Competing through Services: Service Migration of Information Technology Product Vendors

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Abstract

The provision of services has become an increasingly important component of the economy of industrialized economies and the revenue stream for many traditional product companies. This is especially true for companies offering information technology (IT) products, as service revenues are often several times the initial purchase or licensing fees, making the development of a successful services business both a strategic area for growth and a way to diversify revenue streams. This paper examines factors that influence the extent to which IT product companies are able to utilize services as a source of revenue. Drawing literatures from evolutionary economics, service diversification, and organizational decline, we identify architecture knowledge of IT systems, information asymmetry of service offering, and previous performance as key drivers of the percentage of revenues associated with services.

1 Introduction

Industrialized economies are experiencing a dramatic shift from in labor from the production of products to services, with services now accounting for more than 50 percent of the labor force in Brazil, Russia, Japan and Germany, as well as 75 percent of the labor force in the United States and the United Kingdom. This unparalleled segment growth is not only due to the growth from service sector itself but also the migration of traditional product companies from manufacturing toward providing services. Services provided by product companies, known as the "hidden service sector" (Gronroos 1990), have increased both in the percentage of revenues generated and their strategic role in firm growth (Sawhney, Balasubramanian, and Krishnan 2004). During 2004, 22 percent of sales in the durable goods industry came from product-related services—reaching $500 billion—compared with 12 percent in 1995 (Auguste, Harmon, and Pandit 2006). Information technology products in particular frequently require considerable services—including installation, maintenance, consulting, and training—to realize their utility. For example, Wise and Baumgartner (1999) indicate that only 20 percent of total cost of ownership of both IT products and personal computers lie in initial acquisition costs.

In addition to being an avenue for growth, services also provide an opportunity for product firms to obtain improved design feedback and to inform the strategic direction of product development. Thus, for product firms service strategy represents an increasingly important component of overall firm strategy. Analysts views as reflected in the following quote "*We continue to view Oracle's earnings as some of the most resilient in our coverage group, given the company's sticky, high-margin, maintenance revenue, which now accounts for about 50% of total revenue*." (Wall Street Journal 2009), highlight that service strategy of product companies is part of how the market evaluates software firms. Yet, despite its acknowledged importance, little is known as to the firm-level factors that affect such a strategy. Given the noted importance of a service strategy to product companies, identifying the factors involved in the successful creation and execution of a services strategy is likely to be important to both managers and researchers.

The nascent research on service strategies of product firms has focused on the benefits of products companies providing services, such as increasing profitability (Wise and Baumgartner 1999), providing future growth (Sawhney, Balasubramanian, and Krishnan 2004), reducing vulnerability and volatility of cash flow (Srivastava, Shervani, and Fahey 1998), and achieving customer intimacy. While contributing to our understanding of the possible performance consequence of service migration, it has largely ignored the more fundamental question of what drives the degree or extent of a firm's service migration. The strategic development of service offerings can be viewed as a form of diversification. While prior research has examined the strategic drivers of product diversification, because of their integration with existing firm operations and uniqueness of services, service diversification may present significantly different strategic drivers.

In this research, we develop a model, in which we examine three factors that determine the extent to which product companies incorporate services in their

business portfolio: (1) the architecture knowledge of IT systems (2) information asymmetry of service offering, and (3) previous firm performance. Architecture knowledge acts as a firm resource, as firms with greater knowledge of the IT system are better situated to initiate a service business. Information asymmetry between vendors and customers gives customers incentive to purchase services from the same vendor whom they already buy products from. Thus, product vendors are more motivated to enter a service market when the services they provide impose higher level of information asymmetry. Previous performance—specifically, poor performance in recent years—drives the development of services as a response to maturation. We test our model with a panel data of 52 companies. We find support for each of the drivers identified above in contributing to a higher percentage of services revenue.

The remaining part of the paper is organized as follows. We first develop the hypotheses specific to the research model. We then describe the methodology and data. Finally, we present our results and discuss the implications of our work as well as avenues for future research.

2 Hypothesis Development

2.1 Architecture Knowledge

Market entry is defined as firms' decision to offer a product or service that differs in some way from their current product or service offering (Helfat and Lieberman 2002). The extent to which product companies derive revenue from services in their overall business portfolio not only reflects their entry to services, but also how well they do in providing services.

Pre-entry knowledge/experiences have been considered as antecedents of market entry and the determinants of firm performance in the new market. More importantly, it is not the previous experiences per se, but rather the related experiences that could be leveraged in the new market. Helfat and Lieberman (2002) propose that "*the greater the similarity between pre-entry firm resources and the required resources in an industry, the greater the likelihood that a firm will enter that particular industry, and the greater the likelihood that the firm will survive and prosper*." Related previous knowledge has been found to be positively associated with firm survival in the new market (King and Tucci 2003), market share (Agarwal and Bayus 2005), and higher innovation rate (Klepper and Simons 2000). Consistent with previous literatures, we also propose that related previous knowledge will influence the extent to which product companies devote their resources to service business and their performance in providing services.

It is critical to identify the relevant experiences in certain market entry context. Agarwal and Bayus (2005) identify technological expertise and knowledge of potential market as key relevant experiences since the industry is characterized by high technological dynamism. Particularly, IS researchers have pointed out that services provided by IT product vendors require technological knowledge on complex IT systems (Beath and Walker 1998). Hence, we focus on technological knowledge of IT product vendors. We suggest that technological knowledge of product companies serve as an important pre-entry knowledge base determining their future service entry decisions.

Henderson and Clark (1990) distinguish between component knowledge and architecture knowledge. When a product consists of multiple components, the basic knowledge underlying each component is called "component knowledge". Architecture knowledge is the knowledge of how the system components interact and work together.

The architecture of IT system is characterized by layers of hardware, infrastructure software, and application software, from bottom to top (figure 1). The layers are considered as components complementing each other since they need to work together as a system. This structure is referred as an IT Stack. Architecture knowledge of an IT system refers to the knowledge of how different layers, including hardware, infrastructure software, and application software, communicate and work together as a system. When a company moves from a pure IT product vendor toward providing services, the knowledge about the architecture of the whole IT system and knowledge regarding other components in the system become more important for the following two reasons.

Firstly, due to the intangible nature of service, its outcome or goal is usually not physical but rather a promise/agreement to make sure that the products are working properly. In some cases, service is even charged according to the output of the process where the product is deployed. Particularly, recent trend in IT industry is that vendors are paid based on the computing capacity they provide to customers. Achieving such a goal requires product vendors to have not only the intimate knowledge of the focal products, but also the knowledge of interactions and coordination between the focal products and other components in a complex system. The technology vendor might not have the detailed knowledge about the design and engineering of certain components that they do not produce, but they need to understand the interactions among the components.

Secondly, multiple layers rely on multiple technologies which advance at various rates. Hence, when the technology for certain layer changes at a faster speed, it creates the need for products from other layers to adjust and integrate with the new technology. Due to various reasons, technology buyers tend to replace their technologies gradually rather than updating all components together, which creates additional need for integration (Bresnahan and Saloner 1997). Providing integration services requires knowledge of system architecture and knowledge of other components (Auguste et al. 2006). Using the jet engine producers as an example, Brusoni, Prencipe, and Pavitt (2001) find that system integrators need to have knowledge in excess of what they need for what they make in order to cope with imbalances caused by uneven rates of development in the technologies on which they rely. Davies (2004) argues that the advantage by providing solutions rather than stand-alone products is enabled by the system integration capabilities of product firms, and architectural knowledge is a critical part of system integration capabilities (Brusoni et al. 2001).

Hence, pre-entry architecture knowledge will not only provide incentives for product companies to enter service business, but also help them provide service with higher quality. Hence, we hypothesize that

H1: Product companies with more architecture knowledge will derive greater proportion of their revenues from services.

2.2 Information Asymmetry

Although economies of scope have been viewed as an important incentive for entering related industry or market, firms can also benefit from diversification through information asymmetry, especially when they diversify into service business. There exists certain information asymmetry between buyers and sellers, since sellers generally have more information about the quality of products/services than buyers. The asymmetry is particularly severe for services than products due to the following reasons. Firstly, services are generally more intangible. Secondly, services are produced and consumed simultaneously. And thirdly, the quality of services also depends on customers since service delivery is a social interaction process where both sellers and buyers are involved. Therefore, when making decisions on purchasing new services, to economize on information acquisition costs, customers are likely to choose sellers whom they are already buying products from. Consequently, information asymmetry may provide sellers incentives to diversify into service business so that they can exploit their customer relationship and reputation on existing products.

The extent to which vendors can exploit buyers' incentive to lower information acquisition costs through diversification depends on the characteristics of service business they diversify into. Product/services are characterized by a mix of three types of attributes that customers use to evaluate them: search qualities, which are the attributes potential buyers can evaluate prior to purchase, experience qualities, which are the attributes customers could determine during or after the consumption, and credence qualities, which are the attributes customers may not be able to evaluate even after the consumption (Darby and Karni 1973). Customers incur greater information acquisition costs for purchasing products/services with high credence qualities. On the contrary, products/services high on search qualities will need relatively less information acquisition efforts. Although services have more experience and credence qualities than products in general, different service offerings differ from each other in terms of the mix of three types of qualities. For instance, building maintenance services have more searching and experiencing qualities, while executive placement services are characterized more by experience and credence qualities. If we consider services with only searching qualities at one extreme, and services with only credence qualities at the other extreme, we will have a continuum where all the services actually locate in between (figure 2).

Services provided for products at different stack layers locate at different positions on the continuum. We propose that as products move up the stack, services accompanying them are characterized more by experience and credence qualities and less by search quality. It is because as the layer goes up, it is increasingly difficult to evaluate the performance of services provided at these layers. As for hardware, they work as the underlying infrastructure which provides computing capacity and connectivity. Servicing hardware normally aims to achieve certain uptime, computing speed and capacity, which is relatively easier to measure and evaluate. Infrastructure software locates between hardware and business application. It mostly handles the interaction and integration among different applications. Services on this layer generally aim at improving efficiency of IT assets and flexibility of integration, which is more intangible than the performance criteria of hardware layer. Application software is generally used in specific business function, such as human resource management. Services at this layer may include business process redesign and strategy consulting. The performance of these services is extremely difficult to measure because factors that could determine performance of business functions are diverse, including employee performance, management

leadership, and environmental conditions. In addition, in some cases, the performance effects will not show until after certain time lag. Hence, services at application software layer are mostly characterized by credence qualities.

As we move up the stack from hardware to infrastructure software, and to application software, customers incur greater information acquisition costs to evaluate the services, and are more motivated to economize on these costs through purchasing from an existing vendor. Consequently, vendors who sell products higher on the stack have greater incentive to provide services for their products since they have a better chance to sell them to existing customers. We hypothesize that,

Hypothesis 2a: Revenue from infrastructure software has a greater effect on the proportion of revenues firms derive from services than revenue from hardware.

Hypothesis 2b: Revenue from application software has a greater effect on the proportion of revenues firms derive from services than revenue from hardware.

Hypothesis 2c: Revenue from application software has a greater effect on the proportion of revenues firms derive from services than revenue from infrastructure software.

2.3 Previous Performance

Besides exploiting previous knowledge and information asymmetry, product companies may enter services due to performance decline. The decline might be caused by commoditization of products, saturation in the product market, maturity of technology in the product, entry of low-cost competitors, and change in the social environment.

Researchers supporting that "necessity is the mother of invention" argue that the gap between current performance and aspiration caused by performance decline stimulates searching for new solutions and organizational change (Cyert and March 1963). Empirical studies also confirm that decline is related to a variety of organizational innovation. Miles (1982) finds that tobacco firms diversified strategically into other consumer goods market when faced with declining demand. McKinley (1984) demonstrates that sales declines are associated with patent applications and product innovation in manufacturing industry. In this paper, we consider entering services business as an adaptation or strategic innovation for product companies. We propose that past performance decline of product companies will be associated with proportion of service revenues.

The reasons why product companies experience performance decline could be multi-folded. For some hardware vendors, the maturity of technology and entry of low-cost competitors are the main reasons. For certain large-scale enterprise software companies, the saturation of market could be a major challenge. Exploring various reasons for performance decline is not the focus of our paper, so we focus on the symptom of decline: poor performance. And we hypothesize that,

H3: Past performance of product companies is negatively associated with proportion of revenues derived from services.

The overall research model is shown in figure 3.

3 Methodology and Data

3.1 Sample Selection

Our sample companies are from the industries of Application Software, System Software, Communications Equipment, Computer Hardware, and Computer Storage & Peripheral, from Computstat database. We follow the industry classification scheme developed by Standard & Poor's and Morgan Stanley Capital International, referred as GICS (Global Industry Classifications Standard). We rank these companies based on the sales during the year of 2005, and choose the top 100 firms as our research sample.

3.2 Measurement

Service Revenue Ratio: We calculate service revenue ratio as the percentage of service business revenue over company total revenue. This measurement captures the extent to which firms rely on service business as their source of revenue, and has been used in previous studies (Cusumano et al. 2006).

Service Revenue Ratio=Service Revenue/Total Revenue

Total Revenue=Service Revenue + Total Product Revenue

Architecture Knowledge: Henderson and Clark (1990) refer to component knowledge as the knowledge about the core design concept and the way it is implemented in a particular component. They refer to architecture knowledge as the knowledge about the ways in which the components are integrated and linked together into a coherent whole. In this paper, we measure architecture knowledge through a firm's product experiences. Firms are characterized by their product portfolio. While some firms only produce products on one layer of the stack, other firms diversify into a wide

range of layers on the stack. For instance, IBM competes almost on every layer on the software stack, while Sun Microsystems concentrate more on the hardware and operating system layers. Firms with a diversified product portfolio are more likely to possess architecture knowledge since they are usually exposed to knowledge in the interactions across layer due to the following reasons. Firstly, these companies are more likely to create an overall IT system solution using their own products at different layers, so they will probably possess knowledge regarding the interaction among layers. Secondly, since they have product at different layers, they will be more aware with technological change at different layers, and how the changes affect the interactions between layers.

We calculate the Herfindahl index to capture firms' concentration on IT stack. N is the number of layers firms operate on in the IT stack. α_i is the share of layer i in firms' total product revenue. Please note here that we only consider firms concentration in product market, so we use share of each layer in total product revenue, rather than total revenue.

$$\text{Stack Concentration} = \sum_{i=1}^{N} \alpha_i^{\,2},$$

$$\alpha_i = \frac{\text{Revenue from Layer i}}{\text{Total Product Revenue}}$$

$$\text{Total product Revenue} = \sum_{i=1}^{N} \alpha_i$$

In addition, we use a count measure of the number of stacks that firms operate in to complement the Herfindahl measurement. Based on the layer count measure, we have three groups of companies: focused companies (all products are from the same layer), companies with products distributed across two layers, and companies with products distributed across three layers. Consequently, two dummies (Dummy for Two Layers, Dummy for Three Layers) are created.

Revenue Proportions: We calculate the proportion of each layer in overall product revenue.

Total product Revenue= Revenue from Application Software+ Revenue from Infrastructure Software+ Revenue from Hardware

Revenue proportion from Application Software=Revenue from Application Software/Total Product Revenue

Revenue proportion from Infrastructure Software=Revenue from Infrastructure Software/Total Product Revenue

Revenue proportion from Hardware=Revenue from Hardware/Total Product Revenue

Previous Performance: We use several proxies for pervious performance, including ROA and ROI from previous year, and compound annual growth (CAGR)[1] of sales, net income, market value in the past three years. Profitability of previous year indicates an immediate performance concern, while the average growth in the past three years illustrates the trend of growth or decline in a longer time frame. We use multiple performance measurement including profitability, sales, and market capitalization, which may indicate declines caused by different reasons.

Control Variables: We control for firm size and year effect. We use firm annual sales as a proxy for firm size. Besides, we control for different between consumer goods and industrial goods. We use a dummy variable to distinguish between firms which have more than 50 percentage of their revenue from consumer goods (dummy =1) and the other firms (dummy =0). The information on consumer and industrial goods is obtained from firm annual report.

3.2.1 Empirical Model

We report ordinary least square (OLS) regression with all firms and years pooled, estimated with Huber-White robust standard errors accounting for repeated observations of the same firm. To test hypothesis 1, we include stack diversification as an explanatory variable first (Model 1). Since Herfindahl index measures concentration, we will expect a negative sign if the hypothesis is supported. Secondly, we test the hypothesis using the alternative measurement of architecture knowledge: number of layers. Two dummies which represent firms operate on two and three layers are included in the model (Model 2). We hypothesize that firms operating on both three and two layers will derive more revenue from services, compared to focused firms. Thus, we expect a positive sign from these two dummies for hypothesis 1 to be supported. We also hypothesize that firms operating on three layers have more architecture knowledge, thus derive greater proportion of revenue from services. To test it, we will conduct post-estimation Wald test of whether coefficients of the two dummies are equal. We would expect the coefficient of "dummy for three layers" is larger than that of "dummy for two layers" and the result of Wald test is significant, if the hypothesis is supported.

To test hypotheses 2, we add another two explanatory variables based on model 1 (Model 3):

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[1] CAGR=

$$\left(\left(\frac{EndingValue}{BeginningValue} \right)^{\left(\frac{1}{\#ofYears} \right)} - 1 \right) \times 100\%$$

revenue proportion from infrastructure software (RI) and revenue proportion from application software (RA). Revenue proportion from hardware (RH) is dropped here since the three of them add up to one. For hypothesis 2 to be supported, we expect that 1), coefficients of both RI and RA are positive and significant, and 2), post-estimation Wald test shows that there is a significant difference between the two coefficients. To test Hypothesis 3, we add in the variables indicating previous performance one by one in Model 4, 5, 6, 7, 8.

3.3 Results

Results of all models are listed in table 1. It seems that stack concentration has a negative and significant effect on service revenue ratio. It means that the more diversified the firms are across product layers during previous period, the more they will derive their revenues from services during the current period. In addition, the sign and significance level of stack concentration do not change much across all models. The dummy for firms operating on two layers is positive, but not significant. The dummy for firms operating on three layers is positive and significant. It indicates that compared to firms operating on only one layer, firms operating on three layers derive greater proportion of their revenues from services, while there is no significant difference between firms operating on one layer and two layers. The post-estimation Wald test shows that there exists a significant difference between firms from two layers and three layers. The non-significant results between one layer and two layers indicates that to provide services, a firm really needs architectural knowledge across all the components in a system, and partial architectural knowledge does not suffice. On the whole, hypothesis 1 is supported.

In model 3, we add two more variables: revenue proportion from application software and revenue proportion from infrastructure software. Coefficients of both of them are positive and significant. This demonstrates that compared to revenue proportion from hardware, revenues from application and infrastructure software have greater effects on firm service ratio. And the post-estimation test comparing these two coefficients shows that there is no significant difference between them. H2a and H2b are supported while H2c is not. Overall, the results indicate that there is a significant difference between hardware and software, and no significant difference between infrastructure and application software. Based on the results, it seems that the information asymmetry is greater for services related to software than hardware. On the other hand, there is no evidence that information asymmetry is greater for services associated with application software than infrastructure software. The results imply that it is as difficult to evaluate services related to infrastructure software as to evaluate those related to application software.

From model 4 to 7, we test the effects of previous performance using previous ROA, previous ROI, and compound annual growth of sales, net income, and market value in the past three years. Previous ROA has a negative and significant effect on service ratio ($p<0.05$), while coefficient of previous ROI has a negative sign but is not significant. Hence, the support for poor profitability in previous year is only marginally supported. On the other hand, all the variables which depict the growth trend in the past three years have a negative and significant effect on service ratio ($p<0.01$). It seems that the pressures from a continuous low growth rate or decline stimulate product companies to adjust strategically and enter service business.

4 Implications

Historically, management of services has been put as the opposite of management of product. For instance, services are considered as human-centered while products focus more on the technical core (Schneider and Bowen 1995). Service companies normally have a different culture and are organized differently from product companies. Recently, however, product companies have increasingly introduced service offerings, relied on services as a source of revenue, and considered services as a direction for future growth. As one of the early endeavors in this area, this paper examines the factors that influence the extent to which product companies rely on services as source of revenues.

Prior research on diversification has centered on product diversification. Our research contributes to prior literature by examining product companies' diversifying to service business and incorporating unique characteristics of services. We investigate the unique knowledge resources—system knowledge—required for providing services, which are absent from previous works. We also highlight the importance of scope economies in consumption in diversifying to services.

Managers of software vendors are often faced with such questions: do we need to provide services, how much we can rely on providing services, and what capabilities we need to develop to provide services. Our paper sheds some light on these questions. We find not only the intimate knowledge of the product, but also the knowledge of interactions among products in a complex system can contribute to providing services. Product companies may acquire such knowledge

through different means, such as acquiring other companies or recruiting new employees with such knowledge. For example, EMC has acquired a series of software companies to expand from a storage hardware vendor to a storage management provider. Other companies like IBM acquired architecture knowledge through recruitment of service employees. Secondly, we find that hardware products contribute significantly less to service revenue than software. Product companies need to evaluate their product portfolio to decide on whether or how much service to provide.

It has been called for IS researchers to theorize IT artifact in IS research (Benbasat and Zmud 2003; Orlikowski and Iacono 2001). This research therozies IT artifact through the lens of IT stack, and investigates how characteristics of IT stack affect firm strategy. In the past several years, service management/innovation have received considerable attention in IS community, as shown in the editorial note of ISR[2] (2006), special issue on "Service Science" of CACM (2006) and special issue on "Information Systems in Services" of JMIS (2008). As one of the early endeavors in this area, this paper examines antecedents of service entry of IT product companies. It provides foundations for future research investigations, such as how providing services affects IT company performance and how service offerings affect strategy of technology buyers.

Finally, we will discuss the major limitations of this paper and future research directions. Firstly, we measure architecture knowledge through a firm's product experiences. More direct measures could be used. In the future, we would explore such measures through knowledge portfolio of companies and survey methods. Secondly, as our observations span from year of 1991 to 2007, controls of maturity of IT products, which affect how difficult it is for product companies to enter service business, are needed. Thirdly, product companies enter service business is characterized by both features of related diversification and un-related diversification. It is related in the sense that resources in product business could well be exploited in the service business. It is unrelated in the sense that service business is very different from product business. Thus, in the future, we would like to integrate theories from both related and unrelated diversification. Fourthly, some scholars have used Transaction Costs Theory to understand firms' boundary decision. In the future, research should also investigate whether the costs of coordinating with external service provider affect such a decision.

[2] ISR: Information System Research: CACM: Communications of the ACM; JMIS: Journal of Management Information Systems

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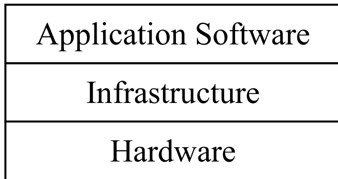

Figure 1: IT Stack

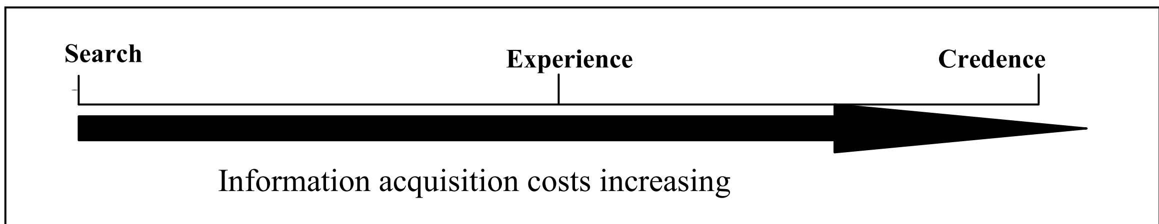

Figure 2: Information Acquisition Costs of different services

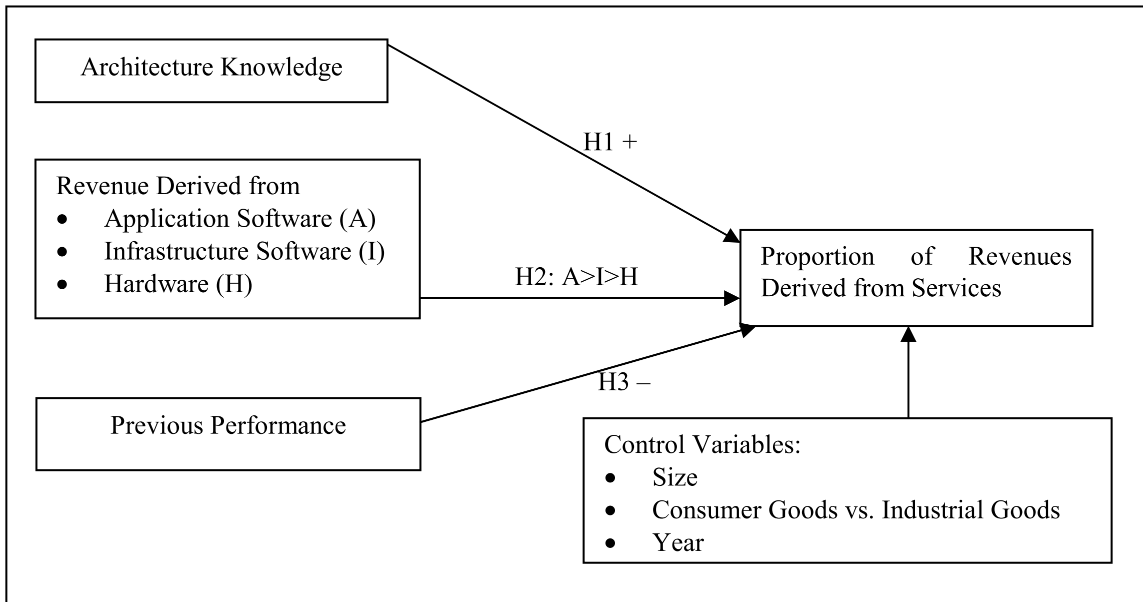

Figure 3: Research Model

Independent Variables	Model 1	Model2	Model3	Model 4	Model 5	Model 6	Model 7	Model 8
Stack Concentration	-0.2883*** 0.0876		-0.2860*** 0.0917	-0.3322*** 0.0974	-0.2965*** 0.0949	-0.3057*** 0.0986	-0.3957*** 0.1236	-0.2615*** 0.0986
Revenue Proportion from Infrastructure Software			0.2174*** 0.0355	0.2353*** 0.0370	0.2171*** 0.0373	0.2024*** 0.0373	0.1713*** 0.0583	0.2364*** 0.0396
Revenue Proportion from Application Software			0.2190*** 0.0352	0.2530*** 0.0382	0.2225*** 0.0370	0.2097*** 0.0360	0.1890*** 0.0605	0.2475*** 0.0398
Dummy for Two Layers		0.0157 0.0329						
Dummy for Three Layers		0.1713*** 0.0396						
Previous ROA				-0.0029** 0.0011				
Previous ROI					-0.0002 0.0002			
CAGR of Sales						-0.0027*** 0.0005		
CAGR of Net Income							-0.0009*** 0.003	
CAGR of Market Value								-0.0010*** 0.0004
Size (Sales)	-0.0291*** 0.0076	-0.224*** 0.0072	-0.0017 0.0083	0.0022 0.0090	-0.0009 0.0084	-0.0102 0.0089	0.0037 0.0128	0.0055 0.0094
Consumer Goods	-0.3389*** 0.0310	-0.3239*** 0.0245	-0.3547*** 0.0338	-0.0029** 0.0011	-0.3532*** 0.0342	-0.3500*** 0.0357	-0.3573*** 0.0507	-0.3739*** 0.0369
Year Dummies								
R-Square	0.2935	0.2657	0.3976	0.4113	0.4011	0.4460	0.3842	0.3879
N	238	299	238	230	229	207	128	209
Wald test (Infrastructure Software Percentage=Application Software Percentage)			0.00	0.02	0.02	0.05	0.16	0.10
Wald test (Dummy for Two Layers=Dummy for Three Layers)		11.21***						

Table 1: Regression Results (Dependent Variable: Service Revenue Ratio)