On a Firm's Core Competency through Information Systems: a Meta-Analysis

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Abstract

This paper reports results of a meta-analysis performed on the aggregation of the literature on the impact of strategic alignment of information systems on yielding firm's core competencies. Drawing from Porter's Framework for Competitive Analysis [1], the Resource Based View of the firm [2], the Value Chain Model [3], and Core Competency Theory [4], we propose that Core Competency is dependent on the integration of various information systems alignment components, including the organizations' leadership , their strategies , the value chain, the roles of IT, the roles of management and their relationships , IT infrastructure , and organizations' flexibility and agility. A statistical meta-analysis through non-parametric tests of 97 hypotheses of top information systems journal articles that focused on the above components of strategic alignments suggests that core competency through information systems can be achieved by the alignment of these components working in unison.

Introduction

As the world is flattened by globalization, companies must ascertain their competitiveness by developing strategies that integrate their business and information systems in order to respond to the market forces that continuously threaten their bottom line. The resulting strategies are no longer constrained by local or national markets, but must take into account aggressive price leadership in different countries. The market has undergone an information technology paradigm transformation forcing successful businesses to not only focus on managing technology at the operational level but to strategically coordinate business activities with well-executed Information Systems (IS) leadership.

Many approaches in the literature have demonstrated that IS alignment and performance are correlated [5]. Despite the constant stream of research on IS business value, IS capabilities, and competitive advantage, there is a need for "a more coherent understanding of the firm-level impacts of IT, and their measurement" [6]. This manuscript aims at providing a meta-analysis to effectively integrate the relationship between IS and business strategy.

Discussion and hypothesis

Research in the stream of IS Alignment treats IS strategy as a realized goal that is designed to be matched with a business strategy and it usually equates existing IS application portfolios with IS strategy [5, 7, 8]. Others argue that competitive advantage depends on a firm's

superior deployment of capabilities and intangible assets [9, 10]. Given that IS assets may be easily copied by competitors in most cases [7], IS itself cannot sustain a firm's competitive advantage, but it is rather the constant alignment of several "right" factors within a firm that contribute to the sustainability of core competencies. Organizational theorists [1, 11] suggest that such appropriate structures are heavily subjected to environmental forces of risk that moderate the degree of success of core competencies. Most authors however, agree that effective strategic alignment leads to superior business performance [5, 12].

The literature suggests that for IS alignment to occur, managers must "mesh things right from the start" and "intertwine technology and business processes"—making it an unpredictable effort. Other scholars have further influenced the stream of research [13, 14, 15, 16]. The complexity of alignment resembles the often unpredictable course that organizations must endure in competitive environments, particularly those that aim at competing worldwide. This journey is best described as "a superset of multiple, simultaneous component alignments that bring together an organization's structure, strategy, and culture at multiple levels, with all their inherent demands" [5]. Such phenomenon is continuously changing as the forces of the market work restlessly to undermine or diminish business core competencies. Thus, we define IS competitive strategy as the *attempt* to obtain a competitive advantage through an information system strategy that is aligned with a value-adding business strategy.

As more alignment components are included by scholars in the stream of research, a comprehensive theoretical anthology which examines this paradox from a wide range of angles would be appropriately addressed by a meta-analysis. The broader picture of the literature that resolves conflicting evidence regarding different findings provided by meta-analysis is often necessary to advance the field. This is made possible because the methodology allows the combination of results, explanations of inconsistencies and the discovery of moderators and mediators that can be more credibly presented with multiple studies [17]. Meta-data-analyses enable researchers to apply new sets of filters and dimensions by elevating the collecting of various perspectives about a particular phenomenon [18, 19]. Such analyses differ from literature reviews in that they require a systematic method of scientific inquire that enable researchers with the ability to generate interpretive rather than aggregative or summative results [18, 19]

Paterson et al. [18] referred to a meta-study as a methodology that would encompass the overview of theory, method and data; and, they proposed meta-data analysis as the synthesis of data presented in different research findings. Such methodology provides a comprehensive framework with guidance on sampling, appraisal and synthesis, while enabling a largely systematic approach [20]. This methodology has been found to be powerful in combining the results of independent studies due to its ability to draw broad statistically supported conclusions while identifying key sources of variability in the magnitude of effects [21]. Previous research suggests that meta-analyses have many advantages over narrative reviews given its quantitative nature and the set of numbers and probabilities that provide reference points for development of general theory and for comparisons with other studies [22, 23]. In addition, meta-analyses objectively account for the variations of sample size or other categorical measures of reliability among different studies [21].

Theoretical Framework

Porter [1] proposed that competitive strategies aim to develop core competencies, or production techniques that deliver value to the customer while providing an organization with a superior business advantage over competitors. The development of Strategic Information Systems is considered to include information technology as a means to help an organization gain a competitive advantage, reduce a competitive disadvantage, or meet other strategic enterprise objectives. Although some scholars argue that information technology and information systems are simply a utility that can be used by many different organizations [24], many others have grounded the importance of being strategically successful as a function of the degree of alignment of the IS strategies with those of the overall business.

The resource-based view of the firm posits that core competencies exist on the basis of unique firm resources that are rare, valuable, non-substitutable and difficult to imitate [2, 25]. Under this view, key IS drivers lead to sustained competitive advantage based on the role of strategic resources in explaining the economic benefits from an IT innovation. The answer to success may exist in the role of strategic resources, not merely IT investments. Clemons and Row [26] maintained that firms seeking competitive advantage through innovative application of information technology usually must rely upon unique resource strengths of the innovating firm, rather than upon competitors' difficulty in duplicating technology, to protect and sustain this advantage. This may be particularly true given the ease of duplication of technology. Piccoli and Ives [27] concur with this proposition that isolated technology does not contribute to firm performance, but instead "contributes as part of an activity system that fosters the creation and appropriation of economic value".

Using a meta approach that elevates the dialogue back to an abstract model while borrowing from Porter's Framework for Competitive Analysis [1], the Resource-Based View of the firm [2], the Value Chain Model [3], and the Core Competency Theory [4], we propose that Core Competency (C) is dependent on the integration of various alignment components (AL), including the organizations' leadership (L), their strategies (s), the value chain (VC), the roles of IT, the roles of management and their relationships (R3), IT infrastructure (ITA), and an organization's flexibility and agility(t). In addition to the alignment of these components, business performance is proposed to be moderated by risk (R) and its Quality Assurance (QA) efforts. In this article we focus on four components of strategic alignments – ITA, L, QA, and, R3 - for statistical analysis.

Research Hypothesis

Many authors have empirically grounded the importance of the leadership in an organization. Broadbent & Kitzis [28] in their "New CIO Leader", provide a good understanding of what is involved in managing an IT organization and the various impacts different leadership styles have on the strategic alignment of information systems. Without the right driver, an organization is deemed to fail. While leadership roles such as CIOs and CEOs are often riddled with ambiguity [29], a firm's success is highly dependent on the maturity of its information leadership capabilities. Scholars further indicate that the IT climates fostered by a firm's leadership highly determine a firm's level of performance [30].

The IT roles in operations, the decision process and competitiveness that information systems, combined with the different roles of management and the inter-organizational relationships, both formal and informal, have been argued to greatly affect the alignment of the IS strategies with the overall business strategies [31]. Several scholars have explored these concepts in the stream of research and have discovered a tendency within some to view communication and collaboration as a result of IT credibility rather than a basis for it [32]. The social dimension of strategic alignment has been defined as "the state in which business and IT executives within an organizational unit understand and are committed to the business and IT mission, objectives, and plans" [33]. By exploring the inter-organizational relationships scholars have determined that properly aligned roles and relationships, whether formal or informal, augment business success factors [11, 31].

Among the most discussed themes in the literature has been the alignment of a firm's infrastructure and its capacity. Henderson & Venkatraman [34] pioneered the critical notion of alignment of infrastructure with business alignments. Since then, the concept has been expanded to accommodate other factors in the alignment formula. This popular conceptualization of strategic IS alignment is the strategic alignment model (SAM) defined in terms of four domains of strategic choice available to an organization, namely, the business strategy, IS strategy, infrastructure, and processes. Most empirical studies have, directly or indirectly, drawn on the four domains of the SAM to operationalize and explain organizations' IS alignment [8, 35]. While some scholars find that IT investments that are aligned with business strategies facilitate core competencies in a firm [25, 36, 37, 38] there are a few scholars who dissent [39, 40].

An area that has been perhaps overlooked by the literature has been the strategic alignment of quality assurance initiatives with IT strategies. Scholars have suggested that there is a strong correlation with quality management implementation and business performance [41, 42, 43], but most research has focused on analyzing the relationships between the implementation of different elements of quality assurance and several types of performance, not necessarily the strategic alignment of its dimensions. While some argue that the benefits of quality assurance do not always result in financial performance [44], others posit that quality assurance has a significant impact on a firm's competitiveness [45]. Based on the above discussion we propose:

H1: A firm's core competency is dependent on its four components of strategic alignments: ITA, L, QA, and, R3.

We also explore which component is the most influential in determining a firm's core competency.

Methodology

Consistent with the process suggested by Kohli and Devaraj [46] and adopted by Palvia et al. [6], we conducted the following major steps: (1) a framework to include all the factors that contribute to explaining Strategic Alignment; (2) a systematic selection of articles that contribute constructs and grounding of several components to strategic alignment; (3) an analysis and coding of the various characteristics of studies; and, (4) a statistical meta-analyses through non-parametric tests.

Data Collection and Coding Process

The target pool of articles included the two top tier journals as reported by the Association of Information Systems' MIS Journal Rankings—*MIS Quarterly* and *MIS Quarterly* Executive—covering a twenty-one-year period from 1990 to 2011. This period was based on the introduction of strategic alignment to the stream of research. The articles were selected by searching for strategic alignment contexts in the abstracts of published articles within the time frame, as well as by searching keywords related to our proposed model as detailed in Table 1. The initial selection yielded 145 articles with more than 200 hypotheses. Of these, several were excluded on the basis of relevance, framework context, inability to operationalize hypothesis, or for their non-empirical nature. This filter rendered a total of 34 articles with 142 hypotheses; however, some of these hypotheses had to be eliminated on the basis of their direct link to the model. More specifically, some hypotheses were sub-elements or sub-factors that contributed to a higher level variable. An example would be one of Reich & Benbasat's hypotheses [33] that suggested that shared knowledge would "positively influence communication between business and IT executives and connections between business and IT planning processes". This hypothesis was only a sub factor of IT executives that was not directly examined against alignment. IT and business planning, together with IT and business communication were researched and found to "positively influence the level of alignment". As such, only these two hypotheses were included as direct variable instances of alignment, whereas shared knowledge was coded as a sub-factor hypothesis and eliminated from the study.

Table 1 – Keywords Related to Strategic Alignment
Ability, Agility, Aligned, Alignment, Assurance, Business, Business Intelligence, Capability, Capacity, CEOs, CIO, Communication, Competencies, Competency , Competition, Competitive, Core competencies, Cost, Culture, Customer Satisfaction, Differentiation, Economic, International, Investment, Leadership, Management, Officer, Organizational, Performance, Productivity, Profitability, Quality, Relations, Relationship, Relationships, Resource , Resource-Based, Risk, Roles, Strategic , Strategies, Strategy, Value

A Microsoft Access 2010 database was used to codify the articles selected for the analysis; Table 2 provides a schematic of the relevant fields used. Most of these fields are self-explanatory and designed to capture descriptive information about the articles.

Table 2 – Database Coding Schema	
Articles	ArticleID, Authors, Title, Periodical, PublicationYear, Volume, Issue, StartPage, OtherPages, Abstract, AccessionNumber, Links, Description, Limitations, Methodology, Companies, Findings, Theories, GlobalIssues
Hypotheses	ArticleID, Hypothesis, HypothesisCategory, DependentVariables, IndependentVariables, Moderators, Mediators, HypothesisResult, Findings, StudyType, CAV, CategoryType, GlobalIssues, Relevance, DirectRelationship, SampleSize, SubFactor
Categories	CategoryID, Category, Tag, Subject
Keywords	ArticleID, Keywords
Exclusions	ArticleID, NonEmpirical, NonRelevant, Framework, Covariate

Dependent and Independent Variables

Core competency is defined by Porter [1] as a specific factor that provides a firm with particular strengths relative to other organizations in the industry which provide the fundamental basis for the provision of added value. Such factors must have the following criteria to give a firm a competitive edge over other firms: it must be difficult to imitate, it should be able to be leveraged to many products and markets and it should contribute to the consumer's experienced benefits. Core competencies must deliver performance advantages over other firms. While

return-on-investment (ROI), return-on-assets (ROA), and revenue have been commonly used by other studies to define performance over other firms [38], our study also included productivity or non-financial based performance measures such as consumer satisfaction, capacity utilization and inventory turnover. Thus, our dependent variable was defined based on a variety of previously used factors of both financial and non-financial performance that fit the definition of Porter's core competency, e.g. effectiveness, efficiency, financial performance, influence, innovation, market value, performance, profitability, quality performance, success and sustainability.

In order to operationalize our independent variables, we examined whether certain constructs identified by the theoretical frameworks [1],[2],[3],[4] were introduced in empirical studies as determining factors of a firm's core competencies. The literature provided a diverse group of independent factors that were found to affect core competency. These various factors where aggregated into the categories defined in Table 3.

Table 3 – Hypotheses Categories
Flexibility/Agility (T); Infrastructure (ITA); Leadership (L); Quality Assurance (QA); Risk (R), Roles, Roles and Relationships (R3); Strategic Alignment (AL); Strategies (S); Value Chain (VC); Other (O)

Only those factors that were directly measured in a hypothesis against a performance measure for core competency were included in our hypotheses table. Thus, all sub-factors or indirect factors were eliminated for purposes of the study. If a hypothesis provided a factor that would fit into any of the categories described above, such category was assigned to that hypothesis. In the rare instance that a hypothesis referenced more than one category, the hypothesis was assigned to both categories. The following are examples of the factors that were identified in the literature as influencing a firm's core competencies: agility, capability, costs, executive involvement, flexibility, good CEO, good CIO, capabilities, IT skills, leadership, risk experience, roles and relationships, shared knowledge, strategic IT and value added systems.

Table 4. Example of Article Hypotheses, Dependent and Independent Variables, CAV and Binary Values

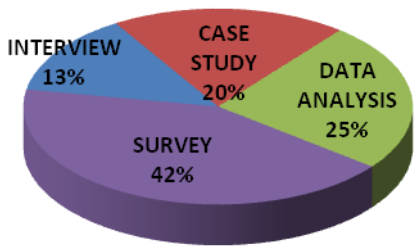
Hypothesis	Dependent Variable	Independent Variable	Hypothesis Category	Hypothesis Result	CAV	Binary
The overall structure and culture antecedents determine firm effectiveness.	Effectiveness	Structure	Roles, Roles & Relationships	Significant-Positive	1	1
The use of information retrieval agents will result in higher quality procurement choices than those made manually (i.e., higher procurement economy and accuracy).	Quality Performance	IT Retrieval	Quality Assurance	Not Significant	0	0
A CEO's high involvement in IT, which is associated with a firm that is highly progressive in its use of IT, is determined by a CEO's participation, an organization's industry conditions, and the CEO's background.	Progressive Use of IT	Executive Participation, Organizational Conditions, Executive Background	Leadership (L)	Significant-Positive	0.5	0
The use of advisory agents will result in lower quality procurement choices than those made manually (i.e., lower procurement economy and accuracy).	Economic Performance	IT Advisory Agents	Infrastructure (ITA)	Significant-Negative	-1	0

The dependent variable was operationalized into two variables, a percentage-based and a binary variable, representing a firm's performance. Similar to Kohli and Devaraj's [46] a Continuous Alignment Variable (CAV) was calculated by analyzing each one of the hypothesis

contained in the articles that were selected for review. Depending on the outcome of each hypothesis, a grade was assigned to this variable to determine if any of the hypotheses established an empirical relationship between certain constructs further defined in our independent variable section and the . Specifically, if a hypothesis was found to be positive and significant, it was assigned a value "1" for its CAV. On the other hand, if a hypothesis was found to be negative and significant, it was assigned a "-1" for its CAV. Hypotheses with partial significant findings were assigned either a 0.5 or -0.5 depending on whether they were positive or negative relationships; and, hypotheses with not significant results were assigned a value of 0. Thus, the possible range of CAV value for each hypothesis value was from -100% to 100%.

A binary variable was also created to define the dependent variable similarly to the CAV for each one of the hypothesis. If the result of an article's hypothesis was significant and positive, its binary value was set to "1"; otherwise, it was set to "0". The following Table 4, displays a small subset of the hypotheses, their findings, and their corresponding CAV and binary values.

Figure 1 – Research Methodology Types



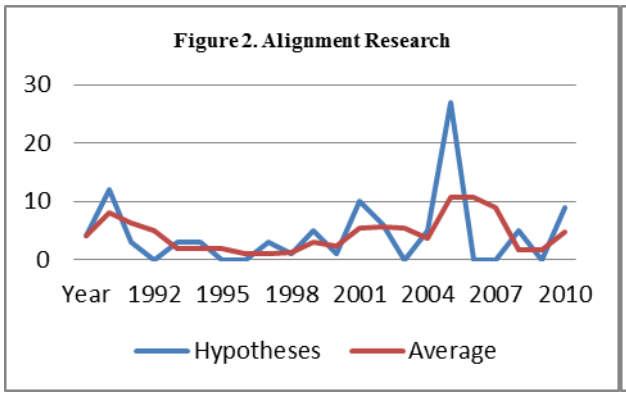
Analysis and Results

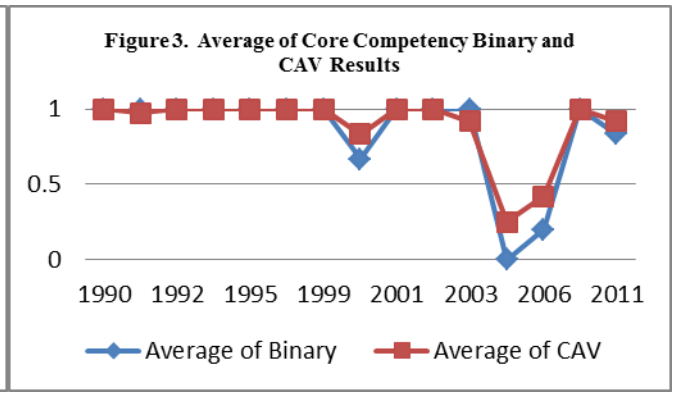
The resulting set of data consisted of 97 hypotheses. Figure 1 and Table 5 provide a summary of article characteristics to include the hypothesis categorization and the research methodology that was used by scholars in the field. Most studies have been conducted via surveys and questionnaires, followed by data analyses and case studies. The descriptive statistics in Table 5 show that alignment of infrastructure, roles and relationships, leadership, and quality assurance were the top factors examined by scholars as factors that contributed to core competencies with 78% of all hypotheses. Quality assurance and risk in terms of alignment have not been addressed until recently. Risk, however, only amounted to 1% of all the hypotheses in our sample.

Figure 2 provides a frequency graph of research on the topic of alignment. The graph shows that there was a sudden interest in alignment research in the early 1990's and once again in the latter part of the 2000's.

Table 5. Hypotheses by Independent Variable and Research Type

Variable Category	CASE STUDY	DATA ANALYSIS	INTERVIEW	SURVEY	Grand Total
Infrastructure (ITA)	5	13	1	10	**29 (30%)**
Roles, Roles and Relationships (R3)	6		6	10	**22 (23%)**
Leadership (L)	5	2	4	4	**15 (15%)**
Quality Assurance (QA)				10	**10 (10%)**
Flexibility/Agility (t)		6	1	2	**9 (9%)**
Strategies (S)	1	2	1	2	**6 (6%)**
Value Chain (VC)	2			3	**5 (5%)**
Risk (R)		1			**1 (1%)**
Grand Total	**19 (20%)**	**24 (25%)**	**13 (13%)**	**41 (42%)**	**97**





This can be explained by the 1991 issue that was dedicated exclusively to the introduction of this important stream of research by MIS Quarterly. The trend shows that the interest on the subject has had a minimum decline over the years only to become far more relevant to scholars in recent years.

It is important to note that both the binary and continuous alignment outcomes reported by studies in our meta-analysis, as displayed in Figure 3, experienced a sharp decline in its findings over the period of 2004-2006. It is possible that the context of these studies and the nature of their research are the cause of this but it would be important to analyze the difference in a future study.

Table 6. CAV and Binary Averages per Category

Row Labels	CAV	Binary
Value Chain (VC)	100%	100%
Risk (R)	100%	100%
Strategies (S)	100%	100%
Roles, Roles and Relationships (R3)	95%	91%
Leadership (L)	93%	90%
Infrastructure (ITA)	82%	75%
Flexibility/Agility (t)	65%	60%
Quality Assurance (QA)	61%	50%
Average	**88%**	**83%**

Table 6 on the other hand, descriptively shows that studies display an overall positive correlation among most of the categories of alignment used in our model. Flexibility/Agility and Quality Assurance are the only two categories that have a CAV and binary variable grades of less than 70%, suggesting either a weaker relationship with a firm's performance based on IT resources or a lack of objective research on the matter. It is also possible that given the operational nature of dimensions of such constructs, they may be already accounted and included in the infrastructure or leadership domains of our model.

Table 7. Standardized Residuals for Independent Variables

Variable Category	Binary Residual	Binary Std. Residual	% within Revised Category
Infrastructure (ITA)	2.1/-2.1	0.8/-0.5	31%/69%
Roles, Roles and Relationships (R3)	-3.2/3.2	-1.4/0.8	9%/91%
Leadership (L)	-1.6/1.6	-0.8/0.5	13%/87%
Quality Assurance (QA)	2.6/-2.6	-1.4/0.8	50%/50%

Statistical test

We performed a Chi-square test for independence to test our hypothesis whether a firm's core competency (denoted by binary variable) is dependent on its four components of strategic alignments – ITA, L, QA, and, R[3]. Our hypothesis is supported with a significant χ^2 (3, n=76) = 8.18, p = .042 and with large effect size (Cramer's V is 0.328, n = 76, p = .042). From Table 7 we can see hypothesis category ITA is most probably to be proven true in research literature (standardized residuals are +/- 2.1).

Conclusion and Managerial Implications

This meta-analysis includes articles that arise only from the information systems discipline; and more specifically, it concentrates on only two of the top scholarly journals. This limits the spectrum of results given the journal specific "review process by peer." While many approaches in the stream of research have shown separate elements of strategic alignment of IS with performance, we find a limited number of articles that address the various components of alignment working in unison. This study provides a broad analysis of the literature with the intent to elevate the discussion on strategic alignment for integration of the different constructs that affect a firm's performance.

While the study has its limitations, it serves well to provide the exploratory value of affording a model that may be empirically tested with a systematic and statistically robust methodology. One contribution is evidence that the complexity of strategic alignment extends across several constructs and is affected by both time constraints and environmental risks. If such complex dynamic was given a measurable index, both scholars and practitioners would be able to effectively assess their competitive positions as it relates to IS.

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