



Virtualization: Healthcare's Cure for the Common Cost? Part 2

Healthcare Provider IT Strategies

TECHNOLOGY ASSESSMENT #HI209705

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HEALTH INDUSTRY INSIGHTS OPINION

In January 2007, Health Industry Insights published *Virtualization: Healthcare's Cure for the Common Cost?* (Health Industry Insights #HI205033, January 2007). This report, part 2, summarizes the second of our four-phase, three-year assessment of the Information Technology Service Transformation Program (ITSTP) at the University of Pittsburgh Medical Center (UPMC). Phase 2 results reaffirm our initial findings. Specifically:

- Server consolidation and virtualization represent an important new technology for controlling the proliferation of the infrastructure costs that accompany the implementation of new applications, allowing more of IT's limited capital to be allocated to additional initiatives.
- Our initial estimate that UPMC would avoid almost \$20 million in server costs has grown to \$30 million and is likely to exceed \$40 million by the conclusion of the project in 2008.
- The adoption of virtualization technologies by healthcare providers continues to lag behind that of other industries.
- Health Industry Insights has yet to identify any healthcare provider organization engaged in a comparably ambitious effort. To date only a small handful of provider organizations have embraced virtualization; none are the size of UPMC and none are implementing virtualization on the scale of UPMC.
- Virtualization efforts in other provider organizations are typically limited to "commodity" Wintel servers; examples involving the virtualization of "mission critical" workloads are very limited.
- Lack of active participation and cooperation on the part of healthcare independent software vendor (ISVs) is hampering the advance of virtualization across the industry.
- UPMC's experience is clearly demonstrating the value of virtualization, an effort that other provider organizations should emulate.



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IN THIS REPORT

This report describes the findings from the second phase of Health Industry Insights' four-phase, three-year longitudinal "benchmark" study of the University of Pittsburgh Medical Center's (UPMC's) Information Technology Service Transformation Program (ITSTP). Health Industry Insights' role is to provide objective, third-party oversight of the program and assess its success.

The intent of the program is to reengineer UPMC's IT infrastructure from three broad but interrelated aspects — people, process, and technology — with the goal of building a stable, flexible, and cost-efficient foundation for future IT innovation. This report focuses on the staffing and storage and server virtualization aspects of the program. It assesses progress to date against the program goals and the performance metrics defined during the Phase 1 baseline period. It also describes the results of cost models that quantify the cost avoidances attributable to UPMC's virtualization efforts compared with server and storage costs and provisioning methodologies employed during the previrtualization baseline period.

SITUATION OVERVIEW

About UPMC

UPMC is the largest health system in western Pennsylvania, anchored by one of the major academic medical centers in the United States. During the past decade, through multiple acquisitions of unrelated healthcare provider organizations, UPMC has reshaped the healthcare landscape in western Pennsylvania. As a more than \$6 billion organization and the region's largest employer, it has transformed the economic landscape as well. It has become one of the largest not-for-profit integrated delivery networks (IDNs) in the United States, and it is currently the largest employer in western Pennsylvania, with almost 43,000 employees.

UPMC is composed of 19 hospitals and a network of other care sites across western Pennsylvania and throughout the world: doctors' offices, cancer centers, outpatient treatment centers, specialized imaging and surgery facilities, in-home care, rehabilitation sites, behavioral healthcare, and nursing homes. It also owns one of the largest health plans in Pennsylvania, with close to 1 million members. An extensive, world-famous research program complements the healthcare delivery organization.

Like most U.S. healthcare providers, UPMC is facing multiple challenges that translate into doing more with less. These challenges include finding solutions that:

- Respond to the growing pressure from payers, consumers, employers, and the government to improve customer service, patient safety, and service quality while reducing care delivery costs
- Improve clinical staff productivity and mitigate the effects of shortages of skilled clinical staff — shortages that are expected to dramatically worsen in the next decade
- Facilitate compliance with increasingly complex regulatory and reporting requirements

IT at UPMC

In order to deliver highly integrated, efficient care in the face of this rapid growth and industry pressures, UPMC recognized that enterprisewide IT systems, data integration, and platform standardization were crucial for its quality and business integration goals and to achieve the economies of scale expected to accrue from these acquisitions.

Also, it was clear that to set a high standard of care and apply that consistently across the health system would require the deployment of a sophisticated, and standardized, portfolio of clinical IT at all of the hospitals and ambulatory care sites. The key components of UPMC's current applications portfolio include clinical and ERP software products from Cerner, Epic, Misys, Oracle/PeopleSoft, Phillips, and GE. Many of the acquired institutions were previously in financial distress and had made only limited investments in IT.

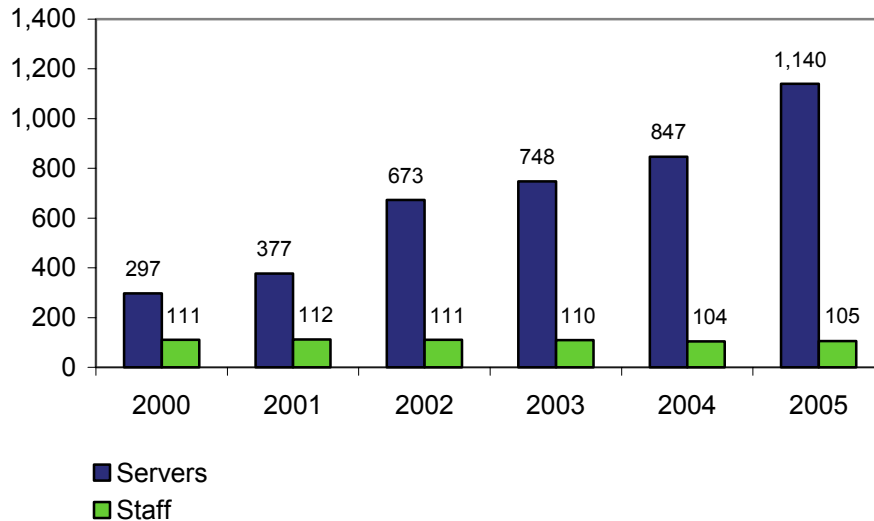
But because these business drivers demand an increased investment in sophisticated IT, particularly in the clinical area, the costs of providing the supporting infrastructure were rising dramatically. Prior to the start of the virtualization effort, in the five-year period from 2000 to 2005, the total number of Wintel and Unix servers had almost quadrupled (see Figure 1). The forecast was for even more dramatic increases in both technology and staff to meet the needs of the additional acquisitions and the goal of deploying a standardized, systemwide, highly sophisticated clinical IT environment.

IT management at UPMC recognized that these infrastructure and staffing costs, though essential for service delivery, were relatively "invisible" to the organization at large. New approaches were needed to maximize IT service levels while mitigating the expected increases in cost, allowing greater visibility of the value of IT delivered to the end-user community. UPMC also recognized that implementation of

this plan would create not only a massive IT environment but also a requirement on the part of the IT staff for improved management processes and tools to ensure that they could provide, and sustain, world-class service levels.

FIGURE 1

UPMC Servers and Staff, 2000–2005



Source: UPMC ISD, 2007

In addition, because each of the acquired hospitals had previously maintained its own datacenter and the goal was to ultimately provide more centralized IT services, space was another key issue. UPMC's long-term strategy was to relocate the equipment at each hospital site into the corporate datacenter in order to allow for the conversion of that space to support revenue-producing patient care activities. However, capacity limitations in UPMC's primary datacenter would prevent this consolidation and/or necessitate significant capital to construct additional space to accommodate the projected growth in equipment inventories.

In late 2004 and early 2005, UPMC sought solutions to meet this growth in a more cost-effective way. Consolidation, standardization, and virtualization, combined with the implementation of a comprehensive set of management tools and ITIL processes, were seen as the optimum solutions to these problems.

In April 2005, UPMC announced a \$328 million, eight-year contract with IBM to transform the UPMC datacenter into an On Demand operating environment (ODOE). The project became known as the Information Technology Service Transformation Program.

ITSTP Project Scope

The scope of this ambitious, multiyear program is to:

- Consolidate and standardize all Wintel and Unix servers
- Convert the majority of server-based services to a virtualized, on-demand environment, with all of its concomitant autonomic load-balancing capabilities
- Eliminate all direct-attached storage (DAS) and consolidate 40 direct- and network-attached storage systems into two storage area networks (SANs) to reduce operating costs and facilitate backup and recovery procedures
- Refresh all desktop and server hardware within three years and adhere to an ongoing three-year refresh cycle
- Reduce the current equipment inventory and footprint in the corporate datacenter by up to two-thirds to accommodate the inward migration and consolidation of equipment from UPMC's more than a dozen remote datacenters
- Improve customer service through the implementation of new IT management practices based on the worldwide process standards of ITSM and ITIL and reorganize the infrastructure support staff accordingly
- Improve disaster planning and recovery effectiveness

Anticipated Benefits of ITSTP

UPMC anticipates a reduction in its IT infrastructure operating expenses of as much as 15–20% annually and a significant reduction in capital costs by the time the eight-year project is concluded. These savings are expected to accrue through a combination of platform standardization, reductions in server counts, improved resource utilization, and the deferral of construction costs associated with the expansion of the corporate datacenter.

In addition, it is expected that autonomic resource sharing will improve system availability and performance by:

- Virtually eliminating unplanned outages

- Providing the ability to dynamically allocate system resources to accommodate peak workload requirements
- Providing the ability to easily shift workloads to available servers during periods of scheduled downtime

Further, consolidation of local datacenters at hospital sites into space freed up in the Forbes Tower datacenter will allow for conversion to revenue-producing activities.

But to determine if the anticipated benefits are ultimately achieved, UPMC recognized the importance of understanding where it started, where it was at each milestone, and how its performance compared with that of other world-class IT organizations. Health Industry Insights was retained to provide objective, third-party oversight to define these initial benchmarks and to assess the extent to which the anticipated benefits are being realized.

Overview of Benchmarking Project Methodology

During Phase 1, Health Industry Insights conducted an extensive audit of approximately 200 internal documents. In total, Health Industry Insights reviewed thousands of pages of text and tens of thousands of data points and created the "Master Metric Model" (MMM) to serve as both an analysis tool and a central data repository for all significant data. Almost 200 metrics in a dozen categories were considered for inclusion in the study. In Phase 1, a core set of 70 metrics was agreed upon by all parties to serve as a basis for Health Industry Insights' calculations and conclusions. In Phase 2, more than 20 additional metrics were added to that core number.

UPMC source data was "mapped" to the MMM by one team of Health Industry Insights analysts, while another culled external data from IDC's benchmark database. From the latter, Health Industry Insights extracted data from 20 leading organizations, seven healthcare providers, and 13 nonhealthcare corporations, all of which were known to have leading-edge IT environments relative to their competitors. In addition, the compiled UPMC data was compared against budgetary statistics from the Healthcare Information and Management Systems Society (HIMSS) to develop a more external view of UPMC's financial performance versus that of industry peers.

Benchmark Metrics Definitions

Benchmark metrics were defined in seven categories:

- **Baseline reduction goals**, to measure progress against expected goals as quantified in the original "deal" documents and press releases

- **UPMC corporate baseline statistics**, to normalize other metric ratios to account for ongoing corporate growth through measures of enterprise size, such as number of inpatient beds, admissions, employees, total revenue, and corporate capital budget
- **IT financials**, to measure changes in IT value ratios and percentages, such as:
 - IT infrastructure operating budget and capital budget to total IT budget
 - IT capital budget to total enterprise capital budget
 - Total IT costs to enterprise revenue
 - IT infrastructure costs versus total IT costs
 - UPMC total IT spending versus that of peer healthcare providers
- **Server services statistics**, including:
 - Ratios of physical servers, operating system instances, and CPUs per server technician
 - Average number of processors per server
 - Cost of provisioning in a virtualized environment versus the traditional methods employed prior to the program initiation
- **Storage services statistics**, including:
 - Number of storage arrays
 - Ratio of SAN storage capacity to total storage capacity
 - Cost of provisioning in a virtualized environment versus the traditional methods employed prior to the program initiation
- **Help desk services statistics**, to measure the impact of improved desktop management technology and reduced system downtime through such ratios as:
 - First-call resolution rates
 - Help desk staffing and volume versus UPMC employee population

- **Desktop services statistics**, including:
 - Average number of desktops supported per technician
 - Average number of desktops per UPMC employee

This report focuses on the major findings related to staffing and server and storage virtualization only.

Findings

The ITSTP is on schedule and continues to accrue an even greater level of financial benefits than originally projected, principally because the level of growth in the UPMC IT environment is exceeding the planning assumptions built into the original agreement.

To date, the program has already reduced capital outlays, introduced operational and management improvements, and yielded IT operating cost reductions consistent with its original objectives. This is a particularly noteworthy achievement for a healthcare provider organization, as healthcare organizations have traditionally lagged behind other industry sectors, such as banking and finance, in their strategic use of IT. Benchmark data, drawn from our own internal, proprietary sources as well as publicly available sources, confirms this finding. Additionally, our interviews with other leading healthcare provider organizations clearly indicate that UPMC is far ahead of other leading healthcare provider organizations in its adoption of virtualization and related infrastructure technologies.

UPMC has already accrued significant economic benefits. Health Industry Insights estimates that, on a conservative basis, the savings already achieved approach \$30 million in both capital and operating costs over a three-year period when compared with baseline-period spending patterns and actual growth. Health Industry Insights expects that this figure will exceed \$40 million by the conclusion of year three of the program.

Overall, the program has met or surpassed all of the midpoint objectives defined in the program charter.

Unix Server Virtualization

Virtualization of UPMC's Unix servers began earlier than planned and has progressed well. Our analysis concluded the following:

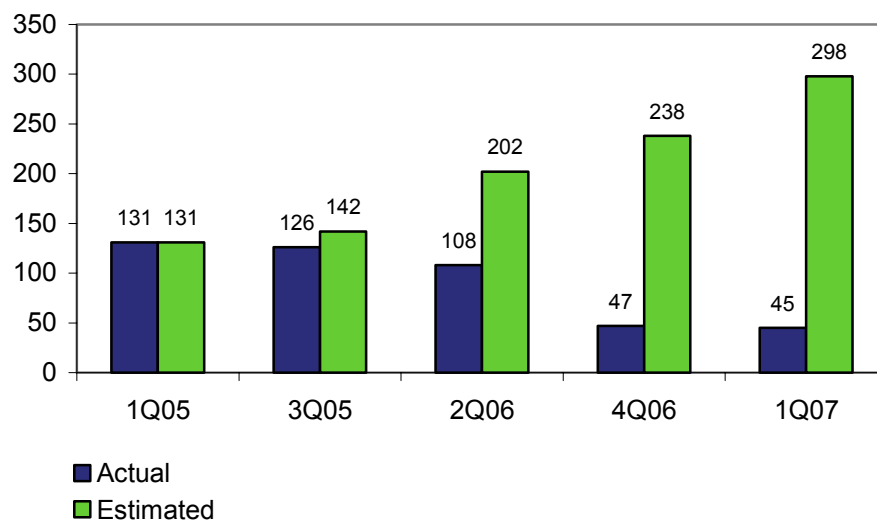
- Had UPMC continued to accommodate growth in demand for Unix server capacity using baseline-period provisioning metrics, we estimate that by 1Q07 an additional 167 physical servers would have been required over 1Q05 inventory levels (from 131 to 298);

instead, the baseline inventory level was reduced by 86 (from 131 to 45), as shown in Figure 2.

- The number of Unix CPUs has declined 24%, from 555 to 422, while the number of OS instances increased 228%, from 178 to 405 (see Figure 3).

FIGURE 2

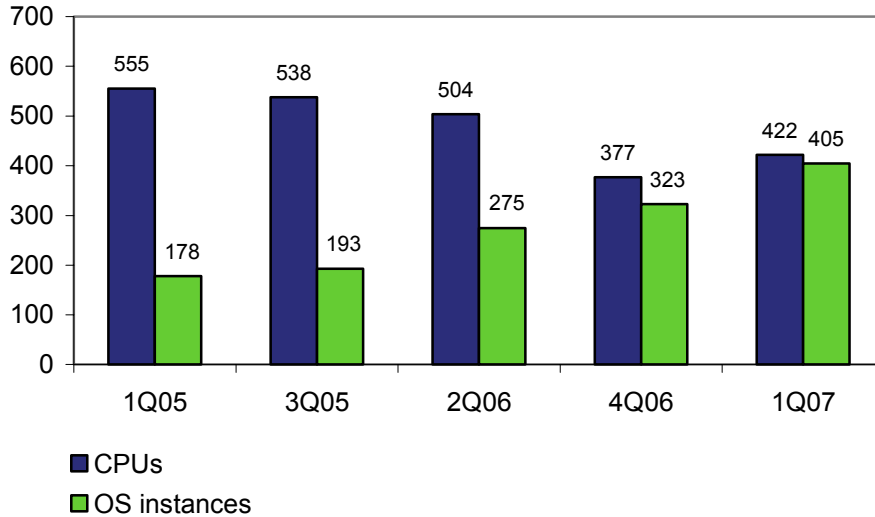
UPMC Actual and Estimated Unix Physical Servers, 1Q05, 3Q05, 2Q06, 4Q06, and 1Q07



Source: Health Industry Insights, 2007

FIGURE 3

UPMC Unix Server CPUs and OS Instances, 1Q05, 3Q05, 2Q06, 4Q06, and 1Q07

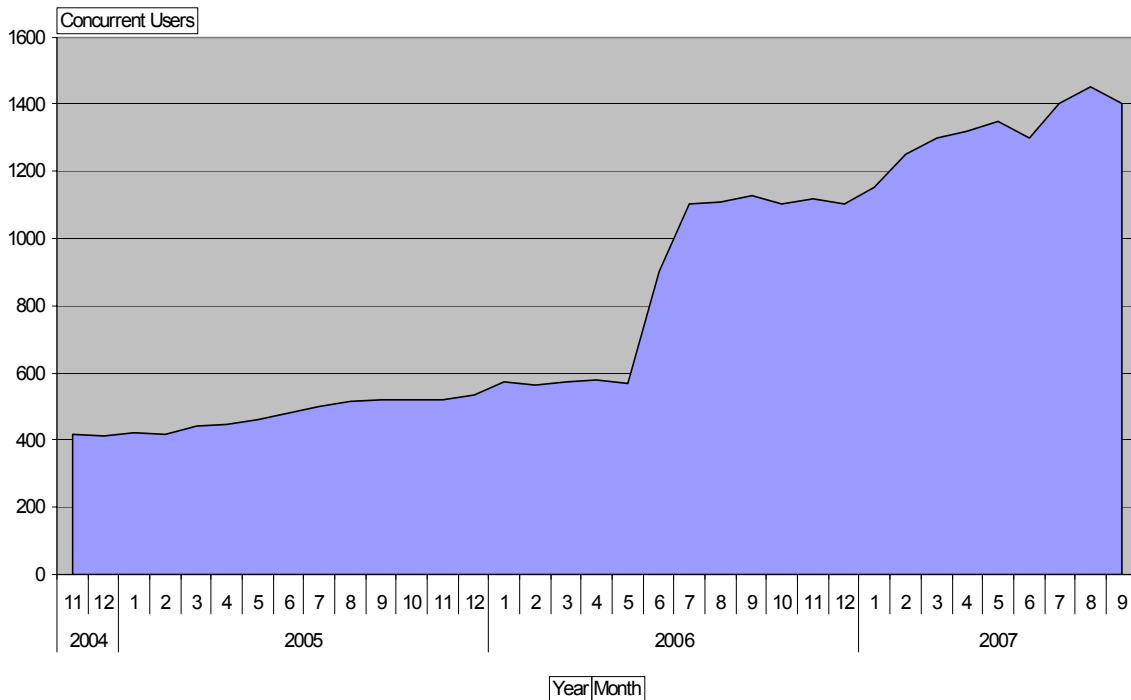


Source: Health Industry Insights, 2007

To date, more than two-thirds of the previrtualization Unix server inventory has been transformed. Simultaneously, UPMC has experienced significant workload increases in the three largest Unix workloads: Cerner, PeopleSoft, and Epic. For example, since the start of the transformation process (3Q05), the average number of concurrent Cerner users has almost tripled (see Figure 4).

FIGURE 4

UPMC Concurrent Cerner Users, November 2004–August 2007



Source: UPMC ISD, 2007

Similar increases have been experienced in PeopleSoft and Epic workloads during this same time frame. In this regard, it is important to also note that UPMC is actively engaged in standardizing and extending its application portfolio across all entities in the health system, and this effort will continue for the next several years. As a result, this rate of growth can be expected to continue.

All of these improvements have been accomplished with no increase in the complement of Unix system engineers and, in fact, the deferral of hiring plans for three additional employees.

Virtualization of the Unix environment has, to date, obviated the need to add the two additional p595-class Unix/AIX processor complexes originally budgeted for. The extent of this cost avoidance is estimated at approximately \$12.6 million over three years, including acquisition, maintenance, and operating costs. An analysis of the cost savings associated with the elimination of one p595 processor complex and the associated staffing costs indicates a three-year savings of \$6.7 million. The elimination of the second p595 increases that amount by an additional \$5.8 million, for a total of \$12.6 million (see Table 1).

TABLE 1

UPMC Three-Year Cost Savings: Unix Servers (\$)

	One-Time Cost	Annual Cost	Three-Year Recurring Cost	Total Cost
p595 Unix server				
Hardware (including installation and activation)	3,065,500	–	–	3,065,500
Floor space (68 sq ft at \$535/sq ft)	36,380	–	–	36,380
Annual hardware maintenance	–	325,080	975,240	975,240
Software license fees	1,000,000	–	–	1,000,000
Annual software license maintenance	–	250,000	750,000	750,000
Net savings per processor complex	4,101,880	575,080	1,725,040	5,827,120
Total savings (2 processor complexes)	8,203,780	1,150,160	3,450,080	11,654,240
Staffing				
Cost avoidance – 2 AIX system engineers + 1 DBA at \$80,000 each + 27% fringe benefits	–	304,800	914,400	914,400
Total savings	8,203,780	1,454,960	4,364,480	12,568,640

Source: Health Industry Insights, 2007

Wintel Server Virtualization

Virtualization of UPMC's Wintel servers is under way and progress has been excellent. Our analysis concludes the following:

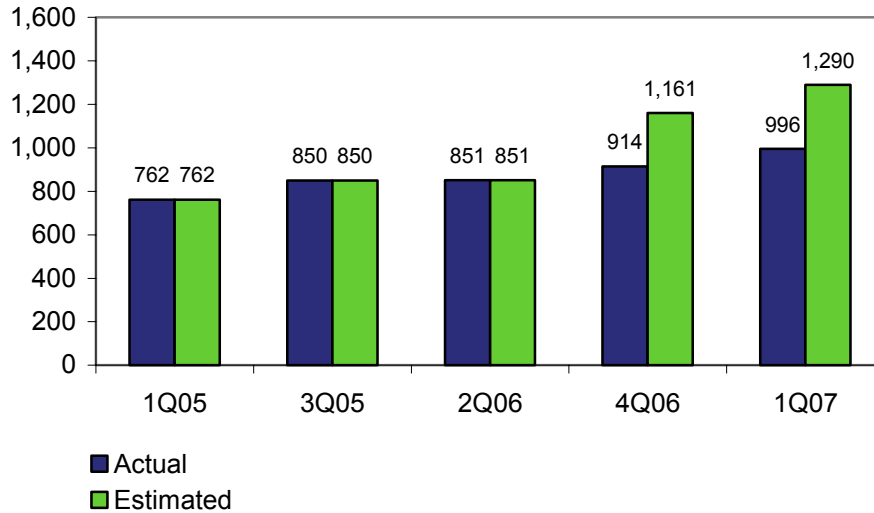
- During the period from 3Q05 through the end of 1Q07, there was an increase of 146 physical Wintel servers, from 850 to 996, or approximately 17%. This equates to a compound annual growth rate (CAGR) of about 10%, a sharp decline in the rate of increase from the period 1Q00–1Q05, when the CAGR was almost 30%.
- Through virtualization, the 996 servers are accommodating 1,290 OS instances. Prior to virtualization, UPMC's traditional provisioning method was limited to one OS instance per physical server.

- Had UPMC continued to accommodate the growth in demand for Wintel server capacity using baseline-period provisioning metrics, we estimate that by 1Q07 an additional 440 servers would have been required over 3Q05 inventory levels; that's a savings of 294 servers (see Figure 5).
- A cost analysis developed by Information Services Division (ISD) staff, and verified by Health Industry Insights, identified a three-year cost savings of \$11 million for every 450 Wintel servers virtualized. This analysis includes savings in the cost of not only the servers themselves but also the equipment necessary for installation and connectivity to the communications and storage area networks and the power and cooling required for operation (see Table 2). It excludes storage costs, which were separately analyzed.
- Virtualization of the remainder of today's inventory levels will conservatively double these savings, but given the continued growth in the Wintel server environment, it is likely that UPMC will realize at least 1½ times this savings, or about an additional \$16 million, by the conclusion of year three.

The original ITSTP planning projections were based on an assumption of only a 7% CAGR in Wintel servers. In reality, UPMC has experienced higher-than-planned growth in server demand, driven by new projects as well as increased workloads for existing applications and services. This demand has slowed the original schedule, but increased the economic benefits. As of the end of 2Q07, the origins of 20% of the 450 Wintel servers in the ODOE were classified as "new projects" and 41% were classified as "growth" (in existing workloads), while only 39% were classified as transformed "legacy" servers.

FIGURE 5

UPMC Actual and Estimated Wintel Physical Servers, 1Q05, 3Q05, 2Q06, 4Q06, and 1Q07



Source: Health Industry Insights, 2007

TABLE 2

UPMC Three-Year Cost Savings: Wintel Servers

	Net Savings in One-Time and Three-Year Recurring Costs (\$)
Power	467,400
SAN connectivity	3,439,800
Network connectivity	2,044,800
Floor, cooling, and rack space	750,000
Server hardware	4,340,250
Total	11,042,250

Note: Data represents sample savings based on 450 Wintel servers (previrtualization) versus 72 physical servers in a virtualized environment.

Source: Health Industry Insights and UPMC ISD, 2007

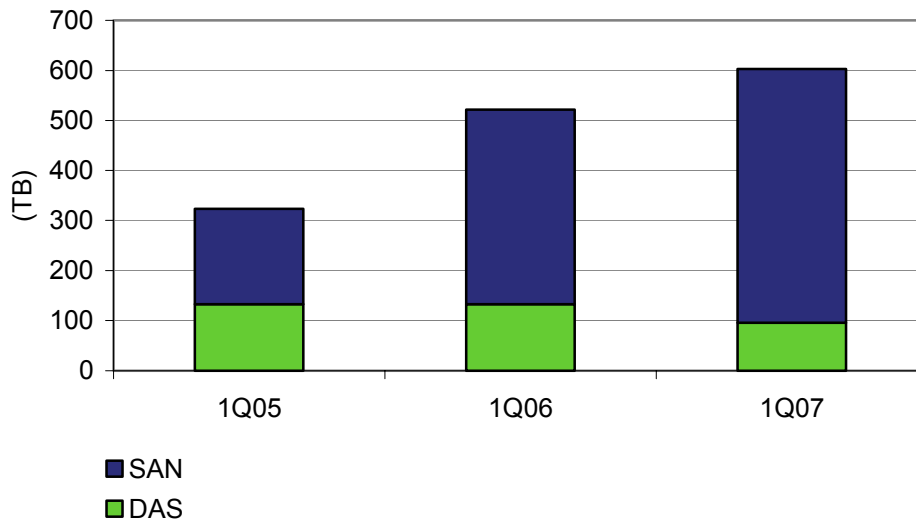
Storage Virtualization and Migration to an All-SAN Environment

Migration from distributed DAS to a centralized SAN is well under way and has also yielded significant cost savings. This process is particularly important in light of the growth in the demand for online storage experienced by UPMC. It has also significantly exceeded planning assumptions:

- ITSTP projections were based on a 25% CAGR, yet between 1Q05 and 1Q07 storage requirements increased by 87%, a 37% CAGR.
- 1Q07 actual storage of 603TB is almost 20% higher than the original forecast of 505TB (see Figure 6).
- Higher-cost DAS has declined from 41% of installed capacity in 3Q05 to 16% as of 1Q07.
- The cost of current SAN technology is 30% cheaper per gigabyte than the SAN technology deployed during the baseline period.
- This lower unit cost, combined with the significant growth in storage requirements, has meant a savings to UPMC of more than \$2 million a year over baseline-period storage costs.

FIGURE 6

UPMC SAN and DAS Storage Capacity, 1Q05, 1Q06, and 1Q07



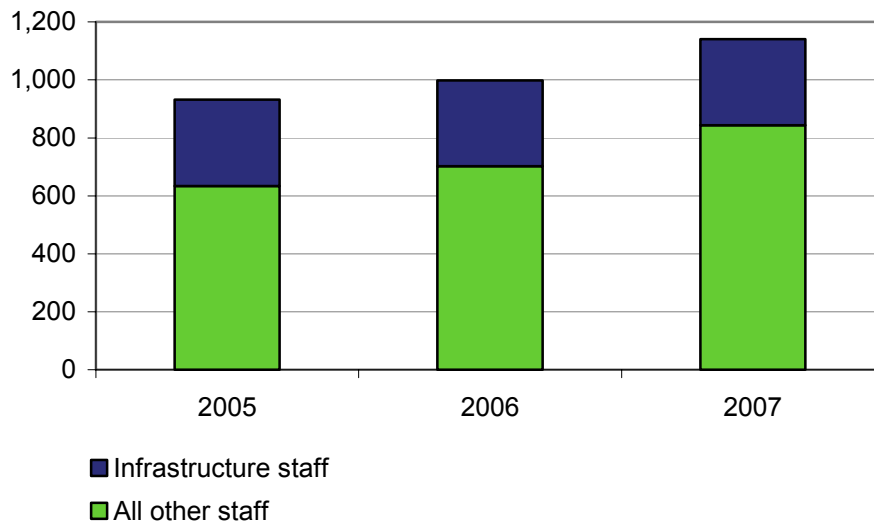
Source: Health Industry Insights, 2007

Staffing Metrics

UPMC has been able to maintain a "flat" infrastructure support staffing model, while the ratio of ISD infrastructure staffing to total ISD staffing has decreased as a percentage of the total corporate IT operating budget and as a percentage of overall ISD staffing, from 15.7% to 12.7% (see Figure 7).

FIGURE 7

UPMC ISD Staff, FY05–FY07



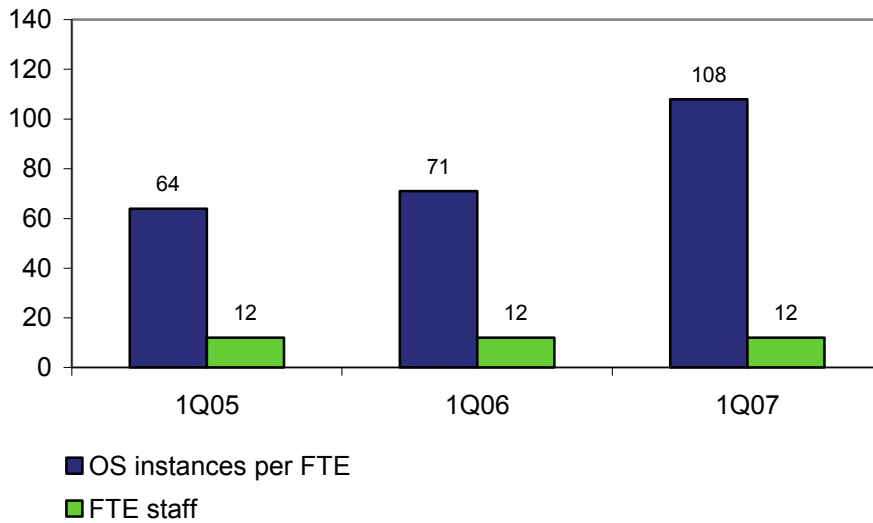
Source: UPMC, 2007

For the period beginning 1Q05 (contract execution) through the baseline measurement period (3Q05) and ending 1Q07, there was no change in the number of Wintel system engineers, despite the dramatic growth in the number of servers and OS instances supported. During the same period, there was a 70% increase in OS instances and in the ratio of OS instances per FTE (from 1:64 to 1:108), as shown in Figure 8. This is six times the ratio of the average external benchmark organization (1:18).

Findings in the Unix areas are similar. For the same period of 1Q05 through 1Q07, there was also no increase in the number of Unix system engineers, while there was a 228% increase in OS partitions or instances, from 178 to 405, and a 220% increase in the number of OS instances supported per engineer (see Figure 9). The UPMC staffing ratio is three times the external benchmark of 1:15.

FIGURE 8

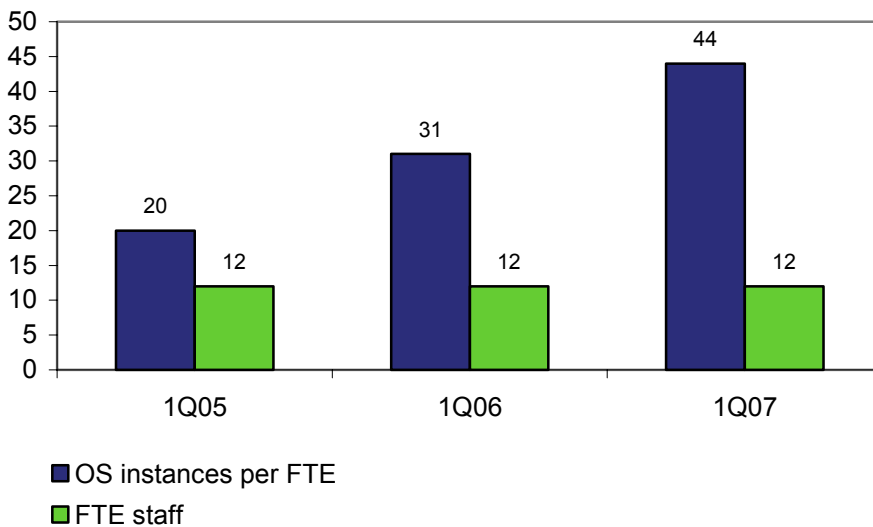
Wintel Support Staff and OS Instances, 1Q05, 1Q06, and 1Q07



Source: Health Industry Insights, 2007

FIGURE 9

Unix Support Staff and OS Instances, 1Q05, 1Q06, and 1Q07

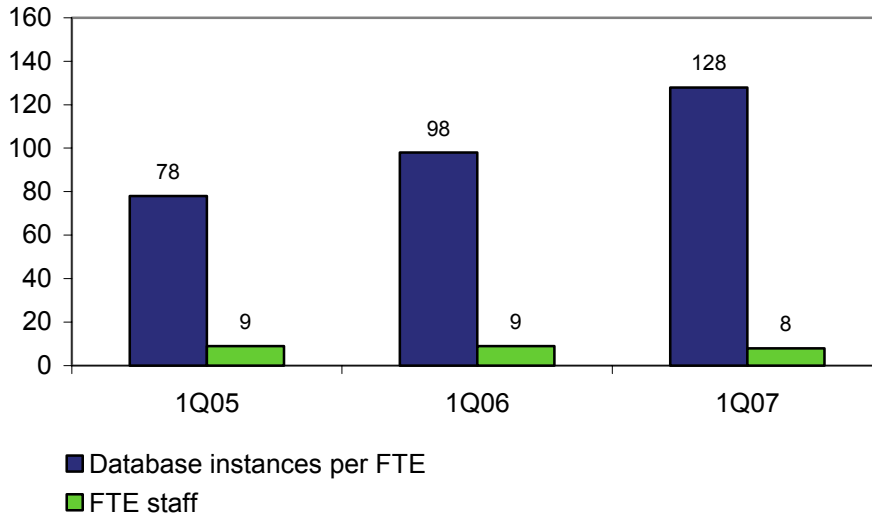


Source: Health Industry Insights, 2007

In the DBA area, although the number of DBA FTEs declined 11%, from nine in 1Q05 to eight in 1Q07, the number of database instances increased 45% during the same period, from 706 to 1,024, an increase in DBA productivity of 63% (see Figure 10). External benchmark data for this skill set is not available.

FIGURE 10

DBA Staff and Database Instances, 1Q05, 1Q06, and 1Q07



Source: Health Industry Insights, 2007

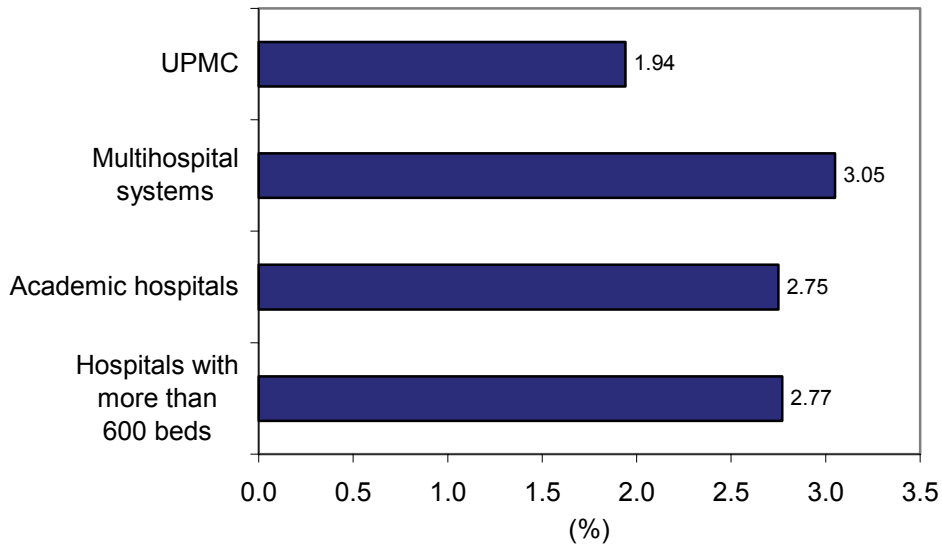
The net effect of these benefits is reflected in the budgetary trends we observed. One of UPMC's key strategic goals was to reduce the ratio of IT infrastructure costs to total IT costs to allow UPMC to redirect those savings into areas that would increase the visibility of IT value delivered to the end-user community. This goal is being met, as IT's infrastructure operating expense is declining both in terms of absolute expenditures and as a percentage of IT's overall operating budget.

Between FY05 and FY07, the ISD infrastructure operating budget declined by 12%. This reduction is consistent with the goal of 15–20% over the first three years that was outlined in the original ITSTP announcement document.

UPMC's focus on improving its IT operating efficiency is evident when benchmarked against other provider organizations. UPMC's IT operating budget currently stands at 1.9% of corporate revenue, well below the 2007 HIMSS benchmarks for three comparative peer groups — multihospital delivery systems (3.05%), academic health systems (2.75%), and hospitals with 600 or more beds (2.77%) — as shown in Figure 11.

FIGURE 11

IT Operating Budget Share of Enterprise Revenue, 1Q07



Source: HIMSS, 2007

FUTURE OUTLOOK

Virtualization technology for Unix and Wintel server environments is now about five years old. But while virtualization is having a noticeable, and profound, technical and economic impact in other industries, it has seen relatively low adoption by healthcare provider IT organizations. We believe that two factors are contributing to this lag. First, the vast majority of a healthcare provider's applications portfolio is obtained from independent software vendors (ISVs), which, to date, have been slow to incorporate the technology into their product offerings. Second, the IT environments of many healthcare providers today are relatively small and lack the critical mass of servers to justify the investment needed to convert their existing inventories.

But over the next year, we see this situation changing. The technology platform vendors that healthcare ISVs have built their products around, principally IBM, HP, Intel, Microsoft, and Oracle, have all embraced virtualization and are now incorporating it into their newest product offerings. As healthcare ISVs upgrade their own product offerings, we expect that virtualization will simply just become one component of the software architecture of this next generation of products. Similarly, as provider organizations replace their aging commodity servers, such as those devoted to file and print services, we expect that they will increasingly choose servers that are virtualized "out of the box." The economics are too compelling.

Ultimately, healthcare provider IT organizations will embrace and rely on virtualization in the same way they did when virtual operating systems transformed mainframe computing 30 years ago. And although there are relatively few provider IT environments of the size of UPMC, the data would suggest that the investment is economically justified even when server inventory levels number in the low hundreds.

ESSENTIAL GUIDANCE

Actions to Consider

Large healthcare provider organizations, many of which are confronted with the same cost and technology challenges facing UPMC, have much to gain from emulating UPMC's approach. Such organizations should begin to develop a strategic plan for virtualization, beginning with an inventory of their server resources and an assessment of the potential economic benefits of standardization, consolidation, and virtualization.

Provider organizations considering such action should also seek to identify "virtualization pioneers" willing to share their experiences, both good and bad. They would do well to look outside of healthcare to financial services, manufacturing, and banking, as those are some of the industries with the most experience to date. IDC data suggests that in industries other than healthcare, upward of 40–50% of companies have implemented server virtualization beyond simple pilots. Among healthcare provider organizations, that number is well below 10%.

Providers seeking to expand their server inventories or replace aging equipment should work with their suppliers to benchmark the performance and economics of virtualized versus traditional server configurations.

If they are not already doing so, healthcare IT (HIT) application software vendors should begin to work with their technology platform partners to assess the ability and benchmark the performance of their products in a virtualized environment. Those that demonstrate the ability and willingness to operate in a virtualized environment will enjoy a competitive advantage in this increasingly cost-conscious marketplace.

LEARN MORE

Related Research

- *The Power of Virtualization Takes Center Stage at Oracle Open World* (Health Industry Insights #HI209563, November 2007)

- *Virtualization: Healthcare's Cure for the Common Cost?* (Health Industry Insights #HI205033, January 2007)
- *U.S. Health Industry 2007 Top 10 Predictions* (Health Industry Insights #HI204993, December 2006)

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