to stand out. This project is one such instance for the Society.

Of course, the publisher must be concerned that the implementation and on-going costs of this product are within the means of the Society's budget.

Customers

Customers have certain expectations of electronic products developed and deployed by the Society. Electronic products from the AMS have offered "…excellent content and powerful search capability"[3] in the past. The Society wants to continue to fulfill this customer expectation when releasing this product. Customer expectations also develop as they use other electronic products on the web. Customers want ease of use, flexible search capabilities and easy purchasing with any website they frequently use.

The nature of the web has caused a number of vocal individuals to express the opinion that information on the web ought to be made available for free. Publishers know how expensive it is to prepare and process data for electronic delivery. Many customers do not and are therefore of the mindset that the information ought to be free now that a print product no longer needs to be produced and shipped.

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[3] Kristine Fowler, "Comparative Reviews: Zentralblatt MATH Database and MathSciNet", The Charleston Advisor, Volume I: III, Jan. 2000.

<u>Authors</u>

This is a new environment for authors. They need assurance that their intellectual rights are being protected and if appropriate, they want to be monetarily compensated. Authors have traditionally looked for ways in which their research can be shared with peers in order to further their research. Just as customers are concerned with ease of use, so are authors who are in fact also customers.

After identifying the stakeholders in this decision, the project team has come to grips with the concerns of each party. They have used this information in developing the final objectives of this decision.

5. Decision Objectives

Two important issues to consider when making a decision are the complexity of the decision and the amount of objectives used. Too few objectives can result in poor decisions, while a significant level of complexity and too many objectives can result in confusion. When reviewing the concerns of the various stakeholders, it became apparent that this decision fell into the latter of those two. The list of criteria, or more correctly decision objectives, was large enough that it would be difficult if not impossible for a decision-maker to assimilate all of the objectives correctly. To combat this problem, the objectives were structured into a hierarchy.

Quality product

All stakeholders are concerned that the project results in a quality-finished product. The AMS wants to satisfy its customers' needs, while furthering its reputation of producing first rate organization electronic products. Customers need to have a product that is easily readable, both on the computer screen and as printed from their workstation. The authors also want to have a quality representation of their work.

When structuring this decision into a hierarchy (see Figure 1), two sub-objectives were noted under "Quality Product". The first sub-objective noted is the quality of the product as viewed from the screen of the user. The mathematical content of the books being offered contains many formulas that are full of small print and subscripts. If users are unable to accurately interpret this information, the project will have failed.

The other sub-objective is visual quality of the product as viewed on a printout from a standard home printer. Researchers will often need to print out the material they are interested in

so that it can be referenced at a later time. Therefore, it becomes imperative that the product be very legible, even in the areas that contain very small print.

Ease of Use

Time and again, it has been proven that regardless of the quality and depth of a product, customers will not use that product if it is not user-friendly. All of the stakeholders realize that this is a necessary component of a successful end product. To help decision makers incorporate this information, "Ease of Use" contains three sub-objectives: search interface, file size, and familiarity.

When considering "Ease of Use", it is important to factor in the computer interface used to search and locate the desired information. If an alternative to this decision is selected that requires an unusual interface, users may have difficulty and become frustrated. Therefore, selecting an alternative that meets user expectations and needs is an important sub-objective in this decision.

Another sub-objective that falls under the umbrella of "Ease of Use" is file size. It is expected that users will often wish to download the books that they will find at the AMS web site. In order to facilitate this need, the selected alternative must have a file size small enough to allow a timely electronic download at today's typical Internet speed. Larger file sizes can cause frustration for the user, which will result in less usage of the final product.

The final area grouped under this objective is familiarity. Users tend to form expectations of how an interface should work from their experiences at similar web sites. These experiences lead users to form paradigms about how to use a web site. The project team believes that if the product does not conform to these expectations, customers will not use it. Therefore, it is

important to consider the extent to which each decision alternative will allow for the familiarity of customer's expectations.

Future Functionality

An important consideration for the Society is the "Future Functionality" of their selected alternative. They want a solution that will allow for additional search features to be added, as well as a file format that can grow and will be supported in the future. Failure to find a solution that meets these needs will result in a large amount of rework by the staff as well as a large additional cost, or will result in a product that doesn't meet the functional needs of its customers. Two sub-objectives became relevant when considering the future of this product: search enhancements, and format.

The needs of customers are ever changing, and AMS wants to have the capability to adapt to these needs in the future. This concern has been encapsulated in the sub-objective of search enhancements. It is expected that as new capabilities for searching text become prominent, customers will need and expect this support from the AMS web site.

The other concern grouped under the objective of "Future Functionality" is format. The AMS also expects that other needs (in addition to search features) will change for customers over time. For instance, the AMS is considering offering web hyper-links from their product to material at other web locations. Therefore, it is important that the file format of any potential solution will support options to change and grow with customer needs.

Cost

The final objective for the Society is to select an alternative that is most preferable with regard to cost. In considering the cost of any alternative, the AMS will evaluate the price of the end product, the price of maintenance, and the price of administrative staff needed to support the alternative. A potential solution must be financially feasible for the AMS to consider it, and less expensive solutions are preferable.

Having explicitly established the different objectives that need to be satisfied in this decision helps to structure the problem. But attempting to weigh each alternative against the identified objectives would be a very difficult task. The decision is too complex. In order to help the decision-makers, the information for this project has been loaded into decision support software.

6. Expert Choice Model

As has been seen, the number of objectives and sub-objectives factored into this decision would make it extremely difficult for a person to accurately assimilate the data into a final selection. The best way to structure and analyze this information is to use decision support software. In this case, Expert Choice decision software was selected because of its use of the Analytic Hierarchy Process (AHP). Because of the way the decision objectives were previously structured as a hierarchy, the use of AHP was a natural extension of the decision process.

The Analytic Hierarchy Process is a powerful tool to assist decision-makers. It helps the user to structure information and objectives into a comprehensive format by use of the hierarchy. It then forces the decision-maker to use relative judgements that result in derived weightings for each decision objective. Once each of the objectives and sub-objectives has been analyzed, the process synthesizes all of the judgements into a final package that shows the decision-maker the results of his judgements. In this case, the AHP was needed due to the complex nature of the decision being considered.

As shown in Figure 1., Expert Choice allowed this decision to be loaded into the software in a visual hierarchy. This allows the user to mentally process how the decision is structured. In the middle of the screen, the blue area represents the goal of this decision: selecting a method to make hardcopy books
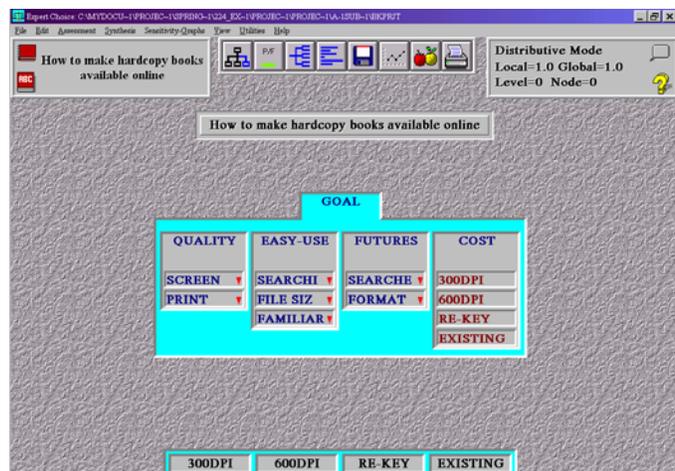

Figure 1. The hierarchy

available online. Each of the four objectives can clearly be seen immediately underneath the

goal. Beneath each of the first three objectives (Quality, Easy-Use, Futures) are the corresponding sub-objectives that were discussed in the previous section of this text. The four potential solutions (or alternatives) to this decision can be seen listed under cost and displayed across the bottom of the screen.
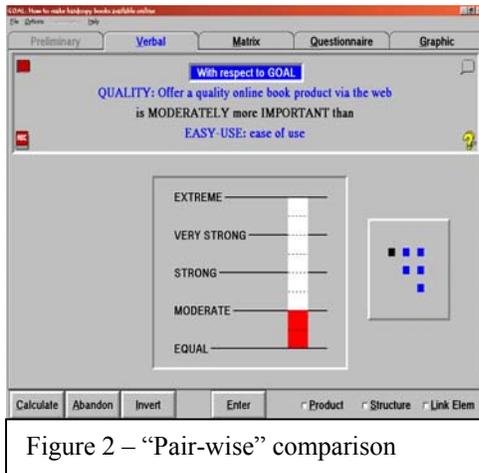

Figure 2 – "Pair-wise" comparison

One of the most common errors made by decision-makers is in the use of absolute judgements. Typically, each objective is assigned a weighting based on an absolute scale of 1-10, or perhaps 1-100. This can result in inaccuracy due to human limitations. As Dr. Ernest Forman notes in his "Decision by Objectives" manuscript, it is extremely difficult for humans to consistently apply ratio weightings when evaluating a multitude of criteria[4]. The Expert Choice software allows users to overcome this limitation by implementing a process of relative judgements called "pairwise comparisons" (Figure 2). For this decision, members of the project team were consulted to find their views on the relative importance of each objective and sub-objective. On each level, the objectives and alternatives are compared against one another and the subject matter expert (SME) decides which of the two is more important and by how much. When this process is carried to the lowest level (as seen in Figure 3), each objective has a corresponding
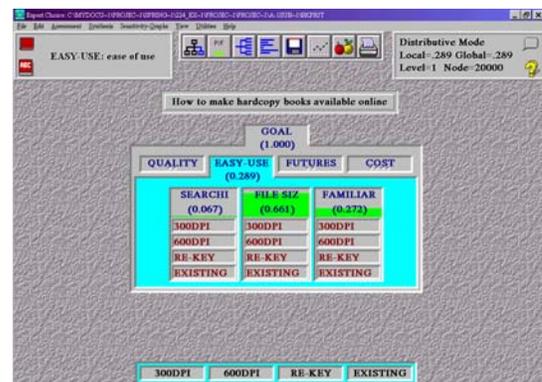

Figure 3. Derived relative weightings

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[4] Ernest Forman, "Decision by Objectives", unpublished manuscript, Expert Choice, Inc., McLean, VA, 1996, pg.31

weighting that has been *derived* by the SME.

At this point, the decision model is nearly complete. Under the lowest level of objectives, the alternative solutions can be seen. In the same manner that weightings were derived for the objectives, each alternative is compared to see which is the most preferable. Once this information has been derived, the software can perform a synthesis of the entire model. This synthesis will incorporate all of the lower level judgements made by the SME and show the decision-maker which alternative is the most preferable.

7. Model Results and Final Recommendation

When the objectives have been loaded into the Expert Choice software, and the relative weightings have been derived by "pairwise" comparisons (Figure 3), the software can then synthesize the user's data into r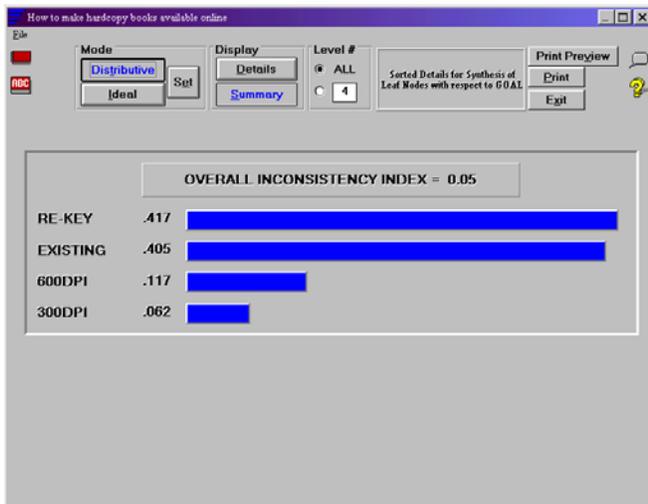ecommendations. These results can be shown by the software's "synthesis from goal" (Figure 4), or even better by the software's graphic output (Figure 5). As can be seen in this graph, the synthesis of the data for this decision results in a recommendation for the "Re-Keying" (blue line) alternative. Even though this alternative doesn't end up being the most preferable in the "Quality" (heaviest weighted objective) objective, its strength in "Future Functionality" shows that it is a more preferable alternative than the "Existing Data" (red line) option.

Figure 4. "Synthesis from Goal"

Because the "Re-Keying" and "Existing Data" alternatives both seem like very good solutions to this project, it is also recommended that the decision makers for this project once again review the derived weightings of all of the decision objectives. Small changes in the weightings could easily
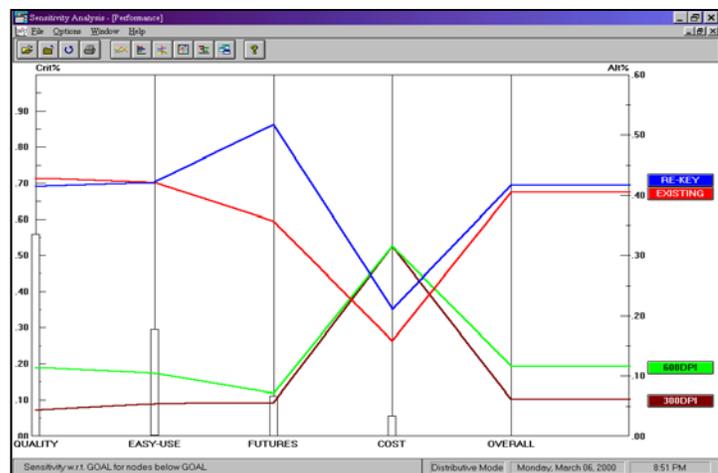
Figure 5. Graphical depiction of results

change which of these two alternatives is the most preferable. (See appendix 1 for more information)

This graphic representation of the software results also shows clearly that, given the derived objective priorities, the two scanning options ("600 DPI" and "300 DPI") are *not* preferable solutions. These two alternatives both do well in the cost objective, but poorly in all others, especially "Quality".

Clearly, the use of the Analytic Hierarchy Process within the Expert Choice software helped to make a logical and supportable decision in this project. The results of this decision have been shared with a few select individuals. Some review of the judgments used has begun. For quite some time, expectations were that scanning would be the preferred method. However, this process forces people to focus not only on the short-term objective of cost but also on the long-term objectives such as future use. Over time, the results of this model will be shown to additional decision-makers with the expectation that the alternative involving re-keying data will be reconsidered.

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Kristine Fowler, "Comparative Reviews: Zentralblatt MATH Database and MathSciNet", <u>The Charleston Advisor</u>, Volume I: III, Jan. 2000.

Appendix I

In the final Expert Choice model, the most preferable solution is the "Re-Keying" alternative. However, by doing what-if analysis with the software, it is possible to have the "Existing Data" option become the most preferable. As the software shows (Figure 6), a lessening of the relative importance of "Future Functionality" results in "Re-Keying" and "Existing Data" becoming equally important. I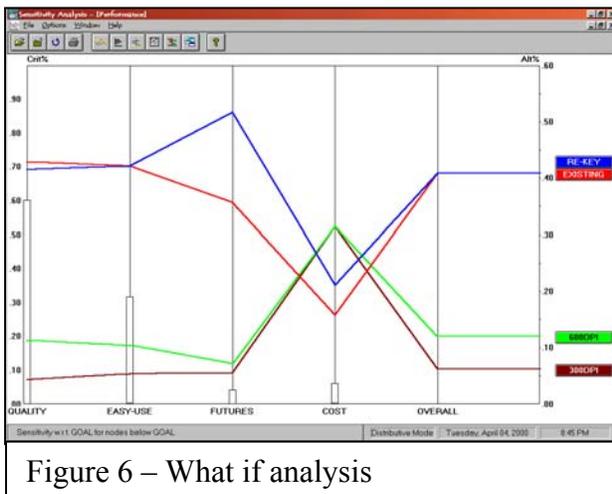n addition, variations on the importance placed on "Quality" could also change the order of preference for the alternatives. Therefore, we additionally will recommend to the management of the AMS that a thorough review of the pairwise comparisons be performed before they accept this as a final model.

Figure 6 – What if analysis