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ASSESSING THE RELATIONSHIPS AMONG IT FLEXIBILITY, STRATEGIC ALIGNMENT, AND IT EFFECTIVENESS: STUDY OVERVIEW AND FINDINGS

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ABSTRACT

Increased competitive pressures upon businesses are continuing to escalate, generating the need for greater efficiency and productivity. Breakthroughs in technology-based services and solutions are driving frequent, rapid, and serendipitous changes in business strategies subsequently placing demand upon information technology for supporting services and solutions required to achieve sustained competitive advantage. The degree to which information technology (IT) can effectively and efficiently deliver these services and solutions is known as ITE (IT Effectiveness).

Strategic alignment has traditionally been viewed as the means to achieve greater IT delivery capabilities, but recent research and trends seem to indicate a growing awareness of need for IT flexibility as a means to achieve IT effectiveness. However, there has been a lack of empirical evidence regarding the relationships between IT flexibility, IT effectiveness, and strategic alignment. There is a need to validate their relationships and to analyze which, if any, factor has a higher correlation with IT effectiveness. This study, therefore is intended to assess: 1) the strength of these three relationships and 2) the extent to which IT flexibility has a greater influence on IT effectiveness than does strategic alignment.

The results of this research indicate that a positive relationship exists among these three areas. Additionally, the data confirmed that IT flexibility has a stronger relationship with IT effectiveness than does strategic alignment. The study findings further indicate that the inclusion of strategic alignment does not improve the predictive power of the construct model because IT flexibility carries the weight of explanatory effect of ITE within the construct model.

Keywords: information technology, flexibility, alignment, effectiveness

INTRODUCTION AND BACKGROUND

Businesses are coming under increased pressure as a result of global competition [79], increased complexity and economic uncertainty [41], and a more dynamic and changing marketplace environment [7]. These types of turbulent and dynamic market environments are characterized by the absence of any structure resulting in unpredictable patterns of change within the marketplace as well as for the enabling technologies [45, 67]. Martin [49], states that the events of 9/11 and subsequent causal global economic downturn have forced businesses to pursue financial stability and competitive advantage through cost reductions and operational efficiencies. Gates [28] offers additional insight that these types of operational improvements are often enabled through automation. As a result, information technology (IT) has taken a prominent role within business as a means to achieve not only operational efficiencies, but increased firm productivity and sustained competitive advantage in the face of dynamic change and uncertainty [24]. IT executives, therefore, must seek ways to improve delivery capabilities without sacrificing speed, quality, or cost, while simultaneously

achieving improved efficiency (e.g., cost reductions) and effectiveness (time-to-market) objectives.

In response to these objectives, strategic planning or strategic alignment has been traditionally viewed as an essential function of business [2], and as a necessary aspect of enabling sustained competitive advantage through coordinated planning between the business and IT [43]. This is true to a large extent as strategic alignment continues to be one of the biggest concerns of management [34, 51]. Studies have shown that strategic alignment is inadequate because the business climate is in a state of dynamic change and innovation [45]. In addition, studies have further shown that strategic alignment is very temporal in nature [6], and that it falters over time [36].

Conversely, studies have indicated that the role of IT has become more prevalent as a business partner [35] as well as an enabler of business performance and sustained competitive advantage [46]. As these studies indicate, reliance upon strategic alignment as a means of delivering IT value towards sustained competitive advantage, will cause IT to be ineffective, and will actually result in negative value to the business [78].

Recently, a study was conducted to better understand and assess the degree to which IT flexibility positively correlates with IT effectiveness as measured by IT's ability to deliver solutions to the business based on changing and increasing levels of demand [56]. The linkages between strategic alignment, IT flexibility, and IT effectiveness were explored. The correlation(s) among these relationships were determined through questionnaires distributed to CIO and IT executives at leading firms and were designed to answer the questions: 1) What are the correlations among IT flexibility, IT effectiveness, and strategic alignment, and 2) is the correlation between IT flexibility and IT effectiveness stronger than that between strategic alignment and IT effectiveness?

Figure 1 depicts the perceptual relationships between the three areas reviewed with both IT flexibility and strategic alignment as inputs to IT effectiveness, and strategic alignment viewed as having a symbiotic relationship with IT flexibility towards increased levels of IT effectiveness (thus the two-way arrow). The primary interest of research was to assess the relationship between IT flexibility and IT effectiveness as a measure of firm success and sustained competitive advantage [19, 77]. Secondary to this, yet necessary for hypothesis confirmation was SA's (strategic alignment's) influence upon IT effectiveness, as well as its interaction with IT flexibility. The secondary objective provided a measure of comparison between the relative influence of IT flexibility versus that of strategic alignment upon IT effectiveness.

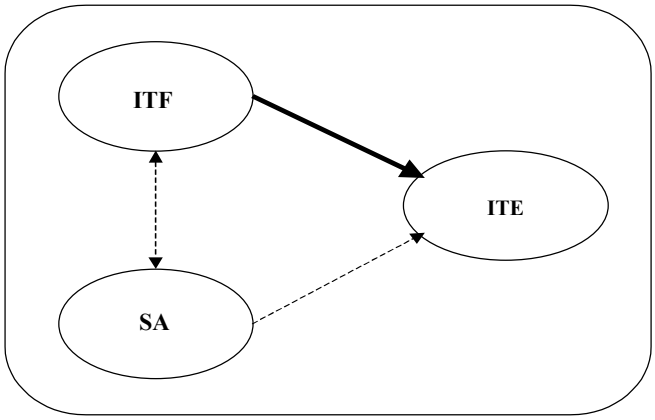


Figure 1: Conceptual Model

Research Expectations

In response to these issues faced by business, the relationship among ITF, SA, and ITE were assessed with regard to the use of information technology as an enabler of sustained competitive advantage. As noted earlier, this topic is timely given today's business climate where economic pressures, innovation, and competition create an ever-increasing demand for rapid and often unplanned changes to operations based on internal and external factors as well as for the associated products and services to be offered. Peters [59] suggests that change has overtaken and subsequently become the environment in which businesses must operate and compete.

It is reasonable that businesses should expect their investments in technology to result in increased productivity and performance [69], value and profitability [50], and competitive advantage [13]; however studies

have found that this is not always the case [37]. IT departments must become flexible for IT to truly become an enabler of sustained competitive advantage through the simultaneous achievement of efficiency and effectiveness [1]. Flexibility becomes the primary means by which IT achieves improved delivery capabilities, which deals with changing business demand and uncertainty [55].

Prior research appears to focus primarily on strategic alignment, rather than IT flexibility, as the key to IT effectiveness, value, and business performance [8, 48]. Without disregarding the validity of the findings produced through prior research, this study posited that IT flexibility is a better indicator of improved IT effectiveness and produces closer strategic alignment by creating better equilibrium between business demand and IT supply. This perspective is supported by recent research [33, 71].

The importance of research in this area lies in establishing the potential value of IT flexibility as it relates to the business's ability to compete through IT effectiveness. This challenges the traditional view of strategic alignment as the primary method for achieving business value and IT effectiveness. The research primarily focused on the relationship between the two variables of IT flexibility and IT effectiveness, but it included an assessment of strategic alignment's association with both IT flexibility and effectiveness.

The intent of this research was to contribute to the body of knowledge that could be applied by researchers, businesses, and IT organizations alike to achieve optimal results through flexibility. These findings may be leveraged towards further research targeted at building a theoretical model for IT flexibility and effectiveness such that strategic alignment and IT effectiveness could be optimally achieved. In addition, a possibility for future research is to evaluate the impact of IT delivery methodologies upon IT flexibility, with the assumption being that an effective systems development life cycle (SDLC) capability, should provide value (e.g., IT effectiveness), regardless of the degree of IT flexibility. This is similar to Luftman's [48] study, but the focus would be on IT effectiveness rather than strategic alignment as the benefactor of improved delivery capability.

LITERATURE REVIEW

The literature supports the general hypothesis that IT flexibility (ITF), IT effectiveness (ITE), and strategic alignment (SA) are positively correlated. The literature also supports the assertion that IT flexibility has a stronger positive correlation with IT effectiveness than strategic alignment and is therefore a better measure of sustained competitive advantage for the business. To validate these hypotheses, research focused on the three primary constructs, or variables, involved: (1) IT flexibility, (2) strategic alignment, and (3) IT effectiveness, as follows.

IT Flexibility (ITF)

Many terms have been used within the industry and research to describe various aspects of IT flexibility. Terms used within the industry include IT Elasticity [20], On-Demand [22], Utility-based Computing [80], Virtual IT [76], Agile IT [54], IT Transformation [75], Real-time Enterprise [25, 26], and Organic IT [29]. These are similar in meaning to IT flexibility, but vary in terms of their focus regarding the breadth of IT processes, strategies, methods, and/or tools to achieve true IT flexibility [62]. In the same way, a term commonly used in literature is that of IT infrastructure flexibility. While within the industry the term *infrastructure* commonly refers to the networking and platform components of the technical architecture, its meaning has been more broadly applied within research to denote the rapid deployment of technology through a firm's existing technology- and personnel-based resources [9, 73]. There appears to be consistency among the literature reviewed suggesting that the dimensions used for assessing and measuring IT flexibility consists of connectivity, compatibility, and modularity.

IT flexibility dimension: connectivity. Connectivity denotes the number of platforms that a firm [or entity] can connect to [21, 73]. Connectivity originally appears to have been derived from the works of Keen [44] in the application of the term "reach", implying the number of locations to which the platform or technology can link to, or can be connected. Goldman, Nagel, and Preiss [30] confirmed this concept when they considered agility as a means of competition and enablement of the virtual organization. In addition, E-Sourcing [22] recognized connectivity as a means of delivering IT on demand (e.g., IT flexibility). Enterprise application integration (EAI) is a good example of this dimension in that it enables a more connected environment and thereby breaking-down application and data rigidity by externalizing connections and the flow of data from the applications themselves.

IT flexibility dimension: compatibility. Similar to the concept of range, compatibility denotes the degree to which technical components can seamlessly communicate with each other [44]. An example of compatibility is in the area of systems designed using a services oriented architecture (SOA) approach, whereby each layer of the technical architecture is loosely-coupled and follows strict industry standards to ensure that components having similar qualities can effectively communicate to each other

[42]. Flexibility, therefore, includes the ability to vary the connectivity, or reach, of the technology, as well as the compatibility, or range, of the technology features.

IT flexibility dimension: modularity. Sanchez [65] introduced the concept of modularity in the areas of product, process, and knowledge architectures as key aspects of flexibility. Sanchez suggested that strategic flexibility is important to manage demand volatility and environments that are in a continual state of flux. Specific to the concept of resource flexibility, Sanchez offered three criteria for providing increased resource flexibility: a larger range of uses for each resource, lowered switching costs and difficulty, and lowered time required to switch from one resource to another. This concept is important as it helps support the aspect of modularity, a key factor of IT flexibility.

Strategic Alignment (SA)

Strategic alignment can be defined as the art and science of formulating, integrating, and implementing decisions between the business and IT, which enables an organization to achieve its objectives [17]. Strategic alignment has been, and remains, one of the top concerns for both business and IT management [16, 27]. Further the interaction and linkages between business and IT strategies remain one of the top objectives among CIO's [34]. The role of strategic alignment as an essential aspect of firm performance [7, 43] and competitive advantage [31] is clear from the literature and should not readily be dismissed. Strategic alignment has been shown to improve organizational effectiveness [10], maximize return on investment [23], allows companies to better manage their overall business needs, technology, and competition [5], and provides balance within the organization 46].

IT Effectiveness (ITE)

IT effectiveness is an important element of research in that it supports the hypothesis that firms having enhanced IT capabilities (e.g., IT flexibility) are more productive (e.g., IT effectiveness), and as asserted causally experience improved performance [32, 66] and sustained competitive advantage [14]. IT effectiveness research has typically focused on IT value as a dimension of strategic alignment, or as a result of IT flexibility. Tallon, Kraemer, and Gurbaxani [74] equated IT effectiveness to the level of performance obtained by the IT organization while IT business value is the result of IT effectiveness in terms of the contribution IT makes to the firm's performance. Further, the authors clarified this definition by stating that IT effectiveness is essentially the delivery of reliable and quality service to the business, supporting their long-term goals. The distinction here between IT effectiveness and IT business value is important in that from a measurement standpoint the elements used to distinguish between the two are in fact different. The dimensions of IT effectiveness defined by the authors are user satisfaction, quality of service, and helpfulness of the IT staff. In reviewing the results of this study, the authors found that IT effectiveness acts as a moderating variable between strategic alignment and IT business value.

Delone and McLean [18] provided meaningful research and analysis in the area of IT effectiveness as measured across the dimensions of user satisfaction and IT strategic contribution. Pitt, Watson, and Kavan [61] built upon the work of Delone and McLean by adding a dimension called IT service quality, providing support for the concept of supply versus demand as a method for modeling and measuring the IT effectiveness construct. In their study, Pitt, Watson, and Kavan [61] defined service quality as the difference between the business user's expectations for information services and the perceived levels of services actually received. This definition corresponds with the idea of demand versus supply and the state of equilibrium as being the measure of alignment between the two. Consequently, ITF provides the capability to adjust output (supply) based on changes to demand such that the degree of equilibrium (between supply and demand) is maximized, thereby improving the degree of IT effectiveness through actual systems, solutions, or services rendered.

METHODOLOGY

Description of Research Design

Prior research was used as the basis for construct elements, measures, and instrumentation, as a means for measuring and determining construct reliability, validity, and correlation. The literature search revealed no previous studies that have been conducted that assess the relationships among IT flexibility, IT effectiveness, and strategic alignment simultaneously. However, several authors provided the elements and instrumentation necessary to measure each construct individually and collectively for this research. In particular, the studies from Tallon and Kraemer [70, 73] and Pierce [60], along with her survey format, were used as a means to achieve construct measurement and instrumentation. To gain a richer set of measurement responses, while retaining identical validity and reliability obtained from prior research methods and instrumentation, a 7-point Likert scale of ordinal values was used. Any risk associated with standardizing from 5-

and 10-point scales to a 7-point Likert scale was minimized by strictly applying the same measurement elements used within the studies conducted by the authors previously cited. Consistent with prior research, the resulting questionnaire allowed this assessment to occur in a cross-sectional versus a longitudinal manner.

The analyses of ordinal data values were handled through chi-square testing followed by regression analysis. The use of regression analysis for ordinal data types was consistent with prior research by Tallon and Kraemer [73] and Pierce [60]. Support for this technique is provided by Jaccard and Choi [38], who found that the occurrences of Type I and Type II errors did not appear to be dramatically affected by these kinds of [severe] departures from interval scales.

Because the basis of research is relational (correlational) versus causal, non-experimental (observation) methods were applied rather than the use of more formal experimental methods used to prove cause-and-effect. This allowed some flexibility in assessing the nature of the relationships as well as eliminating potential issues with extraneous variables, if any, since they did not need to be controlled.

Restatement of the Problem

As the pace of business and competition becomes increasingly rapid, complex, and dynamic resulting from the global network and the proliferation of information sharing and availability, the ability of business to achieve sustained competitive advantage through traditional means, such as strategic alignment, is rapidly deteriorating. The role of IT as a means to simply automate existing business processes and to achieve cost efficiencies is stifling firms' performance by institutionalizing current business models and inhibiting rapid changes based on competitive pressures and/or economic uncertainty. Businesses must evolve to recognize the extent to which technology has become a primary enabler of products and services offered as well as information and processes applied. IT flexibility is therefore viewed, in the context of this research as the potential cornerstone of business transformation, firm effectiveness, and ultimately sustained competitive advantage through increased IT effectiveness and strategic alignment between business and IT.

Statement of Hypothesis

This research provided feedback regarding the validity of the following hypotheses:

H_1: IT flexibility is positively correlated with IT effectiveness

H_2: Strategic alignment is positively correlated with IT effectiveness

H_3: IT flexibility is positively correlated with strategic alignment

H_4: IT flexibility has a higher positive correlation to IT effectiveness than does strategic alignment

The hypothesized relationships among each of the primary factors (H_1-H_3), were either directly or indirectly confirmed through a review of prior research. The relationship between IT effectiveness and strategic alignment (H_2) was shown to be positively correlated by Tallon and Kraemer [70] as well as by Chan, Huff, Barclay, and Copeland [11]. Similarly, the positive correlation between IT flexibility and strategic alignment (H_3) was shown to be true through the research of Tallon and Kraemer [71, 72, 73]. While a direct correlation between IT flexibility and IT effectiveness (H_1) was not evident in prior research, findings by these same authors indicated that both strategic alignment and IT flexibility were positively correlated to the IT business value construct (as a surrogate for IT effectiveness). Based on this, by implication, it appeared that a positive correlation between IT flexibility and IT effectiveness may be true. What has not been shown through prior research, and which this study addressed, is the extent that IT flexibility is correlated with *both* strategic alignment and IT effectiveness as opposed to the traditional view that strategic alignment alone is the basis for IT effectiveness. This perspective was clearly observed through the research conducted by Chan et al. [11, p. 126], and used by Pierce [60, p. 55] as the basis for her research framework [60, p. 16]. The assertion made, and which the measurement results were expected to confirm, was that IT flexibility has a greater level of positive association with IT effectiveness than does strategic alignment, therefore, it should show a stronger positive correlation (H_4).

Taken as a whole, the literature reviewed provided significant reliability and validity from which operational definitions can be made as well as the assertion that these constructs are related and a conceptual construct model could be derived (Figure 1).

Operational Definition of Variables

Elements used to assess each of the constructs (IT flexibility, IT effectiveness, and strategic alignment) were primarily obtained from prior research. These elements provided a valuable source for data gathering and measurement as their validity and reliability has been substantiated through prior research and peer review. Specific construct domain definition and elements are as follows:

IT flexibility. As previously stated, the primary dimensions used to represent the IT flexibility construct are those used in research by Tallon and Kraemer [73] (as originally defined by Byrd & Turner [9]) consisting of connectivity, modularity, and compatibility. The specific research instrument questions (e.g., elements) that were used to assess each dimension are as follows:

Connectivity (source: Tallon & Kraemer [73, p. 36]):

- Our systems are sufficiently flexible to incorporate electronic links to external parties.
- Our company has a high degree of systems interconnectivity.
- All remote offices and mobile personnel can connect to a central office.
- Our firm applies open systems network mechanisms to boost connectivity (e.g., ATM).
- Corporate databases are accessed through many different protocols (e.g., SQL).

Modularity (source: Tallon & Kraemer [73, p. 36]):

- Reusable software modules are widely used throughout our systems development group.
- Legacy systems within our firm do not hamper the development of new IT applications.
- Functionality can be quickly added to critical applications based on end-user requests.
- Data is captured and made available to everyone in the company in real time.
- Data rules and relations (e.g., tax rules, pricing) are not hard coded into applications.

Compatibility (source: Tallon & Kraemer [73, p. 36]):

- Our firm uses enterprise systems to achieve integration (e.g., Oracle, SAP).
- Our business is not limited by our choice of operating system (e.g., UNIX, Windows).
- Software applications can be easily transported and used across multiple platforms.
- Our company makes extensive use of middleware to integrate key enterprise applications.
- Our company offers multiple interfaces or entry points (e.g., Internet) to external users.

Collectively, the three above dimensions constituted the overall scoring for the IT flexibility construct; however, there existed an optional correlation assessment opportunity to see if one dimension was more dominant than another in determining the degree to which IT flexibility may or may not exist.

IT effectiveness. To measure IT effectiveness, and to ensure construct reliability, the elements (e.g., "items") used by Tallon, Kraemer, and Gurbaxani [74] to measure strategic flexibility appeared to be closely aligned operationally, and they provided the best source of measurement. These are as follows (source: Tallon, Kraemer, and Gurbaxani [74, p. 31]):

Compared to other IT units with which you are familiar, how do you rate the IT services of your unit in terms of the following dimensions?

- Overall quality of service
- Users' satisfaction with IT
- Helpfulness of IT staff to users

Strategic alignment. Discussing the area of IT strategic planning, Pierce [60] stated that when implemented, a successful IT plan should improve the business or reduce IT costs, closely align IT goals with the business focus of the company, include information about the fundamentals of the business, and be dynamic.

Specific elements (or "items") identified by Pierce in her research regarding the coordination of business and IT plans were very closely aligned to that required for strategic alignment. The elements defined by Pierce were therefore used as the basis for current research, as follows (source: Pierce [60, pp. 178-179]):

- Our IT planners are aware of the firm's objectives, business strategies and long-term goals.
- Our firm's business plans provide clear directions for IT planning.
- Our IT managers participate in strategic business planning.
- Our IT and business planners interact closely in the formulation of the IT strategic plan.
- Our IT strategic plan is independently developed without significant effort to support business strategy using IT.
- Our IT strategy is derived from business strategy.
- Our business and IT strategies are fully integrated and developed together.

The responses to each of the above questions represented the extent to which the respondents agreed or disagreed with each statement as it related to their businesses specific IT functions and/or capabilities. Consistent with the methodology for this study, the 7-point Likert scale was therefore used as the basis for data collection and analysis.

Description of Materials and Instruments

All construct-specific questions (above) were standardized using a 7-point Likert Scale for assessment. In addition, a section was added to gather general and background information to aid in the assessment and follow-up activities anticipated. These additional items were

assumed to have no direct bearing on the computational aspects of the construct correlations. The questions used for general and background purposes were modified from their source [60] in order to better conform to the current research's requirements and overall instrumentation.

Selection of Subjects

In terms of the targeted survey respondents, they needed not be both IT and a business executive, but someone who had extensive knowledge of IT and its relationship to the business. In most cases this was identified as the senior IT manager (including CIO or CTO). While it is recognized that parallel surveys distributed to both IT and business executives would provide greater measurement validity, it was viewed as neither being practical nor necessary within the parameters of this study. The effort to send and receive parallel surveys to CEO and CIO respondents would require a significantly higher number of surveys to be distributed to achieve the required number of responses requiring the sample population to be doubled and resulting in anticipated lower response rates. In addition, both Tallon and Chan appear to have supported the notion of distributing a single survey to the CIO, or top IT official. Tallon, Kraemer, and Gurbaxani [74] recognized that the CIO's survey feedback was a valid and reliable as that of the CEO. Chan et al. [11] recognized that in many cases the CEO would simply give the survey to the CIO to complete, thus, supporting the notion that the surveys for current research could be sent to the IT head while maintaining a high degree of validity and reliability.

One of the most difficult aspects of this activity was obtaining a reliable and accurate sampling frame of qualified recipients. All studies cited appeared to use different sampling frames, so it didn't seem to matter which source was used as the results appeared to be consistent across all sampling frames [60, 73, 74]. Scanning the Internet for sampling frame sources a company called Applied Computer Research, Inc. (ACR) was identified (www.ITMarketIntelligence.com). ACR maintains a list of top-ranking IT executives (along with their titles and business addresses) of US-based firms having at least 80 IT employees or listed as a Fortune 1000 or Forbes 500 company. For current research, 3080 names were purchased representing 2872 for-profit firms across the United States (US) having 80 or more IT employees or listed as part of either the Fortune 1000 or the Forbes 500. This combination was important for study validity since a non-profit firm may not strive for competitive advantage in their use of IT as do for-profit firms. In addition, larger firms provided greater assurance that the business had a higher level of reliance on IT effectiveness through strategic planning and/or technology solutions provided [12]. These larger firms were believed by this author to have greater issues associated with legacy IT infrastructures and/or ineffective strategic alignment leading to reduced levels of IT effectiveness, while having greater opportunities for enhanced performance through IT flexibility. As previously acknowledged, the ability to assess the relationships of organizational size with IT flexibility, IT effectiveness, and strategic alignment would make for valuable research, but is beyond the scope of this study.

Procedures

Questionnaires were selected as the primary method for data collection and were distributed to CIO's and senior IT executives nationwide (see "Selection of Subjects"). In order to determine the minimum number of completed surveys required, a power analysis was performed using G*Power software (source: http://www.psycho.uni-duesseldorf.de/aap/projects/gpower/). Applying a high effect size of 0.80 [15], a significance (alpha) level of .05, and a power of 0.80, the recommended effective sample size was 42. Because of the inherent nature of the target survey recipients, a low response rate of approximately 3% was assumed, therefore, rather than distributing a random subset of surveys to the sample population, surveys were sent to all 3080 CIO's and senior IT executives at large IT organizations.

Through a memo distributed to the target respondents, a direct link was embedded whereby the recipient could simply complete the survey online (http://www.surveymonkey.com). This method for collecting survey responses provided an expedient method for data collection and analysis while adequately representing the written instrumentation leveraged from prior research. Pilot testing was deemed unnecessary as the instrumentation used paralleled that of research previously cited. In addition to the survey memos distributed, each respondent was given the option to also participate in a more detailed follow-up interview to assess specific examples or circumstances within the company that the respondent represented. Based on these post-survey interviews (not covered herein), a more complete picture could then be obtained in order to enhance the insights and/or analysis as to the actual relationships at that company and to obtain working examples for citation purposes. Unless the respondent specifically requested follow-up, subject anonymity was protected by not requiring personal information to be submitted within the questionnaire responses, as well as through the use of summary statistics within the

final research paper submitted. For all follow-up responses received, respondent anonymity was also maintained by only documenting their responses in terms of their response ID number assigned by SurveyMonkey, and not by any other identifying attribute.

Discussion of Data Processing

With regards to prior studies researched, the primary method used by Tallon, Kraemer, and Gurbaxani [74], and again by Tallon and Kraemer [73] to estimate their conceptual models was structural equation modeling using partial least squares (PLS). The authors preferred this approach to other covariance-based techniques (such as LISREL© for causal modeling) as PLS is not restricted by sample size or distribution assumptions. To determine the goodness of fit between variables and the strengths of their relationships, the authors applied Confirmatory Factor Analysis (CFA), with maximum likelihood estimation. To test for discriminant and convergent validity, two-factor pairing was performed.

Pierce [60] applied the PLS method using least squares estimation rather than maximum likelihood for analyzing her research model. Pierce used SPSS© software to calculate Pearson's correlation coefficient to determine the relationship, if any, between the dependent and independent variables. SPSS© was also used to determine the probability that the hypotheses may be true by performing a one-way ANOVA analysis. Finally, Pierce calculated the coefficient alpha to determine how well the instrument scaled (based on Nunnally's [57], objective of 0.5 – 0.6), and chi-square one-sample test to address possible non-response bias.

For the current research, survey results were assessed through computational analysis using chi-square crosstabs (2x2) to ensure that the hypothesized relationships exist between ITF, ITE, and SA as ordinal response sets (per the Likert-scale used). Multiple regression modeling was then applied using the equation, $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1 X_2 + \varepsilon$, based on one target variable, IT effectiveness (Y), the predictor variables, IT flexibility (X_1) and strategic alignment (X_2) and their interaction term (X_1X_2). Multiple regression analysis was performed as confirmation to the chi-square results obtained as well as to provide comparative analysis to the results obtained through prior research and for analysis of any potential interaction between IT flexibility and strategic alignment. The regression model was evaluated through multiple analysis techniques (including the stepwise regression method within SPSS©). The stepwise method was further analyzed using the higher-order factor values for each construct. The strength of each relationship was then evaluated based on the correlation coefficients and the statistical significance level calculated for each factor and the interaction term. Through the use of the full regression model, the results confirmed both the existence of covariance between factors, as well as whether one or more of the predictor variables (X_1 and/or X_2) influenced the target variable (Y). By assessing the relative impact of IT flexibility (X_1) and strategic alignment (X_2) upon IT effectiveness (Y) this also provided evidence of whether IT flexibility has a higher correlation to IT effectiveness than does strategic alignment (H_4). In addition, the significance of the covariance between the two predictor variables, IT flexibility and strategic alignment was determined through evaluation of the interaction term ($\beta_3 X_1 X_2$). SPSS© for Windows Grad Pack (www.spss.com) was used as the basis for the above calculations and analysis.

In summary, the statistical methods applied for current research using chi-square and multiple regression analysis confirmed the research results obtained by Tallon, Kraemer, and Gurbaxani [74], Tallon and Kraemer [73], and Pierce [60] and produced the results necessary for data analysis, hypothesis testing, and validation of the conceptual model associated with the current research.

Methodological Assumptions and Limitations

This study focused on the larger segment of US-based for-profit corporations. The results should not be construed to represent small-to-medium sized firms, nor non-profit entities. In addition, the results span multiple types of businesses (i.e., financial, service, retail, etc.), and they should not be interpreted as being representative of any specific industry specialization. Finally, the use of the Internet as a method for taking and collecting survey responses was different than the paper-based forms traditionally used, but it seemed to be an acceptable approach in today's "digital age." This method for survey participant was viewed as being in line with the technical inclinations of the target audience of CIO's and IT executives and having negligible effect on actual results obtained.

FINDINGS

Assessment of Reliability

The survey sample set and data collected has shown to be both valid and reliable. Based on the power analysis performed in Chapter 3, a sample size of 42 was recommended to achieve sufficient statistical power. This recommendation was exceeded at 85 cases. In addition, the overall Cronbach's Alpha score as a model for internal consistency (based on the average correlation between

standardized items) was .70 and is above the 0.5-0.6 range recommended by Nunnally [57] as a minimum to substantiate the reliability of the measures used.

Analysis and Evaluation of Findings

Paired Factor Analysis. Chi-square and multiple regression analyses were performed to analyze each of the paired factor relationships, correlations, and/or significance. Chi-square results (Table 1) indicate that Pearson's chi-square is significant for all paired factors. These results validate the existence of a statistically significant relationship between each of the factors. In addition, Pearson's R, or Phi, provided evidence that positive correlations exist between each pair, along with some degree of explanatory value.

at r=.355, p<.001 although the strength of this relationship was noticeably lower (r^2=.126). The two predictor factors of ITF and SA were positively correlated at r=.405, p<.001, showing moderate strength (r^2=.164). In addition, the interaction term was positively correlated with ITE at r=.517 (p<.001, r^2=.267). The corresponding effect sizes are slightly modified upward in that they range from small to moderate [15].

Scatter plots for both of the primary paired factors, ITF-ITE and SA-ITE, were created for the full response set (n=85) to visually demonstrate the results obtained. The linear relationships between both sets of paired factors displayed a high degree of variability and therefore had a high probability of having point lying outside of the 1.5 Inter-Quartile Range (IQR), used within this study as the basis for outlier determination. To objectively confirm the existence of outliers within the target variable ITE, as a basis for removing them from the data set used for regression calculations, a box and whisker plot was completed. Any response set outside of 1.5IQR was removed from the full response set (n=85) for further analysis. The results indicated that four response sets (set numbers 6, 28, 46, and 57) fell outside of the 1.5IQR criteria and were therefore removed, leaving a total of 81 responses for analysis.

Table 1: Chi-Square Crosstabs Analysis Results (n=85)

	ITE-ITF	ITE-SA	ITF-SA
Pearson's chi-square[1]	16.133	4.107	8.584
Phi/Pearson's R	.435	.220	.318
R-Square (calculated)	.189	.048	.101
Approx. Sig.[2]	<.001	.043	<.01

[1] Zero cells (0%) having expected count less than 5. Critical value at $\chi^2_{.050}$=3.841.
[2] Based on normal approximation (per SPSS®).

Applying Cohen's Rule of Thumb [15], the effect size of these correlations is considered small to insubstantial. While it can be observed that the variances explained by each pair are somewhat low, the results are statistically significant (p<.05) and therefore validate the results and their respective findings.

Based on the chi-square results demonstrating the existence of a relationship between the paired factors, further analysis were then performed with ITE as the target (dependent) variable and ITF, SA, as well as the interaction term ITFxSA as the predictor (independent) variables. Individual paired correlations were then performed for each of the primary constructs, ITF, ITE, and SA, and further validated that each of the paired groupings between the target, predictor, and interaction variables were indeed positively correlated. According to the results, ITE and ITF were positively correlated at r=.553 (p<.001, r^2=.306), and ITE and SA were also positively correlated

The chi-square results for the reduced set of responses (Table 2) are still significant for all paired factors. The associated Pearson's R, or Phi, also continued to provide evidence that positive correlations exist between each pair, along with some degree of explanatory value. Reapplying Cohen's Rule of Thumb [15], the effect size of these correlations remains small to insubstantial (including the interaction term).

Table 2: Chi-Square Crosstabs Analysis Results (n=81)

	ITE-ITF	ITE-SA	ITF-SA
Pearson's chi-square[1]	13.208	3.240	7.498
Phi/Pearson's R	.404	.200	.304
R-Square (calculated)	.163	.040	.092
Approx. Sig.[2]	<.001	.073	<.01

[1] Zero cells (0%) having expected count less than 5. Critical value at $\chi^2_{.050}$=3.841.
[2] Based on normal approximation (per SPSS®).

In addition, the inter-scale correlations were re-calculated to reflect the reduced sample size (n=81). Individual paired correlations were once again derived for each of the primary constructs, ITF, ITE, and SA, and further validated that each of the paired groupings between the target, predictor, and interaction variables were still positively correlated. According to the results, ITE and ITF were positively correlated at r=.454 (p<.001, r^2=.206), and ITE and SA were also positively correlated at r=.261, (p<.001, r^2=.068). The two predictor factors of ITF and SA were positively correlated at r=.336, (p<.001, r^2=.113). In addition, the interaction term remained positively correlated with ITE at r=.430 (p<.001, r^2=.185). The corresponding effect sizes continue to show the same pattern as they move slightly upward from their respective r^2 values in that they range from small to moderate [15], although at the revised response level of n=81, the correlational effect size for the paired factors ITE-SA now become inconsequential according to this same criteria. These results confirmed findings previously obtained using the full observation sets at n=85, but better reflect the true correlations due to the removal of outlier responses from the dataset.

After removal of the outliers, the scatter plots continued to indicate evidence of heteroscedasticity, albeit to a lesser extent, and therefore had the potential to violate the linear regression assumption of homoscedasticity. As a means to address the assumption of homoscedasticity, the dependent variable, IT effectiveness (ITE), was subjected to a square-root transformation. The resulting scatter plots having the transformed data show the data points more closely aligned with the regression line. Subsequent findings and analysis for hypotheses examination and construct model validation are based on the removal of outliers from the response set (n=81) and the application of a square root transformation to ITE to meet the assumption of homoscedasticity. The recalculations of the inter-scale correlations, based on these changes, are positive and continue to support results previously obtained.

Examination of hypotheses

The results of the paired-factor analysis (above) were used as the basis for each hypothesis examination and resulting acceptance or rejection.

Research findings confirm that a positive correlation exists between IT flexibility and IT effectiveness (H_1) as identified through correlation analysis, and having values equal to r=.454, r^2=.206, p<0.001. Although the definition for ITE has varied somewhat within the research field [68], this finding is consistent with prior research with respect to the overall importance of flexibility. In addition, this confirms the importance of perceived IT flexibility as being associated with increased levels of effectiveness [41] and efficiency [1, 45].

Research findings indicate that a positive correlation exists between strategic alignment and IT effectiveness (H_2) as identified through correlation analysis, and having values equal to r=.261, r^2=.068, p<0.05. This finding is consistent with prior research suggesting that business to IT alignment (e.g., strategic alignment) remains one of the most important topics among CIO's [2]. Although r^2=.126 is still statistically significant, it is noticeably lower than the correlation between ITF and ITE (r^2=.206). This raises the question as to whether too much emphasis has been placed on strategic alignment and not enough on IT flexibility [39] as a basis for increased IT effectiveness, and then causally towards firm productivity [3, 66], and for gaining a competitive advantage [14].

Research findings indicate that a positive correlation exists between IT flexibility and strategic alignment (H_3) as identified through regression testing, r=.336, r^2=.113, p=0.001. It might be expected that the results would have been negatively correlated as some consider SA as a means to reduce ambiguity and the need for ITF [21, 64] and even as an inhibitor to ITF [52, 53]. Contrary to the findings of these authors, a positive correlation between the ITF and SA is consistent with research expectations and that of prior research in this area [7]. The finding of a positive correlation supports the assertion that strategic alignment works with IT flexibility to help de-

liver systems and solutions to the business that are targeted and more consistent with what the business needs. In addition, IT flexibility improves strategic alignment when incorporated into the firm's investment decisions [40], and by allowing the business and IT to be more adaptive to change (economic, political, competitive, etc.). By enabling more rapid adjustments to strategies and planning cycles associated with achieving sustained competitive advantage, the two-way arrow shown within the construct models (Figures 1 and 2), indicates that ITF and SA possess a symbiotic relationship, e.g. they are mutually supportive.

Finally, research findings confirm that the correlation between IT flexibility and IT effectiveness is stronger than that between strategic alignment and IT effectiveness (H_4). As noted in the discussions for hypotheses findings 1 and 2, the correlational strength between ITF and ITE is r^2=.206, p<.001, while it is only r^2=.068, p<.05 between SA and ITE. This is an important finding to current research in that it confirms the importance of ITF as having a stronger predictive capability towards ITE than does SA. It also further supports the results of prior research by several authors including [60, 73, 74], among others.

Construct model validity and analysis

Using the reduced response set (N=81) and with ITE normalized through a square root transformation, stepwise regression analysis was performed, r^2=.206, $F_{(1,79)}$=20.482, p<.001, with the model regression equation being $\sqrt{ITE}$ =.072(ITF) + 2.056, further validating the adequacy of the conceptual model for research purposes (see Figure 2). At the model level, the effect size of r^2=.206, is considered moderate [15]. After applying the stepwise regression method (above), IT flexibility remains as the only statistically significant predictor variable within the regression model. In addition, an examination of the probability (p) values for the excluded variables indicates that both SA and the interaction term, are sufficiently large enough that they would have still been excluded from the regression model even at higher levels of significance (e.g., p<.10).

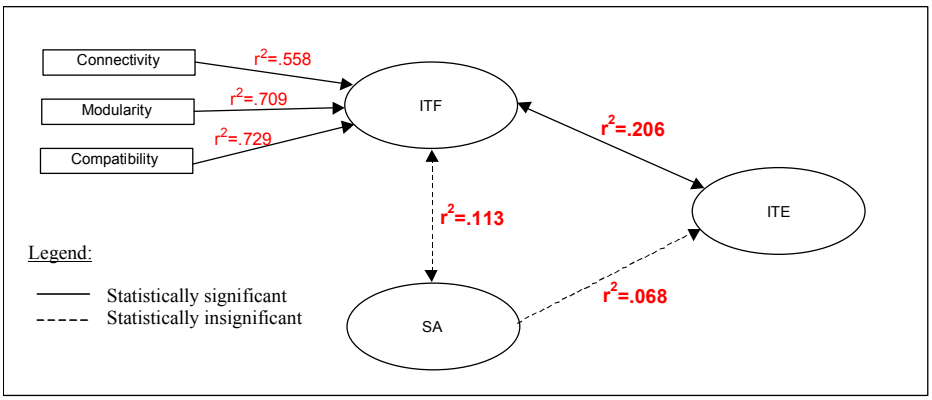
The revised conceptual model depicted in Figure 2, results from the removal of outlier observations and through the transformation of ITE using the square-root method to address the assumption of homoscedasticity. This model visually demonstrates that the relationship between IT flexibility and IT effectiveness is statistically significant and that strategic alignment's relationship to both IT flexibility and IT effectiveness is statistically insignificant when modeled along with IT flexibility.

In summary, research provided empirical evidence that IT flexibility, IT effectiveness, and strategic alignment are all positively correlated (hypotheses one, two, and three) and that IT flexibility has a stronger positive correlation with IT effectiveness than does strategic alignment (hypothesis four). The data and research also support the assertion that when combined at the model level, IT flexibility has a more significant positive influence on IT's ability to deliver systems and solutions to the business (IT effectiveness) than does strategic alignment as is supported by prior research [60, 73, 74]; and others as previously cited). Of equal value to current research is the finding that SA and its interaction with ITF, termed ITFxSA, become statistically insignificant (p>.05) as to their ability to predict variability within ITE. As such, ITF is shown to have the far greater ability to predict the outcome of changes within ITE than does either SA or the interaction term.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Technological innovation and the Internet have



(n=81; r^2=.206; $F_{(1,79)}$=20.482; p<0.001)

Figure 2: Conceptual model results

promoted globalization of the firm by removing information and geographic barriers. However, this has resulted in increased complexity and competition, along with an uncertain and rapidly changing business climate. Consequently, it is becoming increasingly difficult for businesses to plan and successfully attain, and maintain, a sustained competitive advantage. Technology and the role of IT within large corporations have therefore become paramount in working with the business to achieve optimal value in terms of profitability and competitive advantage. Prior research focused on the role of strategic alignment as the means to achieve greater business value [2, 7, 47]; however, recent research indicates a growing awareness for the need of IT flexibility as a means of delivering value to the corporation whenever and however the business demands [43, 58, 81]. For the purpose of the current research, the degree to which IT services and solutions are delivered for business consumption has been defined as IT effectiveness. There has been a lack of empirical research to form an adequate understanding and/or gain insights as to the relationship among T flexibility, IT effectiveness, and/or strategic alignment.

The purpose of this study was to investigate the empirical evidence supporting the research hypotheses that IT flexibility, IT effectiveness, and strategic alignment all possess a positive relationship or correlation to one another, and, more specifically, that perceived IT flexibility has a higher correlation with IT effectiveness than does strategic alignment. The findings for this study are based on the results of survey feedback received from 81 CIO's and IT executives from US-based firms having at least 80 IT employees and/or is listed as a Fortune 1000 or Forbes 500 company.

The 81 responses received represented a sufficient sample exceeding the power requirement established for 42 cases as well as the number of cases used in prior research by Pierce (2002) at 72 (combined CEO and CIO responses). The response rate of 2.66% is distinctly lower than prior research at 10-15% and may be the result of several factors which includes the size of firms selected, the level of the executive involved and their availability, company policy restricting survey responses (several notifications were received to this effect), and many CIO/IT executives and/or their companies that are no longer in place (substantiated by the numerous surveys received back marked "return to sender"). In retrospect, knowing the actual effect size of r=.454 as obtained from the resulting conceptual model (see Figure 2), the power value achieved was approximately .64. To achieve the higher original power value of .80, 122 responses would have been required.

The results of their feedback has provided data that confirms the hypotheses that ITF, ITE, and SA are positively correlated, that the relationship between ITF and ITE is stronger than that which exists between SA and ITE, and that ITF has the highest degree of association with ITE at the construct model level. The alignment of these findings with prior research and their significance will be the subject of the next section focusing on the conclusions of current research.

Conclusions

While there is considerable research on flexibility, effectiveness, and alignment, few studies have focused on the synergy between them. Broadbent and Weill [6] and Duncan [21] were among the first to begin studying these concepts and relationships, closely followed by Chan, et al. [11], Pierce [60], and most recently Tallon and Kraemer [73]. All have evaluated one or two of the relationships among IT flexibility, IT effectiveness, and/or strategic alignment; however, none focused solely upon the relationship among all three simultaneously. Research findings published by these authors of relevance to current research are as follows:

- Strategic alignment is critical for IT effectiveness (as interpreted for current research), and for leveraging IT towards sustained competitive advantage [6]
- IT flexibility is related to IT effectiveness, thus, IT effectiveness itself may be used as a direct indicator of IT flexibility [21]
- The best performing companies are those where strategic alignment exists and has been demonstrated or realized [11]
- Increased strategic alignment leads to improved returns on IT investments and corporate performance [60]
- IT flexibility relates to and improves strategic alignment [73]
- IT flexibility can enable a dynamic state of strategic alignment [73]
- Strategic alignment can be improved through increased IT flexibility [73]

These findings, along with analysis and insights obtained from industry sources [20], were the basis for current research and for the four hypotheses statements. The research findings provided empirical evidence supporting these hypotheses, and each can be compared or contrasted with each of the above findings, as follows:

H_1: IT flexibility is positively correlated with IT effectiveness (accepted)

H_2: Strategic alignment is positively correlated with IT effectiveness (accepted)

H_3: IT flexibility is positively correlated with strategic alignment (accepted)

H_4: IT flexibility has a higher positive correlation with IT effectiveness than does strategic alignment (accepted)

These findings showed that at the higher-order construct level, a positive correlation existed among all factors and the interaction term between ITF and SA (ITFxSA); however, only the relationship between ITF and ITE was statistically significant ($p<.05$). It is evident from the results obtained that ITF is a much better predictor of ITE than is SA, and that at the construct model level, SA and the interaction term, ITFxSA, are in fact statistically insignificant in relation to their ability to predict changes to ITE when ITF is present. Although the hypotheses were proven and the model validated, the opportunity remains for additional research to be performed because the variance in the model implies that other factors, or a better model, might be at play.

Assessing the findings from the four accepted research hypotheses against those of prior research (above), the findings of Duncan [21] that are specific to the relationship between ITF and ITE appear to be validated. The corresponding assertion that ITE can be used as an indicator (measure) of ITF can therefore be implied. Similarly, the findings of Tallon and Kraemer [73] directly support those of current research in that they found that ITF positively related to and improved SA.

Chan's findings indirectly support the hypothesis that ITE and SA are positively correlated. According to Chan [11], if IT effectiveness (ITE) can be considered as being the realization of alignment between the business and IT, then it can be further implied that those companies who perform the best demonstrate a positive relationship between SA and ITE. In addition, this same line of reasoning can be indirectly applied to Pierce's [60] finding that increased levels of alignment (SA), lead to increased levels of corporate performance, which implies the relationship between effectiveness and alignment improved performance, as linked between these studies.

In contrast to the above comparisons, the findings of Broadbent and Weill [6] appear to be contradicted through current research. These authors identified that SA was critical to ITE; however, findings from this study have showed that the relationship between ITF and ITE is stronger, bringing into question the criticality of SA to ITE relative to ITF. This same finding of ITF's strength in relation to ITE can therefore also be applied towards improved corporate performance, and possibly sustained competitive advantage [4, 43, 66]. This finding is important relative to prior research, because while past studies have shown the viability of strategic alignment to that of IT value and sustained competitive advantage [5, 6, 74], the results of current research show that IT flexibility could in fact be of greater importance to corporations than may have been previously considered. Not evident in the findings of prior research; however, is the current finding showing that SA and the interaction term ITFxSA are statistically insignificant ($p>.05$) at the construct model level when ITF is present.

In conclusion, findings from current research validate and/or recast results obtained from similar research previously performed. The importance of IT flexibility to IT effectiveness, and towards corporate performance and/or sustained competitive advantage has been confirmed by IT executives and IT industry research analysts alike in their feedback and analysis provided for this study. This applies to the confirmation of the assertion that IT flexibility should be viewed as a significant factor towards the effective delivery of IT services and solutions, versus that of strategic alignment as the primary focus within the industry and by IT executives over the past decade. This can be rationalized by noting that alignment typically targets a goal, objective, and/or deliverable towards a fixed point in time within a stable environment [45]. On the other hand, flexibility focuses on the ability to adapt to changes over time, which provides a more powerful and viable approach to delivering efficacious IT solutions and services to the business (e.g., ITE). This does not nullify the fact that strategic alignment has been shown to add value (i.e., positive correlation) to the business and IT. Furthermore, as a stand-alone factor of IT effectiveness, strategic alignment does provide a common basis for communication and coordination towards greater levels of sustained competitive advantage for the firm [63].

Recommendations

The research findings presented contribute to and expand the overall understanding of how IT flexibility, IT effectiveness, and strategic alignment relate together. In addition, knowledge of these relationships can be used to create an environment that provides effectiveness towards the timely delivery of IT services and solutions that ultimately provides the business with value as well as the ability to obtain and sustain a competitive advantage.

This researcher recommends that this study be extended to small and medium size organizations and within various market sectors to validate that these findings are consistent across each to verify that they can be universally applied. It is further suggested that the measures for IT flexibility be extended to include IT management processes such as the software development lifecycle (SDLC), the capability maturity model (CMM), as well as

robust processes, and other key business functions that affect IT's ability to provide effective and efficient delivery capabilities. This would extend the current view of flexibility as being limited to technology and/or technical infrastructures and assess whether taking a broader view might strengthen and/or change the results obtain herein.

In addition, it is recommended that the elements used to measure the IT effectiveness construct be extended to include the realization of services and solutions delivered to the business, not just the perceived effectiveness of the IT organization. IT effectiveness measures can therefore be broadened and strengthened to include objective evidence that IT flexibility enables the IT organization to adapt to unplanned changes in business demand that may not be reflected in the original strategic planning scenario. This would provide a more comprehensive model that could be used to better assess the current state of equilibrium between business demand and IT supply, as well as IT's ability to adjust to business demand when unplanned changes occur as a measure of true flexibility.

Finally, in conjunction with the above recommendations, this researcher suggests that an IT flexibility evaluation framework, model, and/or matrix be developed to assess and measure IT flexibility, along with IT effectiveness as a measure of its corresponding business value. With this model and methodology in place, it is anticipated that a firm can then independently, or with consultation, evaluate strategies and opportunities to increase IT flexibility and resulting business value through increased IT effectiveness. In addition, as the business and IT agree on the need for growing flexibility towards increased value, then their efforts can certainly be supplemented and kept on track through strategic planning.

It is this author's wish that others find value in this research and that it inspires others to continue to explore and expand on these concepts. It is also hoped that this research extends the path that has been paved before and will continue to be used to help produce a culture where IT is viewed as a positive contributor to business rather than as a hurdle to overcome, or as an impediment to organizational progress. As has been shown, the business's ability to compete is becoming increasingly tied to technology. To the extent that business partners with, and embraces technology rather than accepts it as a necessary evil, then flexibility, alignment and transformation can truly occur and significant organizational effectiveness within the marketplace can be realized.

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