Electronic Integration and Strategic Advantage: A Quasi-Experimental Study in the Insurance Industry

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Strategic advantage through information technology is a popular and an important theme, but the extent of research support is minimal, anecdotal, and sporadic. This paper reports the results of a quasi-experimental study on the impact of dedicated electronic integration [between a focal insurance carrier and its independent agents in the property and casualty (P&C) market] for the focal carrier. The results indicate that the agents that are electronically interfaced with the carrier report improvements in a set of four performance factors in the expected direction (six months after system installation), but statistically different from a matched set of non-interfaced agents (based on size, state, and location category) only in terms of increases in new business policies, but not in terms of effectiveness—namely, neither increases in premiums and commissions nor operating efficiency. Some explanations, extensions and research implications are outlined.

Electronic integration—Strategic advantage—Insurance industry—Electronic interfacing—Quasi-experimental study

Introduction

The subject of information technology and its potential for strategic advantage has gained currency in recent years. The evolving literature is largely dominated by conceptual frameworks (e.g., McFarlan 1984, Porter and Millar 1985, Wiseman 1985) and detailed case studies on popular examples and applications such as McKesson's Economost system (Clemons and Row 1988), American Airlines' SABRE reservation systems (Copeland and McKenney 1988) or American Hospital Supply's ASAP system (Harvard Business School Cases 1985, 1988; Venkatraman and Short 1990). It can be reasonably argued that a major reason for the consideration of IT-based applications as potential sources of strategic advantage lies in the capability for electronic integration among a set of firms that could potentially change the basis of competition in a marketplace (Barrett and Konsynski 1982, Cash and Konsynski 1984, Johnston and Vitale 1988). Electronic integration is defined as the integration of business processes of two or more independent organizations through

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the exploitation of the capabilities of computers and communication technologies1 and we elaborate on this issue later.

While the role and benefits of interorganizational systems in particular and electronic integration in general have achieved the status of conventional wisdom, the extent of research support for arguing their importance is rather limited. The current literature is restricted to discussions of the nature and levels of IOS (Barrett and Konsynski 1982), descriptive and normative frameworks for managers to assess the role of IOS in their organizational contexts (Cash and Konsynski 1985, Johnston and Vitale 1988) and theoretical discussions of the role of IOS in changing market characteristics (Bakos 1987; Malone, Yates and Benjamin 1987). There is a marked lack of empirical research studies that focus on the specific effects, if any, of such systems on business performance. Indeed, much of the support is based on anecdotes, personal opinions and experiences rather than systematic research studies. Thus, a formal, empirical assessment of the role and benefits of electronic integration appears necessary and timely.

Towards this end, this paper discusses the results of a quasi-experimental study on the effects of electronic integration in the insurance industry, with a particular focus on the commercial lines of the property and casualty (P&C) business. The uniqueness of this study lies in:

(a) its quasi-experimental design with an experimental sample of independent insurance agents that are electronically interfaced (with a dedicated system) and a matched, control sample (based on size, state and location category) of agents that are not electronically interfaced with this particular insurance carrier; and

(b) the use of objective, longitudinal performance data on these agents from the carrier's records to identify the specific performance effects of electronic integration.

Thus, the study offers an opportunity to systematically test an implicitly-accepted, but largely-untested proposition on the benefits of electronic integration. The remainder of the paper is divided into three sections. The next section discusses the theoretical background for the study, and the particular characteristics of the P&C market, leading to the formulation of the research hypothesis. The subsequent section discusses the research design, data and analysis. The final section presents the results for discussing the implications of this study, and raises a set of theoretical issues for future studies in this stream.

Background: Theoretical Concepts and Prior Research

Strategic Advantage Through Electronic Integration

The emerging stream of electronic integration and strategic advantage is characterized by limited theorizing, mostly inductive attributions. In this study, we set the stage for a deductive approach to assessing the effects of electronic integration by developing theoretical arguments from multiple perspectives: institutional economics, especially the transaction-cost theory (see Williamson 1975 for disciplinary arguments and Malone, Yates and Benjamin 1987 for a specific discussion in the context of multi-organizational coordination mechanisms enabled by information technologies); the industrial organization economics and applied game-theory

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1 For an overview of the technical connectivity issues, see Wang and Madnick (1988).
perspective (see for instance Bakos 1987, Rotemberg and Saloner 1989) as well as macro-organizational theories on organization-environment adaptation (see for instance Thompson 1967).

Specifically, following Malone, Yates and Benjamin (1987), developments in information technologies are expected to give rise to three sets of effects: (a) electronic communication effect—reducing costs of communication while expanding the reach (time and distance); (b) electronic brokerage effect—increasing the number and quality of considerations of alternatives, and decreasing the cost of transactions; and (c) electronic integration effects—increasing the degree of interdependence between the set of participants involved in the business processes. Thus, electronic integration is expected to alter the nature of interrelationships in a given market with the potential to provide a set of efficiency (i.e., reduced costs) as well as effectiveness benefits (i.e., increased capabilities for assessing available options leading to better decisions) to the firms involved in electronic integration.

However, this issue needs to be further clarified by discussing the form of IOS deployed, which can be either a common infrastructure through a third-party system (i.e., ANSI .X12 standards) or a unique, proprietary system installed to develop and implement a firm-level electronic integration strategy (e.g., Baxter's ASAP network or American Airlines' SABRE network). In the former case, the benefits of electronic integration cannot be differentially appropriated since other competitors have access to the same technological capabilities, while in the latter the specific firm chooses to commit its strategic investments with the expectation of deriving firm-level advantages.

Following Rotemberg and Saloner (1989), we distinguish between cooperative advantage (i.e., advantage accruing to a set of firms joining together in the creation of a common network) versus competitive advantage (i.e., advantage to the firms differentiating at the level of the network used to develop business relationships) in the discussion of benefits of electronic integration. The basic thesis is that if a firm can successfully differentiate its IOS network, then the competitive advantage gained from such a network may be greater than the cooperative advantage of standardization. The specific determinants of selecting one form over the other is based on a complex set of factors including market structure and the specific strategic choices of the firms to compete in a given market (Porter 1980, Rotemberg and Saloner 1989). In addition, there is a strong possibility of dynamic movement across the forms of competitive and cooperative advantage as the structural and competitive conditions change, as in the case of the automatic teller machine networks. Thus, the overall argument is that these systems create or enhance entry barriers, thus providing the incumbents with greater opportunities for exploiting efficiency and effectiveness.

A complementary strand to the understanding of the role and effects of electronic integration is provided by the macro-organization theories of organization-environment interaction. Thompson (1967) developed a set of propositions that delineate specific actions for competitive versus cooperative postures in a given market. These are rooted in the fundamental argument that firms seek to minimize uncertainty in their task environments. Electronic integration can be argued as an efficient mechanism for organizations to increase their capability to process information (Galbraith 1973), and thus cope with environmental uncertainty. Consequently, electronic integration is expected to increase organizational effectiveness.
Conceptualizing Electronic Integration

We distinguish electronic integration from the common platforms of electronic data interchange (EDI), as well as different types of interorganizational systems (IOS). Specifically, EDI provides the technical platform rooted in a set of standards for informational exchange among participants in a marketplace; IOS builds on these common EDI standards (when necessary) to design and deploy different functionalities that interconnect multiple organizations (for a good classification of IOS, see Konsynski and Warbelow 1989). Even within a single category of IOS (e.g., upstream or downstream linkages), there could be differences in the functionalities across multiple focal organizations. As an example, not all airline reservation systems have the same set of functionalities for travel agencies. In addition, even within a specific IOS, the focal firm may choose to differentially exercise business options within its set of interconnected partners. Consequently, there is a need to differentiate between system features as in Konsynski and Warbelow (1989) from the strategic choices to exploit the functionalities for developing interorganizational relationships for specific business purposes, termed as electronic integration. In other words, the applications within an IOS (say, reservation system) could be the same for the set of organizations, but the specific strategic effects could be different. While there are obvious interrelationships among EDI, IOS and electronic integration, we argue that it is useful to distinguish among them in the delineation of theoretical linkages underlying the role and impact of information-based advantages in the marketplace.

Prior Assessments of Evidence

In addition to limited theorizing, the extent of empirical support for the benefits of electronic integration is also sparse. The American Hospital Supply Corporation’s (AHSC, now Baxter International) ASAP System is a classic, overworked illustration in this area. Although no systematic assessment of its effects is available, by 1984 more than 4500 customers were linked through this system, which carried more than 100,000 products. Further, AHSC increased its sales by an average of 13% per year during 1978–1983; and a typical hospital order through this system averaged 5.8 items as compared to an industry average of 1.7 items. Baxter executives and industry observers credit the system for the success of the company in the competitive hospital supplies marketplace.

In contrast, Clemons and Row (1988) provide a more thorough analysis of McKesson’s Economost system. According to them, since the system was first introduced nationally in 1975, McKesson’s drug sales have grown from $922 million to $4.8 billion, an increase of 422%, while its operating expenses have only gone up by 86%; McKesson also sizably reduced the number of personnel in order entry and sales. Similarly, airlines reservation systems have been studied in detail (e.g., Copeland and McKenney 1988). Although exact data are not available, it is widely acknowledged that the proportion of tickets booked through the SABRE system was much higher for American Airlines’ flights than for any other airline whose schedules were also displayed on the system.

Need for Systematic Assessments. While there appears to be strong face validity to the results reported in these case studies, from a research point of view they need to be supplemented using more formal criteria of social science research. For this purpose,
we use the following set of six criteria provided by Terpstra (1981) in his assessment of research studies on organization development effects: the presence of a probability sample; an adequate sample size for analysis; the use of a control group; random selection for treatment; pre- and post- tests; and the use of significance levels for assessing the effects of treatment. For a systematic evaluation of electronic integration effects, all or most of these criteria need to be satisfied.

The Property and Casualty Insurance Market

The US insurance industry divides broadly into the life and health and the property and casualty (P&C) markets, each with its distinctive set of products and channels of distribution. P&C insurance offers protection against such risks as fire, theft, accident and general liability. The P&C market further breaks out into personal and commercial lines, the former covering individuals (automobile and homeowner insurance, for example) and the latter indemnifying commercial policy holders against general liability and workers' compensation. The industry generated about $200 billion in premiums in 1989.

The P&C insurance market, particularly for its commercial lines, relies on direct writers and independent agents for distribution of its products to the customer. The former has no ownership rights of renewals and is exclusive to one carrier, while independent agents, by definition, represent multiple carriers. They are compensated on commission terms and retain the rights to their policies and accounts, even if their relationship with the insurance carrier issuing the policy is terminated (Stern and El-Ansary 1977). The P&C market is composed of more than 3600 insurance carriers, since there are few barriers to entry. This level of fragmentation and low market power makes for intense price-based competition. Approximately 300 carriers have multiple offices (Frost and Sullivan 1984), and 20 to 30 are major carriers accounting for about 50% of revenues.

Further, the industry is on the threshold of a major industry transformation along several dimensions. One, there has been a reduction in the number of independent agents by as much as 25% during 1980–86 to around 42,000, due to the consolidation of agency operations. Two, there is a growing trend in forward integration by carriers through mechanisms such as direct-writing, commissioned employee arrangements, and exclusive agencies. Three, there is an increasing incidence of the installation of agency automation systems ("back-office" automation), which require larger business volumes with the resulting scale economies in order to be efficient. Finally, electronic integration between insurance carriers and independent agents is another force that appear to be changing the competitive characteristics of the marketplace; a recent survey estimated that 28% of all independent agents were integrated with at least one insurance carrier.

Within the P&C market, personal lines, because of their relatively standardized and regulated nature, have been prime targets of automation by large insurance carriers. In contrast, commercial lines are less regulated and considerably more complex, and thus have only recently been subjected to computerized policy processing. It is not coincidental that expert systems, which have seen a surge of development of

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3 Standard & Poor's Industry Surveys.
4 d'Adolf, Independent Agent, August 1987, p. 27.
5 d'Adolf, Independent Agent, August 1987, p. 28.
late, have had a significant role in the computerized processing of commercial lines. We limit this study to the commercial lines for two reasons: (a) due to the significance of resources committed to computerized policy processing of complex commercial lines, it is an attractive setting for testing theoretical propositions; and (b) the recency of deployment of electronic interfacing allows a more systematic design for the collection of pre- and post-data described later.

The Nature of Electronic Integration

Industry standards for electronic policy information transfer between the carrier and the insurance agents have been set by the industry organization, ACORD, and in 1983, the Insurance Value Added Networks (IVANS) was established. Following Malone, Yates and Benjamin (1987), Rotemberg and Saloner (1989) as well as Thompson (1967), the installation of a common network will favor the independent agents since it would enable them to interface with multiple carriers in the provision of efficient service in the market. Specifically, the agents reduce their dependencies on a narrow set of carriers, while exploiting the full benefits of electronic integration and brokerage effects. Indeed, in the terminology of Malone, Yates and Benjamin (1987), such a move would have propelled the industry from a decentralized marketplace towards an electronic market due to significant reductions in the "unit costs of coordination" of the delivery of the insurance product.

Hence, it is not surprising that the agents seem favorably disposed to the use of a common network, while some carriers are obviously less enthusiastic as they believe that a "true interface" between the agent and all the relevant carriers would force them to compete more on price alone. This is because the cost of accessing and evaluating alternate quotes is dramatically reduced, thereby improving the bargaining power of the agents relative to the carriers. The existence of common rating systems for standard policy modules accelerates the movement towards predominantly price-based competition. Consequently, some leading insurance carriers (such as Aetna, CIGNA, Travelers, St. Paul) have decided to pursue the route of competitive advantage rather than cooperative advantage (Rotemberg and Saloner 1989) by developing and installing systems with proprietary interface standards operated through private networks. This initiative could provide the carriers with alternate routes to compete than predominantly price-based competition. However, it appears that the medium-sized carriers have stronger incentives to pursue cooperative strategies given the high costs of private systems and networks which confer scale benefits to the larger players.

Electronic Integration and the Focal Carrier's Business Strategy

The focal carrier considers electronic integration with its agents as a central element in its business strategy. The carrier's business strategy in the P&C market can be broadly described in terms of (a) reducing the number of agents to concentrate on a limited number of high-potential agents (with significant share-of-business with this carrier); (b) controlling loss ratios (which are highly related to the share-of-business of the agent, i.e., the largest share carrier has the best loss ratios); and (c) creating product differentiation (through higher service levels).

This business strategy is supported by electronic integration by way of the installation of a commercial policy processing system at selected independent agents. The focal carrier has committed a significant level of strategic investments by developing and installing the system and the network at no cost to the agents by bearing the
Electronic Integration and Strategic Advantage

TABLE 1

<table>
<thead>
<tr>
<th>System Characteristics</th>
<th>Impact on Efficiency</th>
<th>Impact on Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-line Policy Quotation</td>
<td>Primary</td>
<td>Secondary</td>
</tr>
<tr>
<td>Multiple Option Flexibility</td>
<td>Secondary</td>
<td>Primary</td>
</tr>
<tr>
<td>Risk Evaluation</td>
<td>Secondary</td>
<td>Primary</td>
</tr>
<tr>
<td>Policy Issuance</td>
<td>Primary</td>
<td>N/A</td>
</tr>
<tr>
<td>Endorsements</td>
<td>Primary</td>
<td>Secondary</td>
</tr>
<tr>
<td>Claims Handling</td>
<td>Primary</td>
<td>Secondary</td>
</tr>
</tbody>
</table>

The entire expense of hardware, software, communications and the associated training. The specific characteristics of the system are: (a) On-line policy quotation, which enables the agent to obtain relevant information on a potential quote with more timeliness (i.e., within a day or two) than the traditional communication with the carrier (with a typical time-lag of one to three weeks). More importantly, the ease of information exchange enabled through dedicated linkages implies that the focal carrier would at least be considered for obtaining a quote; (b) Multiple option flexibility, which enables the agent to explore on-line alternative scenarios of policy specifications at remote locations, and thereby provide greater customer service; (c) Risk evaluation, which provides an efficient basis for evaluating the risk propensity of a prospective policy with the capability offered by the back-end expert systems, with the potential of reducing loss-ratios; (d) Policy issuance, which allows agents to initiate the process of issuing a policy at remote carrier locations with increased timeliness (two weeks instead of six weeks) and reduced paper-handling; (e) Endorsements, which allow the agents to provide post-issuance support (including minor modifications) with the opportunity to offer greater service to the customers; and (f) Claims handling, which automates the steps involved in settling claims, resulting in improved efficiency as well as a higher level of service.

Delineating Distinct Levels of Analysis

In the case of dedicated electronic integration involving two distinct roles, namely the focal carrier (i.e., the deployer of the system) and the agent (i.e., where the system is deployed), it is important to differentiate the effects to the two roles. At the level of the agent—who has not shared in the costs of development of the system—the net benefit is the resultant of the following components: (a) increased efficiency through electronic integration after recognizing some displacement of administrative data-entry costs; (b) increased business through the agent’s ability to leverage the system features as a differentiator in the marketplace; and (c) the costs associated with greater dependency on the focal carrier with a possible shift in relative bargaining power.

For the carrier—who has invested in the proprietary network—the benefits are likely to arise from increased revenues and higher quality insurance business. Specifically, we argue that the six characteristics of the system will have differential impacts on the efficiency dimension (i.e., increased number of policies) and the effectiveness dimension (i.e., increased revenues) of the focal carrier as shown in Table 1. The rationale is as follows: given the greater “ease of doing business” created via system characteristics such as on-line policy quotation, computerized policy issuance,
endorsements and claims handling, the expectation is that (a) the agents will be motivated to channel relatively more business to this carrier than before ("roll-over" effects); and (b) the interfaced agents will be able to compete more efficiently and effectively in their markets, resulting in greater growth in businesses relative to their counterparts, who may not have this source of differentiation. The efficiencies in information processing enabled by these system characteristics would ensure that these agencies could service a larger account base than before. The assumption here is that the differential information processing capabilities (such as timeliness, accuracy, efficiency, expert-system support, etc.) are critical differentiators of the commercial insurance product because of its inherent complexity. Thus, the agent's capability—to quote, issue, and underwrite policies specifically tailored to the customer requirements and differentially from the competitors who are not electronically interfaced—is considerably enhanced. This study is designed to examine the effects of electronic integration at the level of the focal carrier by aggregating the performance across a set of interfaced-agents.

There are interesting parallels with other settings of electronic integration. For example, the ASAP system has reportedly channeled more business to Baxter/American Hospital Supply due to ease of system use as well as its capability to assist in a variety of business transactions such as order-status, tracking, and so on. Similarly, as American Airlines received a greater proportion of business based on the "display bias" in the screen, the expectation is that the focal, interfaced carrier would always be considered as a potential underwriter of a particular business (as long as it offers the product line). Given the similarities, this study provides a formal empirical basis to assess the effects of dedicated electronic integration as a source of competitive advantage.

Assessment of Effects of Electronic Integration

The approaches to assessment of organizational effectiveness is a thorny issue in organizational sciences (Cameron and Whetten 1983) including IS research, which uses several different constructs (Trice and Treacy 1989). There are two dominant approaches to the assessment of expected benefits for the focal carrier, namely:

(a) Cost Versus Benefit Approach—requiring a direct economic assessment of all costs associated with this initiative compared directly against actual realized benefits along a set of pre-specified performance criteria; and

(b) Benchmarking Approach—requiring an assessment of performance improvements for the interfaced agents against a matched sample of agents that are not interfaced.

The cost-benefit approach is complex for the following reasons: (a) the costs were incurred over a period of several years over successive iterations of the system, rendering a direct cost versus benefit comparison somewhat difficult; (b) given the carrier's strategy of adopting a proprietary system to create sources of firm-specific competitive advantage, some of the benefits are not directly measurable in terms of short-term improvements in performance; (c) the system is conceived by the firm as a strategic thrust involving several business lines over many years, thus making any precise cost allocation for a given set of business nearly impossible; and finally, (d) a direct cost versus benefit assessment does not discount the possibility that the agents without the technology could have modified their product offering along other
dimensions on which they have control, such as better service and lower prices, to compensate for the lack of system functionalities.

In contrast, the benchmarking approach has the following benefits: it (a) controls for the temporal context of industry cycles given that both sets of agents are facing the same external conditions; (b) isolates the specific IT-based gains by using a matched sample; and (c) avoids arbitrariness in cost allocation and focuses on effects relative to a benchmarked sample.

**Operationalizing Strategic Advantage.** The conceptualization and operationalization of strategic advantage in general, and IT-based strategic advantage in particular, is a major challenge. In this study, we view IT-based strategic advantage along two complementary dimensions: efficiency (in terms of number of new business policies, and the number of policies in force; and effectiveness (in terms of total written premium and total commissions). [The specific operational indicators in parentheses for the two dimensions were arrived at based on discussions with the company executives, are consistent with the general literature on insurance operations, and reflect a goal-centered view (Cameron and Whetten 1983).] Within a benchmarking approach, efficiency view cannot be based on the conventional cost versus benefit logic. Hence, we view efficiency gains in terms of the ability of the interfaced agents to exploit the information processing capabilities of the system (discussed in Table 1) to realize additional slack to pursue a greater number of business opportunities in the marketplace than otherwise possible. This is distinct from the exploitation of those system capabilities that have more pronounced impact on increasing the level of revenues or increases in market share for the carrier.

**Hypothesis.** The general hypothesis for the study is stated in a null form as follows: $H_0$: Electronic integration will have no effect on the increase in performance of the interfaced agents as compared with the non-interfaced agents.

There are two alternate hypotheses, termed here as the “strong-form” and the “weak-form” alternatives. The strong-form hypothesis, that both dimensions of strategic advantage would emerge as significant, is stated as follows:

$H_{alt\text{-}strong}$: Electronic integration will have a positive effect on the increase in performance (both efficiency and effectiveness) of the interfaced agents as compared to those that are not interfaced.

The rationale for expecting the strong-form hypothesis to hold is as follows: For the efficiency dimension, consistent with the theory developed in the previous section and elaborated in Table 1, we expect the system to lower the costs of coordination between the focal carrier and the agent and increase the information processing capability (e.g., faster turnaround of policy quotes, policy issuance and claims processing) of the dyad. Similarly, for the effectiveness dimension, we expect that the agent would leverage the capabilities by means of more comprehensive “what-if” searching.

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6 It is important to recognize that the commission structure has remained unchanged during the period of study, thereby discounting the possibility that the agents could have bargained a higher commission structure for incurring the efforts associated with this interfacing operation.

7 We would like to have considered the impact on two other effectiveness measures, namely marketshare changes and loss-ratios. Unfortunately, data were not available.
of alternative insurance options, customization of the insurance products to differen-
tiate the insurance services (Etgar 1976) and obtain higher share of the market, higher
revenues and shifts in the market share of the carriers ("roll-over" effects).

The weak-form alternative hypothesis states that only the efficiency dimension
would emerge significant across the two groups, stated as follows:

\[ H_{alt\text{-weak}}: \text{Electronic integration will have a positive effect on the increase in the}
\text{efficiency dimension of performance of the interfaced agents as compared to those that}
\text{are not interfaced.} \]

This takes a restrictive view of the effects of electronic integration and expects
primarily efficiency effects; the effectiveness gains are unlikely to accrue for the fol-
lowing reasons: (a) the policy is a substantial business expense for the insured, which
will be decided based on a set of factors including price. Thus, it is likely that the agent
may not be able to direct the business to the interfaced carrier due to electronic
integration alone without competitive prices; thus, in a highly competitive market,
modified service levels through faster quotes and customization may not outweigh
higher prices; (b) given that insurance products are bought on an annual basis with
high regularity, the speed of response by itself may not be an overwhelming factor for
an insurance customer to switch business; and (c) even if the agent has been able to
leverage the information-processing capabilities to obtain incremental business, this
effect may not be observable within a relatively short period of six months subse-
quent to the introduction of the system.

**Research Design**

*Design of Quasi-Experiment*

As mentioned above, the research design involved a quasi-experimental study of
the performance effects of electronic integration in the commercial lines of the P&C
market with a particular focus on the electronic integration by one major carrier. The
essential characteristics of the design involved the following five steps:

I. Identification of a random sample of agents that are electronically-interfaced
   with the carrier (termed here as the "experimental" group);
II. Identification of a "benchmarking set" of non-interfaced agents who are
   matched using three critical criteria—size (in terms of premium volume), location
category (metro, small city, suburban versus rural), and geographic category (state or
region). In other words, a corresponding agent in the same size category, in the same
state and in the same location category was selected (termed here as the "con-
trol" group)\(^8\);
III. Identification of the date of electronic integration—the later of the two dates
   on which the two most significant commercial lines of business were electronically
   interfaced, as identified by the carrier for each agent.

\(^8\) Following Cook and Campbell (1979), there exists a possibility of bias due to the non-equivalence in
the control group because the experimental group could be chosen for their meritorious prior performance
levels. Suitable corrections may have to be applied to mitigate the confounding effects, if the expected
results are observed in this quasi-experimental study.
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<table>
<thead>
<tr>
<th></th>
<th>6 Months Before</th>
<th>Electronic Integration</th>
<th>6 Months After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interfaced Agents</td>
<td>( \Pi_1 )</td>
<td>( \times )</td>
<td>( \Pi_3 )</td>
</tr>
<tr>
<td>Non-interfaced Agents</td>
<td>( \Pi_2 )</td>
<td></td>
<td>( \Pi_4 )</td>
</tr>
</tbody>
</table>

\( \times \) Electronic Integration ("treatment").
\( \Pi_i \), Performance Assessments at \( t_i \), \( i = 1, 4 \).

**FIGURE 1.** The Design of the Quasi-Experimental Study.

IV. Selection of a "performance effects window"—six months\(^9\) prior to interfacing and six months after interfacing; and

V. Analysis of the performance effects of integration.

The quasi-experimental design adopted for the research needs some discussion. As shown in Figure 1, the design adopted is the *untreated control group design with pretest and posttest* (Cook and Campbell 1979). This is different from the pure experimental design version in which the experimental subjects are assigned randomly from a common population. We could not influence the selection of agents to be interfaced; however, we were fortunate to obtain a reasonable, matched control group. This design controls for a major set of threats to validity and satisfies five of six criteria of Terpstra (1981).

The integration with the agents began in 1985 and is still continuing. The sample was restricted to those integrated in one calendar year where a significant number of interfacing occurred, which was 1987. The sample size for the two groups is approximately 70 for each\(^10\).

**Data**

Data on the four performance indicators were obtained from the internal records of the insurance carrier. For each agent, the performance levels were obtained for six months prior to integration and for six months after the integration (excluding the month of interfacing). Given that all the data are obtained from the internal records, there are no compelling reasons to expect differential measurement systems for the two groups (one of the common threats to validity in this type of design). The measurement error—if any—is common to the two groups of agents.

Table 2 presents the correlations among the four indicators of performance. As summarized, there is a strongly significant correlation between the two indicators of effectiveness, namely total written premium and commissions \((r = 0.92, p < 0.001)\), implying a high level of convergence across indicators. However, the correlation coefficient between the two indicators of efficiency, namely number of policies and

\(^9\) Discussions with the managers and agents indicates that this is an appropriate window. There is an obvious trade-off. If the window is too small, the effects may not be observed, while if the window is too large, the impact of other confounding effects (e.g., internal changes such as process redesign, differential learning, as well as external changes such as consolidation and mergers) cannot be ruled out within this design.

\(^10\) The sample sizes for the two groups are exactly the same given the design of quasi-experiments, but due to missing data on some of the performance measures, the numbers vary across the four performance indicators from 68 to 78.
TABLE 2

A Matrix of Zero-order Correlations Among the Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Total Premium</th>
<th>Commissions</th>
<th>Number of Policies</th>
<th>New Business Policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Premium</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commissions</td>
<td>0.92</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Policies</td>
<td>0.06</td>
<td>0.11</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>New Business Policies</td>
<td>0.42</td>
<td>0.45</td>
<td>0.18</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note: Correlations greater than 0.19 are statistically significant at p-levels better than 0.05 (n = 124).

number of new business policies, is low \( r = 0.18, p < 0.10 \), implying poor convergence across them. Hence, it is inappropriate to treat these two indicators as reflecting the same construct of efficiency. Accordingly, we separate the two with the number of policies reflecting the construct of operating efficiency, and the number of new policies reflecting a new construct of performance, termed as new business.

Performance attributable to integration is assessed as the slope (in terms of differences) rather than as absolute levels. This is because the inherent differences in the performance levels before integration are corrected by focusing on the changes in performance. Discussions with the managers of the carrier indicated that no other major confounding factors exist differentially across the two groups. Thus, if the performance differences were found for the electronically-interfaced group in comparison to the control group, they can be attributed with confidence to electronic integration, subject to assessing the equivalence of the groups at the time of selection.

The performance differences across the two groups are assessed using \( t \)-tests.\(^ {11} \) Since the data on percentage changes in performance appeared not to conform to standard normal distributions, data on percentage changes in performance were rescaled using a natural log transformation. The values for skewness and kurtosis—which far exceeded the normal range in the original scale—now exhibited values within acceptable range for normal distribution.\(^ {12} \) The interpretations and conclusions, therefore, are based on the transformed data.

Results and Discussions

Table 3 summarizes the results of the analysis. Three important patterns emerge from this table: One, the interfaced group had consistently better performance levels before integration (along all the four criteria) than the non-interfaced group (all the \( t \)-values are significant at \( p < 0.05 \)). This is largely attributed to the fact that the carrier obviously selected its better-performing agents for electronic integration, and thus a true experimental design could not have been possible. This further reinforces the need to assess percentage changes in the two groups rather than absolute differences.

\(^ {11} \) One of the reviewers pointed out that in this quasi-experimental design, there is a strong possibility of a negative correlation between the interfaced and the non-interfaced groups, resulting in the standard \( t \)-test being biased. In order to address this concern, we tested the hypotheses using a variant of the \( t \)-test, discussed separately.

\(^ {12} \) For instance, the values of skewness before the transformation and after the transformation are as follows: premium: 5.51 (0.22); commissions: 2.62 (0.22); number of policies: 3.11 (0.88); and new business policies: 6.41 (0.55). This supports the use of the transformed values.
### Performance Effects of Electronic Integration

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>Interfaced Mean</th>
<th>Sd</th>
<th>Non-Interfaced Mean</th>
<th>Sd</th>
<th>t-test Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EFFECTIVENESS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Total Written Premium (Before)(^1)</td>
<td>171.5</td>
<td>271.1</td>
<td>97.6</td>
<td>131.7</td>
<td>2.08***</td>
</tr>
<tr>
<td>Total Written Premium (After)</td>
<td>215.6</td>
<td>459.1</td>
<td>103.0</td>
<td>125.6</td>
<td>2.01***</td>
</tr>
<tr>
<td>Change (%) in Total Premium(^2)</td>
<td>30.7</td>
<td>74.8</td>
<td>47.7</td>
<td>199.5</td>
<td>-0.68</td>
</tr>
<tr>
<td>Change (%) in Total Premium (log transformed)(^3)</td>
<td>4.70</td>
<td>0.63</td>
<td>4.57</td>
<td>0.85</td>
<td>1.02</td>
</tr>
<tr>
<td>2. Commissions (Before)(^4)</td>
<td>26.7</td>
<td>52.5</td>
<td>13.1</td>
<td>13.7</td>
<td>2.13***</td>
</tr>
<tr>
<td>Commissions (After)</td>
<td>32.4</td>
<td>83.6</td>
<td>13.7</td>
<td>14.1</td>
<td>1.87*</td>
</tr>
<tr>
<td>Change (%) in Commissions</td>
<td>26.5</td>
<td>73.6</td>
<td>30.4</td>
<td>132.1</td>
<td>-0.22</td>
</tr>
<tr>
<td>Change (%) in Commissions (log transformed)</td>
<td>4.70</td>
<td>0.61</td>
<td>4.55</td>
<td>0.75</td>
<td>1.03</td>
</tr>
<tr>
<td><strong>OPERATING EFFICIENCY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. No. of Policies in Force (Before)</td>
<td>326.4</td>
<td>625.9</td>
<td>139.4</td>
<td>103.8</td>
<td>2.60***</td>
</tr>
<tr>
<td>No. of Policies in Force (After)</td>
<td>358.0</td>
<td>744.1</td>
<td>140.9</td>
<td>96.1</td>
<td>2.56***</td>
</tr>
<tr>
<td>Change (%) in No. of Policies in Force</td>
<td>11.7</td>
<td>32.6</td>
<td>8.0</td>
<td>34.2</td>
<td>0.69</td>
</tr>
<tr>
<td>Change (%) in No. of Policies in Force (log transformed)</td>
<td>4.69</td>
<td>0.22</td>
<td>4.64</td>
<td>0.27</td>
<td>1.13</td>
</tr>
<tr>
<td><strong>NEW BUSINESS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. New Business Policies (Before)</td>
<td>8.3</td>
<td>9.9</td>
<td>4.3</td>
<td>3.2</td>
<td>3.16***</td>
</tr>
<tr>
<td>New Business Policies (After)</td>
<td>9.6</td>
<td>15.8</td>
<td>3.3</td>
<td>2.3</td>
<td>3.25***</td>
</tr>
<tr>
<td>Change (%) in New Business Policies</td>
<td>19.1</td>
<td>80.2</td>
<td>7.6</td>
<td>155.6</td>
<td>0.54</td>
</tr>
<tr>
<td>Change (%) in New Business Policies (log transformed)</td>
<td>4.63</td>
<td>0.53</td>
<td>4.34</td>
<td>0.72</td>
<td>2.65***</td>
</tr>
</tbody>
</table>

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

\(^1\) Figures in thousands of dollars per month, averaged over six-month period.

\(^2\) Change is calculated as (after - before) $\times 100$/before for each agent and mean values reported for entire sample.

\(^3\) Due to high skewness in the distributions, log transformations provide more appropriate comparisons of percentage changes.

\(^4\) Figures in thousands of dollars per month, averaged over six-month period.

Two, the interfaced group continue to report consistently better performance levels after integration (along all the four criteria) than the non-interfaced group (three $t$-values are statistically significant at $p < 0.05$ and one at $p < 0.10$). Thus, a posttest-only design would not have provided the required results to assess the impacts of electronic integration.

The third pattern, pertaining to the differences in performance, addresses the hypothesis. For the operating efficiency dimension, the differences in performance levels for the total number of policies in force is not statistically different from the non-interfaced (control) group ($t = 1.13; \text{ns}^{13}$). For the effectiveness dimension, the interfaced group continue to report consistently better performance levels after integration (along all the four criteria) than the non-interfaced group (three $t$-values are statistically significant at $p < 0.05$ and one at $p < 0.10$). Thus, a posttest-only design would not have provided the required results to assess the impacts of electronic integration.

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^1^ The variant of t-test that corrects for the bias in the correlated samples is Sandler's A-test (Bruning and Kintz 1987, p. 16). The A-values support the results of the t-test. For instance, they were not significant in the three cases where the t-tests were not significant. In the case where the t-test was significant, the Sandler's A test had a value of 0.099 ($p < .001$).

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neither difference in performance levels for the two indicators is significant: for the total written premium, the difference is not statistically different from the non-interfaced (control) group ($t = 1.02$; ns); for the total commissions, the difference is again not significant ($t = 1.03$; ns). However, for the construct of new business, the difference is statistically significant ($t = 2.65$; $p < 0.01$). Thus, we find minimal support for the weak-form alternative, but the null hypothesis cannot be rejected in favor of the strong-form alternative hypothesis.

**Synthesis**

This study aimed to assess the collective performance of a set of agents that are electronically interfaced against a corresponding group not interfaced electronically with the focal carrier. The results provide support for performance increase for the new business dimension of strategic advantage, but the overall performance differences for the effectiveness and operating efficiency dimensions are absent. Thus, in terms of the underlying hypothesis being tested, the weak-form alternative is minimally supported, while the strong-form alternative did not receive empirical support. Indeed, it is particularly interesting that the system capabilities seem to have pronounced impact on new business policies, further reinforcing the expectation that the technology plays an important part in enhancing the efficiency of processing new business leads. Collectively, our results raise interesting questions pertaining to the nature of strategic benefits through electronic integration.

Strategic benefits through electronic integration seems to have reached the status of an implicitly accepted truism in the professional circles, with scant theorizing and little empirical demonstration. The results of this study call for more systematic theorizing (i.e., reasons for expecting strategic benefits under different contingencies) as well as empirical demonstration of those effects. Specifically, such theorizing should be anchored on the specific information attributes that are modified through electronic integration and the consequent impacts. Thus, we caution against overly optimistic and indiscriminate prescriptions on the role and benefits of electronic integration.

In relation to this research setting, while increases in new policies are an important criterion in the insurance business, it is equally important to focus on the quality of the insurance sold by these agents. If the agents merely leverage the available information processing capabilities for increasing their policy base, but not for attracting and selecting the business with better risk-profiles, then electronic integration serves a limited short-term objective (increase in policies) with potentially dysfunctional longer-term consequences (poor risk policies). Thus, it is critical to also assess effectiveness using criteria such as loss-ratios, especially in those cases where electronic integration also involved the decentralization of underwriting authority to the agents.

**Research Implications**

Two major categories of research implications emerge from this study, discussed below.

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14 As noted in footnote #8, we now tested for the equivalence of the two groups in terms of growth rates of new business policies prior to integration. The t-statistic was 0.80 (not significant), providing confidence in the results.
1. **Theoretical Models.** It is clear that electronic integration activities across segments of business processes of interdependent firms are increasing. There is a glaring lack of theoretical models that comprehensively explain the role and benefits of electronic integration although some preliminary theorizing has been forthcoming recently using disciplinary perspectives such as transaction cost analysis (Malone, Yates and Benjamin 1987), industrial organization economics (Rotemberg and Saloner 1989), and game-theoretic models (Bakos 1987). We believe that theoretical models should focus on the following issues: (a) the structure of electronic integration (including conditions and characteristics of business relationships enabled by the specific functionalities of the inter-organizational systems as well as their consequent benefits to the different participants) and (b) the process of electronic integration (including the roles, responsibilities and control of business activities even within the same interorganizational system of a single focal organization).

   The former could be rooted in disciplinary perspectives such as industrial organization economics, game theory, agency theory and transaction costs, and could deal with choices pertaining to issues of firm boundaries, the shifts in business activities impacted by integration, the selection of partners, risk sharing and the differential nature of benefits to the participants. In contrast, the latter models could be grounded in perspectives such as organization theory, political science and social networks, and could deal with issues such as the changes in relative roles and responsibilities, the transformation of business processes and shifts in the control over activities. Recognizing the interdependencies between the sets of issues, a comprehensive research perspective on electronic integration should devote equal attention to both types of models.

2. **Empirical Demonstrations.** The theoretical models should be accompanied by systematic empirical examinations using multiple research designs. This paper adopted a quasi-experimental design to empirically examine a basic proposition derived from the current theoretical perspectives, and provided minimal support for efficiency benefits from electronic integration. Future research should consider (a) approaches similar to this study (such as experiments and quasi-experiments) that allow for rigorous examination of the impacts; (b) firm-level characteristics of partners interfaced with the focal carrier to delineate differential performance due to variations in the business practices that leverage electronic integration; and (c) possible longitudinal assessments to identify sustainability of effects as well as robustness of the results across business cycles.

   The empirical studies should be sensitive to another temporal dimension in assessing the impacts, namely the time-lag for ascertaining the steady-state effects. This study adopted a six-month window (after integration) to assess the effects. Since electronic interfacing is not a case of implementing a marginal administrative technology, could there be a lag due to learning? In other words, is it possible that the performance improvements were not observed within a six-month window due to slow internal process transformation that may not have yet fully exploited the capabilities offered by integration? Some prior support exists for arguing that the effects of technology are not instantaneous and that organizations need to transform for maximal gains from IT (Rockart and Short 1989). While we did not explore the question of learning effects, it is an important factor to be considered in future designs. Ideally, it should reflect an assessment of not only the time-lag but also the specific process.
actions taken by the implementing organization to leverage fully the potential offered by electronic integration. We are in the process of designing a longitudinal extension with complementary primary data from the agents on their process changes to capture the potential learning effects.

Conclusions
This study focused on the effects of electronic integration (through a dedicated, proprietary system) of one major carrier with a set of independent agents. The effects of electronic integration were assessed from the perspective of the focal carrier in terms of the degree of increases in performance reported by a sample of interfaced agents as compared to a matched set of non-interfaced agents. The results provide minimal support for the weak-form hypothesis of efficiency effects due to electronic integration, but no support for the effectiveness hypotheses.*

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References


