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Introduction

Diffusion of innovation theory has been used to examine various information technology innovations including modern software practices (Zmud, 1982), database machines (Hoffer and Alexander, 1992), CASE tools (Rai, 1990), and customer-based interorganizational systems (Grover, 1990). Premkumar, Ramamurthy, and Nilakanta (1994) found that certain innovation characteristics related to internal and external diffusion of EDI.

This research examines the organizational factors which are expected, according to diffusion of innovation theory, to have correlations with the depth and breadth of EDI implementation in organizations. Emmelhainz (1990) defines EDI as "the inter-organizational exchange of business documentation in structured, machine-processable form." Although EDI has a technical component, its interorganizational nature differentiates it from other information technologies. EDI also represents an important technology for organizations because it may be used in developing strategic information systems.

Extent of EDI Implementation

Alexander (1989) and Rai (1990) followed the recommendation of other researchers (Downs and Mohr, 1976; Tornatzky and Klein, 1982) to use measures of the extent of implementation of an innovation in examining the level of diffusion of innovations. This paper examines two dimensions of the extent of EDI implementation: depth of EDI implementation and breadth of EDI implementation. The depth of EDI implementation refers to the extent to which a particular type of EDI transaction is done via EDI, as opposed to other means. The breadth of EDI implementation refers to the number of different types of transactions being done using EDI, thus indicating how widespread the use of EDI is within the organization. For example, consider an organization which does two transaction types via EDI, invoices and purchase orders. If ten percent of its invoices were done via EDI, and 30 percent of its purchase orders were done via EDI, it would have a depth score of 30. The breadth score wold be two, since it is doing two types of transactions via EDI.

This study examines 12 characteristics of organizations which are expected to impact the extent of EDI implementation: size of the organization, top management support for EDI, top management support for MIS, risk attitude, functional differentiation, external communications, presence of a champion, MIS advocacy for EDI, EDI planning, EDI training, technical expertise, and EDI knowledge.

The size of an organization has consistently been found to be correlated with innovation adoption (Dewar and Dutton, 1986; Rai, 1990; Rogers, 1983). Benjamin, de Long, and Scott Morton (1990) suggest that large manufacturing firms would be likely to use EDI. Top management support has also been found to correlate with extent of implementation of innovations (Rai, 1990). Premkumar and Ramamurthy (1995) found top management support is related to adoption of EDI. Emmelhainz (1988) found that top management support was one of the most frequently cited factors aiding the implementation of EDI. In this study we examine top management support for EDI, and also consider top management support for the MIS function, since MIS is responsible for the technical implementation of EDI. Grover (1990) found that the level of risk top management is willing to accept is positively correlated with adoption of customer-based

interorganizational systems (CIOS). Organizations which have adopted EDI have often done so without calculating paybacks (Emmelhainz, 1988), as might be required in organizations which are more risk averse.

Greater functional differentiation, the degree to which an organization is divided into subunits, can provide more opportunities for deploying EDI. External communications have also been found to be important in explaining the extent of implementation of an innovation (Nilakanta and Scamell, 1990; Rai, 1990). The existence of a champion of the innovation has been found to correlate with extent of implementation of an innovation (Hoffer and Alexander, 1992; Rai, 1990). Emmelhainz found that a talented and competent advocate was the factor most often identified as aiding the implementation of EDI. Swatman and Swatman (1992) quote a 1987 Butler Cox report on EDI which suggests that, in addition to senior management support, a complementary effort may be needed by the MIS function to promote the use of EDI. The existence of technical expertise in an organization has been found to correlate with innovation adoption (Bigoness and Perrault, 1981; Dewar and Dutton, 1986), and this expertise may also enable an organization to attain greater levels of implementation.

Three other factors included in this study relate to the organization's EDI resources: the degree of EDI planning within the organization, the availability of EDI training, and the level of knowledge an organization has about EDI. Rai (1990) and Grover (1990) found that training was correlated with extent of implementation. Planning may lead to improved implementation and concomitantly higher levels of implementation.

Methodology

A national (U.S.) survey of EDI users was conducted to collect data for this study. A list of EDI user companies and contact people was obtained from EDI, Spread the Word. A total of 235 usable responses were used to analyze the relationships.

Organization size has consistently been found to be related to extent of implementation of IT innovations. Organization size is very strongly related (.301) to breadth of EDI implementation, and fairly strongly related (.199) to depth of EDI implementation. Larger organizations may be in a stronger position to encourage their trading partners to use EDI. They may also gain from economies of scale, spreading the overhead costs associated with EDI over a greater number of transactions. To control for the effects of size, partial correlational analysis was performed controlling for size. The results of the analysis are provided in Table 1.

Results and Discussion

Top management support for EDI is weakly related to both breadth and depth of EDI implementation, raising the question of how important this support is for EDI. Top management support for the MIS function is not related to either depth or breadth of EDI implementation. An organization's attitude toward risk is related to the breadth of EDI implementation, but not to depth. The attitude toward risk may help encourage functional units to try EDI. Functional differentiation is related to breadth of implementation, but not to depth. Having more specialized functional areas may lead to greater opportunities for using EDI.

The existence of an EDI advocate in the organization is related to both breadth and depth of EDI implementation, consistent with previous research. It is interesting that the MIS advocacy of EDI is related to depth of EDI implementation, but not to breadth. We expected that MIS advocacy would stimulate the use of EDI throughout the organization (breadth), but the reality may be that only a few functional areas are swayed. EDI planning is related to depth of EDI implementation, but is not related to breadth. The availability of training for EDI is related to both depth and depth of EDI implementation, suggesting that training can help stimulate the use of EDI in the organization. We must be careful not to assume causality; it could be that greater levels of EDI implementation are requiring more training. The existence of technical expertise in the organization is not related to either breadth or depth of EDI implementation. This suggests

that the technical issues of EDI implementation do not require a high degree of technical ability. However, EDI knowledge is highly correlated with both breadth and depth of EDI implementation. We can argue that these organizations may have knowledge of the benefits of EDI, and thus are increasing the use of EDI, but cannot assume causality.

Variable	Breadth	p-value	Depth	p-value
Top Mgmt Support - EDI	.123	0.060	.122	0.064
Top Mgmt Support - MIS	.080	0.222	.015	0.817
Risk Acceptance	.119	0.070	-.017	0.796
Functional Differentiation	.194	0.003	.074	0.269
External Communication	.160	0.014	.116	0.078
Champion	.193	0.003	.188	0.004
MIS Advocacy	.107	0.104	.126	0.056
EDI Planning	.067	0.308	.216	0.001
EDI Training	.195	0.003	.159	0.015
Technical Expertise	.080	0.224	.059	0.369
EDI Knowledge	.302	0.000	.230	0.000

0Table 1. Partial Correlations of Organizational Variables with Breadth and Depth of EDI Implementation Controlling for Size.

These results suggest that organizations can improve their implementation of EDI by increasing their knowledge and providing EDI training. Greater risk acceptance, increased functional differentiation, and a greater degree of external communications can help organizations make more widespread use of EDI in the organization. Managers looking to improve their implementation of EDI should consider the factors they can influence to bring about the results they desire.

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