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Achieving Success: Assessing the Role of and Building a Business Case for Technology in Healthcare

Executive Summary

As the healthcare market continues to evolve, technology will play an increasingly important role in an integrated delivery system's ability to provide high-quality, cost-effective care. Healthcare leaders must be proactive and forward thinking about their technology investments. The financial investment for technology innovation can be significant. Therefore, it is important that healthcare executives deliberately design the role of technology and develop a consistent method for evaluating, identifying, and prioritizing technology investments.

The article begins by describing technology's role in a healthcare organization as a window to the organization, a key driver of business strategy, and a high-performance enabler, and it develops a seven-step process for building a business case to ensure that an organization's technology investments are wise, well-reasoned, and will provide value to its customers. In addition, the article discusses the importance of combining people and process reengineering with new technology to exponentially increase the value to an organization.

Healthcare leaders must understand the multiple roles of technology and consistently develop a business case when making technology investment decisions. Organizations driven by such an understanding will have a robust infrastructure of enabling technology designed to integrate people and process elements with technology to achieve the goals and initiatives of the organization. These organizations will lead the healthcare industry into the next millennium.

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INTRODUCTION

A rapid transformation is taking place in healthcare organizations in response to the continued growth of managed care, swift industry consolidation through vertical and horizontal integration, and an increasingly consumer-driven market. These changes in healthcare have placed a premium on a healthcare organization's ability to provide value—defined as a combination of cost effectiveness, high-quality clinical care, and customer satisfaction—to the patients, providers of care, and payors that constitute its customer base. Previously, healthcare organizations attempted to enhance their performance through initiatives such as system reorganization, quality improvements, and process reengineering. One common thread among these initiatives is their dependence on valid and accessible information. Emerging evidence suggests that to achieve increased and sustainable value to customers and to be competitive in the marketplace, healthcare organizations must significantly improve information systems and implement appropriate technology across sites of patient care delivery.

Healthcare executives and governing bodies are recognizing that without comprehensive, enterprise-wide[1] information systems accompanied by an appropriate information management infrastructure, their ability to compete in an increasingly information-intensive environment will continue to deteriorate (GartnerGroup 1998f).

The critical question is how best to approach the issues of identifying and acquiring the appropriate information systems and technology. This article provides information for healthcare executives who must assess, procure, and manage technology investments. The article presents a framework for understanding technology's role as a window, driver, and enabler in healthcare organizations and then provides healthcare executives with a step-by-step approach to building a "business case" for technology. Business case development ensures that technology investments are evaluated in a consistent and appropriate manner.

[1]For the purposes of this article, "enterprise-wide" refers to the activities or processes associated with an organization that is multi-entity, such as an integrated delivery system that may include acute care hospitals, ambulatory clinics, post-acute care facilities, physician groups, etc. An enterprise-wide system consolidates or connects all or portions of the individual entities under a single infrastructure or system.

THE WINDOW, DRIVER, AND ENABLER FRAMEWORK

For the purposes of this article, technology can be broadly defined as capital, equipment, information systems, and automated environments leading to the access and transmission of information that supports or enables associated work flows. Technology includes more than computer systems—innovation abounds in medical imagery, diagnostic modalities, and distributed or remote automation.

To provide a context for developing a business case for technology investment, the authors have created a framework for understanding technology as a window to the organization, a strategic driver for market dominance and business change, and an enabler of high performance over time.

Technology provides internal and external stakeholders with a window into or reflection from which to view a healthcare organization's capabilities. A window highlights the key business issues served by technology and the interrelationship of those issues. Because technology investments differ by organization, the absence or presence of technology can reflect the culture of the organization and the connectedness of the organization with its patients, providers, and payors. As a result, technology can add to or detract from the interaction of each customer with the employees and physicians of a healthcare organization.

In its role as a driver, technology provides a unique platform to leverage the performance of individuals in pursuit of the strategic initiatives required to achieve the organization's goals and objectives. Technology provides the financial and clinical data that an organization collects, reports, and must rely upon for decision making.

Finally, as an enabler of high performance, technology enhances the performance of the major processes and the people responsible for delivering care or supporting the organization's administrative, financial, diagnostic, and support services. Redesigned processes enabled by technology permit predictable and sustainable improvement in operations and a significant return on investment.

Technology as a Window

The healthcare environment is in a state of constant and dynamic change. This state is no different than that of the rest of the economy, and is best described by a concept called *BLUR* developed by Stan Davis and Chris Meyer, in their book, *BLUR: The Speed of Change in the Connected Economy*. The book describes *BLUR* as the speed, connectivity, and intangibles that

constitute the reality of today's marketplace. Speed in healthcare involves the many things that accelerate activity and provide fast access into an organization. Those activities most relevant for the customer are speedy appointments when sick, speedy test results, speedy referrals, and speedy financial documentation. Connectivity refers to the increased access to "real time" information, especially information accessible through technology such as the World Wide Web and Internet. In addition, connectivity indicates significantly the more interpersonal connection and interdependence of interests among healthcare providers and organizations along the continuum of care. Intangibles are concepts that are hard to quantify and measure. In healthcare, intangibles include perception of pain, confidence in a physician or other clinician, and the value of services provided. Perhaps the most important intangible in healthcare is the information and data collected. According to *BLUR*, because the future arrives at such a fast pace, physical capital such as facilities becomes more of a liability than an asset. Value in healthcare will increasingly reside in information and relationships—things that you cannot see and often cannot measure (Ernst & Young 1998). In other words, *BLUR* describes the dynamic environment in which healthcare organizations, as well as patients, providers, and payors, must function. It is within this context of fast-paced interconnectedness of organizations and people that healthcare executives must rely upon technology to enhance their organizations' internal workings and external appearance.

The insights *BLUR* offers can open up major opportunities for healthcare providers. As indicated in the window, driver, and enabler framework, an organization's current technology infrastructure is a reflection of the organization and can be an indication of how it is viewed by its stakeholders. An assessment of the image the organization's technology presents to internal and external stakeholders can be especially important. If information systems enable improved customer service through elimination of redundant activities and provision of consistent, timely service, then patients are more likely to have confidence and satisfaction in the healthcare organization. This confidence and satisfaction can translate into a favorable "brand name" for the organization. "Brands, after all, are nothing but the information—real or imagined, intellectual or emotional—that consumers have in their heads about a product" (Evans 1997). Value chains have shifted from a flow of physical commodities to the information and relationships that exist within an organization and between the organization and its customers (Evans 1997). Therefore, it is

imperative that as the cost of technology decreases and the availability of high-speed networks, enterprise-wide systems, and secure user-friendly systems increases, healthcare executives and organizations capitalize on technology's ability to capture and convert intangibles into significant value.

Technology as a Key Driver

In today's tumultuous healthcare environment, technology is more than merely a window to an organization; to remain competitive, organizations must use technology as a key driver of their business strategy. One can argue that an organization's most important assets are its employees and information. The magnitude of value that can be created by an organization and the achievement of its business goals are dependent upon the ability to direct, enable, and leverage the organization's human capital and information. Technology is the driver that can maximize an organization's assets and create value.

As a driver, technology must also be able to react quickly and efficiently to market forces. External factors driven by competition, payors, governmental/regulatory agencies, and communities will continue to affect the financial stability and long-term strategy of healthcare organizations. One of the most significant market forces in recent years has been the pervasive desire to cut healthcare costs. At the same time, healthcare organizations face increasing levels of risk contracting and declining reimbursement rates, which have resulted in shrinking revenues. Therefore, it is important for healthcare organizations to maximize operational efficiencies by developing enterprise-wide information systems that facilitate information sharing and knowledge reuse.

Another significant trend affecting the healthcare industry is the move toward standardization. The federal government's desire to reduce healthcare spending and recent regulatory decisions have contributed to making technology a driver in the healthcare industry. For example, in 1996, Congress passed the Kennedy-Kassebaum Act, also known as the Health Insurance Portability and Accountability Act (HIPAA). One aim of HIPAA was to create core data standards in healthcare such as standardized provider identification numbers, payor identification numbers, and clinical terminology. The 40 standards that were included in the legislation are mandatory for all healthcare organizations and must be implemented by the year 2000. The goal of these standards was to reduce the estimated 10 to 20 percent of total operating costs

created by paper-intensive administrative processes stemming from lack of industry uniformity (Savas 1998). In addition, as market forces continue to prompt industry consolidation, standards will be increasingly important in yielding operating efficiencies.

As HIPAA standards and other industry-wide initiatives are mandated, information systems (IS) and information technology (IT) must be flexible enough to make changes as necessary. Healthcare executives will need to realize the importance of embracing technology and business redesign to succeed. It has been said that "the successful enterprises now live in a culture of continuous change and that becomes the ultimate objective of IT: a situation where employees are not threatened by change but are encouraged by it because they believe it will improve their own livelihoods" (Hibbard 1998). The same should be true for healthcare executives.

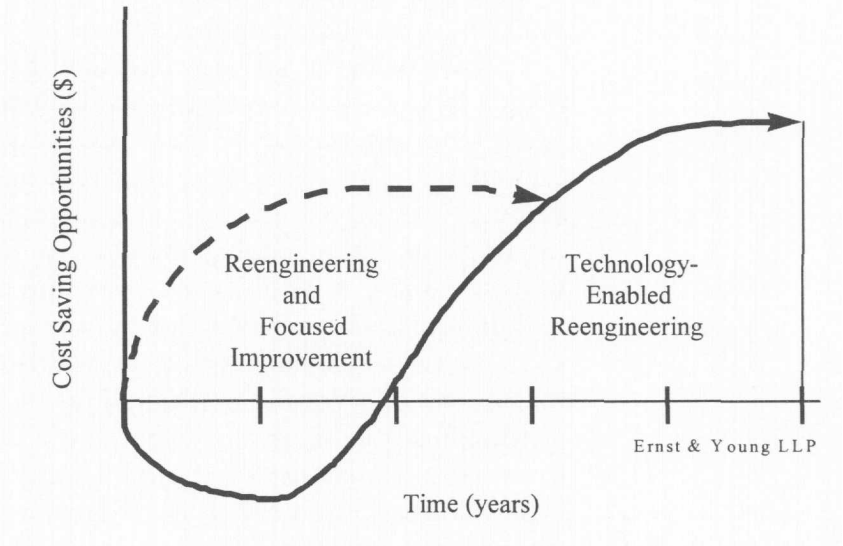
Technology as an Enabler of High Performance

It is clear that technology is and will continue to be a key driver of the healthcare industry. Therefore, it may seem that once the appropriate information systems or medical technology is chosen, the operating efficiencies and value to customers will follow immediately. Indeed, technology provides a wide range of mechanisms that can be used to increase access to and accuracy of information, reduce cycle time, and eliminate geographic constraints (loss of distance), thereby bringing about radical, permanent, and sustainable improvements in business processes. Unfortunately, deciding to implement a new information system or other technology is just the first step. Whether the new technology ultimately results in value to the healthcare organization and its customers is determined by what follows the selection of the technology.

In fact, selecting and installing a new system is not the action that results in positive change; rather, positive change is a result of technology that is supported by and integrated with business process reengineering, changed behavior, and value management (GartnerGroup 1997a).

Some healthcare information technology vendors are beginning to position their products in the marketplace as enablers of change and reengineering (Pasternack 1998). Another major contributor to positive change is the alignment of people, process, and technology to realize and sustain the identified value associated with technology initiatives. In the past, many healthcare

Figure 1.
Cost Savings Opportunities Achieved Over Time



organizations have depended solely on process reengineering to gain incremental improvements in their processes. However, the best way to ensure that value is increased exponentially and in a sustainable manner is through "people enablement," which combines individuals with new information technology, infrastructure, and redesigned processes (see Figure 1).

People enablement takes into consideration education and training, communication, continuous performance improvement, human resource development, organizational structure, leadership, and culture. It has been said that it is the people, not the hardware or software, that hinders organizations from achieving the full benefits of technologic innovation. As a result, the people side of implementing new technology cannot be overlooked, and the importance of appropriate and continuous training cannot be overstated.

The GartnerGroup estimates, "Through 2002, healthcare organizations that fail to provide appropriate training for their IS staff will experience turnover rates of between 22 percent and 30 percent, or up to 50 percent higher than expected for this period (0.7 probability)" (GartnerGroup 1998a).

Moreover, the 1998 Health Information and Management Systems Society (HIMSS) Leadership Survey findings show that "the number one IT priority for healthcare organizations over the next twelve months is recruiting and retaining high quality IT staff" (HIMSS 1998). A critical but often underestimated

requirement is the training and trouble shooting needed by the healthcare delivery staff after technology implementation. A one-time lecture or tutorial is insufficient to help people learn new systems, approaches, and behaviors.

To achieve the full benefits in cost reduction and added value from a technology investment, an organization must recognize the importance of integrating the people and processes with the technology. The financial savings realized by the organizations through operational efficiencies stemming from technology investments can be pooled and used to fund future technology investments. It might be useful to think of the money for technology investments as, for example, college fund raising. Colleges use donations to fund their endowment, which is then used to make investments to fund future expenditures. In a similar fashion, healthcare organizations could target savings generated from current initiatives to fund future investments. Technology expenditures should not be considered a static, linear process but an ongoing, continuous investment in an organization's future.

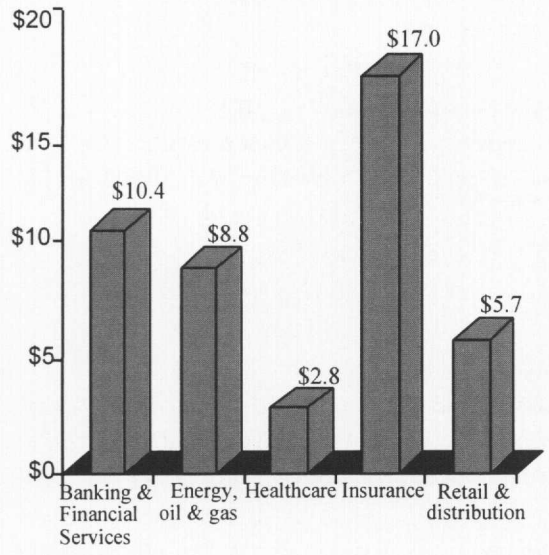
Understanding the three key roles of technology—as a window, driver, and enabler—within an organization is just the beginning. The next step is to identify and select the technology that will enhance the organization's value to customers and, if managed effectively, ultimately improve the organization's bottom line. It is the role of the healthcare executive to determine which technology investments will contribute most to value creation for the organization. The following section will discuss the importance of building a business case to identify and prioritize technology investments.

THE BUSINESS CASE FOR TECHNOLOGY

"Few industries can benefit more from improved technology than healthcare, yet few similarly information-intensive industries are as far behind in its adoption" (GartnerGroup 1998c).

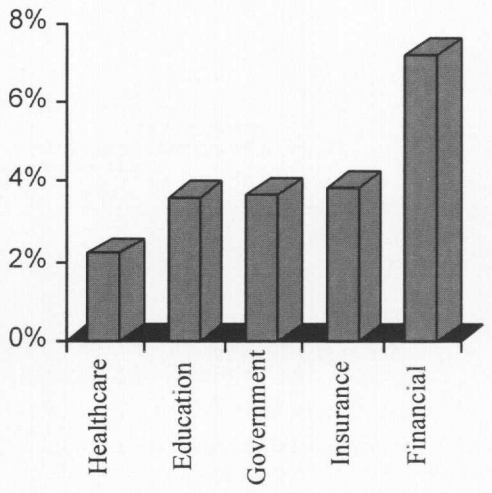
In fact, the financial services industry (which is often compared to healthcare in terms of its similar information-intensive nature) has invested much more in technology and information system development (Savas 1998). As consolidation within the healthcare industry continues and healthcare organizations grapple with year 2000 issues, organizations will

Figure 2.
IT Investment per Employee



Source: Deloitte Consulting, LLC

Figure 3.
IT Budget as % of Revenue



Source: Datarequest Vertical Market Opportunities North America, 4/96

need to make significant progress in IS and IT infrastructure (see Figures 2 and 3).

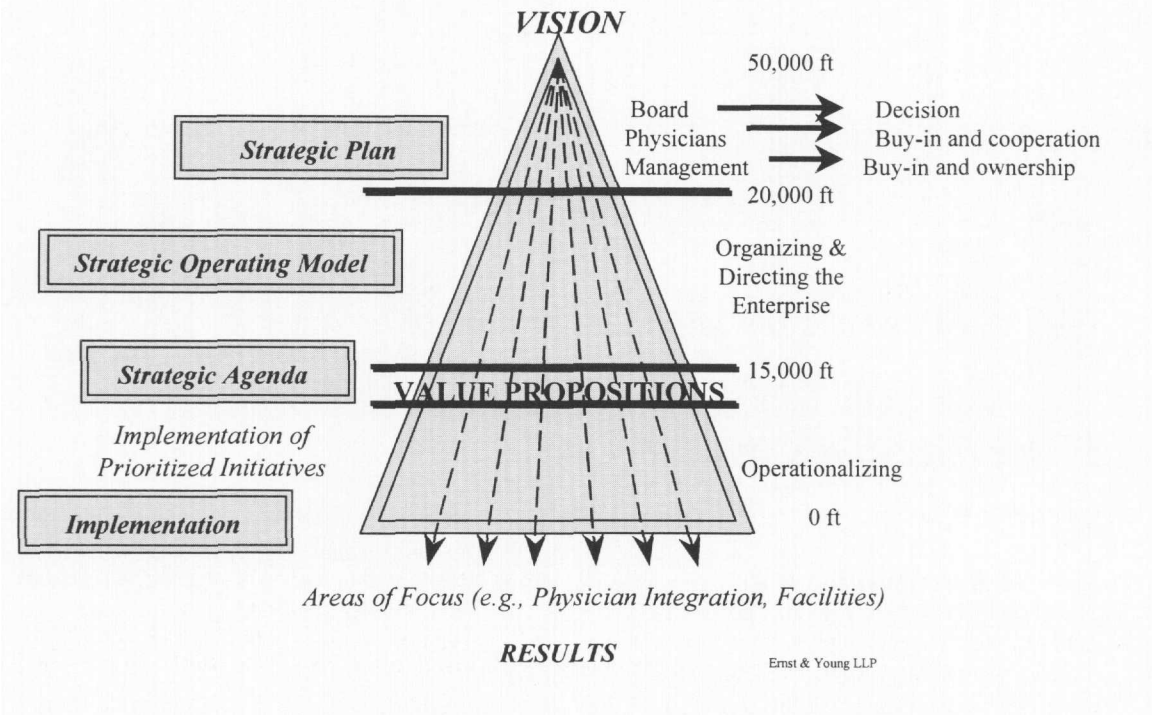
In fact, the GartnerGroup estimates that the typical $1 to 2 billion integrated healthcare delivery system (IDS) will need to invest between $75 million and $275 million in IT over the next five years to remain competitive (GartnerGroup 1998b).

A survey completed by The Kennedy Group, a Redwood City, California–based firm, found that 60 percent of integrated health networks have indicated that they will have to replace one or more of their major business applications by the year 2000. It is therefore critical that leaders of healthcare organizations develop a consistent "business case" methodology for evaluating and assessing technology proposals.

Strategic and Operational Alignment

The rapid vertical and horizontal consolidation in the healthcare industry has led to the development of IDSs that span the entire continuum of care and extend over a significant geographic area. Therefore, it is essential that an organizational strategic operating

Figure 4.
Strategic Operating Model: Alignment of Strategic Plan with Operational Efforts



model (SOM)—a common set of goals, objectives and operating principles—be developed and shared by all the affiliated entities. The purpose of the SOM is to create a working definition of *systemness* for the healthcare organization. An organization's SOM frames and reflects how an IDS behaves and concentrates its decision making and management activities. Each major process and business unit relies on the SOM for leadership, strategic communications, and tactical decisions; therefore, the SOM must reflect and drive an organization's vision and strategy for future market position (see Figure 4).

The SOM links an organization's strategic direction to its operations, incuding its information systems and technology. The healthcare leader who will be making the technology investment decisions must determine whether the SOM and the IS organizational structure or design are aligned. There are four common IS organizational designs—centralized, coordinated, cooperative, and autonomous. The structure of an IS is significant for its effectiveness and efficiency. To understand how IS structure affects the organization, Figure 5 describes the location of decision processes, as well as the potential benefits of each IS design.

Figure 5.
Description of Four IS Organizational Designs for IDSs

I. Centralized Design • Decisions are made at the system/corporate level. • Decisions have a major effect on system. • Formal guidelines and policy are developed and enforced. • Budget is centralized. • The intention is to optimize the system overall.	**II. Coordinated Design** • Decision responsibilities are divided. • Decisions have significant effect on system. • Guidelines are defined and supported. • Budget for enterprise investments is at the system level. • Both system and region/entity interests are represented and involved. • Support for system initiatives exists, with a commitment to local requirements.
III. Cooperative Design • Decision making is distributed. • Decision have a limited effect on system. • Limited consensus exists. • Other entities are informed and issues are discussed; some input is gathered before decision making. • Some cooperative investments are possible. • Focus is on a regional entity.	**IV. Autonomous Design** • Region/entity makes independent decisions. • Decisions do not affect system. • Limited communications outside of region/entity exist. • After decisions are made, no need to inform system is recognized. • The region/entity bears the consequences of the decision. • Funding occurs locally. • The intention is to optimize distributed operations.

Each of these IS designs reflect and affect how the individual entities that compose an IDS are connected through their information systems functions. Choice of leadership for the preferred organizational design requires serious consideration, as does the effect of the chosen design on reporting relationships (system and entity). For example, a centralized structure is dependent upon tight alignment between initiatives and goals and therefore demands the retention of a senior IT executive. The IT executive in a centralized system is usually directly responsible to the chief executive/operating officer for accomplishing the objectives needed to move the IDS toward its future vision with the proper application and management of technology. At the other end of the spectrum, in the autonomous IS design, a manager with strong IS operations skills is needed at each of

the entities to optimize results. The differences in structure and organization apparent in these IS designs illustrates the importance of filtering technology recommendations to determine which are compatible with an organization's SOM and IS structure. As an industry analyst has stated, "when a technology project fails, it fails not because of the technology, but because the underlying culture in the technology doesn't match the company's culture" (Hibbard 1998).

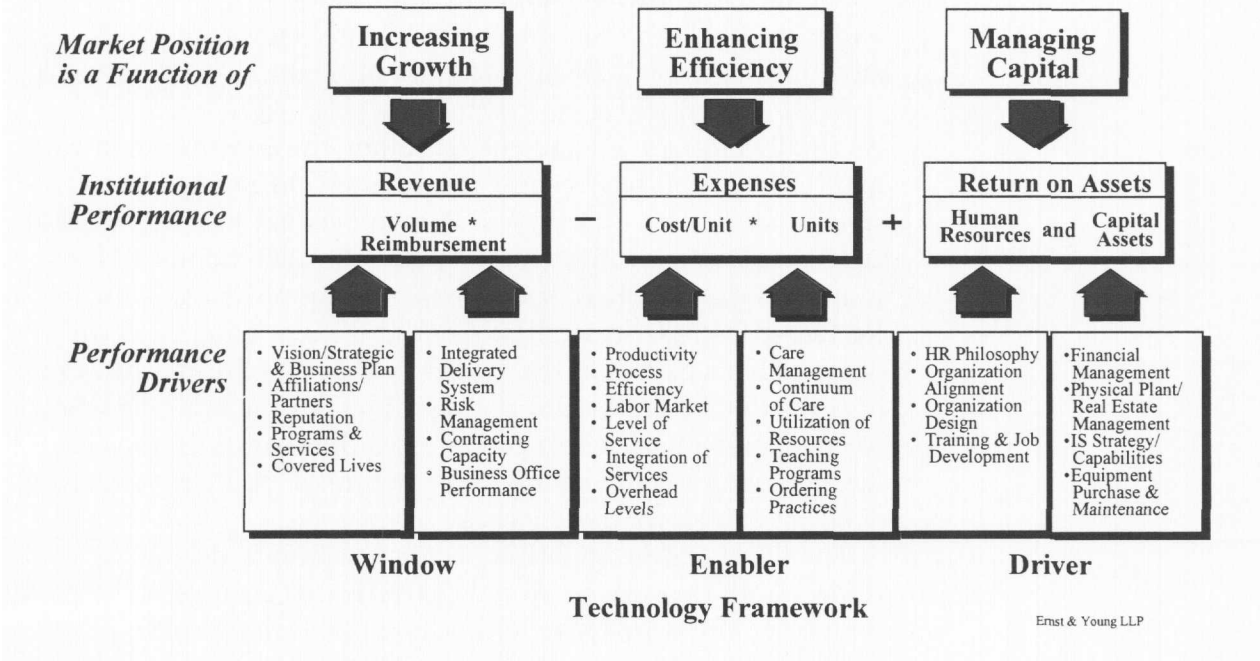
All technology proposals should also be formally reviewed through another filter: the "growth-efficiency-capital" model further facilitates and focuses an organization on *(1)* increasing revenue (growth), *(2)* decreasing operating costs (efficiency), and *(3)* improving return on assets (capital) (see Figure 6). The growth-efficiency-capital model highlights three objectives that are critical for an enterprise's success and should be considered when making technology investment decisions.

The growth-efficiency-capital model can be thought of in terms of the window, driver, and enabler framework. The organization's decision to invest in and maximize technology is related to how the organization balances its strategic and operational priorities and economic resources. Technology plays an important role in the IDS's ability to procure new patient volume, improve capacity, and expand geographic coverage.

For example, the implementation of robotics for routine analysis in regionalized laboratories has yielded exponential opportunities for increased referral volume and associated revenue growth. In addition the replacement of human resource–intensive process elements with technologic innovations (i.e., robotic arms and bar coding technology) has provided significant labor cost reductions and therefore greater efficiency. Finally, the access to and wise deployment of capital, both human and financial, can be demonstrated. Laboratory staff previously dedicated to rote and repetitive functions may be retrained to perform multiple tasks that are larger and more complex. The capital costs for technology innovations can be evaluated with regard to payback based on efficiency savings and potential growth in testing volumes resulting from increased business capacity.

While both the SOM and the growth-efficiency-capital model provide healthcare executives with filters to assess technology recommendations, it is imperative that executives also develop a specific business case for each technology initiative before making an investment decision. The following seven steps in the business case development process are essential to ensuring that wise technology decisions are made:

Figure 6.
Growth-Efficiency-Capital Model



1. Describe and define the proposed technology project;
2. Link proposed technology to the mission, vision, and values of the organization;
3. Determine return on investment and benefits projected;
4. Assess resource investments required to achieve benefits;
5. Establish performance indicators and complete gap analysis;
6. Assess risks, barriers, and critical success factors; and
7. Develop achievement reports to measure initiative progress and benefits.

To provide a concrete example of how to develop a business case, we will use two technology initiatives—clinical data repository implementation and standardized practice management infrastructure development—as examples to guide the process.

Step 1: Describe and Define the Proposed Technology Project

The executive should develop or be provided with a brief and concise statement describing the technology initiative being recommended. The statement should include information describing the organization's current situation, the business needs

and opportunities and problems and issues that arise from this situation, and how the technology initiative will address these needs and opportunities or problems and issues.

For example, in the case of a clinical data repository (CDR) implementation, the following information might be provided:

> As the IDS has grown and entities along the continuum of care have affiliated, it has become increasingly difficult to keep track of and efficiently serve IDS members because there is no centralization of clinical data. As a result, IDS members' files may not be available to specialists or other providers who are located in a different facility. Another issue arising from the decentralized nature of the system is that it is difficult for the organization to look at the member population data as a whole to develop medical management or wellness initiatives. The development and deployment of a central document repository (CDR) will address these issues.
>
> The CDR will be an online warehouse of clinical information that can be stored centrally and accessed remotely. The warehouse will be compiled from feeder departments within the IDS. The CDR stores all of the clinically relevant data for all episodes of patient care within a particular region/facility. This information is designed to support physicians and other clinicians in the day-to-day delivery of patient care. The CDR will provide ready access to information that will assist in the clinical decision-making and patient management process.
>
> Access to online clinical information maintained in the CDR will be provided on a regional/facility basis and will be consistently available, of high quality, and complete. At a minimum, the type of information that will be available includes:
>
> - Assessment of the patient
> - Lab results
> - Transcribed reports (history and physical, operative notes, discharge summary)
> - Radiology (excluding imaging)
> - Visit history (ICD-9, CPT codes)

In the case of a standardized practice management infrastructure development, the following information might be provided:

> As the IDS has expanded to include multiple facilities and physician groups, it has not implemented a uniform practice

management system. As a result, the IDS has not streamlined or consolidated office functions across the IDS. Therefore, the IDS has not capitalized on the economies of scale or operational efficiencies that are currently present. Achieving economies of scale improves the system's long-term cost profile, and consolidating key functions can quickly improve short-term profitability.

The principal operating areas that will benefit from the economies of scale associated with a standardized practice management system include financial management, administration, marketing, centralized billing and collections, and practice development. By implementing an enterprise-wide practice management system, the IDS will also be able to develop and administer managed care contracts and maintain electronic medical records. In addition, an enterprise-wide practice management infrastructure accomplishes the key goals of integrating providers through active information management.

Finally, an enterprise-wide practice management system with advanced management reporting functionality will provide the IDS with new capabilities for executive decision support and cross-organizational comparisons.

Step 2: Link Proposed Technology to the Mission, Vision, and Values of the Organization

The technology sponsor must provide a statement of how the proposed investment supports the strategic business and IT plans and how it relates to the mission, goals, and objectives of the healthcare organization. These statements must be detailed enough to specify the business benefits and how the proposed technology would assist in the achievement of the system's goals and objectives.

For the CDR implementation project the following statement might be provided:

> The IDS's goal is to become the leading cost-effective provider of high quality care in the region. The implementation of a CDR is one step toward reaching this goal. The CDR is, above all else, a critical enabling technology for other information system initiatives. Through its underlying support of key business and clinical applications, the CDR is an indirect but essential enabler of the IDS business strategy. Therefore, as the IDS pursues its business strategy of expanding through mergers with additional healthcare

organizations in its geographic proximity, the CDR and other supporting information systems will enable the organization to achieve improved medical management.

For a standardized practice management infrastructure development project the following statement might be provided:

> The IDS's strategic plan includes seeking opportunities for a single management approach that will further the organization's commitment to becoming a leading regional IDS. By employing a state-of-the-art practice management infrastructure throughout the organization, the IDS can ensure that common functions are performed consistently across all facilities. An investment in technology is necessary and vital to create a technical infrastructure that will significantly enhance the integration and communication capabilities of the various physician practices. Rapid deployment of practice management information systems will accelerate the IDS's ability to succeed in the increasingly competitive managed care environment.

Step 3: Determine Return on Investment and Benefits Projected

"Measuring the business value of IT investments is multifaceted and still more art than science. Even so, measuring the process dynamics of an organization enabled by IT is key" (GartnerGroup 1998e).

Determining the return on investment (ROI) and value of technology investments is a critical step in the decision-making process, but it is not always easy. Trying to tie hard numbers to the benefits of an information system is difficult. How does one put a dollar figure on the potential benefits and power achievable from better data and information? After all, as the GartnerGroup states, "The challenge in measuring the value of IT lies in two aspects: first, information itself is an intangible and so by its very nature difficult to measure. Secondly, information itself has no inherent value. Only when information is applied to specific business problems can value be derived" (GartnerGroup 1998d).

When measurable information is used, value can be determined. For instance, an IDS needs to collect clinical information to measure clinical outcomes and utilization rates so that patients, providers, and payors can concretely and quantitatively see the value that the organization is providing. When possible, it is important to determine the quantitative benefits of a technology investment by completing a

cost-benefit analysis. Key financial indicators that should be included in this analysis are: the net present value (NPV), the average return on investment (ROI), and the internal rate of return (IRR).

In some cases, however, it might be useful to think about ROI in terms of the qualitative value provided to the organization and its customers. For example, in the case of a CDR, the benefits and ROI to the organization might be listed as follows:

> We believe that the qualitative benefits of the CDR and its role as a critical enabling technology provide sufficient business case justification. The CDR will provide rapid access to critical patient data and enables providers to make more informed decisions, thereby significantly improving the timeliness and appropriateness of patient care. In addition, the implementation of the CDR enables the deployment of other important applications, including physician order management, patient education, continuum planning, and online critical paths.

In the case of the standardized practice management infrastructure, the qualitative benefits to the organization might be listed as follows:

- One training program will serve department-specific users across the IDS.
- Employees can be transferred between the IDS facilities easily in response to volume fluctuations or centralization efforts.
- Documentation, billing, and collection for services will be performed consistently.
- On-going process improvement efforts can be streamlined—only one set of processes need to be evaluated and redesigned.

In fact, the ROI on technology investments is not based on the functionality of the technology or information system itself, but on how effectively the technology/information system is integrated and incorporated into an organization's processes. As indicated by the window, driver, and enabler framework, the greater the depth of integration between the technology, the people, and the processes, the greater the ROI.

The costs of implementing new information technology may seem overwhelming to healthcare executives. As a result, there may be a tendency to postpone investment decisions, but the costs associated with delaying or not installing new technology (lost opportunity costs) may be even more dramatic

and devastating to a healthcare organization. Those organizations that implement new systems will have a competitive advantage in the consumer-driven healthcare market. The healthcare organizations that embrace new technology will be able to provide seamless, high-quality service and care to their patients and be able to create operational efficiencies by capturing and maximally using clinical and financial information. Organizations that elect to maintain their current, or legacy, IT systems may face significant opportunity costs associated with maintaining and upgrading old systems and with foregoing benefits that would accrue from the new technology over time.

One final issue to consider when assessing ROI is the value of time—whether acceleration of the decisions and implementation will lead to greater qualitative and quantitative benefits. By working in an accelerated mode, the momentum created can expedite the process and lead to faster, more productive outcomes. One organization that has successfully accelerated their investment and implementation process is the Health Alliance of Greater Cincinnati, an IDS consisting of five acute care hospitals and systems and associated physicians who serve the metropolitan Cincinnati market. One of Health Alliance's major business goals was the implementation of integrated information systems across the enterprise, including a single care management system and associated support. To accomplish this goal, Health Alliance used a *rapid design* model that brings together hundreds of stakeholders in a two- or three-day session, enabling accelerated decision making and tailoring of new technology initiatives. William Finney, the CIO of Health Alliance, has stated that "*rapid design* was one of the major factors enabling the Alliance to meet its objective of bringing a full continuum of care management information systems on-line for five hospital systems within two years" (Finney 1998).

Step 4: Assess Resource Investments Required to Achieve Benefits

The financial resources needed to implement the proposed technology must be assessed to include the people, space, equipment, and time commitments required. The resources should accurately portray the magnitude of the project. For instance, developing and implementing a CDR or a standardized practice management infrastructure requires consideration of the education and training involved with the initiative, as well as the initial and on-going requirements to implement and maintain the technology.

For a CDR implementation project the following might be included in a resource assessment statement:

> The physicians and other clinicians from the various entities of the IDS would need to be educated on the features and use of the CDR to promote effective use. In addition, ancillary staff will need to be educated on the importance of capturing accurate and timely data in their feeder systems to ensure the availability of correct display of data in the CDR. The information sessions and training classes will need to be offered several times at each location as well as by video conference to meet the needs of the staff and clinicians. On-going education support for questions or problems is recommended.

Similarly, for a standardized practice management infrastructure development project the following might be included in a resource assessment statement:

> The administrative employees and physicians from each facility and practice group of the IDS would need to be trained to use the new information system. Significant time, from three to six months, is required to convert the data and information at each facility into a new format and develop new processes to accommodate them. Once the new enterprise-wide system is implemented, the number of full-time equivalents (FTEs) required for administrative purposes will decrease substantially.

Part of the resource investment discussion should include which software, hardware, or medical equipment vendors best fulfill an organization's needs. This decision must be considered carefully, because vendor products and their applications have been changing rapidly as a result of technologic advances and consumer demand. In recent years, rapid consolidation of vendors combined with increasing numbers of start-up companies and new products has had a major effect on vendors with mature products late in their life cycle. Therefore, organizations must be careful to chose a vendor that will be able to meet current and future needs. As healthcare organizations continue to integrate vertically and horizontally, it is increasingly unlikely that any one vendor will be able to provide an organization with all of its needed IS technology. Moreover, healthcare organizations typically do not select, purchase, and implement enterprise-wide systems in a single purchase; instead, they purchase individual systems or components

over several years to build or assemble an enterprise-wide system (Savas 1998). For these reasons, it is increasingly important to ensure that technology and information systems are integrable, meaning that the information system or application that is purchased now can quickly and effectively be linked to other information systems and application modules as future relationships between organizations evolve or dissolve.

Step 5: Establish Performance Indicators and Complete Gap Analysis

It is extremely important to specifically identify all benefits the organization will realize upon completion of the initiative. It is necessary to include baseline qualitative and quantitative performance measures and target goal measures that may be based on industry benchmarks and to determine a time frame in which the benefits are to be realized.

According to the GartnerGroup, "Clearly defining the results expected from healthcare processes provides all stakeholders with a set of shared expectation, the guidance for process design and the criteria for evaluating success and focusing improvement efforts" (GartnerGroup 1997b).

Table 1 demonstrates select performance indicators that might be used by an organization implementing a CDR. Table 2 illustrates performance indicators that may be included for a standardized practice management infrastructure development project.

Step 6: Assess Risks, Barriers, and Critical Success Factors

It is crucial to define the specific risks, barriers, and critical success factors associated with the proposed technology initiative. Some possible risks and barriers to consider are the organization's inability to meet implementation timelines and goals, the staff's unwillingness to change current practices, and a lack of physician buy-in and support. In addition, critical success factors, which are often linked closely to the risks and barriers, must be recognized. Some common critical success factors are physician and employee commitment, appropriate technical support and training, and executive sponsorship.

Figure 7 is an example of risks, barriers, and critical success factors that may exist when implementing a CDR; Figure 8 demonstrates the risks, barriers, and critical success factors involved when implementing a standardized practice management infrastructure.

Table 1.
Performance Indicators for CDR

Performance Indicator	Current State Measure	Industry Benchmark	Target Measure	Time Frame for Realization	Operational Leader(s) Responsible for Value Achieved
Number of phone requests to medical records for clinical results or information	300	300	160	12 months	Director of Medical Records
Number of FTEs in medical records associated with performing the manual retrieval of clinical information	35	25	10	24 months	Director of Medical Records
Percentage of time that complete and accurate CDR data is available for clinical decision making	79%	90%	99%	6 months	Director of Medical Records

Table 2.
Performance Indicators for a Standardized Practice Management Infrastructure

Performance Indicator	Current State Measure	Industry Benchmark	Target Measure	Time Frame for Realization	Operational Leader(s) Responsible for Value Achieved
Denial rates	3%	2%	1%	12 months	Director of Patient Accounting
Missing encounter forms capture	20 days	5 days	10 days	12 months	Director of Patient Accounting
Days in accounts receivable	92	50–75	50	12 months	Director of Patient Accounting

Step 7: Develop an Achievement Report to Measure Initiative Progress and Benefits

Tracking the progress made toward achieving the targeted performance goals expected from a new technology investment is important. Not only does this allow the executive to see the progress that is being made, but it also provides an opportunity for corrective actions to be taken if needed. Achievement reports should be updated monthly.

Figure 7.
Implementation of CDR

Description	*Recommended Actions*
Risks: • Physicians may not use the CDR. • Physicians may not use the CDR appropriately. • The aggregation of data across entities in the region is resisted.	• Strongly emphasize intuitive user interface requirements for system. • Establish education and training requirements, infrastructure and online tools.
Barriers: • Many clinical processes are not currently computer-based. • Certain features of clinical records are difficult to translate into a computer-based system. • Because of security concerns, data dissemination can be difficult.	• Develop phased approach to implementing ancillary participation. • Consider additional automation for departments and processes that would positively affect overall CPR. • Establish security expectations. • Select security tools.
Critical Success Factors: • Easy and quick access to CDR information must exist. • CDR information must be accurate, timely, and complete. • Physicians must participate in the design of the CDR. • Sponsorship of the CDR is required at the highest levels of the organization.	• Invest in appropriate IT infrastructure. • Focus on feeder systems that are continuously validated for accuracy and comprehensiveness. • Create physician working group. • Require physician leadership over the entire life cycle.

Figure 8.
Implementation of Standardized Practice Management Infrastructure

Description	*Recommended Actions*
Risks: • The IDS will be unable to meet implementation timeline goals. • Lack of standardization of applications across clinics exists. • Lack of comfort with switch to Windows™ environment exists.	• Determine overall project management process including program management office. • Create standards and publish the operating guidelines enforced by an IS steering committee. • Consider a web-based interface for user participation.
Barriers: • Staff is not willing to change current practices. • Lack of physician buy-in and support exists. • Lack of information services process integration exists.	• Facilitate change management for both project participants and end-user involvement and acceptance. • Seek project champions and support a communication plan. • Require sponsoring departments to own the outcome with support from IS.
Critical Success Factors: • Physicians are committed. • Staff is committed. • Technical support exists. • Vendor support exists. • Process redesign is completed. • Sponsorship exists at the highest levels of the organization.	• Create an ongoing communications strategy. • Focus information on the business case and the positive affect on those participating. • Ensure that technical infrastructure has been fully defined, created, tested, and maintained. • Require user sponsorship and outcomes measurement. • Require executive sponsorship and leadership throughout the implementation.

Table 3.
Achievement Report for CDR

Performance Indicator	Respon-sible	Value Management	Project Management	Target Amount	Realized Amount	Summary	Required Action Steps
Number of phone requests to medical for clinical results or information		On target	Some difficulty	$2m	$2.7m		Communicate success
Number of FTEs in medical records associated with performing the manual retrieval of clinical information		On target	On target	$3m	$2.9m		
Percentage of time that complete and accurate CDR data is available for clinical decision-making		Major problems	Major problems	$4m	$2.6m		Increase training and deploy CDR to more business units

Table 4.
Achievement Report for a Standardized Practice Management Infrastructure

Performance Indicator	Respon-sible	Value Management	Project Management	Target Amount	Realized Amount	Summary	Required Action Steps
Decrease denial rates		On target	On target	$1m	$1.5k		Establish electronic connection with additional payors
Increase percentage of claims that are electronically submitted		On target	Some difficulty	$3m	$2.5m		Contact area employers' HR departments to gain support
Decrease A/R days		Major problems	Major problems	$12m	$3m		Conduct clinical documentation and cash acceleration reviews

An achievement report for a CDR implementation project might resemble Table 3. An achievement report for a standardized practice management infrastructure development project is outlined in Table 4.

The business case development process focused on two examples of technology initiatives that would add value to an organization—clinical data repository implementation and

Figure 9.
Opportunities of Technology Investments in Healthcare

Focus Areas	*Improvement and Innovation Opportunities*
Healthcare Organization as a Whole • Enterprise-wide system implementations • Care continuum system implementations	• Focused improvement and redesign of all major operational areas • Resource use and care management • Establishment of a vision for care delivery • Nonlabor cost savings
Laboratory • Laboratory information services • Robotics	• Focused improvement of operations • Consolidated/shared services • Nonlabor cost savings • Expansion of services
Materials Management • Materials information system • Accounts payable • Electronic data interchange	• Supply chain redesign • Product standardization and use opportunities • Vendor standardization • Consolidation/shared services
Revenue Cycle • Patient access • Patient accounting • Document imaging • Medical records	• Revenue cycle process redesign • Cash flow acceleration (accounts receivable) • Paperless processes • Consolidation/shared services
Medical Imaging • Radiology information systems • Teleradiography • Digital imaging retrieval, including remote retrieval	• Focused improvement (patient flow and staff scheduling) • Radiologist productivity • Nonlabor savings opportunities • Logistics
Operative Services • Operating room systems • Scheduling	• Capacity planning • Patient flow and practice model redesign • Product standardization and use
Pharmacy • Pharmacy information systems • Dispensing technology • Robotics	• Pharmaceutical care model development • Formulary management and drug use • Focused improvement of dispensing processes

standardized practice management infrastructure development. A multitude of opportunities exist that allow technology to add value to an organization. Figure 9 lists examples of focus areas where technology initiatives can add significant value.

By ensuring that technology investments have a strong business case, organizations can feel confident that technology investments will add value to the organization if implemented successfully. Once a technology investment decision is made, the

organization must develop an ongoing communication strategy to convey the decision and progress to date to all stakeholders throughout the entire implementation and evaluation process.

CONCLUSION

As demonstrated throughout the article, technology will play a major role in achieving the financial and clinical results desired by integrated delivery systems that seek significant and predictable advantages in today's healthcare market. Considered alone, technology will add incremental benefits to an organization, just as other initiatives might produce if executed in a dedicated manner. However, the magnitude of change and the rapid rewards ultimately sought by most organizations can only be accomplished through combining technology with people and process reengineering.

Over the next decade, leveraging the power of information and technology will precipitate changes in the structure of the healthcare industry and affect the way organizations compete. Healthcare leaders must be proactive and forward thinking about their technology investments. Technology offers the healthcare organization the greatest opportunity for creation of value—value for itself and its customers. Those organizations that can capture, integrate, and use clinical and financial data to concretely demonstrate the value they provide to their customers will be those that survive and prosper in the next millennium.

REFERENCES

Datarequest Vertical Market Opportunities, North America. 1996. "IT Budget as % of Revenue." *End User Budget Analysis;* Vertical Markets. April.

Davis, S. and C. Meyer. Ernst & Young Center of Business Innovation. 1998. *BLUR: The Speed of Change in the Connected Economy.*

Deloitte Consulting. 1998. "IT Investment per Employee." Global CIO Survey.

Evans, P.B. 1997. "Strategy and the New Economics of Information." *Harvard Business Review* 75 (5): 70–82.

Ernst & Young LLP. 1998. *BLUR: Health Care's Speed of Change in the Connected Economy.* Reading, MA: Addison-Wesley

Finney, W. and P. Penrod. 1998. "Accelerated Package Integration." *ADVANCE for Health Information Executives* 2 (5): 1–2.

GartnerGroup. 1997a. "Don't Let New IT Systems Perpetuate Old Problems." *Healthcare Executive and Management Strategies* (HEMS) Service. February.

GartnerGroup. 1997b. "Integrated Outcomes: Where CIOs Need to Be Thinking." *Healthcare Executive and Management Strategies* (HEMS) Service. September.
GartnerGroup. 1998a. "IS Training Still a Good Investment?" *Healthcare Executive and Management Strategies* (HEMS) Service. August.
GartnerGroup. 1998b. "Key Issues in Healthcare IT Management." *Healthcare Executive and Management Strategies* (HEMS) Service. January.
GartnerGroup. 1998c. "Underlying, Enabling and Emerging Technologies." *Healthcare Technologies* (HT) Service. January.
GartnerGroup. 1998d. "Determining the Value of IT Investments in Healthcare." *Healthcare Executive and Management Strategies* (HEMS) Service. July.
GartnerGroup. 1998e. "Measuring IT's Benefit in Improving Healthcare Processes." *Healthcare Executive and Management Strategies* (HEMS) Service. July.
GartnerGroup. 1998f. "State of the Healthcare IT Union: Business Drivers and Issues." *Healthcare Perspectives* Report. July.

THE COMMENTARIES: A SUMMARY

For this issue's commentaries, we called upon two healthcare information technology practitioners and one well-established academic expert in information systems.

William C. Reed is senior vice president and chief information and administrative officer for Olsten Health Services. His commentary expands our understanding of what technology in healthcare involves and is consequently a very useful companion to the lead article. For Reed, healthcare technology is not uni-dimensional, but rather a continuum. At the low end of that continuum is automation technology, where discrete and typically repetitive tasks are automated in the interests of economy. Midway down the continuum is information technology. Here, data is transformed into information in the interests of providing consistency and quality in the processes covered. Knowledge technology is the most sophisticated type and uses information to enhance, continually improve, and reengineer the processes performed by an organization.

Knowledge technology is obviously the most desirable and powerful form, but it depends on both automation and information technology to function. Business decisions regarding knowledge technology are the most difficult, but when properly defined, these decisions can produce returns that increase indefinitely as the process continually reengineers and improves itself.

In the second commentary, William B. Finney, chief information officer of the Health Alliance of Greater Cincinnati, provides a glimpse of a healthcare system transformed by information technology. At present, he notes, we operate within a system built on a paper-based legacy, one in which the hospital is simply the optimal location to manage and distribute paper-based information and events.

For Finney, information technology is both an end-product and an enabler of the transformation that is now occurring. The eventual shift to electronic medical records, a technology that is now feasible and will eventually become more affordable and sophisticated, will enable more efficient and effective care by transmitting medical information across time and space. Finney uses surgery as an example of an end product of the technology transformation, arguing that the surgical procedures of the future will require only the virtual—rather than the actual—presence of the surgeon.

Finally, Finney describes how Cincinnati's Health Alliance is using technology to create a truly integrated delivery system. Readers should find the Alliance's information technology strategies quite informative.

Dr. Charles B. Austin, now professor of Health Services Administration at the Medical University of South Carolina, is author of the

definitive text on information systems in healthcare administration. No one is more aware of the importance of information in today's healthcare environment, and it is little surprise that Austin identifies some important omissions in our lead authors' guidelines for developing a business case for technology.

First, Austin reminds us that organizations typically face multiple technologic needs and requests at any given time. A business plan for technology development must incorporate a method for establishing priorities or linking those priorities to the organizational strategic plan. Austin also argues that the lead authors' guidelines give scant attention to any type of feasibility analysis for a technology proposal. He argues that this step is essential for the business plan development and that the analysis should incorporate technologic, economic, and operational concerns. The feasibility analysis should be repeated or continually refined as the technology proposal is developed, and administrators must be willing, Austin warns, to abandon a technology proposal that becomes unfeasible even well into its development.

Austin agrees with our lead authors when they argue that information systems and technology can fail if they are not properly aligned with the organization's culture. But he also warns that there are numerous other reasons for technologic failures, including mismanagement of the process.

—M.E.S.

WILLIAM C. REED

Dimensions of Technology in Healthcare

Introduction

The feature article explores the role and business case for technology in healthcare. Specifically, the article examines the role of technology as related to its potential for being a window, driver, and enabler in healthcare.

The following commentary expands upon that context by identifying that healthcare technology is not unidimensional but rather a continuum of automation technology, information technology, and knowledge technology. The commentary also investigates the ramifications of each of these technology dimensions in relation to building a cogent business case for the use of technology in healthcare.

Dimensions of Healthcare Technology

Although the feature article broadly defines technology as "capital, equipment, information systems, and automated environments," this commentary provides specificity to that definition in three distinct dimensions. The first is automation technology (AT), defined as the application of technology to provide automation for a discrete task or set of tasks. More specifically, AT is the use of microprocessor-based technology, either with or without retained data, to facilitate the operation of repetitive tasks. While some information management may be necessary to perform the automation, it is not the fundamental purpose of the technology. The primary goal of AT is economy, that is, the ability to perform or facilitate tasks at a rate faster than the rate without the technology.

Information technology (IT) will be characterized as the application of technology for the principal purpose of effectively managing information and using it to enhance the effectiveness of a process or flow of processes. IT is the function that enables the conversion of raw "data"—a collection of facts, real or assumed—into "information," that is, the appropriate use of data thus providing it value. While speed is also a benefit of IT, IT's ability to ensure consistent quality in process and information is the primary goal in its application.

Finally, knowledge technology (KT) is the use of technology to substantively enhance the value of processes and ensure their continual evolution and improvement. KT focuses on maintaining and expanding an organization's intellectual capacity. Whether merely maintaining an organization's "tribal knowledge" in the midst of employee turnover, perpetuating standardization throughout a geographically dispersed organization, or

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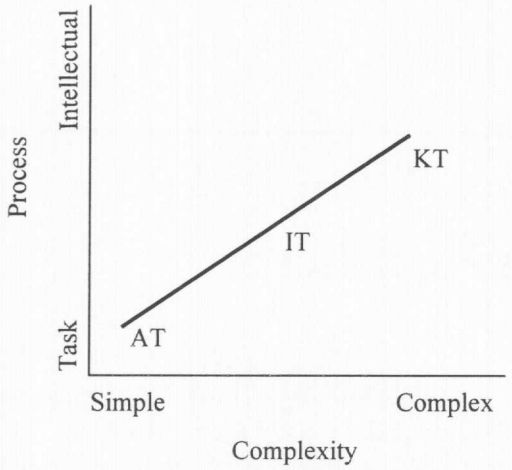
Figure 1.
Technology Process–Complexity Continuum



enhancing an organization's intellectual prowess by enabling the convergence of disparate data information sources into a new knowledge delivery capability, KT functions at the high end of the process-complexity continuum (see Figure 1). While AT focuses on economy and IT on consistency, KT's focus may be viewed as that of enhancing the predictability of achieving a quality outcome.

In one sense, organizations are a reflection of their processes. Collectively, these processes partially represent the organization's intellectual capital. The processes are composed of a series of anticipated deliverables that are progressively produced over time, with each deliverable resulting from the execution of a series of tasks. AT is focused at the task level with an orientation toward speed and economy. IT is targeted at the deliverable level with an orientation toward consistently replicating the deliverables and interpreting any task-related data. KT is directed at the process level with an orientation toward the overall integration and interpretation of information across all deliverables.

It should be noted that both AT and IT technologies can stand alone or function in concert. However, KT clearly is dependent upon AT and IT to be functional. Figure 2 depicts how the dimensions of healthcare technology will evolve over time to transition from an environment mainly based on AT and IT to a predominately KT model. Most of today's technology, whether financially or clinically oriented, is predominately composed of AT and IT (see Figures 2a and 2b). Even when financial and clinical technologies are integrated as in Figure 2c, AT and IT are still the fundamental components. However, the introduction of a robust knowledge component as in Figure 2d results in a new technology hierarchy where KT is the dominant technology (see Figure 2e).

Technology as a Window

Any dimension of technology viewed as a window must be considered as a collective perception. That is to say that the technology for a single discrete process offers an extremely limited view of the healthcare organization. However, when the collective technologies of a healthcare organization are considered, a much more insightful view of the organization's culture and strategy is portrayed.

As previously noted, AT's primary focus is speed, usually for use in processes of limited complexity where the handling of repetitious tasks of limited variability is beneficial. From a window perspective, AT offers little more than the ability to satisfy customers through the expediency of process. For example, a well-scripted interactive voice-response capability may facilitate access to a healthcare organization, and, while this capability in and of itself may not entice customers to that organization, it may certainly provide a very satisfying initial experience.

IT as window can take that customer's satisfaction and begin to embrace them even more fully by enhancing their degree of comfort with the organization. From something as simple as ensuring a single point of customer data collection to highly decision-enabled questioning systems, IT can be used to impress a customer with the organization's handling of its information, thereby increasing their level of comfort that the organization effectively manages all of its processes.

While AT and even IT may serve as the most routine windows to a healthcare organization, KT offers the opportunity to provide the most unique and insightful view of an organization. KT alone has the ability to interest and intrigue customers by enabling the organization to assimilate disparate information rapidly and bring it to bear on a particular medical problem. Furthermore, the ability to provide such information integration in a unique manner will set the organization apart from others.

A note of caution is prudent however. While technology may be used as an effective window to a healthcare organization, a delicate cybernetic balance must be struck between human and computer. Few things in life are more personal than one's healthcare; therefore human interaction and intervention are extremely critical in the healthcare process. While an appropriate "dose" of technology will enhance a customer's view of a healthcare organization, a robotics-based environment as depicted in the movie *Coma* may constitute an "overdose" just as apt to alienate that same customer. The most effective healthcare organizations will be those that can exploit technology to obtain all of the noted benefits in a manner that is unobtrusive to the customer.

Technology as a Driver

Healthcare has migrated from a quality-centric model, where organizations were sought based upon their perceived clinical quality or customer satisfaction, to a more cost-centric model. In the cost-centric model, as long as a minimum threshold of quality is maintained, organizations are evaluated based upon their associated costs. In today's environment, AT and even IT offer opportunities to serve as drivers for a healthcare organization. Both technologies provide the ability for a healthcare organization to reap substantial process efficiencies, and enable it to "drive" to a lower cost structure. But being renowned for the lowest cost structure is not usually sustainable, as competitors identify opportunities to lower their cost structures as well.

The next evolution of the healthcare quality-cost evaluation will be to that of a

Figure 2.
Technology Hierarchy

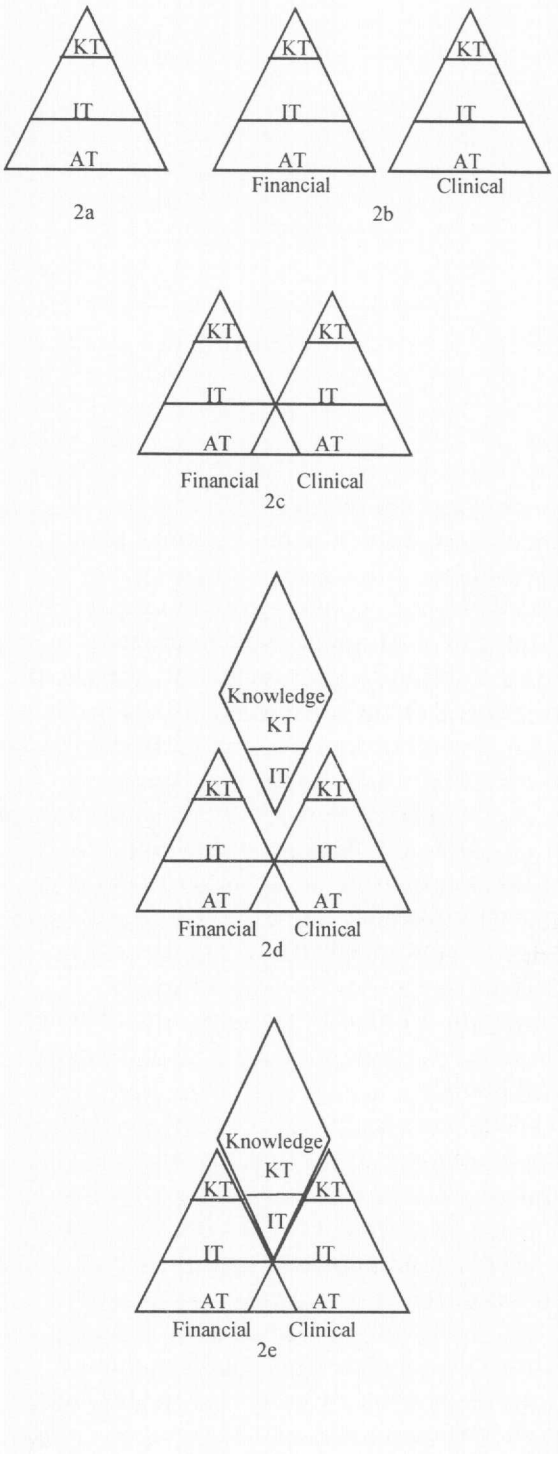
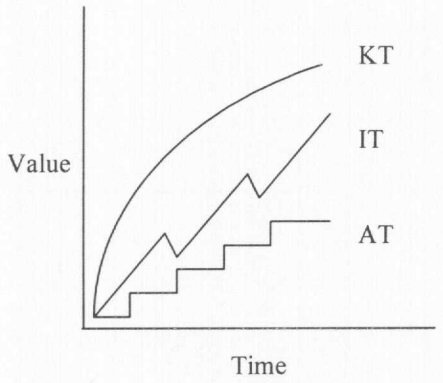


Figure 3.
ROI Calculations for Healthcare Technology



hybrid value-based model. In that value-based environment, not only can KT be a major driver, it may evolve to be the single most critical driver. A healthcare organization's ability to provide convergent clinical knowledge and insight in a unique and comprehensive manner will offer a significant and sustainable opportunity for the organization to be set apart from its competitors, and thus such ability may become a true "branding" opportunity.

Technology as an Enabler

As the feature article so aptly identifies, "an organization's most important assets are its employees and information" and the most important aspect of enabling is "people enablement." The role that any dimension of technology plays in enabling is an extremely valuable one.

AT allows rote tasks, for example, basic data recording through voice recognition, to be offloaded from employees, including clinical professionals, thereby enabling them to focus on the tasks that only they are capable of performing. Likewise, IT facilitates the roles employees perform within a healthcare organization (e.g., informed decision making), enabling them to perform more efficiently and effectively. These two dimensions of technology, while extremely beneficial to employee enablement, only enable employees to do what they already have the capability to do, but faster and more consistently, or at in a least better-informed manner.

With KT as an enabler, however, employees have the potential to expand their capabilities to levels that exceed their historic performances. KT, when effectively applied, offers the greatest potential for people enablement, and ultimately organization enablement as well.

The Business Case in Light of Technology Dimensions

While the core aspects of business case development as portrayed in the feature article remain the same regardless of the technology dimension, each dimension contains nuances that should be considered during development of the business case.

In terms of return on investment (ROI) for a particular technology, three specific dynamics should be considered. First, ROI calculations transition from being mostly objective based for AT investments to being extremely subjective value judgements for KT initiatives. Since by its very nature KT should be continually evolving and improving at undetermined rates, it is virtually impossible to accurately project the eventual return. However, one could conclude that the eventual return would be higher for a KT initiative than a corresponding investment in AT or IT projects.

Finally, one should consider that probable rates of returns vary based upon the technology dimension. AT returns basically follow a step function whereby an investment achieves a value that plateaus relatively quickly (see Figure 3). The return does not tend to increase unless further investments, that is, automation replacements, are made.

IT initiatives tend to have a more gradual but higher rate of value attainment; however, they have a tendency to actually begin to lose value over time unless further investments and enhancements are made. Similar to AT, the

Figure 4.
Process Change for Healthcare Technology

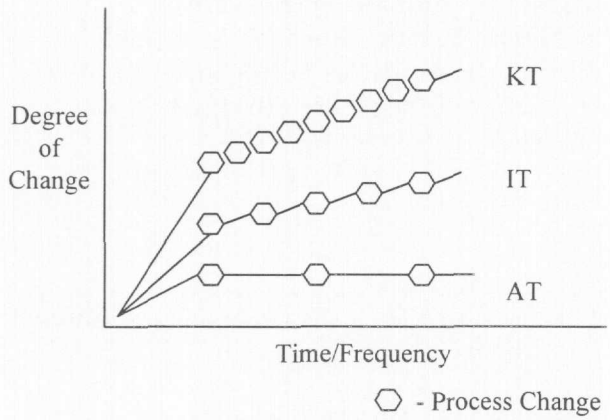
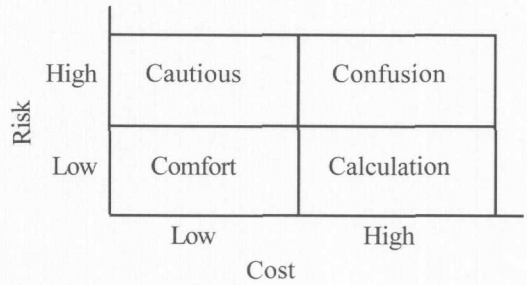


Figure 5.
Four Cs of Business-Case Evaluation



continual value attainment of IT is dependent upon ongoing financial investment.

When KT is properly designed to dynamically reengineer and improve itself, value attainment, although it takes longer to achieve, has the potential to increase indefinitely, without any further substantial financial investments. The value of KT increases through use that continually builds upon the retained knowledge of the organization.

Figure 4 depicts the different ways in which technology affects the interaction of people, process, and technology. Other than employee displacement, AT has nominal effect on employees or fundamental process as it is targeted at replacing rote, repetitive tasks. IT substantially affects both people and process, and thus the assimilation of such IT requires thoughtful change management. However, the process change associated with IT occurs at finite points that are premeditated. KT, while it has the most significant effect on people and process, is based upon continual incremental change that occurs dynamically rather than as a discrete planned event.

Finally, consideration should be given to the executive evaluation and decision process related to the technology business case. As Figure 5 shows, executive evaluation becomes increasingly complex as the cost and risk related to a technology project increases. For initiatives of both low cost and risk, executives reach a comfort level quickly. If the cost alone increases, the decision process becomes highly calculated and ROI based. If only the risk increases, executives tend to react very cautiously. AT is largely low risk and relatively low cost, thus executives are comfortable with the decision process. Conversely, KT projects entail a high degree of cost and risk and thus confuse the executive decision process. Therefore, it should be anticipated that KT projects will probably take longer and require an increased degree of justification than similarly sized AT and IT efforts.

Conclusion

Technology in healthcare is not unidimensional but rather represents a continuum from automation technology to knowledge technology. The nature and ability of technology to serve as an effective window, driver, or enabler in healthcare is dependent upon the specific technology dimension.

Automation technology and information technology will always be important and necessary technologies for healthcare

organizations, and will serve as the foundations for knowledge technology. However, knowledge technology alone will be the fundamental technology that will enable a healthcare organization to have sustainable competitive advantage.

The nuances of these technology dimensions also extend to assembling a business case to support their acquisition. As one transverses the continuum from automation technology to knowledge technology, objective quantification of the associated benefits becomes increasingly difficult. In knowledge technology, the nature of process is altered, not the efficiency of process.

WILLIAM B. FINNEY

Can Information Technology Heal Healthcare?

INTRODUCTION

Healthcare providers have not substantially changed the way service is delivered since medicine became an academic discipline. As the cost of healthcare increases, providers find themselves under intense scrutiny because the market does not perceive that the value received is commensurate with the increasing cost. This perception creates a dilemma for healthcare providers: how to retain the "soft" side of the care delivery process while managing the expectations of patients, physicians, and payors. Information technology is a means to that end.

THE LEGACY

Healthcare is an information-intensive, geography-dependent business. The intensity of information required to provide care is directly related to the condition of the patient. The iterative nature of treating an illness requires an uninterrupted flow of "just-in-time" information related to the cause and effect relationship of treatment. The treatment process continues to evolve into increasing specialty in both diagnostic and therapeutic modalities. The communication of information related to the process is also increasingly complex and time sensitive. The human intervention required to maintain the flow and management of information has fueled the increase in the cost of healthcare.

Geography is also a compounding factor to the human intervention required to maintain the flow and management of information. Paper is the preferred information medium and paper is both user and geography dependent. Unlike electronic data, paper can be in only one user's possession and in only one location at any particular time. I believe that a patient is hospitalized to bring the patient and the providers of care into a single location to facilitate the care-delivery process and the management and distribution of paper-based information and paper-triggered events.

TRANSFORMATION

Information technology is both an enabler of transformation and, in some cases, the end product of transformation. The process of providing healthcare enabled by technology will evolve in concert with data standardization.

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Developing technology-based products and services will be another dimension of transformation.

The electronic medical record is an example of technology-enabled transformation. The healthcare industry has talked about an electronic medical record for 30 years. Although some progress has been made toward an electronic medical record, the progress has not been commensurate with the improvements in the technology because technology is not the gating factor. The healthcare industry references "the medical record" as if there was one. "The medical record" does not exist; "a medical record" exists. Every hospital and every provider has a medical record for every patient. It contains data elements related to the patient's condition and notation related to the treatment plan. It is idiosyncratic in that every physician creates a medical record in their own unique shorthand. It is difficult for me to foresee "the electronic medical record" until the industry defines the standards and the content for "the medical record."

Lessons can be learned from other industries and applied to healthcare. The securities industry is an example of an industry that lacked standard definition and formats for financial records—their equivalent of the medical record. Prior to the development of GAAP (Generally Accepted Accounting Principles) and the initiation of FASB (Federal Accounting Standards Board), the financial records of companies were inconsistent. That inconsistency created an environment that made it difficult for the buyer of a company's stock to make an informed decision related to investment options. The healthcare industry has made it difficult for both the patient and the buyer and for the provider of healthcare because medical records are inconsistent. As it did in the securities industry, technology can revolutionize how the healthcare industry conducts business. Addressing the inconsistencies in the medical record is a prerequisite for that revolution.

Progress can be made in learning how to manage medical records electronically prior to establishing a standard format and content for a medical record. Learning to manage medical records electronically will require a commitment and an investment in the people, process, and technology. This investment is required to transform the healthcare industry from an industry that relies on paper-based information as event triggers for prevention and intervention, to an industry that can provide health services seamlessly over time and space. The technology necessary for an electronic medical record is available today and will become less expensive and more sophisticated. When healthcare establishes "the medical record" it will move easily and quickly into an electronic format.

An example of transformation where technology would be both part and parcel of the product can be seen in surgery. Surgery is an invasive procedure that requires an assembly of specialized equipment in a specialized environment (place) conducted by a team of people with specialized skills. All of these components are an analog of the surgeon who performs the procedure. Today, an invasive surgical procedure is performed when all of the components (patient, operating room, specialized equipment, surgical team, and surgeon) are brought together in time and place. Tomorrow (figuratively) technology will be able to make the surgeon a virtual component of the invasive procedure. With the increased sophistication of electronic networks and the technology that drives miniaturization and robotics, the surgeon will not have to be in the operating suite to perform a surgical procedure. The surgeon could be across the building, across the city, across the country, or across the world. For the patient, the network of surgeons thus expands exponentially. For the surgeon, the patient market increases exponentially. The health system becomes both a provider and a broker, and the health plan can offer a larger yet more selective panel of surgeons. All of this is gained by technology.

The Strategic Operating Model at the Health Alliance of Greater Cincinnati

How does information technology relate to the Health Alliance? We talk about the Health Alliance as if it actually exists; it does not. The Health Alliance is a legal entity that is currently the sum of its component parts. We are on a journey to create an organization capable of transforming itself into an integrated delivery system that has brand equity in selected products and services franchised across the tri-state area comprising southwestern Ohio, north central Kentucky, and southeastern Indiana. Using information technology as both driver and enabler, the Health Alliance is defining and implementing an operating model of multiple physical, conveniently located service sites that function as one logical service organization. The organization must be able to design, package, and deploy products and services where the mean time to market can precede demand and is faster than the competition.

To achieve this operating model, the Health Alliance is investing more than one hundred million dollars in information technology. At the heart of this investment is a set of underlying principles related to the acquisition and deployment of information systems and technology. Those principles are consistent with the vision and the strategic operating model of the Health Alliance and can be summarized in the following statements:

1. Information Systems will be standardized across the Health Alliance for centralized, decentralized, and consolidated functions.
2. Future state technology-enabled workflow will be consistent across the Health Alliance.
3. Integrateability takes precedence in acquiring information systems and technology unless there is a demonstrable and compelling reason against it.
4. The information system and technology must demonstrate a positive contribution to market share, and/or patient satisfaction, financial performance, improved quality (outcome).

The basic tenet of these principles is to reduce the number of information systems that support business processes and to reduce technology diversity. The objective is to reduce complexity that increases time to market.

The Health Alliance has articulated a commitment to information systems and technology as an integral component of the means to achieving our vision and strategic goals. The investments that we are making in information technology will provide the infrastructure that will allow the Health Alliance to package and deliver our products and services to respond to the market and to provide innovative new products and services. Only time will tell if we have the ingenuity and the resolve to transform the Health Alliance.

CHARLES J. AUSTIN

The Coming of the Information Age to Healthcare

Healthcare is an information-intensive business. High-quality patient care requires careful documentation of each patient's medical history and present health status. Administrative and financial information are needed for efficient operational support of the patient care process. Healthcare managers need information for formulating strategy, monitoring costs and quality, and assessing the outcomes of services delivered in the community. Management of information has assumed equal importance to the management of human, financial, and capital resources in modern healthcare organizations.

Neumann, Blouin, and Byrne make a strong case for the application of management principles in planning and evaluating the application of information technology in healthcare organizations. Their article covers three different, and only loosely connected, topics: *(1)* the role of information technology in healthcare; *(2)* strategic alignment of information systems with organizational priorities; and *(3)* development of a business case for implementation of specific applications of information technology in the organization. The first topic is general and philosophical in nature, while the second two deal with more specific concepts of management of the information resource.

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Assessing the Role of Information Technology

It would be difficult to argue with the author's contention that healthcare organizations must "significantly improve information systems and implement appropriate technology" to achieve sustainable value for their patients and be competitive in the marketplace. In the Health System Integration Study, Shortell, Gillies, and Anderson (1994) identify inadequate clinical information systems as a major barrier to system integration in organized delivery systems. In a later study, Conrad and Shortell (1996) state that, "In our view, the key resource barrier to integration is the lack of well-developed, flexible, and timely information systems with the capability to manage and direct information to and from providers along the healthcare continuum."

Neumann, Blouin, and Byrne point out that information technology, if properly managed, can serve as a window to the organization for its stakeholders, a strategic driver for competing in the marketplace, and an enabler of high performance. A symposium published in a recent issue of *Health Affairs* discusses the expected benefits of information technology and the need for a national health information policy covering such items as collaboration, standardization, and privacy protection (see Health Information Revolution 1998).

Strategic Alignment of Information Systems

The Neumann et al. article discusses the need for a strategic operating model (SOM) to create a working definition of "systemness" for integrated delivery systems. However, the SOM is described in very general terms and does not reflect the disparate ways in which vertical and horizontal consolidation is taking place (see, for example, Conrad and Shortell 1996).

The need for strategic alignment of information systems with organizational priorities is discussed briefly, but only as it relates to how the information systems function is structured within the organization. There is no discussion of the need for a strategic information systems plan that establishes priorities for the portfolio of applications to be developed consistent with current organizational goals and objectives (see Austin and Boxerman 1998, 170–72)

Four information system organizational designs are presented: centralized, coordinated, cooperative, and autonomous. Once again there is no discussion of how these alternative designs relate to the various ways in which horizontal and vertical integration is occurring in the marketplace of healthcare. The authors suggest that a senior information technology executive is needed at the system level in the centralized model. It could be argued that the need for a senior executive is just as important in the other three organizational designs, since coordination and cooperation will be even more important (and more difficult) in these decentralized models.

The authors correctly point out that many information systems fail because the underlying culture of the technology employed does not match the culture of the organization. However, the authors fail to point out the many other causes of system failure including improper management of information resources.

Developing a Business Case for Specific Applications of Information Technology

Major investments are required for the development of many information systems in healthcare organizations. Consequently, careful feasibility analysis of proposed projects is essential. Neumann, Blouin, and Byrne present a useful model in their seven steps for the business case development process. The description of the model is enhanced by two examples that are used to illustrate the approach followed in each of the seven steps.

Feasibility analysis should help to determine whether a project is technically, economically, and operationally feasible (see Reynolds 1995). However, a critical question becomes, "At what stage in its development should an information system project be judged as 'feasible'?" The authors do not address this question nor do they suggest an organizational structure for conducting the business case analysis.

The life cycle for information system development consists of seven steps (see Austin and Boxerman 1998, 194–95):

1. Analysis of functional requirements (systems analysis);
2. Selection of a design approach;
3. Specification of system requirements (system design);
4. Acquisition or construction of the system;
5. Implementation;
6. Operation and maintenance; and
7. Periodic evaluation and improvement of the system.

Feasibility analysis is required at several points in this cycle. For example, describing and defining the proposed technology project is difficult until a preliminary systems analysis of user requirements has been completed. Equally difficult are determining a return on investment, assessing resources required to implement the system, establishing performance indicators, and assessing risks and barriers until systems analysis and a preliminary system design have been completed.

This is not to suggest that a preliminary feasibility analysis for business case development should not be carried out. However, it is important to recognize that this preliminary analysis will necessarily be general in nature and will only provide rough estimates of the costs and benefits of the proposed technology. Continued refinement of these parameters will be required as system development progresses through the life cycle. Managers must be willing to evaluate at several key points along this cycle and be prepared to discontinue a project during systems analysis and design if better information becomes available that suggests that the project will not meet the requirements of technical, economic, and/or operational feasibility.

Also important to note is that feasibility analysis is a necessary but not sufficient condition for success of a technology project. The authors state: "The healthcare organizations that embrace new technology will be able to provide seamless, high-quality service and care to their patients...." This will only happen if implementation of the technology is well managed. The key to success is strategic information system planning aligned with organizational priorities supported by careful management oversight of the analysis, design, implementation, and operation of specific information system development projects (see Austin and Boxerman 1998, 256–57).

References

Austin, C. J., and S. B. Boxerman. 1998. *Information Systems for Health Services Administration, 5th ed.* Chicago: Health Administration Press.

Conrad, D. A., and S. M. Shortell. 1996. "Integrated Health Systems: Promise and Performance." *Frontiers of Health Services Management* 13 (1): 3–40.

"Health Information Revolution." 1998. *Health Affairs* 17(6) November/December: 9–60.

Reynolds, G. W. 1995. *Information Systems for Managers, 3rd ed*, 377. St. Paul, MN: West Publishing Company.

Shortell, S. M., R. R. Gillies, and D. A. Anderson. 1994. "The New World of Managed Care: Creating Organized Delivery Systems." *Health Affairs* 14 (Winter): 46–64.

REPLY

We appreciate the commentaries provided by William C. Reed, William B. Finney, and Dr. Charles Austin because they expand upon and add depth to our article and reflect the complexity and enormity of technology's emerging role in healthcare. As we stated in our article, technology is multidimensional and describes a broad array of components. Reed's commentary contributes insightful information on the "continuum of technology," Finney's commentary adds an applied and pragmatic assessment of technology, and Austin's commentary provides additional depth to assessing and managing the technology and enhances the framework we developed in our article.

Our Reply to William C. Reed

Reed's discussion provides a very useful look at the various roles of technology and provides a more in-depth look at technology's multiple dimensions. In his commentary he defines three dimensions of technology—automated technology (AT), information technology (IT), and knowledge technology (KT). Reed's delineation and discussion of these three distinct dimensions of technology provides a significant and important contribution to our discussion of technology's role in healthcare. But it is important to stress that these three dimensions (AT, IT, and KT) are not discrete; rather they should be viewed as interactive elements that support processes that are and will continue to change as the healthcare environment changes.

We agree with Reed's assessment that for technology to act as a window, it must be looked at collectively. In our article, it is assumed that an organization's technology taken as a whole acts as a window to the organization for the customers and stakeholders, and as a result, provides either a positive or negative branding. However, when customers are peering through the window of an organization, it is difficult to separate the technology from the human interactions and relationships. As we stated in our article, it is the people who are the enablers and ultimate determinants of technology's success. Therefore, the human factor that enhances and enables technology to function must not be underestimated. We agree with Reed's assessment that "few things in life are more personal than one's healthcare; therefore human interaction and intervention are extremely critical in the healthcare process."

Reed then comments on the business case for KT and states that it is subjective and that it is difficult to accurately determine the ROI. While KT might be difficult to measure because of the intangible nature of intellectual capital, there are very objective indicators that can be built into KT processes, including rules-based or expert systems that use flags and alerts to provide very objective and tangible ways to enhance both concurrent and prospective

decision-making, support needed changes in behavior, and highlight opportunities for cost savings and improvements in efficiency. One emerging example is the triggering of agreed-to notifications when clinical events occur and meet predetermined criteria. For example, when placing an order, physicians are presented the recommended medication or the clinical path that has been recommended by peers. The systems that invest in KT and do it well will be able to leverage the benefits of KT across time and distance and generate high returns. Furthermore, KT investments, while more challenging and difficult to implement, only reinforce our assertion that reengineering or change management is a critical component of new technology investments.

Reed adds to the business case by using a matrix to show that as technology investments become increasingly complex or costly, the risk increases. What can be added to this diagram and discussion and should not be overlooked are the returns and effects inherent in technology investments. Moreover, if the expense or riskiness of a technology initiative is manageable and the effect on or return to the organization is substantial, it would be prudent for the healthcare organization to strongly consider making the investment. One example of an organization that assumed considerable risk and demonstrated a significant return for an information technology investment is United HealthCare.

United HealthCare has been crowned by *Fortune* magazine as the nation's "most admired healthcare company" (Kenney 1998). One aspect that has set United apart is its clinical information resources. A decade ago, long before other insurers were even thinking about quality measurement, two of United HealthCare's directors in the research and development center began to develop a system for evaluating the performance of its health plans and contracted provider groups. As the *Healthcare Business* article states, "within a few years, United was sitting on a gold mine of healthcare information resources, and in 1996, it created Applied Healthcare Informatics (AHI) to sell this expertise on the open market" (Kenney 1998). Since 1996, United Healthcare has acquired other information companies and now receives more than $200 million in revenue from their clinical information resources.

Our Reply to William Finney

William Finney provides a unique and current perspective on technology's role in healthcare and, more specifically, at the Health Alliance of Greater Cincinnati in Ohio. Finney points out that healthcare costs have increased, but there have been no perceived improvements in outcomes and quality. He supports our assertion that technology will enable the healthcare industry to reduce costs and improve both outcomes and customer satisfaction; however, Finney also believes that information technology may create a dilemma for healthcare providers who must "retain the 'soft' side of the care delivery process" amidst high tech systems. We believe that any dilemma can be an opportunity. Technology should enable physicians to spend more of their time focusing on the "soft" side of the profession by reducing time spent on administration and increasing timely access to data and information such as patient records and lab results.

Finney notes that healthcare as a profession has not changed significantly. We would argue that the healthcare delivery model has changed significantly, and has moved from house calls and single physician practices to multi-entity and multi-specialty networks such as the Health Alliance. Finney is correct in his assertion that it is "the human intervention required to maintain the flow and management of information" that has contributed to healthcare's increasing costs. As individual access to multiple healthcare providers across the continuum and throughout the community has increased, the administrative effort that is needed to maintain appropriate and accurate records for the patients, physicians, and

payors has increased significantly. The repetition and duplication of effort to collect information results from the current market dynamic in which there are multiple providers, payors, and customers. Improvement in information technology and systems integration would alleviate some of the human capital needs and make clinical and financial records management more efficient and accurate, and would ultimately lower administrative costs.

In the near future, as health systems such as the Health Alliance continue to expand their services geographically as well as across the continuum, the technologic needs will become more intense and costly. A major factor noted by Finney is the lack of standardization in record keeping, technologic capabilities, and systems. Health systems that attempt to improve system integration and develop their technologic capabilities are going to incur costs to ensure the predictable delivery, operation, and maintenance of information; however, the opportunities and returns resulting from this investment will be significant. For example, it has been estimated that 40 to 60 percent of administrative costs for paper transactions can be eliminated by increasing/streamlining electronic connectivity between healthcare payors and providers.

Finney uses the electronic medical record to demonstrate the complexity and significant time involvement of technologic innovation and the need for standardization in the healthcare industry. Finney states "it is difficult for me to foresee 'the electronic medical record' until the industry defines the standards and the content of 'the medical record.'" Additional standardization is clearly necessary. The practice of medicine is a complex process; standardization, tailoring, and customizing how data and information is captured, transmitted, and analyzed can help achieve the best possible outcomes for patients and those who serve them. As noted in our article, the HIPAA legislation that mandates that healthcare providers adopt standardized provider and payor identification numbers as well as certain clinical terminology is moving the healthcare industry toward increased standardization. Moreover, much can be accomplished by developing clinical data repositories in which all medical records, standardized or not, are electronically kept and can be accessed by providers in hospitals, home care, and ambulatory clinics.

Finney is correct to say that "learning to manage medical records electronically will require a commitment and an investment in the people, process, and technology." Without significant continuing education, sponsorship, and dedication by employees and physicians, investments in information technology will not result in added value for an organization's patients, physicians, or payors.

Finney and the Health Alliance have developed and continue to pursue a strategic operating model (SOM) that relies on using technology as both a driver and enabler of the organization's strategy and vision. The Health Alliance realizes technology's potential to lead them toward success in developing brand equity and products that will make their system prosper. The authors commend Health Alliance for their significant investment in technology and thus, their future.

Our Reply to Dr. Charles Austin

Dr. Charles Austin offers a perspective that focuses on the rich history of managing new technology within a healthcare organization. His commentary added valuable insight to the framework that we developed throughout our article. Austin states that the SOM was described in "very general terms and does not reflect the disparate ways in which vertical and horizontal consolidation is taking place." The SOM context was described in general terms because the discussion was not intended to distinguish between multiple integration models, but rather to set parameters for interpreting the interface between strategic and operational levels. The SOM does highlight the difficulties of managing the complexity of the technology investments within various

systems. In addition, we agree wholeheartedly with Austin's statement that a strategic information systems plan (SISP) must be developed and followed. But the creation of the plan and completion of a feasibility study should not be viewed as conclusive. While we advocate the importance of developing a plan, it must be a document or "road map" that is routinely revisited, revised, and challenged. The plan must be flexible and dynamic to respond to the changes in business, technology, and economics that are inevitable in the current healthcare system. For long-term capital planning, a SISP also provides input to the overall investment levels required to support strategic initiatives.

In our article, we discuss four organizational structures for information technology and suggest that for the centralized model, there is specific need for a senior executive at the system level. Austin contends that a senior executive is also necessary and even more critical in the other three organizational designs. While we agree that senior executives with a competency in information technology do have a role in the other three organizational designs (coordinated, cooperative, and autonomous), this need does not occur in a uniform manner. The role definition and organizational alignment of the IS function is the more important element, and the role delineation of a single, centralized information systems executive will reflect the conclusions of the organization and its operating model and objectives.

We state in the article that a primary reason that information technology initiatives fail is that the underlying culture of the technology does not match the culture of the organization. Austin notes that we "fail to point out the many other causes of system failure." We agree that there are a myriad of reasons that new technology initiatives fail, including "improper management." Reasons that technology fails include poor planning, design, and execution; inadequate training and ongoing education; inaccurate forecasting of total economic effect and investment; lack of sufficient vendor support; and the changing demands and needs of systems.

Austin addresses the issue of completing a feasibility analysis prior to investing in information technology. He questions why as part of the business case we did not define when a project should be judged to be "feasible" technically, economically, and operationally. Our response is that feasibility is dependent on the eye of the investor. The decision as to whether an investment is feasible cannot be confined to a certain point in the decision-making process. In fact, there can and should be several points at which the feasibility "go, no-go" decision is revisited when planning, selecting, and implementing an information system; all risk factors should be continually monitored and managed.

Finally, Austin states that we do not present an organizational structure for conducting the business case analysis. Though we did not state the recommended organizational structure explicitly, our belief is that regardless of who prepares the actual feasibility study and analysis, the business case must be sponsored by those committed to the desired outcomes and benefits. The success of an information system investment must be evaluated from the perspectives of those who require the information, those who interact with the technology, and those affected by it.

Again, we would like to express our appreciation and thanks to William Reed, William Finney, and Dr. Charles Austin for their thoughts and comments on our article.

References

Kenney, D. 1998. "UNITED They Stand." *Healthcare Business* (October/November): 32–38, 63.