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INVESTIGATING INFORMATION SYSTEMS STRATEGIC ALIGNMENT

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ABSTRACT

Although strategic alignment is an important theoretical concept, and achieving alignment or fit among organizational elements would seem to be an important business objective, empirical demonstrations of the importance of alignment have been uncommon (White 1986). This study attempted to provide an empirical assessment of the nature and importance of information systems strategic alignment.

There is much discussion today about the importance of strategic alignment in general (e.g., Venkatraman and Camillus 1984; White 1986) and information systems (IS) strategic alignment in particular (e.g., Elam et al. 1988; Henderson and Thomas 1992; Henderson and Venkatraman 1992; Keen 1991; Ward, Griffiths and Whitmore 1990). The discussion generally suggests that the better the alignment, the better the expected company performance. However, there have been few empirical verifications of this proposition (White 1986). In addition, the discussion about alignment has tended to be imprecise and vague (Van de Ven and Drazin 1985). Important objectives of this study were to identify a useful, precise model for the IS strategic alignment construct and to examine empirically relationships among IS strategic alignment, IS effectiveness, and business performance.

The discussion opens with a brief overview of the conceptual model underlying this study. Next, instruments that measure business strategy and IS strategy are introduced. Then instruments that measure IS effectiveness and business performance are outlined. This is followed by a general discussion of various approaches that are used to assess alignment. Specific models of alignment are evaluated and the primary model for IS strategic alignment used within this research is selected and described. The links between IS strategic alignment and performance are then discussed. Finally, the paper concludes with a description of the study's implications for management and future research.

1. THE CONCEPTUAL MODEL

The conceptual model underlying the study is depicted in Figure 1. It depicts the propositions that IS strategic alignment, *defined as the fit existing between business strategy and IS strategy*, impacts performance at the IS level and at the overall business level.

The results of the overall study, and detailed descriptions of the instruments used to measure business strategy, IS strategy, IS effectiveness and business performance, have been described in Chan et al. (1993) and Chan and Huff (1992) respectively. (Table 1 provides a brief outline of the overall study.) This paper discusses the derivation and significance of the IS strategic alignment computations and the study's findings regarding alignment.

2. MEASURING BUSINESS STRATEGY AND INFORMATION SYSTEMS STRATEGY

In order to assess IS strategic alignment, there needed to be assessments of both business strategy and IS strategy. Table 2 lists the dimensions of these constructs as operationalized in this study. Multiple indicators were used to measure each dimension.

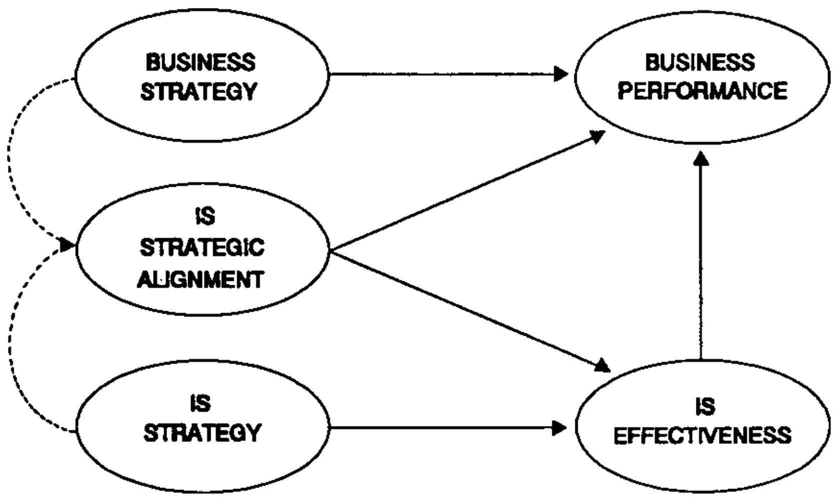

Figure 1: Conceptual Model

2.1 Business Strategy

N. Venkatraman conceptualized *realized* business strategy in terms of *"strategic orientation,"* or STROBE (the *str*ategic *o*rientation of *b*usiness *e*nterprises), a form of company personality (Venkatraman 1989b; see also Miles and Snow 1978). It was recognized that planned or intended strategy often differs from actual strategy (Mintzberg 1978). The emphasis of this study was on determining actual or realized strategy at both the business level and the IS level.

Venkatraman's strategic orientation (STROBE) instrument was pretested and modified for use in this research. Figure 2 provides sample STROBE indicators. Note the emphasis on actual company behavior.

Underlying company orientation was thought to influence specific product-market choices (e.g., the decision to compete on price or to intensively penetrate a market niche), while being more enduring than these marketplace choices (Venkatraman 1989b). Orientation also was expected to be relatively stable across industry settings. Whereas product-market choices often did not lend themselves well to comparisons across industries and even across companies, company orientation was thought to be more intrinsic and fundamental. Measures, which were not industry specific, could be developed to assess the diversity and range of company orientations.

2.2 Information Systems Strategy

In order to measure IS strategy, an instrument called STROIS (the *str*ategic *o*rientation of *i*nformation *s*ystems) was created to assess existing company deployments or uses of information technology. This instrument was designed to determine ways in which information systems were being used by organizations to facilitate business operations. As at the business level, the emphasis at the IS level was on determining actual or *realized* strategy as contrasted with planned or documented strategy.

The new instrument was designed explicitly to parallel Venkatraman's measures of business strategy. For each STROBE item measuring company strategy, a parallel STROIS item was created to determine whether information systems were being used by company personnel to facilitate that particular aspect of business strategic orientation. Thus, like the business strategy instrument, the information systems strategy instrument was designed to have eight dimensions. The instrument assessed the extent to which information technology deployments enabled a given company to be aggressive, analytical, future-oriented, proactive, risk-averse, innovative, and internally and externally defensive. Figure 3 provides the IS strategy indicators that parallel the business strategy indicators depicted in Figure 2.

Table 1: Study Highlights

Research Design

I. **Pilot testing activities** - instrument review by colleagues, questionnaire item sorting (Moore and Benbasat), preliminary factor analysis, review of questionnaires by twelve companies, review of questionnaires by Andersen Consulting.

II. **Mail survey** - introductory letters and telephone calls, questionnaire mailing, four follow-up postcards, packages and telephone calls to non-respondents.

III. **Data analyses** - power calculations, inter-rater reliability analysis, non-response bias analysis, evaluation of measurement and structural models.

Sample

Questionnaire packages were mailed to 904 business units of pharmaceutical preparations manufacturing (SIC 2834), automotive parts manufacturing (SIC 3714), banking (SIC 6025), and insurance (SIC 6321) firms in Canada and the US. Business units all had at least 100 employees and $1,000,000 in sales.

Respondents

Four *senior* executives within *each* business unit - typically CEO, VP Finance, CIO, VP Marketing (or other end user executive) completed instruments that assessed business strategy, business performance, IS strategy, and IS effectiveness respectively.

Respondent Characteristics

	Canadian				US			
	SIC 2834	SIC 3714	SIC 6025	SIC 6321	SIC 2834	SIC 3714	SIC 6025	SIC 6321
Employee Range	120-1,750	140-45,391	102-26,187	100-4,000	120-36,400	190-817,000	114-6,120	100-44,000
Sales Range ($M)	25-335 CDN	15-16,884 CDN	20-6,375 CDN	7-4,809 CDN	6-5,060 US	21-101,000 US	N/A	N/A

Centralized and/or decentralized IS services existed in the business units surveyed.

Response Rate

54 Canadian and 116 US (a total of 170) business units responded yielding response rates of 42% within Canada and 15% within the US. (Only companies returning *four* fully completed questionnaires were considered to have responded. Data from 6 of the 170 companies were not used because a single respondent had completed more than one questionnaire. This yielded a total of 164 valid cases for analysis.)

Company Proactiveness

First to introduce new products and services; a step ahead of the competition.

Primary Analytical Techniques

Analyses included factor analyses, Cronbach's alpha calculations, inter-rater reliability analyses, Partial Least Squares analyses. (The data gathered were split into two independent datasets which were analyzed separately. Minor measurement model refinements were made using the first dataset. The refined models were then evaluated using the second dataset. The analyses reported in this paper used the second dataset (an *n* of 82, i.e., one half of 164 valid cases).)

Period of Study

1991-1992.

Table 2: Higher Order Constructs and Their Dimensions

STROBE - Strategic Orientation of Business Enterprises (i.e., Current Business Strategy)	
Company Aggressiveness	Push to dominate (i.e., increase market share) even if this means reduced prices and cash flow.
Company Analysis	Reliance on detailed, numerically oriented studies prior to action.
Company Internal Defensiveness	Emphasis on cost cutting and efficiency; internally 'lean and mean'.
Company External Defensiveness	Forming tight marketplace alliances (e.g., with customers, suppliers, and distributors).
Company Futurity	Having forward-looking, long-term focus.
Company Risk Aversion	Reluctance to embark on risky projects.
Company Innovativeness	Creativity and experimentation are strengths.
STROIS - Strategic Orientation of Information Systems (i.e., IS Strategy in existence for at least one year)	
Aggressive IS	IS deployments used by the business unit when pursuing aggressive marketplace action.
Analytical IS	IS deployments used by the business unit when conducting analyses of business situations.
Internally Defensive IS	IS deployments used by the business unit to improve the efficiency of company operations.
Externally Defensive IS	IS deployments used by the business unit to strengthen marketplace links.
Future-Oriented IS	IS deployments used by the business unit for planning and projection purposes.
Proactive IS	IS deployments used by the business unit to expedite the introduction of products and services.
Risk-Averse IS	IS deployments used by the business unit to make business risk assessments.
Innovative IS	IS deployments used by the business unit to facilitate creativity and exploration.
BUSINESS PERFORMANCE (Current)	
Market Growth	e.g., market share gains, sales growth, revenue growth.
Financial Performance	e.g., return on investment, return on sales, liquidity, cash flow, profitability.
Product-Service Innovation	e.g., developments in business operations, products and services.
Company Reputation	e.g., reputation among major customer segments.
IS EFFECTIVENESS (i.e., Current IS contribution to Business Performance)	
Satisfaction with IS Staff and Services	e.g., with respect to cooperation received from IS personnel and communication with IS personnel.
Satisfaction with the Information Product	e.g., with the quality of online information and reports available.
Satisfaction with End User Involvement and Knowledge	e.g., with respect to IS development in the organization.
IS Contribution to Operational Efficiency	e.g., improvement in the efficiency of internal company operations attributed to IS services.
IS Contribution to Management Effectiveness	e.g., improvement in management decision making, planning and span of control attributed to company IS.
IS Contribution to the Establishment of Market Linkages	e.g., the creation of electronic ties to customers, suppliers and distributors.
IS Contribution to the Creation/ Enhancement of Products and Services	e.g., via changing the information content of existing products and services.

1. We are almost always searching for new business opportunities.
(Sample measure of *Business Proactiveness.*)

2. We secure our present market position prior to seeking new markets.
(Sample measure of *Business External Defensiveness.*)

3. We are usually the first ones to introduce various products and/or services in our market(s).
(Sample measure of *Business Proactiveness.*)

Figure 2: Sample STROBE Indicators

1. The systems used in the business unit assist in the identification of new business opportunities.
(Sample measure of *Proactive IS.*)

2. The systems used in the business unit provide us with information to defend our market position.
(Sample measure of *Externally Defensive IS.*)

3. The systems used in the business unit help us introduce various products and/or services in our market(s).
(Sample measure of *Proactive IS.*)

Figure 3: Sample STROIS Indicators

Assumptions about the causes and duration of strategic orientation were not made at either the business level or the IS level. Factors and processes which create (in)dependence between the two realized strategies were not examined. The instruments were designed to determine realized strategic orientations *existing* at the time of the research study. However, respondents were required to assess IS strategy based on IS deployments that had been in existence for at least one year. It was recognized that time delays were associated with detecting IS performance impacts (Weill 1988).

3. MEASURING BUSINESS PERFORMANCE AND INFORMATION SYSTEMS EFFECTIVENESS

In order to determine the predictive validity of the IS strategic alignment computations, links to business performance and IS effectiveness were evaluated. The business performance instrument was based on an earlier questionnaire instrument employed by Venkatraman (1989b) that assessed financial performance, market growth, product-service innovation, and reputation. The IS effectiveness instrument was derived from the User Information Satisfaction (UIS) instrument (Ives, Olson and Baroudi 1983; Galletta and Lederer 1989) and from strategic impact measures created by Downs (1988). For more details on these instruments, see Chan and Huff (1992). Dimensions of the business performance instrument and the IS effectiveness instrument are outlined in Table 2.

3.1 Factor Analysis of the Questionnaire Items

Using the survey data, factor analyses were carried out to detect cross-loadings of items among the STROBE, STROIS, IS effectiveness, and business performance research instruments (e.g., an item intended to measure STROIS that was actually measuring IS effectiveness). The items loading highly on the emergent factors, *without exception*, belonged to a single research instrument. Five factors emerged: one contained items measuring STROBE, a second contained items measuring STROIS, a third contained items measuring business performance, and the final two contained items measuring IS effectiveness. The first of these two IS effectiveness factors was composed entirely of items measuring the UIS instrument (Ives, Olson and Baroudi 1983). The second factor was composed entirely of items measuring the strategic contributions of information systems (Downs 1988). Factor analysis was one of many procedures which lent support to the validity of the research instruments (Chan and Huff 1992).

4. MEASURING STRATEGIC ALIGNMENT

The authors faced a sizeable array of choices with respect to modeling alignment. A number of alternative measurement approaches had been discussed in the literature. Two classifications of these approaches had commonly been cited and are discussed below (Venkatraman 1989a; Drazin and Van de Ven 1985, Van de Ven and Drazin 1985).

4.1 The Venkatraman Conceptualizations of Alignment

Figure 4 depicts six key alternative conceptualizations of fit described by Venkatraman (1989a). These are summarized in Table 3. Fit or alignment can be viewed as follows:

Moderation — A contingency perspective is stressed, as is depicted by the following example hypotheses: (1) The impact of business strategy on business performance is moderated by IS strategy; (2) The impact of IS strategy on IS effectiveness is moderated by business strategy. Techniques such as subgroup analysis and moderated regression analysis traditionally have been employed in this approach.

Mediation — An intervening or intermediate variable is specified between the independent and dependent variables. For instance, the proposition could be that business strategy impacts IS strategy which in turn impacts IS effectiveness. Here IS strategy would be the intervening variable between business strategy and IS effectiveness and would account for a significant proportion of the relation between business strategy and IS effectiveness. Path analytic techniques, incorporating modified structural models, commonly have been employed in this approach.

Matching — Fit is defined as a match or equivalence between related variables. For example, a study might investigate the hypothesis that a company's IS strategy simply mirrors its business strategy. The matching perspective has been operationalized commonly via analysis of variance, difference score analysis, and the analysis of regression residuals. These mathematical techniques recently have received much sharp criticism (e.g., Edwards forthcoming).

Gestalts — Fit is defined in terms of the degree of internal coherence among a set of variables (e.g., business strategy and IS strategy variables). For example, we might be interested in studying groups of companies with related IS strategies. Techniques such as cluster analysis and q-factor analysis often have been employed.

Profile deviation — Fit is seen in terms of the degree of adherence to a specified ideal profile. For example, we could hypothesize that firms with a given business strategy profile should have a certain ideal (or best performing) IS strategy profile which has been specified (e.g., by using the average profile of the top 10% of high performing firms [Venkatraman and Prescott 1990]). We could then examine, using pattern analysis techniques, differences in performance among firms with different deviations from this ideal profile.

Covariation — Fit is viewed as a pattern of covariation among a set of related variables. Whereas gestalts (employing cluster analysis) are viewed as groupings of observations or cases based on a set of attributes or variables of interest, covariation (frequently analyzed via factor analysis) groups the attributes based on the observations (Venkatraman 1989a). With covariation, we might be interested in identifying logical consistencies among key IS strategy factors and relationships among the variables which make up these factors.

These conceptualizations require different theoretical interpretations and different mathematical models (Schoonhoven 1981; Venkatraman 1989a). They differ primarily on three dimensions (see Figure 4): the number of variables they employ (i.e., their complexity); the extent to which the detailed nature of fit or alignment can be specified (typically, the more variables in the equation, the less specific the researcher can be about the form of the fit-based relationship); and the degree to which fit calculations require (i.e., cannot be completed without) the specification of a criterion variable (e.g., financial performance). Criterion-free approaches (e.g., matching) may incorporate a criterion variable if so desired.

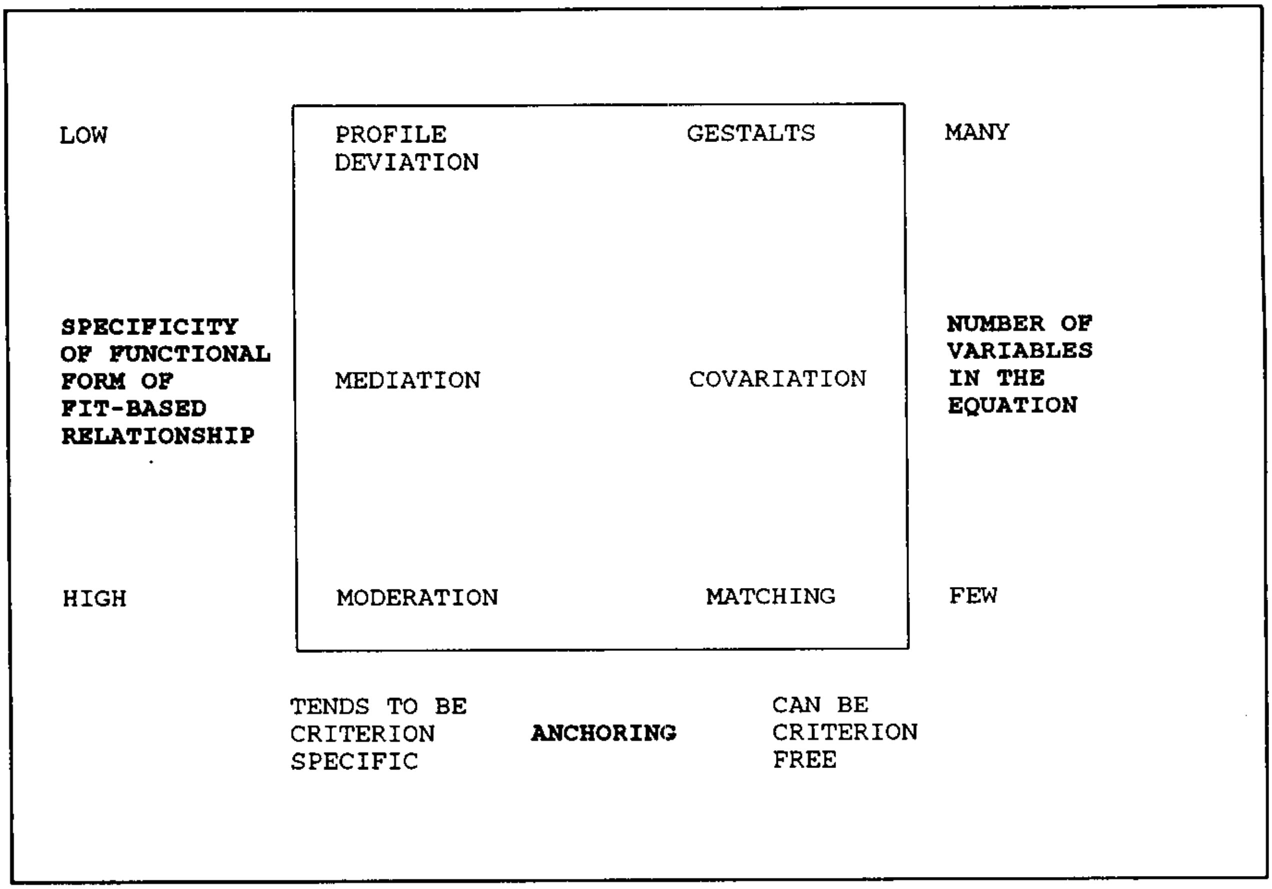

Figure 4: Alternative Calculations of Fit (Venkatraman 1989a)

4.2 The Drazin and Van de Ven Conceptualizations of Alignment

Like Schoonhoven (1981) and Venkatraman (1989a), Drazin and Van de Ven (1985) argued that the operationalization of fit or alignment must depend on the definition of fit adopted and vice versa. Drazin and Van de Ven reviewed the literature on fit and classified the perspectives of fit differently from Venkatraman (1989a). These authors described natural selection, bivariate, and systems approaches to conceptualizing alignment. Table 4 summarizes these three approaches.

Natural Selection Approach — In the context of strategic IS research, the natural selection approach hypothesizes that there will be naturally occurring congruence between business strategy and IS strategy, but it does not explicitly address performance implications. This approach assumes that there will be alignment between business and IS strategies in companies surviving in competitive environments. Without alignment, these companies would not have survived.

Bivariate Approach — This approach explicitly addresses performance issues. It attempts to explain variations in performance by examining specific business strategy and IS strategy factors in pairs. For example, the congruence between one specific dimension of business strategy and its corresponding IS strategy dimension might be examined. This approach assumes that business strategy and IS strategy each can be decomposed into elements which can be examined independently.

Systems Approach — This approach is holistic. It relies on multivariate analyses to examine patterns of consistency among multiple business strategy and IS strategy factors and relates these patterns to performance.

Table 3: Alternative Views of Alignment (Venkatraman 1989a)

	ASSUMPTIONS	TEST METHODS
MODERATION	The relationship between a dependent variable and an independent variable is contingent on a third moderating variable.	Subgroup analysis, moderated regression analysis.
MEDIATION	An intervening variable exists between an independent variable and a dependent variable.	Path analysis.
MATCHING	There is an equivalence relationship, or a theoretically defined match, between two related variables.	Difference score analysis, regression residual analysis, analysis of variance.
GESTALTS	The degree of internal coherence among a set of variables varies.	Cluster analysis, q-factor analysis.
PROFILE DEVIATION	The degree of adherence to a specified "ideal" profile varies, impacting a criterion variable.	Pattern analysis (e.g., the calculation of weighted euclidean distances).
COVARIATION	A pattern of covariation among a set of related variables exists.	Exploratory factor analysis, confirmatory factor analysis.

Table 4: Alternative Views of Alignment (Van de Ven and Drazin 1985)

	ASSUMPTIONS	TEST METHODS
NATURAL SELECTION APPROACH	STROBE-STROIS fit exists because of natural or managerial selection. Performance implications need not be addressed.	Correlation and regression coefficients of STROIS on STROBE should be significant.
BIVARIATE APPROACH	Fit assumes a linear STROBE-STROIS relationship. Low performance results from deviations from this relationship.	Performance regressed on STROBE-STROIS differences should be significant. STROBE*STROIS interaction terms in regression equations also should be significant.
SYSTEMS APPROACH	Fit is the internal consistency of multiple STROBE and STROIS factors. A set of equally effective STROBE-STROIS configurations exists.	Deviations from STROBE-STROIS "ideal patterns" should result in lower performance.

4.3 Integrating the Venkatraman and Drazin and Van de Ven Conceptualizations

Venkatraman's **matching, covariation**, and **gestalt** criterion-free fit approaches all could be incorporated in Drazin and Van de Ven's *natural selection* studies. Moderation, mediation, and profile deviation approaches, however, generally require the explicit consideration of a criterion variable (e.g., performance) and so could not be readily incorporated.

Moderation, mediation, and **matching** approaches often have been employed in studies examining *bivariate fit* (Venkatraman 1989a), although they also can be employed in systems approaches if more than two variables are included in the data analyses. (See the systems matching and moderation computations described below, for example.)

Systems approaches primarily have employed **gestalt, profile deviation**, and **covariation** approaches, which involve more than two variables by definition.

5. APPLYING THE VENKATRAMAN AND DRAZIN AND VAN DE VEN CONCEPTUALIZATIONS IN THIS STUDY

In this research, the above perspectives of alignment were considered to be theoretically supportable. The discussion of alignment in the IS literature does not exclude any of the approaches described by Venkatraman or by Drazin and Van de Ven. The long-term objectives for this research include the examination of each of the above approaches. The complementary information obtained by attempting to utilize more than one theoretically supportable approach provides a richer understanding of the strategy-IS relationship than would be available by selecting *a priori*, and studying, one approach only (Drazin and Van de Ven 1985; Edwards forthcoming). It is recognized that the various conceptualizations or models of IS strategic alignment tested in this research are not likely to receive equal empirical support. This, in turn, has implications for our understanding of alignment.

To date, **matching** and **moderation** models have been employed in this study. These approaches are commonly discussed in the alignment literature (Edwards forthcoming) and have precise functional forms (see Figure 4). The matching and moderation models used have incorporated *bivariate* and *systems* perspectives. A natural selection approach was thought to be less appropriate because of its lack of emphasis on performance outcomes. Therefore, for instance, when matching techniques (which do not require criterion variables) were employed, performance variables always were explicitly incorporated. Simple "basic" matching and moderation models of IS strategic alignment are described below to further illustrate key theoretical and computational differences between these approaches. Relationships to performance also are illustrated.

5.1 A Basic Matching Model of IS Strategic Alignment

Assume that for a given company the score received for the STROBE analysis "we rely on formal planning techniques" indicator was 3.0, and that the score received for the parallel STROIS "our information systems provide planning tools" indicator was also 3.0. A "misalignment" ranking of 0.0 (the lowest possible difference score) then would be assigned. (The individual STROBE and STROIS scores ranged from 1.0 to 5.0. In the case of perfect alignment, they would be coincident. In the case of poorest alignment, the misalignment ranking would equal 4.0.) If, on the other hand, the score received for the STROIS "our information systems provide planning tools" indicator was 4.0, and the STROBE "planning techniques" score remained as 3.0, then a misalignment ranking of 1.0 (the difference between 3.0 and 4.0) would be assigned. In a similar manner, the misalignment scores would be computed for all the indicators for a particular dimension and averaged to produce one overall score for that dimension of strategy. The smaller the misalignment score, the better would be the IS strategic alignment for that dimension.

A bivariate, matching model would involve examining the relationship between an *individual* STROBE-STROIS alignment pair and performance. A systems, matching approach, on the other hand, would involve considering *all* the STROBE-STROIS pairs simultaneously (e.g., via a weighted index).

5.2 A Basic Interaction Model of IS Strategic Alignment

The "matching" difference score approach to measuring alignment has limitations which a "moderation" or interaction approach avoids (see the appendix). (The terms moderation and interaction are used interchangeably in this paper.) However, the theoretical interpretation of alignment modeled as interaction would be quite different from that of alignment modeled by difference scores. Instead of proposing that the match (degree of parallelism) between STROBE and STROIS impacts both business performance and IS effectiveness, the proposition now would be that STROIS moderates the relationship between STROBE and business performance and that, in a similar fashion, STROBE moderates the relationship between STROIS and

IS effectiveness. It would be the combination of, or synergy between, STROBE and STROIS rather than the difference between the two that would be most important. STROBE*STROIS product terms would be computed instead of STROBE-STROIS differences. In other respects, the alignment computations would remain unchanged.

Support for the interaction model would imply that the greater the value of STROBE, the greater the impact of STROIS on business performance; the greater the value of STROIS, the greater the impact of STROBE on IS effectiveness (Schoonhoven 1981). The effect of STROBE would be increased by higher values of STROIS and vice versa. STROIS would not need to parallel STROBE. Instead, STROIS could act as a catalyst or multiplier.

It should be noted that the moderation approach frequently has been utilized in the business strategy literature within contingency studies (Venkatraman 1989a). Within the context of this IS study, moderation implies that the form and/or strength of the effect that company IS strategy has on IS effectiveness is contingent on business strategy; similarly, the form and/or strength of the effect that business strategy has on business performance is contingent on IS strategy (Prescott 1986).

As with the matching approach, both bivariate and systems moderation approaches could be modeled. A bivariate approach would focus on individual STROBE*STROIS pairs and their implications for performance. A systems approach would incorporate all the pairs simultaneously.

6. ASSESSING ALTERNATIVE IS STRATEGIC ALIGNMENT MODELS USING SURVEY DATA

In this research, Partial Least Squares analyses were utilized to test both the matching and moderation models of IS strategic alignment. Unfortunately, very little prior research employing latent variable modeling in the assessment of alignment could be found. (Two notable exceptions were Busemeyer and Jones [1983] and Kenny and Judd [1984].) This study was in many ways exploratory. Evaluations of matching and moderation, and bivariate and systems models, using the survey data gathered are described below. See Table 5, which summarizes the results of exploratory Partial Least Squares analyses utilizing these various approaches.

6.1 Alignment Modeled as Matching

In a preliminary round of data analysis, the three matching (difference score) approaches described in the appendix were tested. (A number of variations of these matching approaches were examined and had very similar findings. For parsimony's sake, only one example of each matching approach is discussed here.) The first matching approach involved signed difference scores; the second involved absolute difference scores; the third involved summed, squared difference scores.

Signed Difference Scores — In the first approach, signed differences between STROBE and STROIS questionnaire items were computed, item by item, and tracked at the dimensional level. For every STROBE-STROIS pair of parallel questionnaire items, a measure of the associated IS strategic "misalignment" (i.e., STROBE minus STROIS) was computed. Thus, a zero difference implied poor misalignment or excellent alignment of business and IS strategies. Therefore, if there were sixty items measuring STROBE and sixty items measuring STROIS, there would be sixty IS misalignment measures. Further, in the same way that STROBE and STROIS had eight dimensions (each composed of multiple questionnaire items), IS strategic misalignment (or the associated alignment) would have eight dimensions, each dimension having multiple measures.

Absolute Difference Scores — The second approach was very similar to the first, except that absolute differences were computed. Table 5 reveals, however, that these two approaches to the modeling of IS strategic alignment resulted in unacceptably high collinearity between IS strategic alignment and STROIS (more precisely between misalignment and STROIS). The correlation between the two higher order constructs was approximately -0.8. (Recall that misalignment was calculated as STROBE minus STROIS, hence the negative correlation.) This approach to modeling alignment appeared to introduce much redundancy and little new information.

These first two models, each involving eight dimensions, were incorporated in bivariate approaches (relating isolated dimensions to performance) and systems approaches (considering all the dimensions simultaneously when predicting performance).

Summed, Squared Difference Scores — In the third approach, the STROBE-STROIS differences, at the questionnaire item level, were squared and summed within a given dimension. The average squared STROBE-STROIS difference, for each dimension, was then computed. (Measures which are sums or averages tend to be more reliable than single item measures [Nunnally 1978].) This resulted in one measure of alignment between a given dimension of STROBE and the corresponding STROIS dimension. Eight measures of IS strategic alignment (one for each STROBE-STROIS dimension) were created. In this way, each company's overall alignment was described by a single, unidimensional index which was comprised of eight measures.

Table 5: Alternative Models of Alignment

Representation	No. of Alignment* Dimensions**	Alignment Dimensions/ Items**	Path Coefficients/ Loadings**	Alignment-STROBE Correlation	Alignment-STROIS Correlation	STROBE-STROIS Correlation	Cycles to Convergence	Alignment-IS Effectiveness Path Coefficient
Signed Difference Scores STROBE - STROIS	8	AAG	.747	.377	-.810	.180	10	.078
		AAN	.732					
		AID	.809					
		AED	.863					
		AFU	.390					
		APR	.775					
		ARI	-.531					
		AIN	.773					
Absolute Difference Scores |STROBE - STROIS|	8	AAG	.677	.138	-.746	.180	10	-.039
		AAN	.726					
		AID	.812					
		AED	.856					
		AFU	.295					
		APR	.609					
		ARI	.580					
		AIN	.629					
Squared, Summed Difference Scores $\Sigma(\text{STROBE - STROIS})^2$	1	AAG	.358	.259	-.330	.311***	12	-.311
		AAN	-.327					
		AID	.440					
		AED	.586					
		AFU	-.393					
		APR	.525					
		ARI	-.210					
		AIN	.004					
Summed Interactions $\Sigma(\text{STROBE * STROIS})$	1	AAG	.635	.384	.331	.311***	11	.222
		AAN	.105					
		AID	.169					
		AED	.048					
		AFU	.202					
		APR	.743					
		ARI	.014					
		AIN	.481					

Legend:

* Alignment is used in this table to refer to both positive alignment and negative alignment (i.e., misalignment)

** Path coefficients apply to 8-dimensional models (bivariate and systems approaches); loadings apply to 1-dimensional models (systems approaches)

*** Measurement models for STROBE and STROIS were changed slightly (i.e., unreliable measures were dropped) prior to these calculations

AAG - Aggressiveness Alignment
AAN - Analysis Alignment
AID - Internal Defensiveness Alignment
AED - External Defensiveness Alignment
AFU - Futurity Alignment
APR - Proactiveness Alignment
ARI - Riskiness Alignment
AIN - Innovativeness Alignment

The unidimensional, summed difference score approach consistently resulted in reduced collinearity between IS strategic alignment and STROIS, relative to the first two matching approaches. Note that this approach involved a systems (i.e., not bivariate) model of alignment. No one alignment measure (e.g., futurity alignment) was singled out for examination. All eight measures were considered simultaneously.

6.2 Alignment Modeled as Moderation

Summed Interaction Terms — A fourth and final approach to measuring IS strategic alignment is described in Table 5. This approach involved computing STROBE*STROIS interactions at the item level and then calculating the average interaction for the items measuring each strategy dimension.

It is important to note that two very distinct approaches can be used to compute summed interaction terms. Both approaches were tested in this research. The first approach involves computing interactions between corresponding STROBE and STROIS questionnaire items only. The second involves computing all possible interactions among STROBE and STROIS questionnaire items measuring a given dimension (i.e., not just the interactions between parallel items; e.g., see Kenny and Judd [1984]). Using the survey data, the results of these two computational approaches were found to be almost identical, however. The first, simpler, calculation was therefore selected and utilized primarily in this study.

The moderation approach resulted in eight measures for each company participating in the study — one measure corresponding to each strategy dimension. As with the third matching approach described above (summed, squared STROBE-STROIS differences), IS strategic alignment was characterized as an index formed from these eight measures and was modeled using a systems approach. Once again, the collinearity between STROIS and IS strategic alignment was reduced significantly.

6.3 A Comparison of the Various Approaches Used to Model Alignment

Table 5 summarizes the results of the matching and moderation, and bivariate and systems models of alignment. These models had different strengths and weaknesses. The signed difference score and absolute difference score matching approaches introduced little new information as was visible from the very weak associated path coefficients (e.g., between IS strategic alignment and IS effectiveness). The redundancy and collinearity introduced were substantial, however, as can be seen by examining the IS strategic alignment—STROIS correlations, for example.

The summed, squared difference score matching approach introduced new information as was visible from the strong associated IS strategic alignment—IS effectiveness path coefficient. The negative sign of this coefficient was ambiguous however. It might simply have been reflecting a negative relationship between misalignment and effectiveness, or it might actually have been providing support for a *moderation* model of IS strategic alignment. (See the appendix. Recall that $(X-Y)^2$ is $X^2 + Y^2 - 2XY$. If alignment is represented well by the XY product term, the squared difference score representation could reveal strong paths in a negative direction.)

Another drawback of the summed, squared difference score approach was that the items measuring alignment (each item representing a single aspect or component of alignment) loaded both positively and negatively on the alignment construct. This suggested (again, not surprisingly, given that three separate terms were being introduced to measure the construct; see the appendix) that when modeled in this way, alignment was not in fact unidimensional. A unidimensional model would not be supportable.

The moderation approach to the measurement of alignment employed the positive product or interaction term. Table 5 shows that this produced a strong IS strategic alignment-IS effectiveness path coefficient in a positive direction. The degree of collinearity with STROBE and STROIS was acceptable. (See Prescott [1986], for example, where a 0.2 cutoff is recommended but intercorrelations slightly above 0.3 are considered acceptable.) The items measuring alignment all loaded positively, lending support to the appropriateness of this unidimensional model. As was the case with the other models of alignment, the number of iterations required for convergence when doing Partial Least Squares analysis was low, revealing good correspondence between the proposed research model and the data.

An important research objective was to examine more than one model of alignment to determine which approach would receive the most support from the data. On the basis of the analyses described above, the *systems moderation* conceptualization of alignment was judged to be the approach best supported by the survey data gathered. Unfortunately space constraints do not permit discussion of the bivariate moderation approaches also examined in this study, which were outperformed by the systems moderation model.

Table 6: Descriptive Information on IS Strategic Alignment

STROBE*STROIS Alignment Measure[+]	Mean	Standard Deviation	Minimum	Maximum
Aggressiveness	13.08	4.67	2.67	25.00
Analysis	13.62	4.65	1.67	25.00
Internal Defensiveness	14.75	4.53	2.67	25.00
External Defensiveness	14.00	4.44	3.50	25.00
Futurity	10.47	4.09	2.00	22.00
Innovativeness	10.88	4.48	2.33	21.67
Proactiveness	8.87	3.48	2.75	18.25
Riskiness	9.16	3.33	2.67	18.67

Legend
[+] As the STROBE and STROIS questionnaire Likert scales ranged from 1 to 5, the minimum possible STROBE*STROIS score was therefore 1 (or 1 times 1), while the maximum was 25 (or 5 times 5).

Table 7: Loadings of IS Strategic Alignment Indicators

IS Strategic Alignment Indicators For Corresponding STROBE and STROIS Dimensions	Loadings
Aggressiveness Alignment	0.53**
Analysis Alignment	0.67**
Internal Defensiveness Alignment	0.28**
External Defensiveness Alignment	0.30**
Futurity Alignment	0.51**
Proactiveness Alignment	0.30**
Riskiness Alignment	0.45**
Innovativeness Alignment	0.74**

Legend: ** $p < 0.01$

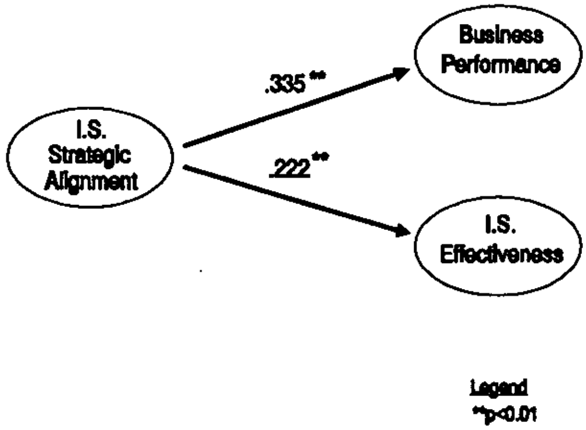

Figure 5: Path Coefficients at the Higher Order Level

7. DESCRIBING ALIGNMENT AND ITS RELATIONSHIP TO PERFORMANCE

Key research findings based on the systems moderation approach are discussed below. First, the IS strategic alignment measures are described. Next, relationships between IS strategic alignment, IS effectiveness, and business performance are outlined.

7.1 A Description of IS Strategic Alignment

Table 6 provides summary descriptive information on IS strategic alignment that is based on the moderation model and survey data gathered. Average STROBE*STROIS scores were computed for each aspect of alignment. The range in actual alignment scores indicates that companies employed information systems to support their business strategic orientations to varying extents.

Loadings of alignment items, computed via Partial Least Squares analysis, are depicted in Table 7. To some extent, these loadings reflect the relative importance of various aspects of the alignment between business strategy and IS strategy, given the moderation model (Chin and Gopal 1992). The Innovativeness, Aggressiveness, Analysis and Futurity components of STROBE*STROIS alignment had higher loadings and were relatively influential.

7.2 Relationships Between Alignment and Performance

Modest empirical support was received for the research propositions linking alignment with performance. Partial Least Squares analyses were performed in two ways: the first examined relationships between IS strategic alignment and the higher order, overall IS effectiveness and business performance constructs; the second examined links between alignment and specific IS effectiveness and business performance dimensions. Figure 5 depicts path coefficients between IS strategic alignment and business performance, and between IS strategic alignment and IS effectiveness, focusing on the higher order constructs. Tables 8 and 9 depict path coefficients between IS strategic alignment and individual dimensions of these higher order constructs. Table 10 describes the variance explained in these dimensions, given the research model depicted in Figure 1.

IS Strategic Alignment—IS Effectiveness Relationships — A key research finding was that **IS strategic alignment was consistently positively related to the various dimensions of IS effectiveness**. This suggested that the alignment between business and IS strategies positively influenced the effectiveness of company information systems.

IS Strategic Alignment—Business Performance Relationships — IS strategic alignment was clearly associated positively with business performance at the higher order level. However, there were mixed findings with respect to the relationships between IS strategic alignment and individual dimensions of business performance (perhaps indicating that business performance, as well as alignment, is best examined via a systems, non-disaggregated approach). The link between alignment and company innovation was found to be positive. However, the link between alignment and company reputation was negative. The two other links (to financial performance and market growth) were relatively weak.

Table 8: Strategic Alignment - Business Performance Path Coefficients at the Unidimensional Level

	ALIGNMENT
Market Growth	.057**
Financial Performance	-.011
Product-Service Innovation	.370**
Company Reputation	-.391**

Legend: ** $p < 0.01$

Table 9: IS Strategic Alignment - IS Effectiveness Path Coefficients at the Unidimensional Level

	ALIGNMENT
Satisfaction with IS Staff and Services	.194**
Satisfaction with the Information Product	.274**
Satisfaction with End User Involvement and Knowledge	.297**
IS Contribution to Operational Efficiency	.377**
IS Contribution to Management Effectiveness	.252**
IS Contribution to the Establishment of Market Links	.346**
IS Contribution to the Creation of Products and Services	.188**

Legend: ** $p < 0.01$

The negative relationship between alignment and company reputation seemed somewhat counter-intuitive. Given that this dimension of business performance was measured by relatively few items (Chan and Huff 1992) and had the lowest reliability (0.82) of all the performance dimensions, to some extent this finding may be discounted and viewed with caution.

8. IMPLICATIONS FOR MANAGEMENT PRACTICE

IS strategic alignment was described as the fit between business strategy and IS strategy. Empirical support was received for modeling IS strategic alignment as *moderation* (i.e., as the interaction between business strategy and IS strategy), rather than merely in terms of a simple match (or difference between the two). It was discovered that these two strategies could reinforce, or mitigate the strength of, each other.

The findings suggested that a HIGHSTROBE*HIGHSTROIS combination was associated with peak performance. Such a STROBE*STROIS combination appeared to impact performance very differently from a LOWSTROBE*LOWSTROIS combination. (The HIGHSTROBE*HIGHSTROIS product was large, whereas the LOWSTROBE*LOWSTROIS product was very small.) This perspective differs from the matching (or difference score) approach which predicts that

Table 10: Variance Explained in Dependent Constructs

Construct	Multiple R-Square (Explained Variance)
Information Systems Effectiveness	
Satisfaction with Staff and Services	0.18
Satisfaction with Information Product	0.31
Satisfaction with End User Knowledge	0.13
IS Contribution to Operational Efficiency	0.22
IS Contribution to Management Effectiveness	0.16
IS Contribution to Market Linkages	0.23
IS Contribution to Products and Services	0.15
Business Performance	
Market Growth	0.40
Financial Performance	0.10
Product-Service Innovation	0.32
Company Reputation	0.40

a LOW-LOW combination would be equivalent to (i.e., equally effective as) a HIGH-HIGH combination because there would still be a good match between STROBE and STROIS (Schoonhoven 1981). The survey data appeared to indicate that, for the firms studied, this was not in fact the case.

The moderation approach to modeling alignment also implies that LOWSTROBE*HIGHSTROIS and HIGHSTROBE*LOWSTROIS combinations might be equivalent. That is, too much systems support for a weak or unimportant aspect of business strategy might result in the same "middle" effect as would too little systems support for a strong (i.e., key) area of business strategy. The moderation model suggested that, given scarce resources, systems support may be most effective when it is provided first to key strategic areas.

9. LIMITATIONS OF THE STUDY AND IMPLICATIONS FOR FUTURE RESEARCH

This study provides interesting empirical results in the relatively new research area of IS strategic alignment. However, it has its limitations. For example, additional measures (e.g., weighted scores [Venkatraman and Prescott 1990]) could have been utilized in the calculation of alignment. However, one objective of this study was to develop an approach that could be used readily by practitioners also; hence, some of these more complex computations were avoided. In addition, a number of analyses that have been planned by the researchers have not yet been carried out; for instance, checking for the existence of nonlinear, nonmonotonic alignment relationships between STROBE and STROIS (Busemeyer and Jones 1983; Schoonhoven 1981; Venkatraman 1989a); investigating potential asymmetrisms in the STROBE*STROIS measure (e.g., 1*4 versus 4*1; see Schoonhoven [1981]); exploring the possibility of aspects of STROBE being able to substitute for missing aspects of STROIS, and vice versa (Van de Ven and Drazin 1985); and examining how the findings vary across industries (finance versus manufacturing) and across countries (US versus Canada).

Researchers also may wish to investigate other more general issues that have not been addressed to date in this study, such as the ones which follow:

- "How enduring or transient is IS strategic alignment?"
- "What factors influence the relative importance of IS strategic alignment components?"
- "Under what circumstances are different models of IS strategic alignment more or less appropriate?"
- "What processes within organizations facilitate or hinder the achievement and maintenance of IS strategic alignment?"

Despite the unanswered questions which remain, this study has strengths that should be noted. Measurement instruments and techniques have been developed to operationalize business strategy, IS strategy, and IS strategic alignment. These constructs, which are of interest to both practitioners and researchers, have been operationalized using related terminology (something that has not been done often enough in the past; see O'Reilly, Chatman and Caldwell 1991). Specific competing models for IS alignment have been examined. A moderation view of alignment has been suggested for consideration in future IS and strategy studies. The emphasis has been on the alignment of realized strategies. Much needed, empirical support for the importance of IS strategic alignment for business and IS performance has been provided. The intent has been to make a useful contribution to our knowledge and understanding of the nature and impacts of IS strategic alignment.

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APPENDIX

AN EXAMINATION OF DIFFERENCE SCORE AND INTERACTION TERM EQUATIONS (EDWARDS FORTHCOMING)

Let us assign X=STROBE and Y=STROIS. If we propose that X and Y impact performance (Z), then we may write:

$$Z = b_0 + b_1X + b_2Y.$$

If we propose that alignment (STROBE-STROIS, for a given dimension) also impacts performance, we must now write:

Difference Score Approach #1:

$$Z = b_0 + b_1X + b_2Y + b_3(X-Y).$$

This may be simplified by writing:

$$Z=b_0 + b_4X + b_5Y.$$

A simple difference score approach brings us back almost to where we started. However, we may attempt to get around this limitation by using squared difference scores or absolute difference scores. Let us first take absolute difference scores. The equation now reads:

Difference Score Approach #2:

$$Z=b_0 + b_1(1-2W)(X-Y)$$

where $W=0$ if $X \geq Y$ and $W=1$ if $X<Y$.

The term (1-2W) reduces to 1 when X is greater than or equal to Y. It reduces to -1 when X is less than Y. This produces a net effect of an absolute value transformation. The above equation can be rewritten as:

$$Z=b_0 + b_1(1-2W)X - b_1(1-2W)Y, \text{ or}$$

$$Z=b_0 + b_2X + b_3Y.$$

We see that we have not progressed very far. We do make some progress, however, when we represent IS strategic alignment by squared difference scores. Examine the equations below:

Difference Score Approach #3:

$$Z=b_0 + b_1X + b_2Y + b_3(X-Y)^2, \text{ or}$$

$$Z=b_0 + b_1X + b_2Y + b_4X^2 + b_5Y^2 + b_6XY.$$

For the first time, new non-redundant information has been introduced into the structural equations. If performance is impacted by the squared terms and/or by the product (interaction) term, this relationship can now be detected, whereas it could not have been observed previously. A limitation however is that we cannot determine whether it is one or more squared terms, the product term, or all of these terms which are useful in predicting performance. The moderation approach described next partially gets around these limitations.

The moderation equation can be written simply as follows:

Interaction Term Approach:

$$Z=b_0 + b_1X + b_2Y + b_3XY.$$

Here new information (the interaction or product term) has been introduced. The form of the relationship between alignment and performance is unambiguous. (Only one new term, not several new terms, has been introduced.) Unfortunately, if one or more squared terms do in fact also impact performance, these additional relationships will not be detected. Edwards (forthcoming) and Venkatraman (1989a) advocate explicitly reintroducing the X^2 and Y^2 terms into the equation and determining the value and significance of their coefficients. In the study described in this paper, the X^2 and Y^2 terms were not explicitly reintroduced.