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IT Strategy and Economic Sustainability: Formulating a 21st Century Paradigm

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ABSTRACT

The resource-based view (RBV) has been widely adopted as the theoretical code for harnessing the strategic contributions of information technology (IT). However, mere ownership of resources, as prescribed by this body of theory, is no guarantee of competitiveness. Furthermore, RBV does not convey the wider concerns of social and environmental sustainability that many leading corporations now accept as pressing responsibilities of the 21st Century. We propose a relevant extension to the RBV as a strategic paradigm. It begins with the argument that the tenets of sustainability translate commercially into a customer-centric strategy of lean production. In this context, the Value Chain concept could be an important mediator for ensuring the most profitable IT investments, while promoting green economic practices. We tested our model using a sample of third party logistics firms, with supportive results.

Keywords

Information technology, IT strategy, technology management, lean production, pull manufacturing, operations-as-marketing, firm performance, resource-based view (RBV), Value Chain, customer-centric, green economy, sustainable economic development, corporate sustainability.

INTRODUCTION

As the 21st century unfolds, many leading corporations (e.g., Toyota, InterfaceFLOR, Subaru) seek a new paradigm for determining competitiveness, one that actively embraces the concept of sustainability. "Sustainable economic development" in principle, calls for "adopting manufacturing processes that meet the needs of the present without compromising the ability of future generations to meet their own needs" (*Bruntland Report* – Our Common Future, 1987). It reflects recognition of the fact that business activities can have detrimental effects on the planet's natural systems and encourages businesses to promote environmental protection and social equity even as they seek economic growth. Concisely meeting market demand with efficiently designed products and services *can* minimize waste, helping to conserve our environment and resource base; but it would require revising established codes and practices by which businesses develop and deploy technologies. However, rather than seek merely to comply with environmental regulations, many corporations now realize that beyond altruistic concerns, adopting the philosophy of economic sustainability could be economically advantageous.

The resource-based view (RBV) has emerged as the theoretical basis for explaining the strategic role of IT resources. Essentially, the theory holds that possessing valuable, rare resources that competitors cannot easily acquire or reproduce, provides a competitive advantage (Barney 1991). Clearly, mere possession of such resource is no guarantee of superior performance (Barney and Arikan 2001). Of equal importance is the firm's ability to combine and exploit its resources in a manner that *creates value.* Moreover, RBV does not adequately convey the social and environmental responsibilities that many see as an urgent issue in the present context. (Priem and Butler 2001; Sirmon et al 2007; Newbert 2007).

This paper proposes a reexamination and enhancement of the RBV as a theoretical lens for gauging IT strategy that could ensure its continued relevancy in the face of this ensuing paradigm shift (Haigh and Griffith, 2008). Building on a customer-centric definition of "value," one of the main tenets of the philosophy of lean production, we advance a strategic framework for an extension of RBV theory that promotes competitiveness while simultaneously embracing the wider concern of

economic sustainability. Known as "operations-as-marketing" the strategy calls for the closest possible collaboration between these two primary activities, eventually transforming the operations of the firm into a strategic tool. This customer-centric approach has been tested previously in the manufacturing (Hayes and Wheelwright 1984), and service industry (Roth and van der Velde 1991; Tallon et al 2000). Here we test its possible mediating role in guiding IT investment decisions to ensure the attainment of intended strategic objectives, while mindful of the wider doctrine of sustainability (See Figure 1).

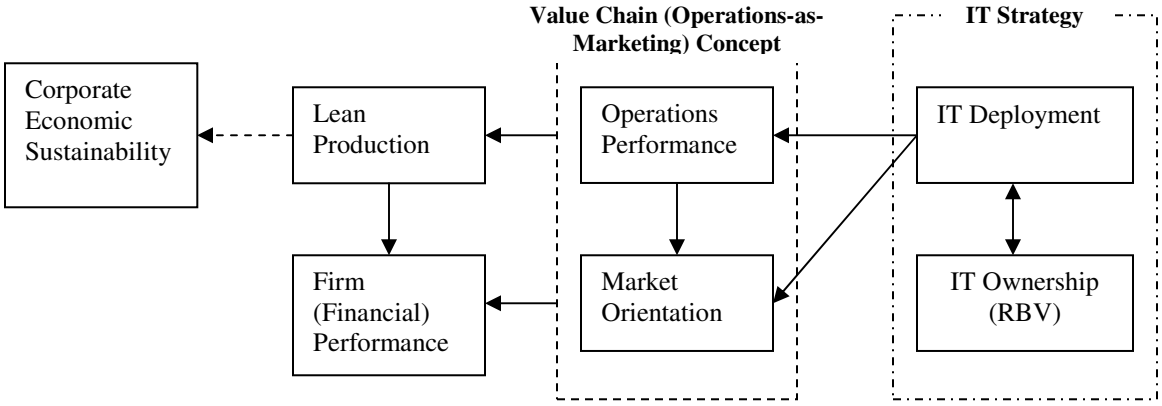

Figure 1: IT Strategy and Corporate Sustainability

The paper proceeds by first linking the concepts of sustainability and lean production. We then explore the concept of the Value Chain, as the motivation for the "operations-as-marketing" strategic paradigm, followed by an outline of our research methodology for exploring its possible mediating role. Finally, we discuss and summarize the results of our analysis.

THEORETICAL BACKGROUND

Corporate Sustainability and Lean Production

Corporate sustainability is a dynamic process with the stated aim of allowing business entities to realize economic objectives that potentially can improve the quality of life for its stakeholders, while simultaneously protecting and enhancing the earth's life support systems. Modern-day concepts of business and industrialism were conceived in an age when there was little consideration for the fragility of our planet or the finiteness of our resources. Today, problems such as global warming, political conflicts, pollution and looming scarcities of vital resources signal the urgency with which we must address these issues. As a result, many successful businesses are demonstrably embracing the notion that sustainability and enhanced financial performance can coexist in the modern business world, even yield new forms of prosperity.

One of the supportive principles of sustainability is the concept of "lean production," which propagates the attainment of productivity goals using minimal inventory - including raw materials, work-in-process (WIP) and finished goods. The term originated from the just-in-time (JIT) tactics of Toyota's assembly plants in the 1970s, but its origin goes as far back as the early 1900s, when Henry Ford used similar tactics to streamline production processes and eliminate waste. In the 1930s, the Japanese adopted various elements of JIT and the philosophy generally remained unchanged until the 1970s when Toyota integrated the approach into their production line to improve delivery time and quality. The term "lean" replaced JIT in the 1990s to emphasize the true objective of the philosophy: eliminating waste throughout the supply chain. "JIT," in this context, refers to the delivery system that supports the execution of "lean production."

Five key principles underlie lean production (Jacobs et al, 2009):

1. *Value* – understanding that the true value of the product is the embodied utility for which the end-consumer is willing to pay.
2. *Value Chain* – identifying process stages of the supply chain that add real value to the final product and eliminate those that do not.
3. *Pull* – eliminating overproduction and excess inventory by producing what the customer wants, and only when and where they want it; thus (ideally) production occurs only in response to the *pull* of customers signaled needs.

4. *Flow* – ensuring that goods flow uninhibited and continuously through the supply chain.
5. *Continuous improvement* (Kaizen) – pursuing the ideal of total waste elimination through successive, iterative adjustments within the production process.

Two important tenets emanate from these principles. First is the belief that the end consumer ultimately determines value as manifest in the price they are willing to pay for the product or service. Second, consumers' signaled needs should be an all-pervading preoccupation guiding every activity along the supply chain and ensuring that the goods and services delivered are the closest possible match. This is an information-intensive environment dependent on tightly coordinated logistics support in order to function as intended.

The Value Chain

Lean production begins with identifying and mapping every stage in the manufacturing and delivery of a product retains only those value chain activities that add net value. Efficient operations, however, while *necessary*, are not *sufficient* to generate competitive advantages. Porter (1985; 1996) suggests that further eliminating all functional distinctions between operations and marketing can attain competitive advantages by combining the strengths of both these primary activities. Since the essence of the firm's existence is to create maximum *value* for its customers (Sirmon et al 2007); it is more important strategically to nurture a culture of *market-orientation*, which would drive internal operations in a manner that ensures minimal divergence between the products and services customers need and those actually supplied by the firm. Ultimately, all parties would benefit: customers would enjoy maximum utility, which would secure their patronage and ensures the long-term (financial) performance and viability of the firm (Fornell et al 1996; Rinehart et al 1989).

The Operations-as-Marketing Concept

The notion that the firm could leverage its operations to generate strategic marketing competencies has attracted increased attention in both the manufacturing and service industries in recent years. Four distinct stages of transformation, each characterized by the significance of the value-added contribution of the firm's internal operations, are identified from the "operations-as-marketing" strategy (Tallon et al 2000).

1. In the earliest stage, the firm essentially adopts a *"revolving door"* policy, in which no value is added in terms of maintaining or capturing additional market share. Instead, the preoccupation of the firm is simply to minimize potentially negative impact as part of internal control and tactical, short-term objectives.
2. In the second stage, the firm strives to attain competitive parity with its peers. Value-added capabilities of operations are *"externally neutral,"* serving only to help retain existing customers and avoid defection.
3. In the third stage, the firm actively becomes a *market attractant* with operations capabilities serving to help win, rather than merely retain, market share.
4. Ultimately, in the fourth stage, the firm attains full integration of its operations and marketing, affording *"golden handcuff"* capabilities – the ability to attract and retain valued customers. Such a capability potentially can pose significant entry barriers to market newcomers.

These four stages of development are consistent with the varying levels of intensity and engagement that characterize supply chain relationships, including outsourcing and third party logistics. Such relationships extend along a continuum from "arms-length," purely transactional-based interaction with customers, to tactical collaboration and, ultimately, strategic alliances that extend across all identified processes of the supply chain partners (Coyle et al 2003). The potential competitive advantages of supply chains are supported by a growing body of research (Wade and Hulland 2004; Rai et al 2006). Here, we examine the mediating role of the operations-as-marketing paradigm, as a dynamic framework for ensuring that IT investments yield the intended enhanced performance for the firm (Figure 2.).

The Role of Information Technology

Information technology plays an elemental role in virtually every facet of modern industry, supporting asynchronous coordination across time and space (Stewart and Kleiner 1996; Kuruppuarachchi 2001). The value chain concept sees value activities of a firm as comprising of a physical component, the required operational tasks and an information-processing component, involving in capturing, manipulating and channeling of data (including market-related data) necessary to perform operational tasks (Porter and Millar 1985).

Extant literature identifies two categories of IT resources, relevant to our model. The first is *explicit* IT resources - the hardware and software components of a generic information system. The second is the more recently defined *tacit* IT

resources – managerial capabilities believed to play an important moderating role in leveraging explicit IT resources (Figure 2). "IT resources" refers to IT *assets* and *capabilities* that are useful in detecting and responding to market opportunities and threats (Christensen and Overdorf 2000; Wade and Hulland 2004). Thus, IT "assets" can be summarily defined as the various tangibles (e.g., IS hardware, network infrastructure, etc.) and intangibles (software patents, manager skills, etc.) that assist the firm in effectively deploying its business processes for producing and distributing its products (Hall 1997). IT "capabilities" are repetitive actions or distinct traits relating to how the firm deploys its assets (Christensen and Overdorf 2000).

Generic IT hardware and software are the easiest resources for competitors to acquire. Thus while this resource may afford industrial parity, it is unlikely to be a source of significant competitive advantage (Wade and Holland 2004). The second, more strategically important category, tacit IT resources may result from the cultivation of socially complex, firm-specific traits and capabilities that competitors cannot easily replicate (Bharadwaj 2000). Evidence suggests that the extent to which IT managers and line managers *share knowledge* regarding how IT can improve process performance, is a critical success factor (Ross et al 1996; Ray et al 2005). Shared knowledge has been linked to increased levels of IT use (Boynton et al. 1994), improved alignment and increased operational and service performance of the IS group (Nelson and Cooprider 1996), increased IT assimilation in value-chain activities and business strategies (Armstrong and Sambamurthy 1999), and improved process performance (Ray et al. 2005). Thus, shared knowledge is a firm-specific asset essential in determining the performance and success of IT investments (Raghunathan 2001; Segars and Henderson 2000).

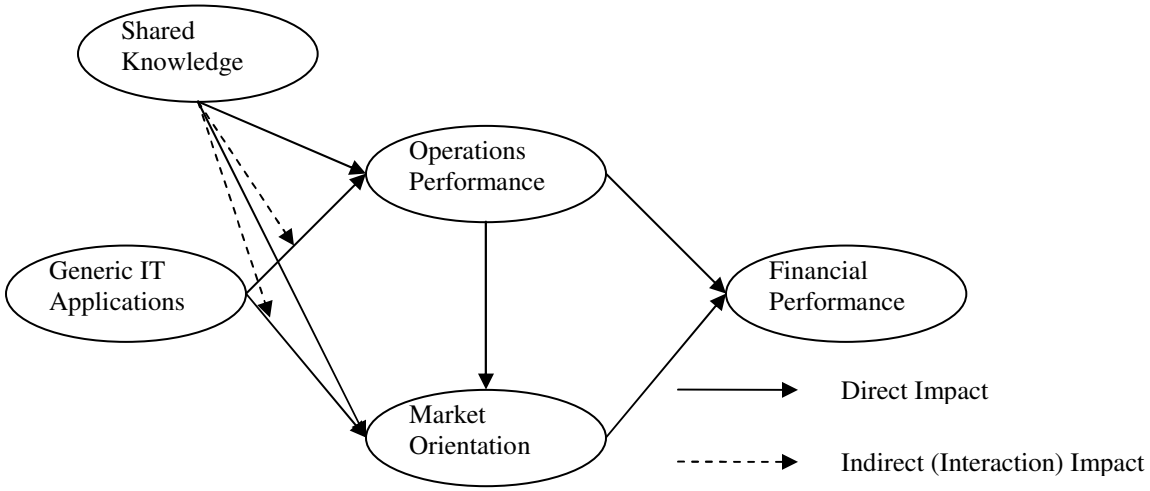

Figure 2: Operations-as-Marketing Mediation of IT Investments

RESEARCH METHODOLOGY

The target sample is third-party logistics (3PL), mostly SME firms that provide outsourced logistics support to clients (mainly large Fortune 1,000 firms) on a contractual basis. This dataset is appropriate for testing the above hypotheses for several reasons. First, the 3PL industry is by nature, IT-intensive. Second, clients view 3PL firms as providing a means of extending the logistics function of the organization beyond its traditional boundaries and the ability to create value for their clients is highly prized (Lieb and Maltz 1999). As such, the ability to nurture long-term relationships with their clients/customers is a key corporate asset that can provide the firm a significant competitive edge (Kanter 1994) and is fundamental to its economic well-being (Rinehart et al 1989; Fornell et al 1996). Retaining valued customers is cost-efficient, but also provides a disproportionate boost to overall profits (Copacino 2001). Third, IT is critical for providing personnel with the information they need to build market relationships; while also supporting the operations of the firms. Much of the strategic value created by 3PL firms stem from inventory visibility and management, and the operational support this capability affords (Leigh and Marshall 2001; Liang and Tanniru 2007). Finally, in this industry there is a high level of variance in the reported ability of firms to satisfy their customers, suggesting that some firms may enjoy competitive advantages in executing their business strategy. Collectively, these characteristics make it possible to test the model at the level of the basic value chain process, as captured in the operations-as-marketing concept.

We designed a survey instrument to elicit information about all the variables, using existing, validated scales (see Appendix). Of the 500 companies solicited, the response rate was 12.8%, yielding 61 useable responses. Several diagnostic tests confirmed the overall integrity of the data. We measured internal reliability by estimating composite reliability (see Table 1). A composite reliability of ≥ 0.70 is acceptable for social science research (Chin, 1998). The fact that each of the measurement items of the latent constructs load significantly (p-value < .05) confirmed convergent validity (Gefen and Straub, 2005). Further evidence of discriminant and convergent validity is the fact that the diagonal cells in Table 2, representing the square root of the average variance extracted (AVE) for each latent variable of the correlation matrix, is greater than the correlations between that latent variable and other in the model (Chin, 1998). Thus, the constructs demonstrate adequate measurement properties.

Construct	Type	No. of Items	Mean	Standard Deviation	Composite Reliability
T (IT Applications)	**Formative**	**5**	**57.02**	**22.44**	**0.833**
SK (Shared Knowledge)	**Reflective**	**6**	**32.72**	**6.82**	**0.911**
OP (Operations Performance)	**Reflective**	**5**	**28.97**	**3.75**	**0.873**
MO (Market Orientation)	**Reflective**	**5**	**25.26**	**5.14**	**0.826**
FP (Financial Performance)	**Reflective**	**5**	**22.51**	**6.38**	**0.940**

Table 1: Descriptive Statistics and Composite Reliability of Main-effect Construct

	T	I	SK	OP	MO	FP
Average Variance Extracted (AVE)	0.501	0.455	0.633	0.583	0.490	0.758
T	**0.708**					
I (Interaction of T and SK)	0.301	**0.675**				
SK	0.165	0.369	**0.796**			
OP	-0.097	0.214	0.517	**0.764**		
MO	0.381	0.371	0.556	0.480	**0.700**	
FP	0.388	0.211	0.195	0.246	0.439	**0.871**

Table 2: Correlations of Latent Constructs and AVEs (Values on diagonals are the square root of average variance explained by the construct)

Data Analysis

Data analysis was performed using Partial Least Squares (PLS), a structural equation modeling technique that takes a component-based approach to estimation while placing minimal demands on measurement scales, sample size and residual distributions (Wold 1985). The moderating role of Shared Knowledge on IT investments is analyzed as Interaction, with a construct formed by cross-multiplying the average of the 6 items in Shared Knowledge with the summed score of each of the 5 group of the IT applications construct. The possible mediating role of the operations-as-marketing paradigm is investigated using path analysis. A control variable, Size, the natural log of the value of the number of dedicated 3PL employees in each firm, was used as additional mitigation against the variability of IT applications among the respondents. This construct is linked formatively to IT Applications and Financial Performance (as indicated in Figure 2). Except for IT Applications, modeled formatively, the indicators of the remaining latent constructs were modeled reflectively according to recommended guidelines (Jarvis et al, 2003; Chin et al, 2003). All data has been *standardized.*

Sample Size

Generally, the larger the sample the more stable the parameter estimates, yet there is no agreement as to what constitutes an adequate sample size. PLS standards suggests a sample size equivalent to the larger of the following: (1) ten times the

number of indicators for the scale with the largest number of formative (causal) indicators, or (2) ten times the largest number of structural paths directed at a particular construct in the structural model. A weak rule of thumb, similar to the heuristic for multiple regression analysis (Tabachnik and Fidell, 1989), suggests a multiplier of five, instead of ten. Our sample size of 61 observations exceeds the more stringent requirements. Furthermore, the PLS approach has been demonstrated to provide reliable information on the appropriateness of indicators for samples as small as 20 (Chin 1999).

Results and Discussion

Analysis of the structural model included estimating the path coefficients, and the r^2 value, which indicates the amount of variance explained by the independent variables. A customary bootstrap re-sampling procedure (300 resamples) was used to test the significance of the path coefficients (Chin, 1998). Figure 3 summarizes the results. The effect of the direct paths from both categories of IT resources, in comparison to the mediation model, is assessed using a procedure similar to the one used to test competing models in stepwise linear regression. Accordingly, the statistic f^2 reflects the difference in the r^2 of the dependent variable, financial performance, between two versions of the model one with and one without the direct paths. The results ($f^2 = 0.044$) suggest that the variance explained by the direct paths is small and does not significantly contribute to the overall explanatory power of the model (Chin, 2003; Patnayarakuni et al, 2006). In other words, the proposed "operations-as-marketing" strategy fully mediates the impact of both categories of IT resources on financial performance.

This represents one of the first empirical studies to demonstrate the potential mediation impact of the "operations-as-marketing" concept in planning IT investments, while simultaneously embraces the tenets of economic sustainability. The results highlight three areas of focus for technology investments: (i) it is necessary, although not sufficient, to ensure efficient operations. But unleashing the full strategic impact of the firm's internal operations is only possible if (ii) the firm nurtures a culture of market orientation that facilitates accurate gauging, even anticipating, customers needs and (iii) processes are in place to effectively internalize this knowledge, allowing operations to quickly and accurately respond to market signals. Such operational responsiveness serves as the foundation for building sustainable path-dependent relationships that transform the firm's internal operations into a potent strategic weapon supporting and reinforcing its marketing capabilities, which includes ensuring customer satisfaction. This strategic paradigm is a proven theoretical motivation that also brings into focus an important stakeholder group all-too-often overlooked in the debate to date regarding IT resources and firm performance. The relationship of 3PL providers and their clients in many ways exemplifies the bond of strategic engagement with customers, as providers strive to become eventually a *de facto* extension of their client/customer. Market orientation provides the cultural foundation for customer-centrism (Narver and Slater, 1990). In turn, this customer-centrism is the basis of lean production, ensuring that inventory arrives at the point of usage when needed (Jacobs, Chase and Acquilano, 2006) and required products are delivered to the consumer in the right form, at the right time and in the right place, the essence of a *pure-pull* (manufacturing) system. As an empirical examination of the relationship of IT and market orientation, this project is timely in that it calls for revisiting the strategic importance of customer-centrism in the face of globalization and the pressing concerns of sustainability. As indicated, while operational *efficiency* is necessary, there is also the need to attain high degrees of operational *effectiveness* through market orientation. Monitoring one's customers, as well as ones competitors, and ensuring that knowledge and insights so acquired are internalized quickly to guide operations within can effectively transform the firm's operations into a strategic weapon with the potent to enhance firm (financial) performance.While the results showed no evidence of an interaction effect between IT resources, it is clear that the impact of shared knowledge, as defined in the model, is highly influential in explaining variance in both operations performance as well as market orientation. The sum effect of explicit and tacit IT resources in this instance well may be *additive,* as opposed to interactive. Explicit IT resources are critical to the mechanical functioning (operations) of business processes, and by facilitating higher levels of visibility and coordination, lends critical support to the marketing functions of the firm. The negative correlation shown in the model is indicative of the potential challenge posed by the reengineering required to integrate new technology into existing operations (Porter, 1996; Powell and Dent-Micallef, 1997; Bharadwaj, 2000). In addition, shared knowledge, a proxy for tacit IT resources, provide the insight and capabilities necessary for developing business processes that ultimately are the basis of superior performance.

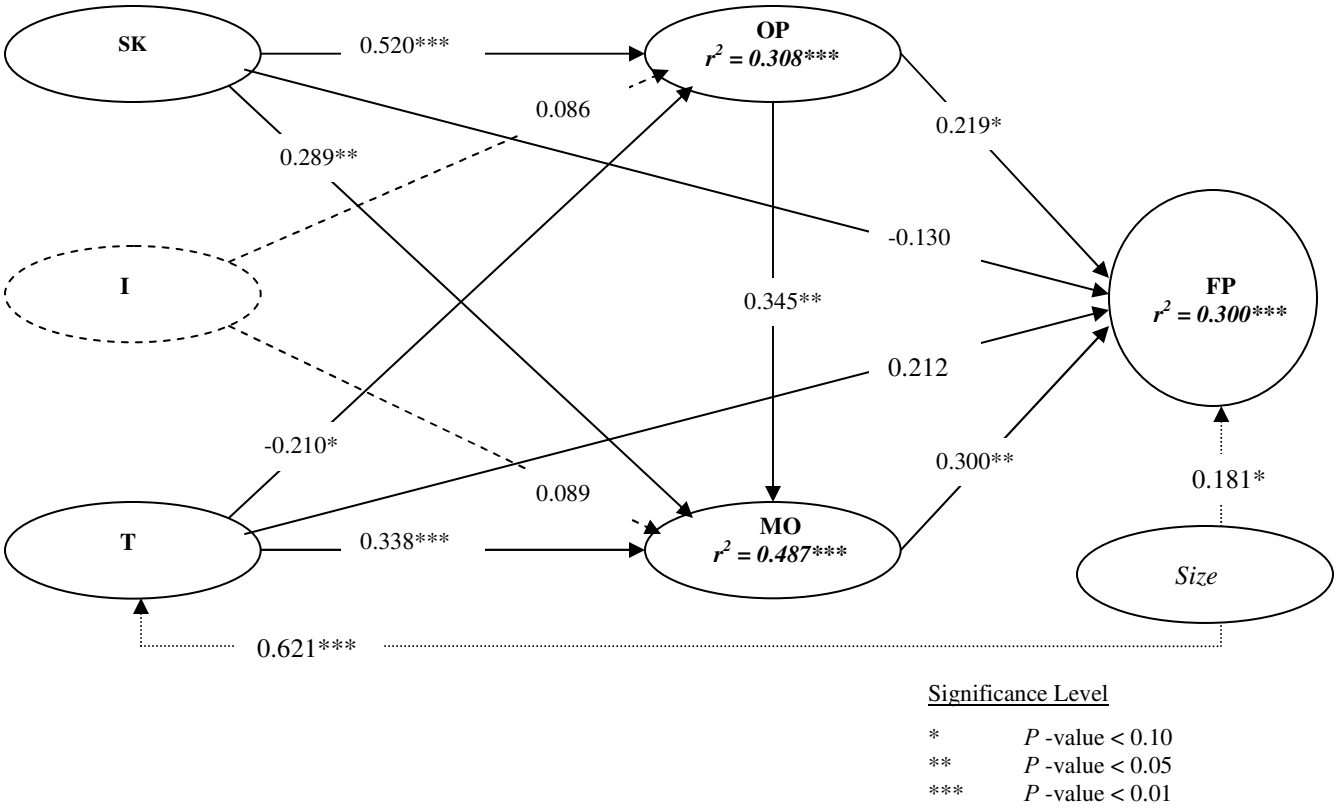

Figure 3: Path Coefficients and Significance Levels

CONCLUSION

Both RBV and the value chain are market-oriented in focus, but the Value Chain model emphasizes the strategic importance of internalizing an in-depth knowledge of the customer as a way of strategically leveraging the firm's operations. We demonstrate that this "operations-as-marketing" strategy, which has been tested empirically in both the manufacturing and service sectors, can effectively mediate IT investments, while simultaneously promoting the tenets of sustainability. Many leading businesses now see this as a pressing responsibility. We examined this concept in the context of the 3PL industry, an inherently customer-centric, IT-intensive, industrial sector. The findings largely support the motivation for the study.

APPENDIX – THIRD PARTY LOGISTICS SURVEY

Financial Performance (FP) [1]

FP1 Over the last 3 years, our financial performance has been outstanding compared to our leading competitors.
FP2 Over the last 3 years, our financial performance has exceeded our leading competitors.'
FP3 Over the last 3 years, our sales growth has been outstanding compared to our leading competitors.
FP4 Over the last 3 years, we have been more profitable than our leading competitors have.
FP5 Over the last 3 years, our sales growth has exceeded our leading competitors.'

Operations performance (OP) [2]

OP1 Our customers are pleased with our record of delivering on time *as promised*.
OP2 Our customers are pleased with our record of delivering on time *as requested*.
OP3 Our customers are pleased with our record of completing tasks or projects as contracted.
OP4 Our customers always receive our deliveries in good condition.
OP5 Our customers think we charge the best prices for the services we provide.

Market-orientation (MO) [3]

MO1 We frequently and systematically measure customer satisfaction.
MO2 We are more customer-focused than our competitors are.
MO3 Our top managers discuss our competitors' strategies.
MO4 We respond rapidly to competitors' actions.
MO5 Over the past year, we have frequently used cross-departmental teams to address key problems.

Shared (Business-IT) Knowledge (SK) [4]

SK1 Our IT managers understand our key business processes.
SK2 Our IT managers understand our business strategy.
SK3 There is common understanding between our IT managers and line managers regarding how IT can be used to improve process performance.
SK4 Our line managers generally recognize the potential of IT as a tool to increase our efficiency.
SK5 Our line managers generally recognize the potential of IT as a tool to improve our service quality.
SK6 There is a common understanding between IS managers and line managers regarding how IT can be used to improve process efficiency and effectiveness.

IT Applications (T) [5]

Warehousing and Transportation

ITR1 Warehouse Management Systems
ITR2 Transportation Management Systems
ITR7 Integrated TMS & WMS

Customer Interaction

ITR3 Customer Relationship Management
ITR8 Demand and Supply Forecasting
ITR13 Internet Customer Access

Network & Process Modeling

ITR4 Network Modeling
ITR11 Transportation Optimization
ITR14 ERP Interface

Data Exchange

ITR5 Freight Billing (Rating, Pay, Audit)
ITR6 Automatic Brokerage Interface
ITR10 Paperless Logging
ITR15 EDI

Visibility & Tracking

ITR9 Global Freight Tracking & Tracing
ITR12 Global Visibility
ITR16 Bar-Coding
ITR17 Radio Frequency
ITR18 Satellite Vehicle Communication

[1] Adopted from Powell and Dent-Micallef, 1997
[2] Adopted from Stank, Goldsby and Vickery, 1999
[3] Adopted from Narver and Slater, 1990
[4] Adapted from Ray, Muhanna and Barney, 2004
[5].Adopted from Armstrong & Associates – Who's Who in Logistics

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