Information technology and strategy: The role of innovation in performance in the US Hospital Sector 1997 2004

Atkinson, Brad Randall

INFORMATION TECHNOLOGY AND STRATEGY: The role of innovation in performance in the US Hospital Sector 1997 – 2004

Brad Randall Atkinson

Doctor of Business Administration

Durham Business School

University of Durham

Submitted February 2006

ABSTRACT

INFORMATION TECHNOLOGY and STRATEGY: The Role of Innovation in Performance in the US Hospital Sector (1997-2004)

Does the early adoption and active integration of Information Technology (IT) into a broad scope of business and clinical functions – aggressive implementation – matter in obtaining strategic gains and competitive advantage in the US hospital sector? While the literature is divided at best, both the public and private segments of the US hospital sector have been investing heavily on the premise that IT can facilitate business transformation to solve complex issues (demands for patient-focused improvements in quality of care, improved efficiency, and long-term financial viability). Specifically, the research questions are: *1) Do the most aggressive implementers of IT exhibit greater economic efficiency than the rest-of-the-sector? 2) Do the most aggressive IT implementers strategically outperform the rest-of-the-sector?* and, 3) *Can we identify organizational characteristics that are associated with superior performance?* The work included the development of a large (n~2700) and rich panel (1997-2004) of cases of US acute care hospitals. The thesis identifies performance differentials among strategic groups across key indicators (operational, financial, and clinical) within an integrated evaluation framework and it examines the characteristics of bundles of investment in intangible assets (governance practices and specific IT capabilities) associated with the generation of strategic value. Methods included generation and testing of stochastic production function estimates; development and testing of strategy maps; the qualitative coding and regression analysis of business intelligence texts for patterns in the tangible and intangible assets of high-performing hospitals; and a flash validation survey sent to a sample of 193 hospital CIOs. While the methodology and methods are grounded in significant works of Weill, Brynjolfsson, Kaplan and Norton, and others, both the focus on the hospital sector and the integrative approach are novel.

ACKNOWLEDGEMENTS AND DECLARATION

The author owes an acknowledgement to both Dr. F.M. Scherer and Dr. David Byrne. The former represented in Scherer, Backenstein et al. (1975) The Economics of Multi-Plant Operations and Scherer (1992) International High-Technology Competition and the latter in Interpretation of Quantitative Data. Reading these works helped the author clarify his own methodology in the use of corporate documentation and datasets to test research questions. The formation of the thesis statement was aided by a brief but vibrant conversation with Professor Derek Pugh. Sheldon Dorenfest provided access to his nationally recognized healthcare information technology market intelligence database. Occasional professional validation and encouragement were provided by Ms. Lisa Weidman, R.N., Dr. Marion Glass, Ph.D., Dr. Lauren Thompson Ph.D., Dr. Charles Thompson, Ph.D., Mr. Stanley Chin, A.B.D., Mr. Kasey Jarosz, and Mr. Wayne Newton. Professor George Wright provided timely support as a secondary supervisor. Mrs. Anne Bailey provided wonderful administrative coordination and occasional "cat-herding" services. Finally, Professor Tony Cockerill has provided outstanding on-going support, supervision, and collegial guidance to this thesis effort.

TABLE OF CONTENTS

TABLE OF EXHIBITS

GLOSSARY OF SELECT TERMS AND ACRONYMS

TERM / ACRONYM	OPERATIONAL DEFINITION
ADRT	A clinical process control performance indicator constructed in Chapter 5 with the operational definition as a hospitals Average Length of Stay for each of its top 3 DRG divided by the national benchmark ALOS for each DRG.
Aggressive IT implementation	Early adoption of IT with substantial concomitant investment in the intangible assets of the organization, such as, process redesign, training, policy and procedures, and technical support, for the purpose of realizing a capability better harmonized to the organization.
AHA	American Hospital Association – primary trade association for continuing education, marketing, lobbying, and consolidated data reporting for US hospitals.
ALOS	Average Length of Stay – the conventional measure in the US health sector for the duration of an inpatient episode of care, measured in days.
AMI	The care protocols from the CMS National Hospital Quality Initiative for Acute Myocardial Infarction (AMI), otherwise known as heart attack.
ANOVA	The Analysis of Variance statistical technique.
BCBS	Blue Cross Blue Shield Association – the national association providing marketing and research support to the many independent BCBS associations providing healthcare insurance across the country.
BEDS	The maximum number of medical beds reported in service during a year.
BLUE	Best Least Unbiased Estimates - "an estimator is...the best linear unbiased estimator if it is a linear function of the data and has minimum variance among linear unbiased estimators." The assumption of obtaining BLUE regression estimates is fundamental to the stability of the predicted regression coefficients and their interpretation.
BSC	Kaplan and Norton (1992) – a Balanced Scorecard framework for strategic management.
CAP	The care protocols from the CMS National Hospital Quality Initiative for Community Acquired Pneumonia (CAP).
Casemix index	The Medicare Case Mix index is a measure of the complexity of the Medicare cases treated by a hospital relative to the national average of all Medicare hospital cases, using Diagnostic Related Groups as a measure of relative complexity of treatment.
CATREG	The Categorical Regression technique – a data conversion technique to convert qualitatively coded (text-based) variables for use within quantitative variables in Ordinary Least Squares regression technique conceptually develop by he Data Theory Group – Leiden University, The Netherlands.
C-D	A Cobb-Douglas production function model of the general form - $Y = a L^{\alpha} K^{\beta}$
CEO	Chief Executive Officer
CIO	Chief Information Officer
CMS	Centers for Medicaid and Medicare Systems – the US federal agency within the department of Health and Human Services that is responsible for the Medicare and Medicaid health plan programs and the source of many health care quality improvement initiatives.
Conversion effectiveness	Weill(1992) – the ability to leverage the value of information technology is a function of top management commitment, user information satisfaction, experience with IT, and political turbulence.
Dorenfest IHDS+®	Proprietary market intelligence database, developed by Dorenfest Associates, Inc Chicago, IL, containing information for more than 1200 hospitals and integrated healthcare delivery systems in the US.
DR	The full-time equivalent for the clinicians reported in a hospital for a year.

DRG	Diagnostic Related Group - each DRG is only one of 503 possible classifications of diagnoses in which patients with similar lengths of stay and resource use are grouped together for billing and analytical purposes .
EBT	Earnings Before Tax
EN	Exponential Normal - a mathematical distribution used to describe the error term of a stochastic regression model that contains an exponential normal curve.
EVA	Economic Value Added
FTE	Full-Time Equivalent staff levels
GAO	US Government Accountability Office
GDP	Gross Domestic Product
GL	A Generalized Leontief production function of the general form: $Y = a_0+\theta_{j=1}^{n}a_j(X_j)^{1/2}+\theta_{j<k}^{n}\ \theta_{k=1}^{n}(X_jX_k)^{1/2}$
H&HN	Hospital & Health Networks, Chicago, Il
HEDIS	Health Plan Employer Data Set NCQA (2002). HEDIS 2003 Volumes 1-3. Washington, DC, National Committee for Quality Assurance.
HF	The care protocols from the CMS National Hospital Quality Initiative for Heart Failure (HF).
HFMA	Healthcare Financial Management Association, Chicago, Il
HN	Half-Normal - a mathematical distribution used to describe the error term of a stochastic regression model that contains a half -normal curve.
HQI	CMS Hospital Quality Initiative - http://www.cms.hhs.gov/quality/hospital/
ICT	Information and Communications Technologies – the broadest definition of Information Technology because it includes routers and servers and other network communication equipment to software and data management systems.
Intangible assets	The human capital, information capital, and the organizational capital of the organization.
IT	Information technology – software and data management systems designed to support all of the administrative, medical decision support, and clinical care support functions of a hospital.
IV approach	An econometric technique using an Instrumental Variable approach to improve efficiency of the estimate by which the predicted value of a structural model is specified as a right hand side variable of a second structural regression model.
LEAPF	The categorical variable coded in chapter 5 for references to Leapfrog group initiatives in IT strategic planning documentation of a hospital.
Leapfrog Group	The Leapfrog Group is an initiative driven by organizations that buy health care who are working to initiate breakthrough improvements in the safety, quality and affordability of healthcare for Americans. It is a voluntary program aimed at mobilizing employer purchasing power to alert America's health industry that big leaps in health care safety, quality and customer value will be recognized and rewarded. http://www.leapfroggroup.org/
LHS	The dependent term of a regression equation to the left of the equals sign.
LIMDEP	LIMDEP Version 8.0, 2002, Econometric Software, Inc., Plainview, NY, USA www.limdep.com.
LNBED	The natural logarithm of the maximum number of medical beds reported in service during a year.
LNDR	The natural logarithm of the full-time equivalent for all doctors reported in a hospital for a year.
LNOTH	The natural logarithm of the full-time equivalent for all other hospital staff – specifically, medical technicians, other clinical care practitioners, administrative, business office, and other support staff – for a year.

LNRN	The natural logarithm of the full-time equivalent for all doctors reported in a hospital for a year.
LTDR	Long term debt to net fixed assets ratio – a financial performance measure used in Chapters 5 and 6.
M&A	Merger and Acquisition
MLE	Maximum Likelihood Estimates
MVA	Market Value Added
NCQA	National Committee for Quality Assurance
OECD	Organization for Economic and Community Development
ORATE	Occupancy rate (average daily census of beds used) for a year, as used in Chapters 5 and 6.
OTH	The full-time equivalent for all other hospital staff – specifically, medical technicians, other clinical care practitioners, administrative, business office, and other support staff – for a year.
PF-EFF	Estimated technical efficiency, using a production function technique, as used in Chapters 5 and 6.
RHS	The independent terms of a regression equation to the right of the equals sign.
RN	The full-time equivalent for the registered nurses reported in a hospital for a year.
ROS	Rest-of-the-Sector
S&P	Standard and Poor's, Inc. A provider of credit and bond ratings in the US market.
Stochastic Production Frontier	Models based on Aigner, Lovell, and Schmidt (1977) that specifically address the concept that a production function is a theoretical ideal, and, u, represents technical efficiency -- an empirical measure of a firm's deviation from the ideal rate of production. In a Cobb-Douglas form: $\ln y = \beta_1 + \sum_k \beta_k \ln X_k - u + v \quad u>=0 \quad v \sim N[0,\sigma_v^2]$
Technical Efficiency	The measure of the percentage difference in the output of a firm compared to the stochastic production frontier, the ideal rate of output for the firm.
TL	A Transcendental logarithm production function model of the general form: $Y = a_0 \sum_{j=1}^{n} a_j \ln X + \sum_{j<k} n^{k=1} a_{jk} \ln X_j \ln X_k$
TN	A mathematical distribution used to describe the error term of a stochastic regression model that contains a truncated normal curve.
Top 100 Solucient Award	A measure produced by Solucient LLC, Chicago, IL that identifies when a hospital has achieved national benchmarks for overall success.
Top Cardio Solucient Award	A measure produced by Solucient LLC, Chicago, IL that identifies when a hospital has achieved national benchmarks for cardiovascular disease management success.
TPM	Total Profit Margin – a financial performance measure used in Chapters 5 and 6 that represents a hospital's ability to generate net operating funds that could be reinvested in the development of its tangible and intangible assets.
US hospitals	US Registered Community Hospitals (Nonfederal, short-term general and other specialty hospitals)
Weill's Typology	1992 – Weill identified that IT capabilities were not homogenous but could be classified as supporting transactional, informational, or strategic purposes.

THE THESIS

Key performance indicators (operational, economic, and clinical) can be constructed within an integrated evaluation framework, based upon the principles of the Neoclassical Theory of the Firm, Strategic Management, and Organization Theory to identify whether there are bundles of information technology and organizational characteristics associated with the generation of strategic value within US hospitals.

Does the early adoption and active integration – aggressive implementation – of Information Technology (IT) into a broad scope of business and clinical functions matter in obtaining strategic gains and competitive advantage in the US hospital sector[1]? While the literature is divided on the topic of performance gains associated with IT investment[2], the US hospital sector has been investing heavily on the premise that IT can facilitate business transformation, a structural improvement in quality and efficiency, to solve complex issues (demands for patient-focused improvements in quality of care, improved efficiency, and long-term financial viability). Specifically, the research questions are:

1) Do the most aggressive implementers of IT exhibit greater economic efficiency than the rest-of-the-sector?
2) Do the most aggressive IT implementers strategically outperform the rest-of-the-sector? and,
3) Can we identify organizational characteristics that are associated with superior performance?

This research was based upon constructing a unique tiered panel dataset of operational, economic, and clinical performance indicators, and qualitatively coding attributes of innovation across a sample US acute care hospitals. The first tier of the

---

[1] The term *aggressive implementers* will be used to mean the early adoption of IT with substantial concomitant investment in the intangible assets of the organization, such as process redesign, training, policy and procedures, and technical support for the purpose of realizing a capability better harmonized to the organization.

[2] See Chapter 2 for detailed discussion of the disparity of findings related to IT investment and performance.

panel contains high-level operational and descriptive information for a large (n~2200) sample of cases per year from 1997 – 2001. The second tier of the panel contains detailed performance and demographic information from 1998 – 2004 for a subset of hospitals that were identified as exceptional performers along with industry benchmark values for these performance measures The third tier contains detailed information on the patterns of investment in tangible and intangible assets for the group of aggressive IT implementing hospitals. Methods include structural testing of stochastic production frontiers, inference testing using strategy maps and scorecards, qualitative regression analysis, and a qualitative survey of select respondents searching for patterns in the tangible and intangible assets of the firm such as scope of healthcare functions automated within a hospital and organizational characteristics of the hospital associated with key performance outcomes. While the research design has methodology and methods that are grounded in significant works of Weill (1992), Brynjolfsson (1993), Brynjolfsson and Hitt (1996), Brynjolfsson, Hitt et al. (2002), Hitt and Brynjolfsson (1996), Kaplan and Norton (1992, 1993, 1996, 2000, 2001a, 2001b), and others, both the focus on the health sector and the integrative approach are novel.

What of approaches not considered, such as New Institutional Economics? This research did not use work from the New Institutional Economics mostly because the focus of that work relates to organizational form, efficiency of transactions, transitions, and evolution:

> *"What is New Institutional Economics? Its goal is to explain what institutions are, how they arise, what purposes they serve, how they change and how - if at all – they should be reformed." (International Society for New Institutional Economics)*[3]

The work of this thesis is focused on identifying competitive advantage in the form of performance differentials and the associated bundles of innovations within organizations. Perhaps similar findings could have been made using a New Institutional Economics framework but the approach taken in this thesis was believed to be the most direct route and brought with it academically tested and

[3] International Society for New Institutional Economics, http://www.isnie.org/ *Online (2006). New Institutional Economics, Washington University Department of Economics.* ***2006.***

reliable methods. Considering the implications of the research issue under consideration, it was prudent to control as many sources of noise as practicable. Adopting from well-understood methodology (Neoclassical Theory of Firm, Strategic Management, and Organizational Theory) that is grounded in the academic literature related to health care delivery and methods was considered important to the usefulness of this research.

Other limitations in this form of work are first the ability to define performance concepts that are generally accepted with the sector and, second, to construct the operational measures using best available data. At every point possible within this work, as noted in Chapters 3, 4, and 5, care was taken to utilize the best available data and to interpret those data carefully and cautiously. However, a study such as this will always be subject to criticisms over particular measure definition or data construction. In the end, these cannot be avoided, but steps have been taken to minimize these comments by use of industry standards, industry and academically trusted data sources as much as possible, to use data sourced from national health care delivery quality improvement initiatives, and to carefully interpret the results of the evaluation phases.

To put the thesis in context, Gartner-Dataquest (2001) estimated that hospitals spent $55.2 billion in 2000 on IT including hardware, software, and services within an expected nominal Compound Annual Growth Rate (CAGR) of 12 percent. Base health care IT spending is nearly 5 percent of all business IT spending and was equivalent to 0.4 percent of GDP in calendar year 2000. Concurrent with this period of IT investment, the sector was also under extreme financial and outcomes pressure. The sector-wide price/outcomes dilemma was described in a recent paper sponsored by the Commonwealth Fund and published in the journal, Health Affairs:

> *"In 2000, U.S. per capita health spending was $4,631, an increase of 6.3 percent over 1999. In addition to being 44 percent higher than Switzerland's per capita spending, the U.S. level was 83 percent higher than neighboring Canada and 134 percent higher than the median of $1,983 for the 30 industrialized countries in the Organization for Economic Cooperation and Development (OECD). Despite efforts to control health spending with managed care in the 1990s, the spending gap between the United States and other industrialized countries in the OECD actually widened slightly between 1990 and 2000.*

"Measured in terms of share of gross domestic product (GDP), the United States spent 13 percent on health care in 2000, Switzerland spent 10.7 percent, and Canada spent 9.1 percent. The OECD median was 8 percent. U.S. private spending per capita on health care was $2,580, more than five times the OECD median of $451. In addition, the U.S. financed 56 percent of its health care from private sources - the highest of the OECD countries, along with Korea." (Anderson, Reinhardt et al. (2003)).

This thesis will explore the nexus of the competitive market conditions, and various bundles of innovation within hospitals to gain understanding of the role of innovation in performance in the US hospital sector.

1.1 The Business Problem

Historically, hospitals have not been able to optimize their capital stock.[4] With 114.8 percent of Net Revenue before Expenses (234.0 percent of Net Earnings) spent on IT in 2000, average earnings' margins fell to 2.9 percent, which led to a continuing cash flow and capital crises within the sector. According to generally accepted industry market research sources, such as Gartner-Dataquest and IDC, Inc, this rate of IT spending was due to expectations of hospital executives that IT will transform health care–providing better care at lower cost[5]. Operating margins were historically low – and the outlook was not good due to continued reductions in federal reimbursement, aging population, growth of uninsured, prospects of bio-terrorism preparedness, *etc.* The Gartner Group estimated expected expenditures for software, services, and hardware to grow at a CAGR of 11.6 percent through 2004.[6] At that rate, expenditures would double by end-of-year 2006.

---

[4] A very interesting historic discussion of this topic and its implications for strategic management can be found in "The Effects of Competition and Regulation on Hospital Bed Supply and the Reservation Quality of the Hospital", by Paul L. Joskow ,The Bell Journal of Economics © 1980, The RAND Corporation.

[5] This is more than just a private sector expectation. See the policy statement of the Bush administration - "*The Decade of Health Information Technology: Delivering Consumer-centric and Information-rich Health Care, A Framework for Strategic Action*" 21 July 2004, Tommy Thompson, Secretary of Health and Human Services, and David Brailer, the National Coordinator for Health Information Technology.

[6] Gartner-Dataquest (2001). Research Brief: US Healthcare IT Market to Reach $44 Billion in 2001, Growing to $61 Billion by 2004. Stamford, CT, Gartner Group, Inc: 6.

1.2 Unit Of Measure

The thrust of the thesis relates to conducting comparative performance analysis across US hospitals looking first for evidence of differential performance in those hospitals that have implemented substantial investment in information technology, then looking for associated qualitative patterns. Therefore, the sector framework needs to provide enough resolution to observe *performance* changes in US hospitals while isolating as many of the potential convolutions as practicable. The unit of measure is the stand-alone, multi-service line acute care facility. While health care is provided at the medical department level within the facility, using the facility–level of analysis would treat the hospital as a combined entity producing a portfolio of care services and responsible for both direct costs of production that occur at the medical department but also the indirect costs, capital costs, and financing strategies of the hospital. This approach is consistent with the current economic literature analyzing hospital performance such as that of Chan and Ho (2000), Borzekowski (2002), and Chow-Chua and Groh (2002).

1.3 Scope

Limiting scope is an effort to prevent a fallacy of comparison and to create a sample that is relatively homogeneous with respect to business mission, environmental conditions, and exogenous influences. Within the national health sector, the care delivery segment is comprised of four distinct supply channels, with varying business models, methods of physician participation, and forms of control. They are independent physician and physician group practices, federal hospitals, state and local government hospitals, and other non-federal, short-term general and specialty hospitals. The scope excludes the federal hospitals[7] from the analysis because these facilities are subject to the least degree of market forces and their mission requirements are unique with limited service competition. However, state and local government hospitals are in scope because they face significant market forces in patient mobility, and market determinants have greater influence in operational budgeting. Long-term care facilities are excluded because they do not provide acute medical care. Finally, the scope excludes hospitals that are not American

[7] 876 hospitals of the Department of Defense, Department of Veterans Affairs, Indian Health Service, and Federal Health Service.

Hospital Association (AHA) (a private, non-profit organization) registered because registration is an indicator of maintaining industry standard levels of operational documentation, quality assurance, and community mission. For year 2000, AHA reported there were 4,934 hospitals in the US--the *US Registered Community Hospitals (Nonfederal, short-term general and other specialty hospitals).* [8,9] For sake of convenience, for the remainder of this thesis the phrase *US Hospitals* will be used in place of *US Registered Community Hospitals (Nonfederal, short-term general and other specialty hospitals).*

1.4 Sector Overview

This section presents a summary analysis of the US hospital sector for the period 1996 to 2001[10]. The flow of the presentation is top-down, placing the US health sector in context with the rest of the world followed by discussions of key issues for US hospitals of demand and production, cost conditions, performance, competitive behavior, and public policy. The first step is comparative, placing the US health sector within the global world health sector.

The US health sector is massive and complex. At 13 percent of year 2000 GDP[11], it was and continues to be the single largest sector of the US economy. Exhibit 1.1 presents a context model from the point of view of the consumer to identify three distinct vertical segments within the sector—Research and Development, Service Delivery, and Payment. It shows the flow of resources across segments and identifies mechanisms of statutory and legislative regulation and the boundaries of public and private control in the health sector. The focus of this analysis is the acute care hospitals (including managed care organizations) within the service delivery segment of the diagram.

[8] These are both for-profit and not-for-profit representing approximately 85 percent of total US facilities and 95 percent of total admissions in 2000.
[9] Managed care organizations are for-profit, horizontally integrated hospitals that perform both provider and payment services.
[10] With additional fragmented data available from 2002 to 2004.
[11] US Centers for Medicare and Medicaid Systems, Baltimore Maryland. www.cms.gov/

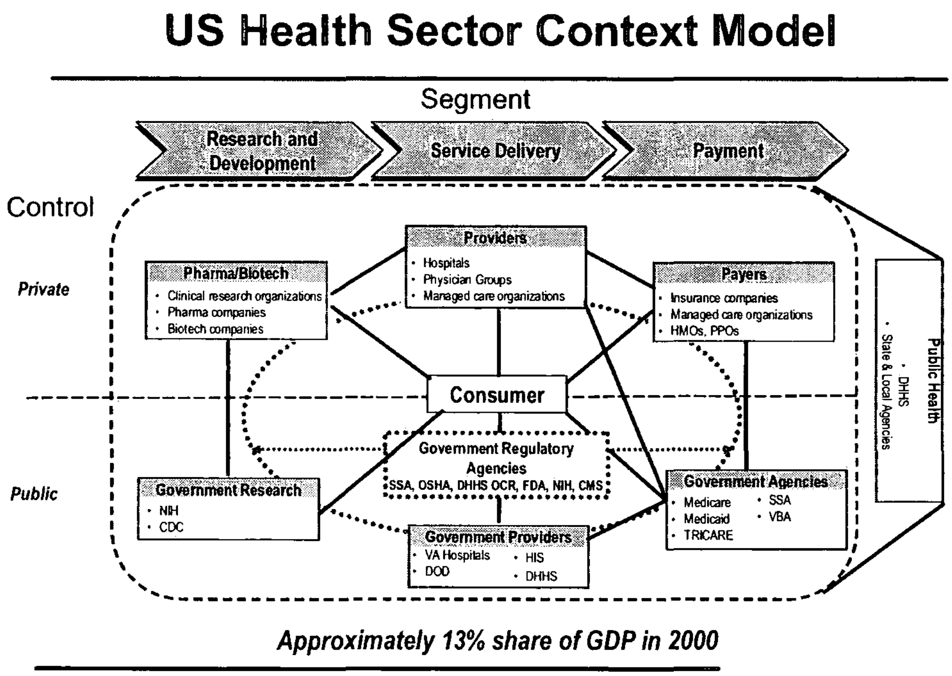


EXHIBIT 1.1: US Health Sector Context Model.

SOURCE: Adapted and revised from working products from a client engagement with Northrop Grumman Information Technology, Inc. (2001)

The take away point from Exhibit 1.1 is that while service delivery is the face of the health sector, it represents only one segment of a complex, inter-dependent sector.

Exhibit 1.2 presents comparative health indicators for US, UK, and the average of OECD members. The US outspends the rest of the world on health care per capita and the private sector plays a more significant role in US health care than in the rest of the world; yet, international researchers continued to question the value-added of the relative higher in spending in the US health system.[12] For example, the US spent more than 260 percent of UK *per capita* expenditure and access to complex care was easier in the US; yet, several basic health outcomes were comparatively better in the UK. Reinhardt, Hussey et al. (2002) provides the standard *caveat* associated with comparative analysis of OECD health statistics, but first impressions are alarming.

Select Health Indicators	**US**	**UK**	**OECD Mean**
OECD OFFICIAL STATISTICS, 2000			
Total Expenditure per capita ($Purchasing Power Parity)	$ 4,631	$ 1,763	$ 1,967
Health Expenditure Percentage of GDP	13.0%	7.3%	8.1%
Public Share of Health Expenditure	44.3%	81.0%	71.5%
Male Life Expectancy	73.9	75.0	73.8
Female Life Expectancy	79.4	79.8	79.9
Infant Mortality	7.1	5.8	7.2
Cancer (Malignant Neoplasm) Incidence/100,000	483.8	242.5	302.3
Average Length of Hospital Stay (Days)	7.0	6.0	7.1
Physicians/1000 population	2.8	1.8	2.9
Acute Care Beds/1000 population	3.0	3.4	4.2
WHO Statistics Year 2001			
Males (for Year 2001)			
Healthy Life Expectancy at Birth	66.4	68.4	-
Percentage Total Life Expectancy Lost to Poor Health	10.8%	6.6%	-
Females (For Year 2001)			
Healthy Life Expectancy at Birth	68.8	70.9	-
Percentage Total Life Expectancy Lost to Poor Health	13.5%	9.0%	-

EXHIBIT 1.2: Comparative Health Sector Indicators.

SOURCE: OECD

[12] See Docteur, E., H. Suppanz and J. Woo (2003). "The US Health System: An Assessment and Prospective Directions for Reform." OECD Economics Department Research Paper **63.**.

Whether the US outcomes justify the level of national per capita expenditure is beyond the scope of this thesis. What is clear, however, is that the US spends a significant share of national wealth on health care. Exhibit 1.3 presents the composition of US health care expenditure in year 2000.[13] After professional services—those fees for physicians and outsourced ancillary services—the consumption related to hospital utilization was 30 percent of all health care consumption in year 2000.

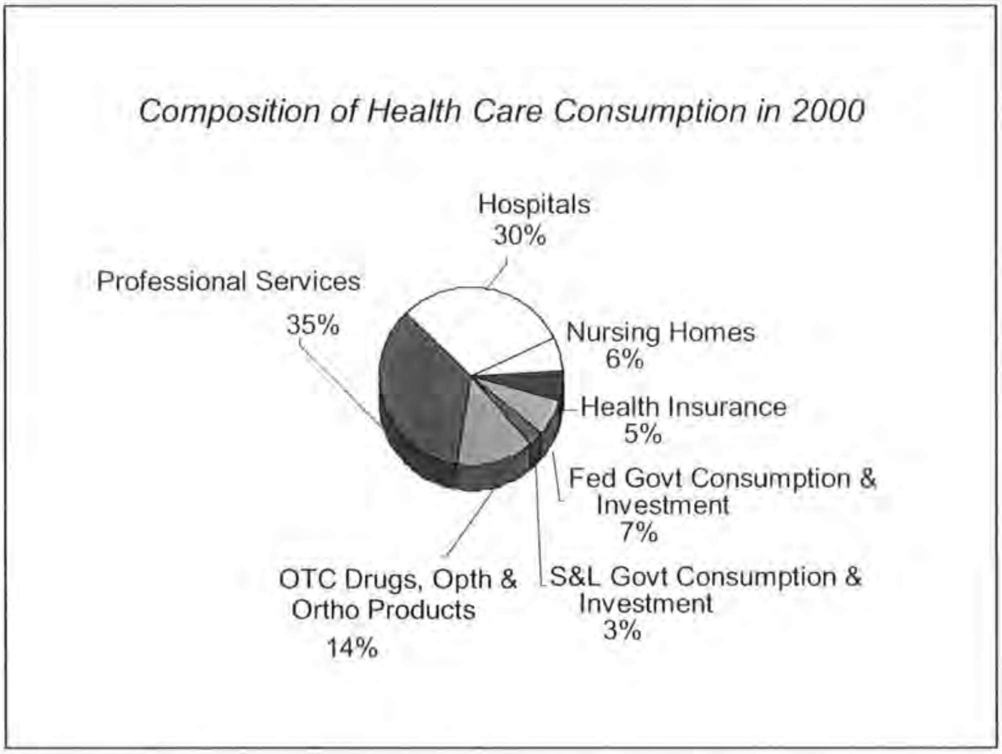


EXHIBIT 1.3: Composition of US Health Care Consumption.

SOURCE: Gartner-Dataquest

The next section steps down into the US hospital sector by summarizing issues of demand and production.

---

[13] See Gartner-Dataquest (2002). Research Brief: Healthcare Predictions -- 2002 and Beyond. Stamford, CT, Gartner Group, Inc.: 4.

1.5 Demand & Production

This section will summarize basic output statistics and revenue flows for inpatient and ambulatory care within US hospitals.

1.5.1 Output Statistics

Exhibit 1.4 and Exhibit 1.5 summarize trends in care demand and output within the sector. The output of inpatient care at US hospitals improved from 1996 to 2000. While the total bed supply nationwide fell 4.5 percent, the following indicators improved: Total admissions increased 6.4 percent; Average Length of Stay (ALOS) fell from 6.2 days to 5.8 days; Inpatient Surgeries increased 1.9 percent; and, despite consolidation of supply, admissions per thousand of population grew 0.3 percent to 117.6 in 2000.

NOMINAL TRENDS IN UTILIZATION

	1996	1997	1998	1999	2000	Nominal CAGR
Inpatient Segment						
Beds..........	862,352	853,287	839,988	829,575	823,560	-1.1%
Admissions..........	31,098,959	31,576,960	31,811,673	32,359,042	33,089,467	1.6%
Inpatient Days..........	193,747,004	192,504,015	191,430,450	191,884,270	192,420,368	-0.2%
Average Length of Stay..........	6.2	6.1	6.0	5.9	5.8	-1.8%
Inpatient Surgeries..........	9,545,612	9,509,081	9,735,705	9,539,593	9,729,336	0.5%
Births..........	3,723,871	3,742,191	3,726,233	3,760,295	3,880,166	1.0%
Outpatient Segment						
Emergency Outpatient Visits..........	93,111,592	92,819,892	94,771,405	99,484,462	103,144,030	2.6%
Other Outpatient Visits..........	346,751,515	357,320,118	379,422,063	395,861,824	418,260,946	4.8%
Total Outpatient Visits..........	439,863,107	450,140,010	474,193,468	495,346,286	521,404,976	4.3%
Outpatient Surgeries..........	14,023,651	14,678,290	15,593,614	15,845,492	16,383,374	4.0%

EXHIBIT 1.4: Nominal Trends in Hospital Utilization—AHA.

Source: Hospital Statistics (2002)

The output of ambulatory care at US hospitals improved, as well: Emergency Outpatient Visits increased 10.8 percent; Total Outpatient Visits increased 18.5 percent; Outpatient Surgeries increased 16.8 percent; Total Outpatient Visits per thousand population increased 11.7 percent; and, Outpatient Surgeries per thousand population increased 10.0 percent.

COMMUNITY HEALTH INDICATORS PER 1000 POPULATION						
	1996	1997	1998	1999	2000	Effective Growth
Total US Population (000s)	265,229	267,784	270,248	272,691	281,422	**100.0%**
Inpatient Care Segment						
Beds..........	3.3	3.2	3.1	3.0	2.9	**95.4%**
Admissions..........	117.3	117.9	117.7	118.7	117.6	**98.6%**
Inpatient Days..........	730.5	718.9	708.4	703.7	683.7	**96.9%**
Inpatient Surgeries..........	36.0	35.5	36.0	35.0	34.6	**97.6%**
Births..........	14.0	14.0	13.8	13.8	13.8	**98.2%**
Outpatient Segment						
Emergency Visits..........	351.1	346.6	350.7	364.8	366.5	**99.6%**
Other Outpatient Visits..........	1,307.4	1,334.4	1,404.0	1,451.7	1,486.2	**101.7%**
Total Outpatient Visits..........	1,658.4	1,681.0	1,754.7	1,816.5	1,851.7	**101.3%**
Outpatient Surgeries..........	52.9	54.8	57.7	58.1	58.2	**100.9%**

Effective Growth Calculation = Line Item's Nominal Compound Average Growth Rate (in index form) divided by Total US Population's Nominal CAGR (in index form).

EXHIBIT 1.5: Population Normalized Community Health Indicators—AHA.

SOURCE: Hospital Statistics (2002)

The effective growth calculations in Exhibit 1.5 demonstrate the continued cost management trend to substitute ambulatory care for inpatient care. Inpatient care grew at rates 1.4 to 3.1 percentage points less than population growth while ambulatory care grew at rates nearly equal to 1.7 percentage points above population growth.

1.5.2 Regional Production Differences

While there is a general national standard of care, the production of care is a regional phenomenon[14]. Atkinson and Cockerill (2006) found that there are structural differences in production functions across the eleven US census divisions.[15] The paper found that the distribution of capital and labor inputs and intra-labor distributions exhibited statistically significant variations across the census regions. This is evidence that regional differences in both demand for care and

[14] See HospitalStatistics (2002). Hospital Statistics 2002. Chicago, IL, Health Forum, LLC.
[15] See Chapter 4.1 for a detailed discussion.

supply of medical services did exist across the US. These sorts of differences could serve to convolute any attempt to assess cross-sectional performance of hospitals unless efforts were taken to control for regional effects.

1.5.3 Revenue

The pricing mechanism of hospital-based care is sub-optimal for revenue maximization because the fee-for-service patient revenue chain at a US hospital is similar to a Reverse Auction. The initial cost for an episode of care is asked by the hospital after the care is provided, the contract payers bid a reimbursement amount that they are willing to pay, and then negotiation settles final reimbursement. Of course, managed care contracts are awarded based on prospective per capita funding rates.

DESCRIPTION	1996	1997	1998	1999	2000	CAGR
Gross Inpatient Revenue	400,236,910,860	409,835,164,075	429,298,979,756	448,184,594,265	481,753,558,221	*4.7%*
Gross Outpatient Revenue	181,556,870,677	197,909,825,321	212,676,292,241	230,532,054,581	255,130,109,523	*8.9%*
		(Includes Inpatient and Outpatient)				
Total Gross Revenue	**581,793,781,536**	**607,744,989,395**	**641,975,271,996**	**678,675,606,538**	**736,883,667,744**	*6.1%*
Deductions from Revenue	*262,208,115,635*	*284,097,781,362*	*315,899,432,400*	*348,935,697,761*	*394,634,720,840*	*10.8%*
Net Patient Revenue	**319,585,665,901**	**323,647,208,033**	**326,075,839,597**	**329,739,908,777**	**342,248,946,904**	*1.7%*
Other Operating Revenue	18,528,449,888	19,449,897,735	20,374,978,828	21,500,583,544	21,691,829,666	*4.0%*
Other Nonoperating Revenue	7,956,326,012	9,685,833,929	9,817,392,794	9,447,138,454	9,649,649,680	*4.9%*
Total Net Revenue	**346,070,441,801**	**352,782,939,698**	**356,268,211,219**	**360,687,630,775**	**373,590,426,250**	*1.9%*

EXHIBIT 1.6: Revenue Chain (Constant 2000 Dollars).

Source: Hospital Statistics (2002)

Exhibit 1.6 presents the revenue chain in US hospitals. The driver of Net Patient Revenue is *Deductions from Revenue*—$395 billion dollars in 2000[16]—and shows that hospitals nationwide lost nearly fifty percent of their potential patient revenues by the end of year 2000. The industry practice has been to consider these items above-the-line adjustments to patient revenue—these line items are not operational

[16] Standard definition: annual bad debts; pricing adjustments required by managed care reimbursement agreements; disallowed cost recovery from indemnity Fee-For-Service insurance; and, *pro bono* service

costs. Moreover, historically management has treated these line items as exogenous to the income statement and beyond management control.

1.6 Cost Conditions

A typical hospital has significant fixed costs in its operating budget. There are substantial costs to the entry and exit from the sector as a stand-alone facility. However, managers do manipulate variable production levels along the margins by varying the number of operational beds within the fixed hospital facility. This does result in a lumpiness of costs for a range of facility sizes. The typical cost structure of a hospital includes *Hospital personnel; Professional services' fees (physicians, outsourced medical procedures and laboratory services); Supplies and supply logistics; Facility management; Equipment expenditures; and Depreciation.*

Classification	Average Stay (days)	Labor Expenses Payroll	Employee Benefits	Total Labor	Total Expenses	Adjusted per Inpatient Day
US Community Hospitals	5.8	$151,438,223	$31,685,539	$183,123,762	$356,563,790	$1,149.40
By Bedsize:						
6-24 Beds	*4.3*	*$680,857*	*$133,714*	*$814,571*	*$1,549,776*	*$895.55*
25-49	*5.1*	*$4,550,243*	*$929,425*	*$5,479,668*	*$10,391,935*	*$891.36*
50-99	*6.5*	*$9,685,806*	*$2,072,528*	*$11,758,334*	*$22,322,023*	*$744.73*
100-199	*5.7*	*$27,128,334*	*$5,696,302*	*$32,824,636*	*$63,358,364*	*$925.32*
200-299	*5.7*	*$28,723,703*	*$5,975,370*	*$34,699,073*	*$67,057,555*	*$1,122.43*
300-399	*5.5*	*$22,742,941*	*$4,772,627*	*$27,515,568*	*$54,273,518*	*$1,276.87*
400-499	*5.6*	*$17,446,426*	*$3,762,360*	*$21,208,786*	*$41,299,819*	*$1,352.58*
500 or more	*6.3*	*$40,479,912*	*$8,343,214*	*$48,823,127*	*$96,310,799*	*$1,468.11*
By Control:						
Nongovernment not-for-profit	*5.7*	*$114,577,475*	*$23,784,418*	*$138,361,894*	*$267,050,921*	*$1,182.32*
Investor-owned (for profit)	*5.4*	*$13,919,780*	*$2,694,428*	*$16,614,208*	*$34,969,346*	*$1,057.32*
State and Local Government	*6.7*	*$22,940,968*	*$5,206,692*	*$28,147,660*	*$54,543,523*	*$1,063.75*

EXHIBIT 1.7: Cost Structure 2000 for 4,915 US Community Hospitals.

Source: Hospital Statistics (2002)

The adjusted cost per inpatient day data in Exhibit 1.7 show the relatively high levels of fixed costs across the size classes for all 4,915 US community hospitals. It also shows some cost lumpiness—i.e., fewer than 100, 100-399, and 400+ beds. Average for-profit operating costs were approximately 11 percent less than the not-for-profit average cost while the average costs of state and local government facilities were between the two private sector averages.

1.6.1 EBT Erosion

Earnings Before Tax (EBT) margins flattened to an annualized average of 3.7 percent in 2000 according to a report in JuneIndustryScan2001 (2001). Margins rose 0.4 percent from 1999 and were 36.8 percent lower than 1997. Smaller facilities finished 2000 best, at 4.8 percent. Larger facilities had smallest margins, at 2.8 percent. Regionally, Western facilities posted weakest margins, 3.9 percent, while Northeast facilities fared the best, at almost 5 percent in 2000, and up from break even in 1999. Generally, managed care market share is high in the West, and low in the Northeast US.

1.6.2 Bond Ratings & Corporate Credit

Standard & Poor's (S&P) also reported in JuneIndustryScan2001 (2001) not-for-profit and for-profit facilities differed in key components of a bond rating analysis. The majority of not-for-profit hospitals were rated investment grade as of April 2001 with 82 percent almost evenly split between A and BBB categories. About 5 percent were assessed as being of speculative investment quality. In the for-profit segment, however, 70 percent of the ratings were speculative grade. The credit quality of the not-for-profit segment declined significantly in 1999 and 2000 as demonstrated by the ratio of downgrades to upgrade of more than 5:1, annually. S&P cited the causes of this decline as reduced reimbursements, increased costs, and the general failure of management strategies. Credit quality in the for-profit segment was relatively stable over the period.

1.7 Competitive Behavior

In InterStudy (2001) it was reported that enrollment in US managed care organizations fell by 0.9 percent to 80.1 million covered lives on July 1, 2000. They found that managed care enrollment grew at increasingly higher rates during the first half of the 1990s, but slowed in the latter half and declined during fiscal year 2000. During the last half of the 1990s, substantial efforts were made to capture a larger market share of both employer-based enrollees and Medicaid[17] enrollees. Pricing wars were prevalent in those US regions with significant managed care penetration. Managed care price cutting further accelerated erosion of EBT margins

---

[17] The federal low-income citizen hospital insurance program.

and led to increased merger and acquisition activity among managed care service delivery organizations and payment organizations. The total number of managed care organizations dropped almost 9 percent, from 613 to 560 during FY2000.

1.7.1 *Impact on Structure*

Evidence is presented in Exhibit 1.8 that concentration occurred throughout the US health sector in the late 1990s. This was true in the hospital sector as well. Over the four-year period 1996-2000, the total number of community hospitals fell 4.3 percent. The number of urban hospitals fell 5.8 percent, driving more than three-quarters of the total decline for the period. The total bed supply nationwide fell 4.5 percent in this period. The mix of control of facilities among Public, Not-for-Profit, and For-Profit remained about constant. The number of physician participation models implemented fell substantially by 2000 after a decade of experimentation aimed at creating performance-based incentives linked to physicians' treatment patterns.

The following two exhibits highlight the effects of concentration and market influences in the sector. Exhibit 1.8 shows the historic trend in the total number of hospital beds. In the late 1960's bed supply hit a peak of approximately 1.7 million. At that point, the share of federal beds was approximately 55 percent. By the year 2000, total bed supply fell to just under 1.0 million with a federal share of approximately 15 percent.

This is evidence that classic market forces do exist in the US hospital sector. As the role of the private sector increased over the period, market forces have acted to better rationalize the supply of beds. Taken another way, Exhibit 1.9 presents the trend in total bed supply versus the trend in market share of for-profit beds. From the exhibit, it would appear that the supply peak of the late 1960's, with no for-profit hospitals, was the incentive for their entry by the middle 1970s to an initial share of just over 5 percent of bed supply. Consistent with Porter's (1998, pp156-188) discussion of industry evolution, the cycles of expansion in the for-profit segment—ending early 1980, early 1990s, early 2000s—appear to last a decade.

OPERATIONAL CHARACTERISTICS OF NON-FEDERAL US HOSPITALS

DESCRIPTION	1996	1997	1998	1999	2000
Total United States Hospitals	**5,134**	**5,057**	**5,015**	**4,956**	**4,915**
Of which:					
Bed Size Category					
6-24	262	281	293	299	288
25-49	906	890	900	887	910
50-99	1,128	1,111	1,085	1,082	1,055
100-199	1,338	1,289	1,304	1,266	1,236
200-299	692	679	644	642	656
300-399	361	367	352	365	341
400-499	196	185	183	161	182
500 +	251	255	254	254	247
Location					
Hospitals Urban	2,908	2,852	2,816	2,767	2,740
Hospitals Rural	2,226	2,205	2,199	2,189	2,175
Control					
State and Local Government	1,330	1,260	1,218	1,197	1,163
Not for Profit	3,045	3,000	3,026	3,012	3,003
Investor owned	759	797	771	747	749
Physician Models					
Independent Practice Association	1,223	1,056	966	874	831
Group Practice without Walls	381	285	232	198	211
Open Physician-Hospital Organization	1,147	1,077	1,055	975	939
Closed Physician-Hospital Organization	560	485	451	414	360
Management Service Organization	1,139	964	866	770	655
Integrated Salary Model	1,016	1,016	1,039	1,106	1,126
Equity Model	183	125	121	103	91
Foundation	673	416	349	290	252
Insurance Products					
Health Maintenance Organization	1,153	1,166	1,099	1,009	870
Preferred Provider Organization	1,588	1,543	1,303	1,156	1,028
Indemnity Fee for Service	536	493	387	303	286
Managed Care Contracts					
Health Maintenance Organization	2,986	3,095	2,933	2,916	2,804
Preferred Provider Organization	3,493	3,534	3,291	3,310	3,233
Affiliations					
Hospitals in a System	2,058	2,226	2,176	2,238	2,217
Hospitals in a Network	1,343	1,492	1,380	1,310	1,327
Group Purchasing Organization	0	0	2,778	3,080	3,344

EXHIBIT 1.8: Evidence of Concentration, US Hospitals 1996 – 2000.

Source: Hospital Statistics (2002)

1.7.2 Revenue Management & Cost Control

Hospitals compete in the type and degree of revenue management techniques they implement. Costs, with the exception noted below, are fixed for any given capacity-level. In a study sponsored by Healthcare Financial Management Association, the major portion of revenue lost to *Deduction from Revenue* is due to documentation errors in the medical record and substantial strategic management time is spent in improving a facility's cost recovery capabilities.[18]

---

[18] HFMA (2003). CFO Exchange: Strategizing for the CFO. Healthcare Financial Management CFO Forum, San Francisco, CA, Healthcare Financial Management Association.

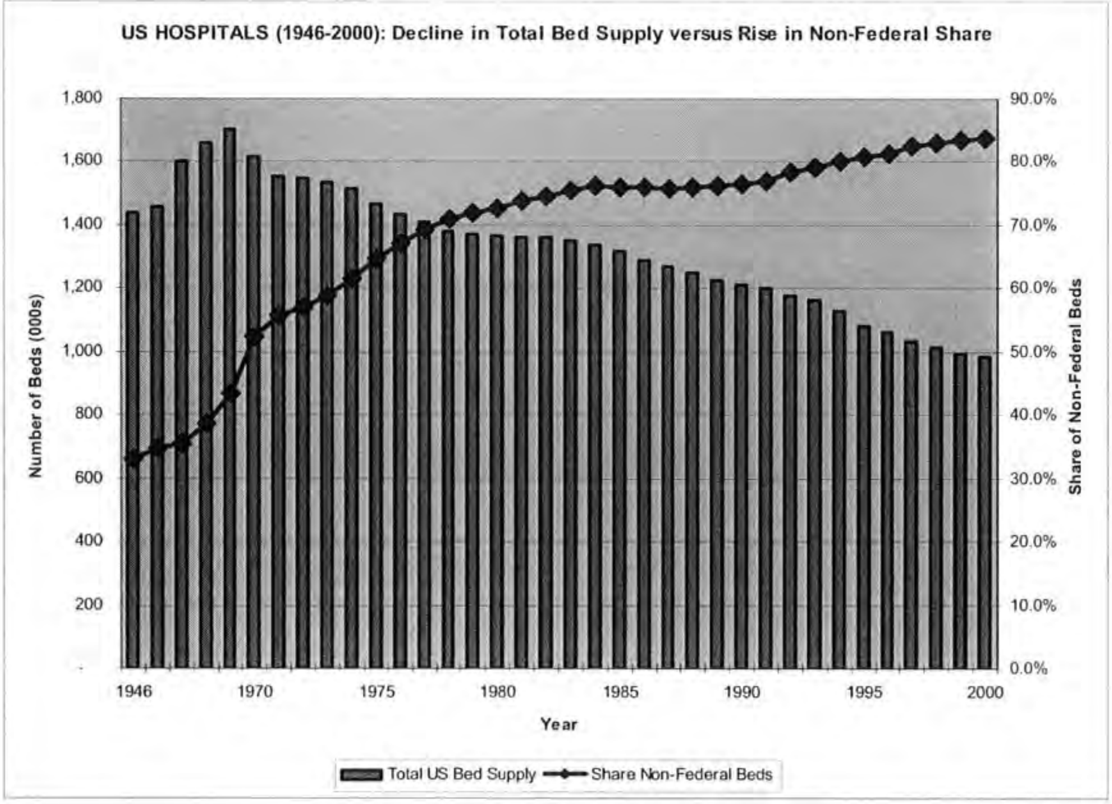


EXHIBIT 1.9: Total Bed Supply versus Non-Federal Share of Beds.

Source: Hospital Statistics (2002)

Hospitals can implement three forms of intervention to mitigate revenue losses: 1) automating the capture of patient and diagnostic code for each encounter throughout a hospital; 2) automation of the grouping of all encounters to a patient's medical record; and, 3) e-business technologies to integrate the business office with third-party collection offices and government agencies. There is some evidence that marginal improvements in revenue matter—EBT margin is extremely sensitive to small changes in *Deductions from Income.*[19]

[19] Atkinson, B. (2003). Unpublished DBA Research Paper. Assignment 4. Durham, England., an unpublished working paper, found that a modal 4.4 percent improvement in *Deductions from Income* generated an expected value EBT margin of 62 percent (baseline FY2000) using Monte Carlo techniques in a micro-simulation model of census division's income statement and balance sheet items **c.p.**.

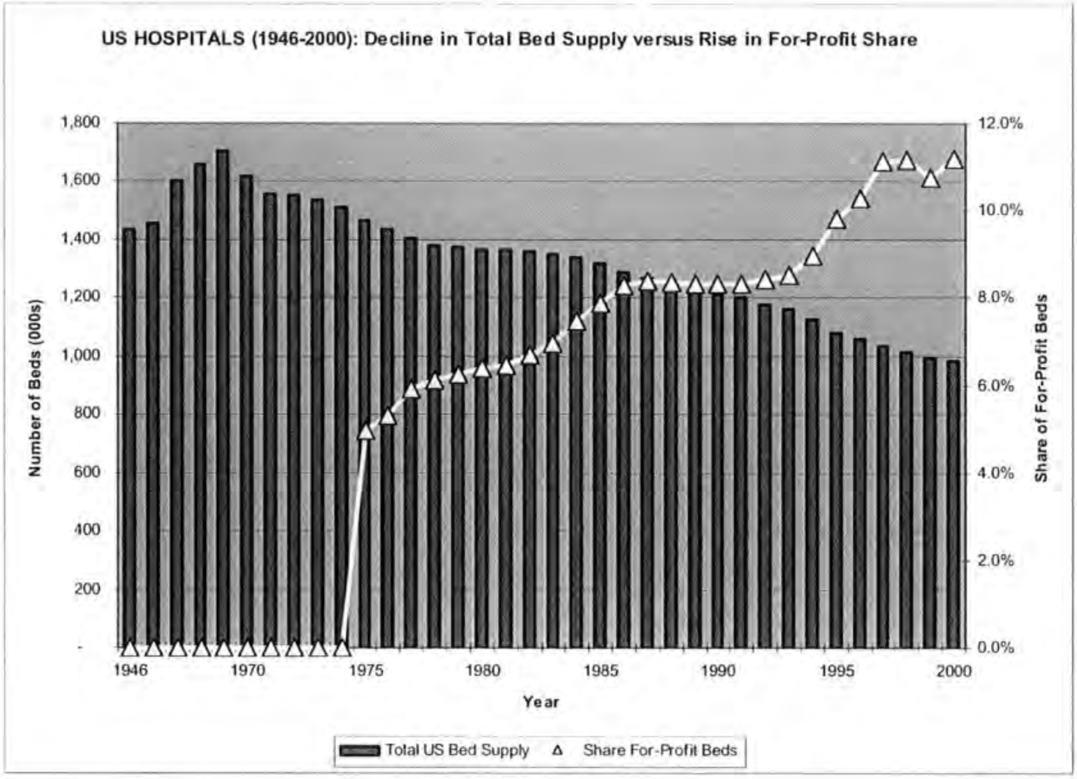


EXHIBIT 1.10: Total Bed Supply versus For-Profit Share of Beds.

Source: Hospital Statistics (2002)

Since much of the cost structure is quasi-fixed, logistics management has become the single most effective tool of cost containment across all hospital segments.[20] Supply-chain purchasing groups, consistent with Porter's (1998, pp319-320) *tapered integration* concept, have lowered logistics costs and captured group bargaining power in supply contracts. Exhibit 1.8 also shows the number of hospitals enrolled in a group purchasing organization grew from zero in 1996 and 1997 to 3,344 (68 percent) in year 2000.

1.7.3 The Clinical Quality Imperative

The most prominent performance measurement dataset across the US health sector is the Health Plan Employer Data and Information Survey (HEDIS). The

[20] HFMA (2003). CFO Exchange: Strategizing for the CFO. Healthcare Financial Management CFO Forum, San Francisco, CA, Healthcare Financial Management Association.

National Committee for Quality Assurance (a private, non-profit organization) oversees the HEDIS survey instruments. More than 90 percent of US health plans use HEDIS to measure performance using more than 60 metrics. While HEDIS is the most widely used set of performance measures in the payment segment of the sector, public reporting of HEDIS results is not widely performed at this time.[21]

The US Centers for Medicare and Medicaid Systems (CMS) have led the health sector in the facilitation of the national consensus performance measures for the service delivery segment. Their work has led to the initiation of the Hospital Quality Initiative (HQI)[22] which is a voluntary reporting project in which hospitals report on clinical performance in three diagnostic cases—Pneumonia, Heart Failure, or Heart Attack.[23] When a hospital reports in the HQI, it is reporting its actual caseload performance against consensus medical best practice protocols. CMS then computes the descriptive statistics associated with each of the three diagnostic cases. These data (both the self-reported performance data and the national comparative performance) are available from CMS for research use and they represent the only non-proprietary, no-fee, consensus-based clinical performance data available for the US hospital sector. These are the data that will be used to drive the exploration of clinical quality improvements to be presented in Chapter 4.2.

Another force for clinical improvement in the sector is from the supply-side. The Leapfrog Group is an initiative driven by organizations that buy health care who are working to initiate breakthrough improvements in the safety, quality and affordability of healthcare for Americans.[24]

---

[21] NCQA (2002). HEDIS 2003 Volumes 1-3. Washington, DC, National Committee for Quality Assurance.
[22] http://www.cms.hhs.gov/quality/hospital/
[23] There are 10 measures that reflect rate of compliance with national consensus care standards: **Heart Attack**: Aspirin at arrival, Aspirin at discharge, ACE Inhibitor for left ventricular systolic dysfunction, Beta Blocker at arrival, Beta Blocker at discharge. **Heart Failure**: Assessment of left ventricular function, ACE Inhibitor for left ventricular systolic dysfunction. **Pneumonia**: Oxygenation assessment, Initial antibiotic timing, and Pneumococcal vaccination.
[24] http://www.leapfroggroup.org/

1.7.4 The Promise of Information Technology

As stated earlier, hospitals have been spending heavily on IT projects, the rate of spend was an estimated $55.2 billion in 2000.[25] This amount was equal to approximately 324.0 percent of EBT and 14.8 percent of Net Patient Revenue.

Estimate of IT Expenditures in Year 2000 *(Billions of Dollars)*	
Health Benefits Administration........	$ 9.3
Health Quality Administration..........	$ 4.2
Health Information Management.....	$ 41.7
Total End of Year......	**$ 55.2**

EXHIIBIT 1.11: Hospital Sector IT Expenditure 2000.

SOURCE: Gartner-Dataquest (2001)

As shown in Exhibit 1.11, the business areas focused for IT are benefits administration and coordination of benefits, quality administration, and general medical records information management. In the same study, Gartner-Dataquest (2001) reported survey results that these IT investments came with expectations of substantial return on investment by enabling strategic realignments of care delivery because of their promised abilities to: *Integrate information flows and resources across the three health segments, Improve patient safety, Improve revenue-chain management, Provide labor resource leveling, Provide patient education and preventive care, Improve cost accounting at patient-level, and Increase access to appropriate care.*

Despite this rate of expenditure, limited evidence has emerged to support the promise of information technology. Lee and Menon (2000) found that hospitals with high technical efficiency also had relatively higher amounts of information technology capital. Menon and Lee (2000) and Borzekowski (2002) both identified the role of certain IT applications in reducing long-term hospital operational costs.

[25] Gartner-Dataquest (2001). Research Brief: US Healthcare IT Market to Reach $44 Billion in 2001, Growing to $61 Billion by 2004. Stamford, CT, Gartner Group, Inc: 6.

These papers did not attempt to determine whether payback was achieved nor did they address quality management issues. Li and Collier (2000) documented that no research to date has examined the relationships between the type of technology, the type of quality, and hospital financial performance. Li and Collier found that the type of technology (clinical or information) drives different types of quality performance (clinical or process) and directly or indirectly affects hospital financial performance. They, too, did not develop a strategic performance model.

1.8 Public Policy Issues

While the US hospital sector is primarily in the private sector, there are significant public policy issues related to access to care and public financing that will have enormous import for the future of the sector. Health care financing is a large topic but this thesis will evaluate financial performance at the hospital level and identify sources of competitive advantage from tangible and intangible assets.

1.8.1 National Health Expenditures

CMS Heffler, Smith *et al.* (2002) reported to Congress that health expenditures will reach $2.8 trillion in 2011, growing at a mean annual rate of 7.3 percent. CMS expects health spending to grow 2.5 percent per year faster than nominal GDP, so that by 2011 the current 13 percent GDP share will grow to 17 percent.

1.8.2 Federal Hospital Insurance Fund Liability

Walker (2003) reported to Congress for the Government Accountability Office (GAO) that trends in health care spending pose significant challenges for the Medicare[26] hospital insurance (HI) program. Demographic trends and the resulting growth in costs drive Medicare's long-term financing problem with a current estimate of 2.4 workers per HI beneficiary in 2030 under the current program. Under those trends, Medicare HI will be in current cash deficit by 2013 and reach a -$300 billion dollar operating deficit by 2040. Walker concluded that Medicare reforms are required to realign incentives, improve transparency, and strengthen accountability.

[26] The federal senior citizen health insurance program.

1.8.3 Malpractice Liability

A recent survey conducted by the Blue Cross Blue Shield (BCBS) health plans found that malpractice medical insurance premium rates are causing a crisis in health care management that affects both access to care and growth in total expenditures. BCBSAssociation (2003) reported that medical liability insurance rate hikes may be responsible for limiting, or eliminating, access to some types of care. BCBS cited obstetricians/gynecologists, surgeons, and other high-volume specialists as most at risk and rural areas as most affected by loss of providers. Malpractice insurance is a significant portion of the provider's cost-of-doing-business. Many times, reimbursement caps limit the ability of a physician to recapture the total rate hike. A majority of BCBS health plans reported that physicians are cutting back on medical practice due to actual or expected insurance rate hikes.

1.9 Interpretations

Strategic management in the hospital sector can be difficult because the primary output—improved health—is hard to measure in a time-period consistent with operational budgeting. The consequence of the poor financial outlook for the sector is significant because most hospitals use the debt markets to obtain long-term capital financing. Both non-profit and for-profit hospitals need to be cautious about income statement issues and to maintain favorable bond and/or credit ratings. Even non-profit US hospitals must generate a cash flow dividend in the form of earnings before tax (EBT) to fuel their community health mission needs such as capital stock replenishment, expanding service offerings, and improving population outreach initiatives because demographic and disease factors are driving the demand for care. The managed care portion of the US hospital sector apparently attempted in the 1990s to move out of Porter's *Stuck-in-the-Middle* Porter (1998) conditions However, as Porter suggests, the moves backfired over time as the increased price competition and decreased federal reimbursement rates drove the excess profits out of the sector. The managed care pricing competition also spawned price competition across the entire hospital sector. Regional contract pricing wars created loss leaders among service lines, decaying hospital margins, and, finally, merger and acquisition activity among both providers and insurers. Eventually, the Porter model held, as M&A activity consolidated all portions of the US hospital sector by 2000. Despite the increased sector concentration, there was no obvious evidence of the accumulation of market power. Although EBT margins have fallen, the sector is not in decline—demand is growing—the issue is that the management paradigm is shifting to simultaneous optimization of quality management and financial performance. This is characteristic of Porter's depiction of a sector in transition somewhere in or near maturity.

There are mandates easily taken from this section. For example, a stakeholders' perspective would be to create viable public-private pricing mechanisms while improving the health status of the population. A consumers' perspective would be to 'reduce the cost of care' which can be interpreted in many ways but is in its simplest form, 'reduce the out-of-pocket expenses of care borne by the typical consumer of care'.[27] A hospital ownership/management perspective would be to improve return on equity while the physician/clinician perspective would be to reduce the administrative burden of providing care while maximizing opportunities to improve the standard of care delivered.

This is a transitional period for the US hospital sector. Information technology is one of the strategies hospitals are implementing aggressively in efforts to transform health care business models. The promise of these investments is that they will enable hospitals to reengineer care delivery to provide better care at lower cost with improved resource stewardship. However, the academic literature is nearly silent on the topic with respect to the hospital sector; in many regions of the country, margins are so low there is little room for error. Further study is required to determine whether US hospitals are achieving strategic breakout value from their IT investments. This thesis will develop the strategic framework to identify necessary performance indicators and evaluate measures in terms of gains in efficiency, clinical process quality, clinical process control, market share, and fundamental financial measures.

---

[27] Whether consumers understand their real economic costs of health care or the tradeoffs among insurance and financing alternatives is an interesting topic but beyond the scope of this work.

The issue in managing a hospital's IT capital portfolio is in knowing those portions of the IT promise that can address portions of the competing mandates to facilitate strategic change, to understand those that are operational necessities, and those that are ineffective and wasteful. However, organizational transformation does not occur in isolation from its environment of human and organizational capital and IT, alone, does nothing. Using the working definitions of both Brynjolfsson (2003) and Kaplan and Norton (1992), the potential growth of any organization is based on the quality and character of those *intangible assets* - the human capital, information capital, and the organizational capital of the firm. Investing in intangible assets would translate as investing in the strengthening and enhancing of the skills of the people, the clarity and appropriateness of policy and procedure, and the effectiveness of the systems of the organization.

Within this view, the management challenge, therefore, is to identify those bundles of investments in the intangible assets of the organization that can facilitate strategic change, those that are operational necessities, and those that are wasteful and inefficient. In exploring this challenge, the thesis is comprised of six chapters. Chapter 1 frames the research questions. Chapter 2 presents the literature supporting the methodology. Chapter 3 presents the methodology, methods and data sources that were used in this research. The first research question (*Do the most aggressive implementers of IT exhibit greater economic efficiency than the rest-of-the-sector?)* is addressed in Chapter 4.1. The second research question (*Do the most aggressive IT implementers strategically outperform the rest-of-the-sector?)* is addressed in Chapter 4.2. The third research question (*Can we identify organizational characteristics that are associated with superior performance?)* is addressed in Chapter 5. Finally, Chapter 6 presents the application to management, limitations, and extensions.

The next section presents Chapter 2, Perspectives on Corporate Performance, which provides the detailed literature review supporting this thesis.

2 Perspectives On Corporate Performance

> *"You can see the computer age everywhere but in the productivity statistics..."*
> *Robert Solow (1987)*
>
> *"From our sample of firms, it appears the paradox ceased to exist by 1991."*
> *Hitt and Brynjolfsson (1996)*

This chapter presents perspectives on corporate performance as a review and synthesis of the academic literature in support of developing and testing a focal theory of the associations among information technology (IT) and the intangible assets within US hospitals. The research is comprised of three questions: 1) *Do the most aggressive implementers of IT exhibit greater economic efficiency than the rest-of-the-sector (ROS)? 2) Do the most aggressive IT implementers strategically outperform the ROS? 3) Can we identify organizational characteristics that are associated with superior performance?* The agenda is about assessing whether investment in IT within US hospitals since 1995 has been of value to the sector, to identify any relative performance differences associated with aggressive IT implementation, and to identify those bundles of IT applications and organizational characteristics that are associated with superior performance. To accomplish this research agenda requires integrating three academic research domains—*neoclassical economic theory of the firm*, *strategic management theory of value*, and *organization behavior theory of the ability of information technology to impact mechanisms and systems within an organization*—and focusing a framework for the US hospital sector. The need for an integrative approach to the methodology is due to the complexity of the problem of specification, identification, and measurement of performance. One of the consequences of this complexity is the conflict of research findings evident in the quotations above. While the focal theory in the proposal presents a new integrated model, academic discourse has developed, challenged, and refined its foundations. Therefore, the focal theory is grounded on the foundations of both academic literature and management practices within the sector.

The organization and flow of the chapter is as follows. The neoclassical theory of production is presented in Chapter 2.1. A strategic management framework that identifies and measures performance is presented in Chapter 2.2. And organizational theory related to the role of innovation in performance is presented in Chapter 2.3. Each section discusses the background literature and ends with a focus on the studies related to the health sector. The chapter ends by identifying the areas in the literature where common ground may exist which then forms the basis of forming the integrated focal theory. Chapter 2.1 begins the discussion of performance from neoclassical theory.

2.1 Neoclassical Theory – The Empirical Measurement of Production

The Neoclassical Theory of the Firm has provided a foundation for economic thought for decades. As noted by Mbaga, Romain et al. (2000), the current debate within neoclassical theory related to the technical and allocative efficiency of the firm is empirical in that the debate is related to how production functions are best estimated, not over whether it is proper to acknowledge the concept of a production function and related issues such as technical efficiency.

2.1.1 Evolution of Production Theory

Based upon an historic reading within the field, one can argue that the fundamental principles of economic theory are the concepts of utility and production. Humphrey (1997) traces the intellectual development of production concepts from the mid-eighteenth century to the early twentieth century. As described by Humphrey (1997), the lineage of production function theory starts with Turgot (1767) and runs through Malthus (1798), Ricardo (1817), Von Thunen, Marshall (1882), Wicksteed, Walras, Barone, Flux, and Wicksell (who presented a form of the Cobb-Douglas model twenty-seven years before Charles Cobb and Paul Douglas). While the theory of the firm is not a glamorous new concept, it is fundamental to corporate performance analysis. It provides a common language of mathematics with which to explore performance issues.

2.1.2 The Dominant Functional Forms

The literature provides evidence of three dominant functional forms among the parametric approach to economic efficiency as shown in Exhibit 2.1.

MODEL	SIMPLIFIED GENERAL SPECIFICATION
Cobb-Douglas	$Y = a L^{\alpha} K^{\beta}$
Generalized Leontief	$Y = a_0 + \Theta_{j=1}{}^{n} a_j(X_j)^{1/2} + \Theta_{j<k}{}^{n} \Theta_{k=1}{}^{n}(X_jX_k)^{1/2}$
Transcendental Logarithm	$Y = a_0\sum_{j=1}{}^{n} a_j \ln X + \sum_{j<k} n^{k=1} a_{jk} \ln X_j \ln X_k$

EXHIBIT 2.1: Simplified Forms of the Dominate Production Frontiers.

The Cobb-Douglas (C-D) form has been widely used as a technology specification in the literature. However, the mathematical simplicity of the C-D form requires **a priori** assumptions about the nature of the technology. Some parametric frontier researchers find these assumptions too restrictive. They prefer what have become known as *flexible form* specifications. The dominant flexible form specifications are the transcendental logarithmic and the generalized Leontief. Christensen, Jorgenson et al. (1973) published a definitive paper on the transcendental logarithmic (TL) production frontier as a model that maintains most neoclassical principles yet does not require the strict C-D assumptions of homogeneity and group-wise additivity. Caves and Christensen (1980) outline the contrasts between the TL and generalized Leontief (GL) forms suggesting that while it can be easy to determine when the C-D form is too restrictive a functional form, it is a matter of sophistication to interpret whether the TL or the GL results are the most reliable and efficient parametric estimates. The choice between TL and GL form is best made by identifying which form is likely to have the larger regular region. For two commodities and nearly homothetic preferences, the GL is preferred when elasticities of substitution are low; the TL is preferred when elasticities of substitution are high. In the case of substantial deviation from homothetic conditions, neither GL nor TL dominates. The C-D form is a specialized case of the transcendental logarithmic form that brings with it a great deal of analytical convenience and a resultant broad coverage within the literature as a tool to investigate technical efficiency of firms. Chapters 2.1.3 and 2.1.4 present the analytically important properties of the C-D form that will be utilized in Chapter 4.

2.1.3 Special Case: The Cobb-Douglas Form

The classic two-factor C-D production function, first published in *The Theory of Wages*, 1934, by Charles Cobb and Paul Douglas, is of the form:

$$\mathbf{P} = b\mathbf{K}^{k}\mathbf{L}^{1-k}$$

Where P is physical product, b is a secular constant, L is the input of labor, and K is the input of Capital. Converted to linear form, the exponents represent the output elasticities of Labor and Capital. This equation also provided the needed linkage between changes in factor quantities, productivity, and real prices. The fundamental properties of C-D production functions link the concept of production with an empirical model.

This section reviews the importance of the C-D form in the evolution of microeconomic theory as it provides a reliable analytical framework to analyze the productive efficiency of a firm or an industry. However, the C-D model requires several assumptions to be imposed upon the cases being analyzed. One of the assumptions is that elasticity of substitution between factor inputs is constrained to equal -1. Thus, the C-D form cannot be appropriate in considering the rate of substitution of inputs. There has been an increased application of the flexible form specifications such as GL and the TL over the C-D. In application, appropriateness of functional form comes down to fit with the research cases. In addition, several mathematical extensions to the basic form have evolved in the literature representing attempts to reconcile the conceptual model of technology with empirical evidence. The next section presents the concept of stochastic frontier functions as one of those extensions to the basic model that is important to pragmatic study of production efficiency.

2.1.4 Stochastic Frontier Models—The Way Ahead

Several mathematical extensions have been made to the original C-D form to accommodate the application of the model to complex, real-world systems. The Tinbergen-Solow extension allows explicit modeling of technological change within the system:

$$\mathbf{P} = e^{rt}\mathbf{L}^{k}\mathbf{C}^{1-k}$$

The residual term e captures the contribution of exogenous technological progress, at trend rate r over time period t. More complex mathematical forms have been developed to capture endogenous rates of technological change. For example Zellner, Kmenta et al. (1966) specified:

$$X_i = AK_i^{\alpha 1} L_i^{\alpha 2} \mathbf{e}^{u0i}$$

This specification is equivalent to the Tinbergen-Solow extension with the exception of the last term–e^{uoi}. u_{oi} is a random disturbance that represents the impact of unpredictable internal and external factors on production. The impact of a random disturbance is to create mathematical uncertainty around the conventional single point estimate. In this model, it is the mathematical expectation of profit, not the traditional calculation of profit that is to be maximized.

Work published in 1977 has set the precedent for current production function specifications. Aigner, Lovell et al. (1977) developed a linear model with an error specification that asserts that the production process is subject to two distinct random disturbances:

$$\epsilon_i = v_i + \mu_i$$

where, v_i is a symmetric disturbance with mean zero and standard deviation σ^2 and μ_i is independently distributed and greater than or equal to zero.

This model is stochastic, that is: $y_i = f(x_i;\beta)+v_i$. Another unique feature of this model is that productive efficiency is mathematically represented as: $y_i/[f(x_i;\beta)+v_i]$.

Productive inefficiency is therefore measurable and a separate phenomenon from other sources of productive variance that are, truly, exogenous.

Meeusen and van Den Broeck (1977) developed what they called a compound error C-D model that has a multiplicative disturbance term which is a function of a true error term and the efficiency measure:

$$y_t = \emptyset(x_t)k_t u_t.$$

where, k_t is the efficiency measure and is distributed between zero and one; u_t is the true disturbance term greater than zero; and x_t, k_t and u_t are mutually independent.

They specify the compound error C-D model as: $y_t = A\prod_j x_{tj}^{\beta j} e^{-zt} e^{-vt}$. *V* is assumed a random Gaussian distribution $(0,\sigma^2)$; Z is greater than zero; and V and Z are independent distributions.

The power of the C-D form is that it has been robust enough to withstand adaptation over eighty years of empirical work while continuing to deliver reliable insight into corporate performance. Its survival as a valid functional form is due, in part, to the standard properties and analytical tools that result from the C-D mathematical model. Through generations of academic refinements, the form continues as a viable and reliable model. The next section presents a review of major studies that employ neoclassical techniques from the US hospital sector.

2.1.5 Hospital Sector Studies

Hospital performance evaluation has been an area of research interest in the US since the late 1950s. However, with the significant changes that have taken place since the early 1980s in the nature, methods, and reimbursement mechanisms of health care delivery, it is hard to carry-forward earlier empirical results. For this reason, only studies conducted on later datasets are covered here. The literature is a mix of both scholarly studies of cost and production and pragmatic studies of reimbursement efficiency.

Pauly (1986) developed a hybrid multiple output cost function for US hospitals that accounted for second- and third- order terms for outputs, output interaction terms, case-mix index, regional differences, and proxies for quality differences, among other terms. Pauly found that the multiple output form provided a superior estimating platform to a single output approach (typically, cost-per-adjusted-patient day). Pauly constructed a cross-sectional dataset based in terms of 1981 data from three sources: American Hospital Association's (AHA) description and workload statistics; the area resource file for local market conditions; and the hospital ambulatory care survey. He used a sample of AHA data detailed to the medical care service line level for inputs and the Ordinary Least Squares estimation technique with more than fifty right hand side terms. Pauly did not specifically address the potential problem of endogeneity of output but he asserted that the existence of medical insurance reimbursement diminished the linkages between gross price charged and quantity of care demanded, therefore, minimizing the potential of endogeneity of output. However, he did not publish the detail of his regression statistics so it is difficult to verify that the parameter estimates were Best Linear Unbiased Estimators (BLUE).[28]

Cromwell and Puskin (1989) outlined the methodology and methods to account for US hospital productivity changes in the (then) new era of shifting care from inpatient to ambulatory care settings. Cromwell developed a productivity model based upon two measures: labor hours per discharge, and labor hours per intermediate unit. He was concerned with accounting for changes in resource intensity and costs of care. His model fundamentally implies a static state of technology, a fixed relationship of inputs to all output, and a single form of output. While it may be acceptable to develop such a model for short-term or short-period analysis of performance, for example, within an accounting cycle, it would be extremely limiting to consider such a model as adequate for academic application over a time-series frontier.

---

[28] Greene, W. (2003). Econometric Analysis: Fifth Edition. Upper Saddle River, NJ, Prentice Hall. Page 890, "*an estimator is…the best linear unbiased estimator if it is a linear function of the data and has minimum variance among linear unbiased estimators.*" The assumption of obtaining BLUE regression estimates is fundamental to the stability of the predicted regression coefficients and their interpretation.

In a direct line from Cromwell though nearly eleven-years later is Ashby, Guterman et al. (2000) who developed a model to measure the contribution of changes in length of stay, service intensity, and productivity to the rate of growth of hospital costs per discharge. In this model, hospital performance was measured in terms of real costs per case-mix adjusted discharge. The model was based on developing what is in essence an accounting measure of the components of real input use per discharge. Ashby specified the following model:

Eq (1) Real Input use per Discharge =

F(Length of Stay + Service Intensity + Real Input Use per Service)

In first differences:

Eq (2) Δ(Real Inputs/Discharge) =

Δ(Days/Discharges) + Δ(Services/Days) + Δ(Inputs/Services)

Equation (2) was the basis of Ashby's model. Ashby found that although the rate of change in real input use per discharge has varied considerably, the general trend has been toward slower growth over time. He also was able to identify three periods of performance that demonstrate that the health care delivery sector has transitioned from a high-cost growth into a low-cost growth sector. His conclusion is that management practices and care standards had changed significantly by the late 1980s that resulted in shifting aspects of what traditionally was inpatient care to other care settings, which would explain the falling length of stay and hospital product terms. His somewhat flat service intensity findings suggest that while expected activities may be shifted to other care settings, the performed activities within the new episode of care are somewhat increasing in cost. One of Ashby's least developed findings was *"...changes in factors other than length of stay could now be playing a more prominent role in holding down costs."* He attributed this finding to reductions in input utilization per discharge and was unsure whether a change of service quality was responsible. While Ashby's approach to developing a cost function for healthcare delivery does not explicitly address any of the neoclassical economic theory conditions of cost and production, it is representative of standards and practices within the field of healthcare administration. The limitations of Ashby's approach are in three broad categories. First, by not segmenting the data panel in terms of management form (for-profit and not-for-profit) the results are convoluted by varying market conditions and management responses. Second, by not explicitly applying a neoclassical form, the approach lacks the ability to make quantified assertions of the rate of technical substitution among the inputs to service and their marginal physical products. Finally, the analytical focus on 'cost of service' reflects a 1980's management mindset that all costs in a hospital are fixed costs with the exception of labor, when in current health care practice, the cost structure can be managed in more strategic ways (HFMA (2003)).

Lee and Menon (2000) used hospital financial data over an eighteen-year panel to find that cost and technical and allocative efficiencies were statistically significant in empirical production functions. They found that hospitals with high technical efficiency also had relatively higher amounts of information technology capital. However, they also found relatively low allocative efficiency in those hospitals. One way to interpret such findings would be that those hospitals were very efficient at output yet inefficient at organizational management. Interestingly, Byungtae and Menon directly examined the role of IT-labor in productivity and found that labor associated with IT support had a negative contribution to productivity and that non-IT capital had a greater contribution to productivity that IT capital.

Folland and Hofler (2001) used the AHA annual survey results to compare various functional forms and other elements of the sensitivity of the specification of cost functions. In general, Folland and Hofler were writing against the use of cost functional forms that did not hold the neoclassical assumptions of closed form and homothetic on several grounds. Specifically, they address the issues of: 1) *specification error that results in individual hospital estimates from applying an* *incorrect functional form to a pooled group of hospitals*; 2) a *comparison between the two generally accepted mathematical production functions in the heath economics literature – the translog and the generalized Cobb-Douglas functional forms*; and, 3) *two alternative measures of capital input price.* They compared previously published estimates of hospital inefficiency using the translog form to estimates they developed using the generalized C-D form of the cost function. They discounted the value of the Data Envelopment Analysis technique because it exclusively speaks to technical efficiency whereas a cost function derived as a dual to a closed-form production function could simultaneously estimate allocative and technical efficiency estimates. They found that choice of specification had little real world effect on estimates of inefficiency for mean group values but that differences in individual hospital estimates were significant. They also found that not using the closed form, homothetic cost function delivers less robust individual results which would result in bias if those estimates would be used in individual ranking exercises.

Li and Rosenman (2001) estimated a GL long-run hospital cost function with multiple outputs and inputs using a panel data set from 1988-1993 of Washington state hospitals. Among their findings was that for-profit hospitals in Washington State paid less for most types of labor except for outpatient services. They used inpatient days and outpatient visits as their two products and classified care into various service lines to classify inputs.

Rosko (2001) used a stochastic frontier regression model to study the impact of managed care on hospital efficiency on a panel of 1631 hospitals from 1990-1996. He found the inefficiency was negatively associated with managed care market penetration and the inefficiency decreased an average of 28 percent over the period. He found inefficiency to be positively associated with Medicare share and for-profit management form.

Kessler and McClellan (2002) used AHA data and proprietary data sources to develop a three-stage model to estimate the effects of hospital ownership on productivity. They used the Diagnostic Related Group (DRG) for new heart attack victims to develop a patient flow/hospital utilization model. Their model consisted of: 1) a zip code-based catchment area patient-choice model, 2) an admissions catchment area density model to determine admission flows into specific facilities, and 3) a model that estimated the effect on specific catchment area hospital characteristics and cost of service. They presented new findings on how hospital ownership and other aspects of market composition affect productivity. They found that for-profit hospitals exhibited approximately 2.4 percent lower operating costs than non-profit hospitals. Further, they found that within market segments, when for-profit hospitals captured local admissions for this DRG greater than 10 percent, it resulted in spillover effects reducing costs across that DRG for all hospitals within that catchment area.

Li, Benton et al. (2002) developed a strategic operations management model that linked long-term service choices, intermediate operational decisions and hospital performance given location, size, and teaching status of the hospital. They found that while a hospital's location and size have a significant long-term influence on performance, intermediate infrastructural operations decisions (where IT investment would fit in their model) affect a community hospital's cost, quality, and financial performance. They also found that many hospitals' have adapted new staff and demand management decisions in response to market conditions.

Brown (2002) used the stochastic frontier model on a panel data set from 1992-1996 to investigate the impacts of management operational form on the technical efficiency of US hospitals in markets with varying levels of managed care concentration. His model for technical efficiency was: $Y_{it} = \exp(x_{it}\beta+(V_{it}-U_{it}))$ where Y_{it} are the $_t$th year outputs for hospital i;. x_{it} is a vector of hospital inputs for the $_t$th year output for hospital i, transformed to natural logs, and β are parameters corresponding to those inputs. The error is composed of $\epsilon_{it} = V_{it} - U_{it}$. V_{it} is assumed to be normally distributed with mean of 0 and independent of U_{it}, which is the non-negative random variable accounting for technical inefficiency. He found strong evidence that managed care insurance is associated with increases in hospital technical efficiency. Brown constructed a proprietary data set incorporating data from the US Health Care Cost and Utilization Project, the AHA, and proprietary market condition data from third-party vendors. His total number of cases was surprisingly low (1907) considering AHA reports data on nearly 6,000 hospitals annually; however, his choice of source for managed care market research data led him to exclude hospitals that could not be matched into cases. While Brown used discharges as his output measure, he did stratify his cases according to a DRG intensity measure to create three classes of output.

Smet (2002) published a meta-study of empirical papers related to the methodological aspects of multi-product cost structure of US hospitals. He found that most papers did not sufficiently address in the appropriateness of the data to the underlying neoclassical assumptions of their mathematical specifications. He found that short-term cost models were most appropriate because the hospitals in his sample tended not be operating at long-term equilibrium and they tended to be over investing in capital. He found that applying flexible forms implies cost-minimizing behavior, exogeneity of outputs and a competitive factor market free from monopsonistic pressures—the more appropriate specification for US hospitals.

The preceding section has provided ample evidence that it is generally accepted practice to apply neoclassical theory to investigate the cost and productivity of US hospitals. The next section moves on to provide perspectives on corporate performance from the domain of finance and accounting theories.

2.2 Strategic Management – The Identification and Measurement of Performance

The expression, measurement, and valuation of corporate value are not new concepts. However, traditionally, economic valuation and accounting valuation have generated distinct results.

2.2.1 General Performance Frameworks

Economics provided the historic basis for the domains of finance and accounting; however, they each can approach identification and measurement of fundamental business concepts differently. While the production function of neoclassical theory is modeling the rate of conversion of factor inputs into tangible output, the accounting equation demonstrates the firm's ability to control costs while generating products the market wants. In reality, any firm maintains book valuation, tax valuation, and scenario variations all representing its performance. Whether the differences in valuation are based on statutory requirements or uncertainties in forecast parameters, the existence of multiple views of corporate performance tends to blur an understanding of actual market place performance – efficiency of tangible and intangible assets, process effectiveness, market share, and financial performance. This lack of consistency in valuation leads to miscommunication of performance and inefficiencies in market pricing mechanisms. Because of this sort of dual treatment of corporate activity, there has been significant activity between 1988 and 2006 that results in a convergence of thinking on corporate performance measurement. Such frameworks as Economic Value Added, Market Value Added, and the Balanced Scorecard have emerged in efforts to achieve a consistency in measurement and to provide a common basis of comparison.

Economic Value Added (EVA) is a service-marked concept developed by the consulting firm Stern Stewart, Inc. that relies heavily on traditional economic concepts to calculate a single measure of the performance of a firm. In the simplest form, EVA equals *cash operating profit after taxes less total cost of ownership.* Market Value Added (MVA) is a derivative concept from EVA that more broadly measures improvements in the market capitalization of a firm. The Balanced Scorecard (BSC) is not a single measure at all. Instead, the BSC is a methodology related to how a firm must identify strategic goals, trace them to business unit performance, and communicate the performance results across the firm. While EVA and MVA are singular financial metrics, the BSC adds performance goals from the perspectives of internal business operations, the customer, and the degree of learning and growth across the firm to traditional financial metrics. The BSC lends itself to for-profit and non-profit firms due to its flexibility in accommodating performance metrics related to performance categories that are functionally relevant to the individual firm.

Walbert (1994) published a ranking and comparative analysis of 1000 publicly held companies based on EVA and MVA scores. Walbert finds that MVA provides an effective measure of strategic performance on an individual firm basis and across sectors as well. EVA is the measure most relevant to internal management decisions as it restates accounting concepts of book value to (near) true economic concepts of value. MVA is the more suitable external performance measure as it captures the stock market's assessment of the management's efficiency in using capital.

Lehn and Makhija (1996) used a panel from 1987–1993 to analyze the validity of EVA and MVA in measuring corporate performance. They found that both EVA and MVA were significantly positively correlated with stock price performance. They found a significant inverse relationship among EVA and MVA performance and CEO turnover. Finally, they found that firms that have an apparent focus on their business activities had significantly higher EVA and MVA. They conclude the EVA and MVA are effective corporate performance measures that contain information about the strategic quality of management and signals of strategic change.

Gapenski (1996) published a short article on the practicality of using EVA and MVA within both for-profit and non-profit US hospitals. He points out the MVA is focused on measuring the maximization of shareholder wealth. While MVA can be applied to non-profit environments, EVA would be the more appropriate non-profit measure of financial performance.

2.2.2 Balanced Scorecard Framework

Kaplan and Norton (1992) published their first in a series of Harvard Business Review articles articulating the methodology and methods of the BSC. Kaplan and Norton's thesis is that *what gets measured is what is achieved*; yet they recognize that financial measures alone can provide misleading information about corporate performance. Working with twelve consulting firm clients, Kaplan and Norton established the architecture to design, implement, and measure a balanced approach that includes performance views from the financial, the *customer*, *internal business processes*, and *learning and innovation* perspectives. Within each perspective, the objective is to identify goals and measures that capture the essential few characteristics that determine success. Kaplan and Norton (1993) and Kaplan and Norton (1996) further establish that a corporate implementation of the BSC requires managers to have access to current performance results to empower decision-making and planning consistent with financial and non-financial strategic goals. Kaplan and Norton (2000, (2001a, b)) have expanded the use of the BSC to that of a rationalized approach to strategic planning. Kaplan and Norton continue to collect and manage a large following of corporate supporters of the BSC. The success of the BSC however, also creates its weakness. The use of a BSC framework requires significant overhead costs to design and implement within a firm as each firm must design its own strategic architecture and scorecards to succeed. There is a reasonable likelihood that under-informed managers would think that 'doing the balanced scorecard' means being given a set of goals, objectives, and measures to implement (for example, as a template) within their firm—this is precisely NOT what it means. Part of the intent of implementing a BSC system is to engage managers within strategic business units to operationally own the goals, objectives and measures within their line of responsibility. The hard part of BSC implementation is in obtaining consensus on measures and minimizing the organizational costs of maintaining the reporting processes.

2.2.3 Hospital Sector Studies

The literature related to BSC in health care delivery is thin. This may relate to the relatively low margins available within the health care sector to sponsor such research projects, or it may be because publishing a paper related to a BSC implementation may not reveal enough new knowledge to pass peer-review publication scrutiny, or it may simply be too early in the lifecycle of the model. However, there are a few interesting papers in the literature.

Chow, Haddad et al. (1998) published an early paper on the benefits of implementing a BSC framework within a healthcare delivery setting. They present some anecdotal evidence in the form of 'opinions of many high-level healthcare administrators' that support the use of the scorecard in healthcare management.

Chan and Ho (2000) published a survey of use and scope of BSC implementation across Canadian hospitals. They found that most hospital managers surveyed understood the theory and structure of BSC framework; however, about one-third of respondents reported that their organizations lacked either the technical expertise or management commitment to sustain a BSC system. Chan and Ho compile a table of performance indicators that were common to successful implementations. They also found that despite the fact that implementations were moderately successful with an average implementation of less than two years, hospital managers remained confident in the BSC's potential to improve health care delivery cost and quality.

Pink, McKillop et al. (2001) reported on their BSC implementation project involving hospitals in Ontario, Canada. They develop measures of clinical utilization and outcomes, patient satisfaction, system integration and change, and financial performance and condition. As can be seen, this project used the BSC's vision of financial, internal business, innovation and learning, and customer perspectives to design a balanced set of performance indicators. Their lessons learned speak to the issues of data availability, data interpretation, the lack of technical expertise in managing scorecards, and the importance of the form of scorecard initiative in the success of the implementation. Most importantly, Pink et al found the hospitals that chose to sustain a BSC were seeing improvements in overall performance and improved accountability.

Chow-Chua and Groh (2002) present a case study of combining the requirements of the Singapore Quality Award with the BSC. They proposed a framework for use by public sector hospitals within Singapore. They found that while there were data collection and management problems associated with using the BSC approach, significant improvements in patient satisfaction and improved inter-departmental communication could be achieved through implementing the framework.

Griffith and Alexander (2002) present an important piece of exploratory work in furthering the implementation of a BSC framework within the US hospital sector. They assessed the content validity, reliability and sensitivity, validity of comparison, and independence of a proprietary set of performance measures available to the public that are constructed from federal Medicare cost and service reports. The dataset analyzed is that published by Soluciet LLC, Evanston, ILL and it is based upon the federal MedPar dataset. They found that the measures published by

Solucient were valid, consistent, and reliable measures over the periods 1996 to 1997, 1996 to 1998, and 1997 to 1998. They also found that by developing a simple BSC framework using these data and peer group comparisons of individual performance, a hospital would likely find tangible areas of performance improvement.

This section provides evidence that application of finance and accounting frameworks such as the BSC is growing in acceptance and in practice. In particular, it appears best suited to operational environments that are driven by performance factors that have previously been classified as intangible by finance and accounting. The intent of the BSC framework is to make explicit and tangible values that were previously classified intangible. Consistent with its name, the BSC framework strives to create line of sight visibility into performance that is balanced by strategic and operational needs of the firm.

The next section moves on to provide perspectives on the impact of IT on aggregate productivity and corporate performance.

2.3 Organization Theory - The Role of Innovation in Performance

Upon review of the literature related to the impact of IT on performance, it has become clear that one can segment the studies based on the data theory of the researcher. Those studies employing external analysis by using the national income and product accounts tables (the components of US Gross Domestic Product[29]) or publicly reported corporate data alone typically have not found significant evidence of the business value of IT. However, those studies that have focused on internal firm performance have found evidence of IT creating business value in reducing administrative and/or operational costs, improving productivity, improving process quality, improving customer satisfaction, and improving employee satisfaction. The research question, though, remains how does the firm ultimately value the improvement in what can be termed *intangible assets*—what is achieved? The next two sections present the literature on quantifying the impact of

[29] http://www.bea.gov/bea/dn/nipaweb/index.asp

IT on performance first from the point of view outside the firm, then from the point of view inside the firm.

2.3.1 Focal Point Outside the Firm

The discussion of the studies conducted with a focal point outside the firm will start with the work of Baily, Gordon et al. (1981) which explored the then slowdown in national productivity and found unconventional findings. They attributed the majority share of the productivity slowdown to a decline in the effective flows of services of capital and labor. They found that the decline of capital flows was most significant in the national productivity slowdown and that it was caused by the increasing obsolescence of the capital stock and structural adjustment problems within the economy. They found that increases in capital investment would do more to improve productivity growth than the conventional expectation of that time. They also discuss difficulties in identifying and consistently measuring the modern capital flows. This paper set the stage for future work on aggregate productivity and the relative effectiveness of the capital stock.

Skinner (1986) found that during the period 1978 to 1982, US manufacturing corporations had been aggressively pursuing productivity improvements that were further driving away true productivity gains—*The Productivity Paradox*. His findings were that so-called productivity initiatives were: mostly concerned with direct labor efficiency, focused excessively on efficiency of factory workers, ignoring other ways to compete that use manufacturing as a strategic resource, and failing to provide a coherent manufacturing strategy. He found examples of highly successful firms that recognized the paradox and chose to break out by seeking strategic objectives other than cost objectives.

In advancing the discussion of the macroeconomic productivity slowdown, Baily, Gordon et al. (1988) focused on the broad issue of the dynamics of macroeconomic productivity. They outline three issues of productivity measurement that relate to IT. Firstly, they discuss the phenomenon of the impact of real changes in relative prices of computational power on productivity measurement, which is not captured in the price deflators used in computing national accounts (Gross Domestic Product).

Secondly, they discuss the impact of technology as spurring qualitative improvements in the marketplace that are not accountable for in national accounts. Thirdly, they discuss the difficulties and contradictions in measuring aggregate stock of IT capital across the economy. They then develop a case study from the finance sector to demonstrate productivity improvements from IT that were not consistently accountable for in the national accounts.

Strassmann (1990) is a self-published text that develops a proprietary dataset of primarily publicly held private, international corporations. He reported 292 statistically independent cases containing operational and financial data for the period 1980 to 1988. Strassmann's analysis was based on management accounting standards in which he applied a relentless cascade of ratio analysis that explored relationships within income statements and balanced sheets.[30] His thesis is that there is no relationship between expenditures on computers and business profitability but there is a relationship between the actions of management—*management value added*—and the probability of achieving return on investment from IT. Further, Strassmann says:

> *Measuring management productivity is the key to knowing how to invest in information technologies. Improve management before you systemize or automate. Make management more productive, by electronic means, if you know where, when and how. Automate success, not failure. The Business Value of Computers, page xvii.*

Strassmann found that it was much more likely as a result of IT implementation that administrative costs would be reduced than improvements would be made to profitability. He also discusses the difficulties in evaluating the effectiveness of IT projects which according to Strassmann is because IT supports managerial work – not the direct outputs of the organization. This theme – the management value added of work – will be a recurring theme throughout all of Strassmann's writings.

Solow (1994) in response to the increasing research interest in aggregate productivity provides an overview of the state of growth theory. Important to this thesis were his comments on the neoclassical model and its assumptions of

---

[30] Return on Assets, Return on Equity, Return on Management, and management cost structures were the terms most often used by Strassmann in building his thesis.

technological progress as exogenous to the productivity of the economy. Solow reminds the reader that *exogenous to the model* does not ignore nor diminish the importance of technological progress, it simply means it has no explanation within the model. It does not imply technology progress is not understandable from other sources of knowledge whether that knowledge comes after-the-fact, from intuitive understanding, or from cumulative observation. The point of technological progress being exogenous to the aggregate growth model is that knowledge cannot be converted into a mathematical form represented in the growth model. Solow discussed the new wave of productivity models that attempt to capture the role of innovation on aggregate growth; however, he found that many of these good intentions fall short:

> *Ideally, such modeling decisions should be based on facts. Unfortunately there are not a lot of usable facts to be digested...Never the less I think the best candidate for a research agenda right now would be an attempt to extract a few workable hypotheses from the variegated mass of case studies, business histories, interviews, expert testimony, anything that might throw light on good ways to model the flow of productivity-increasing innovations and improvements. (Solow 1994, page 53)*

Oliner, Sichel et al. (1994) explored how much computing equipment could have affected aggregate growth. They found that even with very rapid growth of hardware, software, and labor inputs, the contribution of computing services to growth was unlikely to increase appreciably over the next ten years because computer equipment's share of national capital stock was low and, in their computations, it provided a non-competitive rate of return. As long as computer hardware and software earn the same net return as other capital, the nominal income share of computer services would remain modest reaching only 2.8 percent under their most optimistic scenarios. They found little evidence of a computer related surge in aggregate productivity. In fact, they dismissed both the economic impact of IT and the proliferation and diffusion of IT within the US economy. To summarize their position, the lack of increasing productivity was not a paradox because IT was not as ubiquitous as one would think and IT does not have real impact on economic processes.

Roach (1996) thought that the increasing investment in IT led to confusion about the difference between one-time efficiency gains and long-term productivity gains. Roach feared US businesses were risking long-term viability by both over-estimating the importance of IT to output and under-compensating employees for their productivity contributions.

Roach (1998) dismisses the significance of the impact of IT on productivity growth from two points: while gross investment on IT is increasing, it is the net capital stock of IT that matters; and that there is a logical flaw in applying the historic precedents from the Agricultural and Industrial Revolutions to the Information Age. Roach finds that there are enormous differences between tangible goods production and intangible knowledge production. Economic advances in white-collar work may be more difficult to obtain because they are limited by human capacity to absorb, interpret, and act upon information. In analyzing micro-level cases, Roach asserted that there has been a logical flaw in many prior studies because to identify economy-wide impacts on productivity would require aggregating performance changes across all industries. Yet, he found most prior papers to be extrapolating high performer anecdotes. He also asserts that benefits of IT typically do not fully account for the true costs of the technologies such as from unaccounted for research and development costs or public/private infrastructure communication costs.

Strassmann (1999) updated his proprietary corporate dataset to re-examine the rate of growth of information-based productivity. He reaffirmed his original thesis that there is no relationship between investment in IT and corporate financial performance. He also found that US corporations have lowered administrative costs associated with IT and have increased spending on IT at growth rates faster than increases in employee compensation.

In the annual report from the US Department of Commerce, Digital Economy 2002, Evans (2002) found corporate IT capital partially responsible for changing the structure and performance of the US economy in last part of the twentieth and first years of the twenty-first century. He found that for the first time since 1950, inflation was curbed and productivity positive throughout a recessionary cycle. Evans reported corporate IT investment and expenditures on IT goods and services accounted for 37 percent of the growth of US GDP. During the recession of 2001, productivity growth was 1.9 percentage points above the 1973-1995 average, and it was nearly equal to that of the 1995-2000 economic boom. In summary:

> *Continued strong productivity growth in a period of economic weakness suggests that US industries are continuing to benefit from past and current investments in IT equipment, software and services, and related human skills. In effect, even as these industries continue to build the foundations of future US economic strength, they are realizing the benefits of the new economy.* *Digital Economy 2002, page vii.*

Carr (2003) finds that there has been substantial over-investment in IT in the 1990s and the potential resulting growth in productivity could result in sustained deflation similar to that of the mid-to-late 1800s. He also asserts that proliferation of IT (measured as host computers on the internet) since 1990 has reached a level of saturation that is equivalent to railways from 1841 to 1876 and electric power capacity between 1889 and 1920. Carr reports that high-levels of IT spending rarely translate into superior financial results. The *commoditization* of IT requires a revised corporate policy toward IT: spend less; follow do not lead; focus on vulnerabilities, not opportunities.

Finally, in this line, Gordon (2003) argues that the information and communication technology (ICT)[31] investment boom is unsustainable for both micro and macro economic reasons. Gordon finds that while Moore's Law[32] influences the rate of growth of producing processing power per unit, there is no corresponding mechanism generating increasing growth in the demand for processing power. He does not find ICT investment contributing to the post-1995 productivity boom. He cites three reasons that the studies asserting a significant contribution of ICT **use** to productivity growth are flawed. Those studies unrealistically assume returns are instantaneous to implementation. Retail sector studies often find high gains from

---

[31] A more broad definition than IT because it includes communications equipment such as routers, servers, and network switches.

[32] In 1965, Intel co-founder Gordon Moore saw the future. His prediction, popularly known as Moore's Law, states that the number of transistors on a chip doubles about every two years. But Moore's Law also means decreasing costs. As silicon-based components and platform ingredients gain in performance, they become exponentially cheaper to produce. http://www.intel.com/technology/silicon/mooreslaw/

ICT, yet there is strong evidence that gains in productivity in the retail sector are not related to ICT use. He notes that those studies finding differential productivity growth across the US appear to be related to ICT *production* but not ICT *use.* Finally, he notes that European retailers use the same ICT as US retailers but have not realized same productivity gains as studies find in US retailer, thus, to Gordon's interpretation, ICT is not the cause of the US retail sector productivity gains.

2.3.2 Focal Point Within The Firm

According to Hatch's discussion of the emergence of technology in organizational theory, Hatch (1997 pp127-159), the origins of developing models of the impact of technology on the internal mechanisms and systems of the firm can be attributed back to Woodward's typology, which identified three technology groups from small batch processing, large batch and mass production, and continuous process production. The importance of this typology was in beginning the process of identifying unique channels within which technology can influence the existing mechanisms and systems of the firm. Others later built upon Woodward's work by developing a theory of technology around three types of technology, long-linked, mediating, and intensive technologies. This typology is based upon the role of the technology within the firm. *Long-linked technologies* typically are sequential, fixed proportion of inputs to outputs, such as that of assembly lines and other forms of manufacturing. *Mediating technologies* affect and influence the relationship between customers and the firm and result in a pooled interdependence among labor. *Intensive technologies* typically require the coordination of multiple labor inputs to transform inputs into customized outputs and they create reciprocal task interdependence such as in the delivery of health care. There has also been work related to the role of technology within the firm. It was found that technology mediated the relationship between corporate structure and performance and, as corporate and social complexity rise, the role technology plays is to provide information demanded by organizational structures. This is the beginning of the discussion of the complementary role of intangible assets of the organization – human capital, information capital and organizational capital – affecting performance.

Weill (1992), following several years later but in a line that could be traced back to Woodward, constructed a six year panel dataset to study thirty-three small- and medium- sized US firms in the valve manufacturing industry. The thesis of this study was to define and explore a concept Weill termed *conversion effectiveness,* which is a function of top management commitment, user information satisfaction, experience with IT, and political turbulence. The measures of performance Weill used were sales growth, return on assets, and labor productivity. He specified a recursive model of firm performance and level of IT investment. The analysis employed a hierarchical regression technique and a two-stage estimation approach to reduce problems of endogeneity. Weill classified IT projects three ways: transactional, informational, and strategic. *Transactional IT* was that supporting processing of operations and administrative back office functions. *Informational IT* provides management information as well as the communications infrastructure for the firm. *Strategic IT* projects are those that are made to gain competitive advantage and to increase market share. He found that heavy transaction IT was significantly associated with stronger firm performance, particularly in reducing costs. He found a weak association between strategic IT and *lower* firm performance. There was no evidence of a long-term relationship to performance. No significant associations were found with informational IT and any performance measures.

Brynjolfsson (1993) set the framework for research in this area and provides a survey of studies in three areas: the macro-level, the manufacturing sector and the services sector. He identified research problems in terms of: measurement error, lags, and income redistribution. He found that the failure of studies to demonstrate impact of IT is as much due to deficiencies in measurement and methodological tools as it is to miss-management of IT.

Hitt and Brynjolfsson (1996) address three research questions: Has IT increased productivity? Has IT improved business profitability? Has IT created value for consumers? They used a panel representing 370 US firms from 1988–1992. They used a Cobb-Douglas production specification with the right hand side of total IT stock, non-computer capital, and labor and left hand side of corporate value added. They used a dummy variable approach to control for the year of the observation and the industry sector. They used three estimation techniques Ordinary Least Squares, Iterated Seemingly Unrelated Regression, and Two-Stage Least Squares in an attempt to maintain the best linear unbiased estimator assumptions.[33] They estimated an approximate rate of return gross of investment costs for the IT stock of 94.9 percent. To analyze profitability they replicated and extended Strassmann's model. In their base case, they replicated Strassmann's results of no significant relationship between IT investment and profitability. They then performed several extensions of the model. They found little evidence of IT's positive impact on supranormal firm profits; however, they did find nominal evidence of a negative relationship. They used a transcendental logarithm model to measure consumer surplus effects. They found the IT stock in their sample created significant consumer surplus. They conclude that managers are making IT investments necessary to maintain competitive parity but that they are not able to gain competitive advantage. They recommend that IT may be an important part of cost leadership strategies; however, firms are unlikely to create long-lasting strategic advantage by increasing IT spending alone. They suggest that IT may be used to change radically the products or services that are produced or to enter new markets in areas where competition is low. Thus, they were discussing business transformation before that term was fashionable.

Brynjolfsson and Hitt (1996) published their findings of firm-level evidence on the returns to information systems spending. They constructed a panel dataset of 367 large US firms reporting over the period 1987 – 1991. They used the C-D form to estimate an average gross marginal product of IT of 81 percent within their sample. They also found that IT capital marginal product was at least as large as the marginal product of other capital within the firms. They attributed the differences of their results to prior studies due to the freshness of their sample and its large size. They concluded that, for their sample, the IT productivity paradox disappeared by 1991.

---

[33]Wonnacott, R. and T. Wonnacott (1979). Econometrics Second Edition. New York, NY, John Wiley and Sons. Pp27-28, The properties of the error terms meeting the criteria of the Gauss-Markov Theorem - the error terms will be: normally distributed; homoskedastic; and exhibiting no autocorrelation.

Mistry (1999) estimated the differential impact of IT on cost driver relationships within selected banking functions in a panel of US financial institutions. He used Weill's typology to construct three types of cost drivers within a banking environment—volume, operational, and product-design based—on revenues and costs for the US commercial banking sector. He used a multivariate regression analysis within interaction terms to estimate the cost models. He found transactional IT significant in both cost driver relationships in the cost functions and revenue driver relationships in the revenue functions within his panel.

Brynjolfsson and Hitt (2000) explore the relationships among IT investment, organizational structure, and corporate performance. They found that firms that adopt decentralized organizational and work structures have a higher contribution of IT to productivity. They found that firms that are more decentralized than the industry median have on average 13 percent greater IT elasticity and a 10 percent greater investment in IT than does the median firm. They found that firms above the median in both IT investment and organizational decentralization are on average 5 percent more productive than firms that are above average in one of the other but not both aspects. They found similar results when they explored the relationship of IT and organizational structure to stock market valuation. Firms in the top third of decentralization have 6 percent higher market valuation, all else equal. They also found that the stock market valuation of a dollar of IT investment is between $2 and $5 greater in decentralized firms than in centralized firms. Their evidence at the firm-level shows that it is the combination of IT investment and changes in organizations and work practices facilitated by these technologies that contributes to firms' productivity and market value. They describe the effect of IT and organizational transformation as contributing to the complementary assets of the firm and thus expressed in productivity and market value. It is their position that these complementary assets are difficult to measure and create output changes in firms that distort measurement within the national accounts.

Li and Collier (2000) directly studied the issue of rationalizing investment in IT within US hospitals. The fundamental premise of their work was that hospital technology is the driver of quality and hospital performance. They pursued three research questions: 1) How are the following five constructs related—clinical technology, information technology, clinical quality, process quality, and hospital financial performance? 2) How should a hospital's scarce resources be allocated among clinical and information technology to improve hospital financial performance? 3) How should a hospital's scare resources be allocated to improve clinical and process quality, and ultimately financial performance? They constructed a recursive two-segment model of hospital performance as shown in Exhibit 2.2. One segment was driven by clinical technology and the other segment by information technology. Each segment allowed direct effects and indirect effects on hospital financial performance, information technology through process quality, and clinical technology through clinical quality.

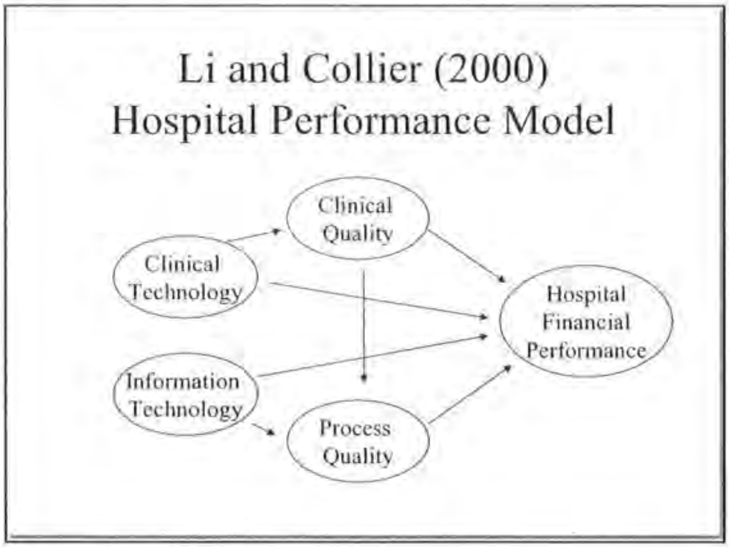


EXHIBIT 2.2: Li and Collier's Performance Model.

Li and Collier found that clinical and information technology, clinical quality, and process quality were related to financial performance but they could not identify precise models related to financial performance. Additionally, they found that process quality was a pivotal construct in their models. One of their recommendations was that hospital resources should be equally allocated between clinical and information technology.

There are deficiencies in Li and Collier's analysis. Their assessment is based solely on perceptions of financial performance. The separation in their model of clinical quality from information, the medical record of the patient itself, appears not to be sustainable. The use of a survey to assess investment flows and performance returns is at best arbitrary. In addition, they limited performance to financial performance. The study is cross-sectional; it does not identify the period, and does not account for the differing vintages of stock of IT across hospitals in its sample. The survey was sent to executive management titles within hospitals (CEO, Medical Director, etc.) it is not clear what operational understanding executive staff would have of the performance of IT. Their categorization of technology may be consistent with academic discourse of IT but it does not reflect how IT is used within a hospital. Finally, it is quite likely that what they really measured is how senior management hopes IT affects performance.

Menon and Lee (2000) used an eighteen-year panel (1976-1994) to generate a general cost function. They tested various hypotheses regarding technical change, substitution, and the complementary effects between IT investments, medical capital investments and labor expenses and the role of regulation on the cost structure of US hospitals. They found that IT labor expense rose at an increasing rate due to regulatory effects, and that hospitals were successfully using IT as part of cost containment initiatives.

Shafer and Byrd (2000) proposed a data envelopment analysis (DEA) approach to measure the productivity impacts from IT investments. Three inputs related to investment in IT in this study were: IT budget as a percentage of sales, an organization's total processor value as a percentage of sales, and the percentage of the IT budget allocated to training. Their output measures were sales growth and revenue growth over a five-year period. While Shafer and Byrd (2000) (page 126) cite the importance of using a measurement technique that allows use of only data that are of research interest. The advantage gained from the non-parametric approach of DEA is counter-balanced by the disadvantages that include a high degree of sensitivity of the results to extreme cases, the inability to perform statistical tests on the resulting efficiency estimates, the inability to assess efficiency against theoretical frontiers, and the requirement for comparator benchmark data.[34]

Solovy (2001), in a non-peer reviewed trade journal, published results of a study supported by Deloitte Consulting (a firm with substantial health care market share) and McKesssonHBOC (a major health care IT vendor) that found that 'the most wired' (those with broadest scope of IT) hospitals in America outperformed their less IT aggressive peers in multiple categories of hospital performance. They compared corporate bond ratings, operational efficiency, clinical effectiveness, and the degree of disease management practiced. The most wired hospitals managed costs better, were more productive (not using neoclassical terms), and had better clinical effectiveness than the average US hospital. Solovy did not publish his data and did not respond to requests to discuss his data or methods. He did publish a detailed list of the 100 most wired hospitals with their level of implementation among ten categories of functions supported by IT within US hospitals: *patient services, disease management, clinical information, clinical support, employee services, supplier functions, supplier activities, payer functions, and payer activities*. This information is obtained annually by way of a heavily marketed survey in search of the so-called *most wired* hospitals, while the survey itself is subject to self-selection bias it did represent 1,177 hospitals in 2001, which was nearly one-half of US hospitals with more than 100 beds. The annual survey results are independent of the analysis of performance presented by Solovy. In referring to the Hospitals and Health Networks' website, one can find this listing going back several years so it is possible to develop a vintage-pattern of the scale and scope of IT implemented within the surveyed hospitals.

Shao and Lin (2001) used both the C-D and the translog form within a stochastic

---

[34] Thanassoulis, E. (2001). INTRODUCTION TO THE THEORY AND APPLICATION OF DATA ENVOLOPMENT ANALYSIS: A Foundation Text with Integrated Software. Norwell, MA, Kluwer Academic Publishers. and Cooper, W., L. Seiford and K. Tone (1999). DATA ENVELOPMENT ANALYSIS: A Comprehensive Text with Models, Applications, References and DEA-Solver Software. Norwell, MA, Kluwer Academic Press..

production frontier framework to investigate the impact of IT investment on corporate productivity. Using a panel dataset, they determined that IT does have significant positive impact on technical efficiency and contributes to corporate productivity growth. They found similar and consistent results from both functional forms estimated—their results and conclusions would not change using either the translog or C-D specification.

Memel (2001) published a case study on the development and implementation of an information management and information technology strategy for improving healthcare services. He used an extended single firm case study from a large multi-state not-for-profit integrated care delivery network. Memel outlined three challenges to the successful implementation of health care IT: organizational challenges, data information challenges, and technical challenges. He found that the most important aspect of the value proposition of a successful e-health strategy results from timely information, improved dissemination of and access to information, and improved quality of information for providers, patient-customers, employees, managers, and executives. Memel reported that changing the quality and timeliness of information across the hospital enterprise resulted in reducing overall cost of care delivery. He found the most likely reason for this reduction in utilization was due to the improved ability for decision-makers to measure, manage, and improve processes and outcomes. These findings would suggest improved technical efficiency gains but Memel did not specifically address the issue.

Jaramillo (2001) presented a systems model of how data warehouse applications combined with internet-based applications can produce process efficiencies and quality improvements to a hospital's disease management program. He did not present data to substantiate his claims of improved efficiency and quality but rather qualitative statements of those potential improvements. More importantly, what Jaramillo is suggesting is that the hospital's existing resources can produce an output that is significantly transformed by the insertion of IT applications and the reengineering of disease management processes—doing more with existing human resources and producing a high quality of patient care.

Borzekowski (2002) constructed a proprietary panel dataset from multiple commercial sources of US hospitals sized with more than 100 beds to study the impact of hospital information systems during the period 1987-1994. He employed a short-run cost function specification to find lagged associations among IT implementation and administrative and clinical cost reductions. He also found evidence of learning effects in both 3-year and 5-year lags.

McKeown and Philip (2003) used a small number of case studies to explore the issue of business transformation and relationships to competitive strategies of organizational development, process improvement, and IT. They found that management leadership and clear alignment of projects to corporate objectives were the most critical to success of business transformation initiatives. They also found that transformation was more likely to be successful when implemented in a multi-stage approach that incorporated a mix of organizational development, process reengineering, and IT.

Bates and Gawande (2003), both physicians, published a special article in The New England Journal of Medicine on the role IT in improving patient safety in health care. They found that IT facilitates the reduction of medical errors by: improving communication among staff and with patients; providing access to information for staff and for patients; requiring information and assisting with calculations at the time and place of care; monitoring patients' status and execution of clinical orders; decision support; response and tracking of adverse events; and, assurance of medication safety. However, they also found that there are significant barriers to IT becoming a broadly distributed agent of patient safety within and across US hospitals: cost of implementation and maintenance; lack of IT standards to support health care; and cultural barriers that limit adaptation by providers and patients.

Wickramasinghe and Silvers (2003) used qualitative techniques to explore the impact of managed care on medical practice performance. They applied agency theory to three cases--multi-specialty practice, independent physician association, and a faculty practice. Each was implementing IT as part of practice management and business management functions. They found that these applications were important to the success of the organizations and that they allowed organizational restructuring to improve alignment of organization to mission goals.

Rogers (2003) (page 1) in updating his work since 1962 on the phenomenon of the diffusion of innovations, starts the first chapter with the following: *"Getting a new idea adopted, even when it has obvious advantages, is difficult...a common problem for many organizations is how to speed up the rate of diffusion of an innovation."* This inability to quickly assimilate new information technology may be a recurring theme of the hospitals to be studied in this thesis. However, one of the intentions of the evaluations to be performed in Chapters 4,5, and 6 is to explore whether there are consequences to be found as a result of inabilities to successfully adopt innovation.

2.4 Interpretations

This chapter developed the themes that serve as the basis of the focal theory. It also presented the dichotomy within the literature that on one hand tends not to find an economic impact of IT within the US economy while on the other hand finds IT combined with organization improvements creating enhancements to intangible assets within the firm, eventually leading to performance improvements in cost, quality, and consumer surplus. However disparate the quotations opening this chapter appear, it may be that some participants from both sides of this issue are converging, albeit not intentionally. A close reading of Gordon–*ICT investment alone does not produce productivity gains, other factors are needed*–may be congruent with Brynjolfsson (2003) discussing the IT value chain as *only 10 percent IT and the remaining 90 percent as business process reengineering, organizational development, training, etc that act together with the IT to produce value within the firm.* Thus we have the foundational point that implementation projects within organizations do not perform as controlled laboratory experiments; instead, organizations are a complex amalgamation of the stocks of human-, organizational-, and information technology- capital that interact and react in stochastic ways to influence the relative productivity of factor inputs in the process of transformation into output. Chapter 3 formally presents the methodology, methods and cases used to develop this thesis.

3 Methodology

This chapter discusses the methodology that drives the research. The conceptual framework starts with an overview of the major academic themes, and a presentation of an integrated model of the conceptual flow and the mechanisms of strategic value within US hospitals. While this thesis involves a high degree of quantitative methods, this is not the study of a Brute-Positivist as labeled by Byrne.[35] This researcher would best be described as a liberal-capitalist, a realist, constructionist, who is very comfortable using empirical methods to interpret patterns, trends and behavioral relationships; tends to think in systems theory; has been trained extensively in business economics; and finds qualitative techniques useful in uncovering emerging workplace phenomena. The thrust of the thesis is about constructing a temporal framework for evaluation and interpreting the meaning of the results. Therefore, the evaluation needs to provide enough resolution to observe *performance* changes in US hospitals while isolating as many of the potential convolutions as practicable.

3.1 Themes

This section presents the major themes used to develop the focal theory.[36] The most significant conclusion that can be taken from the literature is that data theory drives what a researcher finds within the topic of investment in IT and business value. It appears that the closer the researcher is to being a true Positivist the less likely it is that the researcher will find any incremental value in corporate investment in IT. Much of the empirical work in the literature reviewed was based on investment made before 1996 and, therefore, is measuring the impact of a qualitatively different stock of capital than those IT investments after 1995 which are based on a graphical-user interface and distributed networks of users and data. From the detailed discussion in Chapter 2, researchers such as Skinner (1986), Strassmann (1990), Solow (1994), Roach (1996), Gordon (2003), and Carr (2003), who rely on a sector-level unit of analysis and the national accounts components of GDP, find little

---

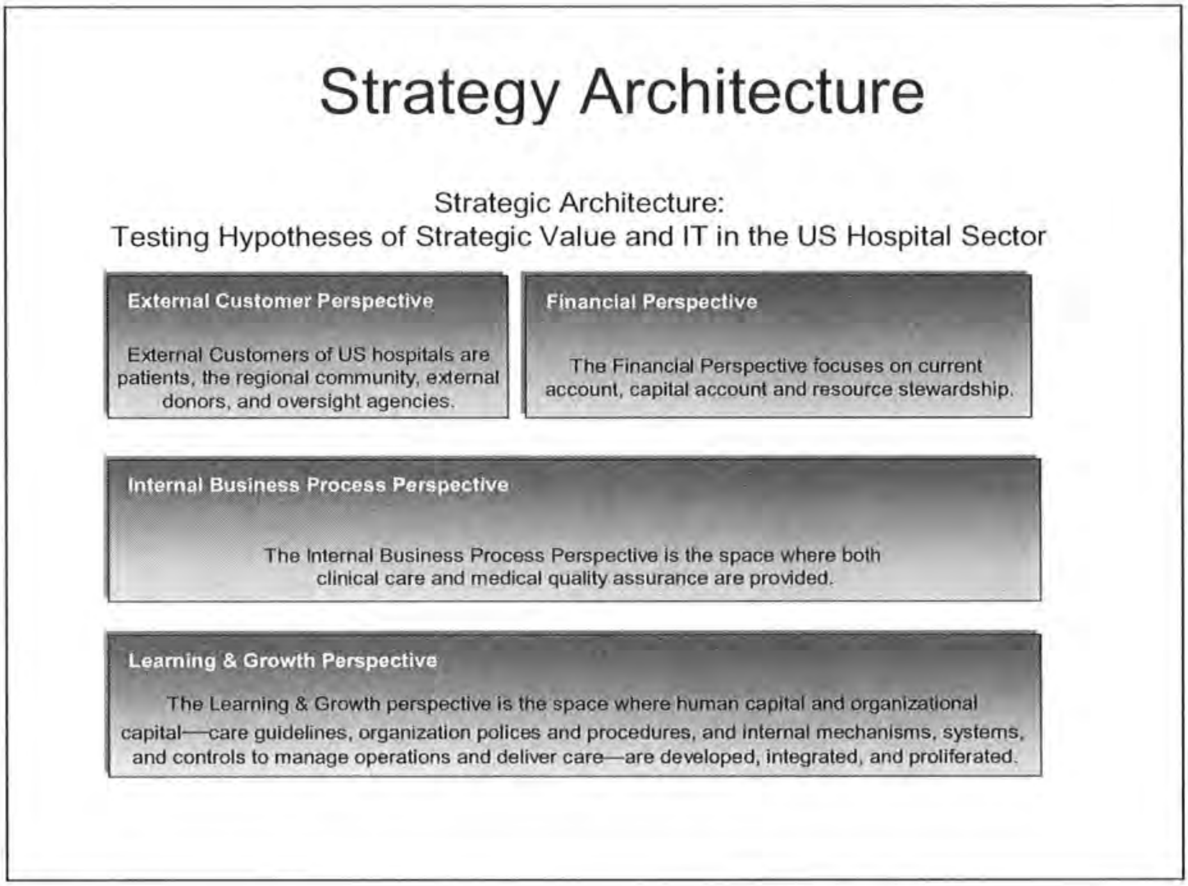
[35] Byrne, D. (2002). Interpreting Quantitative Data. London, UK, Sage Publications.
[36] An expanded discussion developing these themes can be found in Chapter 2.

or no evidence of productivity gains from IT at the aggregate economy. Several of these researchers suggest negative effects on the economy from an overinvestment in IT. While some of this side of the argument is based on national accounting and measurement issues, fundamentally, the argument is that the stock of IT capital is too small to have a significant effect on aggregate productivity.

However, those researchers who are looking inside the firm for evidence, the value of successful IT implementation is: in creating the potential to improve process quality; to enhance the knowledge base of the firm; and to enhance the access to specialized knowledge by qualified workers. All of this in turn enhances the intangible assets of the firm and generates excess consumer value by qualitatively transforming the output of the firm. Several researchers writing since the 1990s, whose papers were discussed in Chapter 2, including Brynjolfsson (1993), Hitt and Brynjolfsson (1996), Memel (2001), Borzekowski (2002), Bates and Gawande (2003), McKeown and Philip (2003) found a role for IT to facilitate the strategic transformation of the firm. The mechanism of transformation is in the ability both to reduce inefficiencies of time and distance and, more importantly, to empower skilled workers to achieve levels of process quality that were previously unattainable. The ability of IT to diffuse knowledge could be important in the health care delivery setting, where the delivery of care is segmented into portions that are sequential and task dependent, and segments that are non-linear and task interdependent. Being able to spread the knowledge and expertise of highly trained consultants across the health care enterprise can not only decrease the diagnostic cycle time but it also can improve the quality of care for patients and their access to self-care, and over the long-term it may reduce the total cost of care as more preventive medicine can be practiced.

3.2 Conceptual Model

Recognizing the complexity of the evaluation model to be developed, Kaplan and Norton's Balanced Scorecard (BSC) framework was found to be suitable in capturing performance improvements that would be critical to strategic success in the sector. The strategy architecture presented in Exhibit 3-1 depicts the first step in developing a BSC framework to support the thesis.



EXIBIT 3.1: A Prototypical Strategy Architecture for US Hospitals.

Exhibit 3.1 presents the inferred strategy architecture for US hospital sector from 1997-2004. The architecture is a device to identify stakeholders and communicate the planning framework across the enterprise.

From this external analysis, the research developed a proposed flow of strategic value within hospitals. The flow was complex and required a framework to predict where returns may occur and when they may accrue. A strategic value framework was proposed to attribute the performance changes into a classification scheme. The first part of the classification is for financial value. Dollar-valued benefits are parsed into—*direct cost savings, revenue increases, or mid-to-long term cost* *avoidance*. The remainder of the classification is for capturing the non-financial value in terms of time-lagged operational and strategic performance benefits—these would include the technical efficiency gains, process quality or clinical quality improvements. Besides being lagged in accrual these performance benefits, there is also a recursive flow from external and internal value mechanisms back into the financial value mechanisms. Exhibit 3.2 presents the proposed strategic value framework.

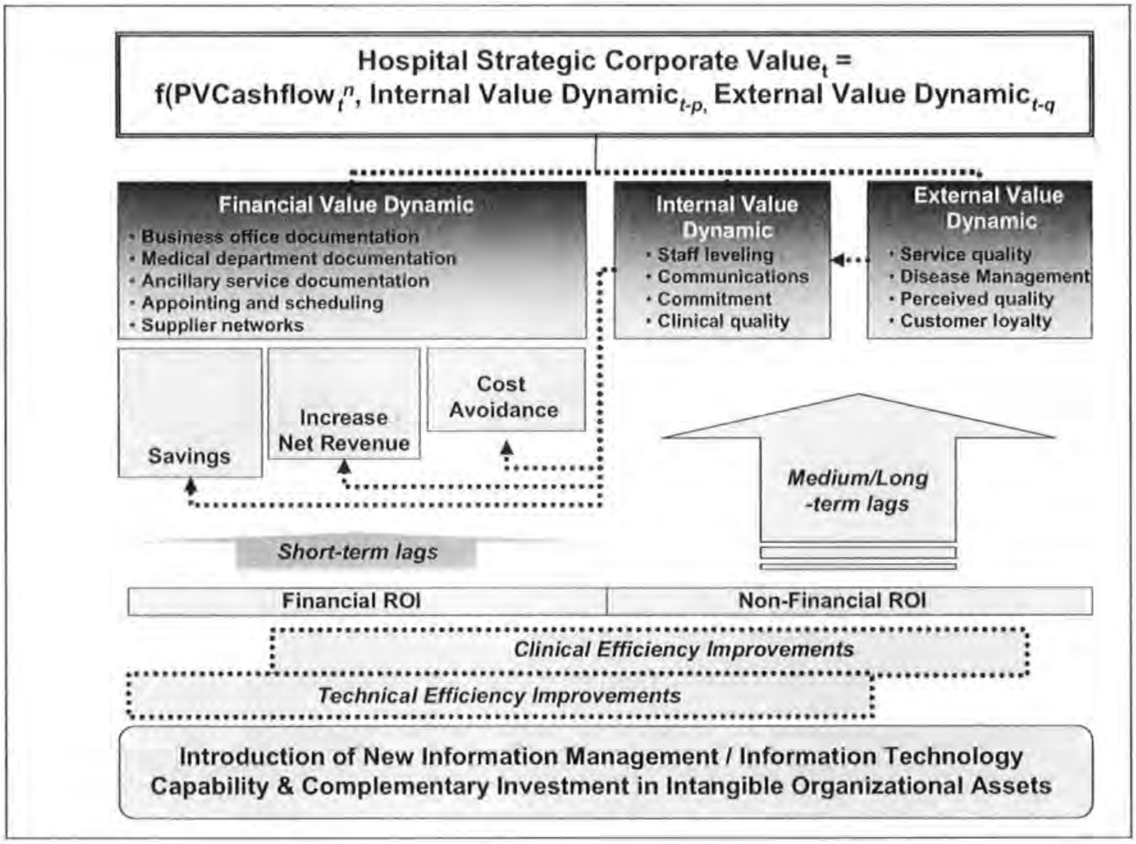


EXHIBIT 3.2: Strategic Value Flows in a Hospital.

The preceding exhibit provides a framework for accounting for the flow of strategic value through a hospital. According to Thompson[37], the role of task interdependence can be used to classify the transformation processes. Therefore, clinical information systems would provide the integration of information that is

[37] As described in Hatch, M. (1997 pp127-159). Organization Theory: Modern, Symbolic, and Postmodern Perspectives. Somerset, Oxford University Press..

needed to support the collaborative work processes inherent in patient encounters that would produce improvements in quality of care, access to care, medical readiness, and cost of care. The IT would enable these measurable improvements in the efficiency of the patient encounter as it forms a transformation process based on reciprocal task interdependence, while the implementation of administrative systems would generate improvements in access to care, medical readiness, cost of care, and revenue recapture based on the ability to facilitate both the sequential and pooled interdependence nature of those tasks. Borrowing from Weill (1992), conversion effectiveness mediates IT and performance, and, from both Weill and Borzekowski (2002), time-series lag structures would exist in the performance relationships. At the enterprise level, therefore, strategic value would be realized as: improvements in population/member health status as a result of improvements in delivered clinical quality[38], increased market share and revenue, and improved financial performance, staff retention and customer loyalty. While not explicit to the model, risk mitigation both from a clinical provider point of view (individual malpractice avoidance) and from a hospital point of view (future view of aggregated malpractice avoidance) is implicit to the model in the internal value dynamic. Later in the strategy architecture presented, risk mitigation is inherent in the internal process perspective and the clinical process and clinical quality measures identified. This research model is shown in Exhibit 3.3.

[38] While economists may first think of patient/member social welfare as the output of healthcare delivery, the programmatic issue is one of first concept definition and second data availability. In the US hospital sector, the proxy for clinical quality can be either a risk-adjusted outcomes measure for each service line for each hospital or a measure of the ability of a hospital to deliver care to nationally recognized care standards for a given diagnosis. This study will use the latter concept as the proxy for clinical quality as these data were available for the first time in history of the US health sector for nearly 1200 US hospitals for cases treated through the first half of calendar year 2004.

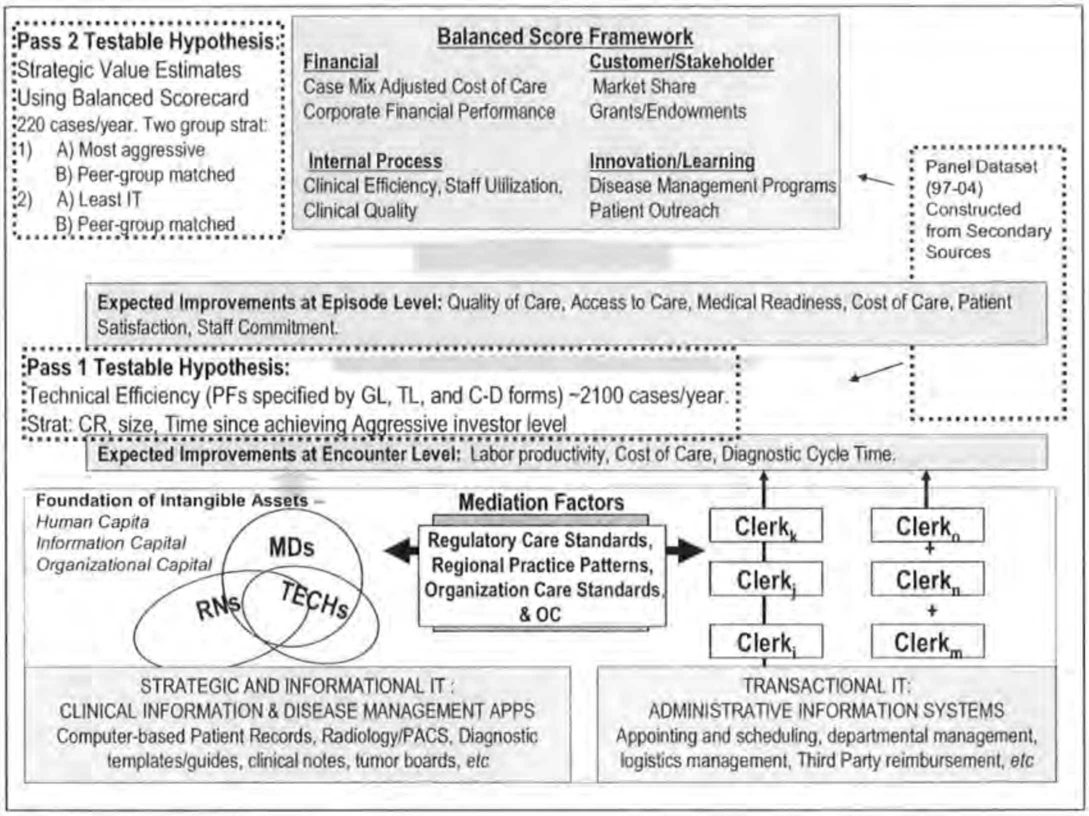


EXHIBIT 3.3: IT, Intangible Assets, Process Dependence and Generation of Value.

Source: Author's development following Thompson, Weill, Kaplan & Norton, and Brynjolfsson.

3.3 The Research Questions

The research questions are presented in Exhibit 3.4. Q1 and Q2 will be examined against the null hypothesis. Q3 will be examined using qualitative techniques. These questions focus on performance differentials achieved by the aggressive implementers, i.e., *the early adopters of IT who actively worked to integrate a broad scope of IT business and clinical functions*, not the cost of the IT, as there is substantial debate on the reporting of the net IT capital stock.[39]

[39] This is a theme on both sides of the argument—including Gordon, Brynjolfsson, Strassmann.

GENERAL HYPOTHESES	FOCUSED QUESTIONS
Q1. Do the most aggressive implementers of IT exhibit greater economic efficiency than the Rest-of-the-Sector (ROS)?	
	1.1) Do the most aggressive implementers of transactions IT exhibit greater productivity than ROS? 1.2) Do the most aggressive implementers of (internal) informational IT exhibit greater productivity than the ROS? 1.3) Do the most aggressive implementers of strategic IT exhibit greater productivity than ROS?
Q2. Do the most aggressive IT implementers strategically outperform the ROS?	
	2.1) Do the most aggressive implementers of transactions IT strategically outperform the ROS? 2.2) Do the most aggressive implementers of (internal) informational IT strategically outperform the ROS? 2.3) Do the most aggressive implementers of strategic IT strategically outperform the ROS?
Q3. Can we identify organizational characteristics that are associated with superior performance?	Potential Areas of Interest from the literature (Intangible Assets, Governance and Organizational Form): -Strong/weak CIO -Role of CIO in developing business strategy -Role of CIO in executing business strategy -Degree of organizational redesign accompanying IT -Inclusion of external stakeholders in IT planning processes -Ownership/form of management -Degree of organizational centralization

EXIHIBIT 3.4: Focused Research Questions.

The next section discusses the methods used to test the research questions.

3.4 EVALUATION OF THE MODEL

The research followed a two-group, continuous period design to test a series of null hypotheses. A rich data panel (1997-2004) was constructed from broadly accepted industry sources.[40] The thesis quantitatively evaluated performance from those cases. The thesis then focused on the superior performers to develop in-depth qualitative cases intended to validate the quantitative findings and identify those organizational characteristics associated with their achievements and to look for unintended consequences or findings. The panel itself represents a unique contribution to the field of strategic management because it contains detailed performance indicators representing financial, operational, clinical effectiveness, and customer response performance, and contains descriptive information on investment in IT and intangible assets within US hospitals. This information is not collectively available from any known source.

Identifying the performance of a hospital is a complex task. It varies in complexity across hospitals for reasons that include differences in medical service lines offered, existence and scope of teaching programs, statutory and regulatory variations, variations in demographics of regional populations, differences in business models employed, and differences in regional market penetration of managed care plans. Therefore, multiple methods will be applied to the cases in an attempt to evaluate relative performance differentials. Due to the complexity of the methods and their unique data requirements, each method will be segmented into separate analytical passes over the panel. The basic method and null hypotheses of each analytical pass are discussed in the next three sections.

[40] Operational data and descriptive information (1997-2001) were obtained from American Hospital Association, American Hospital Directory; detailed operational and clinical performance data (1998-2002) were obtained from Solucient, LLC (1998-2002), one of the few commercial aggregators of Federal CMS data; detailed IT implementation data and planning information (2002-2003) were obtained from Dorenfest Associates, Inc, the sole provider of such information for nearly all US registered hospitals; the annual survey results from Hospitals and Health Network's Most Wired® survey (1997-2002) were tabulated to identify aggressive implementers; and, the CMS Hospital Quality Initiative data were downloaded and matched to cases for 2004.

3.4.1 Pass 1: The Empirical Evaluation of Production

Based upon the volume of literature using neoclassical theory to investigate performance of US hospitals[41], concepts from neoclassical theory of the firm been used to identify and evaluate the productive efficiency of the hospital sector. As discussed in Chapter 2, the literature is clear in warning of the implications of choice of functional form for robustness and limitations on the results. The interpretation of the body of work related to hospital productivity models is that, given an appropriate level of caveat and interpretative sophistication, researchers would be expected to use the transcendental logarithmic (TL), generalized Leontief (GL), or Cobb-Douglas (C-D) forms to estimate production relationships of US hospitals. This research program is neutral toward the functional specification. Given that and the debate over appropriateness of functional specification, the research compared estimates from each of three forms using an approach similar to that found in Mbaga, Romain *et al.* (2000) who published a study of the technical efficiency of a segmented sector (Quebec dairy farms).[42] Endogeneity can be a concern in the proposed sample, that is, the statistical concern that determinant relationships exist both among labor and capital levels employed in a given time period and that previous period output levels drive current period labor and capital usage. The implication being that the Ordinary Least Squares technique would not produce best linear unbiased estimates (BLUE) of the parameters. This is a standard concern of any econometric model in general, and of a production function in particular. There are various quantitative techniques available to abate the consequences of endogeneity. The choice of technique would depend on the characteristics of the analytical dataset. Therefore, as discussed in Mbaga *et al,* stochastic frontier techniques were used upon time series data to generate maximum likelihood estimates (MLE). By definition, MLE do not require additional empirical techniques to reduce estimation bias for a given dataset and model specification.[43] In addition, care was taken in the actual data panel developed for the regression analyses to

---

[41] See Chapter 2.1.

[42] Mbaga constructed two panels, the corn producing and the non-corn producing regions and compared empirical results from TL, C-D, and GL stochastic production frontier estimates with data envelopment analysis. Upon both parametric and non-parametric testing, they found that the GL specification as the dominant functional form.

[43] See Greene (2003, p503).

exercise caution with respect to co-linearity of the right hand side variables and the heteroskedastic, and autoregressive characteristics within the residuals.

There is continued disagreement in the literature on the specification of the left hand side (LHS) of the production function with many researchers preferring the concept of the patient discharge as the output measure. While the discharge may be appropriate when studying the homogenous output of a single medical sub-department, it does not seem reasonable to use the discharge as the representation of output across the hospital. Li and Rosenman (2001) addressed this issue:

> *"There is some disagreement whether patient days or discharges is the correct measure for inpatient activity in a hospital. If the majority of the costs for a patient were incurred by the visit—indicating that most of the costs are fixed—then discharges would be the proper measure. However, we believe that significant costs are proportionate to the amount of time a patient spends in the hospital, thus, making patient days the correct measure for measuring the output of inpatient services." (Li and Rosenman 2001, page 528)*

The LHS specification was the Adjusted Patient Days data from the American Hospital Association data warehouse. This variable is a combination of occupied bed days (inpatient data) and outpatient visits (outpatient data) where the outpatient visits are adjusted based on the ratio of outpatient revenue to inpatient revenue to attempt to achieve equivalence in the output measures. While there are concerns over the measurement of output, the goal of this regression exercise was to identify relative differences in efficiency among groups of hospitals. Any errors of measurement likely would result in equivalent errors in estimation that would be equally distributed across the sector—thus the emphasis on relative differences, not the levels of the estimates. As shown in Exhibit 3.5, the basic right hand side specification was four independent variables, where labor was specified as: Full-Time-Equivalent values for each Physicians, Registered Nurses and Others.[44]

[44] The sum of medical technicians, other clinical care practitioners, administrative, business office and other support staff labor.

FUNCTIONAL SPECIFICATION OF REGRESSION MODEL
Adjusted Patient Days_n^{yr} =
$\alpha 1_n^{yr} + \alpha 2_n^{yr}\text{FTE-Physicians}_n^{y} + \alpha 3_n^{yr}\text{ FTE-RNs}_n^{y} + \alpha 4_n^{yr}\text{ FTE-Others}_n^{y} + \alpha 5_n^{yr}\text{ Number of Licensed Beds}_n^{y} + \hat{e}_n^{yr}$

EXHIBIT 3.5: Functional Specification of the Regression Model.

The importance of allowing functional freedom to specific labor sub-categories was to capture effects of potential labor substitution, and to capture relative productivity differentials among sub-categories – this specification is an extension of the traditional Cobb-Douglas form.[45] As is a convention in the literature, capital was specified as the number of operational beds in the facility.

The econometric procedures were performed using LIMDEP version 8.0 software[46] for the extended Cobb-Douglas (C-D), General Leontief (GL) and Translog (TL) models over two data partitions: the Rest-of-the-Sector (ROS), *partition 0*, and the most aggressive implementers, *partition 1*. Each of the stochastic models was estimated using the three standard forms for the error term (*half-normal, exponential normal, and truncated normal* distributional assumptions) within a fixed-effects model.

This work was expected to enable: 1) the identification of the dominant functional form using the likelihood dominance criterion; 2) statistical testing for efficiency differences across the two data panel partitions; 3) statistical testing among Weill's three classes of IT; and, 4) the identification of exceptional cases of relative efficiency.

---

[45] This form is not the classic Cobb-Douglas form of two RHS terms. It is an extension of the C-D form that provides enhanced specification of the labor components. The RHS terms were constructed with care to minimize covariance among all RHS terms but specifically focused on covariance among FTE data. This form is less restrictive than the classic C-D model and more restrictive than the full TL model. While this form loses the pure simplicity of calculations discussed in Chapter 2, it does reveal more sensitive insight into the bundles of inputs being used to produce adjusted patient days within a hospital.

[46] See Greene, W. (2002). LIMDEP Version 8.0 Econometric Modeling Guide Plainview, NY, Econometric Software, Inc..

However, this work would not be sufficient to determine thoroughly the research questions in general. In particular, the work is silent at this stage on two important issues related to performance – strategic performance gains, and the value of multifactor substitution. If in fact aggressive IT implementers were achieving higher productivity levels on the productive margins by substituting information technology capital for specialized labor, then questions would arise of whether these gains would be an unstable short-term phenomenon or not.[47]

The second evaluation pass was focused on revealing insight into gains of strategic value among US hospitals.

3.4.2 Pass 2: The Identification and Evaluation of Strategic Performance

The second evaluation method applied the Kaplan and Norton Balanced Scorecard (BSC) approach[48] to sub-sets of the sector-level data panel. As this work required extremely detailed case data, the number of cases evaluated was greatly reduced from the first evaluation pass. This work was focused on comparison and contrast among the two data panel partitions. The structure of the data panel would enable three levels of comparison--at the group level, at individual peer-match level, and among Weill's IT typology.

Guidance existed in the literature from Chow, Haddad et al (1998), Chan and Ho (2000), Pink, McKillop et al (2001), Chow-Chua and Groh (2002), and Griffith and Alexander (2002) in terms of appropriate use of BSC technique within the health care sector in general and the hospital sector in particular.[49] Exhibit 3.6 presents the initial mapping of the BCS perspectives with health care specific performance

---

[47] If an firm operating under its long-term productive levels could be made relatively more efficient by the infusion of new capital with relatively higher marginal productivity than its existing capital stock, then this would appear to be not a movement along a simplified production isoquant but instead a **shift** to a higher productivity level isoquant. Over time, however, a question would be whether the firm would be able to continue to maintain higher productivity levels. Would the surrounding intangible assets be able to sustain the higher levels of productivity (**an isoquant shift**) or would the productive capacity drop back to lower levels out of exhaustion, frustration, or simply inertia resulting in a net substitution of capital for labor and a movement along the original isoquant?

[48] See Chapter 2.2.2.

[49] See Chapter 2.2.3.

metrics and likely data sources as found in the literature that served as the foundation of the strategic value evaluation.

SCORECARD PERSPECTIVES (Kaplan and Norton 1991)	HEALTHCARE PERFORMANCE MEASURES (Pink, McKillop et al 2001)	POTENTIAL SOURCES (Pink, McKillop et al 2001) (Griffith and Alexander 2002)
Financial	Financial performance and Condition	-AHA -AHD -Profiles of US Hospitals
Innovation & Learning	System integration and Change	-Most Wired Surveyfor IT -AHA for disease management programs
Customer Response	Patient Satisfaction	-Profiles of US Hospitals -AHD
Internal Business	Clinical Utilization and Outcomes	-Profiles of US Hospitals -AHA survey

EXHIBIT 3.6: Literature Mapping BSC to Indicators and Sources.

To the literature sourced information, the cases available from the CMS Hospital Quality Initiative[50] were added to internal process perspective as a proxy for clinical quality.

[50] See Chapter 1.7.3

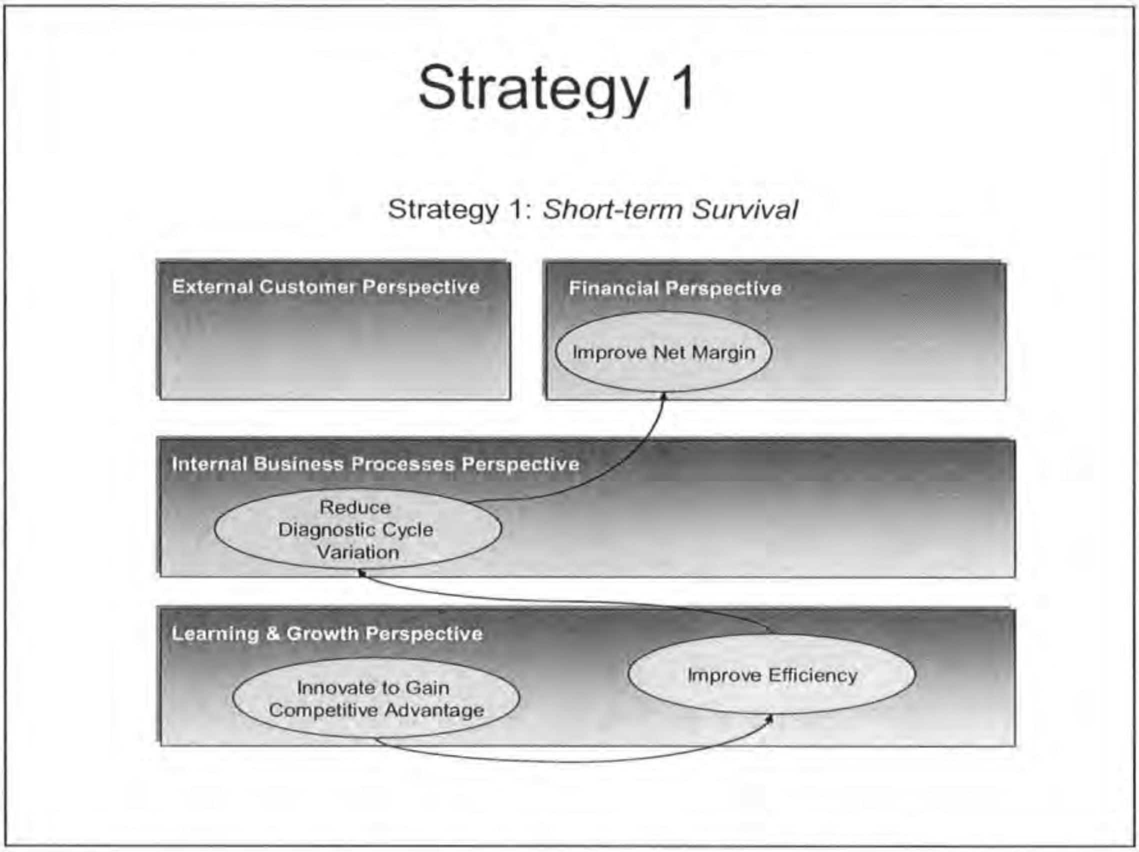


EXHIBIT 3.7: Strategy Map 1 "Short-Term Survival".

The next step for the author of this thesis was to create strategy maps to reflect the major performance objectives within the hospital sector during the evaluation period. These maps were inferred by the author from the competitive context analysis presented in Chapter 1 and they have been validated by review by an informal panel of hospital sector professionals.

While these maps do not reflect a specific case of any one hospital, they are prototypical in that they reflect representative scenarios used on average across the hospital sector. They are consistent with the survey response findings cited in Chapter 1.7.4 as to what senior executives are expecting to achieve with health information technology. They are also consistent with the strategy language of the US President's Agenda for health information technology.[51]

Exhibit 3.7 depicts the strategy of IT implementation to stabilize financial condition that resulted from the historic period (starting about 1995 to 2001) of deteriorating operating margins within hospitals. Due to several compounding factors of revenue realization and cost structures, hospital management was faced with a drive to innovate within its organizational, human capital, and information capital to gain advantage. The intent was that innovation would affect efficiencies that would standardize cost variations in diagnostic cycles, resulting in improvements in net margin.

Strategy map 2, Exhibit 3.8, reflects the mid-to-long term drive within the US health sector to improve clinical outcomes and to improve population health management. This strategy was implemented by innovating within organizational, human and information capital to gain competitive advantage that was intended to improve health outcomes over time and to maintain accreditations; with an additional lag there are expectations of improvements in market share and assured long-term viability.

---

[51] Online (2004). Health IT Value Statement, Office of the National Coordinator for Health IT. **2006**. http://www.hhs.gov/healthit/ "We Need to Bring Every Doctor, Outpatient Office, Hospital and Nursing Home into Information Age The Benefits Health IT Can Bring to Our Nation – Fewer Mistakes, Lower Costs, Less Hassle, Better Care."

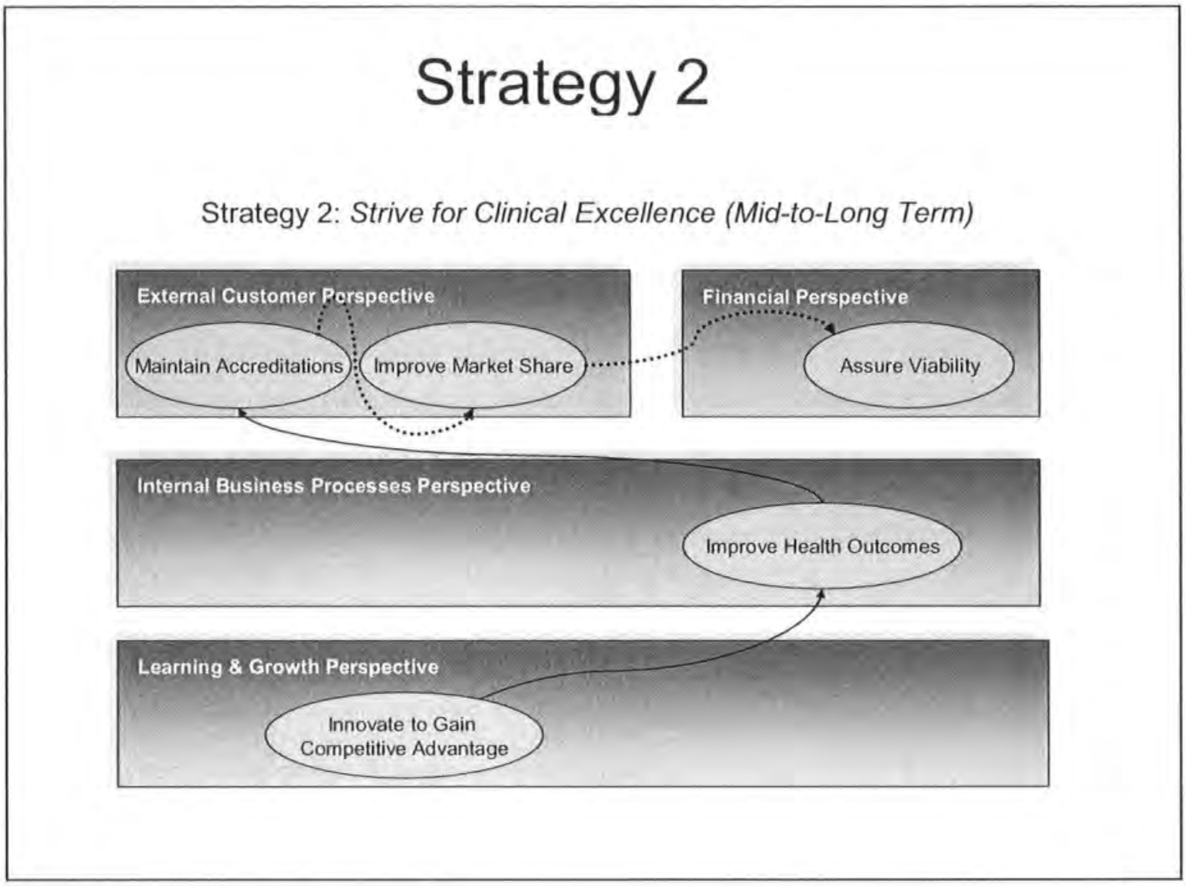


EXHIBIT 3.8: Strategy Map 2 – "Strive for Clinical Excellence".

Exhibit 3.9 reflects the author's view of the complex and the contingent nature of strategic planning within the US hospital sector as simultaneous and sometimes conflicting initiatives are occurring. This is the integrated strategy map that was used to test for performance differentials across the panel.

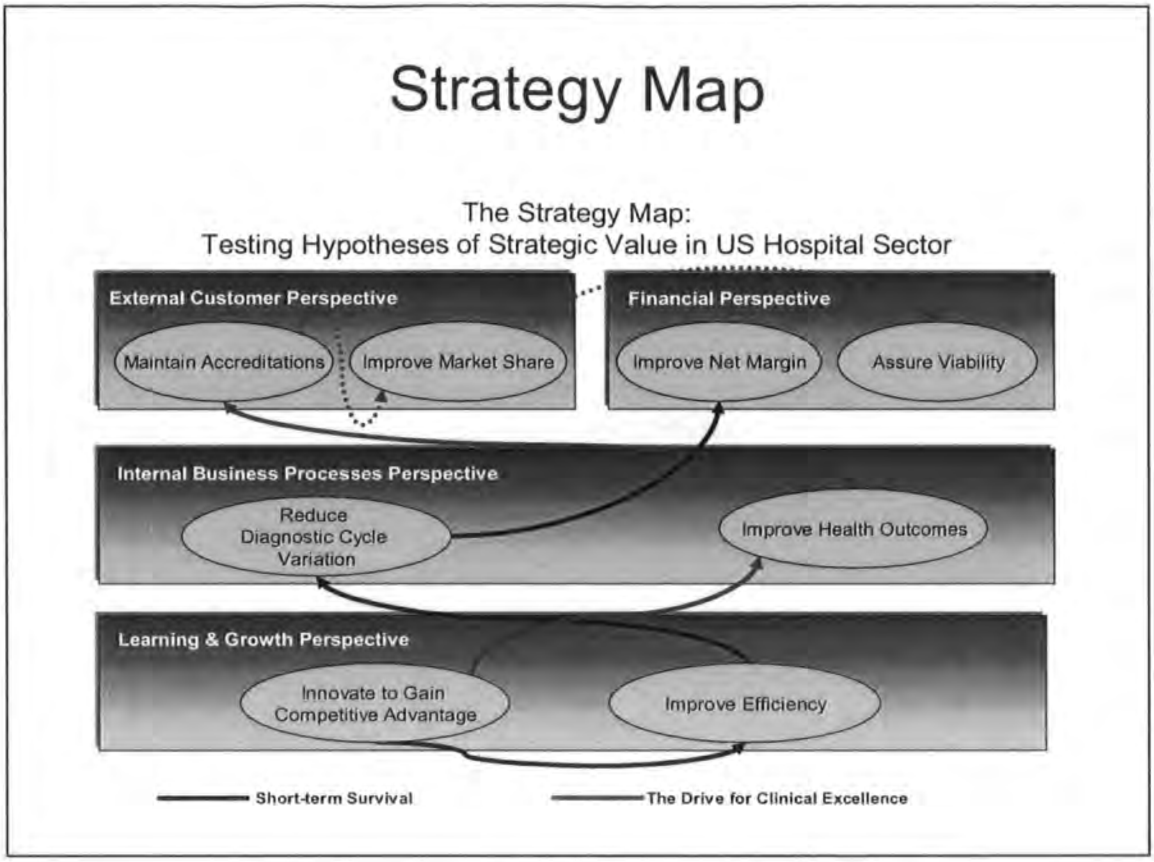


EXHIBIT 3.9: The Integrative Strategy Map.

The work of pass 2 will be to examine the research questions presented in Exhibit 3.10. In process of examining those questions, the strategy maps will be validated, and scorecards will be developed and longitudinally evaluated for each of the BSC perspectives. The examination will include both relative performance outcomes of the hospitals in the panel and detailed performance differences among and within analytical groups.

PASS	H_0	H_a
Pass 2 – Balanced Scorecard Framework	Financial Perspective Change $_{(2001-1997)}$ Most Aggressive Implementers = Financial Perspective Change $_{(2001-1997)}$ ROS.	Not equal.
	Customer Perspective Change $_{(2001-1997)}$ Most Aggressive Implementers = Customer Perspective Change$_{(2001-1997)}$ ROS.	Not equal.
	Internal Business Process Perspective Snapshot $_{2004}$ Most Aggressive Implementers = Internal Business Process Perspective Snapshot $_{2004}$ ROS.	Not equal.
	Learning & Growth Perspective Change$_{(2001-1997)}$ Most Aggressive Implementers = Learning & Growth Perspective Change $_{(2001-1997)}$ ROS.	Not equal.

EXHIBIT 3.10: Research Questions for Pass 2.

The core clinical **process** quality performance measures were available from 1998 – 2002 while the clinical **practice** quality performance measures were available starting in 2004. Therefore the evaluation was based on time-series differentials (2001-1998) for Financial, Learning & Growth and Customer perspectives, while the Internal Business Process perspective evaluation was based upon both the 2001-1998 differentials and the snapshot of practice quality performance reported in 2004. The time lag between Internal Business Process and the rest of the perspective remains consistent with the lagged structure of the model flow of value within US hospitals presented in Chapter 3.2.

The analytical purpose was to test for differences between means and mean variance of the indicators constructed within each of the BSC perspectives. Therefore, this pass identifies whether there were strategic performance differences among the data panel and to identify cases of exceptional performance. This pass also allowed a broad assessment of the role of the Weill's typology of IT on performance outcomes.

3.4.3 Pass 3: The Role of Innovation in Performance

Clusters of hospitals behaving more or less similarly were expected; however, it was expected that there also would be a handful of exceptional performers across the panel. The third pass applied qualitative techniques to this subgroup of exceptional performers to assess the associations among specific IT capabilities implemented, organizational characteristics and performance. The focus was on the following organizational characteristics: *Role of CIO in developing strategy, Role of CIO in executing strategy, Degree of re-investment in intangible assets that accompanied IT implementations, Degree of inclusion of external stakeholders in capital planning processes, and the Affect of organizational structure*[52] *on performance.* The qualitative assessment of characteristics was performed using NUD*IST Vivo 1.0 software[53] using information developed from the panel dataset, the empirical results developed in Pass 1 & Pass 2, and hospital specific, secondary-sourced IT capital asset management processes surveys. The expectations from the literature were that:

- Organizational structure and business process reengineering would be dominant drives of positive performance -- Brynjolfsson (1993), Brynjolfsson and Hitt (1996), Brynjolfsson and Hitt (2000), and Brynjolfsson (2003);
- Ownership and level of managed care penetration would be expected to influence the ability of IT to impact performance -- Ashby, Guterman *et al.* (2000) and Brown (2002).

Qualitative techniques were applied to the cases searching for significant patterns among characteristics, IT implemented and performance achieved. The analytical purpose of this pass was to reveal organizational characteristics associated with unique performance, to validate those bundles of IT capabilities associated with superior performance and to identify strategic lessons learned related to achieving performance from IT implementation in US hospitals.

---

[52] For these purposes, organization structure was defined as the following: For profit/Non-profit, Teaching/Not teaching, Centralized management/Decentralized, Region, Network partner/Stand-Alone Facility, and Size.
[53] NVivo, QSR International Pty Ltd, Victoria, Australia.

3.5 Case Data

The research followed a two-sample plus industry benchmark continuous period design that will test a series of null hypotheses. A rich data panel (1997-2004) was constructed from broadly accepted industry sources. The research performed a complex quantitative evaluation of performance. The research then focused on the superior performers to develop in-depth qualitative cases intended to validate the quantitative findings and explore for association among organizational characteristics, IT and performance. The panel itself represents a unique contribution to the field of strategic management because it contains detailed performance indicators representing the financial, operational, clinical effectives, and customer response perspectives for US hospitals, which are not collectively available from any known source.

3.5.1 Sources

The panel was constructed from five widely accepted secondary sources of information, the American Hospital Association (AHA), the American Hospital Directory (AHD), Hospitals and Health Networks (H&HN), Dorenfest Associates 6th Complete Integrated Healthcare Delivery Systems (IHDS+)tm database®[54], Solucient, LLC, and the CMS Hospital Quality Initiative.[55] AHA maintains a comprehensive annual survey of US hospitals. The AHA survey is considered a definitive and reliable source within the sector as evident in that every paper reviewed used some form of the AHA data. The scope of the survey includes basic financial data, product line, demographic, and business model information. These data constitute the backbone of the constructed dataset. AHD provides a cross-link between AHA information and detailed utilization and financial reports filed by hospitals to various Federal authorities. The result is detailed income statement, balance sheet, and detailed costs services reports to the Diagnostic Related Group (DRG) level that are not available from other sources. The reports from H&HN's

[54] The Dorenfest IHDStm is a survey related to information systems infrastructure within US hospitals which has been used for more than 25-years us a business intelligence source for IT vendors, consultants, and process benchmarking. IHDS is maintained through a process of on- and off- site interviews with IT executives in more the 1200 facilities nationwide. Size.

[55] Centers for Medicaid and Medicare Systems pilot project on self-reporting of compliance with consensus clinical quality protocols. Approximately 800 facilities reported in first-half of 2004.

survey of IT implementation were used to identify, annually, the 100 most aggressive IT implementers. As recommended in Griffith and Alexander (2002), the clinical process quality and customer response indicators were constructed from Profiles of US Hospitals, published annually by Solucient who maintain a proprietary dataset that is constructed from the enormous Medicare MedPar inpatient and ambulatory care utilization national datasets. MedPar data are considered accurate and reliable in that hospital management are legally required to certify accuracy under penalty of law and they are periodically audited. The Dorenfest IHDS+ database® provides detailed survey results covering IT management processes, implementations and planned acquisitions for hospitals across the US. The CMS quality initiative provided the self-reported data for Heart Failure, Heart Attack and pneumonia treatment patterns that were used for clinical practice quality measures.

3.5.2 Cases

The unit of measure was the stand-alone hospital facility. While health care is provided at the medical department level within the facility, using the facility–level of analysis treats the hospital as a combined entity producing a portfolio of care services and responsible for both direct costs of production which occur at the medical department but also the indirect costs, capital costs, and financing strategies of the hospital. This approach is consistent with the current economic literature analyzing hospital performance such as that of Lee and Menon (2000), Chan and Ho (2000), Borzekowski (2002), and Chow-Chua and Groh (2002).

The scope excluded the 876 federal hospitals of the Department of Defense, Department of Veterans Affairs, Indian Health Service, and Federal Health Service from the analysis because these facilities are subject to the least degree of market forces and their mission requirements are unique with limited service competition. Long-term care facilities were excluded because they do not provide acute medical care. Finally, hospitals that are not AHA registered were excluded because registration is a primary indicator of hospital quality. The distribution for 4,915 hospitals in year 2000 is shown in Exhibit 3.15. They were both for-profit and not-for-profit and represented approximately 85 percent of total US facilities and 95 percent of total patient admissions in 2000.

NUMBER OF BEDS	NUMBER OF HOSPITALS	TOTAL BEDS	SHARE OF TOTAL INPATIENT DAYS*	SHARE OF TOTAL OUTPATIENT VISITS*
6-24	288	5,156	.003	.009
25-49	910	33,333	.026	.052
50-99	1055	75,865	.079	.095
100-199	1236	175,778	.201	.219
200-299	656	159,807	.197	.190
300-399	341	117,220	.146	.141
400-499	182	80,763	.107	.10
500+.	247	175,638	.241	.194
	4915		**1.00**	**1.00**

EXHIBIT 3.15: Distribution of US Hospitals by Size

Source: AHA Survey 2000

The eight size classes were collapsed into three—Small, Medium, and Large—as presented in Exhibit 3.16 to examine the distribution of utilization by size.

POOLED GROUP	NUMBER OF BEDS	NUMBER OF HOSPITALS	TOTAL BEDS	SHARE OF TOTAL INPATIENT DAYS	SHARE OF TOTAL OUTPATIENT VISITS
SMALL	6-99	2253	114354	*0.108*	*0.156*
MEDIUM	100-299	1892	335585	*0.398*	*0.409*
LARGE	400-+	770	373621	*0.494*	*0.435*
		4,915	**823,560**	**1.00**	**1.00**

EXHIBIT 3.16: US Hospital Size Distribution

The Small category is characterized by rural facilities typically not staffed to operational standards[56] and this category of facility was dropped from the data collection process based upon consultation with the AHD data warehouse specialists consulted by the author.[57]

Chapter 4 presents the evaluation results.

[56] See Hospital Statistics (2002)

[57] As noted in conversations with the AHD data mart consultants, Small facilities likely would have the least accurate preparation of the raw data collection instruments; likely would be most underreported in annual reports; and, the complexity of care provided in this group is significantly different from the other categories.

4 Evaluation of Performance

Chapter 4 presents the findings that form the contribution to knowledge developed by this thesis[58] and it specifically addresses research question 1: *Do the most aggressive implementers of IT exhibit greater economic efficiency than the rest-of-the-sector (ROS)?* And, research question 2: *Do the most aggressive IT implementers strategically outperform the ROS?* Chapter 4.1 presents the interesting and at times surprising comparative econometric evaluation of hospital inefficiencies across a five-year panel of hospital cases representing a time-series of over 13,000 observations. Chapter 4.2 presents the comparative evaluation of strategic performance differentials using a Balanced Scorecard framework. To begin this chapter on evaluation, Chapter 4.1 presents the empirical results of stochastic production frontier estimates across the US hospital sector.

4.1 Pass 1 – The Empirical Evaluation of Production

The empirical evaluation of production within US hospitals over the period 1997 – 2001 is deeply grounded within the academic literature related to hospital performance evaluation.[59] One of the on-going themes in this segment of the literature is a debate over appropriate mathematical form to represent a production function of a hospital. One of the main reasons for this debate is to establish the mathematical principles underlying the estimates to inform policy, for example, with respect to labor markets or efficient capacity planning. Since this research is neutral with respect to functional form, the approach taken was to specify production models based upon the primary forms found in the health evaluation literature – the Translog, the General Leontief, and an extension of the Cobb-Douglas form[60] – to apply structural model testing to identify performance differentials.

---

[58] Chapters 5 and 6 interpret and extend these findings using qualitative techniques as the basis of the contribution to management practice.

[59] Please see Chapter 2 for an extensive discussion of the current state of the Theory of Production and its recent application within the hospital sector.

[60] While this Cobb-Douglas extension is important to testing changes in the task dependencies presented in the flow of value model in Chapter 3, it is not present in the literature citations, therefore, it is unique to this work.

This research is less neutral with respect to the empirical methods employed to perform the evaluation of production in that three criteria were developed for choosing the methods: 1) to be grounded within the body of literature in business economics and production theory generally, and with the body of literature in the health services evaluation; 2) to be a viable technique to apply to a large, time-series case dataset; and 3) to produce statistically reliable, and statistically testable estimates of efficiency. These criteria drove the selection of methods for this evaluation and, as documented in Chapter 2, the stochastic production function frontier technique[61] is the quantitative approach that met each of the three criteria.[62] The next section, then, presents the models specified using the stochastic production function technique to perform the evaluation of production.

4.1.1 Models

The model specification used in this evaluation was grounded in the literature cited in Chapter 2 and it is derived to test the original flow of value model presented in Chapter 3. This work extends from most of the literature in the operational construction of the right hand side (RHS) variables of the models. Most, if not all of the papers cited, specify the labor term as a single term representing the full-time equivalents (FTEs) of all hospital labor categories. Excluding the interaction terms inherent in the TL and GL forms, the RHS specification of labor was decomposed into three separate terms—Clinicians[63], Registered Nurses, and a residual category of labor. For this evaluation, the lumping together of labor categories into one RHS term would lose the granularity of insight into the substitution and tradeoff effects within labor categories predicted by Organizational Theory related to investment in the development of a hospital's intangible asset-base.[64] Therefore, labor was specified as three independent terms: FTEs for Clinicians, Registered Nurses, and

---

[61] See Greene(2003, pp 429, 501-505). This stochastic frontier approach is based upon a maximum likelihood estimator and therefore also benefits from the estimation efficiency benefits of the MLE.
[62] Chapter 2 documents both the depth of use of the stochastic technique in the healthcare setting and discusses the limitations of other techniques such as data envelopment analysis which fails to meet criterion #3.
[63] In the US, a Clinician can be an MD or a registered nurse practitioner who does not perform traditional nursing functions but instead performs traditionally doctor functions in primary care settings, only.
[64] E.g., the effects of investment in intangible assets (labor, mechanisms and systems) that affect task dependency, role inter-dependence, and improvements in learning and growth.

Others.[65] Capital was specified as the number of operational beds in the facility. The left hand side (LHS) of the specification was the Adjusted Patient Days data for each hospital. Adjusted patient days is a combination of occupied bed days (inpatient data) and outpatient visits (outpatient data) where the outpatient visits are adjusted based on the ratio of outpatient revenue to inpatient revenue to attempt to achieve equivalence in the output measures.[66] As discussed in Chapter 3, while the literature is split between discharges and adjusted patient days as the choice of output specification, the strong reason for using the adjusted patient day model is that it accurately reflects the timing and flow of resources through a hospital. By using an extension from the classic Cobb-Douglas model, the basic regression specification was as follows:

$$\mathrm{LN}(\text{Adjusted Patient Days})_{\text{hospital}}^{\text{yr}} =$$

$$\beta_1 + \beta_2 * \mathrm{LN}(\mathrm{DR})_{\text{hospital}}^{\text{yr}} + \beta_3 * \mathrm{LN}(\mathrm{RN})_{\text{hospital}}^{\text{yr}} + \beta_4 * \mathrm{LN}(\mathrm{OTH})_{\text{hospital}}^{\text{yr}} + \beta_5 * \mathrm{LN}(\mathrm{BEDS})_{\text{hospital}}^{\text{yr}} + \textit{stochastic error function.}$$

As discussed in Chapter 2, the choice of model specification is related to optimizing the tradeoffs between model simplicity and the burden of mathematical restrictions imposed by the model. While the Cobb-Douglas extension results in four RHS terms, the imposed assumptions on the production frontier are high. The full TL specification is a more open functional form and as a consequence that model resulted in a total of fifteen (15) RHS terms. The GL model specification, which is sometimes referred to as the square root function, is also considered an open model, it resulted in a total of eleven (11) RHS terms. The difference between the Cobb-Douglas extension specification of 5 RHS terms and the 15 and 11 RHS terms are from the addition of interaction and cross-product terms inherent to those open functional models – not shown here. Cross-sectional, fixed effects regression

---

[65] The sum of medical technicians, other clinical care practitioners, administrative, business office and other support staff labor.

[66] While there are concerns over the measurement of output, the goal of this regression exercise is to identify relative differences in overall efficiency among groups of hospitals. Any errors of measurement would likely result in equivalent errors in estimation that would likely be equally distributed across the sector—thus the emphasis on relative differences, not the levels of the estimates.

models were estimated for the rest of the sector sample (partition 0) and the most aggressive implementers sample (partition 1) using the standard distributional assumptions for the stochastic error term – the half-normal, the exponential normal, and the truncated normal distributions.

Of course, the purpose of this phase of research is to address the research question that is related to economic efficiency. Estimating stochastic production frontiers is mostly done to obtain estimates of economic efficiency[67] as the modern computation of the stochastic error term is comprised of two components: "*idiosyncratic effects that are specific to the firm...and productive inefficiency*".[68,69] The efficiency scores produced by the stochastic frontier approach are, in fact, the measures of technical efficiency of each hospital – the deviation in production from the stochastic production frontier.

However, all of the modern developments in the literature related to a computable model of economic efficiency can all be traced back to the foundational work in Farrell (1957). There were many innovations in this work. Farrell presented an approach to productive efficiency that was computable, that considered all inputs of the firm, and that did not require homogeneity of inputs. Farrell was keen to make the distinction between price efficiency (choosing an optimal set of inputs) and technical efficiency (success in producing maximum output). Efficiency in production was measured against a standard of ideal productive output. Therefore, technical efficiency (efficient production) was a measure of variation from an ideal standard as expressed in the choice of the ideal production function:

> *"Technical efficiency, then, is defined in relation to a given set of firms, in respect of a given set of factors measured in a specific way, and any change in these specifications will affect the measure. This is inevitable in any such measure. But with these qualifications it functions in a natural and satisfactory way as a measure of efficiency." Farrell (1957, page 260).*

---

[67] Greene (2002, page E24-6).
[68] Greene (2003, page 502).
[69] See Chapter 2.1.4, the general stochastic error term is $\epsilon_i = v_i + \mu_i$ from the model developed in Aigner, D., C. Lovell and P. Schmidt (1977). "Formulation and estimation of stochastic frontier production function models." Journal of Econometrics **Vol. 6**: 21-37.

It is with the same caveats related to input measurement, sample selection, and interpretation of results that this work precedes to the next section that describes the process that was used to build the case dataset for this pass of the evaluation.

4.1.2 Cases

The unit of analysis for this thesis is the stand-alone, short-term acute care hospital within the US.[70] The period of the case data was defined to cover the period 1997 through 2001.[71] The data were obtained from two sources: the American Hospital Association's hospital data warehouse service[72] which provided the US Medicare identification code, facility name, network identification, adjusted patient days, the various FTE elements, and the count of beds in use per facility; and the Hospital & Health Network's annual nominations for those hospitals across the US that were most aggressively implementing information technology across the scope of their operations.[73]

Constructing Cases The process used to develop the panel was to use the AHA data extract as the backbone of the panel to service all three of the analytical passes to be performed in this thesis. The specification made for the AHA data extract was to include all US short-term acute care hospitals with greater than 99 staffed beds in service.[74] This size restriction is a practice that was found in the cited literature presented in Chapter 2. The next piece of work was to match the facility names reported in the annual H&HN's reports with the identifying information from the AHA extract. This was a manual, time consuming process in that several health networks were reported in the A&HN reports which could contain multiple

---

[70] A detailed explanation of this unit of measurement is in Chapter 2.

[71] The predicted existence of extended lag period among operational process improvements and later state clinical process, clinical outcomes, and population benefits requires that addition data be defined and collected in Chapter 4.2 that cover up to year 2004. See Chapter 4.2 for this discussion.

[72] AHA data service http://www.ahadata.com/ahadata/index.jsp.

[73] H&HN's **Most Wired®** Survey Results (1999, 2000, 2001, 2002) http://www.hhnmostwired.com.

[74] In discussions with AHA data specialists and in reviewing Hospital Statistics 2000, it was apparent that the 2253 facilities reported in 2000 in this category were rural facilities typically not staffed to operational standards, with exceptionally low levels of financial performance and therefore unlikely to participate in the information technology spending boom that occurred between 1997 and 2002. They likely will have the least accurate preparation of the raw data collection instruments; likely would be most underreported in annual reports; and, the complexity of care provided in this group is significantly different from the other categories. The added value of extracting those records was not deemed to match the expense that would have been incurred to extract them.

stand-alone hospitals that would exist in the AHA extract. The majority of the facility matches were performed based on facility name, alone. Cases did occur where a match was not possible based on facility name. The next step was to identify a network affiliation of the H&HN record, and match that to a network reported in AHA extract. Given a match with a health network (a parent business organization for a hospital), then a search on network or facility name was run through the American Hospital Directory.[75] A few cases occurred where the H&HN reported organization name was found neither in the AHA extract nor the AHD, at this point an internet search was run through google.com to attempt to identify the facility. These cases identified these reported 'facilities' as distributed health networks without stand-alone hospital facilities and therefore were excluded from the case data panel. Additional exclusions were made of those H&HN reported facilities that were part of US Federal government departments—specifically facilities of the Department of Defense and Department of Veterans Affairs.[76]

The resulting numbers of analytical cases per year were 2775, 2737, 2688, 2662, and 2641, from 1997 through 2001, respectively. Of which, the number of cases of aggressive implementers were 55, 97, 81, 135, 71 over the same period. While each annual H&HN survey[77] reports 100 most aggressive organizations, the variation in identified facilities per year for this study relate to: variation in a hospital's reporting to AHA each year; not including federal facilities; the inclusion of health networks with multiple facilities; the rush in 2000 to avoid the so-called "year 2000" software bug; and, importantly, the affects of merger and acquisition within the sector. See Appendix 4 to view the descriptive statistics of the panel data, and the tabulation of the most aggressive implementers over the period 1999 to 2002 which was used to partition the case data.

Data Pre-Whitening Part of the value of obtaining data from AHA data service was that AHA has maintained the standard hospital survey database for decades. In that

---

[75] American Hospital Directory //www.ahd.com/.
[76] Chapter 2 provides the rationale for the exclusion of Federal government hospitals.
[77] As stated in Chapter 2, the H&HN survey of aggressive implementers is not a peer-reviewed source of comparative analysis. However, the only information used from this source is the reporting of any hospital on the top 100 list any year in the 1997-2002 period.

time, they have developed proprietary methods to verify and gap-fill extraneous survey reports by individual hospital facilities.[78] The AHA data are considered the standard operational and descriptive data source for US hospitals as evidenced by its ubiquitous presence in the hospital based citations in Chapter 2. Extreme cases were neither removed nor otherwise manipulated prior to the estimation process.

The only rule that was applied for pre-whitening the data was for instances where a case contained adjusted patient day data greater than 0.0 and at least one of the FTE categories reported as 0.0. In such instances, the econometric software package would have dropped the entire case from panel to estimate the stochastic frontiers. The specific FTE data element was reset from 0.0 to 0.25 to prevent the loss cases from the panel because the judgment was made that for all practical purposes, the value to 0.25 FTE would not have changed the operational meaning of the data, if in fact the true value was 0.0 FTE, while the value of extracting maximum information from the panel was determined to be high.

The final preparation before regressions were run was to test the panel data for multi-co-linearity among the RHS terms—LNDR, LNRN, LNOTH, and LNBED. Exhibit 4.1 presents the results for the largest cohort of data, the 12,075 hospitals with five-years of data. As can been in the table, the highest correlation exists, 90.3 percent, between the LNRN term and the LNOTH term while the next highest correlation, 83.1 percent, exists between the LNBED and LNOTH terms. These findings could be consistent with staffing patterns in US hospitals in that many facilities have used a staffing algorithm based upon a bed count.

	MW	CLASS	DIVISION	LNDR	LNRN	LNOTH	LNBED	LNAPD
MW	**1.00000**	**.92299**	**-.03203**	**.06580**	**.19346**	**.19961**	**.18031**	**.17661**
CLASS		**1.00000**	**-.02987**	**.05953**	**.17467**	**.18085**	**.16628**	**.16093**
DIVISION			**1.00000**	**-.20450**	**-.05861**	**-.09463**	**-.08319**	**-.16177**
LNDR				**1.00000**	**.37874**	**.43517**	**.34008**	**.37746**
LNRN					**1.00000**	**.90295**	**.79285**	**.73355**
LNOTH						**1.00000**	**.83129**	**.80795**
LNBED							**1.00000**	**.88565**
LNAPD								**1.00000**

EXHIBIT 4.1: Correlation Matrix for 12075 cases with 5-years of data.

[78] AHA Hospital Statistics 2002, Notes to the Survey, page xix.

A possible consequence of the correlation between the LNRN and the LNOTH terms in small sample datasets could be that the estimated parameters for those two terms may be unstable, resulting in biased parameter estimates. However, concerns of estimation bias from this panel are limited due to two factors: 1) the large size of this time-series panel dataset; and, 2) the use of a maximum likelihood estimator satisfies the assumptions of the Gauss-Markov Theorem and it is more efficient than least squares, Greene (2002, p503). If this work was not focused on estimation and interpretation of structural model differences, then a step-wise regression procedure could have been used to explore dropping either the LNRN or LNOTH term from the final model. Again, the purpose of maintaining the detailed specification was to explore structural differences in productive efficiency among the sample partitions and to explore differences among the relationships of the intangible assets. It was assumed that any risk of bias was worth the ability to perform full structural specification testing. The next section presents the empirical results of the stochastic frontier estimations and a discussion of findings.

4.1.3 Exploring Structural Differences

In pursuit of answering research question 1 Do the most aggressive implementers of IT exhibit greater economic efficiency than the rest-of-the-sector?, the econometric results of testing the estimated models for various structural differences are presented. LIMDEP© version 8.0 software[79] was used to perform the econometric procedures for the Cobb-Douglas (C-D) extension, the General Leontief (GL) and the transcendental logarithmic (TL) models.

[79] LIMDEP Version 8.0, 2002, Econometric Software, Inc., Plainview, NY, USA www.limdep.com.

LOG LIKELIHOOD VALUES: Alternative Estimation Techniques, Functional Forms, and Error Distributions

Stochastic Frontier (Maximum Likelihood Estimators)

			Error Distribution Assumptions		
Form	**Group**	**Cases**	**HN**	**Exp**	**TN**
CD	*0*	12463	654.0	493.5	998.2
CD	*1*	1040	375.0	368.2	377.0
	SSR		*1,029.1*	*861.7*	*1,375.2*
	Pooled	13503	947.4	779.2	929.8
	Pooled-SSR		*(81.7)*	*(82.6)*	*(445.3)*
TL	*0*	12463	166.2	(59,569.8)	182.4
TL	*1*	1040	204.8	229.5	200.8
	SSR		*371.0*	*(59,340.3)*	*383.2*
	Pooled	13503	(2,800.6)	248.0	282.9
	Pooled-SSR		*(3,171.6)*	*59,588.3*	*282.9*
GL	*0*	12463	(72,271.0)	(213,571.0)	N/A
	1	1040	N/A	N/A	N/A

EXHIBIT 4.2: Results from Stochastic Frontier Procedures.

Exhibit 4.2 presents the econometric results in the form of the log likelihood estimate for each of the six regression models estimated: the C-D, TL, and GL models for both the rest-of-the-sector and the most-aggressive-implementers partitions of the cases. Each of the six models had a maximum of three specifications to accommodate the standard error term assumptions.

SELECTION OF PREFERED MODEL BASED UPON LIKELIHOOD DOMINANCE CRITERION*

Stochastic Production Function Techniques, Panel Form

	Model Choice	Chi-Squared Test Statistic							
Partition	**M2 - M1**	**Half Normal**	**Exponential Normal**	**Truncated Normal**	**# Betas M1**	**# Betas M2**	**Estimated Chi2 Critical Range**		**Dominance Decision(s)**
0	GL - CD	*(72,925.0)*	*(214,064.5)*	*n/a*	5	11	*4.2*	*5.1*	CD-HN, CD-EN, CD-TN
	TL - CD	*(487.8)*	*(60,063.3)*	*(815.8)*	5	15	*7.2*	*8.2*	CD-HN, CD-EN, CD-TN
	CDEN - CD HN	*(160.5)*			5	5	*0.0*	*1.7*	HN
	CDTN - CD EN		*504.7*		5	5	*0.0*	*1.7*	TN
	CDTN - CD HN			*344.2*	5	5	*0.0*	*1.7*	**TN**
1	GL - CD	*n/a*	*n/a*	*n/a*	5	11	*4.2*	*5.1*	CD-HN, CD-EN, CD-TN
	TL - CD	*(170.3)*	*(138.7)*	*(176.2)*	5	15	*7.2*	*8.2*	CD-HN, CD-EN, CD-TN
	CDEN - CD HN	*(6.8)*			5	5	*0.0*	*1.7*	HN
	CDTN - CD EN		*8.8*		5	5	*0.0*	*1.7*	TN
	CDTN - CD HN			*2.0*	5	5	*0.0*	*1.7*	**TN**
Pooled	GL - CD	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	CD-HN, CD-EN, CD-TN
	TL - CD	*(3,748.0)*	*(531.1)*	*(647.0)*	5	5	*0.0*	*1.7*	CD-HN, CD-EN, CD-TN
	CDEN - CD HN	*(168.2)*			5	5	*0.0*	*1.7*	HN
	CDTN - CD EN		*150.7*		5	5	*0.0*	*1.7*	TN
	CDTN - CD HN			*(17.5)*	5	5	*0.0*	*1.7*	**HN**

* Pollak & Wales(1991) *Journal of Econometrics* (47), pp227-243

EXHIBIT 4.3: Structural Differences using Likelihood Dominance Criterion.

The resultant work was a total of eighteen possible regression models to estimate. Estimates for the GL model were undefined within partition 1, as was the GL model with truncated normal error term assumptions. The interpretation was to expect to drop the GL model as an appropriate form for this panel. This expectation was validated when formal statistical testing was performed on the regression models to identify a dominant form. Exhibit 4.3 shows the likelihood dominance criterion[80] results used to identify best functional form for each partition. To summarize Pollack and Wales (1991) the likelihood dominance criterion is calculated by subtracting log likelihood values of presumed to be nested models. A series of conditional tests are constructed *a priori* to determine which model dominates and the test statistic is calculated as a bounded Chi^2 area. When using the stochastic frontier technique within this panel, the C-D half-normal and truncated-normal forms

[80] See Pollack, R. and T. Wales (1991). "The Likelihood Dominance Criterion, A New Approach to Model Selection." Journal of Econometrics **Vol. 47**: pp227-42., for the formal definition and explanation of the Likelihood Dominance Criterion as the preferred statistical test when choosing a dominant model specification among a series of model forms.

dominated both partitions in the sample. Therefore, the TL and GL forms and the C-D exponential form were dropped from further analysis.

In addition to the primary analysis of production models, ANOVA tests[81] were conducted testing for differences by US Census Division region and by an unexpected classification, developed based upon a qualitative review of consolidated list of aggressive implementers[82], to reflect both the degree of commitment to aggressive IT implementation and the timing of the commitment, labeled – investment strategy class. Six classes were identified within partition 1:

- *Pioneer-High Commitment* – hospitals that achieved aggressive implementer status every year from 1999-2002;
- *Pioneer-Moderate Commitment* – hospitals that achieved aggressive implementer status at least twice between 1999-2002;
- *Pioneer-Low Commitment* – hospitals that achieved aggressive implementer status once in either 1999 or 2000;
- *Bandwagon-Moderate Commitment* – hospitals that achieved aggressive implementer status in 2000 and 2002;
- *Bandwagon-Low Commitment* – hospitals that achieved aggressive implementer status in 2001 only; and,
- *Follow-the-Leader* – hospitals that achieved aggressive implementer status in 2002 only.

Exhibit 4.4 presents ANOVA results from testing for structural differences by implementation strategy class for both the half-normal and truncated normal forms of the extended Cobb-Douglas form.

[81] Tests performed using SPSS version 11.0.
[82] See Appendix 4.2 to see the consolidated list.

			Sum of Squares	Df	Mean Square	F	Sig.
CDHN * Class	Between Groups	(Combined)	19.963	6	3.327	143.866	.000
	Within Groups		312.112	13496	.023		
	Total		332.075	13502			
CDTN * Class	Between Groups	(Combined)	2.346	6	.391	72.552	.000
	Within Groups		72.727	13496	.005		
	Total		75.073	13502			

EXHIBIT 4.4: Pooled Sample—One-way ANOVA Inefficiency Scores by Functional Form by Implementation Strategy Class (Class = 0-6).

In asking the question, *are there structural differences in the functional form by implementation strategy class*, the answer is a strong – yes. This is evident from the calculated F-test statistics, which are significant at greater than 99.9 percent level of confidence. The interpretation of this finding was that the efficiency functions vary across the pooled panel. The next question was to ask if there were intra-partition structural differences. Exhibit 4.5 presents the descriptive statistics of the efficiency functions within the two partitions of the panel.

	Partition	N	Mean	Std. Deviation	Std. Error Mean
CDHN	1	1040	.312134868	.0928177771	.0028781571
	0	12463	.455918508	.1560010112	.0013973851
CDTN	1	1040	.063583373	.0666677630	.0020672796
	0	12463	.112473235	.0739557393	.0006624614

EXHIBIT 4.5: Grouped Sample—Descriptive Statistics for Inefficiency Scores by Sample Partition (0 versus 1).

A two-step method was used to test for intra-partition structural differences – testing for equality of variance and equality of means. Exhibit 4.6 present the results that show the means and variances between the data partitions, within each functional form, are statistically different at greater than a 99.9% level of confidence.

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F Stat	Sig.	T Stat	df	Sig. (2-tailed)
CDHN	Equal variances assumed	135.425	.000	-29.293	13501	.000
	Equal variances not assumed			-44.940	1579.250	.000
CDTN	Equal variances assumed	12.384	.000	-20.631	13501	.000
	Equal variances not assumed			-22.521	1262.234	.000

EXHIBIT 4.6: Grouped Sample—Independent Samples Test.

Both the sample variances and the sample means are significantly different at a probability greater than 99.9% confidence. This is strong evidence of structural differences in hospital inefficiency scores across the pooled panel data set. This finding is consistent with Lee and Menon (2000) who found that hospitals that exhibited high technical efficiency over an eighteen-year period also used a greater amount of IT capital than those hospitals exhibiting lower technical efficiency. The findings of this thesis are different in that the discriminating factor of the partition 1 hospitals is not simply amount of IT capital but also aggressiveness of functional integration of IT into clinical and business functions. Therefore, the partition 1 hospitals of this analysis would be a sub-set of the high technical efficiency hospitals of Byungtae and Menon.

ANOVA: Inefficiency Scores by Partition by Census Division Regions

			Sum of Squares	df	Mean Square	F	Sig.
CDHN * MW	Between Groups	(Combined)	19.845	1	19.845	858.095	.000
	Within Groups		312.230	13501	.023		
	Total		332.075	13502			
CDTN * MW	Between Groups	(Combined)	2.294	1	2.294	425.626	.000
	Within Groups		72.778	13501	.005		
	Total		75.073	13502			

EXHIBIT 4.7: Pooled Sample—ANOVA of Efficiency Scores.

The question then was, *are there structural differences driven by region*? Exhibit 4.7 presents the corresponding ANOVA across the panel. The results from the pooled data set suggested that there were strong regional differences among the efficiency scores at a greater than 99.9% level of confidence. The finding of strong regional differences in the pooled data leads to the question of whether the differences held on an intra-partition basis, as well.

ANOVA: Inefficiency Scores by Strategy Class for Partition 1

		Sum of Squares	df	Mean Square	F	Sig.
CDHN	Between Groups	.118	5	.024	2.759	.017
	Within Groups	8.833	1034	.009		
	Total	8.951	1039			
CDTN	Between Groups	.051	5	.010	2.329	.041
	Within Groups	4.567	1034	.004		
	Total	4.618	1039			

EXHIBIT 4.8: ANOVA Inefficiency Scores by Strategy Class for the Most Aggressive Implementers.

Exhibit 4.8 shows that the most aggressive implementers did have intra-partition structural differences, at greater than 95% level of confidence, within their efficiency function estimates. This finding led to the question of whether there were structural differences by region within the partition. While this question is not core to the developing the thesis, it does present potentially useful insight into regional performance variation. There is anecdotal discussion of inter-regional demand for care differences and certainly there are differences in the implementation of health care business models across the country[83] but no literature was found related to efficiency differences at a regional level. While all of the regional data can be found in Appendix 4, Exhibit 4.9 presents the inefficiency scores for partition 1.

[83] See Chapter 2 for discussion of regional differences.

DIVISION	CDHN	CDTN
New England	.258567	.052208
Middle Atlantic	.282702	.056217
South Atlantic	.286220	.054211
East North Central	.303375	.059245
East South Central	.319851	.060331
West North Central	.310194	.055041
West South Central	.324309	.061222
Mountain	.282914	.052912
Pacific	.321399	.058298
Pooled Partition 1	.299622	.057130

EXHIBIT 4.9: Partition 1: Regional Differences in Efficiency.

These inefficiency scores tend to fall within expectations based on the literature such as Rosko (2001) and Brown (2002) that found efficiency to be associated with positive increases in regional managed care market share.[84] For example, managed care market is highest in the southeast and the geometric average inefficiency score for hospitals in the South East region, 28.6 percent or 5.4 percent based on the model, is among the lowest of the panel. However, the Pacific region also tends to have high managed care market penetration but its average inefficiency score is the highest of the panel. This apparent anomaly may be driven by the relative concentration of managed care enrollees in the few population dense metropolitan statistical market areas in the Pacific region thereby diluting the effects of managed care on efficiency when aggregated to the Census Division region.[85]

Overall the findings reveal that the most aggressive implementers ARE more efficient in production than the rest of the sector. Interestingly, it was found that within the aggressive group there were unexpected patterns of performance.

[84] See Chapter 2 for the extended discussion.

[85] Broadly speaking, managed care market share is a local phenomenon that can vary within small distances across the country.

Exhibit 4.10 presents the results of both partition 0 and partition 1 and segregated strategy classes within partition 1, which was comprised of 204 unique facilities -- those repeat achievers over the 5-year period.

Ranking of Inefficiency Scores By Strategy Class				
	Partitioned (C-D TN) Estimates			
CLASS	**N**	**G-MEAN**	**RANK**	**Gain**
0) Rest-of-the-Sector	13501	10.5%	7	
Most Aggressive - Sub-groups Based on Timing Strategy				
1) Pioneer-High Commitment	48	5.7%	*3*	*4.8%*
2) Pioneer-Moderate Commitment	44	5.9%	*5*	*4.6%*
3) Pioneer-Low Commitment	50	5.4%	*1*	*5.1%*
			3.0	**4.8%**
4) Bandwagon-Moderate Commitment	19	6.2%	*6*	*4.3%*
5) Bandwagon-Low Commitment	13	5.7%	*4*	*4.8%*
6) Follow-the-Leader	30	5.5%	*2*	*5.0%*
	204		***4.0***	**4.7%**
Class 1-6 represent 11.4% of Adjusted Patient Days in the Panel				

EXHIBIT 4.10: Aggressive High Commitment Strategy May Not Payoff.

Within the dominant Cobb-Douglas TN models specified, those aggressive implementers in the top half of the partition, classes 1-3, yielded an average class rank of 3.0 and an average efficiency gain of 4.8 percentage points over the rest of the sector, based upon 142 cases. However, the bottom half, classes 4-6, yielded an average class rank of 4.0 and an average efficiency gain of 4.7 percentage points over the rest of the sector, for 62 cases. If one were to view these results in terms of a Monte Carlo experiment,[86] the question would be how much a hospital would be willing to pay in terms of maintaining aggressive implementation of IT to achieve a probabilistic certainty of an efficiency gain of 0.1 percentage point over those that employ late entry strategies. While all 204 hospitals in partition 1 were more aggressive in IT implementation than the average US hospital, the top 142 hospitals were exhibiting the characteristics that Porter (1998, pp267-268) identified as leadership tactics in declining industries by investing in aggressive competitive actions, demonstrating a strong commitment to staying in the business, demonstrating clear superiority of competitive strengths, raising the stakes for

[86] This question does not assume causality between IT implementation and efficiency gains.

competitors to stay in markets, and using technology to provide information to stakeholders that reduced their uncertainty.

The results in Table 4-10 also present an interesting comparison to Folland and Hofler (2001) who found inefficiency scores of between 10.9 and 12.7 percent using Cobb-Douglas stochastic frontier on 1985 case data. They did not report the distributional assumption (HN, EN or TN) that was used to generate their results but from the likelihood dominance criterion results over this pooled panel (Table 4-3), the half normal distributional form was dominant.[87] The first reading would be that the vast majority of US hospitals have essentially more than tripled their overall inefficiency score since 1985. What is a more likely implication, however, is that the major shift in medical workload to ambulatory care settings that has occurred since 1985, is not fully captured in the adjusted patient days, the left hand side variable, generating specification bias in the time-series 1997 to 2001 estimates when compared to the cross-sectional 1985 estimates. However, when the data are partitioned, the TN form was dominant for each partition and the TN estimates provide a story that suggests that the vast majority of hospitals have somewhat improved their overall efficiency from an average of 11.8 percent to an average of 10.5 percent. While a small group of hospitals have achieved a halving of their inefficiency score from the average of 11.8 percent to 5.7 percent representing a gain that would be consistent with striving for market leadership. However, to restate, the purpose of the current estimate was to generate relative performance differences within the constructed panel data set to answer research Question 1. Therefore, the comparative difference with Folland generates an interesting opportunity for future extension of this work. The maximum likelihood stochastic frontier technique used generates an estimate of technical inefficiency. These estimates reflect the percentage by which a particular hospital fails to achieve the frontier, *the ideal production rate*[88], *based* upon each hospital's unique technical inefficiency characteristics.[89]

---

[87] See Table 4-3, the test statistical value of (-17.5).

[88] Greene(2002, pp.501-502)

[89] The thesis does not consider either overall economic efficiency or allocative efficiency but these topics could be topics for future work.

The next section provides a brief exploration of the dynamics found in the productive relationships among the RHS of the models. As shown in Exhibit 4.11, when comparing elasticity estimates within the same form of the frontier models, there are at least two interesting phenomena that emerge.

Estimated FTE Coefficients			
	Paritioned (C-D TN) Estimates		
	P0	P1	Diff
LNDR	0.00572	0.00303	-47.0%
LNRN	0.02136	0.03950	84.9%
LNOTH	0.18031	0.18053	0.1%
LNBED	0.70808	0.70690	-0.2%
Returns To Scale	*0.9155*	*0.9300*	1.6%

EXHIBIT 4.11: Estimated Coefficients from Frontier Functions.

The first finding is the difference in the relative mix of labor used to deliver health care within the two partitions. For the rest of the sector (partition 0), the labor elasticity of Clinician FTEs was 47 percent higher than that of the most aggressive implementers (partition 1). The labor elasticity of Registered Nurses was 85 percent higher in partition 1 than partition 0. Structurally, the elasticities of Other labor FTEs and the capital stock were equivalent across the panel and the returns to scale were 2 percent higher in partition 1 than the rest of the sector. Thus, by comparison with the rest of the sector, the more efficient, IT-intensive, hospitals have reduced their dependency on the contribution of clinicians while increasing the combined output of the bundle of clinicians and RNs.[90]

This finding could have an important impact on the success or failure of a hospital's business model as most clinicians in the US are not directly employed by a given hospital but, instead, are allied with one or more facilities in a given region. By having a productive workflow that requires fewer FTE clinicians to generate a higher volume of medical output, the adjusted patient day, a hospital can create a potential strategic advantage around its core clinical staff (clinicians and registered nurses) labor inputs.

[90] The returns to scale among clinicians and RNs was 0.027 for the ROS compared with .0430 for the aggressive implementers – a 59% output differential.

This finding represents a fundamental change in the management paradigm of the hospital sector. Much of the literature on hospital efficiency published through the early 1990s dealt with increasing volume as the sole imperative of strategic performance. The finding that a group of hospitals has reduced its required structural input from clinicians to produce an increased rate of output could be important, strategically valuable, if the characteristic nature of that output also is aligned with the strategic imperatives of the sector. The roles among the intangible assets of the hospital, of which clinicians and RNs are the most expense to acquire and maintain, are not simple linear relationships; neither is it a simple process of downgrading care standards. In these conditions, increased capital investment will generate strategic value only if it allows a complex transformation of the relationships among the intangible assets required to create a higher qualitative standard of care delivered.

This finding also may signal a fundamental characteristic of a hospital for dynamic efficiency and sustained competitive advantage. In considering dynamics, it may be necessary to extend the Neoclassical Theory of the Firm to include a resource-based view of the firm where the resources of production are not free-standing entities but tightly bound to the firm.[91] Stated in this way:

> *"Resources are not in general free-standing entities; they are tightly bound to firms. They can be accessed and exchanged – but generally through complex interfirm transactions. Resources are bundled together into firms – with the prime challenge for the firm being to build synergies between the resources to ensure distinctiveness and generate entrepreneurial profits." (Matthews (2002, page 2)*

Dynamic efficiency as constructed in Matthews (2002), therefore, is related to the success or failure of a hospital to continually adjust both the types of resources developed/acquired but also the bundles of those resources applied to productive processes. Matthews calls the characteristic of a hospital to make these adjustments *adaptive capacity.*[92] Adaptive capacity is the driver in determining whether a firm will be able to develop/acquire the bundles of resources necessary to sustain competitive advantage.[93] Firms then compete in their ability to

[91] Matthews (2002, page 2).
[92] Matthews (2002, page 5).
[93] Matthews (2002, page 6).

develop/acquire those bundles of resources that can generate strategic advantage.[94] Over time:

> *"Firms are competing with each other, at the most basic level, through emulation, variation and substitution of each other's resources. It is the competitive struggle over resources that may be viewed as the fundamental driving force of the capitalist economy." (Matthews (2002, page 9).*

This model is also consistent with Schumpeter's *creative destruction*[95] where resource imitation, resource transfer and resource substitution are the actions that create competitive advantage. Any actions related to making those resources proprietary, increases the expected longevity of the competitive advantage for the firm.[96] Matthews uses the phrase *reliable imitability* for the action of challenger firms in choosing the most opportunist market segment to enter based upon its assessment of its ability to acquire/develop the necessary bundles of resources to be successful by imitating those firms with competitive advantage.

To return to our hospitals that have created competitive advantage in their combination of clinician and registered nurse FTEs, the next moves in the evolution of the sector will determine whether the efficiency gains are temporary or sustained (static or dynamic). If the hospitals in the efficient partition continue to make the decisions to allocation and acquire resources to drive efficiency, they would at least maintain their advantage if not continue to increase their efficiency differentials over the ROS. If the hospitals in the ROS begin to adopt a reliable imitability strategy, then some may be able to close the gap in static efficiency with the other partition of hospitals. However, what is most likely is that multiple permutations of outcomes will be observed over time in the sector. That is, some partition 1 hospitals will continue to innovate their bundles of resources while others will stand still. At the same time, some of the ROS will adopt the imitation strategy while others will continue to founder. Based on what is found in Chapters 4.2 and 5, it is likely the some of the hospitals in investment strategy classes 1,2 and perhaps 4 or 5 will continue to

---

[94] See also Barney, J. (1991). "Firm Resources and Sustained Competitive Advantage." Journal of Management 17(1): 99-120. for a paper that baselines the detailed concepts associated with competitive advantage in a resource-based view.
[95] Schumpeter, J. (1975 (1942) (pp.82-85)). Capitalism, Socialism and Democracy New York, NY, Harper. See also discussion in Chapter 6.3.
[96] Matthews (2002, pp. 10-11).

execute strategies to innovate their resource bundles. For the others, the sector's history of increasing merger and acquisition behavior[97] will sort out the successful innovators from the less effective innovators.

The second finding may be contradictory to management expectations of IT implementation to streamline business office and administrative support functions across the hospital. The elasticity of the Other Labor – the technicians, business office staff, and other non-clinical support staff – is not statistically different between the partitions. These are activities that have mostly sequential task dependency without requiring clinical judgment and they have been aggressively automated within hospitals.[98] This finding may just be revealing a nearly complete independence of the non-clinical staff to the flow of workload within a hospital; however, this category does include several gate-keeper types of labor roles that would have influence on timing of workload but perhaps not a significant affect on flow over the course of a year.[99]

The overall interpretation of these results is that while the hospitals in partition 1 are demonstrably more efficient than those in partition 0, they have also reduced their dependency on the clinician labor category to achieve this level of output when compared to partition 0. This finding could have an important impact on the success or failure of a hospital's business model as most clinicians in the US are not directly employed by a given hospital but instead they are allied with one or more facilities in a given region. By having a productive workflow that requires fewer clinician FTEs to generate a higher volume of medical output, the adjusted patient day, a hospital would have created a potential strategic advantage around its core, most highly skilled clinical staff labor inputs. As documented in Chapter 2, much of the literature on hospital efficiency published through the early 1990s, dealt with increasing volume as the sole imperative of strategic performance which is only consistent in a fee-for-service reimbursement business model with small variable

---

[97] See Chapter 1.

[98] E.g. Business office support, insurance claims verification, processing and collection, appointment scheduling, logistics management, etc. Chapters 4.3 and 4.4 explore this further.

[99] Labor roles such as admission, insurance approval, medical record collection and management, etc.

costs (which was the near universal operational definition). Consequently, the finding that a group of hospitals have reduced their required structural input from clinicians to produce an increased rate of output is strategically valuable if the qualitative characteristics of that output are also aligned with the strategic imperatives of the sector – to avoid unintended consequences.[100]

As discussed in Exhibit 3.3, the roles among the intangible assets of the hospital are NOT linear relationships, nor is it a simple process of downgrading care standards. If the hypothesized strategic value model holds, the increased capital investment would generate strategic value ONLY if it allows a complex transformation of the relationships among the intangible assets required to create a higher qualitative standard of care delivered.

In response to research question Q1: ***"Do the most aggressive implementers of IT exhibit greater economic efficiency that the Rest-of-the-Sector?"***

The most aggressive hospitals were more efficient in production, they generated more output per unit of inputs, and they appear to have created several sources of strategic value within their operations compared to the rest of the sector. However, if the qualitative aspect of the output of partition 1 hospitals has not been transformed to match the strategic market needs identified in the strategy map in Exhibit 3.9, then these findings may not be indicative of strategic value. What has been found is an exceptional level of investment in information technology capital and associated substitutions of labor inputs in the generation of healthcare services. One interpretation of this finding is in the partition 0 sample, the hospitals could have exceptional bottle-necks in workflow and other forms of inefficiencies within the mechanisms and systems[101] that exist within their work. Another implication could be that the work flow on the partition 0 hospitals has resulted in significantly more task inter-dependencies on RN FTEs that result in a lumpier productive

---

[100] For example, a hospital could exhibit higher efficiency by switching service lines offer to less complex care or by reducing the quality of care given both NOT considered in alignment with the strategic imperatives explored in Chapter 1.

[101] These would include the physical mechanisms and systems and the soft ones as well such as standard operating procedures, policies, work place guidance, etc.

relationship than in partition 1. The analogy that comes to mind is that of adding more sand to the top half of an empting hour glass, at some point, the sand will clog and stop falling if no intervention is made to re-direct the flow of sand in an orderly flow.

Chapter 4.2 evaluates whether exceptional strategic value is also associated within the partition of aggressive IT implementers. If it is not, then the substitution of IT capital for labor has only an efficiency effect for those hospitals and NOT a transformational strategic effect. This issue was examined by Hitt and Brynjolfsson (1996) where they found that *while productivity, consumer value, and business profitability are related, they are ultimately separate questions.* Fundamentally, this is the thesis of Kaplan and Norton (1992) behind their construct of a *balanced scorecard:*

> *"Executives also understand that traditional financial accounting measures like return-on-investment and earnings-per-share can give misleading signals for continuous improvement and innovation." (Kaplan and Norton (1992, page 1).*

They continue by stating that *no single measure can provide clear performance target of focus attention on critical areas of the business.* As the US hospital sector seeks to deal with the financing, cost growth, and customer demands for improved clinical quality, a balanced set of performance measures would enable the evaluation of cross-functional measures that would serve as indicators of a hospital's progress in achieving the qualitative gains for which the sector is seeking.

The ability to capture those qualitative improvements may be linked to the economics of information and communications.[102] Bryniolfsson, Hitt et al. (2002) found a complementarity between the use of IT and changes in organization. However, there is a multiplier cost to implementing IT:

> *"Although the organizational complements ar valuable and, in some case, even essential to the success of the IT innovations, implementing organizational changes is costly and risky, yielding both successes and failures. Both the case evidence and the econometric results suggest that the costs of these organizational complements to IT investments typically exceed the direct financial costs of the IT investments themselves. Importantly, although many of these organizational practices may be readily visible to competitors and are*

[102] Brynjolfsson, Hitt, and Yang (2002, page 143).

copiously documented in articles by business school professors and consultants, they are notoriously difficult to imitate successfully." (Brynjolfsson, Hitt, and Yang (2002, page 144).

In this way, their discussion of the difficulties of imitators to copy bundles of intangible assets from a successful competitor is aligned with the resource-based view of dynamic efficiency discussed above. Chapter 4.2 examines the issue of whether strategic advantage was gained[103] from aggressive IT implementation.

4.2 Pass 2 – The Strategic Evaluation of Performance

This section presents the strategic evaluation of performance using a Balanced Scorecard (BSC) framework. As discussed in Chapter 2 the use of such a framework is consistent with the growing body of strategic management literature emerging from the health sector. While the use of a scorecard approach is grounded within the literature, the unique aspect of the work developed in this section relates to three characteristics: 1) this work developed a strategy architecture for the US hospital sector based upon the environmental assessment conducted in Chapter 2.2 and the experiential knowledge gained by the author in a 17-year career in the sector; 2) the focus of the strategic value generated with information technology; and, 3) none of the papers cited in Chapter 2.2 discussed the actual evaluation of performance using data from one or any number of hospitals—they instead focus on the use of the tool in the context of strategy development and communication. This work was also grounded in the on-going process of working in the health care sector with other managers, analysts and other stakeholders. Periodic efforts were made to discuss with clients and other colleagues the fundamental issues involved in developing a relevant strategic performance framework. These conversations ranged from informal discussions related to availability and quality of data, to focused conversations related to specific topics of the linkages among strategic intent, tangible process improvements and measurable effects. While there was no formal process used to manage this aspect of the research, these forms of professional interactions continue to serve to ground the development and execution of the evaluation.

[103] Gains within the value-chains linking efficiency gains to process gains, market share gains, and eventually financial gains.

The remainder of this section presents the strategy architecture that was developed by the author and tests the results over the period 1997-2004 by extending the panel data set used in Chapter 4.1. The first step is to describe the architecture developed to test the framework.

4.2.1 Strategy Architecture and Maps

The architecture and strategy maps presented in this section were developed inferentially by the author. The purpose of the maps was to define strategic objectives facing both partitions of the data panel in which data could be obtained and then evaluated for differential performance. In the lexicon of Kaplan and Norton (1992), the *strategy architecture* is constructed with an eye to critical review of the following questions: *how do customers see us? What must we excel at? Can we continue to improve and create value? How do we look to shareholders?* Their focus (p79) was to identify those measures that will drive the organization forward by putting strategy and vision at the center of attention, not financial control. The strategy architecture is developed by defining strategically meaningful perspectives of the performance of an organization, perspectives that are designed to capture the intrinsic value of the organization from the point of view of the important stakeholders of the organization. Kaplan and Norton (p72) presented four-perspective architecture as the archetype – Customer perspective, Financial perspective, Internal Business Process perspective and the Learning & Growth perspective. Exhibit 4.12 presents the strategy architecture developed to test the focal theory of this thesis. The architecture is a multi-function planning device intended to be used to identify stakeholders and develop performance objectives during the planning phase and to serve as a communication device during the execution phase.

Strategy Architecture

Strategic Architecture:
Testing Hypotheses of Strategic Value and IT in the US Hospital Sector

External Customer Perspective

External Customers of US hospitals are patients, the regional community, external donors, and oversight agencies.

Financial Perspective

The Financial Perspective focuses on current account, capital account and resource stewardship.

Internal Business Process Perspective

The Internal Business Process Perspective is the space where both clinical care and medical quality assurance are provided.

Learning & Growth Perspective

The Learning & Growth perspective is the space where human capital and organizational capital—care guidelines, organization polices and procedures, and internal mechanisms, systems, and controls to manage operations and deliver care—are developed, integrated, and proliferated.

EXHIBIT 4.12: Strategy Architecture for US Hospitals.

Kaplan and Norton (2000) expanded the BSC framework by explicitly presenting the use of *strategy maps* to target and refine enterprise strategy. In this sense, strategy maps can be the most visible aspect of a BSC implementation as they tend to be the objects that are most widely published within an organization. Exhibit 4.13 presents the Short-term Survival map.

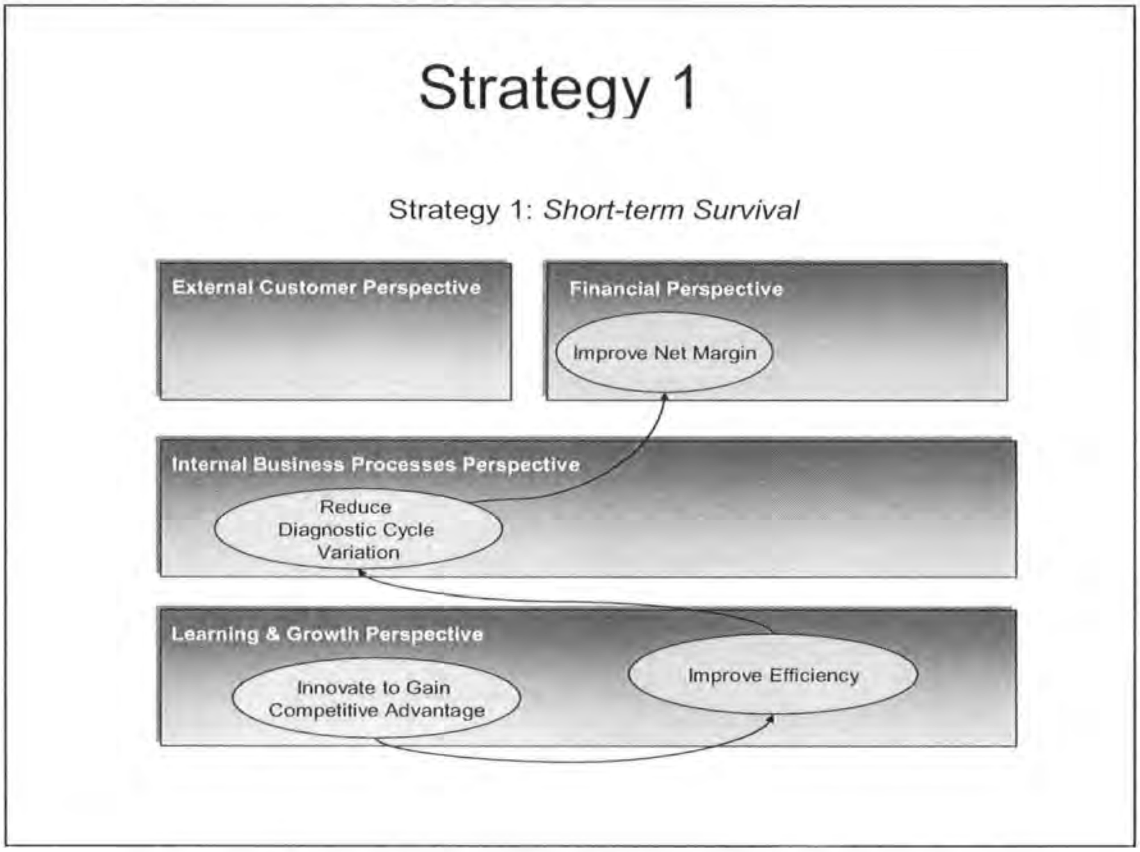


EXHIBIT 4.13: Strategy Map 1 "Short-Term Survival".

This map depicts the strategy resulting from the historic low period of operating margins within hospitals. Due to several compounding factors of revenue realization and cost structures, hospital management is faced with a drive to innovate within its organizational, human capital, and information capital to gain advantage. The intent is that innovation will affect efficiencies that would standardize cost variations in diagnostic cycles, resulting in improvements in net margin. Exhibit 4.14 presents the Strive for Clinical Excellence map.

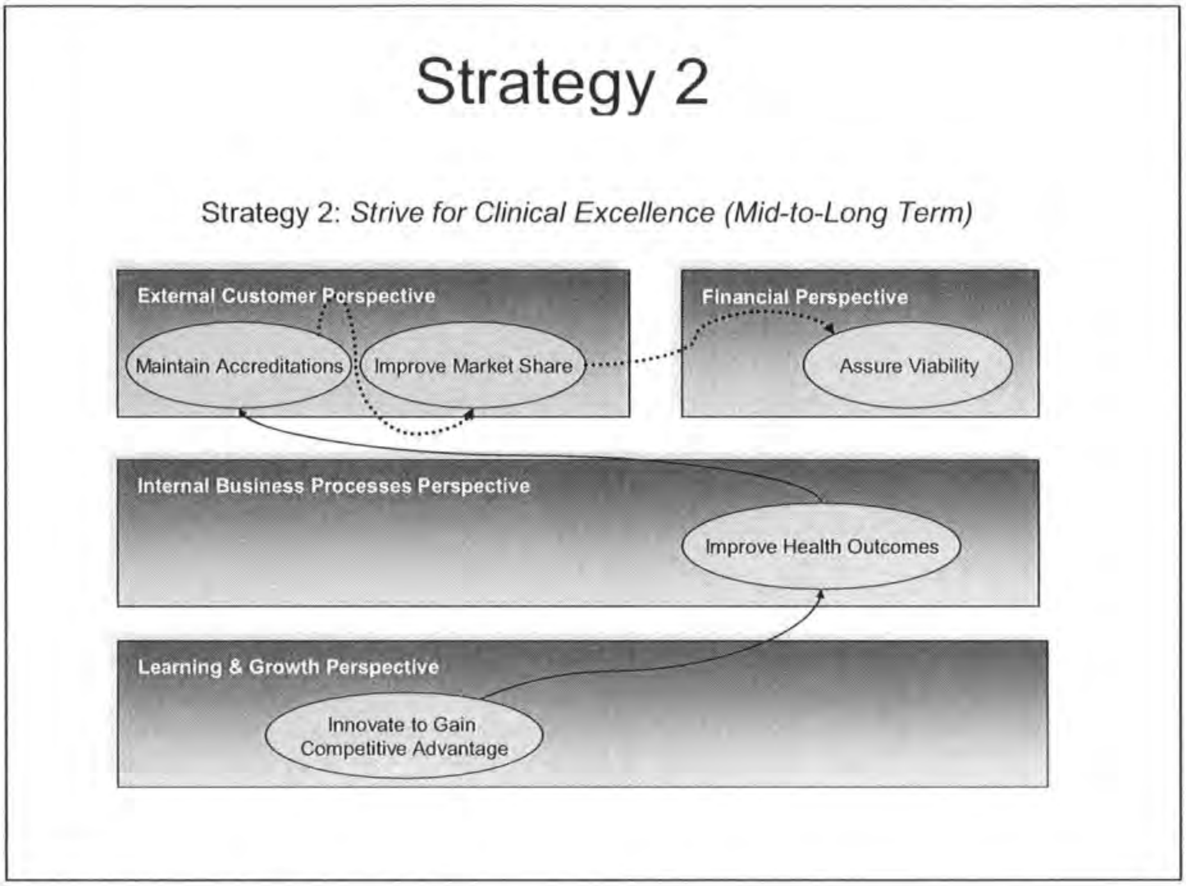


EXHIBIT 4.14: Strategy Map 2 – "Strive for Clinical Excellence".

Strategy map 2 reflects the author's model of the mid-to-long term drive within the US health sector to improve clinical outcomes and to improve population health management. This strategy is implemented by innovating within organizational, human and information capital to gain competitive advantage that is intended eventually to improve health outcomes and maintain accreditations; with an additional lag there are expectations of improvements in market share and assured long-term viability.

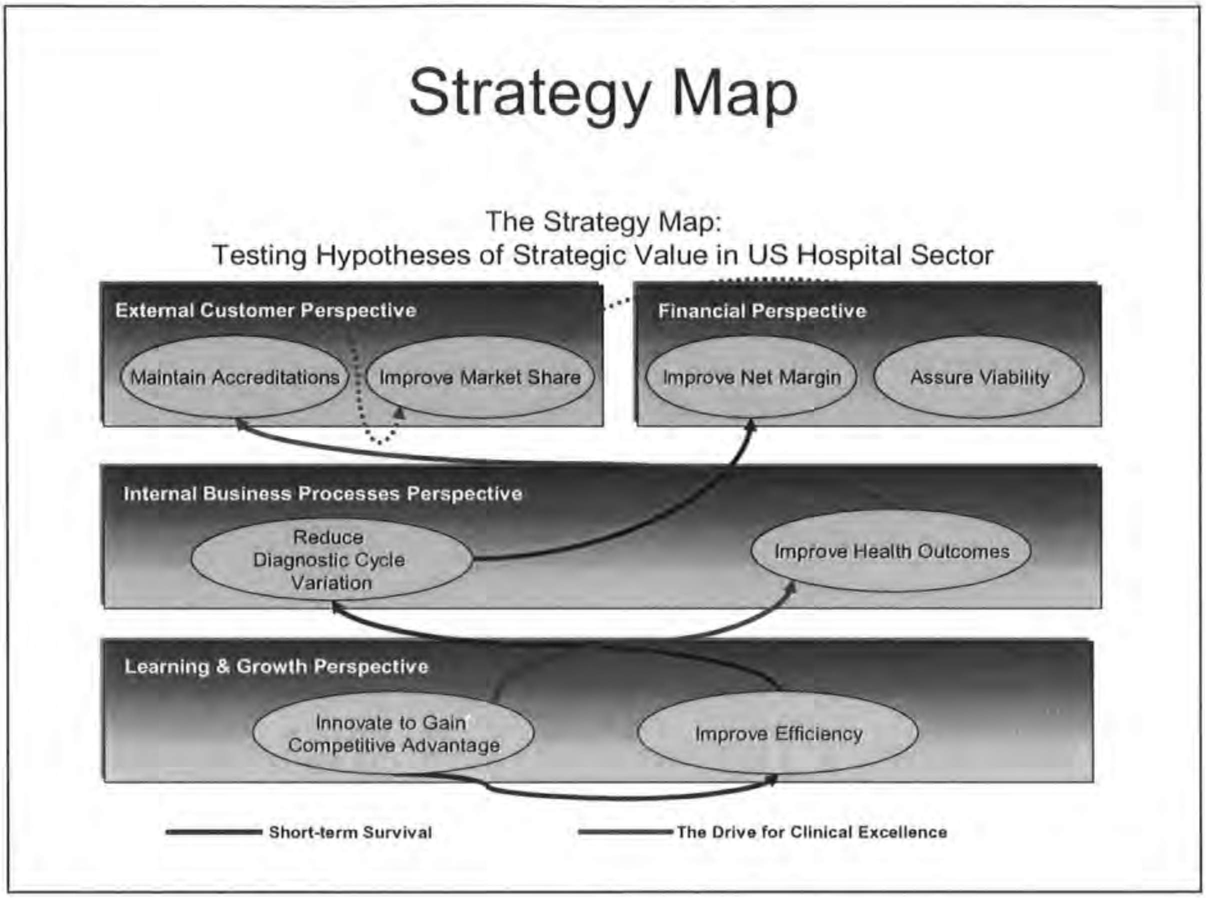


EXHIBIT 4.15: The Integrative Strategy Map.

Exhibit 4.15 reflects the author's model of the complex and contingent nature of strategic planning within the US hospital sector as simultaneous and sometimes conflicting initiatives are occurring. This is the strategy map that is used to test for performance differentials across the sector. The operational measures and longitudinal evaluation is discussed in the next section.

4.2.2 Defining Scorecards & Longitudinal Evaluation

This section discusses the operational measures that were used to populate the scorecards from the US hospital sector over the period 1997 – 2004. The difficulties in populating the scorecards with measures was multi-fold: measures needed to be stable in terms of operational definition over the period, measures needed to be available for a plurality of hospitals in the data panel, measures needed to be available from a reputable source, etc. Perhaps most importantly for this phase of the thesis, the intended use of the measures within the scorecards needed to comport with the generally accepted meaning of the measures within the sector; for the most part, this requirement on the measures was considered to be the most important component of measurement validity. There was no interest in, or intent to impute a meaning to an available measure that did not comport with its general use in the sector.

The next section presents the scorecards developed to test the focal theory through the longitudinal evaluation of the scorecards across the data partitions and strategy classes. As a reminder, six strategy classes were identified within partition 1:

1) *Pioneer-High Commitment* – hospitals that achieved aggressive implementer status every year from 1999-2002;
2) *Pioneer-Moderate Commitment* – hospitals that achieved aggressive implementer status at least twice between 1999-2002;
3) *Pioneer-Low Commitment* – hospitals that achieved aggressive implementer status once in either 1999 or 2000;
4) *Bandwagon-Moderate Commitment* – hospitals that achieved aggressive implementer status in 2002 and 2002;
5) *Bandwagon-Low Commitment* – hospitals that achieved aggressive implementer status in 2001 only; and,
6) *Follow-the-Leader* – hospitals that achieved aggressive implementer status in 2002 only.

The remainder of this section discusses the scorecards developed for this thesis and the longitudinal evaluation using the scorecards. The order of discussion follows the implied bottom-up flow of cause-and-effect relationships among performance objectives envisioned by Kaplan and Norton. This discussion starts with the Learning & Growth perspective and sequentially proceeds to discuss the Internal Business Process, Customer, and Financial perspective, respectively.

<u>Learning & Growth Perspective</u> The production function estimation and evaluation work of Chapter 4.1 demonstrated the dominance of partition 1 in the learning & growth perspective by outperforming in both objectives. L&G-1: They out innovated

in use of technology aligned to process as demonstrated by their annual nomination to H&HN's **100 Most Wired Survey**®.[104] L&G-2: They achieved statistically significant higher overall efficiency scores than the rest of the sector. Exhibit 4.16 presents the Learning & Growth Perspective scorecard.

Learning & Growth Perspective			
L&G-1 Innovate to Gain Competitive Advantage		**L&G-2 Improve Efficiency**	
Objective	**Conceptual Measures**	**Operational Metrics**	**Source**
L&G-1: Innovate to Gain Competitive Advantage	The ability to identify and respond to competitive forces in the market place with informational capital	Scope of informational information technology applications implemented to support planning objectives – transactional, informational, and strategic IT. (Weil's typology of technology)	H&HN's survey results from Pass 1
L&G-2: Improve Efficiency	Technical efficiency	Maximum likelihood estimates of hospital efficiency scores from stochastic frontier production functions.	Constructed in Pass 1

EXHIBIT 4.16: Learning & Growth Perspective Scorecard.

The internal business process perspective is presented next.

[104] H&HN (1997-2002). Annual Most Wired Survey of US Hospitals. Chicago, Hospital and Health Networks, Inc: http://www.hhnmag.com/hhnmag/index.jsp.

Internal Business Process Perspective Exhibit 4.17 presents the internal business process perspective scorecard that defines the operational understanding and measurement of two different but related performance objectives. The concept of improving clinical care quality is measured by two available proxies: the degree of diagnostic cycle variation, and compliance with CMS (2004) clinical care protocol standards from the Hospital Quality Initiative.[105] These data that were voluntarily reported by hospitals on case volume compliance with the US medical consensus protocols represent the state of the art for publicly available clinical performance reporting. The first objective, IBP-1, relates to knowledge management applied to effect process control with healthcare delivery itself, to result in reducing diagnostic cycle variations. Most care delivered is considered routine care and the recent studies in medical management field identify variation in care patterns as inefficient and causing unexpected clinical outcomes.[106] The second objective, IBP-2, measures a hospital's compliance with the census care protocols for three major diagnostic related groupings. The concept of risk mitigation is expressed within both of these objectives. IBP-1 expresses the degree to which clinical **process** within a diagnostic related group is an positive or negative outlier compared to industry standards while IBP-2 expresses the degree to which clinical **practice** is within medical care standard protocols.[107]

[105] The Hospital Quality Initiative (HQI), like other CMS quality initiatives, consists of many facets. Its goals are to improve the care provided by the nation's hospitals and to provide quality information to consumers and others. CMS has several efforts in progress to provide hospital quality information to consumers and others and improve the care provided by the nation's hospitals. These activities build upon previous CMS and QIO efforts on behalf of Medicare beneficiaries and other adults to promote the best medical practices associated with certain clinical conditions. This page links to fact sheets, reports and other documents.
[106] The exploration of the topic of variation in practice patterns is beyond the scope of this work, however, it is a topic of concern in the field of the management of care delivery.
[107] There are no data available for individual or aggregated population health status within the US and if there were, there is no mechanism to link those outcomes back to a particular hospital as most care in the US is delivered in business models other than the managed care model.

Internal Business Process Perspective			
IBP-1 Reduce Diagnostic Cycle Variation		IBP-2 Improve Health Outcomes	
Objective	**Conceptual Measures**	**Operational Metrics**	**Source**
IBP-1: Reduce Diagnostic Cycle Variation	Understanding and application of appropriate clinical practice patterns to reduce outlier episodes of care.	Average Length of Stay per each of a hospital's Top 3 Diagnostic Group volume	Profiles US Hospitals
IBP-2: Improve Health Outcomes	The practice of evidence-based medicine.	Rate of compliance with national consensus care standards: **Heart Attack**: *Aspirin at arrival, Aspirin at discharge, ACE Inhibitor for left ventricular systolic dysfunction, Beta Blocker at arrival, Beta Blocker at discharge*	CMS National Quality Initiative
		Rate of compliance with national consensus care standards: **Heart Failure**: *Assessment of left ventricular function, ACE Inhibitor for left ventricular systolic dysfunction*	CMS National Quality Initiative
		Rate of compliance with national consensus care standards: **Pneumonia**: *Oxygenation assessment Initial antibiotic timing, Pneumococcal vaccination.*	CMS National Quality Initiative

EXHIBIT 4.17: Internal Business Process Perspective Scorecard.

IBP-1 Process Variation: The measure used to evaluate IBP-1 was the average length of stay (ALOS) for each of a hospital's top 3 service lines (reported by Diagnostic Related Grouping (DRG)). The convention is to measure ALOS in terms of days spent between a patient's admission to the hospital and the date of discharge from the hospital. Exhibit 4.18 shows the tabulation of the partition 1 group median and mean ALOS difference for the group's top 3 reported DRG.[108] The differences are reported in index form for purposes of comparison across the top 3 DRG and across the strategy classes themselves. As can be seen, for the 42 cells reported in the table, only 4 cells are nominally above 1.00. This finding suggests partition 1 facilities have greater control over diagnostic process variation.

Outcomes Measure - ALOS
Percentage Comparison of ALOS
(DRG-based ALOS/Benchmark DRG-ALOS)

		DRG1	DRG2	DRG3
Parition 1	*Median*	0.941	0.913	0.922
	Mean	0.990	0.913	0.897
	Class 1 n = 62			
Median		0.910	0.951	0.891
Mean		0.940	0.931	0.894
	Class 2 n = 47			
Median		1.005	0.929	0.968
Mean		1.025	0.913	0.948
	Class 3 n = 48			
Median		0.936	0.868	0.857
Mean		0.911	0.908	0.834
	Class 4 n = 29			
Median		0.980	0.920	0.910
Mean		1.279	0.984	0.887
	Class 5 n = 17			
Median		0.780	0.900	0.929
Mean		0.736	0.806	0.858
	Class 6 n = 33			
Median		0.940	0.882	0.929
Mean		1.028	0.880	0.951

(For each facility in class, Top 3 DRG ALOS/DRG National ALOS)

EXHIBIT 4.18: Diagnostic Variation Control Measure.

Exhibit 4.19 presents the test of statistical significance for diagnostic variation control.

[108] The method was to take the top 3 DRG reported for each hospital, to lookup the national average medicare benchmark ALOS for that DRG, and to then divide the hospital's ALOS/Benchmark ALOS. This data transformation was labeled ADRT in the model.This was done for each facility in partition 1. The table is reporting the mean and median values of this calculation for the sample.

One-Sample Test

	Test Value = 1.0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
DRG1	-.227	235	.820	-.0098	-.0948	.0752
DRG1.1	-1.347	61	.183	-.0604	-.1500	.0292
DRG1.2	.654	46	.516	.0248	-.0515	.1012
DRG1.3	-1.646	47	.107	-.0886	-.1969	.0197
DRG1.4	.935	28	.358	.2790	-.3326	.8906
DRG1.5	-3.416	16	.004	-.2637	-.4273	-.1001
DRG1.6	.317	32	.753	.0275	-.1491	.2041
DRG2	-4.161	235	.000	-.0869	-.1281	-.0458
DRG2.1	-1.663	61	.101	-.0689	-.1516	.0139
DRG2.2	-2.208	46	.032	-.0873	-.1669	-.0077
DRG2.3	-1.950	47	.057	-.0922	-.1873	.0029
DRG2.4	-.213	28	.833	-.0158	-.1677	.1361
DRG2.5	-2.378	16	.030	-.1944	-.3677	-.0211
DRG2.6	-2.407	32	.022	-.1198	-.2211	-.0184
DRG3	-4.347	235	.000	-.1030	-.1497	-.0563
DRG3.1	-1.973	61	.053	-.1058	-.2130	.0014
DRG3.2	-1.200	46	.236	-.0519	-.1389	.0352
DRG3.3	-2.863	47	.006	-.1663	-.2832	-.0495
DRG3.4	-2.310	28	.029	-.1136	-.2143	-.0128
DRG3.5	-1.377	16	.187	-.1417	-.3599	.0764
DRG3.6	-.877	32	.387	-.0492	-.1634	.0650

EXHIBIT 4.19: Student's T-test of Significance for IBP-1.

The results of this test are complicated but they are revealing nonetheless. The partition 1 sample's ALOS for their second and third highest volume DRG are statistically less than 1.00. They demonstrate greater diagnostic variation control in those work activities. Interestingly, only strategy class 5 – Bandwagon, Low Commitment – outperforms the national benchmarks in their highest volume DRG work. Many of the facilities in partition 1 are teaching hospitals which would imply that their ALOS could be somewhat higher than national benchmarks but it is unclear at the moment why they would have much control over 2 but not all three of their highest volume services lines of care delivery.

The next measure in the internal business process scorecard was related not to process variation but the process (clinical) quality based upon national consensus standard protocols of care with nationally recognized diagnoses.

<u>IBP-2: Increase Use of Evidence-based Medicine:</u> This measure reflects state-of-the-art for the US hospital sector in terms of national consensus[109] on design and intent of the measures and the self-reporting by approximately 1200 hospitals. Just as medical management journals are writing on impact of process variation, medical journals are writing on the impact of evidence-based medicine as the evolving standard of care. The care protocols from the CMS National Hospital Quality Initiative[110] for Acute Myocardial Infarction (AMI), Heart Failure, and Community Acquired Pneumonia produced more than 30 indicators of quality care standards. Exhibit 4.20 shows the author's unique tabulation of all data reported in Q2 of fiscal year 2004 for all participating hospitals. As shown, hospitals were only reporting on progress toward achieving 10 of those care standards within the three diagnostic groups.

Internal Business Perspective: Clinical Process Quality - Related to Health Outcomes							
		Testing Scorecard Objective IBP-2					
		Cases					
		Partition 0		Partition 1			
CMS Metric #	CLINICAL PERFORMANCE MEASURE	Protocol Met *	Dx Rate**	Protocol Met	Dx Rate	t-stat	Sig 5%
	Dx - Acute Myocardial Infarction (AMI)						
1	*Aspirin at arrival*	871	94.1%	92	87.7%	*59.1%*	
2	*Aspirin at discharge*	714	91.8%	204	95.0%	*25.1%*	
3	***ACE Inhibitor for LVSD***	**1084**	**76.7%**	**157**	**78.8%**	***5.1%***	☑
5	***Beta blocker at discharge***	**718**	**88.7%**	**91**	**92.1%**	***0.0%***	☑
6	***Beta blocker at arrival***	**851**	**87.5%**	**101**	**89.6%**	***0.0%***	☑
	Dx - Heart Failure (HF)						
18	***Assessment of Left Ventricular Function***	**1143**	**81.2%**	**113**	**89.5%**	***0.0%***	☑
20	***ACE Inhibitor for LVSD***	**1084**	**96%**	**157**	**100.0%**	***0.0%***	☑
	Dx - Community Acquired Pneumonia (CAP)						
22	***Oxygenation assessment***	**1296**	**97.2%**	**113**	**90.3%**	***2.2%***	☑
26	*Pneumococcal Vaccination*	1098	39.4%	94	63.5%	*56.4%*	
27	*Initial Antibiotic Timing*	1260	70.6%	104	68.8%	*12.3%*	

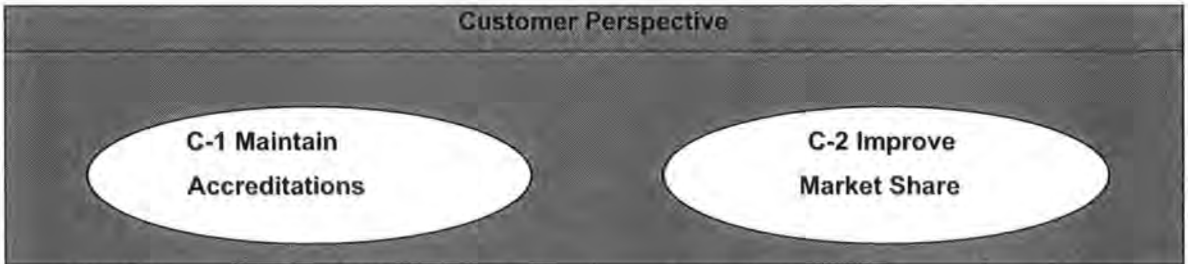
Source: FY04 - Q2 report of hospitals participating in CMS Hospital Quality Initiative
* The documented occurance of performing to the protocol standard.
** Retrospective rate of occurance of meeting the standard across all same Dx cases for the reporting period.

EXHIBIT 4.20: Achieving Evidence-Based Care Standards.

109 CMS HQI www.cms.hhs.gov/HospitalQualityInits/.
110 Discussed in greater detail in Chapter 3.

Those hospitals from partition 1 that reported in Q2 fiscal year 2004 overall achieved statistically significant higher rates of compliance on 6 of the ten reporting indicators of quality care. Within the AMI diagnosis, partition 1 achieved statistically significant differences in compliance within the three more difficult processes within the guidelines. They completely achieved the two reportable process standards for heart failure and one of the process standards for community acquired pneumonia. These findings are interpreted as emerging evidence that facilities within partition 1 sample were outperforming the rest of the sector in the very important clinical quality objective in fiscal year 2004.

Customer Perspective Exhibit 4.21 presents the External Customer Perspective scorecard. For measure C-1, the chosen measure was status of a facility's accreditation with the national committee on hospital accreditation. Over the period of this evaluation, no hospitals in partition 1 lost accreditation. It is likely that a few hospitals in the rest of the sector did lose accreditation during the period. The (2100 or so) facilities in partition 0 were not tracked in a one-for-one period over the test period; however, if a hospital lost accreditation during the period, then it would also result in a change in the reporting of operational data – therefore dropping from the partition.



Objective	Conceptual Measures	Operational Metrics	Notes
C-1: Maintain Accreditations	National quality accreditation, Community Hospital Registration	All hospitals in test sample are accredited, will construct peer matches only with accredited organizations	Data not directly collected.
C-2: Improve Market Share	Demand, Market Share	Hospital Bed Occupancy Rate	Profiles of US Hospitals

EXHIBIT 4.21: Customer Perspective Scorecard.

Objective C-2 is measured by the occupancy rate of facilities as reported to State and Federal oversight agencies and collected and reported annually in Profiles of US Hospitals. Occupancy rate is widely held in the sector as a measure of perceived value by customers – a phrase that is often heard is that *patients vote with their feet.* Given that most hospitals within the highlighted sample exist in overlapping catchment areas – that is, they exist in regions without exclusive territory – occupancy rate tends to be sensitive to short-term changes in market perception of facilities.

According to the statistical introduction to the annual The Comparative Performance of US Hospitals: The Sourcebook, Solucient (2004b), the standard comparative practice within the sector is to use median performance values. The scorecards, therefore, were constructed to provide both median and mean comparisons.

Exhibit 4.22 presents the results of longitudinal evaluation of the customer perspective scorecard, the occupancy rate measure. The scorecard presents two benchmark comparator groups: *All US Acute Care Hospitals*, and *Acute Care Hospitals with greater than 99 Beds*. The median occupancy rate for the partition 1 sample (61.1 percent occupancy) was 33.9 percent above the All US hospital benchmark (45.6 percent occupancy) in 1998 while the partition 1 sample increased the performance spread to 36.7 percent by 2002 with a 71.3 percent occupancy. It is not surprising that the partition 1 sample, which was identified as the exceptional efficiency group in Chapter 4.1, would achieve occupancy rate levels more than one-third higher than the rest of the sector. The partition 1 sample also outperformed the more closely matched peer group of hospitals with greater than 99 beds. In 1998 the gap in occupancy rates was negligible (61.1 percent occupancy versus 61.0 percent occupancy), however, by year 2002, the performance gap was expanded to 8.6 percent (71.3 percent occupancy versus 65.7 percent occupancy).

Perspective	**Customer**		
Objective	Improve Market Share		
Measure	*Occupancy Rate*		
Partition 1	**1998**		**2002**
Median	61.1%		71.3%
Mean	59.7%		68.9%
Class 1 n = 62			
Median	60.0%		71.3%
Mean	58.9%		68.4%
Class 2 n = 47			
Median	63.4%		72.0%
Mean	60.4%		71.8%
Class 3 n = 48			
Median	63.7%		70.0%
Mean	58.9%		65.7%
Class 4 n = 29			
Median	65.2%		75.8%
Mean	63.4%		73.9%
Class 5 n = 17			
Median	54.6%		66.9%
Mean	54.8%		66.6%
Class 6 n = 33			
Median	61.6%		69.6%
Mean	60.8%		66.4%
Benchmark Comparators			
	1998	**2000**	**2002**
All US Acute Care Hospitals			
75th Percentile	*60.1%*	*63.2%*	67.3%
50th Percentile	***45.6%***	***47.9%***	**52.2%**
25th Percentile	*30.1%*	*30.7%*	35.1%
Performance Gap	***33.9%***		***36.7%***
Acute Care Hospitals > 99 Beds			
75th Percentile	*68.9%*	*70.8%*	*73.6%*
50th Percentile	***61.0%***	***63.1%***	***65.7%***
25th Percentile	*50.9%*	*53.5%*	*56.0%*
Performance Gap	***0.2%***		***8.6%***

EXIBIT 4.22: Longitudinal Customer Perspective Scorecard.

Exhibit 4.23 presents the one-sample student's t-tests performed on the mean values of the partition 1 sample and using the reported median value from the benchmark comparator group. The scorecards were constructed to provide both median and mean comparisons as standard statistical tests could be performed on group means. The performance gap in occupancy rate was statistically significant at least at the 5% level for the pooled partition 1, strategy classes 2 and 3. The partition 1 sample managed to increase its comparative performance against both the rest of the sector and the more closely matched peer group of acute care hospitals with greater than 99 licensed beds.

One-Sample Test

	Test Value = 0.657					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
ORATE	3.304	224	.001	.0318	.0128	.0507
OR1	1.489	60	.142	.0276	-.0095	.0647
OR2	3.940	46	.000	.0607	.0297	.0916
OR3	.013	41	.989	.0004	-.0576	.0583
OR4	3.481	26	.002	.0830	.0340	.1320
OR5	.266	16	.794	.0095	-.0660	.0850
OR6	.258	30	.799	.0062	-.0431	.0556

Exhibit 4.23: Testing Customer Perspective Scorecard.

The next section presents the financial perspective scorecard and its longitudinal evaluation.

Financial Perspective The financial perspective scorecard is represented by objectives F-1 and F-2 in Exhibit 4.24. The measure selected for F-1 was Total Profit Margin. This measure is generally accepted within the sector to represent the flow of resources through the hospital:

> *For a hospital with large endowments or other sources of investment income or a strong consistent flow of current philanthropy, this is the measure of profitability that is accorded the most weight. For other hospitals, it is viewed as a less important indicator of long-term credit worthiness than the operating profit margin because it is vulnerable to changes in interest rates and other fluctuations in investment income. The inconsistent and sporadic nature of other types of non-operating revenue, such as donations, diminishes this element's reliability as a source of additional credit worthiness support.* The Source Book, Solucient (2004b, p23)

However, as these scorecards are intended to capture broad and subtle indicators of changes in strategic value, this measure is ideally suited for this strategic evaluation:

> "*A hospital's overall level of profitability may be the best indicator of the need for a reassessment of marketing and fundraising strategies.*" The Source Book, Solucient (2004b, p25)

This measure was constructed according to Solucient (2004a) in the generally accepted manner:

> *...the difference between total revenue (computed as the sum of operating revenue and non-operating revenue) and total expense, divided by total revenue.* Profiles of US Hospitals Solucient (2004a, vii)

The measure selected for F-2 was the Long-Term Debt to Total Net Fixed Assets ratio. This measure was constructed in the generally accepted manner:

> *The sum of a hospital's long-term liabilities divided by the sum of its property, plant and equipment net of accumulated depreciation.* Profiles of US Hospitals, Solucient (2004a, vii)

Values of this measure greater than 1.0 indicate that debt is imposing an excessive financial burden on hospital operations. The Source Book, Solucient (2004b, p20)

Financial Perspective			
F-1 Improve Net Margin		F-2 Assure Viability	
Objective	**Conceptual Measures**	**Operational Metrics/Comments**	**Source**
F-1: Improve Net Margin	Short-term measure of cash availability to pay current expenses, make necessary capital improvements, and service current debt.	Total Profit Margin	Profiles US Hospitals
F-2: Assure Viability	Long-term measure of resource stewardship suitable to support current operations and manage capital account projects, research and community outreach missions.	Leverage – Long-term debt to Net Fixed Assets ratio	Profiles US Hospitals

EXHIBIT 4.24: Financial Perspective Scorecard.

F-1: Total Profit Margin: Exhibit 4.25 presents the longitudinal evaluation of the total profit margin measure for objective F-1. In nominal terms, the total profit margin (TPM) for partition 1 hospitals deteriorated over the period. As a group, the median performance gap was +12.8 percent in 1998 but by 2002 the gap fell to -4.3

percent. In nominal terms the total profit margin fell from 5.1 percent to 2.7 percent by 2002 while the rest of the sector fell from 4.5 percent to 2.8 percent over the same period. Therefore, there was greater relative and nominal decline in financial performance in partition 1 than the rest-of-the-sector over the period.

Perspective:	**Financial**		
Objective:	Improve Net Margin		
Measure:	*Total Profit Margin*		
Partition 1	**1998**		**2002**
Medians	5.11%		2.67%
Mean	2.76%		1.03%
	Class 1 n = 62		
Median	5.11%		2.67%
Mean	4.45%		3.27%
	Class 2 n = 47		
Median	6.97%		1.90%
Mean	3.91%		0.63%
	Class 3 n = 48		
Median	3.51%		2.67%
Mean	-0.39%		-0.49%
	Class 4 n = 29		
Median	5.11%		4.16%
Mean	4.31%		4.58%
	Class 5 n = 17		
Median	5.11%		4.16%
Mean	0.51%		0.75%
	Class 6 n = 33		
Median	5.11%		4.16%
Mean	2.26%		-3.15%
Benchmark Comparators			
	1998	**2000**	**2002**
	All US Acute Care Hospitals		
75th -	*8.66%*	*7.50%*	*6.56%*
50th -	***4.49%***	***3.33%***	***2.79%***
25th -	*0.53%*	*-0.59%*	*-0.89%*
Performance Gap	***13.81%***		***-4.30%***
	Acute Care Hospitals > 99 Beds		
75th Percentile	*9.20%*	*7.91%*	*6.62%*
50th Percentile	***5.26%***	***3.76%***	***2.81%***
25th Percentile	*1.18%*	*-0.11%*	*-0.50%*
Performance Gap	***-2.79%***		***-4.98%***

EXHIBIT 4.25: Longitudinal Financial Perspective Scorecard.

The group performance against the more closely matched peer group of hospitals with greater than 99 beds was not as bad as it was with the rest of the sector – the peer group total profit margin fell from 5.3 percent in 1998 to 2.8 percent by 2002. This represents a performance gap of -2.8 (.0511/.0526) percent in 1998 and falling to -5.0 (.0267/.0281) percent gap by 2002. Clearly, the means and medians show more variability for total profit margin than was shown in occupancy rate which demonstrates the impact of 'outlier' responses on the mean values. The means for classes 1, 4, and 6 were above the national peer group benchmark of 2.8 percent.

One-Sample Test

	Test Value = 0.0281					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
TPM	-2.040	227	.043	-.017774	-.034943	-.000605
TPM1	.348	59	.729	.004582	-.021746	.030909
TPM2	-1.254	45	.216	-.021815	-.056841	.013211
TPM3	-1.395	44	.170	-.033042	-.080764	.014680
TPM4	1.866	26	.073	.017715	-.001802	.037231
TPM5	-.618	16	.545	-.020571	-.091160	.050019
TPM6	-1.860	32	.072	-.059564	-.124778	.005651

EXHIBIT 4.26: Significance Tests F-1.

Exhibit 4.26 presents the mean tests of significance for measure F-1 which shows that only the pooled-group mean difference was significant at the 5 percent level. Interestingly, the pooled-group mean was more than 60 (.0103/.0281) percent below the benchmark. This analysis suggests that as a group, the partition 1 hospitals were consuming more of the net free cash on operations and servicing payments than the rest of the sector. This is not really surprising as this group was known as investing comparatively more heavily in their intangible assets than the rest of the sector, and these hospitals may also have been spending more aggressively on other aspects of their operations as well as IT than the rest of the sector. All of this would imply that cash flow could be lower in the short-term.

F-2: Long-Term Debt to Net Fixed Assets Ratio: It is worth noting that for this measure, lower ratios represent improved performance. Unlike the cash flow evaluation, F-1, the evaluation of long-term debt to net fixed assets ratio tells a strong story of improvement. As shown in Exhibit 4.27, the median performance of partition 1 hospitals dramatically closed the performance gap in leverage with the rest of the sector from -18.2 percent to equal by 2002. While compared to the national peer group benchmark, the partition 1 hospitals went from equal leverage in 1998 to an 18.2 (0.66/0.81) percent improvement in leverage by year 2002. This comparative performance improvement was not consistent within partition 1, as the median leverage deteriorated for classes 3 and 4.

Perspective:	**Financial**		
Objective:	Assure Viability		
Measure:	*LT Debt/Net Fixed Assets Ratio*		
Partition 1	**1998**		**2002**
Medians	0.78		0.66
Mean	0.83		0.89
	Class 1 n = 62		
Median	0.86		0.61
Mean	0.88		0.84
	Class 2 n = 47		
Median	0.72		0.66
Mean	0.80		0.85
	Class 3 n = 48		
Median	0.78		0.98
Mean	0.86		0.90
	Class 4 n = 29		
Median	0.86		0.98
Mean	0.92		1.06
	Class 5 n = 17		
Median	0.72		0.64
Mean	0.74		0.82
	Class 6 n = 33		
Median	0.78		0.61
Mean	0.72		0.94
	Benchmark Comparators		
	1998	**2000**	**2002**
	All US Acute Care Hospitals		
75th -	*1.01*	*1.02*	*1.06*
50th -	***0.66***	***0.65***	***0.66***
25th -	*0.32*	*0.31*	*0.31*
Performance Gap	***-18.2%***		***0.0%***
	Acute Care Hospitals > 99 Beds		
75th Percentile	*1.09*	*1.10*	*1.15*
50th Percentile	***0.78***	***0.71***	***0.81***
25th Percentile	*0.46*	*0.44*	*0.43*
Performance Gap	***0.0%***		***18.2%***

EXHIBIT 4.27: Longitudinal Scorecard Financial Perspective.

Exhibit 4.28 presents the results of the statistical test of means against the national peer benchmark for 2002. For the mean tests, none of the differences were significant at the 5 percent level although the group mean difference would be significant at 6 percent level and strategy class 4 would be significant at 7 percent.

One-Sample Test

	Test Value = 0.81					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
LTD	1.890	192	.060	.078653	-.003443	.160749
LTD1	.294	50	.770	.025490	-.148937	.199917
LTD2	.512	40	.611	.043171	-.127114	.213456
LTD3	.992	38	.328	.088462	-.092079	.269002
LTD4	1.944	18	.068	.252632	-.020393	.525656
LTD5	.043	13	.966	.007143	-.349747	.364033
LTD6	1.176	28	.250	.129655	-.096214	.355524

EXHIBIT 4.28: Statistical Tests F-2.

Again, there are large differences in the mean and median values within partition 1. The difference between mean and median for the pooled-group was more than 23 basis points (.89 -.66). Given the t-test finding of .06 for the difference between .89 and the benchmark median of .81, we can say that the difference between the partition 1 mean of 0.89 and the median of 0.66 would be statistically significant. We could infer that the difference in the two medians would be statistically significant but we have not demonstrated that with a parametric test.

The next section summarizes the findings from the longitudinal evaluation of the scorecards.

4.3 FINDINGS

The findings of the longitudinal BSC evaluation are summarized in this section.

- The Learning & Growth Perspective Objectives:
  1) L&G-1 *Innovate to Gain Competitive Advantage* – By definition partition 1 facilities demonstrated higher levels of commitment to information technology to transform health care.
  2) L&G-2 *Improve Efficiency* – Partition 1 facilities were found through stochastic frontiers and resulting efficiency scores to be significantly more efficient than the rest of the sector.
- The Internal Business Process Perspective Objectives
  3) IBP-1 *Reduce Diagnostic Cycle Variation* – Of the Top 3 Diagnostic Related Group work within each hospital, partition 1 hospitals demonstrated greater process control.
  4) IBP-2 *Improve Health Outcomes* – Across the sample of 1200 facilities eligible to report in 2004, those partition 1 facilities who reported to CMS outperformed in 6 of 10 clinical process metrics identified as clinical practice benchmarks for AMI, HF, and CAP.
- The Customer Perspective Objectives
  5) C-1 *Maintain Accreditations* – None of the hospitals in partition 1 lost accreditation during the period. It is likely that some hospitals did lose accreditation in the rest of the sector. These facilities would likely stop reporting data through standard sources and at that point, they would drop from the standard data collection systems and therefore be dropped from the comparative measures.
  6) C-2 *Improve Market Share* – Both across the sector and within their peer group, partition 1 facilities had increased their relative performance gap in occupancy rate.
- The Financial Perspective Objectives
  7) F-1 *Improve Net Margin* – Both across the sector and within their peer group, partition 1 performance fell over the period.

8) F-2 *Assure Viability* – Measured in terms of medians, partition 1 improved its position while the sector deteriorated.

Exhibit 4.29 resets the strategy map with the findings of the longitudinal evaluation of the scorecards:

- Strategy 1 *Short-term Survival* – Composed of 4 strategic objective steps, partition 1 hospitals demonstrated performance gains in the first three performance objectives. Two of the objectives were statistically testable and those tests were significant at the 5 percent level. The fourth objective, *Improve Net Margin*, did not show a relative performance gain by end of fiscal year 2002; in fact, while margin continued to deteriorate for all hospital subgroups, the deterioration was accelerated for partition 1 hospitals. Given that these facilities were aggressively investing in technology, and perhaps similarly aggressively investing in their intangible assets, one could expect net free cash to be lower in these facilities. From the point of view of expected reductions in total cost of ownership from IT investments, Borzekowski (2002) found at least a three year lag between hospital information technology investments and structural reductions in hospital cost functions.[111]

- Strategy 2 *Strive for Clinical Excellence* – Composed of 5 strategic objective steps, partition 1 hospitals out-performed in nominal terms in all 5 objectives through 2002. Three of those objectives were statistically testable and two of those tests were significant at the 5 percent level. The fifth objective, *Assure Viability*, would be significant at the 6 percent level. This finding is revealing because one would expect leverage to at least be subject to similar time lags as would total profit margin (F-1). Perhaps what this indicator is signaling is that while partition 1 hospitals were spending more net free cash on intangible assets across the analysis period lowering their profit margins, they apparently also were using more net free cash to pay-off long-term debt

[111] See Chapter 2.0 for an extended discussion.

and using their higher market profiles to take advantage of improved capital market conditions to restructure their obligations at more favorable terms.

The integrated strategy map has been modified to show: 1) whether a positive performance gain was found; 2) whether that finding was statistically significant in parametric testing; and, 3) what time frame was used for testing the performance objective(s).[112]

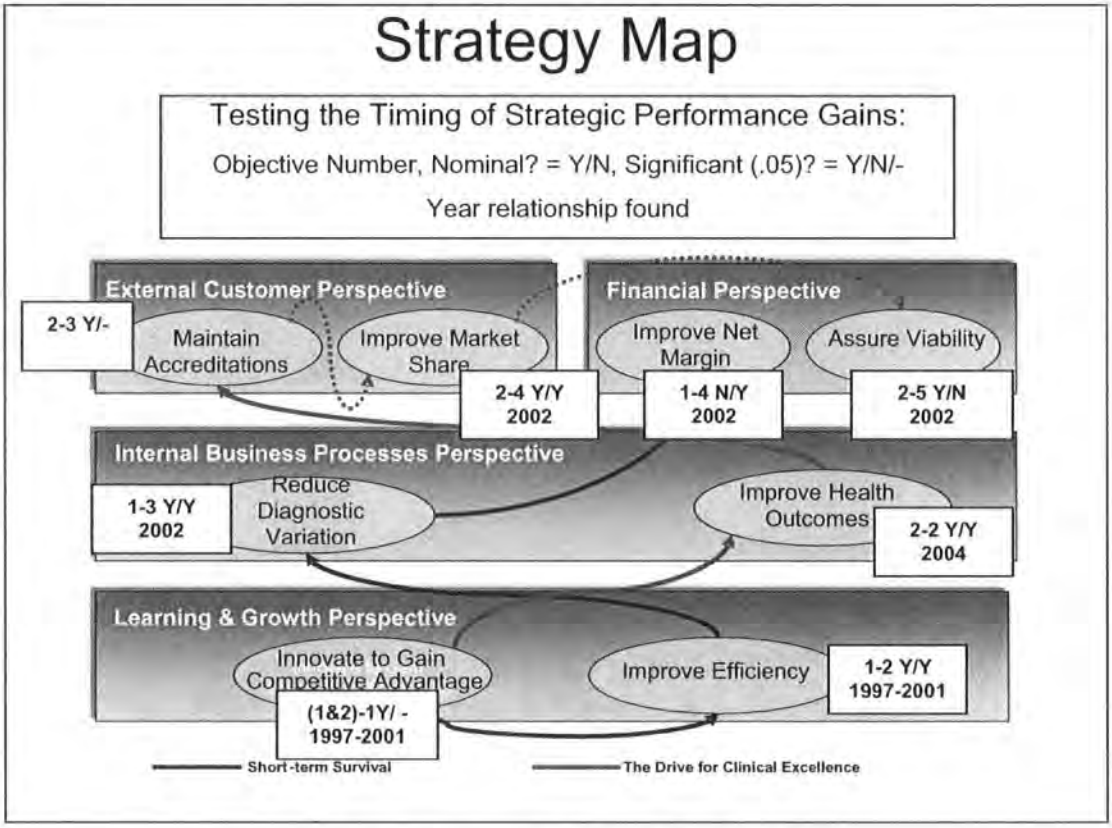


EXHIBIT 4.29: Testing the Strategy Map.

[112] The baseline period of performance for the analysis was 1997-2001 – the period for which hospitals were observed to be aggressive IT implementers. The most current operational data are subject to a two-year lag in production yet the clinical quality data are updated semi-annually since January 2004.

In response to research question Q2: ***"Do the most aggressive IT implementers strategically outperform the Rest-of-the-Sector?"***

Exhibit 4.30 is presented at this point to re-enforce the concept of the hypothesized generation and flow of strategic value through a hospital as a result of investment in the intangible assets of the organization. The flow of value model taken collectively with the findings presented in this chapter provides compelling evidence that the most broadly aggressive implementers of information technology did outperform the rest of the sector over the period 1997 to 2004. More importantly for them, the hospitals are moving in positive directions in most strategic perspectives while the rest of the sector appears to continue to deteriorate. However, financial performance for these hospitals was nominally below that of the rest of the sector which may signal future additional risks for these hospitals. Combined with the findings that all of the facilities in partition 1 were more efficient than the rest of the sector, we now know that these hospitals were also generating exceptional performance flows that are associated with strategic objectives within the sector.

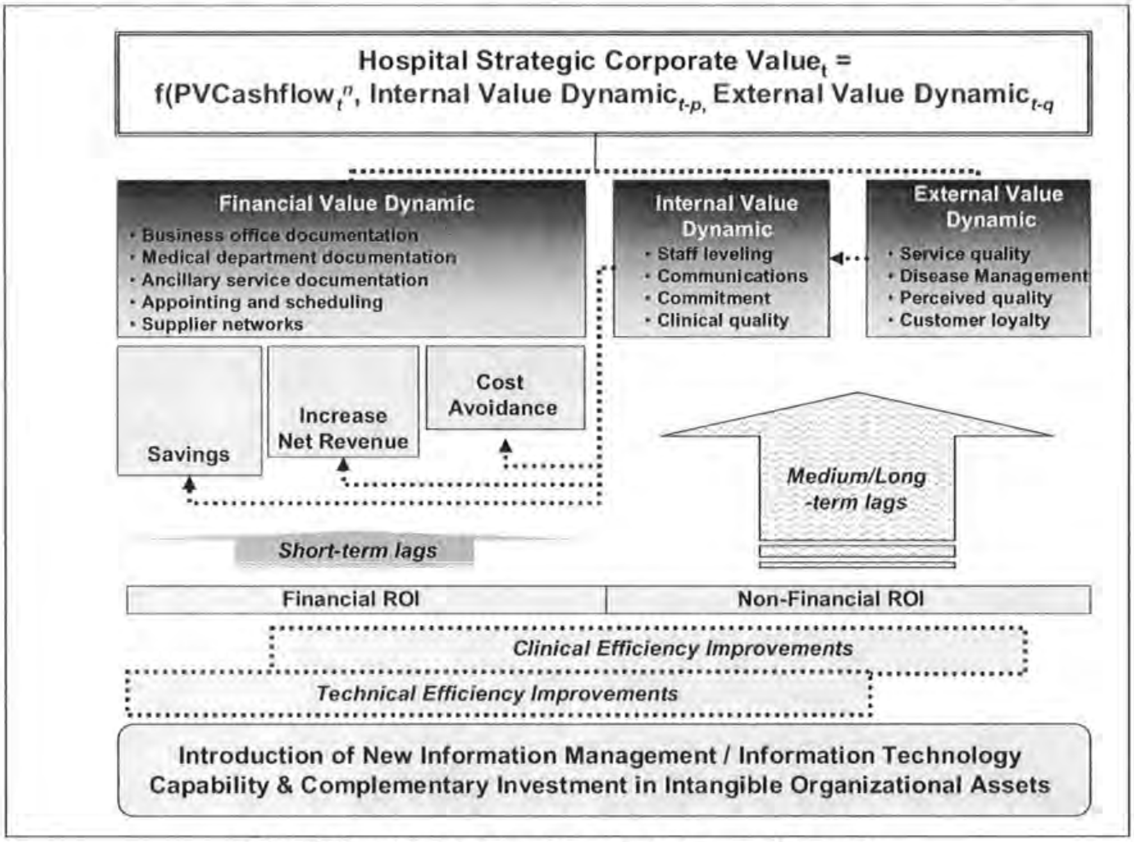


EXHIBIT 4.30: Validation of the Focal Theory.

This evaluation represents an original contribution to knowledge related to the impact of information technology, organizational commitment and organizational innovation. No peer reviewed study was found that employed a panel data approach across the vast majority of the US hospital sector. While these findings are unique to this thesis, the findings do conform to an integrative review of the organizational theory building citations from Chapter 2 and they are consistent with the empirical analysis findings related to innovation and IT from Brynjolfsson (1993, 2003), Brynjolfsson and Hitt (1996, 2000), Hitt and Brynjolfsson (1996), and Lee and Menon (2000). This chapter did not consider a further decomposition of the type of technology implemented, such as Weil's (1992) information technology typology – Transactional, Informational, and Strategic information technology as this decomposition is a major focus of Chapter 5, along with other organizational characteristics related to innovation in a hospital that may be driving the performance gains observed in this chapter.

5 Qualitative Exploration of Innovation

This chapter presents a discussion of the thesis research with a focus on the findings that directly relate to organizational characteristics, investment strategy, and performance. A categorical regression technique is used to identify bundles of characteristics and investment strategies that are associated with performance across five strategic measures: overall efficiency, diagnostic process variation, occupancy rate, total profit margin, and the long-term debt to net fixed assets ratio.[113]

5.1 THE OPERATIONAL DEFINITION OF INNOVATION

For these purposes, the meaning of innovation is taken as that of Brynjolfsson (2003) "*investment in the intangible assets of the organization – training people, redesigning processes, harmonizing policy and complementary mechanisms, and IT – for the purposes of generating competitive advantage.*" There were six strategy classes within the high performance partition of hospitals identified in Chapter 4 which were characterized as their commitment to IT implementation based upon the timing of their achievement of aggressive implementer status:

1) *Pioneer-High Commitment* – every year from 1999-2002;
2) *Pioneer-Moderate Commitment* – at least twice between 1999-2002;
3) *Pioneer-Low Commitment* – once in 1999 or 2000;
4) *Bandwagon-Moderate Commitment* – both in 2001 and 2002;
5) *Bandwagon-Low Commitment* – 2001 only; and,
6) *Follow-the-Leader* – in 2002 only.

On average this partition outperformed its peer-group(s) in each of the measures presented in Chapter 4. The next section identifies exceptional performance within these strategy classes and begins to unwind drivers of exceptional performance.

[113] See Chapter 4.2 for the detailed construction and evaluation of these measures.

5.2 STRATEGIC PERFORMANCE AND IT IMPLEMENTATION STRATEGY

Exhibit 5-1 presents the results from the occupancy rate performance measure from Chapter 4. Classes 2, 4, and 5 appear to outperform the others in that they achieve outcomes north of the other groups.

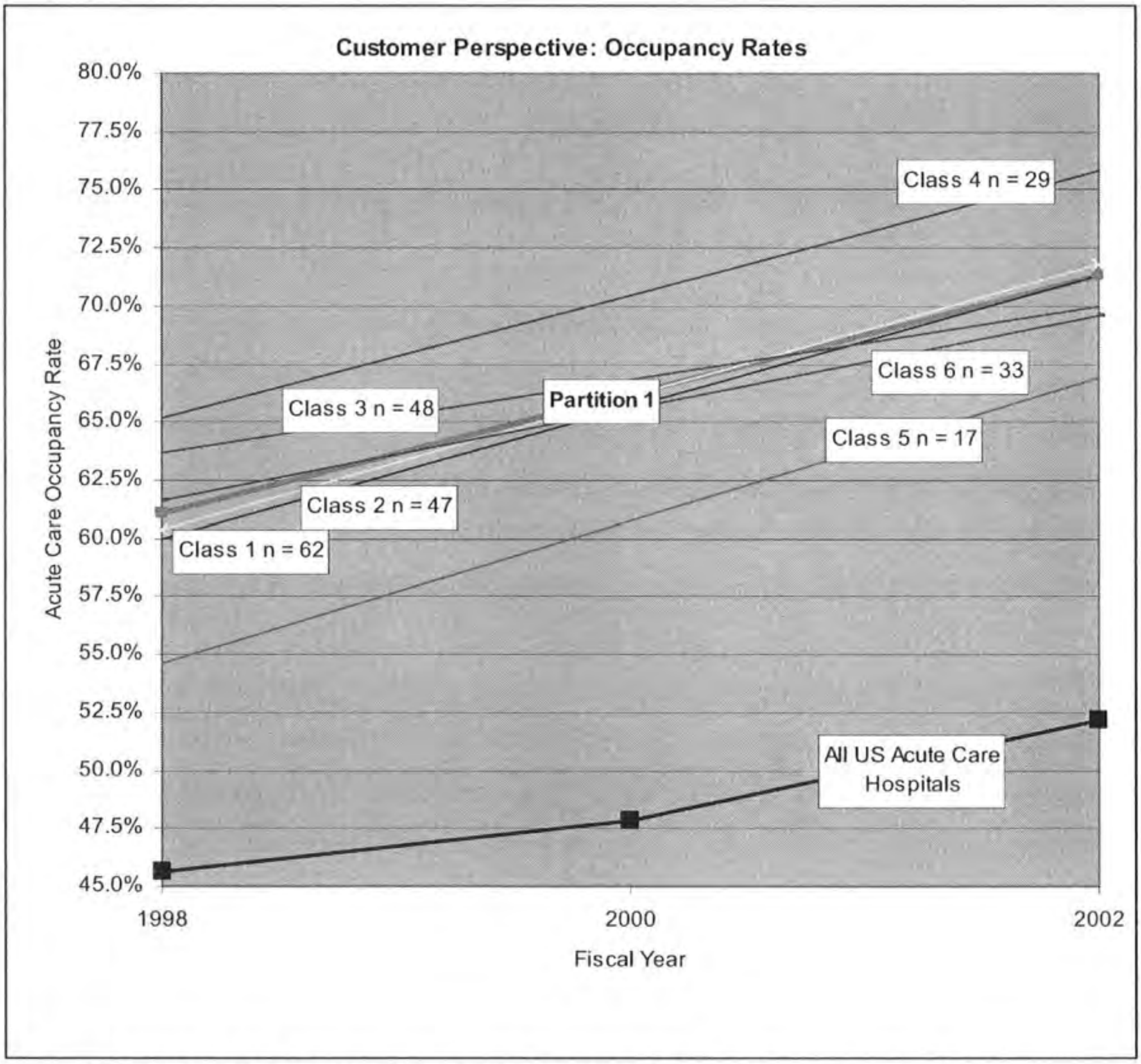


EXHIBIT 5.1: Performance by Strategy Class: Occupancy Rate.

In fact they did outperform on a weighted average gain basis achieving an approximate 18 percent while the All US Hospital average was an approximate 14 percent.

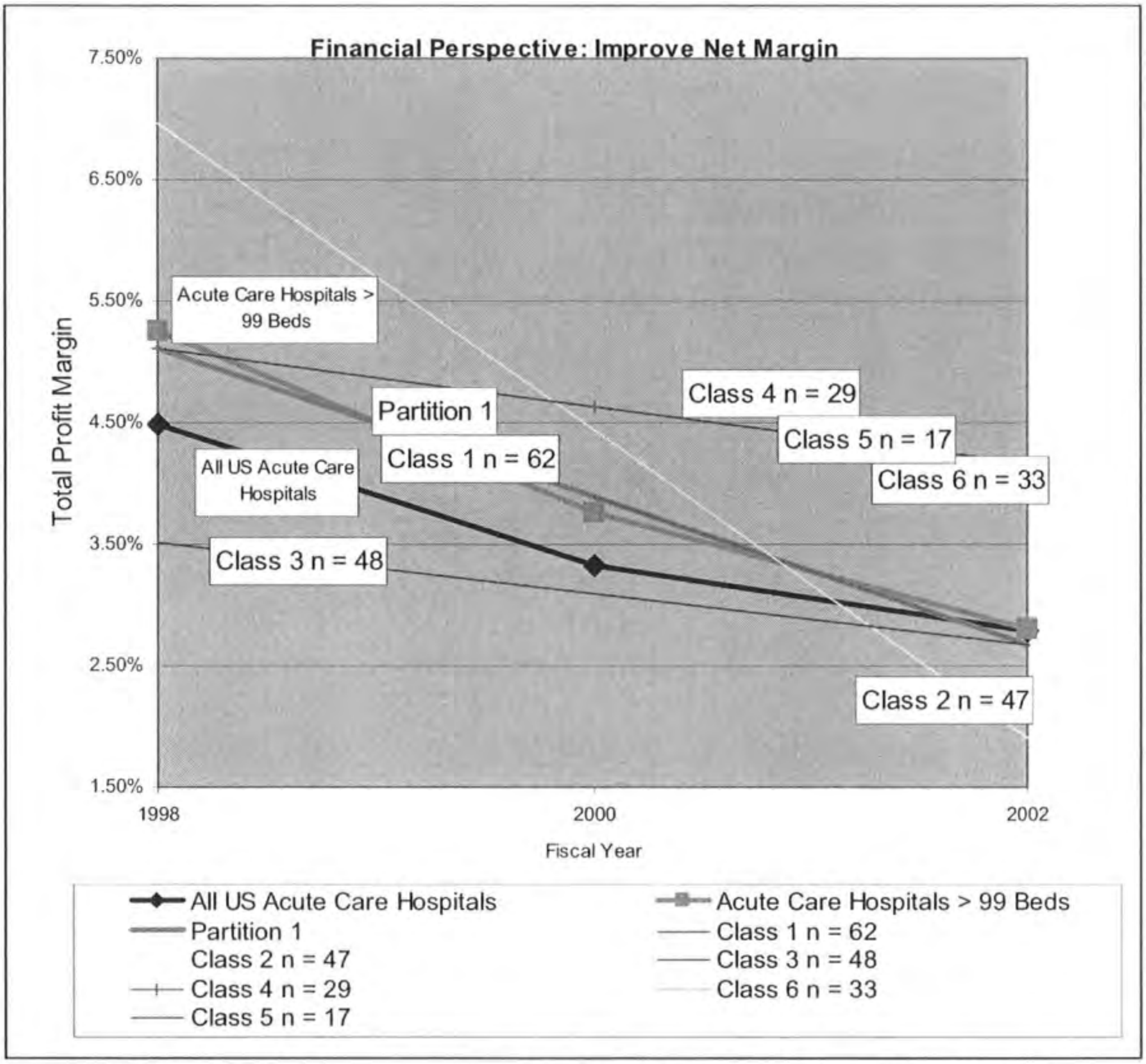


EXHIBIT 5.2: Performance by Strategy Class: Net Operating Margin.

The next exhibit, 5-2, presents the results for the total operating margin measure. In which classes 4,5, and 6 outperform the others in terms of slope and FY02 data point.

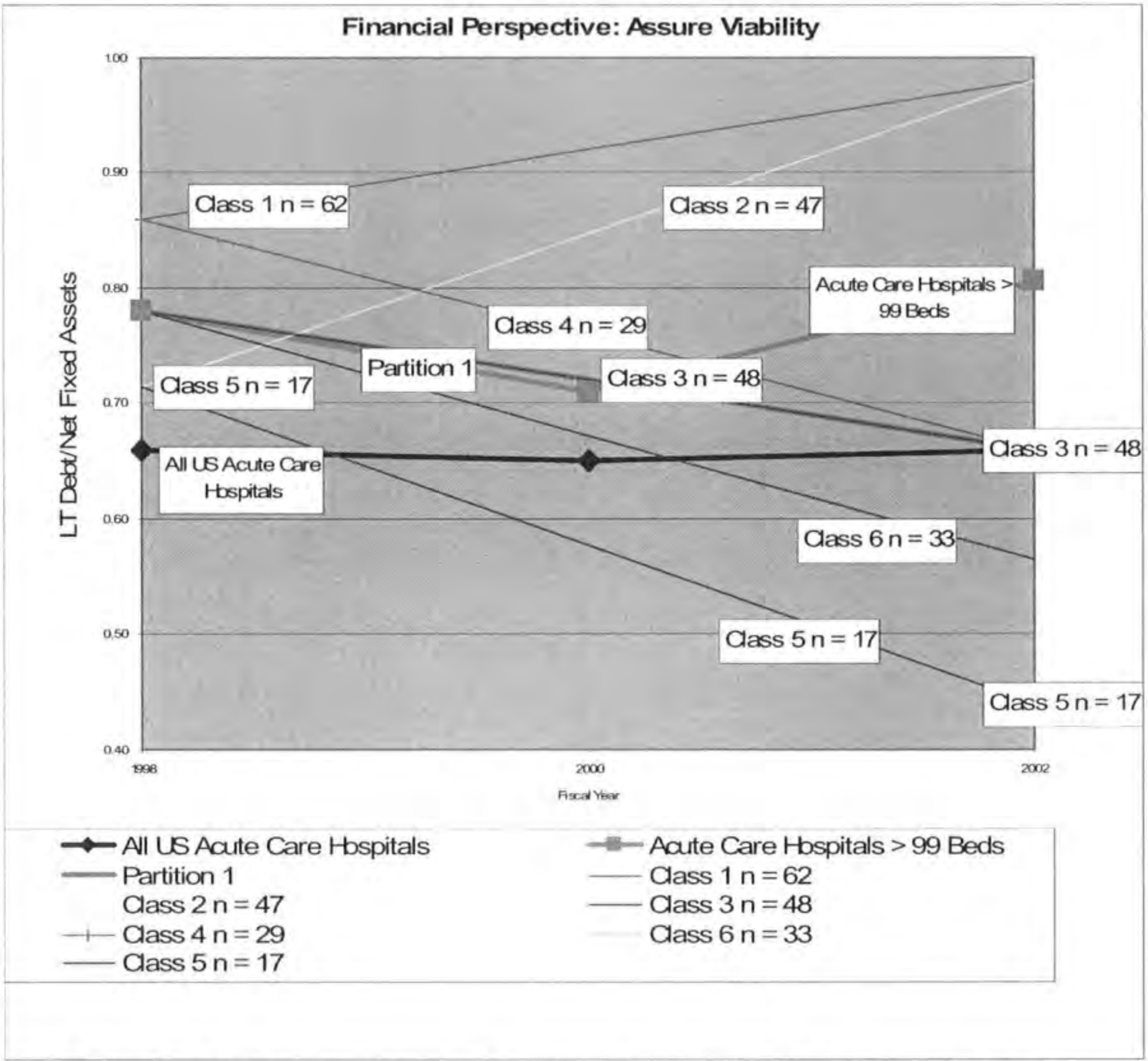


EXHIBIT 5.3: Performance by Strategy Class: Long Term Debt Ratio.

In Exhibit 5.3 it can be seen that classes 1,5, and 6 appear to outperform the other classes in that their slope and FY02 data point are lower than the others'. This measure is the most difficult to interpret in a brief snap-shot such as this without a detailed knowledge of the individual cases involved.[114]

These findings are interesting in that classes 4, 5, and 6 were the Bandwagon and Follow-the-Leader groups. These organizations employed competitive tactics relatively late in the market and the data show that they were at least keeping up

[114] There are a variety of debt management and financing strategies that can be successfully applied across the hospital sector depending on the business model of the hospital, regional conditions, and forms of external financing available to the hospital.

with the high performing hospitals. **Perhaps this finding is signaling that returns to achieving most aggressive implementation of IT do not bring concomitant financial performance returns.** Perhaps this finding is signaling that performance in improving the long term debt ratio is not sensitive to either the strategy classes themselves or to the length of evaluation period. The expectation of the literature would be at least a three year lag in hospital cash flow performance based on Borzekowski (2002) and Weill (1992) found negative financial performance across various lag structures in the valve manufacturing industry.

However, the exhibits may be signaling a patch of rough times ahead for hospitals in group 3 and 4. Apparently, they were late into the IT game, although, they have achieved a level of efficiency beyond that of the rest of the sector, as shown in Chapter 4. Perhaps these hospitals are much more reactive to all market conditions. While group 4's total profit margin performance was exceptional, perhaps they are financing their growth in performance in ways that would subject them to excessive swings in cashflow margins in the event of an economic downturn.[115] For example, in the event of some form of economic recession, market interest rates would rise, placing higher demands on their debt service levels than their peers, at the same time that federal reimbursements would likely continue to decrease due to recessionary impacts on federal revenues and subsequent federal payment rates, while there would be increases in patients presenting with economic hardships which affect rates of gross revenue collection, as discussed in Chapter 2. These organizations may be high-performing through a high-leverage mechanism which makes them increasingly at risk of financial survival, which is counter to the assumed goal of increasing competitiveness though organizational investment in innovations such as information technology. The market performance of those hospitals in strategy class 4 will be interesting to watch over the next 3-5 years to see how they negotiate market conditions and competitive forces.

[115] While this sort of dynamic adjustment model would be interesting to explore within the sector and these strategic groups, this sort of modeling is beyond the scope of this thesis.

The next section continues to explore inside these hospitals to examine characteristics and innovations associated with performance.

5.3 PASS 3: THE ROLE OF INNOVATION IN PERFORMANCE

In this section, the level of analysis moves inside the organization through use of several qualitative sources including the American Hospital Association Hospital Source Book, the American Hospital Directory, and the Dorenfest Integrated Hospital Database® for fiscal year 2003. Exhibit 5.4 presents the distribution of IT applications implemented within the partition 1 hospitals. The table has also been cross-referenced using Weil's (1992) typology of information technology. The work of creating the cross-reference to Weill was done based upon a careful reading of his paper and bringing the sector experience of the author to understand the fit of hospital information technology within the categories of transactional, informational, and strategic IT. As seen in Exhibit 5.4, transactional IT is nearly ubiquitous within this partition of hospitals. There is larger variance in the reporting of informational IT and even larger variance in reporting strategic IT applications[116] within these hospitals.

---

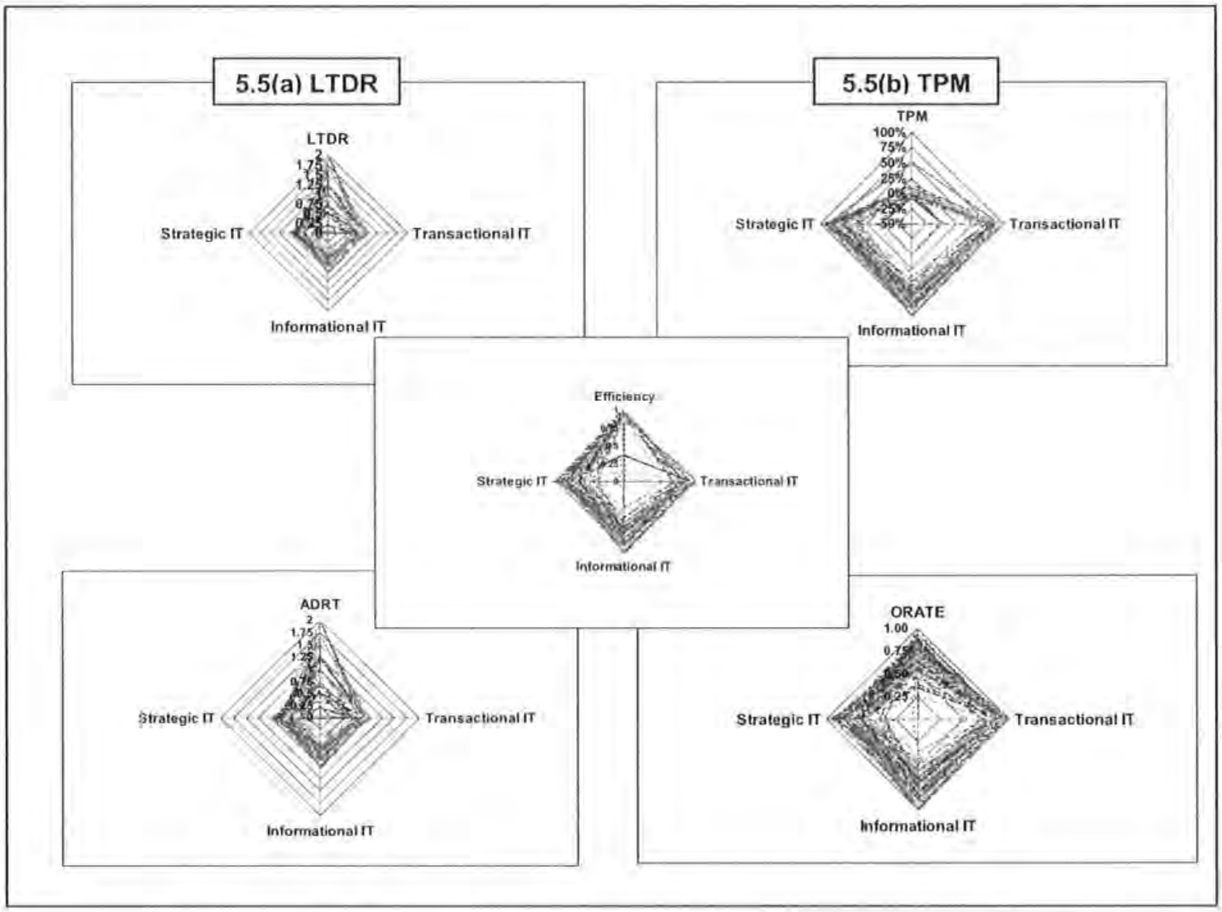
[116] As a side note, the US President's Electronic Healthcare Initiative and the British Prime Minister's investment program for the National Health Service both relate to capabilities within the strategic category in this exhibit – such as clinical data repositories, clinical documentation, computerized patient records, computerized physician order entry, picture archiving and storage for radiology services, etc – these are capabilities that transform various fragmented pieces of information from a health record into a form more readily usable by the clinician at time of and point of care.

Scope of IT Implementation (219 Cases)			
Weill Taxonomy	**Business Function**	**IT Capability**	**Freq**
Transactional	Business Office	Credit/Collections	196
		Electronic Claims	208
		Patient Billing	215
		Patient Registration	215
		Patient Scheduling	163
	General Financials	AP	214
		ERP	30
		G-Ledger	215
		Materials Management	214
	Human Resources	Benefits Adm	207
		Payroll	214
		Personnel Adm	209
		T&A	184
Informational	Decision Support	Casemix	199
		Clinical DS	151
		Cost Accounting	193
		Exec IS	140
		Flexible Budgeting	187
		Outcomes&Quality Mgt	138
	Managed Care Support	Elegibility	78
		MC Contract Mgt	160
		Premium Billing	62
	Medical Records	Abstracting	214
		Chart Deficiency	208
		Chart Tracking	207
		Dictation	166
		Encoder	213
		Master Patient Index	215
		Med Rec Imaging	102
		Transcription	195
Strategic	Clinical Support	Cardiology	83
		C Data Repository	180
		Clinical Documentation	173
		Computerized-Patient Rec	147
		CPOE	59
		ER Department	138
		Intensive Care	97
		Lab	215
		Nurse Staffing	177
		OB Systems	40
		OE/RR	210
		PACS	133
		RX	213
		POC-Med/Surg Bedside	121
		Rad	213
		Surg	196

EXHIBIT 5.4: Scope of IT within High Performing Partition

Source: IHDS2003 mapped to Weill's typology and hospital functions by the author.

The next exhibit, 5.5, presents a basic analysis of the patterns of usage of IT within these hospitals. Each of the five diagrams is constructed as a radar plot with the axis representing the percentage of total capabilities available with the strategic, informational, and transactional categories while the Y-axis is the value of the performance measure. The diagram labels a-e are associated with the measures as follows: long term debt ratio (a), total profit margin (b), efficiency (c), clinical control (d), and occupancy rate (e).



EXIHIBIT 5.5(a,b,c,d,e): Pattern Analysis of Performance Using Weill's Typology.

While these charts are difficult to read in detail due to the volume of data plotted, these charts were designed as a diagnostic tool. What they are intended to show is the cluster patterns of implementation associated with values of the respective performance measure. Efficiency (5.5c) appears to be closely associated with transactional capabilities as the radial-arm of transactional IT appears to be densely packed toward the high-end of the transactional scale. Similarly the total profit margin measure also would appear closely associated with transactional capabilities. Further evaluation was performed in ANOVA cross tests across the set of performance measures across the technology typology As reported in Exhibits 5.(6-8), only total profit margin measure exhibited a statistically significant finding, and that finding was that variation in informational IT was positively correlated with variation in total profit margin values within this partition of hospitals (p=.002). A secondary finding was that variation in informational IT was positively correlated with variation in the average length of stay comparator measure (p=.150).

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * TRANSIT	Between Groups	(Combined)	.012	6	.002	.264	.953
	Within Groups		1.316	180	.007		
	Total		1.327	186			
ADRT * TRANSIT	Between Groups	(Combined)	.236	6	.039	.517	.795
	Within Groups		14.845	195	.076		
	Total		15.081	201			
TPM * TRANSIT	Between Groups	(Combined)	.077	6	.013	.680	.666
	Within Groups		3.782	200	.019		
	Total		3.859	206			
LTDR * TRANSIT	Between Groups	(Combined)	.860	6	.143	.425	.862
	Within Groups		56.725	168	.338		
	Total		57.586	174			
ORATE * TRANSIT	Between Groups	(Combined)	.016	6	.003	.137	.991
	Within Groups		3.980	202	.020		
	Total		3.996	208			

EXHIBIT 5.6: ANOVA among Transactional IT and Performance.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * STRATIT	Between Groups	(Combined)	.050	11	.005	.623	.808
	Within Groups		1.277	175	.007		
	Total		1.327	186			
ADRT * STRATIT	Between Groups	(Combined)	.539	11	.049	.640	.793
	Within Groups		14.542	190	.077		
	Total		15.081	201			
TPM * STRATIT	Between Groups	(Combined)	.111	11	.010	.527	.884
	Within Groups		3.747	195	.019		
	Total		3.859	206			
LTDR * STRATIT	Between Groups	(Combined)	2.171	11	.197	.581	.843
	Within Groups		55.415	163	.340		
	Total		57.586	174			
ORATE * STRATIT	Between Groups	(Combined)	.210	11	.019	.992	.455
	Within Groups		3.786	197	.019		
	Total		3.996	208			

EXHIBIT 5-7: ANOVA among Informational IT and Performance.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * INFOIT	Between Groups	(Combined)	.020	13	.002	.199	.999
	Within Groups		1.308	173	.008		
	Total		1.327	186			
ADRT * INFOIT	Between Groups	(Combined)	1.354	13	.104	1.426	.150
	Within Groups		13.727	188	.073		
	Total		15.081	201			
TPM * INFOIT	Between Groups	(Combined)	.576	13	.044	2.607	.002
	Within Groups		3.282	193	.017		
	Total		3.859	206			
LTDR * INFOIT	Between Groups	(Combined)	4.372	13	.336	1.018	.437
	Within Groups		53.213	161	.331		
	Total		57.586	174			
ORATE * INFOIT	Between Groups	(Combined)	.251	13	.019	1.004	.449
	Within Groups		3.745	195	.019		
	Total		3.996	208			

EXHIBIT 5.8: ANOVA among Strategic IT and Performance.

As another approach to identifying association, Exhibits 5.(9-11) report the results of test of association between the technology typology and the performance measures. Eta-squared represents the proportion of the total variability in the dependent variable that is accounted for by variation in the independent variable. It is the ratio of the between groups sum of squares to the total sum of squares. As reported in Exhibit 5.9, associations are very low for transactional IT and performance in this sample – this finding may reflect the low variance in reporting and the ubiquitous nature of transactional IT in this sample as shown in Exhibit 5.4.

Measures of Association

	Eta	Eta Squared
EFFICIEN * TRANSIT	.093	.009
ADRT * TRANSIT	.125	.016
TPM * TRANSIT	.141	.020
LTDR * TRANSIT	.122	.015
ORATE * TRANSIT	.064	.004

EXHIBIT 5.9: Associations among Transactional IT and Performance.

Exhibit 5.10 confirms that there is a weak positive statistical association of informational IT and profit margin with this partition of hospitals while the clinical process control measure is found to have less than 10 percent association.

Measures of Association

	Eta	Eta Squared
EFFICIEN * INFOIT	.122	.015
ADRT * INFOIT	.300	.090
TPM * INFOIT	.386	.149
LTDR * INFOIT	.276	.076
ORATE * INFOIT	.250	.063

EXHIBIT 5.10: Associations among Informational IT and Performance.

Similarly, as reported in Exhibit 5.11, strategic IT was found to have very low statistical associations with performance in this sample of hospitals.

Measures of Association

	Eta	Eta Squared
EFFICIEN * STRATIT	.194	.038
ADRT * STRATIT	.189	.036
TPM * STRATIT	.170	.029
LTDR * STRATIT	.194	.038
ORATE * STRATIT	.229	.053

EXHIBIT 5.11: Associations among Strategic IT and Performance.

This section describes the results of exploring the direct linear levels of association among the technology classifications and performance. However, the simple ANOVA technique captures neither non-linear association nor inter-action effects. Therefore, the next section of this chapter presents a further qualitative exploration of the organizational characteristics and innovations that existed within this sample of hospitals in an attempt to identify bundles of characteristics associated with performance and to clarify the role of IT in performance within these hospitals.

5.3.1 Qualitative Coding Of Patterns Of Innovation

This section qualitatively explores in detail across the sample of 219 cases investigating for patterns of innovation, applying the Brynjolfsson definition cited in Chapter 5.1, *investment in the intangible assets of the organization – training people, redesigning processes, harmonizing policy and complementary mechanisms, and IT – for the purposes of generating competitive advantage.* In pursuit of this research interest, a significant qualitative data coding exercise was conducted on a proprietary set of IT market intelligence reports for each of the 219 cases in the high performance partition. These reports were compiled by a third-party vendor of health sector market intelligence information that has been in existence since the late 1970s and is designed as a resource for IT and consulting vendors to sell into US hospitals and health plans across the country.[117] A pilot-test

[117] Integrated Hospital and Health Network Database, Sixth Complete Dorenfest IHDS+ Database contains proprietary information and market intelligence information on 1,444 IHDSs across the US, Sheldon Dorenfest Associates Inc, Chicago, The process of updating he database takes on average one-year and is performance

of a qualitative coding exercise using QSR International's[118] NVivo version 2.0 software was performed on the IT strategic plans portion of the database – these are, typically, ten page double-sided reports in adobe acrobat format that detail who the IT decision makers are, the management process, future investment plans and goals, and details of the vendor and quantities of all of the health technology implemented within a facility to include software, hardware, user-devices, and specialty devices such as hand-held, radiology, and bed-side diagnostic devices.[119] Through a process of trial-and-error using NVivo, it was determined that five attributes from the strategic planning section of the database could be coded for most of the hospitals in the high performance partition that would relate to the definition of innovation.[120] Those attributes (with coded variable name in parentheses) were:

- Strategy class – (*CLASS*)
- To whom the CIO directly reports – (*REPTO)*
- Whether the organization has agreed to pursue Leapfrog Group[121] targets for clinician pharmaceutical ordering – (*LEAPF)*
- Whether IT investment decision are routinely vetted through a standard IT committee review process – (*ITCOMM)*
- Whether the IT decision making process included routine input from clinical stakeholders – (*CREP)*.

---

approximately every two years. For the purpose of this research, a data license was obtained to the latest available version of the database as of May 2004, providing information current through the end of 2002 which ties with the performance measure data coverage.

118 http://www.qsrinternational.com/software.htm

119 An example from Anne Arundel Medical Center, Annapolis, MD, is presented in the Appendix. Due to data rights issues, all of the input information reports cannot be reproduced in this report.

120 Other attributes tested included the dollar level of CIO spending authority, the dollar thresholds to invoke corporate board involvement in decisions, the percentage of total budget allocated to IT, and the number of FTE in IT department; however, upon completing the coding exercise it was found that these attributes were not reported consistently across the relevant sample which if used would have resulted in excessive dropped cases and lowering the degrees of freedom of the analysis.

121 The Leapfrog Group is an initiative driven by organizations that buy health care who are working to initiate breakthrough improvements in the safety, quality and affordability of healthcare for Americans. It is a voluntary program aimed at mobilizing employer purchasing power to alert America's health industry that big leaps in health care safety, quality and customer value will be recognized and rewarded. http://www.leapfroggroup.org/

These attributes were added to the existing case panel dataset and merged with HMO market share of the region, bed size, Medicare share, Medicaid share, Casemix index, Top100 Solucient Award, TopCardio Solucient Award, Facility setting, form of ownership, teaching status, and the census division of the hospital. The interest in these attributes stems from viewing the mechanisms of performance from the point of view of governance and influence of organizational behavior. The attributes were grouped into executive governance sphere and IT governance sphere. This grouping of attributes would allow direct testing of the role of IT, IT governance, and overall executive governance within these high performing hospitals. The qualitative component of the panel data set is shown in Exhibit 5.12.

The next step was to perform ANOVA of these attributes with the set of performance measures to examine whether this additional level of granularity on the behavior of the organizations reveals more insight into performance patterns.

Data Elements Available for CATREG Evaluation (219 Total Cases of Aggressive IT Implementors)																			
Organizational Characteristics																			
Organizational Characteristics	Distributions																		
Quantitative Component	Min	Max	Mean	Median	Valid Cases														
HMO Market Share	0.014	0.535	0.272	0.300	219														
Bedsize	32.00	2,172.00	400.29	337.00	214														
Medicare Share	0.01	0.74	0.36	0.36	210														
Medicaid Share	0.01	0.71	0.14	0.12	212														
Casemix Index	0.76	2.50	1.54	1.56	208														
Qualitative Component	Res	Freq	Res	Freq	Res	Freq	Res	Freq	Res	Freq	Res	Freq	Res	Freq	Res	Freq	Res	Freq	Valid Cases
Leapfrog Targets	Yes	174	No	45															**219**
Clinical Rep	Yes	117	No	102															**219**
Top100 Award	Yes	14	No	205															**219**
Top100 Cardio Award	Yes	27	No	192															**219**
IT Committee	Yes	207	No	7	NR	5													**219**
Setting	Rural	28	Urban	190	NR	1													**219**
Ownership	Govt	25	Investor	5	Non-Profit	188	NR	1											**219**
Teaching Status	Center	60	Minor	74	Non	84	NR	1											**219**
CIO Direct Report	Clinical	9	CEO	122	CFO	66	Legal	1	COO	31									**229**
Strategy Class	1	59	2	42	3	45	4	25	5	17	6	31							**219**
Census Division	1	15	2	27	3	35	4	44	5	17	6	22	7	15	8	19	9	25	**219**

{6AUG2005/update 13nov05}

EXHIBIT 5.12: The Qualitative Component (excluding specific IT capabilities implemented) of the Panel Dataset.

Source: Author's integration of operational, clinical, and financial performance data and the product of an extended qualitative coding of business intelligence reports exercise.

5.3.2 ANOVA Comparison of Means

This section describes the results of comparison of means across the qualitative factors – strategy class, clinical representation on IT committee, census division, the CIOs direct manager, the existence of references to Leapfrog Group targets for clinician prescription ordering, etc – coded into the database. The first table presents the factor analysis of the strategy class categorical variable.

Report

STCLASS		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
1	Mean	.0774327	.69220	.9891	.0395	.8390	.35263	.12862	.2769
	N	52	59	57	58	50	57	58	59
	Std. Deviation	.08186228	.140025	.19914	.12031	.62596	.103812	.117016	.12597
2	Mean	.0764225	.72714	1.0208	.0021	.8283	.34643	.16690	.2550
	N	40	42	41	41	36	42	42	42
	Std. Deviation	.09242608	.088876	.19101	.12245	.53074	.119099	.121324	.13064
3	Mean	.0627314	.66718	.9701	.0040	.9300	.35846	.12974	.2914
	N	35	39	38	39	33	39	39	39
	Std. Deviation	.01999135	.173098	.22131	.14997	.53576	.119638	.073430	.11026
4	Mean	.0650130	.74435	1.1067	.0518	1.0925	.36261	.13174	.2377
	N	23	23	23	23	16	23	23	23
	Std. Deviation	.01910472	.125656	.56208	.05105	.60214	.093625	.106201	.13446
5	Mean	.0658167	.66647	.9067	.0075	.8171	.33688	.17941	.2487
	N	12	17	15	17	14	16	17	17
	Std. Deviation	.02912256	.146839	.15101	.13729	.61812	.117514	.095162	.09662
6	Mean	.1025200	.66172	.9947	-.0419	.9231	.38679	.13679	.2998
	N	25	29	28	29	26	28	28	29
	Std. Deviation	.15727489	.137323	.26293	.19358	.56067	.110924	.123350	.12888
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.13: Factor Analysis of Means by STCLASS Categorical Variable.

Exhibit 5.13 reports some variation in performance across the strategy classes. Class 6 exhibited the highest mean efficiency, 36 percent above the pooled mean. Class 4 exhibited occupancy rate 7 percent higher than the pooled mean. Class 6 exhibited 9 percent better average clinical control than the pooled group. Class 4 exhibited Total Profit Margins (TPM) of 5.2 percent which was more than 4 times the pooled mean of 1.3 percent TPM. Yet it is shown in Exhibit 5.14 that none of the variations were significant at the 5 percent level. The occupancy rate and profit margin measure differences were significant at the 10 percent level (significance reported from testing .101 and .102, respectively).

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * STCLASS	Between Groups	(Combined)	.028	5	.006	.776	.569
	Within Groups		1.300	181	.007		
	Total		1.327	186			
ORATE * STCLASS	Between Groups	(Combined)	.176	5	.035	1.868	.101
	Within Groups		3.820	203	.019		
	Total		3.996	208			
ADRT * STCLASS	Between Groups	(Combined)	.452	5	.090	1.211	.306
	Within Groups		14.629	196	.075		
	Total		15.081	201			
TPM * STCLASS	Between Groups	(Combined)	.171	5	.034	1.865	.102
	Within Groups		3.688	201	.018		
	Total		3.859	206			
LTDR * STCLASS	Between Groups	(Combined)	1.078	5	.216	.645	.666
	Within Groups		56.508	169	.334		
	Total		57.586	174			
MEDISHR * STCLASS	Between Groups	(Combined)	.038	5	.008	.613	.690
	Within Groups		2.461	199	.012		
	Total		2.499	204			
MCAIDSHR * STCLASS	Between Groups	(Combined)	.069	5	.014	1.164	.328
	Within Groups		2.393	201	.012		
	Total		2.462	206			
HMOSHARE * STCLASS	Between Groups	(Combined)	.087	5	.017	1.140	.340
	Within Groups		3.094	203	.015		
	Total		3.181	208			

EXHIBIT 5.14: ANOVA by STCLASS Categorical Variable.

Similarly for the REPTO variable in Exhibit 5.15, none of the differences were significant at the 5 percent level. As seen in Exhibit 5.16, the occupancy rate measure was significant at the 10 percent level (significance reported from testing of .096).

Report

REPTO		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
C	Mean	.0709444	.73556	1.0687	.0333	.8700	.34889	.18333	.3211
	N	9	9	9	9	8	9	9	9
	Std. Deviation	.02199881	.091530	.32312	.06326	.74249	.110617	.154110	.15498
E	Mean	.0748223	.70830	1.0085	.0091	.8687	.34808	.14438	.2718
	N	94	106	104	105	87	104	105	106
	Std. Deviation	.08395289	.148057	.33025	.14139	.52930	.103709	.114606	.12058
F	Mean	.0745929	.65859	.9670	.0029	.9402	.37921	.13190	.2804
	N	56	64	62	63	52	63	63	64
	Std. Deviation	.07889142	.126765	.15836	.15134	.60490	.095720	.088297	.12839
L	Mean	.1419000	.54000	.8627	.0416	.3600	.47000	.07000	.3000
	N	1	1	1	1	1	1	1	1
	Std. Deviation	.	.	.	.	.	.	.	.
O	Mean	.0791185	.71207	1.0264	.0399	.8737	.33893	.14655	.2364
	N	27	29	26	29	27	28	29	29
	Std. Deviation	.11105741	.128741	.23043	.10251	.63583	.156757	.118692	.11342
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.15: Factor Analysis of REPTO Categorical Variable.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * REPTO	Between Groups	(Combined)	.005	4	.001	.173	.952
	Within Groups		1.322	182	.007		
	Total		1.327	186			
ORATE * REPTO	Between Groups	(Combined)	.151	4	.038	1.998	.096
	Within Groups		3.845	204	.019		
	Total		3.996	208			
ADRT * REPTO	Between Groups	(Combined)	.155	4	.039	.510	.728
	Within Groups		14.926	197	.076		
	Total		15.081	201			
TPM * REPTO	Between Groups	(Combined)	.033	4	.008	.441	.779
	Within Groups		3.825	202	.019		
	Total		3.859	206			
LTDR * REPTO	Between Groups	(Combined)	.461	4	.115	.343	.849
	Within Groups		57.125	170	.336		
	Total		57.586	174			
MEDISHR * REPTO	Between Groups	(Combined)	.062	4	.015	1.269	.283
	Within Groups		2.437	200	.012		
	Total		2.499	204			
MCAIDSHR * REPTO	Between Groups	(Combined)	.028	4	.007	.584	.674
	Within Groups		2.434	202	.012		
	Total		2.462	206			
HMOSHARE * REPTO	Between Groups	(Combined)	.064	4	.016	1.044	.386
	Within Groups		3.117	204	.015		
	Total		3.181	208			

EXHIBIT 5.16: ANOVA by REPTO Categorical Variable.

Exhibit 5-.17 reports the results of factor analysis for the categorical variable which represents whether the hospital mentioned application of the national Leapfrog Group's targets for clinician order entry. In the case of this categorical variable, as shown in Exhibit 5.18, efficiency is statistically associated at the 5 percent level (significance reported from testing .043) with a mention of Leapfrog Group targets in the planning documentation. Those hospitals that referenced those targets averaged 0.0692 percent inefficiency compared with 0.100 percent inefficiency in those hospitals not referencing Leapfrog Targets. Remember that this test is performed on the partition of high performing hospitals, so this test has identified a management best practice associated with exceptional performance.

Also, the mean long term debt ratio for the subgroup with Leapfrog text was .92 while the mean for the subgroup without Leapfrog references was .75. This difference was significant at the 11 percent level (significance reported from testing .109), this finding of increased leveraged among the Leapfrog subgroup may reinforce the interpretation of the Leapfrog references as a signal of more aggressive management practices.

Report

LEAPF		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
N	Mean	.1002474	.68163	.9596	-.0107	.7508	.34452	.13674	.3167
	N	38	43	42	43	36	42	43	43
	Std. Deviation	.15614831	.138580	.23894	.14169	.40818	.113120	.105801	.12311
Y	Mean	.0692463	.69717	1.0106	.0189	.9234	.36025	.14366	.2601
	N	149	166	160	164	139	163	164	166
	Std. Deviation	.05173524	.138847	.28210	.13534	.60734	.110168	.110498	.12149
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.17: Factor Analysis of LEAPF Categorical Variable.

Another interesting finding emerged from Exhibit 5.18. Those hospitals that referenced Leapfrog Targets were in regions that had statistically different levels of managed care market penetration – an average of 31.7 percent penetration for those not referencing Leapfrog and 27.2 percent penetration for those that did reference Leapfrog Group targets. This would suggest that contrary to some earlier studies, managed care market penetration may contribute to reducing competitive motivation within regions. This is a new finding.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * LEAPF	Between Groups	(Combined)	.029	1	.029	4.147	.043
	Within Groups		1.298	185	.007		
	Total		1.327	186			
ORATE * LEAPF	Between Groups	(Combined)	.008	1	.008	.428	.514
	Within Groups		3.988	207	.019		
	Total		3.996	208			
ADRT * LEAPF	Between Groups	(Combined)	.086	1	.086	1.154	.284
	Within Groups		14.994	200	.075		
	Total		15.081	201			
TPM * LEAPF	Between Groups	(Combined)	.030	1	.030	1.599	.208
	Within Groups		3.829	205	.019		
	Total		3.859	206			
LTDR * LEAPF	Between Groups	(Combined)	.851	1	.851	2.596	.109
	Within Groups		56.734	173	.328		
	Total		57.586	174			
MEDISHR * LEAPF	Between Groups	(Combined)	.008	1	.008	.673	.413
	Within Groups		2.491	203	.012		
	Total		2.499	204			
MCAIDSHR * LEAPF	Between Groups	(Combined)	.002	1	.002	.136	.713
	Within Groups		2.460	205	.012		
	Total		2.462	206			
HMOSHARE * LEAPF	Between Groups	(Combined)	.109	1	.109	7.373	.007
	Within Groups		3.072	207	.015		
	Total		3.181	208			

EXHIBIT 5.18: ANOVA of LEAPF Variable.

Exhibits 5.(19-20) report the factor and ANOVA results for the existence of clinical representation within the IT decision-making process categorical variable. None of the performance measures were significant across this attribute.

Report

CREP		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
N	Mean	.0781963	.68438	.9673	.0144	.9044	.35547	.12326	.2704
	N	81	96	93	96	72	95	95	96
	Std. Deviation	.06717080	.140134	.19163	.13864	.57695	.112956	.101504	.12114
Y	Mean	.0735208	.70212	1.0279	.0113	.8763	.35836	.15830	.2729
	N	106	113	109	111	103	110	112	113
	Std. Deviation	.09588755	.137383	.32657	.13592	.57666	.109180	.113518	.12631
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.19: Factor Analysis of Clinical Representation Variable.

Exhibit 5.20 does report that hospitals with clinical representation within their IT decision-making processes did provide a statistically higher level of Medicaid service than those that did not. It is known that Medicaid services occur more in urban areas and that in the early 2000s managed care organizations were attempting to capture high levels of Medicaid patients at profitable pricing levels to improve profits. It is not clear whether there is any managerial significance to this correlation between clinical representation and Medicaid market share.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * CREP	Between Groups	(Combined)	.001	1	.001	.140	.709
	Within Groups		1.326	185	.007		
	Total		1.327	186			
ORATE * CREP	Between Groups	(Combined)	.016	1	.016	.851	.357
	Within Groups		3.979	207	.019		
	Total		3.996	208			
ADRT * CREP	Between Groups	(Combined)	.184	1	.184	2.469	.118
	Within Groups		14.897	200	.074		
	Total		15.081	201			
TPM * CREP	Between Groups	(Combined)	.000	1	.000	.025	.874
	Within Groups		3.858	205	.019		
	Total		3.859	206			
LTDR * CREP	Between Groups	(Combined)	.034	1	.034	.101	.751
	Within Groups		57.552	173	.333		
	Total		57.586	174			
MEDISHR * CREP	Between Groups	(Combined)	.000	1	.000	.035	.853
	Within Groups		2.499	203	.012		
	Total		2.499	204			
MCAIDSHR * CREP	Between Groups	(Combined)	.063	1	.063	5.393	.021
	Within Groups		2.399	205	.012		
	Total		2.462	206			
HMOSHARE * CREP	Between Groups	(Combined)	.000	1	.000	.022	.883
	Within Groups		3.181	207	.015		
	Total		3.181	208			

EXHIBIT 5.20: ANOVA Clinical Representation Variable.

Exhibits 5.(21-22) present the factor analysis and ANOVA for the census division categorical variable.

Report

CDIV		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
1	Mean	.0695000	.72800	.9424	-.0301	1.0521	.37933	.10867	.4640
	N	14	15	15	15	14	15	15	15
	Std. Deviation	.02227385	.121255	.14567	.13567	.57266	.118711	.075011	.08007
2	Mean	.0903923	.72115	1.1944	.0296	1.1088	.35120	.09960	.3384
	N	26	26	26	26	25	25	25	26
	Std. Deviation	.15550993	.159933	.26280	.14812	.54389	.088709	.128176	.01597
3	Mean	.0737839	.70424	1.0756	.0172	.7568	.37606	.16364	.2219
	N	31	33	32	33	31	33	33	33
	Std. Deviation	.10451870	.125275	.48841	.13432	.57363	.141464	.105884	.09494
4	Mean	.0652452	.66907	.9694	.0054	.9541	.38674	.13907	.2187
	N	42	43	43	43	34	43	43	43
	Std. Deviation	.02254372	.149488	.14877	.12146	.46531	.094105	.092706	.05771
5	Mean	.0982588	.68353	1.0173	-.0226	.8521	.39588	.18118	.2508
	N	17	17	16	16	14	17	17	17
	Std. Deviation	.13921526	.150164	.18049	.18929	.60217	.133934	.110504	.12587
6	Mean	.0732231	.66526	.9322	.0608	.7119	.36842	.11667	.2014
	N	13	19	19	19	16	19	18	19
	Std. Deviation	.03029018	.123395	.15483	.05600	.43814	.068497	.044192	.11824
7	Mean	.0684643	.76000	1.0159	.0031	.7725	.33077	.12714	.1601
	N	14	14	12	14	12	13	14	14
	Std. Deviation	.02167010	.070493	.11142	.15254	.64685	.128288	.101635	.03638
8	Mean	.0807769	.66842	.8430	.0319	.5990	.29778	.13632	.2963
	N	13	19	17	19	10	18	19	19
	Std. Deviation	.02979080	.112806	.12020	.03821	.66657	.081136	.094470	.11612
9	Mean	.0673765	.68522	.9180	.0035	.9711	.28591	.19087	.3632
	N	17	23	22	22	19	22	23	23
	Std. Deviation	.02248626	.168114	.26965	.19773	.71073	.084496	.161243	.15655
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.21: Factor Analysis Census Division Variable.

Only the clinical process control performance measure (ADRT) was statistically significant at the 5 percent level which tends to confirm the generally acceptable idea that there are regional differences to care practice patterns across the country which are a function of demand differences and clinician practice differences. The managed care market penetration variable was highly significant which confirms that managed care penetration is also a regional phenomenon.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * CDIV	Between Groups	(Combined)	.022	8	.003	.372	.934
	Within Groups		1.306	178	.007		
	Total		1.327	186			
ORATE * CDIV	Between Groups	(Combined)	.159	8	.020	1.039	.408
	Within Groups		3.836	200	.019		
	Total		3.996	208			
ADRT * CDIV	Between Groups	(Combined)	1.918	8	.240	3.515	.001
	Within Groups		13.163	193	.068		
	Total		15.081	201			
TPM * CDIV	Between Groups	(Combined)	.112	8	.014	.739	.657
	Within Groups		3.747	198	.019		
	Total		3.859	206			
LTDR * CDIV	Between Groups	(Combined)	3.919	8	.490	1.515	.155
	Within Groups		53.667	166	.323		
	Total		57.586	174			
MEDISHR * CDIV	Between Groups	(Combined)	.270	8	.034	2.965	.004
	Within Groups		2.229	196	.011		
	Total		2.499	204			
MCAIDSHR * CDIV	Between Groups	(Combined)	.174	8	.022	1.879	.065
	Within Groups		2.288	198	.012		
	Total		2.462	206			
HMOSHARE * CDIV	Between Groups	(Combined)	1.353	8	.169	18.492	.000
	Within Groups		1.829	200	.009		
	Total		3.181	208			

EXHIBIT 5.22: ANOVA Census Division Variable.

Exhibits 5.(22-23) present the factor and ANOVA results for the form of ownership categorical variable. Interestingly, none of the performance measures were statistically significant in the ANOVA. Form of ownership was found not to be significant to efficiency in this sample of high performing hospitals which is contrary to earlier papers of Li and Rosenman (2001), Rosko (2001), Kessler and McClellan (2002), and Brown (2002). The high level of significance of the Medicaid market share variable tends to confirm that Medicaid patients were mostly cared for by the government hospitals in this panel – state government facilities, all federal hospitals were excluded in the original panel – and that the for-profit hospitals were next highest in providing Medicaid services in pursuit of profitable capitated contracts.

Report

OWNERSHP		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
G	Mean	.0806120	.72960	1.0767	-.0189	.8611	.30760	.24000	.2939
	N	25	25	25	23	19	25	25	25
	Std. Deviation	.11558239	.131608	.27430	.21738	.73482	.121493	.174308	.13909
I	Mean	.0727800	.61800	1.0607	-.0089	.5620	.44800	.19800	.1960
	N	5	5	5	5	5	5	5	5
	Std. Deviation	.04131183	.165892	.19218	.06904	.38577	.074632	.073959	.10224
N	Mean	.0748274	.69112	.9871	.0174	.9021	.36149	.12684	.2708
	N	157	179	172	179	151	175	177	179
	Std. Deviation	.08003047	.138369	.27501	.12477	.55795	.107656	.089647	.12165
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.23: Factor Analysis Ownership Categorical Variable.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * OWNERSHP	Between Groups	(Combined)	.001	2	.000	.053	.949
	Within Groups		1.327	184	.007		
	Total		1.327	186			
ORATE * OWNERSHP	Between Groups	(Combined)	.062	2	.031	1.625	.199
	Within Groups		3.934	206	.019		
	Total		3.996	208			
ADRT * OWNERSHP	Between Groups	(Combined)	.194	2	.097	1.297	.276
	Within Groups		14.887	199	.075		
	Total		15.081	201			
TPM * OWNERSHP	Between Groups	(Combined)	.029	2	.015	.778	.461
	Within Groups		3.830	204	.019		
	Total		3.859	206			
LTDR * OWNERSHP	Between Groups	(Combined)	.575	2	.287	.867	.422
	Within Groups		57.011	172	.331		
	Total		57.586	174			
MEDISHR * OWNERSHP	Between Groups	(Combined)	.106	2	.053	4.471	.013
	Within Groups		2.393	202	.012		
	Total		2.499	204			
MCAIDSHR * OWNERSHP	Between Groups	(Combined)	.296	2	.148	13.964	.000
	Within Groups		2.166	204	.011		
	Total		2.462	206			
HMOSHARE * OWNERSHP	Between Groups	(Combined)	.041	2	.021	1.348	.262
	Within Groups		3.140	206	.015		
	Total		3.181	208			

EXHIBIT 5.24: ANOVA Ownership Categorical Variable.

Exhibits 5.(25-26) present the factor and ANOVA results for the hospital setting categorical variable. Not surprisingly, Medicare market share was found to be correlated with hospital setting. In this case, rural hospitals do a higher share of Medicare services than urban hospitals (p=.001). Occupancy rate was found significant (p=.000). Urban hospitals averaged 71.1 percent occupancy while rural hospitals averaged 58.2 percent occupancy. This is likely reflective of higher teaching status in urban hospitals and a higher casemix index (medical complexity) at urban hospitals than rural hospitals. It may also indicate a higher competitive drive in urban setting hospitals; however the other convolutions cannot be isolated in this test. The clinical process control measure was significant (p=.020) which tends to confirm the generally accepted belief that urban hospitals tend to have higher complexity of care than rural hospitals. Long-term debt ratio was statistically significant (p=.010) with urban hospitals averaging 0.93 ratio while rural hospitals average .595 LTDR. This finding may be reflective of several market conditions as well as more aggressive organizational investments in innovation and physical plant.

Report

SETTING		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
R	Mean	.0707444	.58179	.8858	.0151	.5950	.42179	.15556	.2488
	N	18	28	27	28	22	28	27	28
	Std. Deviation	.02657717	.130329	.13576	.05211	.42891	.116970	.070837	.11342
U	Mean	.0760574	.71133	1.0176	.0124	.9300	.34678	.14022	.2753
	N	169	181	175	179	153	177	180	181
	Std. Deviation	.08846927	.131873	.28562	.14583	.58244	.106431	.113993	.12510
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.25: Factor Analysis Hospital Setting Categorical Variable.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * SETTING	Between Groups	(Combined)	.000	1	.000	.064	.801
	Within Groups		1.327	185	.007		
	Total		1.327	186			
ORATE * SETTING	Between Groups	(Combined)	.407	1	.407	23.470	.000
	Within Groups		3.589	207	.017		
	Total		3.996	208			
ADRT * SETTING	Between Groups	(Combined)	.407	1	.407	5.544	.020
	Within Groups		14.674	200	.073		
	Total		15.081	201			
TPM * SETTING	Between Groups	(Combined)	.000	1	.000	.010	.921
	Within Groups		3.859	205	.019		
	Total		3.859	206			
LTDR * SETTING	Between Groups	(Combined)	2.159	1	2.159	6.737	.010
	Within Groups		55.427	173	.320		
	Total		57.586	174			
MEDISHR * SETTING	Between Groups	(Combined)	.136	1	.136	11.684	.001
	Within Groups		2.363	203	.012		
	Total		2.499	204			
MCAIDSHR * SETTING	Between Groups	(Combined)	.006	1	.006	.461	.498
	Within Groups		2.456	205	.012		
	Total		2.462	206			
HMOSHARE * SETTING	Between Groups	(Combined)	.017	1	.017	1.117	.292
	Within Groups		3.164	207	.015		
	Total		3.181	208			

EXHIBIT 5.26: ANOVA Hospital Setting Categorical Variable.

Exhibits 5.(27-28) report the factor and ANOVA results for the hospital teaching status categorical variable. Exhibit 5.28 shows that the occupancy rate, clinical process control, and long-term debt ratio measures were statistically significant at the 5 percent level. Major teaching centers demonstrated highest occupancy rates (p=.000), the highest comparative difference in benchmark average length of stay (p=.000), and the highest long-term debt ratio (p=.024) in this sample of high performing hospitals. These findings would be consistent with generally accepted understanding of the impact of the teaching mission on performance that providing highest quality care in a teaching environment which is likely to present both complex cases and high concentrations of uninsured patients, leads to utilization patterns and consumption patterns higher than otherwise expected.

Report

TEACHING		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
C	Mean	.0749691	.77536	1.1336	-.0136	1.0519	.31125	.15429	.2936
	N	55	56	54	55	48	56	56	56
	Std. Deviation	.10774845	.086402	.40497	.17410	.58954	.095500	.133741	.11988
M	Mean	.0828233	.70689	.9716	.0175	.8975	.35736	.14405	.2504
	N	73	74	71	73	64	72	74	74
	Std. Deviation	.09541033	.100600	.19263	.14343	.58165	.105336	.112857	.13817
N	Mean	.0670797	.62418	.9325	.0266	.7532	.39000	.13169	.2764
	N	59	79	77	79	63	77	77	79
	Std. Deviation	.02522559	.163233	.17841	.09376	.53123	.115200	.083625	.10948
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.27: Factor Analysis Teaching Status Categorical Variable.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * TEACHING	Between Groups	(Combined)	.008	2	.004	.566	.569
	Within Groups		1.319	184	.007		
	Total		1.327	186			
ORATE * TEACHING	Between Groups	(Combined)	.768	2	.384	24.511	.000
	Within Groups		3.228	206	.016		
	Total		3.996	208			
ADRT * TEACHING	Between Groups	(Combined)	1.372	2	.686	9.958	.000
	Within Groups		13.709	199	.069		
	Total		15.081	201			
TPM * TEACHING	Between Groups	(Combined)	.055	2	.028	1.481	.230
	Within Groups		3.804	204	.019		
	Total		3.859	206			
LTDR * TEACHING	Between Groups	(Combined)	2.440	2	1.220	3.805	.024
	Within Groups		55.146	172	.321		
	Total		57.586	174			
MEDISHR * TEACHING	Between Groups	(Combined)	.201	2	.101	8.837	.000
	Within Groups		2.298	202	.011		
	Total		2.499	204			
MCAIDSHR * TEACHING	Between Groups	(Combined)	.017	2	.008	.707	.494
	Within Groups		2.445	204	.012		
	Total		2.462	206			
HMOSHARE * TEACHING	Between Groups	(Combined)	.062	2	.031	2.052	.131
	Within Groups		3.119	206	.015		
	Total		3.181	208			

EXHIBIT 5.28: ANOVA Teaching Status Categorical Variable

Exhibits 5.(29-30) present the results of factor and ANOVA analysis for the existence of formal IT decision-making and oversight committee within the hospital.

Report

ITCOMM		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
D	Mean	.0730800	.68600	.9085	.0473	.1600	.41800	.05800	.2330
	N	5	5	5	5	4	5	5	5
	Std. Deviation	.02903940	.032863	.04495	.05270	.15319	.078867	.035637	.11590
N	Mean	.0683667	.65714	.9468	.0370	.9657	.34143	.16429	.1679
	N	6	7	7	7	7	7	7	7
	Std. Deviation	.02054144	.148965	.09670	.03786	.37762	.071747	.104858	.08892
Y	Mean	.0758608	.69548	1.0044	.0110	.9023	.35601	.14359	.2764
	N	176	197	190	195	164	193	195	197
	Std. Deviation	.08689999	.140118	.28126	.14048	.57804	.112334	.110100	.12357
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.29: Factor Analysis IT Committee Categorical Variable.

As seen in Exhibit 5.30, the existence of a formal IT committee impacts the long-term debt ratio (p=.035); however, this finding is driven by the four cases of "Do Not Know" coded from interpretation of the original source material. These cases reported extremely low debt ratios, falsely biasing the estimates of variance of the measures and potentially distorting the ANOVA tests. Given this uncertainty, hospitals with formal committees had lower debt ratios than those without.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * ITCOMM	Between Groups	(Combined)	.000	2	.000	.025	.976
	Within Groups		1.327	184	.007		
	Total		1.327	186			
ORATE * ITCOMM	Between Groups	(Combined)	.010	2	.005	.265	.767
	Within Groups		3.986	206	.019		
	Total		3.996	208			
ADRT * ITCOMM	Between Groups	(Combined)	.065	2	.033	.433	.649
	Within Groups		15.015	199	.075		
	Total		15.081	201			
TPM * ITCOMM	Between Groups	(Combined)	.011	2	.005	.284	.753
	Within Groups		3.848	204	.019		
	Total		3.859	206			
LTDR * ITCOMM	Between Groups	(Combined)	2.196	2	1.098	3.409	.035
	Within Groups		55.390	172	.322		
	Total		57.586	174			
MEDISHR * ITCOMM	Between Groups	(Combined)	.020	2	.010	.835	.435
	Within Groups		2.479	202	.012		
	Total		2.499	204			
MCAIDSHR * ITCOMM	Between Groups	(Combined)	.039	2	.020	1.652	.194
	Within Groups		2.423	204	.012		
	Total		2.462	206			
HMOSHARE * ITCOMM	Between Groups	(Combined)	.087	2	.044	2.910	.057
	Within Groups		3.094	206	.015		
	Total		3.181	208			

EXHIBIT 5.30: ANOVA IT Committee Categorical Variable.

Exhibit 5.31 reports the factor and ANOVA results for the Top 100 Hospital Award categorical variable. Top 100 Award winners had debt ratios 40 percent less than those not receiving this award (p=.029). They also were more profitable (p=.106) and tended to demonstrate better control of clinical processes (p=.297).

Report

TOP100		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
N	Mean	.0758503	.69459	1.0053	.0088	.9136	.35745	.14670	.2720
	N	175	196	189	194	163	192	194	196
	Std. Deviation	.08704741	.136342	.27821	.14009	.57991	.110975	.110910	.12371
Y	Mean	.0711083	.68462	.9232	.0721	.5383	.35077	.07538	.2685
	N	12	13	13	13	12	13	13	13
	Std. Deviation	.02808576	.175529	.19309	.04293	.37312	.110413	.046479	.12803
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.31: Factor Analysis Top100 Hospital Award Categorical Variable.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * TOP100	Between Groups	(Combined)	.000	1	.000	.035	.851
	Within Groups		1.327	185	.007		
	Total		1.327	186			
ORATE * TOP100	Between Groups	(Combined)	.001	1	.001	.063	.802
	Within Groups		3.995	207	.019		
	Total		3.996	208			
ADRT * TOP100	Between Groups	(Combined)	.082	1	.082	1.093	.297
	Within Groups		14.999	200	.075		
	Total		15.081	201			
TPM * TOP100	Between Groups	(Combined)	.049	1	.049	2.634	.106
	Within Groups		3.810	205	.019		
	Total		3.859	206			
LTDR * TOP100	Between Groups	(Combined)	1.574	1	1.574	4.862	.029
	Within Groups		56.012	173	.324		
	Total		57.586	174			
MEDISHR * TOP100	Between Groups	(Combined)	.001	1	.001	.044	.834
	Within Groups		2.499	203	.012		
	Total		2.499	204			
MCAIDSHR * TOP100	Between Groups	(Combined)	.062	1	.062	5.293	.022
	Within Groups		2.400	205	.012		
	Total		2.462	206			
HMOSHARE * TOP100	Between Groups	(Combined)	.000	1	.000	.010	.921
	Within Groups		3.181	207	.015		
	Total		3.181	208			

EXHIBIT 5.32: ANOVA Top 100 Hospital Award Categorical Variable.

Exhibits 5.(33-34) present the factor and ANOVA results for the Top 100 Cardiology service categorical variable. Interestingly, these hospitals were nearly 50 percent less efficient than the other hospitals in this high performing sample (p=.049). It is possible this finding reflects the degree of custom-cardio-care performed by those hospitals to achieve such industry recognition – and their choice to achieve the service-line dominance.

Report

CARIO100		EFFICIEN	ORATE	ADRT	TPM	LTDR	MEDISHR	MCAIDSHR	HMOSHARE
N	Mean	.0706702	.68841	1.0094	.0108	.8867	.35854	.14900	.2709
	N	161	182	175	180	151	178	180	182
	Std. Deviation	.06654269	.138389	.28597	.14575	.58729	.113636	.113261	.12459
Y	Mean	.1057385	.73148	.9393	.0255	.8954	.34704	.09704	.2779
	N	26	27	27	27	24	27	27	27
	Std. Deviation	.15380167	.136683	.16833	.04436	.50425	.089949	.062746	.11934
Total	Mean	.0755460	.69397	1.0000	.0127	.8879	.35702	.14222	.2718
	N	187	209	202	207	175	205	207	209
	Std. Deviation	.08447724	.138602	.27391	.13686	.57528	.110682	.109322	.12367

EXHIBIT 5.33: Factor Analysis Top 100 Cardiology Award Categorical Variable.

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
EFFICIEN * CARIO100	Between Groups	(Combined)	.028	1	.028	3.918	.049
	Within Groups		1.300	185	.007		
	Total		1.327	186			
ORATE * CARIO100	Between Groups	(Combined)	.044	1	.044	2.285	.132
	Within Groups		3.952	207	.019		
	Total		3.996	208			
ADRT * CARIO100	Between Groups	(Combined)	.115	1	.115	1.534	.217
	Within Groups		14.966	200	.075		
	Total		15.081	201			
TPM * CARIO100	Between Groups	(Combined)	.005	1	.005	.270	.604
	Within Groups		3.854	205	.019		
	Total		3.859	206			
LTDR * CARIO100	Between Groups	(Combined)	.002	1	.002	.005	.945
	Within Groups		57.584	173	.333		
	Total		57.586	174			
MEDISHR * CARIO100	Between Groups	(Combined)	.003	1	.003	.252	.616
	Within Groups		2.496	203	.012		
	Total		2.499	204			
MCAIDSHR * CARIO100	Between Groups	(Combined)	.063	1	.063	5.418	.021
	Within Groups		2.399	205	.012		
	Total		2.462	206			
HMOSHARE * CARIO100	Between Groups	(Combined)	.001	1	.001	.075	.785
	Within Groups		3.180	207	.015		
	Total		3.181	208			

EXHIBIT 5.34: ANOVA Top 100 Cardiology Award Categorical Variable.

This section described the results of factor analysis and ANOVA of the qualitative attributes constructed in the panel data set. This technique however would only reveal linear, direct relationships of a single independent variable and the dependent performance measures. The next section describes the results of an analytical technique developed for the purpose of extracting statistical associations among complex qualitative models.

5.3.3 Categorical Multiple Regression with Optimal Scaling Technique

The categorical regression with optimal scaling technique used in this section is documented in Van der Kooij, Neufeglise et al. (2001).[122,123] Exhibit 5.35 presents the statistical results of multiple structural models with the set of performance measures as the dependent variables and the full set of qualitative attributes as the independent variables. In addition, to capture the Kaplan and Norton concept of a strategy map reflecting cause-and-effect relationships, the predicted values of the efficiency measure were used in a stepwise regression with an instrumental variable (IV) approach. The IV approach is equivalent to a two-stage least squares technique to minimize specification errors and estimation biases. The approach used was to specify the full-scale structural model in the first instance, and then proceed to drop terms as appropriate based upon first structural efficiency of the model and secondarily on individual t-statistics of the standardized coefficients. As shown in Exhibit 5.35, of the five structural models specified – Efficiency, Clinical Process Control, Occupancy Rate, Total Profit Margin, and Long-term Debt Ratio – the final form equations explained from 15 percent of the variation of the dependent variable up to 47 percent. As these were cross-sectional regressions with structural significance of each model at least to the .05 confidence level and the pattern of residuals of each model found to be clean relatively of heterogeneity and missing variable symptoms, these structural models were deemed to be reasonable and valid sources of interpretive information. However, any associations found would be characterized as statistically significant, relatively weak associations of the total variations in the dependent variables, as the r^2 values were less than 50 percent.[124]

---

[122] Van der Kooij, A., P. Neufeglise and J. Meulman (2001). CATREG, Categorical Multiple Regression with Optimal Scaling (revised and updated version). Chicago, IL, SPSS, Inc..

[123] CATREG was developed to allow the use of coded (text-based) qualitative independent variables in a multiple regression technique. This approach unlocks both of the problems with the simple cross-tab ANOVA results in that non-linearity of form, and specifications including interaction effects and instrumental variables can be employed.

[124] The plots of the residuals for each transformed RHS term were examined. These presented no obvious structural patterns. The residual plots are presented in the appendix.

Nevertheless, interesting findings and interpretations are available from these results.

EXPLORING THE ROLE OF INNOVATION IN STRATEGIC PERFORMANCE: Reduced Form Specifications. Instrumental Variable Approach within the CATREG Technique Applied to Cross-Section of the Panel (FY02) from the Partition of Most Aggressive IT Implementers in US Hospital Sector, 1997-2002

			Cross-Section Categorical Regressions of the Focal Theory BSC Framework																			
			L&G				Clinical				Customer				Financial							
			PF-EFF				ADRT				ORATE				TPM				LTDR			
		Cases	188				207				183				210				177			
		F-stat / Sig	1.292 / .183				3.719 / .000				3.422 / .000				1.656 / .020				1.956 / .009			
		R2	0.147				0.465				0.431				0.243				0.227			
		St Dev	0.08448				0.27391				0.1386				0.13686				0.57528			
			Mulltple Regression Results																			
			Pratt's Import	$Part^2$	Coeff.	Sig	Pratt's Import	$Part^2$	Coeff.	Sig	Pratt's Import	$Part^2$	Coeff.	Sig	Pratt's Import	$Part^2$	Coeff.	Sig	Pratt's Import	$Part^2$	Coeff.	Sig
MARKET FORCES		**Component**	**0.4%**	**1.3%**			**5.0%**	**1.2%**			**0.0%**	**0.0%**			**-0.4%**	**3.1%**			**21.1%**	**4.0%**		
		Census Division	0.4%	1.3%	0.119	.046				.046					-0.4%	3.1%	0.207	.000	10.4%	2.9%	-0.178	.000
		HMO Market Share																				
		Setting					5.0%	1.2%	0.118	.026									10.7%	1.1%	0.147	.021
ORGANIZATIONAL INNOVATION																						
	Governance	**Component**	**39.5%**	**6.7%**			**74.0%**	**32.5%**			**68.3%**	**20.8%**			**4.5%**	**2.4%**			**33.3%**	**8.2%**		
		Ownership					4.0%	3.1%	-0.194	.000												
		Bedsize					54.8%	22.2%	0.533	.000	20.1%	4.9%	0.258	.000								
		Teaching Status	7.9%	1.7%	-0.140	.020	9.1%	2.8%	-0.185	.000	14.2%	1.8%	-0.165	.003					13.1%	2.3%	-0.159	.004
		Medicare Share	18.9%	3.3%	0.190	.012					33.4%	10.2%	-0.409	.000								
		Medicaid Share									1.4%	3.2%	-0.205	.004	4.5%	2.4%	-0.163	.019	3.5%	2.0%	-0.145	.051
		Casemix Index																				
		Top100 Award					2.5%	1.5%	-0.129	.000									16.7%	4.0%	-0.205	.001
		Top100 Cardio Award	12.7%	1.6%	0.130	.048	3.6%	3.0%	-0.183	.000												
		PF-Efficiency Score (IV)	X								-0.8%	0.6%	0.098	.211								
	IT Governance	**Component**	**31.4%**	**5.6%**			**0.4%**	**0.9%**			**4.3%**	**3.9%**			**2.9%**	**1.7%**			**23.8%**	**5.1%**		
		Strategy Class	11.8%	2.3%	0.157	.074	0.4%	0.9%	-0.106	.023	4.3%	3.9%	-0.225	.000								
		CIO Direct Report																				
		Leapfrog Targets	19.6%	3.3%	-0.184	.002													8.6%	1.7%	0.139	.038
		IT Committee													2.9%	1.7%	-0.14	.010	15.2%	3.5%	0.19	.000
		Clinical Representation																				
	Scope of IT Implementation																					
Intangible Assets	**Weill**	**BF**	**IT Capability**																			
			28.6%	**5.2%**			**20.5%**	**13.2%**			**27.2%**	**21.1%**			**93.1%**	**34.0%**			**22.0%**	**7.1%**		
	Transactional	BO	Credit/Collections					2.7%	1.6%	-0.141	.008											
			Electronic Claims									5.7%	3.9%	0.226	.000	2.8%	2.4%	-0.179	.004			
			Patient Billing																			
			Patient Registration																			
			Patient Scheduling													8.8%	3.4%	-0.203	.001			
		GF	AP																			
			ERP					3.3%	0.7%	-0.094	.121	0.8%	1.6%	0.133	.019							
			G-Ledger																			
			Materials Management																			
		HR	Benefits Adm																			
			Payroll																			
			Personnel Adm																			
			T&A													15.6%	3.3%	0.216	.001			
		Subtotal		**0.0%**	**0.0%**			**6.0%**	**2.3%**			**6.5%**	**5.5%**			**27.2%**	**9.1%**			**0.0%**	**0.0%**	
	Informational	DS	Casemix																			
			Clinical DS																			
			Cost Accounting																			
			Exec IS									5.7%	5.1%	-0.244	.000							
			Flexible Budgeting													11.8%	2.0%	0.172	.011			
			Outcomes&Quality Mgt													3.9%	1.2%	0.117	.070			
		MCS	Elegibility									7.3%	2.4%	-0.169	.002	5.0%	4.0%	-0.231	.000			
			MC Contract Mgt													17.5%	4.6%	0.253	.000			
			Premium Billing	9.2%	1.5%	-0.127	.054															
		MR	Abstracting																			
			Chart Deficiency									1.5%	0.7%	0.129	.149	4.2%	3.3%	-0.27	.001			
			Chart Tracking					1.0%	1.2%	0.134	.023	1.1%	1.4%	-0.174	.031	4.8%	1.5%	0.177	.032			
			Dictation					-0.1%	0.7%	0.099	.111									3.2%	2.2%	0.152
			Encoder																			
			Master Patient Index																			
			Med Rec Imaging					-1.3%	0.6%	0.09	.138											
			Transcription					1.6%	0.6%	-0.095	.170					12.2%	3.3%	0.217	.001			
		Subtotal		**9.2%**	**1.5%**			**1.2%**	**3.2%**			**15.6%**	**9.6%**			**59.4%**	**19.9%**			**3.2%**	**2.2%**	
	Strategic	CS	Cardiology	11.3%	2.2%	0.154	.016									1.7%	1.7%	0.143	.021			
			C Data Repository									-0.4%	1.0%	-0.122	.068							
			Clinical Documentation					1.8%	0.8%	-0.099	.085											
			Computerized-Patient Rec									3.9%	1.6%	0.145	.017							
			CPOE																			
			ER Department																	2.8%	1.0%	0.101
			Intensive Care									-0.5%	0.6%	-0.101	.221							
			Lab																			
			Nurse Staffing					4.9%	1.3%	0.124	.020											
			OB Systems	8.1%	1.5%	-0.127	.058					1.9%	1.6%	0.14	.016							
			OE/RR					0.7%	1.3%	0.142	.022											
			PACS					4.0%	3.6%	-0.202	.000					3.9%	1.8%	-0.14	.018			
			RX																			
			POC-Med/Surg Bedside									0.2%	1.1%	0.142	.057					16.0%	3.9%	-0.201
			Rad																			
			Surg					1.9%	0.8%	0.107	.076					0.9%	1.5%	-0.126	5.8%			
		Subtotal		**19.4%**	**3.7%**			**13.3%**	**7.7%**			**5.1%**	**5.9%**			**6.5%**	**5.0%**			**18.8%**	**4.9%**	
Total Importance			**100%**	**19%**			**100%**	**48%**			**100%**	**46%**			**100%**	**41%**			**100%**	**24%**		

EXHIBIT 5.35: Multiple Regression Exploring Qualitative Characteristics of High Performing, Aggressive IT Implementing Hospitals.

5.4 *FINDINGS*

This chapter answers the fundamental research question driving this thesis – Does IT matter in the US hospital sector in terms of generating strategic value and possibly competitive advantage? The answer is *Yes*, but these statistically significant associations, while providing new insights into IT and innovation are clearly not the dominant associations within the strategic performance measures examined. Exhibit 5.35 also reports the Pratt's Importance[125] measure, the squared-part correlation statistic, and the estimated beta coefficient for each of the right hand side terms in each of the models. As described in Thomas, Hughes and Zumbo (1996) the use of Pratt's measure is in determining both the relative importance of RHS terms and in identifying the additive importance of the terms. By examining both the importance and the squared-part statistics, several interesting findings emerge from the table. The scope of IT implemented within US hospitals during the period 1997 – 2002 was found to have the following impact on hospital strategic performance.

The first significant finding is that IT implemented explained 29 percent of the modeled variation in efficiency, 21 percent of the modeled variation in clinical process control, 27 percent of the modeled variation in occupancy rates, 93 percent of the modeled variation in total profit margin, and 22 percent of the modeled variation in long-term debt ratios.

The explained variation can be further decomposed within the regression models. In terms of importance (Pratt's measure):

- Transactional IT was associated with 0.0 percent of efficiency, 6.0 percent of clinical process control, 6.5 percent of occupancy rate. 27.2 percent of total profit margin, and 0.0 percent of long-term debt ratio performance.

[125] Pratt's measure of relative importance. This measure defines the importance of predictors additively, i.e., the importance of a set of predictors is the sum of the individual importance of the predictors. This measure also signals the presence of multicollinearity among the predictors by a substantive negative importance value and the presence of a suppressor variable by a low importance value while the regression coefficient is comparable to the coefficients of variables deemed to be important. SPSS v11.0

- Informational IT was associated with 9.2 percent of efficiency, 1.2 percent of clinical process control, 15.6 percent of occupancy rate, 59.4 percent of total profit margin, and 3.2 percent of long-term debt ratio performance.
- Strategic IT was associated with 19.4 percent of efficiency, 13.3 percent of clinical process control, 5.1percent of occupancy rate, 6.5 percent of total profit margin, and 18.8 percent of long-term debt ratio performance.

The regression results demonstrate the following, significant at least at the .05 level across the balanced scorecard measures:

- On average Transactional IT was associated with 7.9 percent of the movement over the set of performance measures,
- Informational IT was associated with 17.7 percent of the movement over the set of performance measures with these models, and
- Strategic IT was associated with 12.6 percent of the movement of the performance measures.

In terms of isolating individual contribution (part-squared):

- Transactional IT was associated with 0.0 percent of efficiency, 2.3 percent of clinical process control, 5.5 percent of occupancy rate, 9.1 percent of total profit margin, and 0.0 percent of long-term debt ratio performance.
- Informational IT was associated with 1.5 percent of efficiency, 3.2 percent of clinical process control, 9.6 percent of occupancy rate, 19.9 percent of total profit margin, and 2.2 percent of long-term debt ratio performance.
- Strategic IT was associated with 3.7 percent of efficiency, 7.7 percent of clinical process control, 5.9 percent of occupancy rate, 5.0 percent of total profit margin, and 4.9 percent of long-term debt ratio performance.

An additional interpretation of the regression results for the IT capabilities is that the efficiency model generates the highest degree of observable inter-action among the IT capabilities than the other four models in that the importance measure was 28.6 percent while the sum of part-square was 5.2 percent. In other words, according to this model, it is the collective value of IT implemented that generates valuable efficiency gains – there is not a single 'silver bullet' efficiency solution.[126] In contrast with the occupancy rate model in which importance was 27.2 percent and part-squared 21.1 percent for IT capabilities – the interpretation is that there is little inter-action effects among the significant IT capabilities identified in the occupancy rate model.

The IT capability with the highest part-squared was executive information systems (5.1 percent). These systems are designed to produce management views of operations and what-if analyses and therefore could be expected to be correlated with occupancy rates.

Claims processing was the second highest single capability in the occupancy rate model. Claims processing systems are the mechanism for a hospital to identify third-party (insurance) payers of patient treatment and to provide electronic transactions for claims payments once a patient has been discharged. For hospitals that had established a strategy to maximize turnover and reduce the length of days in receivables, then one can see a relationship between claims processing systems within the occupancy rate model.

A point to remember is that the operational measure used as the dependent variable in the efficiency model is the relative inefficiency estimated in each hospital from the stochastic model developed in Chapter 4. Therefore, one can find interesting interpretations of the signs of the efficiency model coefficients. The sign of the coefficient for cardiology systems was positive – implying that those hospitals with cardiology systems implemented had, on average, inefficiency scores .0130 percentage points higher (less efficient) than those hospitals that did not implement cardiology systems. This finding while perhaps counter-intuitive is consistent with the comparison of means ANOVA presented Exhibit 5.(33-34) which found hospitals

[126] A difficult aspect of this efficiency model is that the 219 cases in this regression were all high efficiency performers. What the regression generates are relative discriminators within this sample. For example, transactional IT is nearly ubiquitous across the entire panel, as shown in Exhibit 5-4, so it may be that well implemented transactional IT drives performance differences within the entire panel but does not generate exceptional differentials within the high-performing partition.

identified by a third-party industry source as cardiology service top-performers were less efficient than the rest of the hospitals in this sample. This finding can be interpreted as a signal that the industry standard practice for cardiology care is not sufficient to meet the medical standard of cardiology care expected by the market.

The efficiency model was explained 40 percent by executive governance, 31 percent IT governance, and 29 percent from specific IT capabilities. The highest part[2] (3.3 percent) was found in two measures -the Medicare market share and references to Leapfrog Group targets. The impact of Leapfrog Targets in the model was to reduce inefficiency scores, on average, by .0155 percentage points. Those hospitals that referenced attempting to comply with Leapfrog Group targets for clinician order entry in their IT strategic plans were statistically more efficient than those hospitals that did not reference Leapfrog Group targets. These hospitals did not claim achievement of those targets, they simply made reference *to considering, planning, or pursuing* those targets – in fact few (13 percent) of these hospitals have the clinical order entry systems implemented to achieve Leapfrog performance targets, yet 79 percent of them referenced the Leapfrog initiative in their planning. In this way, this measure appears to have captured in textual coding a signal that it is a true indicator of strategically cognizant hospital organizations – the Solid Citizens of the Sector – whether the specific Leapfrog targets have any meaning is not important to this finding, the finding is about the 'frame of mind' of the organization in their governance of IT.

The clinical process control model was explained 74 percent by executive governance while specific IT capabilities explained 21 percent of the variation in the clinical process control measure. A hospital's size and degree of teaching mission drove the executive governance attributes in this model. Strategic IT capabilities drove a total of 13 percent of the model. However, no single IT component drove more than 4 percent of the model.

The occupancy rate model was explained 68 percent by executive governance, 4 percent by IT governance, and 27 percent by specific IT capabilities. As with the clinical process measure, the occupancy rate model was driven by size, teaching mission, Medicare market share and Medicaid market share.

In contrast, the total profit margin model was explained 5 percent by executive governance, 3 percent by IT governance, and 93 percent by specific IT capabilities. The single highest independent correlations (the $part^2$ statistic of the regression) were found in the informational IT category – flexible budgeting (2 percent), Outcomes/Quality Management (1 percent), eligibility (4 percent), managed care contract support (5 percent), chart deficiency (3 percent), chart tracking (2 percent), and transcription (4 percent). Transaction IT single correlations were claims processing (2 percent) and patient scheduling (3 percent). Strategic IT single correlations were cardiology (2 percent), picture archiving and storage (2 percent), and surgical suite scheduling and support (2 percent). This finding is at least supportive of Borzekowski (2002), discussed in Chapter 2, that found statistically significant reductions in cost functions to be subject to at least a three-year lag from IT implementation date. The performance data were FY2002 and the IT aggressive implementers were identified over the period 1997-2001. A three-year lag would include IT implemented in 1999 which includes strategic groups 1, 2, and 3 or precisely two-thirds of this sample of hospitals.

Finally, the long-term debt ratio model was explained 33 percent by executive governance, 24 percent by IT governance, and 22 percent by specific IT capabilities. The high single correlation terms from governance were teaching mission (2 percent), Medicaid market share (2 percent), and identification by a third-party source as a Top100 hospital (4 percent). The high single correlation terms within IT governance were a reference to Leapfrog Group targets (2 percent), and the existence of a formal mechanism for IT decision-making (4 percent). The high correlation terms from specific IT components were: chart tracking (2 percent), emergency room departmental automation (1 percent), and point-of-care bedside terminals (4 percent). The example of point-of-care medical/surgical bedside terminals was interesting as they represent a most aggressive merging of clinical practice process change and advanced technology and they were implemented within 55 percent of the 219 cases. The impact of the bedside terminals on the model was to decrease long-term debt ratio by 0.12 basis points – a financial improvement in the measure. This represents an intriguing finding as a statistically significant and correct sign finding for bedside terminals existed within the occupancy rate model as well. This sort of association across the models would tend to reinforce the expected cause-and-effect flows of the strategy maps presented in chapter 4.2 as Strategy Map 2 – *Strive for Clinical Excellence*.

Within the executive governance attributes, the most commonly significant attribute across the models was the teaching status attribute. It was found to increase efficiency (a positive), increase clinical process control (a positive), decrease occupancy rates (typically considered negative), and decrease long-term debt ratios (a positive). The level of Medicaid market share captured by a hospital was found to decrease occupancy rates (a negative), decrease total profit margin (a negative), and decrease long-term debt ratios (a positive).

Within the IT governance attributes, as the IT implementation strategy class progresses from 1-6: efficiency decreases by .0133 percentage points (.157 coefficient * .08448 st dev of the inefficiency measure); clinical process control improves by .029 percent points (-.106 coefficient * .27391 st dev of ADRT); and occupancy rate falls by .031 percentage points (-.225 coefficient * .1386 st dev occupancy rate measure). A strict reading of the these results would be that first to market with innovation mattered with respect to efficiency in this sample but that it hindered improvement in clinical process control and occupancy rate measures. However, a strict reading would not be the best interpretation available.

There are two factors not controlled in these findings. The first is that these results may be revealing the consequence of the lag structure inherent to the strategic groupings. Strategy classes 4 and 5 were identified as aggressive implementers in 2001 or 2002; the performance of these groups may not reveal the impact of IT on operations in their FY2002 operational and clinical data.

The second, and perhaps more influential factor, is that the majority of the hospitals in strategy classes 1 and 2 were the flagship major medical centers across the country, facilities that have well-known name brands for innovation in medical care. This could explain the apparent improvement in clinical process control in the later to market groups, since the clinical process control measure was constructed as the average for a hospital's top three DRG (ALOS per DRG/Benchmark ALOS per DRG). The issue possibly creating a convolution would be if the ALOS for the top three DRG for hospitals in strategy classes 5 & 6 were marginally under-performing before they implemented innovations. If hospitals just marginally underperforming in ALOS achieved marginal improvements, then their movement in the ADRT measure would be statistically significant. However, their resulting final position in ADRT may not have caught up with the performance of the flagship hospitals.

If the hospitals are providing more complex care and underperforming in process control, even a comparable improvement in ALOS may not result in significant improvement in the ADRT measure as more complex care tends to have larger ALOS. This could explain facilities late to market providing services of slightly less complexity than classes 1 and 2 and somewhat struggling to differentiate in the marketplace. It could be expected that their efficiency scores would be lower as they are just under state of the art, and as they provide slightly less complex care, any small improvement in ALOS may generate significant improvement in the relative measure of ALOS. They would exhibit fast cycle times (clinical process control measure) as they may be out-referring the most complex cases and some-what cherry-pick service line offerings to best match their capabilities and market position. In this case their occupancy rates would be lower for similar reasons. However, only time would tell whether these performance differences associated with IT implementation strategy class were meaningful or spurious.

In response to research question Q3: "Can we identify organizational characteristics associated with superior performance?"

Qualitative techniques were used in this chapter to explore for patterns of organizational characteristics that could be associated with superior corporate performance. **Clearly, within this sample of high-performing hospitals with various levels of commitment to integrating IT within business and clinical**

processes, IT matters in statistically significant ways but it is a story of dependent performance. Taken alone, IT explains no more than 13 percent (93.1 percent importance * .13686 r^2) of TOTAL variation in any of the models. IT itself was most dominant in the total profit margin measure and least dominant in the efficiency model 4 percent (28.8 percent importance * .147 r^2). What was found, however, was that **commitment to actively integrating IT implementation combined with a separate IT governance business unit (CIO) that explicitly focused on national initiatives of clinician adoption of IT produced highest performance across the set of measures. These firms could be called the *Solid Citizens* of the sector. In general within this sample of high performing US hospitals it was the interactions of executive governance strategies, IT governance strategies, and specific bundles of IT capabilities that were the forces that drove strategic measures of performance across a balanced scorecard view of the sector.** It was also found that several factors did not matter when examined in a broad structural model of performance including: the structure of management reporting between a CIO and executive management, and the inclusion of clinical stakeholders in IT management decision-making.

The statistical finding that clinical representation in IT projects was not statistically significant to the performance measures is an interesting and challenging finding. Of the 219 hospitals, 53 percent reported use of clinical stakeholders in the process. So this level of involvement is not a universal condition in the sector, it is nearly a 50-50 proposition across the 219 hospitals. Yet, it is generally accepted in the industry that clinicians must be involved in projects for them to be 'successful' (defined as getting clinicians to use the capability in a redesigned care process). The lack of significance can only be interpreted two ways. Either it is signaling that those 53 percent that report using clinical representation are not be obtaining full value from the use of clinical end-users, or the 47 percent that do not report clinical representation are well enough enmeshed in clinical processes that they do not need explicit participation to obtain the same high performance as those that do include clinical representation. What cannot be interpreted from these findings is that the clinical experience in IT implementation does not matter because the finding may be a signal of tacit knowledge or other informal processes going on in those hospitals.

The next chapter presents a discussion of the specific application to management and extensions of these findings.

6 Application to Management, Limitations and Extensions

This chapter will present the findings of the thesis research in terms of management relevance, limitations, and potential extensions related to the role of innovation in strategic performance. Chapter 6.1 starts with the management findings related to the impact of innovation on strategic performance.

6.1 MANAGEMENT FINDINGS

The measures of strategic performance presented in this section were defined as part of the strategy maps presented in Chapter 4.2. The performance differentials between the partition of aggressive IT implementers (219 complete cases) and the rest of the sector were found to be positive and statistically significant at equal or better than the .05 level. The measures in Chapter 4 were hospital efficiency scores, clinical process control, clinical process quality, occupancy rate, total profit margin, and long-term debt ratio. This section will reflect on the work in Chapter 5 that used qualitative techniques to explore the role of innovation in achieving the performance findings from Chapter 4. Exhibit 6.1 presents the finding from the development of stochastic production frontiers in Chapter 4 that within the US hospital sector (1997-2001) IT implementation that focused on integration with business and clinical processes mattered the most to improving average efficiency scores. This finding reinforces the concept that business process reengineering must accompany IT implementation to be successful. In this sample, the two sub-groups of most aggressive implementers' efficiency scores averaged 5 percentage points higher than the rest-of-the-sector. The construct of process reengineering proceeding or concomitant with IT implementation was made a famous consulting buzz-phrase by Hammer and Champy (1993) and can also found in the academic works of Strassmann (1990) and Brynjolfsson, Hitt *et al.* (2002).

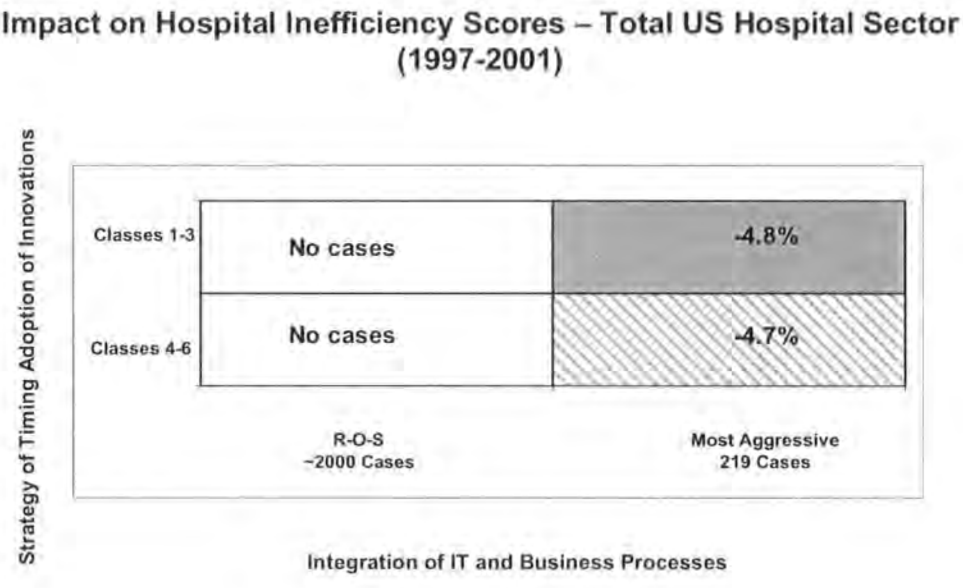
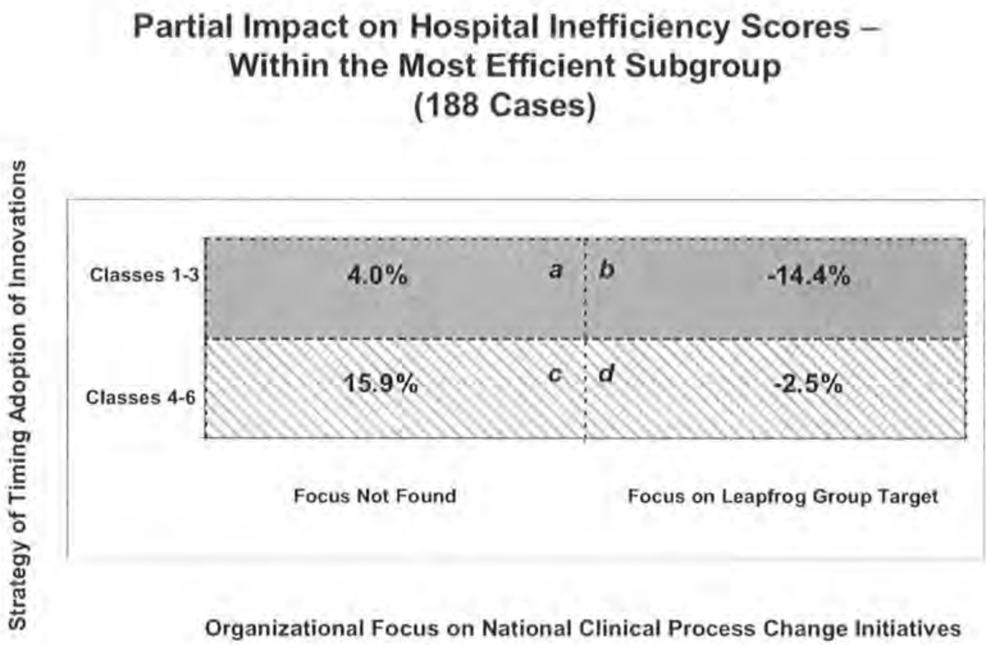


EXHIBIT 6.1: IT Implementation with a Focus on Integration with Business and Clinical Processes Matters, Timing and Commitment Appear Neutral.

The role of innovation in strategic performance is further highlighted in Exhibit 6.2 which shows that it was the interaction among the scope of implementation of various innovations with the organization's focus on national clinical process reengineering initiatives that drove increases in hospital efficiency.[127] The partial impacts reported are the result of summation of the CATREG elasticity equivalents across the variables reported in each cell.[128]

[127] The construction of exhibits 6.2-6.7 was based upon the CATREG regression models presented in Exhibit 5.35.

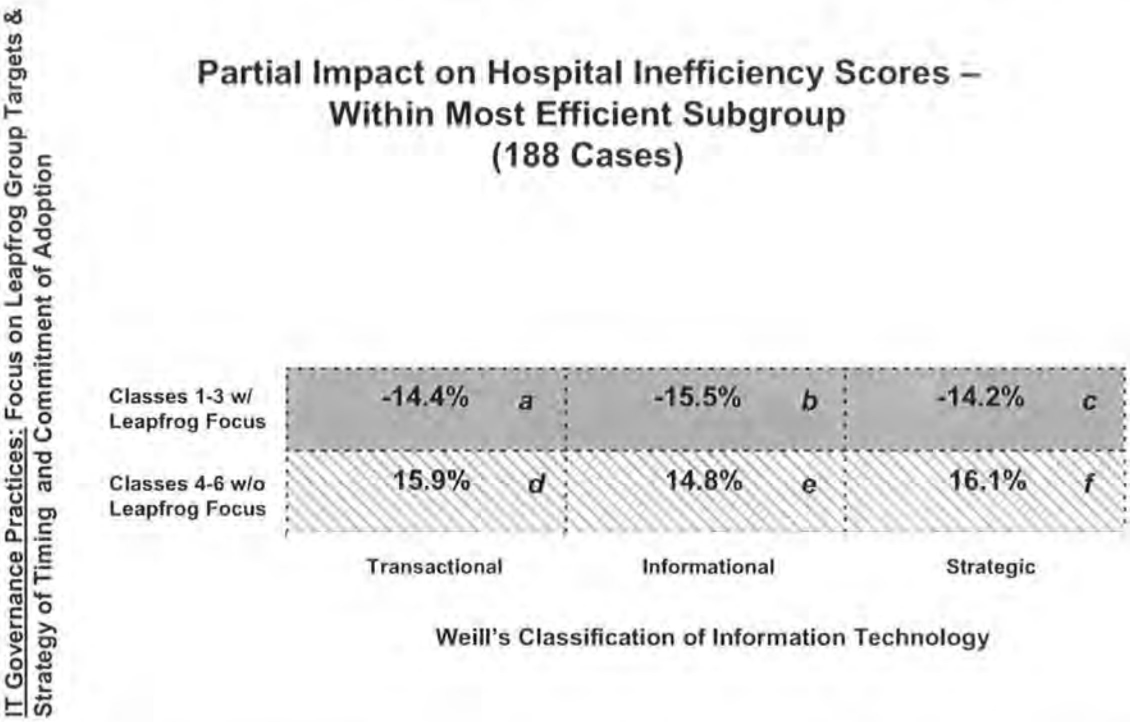
[128] SPSS v11.0 CATREG user documentation, Meulman, J. and W. Heiger (2001 pp 93-118). SPSS Categories 11.0. Chicago, IL, SPSS, Inc.



N.B. Event Cell = $\sum$ (Calculation of CATREG elasticity equivalent for each cell attribute defined as the estimated coefficient * the number of standard deviations of the CAT variable * the Standard Deviation of the LHS variable)$_{i}$ $^{\text{number of attributes}}$
Raw CATREG regression results from Exhibit 5.35

EXHIBIT 6.2: Timing and Commitment to the Adoption of Innovation and Identifying a Focus on Clinical Process Reengineering Matters.

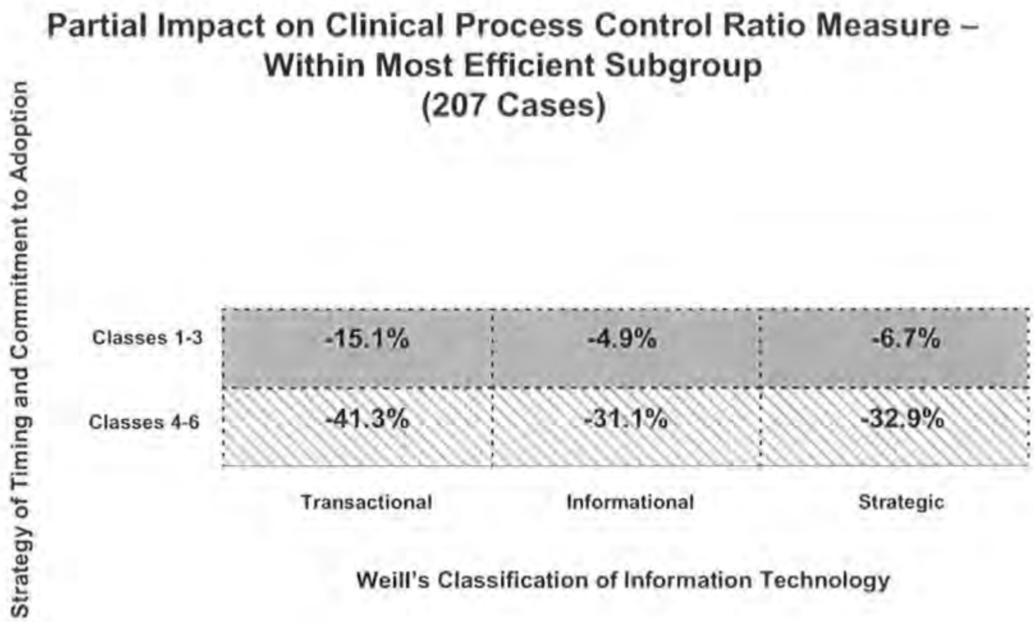
There was an 18.4 (4.0 - -14.4) percent swing in hospital efficiency scores attributed to an organization's identified focus on national clinical process reengineering efforts in their internal strategic planning material. The hospitals in cell (b) above had the highest average efficiency scores. This finding is interpreted as the importance of management in maintaining an eye on external performance benchmarks as guiding landmarks along the way of implementing internal process reengineering initiatives. The difference in performance impact between class 1-3 and class 4-6 of those focused on Leapfrog Group initiatives may reflect structural differences in productive capacity among the strategic groups or, the difference may be related to the average learning curve differences among the strategic groups. Organizations in classes 1-3, by definition, have an average 2-3 years more time invested in their IT implementations.



N.B. Event Cell = $\sum$ (Calculation of CATREG elasticity equivalent for each cell attribute defined as the estimated coefficient * the number of standard deviations of the CAT variable * the Standard Deviation of the LHS variable)$_i^{\text{number of attributes}}$
Raw CATREG regression results from Exhibit 5.35

EXHIBIT 6.3: Among the Most Efficient Hospitals IT Contribution to Hospital Efficiency Scores was Low and a Function of Other Management Innovations.

Exhibit 6.3 continues to reveal the story of the role of innovation in strategic performance. It was found that while structurally significant in explaining variation in efficiency, the individual contribution of IT by classification was both small and a function of the interactions with other management innovations adopted by hospitals in the partition. This can be seen when comparing Exhibit 6.2 cell (b), which demonstrated an average 14.4 percent decrease in inefficiency, with Exhibit 6.3 (a)-(b)-(c) that demonstrate performance impacts of -14.4, -15.5, -14.2 percent for transactional IT, informational IT, and strategic IT, respectively. Therefore, transactional IT was the dominant form of IT since its individual contribution to reducing inefficiency was equal to the average reduction for all class of IT. Interestingly, informational IT had slightly higher contribution to reducing inefficiency in this sample.



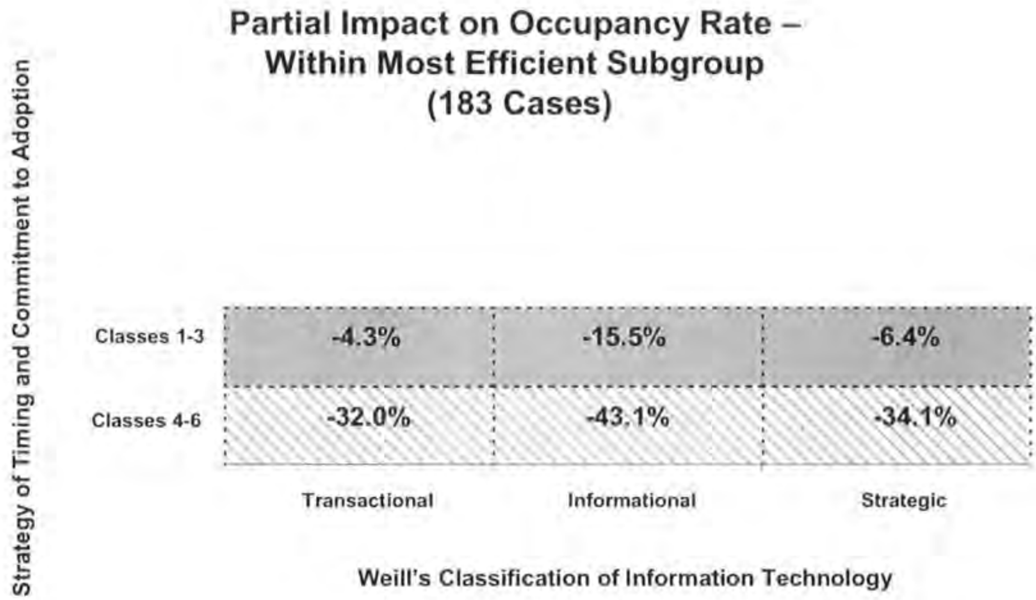
N.B. Event Cell = ∑ (Calculation of CATREG elasticity equivalent for each cell attribute defined as the estimated coefficient * the number of standard deviations of the CAT variable * the Standard Deviation of the LHS variable)$_{i}$ $^{\text{number of attributes}}$
Raw CATREG regression results from Exhibit 5.35

EXHIBIT 6.4: Transactional IT had Highest Impacts on Clinical Process Control.

Exhibit 6.4 presents the findings related to the role of innovation in the impact of the clinical process control measure. Transactional IT had the largest contribution to improving clinical process control and Strategic IT had the second highest impact.[129] The finding is consistent with the findings related to efficiency scores in that the rate of adoption of innovation matters; however, in the case of clinical process control, the late adopters realized greater rates of clinical process improvement than the early adopters. This finding may reinforce the fact that hospitals in classes 1-3 were the brand name, highly innovative facilities across the country. They may not have as much headroom with respect to clinical process control to experience the size of relative gains realized by classes 4-6. What is clear, however, is that gains were realized in clinical process control across the IT classifications and strategy classes.

[129] As defined in Chapter 4.2, clinical process control is measured as a hospital's average length of stay per DRG divided by the industry average LOS for same DRG. A smaller ratio demonstrates improvement over the sector.

The marketing of IT vendors suggests the strategic IT would have significant impact in this measure but this was not found in this sample.

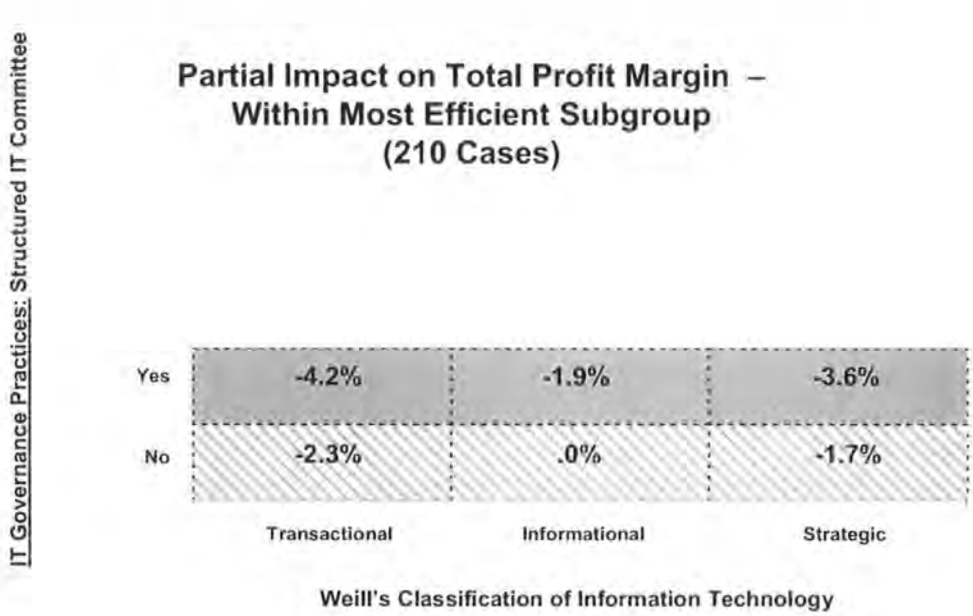


N.B. Event Cell = $\sum$ (Calculation of CATREG elasticity equivalent for each cell attribute defined as the estimated coefficient * the number of standard deviations of the CAT variable * the Standard Deviation of the LHS variable)$_{\text{number of attributes}}$
Raw CATREG regression results from Exhibit 5.35

EXHIBIT 6.5: IT Implementation was Associated with Marginal Decreases in Occupancy Rate Measure Performance, Yet the Most Committed Strategies Outperformed the Lower Commitment Strategies.

Exhibit 6.5 presents the findings related to the occupancy rate measure. Once again the impact of the timing and commitment to adoption of innovation was significant across the partition. It is also shown that for the case of occupancy rates, IT was mixed in terms of impact on the occupancy rate measure. Taken incrementally, the following informational IT capabilities were associated with reductions in occupancy rates: executive information systems, outcomes and quality management systems, chart tracking systems, clinical data repositories, and intensive care support systems. The following capabilities were associated with increasing occupancy rates: electronic insurance claims systems, enterprise resource planning systems, chart deficiency systems, computerized patient record systems, and obstetrics systems.

When the positive impact on clinical process control (closing individual episodes of care faster) is combined with decreases in occupancy rates, the story that emerges, particularly in Class 4-6, is that hospitals had accelerated their diagnostic- and treatment- cycle times to the extent that their turnover of hospital beds exceeded their management capability to increase market share for those beds.

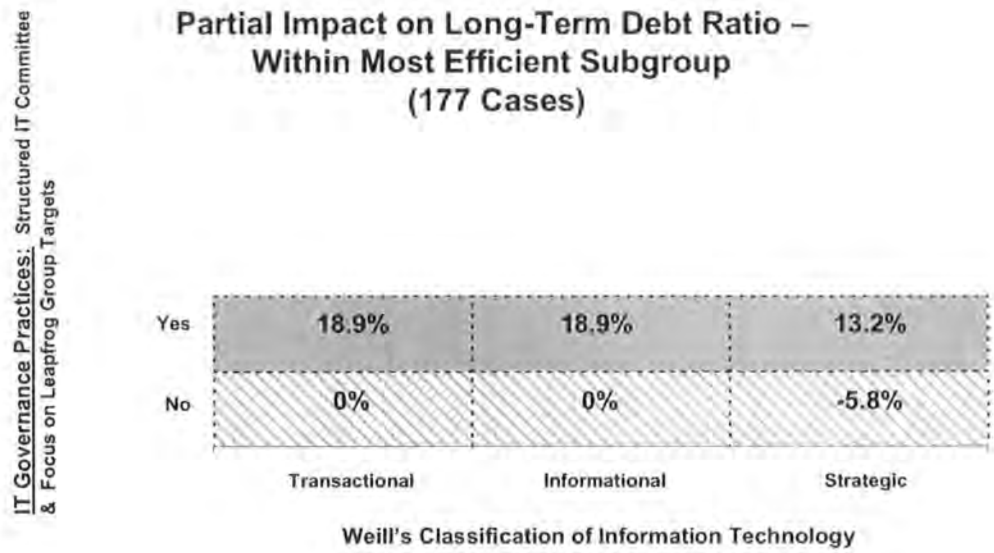


N.B. Event Cell = $\sum$ (Calculation of CATREG elasticity equivalent for each cell attribute defined as the estimated coefficient * the number of standard deviations of the CAT variable * the Standard Deviation of the LHS variable)$_{\text{number of attributes}}$
Raw CATREG regression results from Exhibit 5.35

EXHIBIT 6.6: IT Committees were Associated with Nearly Doubling Reductions in Total Profit Margins.

Exhibit 6.6 presents the role of innovation on total profit margin performance. This model shows that the impact of a hospital establishing a structured and repeatable IT committee decision-making process (of any form) interacts significantly with the class of IT implemented to impact financial performance. The partial impact of structured IT committees was to lower total profit margin nearly double the rate without committees. The findings was a reduction of between 2 and 4 percent with

IT committees while the reduction was between 0 and 2 percent for hospitals without such committees, all else equal. Borzekowski (2002) found that hospital IT implementations required between 3-5 years to realize reductions in structural cost functions so the full impact of the aggressive IT implementation may not have hit cost profiles of these facilities. This finding may also point to the difference in costs incurred in facilities with committees versus no committee. There exists a national debate over *appropriate* levels of IT spending in hospitals. We may be seeing in this exhibit that one role of the IT committee is to bring forward IT requests to support a broad constituency across a hospital, which one could expect to be a good thing; however, it also drives up the cost of doing business. The next exhibit presents the impacts of innovation on long-term debt ratio performance.



N.B. Event Cell = ∑ (Calculation of CATREG elasticity equivalent for each cell attribute defined as the estimated coefficient * the number of standard deviations of the CAT variable * the Standard Deviation of the LHS variable)$_{1}$ $^{\text{number of attributes}}$
Raw CATREG regression results from Exhibit 5.35

EXHIBIT 6.7: The Role of Innovation on Long-Term Debt Ratio Performance.

Exhibit 6.7 is similar to total profit margin in that among the adopters of innovation in IT management practices IT is associated with decreases in financial performance. Hospitals that both had structured IT committees and referenced Leapfrog Group targets were found to have the impact of increasing long-term debt ratios by on average 17 percent. The lowest LTD ratios were found in hospitals that did not adopt both innovations. In those hospitals, Transactional and Information IT were found to have no impact on long-term debt ratios and Strategic IT was found to decrease long-term debt ratios.

This finding is subject to the learning curve issue as is the other financial perspective measure discussed above. So, interpretation of this result is conditional but what it could suggest is that in facilities with structured IT committees and an organizational focus on clinical process improvement that those facilities are both spending more on current period IT (relatively lower Total Profit Margin) and they are using more financial leverage (relatively higher Long-term Debt Ratio) in operations. This analysis is neutral as to what an ideal LTDR would be for these hospitals, so it may be that the higher values seen in the innovators in Exhibit 6.7 were more optimally managing their cash flow and debt service loads to achieve transformational improvements.

The next section discusses the responses to three research questions driving this thesis.

6.2 RESEARCH ANSWERS

6.2.1 Are The Most Aggressive IT Implementers More Economically Efficient Than ROS?

Yes, conditionally – the operational definition presented in this thesis of the aggressive implementers implies *"those early adopters who actively work to integrate a broad scope of IT within business and clinical functions."* From Chapter 4.1 the most aggressive hospitals were more technically efficient in production, they generated more output per unit change of inputs, and from Chapter 4.2 they have created several sources of strategic value within their operations compared to the rest of the sector. Transactional IT was not found to be a differential factor in efficiency. Informational IT added 1.1 percent to average efficiency scores while strategic IT decreased efficiency scores by .2 percent.

6.2.2 Do The Most Aggressive IT Implementers Strategically Out Perform The ROS?

Yes, from Chapter 4.2 using a balanced strategic management scorecard approach it was found that the most aggressive IT implementers statistically outperformed the rest of the sector over the period 1997-2004. The findings stand across four strategic perspectives (learning and growth, clinical process, customer, and financial) populated with six performance measures (total factor efficiency, clinical process control, clinical process quality, occupancy rate, total profit margin, and long-term debt ratio). A more detailed examination of cases revealed that across six strategic groupings:

- Improvements in clinical process control: transactional IT, informational IT, and strategic IT classes were associated with improvements in clinical process control averaging 8.9 percent improvement for the early adopters and 35.1 percent for the late-to-market adopters of innovation. Transactional IT averaged a 28.2 percent impact, informational IT 18.0 percent and strategic IT 19.8 percent

- Improvements in occupancy rates: The contribution of the three IT classes average a 10 percent decrease in occupancy rates for early adopters and a 37.6 percent decrease for the late adopters:. Transactional IT averaged -21.8 percent; information IT -29.3 percent; and, strategic IT -20.3 percent.

- Changes in financial measures: For the early adopters the technology classes averaged a 3.2 percent reduction in total profit margin and a 17.0 percent increase in long-term debt ratios. While for the late adopters the IT classes contributed an average 1.3 percent reduction in total profit margin and a 1.9 percent decrease in long-term debt ratios: Transactional IT averaged -3.3 percent; informational IT -1.0 percent; and, strategic IT -3.1 percent for total profit margin and 9.5 percent, 9.5 percent and 3.7 percent for long-term debt ratio.

Chapter 5 also presented detailed impacts for specific organizational innovations including governance, IT governance and specific IT capabilities.

6.2.3 Are Organizational Characteristics Associated With Superior Performance?

Yes, Chapter 5 revealed that the joint interaction of the timing of IT adoption with evidence that organization's management is aware of and/or pursing external clinical practice improvement targets generated significant performance gains in this panel. This is evidence that hospitals need to be simultaneously internally focused and externally driven to innovation to excel.

The next section places these finding within the context of the literature.

6.3 PLACEMENT OF FINDINGS IN PREVIOUS WORK

It cannot be known at this time whether these outcomes are positive for the sector. It can be said that these 219 hospitals outperformed their peers between 1997 and 2004 in terms of operational and clinical performance. IT was used along with a portfolio of management innovations to achieve competitive advantage through that point in time. It is not known what the role of IT will be in the evolution of the hospital sector but based upon both investment levels and signs of contribution to strategic performance, IT will continue to be one of the significant innovations in the sector.

What is suggested by the findings that any manager would need to know? Using Porter's (1998, pp247-253) model of *strategic pitfalls in transition* for sectors reaching maturity, there are nine behaviors to avoid in this transition:

1) *Mismatch of corporate perceptive versus objective performance reality;*
2) *Caught in the Middle;*
3) *The cash trap – investments to build share in a mature market;*
4) *Giving up market share too easily in favor of short-term profits;*
5) *Resentment and irrational reaction to price competition;*
6) *Resentment and irrational reaction to changes in industry practices;*

7) Overemphasis on creative, new products rather than improving and aggressively selling existing ones;

8) Clinging to higher quality as an excuse for not meeting aggressive pricing and marketing moves of competitors;

9) Overhanging excess capacity.

While not intentionally looking to validate the strategic pitfalls, this research has found the 219 hospitals operating in ways that address pitfall #1 through #6. Clearly, it may be argued that #8 is one of the deepest ruts of the hospital sector but it too appears to have been avoided. Particularly when the finding stated is Chapter 6.2.3 is given another review:

> ***This is evidence that hospitals need to be simultaneously internally focused and externally driven to innovation to excel.***

In itself, this finding appears to address pitfall #s 1, 6, 7 and 8 simultaneously. The internally focused and externally driven hospital is not resting on claims of quality and superiority. Instead, the hospital is driving both to understand what is going in its departments and clinics and to interpret the value of secular trends and technology advances.

This research found that the most aggressive IT implementers who focused on integrating IT with business and clinical processes realized operational gains in efficiency, clinical process control, clinical process quality, occupancy rates, total profit margin, and long-term debt ratio. In attempting to isolate the contribution of IT to these achievements, it was found that the operational gains in efficiency and clinical process control were associated with both IT governance innovations and IT specific IT capabilities. It was found that IT capabilities may be driving down total profit margins and long-term debt ratios but this finding is dependent on time to verify.

The findings point to the significance of innovation in maintaining or achieving strategic positioning within the sector and they also point to the short- to medium-term costs of sustaining innovation and exceptional performance leadership in the sector. This can be related to the role of innovation from a Schumpeterian framework of organizations in a tightly regulated sector using innovation to continue along an edge of competitive survival:

> *But in capitalist reality as distinguished from its textbook picture, it is not that kind of competition which counts but the competition from the new commodity, the new technology, the new source of supply, the new type of organization (the largest-scale unit of control for instance)–competition which commands a decisive cost or quality advantage and which strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives. This kind of competition is as much more effective than the other as a bombardment is in comparison with forcing a door, and so much more important that it becomes a matter of comparative indifference whether competition in the ordinary sense functions more or less promptly; the powerful lever that in the long run expands output and brings down prices is in any case made of other stuff. Schumpeter (1975 (1942) (pp.82-85))*[130]

The hospitals in classes 1-3 were the high-profile, brand name facilities. Who by seemingly organic reasons continued to innovate their services in support of their brand. The hospitals in strategy classes 4,5 and 6 were not cutting-edge, brand name hospitals yet they too were out-performing the sector average efficiency. In addition, they achieved significant strategic gains from technology above the rates achieved by hospitals in classes 1-3. The questions of '"At what price?", "Is this sustainable?", and with "What are the market consequences?" cannot be examined at this time but the findings would suggest facilities in classes 4-6 would be prime targets of competitive market forces to consolidate or merge in the near term.

Also, this research may suggest that in those highly innovating hospitals, the nature of the specific IT capabilities that made them decide to implement was their potential to innovate as opposed to an interest in the IT capabilities themselves. This may be a fine point but upon spending many years working with health sector clients, many clients do appear to be more interested in 'owning' and marketing the IT capability itself as opposed to internalizing the potential value proposition (the innovation) that the IT can facilitate.[131]

---

130 http://transcriptions.english.ucsb.edu/archive/courses/liu/english25/materials/schumpeter.html

131 An analogy would be to the new Porsche owner who keeps it in the garage, has friends over to look and talk about it but the car rarely is driven compared with the owner who participates in amateur track days at the local motor speedway and is not concerned with the consequences of driving it day-to-day. The former is preoccupied with the brand; the latter is preoccupied with its ability to perform.

The findings advance Weil's contribution in that transactional, informational, and strategic IT capabilities were found to have varying impacts and statistical significance in this sample of high performing hospitals. Consistent with Weill is the finding that IT is associated with decreases in financial performance (regardless of the significance levels).

The findings advance Brynjolfsson's work related to both the nexus of IT implementation and process reengineering, and his assertion that for a typical IT project the costs are distributed approximately 10 percent to the technology and 90 percent to the intangible assets.

The findings may be consistent with Borzekowski's paper that estimated a 3-5 year lag in impact of hospital IT on empirical cost functions.

It is not clear if these findings conflict with the national studies of IT impact on gross domestic investment and rate of GDP growth of writers such as Solow, Gordon, Roach (discussed in detail in Chapter 2.3.1). If one uses the Bureau of Economic Analysis (BEA) definition of GDP:

> ***Gross domestic product (GDP):*** *The total market value of goods and services produced domestically during a given period. The components of GDP are consumption (both household and government), gross investment (both private and government), and net exports.* *(http://www.cbo.gov/showdoc.cfm?index=3280&sequence=0#grossdomesticproduct)*

From this definition, the potential impact of hospital IT would appear as one of three forces: Changes in consumption patterns for healthcare through efficiency gains, changes in supplier cost and performance through downward pushed cost economies and operational efficiency, and through changes in aggregate gross investment across the sector to capture the associated IT expenditures. It is not likely that the 5 percent efficiency gain found in aggressive IT implementers would drive statistically significant changes in total sector output – the scale and scope are not large enough to have such impact. The interpretation of findings is that the nature of the output of these 219 hospitals was experiencing qualitative change in fundamental characteristics of their output as both clinical process and clinical quality measures exhibited statistically significant improvements. This sort of change in qualitative output quality occurs often in other sectors as new and improved product is shipped to market. The national measure of GDP is kept in alignment with qualitative output changes by employment of product weights in the empirical estimation process. It may be that for the hospital sector, visible impact of healthcare IT will never be isolated in the national accounts as the health sector continues to be investing heavily in IT and other innovations to improve quality and cost of care. Except for operational characteristics such as 'ease of access to medical information' or 'administrative cost per claims transaction' or 'time required to book an appointment with a specialist' the effects of IT may likely continue to be difficult to isolate at the national level. However, GDP growth was not the goal of the IT investment. Instead, the goal of the investment was to recover from the financial crisis that hit US healthcare in the late 1990s and to initiate a medium- to long- term path towards improving clinical quality of care. These two goals were achieved by the hospitals that aggressively pursued them in conjunction with other management innovations. The quandary, either as a government public policy initiative or as a private sector initiative, is to find mechanisms to inculcate findings that strategic performance gains can be achieved when innovations are both internally focused and externally guided by best practices. It was found that in the US hospital sector, problems were not solved by investment in IT alone. The next section discusses the aspects of this research program that are innovative to the literature.

6.4 WHAT IS INNOVATIVE ABOUT THIS STUDY

There are several innovative aspects of this study. The strategic management framework employed integrated economic efficiency with the Neoclasssical Theory of the Firm performance paradigm. This approach provided results that were linked both to academic research in production theory and sector best practices for strategic management.

The panel (1997-2004) database constructed for this study is singular in that it has merged four components: performance data from generally accepted operational, clinical, and financial measures; demographic hospital market data; qualitative information related to the scope of information technology implemented and patterns of investment in other intangibles assets within each hospital. Operational information was constructed for an average of 2200 hospitals per year. The panel was partitioned into the most aggressive IT implementers and the rest of the sector. Within the most aggressive group of 219, six strategic groups were also identified. The majority of the data represent operational performance from FY97-FY2002 while clinical performance was captured through FY98-Q2 FY04 and the qualitative attributes from FY03 were merged into the panel. The panel integrates quantitative performance data, qualitative attributes of governance and patterns of investment in intangible assets, and the scope of specific IT capabilities implemented.

The techniques employed included multiple empirical techniques: stochastic production frontiers; ANOVA of scorecards & strategy maps; ANOVA of attributes to performance and CATREG of full-scale attributes and performance; and, a brief survey of CIO attitudes based on the findings of Chapter 5. The analytical tools used extracted a broad range of insight from the panel.

The next section describes the efforts that were taken through the lifecycle of this research program to obtain external validation.

6.5 EXTERNAL VALIDATION

This section describes the efforts that were taken throughout the lifecycle of this research program to obtain external validation. These efforts were taken in the design, evaluation, and interpretive phases of the thesis.

6.5.1 Peer-Practitioner Review

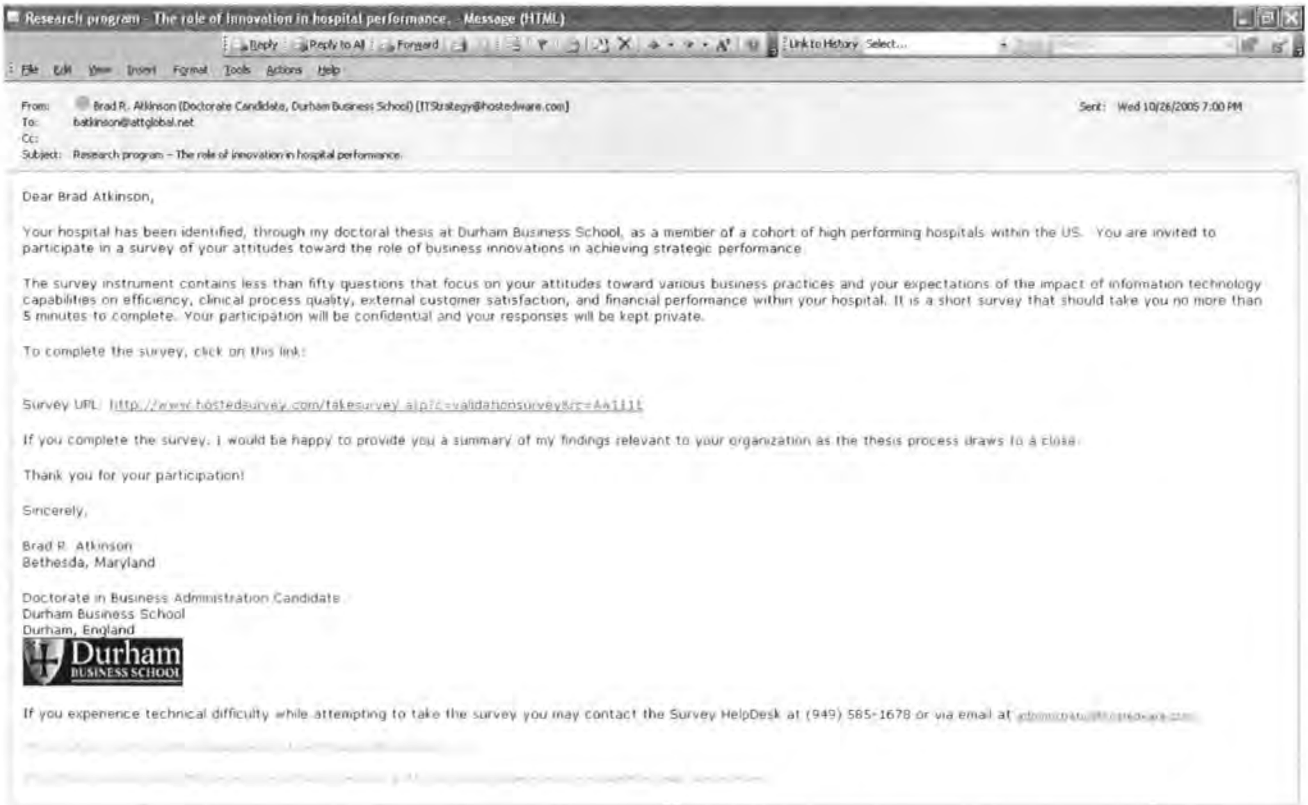
This work has benefited from periodic input from colleagues and other contacts across the healthcare sector. These contacts have included subject matter experts on technology, hospital performance, information technology management, and general management contacts within Lockheed Martin information Technology Services, Inc., Falls Church, Va., Principal Innovation Inc, Arlington, Va., KSJ and Associates, Inc, Arlington, Va, Research Triangle international, Inc, Rockville, Md, Northrop Grumman Information Technology, McLean, Va, Dorenfest Associates, Inc, Chicago, Ill, Solucient, LLC, Evanston, Ill, the American Hospital Association's datamart services, Chicago, Ill, Z-Tech Corporation, Inc, Rockville, Md, and Hostedware, Inc. While it would be difficult to identify specific contributions from each of these contacts, there have been valuable discussions with these contacts of various aspects of the research topics within this thesis.

6.5.2 Flash validation survey

A flash survey was constructed from the findings of Chapter 5 to validate the findings of this thesis. Forty-four Likert scale questions were designed to elicit the attitudes of the Chief Information Officers (CIOs) within the cohort of 219 hospitals that were the subject of Chapter 5 to validate the basic thesis findings. It was conducted online between October 27, 2005 and November 30, 2005.

The final respondent size of the survey was limited by the number of valid email addresses obtained. Due to network affiliations, it was found that the list of 219 hospitals represented 198 individual CIOs. Through the market intelligence database, 155 email addresses were identified. Many of the missing 43 addresses were from CIOs not opting into email directories—making the legal statement they do not want to be contacted by unsolicited email.

The first round of personalized invitations was sent to 155 respondents on Thursday, October 27 as shown in Exhibit 6.8. From this round of invitations, 38 email addresses failed and bounced back, reducing the potential pool of respondents to 117. Additional sources of contact information were used to identify a total of 59 addresses that were either updates of the original or gap-filling from the initial missing 45 addresses.



Research program - The role of innovation in hospital performance. - Message (HTML)

From: Brad R. Atkinson (Doctorate Candidate, Durham Business School) [ITStrategy@hostedware.com]
To: batkinson@attglobal.net
Cc:
Subject: Research program – The role of innovation in hospital performance.
Sent: Wed 10/26/2005 7:00 PM

Dear Brad Atkinson,

Your hospital has been identified, through my doctoral thesis at Durham Business School, as a member of a cohort of high performing hospitals within the US. You are invited to participate in a survey of your attitudes toward the role of business innovations in achieving strategic performance.

The survey instrument contains less than fifty questions that focus on your attitudes toward various business practices and your expectations of the impact of information technology capabilities on efficiency, clinical process quality, external customer satisfaction, and financial performance within your hospital. It is a short survey that should take you no more than 5 minutes to complete. Your participation will be confidential and your responses will be kept private.

To complete the survey, click on this link:

Survey URL: http://www.hostedsurvey.com/takesurvey.asp?c=validationsurvey&c=AA1111

If you complete the survey, I would be happy to provide you a summary of my findings relevant to your organization as the thesis process draws to a close.

Thank you for your participation!

Sincerely,

Brad R. Atkinson
Bethesda, Maryland

Doctorate in Business Administration Candidate
Durham Business School
Durham, England

Durham BUSINESS SCHOOL

If you experience technical difficulty while attempting to take the survey you may contact the Survey HelpDesk at (949) 585-1678 or via email at

EXHIBIT 6.8: Sample Personalized Invitation Email Sent to CIO Potential Respondents.

A personalized first reminder invitation was sent to all non-participating respondents on Thursday, November 11, 2005. It was determined from this round that the author had 137 valid email addresses and this number was used as the maximum size of the respondent population. A second and final round of reminder invitations was sent to all non-participating respondents on November 15, 2005 stating the survey close date of November 22, 2005.

Two days after the second round of invitations were sent by the author, eleven respondents had participated. By the close of the survey on November 22, twentyone unique respondents had participated in the survey, a 15.3 percent response rate. This response rate for this population size (198) yields a .25 confidence level with precision of +/- 12.0 percentage points. Since the total number of valid email addressed was determined to be 137 valid addresses, the effect on interpretation of survey results would be to tighten precision to +/- 11.75 percentage points at the .25 confidence level. For the purpose of this analysis, the population size used will be 137 respondents and, due to the confidence level and range of precision, the results will be discussed in terms of finding consensus among the attitudes of respondents, as opposed to precise population estimates. The invitations contained a web link to the survey website. The home page of the survey is shown in Exhibit 6.9.

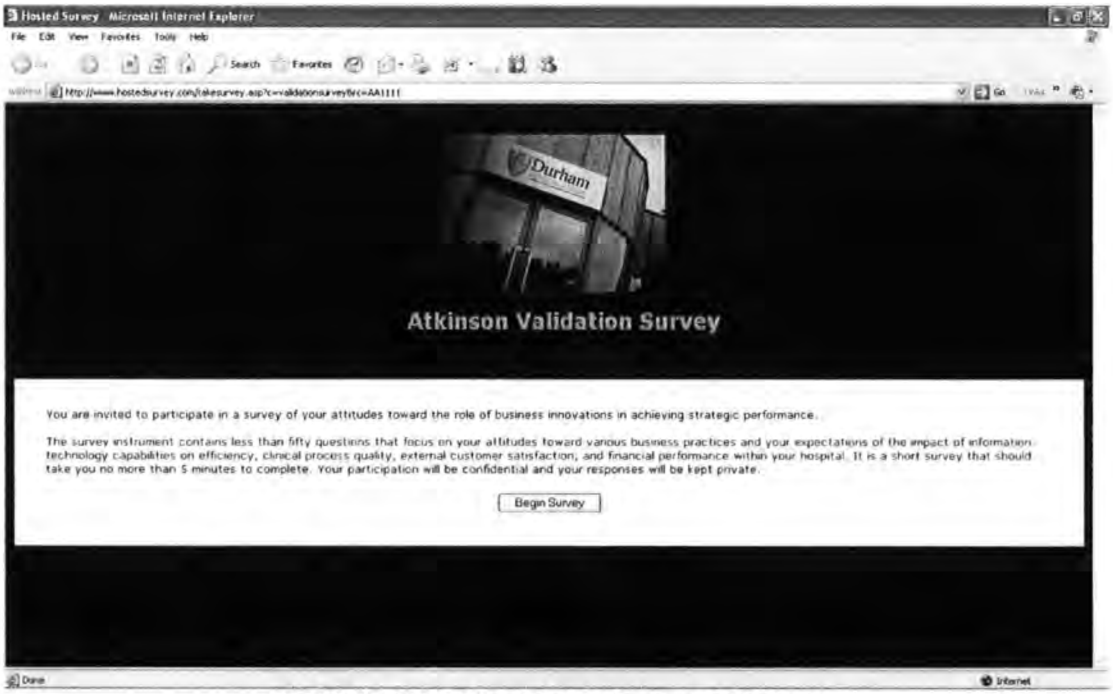
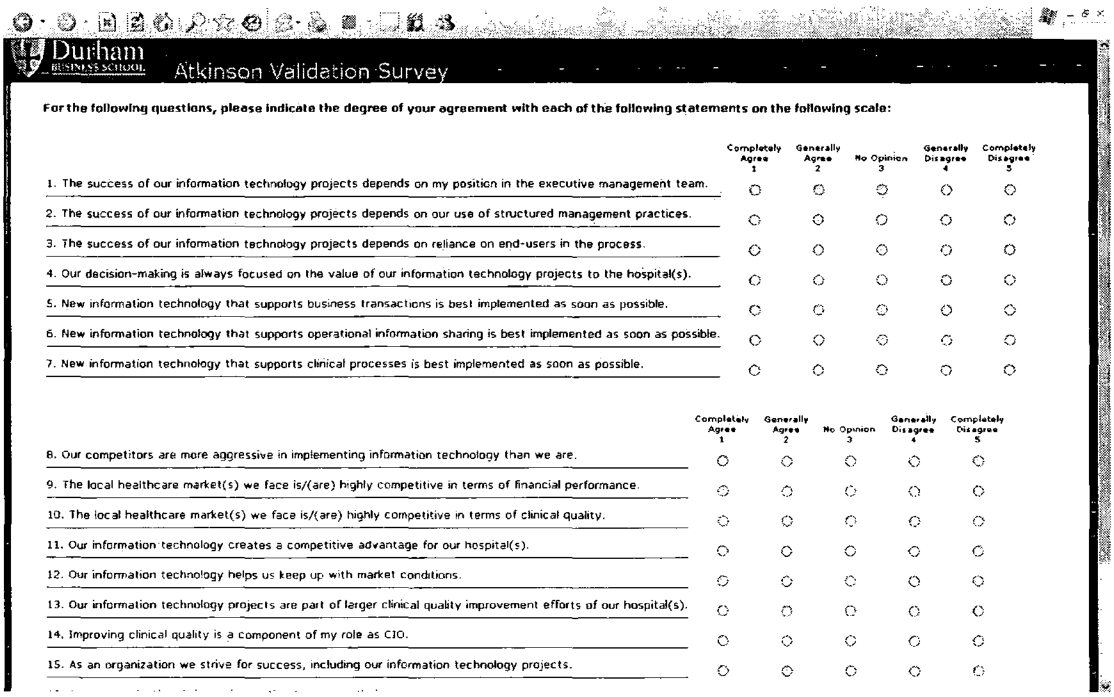


EXHIBIT 6.9: The Flash Survey Website.

The first sixteen questions were derived from the findings of Chapter 5 and they were related to the role of IT governance in performance, the importance of aggressive implementation, the importance of market forces, and the loosely termed 'Solid Citizen Effect' which reflected a continuous performance improvement focus. These questions were constructed using a five point Likert scale that was labeled along the continuum as follows: "Completely Agree", "Generally Agree", "No

Opinion", "Generally Disagree", and "Completely Disagree". A sample screen page from the survey is presented in Exhibit 6.10.


Durham Business School

Atkinson Validation Survey

For the following questions, please indicate the degree of your agreement with each of the following statements on the following scale:

	Completely Agree 1	Generally Agree 2	No Opinion 3	Generally Disagree 4	Completely Disagree 5
1. The success of our information technology projects depends on my position in the executive management team.	○	○	○	○	○
2. The success of our information technology projects depends on our use of structured management practices.	○	○	○	○	○
3. The success of our information technology projects depends on reliance on end-users in the process.	○	○	○	○	○
4. Our decision-making is always focused on the value of our information technology projects to the hospital(s).	○	○	○	○	○
5. New information technology that supports business transactions is best implemented as soon as possible.	○	○	○	○	○
6. New information technology that supports operational information sharing is best implemented as soon as possible.	○	○	○	○	○
7. New information technology that supports clinical processes is best implemented as soon as possible.	○	○	○	○	○

	Completely Agree 1	Generally Agree 2	No Opinion 3	Generally Disagree 4	Completely Disagree 5
8. Our competitors are more aggressive in implementing information technology than we are.	○	○	○	○	○
9. The local healthcare market(s) we face is/(are) highly competitive in terms of financial performance.	○	○	○	○	○
10. The local healthcare market(s) we face is/(are) highly competitive in terms of clinical quality.	○	○	○	○	○
11. Our information technology creates a competitive advantage for our hospital(s).	○	○	○	○	○
12. Our information technology helps us keep up with market conditions.	○	○	○	○	○
13. Our information technology projects are part of larger clinical quality improvement efforts of our hospital(s).	○	○	○	○	○
14. Improving clinical quality is a component of my role as CIO.	○	○	○	○	○
15. As an organization we strive for success, including our information technology projects.	○	○	○	○	○

EXHIBIT 6.10: Sample Page from the Flash Survey.

The sixteen questions, responses, and Cronbach's Alphas are presented in Exhibits 6.11-12. Exhibit 6.11 presents the general distribution of responses while Exhibit 6.12 presents the responses correlated with the respondents' strategy class. The exhibits demonstrate that the responses were generally consistent across the strategy classes.

Given the limitations of the survey response rate discussed above, when considering the individual questions, the emerging results provide an interesting backstop for the evaluation work presented earlier in this thesis.

Validation Questions – Attitudes Toward Governance, Importance of Aggressive Implementation, Market Forces, and the Solid Citizen Effect.	*Completely Agree*	*Generally Agree*	*No Opinion*	*Generally Disagree*	*Completely Disagree*	*Cronbach's Alpha*
IT GOVERNANCE (# of respondents = 21/137)						**-.0433**
Q1. The success of our information technology projects depends on my position in the executive management team.	*33.3%*	*47.6%*	*4.8%*	*14.3%*	*0.0%*	
Q2. The success of our information technology projects depends on our use of structured management practices.	*28.6%*	*57.1%*	*4.8%*	*9.5%*	*0.0%*	
Q3. The success of our information technology projects depends on reliance on end-users in the process.	*71.4%*	*28.6%*	*0.0%*	*0.0%*	*0.0%*	
Q4. Our decision-making is always focused on the value of our information technology projects to the hospital(s).	*28.6%*	*66.7%*	*0.0%*	*4.8%*	*0.0%*	
AGGRESSIVE IMPLEMENTATION (# of respondents = 21/137)						**.7318**
Q5. Information technology that supports business transactions is best implemented as soon as possible.	*4.8%*	*57.1%*	*23.8%*	*14.3%*	*0.0%*	
Q6. Information technology that supports operational information sharing is best implemented as soon as possible.	*4.8%*	*57.1%*	*28.6%*	*9.5%*	*0.0%*	
Q7. Information technology that supports clinical decision making is best implemented as soon as possible.	*38.1%*	*52.46%*	*4.8%*	*4.8%*	*0.0%*	
MARKET FORCES (# of respondents = 21/137)						**-.0682**
Q8. Our competitors are more aggressive in implementing information technology than we are.	*0.0%*	*23.8%*	*4.8%*	*52.4%*	*19.0%*	
Q9. The local healthcare market(s) we face is/(are) highly competitive in terms of financial performance.	*42.9%*	*52.4%*	*0.0%*	*4.8%*	*0.0%*	
Q10. The local healthcare market(s) we face is/(are) highly competitive in terms of clinical quality.	*52.4%*	*33.3%*	*0.0%*	*14.3%*	*0.0%*	

Q11. Our information technology create competitive advantage for our hospital(s).	*47.6%*	*28.6%*	*4.8%*	*19.0%*	*0.0%*	
Q12. Our information technology helps us keep up with market conditions.	*33.3%*	*61.9%*	*4.8%*	*0.0%*	*0.0%*	
THE SOLID-CITIZEN EFFECT (# of respondents = 21/138)						**.6625**
Q13. Our information technology projects are part of larger clinical quality improvement efforts of our hospital(s).	*76.2%*	*19.0%*	*4.8%*	*0.0%*	*0.0%*	
Q14. Improving clinical quality is a component of my role as CIO.	*61.9%*	*28.6%*	*4.8%*	*4.8%*	*0.0%*	
Q15. As an organization we strive for success, including are information technology projects.	*90.5%*	*9.5%*	*0.0%*	*0.05*	*0.0%*	
Q16. As an organization, it is our imperative to constantly improve.	*90.5%*	*9.5%*	*0.0%*	*0.0%*	*0.0%*	

EXHIBIT 6.11: Thesis Flash Validation Survey Questions of the Attitudes of Hospital CIOs in the 219 Sample.

Report

SCLASS		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
1	Mean	4.00	4.40	5.00	4.40	3.60	3.60	4.20	2.00	4.60	4.20	4.40	4.40	4.60	4.40	5.00	4.80
	N	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Std. Deviation	1.225	.548	.000	.548	.548	.548	.837	1.225	.548	1.304	.548	.548	.894	.894	.000	.447
2	Mean	4.40	4.40	4.40	4.20	4.00	3.80	4.40	2.20	4.80	4.40	4.20	4.60	4.80	4.80	5.00	5.00
	N	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Std. Deviation	.548	.548	.548	.447	.707	.447	.548	1.095	.447	1.342	1.304	.548	.447	.447	.000	.000
3	Mean	4.17	3.67	4.67	4.17	3.67	3.50	4.00	2.50	4.17	4.00	3.83	4.17	4.83	4.50	4.83	5.00
	N	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	Std. Deviation	1.169	1.033	.516	1.169	.816	1.225	1.095	1.225	.408	1.095	1.169	.408	.408	.548	.408	.000
5	Mean	4.00	5.00	5.00	4.00	3.00	4.00	4.00	2.00	4.00	4.00	5.00	4.00	4.00	4.00	4.00	5.00
	N	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Std. Deviation	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6	Mean	3.25	3.50	4.75	4.00	2.75	3.25	4.50	2.75	3.75	4.50	3.50	4.00	4.75	4.25	5.00	4.75
	N	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Std. Deviation	.957	1.000	.500	.000	.957	.500	.577	.957	1.258	.577	1.732	.816	.500	1.500	.000	.500
Total	Mean	4.00	4.05	4.71	4.19	3.52	3.57	4.24	2.33	4.33	4.24	4.05	4.29	4.71	4.48	4.90	4.90
	N	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
	Std. Deviation	1.000	.865	.463	.680	.814	.746	.768	1.065	.730	1.044	1.161	.561	.561	.814	.301	.301

EXHIBIT 6.12: Thesis Validation Survey Questions of the Attitudes of Hospital CIOs in the 219 Sample.

In terms of IT governance, the responses to Q1, Q2, and Q4 are consistent with findings from the qualitative regression analysis presented in Exhibit 5-35. One respondent generally disagreed that "decision-making is always focused on the value of our information technology projects to the hospital". However, the alpha for this construct was negative which would reflect inconsistent coding by respondents or poor design by the author.

Each of the 219 hospitals had a CIO, regardless of specific title, and 64 percent of the respondents believe "the success of IT projects depends on their position in the executive management team". Q2 and Q4 relate to the use of structured IT committee. The contrary finding relates to Q3 – the inclusion of end-users in the process. The regression analyses did not find clinical representation as statistically significant in any of the performance measures. However, a plurality of the respondents believed "success is dependent on including end-users". Since the entire sample of 137 are the most successful hospitals, as defined within this thesis, perhaps the variation in inclusion of clinical representation was not sufficient to generate a significant result for that component within the regression. It may be that only by sampling broadly across the entire sector would significant variation occur to enhance the explanatory power of the clinical representation component in a structural regression.

In terms of the perceived importance of aggressive implementation, among this group of aggressive implementers, Q5 and Q6 are basically 60-40 for business transactions and operational information sharing capabilities. The respondents were clear, more than 90 percent, in the perception of the importance to implement clinical information technology aggressively. The alpha for this construct was .7318 which would reflect the significance of this construct within these respondents.

In terms of market forces, Q8-Q12, the respondents do perceive themselves to be more aggressive than their competitors and they face strong competition in terms of both financial performance and clinical quality. Interestingly, Q11, two-thirds of the respondents perceive their information technology creates competitive advantage and more than 90 percent perceive their information technology helps to keep up with market conditions. This finding would be consistent with one of the continuing themes throughout this thesis that the US hospital sector exhibits conditions of a mature and or declining market and that the technology spending was not a “nice to have” but a cost of doing business. The respondents in general do perceive competitive advantage from their IT. They appear to recognize that they exist in highly competitive market spaces and that IT contributes to competitive advantage. This finding reinforces the statistically significant but comparatively small impact of information across the performance measures documented in Exhibit 5.35. However, the alpha for this construct was negative which would reflect either inconsistent coding by the respondents or poor design by the author.

The Solid Citizen effect discussed in Chapter 5 was constructed in Q13-Q16, more than 95 percent of respondents agreed that “information technology projects are part of larger clinical quality improvement efforts” while 100 percent at least agreed that “as an organization we strive for success” and “it is our imperative to constantly improve”. One respondent generally disagreed with the statement that “improving clinical quality is a component of my role as a CIO”, one respondent had no opinion, while the remainder either completely or generally agreed with the statement. These responses could be interpreted as supporting the thesis of the Solid Citizen effect within these high performing hospitals. The alpha for these questions was .6625 which would reflect significance of the construct within these respondents.

A factor analysis was performed on the 44 question survey data set but it is difficult to interpret those findings. A similar analysis was performed on the questions in Exhibit 6-11 that produced 4 statistically relevant components. They are presented in Exhibit 6.13.

The primary component extracted was comprised of Q13 and Q14 which relate to the Solid Citizen effect — IT serving larger clinical quality efforts, and improving clinical quality is a component of the role of the CIO, respectively. Component 1 would be labeled "Hospital CIO Solid Citizen Effect".

Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
Q1	-7.49E-02	.560	.404	-.166	-.115	.246	.383
Q2	-2.16E-02	.189	-.708	.353	.370	-5.82E-02	6.331E-02
Q3	.178	-.331	-.424	-.105	.299	.651	-.149
Q4	.547	9.768E-02	.332	-.292	.569	.177	4.435E-02
Q5	9.820E-02	.885	-.126	.103	.227	9.627E-03	-.182
Q6	-6.60E-02	.620	.206	.258	4.330E-02	.485	-4.23E-02
Q7	-.486	.682	.139	-.136	.217	-.124	-.161
Q8	-.785	.191	-.146	-.304	1.022E-02	-.289	-.112
Q9	-3.12E-02	-.347	.184	.650	.406	-.287	.131
Q10	-.271	-.134	.680	-9.18E-02	.263	-.109	.454
Q11	.340	-.122	.561	.463	-.197	.306	-.175
Q12	.586	.396	.135	.381	5.167E-02	-.401	-9.80E-02
Q13	.883	2.554E-02	-.100	-.307	-.135	-.148	.171
Q14	.769	.304	-1.79E-02	-8.95E-02	-.420	-.180	-.116
Q15	.473	-.183	.224	-.375	.543	-.204	-.308
Q16	.349	.230	-.560	2.324E-02	9.890E-02	1.832E-02	.595

Extraction Method: Principal Component Analysis.

a. 7 components extracted.

EXHIBIT 6.13: Principal Component Analysis of Survey Questions.

The second component was comprised of Q5, Q6, and Q78 – "implement information technology that supports business transactions/information sharing/clinical decision making as soon as possible". This component would be labeled "Aggressive Implementation".

The third component was comprised of Q10, "the local markets are highly competitive in terms of clinical care". It would be labeled "Clinical Competition".

Finally, the fourth component was comprised of Q9, "the local markets are highly competitive in terms of financial performance". It would be labeled "Financial Survival".

The factor analysis tends to validate both the design of the strategy maps in Chapter 4 (Short-term financial survival, and Strive for Clinical Excellence), and the fundamental findings from Chapter 5 that IT alone does not explain successful strategic performance but that strategic performance can be explained by the interactions among executive governance, IT governance, external market conditions, and the scope of IT implemented in a hospital.

6.5.3 *Peer-reviewed publication*

The author is targeting submittal of a single author paper to Management Information Systems Quarterly and/or the European Journal of Information Systems for peer review and potential publication opportunities. Also, the author and his supervisor presented a joint paper extracting Chapter 4.1 to the International Industrial Organization Conference 2006 with many positive comments from the discussant. A revised version of that paper has been submitted for publication consideration in the Journal of the Industrial Organization society.

The next section discusses the extensions and limitations of this research.

6.6 EXTENSIONS, LIMITATIONS AND FUTURE AVENUES OF STUDY

6.6.1 What can be broadly extended?

The framework of integrating efficiency with structure-conduct-performance can be employed to make comparative studies of health sector performance. The existing framework could be converted into cross-national comparisons without much difficulty. For example it is likely the existing strategy maps and scorecards could be used in a comparative study of US and UK hospital sectors. The difficulty would be in locating and obtaining rights to appropriate operational, clinical and qualitative organizational data. The general framework of integrating efficiency with structure-conduct-performance can be employed across sectors nationally. This would be a more labor intensive exercise, of course, as each sector would require custom tailoring of the strategy maps and scorecards, but the approach is there.

The finding that strategic IT can be associated with both lowered total profit margin and increased long-term debt ratio presents a public policy issue in both US and UK where different national initiatives are underway to fully implement informational IT and strategic IT architectures as part of government healthcare agendas. These findings offer the reminder that these technologies may improve and population health but they will not necessarily generate near-term financial return on investment. In fact, they may require additional subsidy to the healthcare system as the total cost of ownership is fully identified.

The high level finding that IT alone does not generate strategic value is likely very extendable across sectors. This is reinforced by the finding that the organizations that demonstrated strategic performance gains are those that also exhibited an internal drive to improve combined with an external focus on benchmark performance. The finding that the precise nature of IT governance attributes, other than presence of a CIO and an IT committee, are neutral to performance is good news for flexibility and again is likely a portable finding.

6.6.2 What are the limitations?

As in any research, precisely the characteristics that make it innovate also influence its limitations. The desire to generate broad sector coverage led to use of a mix of public, semi-public, and third-party collected survey data. As such the limitations of each of the primary sources pass on to this study. However, given the high visibility of operational and clinical data in the US, these sources are as a good as it gets other than intensive site visits with welcoming on-site sponsors. In hindsight more was expected to be usable from the Dorenfest market intelligence database in terms of the qualitative attributes of IT governance. However, the attributes coded and the subset of those used in the analysis was the most consistently reported attributes from that source related to IT governance. What is the most important limitation of all of the findings presented is that they require the fully specified conditional statement to accompany them and not a less precise rounded statement of findings but this limitation is not unique.

6.6.3 What Issues Are Raised That May Be Interesting To Continue?

As the literature review was structured in three segments, so will opportunities for future exploration. Organizational Theory-Related Interactions among executive governance, IT-specific governance and strategic performance; Detailed understanding of successful mechanisms of IT governance; Extended follow-up with the validation survey to cross-tabulate survey responses with the stratification variables in the panel to explore for additional attitudinal patterns; Effects of IT governance on implementation of projects; Exploring relationship between 'successful' IT project implementation and strategic organizational performance; Exploring a facility's ability to internalize the influence of external benchmark initiatives; is it sustainable or transitory? Strategic Management-Related Continued longitudinal review of performance gains within the strategic groups to see if achievements were sustaining, Review to see if cost-structure reductions are achieved; The evolution of industry to continue to examine the performance of the strategic groups 4, 5, and 6 to see if these groups represent organizations in the throes of change that managed to turn-around and thrive or if they were in the throws of change and do not survive. Business Economics-Related Maintain the basic analytical framework but expand the scope to that of a comparative national level to examine additional influences of varying market structures and forces on performance; Examine the potential to extend the results as a predictive tool to support on-going national initiatives in US and UK to provide national health care information infrastructure; Extend the framework to a comparative industry examination of the impact of innovation and IT on strategic performance.

###

(48,287 words, inclusive)

7 References

Aigner, D., C. Lovell and P. Schmidt (1977). "Formulation and estimation of stochastic frontier production function models." Journal of Econometrics Vol. 6: 21-37.

Anderson, G., U. Reinhardt, P. Hussey and U. Varduhi (2003). ""United States Spends Substantially More On Health Care Than Any Other Country, Yet Does Not Provide More Services"." Health Affairs 22(3): 89-105.

Ashby, J., S. Guterman and T. Greene (2000). "An analysis of hospital productivity and product change." Health Affairs Vol. 19(No. 5): 197-205.

Atkinson, B. (2003). Unpublished DBA Research Paper. Assignment 4. Durham, England.

Atkinson, B. and T. A. J. Cockerill (2006). Information Technology Implementation and Efficiency in the US Hospital Sector 1997-2001. International Industrial Organization 2006. Boston, MA.

Baily, M., R. Gordon, W. Nordhaus and D. Romer (1988). "The Productivity Slowdown, Measurement Issues, and the Explosion of Computer Power." Brookings Papers on Economic Activity Vol. 1988(No. 2 (1988)): 347-431.

Baily, M., R. Gordon and R. Solow (1981). "Productivity and the Services of Capital and Labor." Brookings Papers on Economic Activity Vol. 1981(No. 1 (1981)): 1-65.

Barney, J. (1991). "Firm Resources and Sustained Competitive Advantage." Journal of Management 17(1): 99-120.

Bates, D. and A. Gawande (2003). "Improving Safety with Information Technology." New England Journal of Medicine Vol. 348:2526-2534(No. 25 June 19, 2003).

BCBSAssociation (2003). The Malpractice Insurance Crisis. Chicago, BlueCross BlueShield Association: 11.

Borzekowski, R. (2002). "Measuring the Cost Impact of Hospital Information Systems: 1987 - 1994." Board of Governors, Federal Reserve Bank, Washington, DC, Working Papers: 37.

Brown, H. S. (2002). "Managed care and technical efficiency." Health Economics Vol. 12(No. 2): 149-158.

Brynjolfsson, E. (1993). "The Productivity Paradox of Information Technology." Communications of the ACM Vol. 36(No. 12): 67-77.

Brynjolfsson, E. (2003). Buried Treasure? Financial Times. London: 4.

Brynjolfsson, E. and L. Hitt (1996). "Paradox lost? Firm-level evidence on the returns to information systems spending." Management Science Vol. 42(No. 4 April 1996): 541-558.

Brynjolfsson, E. and L. Hitt (2000). "Beyond computation: information technology, organizational transformation and business performance." Journal of Economic Perspectives Vol. 14(No. 4 Fall 2000): 23-48.

Brynjolfsson, E., L. Hitt and S. Yang (2002). "Intangible Assets: Computers and Organizational Capital." Brookings Papers on Economic Activity 1:2002: 137-198.

Byrne, D. (2002). Interpreting Quantitative Data. London, UK, Sage Publications.

Carr, N. (2003). "IT Doesn't Matter." Harvard Business Review Reprint 3566(May 2003).

Caves, D. and L. Christensen (1980). "Global Properties of Flexible Functional Forms." The American Economic Review Vol. 70(No. 3 June 1980): 422-432.

Chan, Y. and S. Ho (2000). "Performance measurement and the use of the Balanced Scorecard in Canadian hospitals." Advances in Management Accounting Vol. 9: 145-170.

Chow-Chua, C. and M. Groh (2002). "Framework for evaluating performance and quality in hospitals." Managing Service Quality Vol. 12(No. 1 2002): 54-66.

Chow, C., K. Haddad and J. Williamson (1998). "The balanced scorecard: A potent tool for energizing and focusing healthcare organization management." Journal of Healthcare Management Vol. 43(No. 3 May-June 1998): 263-280.

Christensen, L., D. Jorgenson and L. Lau (1973). "Transcendental Logarithmic Production Frontiers." The Review of Economics and Statistics Vol. 55(No. 1 February 1973): 28-45.

CMS (2004). Hospital Quality Initiative. Baltimore, MD, Centers for Medicare and Medicaid Systems.

Cooper, W., L. Seiford and K. Tone (1999). DATA ENVELOPMENT ANALYSIS: A Comprehensive Text with Models, Applications, References and DEA-Solver Software. Norwell, MA, Kluwer Academic Press.

Cromwell, J. and D. Puskin (1989). "Hospital productivity and intensity trends." Inquiry Vol. 26(No. 3): 366-380.

Docteur, E., H. Suppanz and J. Woo (2003). "The US Health System: An Assessment and Prospective Directions for Reform." OECD Economics Department Research Paper 63.

Evans, D. (2002). Digital Economy 2002. Washington, DC, US Department of Commerce, Economics and Statistics Administration: 65.

Farrell, M. (1957). "The Measurement of Productive Efficiency." Journal of the Royal Statistical Society. Series A (General) 120(3): 253-290.

Folland, S. and R. Hofler (2001). "How Reliable are hospital efficiency estimates? Exploiting the dual to homothetic production." Health Economics Vol. 10(No. 8): 683-698.

Gapenski, L. (1996). "Using MVA and EVA to measure financial performance." Healthcare Financial Management Vol. 50(No. 3): 56-60.

Gartner-Dataquest (2001). Research Brief: US Healthcare IT Market to Reach $44 Billion in 2001, Growing to $61 Billion by 2004. Stamford, CT, Gartner Group, Inc: 6.

Gartner-Dataquest (2002). Research Brief: Healthcare Predictions -- 2002 and Beyond. Stamford, CT, Gartner Group, Inc.: 4.

Gordon, R. (2003). "Hi-Tech Innovation and Productivity Growth: Does Supply Create Its Own Demand?" National Bureau of Economic Research Working Paper 9437(January 2003): 1-53.

Greene, W. (2002). LIMDEP Version 8.0 Econometric Modeling Guide Plainview, NY, Econometric Software, Inc.

Greene, W. (2003). Econometric Analysis: Fifth Edition. Upper Saddle River, NJ, Prentice Hall.

Griffith, J. and J. Alexander (2002). "Measuring Comparative Hospital Performance." Journal of Healthcare Management Vol. 47(No. 1): 41-57.

H&HN (1997-2002). Annual Most Wired Survey® of US Hospitals. Chicago, Hospital and Health Networks, Inc: http://www.hhnmag.com/hhnmag/index.jsp.

Hammer, M. and J. Champy (1993). Reengineering the Corporation. New York, NY, Harper Business.

Hatch, M. (1997 pp127-159). Organization Theory: Modern, Symbolic, and Postmodern Perspectives. Somerset, Oxford University Press.

Heffler, S., S. Smith, G. Won, M. Clemens, S. Keehan and M. Zezza (2002). "Trends: Health Spending Projections for 2001-2011." Health Affairs 21:2(March/April): 207-218.

HFMA (2003). CFO Exchange: Strategizing for the CFO. Healthcare Financial Management CFO Forum, San Francisco, CA, Healthcare Financial Management Association.

Hitt, L. and E. Brynjolfsson (1996). "Productivity, business profitability, and consumer surplus: three different measures of information technology value." MIS Quarterly Vol. 20(No. 2 June 1996): 121-142.

HospitalStatistics (2002). Hospital Statistics 2002. Chicago, IL, Health Forum, LLC.

Humphrey, T. (1997). "Algebraic Production Functions and Their Uses Before Cobb-Douglas." Federal Reserve Bank Richmond, Economic Quarterly Vol 83/1(Winter 1997): 51-83.

InterStudy (2001). Managed Care Enrollment. St. Paul, InterStudy Publications.

Jaramillo, A. (2001). "Data Warehousing Solutions and Internet Initiatives in the Disease Management Era." Disease Management Health Outcomes Vol. 9(No. 1): 1-9.

JuneIndustryScan2001, H. (2001). Industry Scan June 2001. Chicago, Healthcare Financial Management Association.

Kaplan, R. and D. Norton (1992). "The Balanced Scorecard--Measures that drive performance." Harvard Business Review(Jan-Feb 1992): 71-79.

Kaplan, R. and D. Norton (1993). "Putting the Balanced Scorecard to work." Harvard Business Review(Sept-Oct 1993): 134-147.

Kaplan, R. and D. Norton (1996). "Using the Balanced Scorecard as a strategic management tool." Harvard Business Review(Jan - Feb 1996): 75-85.

Kaplan, R. and D. Norton (2000). "Having trouble with strategy, then map it." Harvard Business Review(Sept - Oct 2000): 3-11.

Kaplan, R. and D. Norton (2001a). "Transforming the Balanced Scorecard from performance measurement to strategic management Part I." Accounting Horizons Vol. 15(No. 1 March 2001): 87-104.

Kaplan, R. and D. Norton (2001b). "Transforming the balanced scorecard from performance measurement to strategic management: Part II." Accounting Horizons Vol. 15(No. 2 June 2001): 147-160.

Kessler, D. and M. McClellan (2002). "The effects of hospital ownership on medical productivity." RAND Journal of Economics Vol. 33(No. 3 Autumn 2002): 488-506.

Lee, B. and N. Menon (2000). "Information Technology Value through Different Normative Lenses." Journal of Management Information Systems Vol. 16 No. 4(Spring 2000): pp. 99-120.

Lehn, K. and A. Makhija (1996). "EVA and MVA as performance measures and signals for strategic change." Strategy and Leadership, The Strategic Leadership Forum Vol. 24(No. 3): 34-38.

Li, L., W. Benton and G. Leong (2002). "The impact of strategic operations management decisions on community hospital performance." Journal of Operations Management Vol. 20(2002): 389-408.

Li, L. and D. Collier (2000). "The role of technology and quality on hospital financial performance: an exploratory analysis." International Journal of Service Industry Management Vol. 11(No. 3): 202-224.

Li, T. and R. Rosenman (2001). "Estimating hospital costs with a generalized Leontief function." Health Economics Vol. 10(No. 6 September 2001): 523-538.

Matthews, J. (2002). "A resource-based view of Schumpeterian economic dynamics." Journal of Evolutionary Economics 106(26pp).

Mbaga, M., B. Romain and L. Lebel (2000). "Assessing technical efficiency of Quebec dairy farms." Research Series, Centre for Research in the Economics of Agrifood SR.00.10(November 2000): 1-24.

McKeown, I. and G. Philip (2003). "Business transformation, information technology and competitive strategies: learning to fly." International Journal of Information Management Vol. 23: 3-24.

Meeusen, W. and J. van Den Broeck (1977). "Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error." International Economic Review 18(2): pp435-444.

Memel, D. (2001). "Development and implementation of an information management and information technology strategy for improving healthcare services: a case study." Journal of Healthcare Information Management Vol. 15(No. 3 Fall 2001): 261-285.

Menon, N. and B. Lee (2000). "Productivity of Information Systems in the Healthcare Industry." Information Systems Research March 2000 11(1): 83-92.

Meulman, J. and W. Heiger (2001 pp 93-118). SPSS Categories 11.0. Chicago, IL, SPSS, Inc.

Mistry, J. (1999). "Differential impact of information technology on cost driver relationships in selected banking functions." Unpublished DBA Dissertation, Boston University USA.

NCQA (2002). HEDIS 2003 Volumes 1-3. Washington, DC, National Committee for Quality Assurance.

Oliner, S., D. Sichel, J. Triplet and R. Gordon (1994). "Computers and Output Growth Revisited: How Big is the Puzzle?" Brookings Papers on Economic Activity Vol. 1994(No. 2 (1994)): 273-334.

Online (2004). Health IT Value Statement, Office of the National Coordinator for Health IT. 2006.

Online (2006). New Institutional Economics, Washington University Department of Economics. 2006.

Pauly, M. V. (1986). "Estimating hospital costs." Journal of Health Economics Vol. 5: 107-127.

Pink, G., I. McKillop, E. Schraa, C. Preya, C. Montgomery and G. Baker (2001). "Creating a Balanced Scorecard for a hospital system." Journal of Health Care Finance Vol. 27(No. 3): 1-20.

Pollack, R. and T. Wales (1991). "The Likelihood Dominance Criterion, A New Approach to Model Selection." Journal of Econometrics Vol. 47: pp227-42.

Porter, M. (1998). Competitive Strategy: Techniques for Analyzing Industries and Competitors. New York, The Free Press: Simon & Schuster.

Reinhardt, U., P. Hussey and G. Anderson (2002). ""Cross-National Comparisons of Health Systems Using OECD Data, 1999."" Health Affairs 21(3)(May/June): 169-181.

Roach, S. (1996). "The Hollow Ring of the Productivity Revival." Harvard Business Review Reprint 96609(November - December 1996): 81-89.

Roach, S. (1998). "In Search of Productivity." Harvard Business Review Reprint 98509(September - October 1998): 8.

Rogers, E. (2003). Diffusion of Innovations. New York, NY, The Free Press.

Rosko, M. (2001). "Cost efficiency of US hospitals: a stochastic frontier approach." Health Economics Vol. 10(No. 6): 539-551.

Scherer, F. M. (1992). International High-Technology Competition. Cambridge, MA, Harvard University Press.

Scherer, F. M., A. Backenstein, E. Kaufer and D. Murphy (1975). The Economics of Multi-Plant Operation: An International Comparisons Study. Cambridge MA., Harvard University Press.

Schumpeter, J. (1975 (1942) (pp.82-85)). Capitalism, Socialism and Democracy New York, NY, Harper.

Shafer, S. and T. Byrd (2000). "A framework for measuring the efficiency of organizational investments in information technology using data envelopment analysis." Omega Vol. 28(No. 2 April 2000): 125-141.

Shao, B. and W. Lin (2001). "Measuring the value of information technology in technical efficiency with stochastic production functions." Information and Software Technology Vol. 43(No. 7): 447-457.

Skinner, W. (1986). "The Productivity Paradox." Harvard Business Review Reprint 86414(July - August 1986): 54-59.

Smet, M. (2002). "Cost characteristics of hospitals." Social Science & Medicine Vol. 55(2002): 895-906.

Solovy, A. (2001). "Health Care's Most Wired." Hospitals & Health Networks Journal July 2001: 11.

Solow, R. (1994). "Perspectives on Growth Theory." The Journal of Economic Perspectives Vol. 8(No. 1 (Winter 1994)): 45-54.

Solucient (2004a). Profiles of US Hospitals. Chicago, IL, Solucient LLC.

Solucient (2004b). The Source Book - The Comparative Performance of US Hospitals. Chicago, IL, Solucient LLC.

Strassmann, P. (1990). The Business Value of Computers. New Canaan, Information Economics Press.

Strassmann, P. (1999). Information Productivity: Assessing the Information Management Costs of US Industrial Corporations. New Canaan, Information Economics Press.

Thanassoulis, E. (2001). INTRODUCTION TO THE THEORY AND APPLICATION OF DATA ENVOLOPMENT ANALYSIS: A Foundation Text with Integrated Software. Norwell, MA, Kluwer Academic Publishers.

Thompson, T. and D. Brailer (2004). "The Decade of Health Information Technology: Delivering Consumer-centric and Information-rich Health Care, A Framework for Strategic Action", US Department Health and Human Services, Office of the Director of Health Information Technology, Washington, DC, 21 July 2004.

Van der Kooij, A., P. Neufeglise and J. Meulman (2001). CATREG, Categorical Multiple Regression with Optimal Scaling (revised and updated version). Chicago, IL, SPSS, Inc.

Walbert, L. (1994). "The Stern Stewart performance 1000: Using EVA to build market value." The Continental Bank Journal of Applied Corporate Finance Vol. 6(No. 4): 109-120.

Walker, D. (2003). MEDICARE: Financial Challenges and Considerations for Reform. Washington, DC, US General Accounting Office: 27.

Weill, P. (1992). "The relationship between investment in information technology and firm performance: a study of the valve manufacturing sector." Information Systems Research Vol. 3(No. 4 December 1992): 307-333.

Wickramasinghe, N. and J. Silvers (2003). "IS/IT the Prescription to Enable Medical Group Practices Attain Their Goals." Health Care Management Sciences Vol. 6(2003): 75-86.

Wonnacott, R. and T. Wonnacott (1979). Econometrics Second Edition. New York, NY, John Wiley and Sons.

Zellner, A., J. Kmenta and J. Dreze (1966). "Specification and Estimation of Cobb-Douglas Production Function Models." Econometrica Vol. 34(No. 4): 784-795.

8 Bibliography

Best, S. (2004). Internet Data Collection. London, UK. Sage.

Cohen, A. (2002). The Portable MBA in Management. 2nd Edition. New York, NY. Wiley & Sons.

Damodaran, A. (2001). The Dark Side of Valuation: valuing old tech, new tech, and new economy companies. Supper Saddle River, NJ, Financial Times/Prentice Hall.

Fowler, F. (1995). Improving Survey Questions. London, UK. Sage.

Kelly, T. (2001). The Art of Innovation. New York, NY, Doubleday.

9 Appendices

This chapter contains appendices for each of the thesis chapters to provide expanded text on certain topics, derived statistical material, or documentation of source data, as required.

9.1 APPENDIX 1

This section is intentionally blank.

9.2 APPENDIX 2

This section is intentionally blank.

9.3 APPENDIX 3

This section is intentionally blank.

9.4 APPENDIX 4

1. **Econometric Case Data**
2. **Most Aggressive Information Technology Implementers by Year 1997-2002**
3. **Cross-Tab Inefficiency Scores by Partition by Region**

9.4.1 *Econometric Case Data*

ESTIMATING PRODUCTION FUNCTIONS
US Community Hospitals
All Cases – 1997

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	21.5341441	67.9104044	.250000000	1148.00000	2775
RN	303.075405	257.016895	.250000000	2737.00000	2775
OTH	939.359640	796.382615	20.0000000	7104.00000	2775
BED	262.880721	165.029232	100.000000	1789.00000	2775
APD	89283.4353	59179.3764	1821.00000	629184.000	2775

Early, Aggressive IT Adopters - 1997

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	16.6090909	19.5304702	.250000000	74.0000000	55
RN	553.309091	415.594704	59.0000000	1580.00000	55
OTH	1587.02727	1018.01406	269.000000	4812.75000	55
BED	360.654545	247.146397	128.000000	935.000000	55
APD	132303.909	76470.4370	57712.0000	299856.000	55

The Rest of the Sector - 1997

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	21.6337316	68.5349184	.250000000	1148.00000	2720
RN	298.015533	250.342630	.250000000	2737.00000	2720
OTH	926.263419	786.012397	20.0000000	7104.00000	2720
BED	260.903676	162.404359	100.000000	1789.00000	2720
APD	88413.5360	58469.7325	1821.00000	629184.000	2720

ESTIMATING PRODUCTION FUNCTIONS
US Community Hospitals
All Cases – 1998

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	18.9736938	54.1087219	.250000000	862.000000	2737
RN	284.698575	285.729766	.250000000	3325.00000	2737
OTH	913.183687	871.102196	32.0000000	9044.00000	2737
BED	252.203507	169.216899	100.000000	1681.00000	2737
APD	88434.4220	64176.8078	2161.00000	624773.000	2737

Early, Aggressive IT Adopters - 1998

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	69.5360825	132.043489	.250000000	862.000000	97
RN	614.309278	515.935141	49.0000000	2605.00000	97
OTH	2061.46134	1641.50076	241.750000	7705.00000	97
BED	468.391753	305.195073	103.000000	1379.00000	97
APD	160918.010	109847.172	23970.0000	23970.0000	97

The Rest of the Sector - 1998

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	17.1159091	47.9967416	.250000000	676.000000	2640
RN	272.587879	266.118432	.250000000	3325.00000	2640
OTH	870.993182	799.027609	32.0000000	9044.00000	2640
BED	244.260227	156.580650	100.000000	1681.00000	2640
APD	85771.1992	60256.9218	2161.00000	624773.000	2640

ESTIMATING PRODUCTION FUNCTIONS
US Community Hospitals
All Cases – 1999

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	31.8467262	102.291500	.250000000	1401.00000	2688
RN	333.823382	335.061201	.250000000	2287.00000	2688
OTH	1080.52790	1056.34854	45.7500000	10788.0000	2688
BED	274.613095	193.499125	100.000000	2121.00000	2688
APD	106018.274	75802.5794	3435.00000	625156.000	2688

Early, Aggressive IT Adopters - 1999

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	119.901235	236.882129	.250000000	991.000000	81
RN	642.740741	520.406014	520.406014	114.000000	81
OTH	2028.30556	1437.33382	329.750000	7286.00000	81
BED	408.271605	208.585834	119.000000	967.000000	81
APD	161103.667	94851.5776	39146.0000	465806.000	81

The Rest of the Sector - 1999

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	29.1108554	93.9026684	.250000000	1401.00000	2607
RN	324.225259	323.084104	.250000000	2287.00000	2607
OTH	1051.08026	1028.76003	45.7500000	10788.0000	2607
BED	270.460299	191.566010	100.000000	2121.00000	2607
APD	104306.760	74506.3482	3435.00000	625156.000	2607

ESTIMATING PRODUCTION FUNCTIONS
US Community Hospitals
All Cases – 2000

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	35.8188392	98.8995260	.250000000	1327.00000	2662
RN	346.032682	327.442342	8.00000000	3111.00000	2662
OTH	1132.05485	1126.73458	81.0000000	15382.0000	2662
BED	294.171300	224.602614	100.000000	2518.00000	2662
APD	115173.993	92881.1319	9267.00000	890169.000	2662

Early, Aggressive IT Adopters - 2000

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	27.6648148	48.8731621	.250000000	333.000000	135
RN	619.340741	592.706342	63.0000000	3111.00000	135
OTH	2011.87963	2132.10636	215.750000	15382.0000	135
BED	428.318519	412.847297	110.000000	2518.00000	135
APD	162759.393	149803.208	28573.0000	843493.000	135

The Rest of the Sector - 2000

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	36.2405063	100.845784	.250000000	1327.00000	2528
RN	331.336630	300.157596	8.00000000	2331.00000	2528
OTH	1084.72716	1084.72716	81.0000000	11933.0000	2528
BED	286.934731	207.564211	100.000000	1875.00000	2528
APD	112598.586	88146.1475	9267.00000	890169.000	2528

ESTIMATING PRODUCTION FUNCTIONS
US Community Hospitals
All Cases – 2001

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	12.3533699	46.4591382	.250000000	1001.00000	2641
RN	287.147671	271.479444	.250000000	1683.00000	2641
OTH	903.918213	859.549714	55.0000000	8821.00000	2641
BED	246.298372	161.596227	100.000000	1294.00000	2641
APD	87733.3707	62378.8577	4977.00000	576712.000	2641

Early, Aggressive IT Adopters - 2001

MEASURE	Mean	Std. Dev.	Min	Max	Cases
DR	71.3661972	144.542331	.250000000	588.000000	71
RN	704.933099	469.843838	.250000000	1611.00000	71
OTH	2247.59507	1559.98439	262.000000	7021.00000	71
BED	477.816901	292.293752	116.000000	1294.00000	71
APD	175699.479	110804.616	11355.0000	497574.000	71

The Rest of the Sector - 2001

MEASURE	N	Mean	Std. Dev.	Min	Max
DR	10.7230545	39.3690442	.250000000	1001.00000	2570
RN	275.605739	254.491082	.250000000	1683.00000	2570
OTH	866.797179	801.036140	55.0000000	8821.00000	2570
BED	239.902335	151.607359	100.000000	1257.00000	2570
APD	85303.1786	58688.6236	4977.00000	576712.000	2570

9.4.2 *Most Aggressive Information Technology Implementers by Year*

Reported by Hospital and Health Networks Annual Most Wired Survey (1999-2002)

Hospital and Health Network's Annual Most Wired Survey Selections (1999-2002)

Organization	1999	2000	2001	2002
Advocate Health Care, Oak Brook, IL			1	1
Alegent Health, Omaha, NE				1
Alliant Health System, Louisville, Ky.	1			
Allina Health System, Minneapolis, MN			1	
Altru Health System, Grand Forks, ND			1	
Ancilla Systems, Hobart, Ind.	1	1		
Anne Arundel Health System, Annapolis MD			1	1
Arkansas Children's Hospital, Little Rock	1			
Arnot Ogden Medical Center, Elmira, N.Y.	1	1	1	
Ascension Health, Evansville, IN			1	1
Avera Health, Sioux Falls, SD	1	1	1	1
Banner Health System, Fargo, ND		1		
Bapist Health Systems of South Florida Coral Gables	1		1	1
Baptist Health Care, Pensacola, FL	1	1	1	
Baptist Health Systems, Jackson, Miss.	1	1		
Baptist Health, Little Rock, AR		1	1	1
Baptist Memorial Health Care Corp., Memphis, Tenn.	1	1		
Baylor Health Care System, Dallas, TX		1	1	1
Berkshire Health System, Pittsfield, Mass.	1	1	1	1
Borgess Health Alliance, Kalamazoo, MI		1		
Cape Fear Valley Health System, Fayetteville, N.C.	1	1	1	
CareGroup Healthcare System, Boston, MA				1
Carilion Health System, Roanoke, VA		1		1
Carle Foundation, Urbana, Ill.	1			
Carson City (Mich.) Hospital	1	1	1	
Cedars-Sinai Health System, Los Angeles, CA			1	1
CentraCare Health System, St. Cloud, MN				1
Charleston (W.Va.) Area Medical Center	1			
Children's Health System, Birmingham, AL			1	
Children's Healthcare of Atlanta, Atlanta, GA		1	1	
Children's Hospital and Research Center, Oakland, CA				1
Children's Hospital of Philadelphia	1			1
Children's Hospital, Boston	1			
Children's Medical Center of Dallas, Dallas, TX			1	

Hospital and Health Network's Annual Most Wired Survey Selections (1999-2002)

Organization	1999	2000	2001	2002
Clarian Health Partners, Indianapolis	1			1
Clarksville (Tenn.) Regional Health System	1			
Colleton Medical Center, Walterboro, S.C.	1			
Community Hospital Indianapolis	1			1
Community Memorial Hospital, Winona, MN				1
Concord Hospital, Concord, NH				1
Crozer-Keystone Health Systems, Springfield, Pa.	1		1	
Dartmouth-Hitchcock Medical Center, Lebanon, NH		1	1	
Daughters of Charity National Health System, Evansville, Ind./StLMO	1	1		
Doylestown Hospital, Doylestown, PA		1		
Ellis Hospital, Schenectady, N.Y.	1	1		
Empire Health Services, Spokane, WA				1
ETMC Regional Healthcare System, Tyler TX		1	1	1
Fauquier Hospital Inc, Warrenton, VA			1	1
Florida Hospital Heartland Division, Sebring, FL		1		
Florida Hospital, Orlando, FL		1	1	
Gateway Health System, Clarksville, TN			1	
Geisinger Health System, Danville, PA				1
General Health System, Baton Rouge, LA		1	1	
Good Hope Hospital, Erwin, N.C.	1	1	1	1
Greenwich (Conn.) Hospital	1			1
Gritman Medical Center, Moscow, ID		1	1	
Guthrie Health, Sayre, PA				1
Hackensack (N.J.) University Medical Center	1	1	1	1
Hamot Medical Center, Erie, PA			1	
HCA--The Healthcare Company, Nashville, TN			1	
Henry Ford Health System, Detroit	1	1		
Hitchcock Clinic/Hitchcock Alliance, Lebanon, N.H.	1			
Holland Community Hospital, Holland, MI		1		
Holy Family Hospital, Spokane, WA				1
Hunterdon Healthcare System, Flemington, N.J.	1	1		1
Huntsville Hospital, Huntsville, AL				1
Inova Health System, Falls Church, VA				1
INTEGRIS Health, Oklahoma City, OK	1	1	1	1
Intermountain Health Care,	1		1	1
Iowa Health System, Des Moines, IA			1	1
Jacobi Medical Center, Bronx, NY				1
Jefferson Health System, Radnor, PA			1	1
Johns Hopkins Institutions, Baltimore, MD				1
Kishwaukee Health System, DeKalb, IL				1

Hospital and Health Network's Annual Most Wired Survey Selections (1999-2002)

Organization	1999	2000	2001	2002
Kootenai Medical Center, Coeur d'Alene, ID	1		1	1
Lancaster General, Lancaster, PA				1
Lancaster Health Alliance, Lancaster, PA		1	1	
Legacy Health Systems, Portland, OR		1		1
Lehigh Valley Health Network, Allentown, Pa.	1			
Lifespan, Providence, RI				1
Lowell (Mass.) General Hospital	1	1	1	
Loyola University Health System, Maywood, IL		1	1	1
Lutheran Health Systems, Fargo, N.Dak.	1			
MacNeal Health Network, Berwyn, Ill.	1	1		
Maimonides Medical Center, Brooklyn, NY		1	1	1
Major Hospital, Shelbyville, Ind.	1			1
Marion General Hospital, Marion, IN			1	1
Marquette (Mich.) General Hospital	1	1	1	
Martin Memorial Health System, Stuart, Fla.	1			
Maury Regional Healthcare Systems, Columbia, TN	1	1		
McLeod Regional Medical Center, Florence SC		1	1	
Medical College of Georgia Hospital, Augusta, GA	1	1		
Memorial Health Services, Long Beach, CA		1	1	1
Memorial Health System, Savannah, GA		1	1	1
Memorial Healthcare Center, Owosso, MI				1
Memorial Healthcare System, Hollywood, FL			1	
Mercy Health Services, Farmington Hills, Mich.	1			
Meridian Health System, Neptune City, NJ		1	1	1
MeritCare Health System, Fargo, N.Dak.	1	1	1	1
Methodist Health Care System, Houston	1		1	1
Methodist Health System, Omaha, NE				1
Methodist HealthCare, Memphis, Tenn.	1			
Methodist Hospitals of Dallas, Dallas, TX			1	
Metropolitan Hospital and Metro Health, Grand Rapids, MI			1	
Mississippi Baptist Health Systems, Jackson, MS				1
Moses Cone Health System, Greensboro, NC			1	1
Mountain States Health Alliance, Johnson City, TN		1	1	
NCH Healthcare System, Naples, Fla.	1			
Nebraska Methodist Health System, Omaha, NE		1	1	
New York (N.Y.) Presbyterian Hospital	1			
North Broward Hospital District, Fort Lauderdale, FL	1	1	1	
North Mississippi Health Services, Tupelo MS			1	1
Northeast Health, Troy, NY				1
Northwestern Memorial Hospital, Chicago IL		1	1	1

Hospital and Health Network's Annual Most Wired Survey Selections (1999-2002)

Organization	1999	2000	2001	2002
Norton Healthcare, Louisville, KY		1		
Oak Valley Hospital, Oakdale, Calif.	1			
Ohio State University Health System, Columbus, OH	1		1	1
Oregon Health & Science University, Portland, OR	1		1	1
Orlando Regional Healthcare, Orlando, FL			1	1
OSF HealthCare System, Peoria, IL	1	1		
Overlake Hospital Medical Center, Bellevue WA		1	1	
Parma (Ohio) Community General Hospital	1	1		
Partners Healthcare System, Boston	1	1	1	1
PeaceHealth, Bellevue, WA				1
PeaceHealth, Eugene, Ore.	1			
Penn State Geisinger Health System, Danville	1			
Pittsburgh Mercy Health System	1			
Pratt Regional Medical Center, Pratt, KS		1		
Presbyterian Healthcare Services, Alburquerque, NM		1		
PROMINA Health System, Atlanta, GA		1		1
Providence Health System, Tigars, Ore.	1			
Quincy (Mass.) Hospital	1			
Rancho Los Amigos Medical Center, Downey, Calif.	1		1	
Rehoboth McKinley Christian Health Care Services, Gallup, NM	1	1	1	
Rex Healthcare, Inc., Raleigh, NC		1		
Riverside HealthCare, Kankakee, IL				1
Robert Wood Johnson University Hospital, Hamilton, NJ				1
Rockford Health System, Rockford, IL				1
Rush-Copley Medical Center, Aurora, IL	1	1	1	1
Rush-Presbyterian-St. Luke's Medical Center, Chicago, IL	1		1	
Sacred Heart Medical Center, Spokane, WA				1
Saint Alphonsus Regional Medical Center, Boise, ID		1	1	1
Saint Joseph's Hospital, Marshfield, WI		1	1	
Saint Luke's Shawnee Mission Health System, Kansas City, Mo.	1		1	1
Salem (Mass.) Hospital	1	1		
Scottsdale Healthcare, Scottsdale, AZ		1		
Sentara Health System, Norfolk, Va.	1	1	1	1
Sharp Healthcare, San Diego	1	1	1	1
Sioux Valley Hospital & University Medical Center, Sioux Falls, SD		1	1	
Sisters of Mercy Health System-St Louis, St Louis, MO			1	1
Somerset Hospital, Somerset, PA			1	1
South Central Kansas Regional Medical Center, Arkansas City, KS		1		
Southeastern Ohio Regional Medical Center, Cambridge, OH		1		
Sparrow Health System, Lansing, MI			1	

Hospital and Health Network's Annual Most Wired Survey Selections (1999-2002)				
Organization	**1999**	**2000**	**2001**	**2002**
St. Clare's Health Services, Denville, N.J.	1			
St. Dominic-Jackson (Miss.) Memorial Hospital	1	1		
St. Francis Health System, Pittsburgh, PA		1		
St. Francis Hospital, Beech Grove, Ind.	1			
St. John Health System, Tulsa, OK	1	1	1	
St. Joseph Healthcare, Albuquerque, N.Mex.	1	1		
St. Joseph Hospital, Bellingham, WA		1		
St. Joseph's Hospital, Parkersburg, WV			1	
St. Luke's Episcopal Hospital, Houston,TX			1	1
St. Mary's Health System, Knoxville, Tenn.	1	1	1	
St. Peter's Hospital, Helena, Mont.	1	1	1	
St. Vincent's Hospital, Birmingham, Ala.	1			1
Stanly Memorial Hospital, Albemarle, N.C.	1			
Susquehanna Health System, Williamsport, PA		1	1	1
Sutter Health, Sacramento, CA			1	1
SwedishAmerican Health System Rockford Ill	1	1	1	1
Texas Health Resources, Arlington, TX	1	1	1	1
The Children's Hospital of Philadelphia, Philadelphia, PA		1	1	
ThedaCare, Appleton, WI				1
Trinity Health System, Steubenville, Ohio	1			
Trinity Health, Novi, MI			1	
UAB Health System, Birmingham, AL	1	1	1	
Uconn Health Center, Farmington, Conn.	1			
University Health Systems of Eastern Carolina, Greenville, NC		1	1	
University Hospital, Little Rock, AR		1	1	
University Hospitals and Clinics, Salt Lake City, UT		1		
University Hospitals Health Systems, Cleveland	1			
University of Michigan Hospitals & Health Centers, Ann Arbor, MI		1		
University of New Mexico Hospitals & Healthcare, Albuquerque, NM				1
University of Pennsylvania Health Sys., Philadelphia, PA			1	1
University of Texas M.D. Anderson Cancer Center, Houston, TX		1		
University of Utah Hospitals and Clinics, Salt Lake City, UT			1	1
University of Virginia Health System, Charlottesville, VA	1	1	1	
UPMC Health System, Pittsburgh	1	1	1	1
Upper Valley Medical Center, Troy Ohio	1			
UT Medical Center, Knoxville, Tenn.	1			1
Valley Health System, Ridgewood, NJ			1	1
Valley Health System, Winchester, VA		1	1	1
Via Christi Regional Medical Ctr., Wichita, Kans.	1			
Virginia Mason Medical Center, Seattle	1			

Hospital and Health Network's Annual Most Wired Survey Selections (1999-2002)

Organization	1999	2000	2001	2002
Virtua Health, Marlton, NJ		1	1	1
Wadley Regional Medical Center, Texarkana, Texas	1			
Wake Forest Univ. Baptist Medical Center, Winston-Salem, NC			1	1
Warren Grant Magnuson Clinical Center, Bethesda, Md.	1			
Washington County Health System, Hagerstown, Md.	1			1
Wellmont Health System, Kingsport, Tenn.	1			
Wellspan Health, York, PA				1
Wentworth-Douglass Hospital, Dover, NH				1
William Beaumont Hospital, Royal Oak, Mich.	1	1		1
Yale-New Haven (Conn.) Hospital	1			1
TOTALS	**94**	**90**	**96**	**96**

9.4.3 Cross-Tab Inefficiency Scores

Cross-Tab of Inefficiency Score Means for The Rest of the Sector Hospital Sample by the Nine US Census Division Regions

Partition	DIVISION		CDHN	CDTN
0	New England	Mean	.362923	.100979
		N	546	546
		Std. Deviation	.0873400	.0804905
		Geometric Mean	.352460	.093304
	Middle Atlantic	Mean	.397237	.101583
		N	1912	1912
		Std. Deviation	.1010363	.0565183
		Geometric Mean	.385056	.097283
	South Atlantic	Mean	.455490	.111134
		N	2334	2334
		Std. Deviation	.1610128	.0664576
		Geometric Mean	.432440	.104829
	East North Central	Mean	.448574	.111386
		N	1980	1980
		Std. Deviation	.1392725	.0721744
		Geometric Mean	.429781	.104518
	East South Central	Mean	.483439	.115100
		N	999	999
		Std. Deviation	.1573452	.0774871
		Geometric Mean	.459158	.107208
	West North Central	Mean	.419536	.110790
		N	1019	1019
		Std. Deviation	.1701451	.0956585
		Geometric Mean	.393270	.099006
	West South Central	Mean	.540865	.125651
		N	1412	1412
		Std. Deviation	.1990314	.0776855
		Geometric Mean	.512062	.117333
	Mountain	Mean	.494462	.121900
		N	631	631
		Std. Deviation	.1648698	.0862593
		Geometric Mean	.469803	.112543
	Pacific	Mean	.482811	.116714
		N	1630	1630
		Std. Deviation	.1304535	.0733143
		Geometric Mean	.467162	.110219
	Pooled Partition 0	Mean	.455919	.112473
		N	12463	12463
		Std. Deviation	.1560010	.0739557
		Geometric Mean	.433628	.105145

Cross-Tab of Inefficiency Score Means for Most Aggressive Hospital Sample by the Nine US Census Division Regions

Partition DIVISION			
1 New England	**Mean**	.262301	.052404
	N	45	45
	Std. Deviation	.0446973	.0045797
	Geometric Mean	.258567	.052208
Middle Atlantic	**Mean**	.296717	.064095
	N	182	182
	Std. Deviation	.0980225	.0739728
	Geometric Mean	.282702	.056217
South Atlantic	**Mean**	.294985	.057307
	N	174	174
	Std. Deviation	.0737760	.0442546
	Geometric Mean	.286220	.054211
East North Central	**Mean**	.313415	.068072
	N	204	204
	Std. Deviation	.0797127	.0799093
	Geometric Mean	.303375	.059245
East South Central	**Mean**	.332065	.069715
	N	95	95
	Std. Deviation	.0945970	.0828325
	Geometric Mean	.319851	.060331
West North Central	**Mean**	.343789	.057002
	N	84	84
	Std. Deviation	.1606846	.0149667
	Geometric Mean	.310194	.055041
West South Central	**Mean**	.332872	.072599
	N	115	115
	Std. Deviation	.0815298	.0917303
	Geometric Mean	.324309	.061222
Mountain	**Mean**	.289599	.053483
	N	43	43
	Std. Deviation	.0576123	.0073293
	Geometric Mean	.282914	.052912
Pacific	**Mean**	.330539	.063117
	N	98	98
	Std. Deviation	.0772141	.0582262
	Geometric Mean	.321399	.058298
Pooled Partition 1	**Mean**	.312135	.063583
	N	1040	1040
	Std. Deviation	.0928178	.0666678
	Geometric Mean	.299622	.057130

9.5 APPENDIX 5

This section contains a sample market intelligence report that was use in the qualitative coding activity and the residual plots from CATREG analysis.

9.5.1 Sample Market Intelligence Report

TH

THE 6 DORENFEST COMPLETE INTEGRATED HEALTHCARE DELIVERY SYSTEM+ (IHDS+) DATABASE

Key Personnel at Anne Arundel Medical Center:

Anne Arundel Medical

CEO: Mr. Martin L. Doordan, President & CEO

Center

CIO: Mr. Chuck Shafer, Interim Chief Information Officer

2001 Medical Parkway

CFO: Mr. Bill Hughes, VP of Strategic Planning

Annapolis, MD 21401

COO: Ms. Sharon Riley, COO

Phone: (443) 481-1000

Patient Safety Head: Mr. Peter Quentin, Director of Engineering

Business Office Head: Jackie Smith, RN, Director of Patient Financial Services

Number of Beds: 260

Ambulatory Care Head: Vickie Diamond, RN, Vice President of Patient Care Facility ID: 32479 Services

Date of Data: 3/6/2003

Medical Staff Chief: George Samaras, MD, President of Medical Staff Nursing Head: Ms. Beth Evins, Nurse Exec. & VP of Quality Improvement

Pharmacy Head: Mr. Paul Vitale, Director of Pharmacy

Parent Name: Anne Arundel Medical Center 2001 Medical Parkway, Annapolis, MD 21401

HIM Director: Ms. Sabrena Gregrich, HIM Director
Chief Compliance Officer: Ms. Beth Evins, Nurse Exec. & VP of Quality Improvement
Pathology Chief: Mr. Paula Wadley, Director of Pathology
Laboratory Director: Mr. Roscoe Davis, Director of Laboratory
Radiology Med Dir: Mr. David Klinger, Director of Radiology
Radiology Adm Dir: Mr. David Klinger, Director of Radiology
PACS Administrator: Mr. David Klinger, Director of Radiology

Admissions Director: Ms. Pat Travis, Director of Clinical Efficiency
ER Director: Ms. Mary-Ellen Palowitch, Acting Director of ER

Phone: (443) 481-1000 www.aahs.org
aamcpr@aahs.org

APPLICATION	STATUS	SOFTWARE VENDOR/PRODUCT	CONTRACT	HARDWARE VENDOR/PRODUCT	Plan Status	Plan Group
Business Office						
CREDIT/COLLECTIONS	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
ELECTRONIC CLAIMS	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
PATIENT BILLING	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
PATIENT REGISTRATION	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
PATIENT SCHEDULING	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
General Financials						
ACCOUNTS PAYABLE	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
ENTERPRISE RESOURCE PLANNING	Not Automated				No	-
GENERAL LEDGER	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
MATERIALS MANAGEMENT	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
Human Resources						
BENEFITS ADMINISTRATION	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
PAYROLL	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
PERSONNEL ADMINISTRATION	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
TIME & ATTENDANCE	Automated	AUTOMATING PERIPHERALS, INC./PAYROLLMATION	--/01	HEWLETT-PACKARD CO./COMPAQ	No	-
Decision Support						
CASE MIX ANALYSIS	Automated	THE SHAMS GROUP, INC./GALAXY	--/98	HEWLETT-PACKARD CO./COMPAQ	No	-
CLINICAL DECISION SUPPORT	Not Automated				No	-
COST ACCOUNTING	Automated	THE SHAMS GROUP, INC./GALAXY	--/98	HEWLETT-PACKARD CO./COMPAQ	No	-
EXECUTIVE INFO SYS	Automated	THE SHAMS GROUP, INC./GALAXY	--/98	HEWLETT-PACKARD CO./COMPAQ	No	-
FLEXIBLE BUDGETING	Automated	THE SHAMS GROUP, INC./GALAXY	--/98	HEWLETT-PACKARD CO./COMPAQ	No	-
OUTCOMES AND QUALITY MANAGEMENT	Automated	THE SHAMS GROUP, INC./GALAXY	--/98	HEWLETT-PACKARD CO./COMPAQ	No	-

Anne Arundel Medical Center Annapolis, MD *Facility ID # 32479 Acute Care Hospital Profile*

APPLICATION	STATUS	SOFTWARE VENDOR/PRODUCT	CONTRACT	HARDWARE VENDOR/PRODUCT	Plan Status	Plan Group
Managed Care Support						
ELIGIBILITY	Not Automated				No	-
MANAGED CARE CONTRACT MANAGEMENT	Not Automated				No	-
PREMIUM BILLING	Not Automated				No	-
Medical Records						
ABSTRACTING	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
CHART DEFICIENCY	Automated	SOFTMED SYSTEMS, INC./CHARTFACT	--/87	HEWLETT-PACKARD CO./COMPAQ	No	-
CHART TRACKING/LOCATOR	Automated	SOFTMED SYSTEMS, INC./CHARTLOCATOR	--/87	HEWLETT-PACKARD CO./COMPAQ	No	-
DICTATION	Automated	DICTAPHONE/Unknown	--/01	HEWLETT-PACKARD CO./COMPAQ	No	-
ENCODER	Automated	QUADRAMED CORP./NCODER+	--/01	HEWLETT-PACKARD CO./COMPAQ	No	-
MASTER PATIENT INDEX	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
MED REC IMAGING	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
TRANSCRIPTION	Automated	THE SHAMS GROUP, INC./Unknown	--/95	HEWLETT-PACKARD CO./COMPAQ	No	-
Clinical						
CARDIOLOGY	Automated	PHILIPS MEDICAL SYSTEMS/TRACEMASTER	--/01	HEWLETT-PACKARD CO./COMPAQ	No	-
CLINICAL DATA REPOSITORY	Automated	THE SHAMS GROUP, INC./Unknown	--/95	HEWLETT-PACKARD CO./COMPAQ	No	-
CLINICAL DOCUMENTATION	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
COMPUTERIZED PATIENT RECORD	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
CPOE	Not Automated				Yes	1
EMERGENCY DEPARTMENT	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
INTENSIVE CARE (Critical Care)	Not Automated				No	-
LABORATORY	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
NURSE STAFFING	Automated	PER-SE TECHNOLOGIES/ANSOS	--/93	HEWLETT-PACKARD	No	-

Anne Arundel Medical Center Annapolis, MD *Facility ID # 32479 Acute Care Hospital Profile*

APPLICATION	STATUS	SOFTWARE VENDOR/PRODUCT	CONTRACT	HARDWARE VENDOR/PRODUCT	Plan Status	Plan Group
				CO./COMPAQ		
OBSTETRICAL SYSTEMS	Automated	GE MEDICAL SYSTEMS/QS	--/01	HEWLETT-PACKARD CO./COMPAQ	No	-
ORDER COMMUNICATION/RESULTS	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
PACS	Automated	GE MEDICAL SYSTEMS/PATHSPEED	--/01	HEWLETT-PACKARD CO./COMPAQ	No	-
PHARMACY	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
PHARMACY DISPENSING	Automated	CARDINAL HEALTH, INC./PYXIS	--/01	HEWLETT-PACKARD CO./COMPAQ	No	-
POINT OF CARE (MED/SURG BEDSIDE TERM)	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
RADIOLOGY	Automated	MEDITECH/MAGIC	--/79	HEWLETT-PACKARD CO./COMPAQ	No	-
SURGERY	Automated	PICIS/MSM/MEDSURG	--/92	HEWLETT-PACKARD CO./COMPAQ	No	-

™

Anne Arundel Medical Center *Annapolis, MD* *Facility ID # 32479* *Acute Care Hospital Profile*

Modality for PACS	Status	Software Vendor/Product	Contract Date	Hardware Vendor/Product	Plan Status	Plan Group

Angiography Automated GE MEDICAL SYSTEMS/PATHSPEED CR (Computed Radiography) Automated GE MEDICAL SYSTEMS/PATHSPEED CT (Computed Tomography) Automated GE MEDICAL SYSTEMS/PATHSPEED DF (Digital Fluroscopy) Automated GE MEDICAL SYSTEMS/PATHSPEED DR (Digital Radiography) Automated GE MEDICAL SYSTEMS/PATHSPEED MRI (Magnetic Resonance Imaging) Automated GE MEDICAL SYSTEMS/PATHSPEED Nuclear Medicine Automated GE MEDICAL SYSTEMS/PATHSPEED US (Ultra Sound) Automated GE MEDICAL SYSTEMS/PATHSPEED --/01 HEWLETT-PACKARD CO./COMPAQ No ---/01 HEWLETT-PACKARD CO./COMPAQ No ---/01 HEWLETT-PACKARD CO./COMPAQ No ---/01 HEWLETT-PACKARD CO./COMPAQ No ---/01 HEWLETT-PACKARD CO./COMPAQ No ---/01 HEWLETT-PACKARD CO./COMPAQ No ---/01 HEWLETT-PACKARD CO./COMPAQ No ---/01 HEWLETT-PACKARD CO./COMPAQ No

IMAGE VOLUME:

Total Radiology Image Volume: 200,000

Radiology Images Digitalized: 180,000

ADDITIONAL PACS INFORMATION:

Vendor: GE MEDICAL SYSTEMS
Licensed Workstations: 1500

Storage:

Vendor: -
Media: RAID

Storage Network: SANS
Capacity: Between 1 and 5 TB

Long-term Storage: Magnetic Optical Disk (MOD)

Archiving Architecture: Centralized

Network Connection Method: Hospital-wide or Enterprise-wide based LAN

CURRENT SITUATION

Anne Arundel Medical Center uses GE MEDICAL SYSTEMS/PATHSPEED for its PACS technology at the acute and sub-acute care facilities for the CT, DF, MRI, CR, angiography, DR, US, and nuclear medicine modalities. The system has 1,500 licensed workstations and stores its images in-house on optical CD. Its storage architecture is centralized with between 1 and 5 TB of available storage. Anne Arundel Medical Center is using more than 90% of the system's functionality.

Anne Arundel Medical Center Annapolis, MD *Facility ID # 32479 Acute Care Hospital Profile*

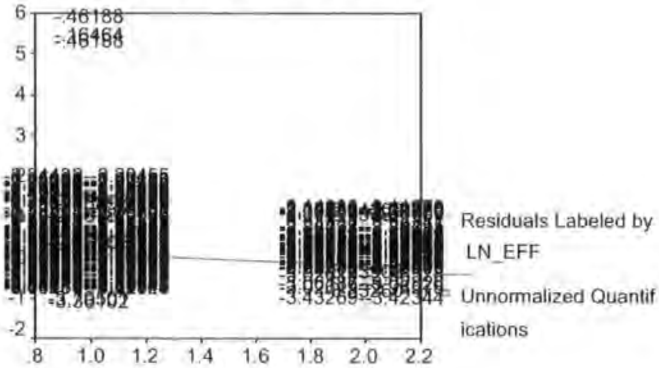
SOFTWARE PLAN INFORMATION

Group Buying Process First Considered 1 Anne Arundel Medical Center is considering purchasing CPOE software for its acute and sub-acute care facilities. MEDITECH/MAGIC is the software being considered. It does not know when it will sign a contract or begin installation. 2 Anne Arundel Medical Center is considering purchasing physician access software. MERCURY MD, INC. is the vendor of choice. It does not know when it will sign a contract or begin installation.	**RFP Out**	**Vendor Decision Contract Installation Facilities** All Acute Facilities, All Sub-Acute Facilities All Acute Facilities, All Sub-Acute Facilities

9.5.2 *Efficiency Residuals*

Residuals

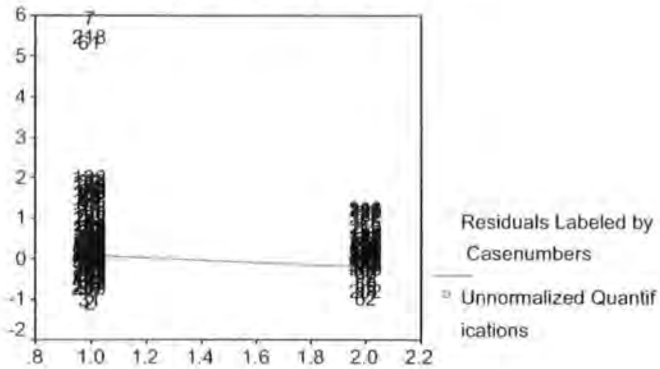
Residuals: PREMBILL



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

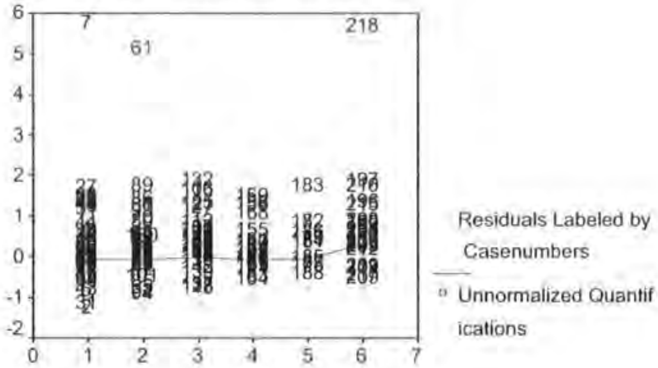
Residuals: PREMBILL



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

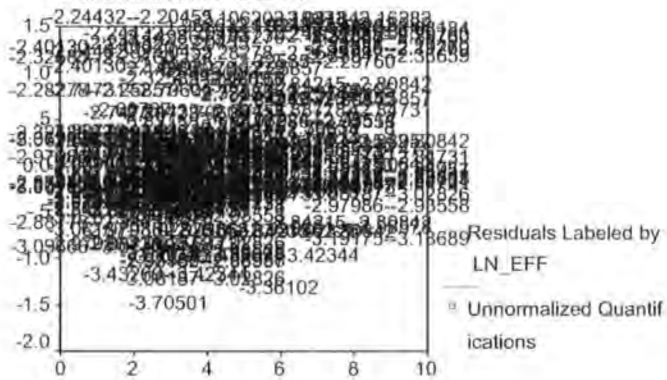
Residuals: STCLASS



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

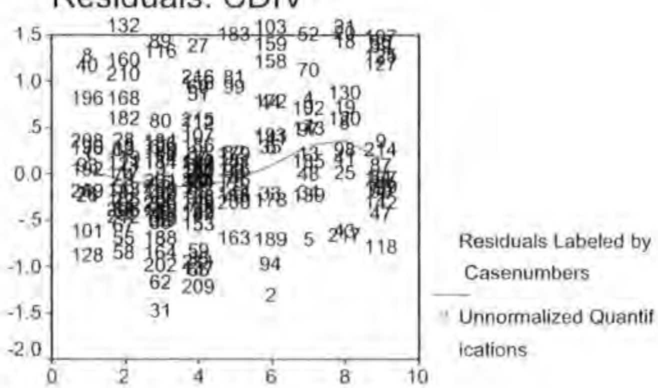
Residuals: CDIV



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

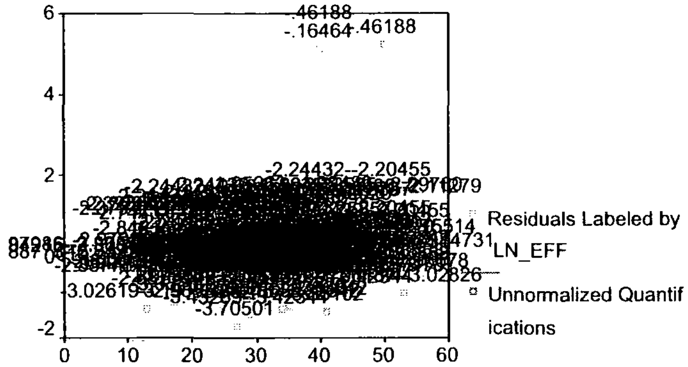
Residuals: CDIV



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

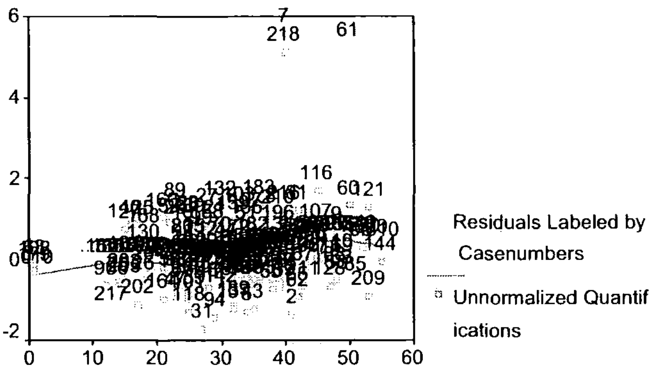
Residuals: MEDISHR



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

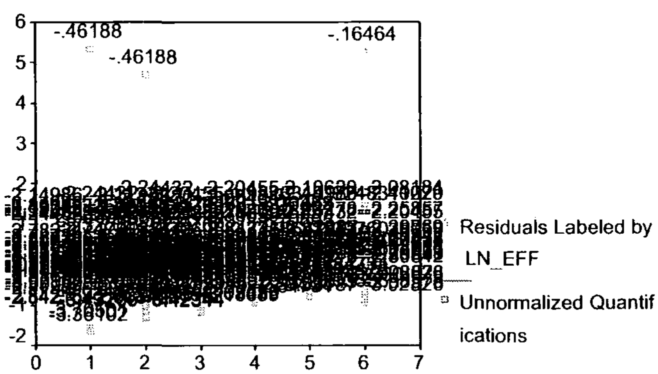
Residuals: MEDISHR



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

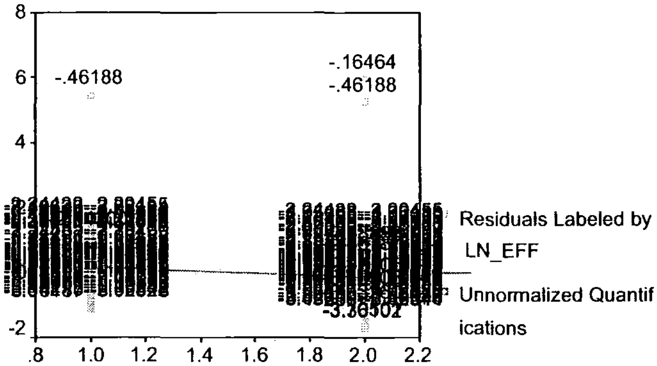
Residuals: STCLASS



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

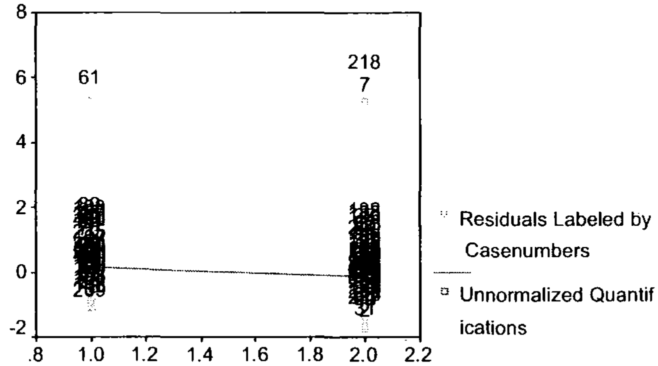
Residuals: CREP



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

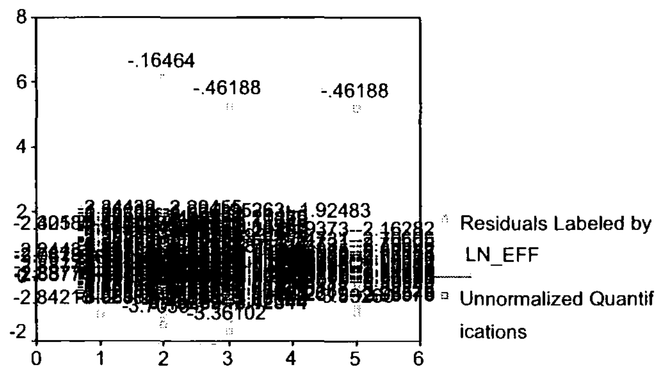
Residuals: CREP



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

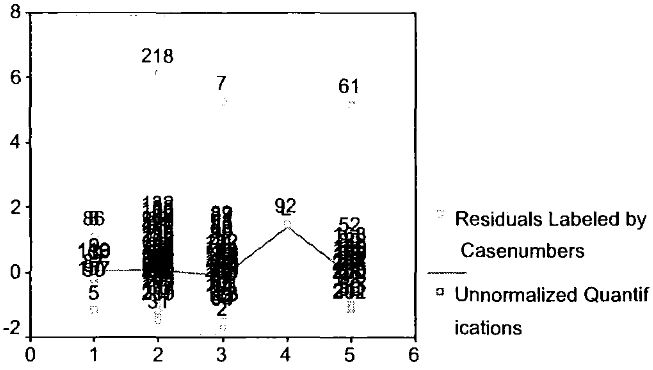
Residuals: REPTO



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

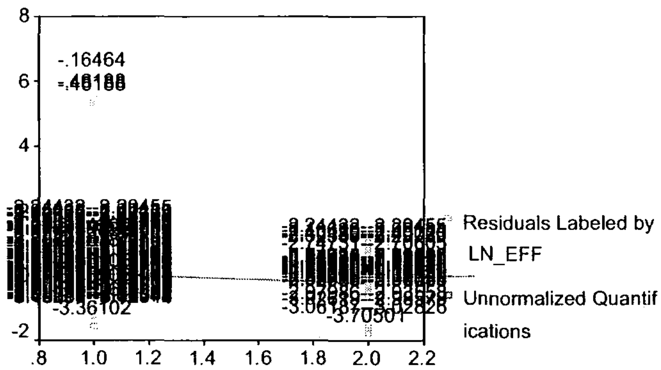
Residuals: REPTO



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

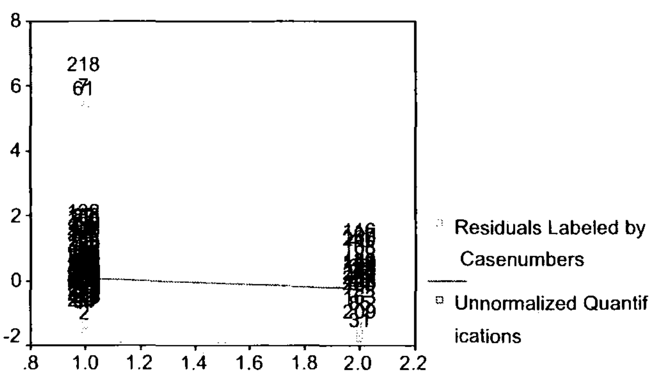
Residuals: OB



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

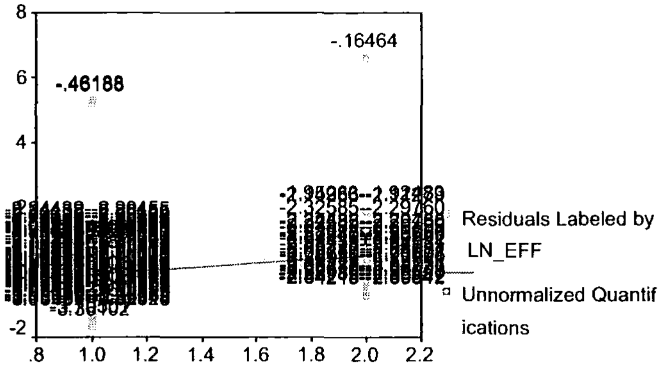
Residuals: OB



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

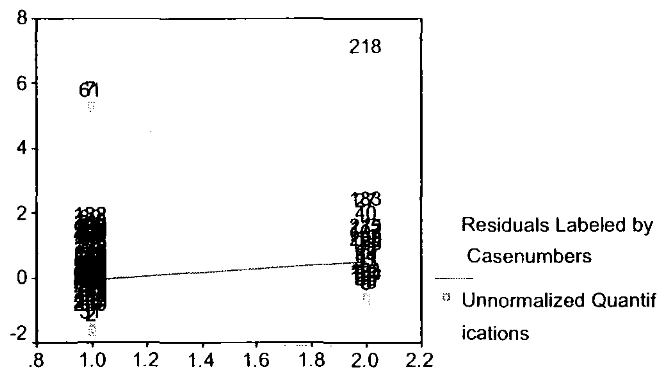
Residuals: CARIO100



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

Residuals: CARIO100



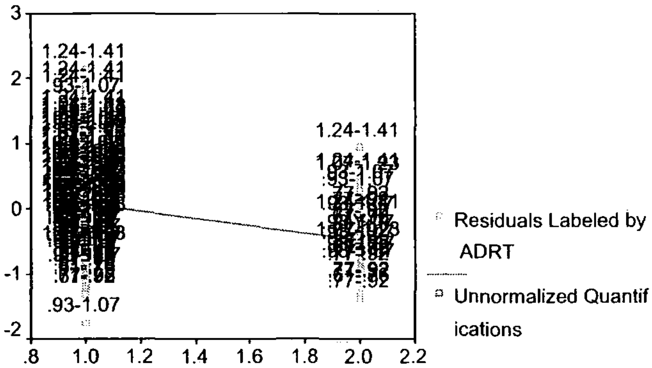
Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

9.5.3 *ADRT Residuals*

Residuals

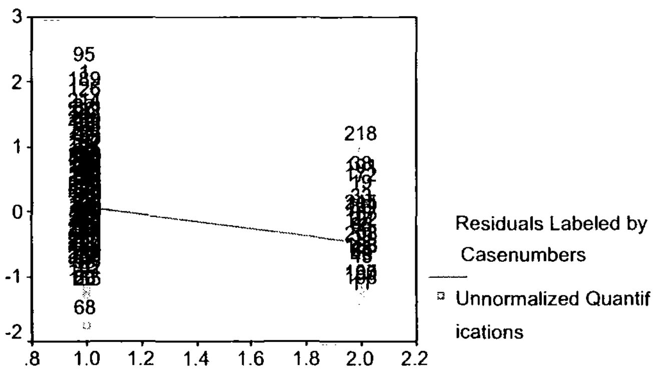
Residuals: CARIO100



Categories

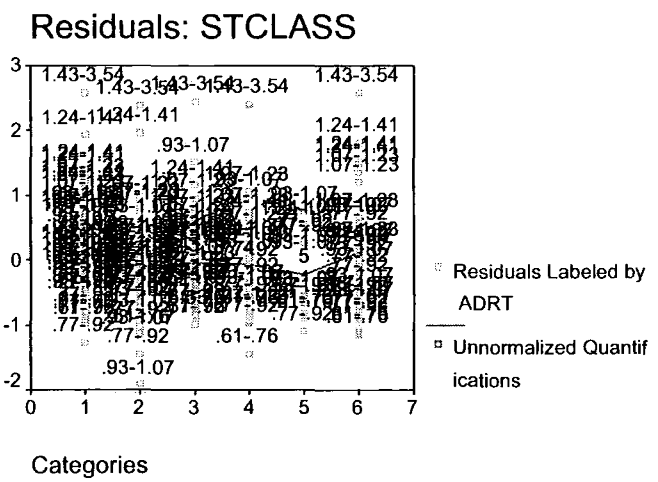
Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

Residuals: CARIO100

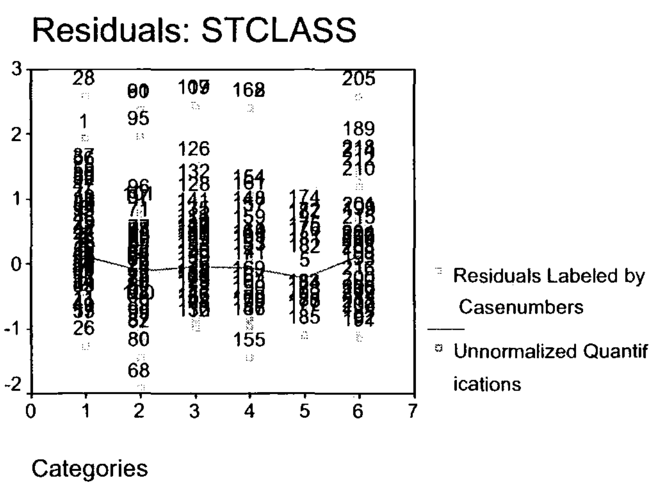


Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).



Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

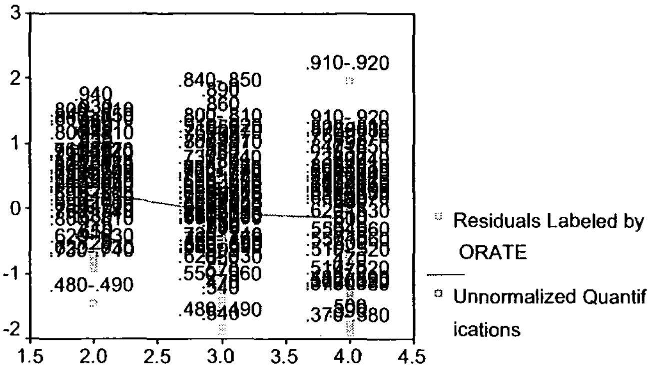


Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

ORATE Residuals

Residuals

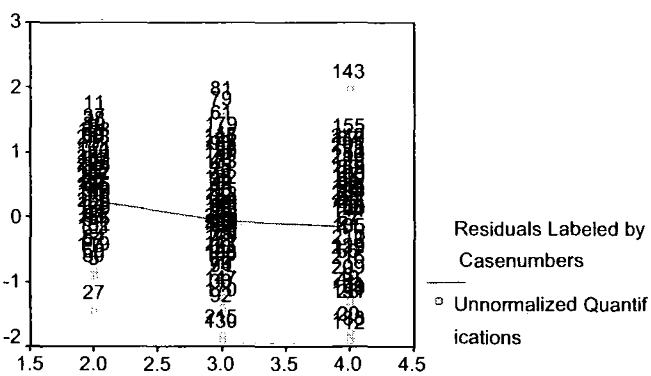
Residuals: TEACHING



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 1).

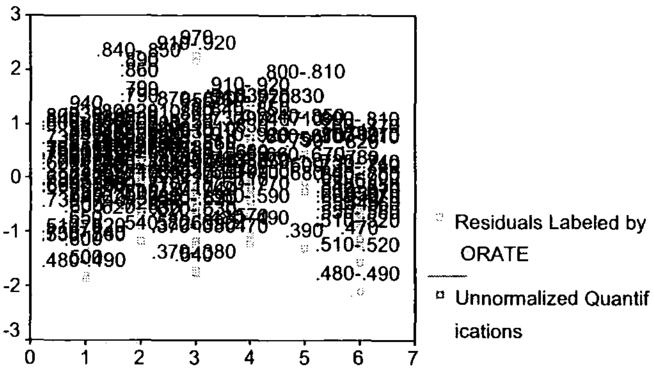
Residuals: TEACHING



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 1).

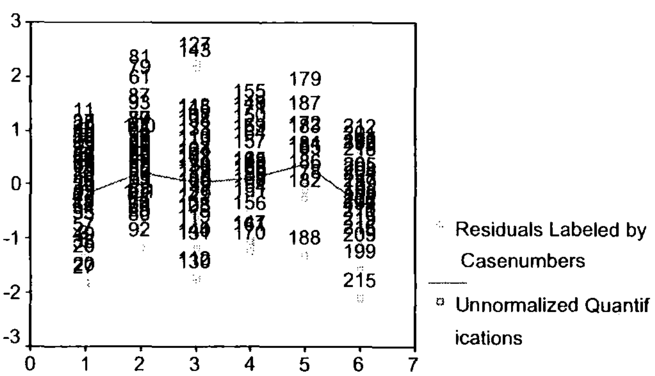
Residuals: STCLASS



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

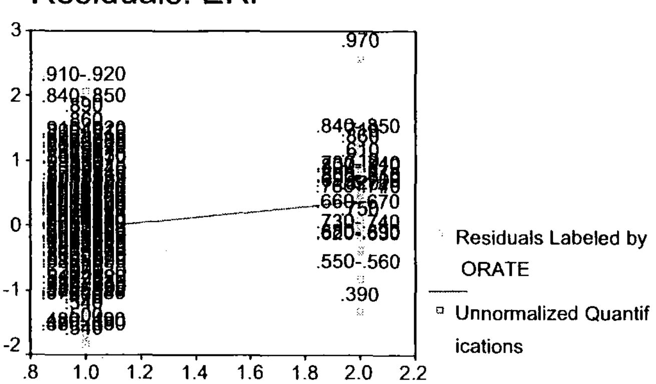
Residuals: STCLASS



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

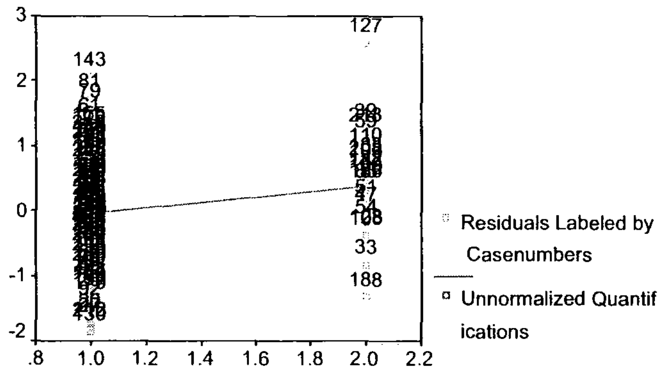
Residuals: ERP



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

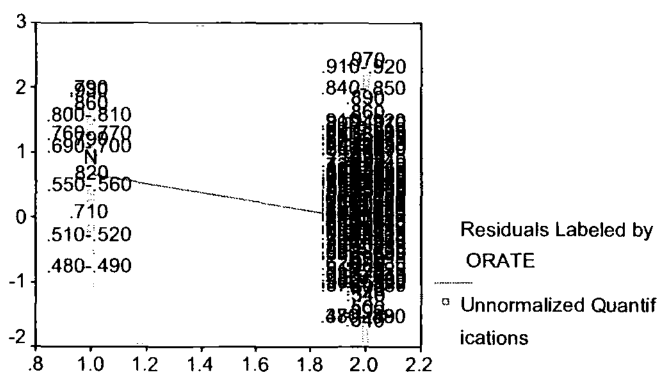
Residuals: ERP



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

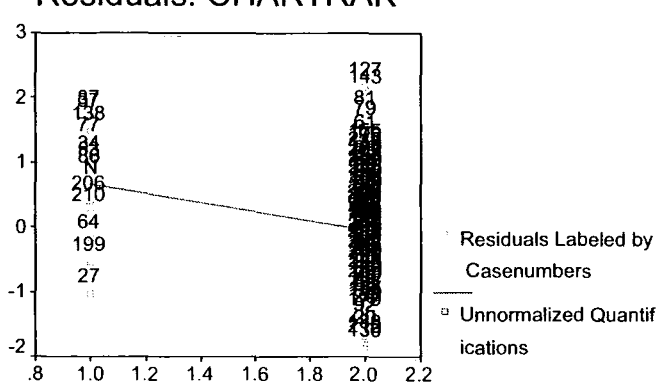
Residuals: CHARTRAK



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

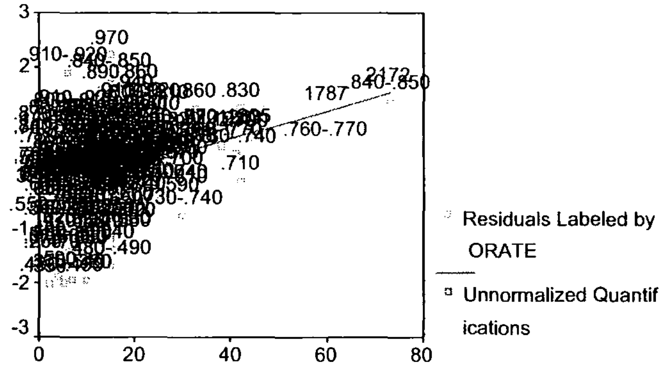
Residuals: CHARTRAK



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

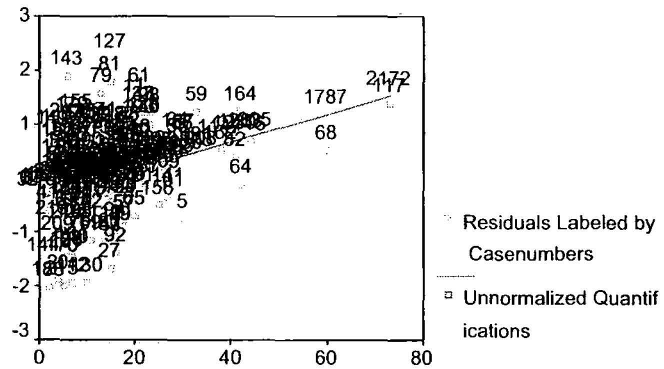
Residuals: BEDS



Categories

Optimal Scaling Level: Numerical.

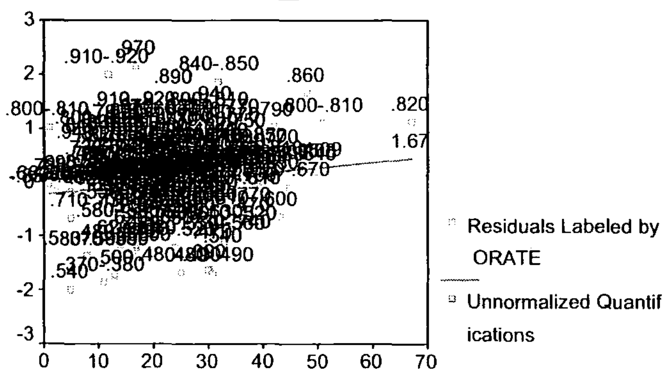
Residuals: BEDS



Categories

Optimal Scaling Level: Numerical.

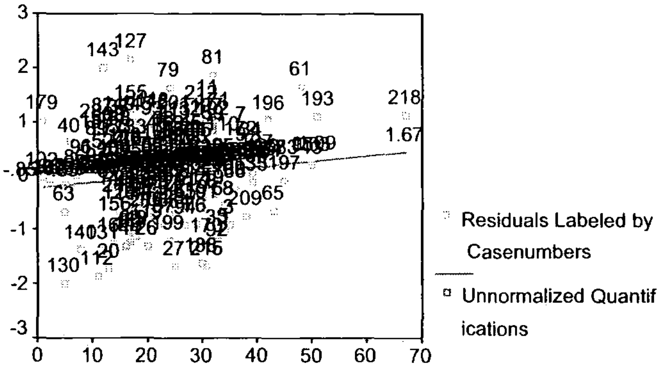
Residuals: EFF_HAT



Categories

Optimal Scaling Level: Numerical.

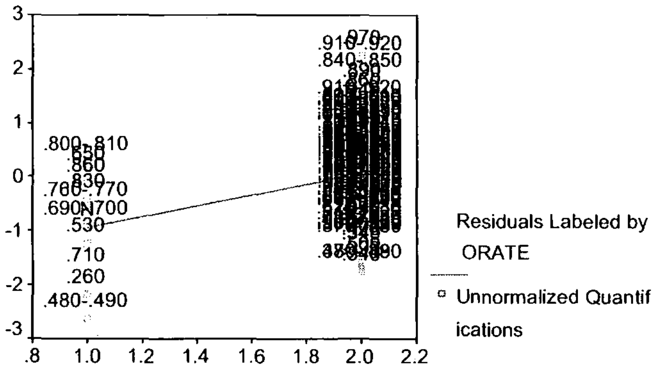
Residuals: EFF_HAT



Categories

Optimal Scaling Level: Numerical.

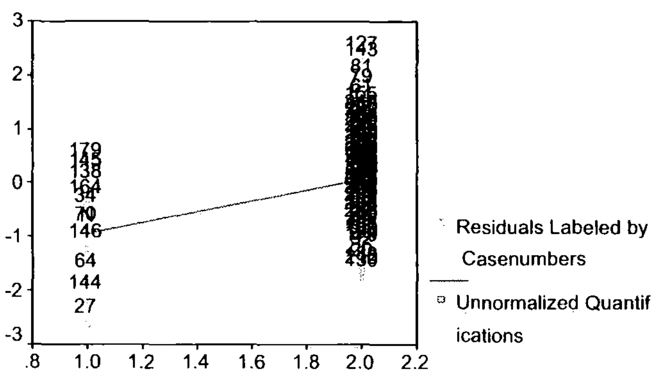
Residuals: CLAIMS



Categories

Optimal Scaling Level: Spline Ordinal (degree 2, interior knots 0).

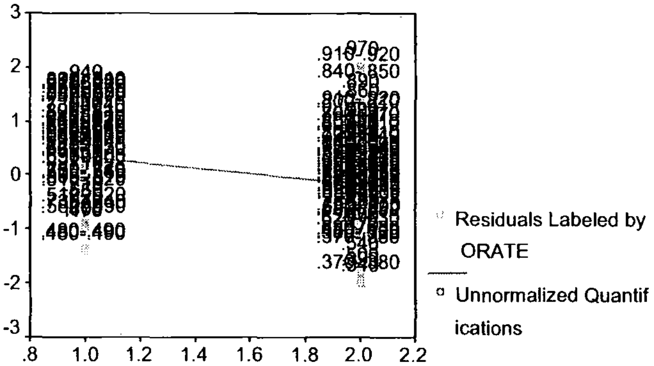
Residuals: CLAIMS



Categories

Optimal Scaling Level: Spline Ordinal (degree 2, interior knots 0).

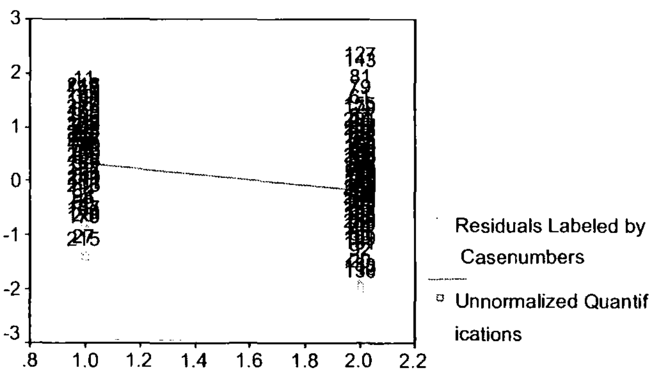
Residuals: EXECIS



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

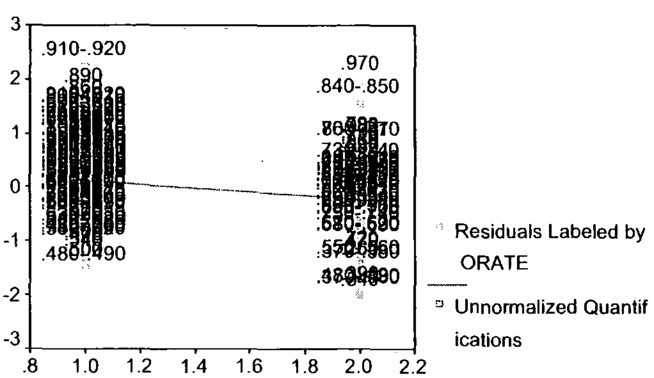
Residuals: EXECIS



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

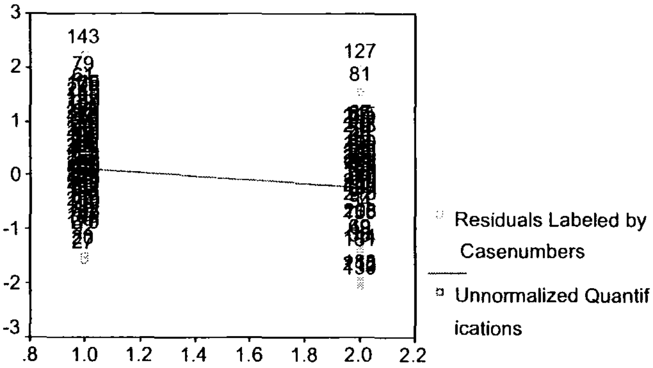
Residuals: ELIG



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

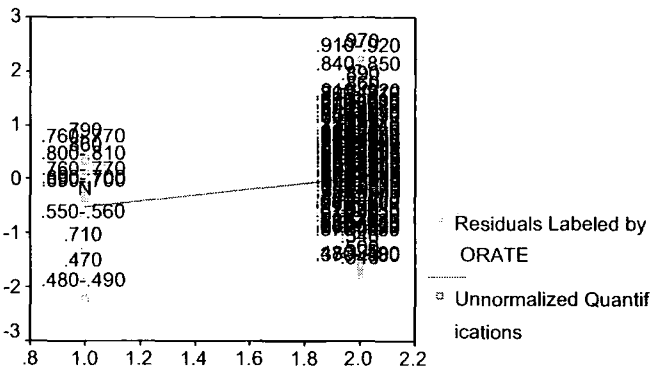
Residuals: ELIG



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

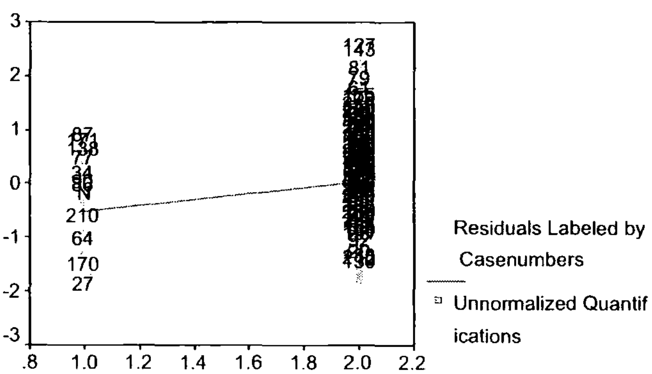
Residuals: CHARTDEF



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

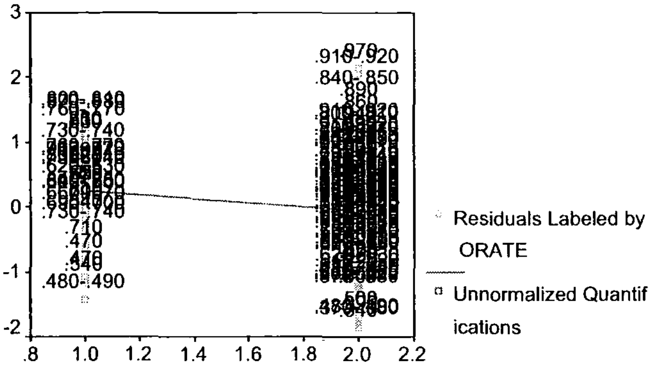
Residuals: CHARTDEF



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

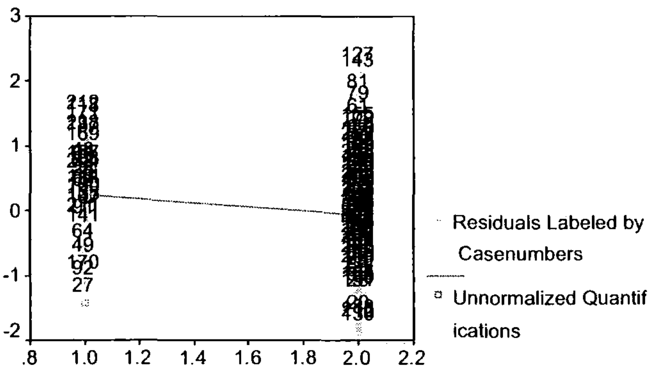
Residuals: CDREP



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

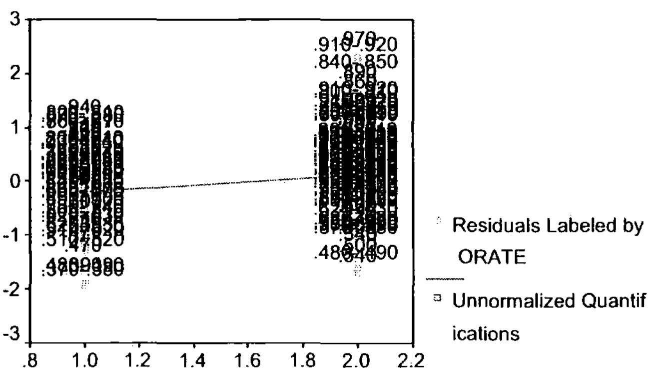
Residuals: CDREP



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

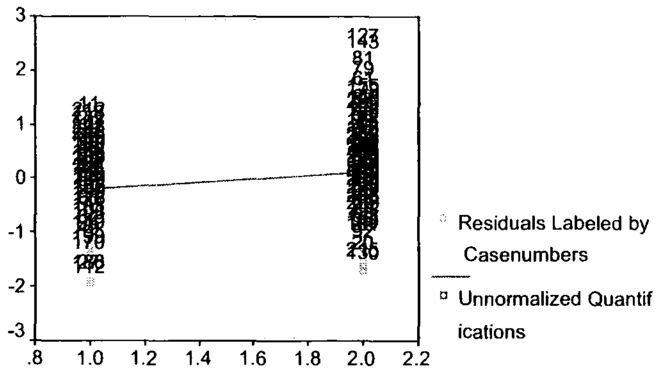
Residuals: CPR



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

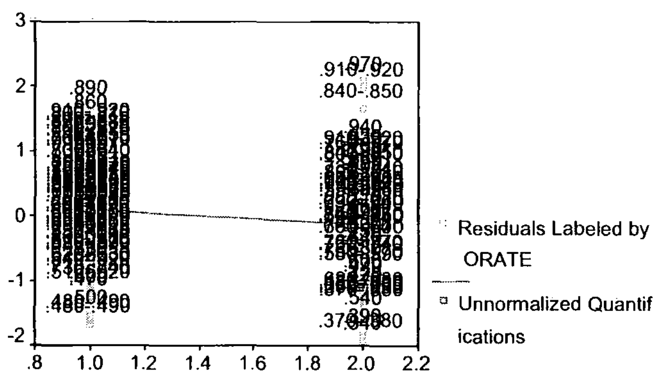
Residuals: CPR



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

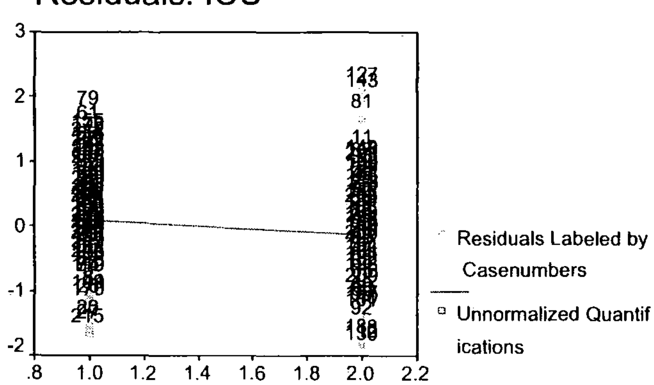
Residuals: ICU



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

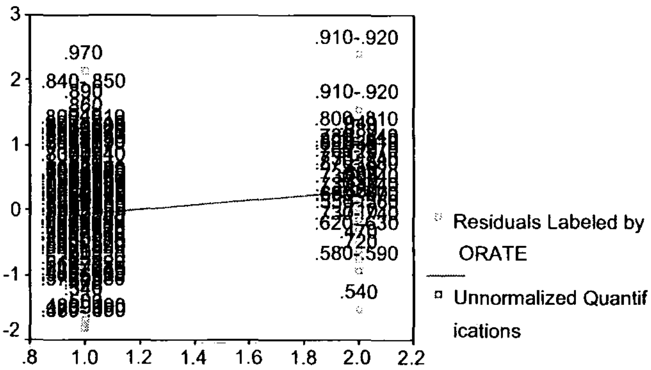
Residuals: ICU



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

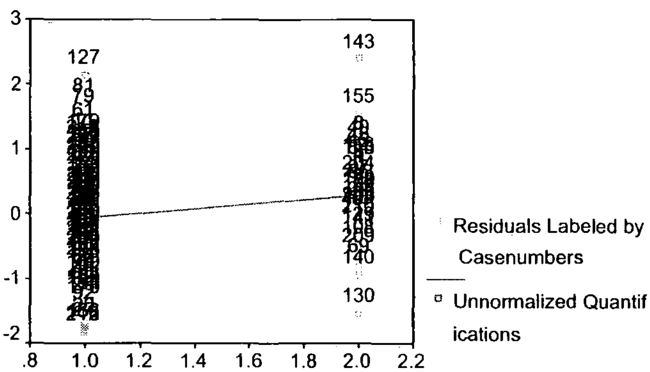
Residuals: OB



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

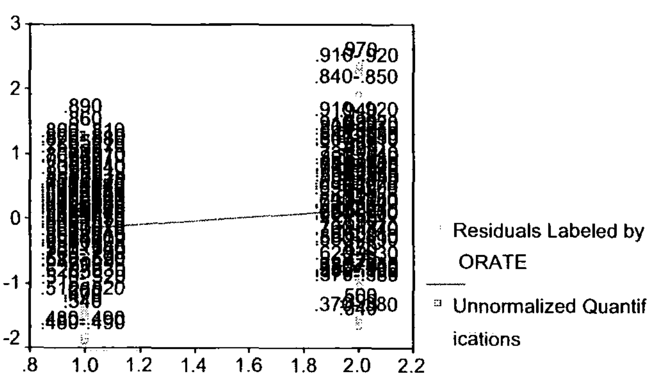
Residuals: OB



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

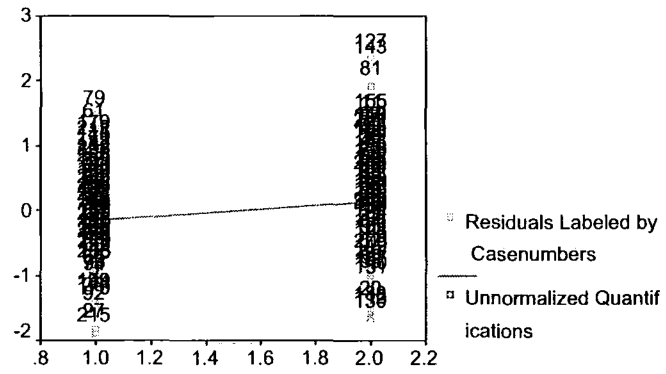
Residuals: POCBED



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

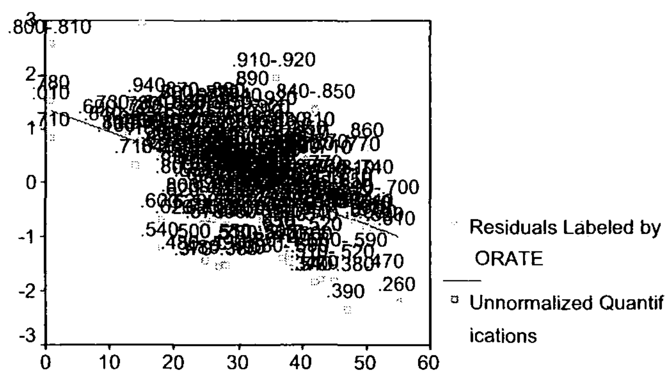
Residuals: POCBED



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

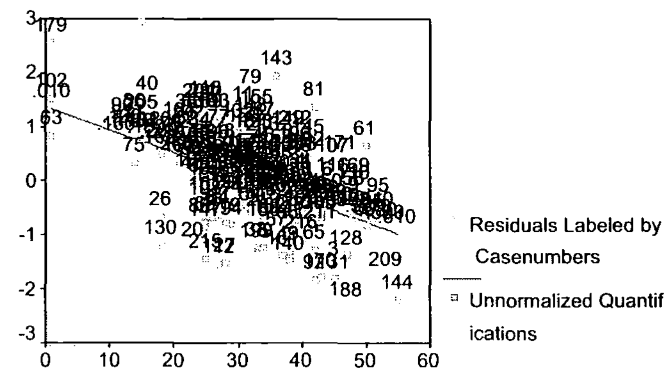
Residuals: MEDISHR



Categories

Optimal Scaling Level: Numerical.

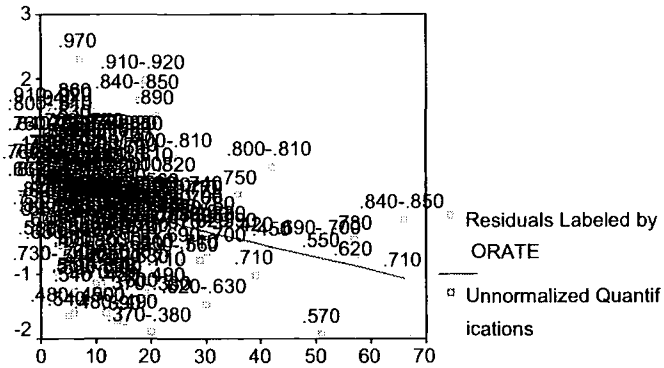
Residuals: MEDISHR



Categories

Optimal Scaling Level: Numerical.

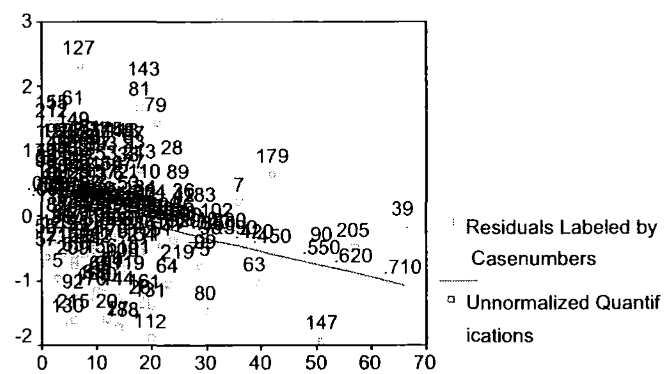
Residuals: MCAIDSHR



Categories

Optimal Scaling Level: Numerical.

Residuals: MCAIDSHR



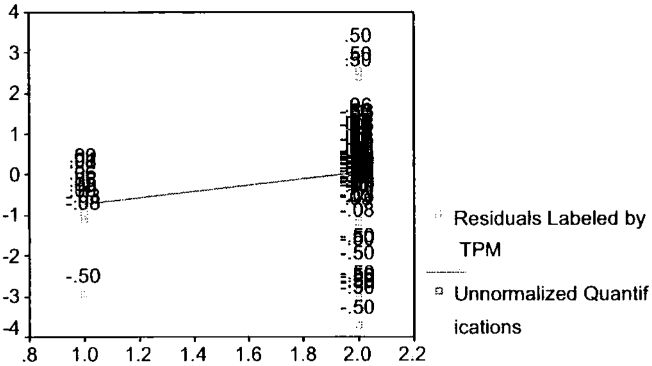
Categories

Optimal Scaling Level: Numerical.

9.5.4 *TPM Residuals*

Residuals

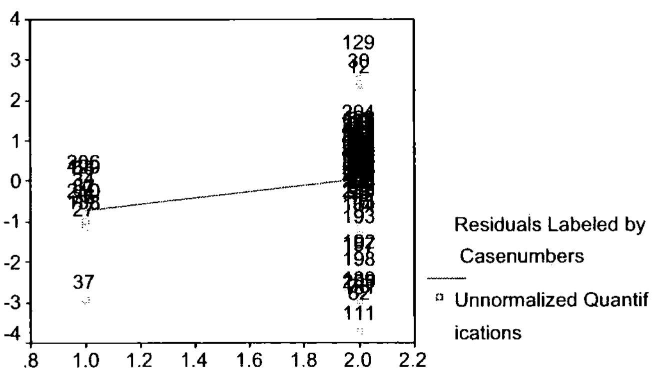
Residuals: CHARTRAK



Categories

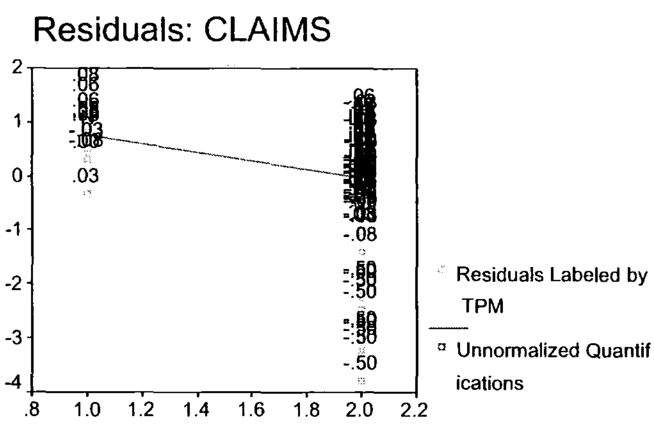
Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

Residuals: CHARTRAK



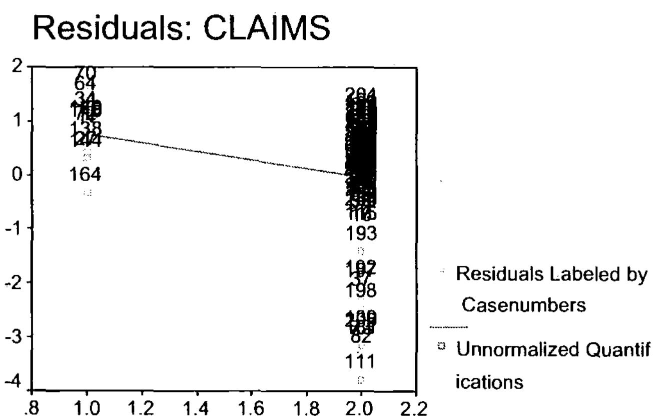
Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).



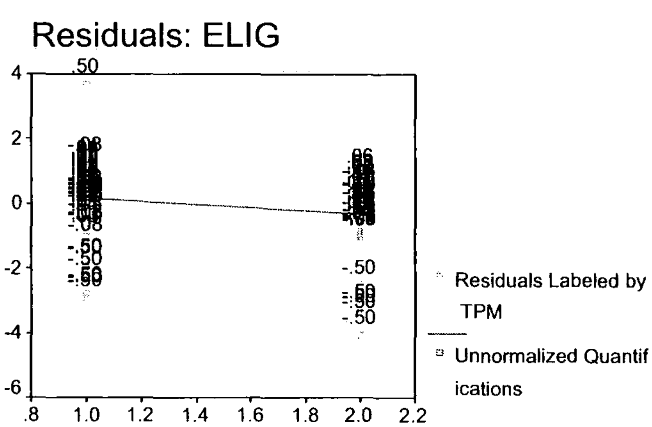
Categories

Optimal Scaling Level: Spline Ordinal (degree 2, interior knots 0).



Categories

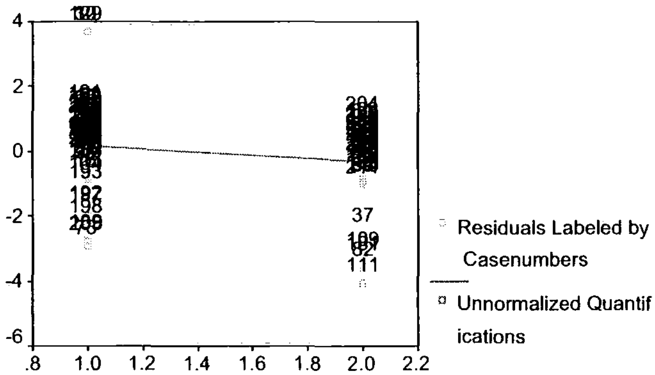
Optimal Scaling Level: Spline Ordinal (degree 2, interior knots 0).



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

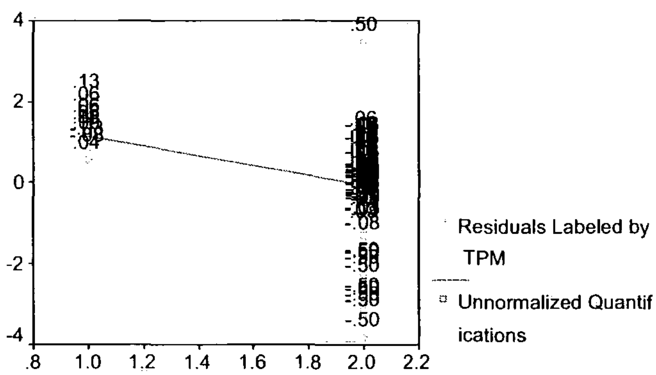
Residuals: ELIG



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

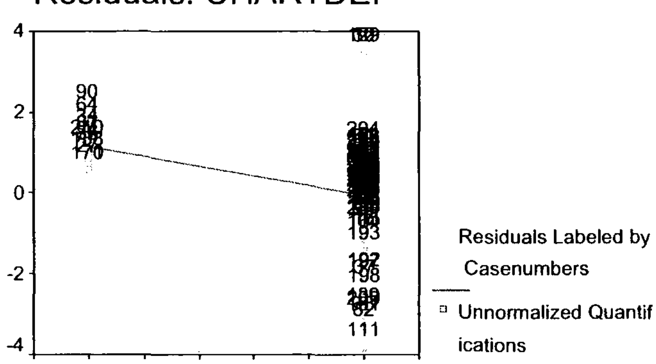
Residuals: CHARTDEF



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

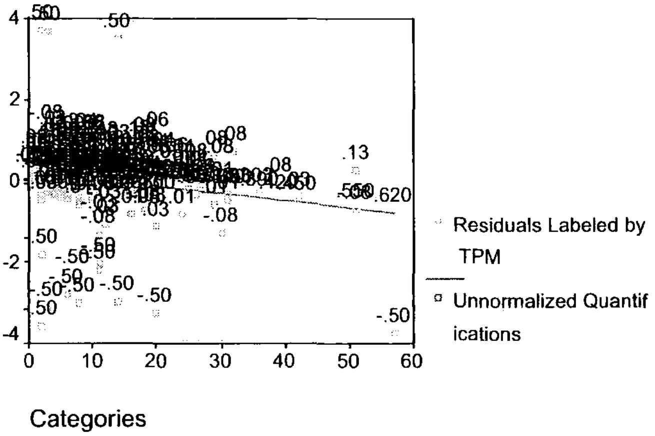
Residuals: CHARTDEF



Categories

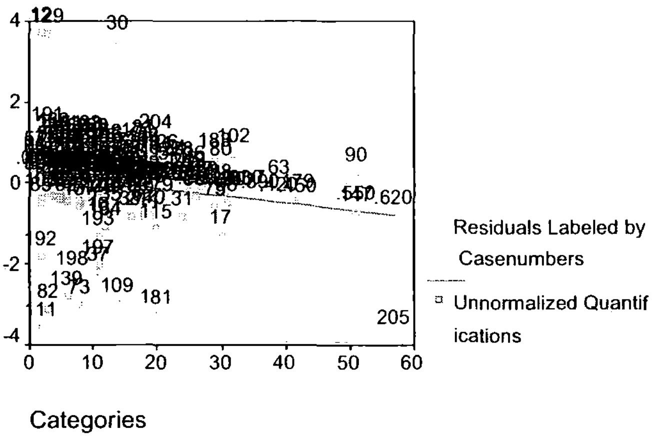
Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

Residuals: MCAIDSHR



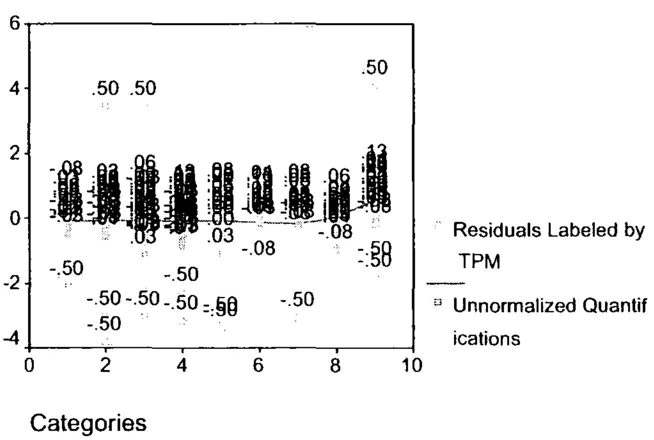
Optimal Scaling Level: Numerical.

Residuals: MCAIDSHR



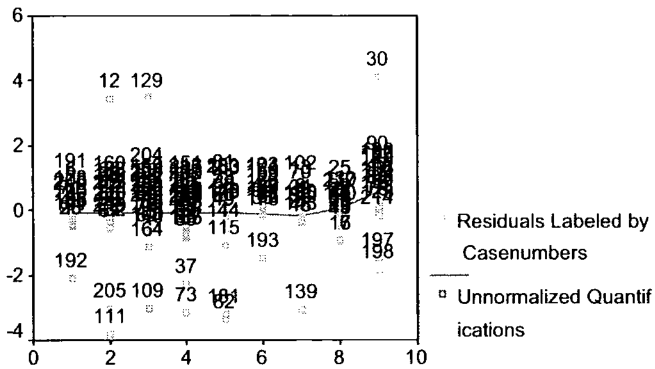
Optimal Scaling Level: Numerical.

Residuals: CDIV



Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

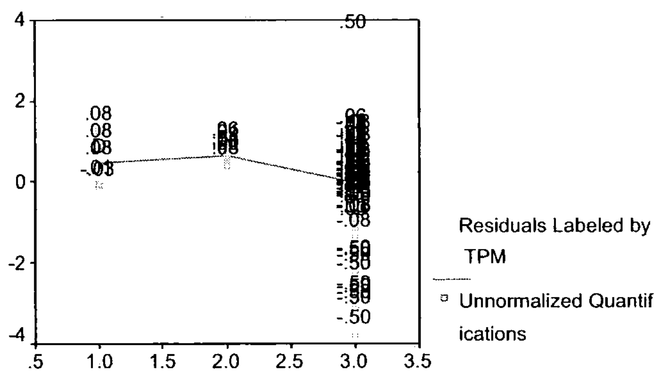
Residuals: CDIV



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

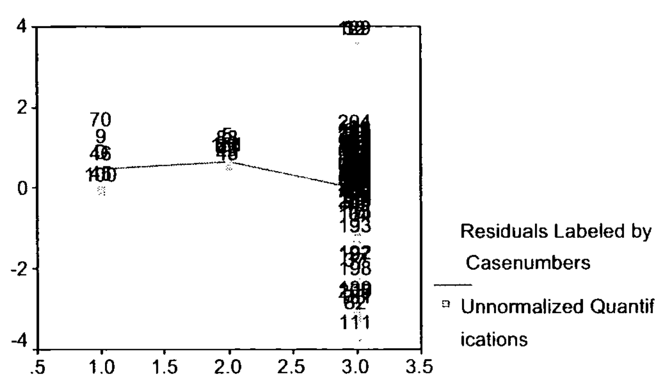
Residuals: ITCOMM



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 1).

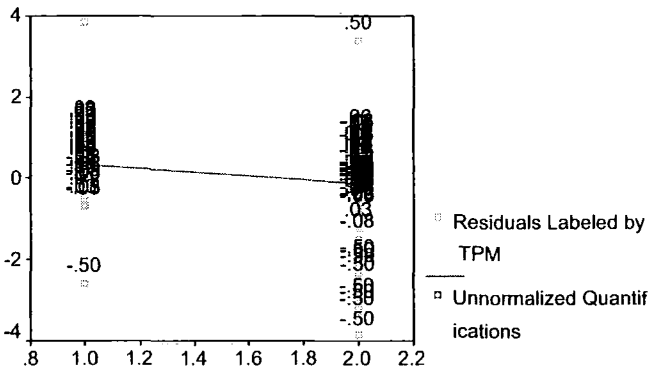
Residuals: ITCOMM



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 1).

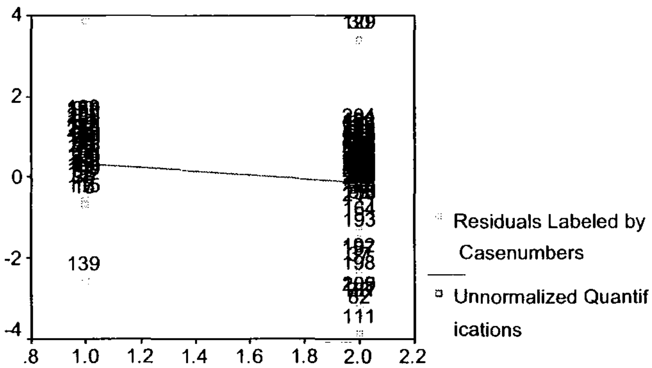
Residuals: SCHED



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

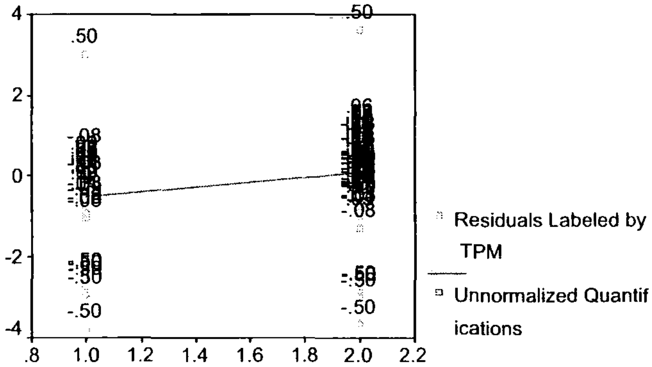
Residuals: SCHED



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

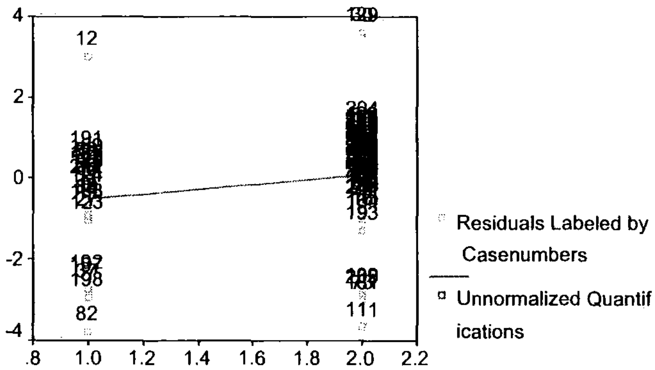
Residuals: TA



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

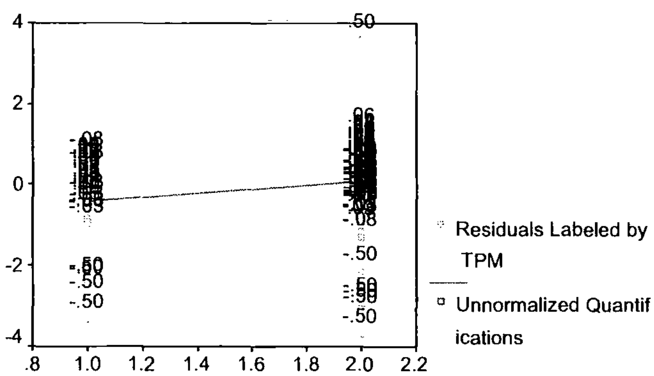
Residuals: TA



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

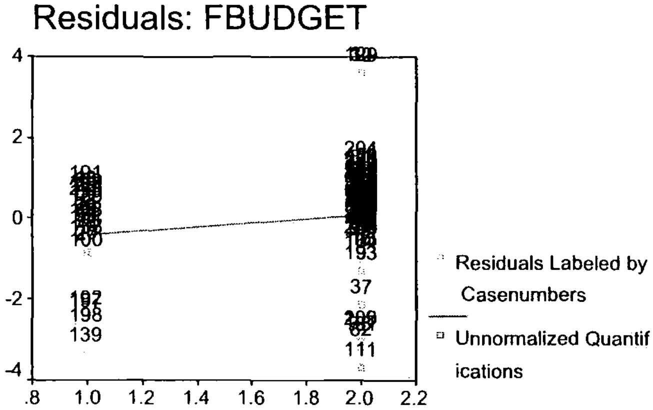
Residuals: FBUDGET



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

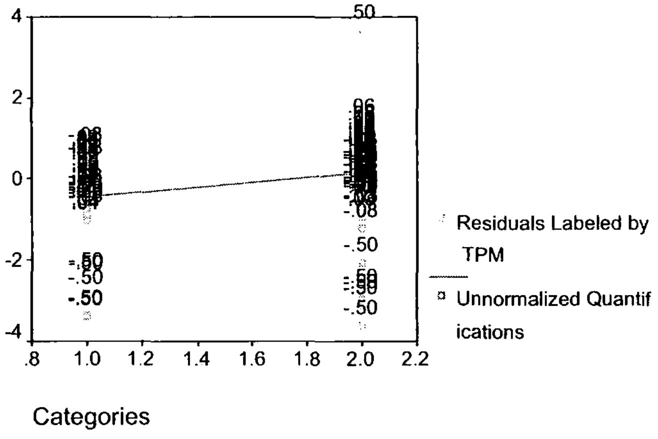
Residuals: FBUDGET



Categories

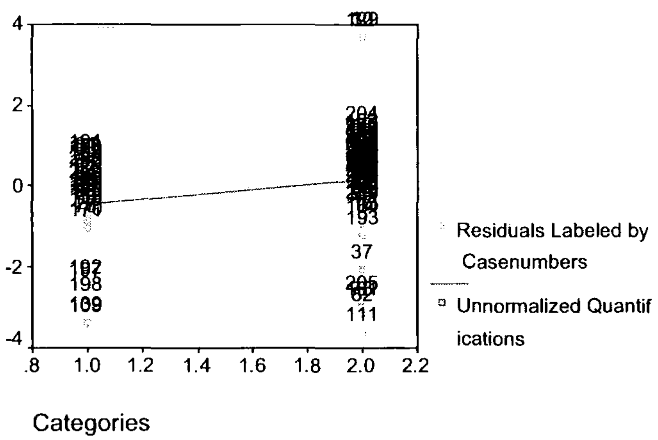
Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

Residuals: MCONTRCT



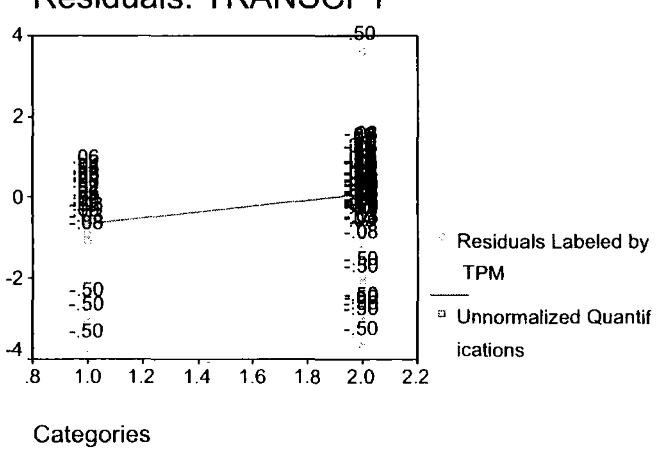
Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

Residuals: MCONTRCT



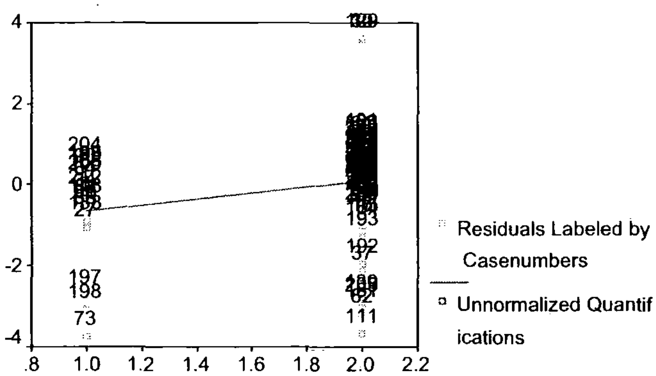
Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

Residuals: TRANSCPT



Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

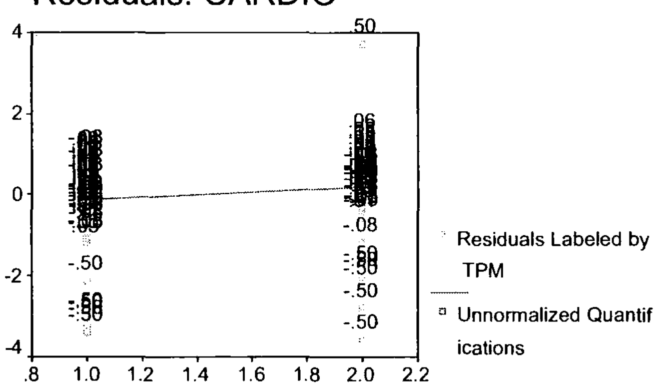
Residuals: TRANSCPT



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

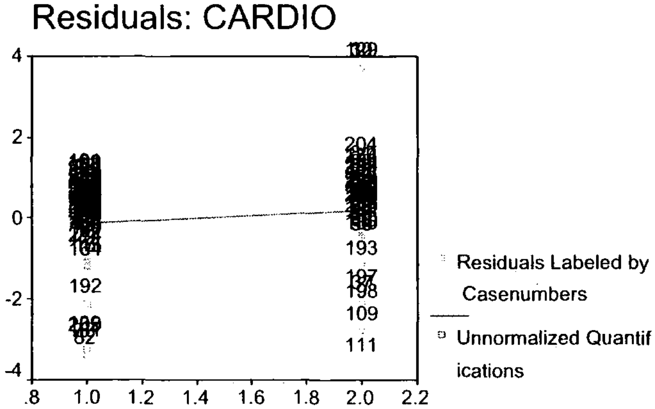
Residuals: CARDIO



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

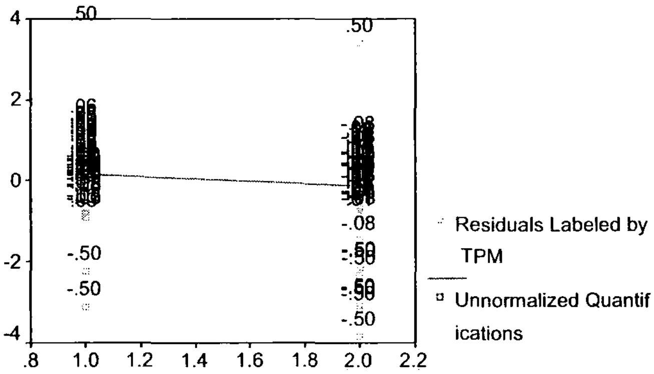
Residuals: CARDIO



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

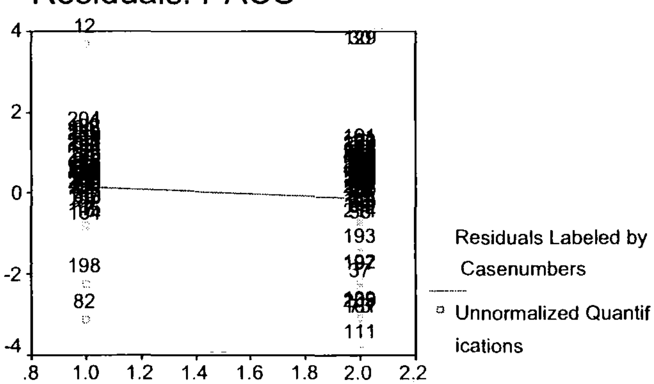
Residuals: PACS



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

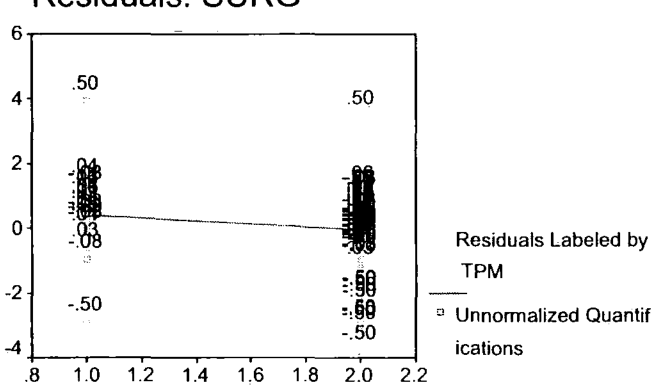
Residuals: PACS



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

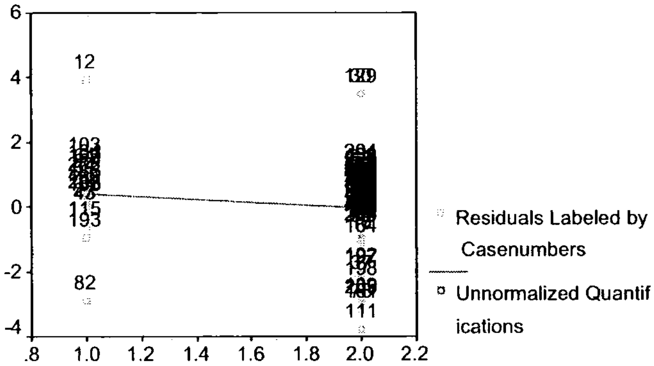
Residuals: SURG



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

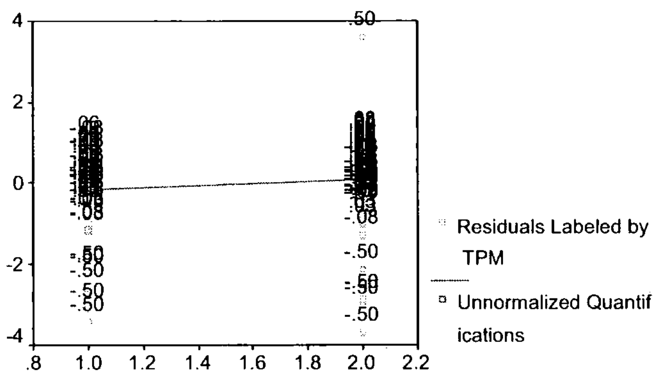
Residuals: SURG



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

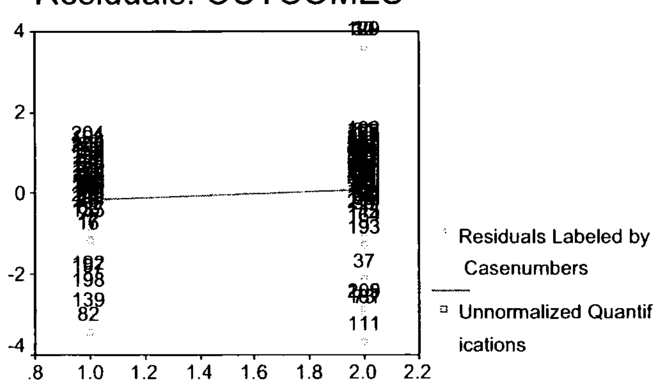
Residuals: OUTCOMES



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

Residuals: OUTCOMES



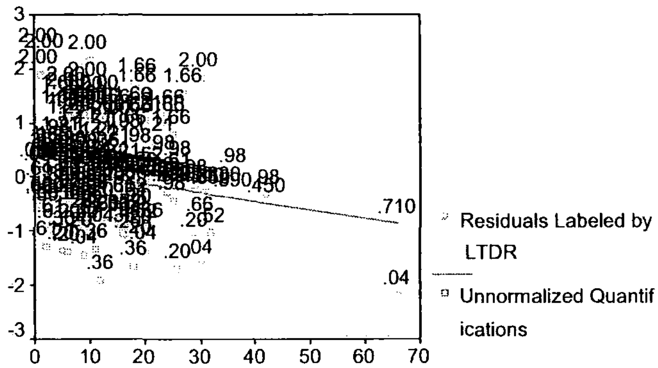
Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

9.5.5 LTDR Residuals

Residuals

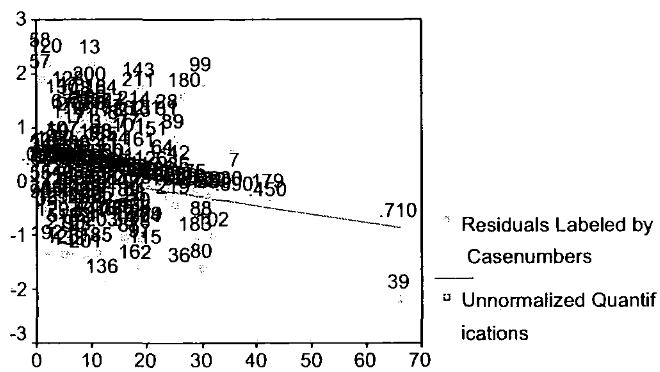
Residuals: MCAIDSHR



Categories

Optimal Scaling Level: Numerical.

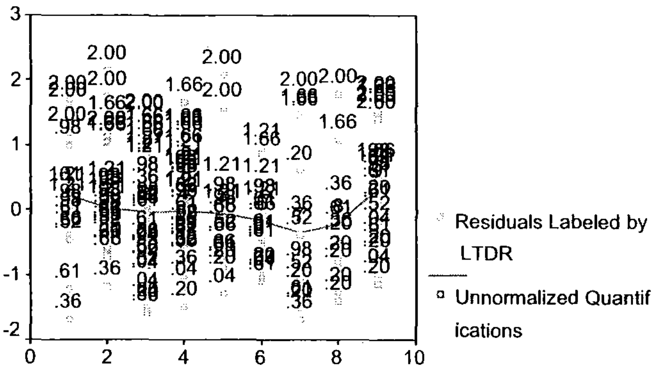
Residuals: MCAIDSHR



Categories

Optimal Scaling Level: Numerical.

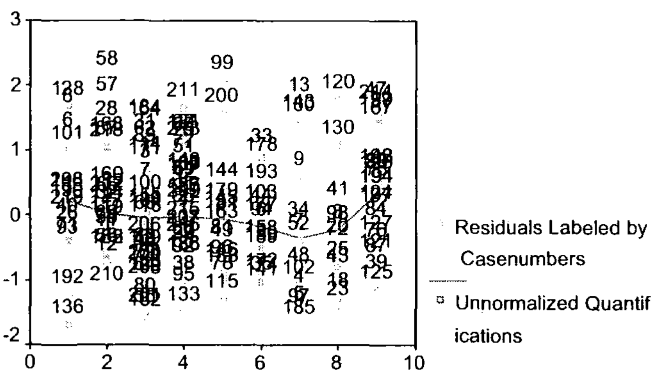
Residuals: CDIV



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

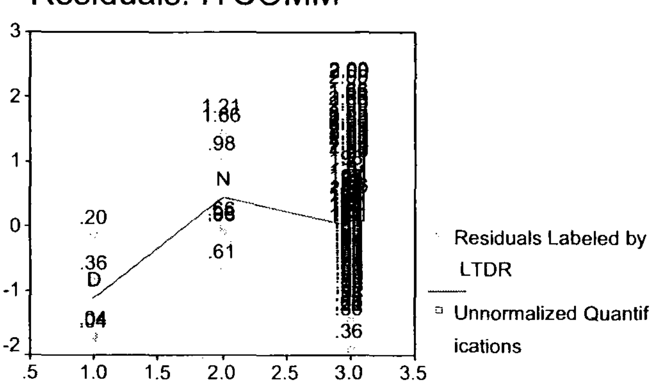
Residuals: CDIV



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 2).

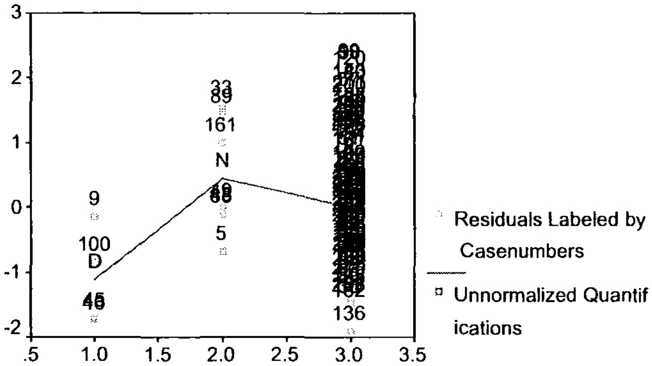
Residuals: ITCOMM



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 1).

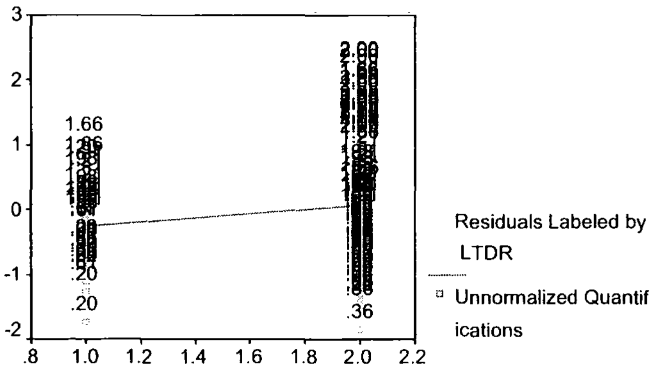
Residuals: ITCOMM



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 1).

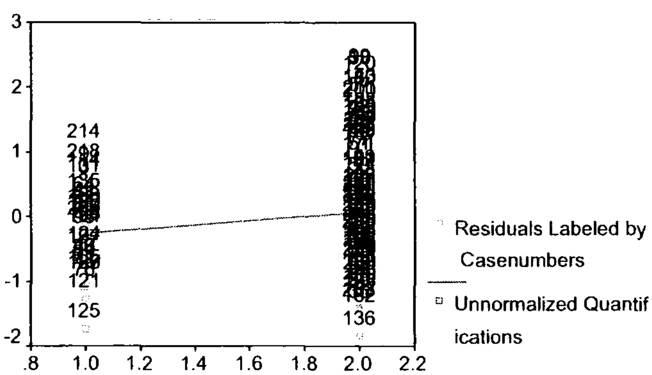
Residuals: LEAPF



Categories

Optimal Scaling Level: Spline Ordinal (degree 2, interior knots 0).

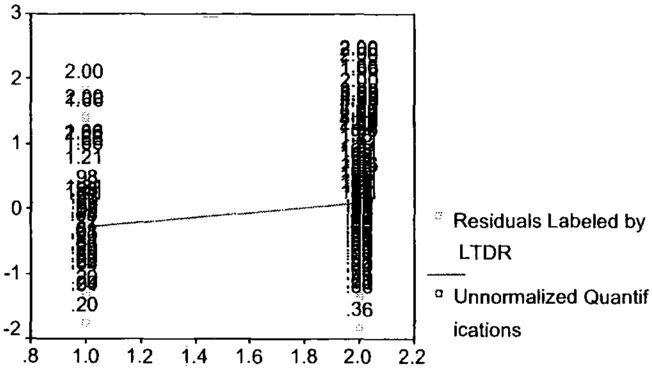
Residuals: LEAPF



Categories

Optimal Scaling Level: Spline Ordinal (degree 2, interior knots 0).

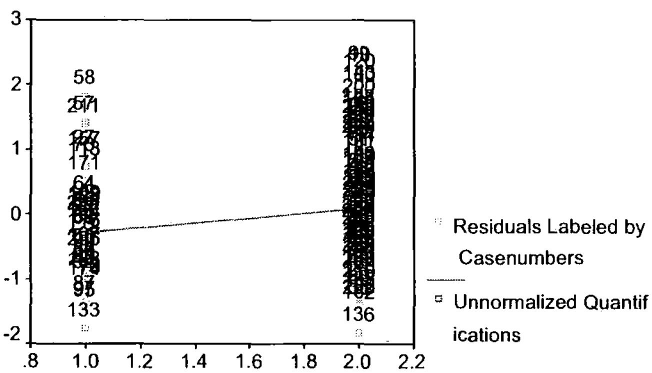
Residuals: DITATION



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

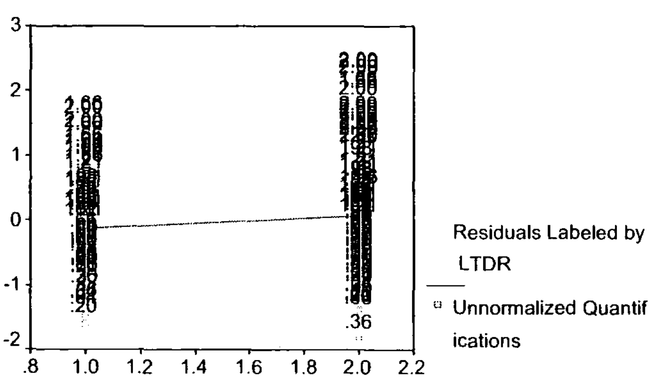
Residuals: DITATION



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

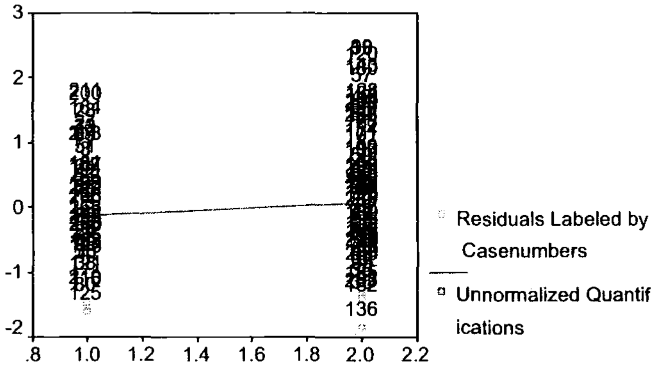
Residuals: ERDEPT



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

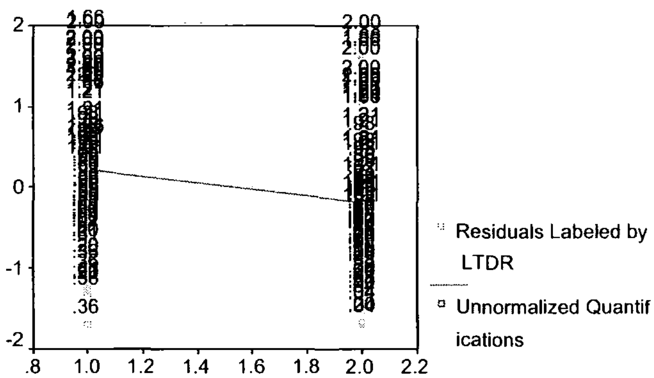
Residuals: ERDEPT



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

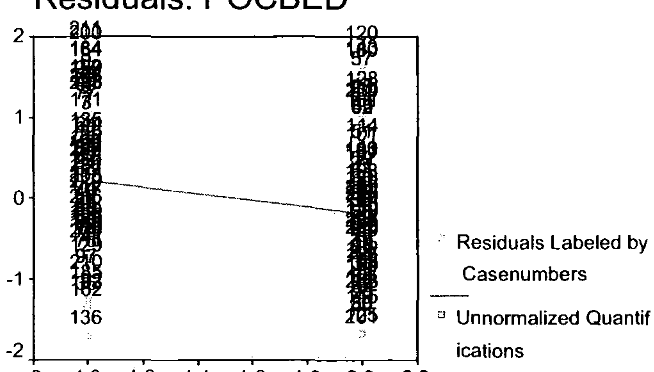
Residuals: POCBED



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

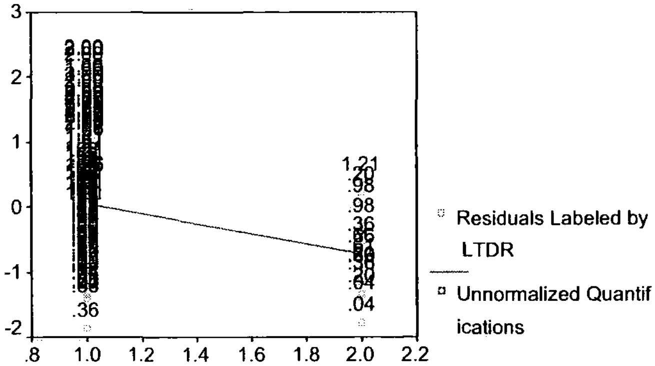
Residuals: POCBED



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

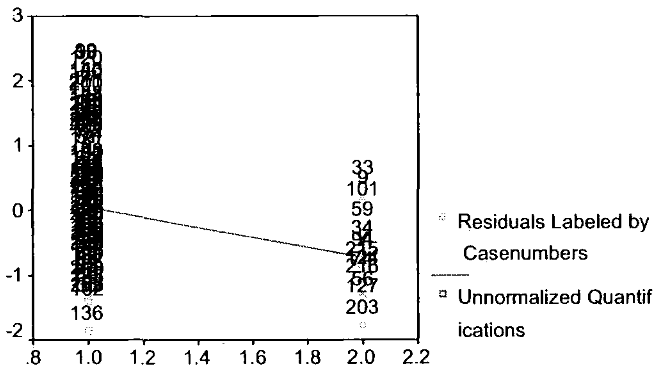
Residuals: TOP100



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

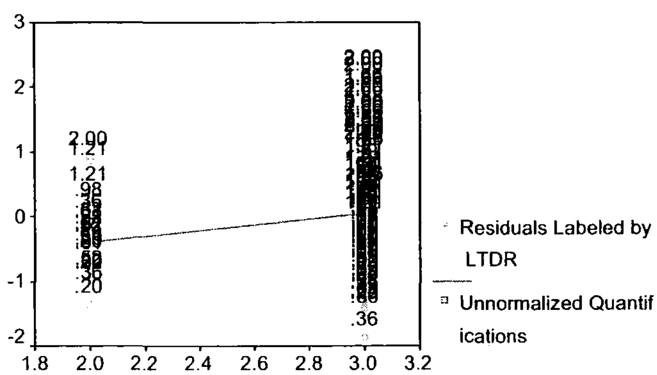
Residuals: TOP100



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

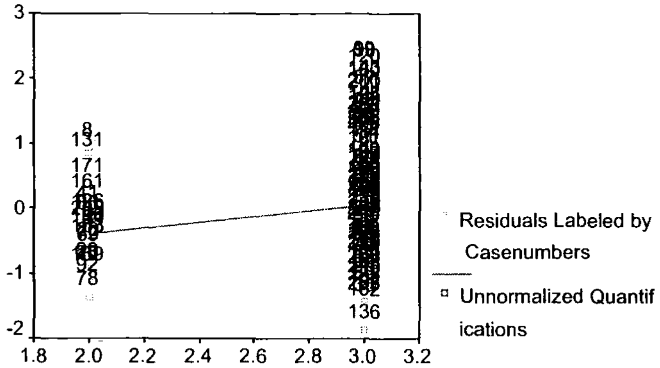
Residuals: SETTING



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

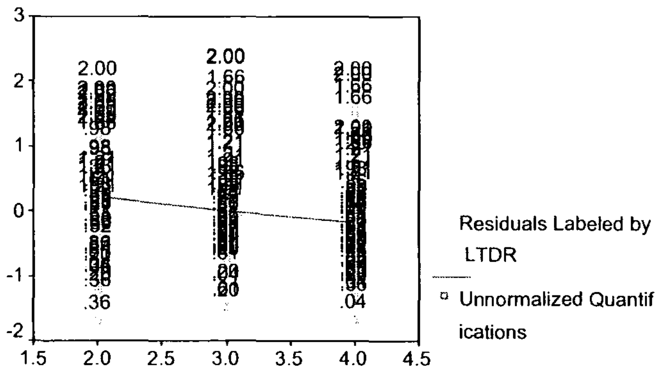
Residuals: SETTING



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 0).

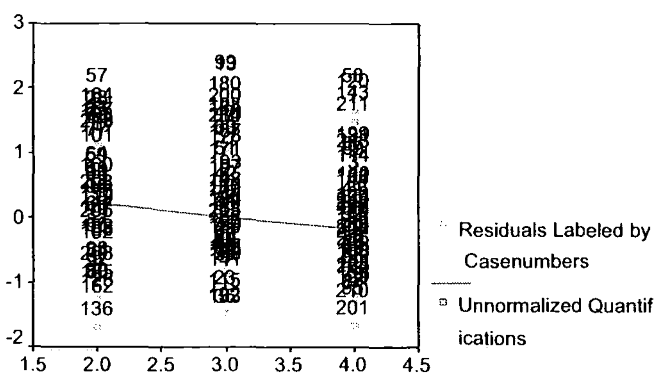
Residuals: TEACHING



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 1).

Residuals: TEACHING



Categories

Optimal Scaling Level: Spline Nominal (degree 2, interior knots 1).

9.6 APPENDIX 6

This appendix contains the validation survey and the statistical analysis results.

9.6.1 Flash Survey Responses: Descriptive Statistics

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Q1	Between Groups	3.217	4	.804	.767	.562
	Within Groups	16.783	16	1.049		
	Total	20.000	20			
Q2	Between Groups	4.219	4	1.055	1.572	.230
	Within Groups	10.733	16	.671		
	Total	14.952	20			
Q3	Between Groups	1.002	4	.251	1.221	.341
	Within Groups	3.283	16	.205		
	Total	4.286	20			
Q4	Between Groups	.405	4	.101	.183	.944
	Within Groups	8.833	16	.552		
	Total	9.238	20			
Q5	Between Groups	3.955	4	.989	1.704	.198
	Within Groups	9.283	16	.580		
	Total	13.238	20			
Q6	Between Groups	.893	4	.223	.348	.841
	Within Groups	10.250	16	.641		
	Total	11.143	20			
Q7	Between Groups	.810	4	.202	.294	.877
	Within Groups	11.000	16	.688		
	Total	11.810	20			
Q8	Between Groups	1.617	4	.404	.307	.869
	Within Groups	21.050	16	1.316		
	Total	22.667	20			
Q9	Between Groups	3.083	4	.771	1.626	.216
	Within Groups	7.583	16	.474		
	Total	10.667	20			
Q10	Between Groups	.810	4	.202	.154	.958
	Within Groups	21.000	16	1.313		
	Total	21.810	20			
Q11	Between Groups	3.119	4	.780	.523	.720
	Within Groups	23.833	16	1.490		
	Total	26.952	20			
Q12	Between Groups	1.052	4	.263	.804	.540
	Within Groups	5.233	16	.327		
	Total	6.286	20			
Q13	Between Groups	.702	4	.176	.503	.734
	Within Groups	5.583	16	.349		
	Total	6.286	20			
Q14	Between Groups	.988	4	.247	.323	.859
	Within Groups	12.250	16	.766		
	Total	13.238	20			
Q15	Between Groups	.976	4	.244	4.686	.011
	Within Groups	.833	16	.052		
	Total	1.810	20			
Q16	Between Groups	.260	4	.065	.670	.622
	Within Groups	1.550	16	.097		
	Total	1.810	20			

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Q1 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q2 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q3 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q4 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q5 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q6 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q7 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q8 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q9 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q10 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q11 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q12 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q13 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q14 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q15 * SCLASS	21	100.0%	0	.0%	21	100.0%
Q16 * SCLASS	21	100.0%	0	.0%	21	100.0%

Frequencies

Statistics

SCLASS

N	Valid	21
	Missing	0
Mean		2.95
Median		3.00
Std. Deviation		1.802
Variance		3.248
Minimum		1
Maximum		6

SCLASS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	5	23.8	23.8	23.8
	2	5	23.8	23.8	47.6
	3	6	28.6	28.6	76.2
	5	1	4.8	4.8	81.0
	6	4	19.0	19.0	100.0
	Total	21	100.0	100.0	

Frequency Table

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	3	14.3	14.3	14.3
	3	1	4.8	4.8	19.0
	4	10	47.6	47.6	66.7
	5	7	33.3	33.3	100.0
	Total	21	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	2	9.5	9.5	9.5
	3	1	4.8	4.8	14.3
	4	12	57.1	57.1	71.4
	5	6	28.6	28.6	100.0
	Total	21	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	6	28.6	28.6	28.6
	5	15	71.4	71.4	100.0
	Total	21	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	4.8	4.8
	4	14	66.7	66.7	71.4
	5	6	28.6	28.6	100.0
	Total	21	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	3	14.3	14.3	14.3
	3	5	23.8	23.8	38.1
	4	12	57.1	57.1	95.2
	5	1	4.8	4.8	100.0
	Total	21	100.0	100.0	

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	2	9.5	9.5	9.5
	3	6	28.6	28.6	38.1
	4	12	57.1	57.1	95.2
	5	1	4.8	4.8	100.0
	Total	21	100.0	100.0	

Q7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	4.8	4.8
	3	1	4.8	4.8	9.5
	4	11	52.4	52.4	61.9
	5	8	38.1	38.1	100.0
	Total	21	100.0	100.0	

Q8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	4	19.0	19.0	19.0
	2	11	52.4	52.4	71.4
	3	1	4.8	4.8	76.2
	4	5	23.8	23.8	100.0
	Total	21	100.0	100.0	

Q9

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	4.8	4.8
	4	11	52.4	52.4	57.1
	5	9	42.9	42.9	100.0
	Total	21	100.0	100.0	

Q10

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	3	14.3	14.3	14.3
	4	7	33.3	33.3	47.6
	5	11	52.4	52.4	100.0
	Total	21	100.0	100.0	

Q11

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	4	19.0	19.0	19.0
	3	1	4.8	4.8	23.8
	4	6	28.6	28.6	52.4
	5	10	47.6	47.6	100.0
	Total	21	100.0	100.0	

Q12

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	4.8	4.8	4.8
	4	13	61.9	61.9	66.7
	5	7	33.3	33.3	100.0
	Total	21	100.0	100.0	

Q13

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	4.8	4.8	4.8
	4	4	19.0	19.0	23.8
	5	16	76.2	76.2	100.0
	Total	21	100.0	100.0	

Q14

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	4.8	4.8
	3	1	4.8	4.8	9.5
	4	6	28.6	28.6	38.1
	5	13	61.9	61.9	100.0
	Total	21	100.0	100.0	

Q15

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	2	9.5	9.5	9.5
	5	19	90.5	90.5	100.0
	Total	21	100.0	100.0	

Q16

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	2	9.5	9.5	9.5
	5	19	90.5	90.5	100.0
	Total	21	100.0	100.0	

Frequency Table

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	3	14.3	14.3	14.3
	3	1	4.8	4.8	19.0
	4	10	47.6	47.6	66.7
	5	7	33.3	33.3	100.0
	Total	21	100.0	100.0	

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	2	9.5	9.5	9.5
	3	1	4.8	4.8	14.3
	4	12	57.1	57.1	71.4
	5	6	28.6	28.6	100.0
	Total	21	100.0	100.0	

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	6	28.6	28.6	28.6
	5	15	71.4	71.4	100.0
	Total	21	100.0	100.0	

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	4.8	4.8
	4	14	66.7	66.7	71.4
	5	6	28.6	28.6	100.0
	Total	21	100.0	100.0	

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	3	14.3	14.3	14.3
	3	5	23.8	23.8	38.1
	4	12	57.1	57.1	95.2
	5	1	4.8	4.8	100.0
	Total	21	100.0	100.0	

Q6

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	2	9.5	9.5	9.5
	3	6	28.6	28.6	38.1
	4	12	57.1	57.1	95.2
	5	1	4.8	4.8	100.0
	Total	21	100.0	100.0	

Q7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	4.8	4.8
	3	1	4.8	4.8	9.5
	4	11	52.4	52.4	61.9
	5	8	38.1	38.1	100.0
	Total	21	100.0	100.0	

Q8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	4	19.0	19.0	19.0
	2	11	52.4	52.4	71.4
	3	1	4.8	4.8	76.2
	4	5	23.8	23.8	100.0
	Total	21	100.0	100.0	

Q9

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	4.8	4.8
	4	11	52.4	52.4	57.1
	5	9	42.9	42.9	100.0
	Total	21	100.0	100.0	

Q10

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	3	14.3	14.3	14.3
	4	7	33.3	33.3	47.6
	5	11	52.4	52.4	100.0
	Total	21	100.0	100.0	

Q11

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	4	19.0	19.0	19.0
	3	1	4.8	4.8	23.8
	4	6	28.6	28.6	52.4
	5	10	47.6	47.6	100.0
	Total	21	100.0	100.0	

Q12

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	4.8	4.8	4.8
	4	13	61.9	61.9	66.7
	5	7	33.3	33.3	100.0
	Total	21	100.0	100.0	

Q13

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	4.8	4.8	4.8
	4	4	19.0	19.0	23.8
	5	16	76.2	76.2	100.0
	Total	21	100.0	100.0	

Q14

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	4.8	4.8
	3	1	4.8	4.8	9.5
	4	6	28.6	28.6	38.1
	5	13	61.9	61.9	100.0
	Total	21	100.0	100.0	

Q15

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	2	9.5	9.5	9.5
	5	19	90.5	90.5	100.0
	Total	21	100.0	100.0	

Q16

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	2	9.5	9.5	9.5
	5	19	90.5	90.5	100.0
	Total	21	100.0	100.0	

Q17

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5	2	9.5	10.5	10.5
	6	2	9.5	10.5	21.1
	7	3	14.3	15.8	36.8
	8	6	28.6	31.6	68.4
	9	3	14.3	15.8	84.2
	10	3	14.3	15.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q18

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5	4	19.0	21.1	21.1
	6	4	19.0	21.1	42.1
	7	2	9.5	10.5	52.6
	8	3	14.3	15.8	68.4
	9	6	28.6	31.6	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q19

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5	1	4.8	5.3	5.3
	6	1	4.8	5.3	10.5
	7	4	19.0	21.1	31.6
	8	7	33.3	36.8	68.4
	9	2	9.5	10.5	78.9
	10	4	19.0	21.1	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q20

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	1	4.8	5.3	5.3
	6	2	9.5	10.5	15.8
	7	4	19.0	21.1	36.8
	8	4	19.0	21.1	57.9
	9	5	23.8	26.3	84.2
	10	3	14.3	15.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q21

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	2	9.5	10.5	10.5
	5	1	4.8	5.3	15.8
	6	3	14.3	15.8	31.6
	7	2	9.5	10.5	42.1
	8	4	19.0	21.1	63.2
	9	4	19.0	21.1	84.2
	10	3	14.3	15.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q22

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6	2	9.5	10.5	10.5
	7	3	14.3	15.8	26.3
	8	4	19.0	21.1	47.4
	9	8	38.1	42.1	89.5
	10	2	9.5	10.5	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q23

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6	1	4.8	5.3	5.3
	7	1	4.8	5.3	10.5
	8	5	23.8	26.3	36.8
	9	7	33.3	36.8	73.7
	10	5	23.8	26.3	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q24

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	2	9.5	10.5	10.5
	3	1	4.8	5.3	15.8
	4	2	9.5	10.5	26.3
	5	5	23.8	26.3	52.6
	7	3	14.3	15.8	68.4
	8	4	19.0	21.1	89.5
	9	2	9.5	10.5	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q25

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	5.3	5.3
	3	1	4.8	5.3	10.5
	4	1	4.8	5.3	15.8
	5	8	38.1	42.1	57.9
	6	1	4.8	5.3	63.2
	7	3	14.3	15.8	78.9
	8	3	14.3	15.8	94.7
	10	1	4.8	5.3	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q26

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	4.8	5.3	5.3
	5	9	42.9	47.4	52.6
	6	1	4.8	5.3	57.9
	7	2	9.5	10.5	68.4
	8	3	14.3	15.8	84.2
	9	1	4.8	5.3	89.5
	10	2	9.5	10.5	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q27

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	4.8	5.3	5.3
	4	1	4.8	5.3	10.5
	5	1	4.8	5.3	15.8
	6	4	19.0	21.1	36.8
	7	4	19.0	21.1	57.9
	8	4	19.0	21.1	78.9
	9	1	4.8	5.3	84.2
	10	3	14.3	15.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q28

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	1	4.8	5.3	5.3
	5	4	19.0	21.1	26.3
	6	4	19.0	21.1	47.4
	7	5	23.8	26.3	73.7
	8	2	9.5	10.5	84.2
	9	3	14.3	15.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q29

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5	1	4.8	5.3	5.3
	7	2	9.5	10.5	15.8
	8	6	28.6	31.6	47.4
	9	4	19.0	21.1	68.4
	10	6	28.6	31.6	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q30

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	8	2	9.5	10.5	10.5
	9	6	28.6	31.6	42.1
	10	11	52.4	57.9	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q31

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	5.3	5.3
	3	1	4.8	5.3	10.5
	5	3	14.3	15.8	26.3
	6	1	4.8	5.3	31.6
	7	1	4.8	5.3	36.8
	8	4	19.0	21.1	57.9
	9	5	23.8	26.3	84.2
	10	3	14.3	15.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q32

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	9.5	10.5	10.5
	4	2	9.5	10.5	21.1
	5	8	38.1	42.1	63.2
	6	1	4.8	5.3	68.4
	7	1	4.8	5.3	73.7
	8	4	19.0	21.1	94.7
	9	1	4.8	5.3	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q33

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	4.8	5.3	5.3
	4	1	4.8	5.3	10.5
	5	4	19.0	21.1	31.6
	6	3	14.3	15.8	47.4
	7	4	19.0	21.1	68.4
	8	2	9.5	10.5	78.9
	9	2	9.5	10.5	89.5
	10	2	9.5	10.5	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q34

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	3	14.3	15.8	15.8
	5	6	28.6	31.6	47.4
	6	1	4.8	5.3	52.6
	7	5	23.8	26.3	78.9
	8	1	4.8	5.3	84.2
	9	3	14.3	15.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q35

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	1	4.8	5.3	5.3
	5	5	23.8	26.3	31.6
	6	3	14.3	15.8	47.4
	7	6	28.6	31.6	78.9
	8	1	4.8	5.3	84.2
	9	1	4.8	5.3	89.5
	10	2	9.5	10.5	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q36

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	1	4.8	5.3	5.3
	5	4	19.0	21.1	26.3
	6	2	9.5	10.5	36.8
	7	3	14.3	15.8	52.6
	8	4	19.0	21.1	73.7
	9	1	4.8	5.3	78.9
	10	4	19.0	21.1	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q37

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	5.3	5.3
	5	2	9.5	10.5	15.8
	8	7	33.3	36.8	52.6
	9	4	19.0	21.1	73.7
	10	5	23.8	26.3	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q38

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7	2	9.5	10.5	10.5
	8	3	14.3	15.8	26.3
	9	7	33.3	36.8	63.2
	10	7	33.3	36.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q39

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6	2	9.5	10.5	10.5
	7	3	14.3	15.8	26.3
	8	3	14.3	15.8	42.1
	9	8	38.1	42.1	84.2
	10	3	14.3	15.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q40

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5	2	9.5	10.5	10.5
	6	2	9.5	10.5	21.1
	7	7	33.3	36.8	57.9
	8	4	19.0	21.1	78.9
	10	4	19.0	21.1	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q41

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6	2	9.5	10.5	10.5
	7	3	14.3	15.8	26.3
	8	4	19.0	21.1	47.4
	9	5	23.8	26.3	73.7
	10	5	23.8	26.3	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q42

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5	2	9.5	10.5	10.5
	6	1	4.8	5.3	15.8
	7	2	9.5	10.5	26.3
	8	7	33.3	36.8	63.2
	9	2	9.5	10.5	73.7
	10	5	23.8	26.3	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q43

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5	3	14.3	15.8	15.8
	6	2	9.5	10.5	26.3
	7	4	19.0	21.1	47.4
	8	3	14.3	15.8	63.2
	9	4	19.0	21.1	84.2
	10	3	14.3	15.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

Q44

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	4.8	5.3	5.3
	6	4	19.0	21.1	26.3
	8	5	23.8	26.3	52.6
	9	6	28.6	31.6	84.2
	10	3	14.3	15.8	100.0
	Total	19	90.5	100.0	
Missing	System	2	9.5		
Total		21	100.0		

9.6.2 *Flash Survey: Reliability*

****** Method 1 (space saver) will be used for this analysis ******

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	Q1	4.0000	1.0000	21.0
2.	Q2	4.0476	.8646	21.0
3.	Q3	4.7143	.4629	21.0
4.	Q4	4.1905	.6796	21.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	16.9524	2.3476	1.5322	4

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
Q1	12.9524	1.6476	-.1169	.2038
Q2	12.9048	1.7905	-.0823	.0957
Q3	12.2381	1.9905	.1094	-.1651
Q4	12.7619	1.6905	.1105	-.2408

Analysis of Variance

Source of Variation	Sum of Sq.	DF	Mean Square	F	Prob.
Between People	11.7381	20	.5869		

Within People	43.5000	63	.6905		
Between Measures	6.7619	3	2.2540	3.6811	.0168
Residual	36.7381	60	.6123		
Total	55.2381	83	.6655		
Grand Mean	4.2381				

Reliability Coefficients

N of Cases = 21.0 N of Items = 4

Alpha = -.0433

Reliability

****** Method 1 (space saver) will be used for this analysis ******

_

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

		Mean	Std Dev	Cases
1.	Q5	3.5238	.8136	21.0
2.	Q6	3.5714	.7464	21.0
3.	Q7	4.2381	.7684	21.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	11.3333	3.5333	1.8797	3

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted

Q5	7.8095	1.5619	.6440	.5305
Q6	7.7619	1.8905	.5290	.6751
Q7	7.0952	1.8905	.4980	.7103

Analysis of Variance

Source of Variation	Sum of Sq.	DF	Mean Square	F	Prob.
Between People	23.5556	20	1.1778		
Within People	19.3333	42	.4603		
Between Measures	6.6984	2	3.3492	10.6030	.0002
Residual	12.6349	40	.3159		
Total	42.8889	62	.6918		
Grand Mean	3.7778				

Reliability Coefficients

N of Cases = 21.0 N of Items = 3

Alpha = .7318

Reliability

****** Method 1 (space saver) will be used for this analysis ******

_

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

		Mean	Std Dev	Cases
1.	Q8	2.3333	1.0646	21.0
2.	Q9	4.3333	.7303	21.0
3.	Q10	4.2381	1.0443	21.0
4.	Q11	4.0476	1.1609	21.0
5.	Q12	4.2857	.5606	21.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	19.2381	4.1905	2.0471	5

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
Q8	16.9048	4.6905	-.3542	.3993
Q9	14.9048	3.2905	.1384	-.2412
Q10	15.0000	2.2000	.2905	-.6840
Q11	15.1905	3.0619	-.0539	-.0041
Q12	14.9524	3.7476	.0592	-.1271

Analysis of Variance

Source of Variation	Sum of Sq.	DF	Mean Square	F	Prob.
Between People	16.7619	20	.8381		
Within People	132.8000	84	1.5810		
Between Measures	61.1810	4	15.2952	17.0851	.0000
Residual	71.6190	80	.8952		
Total	149.5619	104	1.4381		
Grand Mean	3.8476				

Reliability Coefficients

N of Cases = 21.0 N of Items = 5

Alpha = -.0682

Reliability

****** Method 1 (space saver) will be used for this analysis ******

R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

		Mean	Std Dev	Cases
1.	Q13	4.7143	.5606	21.0
2.	Q14	4.4762	.8136	21.0
3.	Q15	4.9048	.3008	21.0
4.	Q16	4.9048	.3008	21.0

Statistics for	Mean	Variance	Std Dev	N of Variables
SCALE	19.0000	2.3000	1.5166	4

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
Q13	14.2857	1.0143	.8603	.2535
Q14	14.5238	.7619	.6169	.5250
Q15	14.0952	1.9905	.2581	.6962
Q16	14.0952	1.9905	.2581	.6962

Analysis of Variance

Source of Variation	Sum of Sq.	DF	Mean Square	F	Prob.
Between People	11.5000	20	.5750		

Within People	14.2500	63	.2262		
Between Measures	2.6071	3	.8690	4.4785	.0067
Residual	11.6429	60	.1940		
Total	25.7500	83	.3102		
Grand Mean	4.7500				

Reliability Coefficients

N of Cases = 21.0 N of Items = 4

Alpha = .6625

9.6.3 Flash Survey: Factor Analysis

Communalities

	Initial	Extraction
Q1	1.000	.581
Q2	1.000	.668
Q3	1.000	.776
Q4	1.000	.637
Q5	1.000	.863
Q6	1.000	.611
Q7	1.000	.730
Q8	1.000	.840
Q9	1.000	.916
Q10	1.000	.694

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.552	25.521	25.521	2.552	25.521	25.521
2	1.854	18.535	44.056	1.854	18.535	44.056
3	1.730	17.303	61.359	1.730	17.303	61.359
4	1.179	11.786	73.145	1.179	11.786	73.145
5	.889	8.885	82.030			
6	.658	6.582	88.613			
7	.523	5.228	93.841			
8	.271	2.711	96.551			
9	.236	2.364	98.915			
10	.108	1.085	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component			
	1	2	3	4
Q1	.650	-.239	.288	-.131
Q2	-2.22E-02	.703	-.198	.365
Q3	-.460	.555	.232	-.450
Q4	2.898E-02	-3.30E-02	.776	-.179
Q5	.722	.498	.215	.219
Q6	.591	.182	.447	.167
Q7	.834	-3.93E-03	-.183	3.610E-02
Q8	.426	-.107	-.789	-.153
Q9	-.400	-.213	.136	.832
Q10	9.377E-02	-.809	.172	2.820E-02

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

Factor Analysis

Communalities

	Initial
Q1	.399
Q2	.468
Q3	.530
Q4	.591
Q5	.730
Q6	.565
Q7	.591
Q8	.675
Q9	.468
Q10	.603

Extraction Method: Principal Axis Factoring.

Total Variance Explained

	Initial Eigenvalues		
Factor	Total	% of Variance	Cumulative %
1	2.552	25.521	25.521
2	1.854	18.535	44.056
3	1.730	17.303	61.359
4	1.179	11.786	73.145
5	.889	8.885	82.030
6	.658	6.582	88.613
7	.523	5.228	93.841
8	.271	2.711	96.551
9	.236	2.364	98.915
10	.108	1.085	100.000

Extraction Method: Principal Axis Factoring.

Factor Matrix[a]

a. Attempted to extract 4 factors. In iteration 25, the communality of a variable exceeded 1.0. Extraction was terminated.

Factor Analysis

Communalities

	Initial	Extraction
Q1	1.000	.581
Q2	1.000	.668
Q3	1.000	.776
Q4	1.000	.637
Q5	1.000	.863
Q6	1.000	.611
Q7	1.000	.730
Q8	1.000	.840
Q9	1.000	.916
Q10	1.000	.694

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.552	25.521	25.521	2.552	25.521	25.521
2	1.854	18.535	44.056	1.854	18.535	44.056
3	1.730	17.303	61.359	1.730	17.303	61.359
4	1.179	11.786	73.145	1.179	11.786	73.145
5	.889	8.885	82.030			
6	.658	6.582	88.613			
7	.523	5.228	93.841			
8	.271	2.711	96.551			
9	.236	2.364	98.915			
10	.108	1.085	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component			
	1	2	3	4
Q1	.650	-.239	.288	-.131
Q2	-2.22E-02	.703	-.198	.365
Q3	-.460	.555	.232	-.450
Q4	2.898E-02	-3.30E-02	.776	-.179
Q5	.722	.498	.215	.219
Q6	.591	.182	.447	.167
Q7	.834	-3.93E-03	-.183	3.610E-02
Q8	.426	-.107	-.789	-.153
Q9	-.400	-.213	.136	.832
Q10	9.377E-02	-.809	.172	2.820E-02

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

Factor Analysis

Communalities

	Initial	Extraction
Q1	1.000	.618
Q2	1.000	.764
Q3	1.000	.896
Q4	1.000	.840
Q5	1.000	.918
Q6	1.000	.703
Q7	1.000	.772
Q8	1.000	.867
Q9	1.000	.834
Q10	1.000	.775
Q11	1.000	.785
Q12	1.000	.838
Q13	1.000	.927
Q14	1.000	.891
Q15	1.000	.833
Q16	1.000	.752

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.545	22.159	22.159	3.545	22.159	22.159
2	2.754	17.210	39.369	2.754	17.210	39.369
3	2.300	14.377	53.747	2.300	14.377	53.747
4	1.571	9.821	63.568	1.571	9.821	63.568
5	1.497	9.359	72.926	1.497	9.359	72.926
6	1.345	8.407	81.334	1.345	8.407	81.334
7	.775	4.843	86.177			
8	.630	3.937	90.114			
9	.450	2.813	92.927			
10	.388	2.426	95.353			
11	.271	1.692	97.044			
12	.183	1.144	98.188			
13	.141	.883	99.071			
14	.101	.628	99.700			
15	4.463E-02	.279	99.979			
16	3.410E-03	2.131E-02	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component					
	1	2	3	4	5	6
Q1	-3.47E-02	.496	-.498	1.084E-02	.114	-.331
Q2	-.171	.285	.751	.215	8.432E-02	.189
Q3	.196	-.224	.662	-.148	.139	-.572
Q4	.612	.133	-8.99E-02	-.121	.628	-.174
Q5	.108	.938	.143	9.537E-03	3.998E-02	6.857E-02
Q6	-7.17E-03	.612	-.184	.323	-9.58E-03	-.437
Q7	-.428	.655	-.282	-.137	.208	.131
Q8	-.759	.174	-5.20E-02	-.424	2.370E-02	.277
Q9	8.657E-02	-.325	7.134E-02	.684	.267	.420
Q10	-.104	-.207	-.621	.171	.552	3.734E-02
Q11	.549	-.129	-.324	.477	-.265	-.252
Q12	.583	.436	-1.92E-02	.288	-9.38E-02	.466
Q13	.890	5.431E-02	7.347E-02	-.347	3.847E-03	8.147E-02
Q14	.702	.344	-5.50E-02	-.201	-.464	.145
Q15	.613	-.132	2.866E-02	-.378	.491	.235
Q16	-.105	.389	.632	.271	.327	-.105

Extraction Method: Principal Component Analysis.

a. 6 components extracted.

9.7 DATA APPENDIX

This appendix contains the input case data from the 1998 and 2002 panels including the expanded qualitative attributes coded for the FY2002 panel.

DESCRIPTIVE AND OPERATIONAL CASES FY1998 BY ORGANIZATION

LTDR	0.5100	0.9400	1.5800	0.0000	0.3600	1.1500	1.5800	0.7800	0.6500	1.5800	0.2100	0.2100	0.3600	0.5100
TPM	0.0511	0.0351	0.0174	0.0351	0.0511	0.0697	-0.0269	0.0351	-0.0785	0.0511	0.0004	0.0931	0.0174	0.0174
ALOS3	6.6	3.6	5.5	6	5	6.2	6	4.4	4.7	7	5.5	8.5	10.6	6.5
DRG3	209	116	88	88	209	209	89	478	209	430	14	430	79	14
ALOS2	5.3	4.4	5.1	6.3	4.1	5.4	5.1	5.6	11.2	4.9	4.6	5.3	7.1	7.8
DRG2	116	209	127	14	116	127	127	127	430	209	209	89	127	89
ALOS1	8.1	12.1	7.5	6.5	6.2	3	17.5	14.8	4.4	4.6	4.6	63	8.5	6.2
DRG1	127	462	430	127	127	116	462	462	127	116	127	79	89	127
Total Profit Margin	4	5	6	5	4	3	8	5	9	4	7	2	6	6
Medicaid %	15%	9%	13%	9%	5%	9%	13%	45%	17%	11%	9%	20%	3%	2%
Medicare %	42%	46%	49%	46%	41%	35%	45%	39%	36%	40%	50%	64%	45%	36%
Casemix	1.56	1.87	1.6	1.52	1.83	1.86	1.32	1.53	1.3	2	1.81	1.11	1.3	1.3
Occupancy Rate	53.8%	60.0%	49.6%	55.8%	58.4%	67.2%	65.7%	80.5%	32.9%	70.5%	69.5%	47.4%	48.6%	55.0%
Beds	256	519	492	619	635	908	296	555	63	315	417	72	606	
Teaching	N	M	N	N	M	C	C	M	M	C	N	N	C	
Setting	U	U	U	U	U	U	U	U	R	R	U	R	U	
Ownership	N	N	N	N	N	N	N	G	N	N	N	N	N	
Cardio?						1							1	
TOP 100?											1			
State	NY	SD	FL	MS	AR	TX	MA	NC	MI	NH	TX	NC	NJ	NJ
Census Division	2	6	3	4	7	7	1	3	4	1	7	3	2	2
Pass 2 SC	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pass 1 SC	1	1	1	2	1	1	1	1	1	2	1	1	1	1
Organization	Arnot Ogden Medical Center, Elmira, N.Y.	Avera Health, McKenna Hospital, Sioux Falls, SD	Baptist Health Care, Pensacola, FL	Baptist Health Systems, Jackson, Miss.	Baptist Health, Little Rock, AR	Baylor Health Care System, Dallas, TX	Berkshire Health System, Pittsfield, Mass.	Cape Fear Valley Health System, Fayetteville, N.C.	Carson City (Mich.) Hospital	Dartmouth-Hitchcock Medical Center, Lebanon, NH	ETMC Regional Healthcare System, Tyler TX	Good Hope Hospital, Erwin, N.C.	Hackensack (N.J.) University Medical Center	Hunterdon Healthcare System, Flemington, N.J.
CASE ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14

15	INTEGRIS Health, Oklahoma City, OK	1	1	7	OK			N	G	U	548	63.3%	1.9	34%	4%	3	116	2.9	127	5.2	106	8.8	0.0697	2.0000
16	Intermountain-Alta View Hospital, Sandy, UT	1	1	8	UT			N	U	N	72	49.5%	1.14	20%	9%	4	89	5	127	4.9	209	4	0.0511	
17	Intermountain-American Fork Hospital, American Fork, UT	1	1	8	UT			N	U	N	93	57.9%	1.18	13%	8%	1	89	4.2	127	3	209	4.2	0.1320	
18	Intermountain-Bear River Valley Hospital, Tremonton, UT	1	1	8	UT			N	R	N	58	64.3%	1.06	29%	9%	3							0.0697	
19	Intermountain-Cassua Regional MC, Burley, ID	1	1	8	ID			N	R	N	38	47.8%	1.16	39%	13%	6	127	5.3	89	5.8	209	6.4	0.0174	
20	Intermountain-Cottonwood Hospital, Murray, UT	1	1	8	UT			N	U	N	172	58.1%	1.34	20%	6%	3	89	4.4	14	4.7	127	3.9	0.0697	0.2100
21	Intermountain-LDS Hospital, Salt Lake City	1	1	8	UT		1	N	U	M	466	65.7%	2.1	28%	3%	4	116	2.6	209	4.7	107	8.3	0.0511	
22	Intermountain-Logan Regional Hospital, Logan, UT	1	1	8	UT			N	R	N	148	41.0%	1.24	23%	14%	2	209	4.1	127	3.9	89	5.2	0.0931	0.3600
23	Intermountain-McKay Dee Hospital, Ogden, UT	1	1	8	UT			N	U	M	287	52.4%	1.78	26%	11%	3	209	3.8	14	3.8	127	3.7	0.0697	0.2100
24	Intermountain-Primary Children's MC, Salt Lake City	1	1	8	UT			N	U	N	199													
25	Intermountain-Utah Valley Regional MC, Provo, UT	1	1	8	UT			N	U	M	324	60.5%	1.78	27%	6%	4	116	2.6	209	4.7	89	6.4	0.0511	0.2100
26	Intermountain-Valley View Medical Center, Cedar City,UT	1	1	8	UT			N	R	N	34	34.7%	1.31	25%	19%	2	209	3.7					0.0931	
27	Kootenai Medical Center, Coeur d'Alene, ID	1	1	8	ID			G	R	N	264	51.0%	1.23	44%	14%	2	89	5.2	14	3.9	209	4.4	0.0931	0.2100
28	Lowell (Mass.) General Hospital	1	1	1	MA			N	U	N	221	59.1%	1.27	20%	18%	3	430	10	127	4.6	89	6	0.0697	0.7800

29	Loyola University Health System, Maywood, IL	1	1	4	IL		1	N	U	C	473	61.0%	2.07	32%	17%	6	127	4.8	116	4.1	107	8.2	0.0174	0.9400
30	Maimonides Medical Center, Brooklyn, NY	1	1	2	NY			N	U	C	705	76.1%	1.81	31%	25%	5	127	6.4	116	4.5	89	7.4	0.0351	1.1500
31	Marquette (Mich.) General Hospital	1	1	4	MI			N	R	M	281	54.5%	1.84	43%	11%	4	462	7.1	116	5.6	209	7	0.0511	0.6500
32	Memorial Health Services, Long Beach, CA	1	1	9	CA			N	U	C	541	60.9%	1.61	19%	18%	6	127	4.9	116	3.9	209	4.1	0.0174	0.9400
33	Memorial Health System, Savannah, GA	1	1	3	GA			N	U	C	498	69.8%	1.86	29%	26%		462	10.6	127	4.6	430	9		1.5800
34	Meridian Health System, Jersey Shore Medical Center, Neptune City, NJ	1	1	2	NJ			N	U	C	474	69.1%	1.68	36%	5%	4	116	3.6	127	8	112	3.3	0.0511	0.9400
35	MeritCare Health System, St Luke's Hosp.,Fargo, N.Dak.	1	1	6	ND	1	1	N	U	M	376	59.6%	1.93	41%	12%	1	116	2.8	209	4.6	89	4.5	0.1320	0.9400
36	Methodist Health Care System, Houston	1	1	7	TX	1		N	U	C	873	67.8%	2.08	39%	4%	3	116	3.2	209	5.1	462	8.3	0.0697	2.0000
37	Methodist Health System, Omaha, NE	2	1	6	NE			N	U	M	315	32.3%	0.82			10	430	12.4					-0.5000	0.5100
38	North Broward Hospital District, Fort Lauderdale, FL	1	1	3	FL			G	U	M	613	59.6%	1.53	16%	31%	7	430	11.9	116	3.2	127	6.3	0.0004	0.7800
39	Northwestern Memorial Hospital, Chicago IL	1	1	4	IL			N	U	C	673	70.1%	1.65	28%	15%	1	430	10.3	209	5.6	127	5.5	0.1320	2.0000
40	Ohio State University Health System, Columbus, OH	1	1	4	OH		1	G	U	C	566	71.5%	1.88	31%	23%	8	462	15.4	127	4.8	116	4.4	-0.0269	0.3600
41	Oregon Health & Science University, Portland, OR	1	1	9	OR			G	U	C	407	78.3%	1.8	17%	36%	7	430	10.8	127	4.8	1	4.5	0.0004	0.9400
42	Partners Healthcare-Brigham and Womans Hospital, Boston	1	1	1	MA		1	N	U	C	692	77.6%	2.11	23%	11%	6	209	5.2	116	4	127	5.2	0.0174	0.9400

43	Rehoboth McKinley Christian Health Care Services, Gallup, NM	1	1	8	NM			N	R	N	73	35.0%	1.23	30%	14%	7	89	5.1	127	4.6	88	4.3	0.0004	0.3600
44	Rush-Copley Medical Center, Aurora, IL	1	1	4	IL			N	U	M	148	59.9%	1.34	28%	20%	4	462	14.1	127	3.8	89	5.9	0.0511	0.9400
45	Saint Alphonsus Regional Medical Center, Boise, ID	1	1	8	ID		1	N	U	M	344	64.1%	1.67	46%	4%	3	462	7.1	209	4	116	2.6	0.0697	0.3600
46	Saint Luke's Shawnee Mission Health System, Kansas City, Mo.	1	1	6	MO			N	U	C	450	64.4%	1.87	39%	20%	3	116	3.9	209	5.9	127	6.1	0.0697	1.5800
47	Sentara Health System, Norfolk General Hospital, Norfolk, Va.	1	1	3	VA		1	N	U	M	539	61.8%	2.09	40%	6%	1	116	2.3	127	6	107	7.4	0.1320	1.1500
48	Sentara Health System, Sentara Leigh Hospital. Norfolk, Va.	1	1	3	VA			N	U	M	250	60.1%	1.54	40%	3%	1	209	4.7	127	5.3	14	5.4	0.1320	0.9400
49	Sharp Healthcare, San Diego	1	1	9	CA			N	U	M	565	53.5%	1.7	15%	18%	6	430	11.3	116	3	127	4.1	0.0174	0.3600
50	St. John Health System, Tulsa, OK	1	1	7	OK			N	U	M	559	71.9%	1.65	36%	8%	2	209	5	127	5.1	116	3	0.0931	1.1500
51	St. Mary's Health System, Knoxville, Tenn.	1	1	5	TN			N	U	N	516	42.6%	1.64	47%	4%	6	462	15.2	209	4.4	127	5.3	0.0174	0.7800
52	St. Peter's Hospital, Helena, Mont.	1	1	8	MT			N	R	N	99	44.8%	1.21	38%	12%	1	89	4.7	127	3.7	209	4.3	0.1320	0.9400
53	Susquehanna Health System, Divine Providence Hospital, Williamsport, PA	1	1	2	PA			N	U	N	176	30.3%	1.33	46%	6%	7	430	11.9	410	2.5	89	5.8	0.0004	1.5800
54	SwedishAmerican Health System Rockford Ill	1	1	4	IL			N	U	M	286	51.5%	1.68	34%	24%	1	127	5.5	209	4.4	116	3.7	0.1320	1.5800
55	Texas Health Resources - Arlington Mem Hospital, Arlington, TX	1	1	7	TX			N	U	N	372	60.6%	1.42	27%	3%	4	127	6.2	88	5.9	116	4.2	0.0511	0.7800
56	UAB Health System, Birmingham, AL	1	1	5	AL			G	U	C	867	70.9%	1.99	28%	16%	4	116	2.7	462	12	430	14.4	0.0511	

57	University of Virginia Health System, Charlottesville, VA	1	1	3	VA		1	N	U	C	554	75.2%	1.95	35%	15%	5	116	3.1	430	9.4	127	3.9	0.0351	0.5100
58	UPMC Passavant Hospital, Pittsburgh	1	1	2	PA			N	U	N	292	45.9%	1.33	55%	2%	4	127	6.3	88	6.4	89	7.4	0.0511	0.7800
59	UPMC Presbyterian Hospital, Pittsburgh	1	1	2	PA	1		N	U	C	892	74.1%	2.17	41%	10%	3	116	3.2	430	24.9	462	9.7	0.0697	1.1500
60	UPMC Shadyside Hospital, Pittsburgh	1	1	2	PA			N	U	C	535	63.1%	1.89	53%	4%	1	116	2.9	127	5.9	106	9.8	0.1320	0.7800
61	UPMC Southside Hospital, Pittsburgh	1	1	2	PA			N	U	N	136	51.4%	1.33	63%	6%	3	462	11.8	127	6.2	89	7.5	0.0697	2.0000
62	William Beaumont Hospital, Royal Oak, Mich.	1	1	4	MI	1	1	N	U	C	991	82.6%	1.69	45%	3%	3	116	3.3	127	5.9	209	5.3	0.0697	0.9400
63	Ancilla Systems, St Mary's MC, Hobart, Ind.	2	2	4	IN			N	U	M	195	46.2%	1.49	51%	9%	1	127	6.4	88	5.2	89	7.5	0.1320	0.7800
64	Baptist Memorial Hospital-East, Memphis, Tenn.	2	2	5	TN			N	U	M	624	64.9%	1.88	35%	0%		127	8	116	5.6	462	15.6		0.2100
65	Carilion Health System-Medical Center, Roanoke, VA	2	2	3	VA			N	U	C	762	65.3%	1.68	46%	16%		127	6.8	116	4.8	124	3.5		1.5800
66	Children's Healthcare of Atlanta, Atlanta, GA	2	2	3	GA			N	U	C	202	77.2%		1%	44%	10							-0.5000	0.7800
67	Clarian Health Partners, Indianapolis	2	2	4	IN			N	U	C	1263	68.4%	1.85	29%	24%	5	127	5.7	209	4.3	116	3.7	0.0351	0.7800
68	Community Hospital Indianapolis	2	2	4	IN		1	N	U	M	610	59.9%	1.64	39%	8%	8	116	3.1	89	5.2	127	5.2	-0.0269	1.5800
69	Crozer-Keystone Health Systems, Chester Medical Center, Upland, Pa.	2	2	2	PA			N	U	C	604	63.9%	1.46	27%	19%	7	462	11.8	127	5.2	89	6	0.0004	1.1500
70	Ellis Hospital, Schenectady, N.Y.	2	2	2	NY			N	U	N	450	58.3%	1.71	52%	5%	9	127	7.7	430	15.2	116	3.3	-0.0785	1.5800
71	Florida Hospital, Orlando, FL	2	2	3	FL			N	U	M	1787	56.4%	1.89	36%	9%	3	116	3.5	127	5	209	5.1	0.0697	0.9400

72	Geisinger Health System, Danville, PA	3	2	2	PA			N	R	C	349	65.6%	1.85	25%	13%	8	209	5	127	4.2	430	13.5	-0.0269	0.7800
73	General Health System, Baton Rouge, LA	2	2	7	LA			N	U	C	436	65.9%	1.49	43%	11%	1	430	9.8	127	4.7	462	18.6	0.1320	0.2100
74	Greenwich (Conn.) Hospital	2	2	1	CT			N	U	M	160	69.7%	1.37	35%	2%	4							0.0511	2.0000
75	Gritman Medical Center, Moscow, ID	2	2	8	ID			N	R	N	38	37.6%	1.29	38%	10%	3	209	4.5	89	5.1			0.0697	0.3600
76	Henry Ford Health System, Detroit	2	2	4	MI			N	U	C	722	75.0%	1.59	32%	8%	9	127	4.7	14	6.8	89	6.1	-0.0785	0.9400
77	Lancaster General, Lancaster, PA	2	2	2	PA	1		N	U	M	498	63.9%	1.66	35%	8%	5	116	4.6	127	5.6	209	4.6	0.0351	0.6500
78	Legacy Emanual Hospital, Portland, OR	2	2	9	OR			N	U	M	370	65.6%	1.65	10%	26%	2	209	4.1	127	2.7	14	4.1	0.0931	0.7800
79	Legacy Good Samaritan Hospital, Portland, OR	2	2	9	OR			N	U	M	274	59.1%	1.93	28%	13%	3	116	2.2	127	4	107	7.5	0.0697	0.6500
80	MacNeal Health Network, Berwyn, Ill.	2	2	4	IL			N	U	C	285	69.4%	1.38	35%	9%	4	430	11.6	127	4.8	14	5.3	0.0511	1.1500
81	Major Hospital, Shelbyville, Ind.	2	2	4	IN			G	U	N	58	23.9%	1.11	49%	15%	2	127	5	88	4.1	89	5.7	0.0931	0.9400
82	Maury Regional Healthcare Systems, Columbia, TN	2	2	5	TN			G	R	N	275	55.8%	1.28	41%	20%	2	127	5.4	88	5.5	89	6.1	0.0931	0.5100
83	McLeod Regional Medical Center, Florence SC	2	2	3	SC			N	U	M	411	79.5%	1.65	38%	21%	2	127	5.2	116	4.7	430	7.4	0.0931	0.9400
84	Medical College of Georgia Hospital, Augusta, GA	2	2	3	GA			G	U	C	462	56.2%	1.59	25%	25%	8	127	4.3	209	4.5	14	7.6	-0.0269	0.0600
85	Mountain States Health Alliance, Johnson City, TN	2	2	5	TN			N	U	M	409	74.7%	1.67	41%	15%	3	462	7.8	127	5.4	89	6.1	0.0697	0.6500
86	Norton Healthcare, (nee:Alliant), Louisville, Ky.	3	2	5	KY			N	U	M	1230	62.0%	1.57	23%	25%	6	430	12.4	209	4.7	127	5	0.0174	0.3600
87	OSF HealthCare System, Peoria, IL	2	2	4	IL			N	U	M	525	70.2%	1.82	34%	18%	7	127	5.4	14	5.6	89	5.8	0.0004	

88	Overlake Hospital Medical Center, Bellevue WA	2	2	9	WA		1	N	U	N	228	65.4%	1.67	23%	4%	6	209	4.8	89	4.1	127	4.2	0.0174	0.6500
89	Parma (Ohio) Community General Hospital	2	2	4	OH		1	N	U	N	330	58.9%	1.29	56%	3%	6	127	5.3	462	17.7	89	6.6	0.0174	1.5800
90	PeaceHealth, St John MC, Longview, WA	3	2	9	WA			N	R	N	171	48.5%	1.32	28%	18%	3	127	3.9	89	4.3	209	4	0.0697	0.5100
91	PeaceHealth, St Joseph Hospital, Bellingham, WA	3	2	9	WA			N	U	N	215	54.0%	1.45	31%	19%	3	89	4.2	209	4.4	127	3.4	0.0697	0.5100
92	PeaceHealth,Sacred Heart MC, Eugene, OR	3	2	9	OR			N	U	N	426	49.9%	1.79	33%	9%	5	116	2.6	209	5.3	127	3.8	0.0351	0.6500
93	PROMINA Health System, DeKalb MC, Decatur, GA	2	2		GA			N	U	N	502	1.5%	1.47	28%	16%	3	462	13.4	127	4.8	89	6.2	0.0697	0.6500
94	PROMINA Health System, Gwinnett Hospital, Lawrenceville, GA	2	2	3	GA			G	U	N	441	57.4%	1.36	28%	12%	3	462	13.9	89	6.9	88	6.2	0.0697	1.1500
95	Rancho Los Amigos Medical Center, Downey, Calif.	2	2	9	CA			G	U	M	288	67.6%	1.26	13%	58%	1	462	20.3	271	52.4			0.1320	
96	Rush-Presbyterian-St. Luke's Medical Center, Chicago, IL	2	2	4	IL			N	U	C	677	63.4%	1.78	32%	15%	7	430	16.7	462	13.4	209	4.7	0.0004	0.9400
97	Saint Joseph's Hospital, Marshfield, WI	2	2	4	WI			N	R	M	504	46.4%	1.7	48%	7%	2	209	4.5	116	3.1	127	6.4	0.0931	0.5100
98	Salem (Mass.) Hospital	2	2	1	MA			N	U	M	241	59.9%	1.39	34%	10%	5	127	4.9	89	5.3	209	4.3	0.0351	0.0600
99	Sioux Valley Hospital & University Medical Center, Sioux Falls, SD	2	2	6	SD	1		N	U	M	482	61.1%	1.77	41%	11%	2	209	5.1	116	4.1	462	14.4	0.0931	0.5100
100	St. Dominic-Jackson (Miss.) Memorial Hospital	2	2	4	MS			N	U	N	478	74.3%	1.53	63%	5%	2	430	16.2	127	6.7	116	4.8	0.0931	
101	St. Joseph Medical Center, Albuquerque, N.Mex.	2	2	8	NM			N	U	N	443	61.4%	1.6	35%	2%	1	116	4.2	127	4.9	89	5.9	0.1320	0.7800

102	St. Joseph Northeast, Albuquerque, N.Mex.	2	2	8	NM			N	U	N	114	31.8%	1.21	16%	16%	1	89	5.8	127	5.2	88	4.7	0.1320	0.7800
103	St. Vincent's Hospital, Birmingham, Ala.	2	2	5	AL			N	U	N	325	60.7%	1.33	35%	1%	3	127	6.9	89	8	14	6.6	0.0697	0.6500
104	University Health Systems of Eastern Carolina, Greenville, NC	2	2	3	NC			G	U	C	750	75.7%	1.79	36%	23%	3	462	14.2	127	4.7	116	3.8	0.0697	1.5800
105	University Hospital, Little Rock, AR	2	2	7	AR			G	U	C	285	75.7%	1.69	25%	18%	7	127	5	209	6.5	410	5.2	0.0004	0.3600
106	University Hospitals and Clinics, Salt Lake City, UT	3	2	8	UT			G	U	C	378	78.1%	1.85	25%	18%	8	209	6.6	462	17.3	430	17.9	-0.0269	0.6500
107	UT Medical Center, Knoxville, Tenn.	2	2	5	TN			G	U	M	483	64.6%	1.8	30%	36%	1	127	5.1	89	6.1	116	6.1	0.1320	0.6500
108	Washington County Health System, Hagerstown, Md.	2	2	3	MD			N	U	N	307	55.9%	1.44	36%	11%	5	127	4.7	89	6	88	5.3	0.0351	0.3600
109	Yale-New Haven (Conn.) Hospital	2	2	1	CT	1	1	N	U	C	806	72.5%	1.86	26%	19%	4	116	3	127	6	430	12.1	0.0511	1.1500
110	Arkansas Children's Hospital, Little Rock	3	3	7	AR			N	U	C	233	75.0%		50%	36%	5							0.0351	0.3600
111	Banner Health System, Baywood (nee:Lutheran), Mesa, AZ	3	3	6	AZ			N	U	N	235	66.0%	1.37	46%	3%	2	209	4.2	89	5.9	127	4.8	0.0931	
112	Banner Health System, Good Samaritan, Pheonix, AZ	3	3		AZ			N	U	C	901	63.6%	1.81	12%	24%		116	3.4	209	4.4	127	4.4		1.1500
113	Banner Health System, Thunderbird MC, Glendale, AZ	3	3		AZ			N	U	M	318	56.7%	1.68	14%	16%	2	127	4	430	12.4	88	4.5	0.0931	1.5800
114	Banner Health System,Desert MC, Mesa, AZ	3	3		AZ			N	U	N	601	75.7%	1.81	16%	17%	3	89	4.9	209	4.3	127	4	0.0697	0.9400
115	Borgess Health Alliance, Kalamazoo, MI	3	3	4	MI		1	N	U	M	338	63.7%	1.9	47%	9%	3	116	2.2	127	4.6	112	2.1	0.0697	1.5800
116	Carle Foundation, Urbana, Ill.	3	3	4	IL		1	N	U	M	261	55.6%	1.91	33%	13%	5	209	3.6	127	4.5	116	3.5	0.0351	

117	Charleston (W.Va.) Area Medical Center	3	3	3	WV			N	U	C	777	72.2%	1.88	39%	14%	6	116	5.3	106	11.7	127	5.9	0.0174	0.6500
118	Children's Hospital, Boston	3	3	1	MA			N	U	C	324	73.4%		2%	16%	10	296	15.5					-0.5000	0.6500
119	Colleton Medical Center, Walterboro, S.C.	3	3	3	SC			I	R	N	131	45.8%	1.3	52%	20%	2	127	5.7	462	12.3	88	6.3	0.0931	0.2100
120	Doylestown Hospital, Doylestown, PA	3	3	2	PA			N	U	N	187	78.0%	1.36	35%	1%	6	462	11.8	127	4.8	89	7.8	0.0174	1.1500
121	Holland Community Hospital, Holland, MI	3	3	4	MI			N	U	N	213	33.3%	1.23	28%	16%	1	127	3.9	89	4.5	14	4.1	0.1320	0.9400
122	Lehigh Valley Health Network, Allentown, Pa.	3	3	2	PA			N	U	C	599	75.3%	1.8	41%	8%	7	127	5.4	116	3.9	209	4.3	0.0004	1.5800
123	Martin Memorial Health System, Stuart, Fla.	3	3	3	FL			N	U	N	336	61.8%	1.39	46%	9%	3	127	5.6	124	4.1	209	4.6	0.0697	0.9400
124	Methodist HealthCare, Memphis, Tenn.	3	3	5	TN			N	U	M	1305	65.8%	1.66	34%	22%	5	127	6.4	116	6.1	14	7.7	0.0351	0.0600
125	NCH Healthcare System, Naples, Fla.	3	3	3	FL			N	U	N	506	69.0%	1.55	55%	11%	3	127	4.7	462	9.8	209	5.1	0.0697	0.9400
126	New York (N.Y.) Presbyterian Hospital	3	3	2	NY			N	U	C	2172	76.4%	1.79	27%	30%	6	430	25.3	127	8.3	116	4.1	0.0174	1.1500
127	Oak Valley Hospital, Oakdale, Calif.	3	3	9	CA			G	U	N	144	85.5%	1.25	39%	19%	4	89	4.4	127	3.9			0.0511	0.6500
128	Pittsburgh Mercy Hospital	3	3	2	PA			N	U	C	416	75.3%	1.9	39%	19%	7	116	3	127	6.2	462	13	0.0004	0.6500
129	Pratt Regional Medical Center, Pratt, KS	3	3	6	KS			G	R	N	114	59.4%	1.32	61%	6%	7	89	6	127	406	209	4.7	0.0004	0.2100
130	Presbyterian Healthcare Services, Alburquerque, NM	3	3	8	NM			N	U	N	443	65.6%	1.81	23%	4%	4	116	3.6	209	4.9	127	5.1	0.0511	2.0000
131	Providence Health System, Hosp, Medford, Ore.	3	3		OR			N	U	N	122	49.0%	1.42	34%	11%	7	209	4.3	89	4.7	127	3.4	0.0004	0.5100
132	Providence Health System, Hosp. Newberg, Ore.	3	3	9	OR			N	U	N	41	30.8%	1.23	21%	1%	4	127	3.7	89	3.9			0.0511	

133	Providence Health System, Memorial Hosp, Hood River, Ore.	3	3	9	OR			N	R	N	35	31.7%	1.22	38%	15%	7	89	4.5	209	3.6			0.0004	0.7800
134	Providence Health System, Milwaukie Hosp. Milwaukie, Ore.	3	3		OR			N	U	N	85	42.5%	1.26	18%	2%	5	209	3.9	127	3.1	89	3.9	0.0351	0.2100
135	Providence Health System, Portland Medical Cntr, Portland, Ore.	3	3		OR			N	U	C	379	66.8%	1.52	20%	3%	5	209	4.5	127	3.5	462	8.7	0.0351	0.2100
136	Providence Health System, Seaside Hosp, Seaside, Ore.	3	3		OR			N	R	N	53	45.4%	1.02	31%	20%	6	89	4.3					0.0174	
137	Providence Health System, St Vincent, Portland, Ore.	3	3		OR			N	U	M	509	57.3%	1.74	17%	3%	2	116	3.3	209	4.6	127	3.8	0.0931	0.2100
138	Quincy (Mass.) Hospital	3	3	1	MA			G	U	M	228	40.7%	1.29	35%	8%		127	4.6	89	4.8	79	7.8		1.5800
139	Rex Healthcare, Inc., Raleigh, NC	3	3	3	NC			N	U	N	526	75.6%	1.61	25%	2%	5	127	5.7	209	4.2	14	7	0.0351	1.1500
140	Scottsdale Healthcare, Scottsdale, AZ	3	3	8	AZ			N	U	M	315	68.5%	1.68	40%	2%	2	209	5	127	4	89	5	0.0931	0.7800
141	South Central Kansas Regional Medical Center, Arkansas City, KS	3	3	6	KS			G	R	N	70	17.1%	1.15	56%	15%	9	127	4.2	89	4.6	209	3.6	-0.0785	0.3600
142	Southeastern Ohio Regional Medical Center, Cambridge, OH	3	3	4	OH			N	R	N	202	31.2%	1.17	58%	19%	5	89	7	127	5.9	132	2.9	0.0351	1.1500
143	St. Clare's Health Services, Denville, N.J.	3	3	2	NJ			N	U	N	361	69.4%	1.21	24%	5%	10	430	13.4	127	7.2	88	7.5	-0.5000	0.9400
144	St. Francis Hospital, Beech Grove, Ind.	3	3	4	IN			N	U	M	416	59.4%	1.6	45%	7%	4	127	5.6	89	6.2	88	5	0.0511	0.3600
145	Stanly Memorial Hospital, Albemarle, N.C.	3	3	3	NC			I	R	N	119	47.5%	1.21	55%	15%	1	127	4.4	89	5.3	462	15	0.1320	0.9400

146	Trinity Health System, (nee:Mercy&HolyCross systems),Steubenville, Ohio	3	3	4	OH			N	U	N	359	29.0%	1.26	53%	14%	5	127	6.2	88	6.2	89	7.4	0.0351	0.5100
147	UCONNHC, John Dempsey Hospital, Farmington, Conn.	3	3	1	CT			G	U	C	202	64.0%	1.73	39%	17%	8	430	13	116	2.1	89	5	-0.0269	0.2100
148	University Hospitals Health Systems, Cleveland	3	3	4	OH		1	N	U	C	542	80.3%	1.74	27%	8%	2	127	5	430	11.1	209	5	0.0931	0.7800
149	University of Michigan Hospitals & Health Centers, Ann Arbor, MI	3	3	4	MI			G	U	C	659	78.1%	1.93	25%	10%	1	127	5.4	116	4.4	430	11.7	0.1320	0.7800
150	University of Texas M.D. Anderson Cancer Center, Houston, TX	3	3	7	TX			G	U	C	518	64.5%	1.73	26%	3%	10	410	507	398	7.2	492	10.6	-0.5000	
151	Upper Valley Medical Center, Troy Ohio	3	3	4	OH			N	U	N	217	48.7%	1.24	46%	10%	9	127	5.5	89	6.7	88	5.2	-0.0785	1.1500
152	Via Christi Regional Medical Ctr., Wichita, Kans.	3	3	6	KS			N	U	M	830	64.7%	1.76	45%	12%	3	127	6	116	4.2	430	806	0.0697	0.7800
153	Virginia Mason Medical Center, Seattle	3	3	9	WA			N	U	M	270	82.0%	1.75	28%	3%	9	462	9.1	209	4.5	127	4.4	-0.0785	1.5800
154	Wadley Regional Medical Center, Texarkana, Texas	3	3	7	TX			N	U	N	193	49.1%	1.44	41%	19%	5	127	5	14	5.9	88	5.1	0.0351	1.5800
155	Wellmont Hawkins County Mem Hospital, Rogersville, Tenn.	3	3	5	TN			G	U	N	50	27.4%	1	64%	18%	10	88	5.2	127	5.2	89	5.8	-0.5000	0.9400
156	Wellmont Health - Bristol Regional MC, Bristol, Tenn.	3	3	5	TN			N	U	M	294	59.0%	1.72	48%	12%	2	430	10.1	89	4.9	127	5	0.0931	1.1500
157	Wellmont Health-Holston Valley MC Kingsport, Tenn.	3	3	5	TN			N	U	M	425	56.0%	1.74	39%	17%	2	116	3.9	127	5.3	89	5.3	0.0931	0.7800

158	Advocate Health Care, Bethany Hosp. Chicago, IL	4	4	4	IL			N	U	M	133	54.8%	1.17	20%	53%	10	430	7.3	127	4.8	89	5.1	-0.5000	
159	Advocate Health Care, Christ Hosp, Oak Lawn, IL	4	4		IL			N	U	M	652	77.2%	1.72	30%	10%	4	462	12.3	127	5.6	89	6.2	0.0511	
160	Advocate Health Care, Good Samaritan Hosp, Downers Grove, IL	4	4		IL			N	U	N	290	70.1%	1.75	38%	4%	1	430	10.3	127	4.6	89	5.6	0.1320	
161	Advocate Health Care, Good Shepard Hosp, Barrington, IL	4	4		IL			N	U	N	156	59.7%	1.4	30%	2%	1	127	4.3	89	4.6	88	4.7	0.1320	
162	Advocate Health Care, Lutheran General Hosp, Park Ridge, IL	4	4		IL			N	U	C	583	67.3%	1.55		6%	2	127	4.3	462	14.1	209	4.1	0.0931	
163	Advocate Health Care, Masonic Hosp, Chicago, IL	4	4		IL			N	U	C	374	70.5%	1.49	16%	2%	6	430	10.3	127	5.8	89	6.7	0.0174	0.7800
164	Advocate Health Care, South Suburban, Hazel Crest, IL	4	4		IL			N	U	N	209	74.7%	1.31	43%	11%	4	127	5.6	89	5.7	14	5.3	0.0511	
165	Advocate Health Care, Trinity Hosp, Chicago, IL	4	4		IL			N	U	M	254	54.6%	1.33	30%	26%	9	127	6.9	88	6.3	124	7.9	-0.0785	
166	Anne Arundel Health System, Annapolis MD	4	4	3	MD			N	U	N	244	54.3%	1.45	24%	3%	3	127	4.3	89	5.6	209	3.7	0.0697	1.1500
167	Ascension Health, St Marys MC, Evansville, IN	4	4	4	IN			N	U	M	418	51.4%	1.66	37%	8%	1	127	5.1	89	5.7	209	3.9	0.1320	1.1500
168	Cedars-Sinai Health System, Los Angeles, CA	4	4	9	CA			N	U	C	878	75.9%	1.63	30%	12%	6	127	602	430	11	116	4.2	0.0174	1.1500
169	Iowa Health System, Lutheran Hosp, Des Moines, IA	4	4	6	IA			N	U	M	251	60.5%	1.52			1	430	13.5	89	5.6	127	5.5	0.1320	0.9400
170	Iowa Health System, Methodist MC, Des Moines, IA	4	4	6	IA			N	U	M	554	54.8%	1.94	39%	20%		209	5.1	116	3	462	15.7		0.9400

171	Jefferson Health System, Jefferson Hospital Philadelphia, PA	4	4	2	PA			N	U	C	805	72.8%	1.69	27%	3%	7	209	5.2	127	7.4	462	13.1	0.0004	1.1500
172	Marion General Hospital, Marion, IN	4	4	4	IN			N	R	N	213	47.7%	1.22	40%	18%	1	127	6	89	6.8	132	2.9	0.1320	0.6500
173	Moses Cone Health System, Greensboro, NC	4	4	3	NC			N	U	C	1147	79.0%	1.68	37%	12%	1	127	6.4	462	13.2	116	5.7	0.1320	0.2100
174	North Mississippi Health Services, Tupelo MS	4	4	5	MS			N	R	M	742	65.2%	1.54	39%	11%	2	116	3.4	127	5.9	89	7.7	0.0931	0.7800
175	Orlando Regional Healthcare, Orlando, FL	4	4	3	FL		1	N	U	C	1263	64.4%	1.62	19%	15%	6	430	8	127	4.7	143	2.1	0.0174	1.5800
176	Somerset Hospital, Somerset, PA	4	4	2	PA			N	U	N	117	53.9%	1.14	39%	18%	5	127	7	88	5.8	89	8.1	0.0351	0.7800
177	St. Luke's Episcopal Hospital, Houston,TX	4	4	7	TX			N	U	C	n/a	66.8%	2.04	32%	7%	4	116	3.3	127	5.9	462	10	0.0511	2.0000
178	Sutter Health, Sacramento, CA	4	4	9	CA			N	U	M	668	70.9%	1.84	23%	17%	1	116	2.9	209	3.7	127	4.7	0.1320	1.1500
179	University of Pennsylvania Health Sys., Philadelphia, PA	4	4	2	PA			N	U	C	641	80.4%	1.95	24%	10%		462	12.3	127	4.9	430	13		1.5800
180	Valley Health System - Fauquier Hospital Inc, Warrenton, VA	4	4	3	VA			N	U	N	86	46.7%	1.22	47%	6%	2	127	4.1	89	5.2	88	4.2	0.0931	0.6500
181	Valley Health System, Culpeper Memorial Hospital, Culpeper, VA	4	4	3	VA			N	U	N	70	49.7%	1.2	48%	8%	4	127	4.3	430	6.5	14	4.8	0.0511	0.3600
182	Valley Health System, Ridgewood, NJ	4	4	2	NJ			N	U	N	412	71.6%	1.65	38%	1%	6	127	7.2	116	4.6	89	7.9	0.0174	0.3600
183	Valley Health System, Shenandoah Memorial Hospital, Woodstock, VA	4	4	3	VA			N	R	N	157	42.5%	1.21	51%	7%	8	89	6.6	127	4.3	14	4.4	-0.0269	0.6500
184	Valley Health System, Warren Memorial, Front Royal, VA	4	4	3	VA			N	U	M	154	61.6%	1.2	56%	8%	7	127	5.3	89	5.4	132	2.5	0.0004	0.3600

185	Valley Health System, Winchester Medical Center, Winchester, VA	4	4	3	VA			N	R	M	408	65.3%	1.6	51%	11%	2	127	5.8	88	5.9	116	4.5	0.0931	1.1500
186	Wake Forest Univ. Baptist Medical Center, Winston-Salem, NC	4	4	3	NC	1		N	U	C	748	73.2%	1.84	39%	19%	2	116	4.5	127	5.4	14	8.4	0.0931	0.7800
187	Allina Health System, Abbott Northwest, Minneapolis, MN	5	5	6	MN			N	U	M	694	71.9%	1.84	40%	3%	4	116	3.4	430	10.2	127	5.8	0.0511	0.0600
188	Allina Health System, Buffalo Hosp, Buffalo, MN	5	5		MN			N	U	N	40	48.1%	1.07	30%	9%	3	127	3.7	89	3.8	140	1.8	0.0697	0.0600
189	Allina Health System, Cambridge Mem Hosp, Cambridge, MN	5	5		MN			N	U	N	94	48.3%	1.12	36%	12%	10	89	4.8	127	3.4	209	5	-0.5000	
190	Allina Health System, New Ulm MC, New Ulm, MN	5	5		MN			N	R	N	78	31.4%	1.29	45%	8%	6	209	5.2	127	3.2	210	5.5	0.0174	0.5100
191	Allina Health System, Owatona Hosp. Owatona, MN	5	5		MN			N	R	N	103	22.7%	1.19	40%	14%	2	430	8.8	127	3.8	89	6	0.0931	
192	Allina Health System, St Francis, Shakopee, MN	5	5		MN			N	U	N	47	50.8%	1.17	24%	10%	4	127	4.6	89	4.7	209	4.5	0.0511	1.5800
193	Altru Health System, Grand Forks, ND	5	5	6	ND			N	U	M	261	54.6%	1.72	40%	8%		462	9.5	209	3.8	116	2.9		1.5800
194	Children's Health System, Birmingham, AL	5	5	5	AL			N	U	M	225	68.1%		1%	39%	5							0.0351	0.7800
195	Children's Medical Center of Dallas, Dallas, TX	5	5	7	TX			N	U	M	241	69.5%		1%	45%	5							0.0351	0.6500
196	Gateway Health System, Memorial General, Clarksville, TN	5	5	5	TN			G	U	N	243	49.8%	1.23	42%	23%	4	127	5.1	88	4.3	89	6.3	0.0511	1.1500
197	Hamot Medical Center, Erie, PA	5	5	2	PA			N	U	C	302	58.0%	1.84	34%	16%	7	127	5.6	116	4.8	209	3.7	0.0004	0.7800
198	HCA-Centenial Medical Center, Nashville, TN	5	5	5	TN			I	U	N	628	54.6%	1.87	33%	15%	4	430	11.5	107	6.7	116	3.6	0.0511	0.5100

199	Memorial Healthcare System, Hollywood, FL	5	5	3	FL			G	U	M	684	64.0%	1.66	18%	14%	9	430	9.6	462	10.2	127	6	-0.0785	1.1500
200	Methodist Hospitals of Dallas, Dallas, TX	5	5	7	TX			N	U	C	367	72.8%	1.57	36%	0%	6	127	5.4	89	7.3	14	6.6	0.0174	
201	Metropolitan Hospital and Metro Health, Grand Rapids, MI	5	5	4	MI			N	U	M	185	57.4%	1.33	36%	13%		462	7.1	127	4.9	89	5.2		0.6500
202	Sparrow Health System, Lansing, MI	5	5	4	MI			I	U	M	507	68.6%	1.58	30%	16%	4	127	5.7	462	16.9	209	5.8	0.0511	0.7800
203	St. Joseph's Hospital, Parkersburg, WV	5	5	3	WV			I	U	N	61	41.1%	1.29	53%	13%	1	127	4.8	79	7.2	430	4.9	0.1320	0.0600
204	Alegent Health, Omaha, NE	6	6	6	NE			N	U	M	549	54.6%	1.72	34%	10%	3	430	12.4	89	6.7	462	16.8	0.0697	0.7800
205	CareGroup Healthcare- Beth Isreal Deaconess Hospital, Boston, MA	6	6	1	MA		1	N	U	C	532	80.1%	1.79	32%	7%	8	116	3.2	127	4.2	430	13.3	-0.0269	1.1500
206	CareGroup Healthcare- Deaconess Glover Hospital, Needham, MA	6	6	1	MA			N	U	N	41	62.1%	1.19	69%		9	127	4.7	89	6.9	143	1.5	-0.0785	0.2100
207	CareGroup Healthcare- Mt Auburn Hospital, Cambridge, MA	6	6	1	MA			N	U	C	190	62.1%	1.47	42%	3%	8	127	5.2	89	5.6	430	7.9	-0.0269	1.1500
208	CareGroup Healthcare- New England Baptist Hospital, Boston, MA	6	6	1	MA			N	U	M	134	60.1%	1.65	50%	2%	7	209	4.3	79	9.9	127	5.3	0.0004	0.7800
209	CentraCare Health System, St. Cloud, MN	6	6	6	MN			N	U	M	587	74.9%	1.59	37%	12%	1	116	3.1	209	4.8	127	4.8	0.1320	1.5800
210	Children's Hospital and Research Center, Oakland, CA	6	6	9	CA			N	U	M	205	71.3%		0%	35%	8							-0.0269	0.6500
211	Community Memorial Hospital, Winona, MN	6	6	6	MN			N	R	N	198	66.7%	1.18	44%	8%	3	127	5.1	89	6.5	140	3.1	0.0697	0.2100

212	Concord Hospital, Concord, NH	6	6	1	NH			N	R	M	188	66.9%	1.48	40%	7%	3	209	4.8	127	4.1	89	5.6	0.0697	1.1500
213	Empire Health Services, Deaconess Medical Center, Spokane, WA	6	6	9	WA			N	U	M	297	53.7%	1.94	24%	9%	6	116	3.4	209	4.6	106	8.6	0.0174	0.7800
214	Empire Health Services, Valley Hospital & MC, Spokane, WA	6	6	9	WA			N	U	M	93	43.6%	1.36	33%	6%	6	209	4.9	127	4.8	89	6.2	0.0174	1.5800
215	Guthrie Health, Sayre, PA	6	6	2	PA			N	R	M	266	50.0%	1.76	46%		10	127	5	116	3.5	209	5.1	-0.5000	0.7800
216	Holy Family Hospital, Spokane, WA	6	6	9	WA			N	U	N	196	42.4%	1.33	34%	18%	9	89	5.5	209	5.7	127	3.9	-0.0785	0.9400
217	Huntsville Hospital, Huntsville, AL	6	6	5	AL			G	U	M	768	63.0%	1.63	33%	24%	3	127	5.1	116	3.9	14	6.4	0.0697	1.1500
218	Inova Health System, Alexandria Hospital, Alexandria, VA	6	6	3	VA			N	U	N	355	63.9%	1.47	23%	13%	4	127	6.2	14	7.8	89	7.3	0.0511	0.3600
219	Inova Health System, Fair Oaks Hospital, Fairfax, VA	6	6	3	VA			N	U	N	136	68.8%	1.23	21%	4%	2	127	4.2	88	4.7	143	2	0.0931	0.0600
220	Inova Health System, INOVA Fairfax Hospital. Falls Church, VA	6	6	3	VA	1		N	U	C	715	83.2%	1.77	18%	9%	2	116	3.2	127	5.3	14	6.8	0.0931	0.0600
221	Inova Health System, Potomac Hospital, Woodbridge, VA	6	6	3	VA			N	U	N	158	57.1%	1.32	20%	14%	1	127	6.5	88	6.6	89	6.7	0.1320	0.5100
222	Jacobi Medical Center, Bronx, NY	6	6	2	NY			G	U	C	534	80.8%	1.38	12%	45%	2	430	32.7	127	6.7	462	30.4	0.0931	
223	Johns Hopkins Institutions, Baltimore, MD	6	6	3	MD			N	U	C	551	79.8%	1.86	23%	5%	6	116	3.5	430	18.5	127	5.3	0.0174	0.9400
224	Kishwaukee Health System, DeKalb, IL	6	6	4	IL			N	U	N	136	25.9%	1.19	42%	13%	1	127	4.3	88	4.6	209	6.5	0.1320	0.0600
225	Lifespan-Miriam Hospital, Providence, RI	6	6	1	RI			N	U	C	193	86.0%	1.91		4%	8	116	3.6	127	5.4	89	6	-0.0269	0.9400

226	Memorial Healthcare Center, Owosso, MI	6	6	4	MI			N	R	N	147	49.8%	1.23	45%	10%	5	127	4.6	209	4.9	462	12.1	0.0351	0.3600
227	Northeast Health, Samaritan Hospital, Troy, NY	6	6	2	NY			N	U	N	288	46.2%	1.21	48%	9%	4	430	14.1	127	5	89	6.6	0.0511	0.5100
228	Riverside HealthCare, Kankakee, IL	6	6	4	IL			N	U	N	323	42.1%	1.39	40%	22%	3	462	11.3	430	11.4	127	5.6	0.0697	0.6500
229	Robert Wood Johnson University Hospital, Hamilton, NJ	6	6	2	NJ			N	U	N	200	56.3%	1.27	42%	1%	9	127	7	89	7.6	88	6.1	-0.0785	0.7800
230	Rockford Health System, Rockford, IL	6	6	4	IL			N	U	N	318	60.8%	1.73	39%	19%	1	127	4.6	462	17.6	89	6.3	0.1320	1.5800
231	Sacred Heart Medical Center, Spokane, WA	6	6	9	WA			N	U	M	568	61.6%	1.86	31%	15%	4	430	12.5	209	4.4	116	3.3	0.0511	0.3600
232	ThedaCare, Appleton Medical Center, Appleton, WI	6	6	4	WI	1	1	N	U	M	151	53.2%	1.79	46%	2%		209	5	116	2.4	127	4.3		0.0600
233	ThedaCare, Theda Clark Medical Center. Neenah, WI	6	6	4	WI	1		N	U	N	195	57.4%	1.66	44%	4%		209	4.4	127	4.8	462	10.2		0.0600
234	University of New Mexico Hospitals & Healthcare, Albuquerque, NM	6	6	8	NM			G	U	C	374	67.7%	1.53	14%	8%	9	430	13	89	4.8	14	4.4	-0.0785	
235	Wellspan Health, York Hospital,York, PA	6	6	2	PA			N	U	C	480	70.0%	1.61	38%	10%	2	127	5.4	89	5.9	209	4.3	0.0931	0.9400
236	Wentworth-Douglass Hospital, Dover, NH	6	6	1	NH			N	U	N	100	45.5%	1.37	41%	5%	1	127	5.4	88	4.2	209	5.4	0.1320	1.1500

DESCRIPTIVE AND OPERATIONAL CASES FY2002 BY ORGANIZATION

Survey Participant	Organization	Pass 1 SC	Pass 2 SC	State	Cardio?	Ownership	Setting	Teaching	Beds	Occupancy Rate	Casemix	Medicare %	Medicaid %	Total Profit Margin	DRG1	ALOS1	DRG2	ALOS2	DRG3	ALOS3	HMO 2001 share	TPM	LTDR
1	Arnot Ogden Medical Center, Elmira, N.Y.	1	1	NY		N	U	N	256	0.72	1.41	40%	12%	7	127	6.9	89	8.4	209	5.8	0.358	-0.0031	0.5200
1	Saint Luke's Shawnee Mission Health System, Kansas City, Mo.	1	1	MO		N	U	C	450	0.64	1.9	34%	8%	1	517	2.2	127	5.2	462	14.9	0.350	0.1320	1.2100
1	Scottsdale Healthcare, Scottsdale, AZ	3	3	AZ		N	U	M	315	0.54	1.55	20%	5%	4	209	4.2	127	4.7	89	5	0.310	0.0416	1.6600
1	Allina Health System, New Ulm MC, New Ulm, MN	5	5	MN		N	R	N	48	0.51	1.2	35%	4%	4	209	4.7	127	4	89	3.9		0.0416	
1	NCH Healthcare System, Naples, Fla.	3	3	FL		N	U	N	506	0.80	1.57	50%	13%	6	462	11.3	209	4.9	127	4.5	0.310	0.0113	0.6100
1	Stanly Memorial Hospital, Albemarle, N.C.	3	3	NC		I	R	N	119	0.55	1.21	43%	20%	9	127	3.8	430	7.1	89	4.7	0.178	-0.0762	0.5200
1	Medical College of Georgia Hospital, Augusta, GA	2	2	GA		G	U	C	462	0.62	1.6	27%	32%	2	430	6.8	89	4.5	14	5.2	0.175	0.0844	0.0400
1	Memorial Health System, Savannah, GA	1	1	GA		N	U	C	498	0.73	1.82	30%	26%	6	462	13	430	9.9	127	4.7	0.175	0.0113	1.6600
1	PROMINA Health System, DeKalb MC, Decatur, GA	2	2	GA		N	U	N	502	0.77	1.36	25%	32%	6	462	11.5	127	5.2	89	5.8		0.0113	0.6600
1	Providence Health System, Hosp, Medford, Ore.	3	3	OR		N	U	N	122		1.28	59%	10%	4	89	4.9	209	4.8	14	4.8		0.0416	0.2000
1	Borgess Health Alliance, Kalamazoo, MI	3	3	MI		N	U	M	338	0.71	1.77	50%	5%	1	517	1.9	127	4.5	89	5.5	0.270	0.1320	1.2100
1	University of New Mexico Hospitals & Healthcare, Albuquerque, NM	6	6	NM		G	U	C	374	0.84	1.54	14%	16%	7	430	11	209	5.3	89	4.1	0.377	-0.0031	

LTDR	0.9800	1.2100	0.6600	0.3600		0.6100	1.6600	0.6100	1.6600	0.2000	1.2100	
TPM	0.0416	-0.0281	-0.0031	0.0597	-0.5000	0.0844	0.0597	0.0597	0.0113	0.0267	0.5000	0.1320
HMO 2001 share	0.210	0.210	0.099	0.185	0.103	0.120	0.210	0.300	0.130	0.097	0.535	0.535
ALOS3	4.8	14	8.1	9	5.5	6.4	4.4	11.7	4.9	10.2	4.8	n/a
DRG3	89	430	430	462	127	89	209	462	88	430	209	n/a
ALOS2	4.5	4.2	2.2	2.5	12	18.6	4.6	3.3	10.8	4.4	5.4	n/a
DRG2	127	209	143	517	107	462	127	89	462	209	127	n/a
ALOS1	9.1	10.2	5.6	5	3.3	11.8	5.6	7.5	5.9	6.3	12.3	21.3
DRG1	462	462	127	209	517	430	89	430	127	127	462	462
Total Profit Margin	4	8	7	3	10	2	3	3	6	5		1
Medicaid %	28%	17%	23%	1%	15%	17%	19%	6%	9%	9%	15%	55%
Medicare %	23%	32%	35%	45%	44%	35%	38%	28%	56%	44%	37%	13%
Casemix	1.5	1.72	1.48	2.01	1.85	1.8	1.54	1.67	1.43	1.77	1.59	1.16
Occupancy Rate	0.77	0.69	0.89	0.77	0.69	0.70	0.71	0.48	0.57	0.76	0.71	0.70
Beds	148	677	411	873	777	549	318	151	186	635	541	288
Teaching	M	C	M	C	C	M	N	M	M	M	C	M
Setting	U	U	U	U	U	U	U	U	U	U	U	U
Ownership	N	N	N	N	N	N	N	N	N	N	N	G
Cardio?				1				1				
State	IL	IL	SC	TX	WV	NE	IL	WI	IN	AR	CA	CA
Pass 2 SC	1	2	2	1	3	6	6	6	2	1	1	2
Pass 1 SC	1	2	2	1	3	6	6	6	2	1	1	2
Organization	Rush-Copley Memorial Hospital Center, Aurora, IL	Rush-Presbyterian-St. Luke's Medical Center, Chicago, IL	McLeod Regional Medical Center, Florence SC	Methodist Health Care System, Houston	Charleston Area (W.Va.) Medical Center	Alegent Health, Omaha, NE	Rockford Health System, Rockford, IL	ThedaCare, Appleton Medical Center, Appleton, WI	Ancilla Systems, St Mary's MC, Hobart, Ind.	Baptist Health, Little Rock, AR	Memorial Health Services, Long Beach, CA	Rancho Los Amigos Medical Center, Downey, Calif.
Survey Participant	1	1	1	1	1	1	1	1	1			

LTDR	1.2100	0.6600	1.2100	0.2000	0.2000	0.9800	2.0000	0.9800	0.9800	1.6600		2.0000
TPM	0.0597	-0.0281	-0.0762	0.0597	0.0113	0.0416	0.0844	0.0597	0.0113	0.0113		0.1320
HMO 2001 share	0.130	0.270	0.300	0.300	0.097	0.030	0.535	0.130	0.270	0.358		0.535
ALOS3	4	11.4	2.1	6.2	5.6	4.4	4.7	6.4	5.2	6	8.3	5.6
DRG3	209	430	517	430	209	127	209	14	209	89	109	127
ALOS2	4.9	4.6	4.3	6.5	5.1	4.6	4.7	4.6	6.4	6.3	6.1	2.6
DRG2	127	89	127	89	127	89	127	209	127	127	430	517
ALOS1	11.8	5.1	5.3	5.5	4.8	3.7	14.3	6.7	2.3	12	2.2	4.9
DRG1	462	127	209	127	410	209	430	127	517	430	517	209
Total Profit Margin	3	8	9	3	6	4	2	3	6	6		1
Medicaid %	12%	9%	12%		21%	10%	7%	25%	4%	5%		14%
Medicare %	38%	26%	37%	55%	27%	37%	25%	30%	45%	48%		25%
Casemix	1.68	1.9	1.58	1.1	1.77	1.38	1.79	1.82	1.7	1.73		1.9
Occupancy Rate	0.59	0.86	0.81	0.58	0.87	0.81	0.75	0.71	0.86	0.63		0.79
Beds	749	659	632	64	285	239	565	1263	991	450		668
Teaching	U	C	M	N	C	N	M	C	C	N	C	M
Setting	G	U	U	R	U	U	U	U	U	U	U	U
Ownership	N	G	N	N	G	N	N	N	N	N	N	N
Cardio?									1			
State	IN	MI	MN	MN	AR	AZ	CA	IN	MI	NY	AZ	CA
Pass 2 SC	4	3	6	6	2	3	1	2	1	2	3	4
Pass 1 SC	4	3	6	6	2	3	1	2	1	2	3	4
Organization	Ascension Health, St Marys MC, Evansville, IN	University of Michigan Hospitals & Health Centers, Ann Arbor, MI	CentraCare Health System, St. Cloud, MN	Community Memorial Hospital, Winona, MN	University Hospital, Little Rock, AR	Banner Health System, Baywood (nee:Lutheran), Mesa, AZ	Sharp Healthcare, San Diego	Clarian Health Partners, Indianapolis	William Beaumont Hospital, Royal Oak, Mich.	Ellis Hospital, Schenectady, N.Y.	Banner Health System, Good Samaritan, Pheonix, AZ	Sutter Health, Sacramento, CA
Survey Participant												

LTDR	0.9800	0.2000				0.66	0.9800		0.6600	1.6600		0.3600	0.9800
TPM	0.0113	0.0416	0.0597	-0.5000		0.08	0.0844	0.0844	0.0844	0.0113		-0.0281	0.0113
HMO 2001 share	0.130	0.300	0.270	0.358			0.130		0.014	0.358		0.440	0.130
ALOS3	11.2	4.9	6.1	7.2	4.5	5.4	4.6	1.5	5.5	25.2	4.3	1.6	2.9
DRG3	462	127	88	127	89	127	127	143	127	430	209	517	132
ALOS2	9.6	9.5	7.5	14.3	4.1	7	6.2	3.9	12.9	6.5	4.7	4.5	4.5
DRG2	430	430	14	462	127	89	89	127	462	89	89	89	88
ALOS1	4.8	2.2	5.6	28.3	7.8	5	4.1	4.1	1.8	6.3	10.3	10.8	4.8
DRG1	127	517	127	430	430	209	88	89	517	127	430	430	127
Total Profit Margin	6	4	3	10		2	2	2	2	6		8	6
Medicaid %	6%	14%	10%	62%		1%	20%	16%	20%	26%		13%	21%
Medicare %	47%	36%	47%	17%		39%	43%	36%	53%	27%		36%	41%
Casemix	1.68	1.8	1.54	1.3		1.37	1.06	1.06	1.76	1.75		1.61	1.14
Occupancy Rate	0.60	0.85	0.48	0.78			0.53	0.66	0.68	0.80		0.73	0.48
Beds	610	622	619	534		160	58	34	742	705		202	213
Teaching	M	M	N	C	N	M	N	N	M	C	N	C	N
Setting	U	U	U	U	U	U	U	U	R	U	U	U	R
Ownership	N	N	N	G	N	N	G	N	N	N	N	G	N
Cardio?													
State	IN	MN	MS	NY	AZ	CT	IN	MN	MS	NY	AZ	CT	IN
Pass 2 SC	2	5	1	6	3	2	2	5	4	1	3	3	4
Pass 1 SC	2	5	2	6	3	2	2	5	4	1	3	3	4
Organization	Community Hospital Indianapolis	Allina Health System, Abbott Northwest, Minneapolis, MN	Baptist Health Systems, Jackson, Miss.	Jacobi Medical Center, Bronx, NY	Banner Health System, Thunderbird MC, Glendale, AZ	Greenwich (Conn.) Hospital	Major Hospital, Shelbyville, Ind.	Allina Health System, Buffalo Hosp, Buffalo, MN	North Mississippi Health Services, Tupelo MS	Maimonides Medical Center, Brooklyn, NY	Banner Health System,Desert MC, Mesa, AZ	UCONNHC, John Dempsey Hospital, Farmington, Conn.	Marion General Hospital, Marion, IN
Survey Participant													

LTDR	0.0400	0.0400	0.9800	0.9800	0.2000	0.6600	0.3600	2.0000	1.2100	0.6100		0.9800
TPM	0.1320	0.0267	0.0113	0.0416	0.0597	0.0844	0.0844	0.0597	0.0113	-0.0031	0.0844	0.0267
HMO 2001 share		0.270	0.358	0.440	0.130	0.070	0.358	0.535	0.310	0.180		0.178
ALOS3	12.9	6.5	11.3	5.7	4.7	4.3	4.9	11.9	5.2	4.7	3.3	5.2
DRG3	430	209	462	127	88	127	88	462	89	127	127	88
ALOS2	3.4	13	7.4	2.3	5.4	4.5	4.8	6.7	5.1	5.8	9	5.1
DRG2	127	430	127	517	127	209	127	127	127	89	430	127
ALOS1	4.5	5.8	19.7	11.2	5.7	5.3	13.1	12.1	11.7	5.1	4.3	12.2
DRG1	89	127	430	430	89	89	430	430	430	209	89	462
Total Profit Margin	1	5	6	4	3	2	2	3	6	7	2	5
Medicaid %	18%	8%	26%	18%	6%	9%	5%	12%	12%	6%	15%	39%
Medicare %	33%	58%	26%	28%	42%	43%	43%	34%	50%	57%	44%	44%
Casemix	1.1	1.55	1.79	1.8	1.64	1.25	1.24	1.74	1.61	1.32	1.13	1.54
Occupancy Rate	0.64	0.69	0.85	0.80	0.75	0.69	0.56	0.92	0.52	0.65	0.33	0.75
Beds	86	478	2172	806	416	99	238	878	492	114	77	555
Teaching	N	N	C	C	M	N	N	C	N	N	N	M
Setting	U	U	U	U	U	R	U	U	U	R	R	U
Ownership	N	N	N	N	N	N	N	N	N	G	N	G
Cardio?				1								
State	MN	MS	NY	CT	IN	MT	NY	CA	FL	KS	MN	NC
Pass 2 SC	5	2	3	2	3	1	6	4	1	3	5	1
Pass 1 SC	5	2	3	2	3	1	6	4	1	3	5	1
Organization	Allina Health System, Cambridge Mem Hosp, Cambridge, MN	St. Dominic-Jackson (Miss.) Memorial Hospital	New York (N.Y.) Presbyterian Hospital	Yale-New Haven (Conn.) Hospital	St. Francis Hospital, Beech Grove, Ind.	St. Peter's Hospital, Helena, Mont.	Northeast Health, Samaritan Hospital, Troy, NY	Cedars-Sinai Health System, Los Angeles, CA	Baptist Health Care, Pensacola, FL	Pratt Regional Medical Center, Pratt, KS	Allina Health System, Owatona Hosp. Owatona, MN	Cape Fear Valley Health System, Fayetteville, N.C.
Survey Participant												

LTDR	0.3600	0.9800	0.3600	0.2000	0.9800	1.2100	0.6100	0.3600	1.2100	2.0000		0.6100
TPM	0.0113	0.0597	-0.0031	-0.0762	-0.0281	0.0267	-0.0031	0.0416	0.0416	0.0416	-0.5000	0.5000
HMO 2001 share	0.250	0.310	0.180	0.178	0.250	0.310	0.180	0.178	0.250	0.310	0.320	0.178
ALOS3	3	2.9	4.1	5	6.1	6.7	5.9	4.1	5.3	6	5.3	5.7
DRG3	517	517	416	89	89	88	209	462	88	127	88	14
ALOS2	15.1	5	3.7	7.5	13.9	4.3	7.3	4.3	5.1	11.4	5.9	4.1
DRG2	462	127	127	430	462	209	127	209	127	462	89	209
ALOS1	11.1	5.7	4.8	5.9	5.2	5.1	6.3	49.7	6.7	6.1	5.3	5.3
DRG1	430	89	89	79	127	127	430	127	89	430	127	127
Total Profit Margin	6	3	7	9	8	5	7	4	4	4	10	
Medicaid %	17%	9%	20%	21%	2%	7%	11%	20%	22%	13%	3%	3%
Medicare %	24%	39%	45%	74%	57%	47%	42%	38%	50%	17%	40%	30%
Casemix	2	1.66	1.25	1.09	1.4	1.4	1.62	1.57	1.11	1.77	1.55	1.55
Occupancy Rate	0.86	0.76	0.15	0.38	0.71	0.65	0.73	0.76	0.37	0.81	0.74	0.71
Beds	566	1787	70	72	330	336	830	1147	202	684	1230	526
Teaching	C	M	N	N	N	N	M	C	N	M	M	N
Setting	U	U	R	R	U	U	U	U	R	U	U	U
Ownership	G	N	G	N	N	N	N	N	N	G	N	N
Cardio?												
State	OH	FL	KS	NC	OH	FL	KS	NC	OH	FL	KY	NC
Pass 2 SC	1	2	3	1	2	3	3	4	3	5	2	3
Pass 1 SC	1	2	3	1	2	3	3	4	3	5	3	3
Organization	Ohio State University Health System, Columbus, OH	Florida Hospital, Orlando, FL	South Central Kansas Regional Medical Center, Arkansas City, KS	Good Hope Hospital, Erwin, N.C.	Parma (Ohio) Community General Hospital	Martin Memorial Health System, Stuart, Fla.	Via Christi Regional Medical Ctr., Wichita, Kans.	Moses Cone Health System, Greensboro, NC	Southeastern Ohio Regional Medical Center, Cambridge, OH	Memorial Healthcare System, Hollywood, FL	Norton Healthcare (nee:Alliant), Louisville, Ky.	Rex Healthcare, Inc., Raleigh, NC
Survey Participant												

LTDR	1.2100		0.9800	0.2000	2.0000	0.6100	1.2100	2.0000	1.2100	1.2100	1.6600
TPM	-0.0281	0.0844	0.0113	0.0844	0.0267	-0.0762	0.0416	0.0267	-0.0281	0.0267	-0.0281
HMO 2001 share	0.250	0.170	0.250	0.310	0.530	0.178	0.250	0.310	0.530	0.178	0.030
ALOS3	6.9	7.1	4.2	6.3	9.2	6.6	4.9	2.9	1.6	8.1	1.9
DRG3	89	416	296	88	430	14	88	89	143	14	517
ALOS2	5.4	5.1	4.4	7.2	4.5	4.2	5.7	5	4.2	4.8	4.5
DRG2	88	127	209	127	127	127	89	143	127	127	209
ALOS1	6	8.5	4.3	13.6	16.1	12.3	5.6	5.7	2.5	2.6	9.4
DRG1	127	430	127	430	462	462	127	127	517	517	462
Total Profit Margin	8	2	6	2	5	9	4	5	8	5	8
Medicaid %	13%	10%	9%	28%	15%	27%	12%	13%	9%	17%	14%
Medicare %	48%	33%	35%	15%	49%	44%	42%	23%	29%	37%	42%
Casemix	1.39	1.51	1.72	1.48	1.3	1.86	1.22	1.57	1.7	1.93	1.61
Occupancy Rate	0.61	0.70	0.80	0.74	0.71	0.78	0.58	0.83	0.85	0.75	0.60
Beds	359	436	542	545	296	696	217	1263	532	748	261
Teaching	N	C	C	M	C	C	N	C	C	C	M
Setting	U	U	U	U	U	U	U	U	U	U	U
Ownership	N	N	N	G	N	G	N	N	N	N	N
Cardio?										1	
State	OH	LA	OH	FL	MA	NC	OH	FL	MA	NC	ND
Pass 2 SC	3	2	3	1	1	2	3	4	6	4	5
Pass 1 SC	3	2	3	1	1	2	3	4	6	4	5
Organization	Trinity Health System, (nee:Mercy&Holy Cross systems),Steubenville, Ohio	General Health System, Baton Rouge, LA	University Hospitals Health Systems, Cleveland	North Broward Hospital District, Fort Lauderdale, FL	Berkshire Health System, Pittsfield, Mass.	University Health Systems of Eastern Carolina, Greenville, NC	Upper Valley Medical Center, Troy Ohio	Orlando Regional Healthcare, Orlando, FL	CareGroup Healthcare- Beth Isreal Deaconess Hospital, Boston, MA	Wake Forest Univ. Baptist Medical Center, Winston-Salem, NC	Altru Health System, Grand Forks, ND
Survey Participant											

LTDR	2.0000			1.2100	0.9800	1.2100	0.9800	0.6100	0.3600	0.6100	2.0000
TPM	0.0844	0.0844	-0.0762	0.0844	0.0844	0.0597	0.0113	-0.5000	0.0416	0.0267	0.0267
HMO 2001 share	0.150	0.175		0.030	0.150		0.411		0.120		0.530
ALOS3	6.5	n/a	4.4	4.6	5.9	11	1.4	3.4	6.3	4	n/a
DRG3	89	n/a	79	89	89	430	143	499	127	127	n/a
ALOS2	6	n/a	4.5	11.9	5	4.5	3.9	2	6.5	8	n/a
DRG2	127	n/a	127	462	127	89	127	500	89	430	n/a
ALOS1	2.3	n/a	4	4.7	4.2	3.8	9.2	4.7	4.6	2.4	n/a
DRG1	517	n/a	89	209	209	127	430	209	209	517	n/a
Total Profit Margin	2	2	9	2	2	3	6	10	4	5	5
Medicaid %	11%	42%	3%	11%	9%	5%	31%	2%	2%	14%	27%
Medicare %	36%	1%	62%	37%	31%	43%	15%	46%	27%	29%	1%
Casemix	1.9		1.16	1.91	1.56	1.31	1.7	1.72	1.64	1.8	
Occupancy Rate	0.70	0.71	0.49	0.56	0.77	0.77	0.71	0.77	0.83	0.63	0.79
Beds	548	202	41	468	559	190	370	134	315	274	324
Teaching	U	C	N	M	M	C	M	M	M	M	C
Setting	G	U	U	U	U	U	U	U	U	U	U
Ownership	N	N	N	N	N	N	N	N	N	N	N
Cardio?				1							
State	OK	GA	MA	ND	OK	MA	OR	MA	NE	OR	MA
Pass 2 SC	1	2	6	1	1	6	2	6	1	2	3
Pass 1 SC	1	2	6	1	1	6	2	6	2	2	3
Organization	INTEGRIS Health, Oklahoma City, OK	Children's Healthcare of Atlanta, Atlanta, GA	CareGroup Healthcare- Deaconess Glover Hospital, Needham, MA	MeritCare Health System, St Luke's Hosp.,Fargo, N.Dak.	St. John Health System, Tulsa, OK	CareGroup Healthcare- Mt Auburn Hospital, Cambridge, MA	Legacy Emanual Hospital, Portland, OR	CareGroup Healthcare- New England Baptist Hospital, Boston, MA	Methodist Health System, Omaha, NE	Legacy Good Samaritan Hospital, Portland, OR	Children's Hospital, Boston
Survey Participant											

LTDR	0.6100	0.0400	1.6600	0.6100	2.0000	0.3600	0.6100	0.9800	0.9800	0.6100	2.0000	0.9800
TPM	0.0267		0.0113	-0.0281	0.0113	0.0844	0.1320	0.0113	-0.00310	0.1320	-0.0031	0.0267
HMO 2001 share	0.340	0.411	0.175	0.530	0.340	0.165	0.075	0.530	0.340		0.530	0.310
ALOS3	4.9	4.1	5.5	4.2	3.1	4.6	1.9	5.2	4.7	5.7	14	4.4
DRG3	127	127	88	88	617	89	517	127	14	89	430	209
ALOS2	5.2	11.7	6.1	5	10.3	3.9	4.6	5.7	4.9	14.9	5.4	1.9
DRG2	89	430	89	89	430	127	209	209	89	462	89	517
ALOS1	4.4	6.1	11.1	4.7	5	5.2	6.7	2.1	5.4	5.4	4.8	6
DRG1	209	1	462	127	209	209	430	517	127	209	127	127
Total Profit Margin	5	n/a	6	8	6	2	1	6	7	1	7	5
Medicaid %	8%	71%	27%	20%	10%	18%	13%	8%	27%	6%	7%	3%
Medicare %	43%	29%	25%	20%	42%	36%	31%	18%	38%	36%	52%	34%
Casemix	1.5	1.99	1.4	1.22	2.01	1.65	1.58	2.16	1.33	1.76	1.22	1.74
Occupancy Rate	0.79	0.84	0.82	0.60	0.80	0.71	0.69	0.94	0.56	0.72	0.58	0.94
Beds	188	407	479	221	315	426	241	692	100	470	228	606
Teaching	M	C	N	N	C	N	M	C	N	M	M	C
Setting	R	U	U	U	R	U	U	U	U	U	U	U
Ownership	N	G	G	N	N	N	N	N	N	N	G	N
Cardio?												
State	NH	OR	GA	MA	NH	OR	IA	MA	NH	IA	MA	NJ
Pass 2 SC	6	1	2	1	1	2	4	1	6	4	3	1
Pass 1 SC	6	1	2	1	2	3	4	1	6	4	3	1
Organization	Concord Hospital, Concord, NH	Oregon Health & Science University, Portland, OR	PROMINA Health System, Gwinnett Hospital, Lawrenceville, GA	Lowell (Mass.) General Hospital	Dartmouth-Hitchcock Medical Center, Lebanon, NH	PeaceHealth,Sacred Heart MC, Eugene, OR	Iowa Health System, Lutheran Hosp, Des Moines, IA	Partners Healthcare-Brigham and Womans Hospital, Boston	Wentworth-Douglass Hospital, Dover, NH	Iowa Health System, Methodist MC, Des Moines, IA	Quincy (Mass.) Hospital	Hackensack (N.J.) University Medical Center
Survey Participant												

LTDR		0.2000	0.5200				0.9800	1.2100	0.2000	0.2000	0.6100	0.9800
TPM	0.0416	0.0597	-0.0281		-0.0762	-0.0762	0.0113	0.0416	-0.0031	0.0597	-0.0031	0.0416
HMO 2001 share		0.079	0.530	0.310	0.411	0.352	0.440	0.310		0.079	0.440	0.310
ALOS3	n/a	4.1	4.9	n/a	n/a	6.3	4.8	7.5	2.6	7	4.7	5.6
DRG3	n/a	89	209	n/a	n/a	209	89	89	14	430	89	88
ALOS2	1.9	3.3	5.3	n/a	3.6	5.4	3.7	6.9	2.8	4.5	3.6	6.8
DRG2	132	127	89	n/a	209	89	209	127	127	127	88	89
ALOS1	3	6.4	5.3	n/a	3.6	4.6	3.6	2.2	3.5	5.9	4.7	6
DRG1	127	209	127	n/a	89	127	127	517	89	89	127	127
Total Profit Margin	4	3	8	n/a	9	9	6	4	7	3	7	4
Medicaid %	13%	15%	18%		12%	33%	2%	5%	7%	13%	7%	2%
Medicare %	25%	40%	30%		26%	39%	37%	35%	16%	44%	36%	43%
Casemix	1.14	1.17	1.28		1.19	1.12	1.46	1.77	1.2	1.3	1.24	1.21
Occupancy Rate	0.40	0.49	0.79		0.37	0.54	0.91	0.82	0.34	0.62	0.82	0.81
Beds	41	38	241		32	38	244	413	77	264	551	200
Teaching	N	N	M		N	N	N	C	N	N	C	N
Setting	U	R	U		R	R	U	U	U	R	U	U
Ownership	N	N	N		N	N	N	N	N	G	N	N
Cardio?									1			
State	OR	ID	MA	NJ	OR	ID	MD	NJ	OR	ID	MD	NJ
Pass 2 SC	3	2	2	1	3	1	4	1	3	1	6	6
Pass 1 SC	3	2	2	1	3	1	4	1	3	1	6	6
Organization	Providence Health System, Hosp. Newberg, Ore.	Gritman Medical Center, Moscow, ID	Salem (Mass.) Hospital	Hunterdon Healthcare System, Flemington, N.J.	Providence Health System, Memorial Hosp, Hood River, Ore.	Intermountain-Cassia Regional MC, Burley, ID	Anne Arundel Health System, Annapolis MD	Meridian Health System, Jersey Shore Medical Center, Neptune City, NJ	Providence Health System, Milwaukie Hosp. Milwaukie, Ore.	Kootenai Medical Center, Coeur d'Alene, ID	Johns Hopkins Institutions, Baltimore, MD	Robert Wood Johnson University Hospital, Hamilton, NJ
Survey Participant												

LTDR	0.2000	0.2000	0.3600	0.9800	0.5200		0.5200	0.0400		0.6600	2.0000
TPM	0.0597	0.0416	-0.0281	0.0844	0.0416	-0.0762	0.0113	0.0597	0.0113	0.0267	0.0267
HMO 2001 share		0.079	0.440	0.310		0.210	0.310			0.270	0.377
ALOS3	4.4	1.6	8.2	7	5.8	3.9	2.5	8.6	6.2	3.6	5.7
DRG3	89	517	462	89	89	88	517	438	89	127	127
ALOS2	8.8	4	4.9	12.7	4.5	4.1	7.2	2.3	13.4	4.5	5.7
DRG2	462	209	127	430	127	127	89	517	462	89	89
ALOS1	4.5	7.5	5.7	6.8	4.7	7	6	3.8	5.8	8.4	4.9
DRG1	209	462	89	127	209	430	127	209	127	430	209
Total Profit Margin	3	4	8	2	4	9	6	3	6	5	5
Medicaid %	5%	9%	2%	6%	23%	55%	1%	8%	15%	8%	2%
Medicare %	19%	39%	40%	33%	28%	28%	41%	17%	36%	37%	39%
Casemix	1.62	1.75	1.39	1.31	1.55	1.34	1.66	1.73	1.66	1.17	1.65
Occupancy Rate		0.64	0.68	0.79	0.62	0.57	0.88	0.97	0.91	0.41	0.82
Beds	345	344	307	361	47	430	412	451	631	63	443
Teaching	C	M	N	N	N	M	N	M	M	M	N
Setting	U	U	U	U	R	U	U	U	U	R	U
Ownership	N	N	N	N	N	N	N	N	N	N	N
Cardio?								1			
State	OR	ID	MD	NJ	OR	IL	NJ	OR	IL	MI	NM
Pass 2 SC	3	1	2	3	3	4	4	3	4	1	3
Pass 1 SC	3	1	2	3	3	4	4	3	4	1	3
Organization	Providence Health System, Portland Medical Cntr, Portland, Ore.	Saint Alphonsus Regional Medical Center, Boise, ID	Washington County Health System, Hagerstown, Md.	St. Clare's Health Services, Denville, N.J.	Providence Health System, Seaside Hosp, Seaside, Ore.	Advocate Health Care, Bethany Hosp. Chicago, IL	Valley Health System, Ridgewood, NJ	Providence Health System, St Vincent, Portland, Ore.	Advocate Health Care, Christ Hosp, Oak Lawn, IL	Carson City (Mich.) Hospital	Presbyterian Healthcare Services, Alburquerque, NM
Survey Participant											

LTDR	1.2100		1.6600	0.3600	0.9800		0.6600	2.0000	0.6100		0.5200
TPM	0.0113	0.0597	-0.5000	0.0113	-0.5000	0.0844	0.0597	0.0267	-0.0281		0.0113
HMO 2001 share	0.340		0.270	0.377	0.340		0.270	0.377	0.340		0.270
ALOS3	6.6	4.7	5.9	2.6	3.5	5.6	3.6	4.9	13.2	n/a	2.1
DRG3	89	127	14	182	209	89	209	127	430	n/a	517
ALOS2	5.3	5	4.6	3.6	6.3	1.6	4.1	5.8	3.6	n/a	5.4
DRG2	127	89	296	127	89	143	127	89	127	n/a	209
ALOS1	11.5	11.6	5	4.5	5.6	5.4	4.5	5.5	4.6	n/a	9.1
DRG1	462	430	127	89	127	127	89	209	209	n/a	462
Total Profit Margin	6	3	10	6	10	2	3	5	8		6
Medicaid %	4%	6%	9%	14%	2%	3%	22%	4%	12%	n/a	11%
Medicare %	26%	42%	35%	34%	31%	34%	30%	18%	28%	n/a	43%
Casemix	1.37	1.53	1.6	1.23	1.54	1.22	2.5	1.65	1.84	n/a	1.87
Occupancy Rate	0.81	0.83	0.74	0.60		0.85	0.38	0.82	0.72	n/a	0.61
Beds	598	99	722	73	187	146	213	443	349		281
Teaching	C	N	C	N	N	N	N	N	C		M
Setting	U	U	U	R	U	U	U	U	R		R
Ownership	N	N	N	N	N	N	N	N	N		N
Cardio?											
State	PA	IL	MI	NM	PA	IL	MI	NM	PA	IL	MI
Pass 2 SC	2	4	2	1	3	4	3	2	2	4	1
Pass 1 SC	2	4	2	1	3	4	3	2	3	4	1
Organization	Crozer-Keystone Health Systems, Chester Medical Center, Upland, Pa.	Advocate Health Care, Good Samaritan Hosp, Downers Grove, IL	Henry Ford Health System, Detroit	Rehoboth McKinley Christian Health Care Services, Gallup, NM	Doylestown Hospital, Doylestown, PA	Advocate Health Care, Good Shepard Hosp, Barrington, IL	Holland Community Hospital, Holland, MI	St. Joseph Medical Center, Albuquerque, N.Mex.	Geisinger Health System, Danville, PA	Advocate Health Care, Masonic Hosp, Chicago, IL	Marquette (Mich.) General Hospital
Survey Participant											

LTDR	1.2100	2.0000		0.5200	0.6600		0.5200	1.2100		0.6600	0.5200	1.6600	0.9800
TPM	0.0844	-0.0281	0.0267	0.0597	0.0113	0.0113	0.0113	0.0267	0.0416	0.0597	0.0597	0.0416	-0.0762
HMO 2001 share	0.377	0.340		0.270	0.340		0.270	0.340	0.210	0.340	0.210	0.340	0.340
ALOS3	4	4.7	4.8	4.6	5.6	4.5	4.4	13.5	4.8	6.2	4.9	12.2	3.2
DRG3	88	127	88	127	89	88	127	462	89	127	209	430	517
ALOS2	4	3.4	6.4	4.2	5.6	2.9	4.7	6.9	3.4	4.3	4	3.7	12.2
DRG2	320	116	89	430	127	143	89	127	209	209	127	209	462
ALOS1	4.6	3.7	5.4	6.1	3.9	5.4	5.9	4.6	3.6	8.6	5.1	5	6.5
DRG1	89	209	127	429	209	127	462	209	127	462	89	127	127
Total Profit Margin	2	8	5	3	6	6	6	5	4	3	3	4	9
Medicaid %	4%	10%	12%	6%	11%	20%	19%	4%	16%	6%	17%	6%	17%
Medicare %	23%	50%	40%	59%	39%	29%	35%	23%	28%	37%	40%	41%	31%
Casemix	1.08	1.93	1.25	1.21	1.85	1.29	1.34	1.73	1.76	1.76	1.16	1.7	1.72
Occupancy Rate	0.35	0.60	0.79	0.47	0.68	0.71	0.67	0.85	0.63	0.74	0.36	0.83	0.62
Beds	114	266	235	147	302	212	185	805	261	498	136	599	416
Teaching	N	M	N	N	C	M	M	C	M	M	N	C	C
Setting	U	R	U	R	U	U	U	U	U	U	U	U	U
Ownership	N	N	N	N	N	N	N	N	N	N	N	N	N
Cardio?										1			
State	NM	PA	IL	MI	PA	IL	MI	PA	IL	PA	IL	PA	PA
Pass 2 SC	2	6	4	6	5	4	5	4	3	2	6	3	3
Pass 1 SC	2	6	4	6	5	4	5	4	3	2	6	3	3
Organization	St. Joseph Northeast, Albuquerque, N.Mex.	Guthrie Health, Sayre, PA	Advocate Health Care, South Suburban, Hazel Crest, IL	Memorial Healthcare Center, Owosso, MI	Hamot Medical Center, Erie, PA	Advocate Health Care, Trinity Hosp, Chicago, IL	Metropolitan Hospital and Metro Health, Grand Rapids, MI	Jefferson Health System, Jefferson Hospital Philadelphia, PA	Carle Foundation, Urbana, Ill.	Lancaster General, Lancaster, PA	Kishwaukee Health System, DeKalb, IL	Lehigh Valley Health Network, Allentown, Pa.	Pittsburgh Mercy Hospital
Survey Participant													

LTDR	1.6600	0.6100	1.6600	1.6600	0.6100	2.0000		0.6100	1.6600	0.2000	2.0000	2.0000
TPM	-0.0762	0.0597	-0.0031	0.0416	-0.5000	0.0844	0.0113	-0.0281	0.0416	0.1320	0.0844	-0.0031
HMO 2001 share	0.210	0.340	0.210	0.340	0.210	0.340	0.210		0.210	0.340		
ALOS3	1.8	6.1	5.1	n/a	5	4.8	5.1	5.5	6	5.1	4.5	10.7
DRG3	517	89	89	n/a	127	127	209	88	127	127	209	430
ALOS2	4.3	6.1	4.8	n/a	15.5	12.3	5.3	6.5	4.6	10	5.2	5.7
DRG2	127	88	127	n/a	430	462	14	89	209	462	127	127
ALOS1	13.3	5.7	10.7	10	5.1	19.8	5.8	5.9	9.7	19.4	2	9.1
DRG1	462	127	430	430	209	430	127	127	462	430	517	462
Total Profit Margin	9	3	7	4	10	2	6	8	4	1	2	7
Medicaid %	15%	10%	18%		12%	11%	18%	1%	21%	3%	1%	1%
Medicare %	31%	37%	30%		29%	20%	34%	42%	48%	36%	40%	54%
Casemix	1.85	1.12	1.42	0.76	1.6	2.02	1.75	1.43	1.48	2.13	1.85	1.27
Occupancy Rate	0.49	0.68	0.81	0.09	0.93	0.83	0.77	0.60	0.54	0.82	0.65	0.65
Beds	473	117	285	167	673	641	525	292	323	892	535	136
Teaching	C	N	C	N	C	C	M	N	N	C	C	N
Setting	U	U	U	U	U	U	U	U	U	U	U	U
Ownership	N	N	N	N	N	N	N	N	N	N	N	N
Cardio?										1		
State	IL	PA	IL	PA	IL	PA	IL	PA	IL	PA	PA	PA
Pass 2 SC	1	4	2	1	1	4	2	1	6	1	1	1
Pass 1 SC	1	4	2	1	1	4	2	1	6	1	1	1
Organization	Loyola University Health System, Maywood, IL	Somerset Hospital, Somerset, PA	MacNeal Health Network, Berwyn, Ill.	Susquehanna Health System, Divine Providence Hospital, Williamsport, PA	Northwestern Memorial Hospital, Chicago IL	University of Pennsylvania Health Sys., Philadelphia, PA	OSF HealthCare System, Peoria, IL	UPMC Passavant Hospital, Pittsburgh	Riverside HealthCare, Kankakee, IL	UPMC Presbyterian Hospital, Pittsburgh	UPMC Shadyside Hospital, Pittsburgh	UPMC Southside Hospital, Pittsburgh
Survey Participant												

LTDR	1.6600	1.2100	1.2100	0.5200	0.6100	0.6600		0.9800	0.2000	0.2000	0.0400
TPM	0.0416	0.0267	0.0416	-0.0762	0.0267	0.0844	-0.0031	-0.5000	0.0844	0.0597	0.0267
HMO 2001 share	0.340	0.210	0.380	0.099	0.068	0.068	0.330	0.330	0.330	0.330	0.330
ALOS3	14.8	4.9	4.9	7.5	7.3	4.7	8.2	6.4	5.2	6.3	7.7
DRG3	430	209	89	89	430	127	14	89	127	89	14
ALOS2	4.6	2.5	4.8	6.4	12.1	5	4	5.5	11.4	5.5	7.8
DRG2	209	517	127	88	462	209	517	127	462	88	89
ALOS1	5.5	5	2.4	5.9	4.5	11.6	8.6	5	9.5	5.3	6.8
DRG1	127	127	517	127	209	462	127	88	430	127	127
Total Profit Margin	4	5	4	9	5	2	7	10	2	3	5
Medicaid %	8%	24%	4%	21%	10%	14%	6%	22%	31%	21%	22%
Medicare %	44%	38%	37%	53%	46%	32%	56%	39%	40%	45%	35%
Casemix	1.57	1.55	1.7	1.2	1.74	1.72	1.79	1.21	1.8	1.25	1.59
Occupancy Rate	0.82	0.67	0.73	0.61	0.69	0.65	0.86	0.66	0.71	0.68	0.79
Beds	448	286	226	131	499	482	624	180	556	275	1305
Teaching	C	M	C	N	M	M	M	N	N	N	M
Setting	U	U	U	R	U	U	U	U	U	R	U
Ownership	N	N	N	I	N	N	N	G	I	G	N
Cardio?						1					
State	PA	IL	RI	SC	SD	SD	TN	TN	TN	TN	TN
Pass 2 SC	6	1	6	3	1	2	2	5	5	2	3
Pass 1 SC	6	1	6	3	1	2	2	5	5	2	3
Organization	Wellspan Health, York Hospital,York, PA	SwedishAmerican Health System Rockford Ill	Lifespan-Miriam Hospital, Providence, RI	Colleton Medical Center, Walterboro, S.C.	Avera Health, McKenna Hospital, Sioux Falls, SD	Sioux Valley Hospital & University Medical Center, Sioux Falls, SD	Baptist Memorial Hospital-East, Memphis, Tenn.	Gateway Health System, Memorial General, Clarksville, TN	HCA-Centenial Medical Center, Nashville, TN	Maury Regional Healthcare Systems, Columbia, TN	Methodist HealthCare, Memphis, Tenn.
Survey Participant											

LTDR	0.5200	0.6600	2.0000	1.2100	1.2100	0.6100	0.6100	1.6600	0.2000	0.3600	
TPM	0.0844	-0.0031		-0.0031	0.0844	0.0844	0.0597	0.0416	0.0844	-0.0281	
HMO 2001 share	0.330	0.330	0.330			0.330	0.185	0.185	0.185	0.185	0.185
ALOS3	5.6	5.2	4.7	4.3	1.9	5	6	n/a	5.1	5.9	10.8
DRG3	89	462	88	127	143	89	89	n/a	209	14	462
ALOS2	5	4.9	5.2	4	5.3	2.4	5.8	n/a	4.9	4.3	6.3
DRG2	127	209	89	88	89	517	127	n/a	127	127	127
ALOS1	13.2	7.8	4.9	2.1	10.2	4.9	5.8	n/a	5.9	9	2.3
DRG1	462	430	127	143	438	127	209	n/a	430	462	517
Total Profit Margin	2	7	n/a	7	2	2	3	4	2	8	n/a
Medicaid %	20%	12%	33%	15%	13%	16%	3%	29%	9%	12%	n/a
Medicare %	47%	42%	30%	61%	46%	39%	38%	0%	54%	29%	n/a
Casemix	1.65	1.56	1.8	0.94	1.45	1.75	1.88	n/a	1.76	1.73	n/a
Occupancy Rate	0.85	0.47	0.69	0.26	0.65	0.53	0.73	0.76	0.64	0.79	n/a
Beds	449	516	483	50	294	425	908	241	417	367	n/a
Teaching	M	N	M	N	M	M	C	M	N	C	C
Setting	U	U	U	U	U	U	U	U	U	U	U
Ownership	N	N	G	G	N	N	N	N	N	N	N
Cardio?									1		
State	TN	TN	TN	TN	TN	TN	TX	TX	TX	TX	TX
Pass 2 SC	2	1	2	3	3	3	1	5	1	5	4
Pass 1 SC	2	1	2	3	3	3	1	5	1	5	4
Organization	Mountain States Health Alliance, Johnson City Medical Center, TN	St. Mary's Health System, Knoxville, Tenn.	UT Medical Center, Knoxville, Tenn.	Wellmont Hawkins County Mem Hospital, Rogersville, Tenn.	Wellmont Health - Bristol Regional MC, Bristol, Tenn.	Wellmont Health-Holston Valley MC Kingsport, Tenn.	Baylor Health Care System, Dallas, TX	Children's Medical Center of Dallas, Dallas, TX	ETMC Regional Healthcare System, Tyler TX	Methodist Hospitals of Dallas, Dallas, TX	St. Luke's Episcopal Hospital, Houston,TX
Survey Participant											

LTDR	0.5200		1.6600				0.2000		0.3600	
TPM	0.0267	-0.5000	-0.0762	0.0597	0.0597	-0.0281	0.0844	0.0267	0.0597	0.0113
HMO 2001 share	0.185	0.185	0.185	0.352	0.352	0.352	0.352	0.352	0.352	0.352
ALOS3	8.1	8.9	5.5	4.1	3.5	n/a	4.3	8.7	4.1	4.2
DRG3	89	492	14	14	209	n/a	14	109	127	127
ALOS2	6.1	8.3	6.2	3.9	3.7	n/a	4.2	1.9	4.6	4.6
DRG2	88	75	89	209	127	n/a	209	517	89	89
ALOS1	5.8	5.3	4.9	4.8	4	n/a	5.2	4.8	4	4.5
DRG1	127	410	127	89	89	n/a	89	209	209	209
Total Profit Margin	5	10	9	3	3	8	2	5	3	6
Medicaid %	2%	6%	21%	7%	5%	12%	7%	4%	13%	11%
Medicare %	24%	28%	40%	26%	20%	26%	27%	27%	25%	32%
Casemix	1.4	1.79	1.41	1.2	1.12	0.96	1.31	2.03	1.23	1.62
Occupancy Rate	0.74	0.71	0.92	0.72	0.65	0.70	0.74	0.72	0.50	0.65
Beds	372	518	193	72	93	58	172	466	148	287
Teaching	N	C	N	N	N	N	N	M	N	M
Setting	U	U	U	U	U	R	U	U	R	U
Ownership	N	G	N	N	N	N	N	N	N	N
Cardio?										
State	TX	TX	TX	UT	UT	UT	UT	UT	UT	UT
Pass 2 SC	1	3	3	1	1	1	1	1	1	1
Pass 1 SC	1	3	3	1	1	1	1	1	1	1
Organization	Texas Health Resources Arlington Mem Hospital, Arlington, TX	University of Texas M.D. Anderson Cancer Center, Houston, TX	Wadley Regional Medical Center, Texarkana, Texas	Intermountain- Alta View Hospital, Sandy, UT	Intermountain- American Fork Hospital, American Fork, UT	Intermountain- Bear River Valley Hospital, Tremonton, UT	Intermountain- Cottonwood Hospital, Murray, UT	Intermountain- LDS Hospital, Salt Lake City	Intermountain- Logan Regional Hospital, Logan, UT	Intermountain- McKay Dee Hospital, Ogden, UT
Survey Participant										

LTDR		0.2000		0.6100	1.6600	0.0400		0.0400	0.5200	0.0400
TPM	0.0597	0.0416	0.0597	0.0113	-0.0762	0.1320	0.0597	0.0844	0.0597	0.0113
HMO 2001 share	0.352	0.352	0.352	0.352	0.185			0.185		0.185
ALOS3	n/a	4.7	4.2	4.1	6.4	5.6	5.2	5.3	6.6	4.9
DRG3	n/a	127	89	14	89	209	209	209	89	127
ALOS2	n/a	1.9	1.4	14	2.9	2.4	5.8	5.3	7	8.5
DRG2	n/a	517	143	462	517	143	89	127	88	109
ALOS1	n/a	4.1	3.4	5	6.9	7.5	5.3	2.1	6	1.6
DRG1	n/a	209	209	209	127	127	127	517	127	517
Total Profit Margin	3	4	3	6	9	1	3	2	3	6
Medicaid %	29%	9%	21%	34%	20%	10%	6%	13%	22%	5%
Medicare %	0%	28%	31%	25%	47%	27%	19%	16%	21%	38%
Casemix	n/a	1.82	1.3	1.87	1.7	1.46	1.29	1.85	1.35	2.14
Occupancy Rate	0.83	0.72	0.56	0.82	0.72	0.76	n/a	n/a	0.74	0.73
Beds	199	324	34	378	762	355	136	715	158	539
Teaching	N	M	N	C	C	N	N	C	N	M
Setting	U	U	R	U	U	U	U	U	U	U
Ownership	N	N	N	G	N	N	N	N	N	N
Cardio?								1		
State	UT	UT	UT	UT	VA	VA	VA	VA	VA	VA
Pass 2 SC	1	1	1	2	2	6	6	6	6	1
Pass 1 SC	1	1	1	3	2	6	6	6	6	1
Organization	Intermountain-Primary Children's MC, Salt Lake City	Intermountain-Utah Valley Regional MC, Provo, UT	Intermountain-Valley View Medical Center, Cedar City,UT	University Hospitals and Clinics, Salt Lake City, UT	Carilion Health System-Medical Center, Roanoke, VA	Inova Health System, Alexandria Hospital, Alexandria, VA	Inova Health System, Fair Oaks Hospital, Fairfax, VA	Inova Health System, INOVA Fairfax Hospital. Falls Church, VA	Inova Health System, Potomac Hospital, Woodbridge, VA	Sentara Health System, Norfolk General Hospital, Norfolk, Va.
Survey Participant										

LTDR	0.0400	0.5200		0.9800	0.5200	0.5200	1.2100	0.6100	0.9800
TPM	0.0844	-0.0031	0.0113	-0.0031	-0.0031	0.0416	0.0416	-0.5000	-0.5000
HMO 2001 share		0.185	0.185				0.185	0.165	
ALOS3	5.3	4.6	5.6	4.7	4.6	4	10	4.9	4.7
DRG3	89	127	209	127	14	88	462	127	14
ALOS2	5	8.5	5.1	6.9	4.3	1.2	2.3	5.1	6
DRG2	127	430	89	430	127	127	517	89	89
ALOS1	4.7	1.9	4.6	1.7	5.5	5.2	4.7	4.6	4.9
DRG1	209	517	127	143	89	89	127	209	209
Total Profit Margin	2	7	6	7	7	4	4	10	10
Medicaid %	3%	10%	5%	8%	8%	10%	9%	12%	8%
Medicare %	44%	36%	38%	49%	54%	48%	51%	38%	46%
Casemix	1.54	1.97	1.27	1.13	1.15	1.07	1.55	1.89	1.28
Occupancy Rate	0.68	0.74	0.63	0.60	0.74	0.47	0.76	0.66	0.52
Beds	250	554	86	70	157	154	408	297	93
Teaching	M	C	N	N	N	M	M	M	M
Setting	U	U	U	U	R	U	R	U	U
Ownership	N	N	N	N	N	N	N	N	N
Cardio?									
State	VA	VA	VA	VA	VA	VA	VA	WA	WA
Pass 2 SC	1	1	4	4	4	4	4	6	6
Pass 1 SC	1	1	4	4	4	4	4	6	6
Organization	Sentara Health System, Sentara Leigh Hospital. Norfolk, Va.	University of Virginia Health System, Charlottesville, VA	Valley Health System , Fauquier Hospital Inc, Warrenton, VA	Valley Health System, Culpeper Memorial Hospital, Culpeper, VA	Valley Health System, Shenandoah Memorial Hospital, Woodstock, VA	Valley Health System, Warren Memorial, Front Royal, VA	Valley Health System, Winchester Medical Center, Winchester, VA	Empire Health Services, Deaconess Medical Center, Spokane, WA	Empire Health Services, Valley Hospital & MC, Spokane, WA
Survey Participant									

LTDR	2.0000	0.5200	0.6100	0.2000	1.6600	1.6600	0.3600	0.3600	0.3600	0.9800	2.0000	0.6600	
TPM	0.0113	0.0416	-0.0031	0.0597	-0.0762	0.0267	0.0416	0.1320	-0.0031	0.0267	0.0597	0.0267	0.0267
HMO 2001 share	0.165	0.165			0.165	0.165	0.300		0.103	0.075	0.075	0.075	0.075
ALOS3	3.9	4.1	7	3.3	15	3.7	4.1	4	8.7	n/a	2.7	6.3	6.4
DRG3	127	127	430	127	430	127	89	127	430	n/a	517	88	109
ALOS2	4.9	3.7	3.7	4.2	3	3.9	4.6	9.5	4.9	n/a	4.6	4.9	2.2
DRG2	89	89	127	89	517	209	127	462	127	n/a	209	209	517
ALOS1	4.1	4.5	4.6	3.7	4.4	8.5	5.1	4.4	6.1	n/a	5	5.9	13.3
DRG1	209	209	89	209	209	462	209	209	89	n/a	127	127	462
Total Profit Margin	6	4	7	3	9	5	4	1	7	5	3	5	5
Medicaid %	11%	7%	28%	18%	20%	3%	7%	4%	16%	45%	11%	1%	17%
Medicare %	37%	26%	28%	38%	36%	33%	47%	45%	52%	1%	41%	30%	28%
Casemix	1.43	1.62	1.25	1.37	2.1	1.84	1.72	1.5	1.05	n/a	1.63	1.42	2.03
Occupancy Rate	0.51	0.81	0.69	0.79	0.65	0.80	0.54	0.51	0.39	0.80	0.67	0.79	0.79
Beds	196	228	171	215	568	270	504	195	61	225	768	325	867
Teaching	N	N	N	N	M	M	M	N	N	M	M	N	C
Setting	U	U	R	U	U	U	R	U	U	U	U	U	U
Ownership	N	N	N	N	N	N	N	N	I	N	G	N	G
Cardio?								1					
State	WA	WA	WA	WA	WA	WA	WI	WI	WV	AL	AL	AL	AL
Pass 2 SC	6	2	2	2	6	3	2	6	5	5	6	2	1
Pass 1 SC	6	2	3	3	6	3	2	6	5	5	6	2	1
Organization	Holy Family Hospital, Spokane, WA	Overlake Hospital Medical Center, Bellevue WA	PeaceHealth, St John MC, Longview, WA	PeaceHealth, St Joseph Hospital, Bellingham, WA	Sacred Heart Medical Center, Spokane, WA	Virginia Mason Medical Center, Seattle	Saint Joseph's Hospital, Marshfield, WI	ThedaCare, Theda Clark Medical Center, Neenah, WI	St. Joseph's Hospital, Parkersburg, WV	Children's Health System, Birmingham, AL	Huntsville Hospital, Huntsville, AL	St. Vincent's Hospital, Birmingham, Ala.	UAB Health System, Birmingham, AL
Survey Participant													

Survey Participant	Organization	Pass 1 SC	Pass 2 SC	State	Cardio?	Ownership	Setting	Teaching	Beds	Occupancy Rate	Casemix	Medicare %	Medicaid %	Total Profit Margin	DRG1	ALOS1	DRG2	ALOS2	DRG3	ALOS3	HMO 2001 share	TPM	LTDR
	Arkansas Children's Hospital, Little Rock	3	3	AR		N	U	C	233	0.78	n/a	1%	35%	2	n/a	n/a	n/a	n/a	n/a	n/a	0.097	0.0844	0.5200
	Children's Hospital and Research Center, Oakland, CA	6	6	CA		N	U	M	205	0.70		0%	34%	7	n/a	n/a	n/a	n/a	n/a	n/a	0.535	-0.0031	0.6100
	Oak Valley Hospital, Oakdale, Calif.	3	3	CA		G	U	N	144	0.88	1.24	28%	16%	6	127	5.1	89	4.9	n/a	n/a	0.535	0.0113	
	Advocate Health Care, Lutheran General Hosp, Park Ridge, IL	4	4	IL	1	N	U	C	519	0.76	1.46	36%	7%	1	127	4.5	89	4.6	462	14.9		0.1320	
	Sparrow Health System, Lansing, MI	5	5	MI		I	U	M	507	0.83	1.52	36%	11%	5	127	5.6	517	3	430	13.5	0.270	0.0267	1.2100
	Allina Health System, St Francis, Shakopee, MN	5	5	MN		N	U	N	61	0.64	1.16	25%	15%	3	209	4	89	4.4	127	3.8		0.0597	0.6100

QUALITATIVE DATA TO EXPAND CASES FY2002/2003: existence of CIO, IT committee, clinical representation, share of budget for IT, reporting chain for IT, and found references to Leapfrog Initiatives in planning documents.

CASE ID	ORGANIZATION	ST CLASS	CDIV	STATE	CIO	ITCOMM	CREP	SHARE	REPTO	LEAPF
1	Arnot Ogden Medical Center, Elmira, N.Y.	1	2	NY	Y	Y	Y	.0350	F	Y
2	Avera Health, McKenna Hospital, Sioux Falls, SD	1	6	SD	Y	Y	Y	.0299	F	Y
3	Baptist Health Care, Pensacola, FL	1	3	FL	Y	Y	Y	#NULL!	E	N
4	Baptist Health, Little Rock, AR	1	7	AR	Y	Y	Y	.0300	F	Y
5	Baylor Health Care System, Dallas, TX	1	7	TX	Y	N	N	#NULL!	C	Y
6	Berkshire Health System, Pittsfield, Mass.	1	1	MA	Y	Y	Y	#NULL!	F	Y
7	Cape Fear Valley Health System, Fayetteville, N.C.	1	3	NC	Y	Y	Y	#NULL!	F	Y
8	Dartmouth-Hitchcock Medical Center, Lebanon, NH	1	1	NH	Y	Y	Y	.0299	C	Y
9	ETMC Regional Healthcare System, Tyler TX	1	7	TX	Y	D	N	.0149	C	N
10	Good Hope Hospital, Erwin, N.C.	1	3	NC	Y	Y	N	#NULL!	O	Y
11	Hackensack (N.J.) University Medical Center	1	2	NJ	Y	Y	Y	#NULL!	O	Y
12	Hunterdon Healthcare System, Flemington, N.J.	1	2	NJ	Y	Y	Y	.0199	O	Y
13	INTEGRIS Health, Oklahoma City, OK	1	7	OK	Y	Y	N	.0299	E	Y
14	Intermountain-Alta View Hospital, Sandy, UT	1	8	UT	Y	Y	N	.0249	F	Y
15	Intermountain-American Fork Hospital, American Fork, UT	1	8	UT	Y	Y	N	.0249	F	Y
16	Intermountain-Bear River Valley Hospital, Tremonton, UT	1	8	UT	Y	Y	N	.0249	F	Y
17	Intermountain-Cassia Regional MC, Burley, ID	1	8	ID	Y	Y	N	.0249	F	Y
18	Intermountain-Cottonwood Hospital, Murray, UT	1	8	UT	Y	Y	N	.0249	F	Y
19	Intermountain-LDS Hospital, Salt Lake City	1	8	UT	Y	Y	N	.0249	F	Y
20	Intermountain-Logan Regional Hospital, Logan, UT	1	8	UT	Y	Y	N	.0249	F	Y
21	Intermountain-McKay Dee Hospital, Ogden, UT	1	8	UT	Y	Y	N	.0249	F	Y
22	Intermountain-Primary Children's MC, Salt Lake City	1	8	UT	Y	Y	N	.0249	F	Y
23	Intermountain-Utah Valley Regional MC, Provo, UT	1	8	UT	Y	Y	N	.0249	F	Y
24	Intermountain-Valley View Medical Center, Cedar City,UT	1	8	UT	Y	Y	N	.0249	F	Y
25	Kootenai Medical Center, Coeur d'Alene, ID	1	8	ID	Y	Y	Y	.0349	F	N
26	Lowell (Mass.) General Hospital	1	1	MA	Y	Y	Y	#NULL!	O	N
27	Loyola University Health System, Maywood, IL	1	4	IL	Y	Y	Y	#NULL!	F	Y
28	Maimonides Medical Center, Brooklyn, NY	1	2	NY	Y	Y	Y	.0199	E	Y
29	Marquette (Mich.) General Hospital	1	4	MI	Y	Y	Y	#NULL!	E	Y
30	Memorial Health Services, Long Beach, CA	1	9	CA	Y	Y	N	#NULL!	E	Y
31	Memorial Health System, Savannah, GA	1	3	GA	Y	Y	Y	#NULL!	E	Y
32	Meridian Health System, Jersey Shore Medical Center, Neptune City, NJ	1	2	NJ	Y	Y	N	#NULL!	E	Y
33	MeritCare Health System, St Luke's Hosp.,Fargo, N.Dak.	1	6	ND	Y	N	N	.0399	E	Y
34	Methodist Health Care System, Houston	1	7	TX	Y	Y	Y	#NULL!	F	N
35	Methodist Health System, Omaha, NE	1	6	NE	Y	Y	Y	#NULL!	E	Y
36	North Broward Hospital District, Fort Lauderdale, FL	1	3	FL	Y	Y	Y	.0349	E	Y
37	Northwestern Memorial Hospital, Chicago IL	1	4	IL	Y	Y	N	.0298	E	Y
38	Ohio State University Health System, Columbus, OH	1	4	OH	Y	Y	Y	.0249	E	Y

CASE ID	ORGANIZATION	ST CLASS	CDIV	STATE	CIO	ITCOMM	CREP	SHARE	REPTO	LEAPF
39	Oregon Health & Science University, Portland, OR	1	9	OR	Y	Y	Y	.0399	E	Y
40	Partners Healthcare-Brigham and Womans Hospital, Boston	1	1	MA	Y	Y	Y	#NULL!	F	Y
41	Rehoboth McKinley Christian Health Care Services, Gallup, NM	1	8	NM	Y	Y	Y	.0149	E	N
42	Rush-Copley Memorial Hospital Center, Aurora, IL	1	4	IL	Y	Y	Y	.0249	E	N
43	Saint Alphonsus Regional Medical Center, Boise, ID	1	8	ID	Y	Y	N	#NULL!	F	N
44	Saint Luke's Shawnee Mission Health System, Kansas City, Mo.	1	6	MO	Y	Y	Y	.0399	F	Y
45	Sentara Health System, Norfolk General Hospital, Norfolk, Va.	1	3	VA	Y	D	N	.0329	O	Y
46	Sentara Health System, Sentara Leigh Hospital. Norfolk, Va.	1	3	VA	Y	D	N	.0329	O	Y
47	Sharp Healthcare, San Diego	1	9	CA	Y	Y	N	#NULL!	E	Y
48	St. John Health System, Tulsa, OK	1	7	OK	Y	N	N	#NULL!	F	Y
49	St. Mary's Health System, Knoxville, Tenn.	1	5	TN	Y	N	N	#NULL!	E	N
50	Susquehanna Health System, Divine Providence Hospital, Williamsport, PA	1	2	PA	Y	Y	Y	.0249	E	Y
51	SwedishAmerican Health System Rockford Ill	1	4	IL	Y	Y	Y	.0199	E	Y
52	Texas Health Resources - Arlington Mem Hospital, Arlington, TX	1	7	TX	Y	Y	N	.0349	O	Y
53	UAB Health System, Birmingham, AL	1	5	AL	Y	Y	Y	.0249	E	Y
54	University of Virginia Health System, Charlottesville, VA	1	3	VA	Y	Y	Y	.0299	E	Y
55	UPMC Passavant Hospital, Pittsburgh	1	2	PA	Y	Y	N	.0149	F	Y
56	UPMC Presbyterian Hospital, Pittsburgh	1	2	PA	Y	Y	N	.0149	F	Y
57	UPMC Shadyside Hospital, Pittsburgh	1	2	PA	Y	Y	N	.0149	F	Y
58	UPMC Southside Hospital, Pittsburgh	1	2	PA	Y	Y	N	.0149	F	Y
59	William Beaumont Hospital, Royal Oak, Mich.	1	4	MI	Y	Y	Y	.0299	O	Y
60	Ancilla Systems, St Mary's MC, Hobart, Ind.	2	4	IN	Y	Y	N	#NULL!	F	Y
61	Baptist Memorial Hospital-East, Memphis, Tenn.	2	5	TN	Y	Y	N	#NULL!	O	N
62	Carilion Health System-Medical Center, Roanoke, VA	2	3	VA	Y	Y	Y	#NULL!	F	Y
63	Children's Healthcare of Atlanta, Atlanta, GA	2	3	GA	Y	Y	Y	.0399	O	Y
64	Clarian Health Partners, Indianapolis	2	4	IN	Y	Y	Y	#NULL!	E	N
65	Community Hospital Indianapolis	2	4	IN	Y	Y	Y	#NULL!	E	Y
66	Crozer-Keystone Health Systems, Chester Medical Center, Upland, Pa.	2	2	PA	Y	Y	N	#NULL!	E	N
67	Ellis Hospital, Schenectady, N.Y.	2	2	NY	Y	Y	N	#NULL!	F	Y
68	Florida Hospital, Orlando, FL	2	3	FL	Y	Y	Y	#NULL!	E	Y
69	Geisinger Health System, Danville, PA	2	2	PA	Y	Y	Y	.0499	O	Y
70	General Health System, Baton Rouge, LA	2	7	LA	Y	D	N	#NULL!	E	N
71	Greenwich (Conn.) Hospital	2	1	CT	Y	Y	N	.0249	F	N
72	Gritman Medical Center, Moscow, ID	2	8	ID	Y	Y	N	#NULL!	O	Y
73	Henry Ford Health System, Detroit	2	4	MI	Y	Y	N	#NULL!	F	Y
74	Lancaster General, Lancaster, PA	2	2	PA	Y	Y	Y	.0249	E	Y
75	Legacy Emanual Hospital, Portland, OR	2	9	OR	Y	Y	N	#NULL!	E	N
76	Legacy Good Samaritan Hospital, Portland, OR	2	9	OR	Y	Y	N	#NULL!	E	N
77	MacNeal Health Network, Berwyn, Ill.	2	4	IL	Y	Y	N	.0249	F	Y
78	Maury Regional Healthcare Systems, Columbia, TN	2	5	TN	Y	Y	Y	.0300	O	Y
79	McLeod Regional Medical Center, Florence SC	2	3	SC	Y	Y	N	.0399	E	Y
80	Medical College of Georgia Hospital, Augusta, GA	2	3	GA	Y	Y	Y	#NULL!	O	Y
81	Mountain States Health Alliance, Johnson City Medical Center, TN	2	5	TN	Y	Y	Y	#NULL!	E	Y
82	Norton Healthcare (nee:Alliant), Louisville, Ky.	2	5	KY	Y	Y	N	#NULL!	F	N

CASE ID	ORGANIZATION	ST CLASS	CDIV	STATE	CIO	ITCOMM	CREP	SHARE	REPTO	LEAPF
83	OSF HealthCare System, Peoria, IL	2	4	IL	Y	Y	N	#NULL!	E	Y
84	Overlake Hospital Medical Center, Bellevue WA	2	9	WA	Y	Y	Y	.0399	O	N
85	Parma (Ohio) Community General Hospital	2	4	OH	Y	Y	N	.0599	O	Y
86	PeaceHealth, St John MC, Longview, WA	2	9	WA	Y	Y	Y	.0499	C	Y
87	PeaceHealth, St Joseph Hospital, Bellingham, WA	2	9	WA	Y	Y	Y	.0499	C	Y
88	PROMINA Health System, DeKalb MC, Decatur, GA	2	3	GA	Y	N	N	#NULL!	F	Y
89	PROMINA Health System, Gwinnett Hospital, Lawrenceville, GA	2	3	GA	Y	N	N	#NULL!	F	Y
90	Rancho Los Amigos Medical Center, Downey, Calif.	2	9	CA	Y	Y	N	#NULL!	C	N
91	Rush-Presbyterian-St. Luke's Medical Center, Chicago, IL	2	4	IL	Y	Y	Y	.0249	E	N
92	Saint Joseph's Hospital, Marshfield, WI	2	4	WI	Y	Y	N	#NULL!	L	Y
93	Salem (Mass.) Hospital	2	1	MA	Y	Y	Y	#NULL!	F	Y
94	Sioux Valley Hospital & University Medical Center, Sioux Falls, SD	2	6	SD	Y	Y	Y	.0249	F	Y
95	St. Dominic-Jackson (Miss.) Memorial Hospital	2	4	MS	Y	Y	Y	.0149	F	Y
96	St. Vincent's Hospital - Ascension, Birmingham, Ala.	2	5	AL	Y	Y	N	#NULL!	E	Y
97	University Hospital, Little Rock, AR	2	7	AR	Y	Y	Y	.0400	E	Y
98	University Hospitals and Clinics, Salt Lake City, UT	2	8	UT	Y	Y	Y	.0600	E	N
99	UT Medical Center, Knoxville, Tenn.	2	5	TN	Y	Y	Y	.0149	F	Y
100	Washington County Health System, Hagerstown, Md.	2	3	MD	Y	D	Y	#NULL!	F	N
101	Yale-New Haven (Conn.) Hospital	2	1	CT	Y	Y	N	.0249	F	N
102	Arkansas Children's Hospital, Little Rock	3	7	AR	Y	Y	Y	#NULL!	E	Y
103	Banner Health System, Baywood (nee:Lutheran), Mesa, AZ	3	6	AZ	Y	Y	N	#NULL!	E	Y
104	Banner Health System, Good Samaritan, Pheonix, AZ	3	6	AZ	Y	Y	N	#NULL!	E	Y
105	Banner Health System, Thunderbird MC, Glendale, AZ	3	6	AZ	Y	Y	N	#NULL!	E	Y
106	Banner Health System,Desert MC, Mesa, AZ	3	6	AZ	Y	Y	N	#NULL!	E	Y
107	Borgess Health - Ascension, Kalamazoo, MI	3	4	MI	Y	Y	N	#NULL!	E	Y
108	Carle Foundation, Urbana, Ill.	3	4	IL	Y	Y	N	.0349	F	Y
109	Charleston (W.Va.) Area Medical Center	3	3	WV	Y	Y	Y	.0350	F	Y
110	Colleton Medical Center - HCA, Walterboro, S.C.	3	3	SC	Y	Y	Y	#NULL!	E	Y
111	Doylestown Hospital, Doylestown, PA	3	2	PA	Y	Y	Y	.0249	F	Y
112	Holland Community Hospital, Holland, MI	3	4	MI	Y	Y	Y	#NULL!	F	Y
113	Lehigh Valley Health Network, Allentown, Pa.	3	2	PA	Y	Y	N	.0299	E	Y
114	Martin Memorial Health System, Stuart, Fla.	3	3	FL	Y	Y	Y	.0199	F	N
115	Methodist HealthCare, Memphis, Tenn.	3	5	TN	Y	Y	Y	#NULL!	E	Y
116	NCH Healthcare System, Naples, Fla.	3	3	FL	Y	Y	Y	.0249	E	Y
117	New York (N.Y.) Presbyterian Hospital	3	2	NY	Y	Y	Y	#NULL!	O	Y
118	Oak Valley Hospital, Oakdale, Calif.	3	9	CA	Y	Y	N	#NULL!	F	N
119	Pittsburgh Mercy Hospital	3	2	PA	Y	Y	N	#NULL!	C	Y
120	Presbyterian Healthcare Services, Alburquerque, NM	3	8	NM	Y	Y	Y	.0299	E	Y
121	Providence Health System, Hosp, Medford, Ore.	3	9	OR	Y	Y	N	#NULL!	E	N
122	Providence Health System, Hosp. Newberg, Ore.	3	9	OR	Y	Y	N	#NULL!	E	N
123	Providence Health System, Memorial Hosp, Hood River, Ore.	3	9	OR	Y	Y	N	#NULL!	E	N
124	Providence Health System, Milwaukie Hosp. Milwaukie, Ore.	3	9	OR	Y	Y	N	#NULL!	E	N
125	Providence Health System, Portland Medical Cntr, Portland, Ore.	3	9	OR	Y	Y	N	#NULL!	E	N
126	Providence Health System, Seaside Hosp, Seaside, Ore.	3	9	OR	Y	Y	N	#NULL!	E	N

CASE ID	ORGANIZATION	ST CLASS	CDIV	STATE	CIO	ITCOMM	CREP	SHARE	REPTO	LEAPF
127	Providence Health System, St Vincent, Portland, Ore.	3	9	OR	Y	Y	N	#NULL!	E	N
128	Quincy (Mass.) Hospital	3	1	MA	Y	Y	Y	.0249	F	Y
129	Rex Healthcare, Inc., Raleigh, NC	3	3	NC	Y	Y	Y	.0250	F	Y
130	Scottsdale Healthcare, Scottsdale, AZ	3	8	AZ	Y	Y	Y	.0349	O	Y
131	Southeastern Ohio Regional Medical Center, Cambridge, OH	3	4	OH	Y	Y	Y	.0199	F	Y
132	St. Clare's Health Services, Denville, N.J.	3	2	NJ	Y	Y	Y	.0249	E	N
133	St. Francis Hospital, Beech Grove, Ind.	3	4	IN	Y	Y	N	.0349	F	Y
134	Stanly Memorial Hospital, Albemarle, N.C.	3	3	NC	Y	Y	Y	.0249	F	Y
135	Trinity Health System, (nee:Mercy&HolyCross systems),Steubenville, Ohio	3	4	OH	Y	Y	Y	#NULL!	E	N
136	UCONNHC, John Dempsey Hospital, Farmington, Conn.	3	1	CT	Y	Y	Y	#NULL!	C	Y
137	University Hospitals Health Systems, Cleveland	3	4	OH	Y	Y	N	#NULL!	E	N
138	University of Michigan Hospitals & Health Centers, Ann Arbor, MI	3	4	MI	Y	Y	Y	.0349	E	Y
139	University of Texas M.D. Anderson Cancer Center, Houston, TX	3	7	TX	Y	Y	Y	#NULL!	E	Y
140	Upper Valley Medical Center, Troy Ohio	3	4	OH	Y	Y	N	.0249	F	Y
141	Via Christi Regional Medical Ctr., Wichita, Kans.	3	6	KS	Y	Y	Y	#NULL!	E	Y
142	Virginia Mason Medical Center, Seattle	3	9	WA	Y	Y	Y	.0349	E	Y
143	Wadley Regional Medical Center, Texarkana, Texas	3	7	TX	Y	Y	Y	.0249	E	Y
144	Wellmont Hawkins County Mem Hospital, Rogersville, Tenn.	3	5	TN	Y	Y	N	.0100	F	Y
145	Wellmont Health -Bristol Regional MC, Bristol, Tenn.	3	5	TN	Y	Y	N	.0100	F	Y
146	Wellmont Health-Holston Valley MC Kingsport, Tenn.	3	5	TN	Y	Y	N	.0100	F	Y
147	Advocate Health Care, Bethany Hosp. Chicago, IL	4	4	IL	Y	Y	N	#NULL!	E	Y
148	Advocate Health Care, Christ Hosp, Oak Lawn, IL	4	4	IL	Y	Y	N	#NULL!	E	Y
149	Advocate Health Care, Good Samaritan Hosp, Downers Grove, IL	4	4	IL	Y	Y	N	#NULL!	E	Y
150	Advocate Health Care, Good Shepard Hosp, Barrington, IL	4	4	IL	Y	Y	N	#NULL!	E	Y
151	Advocate Health Care, Lutheran General Hosp, Park Ridge, IL	4	4	IL	Y	Y	N	#NULL!	E	Y
152	Advocate Health Care, Masonic Hosp, Chicago, IL	4	4	IL	Y	Y	N	#NULL!	E	Y
153	Advocate Health Care, South Suburban, Hazel Crest, IL	4	4	IL	Y	Y	N	#NULL!	E	Y
154	Advocate Health Care, Trinity Hosp, Chicago, IL	4	4	IL	Y	Y	N	#NULL!	E	Y
155	Anne Arundel Health System, Annapolis MD	4	3	MD	Y	Y	Y	.0199	O	Y
156	Ascension Health, St Marys MC, Evansville, IN	4	4	IN	Y	Y	N	#NULL!	E	Y
157	Cedars-Sinai Health System, Los Angeles, CA	4	9	CA	Y	Y	N	#NULL!	C	Y
158	Iowa Health System, Lutheran Hosp, Des Moines, IA	4	6	IA	Y	Y	N	#NULL!	E	Y
159	Iowa Health System, Methodist MC, Des Moines, IA	4	6	IA	Y	Y	N	#NULL!	E	Y
160	Jefferson Health System, Jefferson Hospital Philadelphia, PA	4	2	PA	Y	Y	N	#NULL!	E	N
161	Marion General Hospital, Marion, IN	4	4	IN	Y	N	N	#NULL!	F	Y
162	Moses Cone Health System, Greensboro, NC	4	3	NC	Y	Y	Y	.0249	E	Y
163	North Mississippi Health Services, Tupelo MS	4	5	MS	Y	Y	N	#NULL!	E	Y
164	Orlando Regional Healthcare, Orlando, FL	4	3	FL	Y	Y	N	.0250	E	Y
165	Somerset Hospital, Somerset, PA	4	2	PA	Y	Y	N	.0350	F	N
166	St. Luke's Episcopal Hospital, Houston,TX	4	7	TX	Y	Y	Y	.0300	F	Y
167	Sutter Health, Sacramento, CA	4	9	CA	Y	Y	Y	#NULL!	E	Y
168	University of Pennsylvania Health Sys., Philadelphia, PA	4	2	PA	Y	Y	Y	.0250	O	Y
169	Valley Health System, Shenandoah Memorial Hospital, Woodstock, VA	4	3	VA	Y	Y	Y	.0300	E	Y
170	Valley Health System, Warren Memorial, Front Royal, VA	4	3	VA	Y	Y	Y	.0300	E	Y

CASE ID	ORGANIZATION	ST CLASS	CDIV	STATE	CIO	ITCOMM	CREP	SHARE	REPTO	LEAPF
171	Valley Health System, Winchester Medical Center, Winchester, VA	4	3	VA	Y	Y	Y	.0300	E	Y
172	Allina Health System, Abbott Northwest, Minneapolis, MN	5	6	MN	Y	Y	Y	.0200	E	Y
173	Allina Health System, Buffalo Hosp, Buffalo, MN	5	6	MN	Y	Y	Y	.0200	E	Y
174	Allina Health System, Cambridge Mem Hosp, Cambridge, MN	5	6	MN	Y	Y	Y	.0200	E	Y
175	Allina Health System, New Ulm MC, New Ulm, MN	5	6	MN	Y	Y	Y	.0200	E	Y
176	Allina Health System, Owatona Hosp. Owatona, MN	5	6	MN	Y	Y	Y	.0200	E	Y
177	Allina Health System, St Francis, Shakopee, MN	5	6	MN	Y	Y	Y	.0200	E	Y
178	Altru Health System, Grand Forks, ND	5	6	ND	Y	Y	Y	.0199	O	Y
179	Children's Health System, Birmingham, AL	5	5	AL	Y	Y	N	.0249	O	Y
180	Children's Medical Center of Dallas, Dallas, TX	5	7	TX	Y	Y	Y	.0249	O	Y
181	Gateway Health System, Memorial General, Clarksville, TN	5	5	TN	Y	Y	Y	#NULL!	F	Y
182	Hamot Medical Center, Erie, PA	5	2	PA	Y	Y	Y	.0290	F	Y
183	HCA-Centenial Medical Center, Nashville, TN	5	5	TN	Y	Y	Y	#NULL!	E	Y
184	Memorial Healthcare System, Hollywood, FL	5	3	FL	Y	Y	Y	.0599	E	Y
185	Methodist Hospitals of Dallas, Dallas, TX	5	7	TX	Y	Y	N	#NULL!	E	Y
186	Metropolitan Hospital and Metro Health, Grand Rapids, MI	5	4	MI	Y	Y	Y	.0249	E	N
187	Sparrow Health System, Lansing, MI	5	4	MI	Y	Y	N	#NULL!	E	Y
188	St. Joseph's Hospital-HCA, Parkersburg, WV	5	3	WV	Y	Y	Y	#NULL!	E	Y
189	Alegent Health, Omaha, NE	6	6	NE	Y	Y	Y	#NULL!	E	Y
190	CareGroup Healthcare- Beth Isreal Deaconess Hospital, Boston, MA	6	1	MA	Y	Y	Y	.0249	E	Y
191	CareGroup Healthcare- Deaconess Glover Hospital, Needham, MA	6	1	MA	Y	Y	Y	.0249	E	Y
192	CareGroup Healthcare- New England Baptist Hospital, Boston, MA	6	1	MA	Y	Y	Y	.0249	E	Y
193	CentraCare Health System, St. Cloud, MN	6	6	MN	Y	Y	Y	#NULL!	O	Y
194	Children's Hospital and Research Center, Oakland, CA	6	9	CA	Y	Y	Y	#NULL!	E	N
195	Community Memorial Hospital, Winona, MN	6	6	MN	Y	Y	N	.0299	F	Y
196	Concord Hospital, Concord, NH	6	1	NH	Y	Y	Y	.0340	E	N
197	Empire Health Services, Deaconess Medical Center, Spokane, WA	6	9	WA	Y	Y	N	#NULL!	E	N
198	Empire Health Services, Valley Hospital & MC, Spokane, WA	6	9	WA	Y	Y	N	#NULL!	E	N
199	Holy Family Hospital, Spokane, WA	6	9	WA	Y	Y	N	#NULL!	F	Y
200	Huntsville Hospital, Huntsville, AL	6	5	AL	Y	Y	Y	#NULL!	O	Y
201	Inova Health System, Alexandria Hospital, Alexandria, VA	6	3	VA	Y	Y	Y	.0299	O	Y
202	Inova Health System, Fair Oaks Hospital, Fairfax, VA	6	3	VA	Y	Y	Y	.0299	O	Y
203	Inova Health System, INOVA Fairfax Hospital. Falls Church, VA	6	3	VA	Y	Y	Y	.0299	O	Y
204	Inova Health System, Potomac Hospital, Woodbridge, VA	6	3	VA	Y	Y	Y	.0299	O	Y
205	Jacobi Medical Center, Bronx, NY	6	2	NY	Y	Y	Y	#NULL!	E	Y
206	Johns Hopkins Institutions, Baltimore, MD	6	3	MD	Y	Y	Y	#NULL!	E	Y
207	Kishwaukee Health System, DeKalb, IL	6	4	IL	Y	Y	Y	.0299	F	Y
208	Lifespan-Miriam Hospital, Providence, RI	6	1	RI	Y	Y	N	.0250	E	Y
209	Memorial Healthcare Center, Owosso, MI	6	4	MI	Y	Y	N	.0199	E	N
210	Northeast Health, Samaritan Hospital, Troy, NY	6	2	NY	Y	Y	Y	.0199	E	Y
211	Riverside HealthCare, Kankakee, IL	6	4	IL	Y	Y	Y	#NULL!	O	Y
212	Robert Wood Johnson University Hospital, Hamilton, NJ	6	2	NJ	Y	Y	Y	#NULL!	E	Y
213	Rockford Health System, Rockford, IL	6	4	IL	Y	Y	Y	.0299	E	Y
214	Sacred Heart Medical Center, Spokane, WA	6	9	WA	Y	Y	N	#NULL!	O	N

CASE ID	ORGANIZATION	ST CLASS	CDIV	STATE	CIO	ITCOMM	CREP	SHARE	REPTO	LEAPF
215	ThedaCare, Appleton Medical Center, Appleton, WI	6	4	WI	Y	Y	N	#NULL!	E	Y
216	ThedaCare, Theda Clark Medical Center. Neenah, WI	6	4	WI	Y	Y	N	#NULL!	E	Y
217	University of New Mexico Hospitals & Healthcare, Albuquerque, NM	6	8	NM	Y	Y	Y	.0399	E	Y
218	Wellspan Health, York Hospital,York, PA	6	2	PA	Y	Y	Y	.0299	E	N
219	Wentworth-Douglass Hospital, Dover, NH	6	1	NH	Y	Y	Y	.0199	F	Y

QUALITATIVE DATA TO EXPAND CASES FY2002/2003: Specific IT Capabilities Implemented as of Mid-Year 2003

	CREDIT	CLAIMS	BILLING	REG	SCHED	AP	ERP	GLEDG	LOGIST	RFNAD	PAYROLL	PERSONL	TA	CASEMIX	CDS	COSTACCT	EXECIS	FBUDGET	OUTCOMES	ELIG	MCONTRCT	PREMBILL	ABSTRACT	CHARTDEF	CHARTRAK	DICTATION	ENCODER	PAINDEX	MRIMAGE	TRANSCPT	CARDIO	CDREP	CDOC	CPR	CPOE	ERDEPT	ICU	LAB	RNSTAFFG	OB	OFRR	PACS	RX	POCBED	RAD	SURG
1	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	Y	Y
2	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	N	N	N	Y	N	N	Y	N	Y	Y	Y	Y
3	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	N	N	N	Y	Y	N	Y	N	Y	N	Y	Y
4	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
5	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
6	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y
7	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
8	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y
9	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	Y	N	Y	N	N	Y	N	Y	N	Y	Y
10	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	N
11	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
12	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	N	Y	N	Y	Y	Y	N
13	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
14	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y
15	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y
16	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	Y	N	Y	N	Y	Y	Y	Y
17	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	Y	N	Y	N	Y	Y	Y	Y
18	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
19	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
20	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y
21	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
22	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y
23	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y
24	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y

25	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
26	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	N	Y	N	Y	Y
27	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
28	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y
29	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	N	Y	Y
30	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
31	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
32	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y
33	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
34	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
35	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	N	Y	Y	Y	Y
36	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y
37	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
38	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
39	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
40	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	Y	Y	Y	N	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y
41	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	Y	Y
42	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	N	N	Y	Y	Y	N	Y	Y
43	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y	Y	N	Y	N
44	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	N	Y	N	Y	N
45	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
46	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
47	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
48	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
49	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
50	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
51	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y
52	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
53	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y
54	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y
55	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y
56	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y

57	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
58	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
59	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
60	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
61	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
62	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
63	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
64	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
65	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y
66	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	N	Y	N	N	Y	Y	Y	N	Y	Y
67	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	N	Y	Y	N	Y	N	Y	N	Y	Y
68	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y
69	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
70	Y	N	Y	Y	Y	Y	N	Y	Y	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	N	N	N	Y	N	N	Y	N	Y	N	Y	Y
71	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
72	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	Y
73	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	N	N	N	Y	Y	N	N	Y	Y	Y	N	Y	Y
74	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
75	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
76	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
77	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	Y	N	Y	N	N	N	N	N	Y	N	N	Y	N	Y	N	Y	Y
78	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
79	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y
80	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
81	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
82	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	Y	N	Y	N	Y	Y	Y	N
83	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	N	Y	N	Y	Y
84	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	N	Y	N	Y	Y
85	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
86	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y
87	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	N	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y
88	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y	N	N	N	Y	Y	Y	N	Y	Y	N	Y	N	Y	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y

89	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	N	Y	N	N	Y	N	N	Y	N	Y	N	Y	Y
90	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	N	N	N	N	Y	N	Y	N	Y	Y	N	N	N	Y	N	N	N	N	N	Y	Y	N	Y	N	Y	N	Y	Y
91	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
92	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y
93	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y
94	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
95	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y
96	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
97	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y
98	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
99	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
100	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
101	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y
102	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y
103	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	N	Y	Y	N	N	N	N	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	Y	N
104	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	N	N	N	Y	Y	Y	N	Y	Y	N	N	N	N	N	N	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	N
105	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	N	N	N	Y	Y	Y	N	Y	Y	N	N	N	N	N	N	N	Y	N	Y	N	N	Y	Y	Y	N	Y	N
106	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	N	Y	Y	N	N	N	N	N	N	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	N
107	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y
108	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y
109	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y
110	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
111	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
112	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
113	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y
114	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
115	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N	N	Y	Y	Y	N	Y	N	Y	Y	Y	N
116	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
117	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y
118	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	N	Y	N	N	N	N	N	N	Y	Y	Y	N	Y	Y	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N
119	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y
120	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y

121	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y
122	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y
123	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	N	N	Y	N	Y	Y	Y	Y
124	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y
125	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y
126	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y
127	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y
128	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
129	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y
130	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
131	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
132	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	N	N	Y	Y	Y	N	Y	N	Y	N	Y	Y
133	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y
134	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N
135	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y
136	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y
137	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	N	Y	N	Y	N	N	Y	N	Y	N	Y	Y
138	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
139	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
140	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y
141	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	N	Y	N	Y	N	Y	Y	Y	Y	N	Y	Y
142	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
143	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
144	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
145	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
146	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
147	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
148	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
149	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
150	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
151	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
152	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y

153	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
154	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
155	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
156	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	N
157	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y
158	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	N	Y	Y	Y	Y
159	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	N	Y	Y	Y	Y
160	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	N	N	N	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
161	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N
162	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y
163	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	Y	Y	Y	N	Y	N	Y	Y
164	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	Y	N	Y	Y
165	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y
166	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
167	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y	N	Y	N	Y	Y	N	Y	N	Y	N	Y	N
168	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
169	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y
170	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	N	N	Y	Y
171	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
172	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
173	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
174	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
175	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
176	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
177	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
178	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y
179	N	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
180	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
181	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
182	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
183	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
184	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y

185	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y
186	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y	N	Y	N	Y	Y	Y	Y	N	Y	Y
187	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
188	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
189	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
190	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
191	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
192	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
193	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N
194	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
195	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	N	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
196	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	Y	Y	N	N	Y	N	Y	Y	Y	Y
197	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	N	N	N	N	Y	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
198	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N	N	N	N	N	Y	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
199	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	N	Y	N	N	Y	Y	N	Y	Y	N	N	Y	Y	N	Y	N
200	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
201	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
202	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
203	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y
204	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y
205	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
206	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
207	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N
208	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
209	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
210	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y
211	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	N	N	N	Y	Y	N	Y	N	Y	N	Y	Y
212	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	N	N	N	N	N	N	N	N	Y	Y	N	Y	Y	Y	N	Y	N
213	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y
214	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
215	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	N	Y	Y
216	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	N	Y	Y

217	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	N	Y	Y
218	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	N	N	Y	Y	N	Y	N	Y	N	Y	Y
219	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	Y	Y	Y	N	Y	Y

-- End of Document --