DOCUMENT RESUME

ED 477 049 IR 021 777

AUTHOR	Landon, Bruce
TITLE	Hard Choices for Individual Situations.
PUB DATE	2002-06-00
NOTE	14p.; In: ED-MEDIA 2002 World Conference on Educational Multimedia, Hypermedia & Telecommunications. Proceedings (14th, Denver, Colorado, June 24-29, 2002); see IR 021 687.
AVAILABLE FROM	Association for the Advancement of Computing in Education (AACE), P.O. Box 3728, Norfolk, VA 23514. Tel: 757-623-7588; e-mail: info@aace.org; Web site: http://www.aace.org/DL/.
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01/PC01 Plus Postage.
DESCRIPTORS	Comparative Analysis; *Computer Software Evaluation; *Computer Software Selection; *Decision Making; Educational Media; *Educational Technology; Evaluation Criteria; *Evaluation Methods; Information Sources; Instructional Design; *Selection Tools

ABSTRACT

This paper focuses on faculty use of a decision-making process for complex situations. The analysis part of the process describes and compares course management software focusing on: technical specifications, instructional design values,tools and features, ease of use, and standards compliance. The extensive comparisons provide faculty with side-by-side product feature descriptions. The decision-making focus of the paper and of the companion site is on supporting a detailed rational decision process for selecting course management software. This decision process uses a grading style model familiar to educators that compensates for the cognitive illusions and limitations of decision makers to achieve a transparent decision process for selecting the "best" application for each local situation. The current site meets needs for decision-making support, as evidenced by 16,000 visitors a month to the site. By the fall of 2002, there will be similar decision making supports available which will focus on student services, teaching technologies and online education policies. Lists conceptual groupings that have been used to provide targeted views for the learners, learner support, and technical administrator audiences, followed by a checklist of tools or features to include within each of these conceptual categories. Includes a Demonstration model of the Comparative Analysis Decision Table with Three Options.(Contains 17 references.) (Author)

Hard Choices for Individual Situations by Bruce Landon, Ph.D.

Overview

The Decision Dinner - a parable about the weighted average decision strategy
by Bruce Landon and Nancy

The novelty of the proposed decision process can be illustrated by a parable about a small group of decision makers and relating it back to the online learning product selection situation. First, assume the task of selecting a restaurant for a board of directors' first dinner in a new city. Also imagine that this dinner is pretty important, perhaps not quite as important as the Nixon dinner in China, but a dinner of consequence, nonetheless. The first steps in the process would be to scan the available resources to see which restaurants (like product providers) are available and then to proceed to get menus (lists of the features available in each provider's product). The menu information could be augmented with reviews of the items on the menu but this would still not be enough. What the decision making group needs to know is what kind of items the members of the board actually like to have for dinner, i.e. which menu items are important to them. So the group decides to collect some more information by sending out a stakeholder survey to find out what each of the board members enjoys for dinner.

To construct this survey, the decision making group had to make a short list of restaurants (product providers) and from their menus make a short list of the most promising items (important features) because the board members would have never responded to a survey that was as long as all of the menus from every restaurant. The group sent out its survey and analyzed the results to calculate the importance weighting for each of the dinner menu items. Knowing the consequences of making a mistake on selecting a restaurant for both the decision makers and the board of directors, they elect to use the most rational decision making strategy known: the weighted averaging strategy.

To be able to use this strategy, the decision makers will have to find out how suitable the menu items actually are. So they have dinner at each of the restaurants to taste and judge the quality for themselves. Not only do they have to carefully taste the suitably of the menu items (features) but they must rate each one on a consistent scale so that the scores can be used in the weighted average strategy. They decide to all use a scale where 0 means awful and 10 means wonderful on suitability rating forms used when they go to the restaurants. Then night after night, dinner after dinner, they evaluate the suitability of each of the short listed restaurants on all of the important menu items. Finally using the board members' weights for each menu item and the decision makers' suitability scores for each menu item at each restaurant, they calculate the winner from the data collected.

The winning restaurant is the one that has the highest average score when the menu item weights are multiplied by the menu item suitability scores. The decision makers make the reservations with the winning restaurant and the board of directors proceeds to have a great dinner. The board of directors was impressed by the rationality of the group of decision makers but in truth they were more impressed by the dinner after which they voted to give bonuses to the decision makers and all live happily ever after.

Selecting an online eductional delivery application is analogous to selecting the restaurant in the parable above. The members of the board of directors are analogous to the stakeholders who will be impacted by the selected product i.e. the students, faculty, staff, and administrators. If the consequences of making an error and selecting the wrong product were not important there would be no need to be so rational as to use the weighted average decision strategy and the group of decision makers could use a less rational process. When the consequences are important such as in the assigning of course grades then a very similar rational process is most often used called weighted averaging grading.

This chapter will focus on faculty use of a decision-making process for complex situations. The analysis part of the process describes and compares course management software focusing on: technical specifications, instructional design values, tools and features, ease of use, and standards compliance. The extensive comparisons provide faculty with side-by-side product feature descriptions. The decision-making focus of the chapter and of the companion site is on supporting a detailed rational decision process for selecting course management software. This decision process uses a grading style model familiar to educators that compensates for the cognitive illusions and limitations of decision makers to achieve a transparent decision process for selecting the "best" application for each local situation. The current site obviously meets needs for decision-making support as evidenced by 16k visitors a month to the site. By the fall of 2002, there will be similar decision-making supports available which will focus on student services, teaching technologies and online education policies.

Introduction

Faculty make decisions every day and most of them are informal choices about what looks good on the menu for lunch. Sometimes, faculty make quite formal and rational decisions about which student gets an A and which student gets an F using a strategy of weighted averaging. The way in which decisions are made often reflects the importance of the decision and the situation as well as the decision maker. The research in psychology over the last few decades has illuminated some of the strengths and weaknesses in the way that people make decisions with the important finding that in many situations people are less than rational decision makers. When a person is overloaded with information or under time pressure then their decision-making can be quite compromised and they seem to use "rules of thumb" to make a decision. The case of selecting an online educational delivery system is examined from this perspective in this chapter. First the difficulties facing the decision maker are addressed and then a remedy is demonstrated to show how decision-making can be assisted to prevent the decision process from being compromised by these "rules of thumb" using a web tool for comparative analysis.

Why choices are difficult

Too many products

The situation is reminiscent of the early automobile industry when there were over a hundred automakers. Like the early auto industry many other competitors will not survive in the long run. The current front-runners: WebCT and BlackBoard started out as small almost personal projects a few years ago and are now multi-million dollar enterprises that span the global education marketplace. There may well be others out the current products that will evolve into the major brands of tomorrow as the market matures. The point of this analogy is that selecting a learning management system is much more complicated than selecting a new car, in part, because there are so many competing models. There are over 100 products in this marketplace that range from relatively simple limited function applications like WebBoard which just provides threaded discussions and chat to complex enterprise wide learning systems that link to backend databases and administrative data systems used by colleges and universities. Previously in 1997, I had attempted to characterize these products as components or suites by this categorization turned out not to be useful because there were so many variations from product to product he became difficult to classify new products. Also, the products in this marketplace evolve quite rapidly with a new model or version almost every year, like automobiles. So to deal with this rapidly changing market it seems better to characterize products in terms of the features that they provide.

Too many product features

The feature and tools are organized in terms of the group that they are most likely to be interested in them: Learners, Learner Supporters and Technical Administrators. These major groupings are further divided into subtypes of features/tools and finally into the individual features of the product. This schema has grown over the years and the language has changed as well so that some of the terms have been replaces in common usage by other terms as in the case of Newsgroup being supplanted by the term discussion or forum. A glossary of terms provides some help for those who are unfamiliar with this area (http://wwww.c2t2.ca/landonline/glossary.html), but the fundamental problem is that there too many features/tool about too many products to keep track of easily (products * features = 3474 facts) especially to keep track of in your head. The most frequent problem in making good decisions in this kind of situation is that of forgetting or omitting some important part of the problem when making the decision. Often we are overly optimistic about how big a decision problem we can do "in out head."

Too little working memory in decision-makers

Nobel laureate, Herbert Simon (1979) characterized the human decision making capacity as having "Bounded Rationality" (also see Gigerenzer & Selten, 2001). When people face decisions they operate within the bounds or capacities of the human mind. They are limited by fallible perceptions, wandering attention, faulty memories, and fluctuating information-processing abilities. People don't optimize, but instead resort to simplifying rules of thumb in order to proceed with their decision-making. These limitations have been investigated for decades with the repeated finding that working memory limitations play a major role in limiting the ability to make rational decisions.

The notion of limited memory was articulated well by George Miller (1953) as the magical number seven plus or minus two "things" that you hold in your mind at once while working on a problem (presumably due to a phonological loop process, Baddeley 1986, cited in Anderson 2000). This limited working memory is a profound handicap for a rational decision maker because when one works with ideas in the head then one is moving them around sort of like a juggler. When there are too many "things" then some of them will get dropped or set aside from consideration in the decision-making. Stated in another way, decision-making becomes more difficult as the number of things to consider increases and quickly reaches a point of overloading working memory.

When facing difficult decisions, people encounter overload and then they resort to ways of coping that involve cognitive shortcuts. When overloaded, they are more susceptible to cognitive illusions (Kahneman and Tversky, 1996). Cognitive illusions are similar to perceptual illusions in that they stem from the fact that in both types of illusions the person can focus only on a small part of the situation at one time. In the case of perceptual illusions this is because the fovea of the eye that sees fine detail encodes only a small segment of the spatial panorama at each fixation. In the case of cognitive illusions this is largely because the conscious working memory can hold only a few "things" and the rest must be inferred or extrapolated in ways that are sometimes biased. In both types of illusions the person is not necessarily aware of any "illusion" at all and may believe that they are "seeing everything correctly."

Too many Cognitive Illusions in Decision-Making

The discrepancies associated with cognitive illusions may be seen a little more clearly in contrast to an idealized rational decision process. In the idealized process, one starts by selecting relevant features/criteria and then assigning an importance weighting to each of those features. Next one evaluates each choice option on each of those important features and assigns a suitability score. Finally one makes the rational decision to choose the option with the highest weighted average suitability score (the average of the weights for a feature multiplied by the feature's suitability score). Choosing the option with the best score is the rational decision (Keeney and Raiffa, 1976 as cited in Roe, Busemeyer and Townsend, 2001). With only a couple of optional choices and a few important features it is likely the limitations of working memory would be overwhelmed even if one were able to do the mental multiplication part. When one is overwhelmed by the size and complexity of the decision situation then one is susceptible to a host of cognitive illusions. A few of the major ones are: Availability Heuristic, Representativeness Heuristic, Hindsight Bias, Gambler's Fallacy, the Framing Effect, Similarity Effect, Decoy Effects, and Overconfidence Effect. When the decision situation is simple and small, on the other hand, most people can and do make good judgments unaffected by these cognitive illusions.

The Availability Heuristic investigated by Tversky and Kahneman (1973) is a powerful cognitive distortion. Essentially, it is captured by the by the saying, "out of sight – out of mind." It turns out that the believing the truth of a piece of information is related to the ease of recall. If something does not easily come to mind then the inference is that it must not be true (Begg, Amour and Kerr, 1985). Unfortunately, the ease of recall is affected by circumstances that have nothing to do with the truth of the information such as the vividness of the information and the number of times it has been repeated. The power of the Availability Heuristic is not lost on those who repeatedly advertise on radio and television.

Another powerful cognitive illusion is the Representativeness Heuristic (Kahneman and Tversky, 1973). The illusion is that if something looks like one of those then it must be one of those in spite of relevant base rate information to the contrary. Common versions of this are "you can tell a book by its cover" and "if it looks good then it works well." These rules of thumb leave out the base rate information such as about how likely it is for a random book to be a good read. The cognitive illusion is to be unable to process additional information about the likelihood of an event given the overwhelming impact of how it looks on the surface.

The Hindsight Bias is the tendency to believe, after the fact, that one would have foreseen a particular event (Fischhoff, 1982 as sited in Galotti, 1999). This has also been referred to as the "I-knew-it-all-along-phenomenon" that inflates self-esteem and feelings of overconfidence in one's predictive abilities. The notion is that hindsight is always 20-20, but in reality, many events like the weather are still uncertain predictions before the fact.

There is an entire industry built on the cognitive illusion of the Gambler's Fallacy. This is the popular illusion of believing that in a game of chance that the more you loose the greater your chance of winning (Tversky and Kahneman, 1971). The truth is that the odds of winning stay the same. The illusion is belief that the law of large numbers applies in the situation of small numbers and that there would necessarily be some balance in the situation of a specific gambler. This shows up as the gambler's belief that in a fair game of chance after you have lost for a while it becomes more and more likely that it is your turn to win. Other forms of this can occur in committees who believe that after a string of poor decisions it is their turn to get lucky in picking a good vendor or whatever has been the focus of their decision-making.

The Framing Effect refers to the impact of the context on the decision. People tend to avoid risks that are described in terms of benefits, but tend to take the same risks that are described in terms of loss (Tversky and Kahneman, 1981). This is reminiscent of the rule of thumb: win – stay, lose – shift. The illusion is that the value of losses is greater than the value of gains when mathematically they are equal. This misinterpretation of the importance of risk can bias the importance weighting of features and thus bias the decision process.

Similarity Effects (Tversky, 1972) and Decoy Effects (Roe et al, 2001) are both products of confusion. When a new option is added to a choice set that is similar to one of the existing options the original option is less likely to be chosen because this effect sort of divides the mind share like a similar product can divide the market share. The Decoy Effect is a special case of the Similarity Effect where a range decoy that is more extreme than the original choice set dramatically reduces the choice likelihood of nearby options (Roe, 1999). In effect, the extreme decoy sabotages the nearby options by altering their context.

Decision Deadlines can also influence the role of Cognitive Illusions. When deadlines are quite short the decision maker tends to rely more on fewer pieces of information. In effect the working memory is further limited by time pressure. Roe's (1999) analysis suggests that the option chosen under time pressure is simply the one that is the current focus of attention when time runs out. With longer decision deadlines the more subtle similarity effects exert more influence. Longer decision timelines in the context of face-to-face group decision making tend to be associated with more extreme decisions due to attitude polarization (Moscovici and Zavalloni, 1969). It is rarely the case that truth wins in the group decision-making situation (White, 1993 as cited in Myers and Spencer 2001).

Overconfidence is a paradoxical Cognitive Illusion in that it is the illusion that one has no cognitive illusions and that one's decisions are without bias. Kahneman and Tversky (1996) have found a replicated tendency for people to be more confident than is warranted by the evidence and to overestimate the accuracy of their beliefs. This overconfidence extends to eyewitnesses testimony where Loftus (1979) has found that the witness's confidence in their testimony to be unrelated to accuracy of their testimony. This overconfidence has the side effect of enhancing personal self-esteem and thereby contributing to resistance to being influenced otherwise i.e. stubbornness.

In summary, there are many mental obstacles for those who would be rational decision makers. Many of these Cognitive Illusions stem from the limitations of working memory. These are the same limitations that cause people to not be able to remember long strings numbers like international telephone numbers. Because large and complex decisions situations are beyond the capacity of working memory, people resort to rule of thumb strategies to do the best they can. In such overwhelming situations Cognitive Illusions bias judgments and compromise decision-making.

Making the decision situation smaller and simpler can circumvent these obstacles. Dividing up a complex decision into several small and simpler decisions keeps the load on working memory within normal capacity and then decision makers can be quite rational in making good decisions.

Donald Norman (1999) has made the case that human-computer interactions can and should be designed to take account of normal human fallible perceptions, wandering attention, faulty memories, and fluctuating information-processing abilities. With good design of decision-making processes that keep the in-the-head part small and simple, a system can be optimized to enable quality decision-making. The normative weighted averaging strategy can be easily divided up into small and simple component parts and then later recombined (outside-of-the-head) into a rational decision process that leads to the "best option." There is a powerful decision-making synergy in combining the focused judgmental prowess of people with the memory and computational prowess of computers.

How people normally Make Decisions: The 5 Basic Strategies

There are five basic decisions strategies (Payne & Bettman, 2001) for choosing among options (products, services etc.) based on features or aspects of the options. All of these five strategies are compromised by the reality that the set of options is limited to those known to the decision-maker and the "best" option may be simply missed in the whole process. While the names of these strategies on may be unfamiliar is quite likely that everyone has used all of the following strategies at one time or another:

Lexicographic strategy (aka one reason, pick the best)
Elimination by aspect strategy (aka pick the last)
Satisficing strategy (aka Bounded Rationality Model)
Equal weight strategy (aka scoring strategy)
Weighted averaging strategy (aka weighted adding strategy, grading model)

The Lexicographic strategy involves two steps: selecting the most important feature and then picking the product from all of the options that is best on that one feature. There is no requirement for the features to be expressed as numbers. If there is a tie then the decision maker simply repeats the process on the second most important feature. This non-compensatory strategy does not allow for some features of an option to make up for other less adequate features. The only involvement of a second feature is in the case of a tie that is broken by considering the next most important feature and selecting the option that is best on that feature.

The elimination by aspect strategy is a simple screening strategy involving two steps: setting the requirements for each of the features and then eliminating options one at a time which do not meet any one of the requirements. The decision maker examines the features of each option one by one and the option is eliminated as soon as a feature is found that does not meet the requirements. This popular strategy does not need for the features requirements be expressed as numbers and is easy-to-use. The elimination by aspect is a non-compensatory strategy so that once an option is rejected on any feature that option is eliminated from further consideration. This strategy does not necessarily result in a single best option since more than one option may pass on all of the requirements. Including any features that are irrelevant or biased in favor of one of the options compromises this process.

The Satisficing strategy (Simon, 1955 cited in Gigerenzer and Selten, 2001) is more psychologically developed model of sequential decision-making that includes setting requirement cutoff levels for each feature. An option is examined until it fails to meet one of the cutoff levels then it is rejected and the next option is considered. The first option that passes on all of the features is selected. If none of the options pass all of the cutoff requirements, then the requirements are reduced to new lower cutoff levels and the process is repeated. The satisficing strategy is non-compensatory and effected by the order in which the options are presented as well as the aspiration level of the initial cutoff requirements.

The Equal weight strategy is comprehensive and considers all of the features on all of the options. The suitability values of one (passed) or zero (failed) are assigned to each to each feature on each option. The total suitability score for each option is the simple sum of the feature suitability values for that option (all features are weighted equally). The option with the highest sum of the values is selected. This strategy is directly analogous to multiple choice test scoring where correct answers are awarded one, wrong answers are awarded zero, and the highest sum score identifies (selects) the best student on the test. This compensatory numeric strategy enables some features assigned one's to compensate for other features that were assigned zero's. This strategy is more useful when there are many features because there is less risk of a tie for best score.

The Weighted averaging strategy is a more complex version of the simple sum score model where each feature is also assigned an importance weighing. This idea implies that the decision maker is willing to make trade-offs to arrive at the selected option. The process involves five steps: (1) setting the importance weights for each of the features, (2) for each option then determining the numerical suitability value for every feature, (3) multiplying the feature suitability value times the feature weight, (4) then summing these weighted features subscores into an option total score, and (5) finally selecting the option with the highest average score. The averaging of the weighted option total scores simply returns the scores to the scaling metric of the feature suitability value units (which are often on a rating scale such as 1=poor to 9=excellent). This strategy is directly analogous to the grading model where different parts of the grade are weighted differentially (or subsections of an exam are weighted differentially) to arrive at the final mark. The weighted averaging strategy is compensatory in two ways: high scores on one feature compensate for low scores on another feature and a lower importance weight on one feature is compensated for by a higher importance weight on another feature. This strategy is less likely to result in ties between options than is the equal weight strategy when using a relatively small number of features. Furthermore, the weighted averaging strategy is considered the normatively rational decision process because it uses all of the information available in a consistent manner to arrive at a selection. This model is similar to the multiple linear regression model used in statistical analyses and suffers from some of the same shortcomings, most notably it is compromised when irrelevant features are used and when unreliable suitability values are used.

Decision makers often make use of combinations of the above strategies. In combined strategies the decision is made in phases. The initial phase is often to screen out some of the potential options in order to reduce the complexity of the situation to as short list of options. This phase is followed by a more thorough consideration phase to select the best option from a short-list of candidate options. The primary reason that everyone does not use the weighted averaging strategy all the time for all decisions is because it would be too mentally difficult and too time consuming. Other strategies are heuristic attempts to make good decisions with less effort and in less time and sometimes they seem to work well enough.

Idealized decision-making process for comparison

Selecting a online educational delivery application is a high-stakes gamble that can impact the future prosperity of an educational institution. The weighted averaging strategy is ideal decision-making process because it is considered to be the only normatively rational decision process. In its most rational form every possible product option would be considered on every possible feature – nothing would be left out. The process involves the five steps: (1) setting the importance weights for each of the features, (2) determining the numerical suitability value for every feature of every product option, (3) multiplying the feature suitability value times the feature weight, (4) then summing these weighted features subscores into a product option total score, and (5) finally selecting the product option with the highest average score from among all of the possible product options. In this ideal there are three major difficulties: discovering every possible product option in a dynamic expanding market, accurately determining the importance weightings of each of the features, and accurately determining the suitability of each feature on every product. The practical difficulty is simply not having sufficient time and resources to carry out the process. The recommended process is below intended to approximate this ideal strategy within the practical limitations of time and resources.

Tailoring decision processes to Individual Situations by involving the stakeholders

The ultimate success of a decision process in addition to making a good decision is that others, the stakeholders, cooperate with the decision makers and carry out the decision and implement the chosen alternative. Tetlock (1983 as cited in Gigerenzer 2001) has studied the social aspects of rationality and proposed three social goals that are important for maintaining this cooperation. The first social goal is that decisions are made in a transparent way that is understandable and predictable. The second social goal is fairness where the decisions are made in a way that does not violate the expectations of people. The third social goal is where decisions are made in an accountable way that can be justified and defended in public. Decisions, which meet all three of these social goals, are more likely to pave the way for the acceptance by the stakeholders of the eventual decision to select a particular product over the competition.

One direct way of accomplishing these goals is to involve the stakeholders in the overall decision process. Including several of the stakeholders on the decision-making or decision-recommending committee often does this. The common difficulty with this approach is that there are many times more stakeholders than there are members on the committee. By dividing up the decision-making tasks it is possible to meaningfully involve more stakeholders and still keep the decision-making committee to a workable size. There are a couple of obvious groups of stakeholders: the student learners and the faculty who will be using the selected system to deliver online courses or use it to deliver the online portion of blended regular courses. In many institutions there will also be other stakeholders who will be interested in some involvement in the decision process. Other obvious stakeholders are the systems and computing personnel who would be doing the technical administration of the Learning Management System if it is not hosted from the vendor's site. Also, there may be a myriad of learner support services from the registrar to instructional design personnel to the library and disabled student services personnel who all have a stake in the decision process. Finally, depending on the level of involvement the institutional Board of Directors may well have political role to making their priorities felt in such an important institutional decision. One recommended approach is to involve some of the stakeholders in deciding the importance of specific product features and also involving the more technical expert stakeholders in judging the suitability a specific feature in a particular product.

When the initial importance weightings of the product features for the comparative analysis site were developed there were many differences of opinion among the experts involved in the peer review committee. These differences were worked out and consensus was achieved by using a couple of face-to-face meetings followed a nominal group process similar to the Delphi process (Delbecq, Van deVen and Gustafson 1975). After people met and had an opportunity to talk about what they thought was important and why, they were then asked to provide importance ratings for the specific features. These ratings were simply averaged to provide a mathematical consensus without resorting to additional face-to-face meetings. The resulting averages were also sent back to the peer review committee by email with requests for further comments if members had strong feelings that there was an error anywhere. These requests produced some new ratings that were again averaged and circulated again for comment and revision. It took only a couple of rounds of this nominal group process to produce a consensus on the feature weights. This consensus was in part because the process was transparent, fair, and accountable as recommended by Tetlock (1983, cited in Gigerenzer 2001).

Focusing on what is important

Colleges and Universities are hugely different as are institutions of 3,000 students and institutions of 30,000 students. Historically, much of educational market has been a geographical patchwork of niche markets with some exceptions. In each institutional situation of there are some considerations that are more important than others. One way to approach the problem of too many products and too many features is to limit the consideration to only those things that are locally important. Determining what features are needed in an institutional Learning Management System is often a political process in each institution that can involve many people. This process is informed by the institutional history of what has worked well and what has not, as well as expectations about what will be needed in the future. In practice, different institutions and faculty within those institutions use products in different ways and in more than a few cases some features of a product are never used. This situation results from the newness of the market and the rapid pace of technological change in recent times. In this situation the wiser approach would seem to be to focus on what is needed rather than what is offered in the market. The idea of a needs analysis is not a new idea, but it can be particularly advantageous in selecting a Learning Management System by informing the process of which product features fit into the institution's needs and which ones are less needed or merely duplicate existing institutional systems.

Each institution is unique and that uniqueness can be augmented or diminished by the choice of an institutional Learning Management System. Sometimes institutional mission and goal statements can provide a guide to which directions to pursue and sometimes these policy documents play no real role in the decision making of the institution. What is at issue in the selection of a Learning Management System is the potential commitment to a product that is as far-reaching as the institutional decision about which word processor application to support. Once the decision is made it will not be easy or inexpensive to undo that decision. By basing the decision around the unique needs of the specific institution there is a better chance that decision made will further the success of the institution rather than the opposite.

Thinking in terms of the audiences of users

One way to reduce the complexity of the decision process is to divide the product features into groupings based on the group of people who are more likely to be involved with those features. In this instance one can think about three different groups of people: Learners, those who support the learners more or less directly and those who are involved in the technical administration of the software installation. These three groups do not exhaust the possibilities but provide a starting viewpoint.

The learners or students are usually the largest group of users. It is useful to consider the Learning Management System from their perspective since any problems or short comings are going to effect so many people and because many institutions profess a "learner focus" as part of their mission. However learners are not a homogeneous group and the needs of "first time users" may well be very different from those of returning successful students.

The Learner Support group includes faculty, teaching assistants, instructional designers, various administrators and others who's job it is to help learners to be successful. The titles and descriptions of these roles vary dramatically from situation to situation

The audience of technical administrators consists of those folks who operate the server as well as those who administer the authorization or security policies out of sight. In many situations is this audience also includes additional administrators involved in setting up course shells on the server and arranging for access to registration lists. In general, the technical administrators operate behind the scenes and are able to access parts of the software system that are not available to instructors or course developers.

Thinking in terms of product features

Within each of the three audiences the features of the products can be further grouped into clusters of features and this can reduce the complexity further. On the Online Educational Delivery Applications site (http://www.c2t2.ca/landonline/) the following conceptual groupings have been used to provide targeted views for the learners, learner support, and technical administrator audiences respectively:

- Learner Tools (for learner audience)
  - Web Browsing
  - Asynchronous Sharing
  - Synchronous Sharing
  - Student tools
- Support Tools (for learner support audience)
  - Course
  - Lesson
  - Data
  - Resource
  - Administration
  - Help desk
- TechInfo (for technical administrator audience)
  - Server Platform
  - Client Platform
  - Pricing
  - Limitations of package
  - Extra Considerations

Within each of these conceptual categories there would be a small number of specific application tools or features. Altogether there were 62 such specific features that could be a part of an individual application. The complete listing of application features inside of the above conceptual structure attempts to organize the otherwise overwhelming list of features: (adapted from http://www.c2t2.ca/landonline/option2.asp)

Check Features to include

Learner_Tools

Web_Browsing

- ☐ Accessibility
- ☐ Bookmarks
- ☐ Multimedia
- ☐ Security

Asynchronous_Sharing

- ☐ E-mail
- ☐ BBS file exchange
- ☐ Newsgroups

Synchronous_Sharing

- ☐ Chat
- ☐ Voice Chat
- ☐ Whiteboard
- ☐ Application sharing
- ☐ Virtual space
- ☐ Group browsing
- ☐ Teleconferencing

Support_Tools

Course

- ☐ Course planning
- ☐ Course managing
- ☐ Course customizing
- ☐ Course monitoring

Lesson

- ☐ Instructional designing
- ☐ Presenting information
- ☐ Testing

Data

- ☐ Marking on-line
- ☐ Managing records
- ☐ Analyzing and tracking

Resource

- ☐ Curriculum Managing
- ☐ Building knowledge
- ☐ Team Building

TechInfo

Server_Platform

- ☐ RAM
- ☐ Disk Space
- ☐ WindowsNT 40 Server
- ☐ Apple Server
- ☐ Unix Server

Client_Platform

- ☐ Minimum Level
- ☐ Target Level

Pricing

- ☐ Start-up Cost
- ☐ On-going Cost
- ☐ Technical Support

Limitations of package

- ☐ IMS Compliance
- ☐ Number of courses
- ☐ Number of students

- [ ] Videoconferencing

Student_tools

- [ ] Self-assessing
- [ ] Progress tracking
- [ ] Searching
- [ ] Motivation building
- [ ] Study skill building
- [ ] Building motivation

Administration

- [ ] Installation
- [ ] Authorization
- [ ] Registering
- [ ] On-line fees handling
- [ ] Server security
- [ ] Resource monitoring
- [ ] Remote access
- [ ] Crash recovery

Help_desk

- [ ] Student support
- [ ] Instructor support
- [ ] Number of connections
- [ ] Number of instructors
- [ ] Other Limitations

Extra_Considerations

- [ ] Options
- [ ] Exit Considerations

No product had all of the possible features and no institutional situation needed all of the features either. The Online Educational Delivery Applications site was intended to help institutions find products with the features that they need and for vendors of products to be discoverable on the basis of the product functionality in the context of a rapidly developing marketplace. The list of product features also turns out to be a moving target over time as new technologies are incorporated into the evolving applications.

Product Reviews and Rapid Product Change

The situation of finding appropriate application candidates is made substantially more difficult by the fact that the products themselves are changing. Most of the products will release a new version one or more times per year and in many situations this "revision" can change the product substantially, especially when the newness comes from a company merger or acquisition. Published product reviews and comparisons quickly become dated in spite of the best of intentions. This dynamism among the vendors is heightened further by technological changes such as the advent of database back-ends on courseware systems that has occurred during the last several months.

In the context of the field of rapidly moving products it is very difficult be base decisions on what is available, but it is still quite feasible to base decisions on what is needed in the individual situation. The institutional context of online learning is changing more slowly than the marketplace and it can be argued that a needs analysis is more valuable than a market analysis in such a situation.

Screening phase of decision-making based on requirements of Individual Situations

The elimination by aspect strategy is a screening strategy involving two steps: setting the requirements for each of the features and then eliminating options one at a time which do not meet any of the requirements. To be able to decide which features are important the conventional approach is to conduct some sort of needs analysis of what is required in the institutional setting. This analysis often reveals the uniqueness of the needs of the future users of the online system. At this stage it can be beneficial to involve the stakeholders: students, faculty, student support personnel, and the technical administrators to gain later acceptance of the eventual decision as well as to become aware of needed features that might have been otherwise overlooked. Politically it can be beneficial to even involve representatives from the governing board of the institution when this decision will represent a new pedagogical direction or is expected to involve significant long-term resource commitment.

Situational Requirements

Individual situation are both nominally different and substantially different. Sometimes the differences are so large that our tendency to attend to differences makes it seem like some institutions are as different as day and night. While there are a host of differences between institutions there are also some similarities so that examining an example of decision-making can be instructive about similarities in the processes. As the online educational delivery applications have begun to move from the one-size-fits-all mold of the industrial era, they are more adaptable to individual situations but still the applications have different strengths and weaknesses. The ideal of making decisions based on individual local institutional situations is to exploit the synergy of matching the strengths of a product to the specific needs of the specific situation. The uniqueness of local situation can be described in many ways but by using the features of the products as the focus for this description the potential synergy is easier to find and exploit. This involves, for example, translating a local need for better two-way communication between instructors and students into the importance of the e-mail feature. Likewise the need for orienting and assisting instructors in how to use an online educational delivery system can be translated into the importance of an instructor help desk feature. When this feature importance is expressed as an importance weighting then this information can be utilized in the weighted average decision strategy which combines information about many such attributes into a overall suitability score as is described in more detail in the example below.

The deciding of which features are more important versus which features are less important based on an analysis of the local situation goes a long way toward reducing the risk that the chosen application will be accepted by the stakeholders and will benefit the institution. Including irrelevant features at this stage will bias the process in favor of those applications which have those irrelevant features so this deciding which features are required is a fundamental part of the overall decision process. This is a process where the stakeholders, as described above, can help out by being involved in determining which specific features are important enough to be "needs" rather than "wants." The elimination by aspect strategy does not require that the feature requirements be numeric so simply identifying which features are really needed is enough. There are 62 feature categories on the Online Educational Delivery Applications site and there are undoubtedly some additional ones are critical in some situations.

The outcome of the deciding which features are important is a Shortlist of important product features. Any product that does not include all of those features would not meet the needs of the institution and should be screened out of the competitive options for the final selection. This initial product screening can effectively be done by the elimination by aspect decision-making strategy. The decision maker examines the features of each option one by one and the option is eliminated as soon as a needed feature is missing or completely inadequate.

Screening tools on the web

Once the set of needed features has be determined then the Online Educational Delivery Applications site can be used to identify which applications provide those features so the number of potential options can be reduced to just those that are likely candidates. By using a page like the above table the decision maker can check the checkbox next to the required features and then click submit and the returning page will include a list of applications which support those features. Using that same page the candidates can be further investigated in side-by-side comparisons of feature descriptions. This side by side comparison may help in further reducing the list of applications to only the appropriate options for the local decision situation.

Making a Short List of Application Options

Using the web tool described above greatly speeds up this elimination by aspect process for those applications that are reviewed on the site. The elimination by aspect is a non-compensatory strategy so that once an option is rejected on any feature that option is eliminated from further consideration. This strategy does not necessarily result in a single best option since more than one option may pass on all of the requirements. The usual outcome of the elimination by aspect strategy is to result in a short list of possibly acceptable options that become the narrowed focus for a more discriminating decision strategy. It may be prudent for comparison purposes to include in the short list any applications that are used by consortia where the local institution is a member or in the case of community colleges the application that is used by local universities where the college has special relationships.

Evaluating product suitability as part of the weighted averaging strategy

Evaluating products (or externally hosted product options) can be a very large task. The greater the number of products and the greater the number of important features multiplies quickly into a potentially overwhelming product research task. This task can be partially shifted to the vendors by structuring a competition among the likely candidates where they are invited to bring the information to the decision makers rather than the decision makers seeking out the vendors and trying to find out the most current product information. The market has matured enough so that most vendors are capable of responding to a request for proposal (RFP) to supply the desired product functionality. Many institutions already have RFP procedures but may never have used them for a situation as complex as selecting an online educational delivery application.

Inviting the shortlist of vendors to competitive presentations/proposals (RFP model)

The RFP model has been described for web software acquisition recently (http://www.technologynews.net/rfp/infotech_rfp.doc) as a necessary part of the decision process.
The RFP model offers several advantages over less formal product selection processes including: all vendors get the same information and have a fair opportunity to compete while the decision makers get a proposal document that can be used to assess both the vendor interest and competence. Local procedures may vary but in general a useful RFP should include the following sections (according to the info-tech research group at http://www.technologynews.net/rfp):

1) Executive Summary
2) Reasons for the online educational delivery application so vendors can understand local situation
3) Explanation of the vendor selection process (the elimination by aspect strategy as above)
4) Explanation of the proposal evaluation process (the weighted average scoring as above)

5) Description of the decision-making team
6) Description of in-house resources that will also be used in the online educational delivery
7) Background Information about the institution and the competition
8) Time line for the vendor's deliverables
9) Penalties for missing deadlines
10) The Specifications including short, medium and long-term specification lists and descriptions
11) General terms and conditions for the institutional agreements
12) Special terms and conditions such as the number of references required, legal requirements etc.

The RFP would be sent to the short list of possible vendors. The vendors will likely have questions as they prepare their proposals so it is useful to have a designated contact person who can supply consistent clarifying information to all of the vendors' requests for information. When the proposals are received there is often another round of elimination by aspect strategy to determine which proposals are in the competitive range. The US Department of Defense (http://web.deskbook.osd.mil/reflib/mfarsups/072ua/009/072ua009doc.htm) further advises that a proposal may be considered outside of the competitive range if (1) it does not address the essential requirements, (2) has a substantial technical drawback the would essentially require a new proposal to fix, or (3) the proposal contains major deficiencies, omissions, or out-of-line costs. They also advise that these proposals are part of a negotiation process and at the end of negotiations, the competitive vendors should be provided with one additional final opportunity to submit a revision known as the "best and final offer."

The RFP method is a time-consuming and involving process both for the institution and for the potential vendors that can be used to produce a fair vendor competition where the best candidate is selected and the social goals of rational decision-making are accomplished. The Online Educational Delivery Application site provides web tool support for the Weighted Averaging Strategy calculation part of the of decision-making. This decision engine tool is little more than an automated score sheet that combines the feature importance and the feature suitability scores into an appropriate total product score. The tool does however enable the decision-makers to use the most rational strategy of decision-making, which would be impossible to do in one's head. The following example illustrates the decision engine web tool using two vendors (WebCT and BlackBoard) with three features (accessibility for persons with disabilities, student help, and instructor help).

Quantifying feature importance in Individual situations

For the purposes of this example let us assume that our institution is part of the Consortium that is offering us the opportunity to use either WebCT or BlackBoard for our existing system. Further lesson soon that there are only three important issues: meeting the 508 accessibility regulations so that are federal funding is not jeopardize, meeting the help desk requirements of our students, and meeting the help desk requirements of our faculty. We could use the default importance weightings from the site that are 1.0 for accessibility, 1.2 for student support, and 0.8 for instructor support but it would be better to tailor the importance weighting to our institutional setting. So for this example let us assume that we did some campus wide information meetings and formed an advisory committee of interested stakeholders.

Potential of involving stakeholders in setting weights

Then with the help of our stakeholders we put together a little three-item telephone survey of a random sample students and a random sample of instructors. The results of our little survey were importance ratings of 9 for the accessibility item, 7 for the student support item, and 6 for the instructor support item. Those numbers can be just entered into the web Decision Table form because the form to product the importance weights normalizes the numbers before they are used.

Judging product feature suitability to local situation

Different persons can make the suitability judgments than were involved in the setting of the importance weights. In this example we could conceivably involve the members of our advisory committee to nominate from among themselves a task group who have experience with our existing system and are willing to spend a week working with WebCT and a week working with BlackBoard to specifically evaluate the accessibility, the student help desk, and the instructor help desk. Further our task group could also get others to help with their evaluation as they chose with the only caveat that at least two persons with disabilities be involved in checking out the accessibility aspects of the two products.

If we had allowed more time it might have been possible conduct a request for proposals and have representatives from the two vendors provide information and trial facilities to the task group to make their hands-on experience come to them. After a week the task group meets with the advisory committee and presents their considered judgments, which are averaged to make them more reliable. Their judgment of the suitability of the accessibility for WebCT is 7, for BlackBoard is 8, and for the status quo is 2 on a scale of 1 to 9. Their judgment of the suitability of student support for WebCT is 8, for BlackBoard is 8, and for the status quo is 4. Lastly, their judgment of the suitability of instructor support for WebCT is 8, for BlackBoard is 6, and for the status quo is 3. Now this is where the doing it in your head is overwhelming with normalizing three numbers to an average weight of 1.0, then multiplying nine pairs of numbers and then averaging three columns to arrive at the winning Weighted Average Score of 7.59 for WebCT followed by runner up BlackBoard with a Weighted Average Score of 7.45 which is well ahead of the status quo at 2.9 socore.

Demonstration model of the Comparative Analysis Decision Table with Three Options

(Insert table similar to the one below adapted from http://www.c2t2.ca/landonline/option4.asp)
Instructions:
To compare applications A and B just enter your ratings for each criteria into the boxes in the column and then press **Score**. Be sure to enter a rating or a 0 (for skipping a criteria) for each of the criteria so that the score can be computed.

Application Evaluation Engine Table for Options: A, B, Status Quo				
Importance Weighting	**Evaluation Criteria Name**	**A** WebC	**B** Black	**Status Quo**
9	**Accessibility**	7	8	2
7	**Student support**	8	8	4
6	**Instructor support**	8	6	3
ScoreButton	**Weighted Average Scores ***	7.59	7.45	2.9

* NaN - Not a Number error results from a empty rating box in the column Help

Make current values the default values so you can save your work

Rechecking by doing Sensitivity Analyses

One of the benefits of using a computerized process is easy to have the machine perform calculations again. The results in the decision table can be recalculated after tweaking the numbers to see if it makes any difference in which one is the winner. The adjusting and recalculating can be done on the basis of the know variability of the numbers involved to get a better idea of the stability of the solution. In the present example lets say we were curious to see if WebCT would still be the winner if the average instructor support rating were one unit lower so we can try a rating of 7 in place of the original 8 and then score the whole table again. In this case the change of a rating from a 8 to a 7 would in fact change the winner to BlackBoard because the Weighted Average Score for WebCT would drop to 7.32 which is lower than BlackBoard. The point of doing a bit of rechecking is that it can become clear as in this case that the products are so close that the small changes in the judgments would change the outcome.

The other rechecking that can be done is to examine if the outcome would change if the importance weights had been a little different. In the present example if the importance weight for accessibility were changed to 90 from 9 to examine a 10 fold increase in the importance of accessibility then BlackBoard would be the winner with a weighted average score of 7.88 compared to WebCT with a score of 7.13. Notice in both of these instances of rechecking the status quo never wins so one reasonable conclusion from this is that our institution should prepare for a change from the status quo as at least that much is quite clearly an outcome of this decision process.

Summary and checklist

The main reason for getting so involved in the decision of which learning management system is the best for an institution to select is that this is a very important decision. Normally when people make a decision or even groups of people make a decision they do not make a rational decision. Only when the judgments that people make are quite small and simple can they avoid cognitive illusions and biases. Fortunately this kind of product selection decision can be divided up into many smaller decisions that can then be recombined into a weighted averaging decision-making strategy that approximates true rationality. The trade-off is suggested to first use an elimination by aspect strategy to arrive at a short list of competitive products worth considering and then do a more detailed weighted averaging strategy to find out which one has the best score. After that the decision table can be further investigated by doing sensitivity analyses to find out how stable the

selection of the winner turned out to be. Using the web tools on the site developed for this decision-making can facilitate this process:
http://www.c2t2.ca/landonline

The online educational deliver application decision checklist:

1) First decide what features are important in the local situation
2) Screen options out based on feature criteria using web tools
3) Making a shortlist of product and features required
4) Optional Request For Proposals (RFP) from vendors on the shortlist
5) Judging the importance of features and assigning feature weights
6) Evaluating the product features for each of the shortlist candidates
7) Using the Comparative Analysis Decision Engine Tool to pick a winner
8) Rechecking your work with sensitivity analyses
9) Communicating how the decision was made to stakeholders

References

Anderson, J.R. (2000). Cognitive Psychology and its Implications 5th Ed. Worth, New York.

Begg, I., Amour, V., & Kerr, T. (1985). On believing what we remember. Canadian Journal of Behavioural Science, 17(3), 199-214.

Delbecq, A.L., Van de Ven, A.H., and Gustafson, D.H. (1975) Group Techniques for Program Planning: a guide to nominal group and Delphi processes. Scott Foresman, Glenview.

Galotti, K. M. (1999). Cognitive Psychology In and Out of the Laboratory, 2nd Ed. Brooks/Cole Wadsworth, Belmont.

Gigerenzer, G. & Selten, R. (2001). Rethinking Rationality. In Gigerenzer, G. (Ed.) & Selten, R. (Ed.), (2001) Bounded rationality: The adaptive toolbox. (pp1-12) MIT Press, Cambridge.

Kahneman, D. & Tversky, A. (1996). On the reality of cognitive illusions. Psychological Review, 103(2), 583-591.

Loftus, E. F. (1979). Eyewitness testimony. Harvard University Press, Cambridge.

Miller, G.A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 63, 81-97.

Moscovici, S. & Zavalloni, M. (1969). The group as a polarizer of attitudes. Journal of Personality and Social Psychology, 12, 124-135.

Myers, D.G. & Spencer, S. (2001). Social Psychology Canadian Edition, McGraw-Hill Ryerson, Toronto.

Norman, D.A. (1999). The invisible computer: why good products fail, the personal computer is so complex, and information appliances are the solution. MIT Press, Cambridge.

Payne, W.J. & Bettman, J.R. (2001). Preferential Choice and Adaptive Strategy Use. In Gigerenzer, G. (Ed.) & Selten, R. (Ed.), (2001) Bounded rationality: The adaptive toolbox. (pp. 123-146). MIT Press, Cambridge.

Roe, R.M. (1999). A Dynamic Neural Network Model of Multiple Choice Decision-Making, Proceedings of the Twenty First Annual Conference of the Cognitive Science Society edited by Hahn, M & Stoness, S.C. 614-618.

Roe, R.M., Busemyer, J.R. & Townsend, J.T. (2001). Multialternative Decision Field Theory: A Dynamic Connectionist Model of Decision Making. Psychological Review, 108(2), 370-392.

Simon, Herbert, (1979). Models of Thought, Yale University Press, New Haven.

Tversky, A. (1972). Elimination by aspects: A theory of choice. Psychological Review. 79, 281-299.

Tversky, A. & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. Cognitive Psychology, 5, 207-232.

Tversky, A. & Kahneman, D. (1981). The framing of decisions and the psychology of choice. Science, 211, 453-458.

NOTICE

Reproduction Basis

X	This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.
	This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").