Information Technology's Impact on Cost Management and Control in the Healthcare Context

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INFORMATION TECHNOLOGY’S IMPACT ON COST MANAGEMENT AND CONTROL IN THE HEALTHCARE CONTEXT

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Introduction

This dissertation consists of three essays on information technology (IT) and control in a healthcare context.

Essay 1: “Concertive Control in the Healthcare Context: A Field Experiment”
The first essay in the dissertation extends the work on concertive control by Rajiv Kohli and William Kettinger (2004). In this essay, we use longitudinal data to empirically validate concertive control implemented via a physician profiling system (PPS). Through a field experiment, we compare physician-level and hospital-level data for two hospitals (one that implemented the PPS and one that did not) and demonstrate a reduction in the variance of performance measures (costs, charges, mortality, and length of stay) due to the PPS.

Essay 2: “Understanding the Relationship Between Strategy and IT investments in a Healthcare Context”
The second essay is described in detail in the following abstract.

Essay 3: “A Model of Audit and Control in Systems of Location Technologies”
The third essay develops a model of audit and control of an information system that incorporates location technologies (e.g. RFID). This essay focuses on the impact of location technologies on hospital processes from a cost management perspective.

Keywords: Health care information systems, Strategy, IT payoff
Essay 2: Detailed Abstract

Understanding the Relationship of Strategy and IT Investments in the Healthcare Context

Introduction

The issue of information technology (IT) payoff and the business value of IT is a popular stream of research in the Information Systems (IS) literature. Although early examination in the 1980s and 1990s focused on explaining the productivity paradox of increased IT investments not being reflected in U.S. productivity measures (e.g., Brynjolfsson 1993), IT is now recognized as a component of a broader system of organizational changes that increases productivity (Brynjolfsson and Hitt 1998). IT payoff has been found to occur at the macroeconomic level (Oliner and Sichel 2000), as well as in productivity-based measures at the process-level (Kohli and Devaraj 2003). A natural progression in this stream of research is to understand how and when IT payoff occurs and the strategic context of IT payoff.

IT is deployed in firms for a variety of reasons, not only as a means of improving productivity, but also for improving profitability and/or operations quality (Devaraj and Kohli 2003). Various measures of IT payoff (i.e., productivity, profitability, and quality) are potential indicators of a firm’s strategy. In their meta-analysis of structural variables in IT payoff research, Kohli and Devaraj (2003) broadly classified the diverse dependent variables of 66 studies as reflecting productivity improvements, profitability improvements, or both. However, this basic categorization represents the extent to which firm strategy has been incorporated into the context of IT payoff, resulting in only a cursory treatment of the relationship among firm strategy type, IT investment levels, and organizational performance.

Firm strategy has been characterized in various ways, most notably the strategy clusters of Miles and Snow (1978) of prospector, defender, analyzer, and reactor, as well as the Porter (1980) generic strategies of cost leadership, differentiation, and focus. A more recent framework for characterizing strategy is the Value, Price, Cost (VPC) framework (Hoopes et al. 2003). The VPC framework has been used frequently in strategy texts to define competitive advantage (e.g., Besanko et al. 1999). According to the VPC framework, the firm that can achieve the largest difference between the value (V) perceived by the customer and the cost (C) of the product or service will have an advantage over competitors. Within VPC, one possible firm strategy is to focus on attracting customers due to superior consumer surplus in its products or services (V-P), which can be called a value-based strategy. An alternative strategy in the VPC framework is a cost-based strategy where a firm’s goal is to increase profits by increasing the gap between the price (P) charged for the product or service and its cost (C), which is indicated by (P-C).

This study examines one particularly relevant context of IT payoff based on the VPC framework—a cost-based strategy in the setting of a hyper-cost focused environment of healthcare in the U.S. Hyper-cost competition occurs when institutional or global market forces push an industry or related industries to focus on cost efficiency as a primary basis for competition. By focusing on the setting of hyper-cost competition, this study incorporates a more in-depth treatment of the relationship between firm strategy and IT payoff. To that end, the following research questions are addressed:

Question 1: What are the characteristics of the different cost-based strategies?

Question 2: Do these different cost-based strategy types moderate the impact of IT investments on organizational performance?

Figure 1 provides a conceptual model of the relationships explored in this study. In Figure 1, IT investment leads to firm performance. However, this relationship is moderated by the type of cost-based strategy pursued by the organization.
In order to study IT payoff in a hyper-cost environment, the health-care setting was selected. In the era of declining reimbursements by insurance companies and government agencies, U.S. hospitals compete in an industry driven by cost and efficiency-oriented strategies. As such, U.S. hospitals represent an appropriate context for examining IT payoff in a hyper-cost environment. The research questions are addressed through the use of both cross-sectional and longitudinal data for a set of U.S. hospitals, with operational data obtained from a healthcare database and supplemented with data from the American Hospital Association. The hospital setting is particularly rich for examining IT payoff, since the level of IT expenditures and numerous performance measures are reported.

**Strategy Groups**

The strategic management literature has a rich tradition of identifying and analyzing strategic groups. Strategic groups represent collections of organizations similar in important strategic dimensions (Porter 1980). Notable examinations of strategic groups include the work of Miles and Snow (1978) who established a typology of business strategy of Defenders, Analyzers, and Prospectors, as well as Porter’s (1980) generic strategies of cost leadership, differentiation, and focus. The groupings represent a way to “meaningfully capture the complexity of organizational reality” (Ketchen and Shook 1996).

In an environment of hyper-cost competition, most of the organizations are pursuing an aggressive cost-based strategy. However, even in a hyper-cost environment, different organizations will manage costs in different ways, resulting in various organizational configurations (groupings) within the overarching cost-based strategy. Additionally, even within a cost-based strategy, some organizations may integrate value-based strategies into their cost management. By identifying these subgroups of cost strategies, the goal is to identify a set of salient differences on how organizations approach cost management.

**Cluster Analysis**

Strategic groupings started as conceptual constructs derived from theory with empirical support based usually on case studies and anecdotal accounts (Galbraith and Schendel 1983). As research in this area matured, cluster analysis emerged as a popular technique for grouping similar entities. With cluster analysis, each observation is grouped based on a set of attributes or dimensions, with the boundaries of the groups not pre-specified. Instead, these boundaries are derived from the data, with the subsequent groups (clusters) emerging from the data (Harrigan 1985).

One example of cluster analysis in IS research is Fiedler et al. (1996), who empirically developed a taxonomy of IT structure (centralized, decentralized, centralized cooperative, and distributed cooperative computing) based on the degree of centralization of computer processing, the capability to support communications, and the ability to share resources. More recently, Malhotra et al. (2005) used cluster analysis to characterize five supply chain partnership configurations (collectors, connectors, crunchers, coercers, and collaborators). Other studies that have used classification-based techniques include Sabherwal and Chan (2001) who developed theoretical profiles of IS strategy based on the Miles and Snow groupings, and Kettinger et al. 1994) who used discriminant analysis to distinguish the factors that facilitate sustainable competitive advantage related to IT.
Research Methodology

Data

The data for this study is obtained from a commercial database maintained by Solucient, Inc., a provider of information to the healthcare industry that allows comparative measurements of cost, quality, and performance for U.S. acute care facilities. The database has information extracted from Medicare cost reports for a 5 year period (2001-2005) on over 7000 hospitals, about 800 of which report values of their IT expenditures. The database contains measures on both financial indicators (e.g. return on assets, return on equity, cash flow per bed, and operating income), as well as clinical indicators (e.g. average length of stay and number of cases).

Analytical Approach

Figure 2 provides an overview of the analytical approach proposed in this study. Four broad steps are identified in our approach: (1) identify the cluster variables; (2) perform the cluster analysis; (3) identify the clusters and a corresponding cost-based strategy grouping; and (4) test the relation between IT investment and Performance for each group.

Figure 2. Analytical Approach

Step 1. Identify the variables for clustering

Choosing the variables for the grouping of the observations has been identified as a fundamental step in the application of cluster analysis (Ketchen and Shook 1996). An advantage of cluster analysis is the inclusion of more than 2 dimensions of sorting into strategic groups (Harrigan 1985). Based on previous studies in the healthcare industry, preliminary clustering variables have been identified from the Solucient database based on three main areas – productivity, revenue, and utilization. Table 1 lists these variables. It is recognized that the selection of these variables requires further theoretical justification.
Table 1. Clustering Variables

<table>
<thead>
<tr>
<th>Type of Variable</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity</td>
<td>FTE Employees - Total Facility</td>
</tr>
<tr>
<td></td>
<td>Plant Operating Expenses %</td>
</tr>
<tr>
<td></td>
<td>Salaries and Benefits as % of Operating Expense</td>
</tr>
<tr>
<td></td>
<td>FTEs per 100 Adjusted Admissions</td>
</tr>
<tr>
<td></td>
<td>Total Asset Turnover Ratio</td>
</tr>
<tr>
<td></td>
<td>Admissions per bed</td>
</tr>
<tr>
<td>Revenue</td>
<td>Cash Flow per bed</td>
</tr>
<tr>
<td></td>
<td>Operating Income</td>
</tr>
<tr>
<td>Utilization</td>
<td>Average Length of Stay (acute care)</td>
</tr>
<tr>
<td></td>
<td>Occupancy Rate - Total Facility</td>
</tr>
</tbody>
</table>

Step 2: Perform the cluster analysis
During this step, a cluster analysis of the data will be performed. Because the nature of this study is exploratory and the number of clusters is not known *a priori*, a hierarchical clustering algorithm is selected (Sharma 1996). In hierarchical clustering, a method must be selected to determine how the distance between two clusters are calculated. As recommended by Sharma (1996), we will be using several different methods for the distance calculation (centroid, single-linkage, complete-linkage, average-linkage, and Ward’s method), compare the results for consistency, and use the method resulting in an interpretable solution.

Step 3: Identify the clusters and a corresponding strategy group
The next step in a cluster analysis is to interpret the clusters identified by the analysis. The goal of this step is to describe each of the configurations and place the configurations within the context of cost management in a hyper-cost environment. From this step, a taxonomy of cost-based strategies emerges from the data.

Step 4: Test the relationship between IT investment and performance
The final step is the testing of the relationship between IT investment and performance for each cluster group. For the sample from the Solucient database, the level of IT expenditures is provided.

Dimensions of Performance
Performance measures of an organization have been identified as consisting of at least three categories – financial, operational, and overall effectiveness (Venkatraman and Ramanujam 1986). In this study, we are examining performance from three different perspectives – a customer (patient) view, the hospital-view, and an institutional-view. Within these different perspectives, we will identify various dependent variables for performance from the various sources listed in Table 2.
Table 2. Performance Measures

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Category of Performance</th>
<th>Dependent Variable for Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient-View</td>
<td>Quality</td>
<td>2006 mortality rankings (1 to 5) from HealthGrades</td>
</tr>
<tr>
<td>Hospital-View</td>
<td>Financial</td>
<td>Traditional financial measures from Solucient, e.g.:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Net Income</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Net Patient Revenue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ROA</td>
</tr>
<tr>
<td>Institutional-View</td>
<td>Reputation</td>
<td>Recognition as a top hospital from rankings (for example:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Solucient (<a href="http://www.100tophospitals.com">www.100tophospitals.com</a>)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• HealthGrades – reputation for specialty excellence (<a href="http://www.healthgrades.com">http://www.healthgrades.com</a>)</td>
</tr>
</tbody>
</table>

From previous literature, we will identify the appropriate control variables. With the variables from the conceptual model (Figure 1) identified, we will then perform a regression analysis testing the relation between IT investment and performance for each cluster group and determine if there is a moderating effect of cost-based strategy type on performance.

**Conclusion**

This study adds to the IT payoff literature by examining IT payoff in the context of hyper-cost competition. Based on the VPC framework for strategy, this study will demonstrate how a specific type of firm strategy (cost-based strategy) and the level of IT investment impacts firm performance from multiple perspectives – patient, hospital, and institutional.
References


