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Americas Conference on Information Systems (AMCIS)

December 2003

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THEORIZING ABOUT DSS USE AND DECISION QUALITY: AN INSTITUTIONAL ECONOMICS AND TASK-TECHNOLOGY FIT PERSPECTIVE

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Abstract

This paper integrates the theory of institutional economics and the task-technology fit model in order to theorize about DSS success (defined in terms of DSS use and decision quality). Institutional economics (Veblen 1899/1912, Ayres 1944 and Bush 1986, 1987) posits that human behavior is either instrumental (rational and associated with "getting a living") or ceremonial and associated with customs, habits, rites and rituals. The task-technology fit model (Goodhue 1995, Goodhue and Thompson 1995) posits that the influence of DSS on performance and use is contingent upon the degree to which the capabilities provided by the system match the requirements of the task. The greater this alignment, the more the DSS will be used and the more performance will be improved. In this context, DSS is viewed through the two lenses proposed by Alter (1977) that of data-oriented and model-oriented systems. The task is viewed through three dimensions suggested by Gorry and Scott Morton (1971): structured, semi-structured and unstructured. The decision-maker is posited to act either instrumentally (the decision-maker believes that the DSS will improve decision quality, therefore the system is used to its potential) or ceremonially (the decision-maker is acting in a habitual or ritual manner and the DSS is only being used to give an air of rationality). Based on these two theoretical lenses, we propose that there are three instances that lead to successful DSS (1) when the DSS is data-oriented, the task is unstructured and the decision-maker acts instrumentally, (2) when the DSS is model-oriented, the task is semi-structured and the decision-maker acts instrumentally and (3) when the DSS is model-oriented, the task is structured and the decision-maker acts instrumentally. Whenever the decision-maker acts ceremonially, the DSS will fail in the sense that it is not being used to its fullest extent.

Keywords: DSS, DSS success, Institutional Economics, Task-technology fit

Introduction

This paper integrates the theory of institutional economics and the task-technology fit model in order to theorize about DSS success (defined in terms of DSS use and decision quality). Institutional economics (Veblen 1899/1912, Ayres 1944 and Bush 1986, 1987) posits that human behavior is either instrumental (rational and associated with "getting a living") or ceremonial and associated with customs, habits, rites and rituals. Technological innovations that are compatible with instrumental behavior are more readily "appropriated" in extant behavior patterns, while those, such as, say, human cloning, that clash with existing beliefs are much less likely to be adopted.

The task-technology fit model (Goodhue 1995, Goodhue and Thompson 1995) posits that the influence of an information system (i.e. DSS) on performance and use is contingent upon the degree to which the capabilities provided by the system match the requirements of the task. The greater this alignment, the more the DSS will be used and the more performance will be improved. Since use is a complex outcome based on many other factors besides fit, we posit that for a DSS to be successful there are two conditions that have to be met: (1) it must be a good fit with the task it supports and (2) it must integrate with the decision maker's value system and behavioral pattern. The DSS is viewed through the two lenses proposed by Alter (1977) that of data-oriented and model-oriented systems. The decision-maker is posited to act either instrumentally (the decision-maker believes that the DSS will improve decision quality, therefore the system is used to its potential) or ceremonially (the decision-maker is acting in an

habitual or ritual manner and the DSS is only being used to give an air of rationality). The task is viewed through three dimensions suggested by Gorry and Scott Morton (1971): structured, semi-structured and unstructured. The two DSS types (model vs. data oriented), the two decision styles (instrumental vs. ceremonial) and the three decision types (structured, semi-structured and unstructured) yield a combination of twelve possible scenarios. On the basis of similarity of expected outcome, we collapse these twelve, to seven combined scenarios. We analyze the interplay between three key constructs: the DSS, the decision-maker and the task, and develop propositions predicting the quality of decisions made in the context of each of the seven combined scenarios. This paper is organized as follows: first we review the literatures on DSS, task technology fit and institutional economics, then we propose our model and different scenarios linking the key constructs and we briefly conclude with suggestions for future research.

Different Conceptualizations of DSS Success

Many different conceptualizations of DSS success have been proposed in the IS literature. DSS was viewed from a variety of perspectives and different measures of success were used including user overall satisfaction and decision-making satisfaction (Sanders and Courtney 1985), level of DSS use (Fuerst and Cheney 1982, Ferras and Vlahos 1998), perceived benefits of DSS (Keen 1981, Guimares et al 1992), improved decision quality and performance (Aldag and Power 1986, Kottermann and Remus 1989) and business profitability (Sharda et al 1988). Among these, system use and decision quality are considered good surrogate measures for DSS success (Guimares et al 1992).

Different factors have been proposed as antecedents to DSS success. For instance, Sanders and Courtney (1985) in a comprehensive field study have proposed as antecedents of DSS success the level of task interdependence (degree of interaction with others), decision context (degree of problem structure), the level of task constraints (degree of decision maker autonomy and authority). They found some evidence that the decision context and the level of task interdependence were related to DSS success.

A comprehensive review of the DSS literature was done by Guimares et al (1992), who proposed an integrated model of the determinants of DSS success. They posited user involvement as a primary determinant of DSS success (measured by DSS satisfaction and perceived DSS benefits), involvement determined primarily by task characteristics (such as task structure, task uncertainty, task difficulty, task interdependence and task variety), DSS characteristics (decision phase supported, level of managerial activity), decision-maker characteristics (experience) and training. They found previous experience with DSS user involvement, user training, top management support, the level of managerial activity and the task structure, difficulty and interdependence as determinants of DSS success. Although many studies have investigated DSS success, additional research and different theoretical perspectives are needed to formulate a more parsimonious model for the determinants of DSS success.

The Task-Technology Fit Model

Different researchers in DSS have adopted a task-technology fit (TTF) model to study DSS performance. Benbasat et al (1986) and Jarvenpaa (1989) suggested that the task and DSS capabilities jointly influence the decision strategy and that strategy in turn, will influence decision performance. Todd & Benbasat (1995) also adopted a TTF perspective to study DSS performance and posited that the degree to which the TTF leads to decision performance is moderated by perceived effort required, perceived accuracy and perceived incentives.

The task-technology fit model (Goodhue 1995, Goodhue & Thompson 1995) posits that the influence of DSS on *performance and use* is contingent upon the degree to which the capabilities provided by the system match the requirements of the task. Thus, the greater the alignment between the DSS and the task, the more the DSS will be used and the better the quality of the decision outcome will be. The TTF model is presented below:

Task Characteristics

In the DSS context, we define three types of tasks (decisions) based on Gorry and Scott Morton's (1971) categories. Structured decisions are tasks in which all phases are programmed, they are repetitive and routine to the extent that a definite procedure has been worked out for handling them so that they don't have to be treated *de novo* each time they occur. Unstructured decisions are tasks that are not programmed, they are novel hence there is no cut-and-dried method of handling the problem. Semi-structured decisions are somewhere in between structured and unstructured ones. Some phases can be programmed, some not.

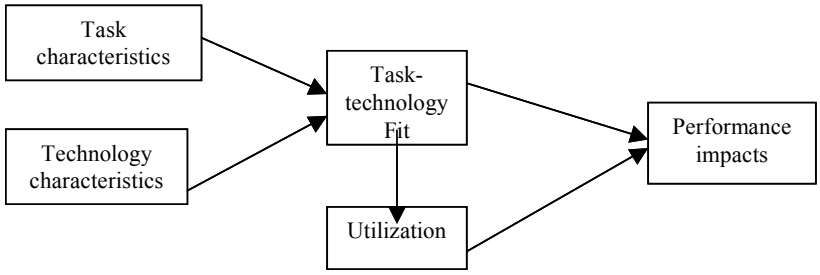

Figure 1. The Task-Technology Fit Model (Goodhue & Thompson 1995)

DSS Characteristics

DSS can be either data-oriented or model-oriented (Alter 1977). Data-oriented DSS are designed for either data retrieval or data analysis and often used to support day-to-day operational tasks. Examples include inventory control systems, financial analysis systems and sales analysis systems. Model-oriented systems are used by managerial or entrepreneurial personnel for planning and decision-making. The model approach to supporting decision-making can be used in situations where there is enough structure to develop a model based on formal logic or mathematical procedures that can range from decision rules to optimization problems. Examples include accounting models, simulation and optimization models.

Institutional Economics

Institutional Economics (Veblen 1899/1912, Ayres 1944, Foster 1981, Junker 1969 and Bush 1986, 1987) posits that the basic dynamic force in economics is technological change. The process of accumulation of technical knowledge has an internal dynamic of its own and this process is not primarily controlled by such an outside motivation as the profit motive. The institutions in which society is organized adjust slowly and reluctantly to assimilate and use new technical knowledge and to accommodate and adjust behavior norms to better utilize this new knowledge

In this section we briefly describe the concepts of technology and institutions and we describe organized behavior in terms of instrumental and ceremonial characteristics. Finally we describe the process of "ceremonial encapsulation" and "progressive" change.

Technology and Institutions

Veblen (1889/1912) defined institutions as "prevalent habits of thought with respect to particular relations and functions of the individual and the community." The emphasis here is on institutionalized behavior or norms of different groupings of people not objects or artifacts (i.e. buildings, organizations).

Four main characteristics of institutions can be distinguished: static (resistant to change), inherited from the past, habit-oriented and ceremonial in nature. Institutions do not entirely fit the situation of today…they tend to persist indefinitely except as circumstances force a change (Veblen 1899/1912). This does not mean that institutions remain totally static over time, they do change but at the same time they provide much of the stability for organizing human activities.

Ayres recognized the static function of institutions, that institutions are "permissive and non-dynamic…in the process of social change, institutional function plays a negative part, it resists change" (Ayres 1944). Ayres also states that "modern institutions derive their substance from the past" (IX, p. 9) thus, institutions of the present period are determined by past patterns of adaptation.

Institutionalists hold the view that all relevant behavior is learned and is for the most part habitual. To isolate a particular aspect of organized behavior that is non-dynamic and habit-oriented, Ayres used the term "ceremonial function." Legitimacy is conferred by ritual and ceremony. Myers & Rowan (1977) also asserted that ceremonial criteria and rituals legitimate institutions in the eyes

of internal and external participants. For example, the "ceremony" of auditing the accounting system legitimates financial statements. Professional and trade associations provide other arenas in which organizational members are given positions of substantive or ceremonial influence (DiMaggio and Powell 1983, p153). Ceremonial values are by nature beyond inquiry, they are never subjected to any test of refutability. Therefore, they slow progress because they are "past-binding", thereby inhibiting innovation and change.

While institutionalists view institutions as a stable, static element of culture, they view technology as the driving force of change. Technology in IE is very broad, including the range of pure science and even all rational knowledge, as well as technology in the narrower sense of technique and artifact. Classified in terms of nature of use or specificity, the types of technologies may be identified as: specific to an individual firm (firm-specific), specific to an industry (industry-specific) or a technology may have a general application in different firms or industries to common types of problems (function-specific) as for example an accounting information system that is usable in many industries; also, the invention of a new product falls into this classification (Gordon 1980, p15).

Ayres (1944, VI) saw technology as being comprised of tools and skilled use of tools and therefore a function of human behavior. Human skills and tools are inseparable because skills always employ tools and tools are always employed in acts of skill by human beings. Tools are capable of being combined (by humans) and applied to new functions and uses. Thus, technology is cumulative and accelerating in character, progressive, dynamic and the main agent of social change. In sum, technology means change and institutions, being backward looking, resist change.

In the context of information systems research, technology can refer to a DSS, that is, a computer system that helps managers choose from among alternative courses of action.

Organized Behavior, Ceremonial Encapsulation and "Progressive" Change

Bush (1987) stated that behavior may possess either ceremonial or instrumental characteristics. Examples of purely ceremonial behavior include discrimination on the basis of race, gender, color or creed, or praying that Windows doesn't crash again. For example, Adam and Richardson (2001) suggest that there may be a gender bias in much of the decision-making research, since Newell and Simon's (1972) original problem solving studies "...were apparently carried out by a small number of college educated middle class American males." (Adam and Richardson, 2001, p. 148) Their problem solving techniques were regarded as universal and these findings were incorporated into the design of the subsequent DSS and artificial intelligence (AI) systems and have been widely influential in the development of symbolic AI. They go on to discuss feminist philosophy and the lack of consideration of a feminist viewpoint in many IS projects.

Similarly, Powell and Johnson (1995) point out research implications in DSS arising from gender considerations. Specifically, they addressed the issue that males and females differ in their decision-making habits or prefer different styles of information, therefore their use of DSS may differ. These kinds of "non-rational" behaviors need to be considered while designing a DSS. Examples of purely technological behavior would be solving a math problem, or replacing Windows with Linux. Therefore, we distinguish between instrumental and ceremonial patterns of behavior. The difference between the two behavioral patterns can be traced to different valuation modes. Instrumental patterns of behavior are based on a valuation mode focused on "instrumental efficiency." To the extent that the new technology is posited to bring enhanced efficiency, it will be adopted within the behavioral pattern. Ceremonial patterns of behavior are based on a valuation mode derived from habits, rituals and ideology, the way things have always been done. Therefore, people acting ceremonially tend to resist changes brought about by the new technology and try to "encapsulate" it in strong ceremonial patterns of behavior.

The process of ceremonial encapsulation (Bush 1986, 1987) involves the attempt to preserve the pre-existing institutionalized behavior in the face of technological innovations by elaboration of ceremonial practices designed to minimize the innovation's impact on established ceremonial behavioral patterns. The new technology will be "encapsulated" in strong ceremonial behavioral patterns.

"Progressive" institutional change (Bush 1986, 1987) occurs when ceremonial behavioral patterns are replaced by instrumental ones or when instrumental behavioral patterns prevail over the ceremonial ones and lead to the adoption of the new technology. The new technology becomes "embodied" in the instrumental behavioral patterns. This means the technology is valued and used in problem-solving processes.

Institutional Economics, Task-Technology Fit and DSS

Decision making in a DSS context involves managers and possibly other personnel interacting with DSS technology in complex ways, especially in the face of largely unstructured problems. Institutional economics gives us valuable information regarding human behavior in the face of new technologies, while the TTF model examines the ways in which the technology fits the task. Both these theoretical lenses have implications for DSS use. Combining these two views lead us to the following model:

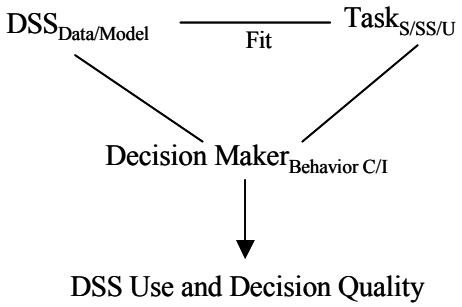

Figure 2. A Task-Technology Fit and Institutional Perspective to DSS

Where: DSS_{Data} – DSS is data-oriented
DSS_{Model} – DSS is model-oriented
$Task_{S}$ – task is structured
$Task_{SS}$ – task is semi-structured
$Task_{U}$ – task is unstructured
$DM_{behavior\ C/I}$ – the decision maker can act either instrumentally or ceremonially

Thus, we integrate the institutional lens and the TTF lens and apply the result to DSS success by postulating that in general, DSS are designed for managerial users at different levels. DSS are intended to help decision-makers improve their performance. However, this requires a change in the behavioral pattern of the decision maker from the current approach taken to making a decision to a new one in which a DSS is used.

The decision-maker is faced with a task context that can be structured, unstructured or semi-structured. In order to better distinguish between different types of task environments (structured, semi-structured and unstructured) and the instances in which a DSS would be used for any of them we can refer to the DSS success measure developed by Sanders and Courtney (1985). In their research, they operationalized measures for task newness, task difficulty, task variability, task interdependence, task standardization and task authority, basing much of their work on instruments developed by Van de Ven and Ferry (1980).

The DSS itself is model-oriented or data-oriented. The degree of DSS use depends upon the degree of "fit" between the DSS and the task but also the decision-maker's predisposition. In general, if the DSS fits the task and the decision-maker is instrumental, then the DSS will be used and the decision quality will be improved. If the decision-maker acts ceremonially or if the DSS does not fit the task, the DSS will be not used. In this context, a successful DSS is one that is used and that leads to improved decision quality.

We propose that there are three instances that lead to successful DSS (1) when the DSS is data-oriented, the task is unstructured and the decision-maker acts instrumentally, (2) when the DSS is model-oriented, the task is semi-structured and the decision-maker acts instrumentally and (3) when the DSS is model-oriented, the task is structured and the decision-maker acts instrumentally.

When the DSS is model-oriented, the task is unstructured and the decision-maker acts instrumentally, the DSS won't lead to use because there is no fit between the DSS and the task. Similarly when the DSS is either data or model-oriented, the task is structured, semi-structured or unstructured but the decision-maker acts ceremonially, the DSS will not be used. When the DSS is data-oriented, the decision-maker acts instrumentally, the task is either structured or semi-structured, the DSS will probably be used but the outcome in terms of decision quality will depend on the decision-maker's judgment.

The possible scenarios are summarized in Table 1.

Table 1. DSS Outcomes for the Seven Possible Scenarios

Scenario	DSS	DM	Task	Outcome	Change
1	Data	Instrumental	Structured	Depends on the DM judgment	?
2	Model	Instrumental	Structured	Success	Progressive change
3	Data	Instrumental	Semi-Structured	Depends on the DM judgment	?
4	Model	Instrumental	Semi-Structured	Success	Progressive change
5	Data	Instrumental	Unstructured	Success	Progressive change
6	Model	Instrumental	Unstructured	Failure	Non fit
7	Data/Model	Ceremonial	Structured/Semi-Structured/Unstructured	Failure	Ceremonial encapsulation

Scenario 1: (DSS_{Data} DM_{I} $Task_{s}$) In this scenario, the DSS is data-oriented, the task is structured and the decision-maker is acting instrumentally. As the decision-maker is instrumental, the system will be considered for adoption; however, because the DSS is data-oriented and the task is structured, this may not be a "perfect" fit, so the outcome (the decision quality) will depend on the decision-maker's judgment. Therefore:

Proposition 1: In an environment in which the DSS is data-oriented, the task is structured and the decision-maker acts instrumentally, the DSS will be used, but the decision-quality will depend on the decision-maker's judgment.

Scenario 2: (DSS_{Model} DM_{I} $Task_{S}$) Here the decision-maker is instrumental, the DSS is model oriented and the task is structured. This scenario leads to use of the DSS and better decision quality as a model-oriented DSS fits a structured task and the decision-maker's behavior is instrumental, that is, efficiency oriented. Cheney et al (1986) also suggested that the more structured and certain the task, the more likely the success of a DSS.

Proposition 2: In an environment in which the DSS is model-oriented, the task is structured and the decision-maker acts instrumentally, DSS will be a success.

Scenario 3: (DSS_{Data} DM_{I} $Task_{SS}$) In this scenario, DSS is data-oriented, the task is semi-structured and the decision-maker acts instrumentally. There may be some fit between the DSS and the task supported by it, so the DSS will be used; however, the decision quality will be based again on the decision-maker's judgment.

Proposition 3: In an environment in which the DSS is data-oriented, the task is semi-structured and the decision-maker acts instrumentally, the DSS will be used, but the decision-quality will depend on the decision-maker's judgment.

Scenario 4: (DSS_{Model} DM_{I} $Task_{SS}$) Here the decision maker is instrumental, the task is semi-structured and the DSS is model-oriented. A model-oriented DSS fits a semi-structured task, so the decision quality will be improved. Sanders and Courtney (1985) also reported that a DSS is likely to be successful in semi-structured environments.

Proposition 4: In an environment in which the DSS is model-oriented, the task is semi-structured and the decision-maker acts instrumentally, DSS will be a success.

Scenario 5: (DSS_{Data} DM_{I} $Task_{U}$) In this scenario, a data-oriented DSS fits an unstructured task, the decision-maker is instrumental, so DSS will be used to help with decision-making, also decision quality will be improved.

Proposition 5: *In an environment in which the DSS is data-oriented, the task is unstructured and the decision-maker acts instrumentally, DSS will be a success.*

Scenario 6: (DSS_{Model} DM_{I} $Task_{U}$) Here, a model-oriented DSS cannot perfectly fit an unstructured task. Even though the decision-maker acts instrumentally, he cannot compensate for the lack of fit between the task and the DSS. So,

Proposition 6: *In an environment in which the DSS is model-oriented, the task is unstructured and the decision-maker acts instrumentally, DSS will fail.*

Scenario 7: ($DSS_{Data/Model}$ DM_{C} $Task_{U/SS/S}$) To the extent that decision-maker's behavior is mostly ceremonial, the DSS may be installed for legitimacy or mimicry reasons (DiMaggio & Powell 1983), that is for the sake of having a system, to imitate other decision-makers that may have acquired the same system. Thus, the decision-maker's makes an attempt to "encapsulate" the new system in strong ceremonial patterns of behavior (Bush 1986, 1987). The system will not be used even though it may fit the task.

Proposition 7: *In any environment in which the decision-maker acts ceremonially, the DSS will fail, at least in the sense that it won't be used to its potential.*

Conclusion

We used institutional economics and the task-technology fit model to analyze the interplay between three key constructs: the DSS, the decision-maker and the task. The two DSS types (model vs. data oriented), the two decision styles (instrumental vs. ceremonial) and the three decision types (structured, semi-structured and unstructured) yielded a combination of 7 possible scenarios. We developed propositions predicting the quality of decisions made in the context of each of the seven combined scenarios. To become testable hypotheses, these propositions need further refinement, a topic for future research. We hope we set the ground for a DSS framework that explains DSS success and failure. This framework can guide DSS designers in considering both the task structure and the decision-makers' characteristics in developing successful DSS.

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