Issues & Opinions

Behavioral Theories Relating to the Design of Information Systems

When designing information systems, the largest portion of the effort is devoted to the technical specifications of the system; behavioral aspects are often overlooked. Although users are frequently involved in the development process, even they tend to focus on the uses of information and not the behaviorial impact of the information itself. There are several theories which suggest how users will react to various types of information; these provide a more reliable prediction of user response than simply asking users. It has been shown, for example, that when asked, users will generally request more information than is necessary to solve a problem [3]. Designers, therefore, need another basis for determining a decision maker's response to new systems. Three theories of value to system designers to predict user reaction to data are operant theory, expectancy theory, and garbage can theory. Each has a separate contribution concerning the reporting systems imposed on organizations.

Operant theory [6] states that individuals will continue behavior that is positively reinforced and eliminate behavior which is punished. Forms of reinforcement and punishment are not limited to electric shock, monetary rewards, or personal interaction; reinforcement and punishment are also derived from the reporting process. Reports defining positive performance are reinforcing, while those highlighting unfavorable results are reacted to as punishment. Therefore, operant theory can yield some guidelines on the design of reporting schemes that enhance decision making and user satisfaction. The general rule of operant theory is to stress positive reinforcement. Unfortunately, most reporting systems do just the opposite [1]. By creating exception reporting systems that highlight only the negative performance aspects, operant theory suggests resultant behavior that is "rigid, nonrealistic, and inappropriately strong" [7, pg. 80]. Efforts should be made to put an equal emphasis on positive performance, not only in remuneration, but in the reporting

system. Several corporations which have implemented this have produced extremely impressive results. Emery Air Freight, for example, experienced increased sales, productivity, and customer service from positive reinforcement programs, saving over $3 million per year [10].

Expectancy Theory. A second behavioral theory to be considered in designing a reporting system is expectancy theory [5, 8, 9]. This theory explains motivation in terms of the value of each potential outcome to the decision maker. The theory states that an individual determines possible actions and estimates the likelihood of various outcomes given those actions. The individual then assesses the desirability of each outcome. Desirability comes from three sources. First are extrinsic sources such as pay and promotion. Second is interest in the task. Some tasks are themselves intrinsically motivating to the individual. Finally, there is the pleasure derived from achievement of the task.

Expectancy theory states that the probability of each outcome is subconsciously estimated by the decision maker. This probability is then multiplied by the desirability to determine the individual's motivation level and performance.

Although this process may seem somewhat convoluted at first, there are many instances of everyday behavior which can be explained in terms of expectancy theory. A project may be monotonous and have no extrinsic reward. There is low desirability and low motivation. A project may be personally interesting, but not improve the individual's upward mobility. This will make the project more unpleasant for some people than for others because the motivating influence of extrinsic rewards differs across individuals.

The role of this theory in the design of systems lies in the transmittal of information. Data should allow the individual to assess the possible actions, outcomes, and probability. The preferences of each individual user can then be applied. Decision support systems have traditionally included actions and outcomes, but the probabilities of occurrence are often omitted.

The intrinsic valence of an individual can be influenced as well by manipulating task characteristics defined in the system. Tasks de-

signed by the system should provide skill variety, knowledge of results, task identity, and task significance. [4] The first two are self-explanatory. Task identity refers to dividing jobs into identifiable sub-parts so that the output from each individual can be viewed as a completed unit. Task significance is the perception that the individual's work has an important impact on others within the organization. Feedback should not only reflect the results of the specific performance, but also indicate how it influenced the firm as a whole. By implementing these job dimensions into the system, tasks become more stimulating–increasing intrinsic motivation. Successful computer-assisted instruction programs, for example, utilize these criteria in order to encourage maximum effort.

Garbage Can Model. A third behavioral construct is the garbage can model. This discusses the use of data for problem solving when there is a turnover of decision makers, ill-defined problems, and unclear cause-effect relationships. In these situations, problem solving is not an organized, structured process; there are problems in search of solutions as well as solutions in search of problems. Cohen, March, and Olsen summarize this:

> One can view a choice opportunity as a garbage can into which various kinds of problems and solutions are dumped by participants as they are generated. The mix of garbage in a single can depends on the mix of cans available, on the labels attached to the alternative cans, on what garbage is currently being produced, and on the speed with which garbage is collected and removed from the scene [2, pg. 2].

The labels on the cans, the frequency with which they are emptied, and in many cases, the production of garbage itself, are the jurisdiction of the information system. The delivery system is especially germane to this model because receipt of reports may trigger a solution to a situation that may or may not be a problem.

This model therefore stresses the importance of limiting data to that which is useful and relevant to a decision, and only providing it to those actively involved in the decision-making process. The model highlights the importance

of the timing of reports. Since solutions go in search of problems, the stream of problems must coincide with the stream of solutions for the optimal decisions to be made. Changing either will influence the final choices made.

The behavioral constructs presented lead the systems designer to different conclusions concerning an inadequate system. A believer in operant theory, for example, would explain a system failure by the breakdown in linkages between behavior and reinforcement or punishment. A follower of expectancy theory would focus on the desirability of outcomes to a particular decision maker. A problem occurs because the system does not emphasize the internal motivators important to the decision maker, therefore these motivators should be defined and the system adapted. Finally, the garbage can theorist would depict the problem by the information flow. Either extraneous information is being provided which causes decision makers to solve problems that do not exist, or the data is too scarce for the decision maker to identify problems or solutions.

The framework used also impacts the major focus of the system design phase. When designing a decision support system, a believer in operant theory posits that control over reinforcement and punishment is the most essential part of the design. Since most individuals have similar reinforcement and punishment stimuli, one DSS would be suitable for all individuals. A follower of expectancy theory, on the other hand, would argue that since each decision maker's desire for specific outcomes differs, individualized decision support systems are appropriate. Finally, those preferring the garbage can model would focus on the proper matching of problem data with solution data rather than the decision maker's motivational forces. Their DSS would control information so that the decision maker is prevented from acting on data that does not require attention.

Fortunately, the major points of these three theories are not mutually exclusive and can be combined to yield a system which will satisfy most users. By realizing that performance reports are reinforcement and punishment, reports can be timed so as to enhance motivation. Expectancy theory sheds light on ways to heighten interest in a task, while garbage can theory emphasizes the importance

of restricting information to that which is necessary to identify and solve a particular problem. With the knowledge of these behavioral theories, the systems designer is able to predict user response to information systems, and thereby build more user-oriented systems.

References

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