Decision Making: A Missing Facet of Effective Documentation

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Introduction

"Most tasks are open-ended and complex, not lending themselves to easy solutions" (Mirel et al, 1991, p. 75).

The old school of software interface design and document writing took the view that if the user could find the information someplace, the user could use it. But simply sticking in details ignores how readers access and process information. Mirel (1988) addresses how users mentally process information through mental schemas when she reviews the results of design research:

With our growing awareness of reader's schema and multi-dimensional strategies for processing information to create meaning, we can no longer rest confident that so long as information is just given, readers will be informed. (p. 111)

To maximize user productivity, we must provide the methods for accomplishing the complex tasks, and provide answers to the questions users ask, because "most tasks are open-ended and complex, not lending themselves to easy solutions" (Mirel et al, 1991, p.75).

The complex tasks Mirel discusses involve more than single program options or tasks; it involves the real questions asked by the user. A simple task involves a single menu option and most current documentation posses it in terms of the program (Using the xxx function). A complex task is the complete piece of the big action which the user is trying to accomplish. The complex task typically involves a question posed in terms of the users job and requires the use of several menu options. In a higher integrated business environment, it may even require more than one program. The common design method of defining and considering each menu option as independent of all other functions does not answer a real-world question.

We must go beyond simple instructions and design documents that assist in solving real-world complex problems. We need to support problem-solving strategies that address the users real tasks. Design for complex tasks means thinking big; it means considering and integrating everything the user sees: user interface, on-line help, error messages, and paper manuals. Effective design means determining and providing answers to the complex problems of the real-world. Although the design and operation of the user interface plays an critical part in assisting in solving complex problems, addressing both user interface and documentation design exceeds the limits of this paper. Thus, this paper only focuses on the decision-making aspect of documentation design for solving complex problems.

The psychology literature has carried articles on how people make decisions for many years, but, unfortunately, this information has not transferred over to document design. Yet, precisely this information on decision-making can form a base for the creation of documentation that answers complex questions in a manner that effectively aids the user.

In this paper, I first explore the current flaws in our methods of analyzing systems which lead to the failure to support the users complex tasks. Then I examine what we currently know about defining and solving the users complex problems. Solving complex problems is highly dependent upon how the user makes decisions; however, this aspect has been ignored in previous documentation research. To begin to remedy this omission, I review the decision-making literature and discuss some of its theoretical implications with respect to user analysis. Considering decision-making helps define the users complex tasks and results in the design of documents which address the users decision-making process for solving complex problems. This

paper concentrates on building a theoretical foundation for the use of decision-making in technical communication; further research is required to fully consider of how to effectively implement this information in document design.

Complex Tasks and Questions

Problems with Our Current Design Methods

Effective design focuses on the users real-world complex tasks. Determining these complex tasks starts with the task analysis and the audience analysis and continues throughout design and development. Unfortunately, the task analysis often gives a list of what functions the programmers think management wants the system to do, and the audience analysis, even after following the checklists provided by many articles and textbooks, often amounts to little more than it's a group with high school education or less, so we better use small words and short sentences.

As a method of improving task analysis and audience analysis and of providing answers for complex questions, Norman (1986) call for creating a science of user-centered design, which, as its basic principle, starts with the user and emphasizes that to the user, the interface is the system (p. 61). The interaction between user and interface drives all design considerations. When we design documentation, we must consider how and why the user interacts with the system. Unfortunately, how we currently go about designing documents fails to conform to Norman's principles. I propose a fundamental flaw is the lack of attention during early analysis to defining the users complex problems. This lack of attention is reflected in four different ways.

Essentially all of our current literature discusses considering the needs of the user when designing a document. However, current practice does not consider how the users' questions depend on how the user makes decisions and interacts with the system (Gerlach & Kuo, 1991; Woods & Roth, 1988). By design, any system should assist the user in decision-making. As the software interfaces present more information and more options for processing the information, considerations of designing for the cognitive processes of the user become even more important in providing effective systems.

The failure to anticipate the user's needs forms the basis of most problems, rather than a lack of information. The information contents of a computer application and its documentation is often high, but, because of poor design, both are impoverished in their ability to transmit that information. The information becomes both hard to find and hard to process. Supporting decision-making requires a framework for cognitive task analysis that describes the decision task in terms of the necessary information processes and mental model of the user (Rasmussen, 1986, p. 3). Woods and Roth (1988) define the critical question as "how knowledge is activated and utilized in the actual problem-solving environment" (p.420).

The analysis ignores an important point: users ask problem-oriented or procedure-oriented questions, and not system-oriented questions. The audience analysis must reveal how and why users ask these questions (Rosenbaum & Walters, 1986). Promoting a simple mental model requires understanding how the users think about the system and how they make decisions with the system. Gaining this understanding comes from effective analysis. Analysis should be stated "in terms of the behavior-shaping goals and constraints that define the boundaries of a space within which actors are free to improvise guided by their local and subjective performance criteria" (Rasmussen et al, 1994). Dobin (1991) insists that to support decision-making for open-ended problems we must gain an in-depth understanding of the user and not the software. "The user's vocabulary, the user's reasons for looking things up, and the problems the user confronts must be clearly anticipated" (p.89).

Finally, rather than address complex problems, current documents center around routine tasks; each menu options of the program exists in its own world, never connecting to any other option. However, "in normal work contexts, decision making is not usually an effort to resolve separate conflicts, but is more like a continuous activity to control a continuously changing state of affairs in the work environment" (Rasmussen et al, 1994, p. 113). With this point in mind, I question whether or not the abundance of current research on addressing layout-type concerns is taking the wrong tack. For example, while it is important for know which of three different layouts of the instructions produces the best results, should this be an end or a means? Missing here are the questions asking what underlying features caused the user to perform better with option B, and whether the instructions tested were really of use in solving a real-world problem.

Flaws of Current Methods of Audience Analysis

In the previous section, we saw that our audience analysis frequently fails to provide the answers that are needed for designing effective documentation. I believe the cause of the these errors is not that the answers derived from the analysis are incorrect, but rather, the result of a methodology which asks the wrong questions or misplaces its emphasis. Our current methodologies do not provide the proper tools to gain an understanding of the user's complex

problems. In the next two sections, I look at the flaws with the current methods of audience analysis which lead to the failure to identify complex problems and then examine the current literature (unfortunately, quite limited) on addressing complex problem solving.

In document design, Mirel et al (1991) found the "active learning needs are inseparable from task type and complexity" (p. 82). Research on poorly designed documents shows users getting frustrated with mastering the basics and failing to learn or conceptualize the appropriate principles for properly using the system. The poorly designed document fails to provide or support the necessary mental models of the user. In complex tasks, the mental model operates along several dimensions. In the course of solving the problem, changes occur along each of these multiple dimensions, but designers often fail to consider all dimensions. As a result, design failures occur because of problems in an unanalyzed dimension (Rasmussen et al, 1994, p. 23).

Dimensions of the mental model go unanalyzed because we concentrate on tasks as a program concept, rather than a real-world action performed by a user; in other words, we define task in the wrong way. During the initial design of a program and its documentation, the designer can define tasks in terms of the program or in terms of the real world. Unfortunately, most designers choose to define the tasks in terms of the program. Although expressing concern for the user, designers are often more concerned with the tasks as they apply to the system than as they apply to the user. With program-based tasks, audience analysis consists of defining what the user needs to learn to execute the function. On the other hand, with the design goal of defining complex tasks, audience analysis expands to include the "strategies and skills that users need to learn to adapt program operations to their conceptual models" (Mirel, 1992, p. 17).

However, the user's conceptual model often gets ignored. Many designers do not think of the user as someone they enter into a conversation with; instead, they design an entity which people happen to use. Yet, precisely this human-computer dialog, controlled by designer choices, allows information to be transferred between the user and computer. The dialog proceeds in what amounts to a series of questions and answers to the users implied questions until reaching the answer to the final question (Battle, 1994). The documentation should provide a means of translating between what the programs is saying and what the user wants to accomplish.

As a method of providing a consistent human-computer dialog, design guidelines were created. They provide a method of accommodating the user and creating consistent documents. However, design guidelines suffer numerous problems, most notably by failing to address user tasks and maintaining an overly narrow focus. Ritter and Larkin (1994) criticize many design guidelines as trying to create interfaces and documents that will produce useful behavior, but failing to define or characterize the actual behavior (p. 376). Mirel (1988) criticizes current design guidebooks as overly prescriptive, advocating fixed formats and wordings without making the writer responsible for considering audience and the communication situation. Also, guidelines tend to emphasize how to put the pieces of a single screen or page together, but do not focus on the task being accomplished. However, the user rarely interacts with just one element; useful information from the system results from the total experience across the displays and documents (Jones, 1989). When task is considered, guidelines become less important: "after attempts to both write and use guidelines, it was recognized that when a design is highly dependent upon task context and user behavior, the usefulness of guidelines diminishes" (Gerlach & Kuo, 1991, p. 528).

The emphasis on single elements conflicts with how users actual approach a system. Mirel (1992) found users were very inventive in how they used the system. The designer must allow for this inventiveness from the earliest stages. Mirel's results show that the "situational demands and interactions define users' tasks and task needs more than technical ones" (p. 34). Her findings show how effective documentation requires more than just presenting concepts and procedures. Instead, the documentation must provide "ways of manipulating a program, integrating and combining its functions in inventive ways" (p. 13). The idea of user inventiveness changes the entire equation for presenting information.

No longer can one assume that meaning is something developed by independent researchers, encoded into messages, packed into containers, and sent off to readers who are isolated from these processes, or that language is simply the common, if sometimes unreliable, vehicle for conveying those messages (Coney, 1992, p. 58).

Current Research on Complex Problem Solving

As we saw in the previous section, the current methodology for task and audience analysis fails to address how users perform complex tasks. Some research has been done which begins to remedy this omission and provide the base for a new methodology. As I shall present in this section, the main findings of current research are: define tasks based on the psychology of problem-solving; break down the entire

system into components and then build a predictive process model; and use the predictive model to develop the design and explore the affects of design decisions.

When we consider designing a document, we have the choice of thinking about the problem in terms of program-defined tasks or in terms of the user solving a problem. Program-defined tasks are based on the psychology of performance and the task becomes just the sum of its operations. On the other hand, systems designed for problem-solving are based on the psychology of problem-solving; the design assumes that tasks vary by situation, and the user conducts opportunistic planning and actions. The resulting system based on problem-solving assumptions more accurately reflects how experienced users interact with a system (Mirel, 1995). Agreeing with Mirel, Hefley (1995) says we must move beyond just defining user functions and user tasks. Instead, we should be doing cognitive task analysis to provide comprehensive user and task models. Our focus must be upon the procedural knowledge needed by the user and the decisions made by the user to perform tasks.

Battle (1994) proposes a method of cognitive task analysis which she calls "knowledge engineering" that meets Mirel's and Hefley's concepts of strategies and skills fitting the users cognitive model. She describes the task of technical readers and writers as being one where they "break down complicated documents into components, adequately describe the causal components of problems, and follow sequences of components in the documentation" (p. 81). After breaking the problem down as Battle suggests, Ritter and Larkin (1994) build a process model which captures the variability of the data and provide a method of coping with complex tasks and the associated varied behavior. Further, Ritter and Larkin consider methods of creating process models of the user as a method of capturing and predicting the users response. Their method ends up with a step-by-step task listing that attempts to capture "why the users did what they did, what information they used from the outside environment, and what knowledge they used to perform the task" (p. 345). Besides Ritter and Larkin, Kieras and Polson (1985) have attempted to develop methodologies for handling the cognitive information required to address complex tasks. They have created a notional system for quantifying "the amount and complexity of the knowledge required and the cognitive load processing involved in using a system" (p.365). The notional system provides a method of designing a process model for determining simplification of the design and simulation of interactions between the user and the system. Regardless of the method of creation, when the process model works well, the form of the document reflects its function by anticipating the user's needs for complex tasks and the function of the each segment of the document performs consistently with the program theme (Jones et al, 1995, p.18).

A good process model gives us a predictive model. With a predictive model, the methods of design will change. Rasmussen (1986) explains how the all parts of an interface (including the documentation) must be treated as an integrated part of the system and designed in a manner that incorporates this view. "The design of interfaces can no longer be allowed to evolve empirically through trial and error; nor can they be solely based on traditional general purpose human factors design criteria and guidelines" (Rasmussen et al, 1994, p. 134). The user brings to the document a schema that profoundly effects the usability of the design. Yet, the design often ignores the user's schema. Rasmussen (1986) makes an explicit call for considering it. "We need predictive models of categories of information processes that enable the prediction of that category that will be activated by a particular interface configuration and its display formats" (p. 3). He want the model to be used to ensure design compatible with the user. A good process model can be used to make predictions about the design, and, in fact, provides a means of testing the design. The model captures the variability of the data and provides a method of coping with complex tasks and the associated varied behavior (Ritter and Larkin, 1994, p. 347). The process model lets us design documents that address complex problems and the associated decision-making required by the user. The purpose of this predictive model is similar to Norman's science of user-centered design. With it, suggested changes can be analyzed and potential negative impacts avoided early in the design cycle.

Decision-making

Up to this point, I have considered the importance of addressing complex problem solving for creating effective documents and reviewed the current research. Specifically, I have:

- Looked at problems with systems.
- Decided the problems come from using the wrong methodology.
- Examined the method practices and found they don't address complex problems.
- Examined the current literature on solving complex problems and found it to be a good beginning for defining a new methodology, but quite limited in scope.

An area which has thus far remained outside the scope of complex problem solving research is how people

make decisions. Yet, decision-making strategies drive how people go about solving complex problems. In this section, I begin to close that gap in our knowledge by examining the decision-making literature and considering how it pertains to helping answer the user's complex questions. Effective document design involves providing the information so the user can make the decisions that give correct answers to complex questions.

Because users rarely base decisions on simple look ups (it says six here, so the answer is no), we almost always must help the user solve a complex problem. In solving the complex problem, the potential choices and reasons for making the choice become of dominating importance. After we understand why users chose these particular choices and reasons, a problem-solving strategy can be developed. That problem-solving strategy must then be applied to the document design (Rasmussen, 1986). Terveen et al (1995) looked at the problem of helping manage knowledge needed to make decisions and revealed the multiple interrelated knowledge issues that must be considered.

The pragmatics of knowledge use are critical. Simply recording a factor is not enough; issues such as where in the process knowledge is to be accessed, how to access relevant knowledge from a large information space, and how to allow for change also must be addressed (p. 3).

The remainder of this section examines some of the current research into how people make decisions, and the links between decision-making and document design. The review focuses on five areas, considering the effects of:

- Mental models on decision-making.
- Heuristic choices and risk avoidance in decision-making.
- Time pressure on decision-making.
- Information presentation on decision-making.
- Irrelevant factors and the tendency to justify decisions.

Effects of Mental Models on Decision-making

Both Rasmussen (1986) and Terveen et al (1995) discuss the importance of the user's mental model of the system. If the designer had a consistent method of creating that model, design would be much easier. However, Bos (1995) considered this issue and made a negative report. "Yet to my knowledge, no detailed model is available that describes how the user's mental representation of computer commands are organized and used in encoding and decoding messages to and from the system" (p. 343). Therefore, unfortunately, we are still at a point of having to start from the beginning in developing the mental model for each new product.

No matter what starting point we use, the mental model must be based upon the information-processing strategies of the user, otherwise the designer will "not be able to ask meaningful questions of cognitive science concerning human capabilities and preference for the interface design" (Rasmussen, 1986, p. 56). Unless the designers understand the cognitive context and ask meaningful questions, the resulting document may suffer one of two problems:

1. It fails to support the users mental models.
2. It includes elements that conflict with the users stereotype as belonging to the system (Rasmussen et al, 1994, p. 134).

However, we must remember that the cognitive context for any mental model is very situation specific. Too often, designers work from generalizations of the user which are too broad.

Information about typical work situations is unreliable for designing information systems. No two work situations are identical since the context of a decision situation and the heuristics brought to bear depend on minute differences in situational and personal characteristics. [The] generalization should be based on an identification of recurrent "prototypical" decision situations using a categorization along and across the representative set of records (Rasmussen et al, 1094, p. 79).

Effects of Heuristic Choices and Risk Avoidance in Decision-making

As the decision task increases in complexity, contrary to intuition, the decision maker does not increase the complexity of the decision-making strategy. In fact, it seems as if "decision makers will not be able to correctly anticipate the simultaneous influence of more than one task feature" (Fennema & Kleinmuntz, 1995, p. 23). In complex situations, rather trying to integrate multiple features, users tend to adapt decision-making strategies which use relatively simple, error-prone heuristics. "Easy to use" seems to be a dominate factor in heuristic choice (p. 21). The extensive use of heuristics brings the concept of "exact results" into question. It seems decision makers know their decisions are not perfect, but good enough. Larichev et al (1995) claim that since the decision maker is not concerned with exact answers, it makes no sense to measure systems based on "exactness of results" (p. 18). Yet, many design guidelines and usability tests use exactness as their definition of effectiveness.

The heuristic the user selects depends heavily upon how the document presents the information. The decision maker mentally creates a goal frame around the decision and, as a result of confirmation bias, preferences frame-compatible features. As the amount of information increases, the user increasingly ignores frame-incompatible features (Ganzach & Schul, 1995, p. 32). While this makes it seem that highly compact information presentation would be best, Rubens and Rubens (1988) found that making the information too compact or too concise hindered performance. Rather, information usage must be of prominent design importance and the information must be structured to enhance its usability.

In a study of business managers, besides failing to attempt exact results, they exhibited decision-making that showed both risk taking and avoiding behavior. Rather than consider each situation individually, the managers tended to base decisions on recent events with the greatest risk taking appearing after a gain. However, overall there appeared to be a greater underlying tendency toward risk avoidance (Sullivan & Kida, 1995, p. 82). Beside avoiding risk, managers also failed to anticipate losses, or exploit gains, but instead adapted a less-than-optimal strategy, consuming resources as if neither a loss or gain would occur (Langholtz et al, 1995, p. 281). Langholtz attributed part of the less-than-optimal behavior to an equal-scheduling tendency for resource-allocation problems. Rather than partitioning resources by their importance, managers tended to divide them equally.

Effects of Time Pressure on Decision-making

The choice of simple heuristics and risk avoidance behavior becomes even more pronounced when the decision maker is under pressure. Wright (1974) found that time pressure and distractions had major influences on decision-making. When under pressure, the user adapted simpler strategies that included ignoring less important data or focusing on only certain regions of the data. With time pressure and distractions being a normal-day occurrence, failure to account for these in the design can lead to erroneous decisions (p.555). Although the normal routine of an office provides numerous distractions, even distractions as simple as having to jump between multiple windows, or refer to manuals or on-line help may influence decision strategies. Currently lacking, further research into examining distractions within the user interface or the document itself seems worthwhile.

Part of Wright's findings on time pressure and decision-making can be viewed in the light that, when under time pressure, users want to quickly reach closure on the problem. Often this results in following impressionist or stereotypical actions and going with initial judgments, rather than evaluating the situation (Webster & Kruglanski, 1994, p. 1049). The impetus for moving quickly to closure comes from strategies based on a trade-off between amount of effort and accuracy. However, the effort used for strategy selection is not actual effort, but anticipated effort. And, unfortunately, "individuals are better at effort anticipation than accuracy anticipation" (Fennema & Kleinmuntz, 1995, p. 23). To complicate the situation, as task complexity increases, accurate judgment of both anticipation of effort and accuracy decrease. When the user meets up with complex problems that the document does not effectively assist in solving, contrary to the desired result, the persons decision-making ability tends to decrease and they make decisions based on simple heuristic rules. Unfortunately, these decision often lead to non-optimal solutions and may lead to incorrect solutions.

Effects of Information Presentation on Decision-making

Russo (1977) claims that better decision-making depends upon presenting information in an easy to process manner. Information presentation has major effects on people's decisions: depending on the presentation, they may actually make opposite choices and believe them to be best (Tversky & Kahneman, 1981; Johnson, Payne, & Bettman, 1988). When people look at information, expectancy bias causes them to see the expected answer. Unfortunately, expectancy bias also tends to be something built up over time and is only evident in hindsight (Klein, 1988). The presentation of information becomes the crucial factor in maintaining the flow of information and assisting in proper decision-making (Laplante & Flaxman, 1995, p. 22). The wording of the presentation forms an important, but often ignored, part of user understanding; the word choice can greatly influence how certain the user feels about the information. Duin claims that documentation "that is poorly organized will not elicit the appropriate schemata from the reader's mind" (Duin, 1989). As a result, the reader voices the commonplace complaint about unusable documentation. The user constructs meaning from the information; the quality of the resulting construction depends on the effectiveness of the presentation. Also, the presentation format can actually change the way users view the information. Slovic (1972) found that users tend to change their assessment strategy to fit to the presentation method, rather than transform the information to fit a better assessment strategy. The amount of perceived cognitive effort seems to be the driver in how different presentations affect assessment strategies. "Since different display formats affect the effort required by

various strategies, decision-makers may react to changes in display format by adapting strategies which minimize effort" (Johnson, Payne & Bettman, 1988, p. 2). Thus, changes that make it easier to process information also increase the informations impact upon the decision-making process. Potential problems can occur when minor, but easy to present information, occupies an excessive amount of the design and, subsequently, diminishes the salience of important, but harder to present, information.

Since people evaluate information based on the order they receive it, information presentation must be in the order that best helps the decision-making process. Klein's (1993) Recognition Primed Model describes the decision maker as performing an assessment of the situation based on experience and attempting to make a satisfactory, rather than optimal, decision. Field research indicates this fits real-life decisions much better than the classical decision-making model which assumes people wait for all data to be presented, sort it analytically, and then make a decision.

Effective decision-making depends on understanding the information. Roberts (1989) studied how well users comprehend information and found their understanding level can be discerned from how they respond to it. When they understand information, users make direct confirmation statements. On the other hand, when unsure of their understanding, they make assumptions or place the information into their own words. Applying this research to the wording of user responses can provide valuable information during usability testing.

Effects of Irrelevant Factors and the Tendency to Justify Decisions

Normally, when considering factors that effect the decision process, most designers only look at relevant factors. However, seemingly irrelevant factors often have a strong influence. Hsee found that given a factor tempting to the decision maker, but irrelevant to the problem, the decision maker would often rationalize using the irrelevant factor. This behavior was especially prevalent when there was uncertainty associated with the factors relevant to the problem (Hsee, 1995, p. 330).

Conclusion

Gribbons (1991) has succinctly summed up the current problem with document design:

The design community has failed to resolve this problem by incorporating the latest findings from the perceptual and cognitive sciences. Instead, they continue to employ 18th and 19th century design conventions to solve 20th century information problems. The results: a flood of poorly designed, inefficient, and ineffective information products (p. 42).

Rather than address complex problems, current documents center around routine tasks. The current design methodology tends to create each document as a new entity, totally separate from any previous one. At best, prescriptive design guidelines give each document the same look and feel. However, they ignore the individual context and how the user interacts with the document. Any practical approach to solving these problems must begin with a deeper understanding of how users solve problems and how to best provide them with the information they need. The intent of this paper was to provide a foundation for further research into developing practical applications of decision-making in the design of documentation.

Not taking into account the user's questions or the users decision-making process constitutes a major failure of current design methodology and hurts productivity. An ironic observation, since any system should, by definition, assist the user in decision-making. To maximize user productivity we must break with the current design methodology and address complex problems. We must provide the methods for accomplishing the complex tasks and provide answers to the real questions users ask. We must go beyond simple instructions and design documents which assist in solving complex problems. The solution to supporting decision-making for complex problems comes from gaining an in-depth understanding of the user, and not the software, by developing new methods of audience and task analysis that revolve around the complex, real-world questions asked by the user.

Supporting the user means designing documents that assist in answering the users complex questions. To accomplish this, goal the designer must adhere to three principles:

1. Look at the material from the users point of view.
2. Consider how the user will use the information.
3. Organize the material logically from the users point of view (Redish et al, 1988).

When thinking about what the user does with the information, three questions must be considered.

4. What does the user need to know?
5. How can the system help the user understand?
6. What decisions need to be made with this information? (Warren, 1993, p. 86)

Documents created after considering these three questions should be substantially better at addressing the user's real-world complex questions and

supporting the decision-making process used to provide answers to these questions.

Future Research

The purpose of this paper was to begin the exploration of the literature on decision-making and problem-solving and how they can contribute to the design of effective documentation. However, these are well established fields with wealth of material and space limitations have prevented me from doing more that scratching the surface. Further research should be done in these areas to:

- Help define which parts of the decision-making research are application to technical communication.
- Consider the impact of decision-making on answering complex questions.
- Develop and test the practical application of the theoretical concepts derived from the decision-making literature.

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