The Structural Context of Executive Information Systems Adoption

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While some firms are developing computer-based Executive Information Systems (EIS) to support key executives and managers, a large number of organizations are presently not using EIS. Our focus here is on structural factors associated with the adoption of EIS capabilities that support managerial communication, coordination, control, and planning. A national survey was conducted to collect data for the empirical study. Our analysis uses data from 210 organizations representing adopters and non-adopters of key EIS capabilities. Adopters of each of the four EIS capabilities have higher levels of environmental dynamism, heterogeneity, and hostility than their non-adopting counterparts. EIS adopters with higher levels of environmental pressures appear to be implementing distributed architectures to deliver EIS applications. Furthermore, adopters of EIS capabilities for purposes of coordination, control, and planning have larger IS departments than non-adopters. It also appears that larger organizations are implementing EIS capabilities for planning purposes to a greater degree than smaller organizations. They also have a greater proportionate representation from the for-profit sector. Implications of these findings are discussed along with directions for future research.

Executive Information Systems (EIS) have become increasingly popular. EIS can be broadly defined as a computer-based information systems for key executives and managers, providing them with sophisticated technological capabilities to support their communication, coordination, planning, and control functions. The traditional view that EIS support only senior executives is being challenged as more and more managerial levels are gaining access to EIS (Rai and Bajwa, 1997; Belcher and Watson, 1993) in firms across all key industrial sectors. Faced with external pressures, many firms are developing EIS applications simply to remain competitive in highly uncertain environments (Watson, et al., 1991). Although it was believed that only large firms are likely to undertake EIS efforts, recent developments in relatively inexpensive EIS software products are making it economically feasible for smaller firms to deliver EIS applications.

Investments in EIS are being spurred because of their suggested benefits. They provide better logistics, efficient communication with more people, and increase visibility into the organization (Rockart and DeLong, 1988). Moreover, by providing on-line access to data and information from internal and external sources, they help key executives and managers to be current with operations (Gauthier, 1989) and facilitate a better understanding of the business (McCartney, 1989). EIS can also have a significant positive impact on executive productivity (Jenkins, 1990). Studies suggest that EIS can improve productivity and decision making, save information distribution costs (Belcher and Watson, 1993), and improve response time associated with decision making (Leidner and Elam, 1993). Over the long run, EIS can lead to elimination of staff levels and administrative tasks in organizations (Wallis, 1989). Such impacts eventually lead to higher levels of orga-
nizational effectiveness (Paller and Laska, 1990).

Numerous case studies provide valuable insights into EIS efforts (Rockart and Treacy, 1982; Rinaldi and Jastrzembski, 1986; Boltz, 1987; Houdeshel and Watson, 1987; Rockart and De Long, 1988; Paller and Laska, 1990; Fireworker and Zirkel, 1990; Barrow, 1990). More recently, Rai and Bajwa (1997) examine how organization size, aggregate levels of environmental uncertainty, and management support impact the adoption of EIS for collaboration and decision support. These and other studies (Watson et al., 1991; Mohan et al., 1990) suggest how the size of a firm, its sector (non-profit, manufacturing, or service), and its environment can affect the propagation of EIS. We extend this line of investigation by focusing on the adoption patterns of four key aspects of EIS functionality. These include EIS support for managerial communication, coordination, control, and planning. We examine the association of selected structural factors with the adoption of each of these four EIS capabilities. We also analyze how environmental and organizational structural characteristics are associated with EIS architecture choices made by organizations adopting EIS, and if their choice of a specific architecture enables or constrains the adoption of certain EIS capabilities.

Our specific research questions can be stated as:

- Does membership in industry sector play a role in the adoption of EIS capabilities by firms?
- Are specific elements of a firm’s external environment, as assessed by dynamism, heterogeneity, and hostility, associated with adoption of EIS capabilities?
- Do size-related factors (firm and IS department) play a role in the adoption of EIS capabilities?
- Do EIS architecture choices made by EIS adopters relate to environmental characteristics and size-related factors?
- Do organizations with different EIS architectures differ in their adoption of EIS capabilities?

The next section describes the research framework of our study. We then summarize the research method, data collection procedures, and sample demographics. Subsequently, we discuss the results of our analysis. Finally, we offer some concluding remarks.

**The Research Framework**

Figure 1 summarizes the research framework of our study. We limit our attention to the adoption of EIS capabilities and do not examine variations in implementation levels of these capabilities within organizations. In addition, we limit our attention to four important categories of structural factors. We do recognize that other structural and process-related characteristics are likely to be associated with the adoption of EIS capabilities, but for reasons of scope these factors are not examined here. We now elaborate on the theoretical underpinnings of our research framework.

**EIS Adoption for Managerial Support**

The common technological clusters associated with EIS can help executives and managers in executing four important functions. First, e-mail and voice-mail applications can improve the geographic reach of executives in terms of their communication with others. These technologies also expand the ability to communicate asynchronously. Thus, these technologies are targeted at enhancing management communication capabilities. Second, electronic calendars, file ticklers, and computer conferencing can improve the logistics and collaboration between executives and managers thereby enhancing management coordination capabilities. Third, man-
management control capabilities, such as monitoring critical success factors, variance reporting, and drill-down applications, provide on-line access to data and information to keep executives and managers current with operations (Gauthier, 1989) and facilitate a better understanding of the business (McCartney, 1989). Finally, management planning capabilities provide access to external information, assist in “what-if” and trend analyses to support executives and managers.

**Sector Membership and EIS Adoption**

A growing body of literature (Bozeman, 1988; Wolf, 1988; Coursey and Bozeman, 1990; Schwenk, 1990) suggests that business organizations face different environments than government organizations. As a result, there are likely to be significant differences in organizational behavior and management practices between private and public sectors. In general, public organizations tend to be less innovative than private firms (Feller, 1980). Furthermore, research in strategic management emphasizes that competitive forces facing firms vary across industries (Porter 1985). For example, manufacturing firms are likely to develop close links with suppliers, while service firms tend to maintain closer contacts with their customers. While existence of sector differences seems to be evident, the IS research community has paid limited attention to these differences (Bozeman and Bretschneider, 1986). A study investigating the diffusion of microcomputer technology across private and government sectors found significant differences between adoption of microcomputer technology in the two sectors (Bretschneider and Wittmer, 1993). While there is paucity of research investigating the role of sector in the adoption of EIS, there is some evidence of differences between EIS in the public and private sectors (Mohan et al., 1990). We examine differences across sectors in the adoption of the four EIS capabilities.

**Size-Related Factors and EIS Adoption**

**Firm Size**

Innovation studies suggest that firm size is associated with adoption behavior (Utterback, 1971; Kimberly and Evanisko, 1981; Meyer and Goes, 1988). Kimberly and Evanisko (1981) note that “the effects of size may depend upon the nature of the innovation in question. A positive relationship between size and adoption behavior should not be assumed” (pp. 699-700). The authors support this notion by providing examples of research where negative relationships between firm size and adoption behavior have been empirically detected (for eg. Mohr, 1969; Thompson, 1969).

The EIS literature suggests that firm size plays a significant role in the adoption of EIS applications (Rockart and DeLong, 1988; Paller and Laska, 1990) and larger organizations are more likely candidates to adopt EIS. However, developments in hardware and software technology enable EIS software to run on client/server systems and workstations. The availability of relatively inexpensive downsized EIS software products have lowered the price tag for delivering EIS capabilities. With dramatic increases in the number of internet-service providers and rapid decline in the costs of internet-related services, such as e-mail and web-related services, resources may represent insignificant constraints for the adoption of certain EIS capabilities. As a result, smaller firms may well find it economically feasible to adopt EIS capabilities to support their key executives and managers.

**IS Department Size**

While the role of firm size in the adoption of EIS capabilities has been addressed in the EIS literature, the relationship between IS department (ISD) size and the adoption of EIS capabilities has not received much attention. Past research has shown that IS department size can have a significant impact on the adoption of emerging technologies within the IS function (Rai, 1996). Larger ISDs can draw upon their technical resources to better support IS innovations (Fuller and Swanson, 1992). This could be particularly critical in the adoption of EIS capabilities requiring integration of data and information across functional areas which may reside on multiple platforms. Substantial IS resources are needed to develop data warehouses that integrate data resources in a manner that can support the information needs of the enterprise, including the requirements of EIS applications. Furthermore, EIS applications for control and planning purposes need IS resources for requirements determination and prototyping.

**Environmental Characteristics and EIS Adoption**

A firm’s external environment can motivate the adoption of EIS capabilities. Watson et al. (1991) suggest that executive sponsor’s interest in developing EIS can be a consequence of both internal and external pressures. As the authors quote: “The external pressures come from the firm’s external environment and can include environmental turbulence (e.g. rapidly changing costs of raw materials), increased competition, and increased government regulations.” Similarly, Armstrong (1990) suggests that: “One of Rockwell’s (firm’s) foremost reasons for adopting an EIS is to better respond to the changing climate in which it does business.” (pp. 69). In a similar vein, Rockart and DeLong (1988) and Gulden and Ewers (1989) also suggest that forces in the organization’s external environment can guide the evolution and spread of computer-based support for executives in order to respond to environmental changes and achieve a better organization-environment fit.

The literature recognizes dynamism, heterogeneity and hostility as three important elements of a firm’s environment. In dynamic environments, it is difficult for a firm to predict competitor moves and consumer demands. Such an environment compels a firm to rapidly change its products and services, marketing practices, and technology. Heterogeneity
refers to the variations in a firm’s environment. A firm has to respond uniquely to each of its environments, yet weave these varied responses into a coherent strategy. Finally, hostility refers to competitive pressures faced by a firm due to price competition, quality competition and shrinking markets for products. Our focus here is on examining the relationships between the levels of dynamism, heterogeneity and hostility that characterize a firm’s environment and the adoption of EIS capabilities for communication, coordination, control, and planning.

**Choice of EIS Architecture by EIS Adopters**

According to Paller and Laska (1990), there are six basic configurations for delivering EIS. They are: mainframe or minicomputer with terminals, mainframe or minicomputer with personal computers, mainframe or minicomputer with a local area network (LAN) serving personal computers, mainframe and a minicomputer and personal computers, and standalone personal computers. Each of the six options represent different degrees to which the EIS hardware configuration is centralized, distributed, or decentralized. Centralized hardware configurations are represented by terminals or personal computers linked directly to the mainframe or personal computers linked to host computers. Standalone LAN and standalone personal computers represent decentralized hardware configurations. Distributed configurations include LANs linking personal computers and host computers, integrated LANs, and client/server implementations. Our empirical study profiles EIS architectures being used by EIS adopters.

**Environmental and Size-related Correlates of EIS Architecture**

Information processing theory suggests that organizations facing increased levels of environmental uncertainty should develop mechanisms to enhance their information processing capabilities (Nadler and Tushman, 1978). Ramaprasad and Rai (1996) observe that organizations should implement designs that balance the processes of information generation and dissipation. Rapid developments in distributed information technology should enable organizations to collect data at the source, interrelate data from disparate geographic locations, and enhance the information processing capabilities of their executives. It appears reasonable to expect organizations facing higher levels of environmental uncertainty to make choices of EIS architectures that are of a distributed nature.

Size-related factors can also influence the choice of EIS architecture. Large and medium-sized organizations are likely to use distributed EIS configurations, while very small organizations are likely to use stand-alone EIS configurations. As organizations get larger their need to coordinate disparate systems can push their architectural choices towards centralization. As part of our empirical assessment, we examine the relationship between organization size and EIS architecture choice in adopter organizations. The interdependencies characterizing distributed systems are greater than mainframe environments suggesting that greater IS resources may be required to manage such architectural choices. We also examine the relationship between IS department size and the EIS architecture in adopter organizations.

**Method and Sample**

A survey-based approach was used for data collection. A detailed questionnaire was developed after reviewing the literature and conducting in-depth interviews with an operating and an executive sponsor from a large firm that had successfully developed EIS applications for 40 key executives and managers in two of its major divisions. The questionnaire was further refined after detailed interviews with IS and corporate executives belonging to six firms in the Midwest USA. All six firms varied considerably in their state of EIS efforts and in their reported technological and organizational context.

The questionnaire was divided into three parts. The first part included a short note to the respondent of the questionnaire, clearly defining an EIS and providing a brief explanation of the purpose of the study. If EIS efforts had not been initiated at any level, respondents were requested to complete only the second part of the questionnaire, which gathered general demographic data and information about the external environment forces facing the firm. The third part of the questionnaire contained items that sought responses on several aspects of EIS efforts, such as position of the executive sponsor, software and hardware used to deliver the EIS, extent of adoption of EIS communication, coordination, control, and planning capabilities, and implementation support factors.

A random sample of 1,423 firms in the United States was selected from a directory of top computer executives. Firms listed in this directory are included if they satisfy at least one of the following three criteria: membership in the Fortune 500, sales of more than $50 million, or an MIS budget exceeding $250,000. The directory represents organizations from a total of 13 industries. The questionnaire was mailed to the highest ranked computer executive in each of the 1,423 firms. A letter accompanying the questionnaire explained the purpose of the study and sought cooperation to participate in the survey. If the top executive was not the most knowledgeable individual in the organization about EIS efforts, they were requested to forward the questionnaire to the person most knowledgeable about such efforts in their firm. A follow-up questionnaire was mailed after two weeks to all those that did not respond to the first mailing.

A total of 238 responses was received from 42 states. Twenty-eight responses were discarded due to insufficient data. Our tests did not suggest presence of non-response bias. Respondents and non-respondents were not found to differ in their industry representation and organization size. No differ-
ences were detected between early and late respondents on study variables.

The 210 firms represent all thirteen industries included in the mailing list. The geographical profile of the sample included responses from the mid-west (39%), northeast (257%), south (20%), west (15%), and other (1%) regions. 207 of the respondents indicated their rank/position. 132 (63.8%) of the respondents belonged to the top management level (both IS and corporate), 67 (32.4%) of the respondents held middle management positions (IS and corporate), and the remaining 8 (3.8%) of the respondents belonged to the lower management level (IS and corporate).

**Measurement**

**EIS Adoption for Managerial Support**

The adoption status of the firm was determined by whether computer-based applications had been installed to support each of the four functions of communication, coordination, control, and planning. Thus, a firm was classified as a non-adopter of communication capabilities if no applications had been installed to support the communication function. A firm that had installed voice mail, e-mail, etc. for one or more key executive(s)/manager(s) was classified as an adopter of communication capabilities. Other firms were classified as non-adopters. The same procedure was applied to classify non-adopters and adopters of computer-based coordination, control, and planning capabilities.

**Sector Membership**

The thirteen key industries that were represented in our mailing list and in the respondent profile were grouped into three main sectors: Non-Profit (local, state, and federal governments, education, and others), Manufacturing, and Services (utilities, banking, finance, health services, insurance, transport, and retail). We should note here that our sample did not consist of private educational institutions; only state-funded universities are included. We, therefore, categorized these respondents as part of the non-profit sector.

**Size-Related Measures**

The number of employees was used as a measure of firm size. This measure has been used in other studies on organizational innovation (Kimberley and Evanisko, 1981; Meyer and Goes, 1988) and IS innovation (Zmud, 1982; Rai, 1995). The natural logarithm of firm size was computed and used in subsequent analysis. One objective item was used to assess the number of full-time employees as a measure of ISD size. Similar measures have been used by Nilakanta and Scamell (1990), Fuller and Swanson (1992), and Rai (1995). As with firm size, the natural logarithm of ISD size was computed and used in subsequent analysis.

**Environmental Characteristics**

We measured three characteristics of the environment, namely, its dynamism, heterogeneity, and hostility. These characteristics were measured using a version of the Miller and Friesen’s (1980) instrument as refined and used by Sabherwal and King (1992).

Five important forces induce environmental dynamism, namely: 1) changes in the competition’s marketing practices, 2) changes in the industry’s product and service offerings, 3) changes in technology, 4) unpredictability of competitor moves, and 5) unpredictability of consumer demand. Five items corresponding to these five forces were used to measure environmental dynamism. A 7-point Likert-type scale (1=low and 7=high) was used for all items. A factor analysis of these items resulted in the expected one factor solution. All five factor loadings were greater than 0.60. Cronbach’s alpha, a measure of internal consistency, for the five item scale was assessed to be 0.80.

Three forces, among others, induce environmental heterogeneity, namely: 1) variations in customer buying habits, 2) variations in nature of the competition, and 3) variations in market uncertainty. Three items corresponding to these three forces were used to measure heterogeneity on a 7-point Likert-type scale. A factor analysis resulted in all three items loading on one factor with factor loadings greater than 0.86. Cronbach’s alphas was computed to be 0.85.

Environmental hostility refers to competitive pressures faced by a firm. Three forces, among others, induce such hostility, namely: 1) tough price competition, 2) demand for product quality, and 3) dwindling product markets. Three items, corresponding to these three forces were used to assess environmental hostility on a 7-point Likert-type scale. A factor analysis of these three items resulted in all items loading on one factor with loadings greater than 0.72. Cronbach’s alpha was computed to be 0.68.

**EIS Technology Configuration**

Based on the Paller and Laska (1990) classification, respondents were asked to indicate which of the six basic architectures best describes their EIS configuration. An option of “other” configurations was included and respondents were requested to describe this option. Thus, the seven choices were: (1) Mainframe/Mini linked to terminals (2) Mainframe/Mini linked to PCs (3) Mainframe/Mini linked to LAN(s) further linked to PCs (4) Integrated LANs linked to PCs (5) Stand-alone LAN(s) linked to PCs (6) Stand-alone PCs, and (7) Other. Respondents were classified as having centralized (choices 1 or 2), distributed (choices 3 or 4), and decentralized (choices 5 and 6) architectures. Organizations indicating “other” were interpreted based on the description provided by the respondent and then classified into one of the three architecture types.
Results and Discussion

Table 1 shows the descriptive statistics for the study variables. In general, all firms in the sample indicated higher external pressures due to hostility as compared to environmental dynamism and heterogeneity. Table 2a shows the adoption profile of the EIS capabilities. Our data show that about 25% of our respondents provide EIS capabilities to support communication, coordination, and control functions of key executives and managers. About 20% of our respondents have developed any EIS capabilities for planning support. Mainframe/Mini linked to LAN(s) is the most popular architecture being used by 25 (37.3%) of the EIS adopters. Mainframe/Mini linked to PCs was the next most popular, used by 17 (25.4%) EIS adopters. Integrated LANs (9, 13.4%), mainframe/mini linked to terminals (7, 10.4%), and standalone LANs (5, 7.5%) were next in order. One respondent (1.5%) indicated using standalone PCs and 3 (4.5%) some combination of a 'distributed' hardware configuration. Using our classification of these choices, 36% of EIS adopters use centralized architectures for their application delivery, 55.2% use some form of distributed configuration, and 9% of EIS adopters use decentralized architectures (see Table 2).

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamism</td>
<td>207</td>
<td>1</td>
<td>7</td>
<td>4.02</td>
<td>1.15</td>
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<td>Heterogeneity</td>
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<td>4.04</td>
<td>1.51</td>
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<tr>
<td>Hostility</td>
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<td>1</td>
<td>7</td>
<td>4.54</td>
<td>1.42</td>
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<td>Size-related Factors</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ISD Size</td>
<td>170</td>
<td>.69</td>
<td>6.35</td>
<td>3.26</td>
<td>1.22</td>
</tr>
<tr>
<td>Firm Size</td>
<td>132</td>
<td>3.18</td>
<td>11.99</td>
<td>7.01</td>
<td>1.75</td>
</tr>
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</table>

Table 1: Descriptive Statistics - Environmental Characteristics and Size-related Variables

<table>
<thead>
<tr>
<th>EIS Capabilities</th>
<th>n</th>
<th>Non-adopters (%)</th>
<th>Adopters (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication Support</td>
<td>210</td>
<td>152 (72.4%)</td>
<td>58 (27.6%)</td>
</tr>
<tr>
<td>Coordination Support</td>
<td>210</td>
<td>128 (76.7%)</td>
<td>49 (23.3%)</td>
</tr>
<tr>
<td>Control Support</td>
<td>210</td>
<td>156 (74.3%)</td>
<td>54 (25.7%)</td>
</tr>
<tr>
<td>Planning Support</td>
<td>210</td>
<td>142 (80.2%)</td>
<td>35 (19.8%)</td>
</tr>
</tbody>
</table>

Table 2a: Adoption Profile of EIS Capabilities

<table>
<thead>
<tr>
<th>Category</th>
<th>Specific Architectures</th>
<th>n</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralized</td>
<td>Mainframe linked to terminals</td>
<td>7</td>
<td>24 (35.8)</td>
</tr>
<tr>
<td></td>
<td>Mainframe linked to PCs</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Distributed</td>
<td>Mainframe linked to LAN &amp; further linked to PCs</td>
<td>25</td>
<td>37 (55.2)</td>
</tr>
<tr>
<td></td>
<td>Integrated LANs linked to PCs</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other distributed configurations</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Decentralized</td>
<td>Standalone LAN(s) linked to PCs</td>
<td>5</td>
<td>6 (9)</td>
</tr>
<tr>
<td></td>
<td>Standalone PCs</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Table 2b: EIS Architectures Among EIS Adopters

Sector Membership and EIS Adoption

Table 3 shows the adoption of EIS capabilities by sector of the firm. Our sample represents 61 firms (29%) from the non-profit sector, 90 firms (43%) from the manufacturing sector, and 58 firms (28%) from the services sector. A chi-square test was used to test for differences between non-adopters and adopters of EIS capabilities across the three sector groups. No differences were found between non-adopters and adopters of communication, coordination, and control capabilities. Significant differences were found between the proportion of non-adopters and adopters of EIS planning capabilities across the three sector groups. This suggests that there are differences in adoption rates of EIS planning capabilities across the three sectors. Firms in the non-profit sector have the lowest adoption rate of EIS planning capabilities followed by the manufacturing sector and the service sector respectively. EIS adoption may be influenced by the fact that competitive pressures in the for-profit industry require greater use of models and external information sources for environmental scanning purposes than those warranted by the lesser competitive pressure that characterizes the not-for-profit sector.

Size-Related Factors and EIS Adoption

The t-test results for differences in size-related variables
between adopters and non-adopters of EIS capabilities are shown in tables 4, 5, 6, and 7. Differences in the ISD size are observed between non-adopters and adopters of EIS coordination, control, and planning capabilities. No such differences are detected between adopters and non-adopters of EIS capabilities for communication. The relative ease of use and installation of e-mail systems diminishes the need for dedicated IS personnel resources for such applications. On the other hand, applications for coordination, control and planning functions require IS personnel to understand user requirements and translate them into EIS applications through processes such as requirements determination and prototyping. Differences in firm size were found to be significant only between non-adopters and adopters of EIS planning capabilities. The increased complexity of larger organizations suggests that they have a greater need for EIS applications for planning purposes. Hence, this group may be ahead of their smaller counterparts in the adoption of these EIS capabilities.

Environmental Characteristics and EIS Adoption

The mean values of environmental dynamism, heterogeneity, and hostility for non-adopters and adopters of EIS capabilities are summarized in tables 4, 5, 6, and 7. Of the three, hostility has the greatest mean value for both non-adopters and adopters of all EIS capabilities and the mean values of environmental dynamism and heterogeneity for non-adopters are almost identical for all EIS capabilities. In general, adopters of EIS capabilities perceive a more dynamic, heterogeneous, and hostile environment.

<table>
<thead>
<tr>
<th>Sector</th>
<th>EIS Functionality</th>
<th>n</th>
<th>Non-Adopters</th>
<th>Adopters</th>
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<tbody>
<tr>
<td>Non-profit</td>
<td>Communication</td>
<td>61</td>
<td>42</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Coordination</td>
<td>61</td>
<td>44</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>61</td>
<td>48</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Planning*</td>
<td>61</td>
<td>56</td>
<td>5</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Communication</td>
<td>90</td>
<td>70</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Coordination</td>
<td>90</td>
<td>73</td>
<td>17</td>
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<tr>
<td></td>
<td>Control</td>
<td>90</td>
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<tr>
<td></td>
<td>Planning*</td>
<td>90</td>
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<td>Service</td>
<td>Communication</td>
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<td></td>
<td>Control</td>
<td>58</td>
<td>39</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Planning*</td>
<td>58</td>
<td>46</td>
<td>12</td>
</tr>
</tbody>
</table>

* Significant differences between non-adopters and adopters across the three sectors as computed by the Chi-square test (p = 0.03)

Table 3: Sector and Adoption Status of EIS Capabilities

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>Non-Adopters</th>
<th>Adopters</th>
<th>p-value</th>
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<td>Mean</td>
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<td>4.79</td>
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<td>Size-related Factors</td>
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<td>SD</td>
<td>Mean</td>
</tr>
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<td>Natural Log - ISD Size</td>
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<td>3.21</td>
<td>1.18</td>
<td>3.40</td>
</tr>
<tr>
<td>Natural Log - Firm Size</td>
<td>112</td>
<td>7.10</td>
<td>1.72</td>
<td>6.80</td>
</tr>
</tbody>
</table>

n.s. = not significant

Table 4: Mean Differences - EIS Adoption for Communication Support

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>Non-Adopters</th>
<th>Adopters</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Characteristics</td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Dynamism</td>
<td>158</td>
<td>3.90</td>
<td>1.10</td>
<td>4.39</td>
</tr>
<tr>
<td>Heterogeneity</td>
<td>155</td>
<td>3.90</td>
<td>1.49</td>
<td>4.50</td>
</tr>
<tr>
<td>Hostility</td>
<td>156</td>
<td>4.46</td>
<td>1.38</td>
<td>4.80</td>
</tr>
<tr>
<td>Size-related Factors</td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Natural Log - ISD Size</td>
<td>132</td>
<td>3.19</td>
<td>1.19</td>
<td>3.50</td>
</tr>
<tr>
<td>Natural Log - Firm Size</td>
<td>120</td>
<td>7.04</td>
<td>1.69</td>
<td>6.91</td>
</tr>
</tbody>
</table>

n.s. = not significant

Table 5: Mean Differences- EIS Adoption for Coordination Support
heterogeneous, and hostile environment than non-adopters do. Of the three characteristics, greater differences between adopters and non-adopters of EIS capabilities are observed with regard to perceptions of environmental heterogeneity and environmental dynamism, and relatively lesser differences are observed with regard to perception of environmental hostility. A t-test procedure was used to statistically determine any significant differences in environmental dynamism, heterogeneity, and hostility between non-adopters and adopters of each of the four EIS capabilities. Table 4, 5, 6, and 7 also show the results of the t-test procedures. Significant differences were found in the mean scores of environmental dynamism, heterogeneity and hostility between non-adopters and adopters of EIS communication, coordination, control and planning capabilities.

While all three environmental characteristics are significantly associated with the adoption of the four EIS capabilities, one could conjecture from the above that environmental heterogeneity and dynamism are more powerful drivers of the adoption of EIS capabilities. In other words, adoption of EIS capabilities seems to be propelled by the need to collate disparate data as this characterizes dynamic and heterogeneous business environments. Responding to hostility requires that the information system help executives understand forces underlying price and product competition. It appears that EIS capabilities are being adopted with a lesser motivation for these purposes than for the management of disparate data and generation of information from such data. With the increased development of external databases and the advent of intelligent agent technology that enables scanning of external environments for price and product competition, EIS capabilities can be expected to be more helpful in understanding and managing environmental hostility.

### Environmental and Organizational Correlates of EIS Architecture Choice

An analysis of variance was conducted to examine differences between the mean scores for environmental characteristics, firm size and ISD size associated with different EIS configurations. A total of six organizations indicated that they were using decentralized architectures for their EIS. These organizations were not considered as part of this analysis and we, therefore, limited our examination to mean differences in variables between users of centralized and distributed EIS architectures. No differences are observed between both size-related variables and adopters using centralized and distributed EIS architectures. Significant differences are observed in the mean values for all three environmental factors between users of centralized and distributed EIS architectures. Organizations facing higher levels of dynamism, heterogeneity, and hostility are using distributed configurations to a greater degree than organizations facing lesser environmental pressures. This suggests that distributed EIS architectures is being used as a technological design response to increase the information processing capabilities of organizations operating in diverse, volatile, and hostile business environments. A chi-square test did not reveal any differences in the choice of distributed or centralized EIS architectures across sectors. Furthermore, no differences were detected in the number of

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>Non-Adopters</th>
<th>SD</th>
<th>n</th>
<th>Adopters</th>
<th>SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td></td>
<td></td>
<td>Mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamism</td>
<td>153</td>
<td>3.88</td>
<td>1.11</td>
<td>54</td>
<td>4.38</td>
<td>1.17</td>
<td>.004</td>
</tr>
<tr>
<td>Heterogeneity</td>
<td>149</td>
<td>3.85</td>
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<td>53</td>
<td>4.56</td>
<td>1.24</td>
<td>.002</td>
</tr>
<tr>
<td>Hostility</td>
<td>149</td>
<td>4.45</td>
<td>1.45</td>
<td>53</td>
<td>4.78</td>
<td>1.31</td>
<td>.075</td>
</tr>
<tr>
<td><strong>Size-related Factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Log - ISD Size</td>
<td>127</td>
<td>3.15</td>
<td>1.16</td>
<td>43</td>
<td>3.59</td>
<td>1.31</td>
<td>.019</td>
</tr>
<tr>
<td>Natural Log - Firm Size</td>
<td>113</td>
<td>7.05</td>
<td>1.59</td>
<td>44</td>
<td>6.92</td>
<td>1.98</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

n.s. = not significant
adopted EIS capabilities across centralized and distributed EIS architectures.

**Concluding Remarks**

EIS are suggested to have the capabilities to support communication, coordination, control, and planning functions of executives and managers. Being an emerging technology, case studies have dominated research in this area with some empirical studies appearing in the last few years. Building upon past research efforts, our study investigates structural differences between non-adopters and adopters of EIS capabilities across U.S. organizations, the technology choices being made by adopters of EIS, and the structural factors influencing these choices. Table 9 summarizes our results.

Our findings suggest that a majority of organizations have not adopted any EIS capabilities. In a relative sense, more firms are deploying EIS capabilities to support the communication, coordination, and control functions of key executives and managers, while a lesser number are using EIS capabilities to support planning functions. Firms facing higher level of environmental dynamism, heterogeneity, and hostility are more likely to adopt EIS capabilities supporting communication, coordination, control, and planning functions. Dynamism and heterogeneity appear to be stronger determinants of EIS adoption than hostility. Evolution of EIS capabilities may make them more useful to support the execution of managerial functions in hostile environments.

Firms with larger IS departments are more likely to adopt EIS capabilities supporting coordination, control and planning functions. IS personnel resources appear to be important for EIS applications that require requirements determination, cross-functional data integration, and applications prototyping. The know-how and the financial resources to undertake these efforts are likely to be found in organizations that have substantially larger ISDs. Larger firms are more likely to adopt EIS capabilities supporting the planning function. The complexity of these organizations may make available EIS planning capabilities more attractive to them than organizations with lesser complexity. Firms in the not-for-profit sectors appear to have adopted EIS for planning purposes less than firms in the profit-based sectors.

A majority of organizations that have adopted any EIS capabilities have a distributed EIS architecture. Firms

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### Table 8: Mean Differences Between Users of Centralized and Distributed EIS Architectures

<table>
<thead>
<tr>
<th></th>
<th>Centralized</th>
<th>Distributed</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamism</td>
<td>4.10</td>
<td>4.53</td>
<td>.09</td>
</tr>
<tr>
<td>Heterogeneity</td>
<td>4.47</td>
<td>5.01</td>
<td>.10</td>
</tr>
<tr>
<td>Hostility 4.28</td>
<td>4.78</td>
<td>.09</td>
<td></td>
</tr>
<tr>
<td><strong>Size-related Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Log - Firm Size</td>
<td>7.27</td>
<td>6.81</td>
<td>n.s.</td>
</tr>
<tr>
<td>Natural Log - ISD Size</td>
<td>3.45</td>
<td>3.64</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

n.s. = not significant

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### Table 9: Summary of Results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Communication</th>
<th>EIS Adoption for Coordination</th>
<th>Control</th>
<th>Planning</th>
<th>EIS Architecture Centralized or Distributed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamism</td>
<td>**</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>Heterogeneity</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Hostility</td>
<td></td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td><strong>Size-related Factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Log - ISD Size</td>
<td>n.d.</td>
<td>**</td>
<td>*</td>
<td>*</td>
<td>n.d.</td>
</tr>
<tr>
<td><strong>Sector Membership</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not-for-Profit</td>
<td>n.d.</td>
<td>n.d.</td>
<td>n.d.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

nd = no differences detected
* = significant at p < 0.05
** = significant at p <= 0.10

---
with distributed EIS architectures are characterized with higher levels of dynamism, heterogeneity, and hostility than firms with centralized EIS architectures. It appears that distributed systems design is a technological response to manage the dynamic, heterogeneous, and volatile information of uncertain business environments.

While our study provides some interesting insights into the adoption of EIS capabilities across U.S. organizations, it leaves several questions unanswered. There are other structure and process variables that theoretically can impact the adoption of EIS capabilities. Furthermore, research examining variations in usage of EIS and the impacts of EIS on executive decision processes and executive team structures should provide interesting insights on how the benefits of EIS can be best realized by organizations. We did not detect any differences in the number of EIS capabilities adopted across organizations with centralized and distributed EIS architectures. However, any examination of the impact of architecture on the spread of EIS across executives in a given organization is an interesting line of future inquiry. It is likely that such spread is a function of the nature of interaction between characteristics of technology, organization and executive tasks.

References
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Dr. Arkalgud Ramaprasad is professor of MIS and Strategic Management at Southern Illinois University at Carbondale. He is also the Director of the Pontikes Center for the Management of Information. He is active in promoting industry-university collaborations. Dr. Ramaprasad has published several research articles on management of information, design of information systems, and strategic management of information technology. His publications have appeared in Academy of Management Review, Decision Sciences, Strategic Management Journal, Management Science, Journal of Information Systems, IEEE Transactions on Engineering Management, Behavioral Science, Cybernetica and several others. He is a member of the Decision Sciences Institute, INFORMS, and Association for Information Systems.


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