Towards a meta-theory of accounting information systems

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Abstract

The purpose of this paper is to articulate a model for accounting information systems (AIS) research that synthesizes the primary theoretical perspectives of the extant literature. Building on the three orientations used in prior research (technological, organizational and cognitive approaches) and adopting an explicit systems perspective, we develop a model that links system design alternatives to the three orientations and to task performance. The model places a central focus on the accounting task and suggests a matching process between requirements of the task and system design alternatives at multiple levels of analysis. We also demonstrate how the application of the model suggests future research opportunities, organized around four research propositions.

Keywords: Accounting information systems (AIS); Information technology; Expert systems; Decision support systems; Decision aids

1. Introduction

Extant accounting information systems (AIS) research has evolved from the source disciplines of computer science, organizational theory and cognitive psychology. An advantage of this evolution is a diverse and rich literature with the potential for exploring many different interrelationships among technical, organizational and individual aspects of judgment and decision performance. AIS research also spans from the macro to the micro aspects of the information system (Birnberg & Shields, 1989). The broad scope of AIS applicability suggests a potentially large sphere of influence for research done in this area. Conversely, the diffused theoretical basis also has resulted in a "nebulous" focus for AIS research (McCarthy, 1987) and an "absence of identity" (Sutton, 1992).

For AIS researchers, the "absence of identity" problem has been exacerbated by the fact that initial applications of information technology (IT)\textsuperscript{1} to accounting systems were transaction processing systems that tended to mirror historically developed manual processes. Sub-disciplines of accounting (e.g. auditing, financial, managerial, and tax) often did not perceive a need to incorporate systems considerations into their research. Now, as IT grows more advanced, AIS applications are recognized as fundamentally changing...
task processes and providing complex decision support, as opposed to simply increasing the speed and accuracy of traditional accounting tasks. As a result, there is a growing need to integrate AIS research more closely with the other sub-disciplines of accounting research.

Practicing accountants are being asked to focus their attention on the design of AIS to add competitive value to information and re-define the scope of AIS (Brecht & Martin, 1996). An integration of AIS research within sub-disciplines could also provide direction for practice. The comparative advantage of accounting researchers within the study of IT lies in their institutional accounting knowledge. Systems researchers can contribute insights into the development of systems utilizing technology, and the other sub-areas can contribute insights into the task characteristics in the environment. For instance, systems researchers have extensively investigated group decision support systems (GDSS), but they have only recently been considered in auditing. On the other hand, auditing research has extensively investigated the role of knowledge and expertise. The merging of the two sets of findings may be relevant to AIS design, training, and use.²

The changes in the nature and purpose of AIS, combined with the diffused theoretical perspectives, suggest a need for an organizing paradigm that provides a means for integrating extant AIS research and mining the synergetic opportunities that differing perspectives hold. We use the term “meta-theory” to suggest the integration and synthesis of the technical, organizational, and cognitive orientations into an overarching model for AIS research. Prior AIS research (e.g. Cushing, 1990; Reneau & Grabski, 1987) has adopted or adapted well-regarded frameworks from the management information systems (MIS) and IT areas (e.g. Ives, Hamilton & Davis, 1980; Mason & Mitroff, 1973; Gorry & Scott-Morton, 1971). The meta-theory model extends prior research by addressing the following four limitations of existing IT frameworks suggested by March and Smith (1995, p. 255):

- failure to recognize that “the nature of the task to which the IT is applied is critical”;
- failure to “recognize the adaptive nature of artificial phenomena; the phenomena itself is subject to change”;
- failure to account for the “design science research being done in the field”;
- failure to “provide direction for choosing important interactions to study” and treating all interactions as equal.

At the center of the approach in this paper is a task-orientation and system perspective that recognizes key interrelationships among major categories of contingency factors; technological, organizational and cognitive.³ A primary result of this paper is the proposition that an AIS research model should be reoriented around a task focus. A significant body of prior research into judgment and decision making performance suggests that performance is highly dependent upon contextual elements of the task (Payne et al., 1993; Solomon & Shields, 1995); the evaluation of an AIS should be considered in conjunction with task achievement.

This reorientation around task also aids an understanding of what March and Smith call “the adaptive nature of artificial phenomena”. Task requirements establish the set of system design characteristics⁴ and alternatives possible for use. Changes in the level of performance needed and/or requirements of the task motivate adapting IT and changing the set of options available for

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² Bamber (1993, p. 15) reaches a similar conclusion in discussing research opportunities for behavioral AIS research: “This research will be most fruitful if it focuses on those domain-specific variables unique to accounting systems and on the accounting decision context... Moreover, as new information technology is integrated into all accounting sub-fields, collaborative research will blur the distinctions between sub-fields.”

³ Similar structures have been suggested by prior research examining decision processes. Newell and Simon (1972) identified three factors in human problem solving as decision-maker characteristics, task demands, and organizational context. Payne et al. (1993) suggested three major classes of factors influencing decision strategy as the problem, the person, and the social context.

⁴ Systems design characteristics are defined as the set of hardware, software, procedures, data, and people, developed to address a particular organizational task (March & Smith, 1995).
system design and implementation.\textsuperscript{5} As March and Smith (1995, p. 252) state: “technologies are often developed in response to specific task requirements using practical reasoning and experiential knowledge”.

The task orientation of the proposed model also suggests an explicit role for design research within the AIS domain. March and Smith (1995) suggest that prior frameworks have omitted a role for “design science”—the building and evaluating of technological models, methods and instantiations. A focus on the task and on task performance makes explicit the need to develop systems that improve task outcomes and to evaluate implementations based upon their incremental task improvement.

Finally, integrating the three source disciplines traced in this paper around a task focus is also intended to help identify which interactions might be more important to study than others and the forms that interactions may take. This approach recognizes key interrelationships between technology, organization science and cognitive processes. AIS technologies, in the form of databases, expert systems and decision aids, represent tools for solving accounting problems. As such, these tools must be selected and implemented considering the task requirements and cognitive and organizational features embedded within that implementation. Users of AIS have differing problem and organizational constraints that necessitate differing AIS approaches. Hopwood (1989, p. 15) states: “…accounting oriented knowledge is more likely to be gained by research which systematically attempts to study the interdependency and inter-penetration of the technical and the human and the organizational.”

The remainder of this paper proceeds as follows. The paper begins by providing an overview of the AIS meta-theory model with illustrations of the model’s design principles. Then, four research propositions are developed and future research implications presented.

2. A meta-theory model for AIS research

AIS encompass systems that are either used by accountants, by other decision-makers employing accounting information, or in tasks that involve the application of accounting data (Reneau & Grabski, 1987). The model developed in this paper builds on previous frameworks in the management information systems (MIS) (e.g. Gorry & Scott-Morton, 1971; Ives et al., 1980; Mason & Mitroff, 1973), and AIS (Cushing, 1990; Reneau & Grabski, 1987) literature. The meta-theory model is illustrated in Fig. 1 and will be explicated through a discussion of four organizing principles, one for each major component of the model. The discussion of each organizing principle includes a description of the theoretical roots of each component. Representative examples of prior research are used to underscore the need for an extended integrated framework. Taken together, these four principles constitute a nomological network with task characteristics at the core.

2.1. Organizing principle No. 1: task focus

The first organizing principle of the framework is that \textit{AIS research should be task focused}. Fig. 1 illustrates this principle through the centrality of task characteristics to system design alternatives and task performance. The importance of task focused research is increasingly recognized, both in psychology and accounting (Einhorn & Hogarth, 1981, 1993; Waller & Jiambalvo, 1984). Gibbins and Jamal (1993, p. 453) argue that research without task considerations may be uninformative: “Without careful observation of the task, it is difficult to relate the research results to important questions about the task and accountants’ performance of it, such as effectiveness, efficiency, expertise, and value.” Payne et al. (1993) emphasize that decision-makers can invoke different strategies depending upon even seemingly minor task features, such as the number of alternatives or outcomes. A task focus is necessary for

\textsuperscript{5} Changes in the level of performance needed by a firm could include the need to achieve an equivalent level of performance for less cost as well as an increase in performance. Value-chain analysis and business process reengineering are two examples of initiatives motivating the adapting of IT to make task processes and outcomes more efficient or effective.
designing and implementing systems in consonance with human judgment and decision processes and organizational strategies. Thus, to understand and improve AIS strategies, research must first understand the task demands. This organizing principle extends prior AIS models, such as Reneau and Grabski (1987), which have subsumed task elements within broader categories of environmental factors constraining IS development.

2.1.1. Defining task characteristics

The concept of task is multidimensional. AIS serve many types of business tasks, including strategic, managerial, and operational (Gorry & Scott-Morton, 1971), and each type of task can be found in all of the accounting sub-disciplines. Although classification by business purpose is intuitively appealing, shifting the focus to core task characteristics may provide new insights for understanding systems. There exists no definitive taxonomy of task characteristics, although several accounting researchers have stressed the importance of task characteristics in understanding cognitive processes (e.g., Bonner & Pennington, 1991; Gibbins & Jamal, 1993).

The meta-theory model of AIS defines four core dimensions of task characteristics that have been considered in prior accounting and AIS research. The first is the mental processes involved in the task, such as external information search, knowledge retrieval, hypothesis generation and evaluation, problem solving design, estimation or prediction, and choice. This dimension is analogous to distinctions made in the behavioral auditing and judgment and decision making literatures, such as in Bonner and Pennington (1991). The second is complexity, considered to be a function of both the amount and clarity of inputs, processing, or outputs (Bonner, 1994). The third dimension is task demands as suggested by a task demand continuum developed by Stone and Gueutal (1985). One end of the continuum is anchored on physical labor and the other end is symbolic, abstract knowledge. While many accounting studies focus purely on the knowledge end of the spectrum, the entire spectrum is important since AIS increasingly impacts a variety of non-accountant decision-makers utilizing accounting information, such as production and clerical personnel. The fourth and final dimension is frequency of occurrence. Regularities in the task over time lead to different adaptations in the cognitive process and in the evolution of systems (Simon, 1981; Gibbins & Jamal, 1993).

2.1.2. Contributions of a task focus

Carefully defining the underlying task requirements, as well as comparing and contrasting those requirements to tasks previously studied, is a critical event necessary to further our understanding of information systems in accounting.
contexts (Peters, 1993). More clearly focused, task oriented research may improve the ability to select appropriate technology to study, a major problem identified in previous AIS research. Technological advances arrive at an ever-increasing pace such that it is extremely difficult to determine, a priori, what should and should not be studied. Weber (1987, p. 7) suggests that researchers have been “seduced” by the excitement of new technology:

> As each wave of new technology occurs, the literature shifts to the predictable descriptions of the technology, examination of implications, case studies of use, exhortations to adopt, etc. . . . The end result is a field devoid of theory and general principles.

March and Smith (1995) argue that the challenge for future AIS research is to categorize technology so that research efforts will not be wasted building and studying systems that have already been built and studied “in kind”. They offer guidance by dividing research activities into four categories (build, evaluate, theorize, and justify), and identifying criteria for research within each domain. For instance, research that builds systems should be judged based on value or utility to a community of users. Building the first application has utility only if the task application is important. Subsequent build studies must justify significant improvement.

The first organizing principle of the meta-theory model provides additional guidance for the design science research challenge in two ways. First, analysis of task requirements needed for a particular accounting function may assist in identifying the potential of a new technology for improving that function. Second, task analysis may assist in determining how well research using a particular task in one area will translate to a task in another area, thereby helping researchers focus on extensions in the application of technology rather than replications of “in kind” systems.

### 2.2. Organizing principle No. 2: design process

The centrality of task leads to the second organizing principle illustrated in Fig. 1 by the left arrow leading from task characteristics to system design alternatives. We suggest that, for AIS, task requirements become the start of a process that establishes the set of system design characteristics needed. It is important to realize that this organizing principle is about designing an Accounting Information System and not just about computers and electronic networks. Simon (1997) states: “in the post-industrial society, the key problem is how to organize to make decisions—that is to process information” and points out that decision making is shared between the human and mechanized components of systems. The meta-theory model suggests that task needs must be considered in choosing among system alternatives for a division of labor between the human and computer components.

System design alternatives, however, operate at different levels of analysis. We adopt March and Smith’s (1995) classification of constructs, models, methods, and instantiations. Constructs are conceptualizations used to describe problems and specify their solutions. Constructs operate at a high level of abstraction. For instance, in an enterprise wide accounting system, constructs would include “data should be captured that supports the organization’s critical events” and “detailed data should be maintained in one place that can be accessed by many different users”. Models are propositions expressing relationships among constructs. The Resources Events Agents (REA) model developed by McCarthy (1982) and discussed below is an example of an enterprise wide model. Methods are a set of steps used to perform a task. Continuing the example, database tables and data dictionaries are two of the many methods that would be used in an enterprise wide accounting system. Instantiations are realized implementations of technology, such as SAP R/3 for an enterprise wide accounting system example.

The model accommodates research at any of the various levels of analysis. The model also recognizes, however, that a system design alternative choice made at a higher level (such as construct) will often subsequently limit choices at lower levels (models, methods, or instantiations). Organizing principle No. 2 suggests a matching
process between requirements of the task and design alternatives at each level of analysis.

2.3. Organizing principle No. 3: contingency factors

The task and system design alternatives may be central to the model, but they do not exist in a vacuum. The third organizing principle of the model is that the effects of AIS on task performance must be examined within the context of cognitive, technological, and organizational contingency factors. Fig. 1 illustrates the three contingency factors as jointly affecting task characteristics. We adopt an explicit systems perspective where the focus is on the interdependence of the elements of the system (Frances & Garnsey, 1996).

2.3.1. Cognitive factors

AIS cognitive research focuses on the impact of AIS on individual and group decisions and draws on the judgement and decision making and psychology literatures. Reviews by Huber (1983), Reneau and Grabski (1987), Amer, Bailey, and De (1987) and Weber (1987) all characterize behavioral AIS research through the mid-80’s as lacking a theoretical basis and generating inconsistent results. More recent AIS research has moved to a closer investigation of judgment and decision processes and strategies, mirroring trends in behavioral research within other accounting areas. The comparative advantage of the cognitive perspective is its recognition that technology affects the decision-maker in three different ways: intended technical effects, transient effects associated with assimilation, and unintended social effects (Kiesler, 1986).

An example of the investigation of unintended effects is cognitive research focusing on identifying changes in cognitive strategies in the presence of automated decision aids designed to improve task performance. Chu (1991) finds that a decision aid does not reduce the potentially biasing use of simplifying strategies as task complexity increases. Subjects using a decision aid generated alternatives using an incremental, “satisficing”, approach significantly more often than non-users, suggesting that the decision aid may induce users to adopt a particular process in a manner that system designers may not have intended. Kottemann, Davis and Remus (1994) finds that subjects making production-planning decisions with a decision aid expressed inflated confidence beliefs in their performance, even though their actual performance was lower than subjects without the aid. One possible cause of this effect is a tendency to assume that the computer is “right”.

The findings of these studies illustrate that the intended technical effect of improved performance is not automatic with the introduction of a decision aid. Subtle task and training differences can affect both performance and research results. The meta-theory model helps to extend prior AIS cognitive research in two ways. First, Libby and Luft’s (1993) expertise paradigm is adopted to represent the cognitive contingency factors in the model. The expertise paradigm concludes that task performance is contingent upon ability, knowledge, motivation and environment. The Libby and Luft model is useful to explicate some of the interrelations among the cognitive characteristics (including knowledge and motivation) with the other two contingent factors identified in the meta-theory model (technological and organizational factors) and with the task characteristics. The expertise paradigm has been widely embraced as the basis for current cognitive auditing research in expertise development (e.g. Bonner & Walker, 1994; Nelson, 1993) and is generalized to AIS. Second, the model provides a clearer focus on accounting specific tasks, as well as organizational contexts, a research extension suggested by Bamber (1993).

2.3.2. Technological factors

Information technology refers to the tools and techniques that have been developed specifically to acquire and process information in support of human purposes (March & Smith, 1995). The meta-theory model incorporates Sutton’s (1992) representation of technology as consisting of three
categories of primary interest to AIS researchers: information economics, diffusion, and presentation. Information economics is concerned with the determination of content, considering expected costs and benefits of the system. Information diffusion is concerned with how to get information to users, while information presentation is concerned with format issues.

The modeling of a multidimensional accounting system is one example of information economics research, highly regarded because it is theoretically grounded in database management research and has often been ahead of practice (Sutton, 1992; Amer et al., 1987). Multidimensional accounting systems are based on the idea that accounting should provide disaggregated data about economic events that can allow individual users to generate information needed for a variety of judgments and decisions. Although the basic idea has been around for many years (Goetz, 1939; Schrader, 1962; Sorter, 1969), it was not until the 1970s that technology began to emerge to enable implementation of a new accounting model. Godfrey and Prince (1971) demonstrated how computer-based information networks could be used to provide disaggregated data to users. More explicit models of multidimensional accounting systems incorporated advances in database technology (Colantoni, Manes & Whinston, 1971; Lieberman & Whinston, 1975; Haseman & Whinston, 1976). McCarthy (1982) introduced the Resource-Events-Agents (REA) accounting model, extending prior database models by clearly including semantic modeling (based on economic exchanges not debits and credits) and more fully developing the structure of the accounting model. The REA model can be used as a starting point in enterprise wide database designs.

Advances in future research may be stimulated through the meta-theory model's integration of technology with organization and cognitive perspectives. A problem identified in prior technology-based research is the fact that technological performance is related to the environment in which it operates. Incomplete understanding or consideration of that environment may lead to inappropriately designed applications of technology, resulting in undesirable side effects, such as under-utilization of technology (March & Smith, 1995). The challenge for future research is to not only determine what technology works, but also understand why technology utility may differ in different applications. For example, Dunn and McCarthy (1997) suggest that validation of the REA model at either the individual or organization level is the greatest need for future research.

The double-sided arrow between technology and cognitive characteristics in Fig. 1 recognizes that, on the one hand, technology may enhance knowledge and provide decision support while on the other hand, cognitive strategies and individual-level factors could affect the technological design and mode of operation chosen. For example, one area of MIS research involves system design features to enhance flexibility. Advances in technology may also increase the ease in adapting technology to individual preferences, analogous to the "smart" systems found in automobile design in which individual climate, lighting and ergonomic preferences can be accommodated.

2.3.3. Organizational factors

The organizational level interactions are represented within Fig. 1 as the set of linkages from technology to task performance through the organizational and task boxes. The link between technological and organizational factors is also two-way since technology may allow changes to the organization structure, for example, and the organization context will determine the technology chosen.

Organizational factors include organizational strategy, structure, and the internal and external business environment. Prior organizational research focuses on the design and implementation of AIS, as well as the relationship between AIS choice and organizational performance. Accounting research into the organizational determinants of AIS have generally been based on three theories: contingency, agency and transaction cost economics.

2.3.4. Contingency theory

Early contingency research, summarized by Otley (1980), found no universally appropriate management accounting system (MAS) applicable to all organizations in all circumstances. Conceptual frameworks developed by Waterhouse and Tiessen
(1978) and Reneau and Grabski (1987) agree that the internal and external environment and production technology are two primary categories of contingent variables to be considered in choosing an AIS.

Empirically, Chenhall and Morris (1986), Gul (1991), and Gul and Chia (1994) examine the contingent relationship between internal and external environmental factors (organizational interdependence, decentralization, and perceived environmental uncertainty) and choice of an AIS (information scope, timeliness, aggregation, and integration). The general conclusion from these studies is that greater organizational interdependence, decentralization, and perceived environmental uncertainty are factors associated with either a greater perceived need for more sophisticated AIS or higher firm performance with more sophisticated AIS. Other contingency research (Chong, 1996; Kim, 1988; Mia & Chenhall, 1994) includes the role of production technology and task variables in assessing the performance and satisfaction with MAS. Kim (1988) finds, in a hospital setting, that when tasks are highly predictable and impersonal communication is used, MAS user satisfaction is higher. Mia and Chenhall (1994) and Chong (1996) find that the use of broad scope MAS positively affects performance only in the presence of high task uncertainty.

These contingency theory findings are particularly germane in the current environment of rapid technological developments. Many business articles seem to imply that all organizations should adopt the latest technology (Brecht & Martin, 1996; Magretta, 1998; Piturro, 1998), yet empirical findings suggest that this could be counter-productive. For instance, Gul and Chia (1994) and Chong (1996) argue that, where either environmental or task uncertainty is low, broad scope MAS may have an adverse effect on performance due to information overload. The meta-theory model provides a clearer task focus with a systems perspective that may guide future MAS choice research.

While recognizing that contingency theory is a valid approach to the study of organizational factors and technology, contingency theory has been criticized for lacking a substantive basis to suggest which variables, and which combinations of variables, are important (Fisher, 1995; Otley, 1980; Weber, 1987). That is, it is difficult to argue against inclusion of any of the contingent variables, yet equally difficult to determine their completeness or to know which combinations of factors make sense and are more important. For management control design in general, Fisher (1995) calls for more comprehensive models that provide a theoretical basis for multiple interactions among variables.

2.3.5. Economics based theories

The meta-theory model adopts suggestions from Tiessen and Waterhouse (1983) and Spicer and Ballew (1983) that transaction cost economics (TCE) and agency theory may sharpen the focus of contingency theory by providing a justification for identifying factors that affect MAS choice. TCE and agency theory share similar roots in economic theory but differ somewhat in their assumptions and research focus. Agency theory already enjoys a prominent role in the investigation of information system choice. Analytical research has focused on the role and value of information in organizations and choice of information systems under conditions of moral hazard (e.g. Arya, Glover & Sivaramakrishnan, 1997; Baiman, 1975). TCE focuses on the structure of the underlying economic transactions: standardization, frequency, uncertainty and investment in unique, or specific, assets. TCE is a comparative theory and, so, would be suited to empirical cross-sectional investigations of organizational differences in the design and implementation of MAS (Williamson, 1985).

Reference to TCE and agency theory could also improve the operationalization of constructs used in prior contingency research. For example, environmental uncertainty has been consistently operationalized using a validated instrument measuring perceived uncertainty. However, a wider range of uncertainty could be examined through comparison of multiple industries in varying locations.

All three of the theories that comprise the organization science orientation bring to AIS research increased recognition of the ways in which technology may be impacted by, and may impact, strategic, contractual and competitive decisions of the firm. Their competitive advantage is in situating the firms’ information needs in a
broader strategic and dynamic business context. The meta-theory model presents a comprehensive view of AIS by integrating theoretically defensible categories of variables with a task focus.

### 2.4. Organizing principle No. 4: task performance

The final organizing principle is that the *AIS outcome is task performance*. While principle one begins with the task orientation, principle four ends with an outcome orientation, representing the fulfillment of the task. Task performance is chosen as the outcome variable because both organizational and IT researchers define information in terms of the value it holds for human action (March & Smith, 1995; Simon, 1997). However, task performance may be operationalized from multiple standpoints, including the efficiency, effectiveness (cost- or process-), output quantity and/or quality, or timeliness of the action taken. Performance criteria will vary according to the level of analysis being conducted, corresponding to the system design alternatives discussed above. For instance, at the construct level, task performance may be strategic effectiveness while at the instantiation level it may be individual decision-maker performance.

The meta-theory model for AIS research depicted in Fig. 1 is a comprehensive, dynamic model that formally recognizes complex interactions between the four components of the model, task demands, system design alternatives, contingency factors, and task performance. The model provides an overview perspective to understand prior research in AIS. The expected contribution of the meta-theory model is the stimulation of research emphasizing the systemic nature of AIS interactions among the components of the model, as outlined in the organizing principles above. To that end, the following section illustrates four research propositions suggested by the meta-theory model.

### 3. Research propositions

#### 3.1. Research proposition No. 1

The first research proposition is that a *temporal ordering of technology, cognitive and organizational influences does not exist*; these coexist and evolve simultaneously. This proposition is based on the systemic perspective of interdependence described in the third organizing principle of the model.

One striking example of the coexistence of multiple influences is found in the application of process improvement (Davenport, 1993) or business process reengineering (Hammer & Champy, 1993). These techniques are heavily dependent upon information technology to transform business processes. However, the central point in such analyses is not to change the fundamental business task, but rather to gain synergy through the use of technology in the process of task accomplishment. Hammer and Champy (1993, p. 47) clearly state this point: “Information technology acts as an enabler that allows organizations to do work in radically different ways.” Research in MIS has found that the biggest obstacle to successful reengineering is change management (Clemens, Thatcher & Row, 1995). Change management involves both organization and individual factors, indicating the importance of the systemic perspective instead of a temporal ordering. The meta-theory model can guide future research examining the interdependence of the three contingency factors.

For example, future research could identify how control systems are impacted by, and impact, reengineering efforts at either a macro or a micro level. Specifically on the micro level, agency theory could provide one approach to examining interdependencies between technology, cognitive, and organizational influences. The idea is that technology may be used as a control mechanism to ensure that the agent’s actions are consistent with the goals of the principal by placing limits on the action decision-makers may take. Using AIS for increased monitoring has implications for reducing information asymmetry, changing existing relationships between the principal and agent. This approach, largely unexplored in the extant literature, is particularly complex since it involves technology, organization control structures, and ability, motivation, and knowledge issues from the cognitive perspective. Mauldin (1999) examines compensation schemes in an expert system environment and concludes that the introduction of technology changes not only the effort effects of
incentives, but also the type of individual attracted to the organization. She also identifies task differences in these relationships. Much remains to be done in this area including examination of other control structures, such as amount and types of firm supervision.

A different approach to testing the first research proposition would be to hold both task and technology constant to more carefully identify the effects of cognitive and organizational influences. For example, a bond-rating task\(^7\) shares many common task demands with a variance analysis task. Both require the integration of multiple cues including retrieval, recognition, comparison, and projection, and both are done on a recurring basis. In spite of these task commonalties, there are likely to be differences in organization structure or cognitive experiences (such as differences in performance evaluation, incentive structures, or ability) that lead to differences in the effects of technology on performance. Technology for the common task characteristics could be examined in the two contrasting environments to begin to understand the complexities arising in the real world.

3.2. Research proposition No. 2

The second research proposition is that the relative significance of technological, cognitive, and organizational factors differ for different tasks. A good illustration of this research proposition is the use of decision aids for different tasks. The accounting profession has devoted considerable attention to the development and implementation of structured decision aids (Messier, 1995). Benefits commonly associated with aided judgment include enhanced performance, reduced decision variability, and facilitation of knowledge transfer (Libby & Luft, 1993). Two types of problems in decision-aided tasks have been identified by prior research. The first is non-reliance on the aid even though the aid has been shown to produce, on average, better outcomes than un-aided judgment (Ashton, 1990; Eining, Jones & Loebbecke, 1997; Boatsman, Moeckel & Pei, 1997). The second is inappropriate reliance where the aid's recommendation is used even when the decision-maker is aware that the aid does not incorporate all relevant features of the environment (Glover, Prawitt & Spilker, 1997).

The non-reliance problem has been found in rating tasks where multiple items of information are used to infer states of the world in a probabilistic setting (determination of bond ratings or management fraud risk assessments). The inappropriate reliance problem was found in a computation problem (calculation of income tax). The two tasks differed on at least two dimensions of task demands, cognitive and complexity. However, incentive structures and knowledge and ability of subjects also differed in the studies. A likely explanation of the differences in outcome is that there are different weights on cognitive, organizational, and technology factors related to each task. The meta-theory model could guide future research explaining the weightings of each of the factors for each type of task, to provide direction for system design alternatives by task.

3.3. Research proposition No. 3

The third research proposition is that there is a relationship between the different levels of analysis such that design choices made at a higher level (such as construct) will affect those at a lower level (such as model). March and Smith (1995) suggest that system development methods move from abstract constructions of problems (constructs) to increasingly concrete representations of user needs (models), system requirements (methods) and implementations (instantiations). This hierarchy logically implies that judgments made at any one level will limit the subsequent choices available at a lower level.

Within the accounting arena, an important research question is whether and how the problem definition at the construct level changes alternative sets of models, methods and instantiations. Brecht and Martin (1996) suggest a redefinition of the scope of AIS, at the construct level, to include strategic, management and task/operational information. Future research is needed to evaluate the

\(^7\) Such as in the information presentation study by Amer (1991).
merits of this revised definition against not only internal requirements, but also external requirements for information, such as real-time, on-line information retrieval by investors.

Future research is also needed to investigate specific changes that might stem from a change in the construct level definition of AIS. Implementation problems, at the instantiation level, associated with realizing a redefinition such as that described above are largely due to the way accounting information has traditionally been defined. David (1997) investigates how the changing definition at the construct level requires changes at the model level. She first defines three types of events: economic events (actual transactions changing resource quantities), business events (information for planning and control) and information events (means of communicating information about the former two events). Then, using a REA framework, she illustrates how a traditional accounting system (i.e. limited to economic events) could evolve into a very different model if business and information events were included. She also discusses the implications of this modeling for process reengineering, noting that cost-benefit analyses are vital in considering alternative models and methods. Future research could empirically validate the match between a revised definition of accounting information systems at the construct level and an REA model for implementation.

Just as the construct level effects the model level, decisions made at the model level effect the methods and instantiations level. For example, instantiations of artificial intelligence (AI), using neural nets and case-based reasoning, are able to quickly discern patterns in data that would take years to discover using older techniques. Several banks and credit card companies are now using AI to study patterns of individual credit card usage to detect transactions that are potentially fraudulent (Widrow, Rumelhart & Lehr, 1994). It is a revised accounting model (maintaining a wealth of detail transaction data) that makes AI methods possible. The decision to model the accounting system multidimensionally allows even traditional transaction data to be used in new instantiations. The meta-theory model could guide future research in identifying and examining the effects of other such applications.

3.4. Research proposition No. 4

The fourth research proposition states that system design alternatives should explicitly consider complementarities and fit between strategy and structure. Complementarities in organizations, introduced by Milgrom and Roberts (1995), are based on the idea that activities are complements if doing more of any one of them increases the returns to doing more of the others. In a system with strong complementarities, changing only a few of the system elements at a time may not achieve all the benefits that are available through a fully coordinated move, and may even have negative payoffs (Milgrom & Roberts, 1995). Frances and Garnsey (1996) demonstrate how capitalizing on complementarities in technology, distribution, and employment practices allowed supermarkets in the United Kingdom to change the structure of market control, resulting in dramatically higher net margins than in many other countries.

Greater recognition of, and empirically testing, research proposition four is particularly important in research building or evaluating emerging technologies. For example, the Internet has the potential to completely redefine external financial reporting as we know it today. Elliott (1995) predicts real-time business reporting and investor access to corporate databases. Research defining complementarities in firm strategy and structure governing existing external relationships and how they are changing seems particularly appropriate to avoid negative consequences of such an implementation. There is a huge gap between having the technology available to provide any user any data within the firm and having a system that will control both the accuracy of the data (important to the external user) and the legitimacy of, and limitations on, data requests (important to the firm). AI is theoretically capable of providing a vehicle of control. The meta-theory model could guide future research analyzing the effect of AI on financial reporting concerns.

Another example of capitalizing on complementarities involves group support systems (GSS), a category of technology that has been extensively studied within the MIS domain and
recently considered in audit research. Bamber, Hill and Watson (1998) review prior audit group research as well as recent audit GSS research and provide a series of propositions for future AIS research, specific to auditing. They note inconsistent findings in MIS research and suggest the importance of evaluating potential GSS applications in a context-specific basis. The framework they develop for further GSS audit research explicitly encompasses task characteristics as well as the group setting and expected GSS process gains and losses (Bamber, Watson & Hill, 1996). The authors note a lack of GSS research in the areas of conflict resolution and execution tasks, which are potentially important tasks in the audit function.

Research proposition four goes one step further to recommend examination of the adoption and diffusion of GSS. The process gain and process loss perspective can help identify complementarities. For example, the effects of networking and workpaper automation through GSS could be positive, in allowing reviewers more freedom, or negative in having less personal contact with audit staff and client representatives. With networking technology, GSS is becoming an important part of audit environments due to the need for interaction among the audit team and the geographic dispersion of audit activity. Reaping the benefits of this technology might also require complementary procedures to mitigate the negative impacts. The meta-theory model can guide research investigating how the process gain and loss tradeoffs are made within organizations. Such research would be relevant to increasing the success of system innovations, not only in auditing, but also in other areas.

Research proposition four applies to models as well as instantiations of system design alternatives. For example, the development of the REA model discussed earlier is predicated on reduction of redundancy and making data structures more efficient. However, Van Alstyne, Brynjolfsson and Madnick (1995) argue that, under some current organization structures, an REA type model may not be effective. Future research identifying complementarities in organization structures could, once again, impact implementation strategies.

4. Conclusions

Technology is a pervasive and growing component of accounting tasks and has been shown to change work processes. The meta-theory model for AIS research contained in this paper explicitly recognizes this factor. Currently, multiple research methods are being employed to investigate dual AIS/accounting problems. This is especially evident in managerial accounting, where experimental, field, and analytical work has addressed the interrelationships between managerial tasks and AIS design and use. Less evident is an explicit combined strategy to employ multi-methods in a manner that most effectively uses the strengths of each approach (Peters, 1993). The meta-theory model develops a comprehensive framework that can be used to help organize and interpret future research.

The meta-theory model may also provide a vehicle to encourage the integration of AIS research with the other sub-disciplines of accounting research. Explicitly considering task commonalities and differences between sub-disciplines may avoid unnecessary duplication of research as well as accelerate the advance of AIS research.

This paper develops a meta-theory model for AIS research that begins with a task focus and suggests a matching process between requirements of the task and system design alternatives at four different levels of analysis. Further, the model suggests that technological, organizational, and cognitive contingency factors impact the outcome, task performance. The three contingency factors are developed from a review of the extant literature and are complimentary, each focusing on an important aspect of AIS design and use in addressing accounting issues. The model provides a nomological structure that can be used in future research to identify variable combinations and critical interactions for specific task settings. Four propositions for future research are also identified using the proposed model. These propositions illustrate questions that have been under-researched regarding the temporal ordering of contingency factors, the relative importance of contingency factors for different tasks, the consequences of system design choices and the complementarities in AIS.
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