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MODULARITY, INFORMATION TECHNOLOGY OUTSOURCING SUCCESS, AND BUSINESS PERFORMANCE

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Completed Research Paper

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Abstract

We propose a model to explain success in large scale, complex outsourcing arrangements. The work is based on a field study of current outsourcing practice and review of literature. The model links outsourcing success to modularity and firm level performance. Data collected from a survey of Chief Information Officers and other senior managers supports our hypotheses. In particular, we observe the effect of outsourcing success on business performance. Modularity has a direct effect on business performance. In addition, outsourcing success mediates the effect of modularity on business performance. Novel conceptualization and operationalization of architectural modularity, is a contribution to empirics and theory. Outsourcing success is seen to be associated with firm level performance, within the boundary conditions of large, multifunction, multiyear IT outsourcing initiatives. The results show several characteristics of "transformational" outsourcing that goes beyond cost reduction, and addresses firm level performance.

Keywords: Outsourcing, modularity, business performance, outsourcing success, architecture.

Introduction

While the link between overall Information Technology (IT) investment and productivity is well known (Stiroh 2002) it is less known that a significant and increasing share of this IT investments is currently outsourced. IT outsourcing (also referred to as sourcing) has been defined as "the delegation, through a contractual arrangement, of all or any part of the technical resources, human resources, and the management responsibilities associated with providing IT services to an external vendor" (Clark et al. 1995). As a conservative estimate, this share has reached 20% of IT budgets among InformationWeek 500 firms (Vallis et al. 2008). Moreover, anecdotal accounts suggest that this share is growing. In addition, outsourcing has also gained wider adoption among the overall universe of firms. As a result, there has been a steady growth of IT outsourcing spending reaching $260 billion by 2009 (Souza et al. 2005). Recent estimates for IT and BPO (Business Process Outsourcing) were $297 billion for 2007. Linder (2004 p. 1) argues that "outsourcing can be more than a tool for cutting costs and improving organizational focus. Increasingly, it is a means of acquiring new capabilities and bringing about fundamental strategic and structural change".

Academic and practitioner research has delved into differential industry level outcomes of IT outsourcing (Han et al. 2005). Yet, the role of this outsourced element in affecting firm level performance is not well understood. Given that IT outsourcing is increasingly a direct proxy for IT investment, success of IT outsourcing initiatives would be the key to future productivity increases. In contrast, market research indicates that a significant share of client firms is not satisfied with the outcomes of outsourcing (Cohen et al. 2006). About half of large outsourcing contracts have been discontinued, or subjected to major changes (CIO 2003). In addition, outsourcing highly customized functions, such as application development, is even riskier (Cohen et al. 2006).

IS literature has largely focused on cost reduction driven outsourcing (Lacity et al. 1998), a trend which is confirmed in recent literature reviews (Lacity et al. 2009). The strategic (as opposed to cost only) effects of outsourcing have largely been researched using financial performance and stock market value. The results have been mixed. Focal firm financial performance has been seen to improve (Mojsilović et al. 2007), or weaken (Hall et al. 2005). Similarly, event study method has shown positive (Hayes et al. 2000), as well as negative (Oh et al. 2006) effects on the firm market value. These results suggest intricacy of the phenomenon.

Recent research suggests that focal firms increasingly complement cost reduction with non cost, or "strategic" success criteria. For example, our initial case study included a focal firm which involved the application development vendor in its CMMI transformation effort (Nagpal 2009). The informant gave his views on this non cost criterion;

Other than cost, and productivity improvement that outsourcer committed to us, the outsourcer is involved in improving and stabilizing the day to day processes that we use, they are helping us (by the way) with a CMMI transformational effort. [Vice President, Enterprise Solutions, US Fortune 100 company]

While cost reduction remains important, a number of non cost criteria have clearly entered the equation (Nagpal 2009). This is a corollary of relatively complex activities such as application development being increasingly outsourced. As expected success criteria for these functions go well beyond cost reduction. Agility and improved time to market are examples of success criteria. A summary of case study results is included as an Appendix.

A related issue is the organization of IT services within the buyer firm, i.e., how these IT services are organized for modularity. Modularity refers to the manner in which system level functionality maps to component level functionality (Baldwin et al. 1997). A modular architecture enables a greater number of outputs to be made available as IT services, using a limited number of IT inputs (Schilling et al. 2001). This can affect outsourcing success. Therefore, modular system theory is a relevant theoretical lens in this context. Notably, modularity has also been mentioned by leading edge practitioners in the context of outsourcing success. Here, congruence of system and component level functionalities is perceived to be important in cost driven and "strategic" outsourcing. The literature has drawn linkages between modularity and vertical disintegration (Baldwin et al. 1997; Tuomi 2002). However, modularity has not been explicitly linked to outsourcing success, or overall firm performance. Against this backdrop, we examine the role of modularity in influencing outsourcing success and firm level performance. We argue that the use of modular architectures is a key antecedent of outsourcing success in large, complex outsourcing arrangements. These are multiyear initiatives, and involve more than one IT functional unit suggesting high levels of complexity. The outsourced IT functions commonly include application development and maintenance in which strategic gains have been difficult to realize (Grover et al. 1996). We view outsourcing success as an intermediate

outcome, ultimately affecting business performance of the focal firm. In this model, we adopt a business or firm level, rather than user (or individual) view of outsourcing success (Grover et al. 1996).

The remainder of the paper is organized as follows. First, we review the relevant IT outsourcing and modularity literatures. The key variables, research model and hypotheses are proposed in section 3. In section 4, we report on research design and methodology, which is followed by data analyses, results and discussion in sections 5 and 6. We conclude with limitations and suggestions for future research.

Literature Review

Outsourcing Success

Outsourcing success has been defined as "level of fitness between the client requirements and outsourcing outcomes" (Grover et al. 1996). This stream of research on the antecedents of outsourcing success has primarily assumed a vendor, or dyadic view point focusing on vendor service quality (Grover et al. 1996) and partnership quality (Lee et al. 1999). Venkatraman (1997) has suggested that the top management approach to IT- whether focused on cost minimization or business capability augmentation- impacts the choice of outsourcing goals. The respective extremes are labeled as 'cost center' and 'IT value center' and theorized to have different success criteria. However, current outsourcing practices are not focused on either cost or value; they need to address both (Ross et al. 2007). Quinn et al. (1999) emphasized similar outcomes and recommended dedicated executive roles such as Chief Sourcing Officer. This latter research stream touches on the need to create mechanisms to control outsourcing, but lacks an overarching theory. Recent literature reviews (Lacity et al. 2009) have noted limited coverage of strategic outsourcing. However, it is important to study strategic or 'transformational' outsourcing as the scope and aims of outsourcing are widening. In this regard Grover et al.'s (1996) operationalization of outsourcing success remains relevant, as it covers several facets of outsourcing success beyond cost reduction. In this paper, we are interested in firm level aspects of outsourcing success, where these strategic outcomes are manifested. Individual or user level success is distinct, and might not be affected by current outsourcing practice.

Modularity

We draw on literature on product level modularity that considers individually designed discrete modules (Baldwin et al. 1997). This product level modularity has been linked to cost as well as non cost advantages. These advantages include lower design and production costs and increased product variety (Sanchez 1999). Similar conceptualizations exist at the organizational level, in which modularity improves organizations' ability to better compete in dynamic environments (Eisenhardt et al. 2000). There is limited evidence on the correspondence across modular organizations and products (Hoetker 2006). The literature is not always clear cut on the distinction across various analogies of product modularity, which are applied to firms. In case of services, for example, it is difficult to sequestrate product and firm effects, where the ability to recombine modules rapidly is involved (Sambamurthy et al. 2003).

Given this diffuse conceptualization, we consider work on modularity in the context of outsourcing, and research on Enterprise Architecture. Recent research on the role of modularity in outsourcing has delved into the extent of modularity across (and not within) firms. These conceptualizations include technological and interfirm modularity (Tiwana 2008a; Tiwana 2008b), which refer to the extent of loose coupling and interoperability across the vendor and client IT system. Some Enterprise Architectures have been linked to increased modularity (Venkatesh et al. 2007), and provide another starting point. However, the quantitative extent of this "architecture related" modularity and its impact on IT outsourcing success has not been addressed in literature. Relatedly, analytical work on service architectures (Voss et al. 2009) has developed a mathematical function of service modularity. However, this analytically derived function has not been tested empirically.

Our field study indicated that outsourcing managers increasingly recognize the need for improved modularity within the focal firm. This would be different from interfirm modularity, however. Informants defined such increased modularity of the focal firm or host architecture, to be related to strategic, in contrast to cost saving advantages of outsourcing (Nagpal 2009). This suggests that expansive and strategic outsourcing involves a shift away from monolithic architectures, toward modular configurations of IT services instead of "all-or-nothing" outsourcing.

Business Performance

Business performance has been defined as "organizational effectiveness of a firm or business unit in terms of its financial and operational performance relative to its competitors" (Venkatraman et al. 1986). This definition has been extensively used in IS literature. Although these measures are typically collected with perceptual surveys, they have been found to be a good proxy for accounting measures (Tallon et al. 2007; Tallon et al. 2000). In addition, there are certain advantages to the use of perceptual measures, for example, at the business unit level, where it is difficult to get good accounting data. In view of mixed findings on the effects of outsourcing using financial measures (Hall et al. 2005; Hayes et al. 2000; Mojsilović et al. 2007; Oh et al. 2006), this represents a plausible alternative.

Summary

As a significant portion of IT investment is outsourced, at least in firms which utilize outsourcing, there is a need to test the link between success in large scale IT outsourcing, and firm level performance. Overall, there is a void in literature on three issues. First, outsourcing success (Grover et al. 1996; Lee et al. 1999) has not been linked to business performance. Extant research has led to mixed evidence on the effect of outsourcing. Next, benefits of modularity such as disaggregated and flexible supply chains (Schilling et al. 2001) and modularity at the level of enterprise architectures has not been studied in IS outsourcing literature. In addition to an effect on the success of outsourcing initiatives, modularity can also have a direct effect on firm level performance.

Given the current status of IT outsourcing, it is important to study if strategic or "transformational" outsourcing has an effect on business performance.

Research Model

Based on the literature review, we identify the following research questions:

1) What is the effect of modularity on outsourcing success?

2) What is the impact of outsourcing success on firm level performance?

3) What is the joint effect of outsourcing success and modularity on firm level performance?

Accordingly, we propose a research model with associated hypotheses, as shown in Figure 1.

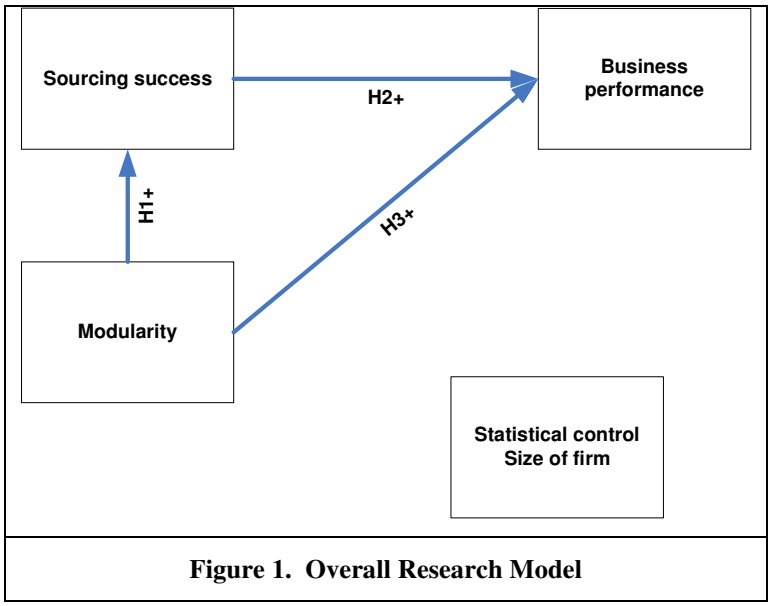

Figure 1. Overall Research Model

The model relates outsourcing success and modularity to business performance, as shown in Figure 1. We argue that success in large scale, complex outsourcing is ultimately linked to overall business performance. We also carry out mediation analyses on the model (Mathieu et al. 2006).

Modularity and Outsourcing Success

The link between outsourcing success and modularity is drawn on the basis of increased efficiency and effectiveness of the outsourcing process, when modular architectures are used in the IT organization. Recombination implies the combination of limited 'modules' to produce a greater number of services, following the logic of increased variety (Sanchez 1999). The number and variety of services improves the value of IT organization to users across the firm, given improved customization and fit with user needs. On the input side, increased modularity implies increased choice in terms of type and number of suppliers that are potentially available to the focal firm. This follows the logic of lower costs (Sanchez 1999). The implications of modularity as regards imitation and innovation (Pil et al. 2006) are relevant to IT outsourcing. Architectural modularity is defined as intra-firm modularity, and does not need to be shared with vendors (Tiwana 2008a). Hence this knowledge is subject to limited imitation effects. On the contrary, innovation related advantages of architectural modularity are not subject to such limitations, and advantage the focal firm. Modular architectures thus enable focal firms to problem solve more reliably and radically (Pil et al. 2006). As vendor markets and individual vendor capabilities continue to evolve (Nagpal 2009), this architectural modularity enables the focal firm to shift and redistribute work more easily among new and existing vendors. This makes available a larger set of potential vendors to the focal firm, which is unavailable to its competitors. Some modules are also reusable across activities in the focal firm, which helps to lower IT costs. This reuse would be relevant to secular reduction in 'break fix' type of maintenance activities, which hog significant IT budgets. Current practice indicates that IT executives aim to minimize such maintenance costs, with resultant savings channeled into new application system development. This reinvestment would help focus IT on the core business, a key attribute of outsourcing success (Grover et al. 1996). Increased control of IT expenses would follow from recombination and reuse of discrete modules. In summary, increased modularity not only facilitates outsourcing, it enhances success rates of outsourcing, all else being equal.

H1: Increased modularity is related with greater outsourcing success.

Outsourcing Success and Business Performance

Outsourcing success has several facets that affect business performance. First, a focus on 'core' activities leads to better utilization of scarce capital, management attention, and other resources in the focal firm. In addition, our field study suggested that successful outsourcers tend to scan the vendor market continuously, and redefine the notion of 'core'. This was done not only based on the focal firm's business strategy, but also new developments in the vendor market (Nagpal 2009). Secondly, firms can enhance their IT competence through leveraging vendor capabilities. This includes learning from the vendor on system development and related methodologies such as project management. Finally, access to skilled personnel at the vendor end is a major benefit, as vendors have the critical mass and variety of work to attract and retain specialists in key technologies. This leads to improved productivity for the focal firm, as turnover and retraining is reduced. Successful outsourcing also reduces the risk of obsolescence as the focal firm can choose from a range of vendors and avoid investing in risky (or bleeding edge) technologies until they stabilize.

As a significant portion of IT investment is outsourced, at least in firms which utilize outsourcing, IT value literature would also suggest a link between success in large scale outsourcing, and firm level performance. The logic for the effects of sourcing success is similar to those of IT value (Tallon et al. 2000). The role of outsourced IT in the major functions such as inbound logistics, operations, service, sales, and outbound logistics (Tallon et al. 2000) would also suggest a link to business performance.

H2: Outsourcing success is directly associated with higher business performance.

Modularity and Business Performance

With increased modularity, heterogeneous inputs can be joined in a combinatorial fashion, so as to meet the increased heterogeneity of demands (Schilling 2000). At the firm or business unit level, there are many ways in

which modularity affects business performance. Modular architectures and processes help firms to utilize a greater variety of inputs, which include more varied internal and external resources. This enhances cost effectiveness and quality, particularly in industries with heterogeneity of inputs. Another advantage of varied inputs is better adjustment to environmental changes. In addition to economies of scale, increased outsourcing is made possible for the firm as a whole. There is some evidence that the effect of product modularity on firm performance is mediated by product variety (Worren et al. 2002). This view applies well to increased heterogeneity in technologies, and the rise of new modular enterprise architectures in current practice.

Modularity enables variety and customization through recombination and reuse of limited inputs. In dynamic demand environments, higher modularity would enable a broader array of 'services' to be customized and delivered by the focal IT organization. In this manner, modularity can support differentiation strategies. An increased customization of the final product results from the use of differentiated IT services. As an alternative, cost driven strategies are also well supported by increased modularity. Lower costs result from reuse and recombination of a limited set of inputs (Schilling 2000). Either of these business strategies improves revenues and profitability relative to competitors. In addition to tangible effects such as revenue growth, modular architectures can also enhance intangibles such as company reputation. It is because services can be scaled up relatively quickly to meet the quantitative changes in demand. In cost led environments, quick adjustment to demand changes can help the firm compete through lower inventory and reaction time to demand changes. In a differentiation strategy, products are better matched to demand, through the use of mass customization.

A number of industry characteristics make modularity more valuable in dynamic environments. These characteristics include high levels of competitive intensity and technological change (Campagnolo et al. 2009). Given this scenario, architectural modularity is a "digital option" for the business, and enables initiation of new competitive actions. The wide range of competitive actions improves firm performance (Sambamurthy et al. 2003).

H3: Increased modularity is related with increased business performance.

Control Variables

Industry and firm size are commonly used controls in IT value research (Kohli et al. 2003). The impact of outsourcing success on firm level performance might be stronger in IT intensive sectors such as financial services. Large firms with greater slack in overall and IT resources may be less affected by the success (or failure) of IT outsourcing initiatives. Thus, industry and firm size are candidates for statistical controls. The differential effect of industry was inherently controlled for in the survey, as business performance scale items asked the respondent to compare the firm to its competitors. The respondent firms were also spread across industries, as we did not approach executives from a single industry. Hence we used firm revenue as a statistical control.

Methodology

Operationalization

The constructs were measured with validated scales, adapted from literature. The definition and items are shown in Appendix A. As there were no well tested scales to measure architectural modularity, we devised a new scale. Modularity was defined as opposite of monolithic, and characterized by a collection of elements that deliver a unique function, independent of others (Pil et al. 2006). The scale was validated through pilots, and conversations with the research division of the association of executives.

Data Collection Strategy

We used survey based data collection to test the hypothesized research model. The respondents were business executives with extensive operational and managerial knowledge of outsourcing, working for buyer or focal firms, i.e., vendors and consultants were excluded. In addition, respondents needed to be able to respond on business (and not merely technical) outcomes. These two criteria made the sampling more difficult when compared to surveys focused solely on IT value. In order to help focus the attention of executives, they were asked to consider a reference IT project that had involved a significant level of outsourcing. They were also asked about IT functions covered in

the reference project. On business performance, respondents were given an option to answer with a view of the firm as a whole, or the business unit germane to the IT project. These criteria were expected to help the respondents to respond concretely on the specific elements of outsourcing, and focus their attention on the related business unit or firm performance.

Instrument Development and Testing

The survey was refined through sorting exercises, face to face interviews, and a small sample web survey. The draft questionnaire was then tested face to face with senior IT executives. In addition, the layout of the web survey was tested. Based on these pretests, the survey was divided into sections, with introductions at the start of each section. The survey was also reviewed on presentation aspects by experts who had a deep knowledge of the web survey software. Additional refinements were suggested by researchers at the association of senior executives, and included in the survey. The research division of the association piloted the survey, and sent the link to a few members before rolling out the survey to its membership. The final items are shown in Appendix A.

Survey Administration and Sample

The web survey was distributed to executive members through the sponsor association, with membership concentrated among senior executives. The respondents were sent an invitation email with a link to the survey. In order to encourage participation, they were promised a summary report of findings. The survey was carried out in summer 2008. As shown in Table 1, the effective response rate is 2.81%. However, the contact lists were not specific to member involvement in outsourcing. The sponsor association indicated that less than 30% of their members were involved in outsourcing. Adjusted for this qualification, the response rate for the survey is 9% or higher.

Table 1. Response rate calculation

Original sample			2047
Less:	Undelivered questionnaires	69	
	Out of office or other responses of lack of interest	57	
	Effective sample size	1921	
Number of questionnaires received			55
Effective response rate			**2.8%**
Adjusted for non involvement in outsourcing			**9.3%**

The survey included two subsamples of senior executives. The later subsample included senior executives mainly from non IT functions, and approached through an association. These were again not specialized to a single industry. In order to test the equivalence of samples, Chow test (1960) for equality of regression coefficients was carried out. The results indicated that the subsamples were statistically equivalent, and were therefore pooled together for subsequent analysis. In the final sample, each organization had experience with at least one major outsourcing arrangement. About half of the overall sample was composed of C level executives such as CEO/CIO/CFO/COO, Vice President or Director level respondents.

The sample profile is summarized in Tables 2 and 3. As shown in Table 2, the vast majority of firms had outsourced application development and maintenance, at least in the reference project. A majority had multiple functions outsourced, with an average of two functions outsourced per firm. The average length of the outsourced project used as a reference to respond to the survey was 34.5 months. The length of projects and range of IT functions involved suggest that these were highly complex outsourcing projects, as specified in our theory and hypotheses section. In view of our work on archival data in a related paper, we are able to draw some conjectures on the value of these projects.

Table 2. IT Functions outsourced		
IT Function	**N**	**(%)**
Application development and maintenance	44	80.0
Systems operations	17	30.9
Networks management and maintenance	17	30.9
End user support	26	47.3
IS planning and management	5	9.1
Multiple response question, n=55	109	198

Table 3. Sample versus Universe firm revenue (%)			
Response	**Number**	**(%) sample**	**(%) universe**
Less than $50 million	0	0	12
$50 million to $99.9 million	5	9.1	10
$100 million to $499.9 million	20	36.3	27
$500 million to $999.9 million	7	12.7	9
$1 billion to $4.9 billion	13	23.6	23
$5 billion to $9.9 billion	5	9.1	6
$10 billion to $14.9 billion	1	1.8	4
$15 billion to $29.9 billion	2	3.6	2
$30 billion to $39.9 billion	0	0	1
$ 40 billion or higher	0	0	2
NA/Don't know	2	3.6	5
Total	55	100	101 (rounded)

As shown in Table 3, the survey sample shows adequate correspondence with the sponsor association membership profile. The latter was however available for the whole membership, not only those involved in outsourcing. This mitigates response bias concerns. The median firm revenue was in $ 500 million range.

Analyses and Results

In view of early stage of theory, we used Partial Least Squares (PLS) to analyze the data. PLS uses a component based approach for estimation, in contrast to covariance based Structural Equation Modeling. It has less stringent demands on scales, sample size, and assumptions of multivariate normality (Chin 1998). We tested the psychometric properties of scales, and then tested for the hypotheses. We also conducted mediation analyses on the model following established procedures.

Validity of Measures

All variables were operationalized as reflective measures. Table 4 shows the descriptive statistics, after removal of items with low factor loadings. The scales met the requirements of the conventional cutoff value (0.7). As shown in Table 5, item level cross loadings met the criteria for convergent and discriminant validity (Fornell et al. 1981).

Items with high cross loadings were removed. However, one item on business performance (item 4) was retained. This item did not cross load, and the business performance scale exhibited good reliability overall (Table 3). Similarly, one item for outsourcing success (item 1) with a loading slightly below 0.7 was retained. These final items were retained to test the hypotheses.

Table 4. Descriptive statistics and reliabilities

	Item	Min.	Max.	Mean	Std. dev.	Cronbach's Alpha	Internal Consistency Reliability
Business performance	5	2.00	6.00	4.23	0.95	0.879	0.897
Modularity	3	1.67	6.33	4.69	1.19	0.884	0.930
Size of firm, revenues in million (log scale)	1	1.88	4.35	2.89	0.67	1.000	1.000
Outsourcing success	4	1.00	7.00	5.01	1.12	0.785	0.862

Note: All reflective indicators, 1-7 point Likert scale

Table 5. Loadings and cross loadings

	Business performance	Modularity	Size of firm	Outsourcing success
modular1	0.317	**0.950**	-0.006	0.290
modular2	0.279	**0.961**	0.008	0.303
modular3r	0.025	**0.789**	-0.098	0.257
perform1	**0.802**	0.098	-0.010	0.283
perform2	**0.942**	0.282	-0.101	0.449
perform3	**0.918**	0.243	-0.101	0.332
perform4	**0.581**	0.13	-0.002	0.043
perform5	**0.702**	0.055	-0.041	0.025
size	-0.083	-0.030	**1.000**	-0.298
ssuccess1	0.279	0.298	-0.217	**0.668**
ssuccess2	0.273	0.205	-0.298	**0.897**
ssuccess3	0.217	0.269	-0.134	**0.761**
ssuccess7	0.417	0.224	-0.261	**0.789**

Table 6 shows the correlation analysis, with the square root of average variance extracted (AVE) in the diagonal. All variables show an AVE of 0.5 and above, with the diagonal elements (or square root of AVE) well above 0.7. This establishes convergent validity for the final scales (Fornell et al. 1981). In addition, the values in the diagonal cells are higher than those in the corresponding row and column, indicating discriminant validity for the scales.

Table 6. Correlations across latent constructs				
	Business performance	**Modularity**	**Size of firm**	**Outsourcing success**
Business performance	0.801			
Modularity	0.243	0.903		
Size of firm	-0.083	-0.030	1.000	
Outsourcing success	0.387	0.314	-0.298	0.783

Note: Square root of AVE in diagonal

Test of Model

PLS provides R square values for the effect of independent variables on the respective dependent variable. The bootstrap run to test the model was carried out with 55 samples and 500 simulations. The path coefficients and R square values of the overall model are shown in Figure 2. In this model, outsourcing success showed a significant link with business performance, with an R square of 0.17.

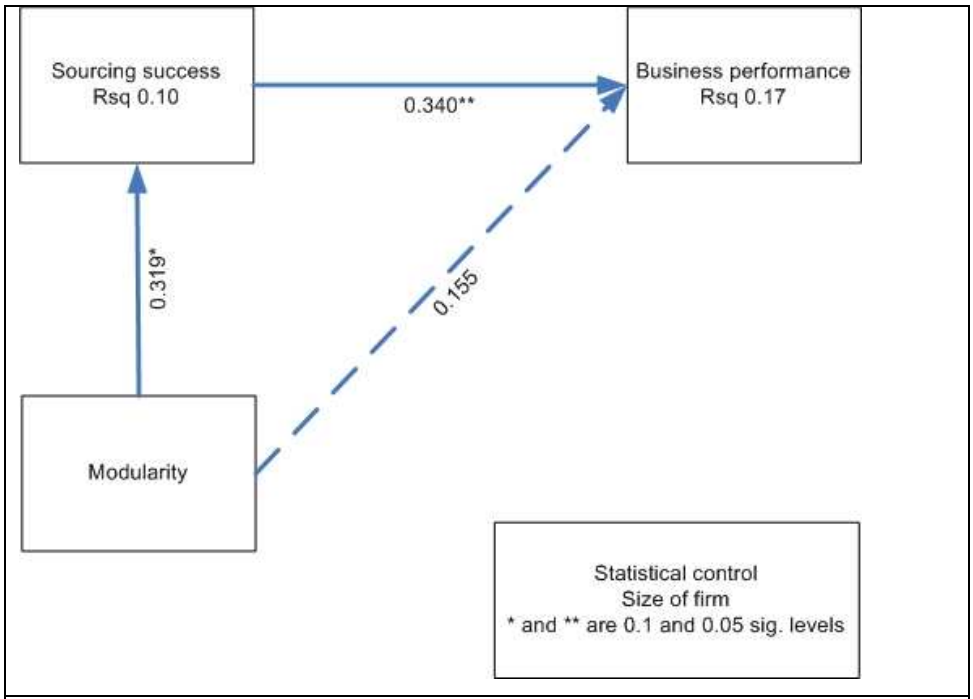

Figure 2. Mediation Effects

Mediation Analyses

Given the significant effect of modularity on outsourcing success, the latter could act as a mediator in this relationship. Alternatively, this could be merely an indirect effect, if there was no relationship between modularity and business performance to start with (Mathieu et al. 2006). In order to ascertain the presence of mediation, we tested additional models. First, we tested the mediated model with the modularity-business performance relationship removed. As shown in Figure 3, the results are very similar to the initial model. In a strong test of mediation

(Mathieu et al. 2006), we also tested the direct effect of modularity on business performance, i.e., with outsourcing success removed from the model. As shown in Figure 4, the link is significant. The model shows an R square of 0.095, as compared to that of 0.17 in the initial model. Thus, modularity explained 9.5% of the variance in business performance. This direct effect shows that outsourcing success mediates fully the effect of modularity on business success.

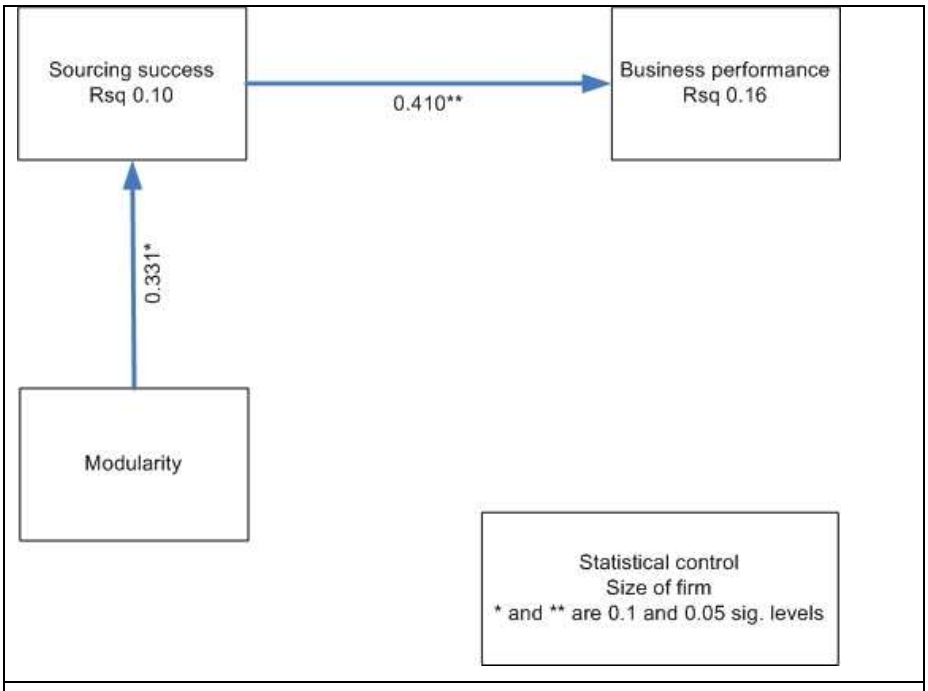

Figure 3. Mediated Effect Only

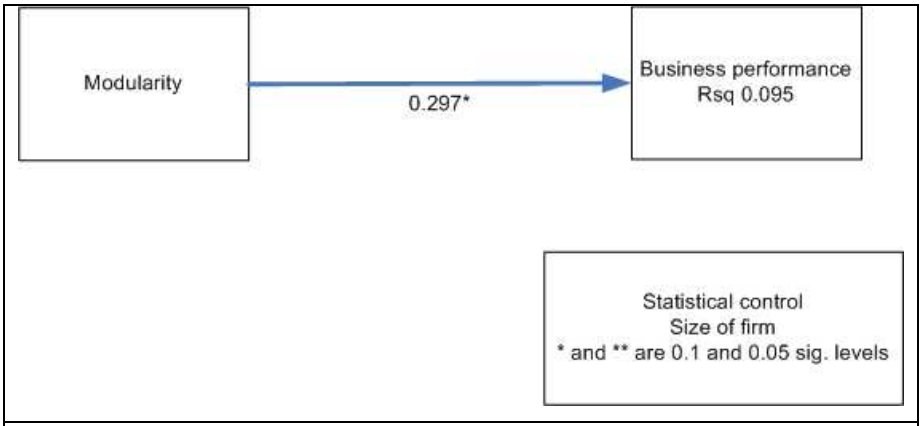

Figure 4. Direct Effect Only

As shown in Table 7, we found support for the hypotheses, with additional presence of mediation. Although some relationships showed weak significance levels, nonetheless the sign indicated directional support. In view of the limited sample size, such limitations were expected. Biased parameter estimates which lead to lower estimates at the structural model (inner model) are also an explanation (Chin et al. 1999). The variance explained by the model was in line with those seen in IT value and strategy research. In line with literature, we also checked correlations with accounting data.

Table 7. Summary of mediation			
Path	**Partial mediation**	**Model with full mediation (no direct effect)**	**Direct model (no mediator)**
H1: Modularity → Outsourcing success	0.319*	0.331*	
H2: Outsourcing success → Business performance	0.340**	0.410**	
H3: Modularity → Business performance	0.155		0.297*
R square for Business performance	**0.172**	**0.160**	**0.095**

Note: * and ** indicate significance at 0.1 and 0.05 levels

Discussion

The boundary conditions of our research are "large, complex outsourcing arrangements" around three years in duration, on an average. In related research using secondary data, we observed average length and value of 65 months and 199 million dollars, respectively. With the secondary data skew toward large firms, the contracts in this survey sample would be conservatively in the multimillion dollar range. These arrangements covered application development and maintenance, in a vast majority of firms. Given the difficulty of achieving firm level outcomes from outsourcing application development and maintenance (Grover et al. 1996), the results are notable. We also emphasize that these are highly customized outsourcing arrangements. Also, each survey represents one firm, i.e., we did not collect data on multiple projects from the same firm. This leads to a higher level of generalizability of the results. Given our definition, this is perhaps the first empirical study of "transformational" outsourcing (Linder 2004).

Modularity was a newly developed construct in this research. In the absence of well known scales, we drew on literature (Pil et al. 2006). The psychometric properties of the scale were adequate. This gives us confidence in the interpretation of results. Again, the domain of modularity is defined at the architectural level. Given the results, advantages of modular architecture are mediated by outsourcing success. In substantially insourced environments, where there is no relevance of outsourcing success (mediator), an increase in modularity of architectures would have a direct effect on business performance. Thus modularity is important in both insourced and outsourced settings. The results hold important implications for theory and practice. Given the lack of empirical research on modularity in relation to outsourcing practices, the results contribute to definition and understanding of this construct. Hence, understanding the role of modularity is an important contribution to outsourcing literature, both theoretically and empirically.

We tested for the effects of outsourcing success and modularity on business performance. The value of R square was in line with values typically seen in IT value research (Kohli et al. 2003), which seeks to link IT investment with firm value. The result shows the importance of strategic IT outsourcing as a value adding activity in its own right. As a significant proportion of IT investment is currently outsourced (Vallis et al. 2008), the results suggest that the outsourced elements need to be managed as well in order to improve business performance. In some ways, the results are reminiscent of IT value research, which established the link between IT investment and firm level performance. Hence, outsourcing success can be an important measure to focus on in IT value research. The success of such complex outsourcing initiatives ultimately affects firm performance. We thus delve into the specifics of how IT managers, broadly defined, can add value.

Mediation analyses suggest that the relationship between modularity and business performance is mediated by outsourcing success. The direct relationship, as shown in the 'direct effect only' model, in Figure 4, is relevant in substantially insourced environments. Thus, for firms which do not outsource (or outsource minimally), modularity remains important, as it has a direct impact on business performance. In outsourced contexts, modular architecture and outsourcing success work jointly to increase the likelihood of improved business performance.

The results hold a number of implications for managers. First, modular architectures and processes are vital to strategic or "transformational" outsourcing. An understanding and control of Enterprise Architectures has to be driven by senior IT managers at the focal firm. As Enterprise Architectures evolve, modularity continues to increase. In order to maintain parity with their competitors, the stewards of enterprise architectures will need to continuously look for ways to increase and leverage modularity. Baldwin and Clark (1997) advocate that users of modular architectures will have to "know more: engineering details that seemed trivial at the corporate level may now play a large part in strategic decisions". We also observe this in our case study. Enterprise Architects work with CIOs to vet large scale outsourcing and manage internal and external sourcing (Nagpal 2009). IT executives of firms involved in outsourcing can make a case for investments in this architectural knowledge. Although outsourcing success is of higher interest within the IT function, its effect on firm level performance is likely to draw the interest of senior executives, and help justify investment in the architectural knowledge required for strategic or transformational outsourcing.

Limitations

There are a number of limitations of the study. The results would be less relevant to smaller and relatively simple outsourcing contracts. The link between outsourcing success and firm level performance needs to be interpreted with caution, as respondents were asked to select "strategic" projects, i.e., which could potentially have an effect on business performance. However, the bias does not guarantee a significant positive coefficient seen in the results. As shown in Table 4, there was a wide range in the values of business performance and outsourcing success, i.e., the sample was not limited to firms with uniformly high (or low) business performance and outsourcing success. The sample profile also shows correspondence with the overall universe, as discussed under sample characteristics, addressing response bias concerns.

The size and extent of outsourcing (as a share of overall IT investment or spends), as well as focal firm experience, could serve as additional controls in the model. However, many respondent executives were uncomfortable with revealing this sensitive information. Low response rates are typical of surveys of executives. Given the respondent qualifications that intersect IT and business criteria, there was a limited set of executives who could respond knowledgeably to the survey. Effective response rate in the range of 9-10% show that the results are comparable to well designed executive surveys. Common method bias is a concern in such surveys, which use a single respondent for each firm. The absence of bias was tested through the use of Harman's single factor test (Podsakoff et al. 1986). There were a number of principal components seen in the data, indicating lack of common method bias. Limitations of PLS include the difficulty of finding small effect sizes, when samples are below 100. However, we avoid the common mistakes related to the use of PLS (Chin et al. 2003). The lack of overall model fit indices is a concern; hence we compare R square values on the same dependent variable. The limited sample made it difficult to analyze sub-samples by industry or IT function.

On a theoretical level, we do not include "softer" organizational issues such as social culture and norms as antecedents. These include high level social, informal and clan controls (Nagpal 2009) that affect success in large scale outsourcing. Indeed, modularity is more than a technical concept. Our research, however, shows some links between the use of organizational controls and modularity. Similarly, the field study (Nagpal 2009) enriches the quantitative analyses of this paper.

Future Research

The results suggest a number of avenues of future research. In recent years, use of multiple vendors has been suggested as a success factor (Cohen et al. 2006). Modular architectures could work in sync with multisourcing to enable success in large outsourcing initiatives. Additional intervening constructs, such as agility or flexibility, could provide an improved explanation for the link between modularity and business performance. IT service clusters related to agility (Weill et al. 2002) hint at the need for modularity of infrastructure. In literature (Sambamurthy et al. 2003), modular IT infrastructure and services are theorized as being instrumental to agility. These constructs would add to the richness of understanding. In addition, it is entirely possible that there are deeper drivers, such as management quality, that affect outsourcing success as well as firm level performance. Both management quality and the support and involvement of top managers in IT related initiatives appear to be important in this context. Although difficult to tease out, these are candidates for future research. Interfirm modularity (Tiwana 2008a) complements our conceptualization of architectural modularity within the focal firm, and future research can study

the role of each type of modularity. It is also possible that there are trade-offs in the use of architectural modularity, with a certain threshold level that is optimal. Although current architectures are well within the range where increased modularity is desirable, curvilinear relationships are candidates for future research.

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Appendix A

Construct Definitions and items: 7 point Likert scale, with Strongly disagree and Strongly agree as the anchors.

Business performance: Organizational effectiveness of a firm/Business Unit in terms of its financial and operational performance relative to its competitors. *Venkatraman and Ramanujam, 1986,* extensively used in IS literature. The extent to which a firm/Business Unit performed better than its competitors on… Sales growth Profitability Overall financial performance Company reputation Return on investment
Outsourcing success: Satisfaction with benefits from outsourcing gained by an organization. *Grover, Cheon and Teng (1996)* We have been able to refocus on core business, as a result of sourcing strategy. We have enhanced our IT competence, as a result of sourcing strategy. We have increased access to skilled personnel, as a result of sourcing strategy.* We have enhanced economies of scale in human resources, as a result of sourcing strategy.* We have enhanced economies of scale in technological resources, as a result of sourcing strategy.* We have increased control of IS expenses, as a result of sourcing strategy. We have reduced the risk of technological obsolescence, as a result of sourcing strategy.* We have increased access to key information technologies, as a result of sourcing strategy.* We are satisfied with our overall benefits from outsourcing, as a result of sourcing strategy.
Modularity of Enterprise Architecture. New scale. *Pil and Cohen (2006), literature, and CIO interviews.* We have more modular architecture. We have more modular processes. We have a monolithic system. (reverse scored)
IT function *Grover, Cheon and Teng (1996)* Application development and maintenance Systems operations Telecommunications/networks management and maintenance End user support IS planning and management

Note: * shows items that were dropped.

Appendix B

Summary of Field Study

We carried out an exploratory multi-site case study among buyer firms on the antecedents of success in large scale Information Technology (IT) outsourcing arrangements. The sampled firms were engaged in long term outsourcing initiatives that had a significant impact on the IT operations and overall business. The range of IT outsourced services was also broad and included application development and maintenance. In addition to seven 'buyer' firms, a leading global IT outsourcing vendor (among the largest IT vendors in the world) was interviewed on successful buyer capabilities. The case study triangulates Chief Information Officer (CIO) interview data in seven successful buyer firms with well known conceptualizations of strategy and management controls, to formulate an extended model of success in IT outsourcing. Content analyses revealed the salient role of a range of organizational controls, as well as modularity and multisourcing.

Using pattern matching, we identify three alternative configurations of focal firms, defined by management controls and firm level characteristics. These configurations are viewed as stable gestalts, suggesting that individual capabilities are difficult to hone in isolation, are context dependent, and co-evolve over time. The configurations of capabilities can be viewed to form higher level sourcing competencies at the firm level.

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