AN EMPIRICAL INVESTIGATION INTO INTERORGANIZATIONAL SYSTEMS INTEGRATION, AND ORGANIZATION PERFORMANCE IN THE GROUP INSURANCE INDUSTRY

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Gregory E. Truman

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Abstract

Interorganizational Systems (IOS) are increasingly used to support exchange of business documents in many industries. Though clear improvements in organization performance are forthcoming in many cases, the research evidence is based largely on anecdotes and suggests that performance improvements may not be uniformly attained across organizations. Though integration of IOS with internal systems is recommended, the affects afforded through integration remain largely unexplored. This research study formulates a theoretical model of the complex interplay of relationships among IOS Usage, Systems Integration and Organization Performance, and tests the model's validity using a dataset of 48 organizations in the Group Insurance industry. The model recognizes two conceptually distinct ways in which IOS may be used more intensively, includes two notions of systems integration which are argued to differentially affect the organization performance advantages, and uses a multidimensional organization performance construct to more adequately reflect the diversity of anticipated organization performance impacts presumed to extend from IOS use. The results are mixed in terms of direct organization performance impacts, and suggest that both notions of integration play a key role in facilitating attainment of the organization performance advantages.

1. Introduction

Resources dedicated to information technology (IT) have been traditionally directed towards increasing the firm's internal operating efficiency or improving managerial decision-making [Boddy and Buchanan 1984]. More contemporary views however recognize IT as enabling strategic or competitive advantages, and, in consequence, suggest inclusion of IT as an integral element of the firm's strategy.[1] One *form* of IT considered particularly useful for enabling competitive advantage is manifested in ***inter***organizational information systems (IOS)[2] [Bakos 1991, Gurbaxani and Whang 1991, Venkatraman and Kambil 1991, Venkatraman and Zaheer 1990, Hansen and Hill 1989, Clemons and Row 1988, Copeland and McKenney 1988, Johnston and Vitale 1988, Cash and Konsynski 1985, Porter and Millar 1985, Barrett and Konsynski 1982].

Though use and acceptance of IOS technology have been impeded by technological (e.g., communication infrastructure) and cultural constraints, their increasing pervasiveness is probable as both constraints are likely to weaken. Indeed, Straub and Wetherbe (1989)[3] reported communication technologies, including IOS, second in key technologies impacting organizational outcomes, structures, processes and cultures during the 1990s. Additionally, in 1989 there were 10,000 users of IOS arrangements with anticipated annual growth advancing by 40% providing, according to estimates, 75,000 corporate users connected into an IOS-

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[1] There has been a dramatic increase of research in recent years on the strategic advantages made possible through use of IT. A few of the more notable works include: Bakos 1991, Banker and Kauffman 1991, Barua et al 1991, Clemons 1991, Gurbaxani and Whang 1991, Venkatraman and Kambil 1991, Feeny and Ives 1990, Floyd and Wooldridge 1990, Jarvenpaa and Ives 1990, Kim and Michelman 1990, Venkatraman and Zaheer 1990, Clark 1989, Tavakolian 1989, Banker and Kauffman 1988, Copeland and McKenny 1988, Clemons and Row 1988, Ives and Vitale 1988, Johnston and Carrico 1988, Johnston and Vitale 1988, Clemons and Row 1987, Doll and Vonderembse 1987, Bakos and Treacy 1986, Beath and Ives 1986, Clemons 1986, Clemons and Kimbrough 1986, Vitale et al 1986, Cash and Konsynski 1985, Clemons and Row 1985, Porter and Miller 1985, Rackoff et al 1985, Gerstein and Reisman 1985, Ives and Learmonth 1984, Wiseman and MacMillan 1984, MacMillan 1983, and Barrett and Konsynski 1982.

[2] An IOS is defined as any computerized system assuming a boundary-spanning role, facilitating exchange of data between an organization and its environment for the realization of specific organizational goals, and whose legitimacy is based on formalized agreement between an organization and other organizations of its environment.

[3] They reported results of a Delphi Survey involving twelve experts, from business as well as academia, of the information systems field.

mediated business relationship by 1995 [Dreyer 1989].[4]

These trends signal that the 1990s will witness substantial expansion of IOS use, increasing both across and within industries. Though some organizations are forced into IOS relationships by other organizations [Bouchard 1993], many organizations elect to enter IOS-mediated relationships due to the proposed organization performance advantages. Many research studies on IOS, particularly early ones, have accepted that the anticipated organization performance advantages will be universally forthcoming simply through greater IOS use. Of these works, the majority has offered only limited anecdotal evidence to support this position however. Moreover, few studies have examined the level of integration between IOS and internal application systems, and the level of integration among internal systems separate from IOS, as moderating the extent to which the organization performance advantages obtain through IOS use. Finally, many studies have defined organization performance narrowly, when the theoretical organization performance impacts are broad and diverse.

1.1 Research Goal

This field study attempts to overcome prior weaknesses of studies relating IOS use to organization performance by testing a theoretically-supported model using data collected from 48 organizations in the Group Insurance industry. The model recognizes two conceptually distinct ways in which IOS may be used more intensively, includes two separate notions of systems integration which are argued to differentially affect the organization performance advantages, and uses a multidimensional organization performance construct to more adequately reflect the diversity of anticipated organization performance impacts.

This paper is organized as follows. Section 2 reviews literature on IOS. Section 3 introduces a theoretically-grounded research model which suggests a complex interplay among variables representing the IOS Usage, Systems Integration and Organization Performance constructs. Formal propositions extend from the research model. Section 4 presents the research methodology, followed by presentation of results in Section 5. A discussion regarding

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[4] See EDI Research, Inc. (1988) for additional survey information regarding IOS growth. (EDI, referred to as electronic data interchange and limited to transaction processing systems, is subsumed by the more inclusive term of IOS.)

the findings, research extensions and study limitations proceeds in Section 6. Finally, conclusions and contributions are provided in Section 7.

2. Literature Review

IOS research may be characterized as pursuant to two streams of research: conceptual and empirical. Conceptual works have examined the varying technological nature [Barrett and Konsynski 1982] and management aspects [Emmelhainz 1993] of IOS. Moreover, a large body of conceptual works has prescribed methods, based on various theoretical frameworks,[5] revealing how IOS may grant strategic or competitive advantages [Bakos 1991, Gurbaxani and Whang 1991, Johnston and Vitale 1988, Cash and Konsynski 1985, Cash 1985, Porter and Miller 1985, Parsons 1983][6]. And a subset of these prescriptive works has examined conditions under which the strategic advantages may be sustainable [Clemons and Row 1987, Clemons and Kimbrough 1986]. These collective results suggest that the strategic advantages extending from IOS use may be manifested in IOS-induced alterations in industry structures and markets, changes in the firm's relationships with suppliers and customers, or incorporations of IT as an element of the firms' process or product. Though these prescriptive works appeal to theory, and some offer convincing theoretical analyses regarding potential IOS effects [Bakos 1991 and Gurbaxani and Whang 1991], their reliance on supporting anecdotes diminishes the prescriptive frameworks' validity.

The empirical research includes both case study and survey methodologies. Using case study methodology, researchers investigated IOS impacts on industry structures [Venkatraman and Kambil 1991], organization strategies [Clemons and Row 1988, Copeland and McKenny 1988], and organization processes [McGee 1991, Hart and Estrin 1991]. More specifically, Hart and Estrin find three general themes emerging from their analyses—IOS relationships invoke management issues surrounding coordination, integration and interdependence. Their findings,

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[5] The commonly used theoretical frameworks include Porter's (1980) framework for industry structure analysis [Johnston and Vitale 1988, Porter and Miller 1985, Cash and Konsynski 1985, Cash 1985, Parsons 1983], Porter's (1985) generic strategies [Porter and Miller 1985, Parsons 1983], Porter's (1985) value added chain perspective [Porter and Miller 1985], and Williamson's (1975) transaction cost theory [Bakos and Treacy 1986].

[6] Some adopt IOS as the primary focus of analysis [Johnston and Vitale 1988, Cash and Konsynski 1985, Cash 1985, Porter and Miller 1985], while others address IT more generally but include specific analyses of IOS [Bakos 1991, Gurbaxani and Whang 1991, Parsons 1983].

generally confirmed by McGee's analyses on firms of different industries, indicate that increased coordination between firms is contingent on integrating IOS systems with internal systems (Interface Integration), which in turn is contingent on the level of integration among the internal systems (Internal Integration). They have identified two important factors that may influence the extent to which the expected organization performance advantages are actually realized, which, collectively, have been overlooked in prior survey research studies on IOS performance impacts.

Survey research on IOS impacts include Hanson and Hill (1989), Venkatraman and Zaheer (1990) and Nidumolu (1989). Generally characterized as descriptive in nature, Hansen and Hill explored the nature and penetration of IOS by industry, function and company size. Venkatraman and Zaheer assessed IOS impacts on branch performance within the property and casualty insurance industry. Using a quasi-experimental design, they found support for a higher percentage increase in new business policies for the group using IOS technology compared to the group not using IOS six months after IOS deployment. No difference was found on three other measures of effectiveness and efficiency. Nidumolu (1989) investigated the effects of IOS use on constructs of interorganizational form and climate, which he cast as characteristics of organizational relationships. He found an increase in vertical interactions and a uniform improvement in all climate constructs resulting from IOS use. However IOS use also led to an increase in centralization of decision-making activity by *one* member of the IOS relationship, which was portrayed as a negative impact.

Though significant empirical research contributions, Venkatraman and Zaheer (1990) and Nidumolu (1989) used dichotomous measures for the IOS usage variable--use or non-use. It is argued here that the efficacy of dichotomous measures may be challenged, since they fail to tap into the *intensity* and *variety*[7] of IOS usage. For the issue from management's perspective is *typically* not one of use or nonuse, but rather how and how much use. Continuous measures representing dimensions of IOS usage may better inform on IOS impacts, and may offer alternatives, options or parameters for formulating IOS management strategies.

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[7] There are two conceptually distinct ways in which IOS may be used more intensively and are discussed in section 3.2.

Furthermore, Venkatraman and Zaheer (1990) used a unidimensional construct as the dependent variable--level and growth of organization output. Existing literature suggests that the set of IOS impacts on organization performance is multidimensional, broad and diverse however. To operationalize organization performance too narrowly may cause some IOS impacts to go undetected.

This collection of IOS research work has contributed valuably to the IOS research domain, yet each of the empirical works has notable methodological weaknesses. Designed and executed with the objective of overcoming these weaknesses and providing a more comprehensive effort to understand the complex relationships among IOS Usage, Systems Integration and Organization Performance, this research study may contribute to the IOS research domain by:

I. Using two continuous-scale IOS usage variables which measure the intensity and variety of IOS usage heretofore neglected in IOS research;

II. Examining how integration between IOS and internal systems (Interface Integration), and among internal systems separate from IOS (Internal Integration), moderate how IOS use may impact organization performance;

III. Adopting a multi-dimensional notion of organization performance advantages, which more adequately accounts for the theoretical organization performance impacts extending from IOS use; and

IV. Performing survey research at the organizational level-of-analysis which allows for some limited degree of generalizability.

3. The IOS Management Model

Beginning with a theoretical argument addressing the general relationship between IOS use and organizational performance, this section continues elaboration of a model--termed the IOS Management Model, through inclusion of two integration variables: (1) the level of integration between the IOS and internal systems; and (2) the level of integration among the internal systems.

3.1 IOS Usage and Organization Performance

Different perspectives of organizations allow researchers to adopt varying analytic postures from which to investigate, examine and explore various features of organizations and their relationships. Organizations as rational, natural and open systems are three traditional

perspectives in the organizational literature [Scott 1981]. The open systems perspective conceives of an organization as an entity (or system of "sub-entities") requiring exchange with its environment to nurture its survival.

Generally speaking, an organization's ***exchange*** with its environment creates problems which the organization must contend with. Aldrich and Mindlin (1978) identify two essential forms of exchange: resources and information. Resource acquisition from and provision to the task environment present problems of dependency, while information exchange presents problems of uncertainty.[8] Though varying degrees of environmental dimensions[9] are proposed to affect dependency and uncertainty levels [Pfeffer and Salancik 1978, Thompson 1967, Dill 1958], it is generally accepted that all organizations confront some problems of dependency and uncertainty with their task environment.

The sources and characteristics of these interdependent relationships between an organization and its task environment form the basic premise of Pfeffer and Salancik's Resource Dependency theory [Pfeffer and Salancik 1978]. They argue that skillful management of these interdependent relationships is key to continued resource acquisition and, consequently, the ability to attain satisfactory levels of organizational effectiveness and efficiency. And in the ***process*** of enacting strategies and actions to manage interdependencies, a common objective is uncertainty reduction for both organizations. Pfeffer and Salancik (1978) write:

> "...interdependence characterizes individuals (organizations) transacting in the same environment, with the connection being through the flow of transactions. We can also see that interdependence can create problems of uncertainty or unpredictability for the organization. This uncertainty, which is typically troublesome to organizations, derives from the lack of coordination of activities among social units. Organizations facing uncertainty attempt to cope with it on occasion by ***restructuring their exchange relationships***." (p.42) (emphasis mine); and

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[8] When an organization's core business activity consists primarily of information exchange, which applies to many service industries such as insurance and financial services, then information becomes a resource in Aldrich and Mindlin's (1978) terms and its exchange can lead to problems of dependency as well as uncertainty. Given this study's sample industry (see section **Error! Reference source not found.**), for purposes of subsequent discussion information exchange will be assumed to present problems of dependency ***and*** uncertainty

[9] See Dess and Beard (1984) for identification of environmental dimensions.

> "Most importantly, ..., to solve their problems of uncertainty regarding outcomes, (organizations) are likely to be led to increase their interdependence with respect to behavior, that is, ***to interstructure their behaviors in ways predictable for each***. The typical solution to problems of interdependence and uncertainty involves increasing coordination, which means increasing the mutual control over each others' activities..." (p.43) (emphasis mine); and
>
> "A recurrent theme reported in this book has been that organizations attempt to manage or avoid uncertainty. Rather than accepting uncertainty as an unavoidable fate, organizations seek to ***create around themselves more stable and predictable environments***. Thus, to forecast increasingly turbulent and unpredictable environments is to simultaneously predict attempts to create negotiated, predictable environments." (p. 282) (emphasis mine).

IOS by definition mediate the exchange of data, information or transactions between two interdependent organizations. IOS represent a restructuring of the exchange relationship by automating an exchange process supported with advanced computer hardware, software and communications technologies. IOS replace manual procedures and processes, and impose data standards to facilitate a shared, common meaning. Additionally, the automated nature of IOS exchange processes increases the degree of formalization, which more uniformly and consistently enforces controls embedded in all exchange processes.

In general, IOS effect an increased ability to pattern, pace, control and solidify[10] interorganizational relationships, thereby reducing uncertainty and enhancing coordination between organizations [Hart and Estrin 1991, Nidumolu 1989]. IOS are a form of negotiated environment; they are a mechanism to interstructure the organizations' behaviors (i.e., their goals, procedures and tasks), thereby creating more stable and predictable environments. Thus, according to Pfeffer and Salancik's theoretical framework and as depicted in the model of Figure 3-1: The IOS Management Model (1), IOS usage will enable an organization to more effectively manage its interdependent relationships, ensure acquisition of critical resources and information, and attain more effective and efficient organization performance.

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[10] Solidify is intended to convey the idea that IOS generally increase switching costs [Nault and Dexter 1993].

The notion of organization performance is broad and diverse however, varying according to the considered constituency [Cameron and Whetton 1983]. This diversity is reflected by an array of anecdotal evidence which suggests certain organization performance advantages, including a reduction in ***costs*** [Barrett and Konsynski 1982, Cash and Konsynski 1985, Dreyer 1989, Hansen and Hill 1989, Johnston and Vitale 1988, Simmons 1989], an increase in ***output*** [Hansen and Hill 1989, Johnston and Vitale 1988, Venkatraman and Zaheer 1990] and an improvement in ***quality*** [Hansen and Hill 1989, Johnston and Vitale 1988], are universally forthcoming from IOS use. Given this multidimensional set of organization performance impacts which are theoretically presumed to occur, it is appropriate to adequately account for them all in research design.

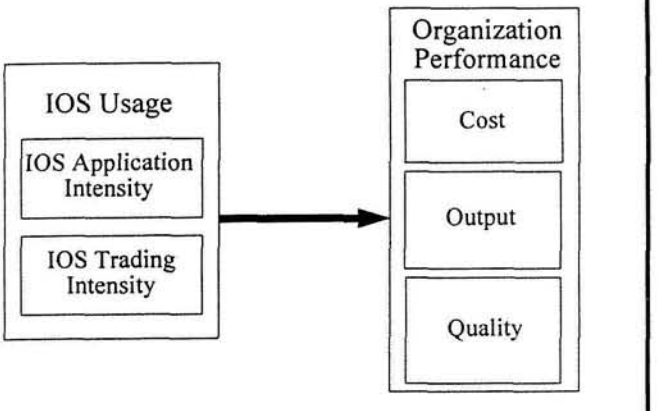

Figure 3-1: The IOS Management Model (1)

3.1.1 IOS Impacts on Costs

Using Williamson's transaction cost theory, Malone et al (1987) argued that information technology will have a comparatively greater impact on reducing transaction costs over coordination costs, thus inducing an inclination to use of market governance structures over hierarchical ones. These comparative impacts and possible shifts in the preponderance of governance structures notwithstanding, their argument for reduced transaction costs is especially germane here. IOS, due to their comparative speed, efficiency and accuracy in contrast to manual systems,[11] offer organizations viable means to reduce transaction costs. The increased speed reduces uncertainty, thereby improving coordination between two organizations (Hart and Estrin 1991); the improved efficiency is rooted in more effective controls and in the lower variable cost associated with automated exchange compared to

[11] Manual systems are defined as inhering two distinctive characteristics: (1) the mode through which information is transferred among tasks, roles or people is primarily via paper; and (2) the controls, which exist in all systems, are embedded in human attention, decision-making and procedure.

manual exchange (Nault and Dexter 1993);[12] and accuracy is improved since (typically) less data transcription among paper documents occurs. Collectively, these effects may reduce transaction costs. Though the manifestation of transaction costs will vary across industries, in service industries, which are considered paper-intensive, a large share of organizations' transaction costs are incurred as labor expenditures.[13] The following proposition is made:

Proposition 1^C: IOS Usage and Cost are negatively associated.

3.1.2 IOS Impacts on Output

IOS are often implemented with strategic intentions or motives [Bakos 1991, Barrett and Konsynski 1982, Cash and Konsynski 1985, Clemons and Row 1988, Copeland and McKenney 1988, Gurbaxani and Whang 1991, Hansen and Hill 1989, Johnston and Vitale 1988, Porter and Millar 1985, Venkatraman and Kambil 1991, Venkatraman and Zaheer 1990], which may inhere several distinct directions or goals [Bakos and Treacy 1986]. Discussing IT more generally, Bakos and Treacy (1986) identify three levels of strategy at which IT-based strategic initiatives may occur: internal strategy, competitive strategy and business portfolio strategy. Though IOS as an internal strategy or business portfolio strategy tool was not precluded in their discussion, Bakos and Treacy (1986) specifically cite IOS as a competitive strategy tool.

In the context of competitive strategy initiatives, IOS technology as the tool may add value to or differentiate an organization's products or services (Porter and Miller 1985, Johnston and Vitale 1988, Johnston and Lawrence 1988). As these competitive advantages are exacted through IOS augmentation of the product or service, a product-pull through effect may arise which increases the demand for the organization's product or service (Nault and Dexter 1993). Consequently may increase demand for an organization's product or service via a

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[12] The cost structure of the transaction costs associated with information exchange between organizations changes subsequent to IOS introduction. Manual systems inhere comparatively lower fixed and higher variable costs, while IOS typically require higher fixed and lower variable costs (Nault and Dexter 1993).

[13] This point is stressed with regard for the specific Cost measures adopted in this study. These are presented in section 4.3.5 Measures of the Organization Performance Variables.

product-pull through effect.[14] Therefore another theoretical impact of IOS use is an increase in the output or volume of the organization's product or service. The following proposition is made:

Proposition 1^{O}: IOS Usage and Output are positively associated..

3.1.3 IOS Impacts on Quality

Keen (1986) has extensively discussed the use of information technology for competing on the dimension of time. If an organization is able to execute business processes faster than their competitors (i.e., to reduce transaction cycle times), it may attain a competitive advantage when time compression adds value, either real or perceived, to the product or service. IOS, due to their comparative speed advantage over manual systems, provide the capability to exchange information faster and reduce transaction cycle times, effectively compressing transaction cycle time. Therefore another theoretical impact of IOS use may be improved quality of the organization's product or service, where quality reflects notions of reduced transaction processing cycles or compressed time.

Notions of quality extend beyond "doing things faster" for the customer. Customers also prefer to have a product or service delivered to them accurately, without error. As discussed earlier, automated data exchange between two organizations creates an opportunity to embed more effective controls into the exchange process [Zuboff 1982, Leavitt and Whisler 1958]. This feature, in addition to the (typical) need for less data transcription, may result in lower error rates. Consequently another theoretical impact of IOS use may be improved quality of the organization's product or service, where quality reflects notions of improved accuracy or fewer errors. The following proposition[15] is made:

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[14] A qualification to this statement is merited. In instances of industry expansion, an increasing demand is not necessarily indicative of improved competitive position. Only in situations of industry stagnation and contraction could such a claim be made. It is argued that since the study will focus on data limited to a single industry, it can be assumed that all organizations confront the same competitive conditions. Therefore, though all organizations' business volume may be increasing, ***greater*** increases vis-a-vis competitors are reflective of improved competitive positions. So long as the measure is standardized, this trend can be detected if it indeed exists.

[15] The specific Quality measures employed in this study are indicators of ***poor*** quality. Therefore a negative correlation confers a positive relationship between IOS Usage and Quality, while a positive correlation confers a negative or inverse relationship between IOS Usage and Quality.

Proposition 1^Q: IOS Usage and Quality are positively associated.

3.2 IOS Usage

Dichotomous operationalizations of IOS Usage are avoided because (i) they do not reflect any notion of usage intensity, and (ii) they do not acknowledge two conceptually distinct ways to proceed with IOS implementation (Mukhopadhyay 1993, Massetti 1991). These two IOS Usage variables are referred to as IOS Application Intensity and IOS Trading Intensity, and are similar to Keen's (1991) notions of "reach" and "range" respectively.

3.2.1 IOS Application Intensity

Figure 3-2 provides a conceptual depiction of an organization operating in an environment where two exchange systems are available: automated systems (i.e., the IOS) and manual systems. Presumably organizations will gradually shift away from manual systems to automated systems due to the presumed organization performance advantages, though their ability to impose automated systems on other organizations (i.e., their trading partners) may be limited [Bouchard 1993].

Notwithstanding this limitation, IOS Application Intensity gauges this shift away from reliance on manual systems and towards greater use of automated systems. The IOS Application Intensity variable measures how comprising an organization's automated systems are in terms of the number and percentage of trading partners exchanging documents via the automated systems.

3.2.2 IOS Trading Intensity

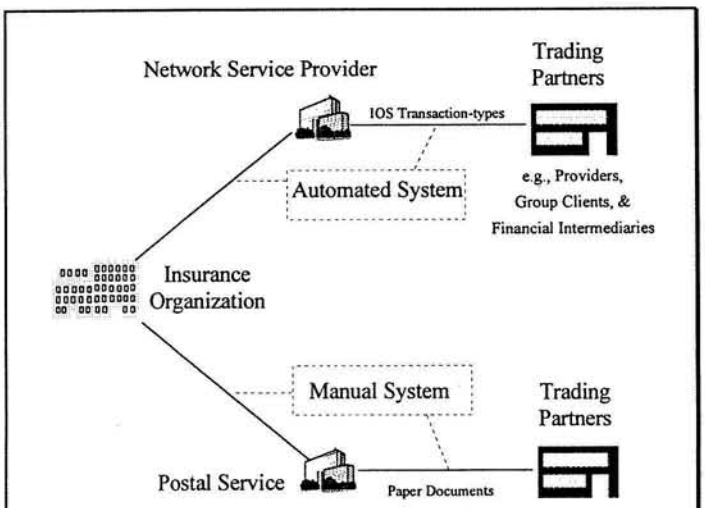

Figure 3-2: A Conceptual Distinction of IOS

Establishing an automated system is typically initiated to accomplish a specific functional objective. In the beginning, the scope of functional objectives is limited as both organizations begin to absorb the substantial organizational change typically induced through introduction of an automated system. Over time the organizations may decide to expand the

scope of functionality supported through automated systems.

This functional evolution is typically characterized by incremental implementation of IOS transaction-types between an organization and its trading partners. The IOS Trading Intensity variable measures the functional scope or extensiveness of the organization's implemented IOS technology.

3.3 Integration as a Moderating Factor

Prior research suggests that the level of integration between the IOS and internal systems [Mukhopodhyay 1993, Swatman and Swatman 1991, Hart and Estrin 1991 and McGee 1991], and among the internal systems [Hart and Estrin 1991 and McGee 1991], may affect the performance advantages afforded through IOS use. Because these propositions remain empirically unconfirmed, an attempt is made to address this issue. A theoretical argument to support subsequent propositions is drawn from Lawrence and Lorschs' (1967) theoretical work on organizations and their environments.

Lawrence and Lorschs' theoretical framework on organizations and environments suggest that out of varying environmental demands rise the efficacy of differentiating organizational subunits along certain dimensions, causing need for integrating their interdependent activities. Supported through empirical analyses, their argument indicates that appropriate integrative devices for coordinating the activities of differentiated organizational subunits will lead to improved performance. Though their use of the term 'integration' was more comprehensive in meaning, IT is one instrument to furnish integrative mechanisms.[16] Therefore IT as an integrative device may, according to theoretical rationale, improve organizational performance through its potential as a coordination-enhancing device.

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[16] Though IT is not specifically mentioned as an integrative device, it is assumed that Lawrence and Lorsch's use of the term 'paper systems' is intended to include computerized information systems. In a latter chapter entitled "Implications for Practical Affairs", they discuss control systems, payment systems, manpower selection, placement and promotion systems as specific management practices or options for attaining appropriate levels of integration in response to varying differentiation across subunits. And with regards to control systems, they write: "The degree of uncertainty of information could also be considered in control system design. Are the time interval and the detail of reporting adjusted for variations in certainty? The computer's great and growing capability for processing information makes such a flexibly designed control system an eminently practical choice." (p.226) Had the pervasiveness of computerized information systems in organizations predated their work of 1967, it is conceivable they would have explicitly recognized computerized information systems as an integrative device.

The *application* of IT does not grant uniform integrative support however; rather, there are varying discretionary technological arrangements which may mitigate the integration effects afforded by it. Though most computers used in business are general purpose, IT is inherently varied across types (e.g., mainframes, midrange, micros), and across hardware and software vendors (e.g., Apple, IBM, Hewlett-Packard, Dell, etc.). Moreover, there are near-infinite design options in the development of application systems (e.g., centralized versus decentralized computing architecture, relational versus hierarchical data architecture) which also manifest varied capacities to integrate IT. These and other discretionary technological arrangements afford varying integrative capacities, which, in turn, may influence the organization performance advantages theoretically presumed to extend from integration.

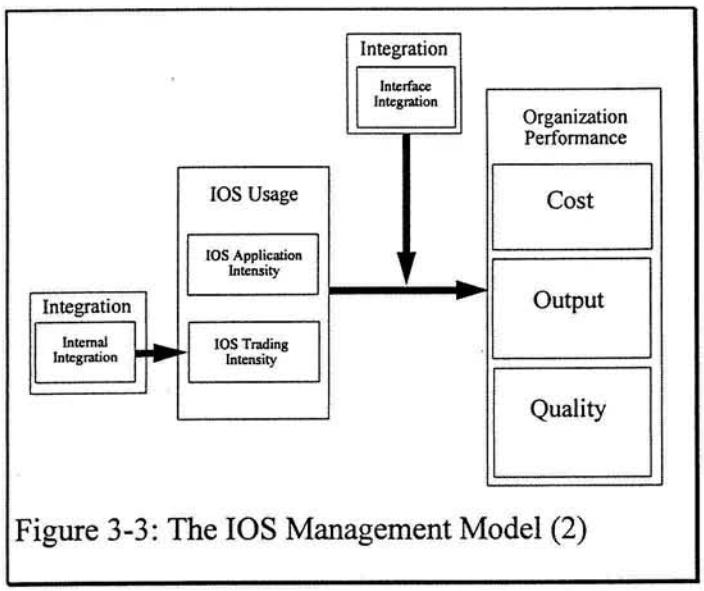

Figure 3-3: The IOS Management Model (2)

McGee (1991) identifies two distinct notions of integration regarding IT generally and IOS specifically. He states:

> "Internal change is logically distinct from interface change and it is important to keep the two notions clear in our minds." (p. 188).

He is suggesting that the level of integration among the internal systems (internal change) and between the internal systems and IOS (interface change) are logically distinct. Each representing a distinct integration concept, both are included in the IOS Management Model and are referred to as Interface Integration and Internal Integration (refer to Figure 3-3: The IOS Management Model (2)).

3.3.1 Interface Integration

Mukhopadhyay (1993), Emmelhainz (1993), Swatman and Swatman (1991), McGee (1991) and Hart and Estrin (1991) have recognized that high integration between IOS and respective internal systems may be critical for obtaining satisfactory performance levels from

IOS, but this issue remains empirically unexplored. Though organizations would logically strive for high integration between IOS and internal systems, in practice high levels of integration appear elusive with substantive variation in actual integration levels across organizations. McGee (1991) writes:

> "One aspect of the technical architecture of boundary systems (IOS) which appears to discriminate among sites is the extent to which boundary systems are integrated with existing transaction processing systems (internal systems)." (p.155)

Interface Integration is intended to characterize the movement of data between IOS and internal systems. Under conditions of high Interface Integration, the data move across the interface in a relatively seamless and automated fashion with little or no manual intervention. Under conditions of low Interface Integration, the movement of data is disjoint, interrupted, and awkward, requiring substantial manual intervention. In the worst case scenario, extensive rekeying is required to move the data into the internal application system.

These contrasting scenarios convey how differently IOS may be implemented across organizations. Moreover, these scenarios suggest that Interface Integration may moderate the relationship between IOS Usage and Organization Performance, with higher Interface Integration strengthening and lower Interface Integration weakening the relationship respectively. This relationship is depicted in Figure 3-3: The IOS Management Model (2) and leads to the following proposition:

> *Proposition 2: Interface Integration will moderate the relationship between IOS Usage and Organization Performance, with greater Interface Integration strengthening and lesser Interface Integration weakening the relationship respectively.*

3.3.2 Internal Integration

Hart and Estrin (1991) found that the integration of internal systems influenced the effectiveness of IOS. They state:

> "We also found that effective use of computer networks for exchanging information between firms is related to the extent of internal computing integration within firms." (p. 372)

Moreover, McGee (1991) suggests:

> "If change is limited strictly to what occurs at the interface (increased interface integration), we have not obtained any higher level of inter-organizational integration than was present without the technology." (p. 188)

Both studies allude to *internal* systems integration as a factor associated with effective integration or coordination *between* two organizations through IOS use. Though both studies base their conjecture on qualitative data analyses from a limited set of firms, that both came to similar conclusions in different firms of dissimilar industries is noteworthy. *How* internal systems integration may influence the organization performance advantages derived through IOS use remains obscure however.

Organizations typically require the bi-directional exchange of multiple document-types to support their exchange relationships. For example in the context of a buyer-supplier relationship, two organizations must minimally exchange purchase orders, invoices and remittance advice documents. Since document-types correspond to transaction-types, these same organizations with an IOS-mediated exchange relationship must exchange multiple transaction-types. Though an organization will ideally exchange multiple transaction-types with a trading partner as it seeks to expand the functional scope of and fully support the business relationship through electronic exchange, its ability to do so may be constrained. Manifested in various ways including financial and trading partners' willingness, these constraints may include internal technological impediments. More specifically, it is proposed that an organization's ability to expand the functional scope of electronic exchange is directly dependent on the level of integration among its internal systems.

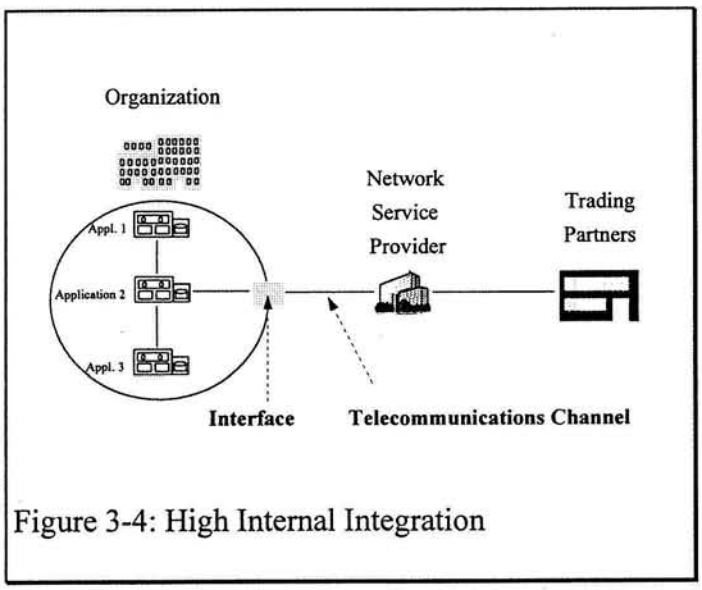

Figure 3-4: High Internal Integration

In the process of implementing IOS an organization must establish an interface to a telecommunication channel, frequently facilitated by a Network Service Provider, which

connects the organization with its task environment. In Figure 3-4 the organization has high integration levels among its internal (application) systems.[17] Under these conditions the organization is well positioned to exchange multiple transaction-types through the single interface and telecommunications channel, since all relevant internal systems may be linked with comparative ease to the interface.

This contrasts to a situation where an organization may have low internal integration as depicted in Figure 3-5. Under these conditions the organization cannot share data among its internal applications in an efficient and cost effective manner. Therefore if it desires to exchange multiple transaction-types with a trading partner, a rational and desirable goal, then it may have to construct a separate interface and establish a separate telecommunications channel for each internal application system. Given the costs and coordination problems associated with this alternative, an organization would not be inclined to pursue this option though the possibility is not precluded. Rather, the organization may be more inclined to redesign the internal applications in order to attain higher internal integration for consideration of IOS implementations.[18]

Notwithstanding the probabilities surrounding the organization's inclinations, it is suggested that organizations with higher levels of internal integration are positioned to implement multiple transaction-types in a more timely and cost effective manner. In contrast, organizations are circumscribed by low internal integration from fully leveraging the functional scope of electronic exchange relationships through implementation of multiple

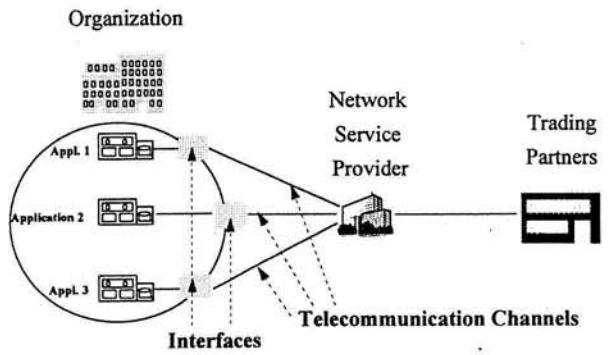

Figure 3-5: Low Internal Integration

[17] There are various technological alternatives for facilitating integration among a set of internal applications. Refer to Wybo (1992) for the more common ones.

[18] Presumably other advantages forthcoming from high internal integration, as identified in Goodhue et al 1992b for example, would provide additional rationale.

transaction-types. The third proposition is:

Proposition 3: Internal Integration and IOS Trading Intensity are positively associated.

4. Method

Methodological details on data sources, the sample industry, variables and measures, reliability and validity testing, and propositions follow.

4.1 Data Sources

Data were collected in two consecutive phases, resulting in use of the 'Combined Method' as presented in Kidder and Judd (1986). Phase 1 involved administration of a survey instrument[19] and collection of secondary data. Phase 2 proceeded with semi-structured personal interviews, conducted with a subset of the organizations of Phase 1. The Combined Method leverages each data collection technique's advantages in order to strengthen interpretation of the results.

4.1.1 Phase 1 Data Collection

Primary and secondary data were collected during Phase 1. Primary data were gathered through a survey instrument, which, after distribution to 66 Group Insurance' organizations, were returned by 48 North American insurance companies representing a 73% response rate. The survey instrument was organized into four sections: (i) general organization data, (ii) IOS data, (iii) internal systems data, and (iv) organization performance data. Different respondents were requested to fill out each section in order to avoid the methodological problem of common-response bias (Kerlinger 1986). In most instances, particularly for the larger companies, different respondents filled out each section. For the smaller companies, the typical case had one respondent provide IOS and internal systems data and a second respondent provide general company and organization performance data. This secured different respondents for data on the independent and dependent variables. According to suggestions put forward in Huber and Power (1985), the typical respondent for sections (ii) and (iii) came from an IS or systems role and for (i) and (iv) from an administrative or line role in order to secure

[19] The survey development process is discussed in Section 4.4 Reliability and Validity.

informed respondents.

Secondary data were obtained from the Life Office Management Association (LOMA) on some Organization Performance measures. LOMA data have been used in prior research studies [Harris and Katz (1991), Harris and Katz (1991b), Bender (1986)]. These data served two purposes: (1) to conduct predictive validity tests and (2) to augment the primary data set for some Organization Performance measures.

4.1.2 Phase 2 Data Collection

Six semi-structured personal interviews constituted Phase 2. These interviews enabled more insightful interpretation of the results extending from the survey data, and were approximately two hours in duration. The interviewees included senior IS project managers intimately involved with the planning and implementation of IOS systems in six Group Insurance companies located in New York, New Jersey and Connecticut.

4.2 The Group Insurance Industry

The Group Insurance industry includes primarily medical, life, disability and dental insurance services, which contrasts to the Personal Insurance industry offering primarily property and casualty insurance services. The Personal Insurance industry has been the sample of prior research studies [Venkatramen and Zaheer 1990], however the Group Insurance industry, to the best of the author's knowledge, has not been.

The Group Insurance Industry consists of several organization sets (Evan 1965). First, there are the insurance companies providing Group Insurance services and are frequently referred to as ***Insurers*** or ***Carriers***, and are the sample organizations. Second, there are the ***Group Clients*** which consist of private and public corporations in all industries. Depending on the contractual arrangements with the Insurer, Group Clients can be divided into ***Full-service Clients*** and ***Administrative Services Only (ASO) Clients***. Full-service Clients contract with the Insurer to underwrite the Group policy, and to perform the primary back-office functions.[20] An ASO Client will contract only for the latter function, while underwriting the insurance coverage

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[20] The primary back-office finctions include maintaining enrollment and eligibility data and processing the claims.

for its own employees. Generally speaking, large corporations will underwrite their own Group policy while contracting with the Carrier to perform the back-office function, since their size enables an adequate spread of risk across their respective pool of employees. Small corporations will typically contract for both underwriting and back-office functions. The ***Payer*** of medical services varies depending on these contractual arrangements. For a Full-service Client, the Insurer is the Payer; for an ASO Client, the Group Client is the Payer.

The third organization set is the health care provider. These organizations include hospitals, private medical practices, Preferred Provider Organizations (PPOs), Health Maintenance Organizations (HMOs) and the like. This organization set is often referred to as ***Providers***. Finally, though their participation is limited, ***Financial Institutions*** form a fourth organization set in their occasional role of distributing claim payments.

4.3 Variables and Measures

The data for IOS Usage and Interface Integration variables are recorded at the transaction-type level, while data for the remaining variables are recorded at the organization level. Transaction-type level data were collected out of methodological concern--the use intensity and integration of IOS systems with internal systems may, and likely will, vary across transaction-types for a given organization [Mukhopadhyay 1993].

Identified through external data sources and pretesting, the set of transaction-types used for IOS Usage and Interface Integration variables was narrowed to five transaction-types: Eligibility, Enrollment, Claim Payment, Claim and Claim Status.[21] The inclusion of these transaction-types, henceforth referred to as the "core" transaction-types, and exclusion of others are based on usage rates as measured by the number of organizations that have implemented the respective transaction-types. (Refer to Table 4-1: Group Insurance Transaction-Types below.) Use of some transaction-types is sufficiently low, indicating a lack of broad-based

[21] PCS Claim and PCS Eligibility are proprietary formats of Prescription Card Services, an intermediary of the medical insurance industry providing the electronic transmission of eligibility and claim data for prescription drugs. As analogues to the Eligibility and Claim transaction-types and functionally equivalent, these data were "rolled into" their more general counterparts for subsequent analyses.

implementation and a possible threat to external validity, to merit their removal.[22]

Claims/Customer Administration Transaction-Types	# of Organizations
Claim	25
Enrollment	18
Claim Payment	10
Claim Status	10
Eligibility	9
PCS Claim ("rolled into" Claim)	6
Crossover Claims	4
HMO Reporting	2
PCS Eligibility ("rolled into" Eligibility)	2
Claim Payment History	2
PPO Reporting/Tapes & Fees	2
Patient Information	1
Claim Statistical Reporting	1
Canada Dental & Pay Direct	1

Table 4-1: Group Insurance Transaction-Types

4.3.1 Measures of the IOS Application Intensity Variable

The IOS Application Intensity variable represents IOS usage intensity in terms of the degree of electronic connectivity which an organization has established with its set of trading partners. Two measures were collected. IOS Application Intensity is measured by the ***number of trading partners*** that the organization has implemented each core transaction-type with, and by the percentage of total exchange volume that is mediated through each respective core transaction-type--referred to as ***electronic exchange volume***. To arrive at an organization-level measure for IOS Application Intensity, the transaction-type level measures are averaged across the core transaction-types. Refer to Figure 4-1 for a hypothetical example using the electronic

[22] To reinforce the efficacy of selecting these five transaction-types, it is important to note that, to date, the Workgroup on EDI (WEDI) has contributed the majority of time and effort for drafting ANSI X.12 standards for these five transaction-types. WEDI is a collection of individuals employed by insurance companies and appointed by their respective organizations, and chartered with the responsibility of drafting ANSI X.12 standards for the Group Insurance industry. To the extent that one accepts WEDI's time and effort as representative of broad-based implementation, use and interest, this provides further face validity that these five transaction-type substantiate the majority of electronic exchange in this industry.

exchange volume measure.

4.3.2 Measures of the IOS Trading Intensity Variable

	Electronic Exchange Volumes						
Organizations	Enrollment	Eligibility	Claim	Claim Status	Claim Payment	IOS Trading Intensity	IOS Application Intensity
1	0%	0%	10%	10%	0%	2	20/2=10%
2	50%	0%	5%	5%	0%	3	60/3=20%
3	0%	0%	0%	0%	0%	0	= 0%
4	5%	5%	5%	5%	0%	4	20/4= 5%
	Transaction-type Level Data (Recorded as Survey Data)					Organization Level Data (Computed/Aggregated)	

Figure 4-1: IOS Application Intensity & IOS Trading Intensity Computation

Reflecting the scope or range of functionality supported by IOS, IOS Trading Intensity is measured according to the ***number of core transaction-types in use*** by the organization. An example of IOS Trading Intensity computation is shown in Figure 4-1.

4.3.3 Measures of the Interface Integration Variable

Interface Integration characterizes the movement of data between IOS and internal systems. Two perceptual measures using Likert scales were used for each core transaction-type to gauge how seamlessly data flow between the IOS and respective internal systems. One measure inquired into the general level of integration between the IOS and internal systems. A second measure inquired into the ease or difficulty by which data flows between the IOS and internal systems. Similar to the IOS Application Intensity variable, the core transaction-type level measures are averaged to attain an organization-level Interface Integration variable.

4.3.4 Measures of the Internal Integration Variable

Six measures of data integration levels within and between the internal systems of three organizational subunits are aggregated to arrive at an organization-level Internal Integration measure. These internal systems include those of the enrollment, eligibility and claims processing subunits (or departments). The theoretical underpinnings and reliability and validity testing of these measures are presented in Truman (1995). Converging at the $p<.01$ level on three of four other measures representative of high Internal Integration, the Internal Integration measure is deemed a valid indicator of the level of integration among the organizations' internal systems.

4.3.5 Measures of the Organization Performance Variables

The Organization Performance variables include measures of cost, output and quality. Selection of corresponding measures is guided by the imperative of identifying less aggregate, more "isolated" IOS effects, thereby departing from frequently used organizational performance measures (e.g., return on assets, profits, etc.). This approach will avoid the undesirable practice of using comparatively aggregate measures sometimes employed in studies relating IT usage or investment to organizational performance [Banker and Kauffman 1988, Cron and Sobol 1983, Floyd and Wooldridge 1990, Venkatraman and Zaheer 1990], which may be obfuscated by effects unrelated to IT . As Panko (1991), in his conclusion to analysis of macro-input and macro-output measures used for assessing office productivity, states:

> "...it is time to stop conducting general IT impact studies for the entire economy and instead, consider studies of the management of IT impacts for departments, individual firms, and individual users."(p.201).

Granted, the studies cited above operationalize organization performance using measures less macro than for the entire economy. However by using measures of less aggregation--moving closer to the intended effect, a researcher is more likely to find existent impacts.

Moreover, aggregate measures contribute little towards understanding the underlying operative mechanisms through which IT usage or investment influences organizational performance. As Crowston and Treacy (1986) state:

> "Other studies use financial performance indicators such as return on assets or total sales. These variables are very aggregate products of the firms' accounting system and are not closely related to information technology impacts." (p. 304); and
>
> "Instead of ... attempting to pick out small variations in, for example, return on investment, we can look at where IT directly impacts the firm and make a much more precise estimate of this impact. Finally, and most importantly, we can discover the contingencies that allow systems to affect firm performance, and prescribe features of systems that will be useful to particular firms." (p. 305).

Given these objectives, selection of the Organization Performance measures are based on and are reflective of *intended* IOS performance advantages in terms of cost, output and quality within the Group Insurance industry.

The Cost measures include the number of total full-time equivalent employees (Total Employees), professional full-time equivalent employees (Professional Employees), and administrative full-time equivalent employees (Administrative Employees). Total Employees

is collected as a nominal figure. Professional Employees and Administrative Employees are computed according to a percentage of Total Employees, specified by the respondent as the proportion of Total Employees performing professional and administrative roles.[23] Separation of labor data into professional and administrative roles is intended to more closely capture any potential IOS impacts, since the IOS included in this study are designed more for support of administrative rather than professional roles.[24] All recorded figures represent employment levels at 1993 year-end. All Cost measures are controlled for organization size effects by dividing by annual premium income.

The Output measures include the number of new policies (New Policies), the number of renewed or retained policies (Renewals) and the number of claims processed (Claims Processed). All three measures are affected by an increase in Full-time Clients; the Claims Processed measure is affected by an increase in ASO Clients only. All recorded figures are for 1993. All Output measures were controlled for organizational size effects by dividing by annual premium income.

The Quality measures include the percentage of claims in error (Claim Error Rate), the time between receipt of claim information and claim payment (Claim Payment Time), and the time required for a policy member to enact a change in enrollment information or terms, e.g., change in marital status or deductible amount (Administrative Change Time). The first Quality measure is a percent measure, while the other Quality measures are scaled on the number of days and reflect averages. All figures are for 1993. The Quality measures are controlled for organizational size effects through statistical control--partialing out the Quality measures' variance accounted for by the Premium Income variable. Refer to Table 4-2 IOS Management Model's Variables and Measures on page 24 for a summary.

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[23] The survey instrument was designed such that the percentage figures had to 100%.

[24] This is generally true of most IOS due to their support of boundary-spanning roles, which are generally more characteristic of administrative, as opposed to professional, roles.

Variable	Variable Description	Measure(s) Description
IOS USAGE		
IOS Application Intensity	Electronic exchange volume as percent of total exchange. Collected at the transaction-type level and averaged across "core" transaction-types for organizational-level measure.	Average of electronic exchange volumes for "core" transaction-types
IOS Trading Intensity	Number of "core" transaction-types implemented	Number of "core" transaction-types implemented
INTEGRATION		
Interface Integration	The level of integration between the "core" transaction-types and respective internal systems	Average of two measures on 7-point scale computed over "core" transaction-types
Internal Integration	The level of integration among the internal systems	Average of six measures on a 0-100 scale reflecting "relative" internal integration
COST		
Total Employees (Adjusted)	Number of Total FTE Group employees per million dollars of premium income	Nominal figure
Professional Employees (Adjusted)	Number of Professional FTE Group employees per million dollars of premium income	Nominal figure--computed as percent of Total Employees
Administrative Employees (Adjusted)	Number of Administrative FTE Group employees per million dollars of premium income	Nominal figure--computed as percent of Total Employees
OUTPUT		
New Policies (Adjusted)	Number of New Group Policies for 1993 per million dollars of premium income	Nominal figure
Renewals (Adjusted)	Number of Renewed Policies for 1993 per million dollars of premium income	Nominal figure
Claims Processed (Adjusted)	Number of Claims Processed for 1993 per million dollars of premium income	Nominal figure
QUALITY		
Claim Error Rate	Of total claims, the percentage held in suspense or requiring successive forms	Percentage
Claim Payment Time	The number of days between claim receipt and claim payment disbursement	Average number of days
Administrative Change Time	The number of days between information receipt and appearance on system for claims/billing	Average number of days

Table 4-2 IOS Management Model's Variables and Measures

4.4 Reliability and Validity

Table 4-3: Reliability and Predictive Validity Tests on page 27 shows the reliability test results for appropriate variables. Inter-item reliability tests were conducted for IOS Application Intensity (at the transaction-type level), Interface Integration (at the transaction-type level),

Internal Integration[25] and the Total Employees variables.

The Electronic Exchange Volume and Number Of Trading Partners measures for IOS Application Intensity are unreliable with alpha values ranging from .00 to .06. Review of the raw data suggests there may have been a misinterpretation as to the meaning of trading partner.[26] Consequently the Number Of Trading Partners as a measure of IOS Application Intensity is considered unreliable, resulting in exclusive use of the Electronic Exchange Volume measure. As a percentage scale measure, Electronic Exchange Volume provides the advantage of controlling for organization size effects.

Two of the five pairs of measures for Interface Integration satisfy the .80 threshold value for Cronbach's α: Claim Payment and Claim have .92 and .94 respectively. The .70 α value for Enrollment is close to the .80 threshold value. Comparatively low are the values for Eligibility (α=.36) and Claim Status (α=.64). Though the reliability of these measures is suspect, the average of the two measures will be maintained in data analyses for lack of alternatives. The measures for Internal Integration are deemed highly reliable due to the .93 α value. The α value for Total Employees is .79.

No reliability testing was conducted for IOS Trading Intensity, Professional Employees, Administrative Employees, the Output measures and Claim Error Rate. Since these measures require largely objective data, this is not considered a major methodological weakness. Moreover, it is noteworthy that IOS Trading Intensity and Premium Income (as a surrogate measure of organizational size) are correlated at .69, $p<.01$ (refer to Table 5-2). Since large organizations are typically early movers in the adoption of new technologies (e.g. IOS) and have greater resources, they are more likely to have implemented a larger number of transaction-types. Therefore, this is offered as evidence of face validity of the IOS Trading Intensity variable.

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[25] As mentioned earlier, the Internal Integration measure was also subjected to convergent validity tests. The measure converged on three of four other measures of Internal Integration at ($p<.01$).

[26] The raw data show that '1' was recorded by many respondents, interpreting 'trading partners' as the 'intermediary' and *not* the end recipient as requested.

4.4.1 Validity Tests

Validity may be discussed in terms of content, predictive/convergent and construct validity [Ives, Olson and Baroudi 1983]. Established through consideration of the process followed in constructing the measuring instrument, ***content validity*** may be justified through pretesting as measures specific to the model's variables are identified according to the sampling population.[27] The survey instrument was pretested by seven individuals: five senior information systems personnel in three insurance companies and two employees of LOMA.

Predictive/Convergent validity is represented through the convergence of two measures for the same variable, but from different data collection instruments and/or data sets. Predictive validity tests have been conducted on three measures using the primary and secondary data sources. The Claim Payment Time and Premium Income measures are significantly correlated at ($p<.01$), providing evidence of predictive validity. The Administrative Change Time measure was not significantly correlated, though this is likely due to the very small 'n' as the correlation is quite high at .53 and in the expected direction.

An assertion of ***Construct validity*** is more tenuous. Given the lack of other empirical data, it is difficult to ascertain whether the constructs are related as hypothesized. No claim of construct validity is made.

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[27] Item-total correlations provide another means to assess content validity, however the survey instrument was not designed for conducting this validity procedure.

Variable	Reliability		Predictive Validity
	Cronbach's α	Items	Pearson's r
IOS USAGE			
IOS Trading Intensity	(no test) ⇒		
IOS Application Intensity	(computed variable)		
IOS Application Intensity by Transaction-types[1]			
Eligibility	.00 (n=9)	2	n/a
Enrollment	.06 (n=20)	2	n/a
Claim Payment	.01 (n=10)	2	n/a
Claim	.00 (n=24)	2	n/a
Claim Status	.00 (n=10)	2	n/a
INTEGRATION			
Interface Integration	(computed variable)		
Interface Integration by Transaction-types[1]			
Eligibility	.36 (n=9)	2	n/a
Enrollment	.70 (n=20)	2	n/a
Claim Payment	.92 (n=10)	2	n/a
Claim	.94 (n=24)	2	n/a
Claim Status	.64 (n=10)	2	n/a
Internal Integration[1]	.93 (n=47)	6	n/a
COST			
Total Employees [1]	.79 (n=33)	2	n/a
Professional Employees	(no test) ⇒		
Administrative Employees	(no test) ⇒		
OUTPUT			
New Policies	(no test) ⇒		
Renewals	(no test) ⇒		
Claims Processed	(no test) ⇒		
QUALITY			
Claim Error Rate	(no test) ⇒		
Claim Payment Time (# of days)[2]	n/a	n/a	.82** (n=12)
Administrative Change Time (# of days) [2]	n/a	n/a	.53 (n=5)
ORGANIZATION SIZE			
Premium Income (millions of dollars) [3]	n/a	n/a	.99** (n=17)

1- Inter-item Reliability; 2- Predictive Validity
**- Significant at the .01 level
*- Significant at the .05 level
n/a- not applicable

Table 4-3: Reliability and Predictive Validity Tests

4.5 Propositions

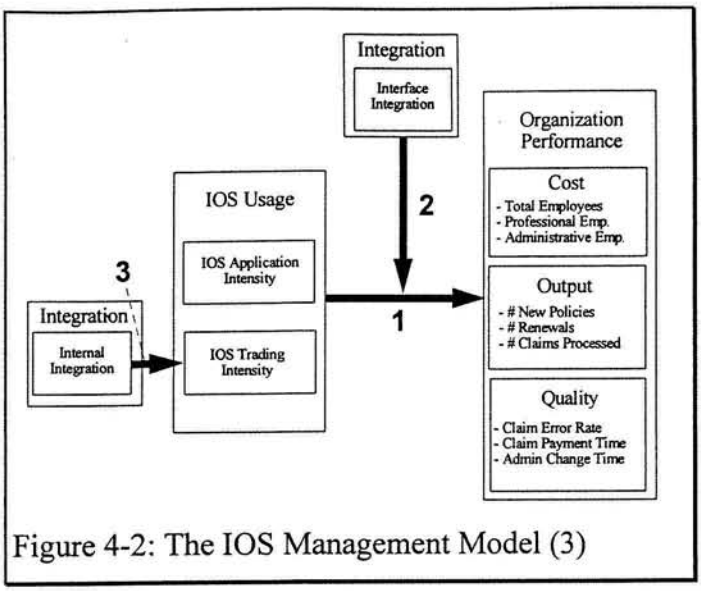

Figure 4-2: The IOS Management Model (3)

The propositions are restated below and depicted in the IOS Management Model in Figure 4-2: The IOS Management Model (3). The measures for the Cost, Output and Quality variables are included as well.

Proposition 1^C: IOS Usage and Cost are negatively associated.

Proposition 1^O: IOS Usage and Output are positively associated..

Proposition 1^Q: IOS Usage and Quality are positively associated.

Proposition 2: Interface Integration will moderate the relationship between IOS Usage and Organization Performance, with greater Interface Integration strengthening and lesser Interface Integration weakening the relationship respectively.

Proposition 3: Internal Integration and IOS Trading Intensity are positively associated.

5. Results

Descriptive statistics of the IOS Management Model's variables are provided below. Next, results of the data analyses are presented beginning with Proposition 1 and followed by Propositions 2 and 3.

5.1 Descriptive Statistics

The mean, standard deviation and number of cases (n) for each variable are shown below in Table 5-1: Descriptive Statistics. The descriptive statistics for IOS Usage are provided for All Organizations and for IOS Organizations Only, since Proposition 2 testing

includes the IOS Organizations Only group. The varying number of cases (n) across the set of measures results from either no use of IOS or missing values on the returned questionnaires. Missing values occurred from either an inability to ascertain the data or an unwillingness to share the data due to confidentiality. First-order correlations among all variables are shown in Table 5-2: First-order Correlations.

IOS Management Model's Variables	Mean	Standard Deviation	n
IOS USAGE			
IOS Trading Intensity - All Organizations	1.7	1.5	48
IOS Trading Intensity - IOS Organizations Only	2.4	1.2	35
IOS Application Intensity - All Organizations	11.9 %	15.5	48
IOS Application Intensity - IOS Organizations Only	16.8 %	16.1	34
INTEGRATION			
Interface Integration (Scale: 1-Low, 7-High)	5.4	1.5	35
Internal Integration (Scale: 0-Low, 100-High)	72.8	23.6	48
COST			
Total Employees (Adjusted) (# total employees per million dollars of premium income)	1.8	2.0	46
Professional Employees (Adjusted)	0.7	0.6	43
Administrative Employees (Adjusted)	1.0	1.4	43
OUTPUT			
New Policies (Adjusted)	4.0	7.6	30
Renewals (Adjusted)	11.0	16.8	26
Claims Processed (Adjusted)	2.2	1.5	34
QUALITY			
Claim Error Rate	2.6%	1.9	28
Claim Payment Time (# of days)	12.1	14.8	35
Administrative Change Time (# of days)	15.1	14.3	32
ORGANIZATION SIZE			
Premium Income (millions of dollars)	2024.4	3987.4	48

Table 5-1: Descriptive Statistics

IOS Management Model's Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IOS USAGE															
1) IOS Trading Intensity (All Organizations)															
2) IOS Trading Intensity (IOS Organizations Only)	1.00 35														
3) IOS Application Intensity (All Organizations)	.38** 48	.07 35													
4) IOS Application Intensity (IOS Organizations Only)	.06 34	.06 34	1.00 34												
INTEGRATION															
5) Interface Integration	.19 35	.19 35	-.06 35	-.04 34											
6) Internal Integration	.00 48	-.28 35	.11 48	.02 34	.42* 35										
COST															
7) Total Employees (Adjusted)	-.08 46	-.19 33	.19 46	.19 32	-.41* 33	-.03 46									
8) Professional Employees (Adjusted)	-.01 43	-.08 32	.06 43	.01 31	-.32 32	.00 43	.74** 44								
9) Administrative Employees (Adjusted)	-.03 43	-.20 32	.26 43	.22 31	-.40 32	-.02 43	.96** 43	.53** 43							
OUTPUT															
10) New Policies (Adjusted)	-.19 30	-.04 27	.25 30	.53** 26	.30 27	.16 30	.09 30	-.06 28	.10 28						
11) Renewals (Adjusted)	-.23 26	-.01 23	.02 26	.23 22	-.10 23	.07 26	.00 26	-.05 24	-.17 24	.41* 26					
12) Claims Processed (Adjusted)	.15 34	.10 30	.37* 34	.35 29	-.10 30	.17 34	.22 33	.27 31	.27 31	.11 30	.04 26				
QUALITY															
13) Claim Error Rate	.18 28	.15 25	-.12 28	-.14 24	.30 25	.22 28	-.21 28	-.27 26	-.18 26	.19 26	-.13 23	-.18 28			
14) Claim Payment Time	.14 35	.26 30	-.03 35	.01 29	.10 30	.01 35	-.03 33	-.13 31	-.09 31	.10 29	.10 25	-.17 33	.75** 27		
15) Administrative Change Time	.11 32	.05 27	-.20 32	-.25 26	.10 27	-.05 32	-.18 30	-.17 29	-.05 29	-.20 27	-.33 23	-.23 29	.29 24	-.08 31	
ORGANIZATION SIZE															
16) Premium Income	.69** 48	.75** 35	.04 48	-.12 34	.12 35	-.13 48	-.18 46	-.09 43	-.18 43	-.18 30	-.22 26	.09 34	.09 28	.07 35	.22 32

** p<.01; *p<.05

Table 5-2: First-order Correlations

5.2 Proposition 1 Results

Ordinary least squares (OLS) regression models were run on the Cost and Quality measures for the IOS Application Intensity and IOS Trading Intensity variables; hierarchical regression models were run on the Quality measures for the IOS Application Intensity and IOS Trading Intensity variables, entering the Premium Income variable first to control for organization size effects. [28] The standardized regression coefficients (β values) are used to ascertain the direction of the significant relationships, denoted by (+) or (-) in Table 5-3. The F *change* (FΔ) values' significance level were used to ascertain significance at $p<.01$, $p<.05$ and $p<.10$.

IOS Application Intensity is significantly associated with one Cost measure and one Output measure. IOS Application Intensity and Administrative Employees are significantly and positively associated at ($p<.10$). That a significant result with Administrative Employees, as opposed to Professional Employees, was found is in accordance with expectations. However, the result is counter to theoretical expectations and merits further discussion.[29]

The relationship between IOS Application Intensity and Claims Processed is significant and positive at ($p<.05$) as expected. No significant relationships was found with the Quality measures.

Surprisingly, no significant relationships between IOS Trading Intensity and the Cost, Output and Quality measures was found.

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[28] First-order correlations would have adequately tested Proposition 1 for the Cost and Output measures, however OLS regression was used to be consistent with the Quality measures.

[29] Discussion of all results is held until section 6.1 Findings

	COST (-)			OUTPUT (+)			QUALITY (-)		
	Total Employees (Adjusted)	Professional Employees (Adjusted)	Administrative Employees (Adjusted)	New Policies (Adjusted)	Renewals (Adjusted)	Claims Processed (Adjusted)	Claim Error Rate	Claim Payment Time	Admin Change Time
Proposition 1									
IOS Application Intensity	--	--	(+)*	--	--	(+)**	--	--	--
IOS Trading Intensity	--	--	--	--	--	--	--	--	--
Proposition 2									
Interaction Term [a] (IOS Application Intensity and Interface Integration)	--	--	--	(+)***	--	(-)*	--	--	--
IOS Application Intensity [b]	--	--	--	(+)***	--	(+)*	--	--	--
Interface Integration [b]	(-)**	(-)*	(-)**	(+)**	--	--	--	--	--
Interaction Term [a] (IOS Trading Intensity and Interface Integration)	(+)*	--	(+)**	--	--	--	--	--	--
IOS Trading Intensity [b]	--	--	--	--	--	--	--	--	--
Interface Integration [b]	(-)**	(-)*	(-)**	--	--	--	--	--	--

*** p<.01; ** p<.05; * p<.10
a - Interaction Effect
b - Main Effect

Table 5-3: Results for Propositions 1 and 2

5.3 Proposition 2 Results

Hierarchical regression models were run on all Organization Performance measures to test for interaction effects between the IOS Application Intensity and IOS Trading Intensity variables with Interface Integration. The standardized regression coefficients (β values) are used to ascertain the direction of the significant relationships, denoted by (+) or (-) in Table 5-3. The F *change* (FΔ) values' significance level are used to ascertain significance at $p<.01$, $p<.05$ and $p<.10$. For the Cost and Output measures the main effect variables were entered first, followed by the interaction term. For the Quality measures the Premium Income variable was entered first to control for organization size effects, followed by the main effect variables and the interaction term last.

The interaction term's FΔ significance level is used to interpret the significance of the interaction effect [Berry and Feldman 1985], similar to the procedure followed by Weill (1992). The direction of the β value shows the direction of the change in the relationship (or slope) between one main effect variable and the dependent variable, as the value of the other main effect variable increases.[30] Where significant interaction effects are shown, the "goodness" of the interaction is possible, but difficult, to ascertain from the direction as indicated by the β, since it depends in large part on the "goodness" related to the first-order relationships between the main effect and dependent variables. Though several methods are available to ascertain the nature of the interaction effect such as reduced equation forms [Berry and Feldman 1985, Cohen and Cohen 1983], the nature of these significant interaction effects is assessed through analysis of the group means.

As shown in Table 5-3 for the Cost measures, though no significant interaction effects involving IOS Application Intensity exists, there are significant interaction effects for IOS

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30 Since interpretation of an interaction term, computed as the product of two main effect variables, is symmetric due to the commutable property of multiplication [Berry and Feldman 1985], assignment of the two independent variables into their roles as main effects variables is methodologically neutral. Interpretation of the interaction terms is determined in accordance with the research question at hand. Therefore of interest is how the relationship (or slope) between the IOS Usage variables and dependent variables (e.g., Cost) changes across levels of Interface Integration. This contrasts to the alternative, yet methodologically symmetric, interpretation of how the relationship (or slope) between the Interface Integration variable and dependent variables changes across levels of IOS Usage.

Trading Intensity and Interface Integration on Total Employees and Administrative Employees at ($p<.10$) and ($p<.05$) respectively. Since Administrative Employees and Total Employees are virtually equivalent for statistical analyses purposes due to the .96 ($p<.01$) correlation (refer to Table 5-2 on page 30), further discussion centers on Administrative Employees.

The IOS Trading Intensity and Interface Integration interaction term accounts for 12% of the variance in Administrative Employees. The nature of the interaction effect, represented through plotting the mean value of Administrative Employees across respective "low" and "high" levels of IOS Trading Intensity and Interface Integration variables, is illustrated in Figure 5-3.[31] Analysis of the interaction effect shows that the relationship between IOS Trading Intensity and Administrative Employees is strongest under conditions of low Interface Integration, which is counter to theoretical expectations. Those organizations with high IOS Trading Intensity usage and low Interface Integration performed best with respect to Administrative Employees with a mean value of 0.39.

It is noteworthy that Interface Integration as a main effect was significantly related to Professional Employees and Administrative Employees at $p<.10$ and $p<.05$ respectively. The Interface Integration variable accounted for 10% of the Professional Employees variance and 16% of the Administrative Employees variance. The direction of the relationship is in accordance with expectations, with higher levels of Interface Integration associated with lower professional and administrative employee levels. Moreover, a greater share of Administrative Employees variance is accounted for by Interface Integration.

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[31] Respective median values were used to delineate between low IOS Trading Intensity and high IOS Trading Intensity, and between low Interface Integration and high Interface Integration.

For the Output measures, two significant interaction effects resulted for IOS Application Intensity and Interface Integration on New Policies and Claims Processed. No significant interaction effects resulted for IOS Trading Intensity and Interface Integration (refer to Table 5-3). The interaction terms between IOS Application Intensity and Interface Integration on New Policies and Claims Processed have significant FΔ values at ($p<.01$) and ($p<.10$) and account for 23% and 12% of the variance respectively.

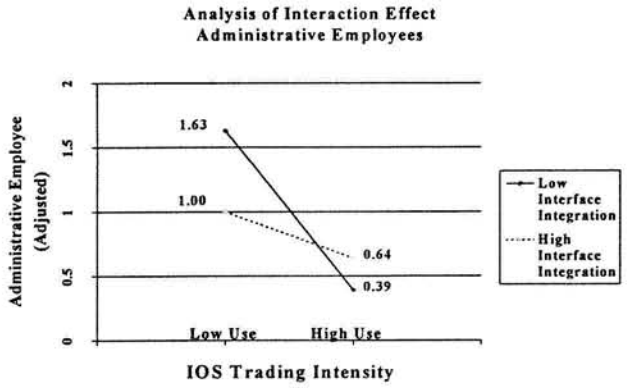

Figure 5-3: Analysis of Interaction Effect for Administrative Employees

The nature of the significant interaction effect for New Policies is illustrated in Figure 5-4. Congruent to theoretical rationale, the relationship between IOS Application Intensity and New Policies is stronger under conditions of high Interface Integration. Moreover, the results indicate that those organizations with high Interface Integration and high levels of IOS Application Intensity perform best as measured by New Policies.

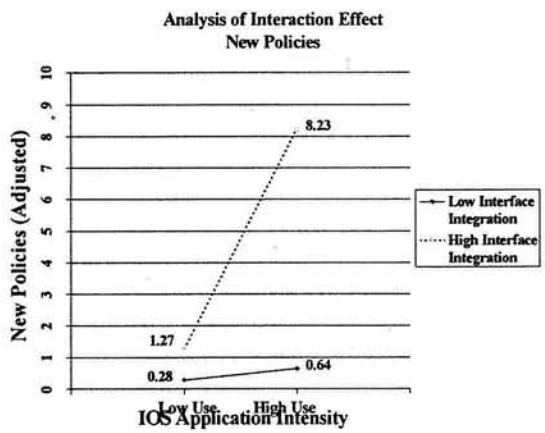

Figure 5-4: Analysis of Interaction Effect for New Policies

The nature of the significant interaction effect for Claims Processed is depicted in Figure 5-5. Similar to the result for Administrative Employees, the finding suggests that the relationship between IOS Application Intensity and Claims Processed is stronger (and in this case in the expected direction) under conditions of low Interface Integration, which is counter to theoretical expectation. Again, the best performing organizations are those with high IOS Application Intensity and low Interface

Integration.

No significant interaction effects between either IOS Usage variable and Interface Integration on the Quality measures occurred.

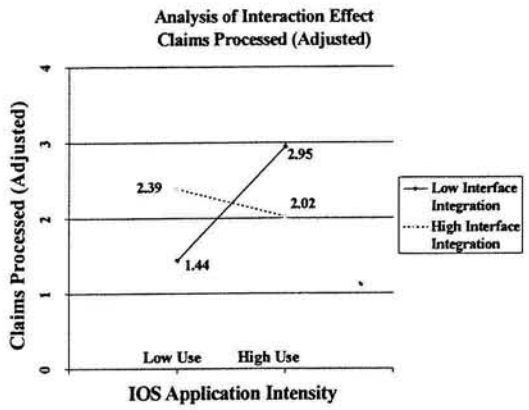

Figure 5-5: Analysis of Interaction Effect for Claims Processed

In summary, three[32] significant interaction terms resulted: (1) between IOS Trading Intensity and Interface Integration on Administrative Employees ($p<.05$); (2) between IOS Application Intensity and Interface Integration on New Policies ($p<.01$); and, (3) between IOS Application Intensity and Interface Integration on Claims Processed ($p<.10$). With regards to these results, two of the three significant interaction terms indicate the relationship between the respective IOS Usage and Organization Performance variables is stronger under conditions of low Interface Integration. An interesting result given theory would predict a weaker relationship under these conditions.

5.4 Proposition 3 Results

The results for Proposition 3 do not support the relationship as depicted in Figure 4-2: The IOS Management Model (3) on page 28. The standardized regression coefficient is .00 with a $p>.95$.

6. Discussion

A discussion of the research findings proceeds, followed by delineation of research extensions and limitations surrounding this research study.

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32 Actually there are four signficant interaction terms, but the one regarding Total Employees is not addressed since it is highly correlated with Administrative Employees.

6.1 Findings

The findings are discussed by order of proposition.

6.1.1 Proposition 1--Findings Regarding Cost

The significant positive relationship between IOS Application Intensity and Administrative Employees contains both an expected and unexpected element. That a significant association appears for Administrative Employees, and not for Professional Employees, is expected, since the intended roles or functions of IOS are more likely to supplant the tasks performed by Administrative Employees rather than those of Professional Employees. The unexpected element is the positive direction of the relationship. More intensive use of IOS as measured by IOS Application Intensity is associated with more Administrative Employees.

Several explanations may account for this. First, since IOS are established with trading partners gradually, an organization exists in an environment whereby operation of both the automated and manual systems remain essential. The automated system introduces new procedures and tasks, while the existing set of procedures and tasks surrounding the manual system remains. Because the automated and manual systems are inherently different, the procedures and tasks surrounding each system are necessarily different as well. Concurrent operation of both the automated and manual systems may cause an increase in the overall number of tasks and procedures performed by the organization, necessitating an increase in the number of Administrative Employees as the organization copes with the new automated and existing manual systems.

Somewhat related to the first explanation, the notion of critical mass[33] may provide another explanation for this unexpected finding. The notion of critical mass, as applied in this context, suggests that some threshold amount of data exchange must be shifted away from the manual system into the automated system, before the technology displacement effect occurs. Given that the average IOS Application Intensity is only 16.8% for the IOS organizations (refer to Table 5-1 on page 29), the possible lack of critical mass provides a plausible explanation.

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[33] Organization theorists will typically use the term 'critical mass', while economists often employ the term 'network externalities' to refer to this phenomenon.

These explanations notwithstanding, the counter-intuitive finding was especially intriguing in light of the information collected during Phase 2 Data Collection. The general theme of reduced administrative costs stressed throughout, respondents indicated several specific ways in which Administrative Employees may be displaced through increased IOS use. These advantages include:

I. A reduction in data entry requirements, manifested in either complete removal of the data entry task under conditions of interorganizational electronic data exchange or offloading of the data entry task to the trading partner;

II. A reduction in routing and logistics tasks/functions (i.e., the manual operations of opening envelopes, collating papers, and routing to proper locations within the organization);

III. A decrease in microfiching requirements which is a frequent legal necessity when processing paper documents in the Group Insurance Industry;

IV. An increase in the automatic adjudication of claims, requiring less work for claims adjusters in dealing with initial and succeeding documents;[34]

V. A decrease in exception processing with fewer claims held in "suspense", resulting in greater throughput of claims per Administrative Employee; and

VI. A reduction in service calls by Providers and ASO Clients, since the information may be alternatively provided less expensively over the IOS.

Given the incongruence between the empirical results derived from Phase 1 and 2 Data Collection, the discrepancy between Phase 1 Data Collection and the existing literature, the evidence extending from the first-order correlations, and the insight gained during conduct of data analyses for Proposition 2, additional analyses were conducted. Since much attribution regarding the criticality of high integration levels between IOS and internal application systems in securing the organization performance advantages has occurred [Mukhopadhyay 1993, Emmelhainz 1993, Swatman and Swatman 1991, McGee 1991 and Hart and Estrin 1991], these subsequent analyses focused on the Interface Integration variable.

Using a hierarchical regression model on Administrative Employees, the $F\Delta$ value for IOS Application Intensity was no longer significant at ($p<.10$) after controlling for Interface Integration which was significant at ($p<.05$) in the negative direction. These findings suggest to

[34] Initial documents are the documents included in the Insurer's initial receipt of the claim. Succeeding document refers to any document, deemed necessary for the proper adjudication of a claim, which is not included in the initial receipt of the claim.

managers that the key to attaining the displacement effect on labor may be to highly integrate or tightly couple the IOS to the respective internal application systems, regardless of how intensively the organization uses (or plans to use) IOS. This finding may seem intuitively obvious, yet guards against the overly optimistic and simplistic statements found in the popular press and some industry circles suggesting that increased use of IOS by itself will lead to a reduction in administrative costs.

6.1.2 Proposition 1--Findings Regarding Output

IOS Application Intensity is significantly and positively related to Claims Processed, indicating that those organizations which have established automated systems with a greater share of their trading partners also have higher output as measured by Claims Processed. With credit specifically accorded the Claim transaction-type, interviewees during Phase 2 Data Collection cited several value-adding or differentiating features of IOS as perceived by Group Clients and Providers. These value-adding features include faster claim payments and lower administrative costs *for the trading partner* as well.

Changes in the health care industry environment punctuate these value-adding features of IOS. There is an increasing preponderance of managed care facilities,[35] which often require IOS services. This creates an imperative for the Insurer to provide IOS capability, though the imperative manifests for different reasons depending on the managed care facility's ownership structure. Managed care facilities may be owned in whole or in part by the Insurer, or the managed care facility may be independent of Insurer ownership. In the case of no ownership, the Insurer may solicit contractual arrangements with the managed care facility in order to expand their coverage (i.e., the number of lives insured). IOS are currently considered a competitive necessity under these circumstances, since most managed care facilities' RFPs include IOS capability as a minimum requirement. Alternatively in the case of whole or part ownership, IOS are viewed as essential for effectively controlling the managed care facility. This need for control is considered particularly acute, since the managed care facility is a

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[35] Managed care facilities are coalitions of Providers, which may translate into greater bargaining power (Pfeffer and Salancik 1978, Porter 1980). Examples of managed care facilities include Health Maintenance Organizations (HMO) and Preferred Provider Organizations (PPO).

hierarchical extension of the insurance organization. IOS are viewed as an efficient means to effectively monitor the managed care facility's profitability.[36]

Due to the inherent weaknesses associated with cross-sectional designs, the alternative causal influence between IOS Application Intensity and Claims Processed merits consideration. It may be that an increasing volume of claims require implementation of IOS in order to expand claim processing capacity at reasonable cost.

6.1.3 Proposition 1--Findings Regarding Quality

No significant relationships was found between the IOS Usage and Quality variables. This is interesting in light of the current literature and what theory would predict. Moreover, with regards to Claim Error Rate, the incongruence between these results and data collected during Phase 2 suggests that a strong learning effect is occurring within Group Insurance organizations.

IOS may lead to improved claim data integrity through inclusion of automated controls programmed into the IOS software. Presumably these controls more effectively and consistently enforce decision rules of the claim adjudication process, than do controls relying on manual procedural and human judgment. For example, these automated controls create mandatory entry of specific fields such as medical procedure codes which are deemed essential for claim adjudication. Consequently, an improvement in claim adjudication rates manifests (which should be reflected in the Claim Error Rate measure). Though these automated controls ***could*** be embedded in the of internal claims processing systems, organizations are seizing the opportunity to embed them during IOS implementation because point of entry is moved to the Provider site. For the Insurer this change imparts the obvious advantage of offloading the data entry task to the Provider. For both the Insurer and Provider this change results in faster claim error resolution, because any additional or correctional data deemed necessary are more aptly provided since point of entry is nearer those best equipped to furnish the data--the Provider.

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[36] One control mechanism is evinced in utilization rates. Utilization rates measure the degree to which the managed care facility is being used. Insurers desire lower utilization rates, since this translates into fewer claim submissions representing lower costs. IOS are considered essential for efficient and timely computation of utilization rates, consequently employed for effective control over the managed care facility.

In contrast to these expectations, Phase 2 respondents indicated that substantial learning takes place in the modeling of the claim adjudication process which is highly complex. Demarcated by initial adverse affects, IOS use beneficially impacts claim adjudication rates, and exceeds the performance of manual systems, only after the automated controls go through a period of refinement. Though it may be argued that manual controls can be refined as well, most respondents indicated that refinement is more rigorous and exhaustive for automated controls, because, being in electronic form, the claim data are amenable to being processed by computer programs. Similar to Zuboff's (1988) notion of 'informatting', the use of computer programs to monitor and audit electronic claim data leads to enhanced monitoring and auditing capacities within reasonable cost effective bounds vis-à-vis the alternative manual review of paper documents. To the extent the organization desires, this may lead toward invocation of additional or enhancement to existing data integrity constraints, creating *long-run* improvements in the capacity to effectively capture claim errors at point of entry over what could be attained through exclusive reliance on manual systems.[37]

Phase 2 Data Collection provided insight into two additional IOS impacts on the claim adjudication process, with the concomitant affect on claim error rates. First, IOS may lead to reduced error rates because duplicate data entry may be eliminated. To the extent the interface between IOS and internal systems is designed such that less data transcription is required, fewer errors are likely to occur. Second, use of IOS technology may force evolution to more adherent data standards. Since IOS use forces adoption of specific data formats, uniform field formats and code meanings are institutionalized among participants. In effect, these data formats establish a formal shared language among organizational participants which may lead to more effective communication and improved coordination. Because of the substantial fixed cost associated with accommodating different formats, an organization is inclined to use ***one*** (or at least few). Therefore, to the extent pervasive IOS use institutionalizes fewer data formats, a shared language evolves, data accuracy improves, and, one may logically deduce, error reduction occurs.

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[37] For example, NEIC conducts a certification program whereby a trading partner's data are continually monitored and reviewed at the front-end for the expressed purpose of improving data integrity. The certification period is intended as temporary, but varies greatly depending on the trading partner and may recur should data integrity degrade for any reason.

6.1.4 Proposition 2--Findings Regarding Interaction Effects

With one exception, the statistically significant interaction effects indicate that the relationship between the respective IOS Usage and Organization Performance variables is strongest under low levels of Interface Integration which is counter to theoretical expectations. However Goodhue et al, (1992) argue that, in pursuit of enhanced coordination to accommodate subunit interdependencies, organizational subunits institute (data) integration schemes which may constrain the subunits' local flexibility and effectiveness. Applying the same argument to different levels of analysis, they conclude that:

> "...partners in electronic data interchange clearly have interdependence interests but must also be cognizant of the needs for local flexibility, especially in the face of industry turbulence. ... Thus, the same issues of interdependence, need for local flexibility and design costs clearly apply in these additional (i.e., interorganizational) realms." (p.308)

In light of their concluding remarks, these results are less surprising and emphasize the theoretical importance of recognizing the *disadvantages* inherent in integrating intra- and interorganizational processes. The same phenomena may be operating--increased levels of integration reduce local autonomy, thereby constraining local flexibility and effectiveness, except that interface integration affects interorganizational processes whereas internal integration affects interdepartmental (intraorganizational) processes. This suggests to managers that tighter coupling of interorganizational processes deserves critical consideration, since it may not produce the most desirable outcomes in terms of organization performance as IOS are used more intensively.

6.1.5 Proposition 3--Findings Regarding Internal Integration and IOS Trading Intensity

The absence of significant results for Proposition 3 has several explanations. First, the theoretical propensity for implementing additional transaction-types under conditions of high internal integration may be overwhelmed by other factors not accounted for here. Each transaction-type constitutes a separate IOS,[38] and the marginal cost of implementing each additional transaction-type beyond the previous one(s) remains very high. Though high internal

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[38] IOS planning and implementation efforts are typically organized around a single transaction-type. In this sense, each IOS is separate.

integration may decrease the marginal cost to some degree, a large share remains unaffected.

Second, an organization may, as a matter of overt or discreet policy, decide not to implement a specific transaction-type. For example, some Insurers have not implemented the Claim Payment transaction-type due to a perceived adverse effect on "float" and out of concern over security and fraud. These decisions are made independent from consideration of internal integration levels. Conversely, some Insurers may be forced into implementing a specific transaction-type by their trading partners. For example, in some instances Providers must be enticed into sending claim data via the Claim transaction-type in exchange for the Insurer's commitment to provide eligibility data via the Eligibility transaction-type. Again, these decisions are made with little or no regard for the level of internal integration.

The lack of confirming results for Proposition 3 notwithstanding, Internal Integration *was* significantly and positively related to Interface Integration with a first-order correlation of .42 at ($p<.05$). (Refer to Table 5-2 on page 30.) This finding has been highlighted in other research works as well [Hart and Estrin 1991, McGee 1991], though based on a limited number of case studies. Several alternative explanations for this relationship were revealed during Phase 2 Data Collection.

High internal integration may create a propensity for the organization to implement IOS with high integration at the interface. For example, assume an IOS needs access to data residing in three internal applications. Three interfaces are required if the internal applications are not integrated; one interface is required if the internal applications are integrated.[39] (The reader may compare, for example, Figure 3-4 and Figure 3-5). Given the typical time and resource constraints, an organization is positioned to implement IOS with higher integration at the interface if only one, in contrast to three, is necessary.

A second explanation relates to the imposition of data standards. Though an extreme policy, an organization may decide to adopt the IOS (external) data standard as its own internal standard. This removes much of the need for data translation as data move between the IOS and respective internal applications. The adoption of these external standards, if enforced

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[39] These examples represent extreme situations, and do not preclude the possibility of two interfaces being required in the event any two of the three internal applications are integrated.

across all internal applications, will increase integration since the meaning and format of data are uniform across the internal applications. To the extent that internal standards can be institutionalized only through IOS external format adoption, then IOS adoption acts to propel internal integration.

A third explanation suggests a spurious relationship between Interface Integration and Internal Integration. IS management, that acknowledges the benefits of and strives for high integration among its portfolio of internal applications, are likely predisposed to strive for high interface integration as well. In addition, the IS staff's skills and knowledge applicable for enhancing internal integration may be useful for attaining high interface integration when implementing IOS.

A final explanation, also suggesting a spurious relationship, rests with the typical formal units created for IOS planning and implementation. Phase 2 Data Collection indicated that most IOS planning and implementation requires joint effort on the part of cross-functional teams. In the normal conduct of work, these cross-functional teams may discover, recommend and spur enhancement or development of the internal applications which have the effect of creating more highly integrated internal applications.

6.2 Research Extensions

Two specific research extensions are offered below.

6.2.1 Longitudinal Design

Though one may provide theoretical arguments to support causal explanations of the significant findings, the cross-sectional research design provides no support to this end. One useful research extension would be to collect the data again in order to test the research model using a longitudinal research design. This may allow greater insight into and provide richer explanations of the complex relationships among IOS Usage, Integration and Organization Performance.

6.2.2 Interface Integration Construct Validity

The research model included Interface Integration as one variable which was proposed to affect the *relationship* between IOS Usage and Organization Performance. The findings

regarding Proposition 2 are mixed, yet other results involving Interface Integration suggest a direct relationship with some organizational performance measures (e.g., Administrative Employees). As such, Interface Integration appears to play a significant role in either promoting or inhibiting an organization's ability to attain some organization performance advantages.

The operationalization of the Interface Integration variable includes perceptual assessment of (i) the general level of integration and (ii) the nature of data flows between the IOS and internal systems. Results from Phase 2 Data Collection indicate that other factors may contribute to more or less integration between the IOS and internal systems, and, in consequence, offer several suggestions regarding *how* integration between IOS and internal systems may be enhanced.

Use of old legacy systems, implementation of functionally interdependent internal applications on dissimilar platforms, utilization of multiple IOS translators, and design of interfaces inhering batch-oriented processing traits were identified as potentially contributing to lower integration levels between IOS and internal systems. In contrast, subscription to external data standards for establishing internal data standards and development (as opposed to acquisition) of managed care systems[40] were identified as potentially contributing to higher integration levels.

Though some factors cited above are industry-specific and cannot be generalized, many are not. The applicability of these factors as promoters or inhibitors of integration between IOS and internal systems lead to generalizable guidelines for IS management considering the introduction of IOS. To the extent these factors may be exhaustively identified (say through case study research) and empirically validated (say through survey research and factor analysis), dimensions of Interface Integration may be identified in order to strengthen Interface Integration construct validity. This extension may grant the research community several advances.

First, since Interface Integration is widely recognized as a critical consideration in IOS

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[40] Managed care facilities are either constructed or acquired by Insurers. When constructed, the managed care facility's computing infrastructure is developed by the Insurer with integration to the Insurers' application systems a key design goal. When acquired, the managed care facility's computing infrastructure already exists and must be integrated through alternative means which typically afford less integration.

implementation and a varying trait in practice, it may be difficult to adequately examine IOS impacts in isolation of Interface Integration considerations. A valid Interface Integration construct will aid empirical research on IOS performance advantages, IOS impacts on organizations' structures and processes, and other IOS effects.

Second, to the extent (business process) reengineering[41] includes IOS technology, a valid Interface Integration construct will contribute toward a better understanding of some of reengineering's constitutive elements. The recent flurry of research activity on reengineering has the tendency to dilute the meaning or definition of 'reengineering', which retards the research agenda by leading to conflicting or inconclusive empirical results due to poor definition of the phenomenon. It is contended here that a valid Interface Integration construct may assist in defining some constitutive elements of reengineering.

Finally, a valid Interface Integration construct may assist management in recognizing where resources should be appropriately expended in pursuit of "desirable" Interface Integration. For example, it may be that migration of internal systems from old "legacy" systems operating on dissimilar mainframe platforms to newly revamped internal systems operating on a client-server platform is a necessary antecedent to establishing highly integrated interfaces between IOS and internal systems. Under this scenario, the efficacy of management decisions to funnel resources immediately into IOS implementation efforts may be dubious. Instead, an incremental reconstruction of internal applications as a precursor to IOS implementation may offer a more expedient outcome in the long run.

6.3 Limitations

There are several limitations related to this research study. First, the research design is cross-sectional which circumscribes a researcher's ability to draw causal interpretations from the significant relationships. Despite this methodological limitation, in those cases where either (1) the findings conformed to strong theoretical arguments or (2) insight into plausible causal explanations was gained during Phase 2 Data Collection, some causal explanations are offered. It remains acknowledged though that causal interpretations are not merited given the research

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[41] IOS is frequently recognized as a key technology component for reengineering business processes [Davenport 1993].

study's design.

Second, experimentwise and investigationwise error (Cohen and Cohen 1983) are not controlled for. Though a common practice, Type I error rates were assigned separately to each of the three propositions resulting in an inflated Type I error rate due to experimentwise error. In addition Propositions 1 and 2 are tested using 18 regression models each, also inflating the Type I error rate due to investigationwise error . By chance one would expect several significant results to be forthcoming, though this limitation is discounted due to the face validity of some significant results.

Third, generalizing these findings beyond the Group Insurance Industry should proceed with caution. Due to the *reasonably* large sample size for organizational level-of-analysis research and the high response rate for the primary survey data, generalizing the findings to other organizations of the Group Insurance Industry may proceed. To extend interpretation of these findings to other insurance industry market segments is tenuous at best, because IOS Usage and Interface Integration data are recorded at the transaction-type level. The set of transaction-types in other insurance market segments differs. For this same reason results should not be generalized to other paper-intensive service industries, though one may argue the *likeness* of other insurance market segments' and paper-intensive industries' business processes to those of the Group Insurance Industry may legitimate these attempts. To extend generalization to non-service industries requires a "leap-of-faith" in trusting the applicability of the results and is not recommended.

The IOS Usage variables reflect relatively low usage rates of IOS technology in the Group Insurance Industry, providing evidence of an early stage of IOS technology diffusion for the industry as a whole. Under these conditions, it is possible that the performance impacts which may result from IOS have not yet manifest. Or, alternatively, due to the dramatic organizational change created by IOS technology implementation, the organizations may be in a state of disruption, flux and general unsettledness. Those findings counter to theoretical expectations may be aberrant, with different performance impacts appearing once the technology has sufficiently diffused and the Group Insurance Industry, as a whole, has settled into these new modes of interorganizational exchange.

7. Conclusions and Contributions

Conclusions are presented below, followed by a rendition of research contributions addressed separately to the practitioner and academic communities.

7.1 Conclusions

Contrary to theoretical expectations, IOS Application Intensity was found to be positively related to Administrative Employees. This relationship is not significant however, if Interface Integration, which was found to be negatively associated with Administrative Employees, is statistically controlled for. These results suggest that high interface integration may be key to reducing administrative costs, and that greater IOS use may have the opposite affect.

The significant positive relationship between Claims Processed and IOS Application Intensity suggests IOS may inhere value-adding features in the delivery for Group Insurance services. These value-adding features include faster business processes, lower costs extending from improved efficiencies, and better information quality leading to more effective managed care facility management. However these value-adding features vary according to the Insurers' and trading partners' roles, suggesting that identification of potential value-adding features should appropriately proceed in consideration of the role.

With one exception, the significant interaction effects suggest that the relationship between IOS Usage and Organization Performance is stronger among those organizations which maintain comparatively low integration levels between the IOS and internal systems. This result challenges the conventional wisdom which promotes the unqualified efficacy of high interface integration levels. It may be that low interface integration levels afford greater opportunity for improved organization performance through increased IOS Usage, though this consideration must be balanced against the possible adverse consequences on administrative costs discussed above.

Internal Integration and Interface Integration were found to be significantly and positively associated, which suggests that implementation of IOS with high levels of interface integration may be contingent on the level of integration among the internal systems. Recognition of this potential constraining influence may lend credence for substantive

revamping of internal applications. Given the increasing preponderance of electronic exchange environments, management is well advised to (re)design their internal systems architectures with IOS in mind, and to evaluate IOS planning objectives and goals with consideration of their internal systems.

7.2 Research Contributions

The research contributions are presented according to the respective interest of the practitioner (management) and academic (research) communities.

7.2.1 Contributions for Management

The results suggest that high internal integration may increase the propensity for establishing high interface integration during IOS implementation. In light of this, improving *internal* systems integration may be warranted in consideration of IOS use. Interestingly, this argument begins to intersect with incentives for proceeding with strategic data planning efforts.

Strategic data planning efforts attempt to move an organization toward an organization-wide data architecture, which includes efforts to increase integration of internal systems' data [Goodhue et al 1992, Lederer and Sethi 1991]. However strategic data planning projects are lengthy, difficult, expensive and prone to failure for various reasons. Given these impediments, and tendencies to view IS strictly in operational terms and not as a strategic tool, senior management may be disinclined to commit resources for enhancing internal integration levels in pursuit of strategic data planning.

On the other hand, senior management's view of IS as a strategic asset may shift these inclinations regarding SDP, and hence internal systems. As Goodhue, et al (1992) propose:

> "Data Integration must be critical to the strategic goals of the organization, as perceived by top management."(p.22)

Therefore to the extent IOS are central vehicles for an organization's strategic goals--an interest of senior management, and internal systems integration is shown to affect IOS performance advantages albeit indirectly, the concern for improving internal integration is elevated from senior management's perspective. IS management is provided with additional rationale for securing the necessary resources dedicated to internal integration enhancement, by linking it to the potential performance advantages extending from a likely trend of increasing IOS usage. An

important issue to address in light of the increasing preponderance of electronic integration as a ***strategic*** means for improving organization performance in many industries (Cash and Konsynski 1985, Johnston and Carrico 1988, Johntson and Vitale 1988).

A second contribution is an examination of the state of IOS (or more commonly referred to as EDI) in the Group Insurance Industry which overlaps with the health care industry--an industry where IOS technology may assume a critical role in producing substantive improvements in effectiveness and efficiency (Eckstein 1993, Hammer 1993, Kessler 1993, O'Donnell 1993). As one of several alternatives promoted to reform the U.S. health care delivery system, the electronic exchange of information among Insurers, Clients, Providers and other organization sets offers one means to improve the system's effectiveness and efficiency.

7.2.2 Contributions for Researchers

This research project is an empirical examination of the complex relationship among IOS Usage, Integration and Organization Performance, and represents an attempt to move beyond pervasive use of anecdotal evidence in the domain of IOS research. As field study and survey research, the research project is designed for analysis of data at the organizational level-of-analysis. Necessary to empirically examine and assess organizational phenomena such as IOS performance impacts, organizational level-of-analysis research design is time consuming due to the difficulty associated with securing an adequate data set for testing propositions. This fact offers explanation as to why IOS research is heavily reliant on anecdotes and case studies, and emphasizes the contributory potential of these research findings.

Operationalizing IOS usage through two conceptually distinct continuous-scaled variables, this research measures two notions of IOS usage intensity which dichotomous variables fail to reflect. These IOS Usage variables facilitate assessment of potential critical mass effects, and support examination of the potential performance benefits extending from alternative IOS management strategies pursuant to an emphasis on increasing IOS Application Intensity over IOS Trading Intensity, or the alternative case.

Employing a multi-dimensional operationalization of organization performance, this research assesses more adequately the set of performance advantages which are theoretically presumed to be forthcoming through IOS use. To examine IOS impacts more narrowly, say by

focusing on either cost, output or quality measures only, fails to examine the broader technological impacts and may, in fact, overlook existent ones.

As empirical research, the research study appraises whether the theoretical underpinnings are supported. Pfeffer and Salancik's Resource Dependency Perspective (1978) suggests that more efficient and effective interorganizational processes between an organization and its environment will reduce uncertainty, improve coordination and optimization, and, consequently, lead to enhanced performance. Lawrence and Lorsch (1967) argue that integration of interdependent subunits, tailored for appropriate differentiation levels, will improve performance as well. IOS, and IT more generally, can and has been used for (1) supporting environmental interfaces and (2) performing an integrating role.

Finally, there is an historical paucity of research into interorganizational phenomena within organizational research generally and IS research specifically. Researchers' acknowledgment of interorganizational analyses neglect is common, often stated explicitly for providing rationale behind such research [Marrett 1971, Warren 1967, Litwak and Hylton 1966, Evan 1965, Levine and White 1961, Coleman 1958], or implicitly by imparting the more inclusive notion of "environment" as meriting further research attention vis-à-vis its exuding influence on the organization [Terreberry 1968, Dill 1962]. For example:

> "The relative neglect of *interorganizational* relations is all the more surprising in ... that all formal organizations are embedded in an environment of other organizations..." [Evan 1965 p.175];
>
> "Although the work on interorganizational relations is not nearly as extensive as that on intraorganizational problems, ..." [Marrett 1971 p.83]; and
>
> "Their (sociologists) chief focus, however, has been on patterns within rather than between organizations." [Levine and White 1961, p.256].

Moreover, there exists potential for greater insight into intraorganizational phenomena contingent on further study of interorganizational phenomena as indicated by Evans (1965):

> "Systematic inquiry into the interactions among various types of organizations may not only unearth new intraorganizational phenomena and processes, ..."; (p.188)

and Clark (1965):

> "To comprehend the shift to interorganizational administration and leadership would be to understand better the changing nature of administration inside the giant organization where large size and deepening expertise have fragmented command." (p.237)

For example, Hart and Estrin (1991) discovered some effects of internal systems integration during analysis of IOS impacts which have been replicated here. Therefore as interorganizational analyses may provide generally the dual benefits of (1) gaining knowledge regarding interorganizational phenomenon and (2) granting further insight into intraorganizational phenomena, IOS analyses (as distinct from internal systems analyses) may provide specifically the parallel benefits of (1) gaining knowledge regarding IOS, and (2) granting further insight into internal systems.

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