THE STRATEGIC APPLICATION OF INFORMATION TECHNOLOGY

IN HEALTH CARE ORGANIZATIONS

THIRD EDITION

JOHN P. GLASER
CLAUDIA SALZBERG

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To Karen Duncan, PhD, Lael Gatewood, PhD,
and Erica Drazen, DSc,
who introduced me to this field.
JOHN GLASER

PREFACE

Efforts to materially improve the quality, safety, and efficiency of health care will require a foundation of health information technology (IT). This book attempts to advance our ability to establish this foundation.

The book focuses on strategy and is directed to the provider organization. Strategies are needed in several areas. Defining and establishing sound application portfolios, infrastructure investments, data management practices, and information technology staff organization and competencies require strategies. Strategies are also needed to ensure the organization has the necessary overall information technology competencies in areas such as change management and IT governance.

Developing sound strategies in these areas can be very important for one simple reason: if you define what you have to do incorrectly or partially correctly, you run the risk of misdirecting significant organizational resources. This risk has nothing to do with how well you execute the direction you

choose. Being on time, on budget, and on spec is of diminished utility if you are doing the wrong thing.

The book is organized as follows. Chapters One through Five cover a wide range of IT strategy issues and observations. Chapters Six through Ten examine specific examples of IT strategy, largely drawn from the experiences of Partners HealthCare; these examples illustrate the material covered in the first five chapters. Chapter Eleven synthesizes IT strategies from Chapters One through Five as applied to examples introduced in Chapters Six through Ten.

Chapter One provides an overview of information technology strategy.

Chapter Two discusses the linkage between the organization's overall strategy and its information technology strategy.

Chapter Three reviews the focus of IT strategy, the IT asset. This asset is composed of applications, infrastructure, data, and the IT staff.

Chapter Four discusses organizational capabilities, such as change management prowess, and characteristics, such as strong leadership, that have a substantial impact on its overall IT effectiveness.

Chapter Five discusses lessons learned about IT strategy from a wide variety of industries and organizations. These lessons should guide development of IT strategy.

Chapter Six discusses the Partners high performance medicine initiative. This initiative led to the broad implementation of clinical information systems, such as computerized provider order entry and the outpatient electronic health record.

Chapter Seven reviews the IT strategy implications of personalized medicine and research in the genomic bases of disease and patient care based on a person's genetic makeup.

Chapter Eight examines service-oriented architecture as an application platform strategy.

Chapter Nine discusses the IT strategy ramifications of changes in care delivery models (such as accountable care organizations and payment reform).

Chapter Ten examines the IT strategies necessary to support public health.

Chapter Eleven uses material presented in Chapters One through Five to discuss examples from Chapters Six through Ten.

We hope that you find the book useful.

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CLAUDIA SALZBERG

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An Overview of Strategy

Strategy, as an art, science, and practice, has been a centerpiece of management and information technology (IT) literature and discussion for many years and will remain a major management concern for the foreseeable future. Effective strategies are key determinants of organizational performance, but developing effective strategies is difficult. A plethora of issues and approaches to assist in strategy formation have been developed over the years (Collis and Rukstad, 2008).

In this chapter we discuss the nature of strategy and the different ways in which we should apply strategy to IT in health care. The chapter will specifically present the following topics:

- Definition of strategy
- Need for IT strategy
- Areas of IT strategy
- Review of strategy considerations and conclusions
- Characteristics of strategic thinking

DEFINITION OF STRATEGY

Strategy is the determination of the basic long-term goals and objectives of an organization, the adoption of the course of action, and the allocation of resources necessary to carry out those actions (Chandler, 1962). Strategy seeks to answer questions such as, "Where does this organization need to go and how will it get there?" and "Where should it focus management attention and expenditures?"

The development of an organization's strategy has two major components: formulation and implementation (Henderson and Venkatraman, 1993).

Formulation

Formulation involves making decisions about the mission and goals of the organization and the activities and initiatives it will undertake to achieve them. Formulation could involve determining the following:

- Our mission is to provide high-quality medical care.
- We have a goal of reducing the cost of care while at least preserving the quality of that care.
- One of our greatest leverage points lies in reducing inappropriate and unnecessary care.
- To achieve this goal, we will emphasize, for example, reducing the number of inappropriate radiology procedures.
- We will carry out initiatives that enable us to intervene at the time of procedure ordering if we need to suggest a more cost-effective modality.

We can imagine other goals directed toward achieving this mission. For each goal, we can envision multiple leverage points, and for each leverage point, we may see multiple initiatives. This is much like an inverted tree whose root, or starting point, represents our mission branching into multiple goals, each of which eventually cascades into a set of leaves representing a series of initiatives.

Formulation involves understanding competing ideas and choosing between them. In our example, we could have arrived at a different set of goals and initiatives.

We could have decided to improve quality with less emphasis on care costs. We could have decided to focus on reducing the cost per procedure. We could have decided to produce retrospective reports of radiology use by provider and used this feedback to lead to clinician ordering behavior change rather than intervening at the time of ordering.

In IT, we also have a need for formulation. In keeping with an IT mission to use the technology to support improvement of the quality of care, we may have a goal to integrate our clinical application systems. To achieve this goal, we may decide to follow any of the following initiatives:

- Provide a common way to access all systems (single sign on).
- Interface existing heterogeneous systems.
- Require that all applications use a common database.
- Implement a common suite of clinical applications from one vendor.

Implementation

Implementation involves making decisions about how we structure ourselves, acquire skills, establish organizational capabilities, and alter organizational processes to achieve the goals and carry out the activities we have defined during formulation of our strategy. For example, if we have decided to reduce care costs by reducing inappropriate procedure use, we may need to implement one or more of the following changes to our organization:

- An organizational unit of providers with health services research training to analyze care practices and identify deficiencies
- A steering committee of clinical leadership to guide these efforts and provide political support
- A provider order entry system to provide real-time feedback on order appropriateness
- Data warehouse technologies to support analyses of health care utilization

Using our clinical applications integration example, we may come to one of the following determinations:

- We need to acquire interface engine technology, adopt HL7 standards for interoperability, and form an information systems department that manages the technology and interfaces applications.
- We need to engage external consulting assistance for selection of a clinical application suite and hire a group to implement the suite.

The implementation component of strategy development is not the development of project plans and budgets. Rather, it is the identification of the capabilities, capacities, and competencies the organization will need if it is to carry out the results of the formulation component of strategy.

Observations on Strategy Definition

In IT, we *conduct strategy*, whether we realize it or not, when we frame our definition of a goal and how we will approach that goal and when we define the staff, technologies, and decision-making structures needed to implement that goal.

If we do not realize we are engaged in a set of strategic decisions, we may carry out one component (for example, formulation) but not the other (for example, implementation).

At times it may not be clear whether a particular IT strategy discussion is focused on the formulation or implementation component of strategy. At a practical level, it may be irrelevant whether a specific insightful observation is one strategic component or the other. What does matter is that both components are included and are well integrated.

One's perspective may influence whether one views a conversation as strategic or tactical. The board, having given its blessing to an overall organizational strategy, may regard an IT conversation on the related clinical information systems as a tactical conversation. From the perspective of the CIO, that same conversation may be quite strategic. The CIO may regard the conversation the clinical information systems project team has about the approach to implementation as tactical, whereas the project team, rightfully so from its own perspective, views that conversation as strategic.

Pragmatically, it may not be particularly worth the exercise to develop an irrefutable, perspective-invariant litmus test of whether a particular conversation is strategic or not. For this book, we adopt the perspective of the CIO and the other members of the senior IT leadership of the organization and treat conversations about IT as strategic.

We can have IT strategy failures in both formulation and implementation. Formulation failures are the most serious, since they can mean that the implementation strategies, no matter how well conceived and executed, are heading down the wrong path.

Let us look at some examples of potential formulation strategy failures.

- We may decide to integrate the applications across our health system. But our health system isn't all that integrated. Rather, it is a loose confederation of relatively independent entities. If our strategy is to put the same system in all entities and thereby achieve integration, we may fail to match the IT view of tight integration with the health system practice of loose integration. We may spend a lot of money and not have advanced the cause of integration.
- We may decide to implement a computer-based referral system that steers the referring physician to one of our specialists and guides the collection of patient history. This system would invoke medical management rules to determine if the referral was necessary and ensure that all of the tests that need to be done prior to the consultation have been performed. We may not realize that from the referring physician's perspective, the primary problem with the referral process is the failure of the specialist to follow up rapidly on evaluation results. Therefore, from the referring physician's perspective, we have solved the wrong problem.
- We may decide to use Web 2.0 tools to implement an online community for patients with a chronic disease. We would hope this would motivate patients to come to our providers when they need care. However, we may fail to appreciate that online sites are not often used by patients whose daily activities are not significantly hindered by their disease, such as hypertension. Such patients may not harbor the feelings

of frustration or isolation associated with daily management of chronic diseases and hence not feel the need for community. And we may fail to understand that online communities are often suspicious of offerings from *outsiders* or entities who are not *like them*, since group members often distrust the motives of the offering entity.

In these examples, the goals may have been sound (integrate applications, improve referrals, and engage patients who have a chronic disease), but mistakes were made in selecting the approach to achieving those goals. Now let us look at some examples of potential implementation strategy failures:

- We may decide to improve the *return* from information systems investments but fail to supply analysts who can work with users to develop more rigorous analyses of possible return and who also fail to follow up after implementation to see if the desired return occurred.
- We may decide to implement mission-critical clinical applications but hinder the usefulness of those applications because we fail to take the steps (for example, high degrees of network redundancy and superior network management tools) necessary to ensure a very high availability infrastructure.
- We may decide to create a system-wide steering committee but not realize that the vast majority of strategy development and capital decision-making power lies in the member hospitals; therefore, our committee is impotent.

In each of these cases, the activities were sound (improve the analyses of the possible return from IT investments, implement mission-critical clinical applications, and provide enterprise-wide guidance on IT direction), but mistakes were made in identifying and establishing the necessary organizational skills, processes, structures, or IT capabilities.

THE NEED FOR IT STRATEGY

IT investments serve to advance organizational performance. These investments should enable the organization to reduce costs, improve service, enhance the quality of care, and, in general, achieve its strategic objectives. The goal of IT alignment and strategic planning is to ensure a strong and clear relationship

between IT investment decisions and the health care organization's overall strategies, goals, and objectives. For example, an organization's decision to invest in a new claims adjudication system should be the clear result of a goal of improving the effectiveness of its claims processing operations. An organization's decision to implement a computerized provider order entry system should reflect the organization's strategy of improving patient care.

Developing sound strategy in these areas can be very important for one simple reason: if you define what you have to do incorrectly or partially correctly, you run the risk that significant organizational resources will be misdirected. This risk has nothing to do with how well you execute the direction you choose. Being on time, on budget, and on spec is of diminished usefulness if you are doing the wrong thing.

In addition the organization can find it has failed to anticipate the future and its response to that future. When the future arrives (as it always does), the organization finds it is playing catch up with others who are capitalizing on the future. Catching up is a dangerous game; the organization may not catch up and *lose*, or the organization, in a fog of panic, may rush to catch up, waste money, and damage the organization in its haste.

There are many times in IT activities in which the goal (or our approach to achieving the goal), is not particularly strategic; strategy formulation and implementation are not needed. Replacing an inpatient pharmacy system, enhancing help desk support, and upgrading an operating system, although requiring well-executed projects, do not always require that we engage in conversations of organizational goals or that we take a strategic look at organizational capabilities and skills.

Often there is little likelihood that the way we achieve the goal will create a distinct competitive advantage. For example, an organization may decide it needs a common data network for its hospitals, clinics, and physicians' offices, but it does not expect that the delivered network, or its implementation, would be so superior to a competitor's network that it would confer an advantage on the organization.

Much of what IT does is not strategic, nor does it require strategic thinking. However, the fact that not all activities are strategic should not reduce the need for the IT organization to find the best technology and continuously improve its own performance. Nonstrategic activities remain very important.

AREAS OF IT STRATEGY

IT strategy centers on two broad areas that are discussed in Chapters One through Four:

1. Activities that establish an IT agenda that is well linked to organizational goals and initiatives. This agenda will define needs for applications, technical infrastructure, data and IT staff, processes, and organization.
2. Initiatives designed to improve internal organizational capabilities and characteristics that enhance the overall ability to be effective in the application of IT (for example, improving the relationships between IT and the rest of the organization).

Linkage to Organizational Goals and Initiatives

Organizations develop missions, goals, and plans. At times these may not be written and may have elements that are vague or volatile. IT initiatives and capabilities, as should be the case with any organizational resource, should be directed to supporting and advancing the organization's goals and plans. IT achieves strategic alignment with the organization by ensuring it develops its goals, activities, and plans in a way that leverages the organization's ability to carry out its overall strategies. This alignment occurs through four basic vectors (Glaser, 2004) that are: derived from organizational strategies, based on continuous improvement of core operational processes and information management needs, determined by examining the role of new information technologies, and derived by assessment of strategic trajectories.

By a *vector* we mean that an organization pursues determination of its IT investment decisions through different perspectives and approaches. (Vectors for arriving at IT strategy are discussed in detail in Chapter Two.) For example, the *first vector* (derived from organizational strategies) involves the organization answering a question such as, "Given our strategy of improving patient safety, what IT applications will we need?" However, the *third vector* (determined by examining the role of new information technologies) involves the organization answering a question such as, "There is a great deal of discussion about wireless technologies. What types of applications would wireless enable us to perform, and would these applications be important to us?"

The first vector involves deriving the IT agenda directly from the organization's goals and plans. For example, an organization may decide it intends to become a low-cost provider of care. It may decide to achieve this goal through implementation of application systems that support disease management programs, the reengineering of inpatient care, and the reduction of the unit costs of certain tests and procedures it believes are inordinately expensive.

Regarding the *second vector*, for all organizations there are a small number of core operational processes and information management tasks that are essential for the effective and efficient functioning of the organization. For a hospital, these processes might include patient access to care, ordering tests and procedures, and managing the revenue cycle. Core information management needs could include measures of care quality and analyses of the costs of treating chronic disease.

This vector involves the organization defining its core operational processes and information management needs. The organization assesses the performance of these processes and develops plans to improve their performance. The organization defines core information needs, identifies the gap between the current status and its needs and develops plans to close those gaps. These plans will often point to an IT agenda.

The third approach involves new information technologies that might enable the organization to consider new (or to significantly alter) current approaches to its strategies. For example, wireless technologies may enable the organization to consider applications that previously were not effective since there was no good way to address the needs of the mobile worker. For example, medication administration systems can now be used at the bedside and do not require the nurse to return to a central work area to document administration.

The *fourth vector* is IT strategies derived by assessment of strategic trajectories. Organizational and IT strategies invariably have a fixed time horizon and fixed scope. These strategies might cover a span of two to three years into the future. They would outline a bounded set of initiatives to be undertaken in that time period.

Assessment of strategic trajectories asks the questions, "What do we think we will be doing after that time horizon and scope?" and "Do we think we will be doing very different kinds of things, or will we be carrying out initiatives similar to the ones we are implementing now?"

We might be planning to introduce decision support into our computerized provider order entry application. This decision support would point out drug-drug interactions and drug-lab test interactions. Answering the question about trajectories for our decision support might indicate to us that patient genetic information will eventually need to be part of our decision support approach since genetic makeup can have a very significant impact on patient tolerance of a drug.

These vectors provide paths to arrive at the IT strategy. Most organizations focus on an inventory of application systems such as the electronic health record (EHR) as the *output* of the linkage discussion. However, the output is more diverse than applications. It also includes the following features:

- Technical architecture, consisting of the base technology (for example, networks, operating systems, and workstations that form the foundation for applications) and the approaches adopted to ensure that these technologies *fit together*
- Data, which refers to all the organization's data, analysis, and access technologies
- IT staff (the analysts, programmers, and computer operators who, day in and day out, manage and advance information systems in an organization), along with the IT organization structure, core competencies, and IT organization characteristics, such as agility

Applications, technical architecture, data, and IT staff are collectively referred to as the *IT asset*.

Each element of the organization's overall strategy may call for new applications, extensions of the infrastructure, or the creation of new IT departments, such as quality analysis. Often, however, there is a need to develop strategies for the IT asset that cuts across several organizational plans and activities. For example, strategies may be developed that alter the asset as a response to questions such as these:

- "What is our approach to ensuring that our infrastructure is more agile?"
- "What is our approach to attracting and retaining superb IT talent?"
- "Is there a way we can significantly improve the impact of our clinical information systems on our care processes?"

Internal Organizational Capabilities and Characteristics

A variety of studies have identified IT-centric organizational attributes that appear to have a significant influence on the effectiveness of an organization in applying IT. These factors include the following:

- The relationship between the IT group and the rest of the organization
- The presence of top management support for IT and the quality of the leadership
- Organizational comfort with *visionary* IT applications and ability to experiment with new technologies
- Organizational experience with IT

If the IT department has a poor working relationship with the clinical staff, it is hard to imagine that the organization would be effective in implementing an EHR. If leadership believes IT is a necessary but barely tolerated expense, it will be difficult for the organization to invest in IT initiatives that push a strategic envelope. If the organization has a troubled history with IT implementations, it will hesitate to take on another *strategic* IT *initiative* that suggests another expensive disappointment.

In addition to these factors, two other characteristics of the organization impact effectiveness, IT governance and change management.

IT governance consists of the organizational mechanisms by which IT priorities are set, IT policies and procedures are developed, and IT management responsibility is distributed. The effectiveness, transparency, and inclusiveness of governance can make a material contribution to the ability of IT to support organizational goals.

Change management skills enable the organization to evolve its direction, identity, processes, and structures as required by its strategy. An IT initiative is often used as a catalyst for change, just as it is used to enable and support change. Even if material change is not envisioned, the implementation of an application system will require some change in workflow and information provision. Organizations that are poor at managing change will be less effective in the application of IT.

These factors, which are different from the IT asset, can be created or changed. The IT strategy development must encompass both the IT asset and these characteristics and capabilities.

STRATEGY CONSIDERATIONS AND CONCLUSIONS

IT strategy involves formulation, the organizational decisions made regarding mission, goals and initiatives, and implementation, the organizational decisions regarding the capabilities, processes, and technologies needed to achieve the goals we have defined during formulation of our strategy. The results of strategy development can include activities centered on the IT asset and IT-centric capabilities and characteristics we have just discussed.

Although these results are the core output, experiences by several industries over many years have led to considerations or conclusions that should guide IT strategy development.

Complementary Strategies

Complementary strategies may be needed. Complementary strategies are organizational initiatives that do not necessarily involve IT but that are needed for the IT strategy to succeed. For example, the IT strategy may call for effective use of EHRs, but for that use to occur the organization may need to arrange financial incentives from payers. The IT strategy may point to the need to extend its reach into a large rural area, but that strategy may require the broad deployment of broadband in that area. Therefore, the organization engages government and private industry in fostering this extension.

The Realization of IT-Enabled Value

As the organization develops its IT strategy, it must understand that the acquisition and implementation of an application does not lead to intrinsic value, streamlined processes, improved decision-making capabilities, or reduced medical errors. This is evident in the wide variety of health care experiences with IT; at times implementation of an EHR clearly improves care and at other times it has resulted in no significant improvements. For value to result, IT must be well managed, process change must be thoughtfully considered, and ongoing efforts to leverage the IT investment must be

put in place. If value is desired, approaches will have to be developed that manage value into existence.

The pace of change can affect the likelihood and quality of IT-enabled value. At times organizations go through rapid and dramatic change. These changes are very risky, and often the organization does not survive the change; it does not understand the *new* organization well enough to be competent at running it, and it collapses under its confusion.

Most of the time organizations change themselves incrementally. This progressive incrementalism enables the organization to take a step, learn from that step, and take the next step informed by the successes and failures of prior steps. Each success improves the next steps (as do the failures), and the failures are modest enough that they are only (metaphorically) flesh wounds.

IT Strategies Evolve

IT strategies must evolve. An application system that provides a competitive advantage today becomes an industry commodity tomorrow. The use of ATMs by banks is an example. At one time ATMs provided a bank an advantage. Today ATMs are a *stay-in-business* expense borne by all banks and distinguishing none of them. In health care, an organization that is in the process of implementing an EHR must understand there will be a day when that implementation is done and when most organizations have an EHR. What then?

An organization could argue it will worry about evolution when the day comes that it needs to do so. However, it is useful to anticipate evolution so that steps can be taken today that will enhance the organization's ability to capitalize on that future.

IT as a Way to Enhance a Competitive Position

The organization may need to determine if an IT investment provides a strategic or competitive advantage. An important aspect of competitive strategy is identifying goals and ways to achieve those goals that are materially superior to the way a competitor has defined them (formulation) and to develop organizational capabilities that are materially superior to the capabilities of a

competitor (implementation). For example, an organization and its competitors may both decide to create a network of primary care providers. However, the organization might believe it can move faster and use less capital than the competition by contracting with existing providers rather than buying their practices.

Competitive strategy should attempt to define superiority that can be sustained. For example, an organization may believe that if it moves quickly, it can capture a large network of primary care providers and limit the ability of the competition to create its own network. *First to market* can provide a sustainable advantage, although no advantage is sustainable for long periods of time.

As an IT example of competitive formulation intended to improve care quality, while a competitor is focusing on implementing provider order entry in an effort to reduce medication errors, an organization is focusing on creating disease management programs it may believe have a greater impact on quality. As an IT example of competitive implementation, an organization may assess whether it can develop a means that will enable it to implement systems faster or for less cost than the competition.

Governing Concepts

Governing concepts refer to how the organization views a particular IT challenge or opportunity. The importance of these concepts can be found in all aspects of our lives, and the ramifications of different concepts are significant. Look at some examples:

- One can view the role of the federal government as the protector of security and individual freedoms or as a force to compensate and overcome injustice and deficiencies in the free market.
- One can view one's destiny as being heavily influenced by one's environment and one's genes, largely determined by the choices one makes in life, or preordained by larger forces in the universe.
- One can view the goal of a college education as preparation for a job, the garnering of knowledge of one's society and civilization, or an opportunity to learn how to party.

These concepts can have a significant bearing on IT strategy because they can frame the organization's core understanding (whether right or wrong) about IT and its potential. For example, there are several ways to think about the Internet and its technologies, all of which can be correct:

- As a *universal* presentation layer allowing access to a diverse array of legacy systems by a diverse array of devices
- As a means to publish organizational knowledge
- As a means to find services and information offered by others
- As a means to extend an organization's services into the home

CHARACTERISTICS OF STRATEGIC THINKING

Strategic thinking and discussion have several characteristics. Strategic thinking centers on discussions of ideas and issues that lead to the determination of goals and initiatives (formulation) and the definition of organizational capabilities and competencies needed (implementation) if we are to implement those goals and initiatives.

The consequences of being wrong are generally serious. An application software company that had a strategy that did not include the Internet revolution is generally paying dearly for that strategy (if it is still in business). Several health care provider organizations have been badly damaged by pay-for-performance strategies based on capitated payment.

A strategic decision has clear and illuminating ramifications for many other decisions. For example, an organization can decide that a critical component of an EHR is the introduction of decision support that guides a provider's decisions on ordering and referring. Such a strategy tells the organization that a provider order entry application and medical logic processors are critical aspects of its clinical systems portfolio. The organization would know it needs a group of physicians and organizational processes to develop and monitor decision rules. The organization would know it needs to code data for medications, lab tests, procedures, and problems, since these data form the basis for many rules. These decisions fall naturally from a strategy of centering on decision support.

Strategic decisions often involve changes in the core understandings that guide organizational activity. Any time the understandings that underlie an organization undergo fundamental change, the organization's activities, market position, processes, and structure can undergo significant change. For example, a move to protocol-driven care, adoption of risk arrangements, and the creation of a continuum of care all involve the adoption of new organizational concepts and will necessitate some level of fundamental change.

The implementation of strategic decisions will require significant resources and intense political activity. Extensive resource commitments and political activity are the natural consequence of and antecedent to the introduction of major organizational change.

Strategies take time, multiple iterations, and lots of analysis to develop, and they must be monitored. Organizations rarely fully understand either the consequences of their strategies or the complete set of organizational activities and investments required to implement them. Strategies can be wrong or *off by 15 degrees*. The organization learns as it adjusts itself and assesses the effectiveness of its strategies.

A strategic discussion often involves frequent, sudden shifts in altitude. At one moment the leadership team is operating at 30,000 feet while discussing principles and concepts. Seconds later it is examining ground-level issues associated with those principles. And then it returns to the stratosphere to refine those principles. Great strategic thinkers are very comfortable with high and low altitudes and frequently shift between them. Great strategies have sound high-level ideas that have been tested against the reality of the ground.

In IT, we often bypass several critical strategic decisions and prematurely move to execution questions. For example, "Should we use applications that are based on cloud computing?" is a premature question. The question needs a formulation or implementation-strategic context before it can be answered.

One might be able to arrive at the cloud question through a line of reasoning as follows:

1. Major goals in development of our technical architecture are the creation of the attribute of architectural agility and the reduction in the costs of our infrastructure (formulation).

2. We would define agility as the ability to scale our systems rapidly (formulation).
3. If we could run our applications on a cloud arrangement that might enable quick processor and storage expansion and put in place a cost structure that is directly related to resource consumption (formulation).
4. If we pursue this technology, we will need, among other things, to partner with a vendor, move our applications to this environment, and put together a contract (implementation).

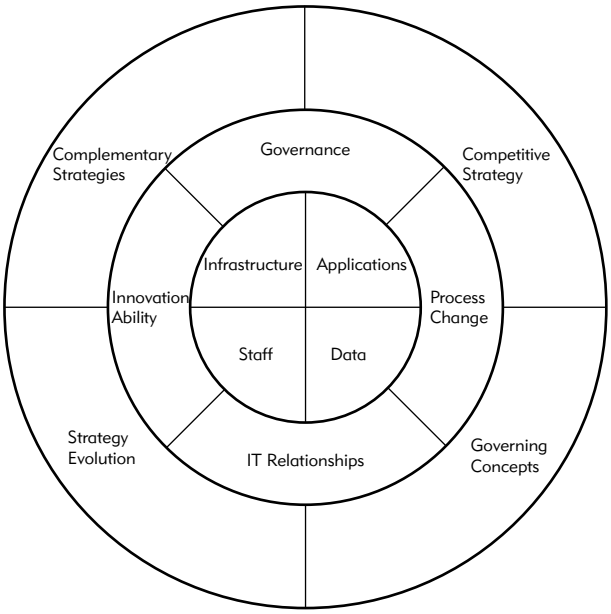
Unless one has started from some level of strategic thinking, it is hard to give a good answer to the cloud computing question.

SUMMARY

It is crucial that health care organizations apply strategic thinking, questioning, and analysis to their investments in information technology. Strategic thinking requires us to pursue fundamental questions regarding the formulation of goals and the activities needed to achieve those goals. Strategic thinking requires that we pursue fundamental implementation questions such as the need to add or change core organizational capabilities.

Figure 1.1 illustrates the core focus of IT strategy and shows the fundamental components that must be considered by organizations when applying strategic thinking. The core focus of the IT strategy is the IT asset (applications, infrastructure, data, and IT staff) represented by the inner circle in Figure 1.1. However, organizations, when applying strategic thinking, must also examine (and perhaps change) capabilities and characteristics, such as change management, that enable organizations to be effective in their IT pursuits. This is represented by the middle circle in Figure 1.1. As organizations address the IT asset, and capabilities and characteristics, they should bear in mind several conclusions and considerations, such as the need for complementary strategies, the need to manage IT-enabled value into existence, and the nature of IT as a source of competitive advantage. We will be referring back to this figure as we explain each of the fundamental components.

Figure 1.1 IT Strategy Scope



Inner circle: The IT asset
Middle circle: IT-centric characteristics and capabilities
Outer circle: IT strategy considerations and conclusions

KEY CONCEPTS

Formulation

Implementation

Information technology asset

Internal organizational characteristics and capabilities

Linkage

Strategic vectors

Strategy

DISCUSSION QUESTIONS

1. Assume a hospital intends to become a low-cost provider of care. Develop a comprehensive set of strategy formulation options that it might pursue.
2. Using your answers to question one, pick two strategies and develop a comprehensive set of implementation actions that could be undertaken in the hospital.
3. Assume a physician practice desires to improve the safety of its care. What might be some of the investments or initiatives needed for applications, technical architecture, data, and IT staff?

2

Linkage of IT Strategy to Organizational Strategy

Information technology can support and at times be a critical contributor to effecting organizational strategies. Efforts to improve care quality can require electronic health records (EHRs) and databases to analyze patterns of care. The management of a population of patients with multiple chronic diseases may point to the need for disease registries, health maintenance reminder logic, and Web sites that enable patients to record data and obtain support for the management of their health.

Information technology can enable the organization to consider new elements and aspects of its strategy. Approaching Web 2.0-based communities of patients with a chronic disease might be a means to reduce the costs of recruitment for clinical trials. Radio-frequency ID tags might enable better tracking of capital assets, reducing asset loss and decreasing productivity loss due to clinicians searching for misplaced equipment.

In this chapter, we explore this linkage between organizational strategies and IT strategies.

IT PLANNING OBJECTIVES

The IT strategic planning process has several objectives:

- To ensure that information technology plans and activities align with the plans and activities of the organization; in other words, the IT needs of each aspect of organizational strategy are clear, and the portfolio of IT plans and activities can be mapped to organizational strategies and operational needs.
- To ensure that the alignment is comprehensive; in other words, each aspect of strategy has been addressed from an IT perspective that recognizes not all aspects of organizational strategy have an IT component, and not all components will be funded.
- To identify non-IT organizational initiatives needed to ensure maximum leverage of the IT initiative (for example, process reengineering) are understood.
- To ensure that the organization has not missed a strategic IT opportunity, such as those that might result from new technologies.
- To develop a tactical plan that details approved project descriptions, timetables, budgets, staffing plans, and plan risk factors.
- To create a communication tool that can inform the organization of the IT initiatives that will and will not be undertaken.
- To establish a political process that helps ensure the plan results have sufficient organizational support.

Despite the simplicity implied by these statements, the development of well-aligned IT strategies has been notoriously difficult for many years, and there appears to be no reason such an alignment will become significantly easier over time.

At the end of the alignment and strategic-planning process, an organization should have an outline that at a high level resembles Table 2.1. With this outline, leadership can see the IT investments needed to advance each of the organization's strategies. For example, the goal of improving the quality of patient care may lead the organization to invest in databases to measure and report quality, computerized provider order entry (CPOE), and the EHR.

Table 2.1 IT Initiatives Linked to Organizational Goals

Goal	*IS Initiatives*
Research and education	Research patient data registry Genetics and genomics platform Grants management
Patient care: quality improvement	Quality measurement databases Order entry Electronic health record
Patient care: sharing data across the system	Enterprise master person index Clinical data repository Common infrastructure
Patient care: non-acute services	Nursing documentation Transition of care
Financial stability	Revenue system enhancements PeopleSoft Cost accounting

In many ways the content of Table 2.1 is deceiving. The table presents a tidy, orderly linkage between the IT agenda and the strategies of the organization. One might assume this linkage is established through a linear, rational, and straightforward series of steps. But the process of arriving at a series of connections like those in Table 2.1 is complex, iterative, and at times driven by politics and instincts. There can be disagreement about the IT response, its relative importance, organizational readiness, and the likelihood of results.

VECTORS FOR ARRIVING AT IT STRATEGY

In Chapter One, we introduced the four major vectors an organization may follow to arrive at an IT strategy. IT strategy may be based on the following:

- Organizational strategies
- Continuous improvement of core processes and information management
- Examination of the role of new information technologies
- Assessment of strategic trajectories

By a vector we mean the choice of perspectives and approaches through which an organization determines its IT investment decisions. For example, the first vector (derived from organization strategies) involves answering a question such as, "Given our strategy of improving patient safety, what IT applications will we need?" However, the third vector (determined by examining the role of new information technologies) involves answering a question such as, "There is a great deal of discussion about software as a service. Does this approach to delivering applications provide us with ways to be more effective at addressing some of our organization challenges?" Figure 2.1 illustrates the convergence of these four vectors into a series of iterative leadership discussions and debates. These debates lead to an IT agenda composed of IT asset initiatives and IT-centric organizational characteristics and capabilities.

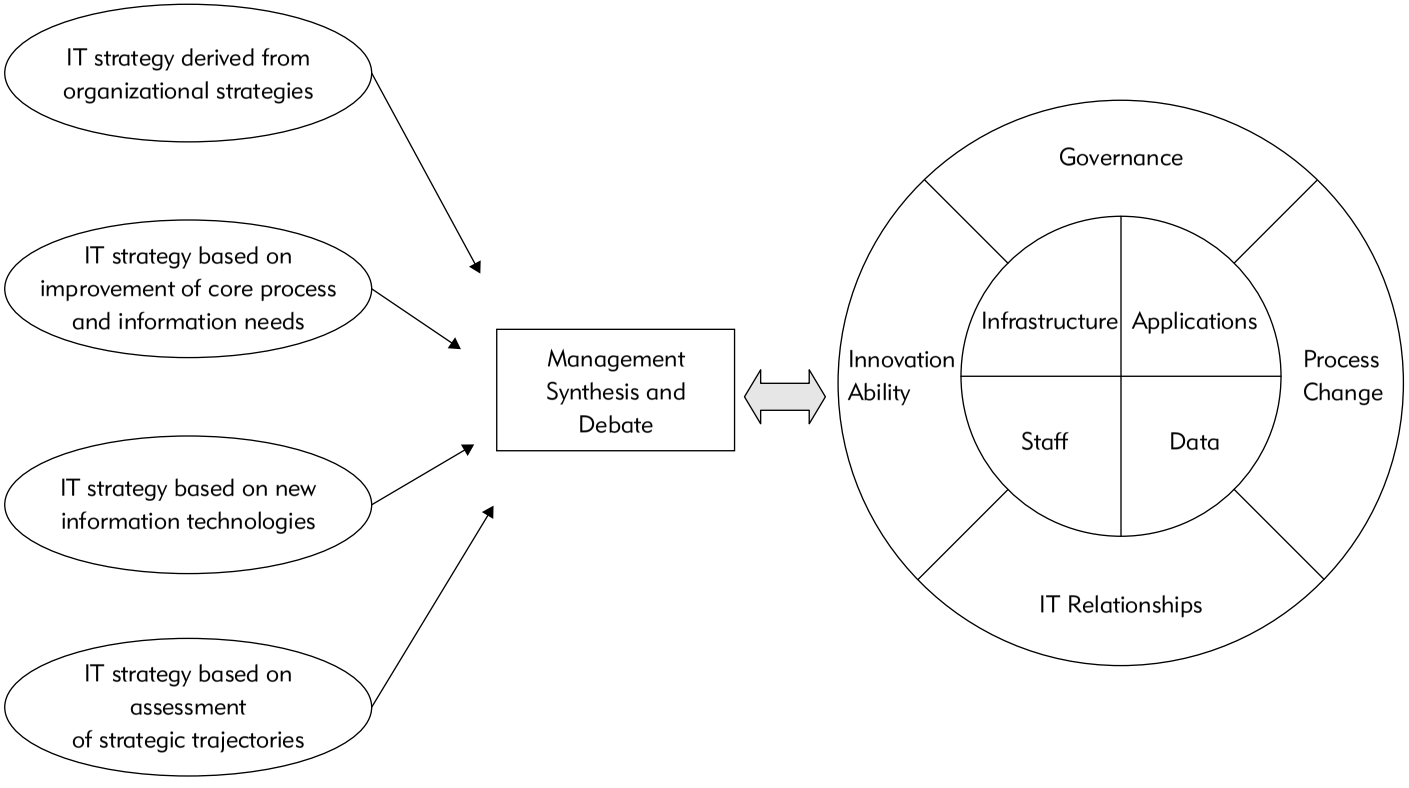
IT Strategies Derived from Organizational Strategies

The first vector involves deriving the IT agenda directly from the organization's goals and plans. For example, an organization may decide it intends to become the low-cost provider of care. It may decide to achieve this goal through implementation of disease management programs, the reengineering of inpatient care, and the reduction of unit costs for certain tests and procedures it believes are inordinately expensive.

The IT strategy development then centers on answering questions such as, "How do we apply IT to support disease management?" The answers might involve Web-based publication of disease management protocols for use by providers, business intelligence technology to assess the conformance of care practice to the protocols, provider documentation systems based on disease guidelines, and CPOE systems that employ the disease guidelines to influence ordering decisions. An organization may choose all or some of these responses and develop various sequences of implementation. Nonetheless, it has developed an answer to the question of how to apply IT in support of disease management.

Most of the time the linkage between organizational strategy and IT strategy involves developing the IT ramifications of organizational initiatives, such as adding or changing services and products, growing market share,

Figure 2.1 Overview of IT Strategy Development



or improving service, streamlining processes, or reducing costs. At times, however, an organization may decide it needs to change or add to its core characteristics or culture. The organization may decide it needs its staff to be more care quality or service-delivery or bottom-line oriented. It may decide it needs to decentralize or recentralize decision making. It may decide to improve its ability to manage knowledge, or it may not. These characteristics (and there are many others) can point to initiatives for IT.

In cases where characteristics are to be changed, IT strategies must be developed to answer such questions as, "What is our basic IT approach to supporting a decentralized decision-making structure?" The organization might answer this question by permitting decentralized choices of applications as long as those applications meet certain standards. (For example, they may run on a common infrastructure or support common data standards.) It might answer the question of how IT supports an emphasis on knowledge management by developing an intranet service that provides access to preferred treatment guidelines.

IT Strategies for Core Processes and Information Management

All organizations have a small number of core processes and information management tasks that are essential for the effective and efficient functioning of the organization. For a hospital these processes might include ensuring patient access to care, ordering tests and procedures, and managing the revenue cycle. For a restaurant these processes might include menu design, food preparation, and dining room service. For a managed care organization, information management needs might point to a requirement to understand the costs of care or the degree to which care practices vary by physician.

Using the vector of continuous improvement of core processes and information management to determine IT strategies involves defining the organization's core processes and information management needs. The organization measures the performance of core processes and uses the resulting data to develop plans to improve its performance. The organization defines core information needs, identifies the gap between the current status and its

needs, and develops plans to close those gaps. These plans will often point to an IT agenda.

This vector may be a result of a strategy discussion, although this is not always the case. An organization may make ongoing efforts to improve processes regardless of the specifics of its strategic plan. For example, every year it may set initiatives designed to reduce costs or improve services. The organization has decided that, regardless of a specific strategy, it will not thrive if core processes and information management are something other than excellent.

Table 2.2 illustrates a process orientation. It provides an organization with data on the magnitude of some problems that plague the delivery of outpatient care. These problems afflict the processes of referral, results management, and test ordering. The organization may decide to make IT investments in an effort to reduce or eliminate these problems. For example, ePrescribing could reduce the prevalence of adverse drug events. Abnormal test results could be highlighted in the EHR to help ensure patient follow-up.

When this vector is used, the IT agenda is driven at least in part by a relentless, year-in and year-out focus on improving core processes and information management needs.

Table 2.2 Summary of the Scope of Outpatient Care Problems

For every:	*There appear to be:*
1,000 patients coming in for outpatient care	14 patients with life-threatening or serious Adverse Drug Events (ADEs)
1,000 outpatients who are taking a prescription drug	90 who seek medical attention because of drug complications
1,000 prescriptions written	40 with medical errors; for example, prescriptions indicating incorrect dose
1,000 women with a marginally abnormal mammogram	360 who will not receive appropriate follow-up care
1,000 referrals	250 referring physicians who have not received follow-up information 4 weeks later
1,000 patients who qualified for secondary prevention of high cholesterol	380 will not have an LDL-C on record within 3 years

IT Strategies Based on Assessment of New Information Technologies

The third vector involves considering how new IT capabilities may enable a new IT agenda or significantly alter the current agenda. For example, telemedicine capabilities may enable the organization to consider a strategy it had not previously considered, such as extending the reach of its specialists across the globe. An organization may also alter its approach to achieving an existing strategy so that, for example, it relies less on specialists visiting regional health centers and more on tele-consultation. Data mining algorithm advances might enable an organization to conduct post-market medication surveillance and to construct a patient phenotype from EHR data to support research into the genomic basis of disease.

In this vector, the organization examines new applications and new base technologies and tries to answer the question, "Does this application or technology enable us to advance our strategies or improve our core processes in new ways?" For example, applications that support personally controlled health records might lead the organization to think of new approaches to providing feedback to the chronically ill patient. Holding new technologies up to the spotlight of organizational interest can lead to decisions to invest in a new technology.

An extreme form of this mechanism occurs when a new technology or application suggests that fundamental strategies (or even the organization's existence) may be called into question or may need to undergo significant transformation. Although IT-induced transformation is rare in health care, it is being seen in other industries. The Internet, for example, has transformed and in some cases challenged the existence of a range of companies that distribute content. Examples are companies such as bookstores, music CD stores, publishers, travel agents, and stockbrokers.

IT Strategies Based on Assessment of Strategic Trajectories

Organization and IT strategies invariably have a fixed time horizon and fixed scope. These strategies might cover a period of time two to three years into the future. They outline a bounded set of initiatives to be undertaken in that time period. Assessment of strategic trajectories asks, What do we

think we will be doing after that time horizon and scope? Do we think we will be doing very different kinds of things, or will we be carrying out initiatives similar to the ones we are doing now?

For example, we might be planning to implement an EHR. The organization believes the future will bring the broad adoption of medical homes and accountable care organizations (ACOs). (ACOs are discussed in Chapter Seven.) These models are not widespread, but the organization believes it should strive to be well positioned to serve as an ACO. The strategic trajectory discussion asks, "What EHR capabilities are we likely to need in an ACO?"

Or we might be in the process of using IT to support joint clinical programs with other hospitals in the area. Given the federal government's emphasis on EHR interoperability, the country may see broad implementation of state-based health information exchanges. The trajectory discussion asks how these exchanges will impact our current approaches to clinical integration with affiliated providers.

The strategic trajectory discussion can be highly speculative. It might be so forward looking and speculative that the organization decides not to act today on its discussion. Yet it can also point to initiatives to be undertaken within the next year to better understand this possible future and to prepare the organization's information systems for it. For example, if we believe our information systems will eventually need to store genetic information, it would be worth understanding whether the new clinical data repository we will be selecting soon will be capable of storing these data.

Vector Summary

Developing IT alignment and strategy requires the convergence of four vectors of thinking and discussion. These vectors bring multiple orientations to strategy formulation and implementation, and each often results in a different type of management discussion.

Chapters Six through Ten provide examples of IT strategies. These examples use different vectors. For example, Chapter Six discusses the Partners high performance medicine initiatives that led to the implementation of several clinical systems to improve care safety, quality, and efficiency (with IT strategies derived from organizational strategies) and the

broad implementation of the EHR to provide a foundation for ongoing care improvement (with IT strategy based on continuous improvement of core processes and information management). Chapter Seven reviews an IT strategy that is based on assessment of strategic trajectories to support personalized medicine. Chapter Eight discusses service-oriented architecture, an IT strategy based on new information technologies. As will be seen in these chapters, a specific IT strategy may reflect more than one vector.

Methodologies have been developed to help guide organizations through the necessary discussions. Organizations commonly use consultants for this purpose; consultants can provide not only methodologies but also perspectives on new technologies and on the IT agenda and experiences of other health care organizations.

Whether methodologies or consultants are used or not, development of the IT strategy is not a cookbook exercise. At its core the alignment with organizational strategy is achieved because smart, thoughtful organizational leadership takes the time to discuss the IT strategy. On the one hand, alignment sounds very simple; smart people talk about it. On the other hand, such simplicity means there is a significant amount of art to this process. In general, accountability for developing an aligned IT agenda should rest with the chief information officer (CIO). The CIO will be discussed in Chapter Three.

A NORMATIVE APPROACH TO DEVELOPING ALIGNMENT AND IT STRATEGY

You may now be asking yourself, how do I bring all of this together? In other words, is there a suggested approach an organization can take to develop its IT strategy that takes into account these various vectors? And by the way, what does an IT strategic plan look like?

Across health care organizations the approaches taken to developing, documenting, and managing an IT strategy are quite varied. Some organizations have well-developed, formal approaches that rely on the deliberations of multiple committees and leadership retreats. Other organizations have remarkably informal processes. A small number of medical staff and administrative leaders meet in informal conversations to define the organization's IT strategy. In some cases the strategy is developed during a specific time in the

year, often preceding development of the annual budget. In other organizations IT strategic planning goes on all the time and permeates a wide range of formal and informal discussions.

There is no right way to develop an IT strategy and to ensure alignment. However, the process of developing IT strategy should be similar in approach and nature to the process used for overall strategic planning. If the organization's core approach to strategy development is informal, its approach to IT strategy development should also be informal.

Recognizing this variability, a normative approach to the development of IT strategy can be offered.

Strategy Discussion Linkage

Organizational strategy is generally discussed in senior leadership meetings. These meetings may focus specifically on strategy, or strategy may be a regular agenda item. These meetings may be supplemented with retreats centered on strategy development and with task forces and committees that are asked to develop recommendations for specific aspects of the strategy. (For example, a committee of clinical leadership might be asked to develop recommendations for improving patient safety.)

Regardless of their form, the organization's CIO should be present at such meetings or kept informed of the discussion and its conclusions. If task forces and committees supplement strategy development, an IT manager should be asked to be a member. The CIO (or the IT member of a task force) should be expected to develop an assessment of the IT ramifications of strategic options and to identify areas where IT can enable new approaches to carrying out the strategy.

The CIO will not be the only member of the leadership team who will perform this role. Chief financial officers (CFOs), for example, will frequently identify the IT ramifications of plans to improve the revenue cycle. However, the CIO should be held accountable for ensuring the linkage does occur.

As strategy discussions proceed, the CIO must be able to summarize and critique the IT agenda that should be put in place to carry out the various aspects of the strategy. Exhibit 2.1 displays an IT agenda that might emerge from a strategy designed to improve the patient service experience in

outpatient clinics. Exhibit 2.2 displays a health plan IT agenda that could result from a strategy designed to improve service to subscribers by improving patient access to health information and reducing costs by developing a plan portal that has a self-service option for users to perform routine administrative tasks for a health plan.

EXHIBIT 2.1. IT INITIATIVES NECESSARY TO SUPPORT A STRATEGIC GOAL FOR A PROVIDER

Strategic Goal

- Improve service to outpatients.

Problem

- Patients have to call many locations to schedule a series of appointments and services.
- The quality of the response at these locations is highly variable.
- Locations inconsistently capture necessary registration and insurance information.
- Some locations are overcapacity, whereas others are underused.

IT Solution

- Common scheduling system for all locations
- A call center for "one stop" access to all outpatient services
- Development of master schedules for common service groups (for example, preoperative testing)
- Integration of scheduling system with electronic data interchange connection to payers for eligibility determination, referral authorization, and copay information
- Patient support material (for example, maps and instructions to be mailed to patient)

EXHIBIT 2.2. IT INITIATIVES NECESSARY TO SUPPORT A STRATEGIC GOAL FOR A HEALTH PLAN

Strategic Goal

- Improve service to subscribers and reduce costs.

Problem

- Subscribers have difficulty finding high-quality health information.
- The costs of performing routine administrative transactions (for example, change of address and responding to benefits questions) is increasing.
- Subscriber perceptions of the quality of service in performing these transactions is low.

IT Solution

- A plan portal that provides the following:
  - Health content from high-quality sources
  - Access to chronic disease services and discussion groups
  - Subscriber ability to use self-service to perform routine administrative transactions
  - Subscriber access to benefit information
  - Functions that enable subscriber to ask questions
  - Plan ratings of provider quality
- A plan-sponsored provider portal that enables the following:
  - Subscribers to conduct routine transactions with their provider (for example, request appointment or renew prescription)
  - Electronic visits for certain conditions (for example, back pain)
  - Subscribers to ask care questions of their provider

EXHIBIT 2.3. SYSTEM SUPPORT OF NURSING DOCUMENTATION

Problem Statement

- Both the admitting physician(s) and nurse document medication history in their admission note.
- The following points of failure have been noted:
  - Incompleteness due to time or recall constraints, lack of knowledge, or lack of clear documentation requirements
  - Incorrectness due to errors in memory, transcription between documents, and illegibility of handwriting
  - Multiple inconsistent records due to failure to resolve conflicting accounts by different caregivers
- Most of the clinical information required to support appropriate clinician decision making is obtained during the history-taking process

Technology Interventions and Goals

- The following core set of clinical data should be made available to the clinician at the point of decision making:
  - Demographics
  - Principle diagnoses and other medical conditions

IT Liaisons

All major departments and functions (for example, finance, nursing, and medical staff administration) should have a senior IT staff person who serves as the function's point of contact. As these functions examine ways to address their needs (for example, lower their costs and improve their services), the IT staff person can work with them to identify IT activities necessary to carry out their endeavors. This identification often emerges with recommendations to implement new applications that advance the performance of a function, such as a medication administration record application to improve the nursing workflow. Exhibit 2.3 provides an example of output from a nursing leadership discussion on improving patient safety through the use of a nursing documentation system.

- Drug allergies
- Current and previous relevant medications
- Laboratory and radiology reports

- The following required information should be gathered only once:
  - Multidisciplinary system of structured, templated documentation
  - Clinical decision support rules, associated to specific disciplines, should guide gathering
  - Workflow should support the mobile caregiver with integrated wireless access to clinical information
- The following needed applications could be implemented in phases:
  - Nursing admission assessment
  - Multidisciplinary admission assessment
  - Planning and progress
  - Nursing discharge plan
  - Multidisciplinary discharge plan

New Technology Review

The CIO should be asked to discuss, as part of the strategy discussion or in a periodic presentation in senior leadership forums, new technologies and their possible contributions to the goals and plans of the organization. These presentations may lead to suggestions that the organization form a task force to closely examine a technology. For example, a multidisciplinary task force could be formed to examine the role of wireless technology in nursing care, materials management, and service provision to referring physicians. Table 2.3 provides an example of a review of the potential contribution of wireless technology; various potential uses of wireless technology are assessed according to their expected ability to increase revenue, reduce costs, improve care quality, and improve patient service.

Table 2.3 Potential Value Proposition of Wireless Technology

	Value			
Function	*Revenue*	*Cost Savings*	*Care Quality*	*Patient Service*
Medical information or textbooks	L	L	M	L
Lab test orders	M	L	L	L
Medication orders	H	M	H	M
Results retrieval	L	M	M	L
Patient charting	M	L	M	L
Charge capture	H	M	L	M
Supply management	L	H	L	L

Legend: H = High, M = Medium, L = Low

Synthesis of Discussions

The CIO should be asked to synthesize or summarize the conclusions of these discussions. This synthesis will invariably be needed during development of the annual budget. And the synthesis will be a necessary component of the documentation and presentation of the organization's strategic plan. Table 2.4 presents an example of such a synthesis.

The organization should expect the process of synthesis will require debate and discussion; for example, trade-offs will need to be reviewed, priorities set, and the organization's willingness to implement embryonic technologies determined. This synthesis and prioritization process can occur in the course of leadership meetings, through the work of a committee charged to develop an initial set of recommendations, and during discussions internal to the IT management team.

An example of an approach to prioritizing recommendations is to give each member of the committee $100 to be distributed across the recommendations. The amount a member gives to each recommendation reflects his or her sense of its importance. For example, a member could give one recommendation $90 and another $10, or give five recommendations $20 each. In the former case the committee member believes that only two recommendations are important and that the first recommendation is nine times more important than the second. In the latter case the member believes that five recommendations

Table 2.4 Summary of IT Strategic Planning

Strategic Challenge	*IT Agenda*
Capacity and growth management	Emergency department tracking Inpatient electronic bed board Ambulatory clinic patient tracking
Quality and safety	Inpatient order entry Anticoagulation therapy unit Online discharge summaries Medication administration record
Performance improvement	Registration system overhaul Anatomic pathology Pharmacy known to be application as is Order communication Transfusion and donor services
Budget management and external reviews	Disaster recovery Joint Commission on Accreditation of Healthcare Organizations (JCAHO) preparation Privacy policy review

are of equal importance. The distributed dollars are summed across the members, with a ranking of recommendations emerging.

The leadership should not feel compelled to accept the ranking as a definitive output. Rather, the process of scoring will reveal that members of the leadership team will rate recommendations differently. For example, some members will rate a project as having a high contribution to patient quality while others will view that contribution as low. The discussion that investigates these discrepancies can help the team understand the recommendation more fully and lead to a consensus that strengthens political support for the recommendation. Moreover, if the leadership team decides to approve a recommendation with a low score it should ask itself why it views the recommendation as more important than the score would suggest.

For an example of the scoring of proposed IT initiatives, see Figure 2.2. It lists categories of organizational goals (for example, *enhance patient care*

Figure 2.2 IT Initiative Priorities

Color Key: High / Moderate / Must Do	Service		People		Financial		Growth		Quality and Safety		Infra-structure	Overall Priority
	Enhances Patient Care	Strengthens Community Outreach	Strengthens Physician Integration	Strengthens Employee Support	Enhances Operational Efficiency	Minimizes Investment Level	Invests in Current Scalable Technology	Supports Growth with Strong ROI	Addresses Significant System Deficiency	Addresses Compliance Issues (Must Do)	Mandatory Technology Building Block	
Clinical Applications												
1. Physician Order Entry	✓		✓		✓				✓	✓		Start Now
2. Patient Care Documentation	✓				✓				✓	✓		Plan It
3. Clinical Data Repository			✓		✓			✓	✓			Start Now
4. Computerized Medical Record			✓		✓							Delay It
5. PACS (Phase I)	✓				✓				✓			Start Now
6. Expansion of Physician Practice Mgmt			✓		✓	✓		✓				Plan It
7. Departmental Systems												Ongoing
Data Integration												
8. Integration Engine							✓		✓		✓	Plan It
Administrative and Financial Systems												
9. General Financials					✓		✓					Plan It
10. Materials Management				✓	✓		✓					Plan It
11. Scheduling Application		✓		✓	✓				✓			Plan It
12. Decision Support System					✓	✓			✓			Start Now
Emerging Technologies												
13. Wireless LAN & WAN			✓		✓		✓	✓				Plan It
14. Voice Recognition			✓		✓		✓					Start Now
Infrastructure												
15. Server Consolidations or Upgrades											✓	Plan It
16. Network Upgrades											✓	Ongoing
17. Security - SSO, HIPAA, Policies					✓				✓	✓	✓	Plan It
Governance												
18. Project or Change Mgmt Office				✓	✓	✓					✓	Start Now
19. U.S. Governance (Steering, Bus. Liasons, SLAs)				✓	✓	✓						Ongoing

and *strengthen employee support*), along with goals within the categories. The leadership of the organization, through a series of meetings and presentations, has scored the contribution of the IT initiative to the strategic goals of the organization. The contribution to each goal may be critical (*must do*), *high*, *moderate*, or none. These scores are based on data but nonetheless are

fundamentally judgment calls. The scoring and prioritization will result in a set of initiatives deemed to be the most important. The IT staff will then construct preliminary budgets, staff needs, and timelines for these projects.

Figure 2.3 provides an overview of the timeline for these initiatives and the cost of each. Management will discuss various timeline scenarios. In evaluating each scenario, management considers project interdependence and ensures that the IT department and the organization are not overwhelmed by too many initiatives to complete all at once. The organization will use the budget estimates to determine how much IT it can afford. Often there is not enough money to pay for all the desired IT initiatives, and some initiatives with high and moderate scores will be deferred or eliminated as projects. The final plan, including timelines and budgets, will become the basis for assessing progress throughout the year.

Overall, a core role of the organization's chief information officer is to work with the rest of the leadership team to develop the process that leads to alignment and strategic linkage.

Once all is said and done, the alignment process should produce these results:

- An inventory of the IT initiatives that will be undertaken. (These initiatives may include new applications and projects designed to improve the IT asset.)
- A diagram or chart that illustrates the linkage between the initiatives and the organization's strategy and goals.
- An overview of the timeline and the major interdependencies between initiatives.
- A high-level analysis of the budget needed to carry out these initiatives.
- An assessment of any material risks to carrying out the IT agenda, and a review of the strategies needed to reduce those risks.
- Changes desired in IT-centric organizational characteristics and capabilities (for example, improvements in IT governance processes).

Figure 2.3 IT Plan Timetable and Budget

Hospital IT Migration Path			FY2010 Capital Expense (in $1000)	FY2011 Capital Expense (in $1000)		FY2012 Capital Expense (in $1000)		Annual Recurring	FY2010	FY2011				FY2012			
	Priority	Funded	Actual	Low	High	Low	High	Operate	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Clinical Applications																	
																	Timeline / FTE Staffing
1. Physician Order Entry	Start Now	Funded	$ 200		$1,800			$ 270	1	4	4	4					
2. Patient Care Documentation	Plan It			$ 333	$ 467	$ 167	$ 233	$ 70				1	3	3			
3. Clinical Data Repository	Start Now				$ 25			$ 4	0.5	0.5	0.5	0.5	0.5				
4. Computerized Medical Record	Delay It					$ 50	$ 125										
5. PACS (Phase I)	Start Now			$ 500	$ 500			$ 75	0.5	0.5							
6. Expansion of Physician Practice Mgmt	Plan It					$ 50	$ 150							1	1	1	1
7. Departmental Systems	Ongoing			$ 167	$ 333	$ 167	$ 333	$ 50		1	1	1	1	1	1	1	1
Data Integration																	
8. Integration Engine	Plan It			$ 100	$ 200						1	1					
Administrative and Financial Systems																	
9. General Financials	Plan It					$ 300	$ 500							1	2	2	
10. Materials Management	Plan It					$ 200	$ 333									1	2
11. Scheduling Application	Plan It					$ 75	$ 150										1
12. Decision Support System	Start Now	$ 100		$ 50				$ 8									
Emerging Technologies																	
13. Wireless LAN & WAN	Plan It					$ 167	$ 667	$ 75								0.5	0.5
14. Voice Recognition	Start Now	Pending		$ 100	$ 300			$ 45	0.5	0.5	0.5	0.5					
Infrastructure																	
15. Server Consolidations/Upgrades	Plan It			$ 250	$ 500			$ 75			0.5	0.5	0.8				
16. Network Upgrades	Ongoing	Funded	$ 100	$ 33	$ 133	$ 33	$ 133	$ 20	1	1	1	1	1	1	1	1	1
17. Security - SSO, HIP AA, Policies	Plan It			$ 33	$ 67	$ 17	$ 33	$ 10				0.5	0.5	0.5			

Annual recurring is the ongoing operating cost of the system
On the right of the figure, the approximate project timeline can be seen. The numbers below the timeline (0.5 and 1) indicate the number of IT staff needed to implement the project.

It is important to recognize the amount and level of discussion, compromise, and negotiation that goes into the strategic alignment process. Producing these results without going through the preceding thoughtful process will be of little real benefit.

OBSERVATIONS ON IT STRATEGY DEVELOPMENT

There are limitations to the effectiveness of IT strategy development. IT strategy development can benefit from processes and methodologies.

However, although these can be helpful they certainly do not guarantee a successful plan. The achievement of IT alignment can be elusive, yet when achieved it does not insure success against other pitfalls.

Planning Methodologies Processes and methodologies that help organizations develop IT plans, whether based on derived linkage or the examination of more fundamental characteristics of organizations, can be very helpful. If well executed, they can do all of the following:

- Lead to the identification of a portfolio of IT applications and initiatives that are well linked to the organization's strategy.
- Identify alternatives and approaches that might not have been understood without the process.
- Contribute to a more thorough analysis of the major aspects of the plan.
- Enhance and ensure necessary leadership participation and support.
- Help the organization be more decisive.
- Ensure the allocation of resources among competing alternatives is rational and politically defensible.
- Enhance communication of the developed plan.

Persistence of the Alignment Problem Despite the apparent simplicity of the normative process we have described, and the many examinations of the topic by academics and consultants, achieving IT alignment has been a top concern of senior organizational leadership for several decades. A survey of CIOs from across multiple industries found improving IT alignment with business objectives to be the number one IT top management priority in 2007 (Alter, 2007). There are several reasons for the persistent difficulty of achieving alignment (Bensaou and Earl, 1998):

- Business strategies are often not clear or are volatile.
- IT opportunities are poorly understood.
- The organization is unable to resolve the different priorities of different parts of the organization.

Weill and Broadbent (1998) note that effective IT alignment requires organizational leadership to clearly understand and strategically and tactically integrate: (1) the organization's strategic context (its strategies and market position), (2) the organization's environment, (3) the IT strategy, and (4) the IT portfolio (for example, the current applications, technologies, and staff skills). Understanding and integrating these four continuously evolving and complex areas is exceptionally difficult.

At least two more reasons can be added to this listing of factors that make alignment difficult. First, the organization finds it has not achieved the gains apparently achieved by others it has heard or read about, nor have the vendors' promises of the technologies materialized. Second, the value of IT, particularly infrastructure, is often difficult to quantify, and the value proposition is fuzzy and uncertain; for example, what is the value of improved security of applications?

In both these cases the organization is unsure whether the IT investment will lead to the desired strategic gain or value. This is not strictly an alignment problem. However, alignment does assume the organization believes it has a reasonable ability to achieve desired IT gains.

The Limitations of Alignment Although alignment is important, it will not guarantee effective application of IT. Planning methodologies and effective use of vectors cannot, by themselves, overcome weaknesses in other factors that can significantly diminish the likelihood that IT investments will lead to improved organization performance. These weaknesses include poor relationships between IT staff and the rest of the organization, incompetent leadership, weak financial conditions, and ill-conceived IT governance mechanisms. IT strategy also cannot overcome unclear overall strategies and cannot necessarily compensate for material competitive weaknesses.

If one has mediocre painting skills, a class on painting technique will make one a better painter but will not turn one into Picasso. Similarly, superb alignment techniques will not turn an organization limited in its ability to implement IT effectively into one brilliant at IT use. Perhaps this reason, more than any other, is why the alignment issue persists as a top-ranked IT issue. Organizations are searching for IT excellence in the wrong place; it cannot be delivered purely by alignment prowess.

Alignment at Maturity

Organizations that have a history of IT excellence appear to evolve to a state where their alignment process is *methodology-less*. A study by Earl (1993) of organizations in the United Kingdom with a history of IT excellence found that their IT planning processes had several characteristics.

IT Planning Was not a Separate Process IT planning and the strategic discussion of IT occurred as an integral part of the organization's strategic planning processes and management discussions. In these organizations, management did not think of separating out an IT discussion during the course of strategy development any more than it would run separate finance or human resource planning processes. IT planning was an unseverable, intertwined component of the normal management conversation. This observation would suggest that having a separate IT steering committee is unnecessary and possibly counterproductive.

IT Planning Had Neither a Beginning nor an End In many organizations, IT planning processes start in a particular month every year and are completed within a more or less set period. In the studied organizations, the IT planning and strategy conversation went on all the time. This does not mean that an organization doesn't have to have a temporally demarked, annual budget process. Rather it means that IT planning is a continuous process that reflects the continuous change in the environment, such as a recession, and organizational strategic plans, such as a desire to explain market share.

IT Planning Involved Shared Decision Making and Shared Learning IT leadership informed organizational leadership of the potential contribution of new technologies and the constraints of current technologies. Organizational leadership ensured that IT leadership understood the business plans, strategies, and their constraints. The IT budget and annual tactical plan resulted from shared analyses of IT opportunities and a set of IT priorities.

The IT Plan Emphasized Themes A provider organization may have themes of improving care quality, reducing costs, and improving patient service. During the course of any given year, IT will have initiatives that are intended to advance the organization along these themes. The mixture of initiatives will

change from year to year, but the themes endure for many years. Because themes endure year after year, organizations develop competence around these themes. They become, for example, progressively better at managing costs and improving patient service. This growing prowess extends into IT. Organizations become more skilled at understanding which IT opportunities hold the most promise and at managing implementation of these applications. And the IT staff becomes more skilled at knowing how to apply IT to support such themes as improving care quality and at helping leadership assess the value of new technologies and applications.

IT Strategy Is Not Always Necessary There are many times in IT activities when the goal, or the core approach to achieving the goal, is not particularly strategic, and strategy formulation and implementation are not needed. Replacing an inpatient pharmacy system, enhancing help desk support, and upgrading the network, although requiring well-executed projects, do not always require leadership to engage in conversations about organizational goals or to take a strategic look at organizational capabilities and skills.

There are many times when it is unlikely that the way an organization achieves a goal will create a distinct competitive advantage. For example, an organization may decide it needs to provide personal health records to patients, but it does not expect that that application, or its implementation, will be so superior to a competitor's personal health record that an advantage accrues to the organization.

Much of what IT does is not strategic, nor does it require strategic thinking. For instance, the IT supporting payroll plays more of a core support role than a strategic position. Many IT projects do not require thoughtful discussions of fundamental approaches to achieving organizational goals or significant changes in the IT asset.

SUMMARY

The development of IT alignment and strategic linkage is a complex undertaking. Four vectors, each complex, must converge. Organizational strategy is often volatile and uncertain, and will invariably be developed in multiple

forums, making it difficult to have a static, comprehensive picture of the strategy. The ability of IT to support a strategy can be unclear, and the trade-offs between IT options can be difficult to assess. The complexity of this undertaking is manifest in the frequent citing of IT alignment in surveys of major organizational issues and problems.

There are no simple answers to this problem. At the end of the day, good alignment requires talented leadership (including the CIO) who participate in effective debates and discussions regarding strategies and who have very good instincts and understandings about the organization's strategy and the potential contribution of IT.

It appears that mature IT organizations have evolved these IT alignment processes to the point where the processes are no longer distinguishable as separate processes. This observation should not be construed as advice to cease using planning approaches or to disband effective IT steering committees. Such an evolution, to the degree that it is normative, may occur naturally, just as kids will eventually grow up (at least most of them will).

KEY CONCEPTS

IT strategies based on assessment of strategic trajectories

IT strategies based on continuous improvement of core processes and information management

IT strategies based on examination of the role of new technologies

IT strategies derived from organizational strategies

DISCUSSION QUESTIONS

1. Identify some potential IT initiatives that would result from an organizational strategy to improve the coordination of care across inpatient, outpatient, and non-acute care settings.
2. What are the core processes for a health plan? What IT initiatives might be undertaken to improve those processes?

3. Pick a new information technology, and discuss how that technology might introduce new IT strategy opportunities for a large physician practice.
4. Assume that a multi-hospital system wants to become among the best in the country at delivering a superior patient experience. What IT strategies might result?

3

The Information Technology Asset

In Chapter Two we discussed issues, observations, and techniques associated with aligning IT initiatives with health care organization strategies. The focus of that chapter was on the relationship between the overall strategy and the IT plan. This chapter will focus on the *IT asset*, which includes technology, IT staff, data, and applications and is represented by the innermost circle of Figure 1.1 (IT Strategy Scope) presented in Chapter One. This focus is critical for the three reasons that follow, the second two of which will be the focus of this chapter.

First, as discussed in Chapter Two, changes to the IT asset are the central outcome of IT strategy development. An objective to improve care may call for changes in the integration of applications, the reliability of the infrastructure, the breadth of clinical data, and the skills of the IT staff.

Second, one needs asset strategies (often in addition to the strategic thinking that links the organization's strategy to the IT agenda) to ensure the

execution of those asset changes is guided by well-crafted and well-thought-out concepts and plans. For example, we might ask the following questions:

- What IT asset strategies will guide our efforts to establish a continuum of care?
- Does a continuum require a common electronic health record (EHR)?
- Will we need to capture clinical data from affiliated care providers?

Third, strategies for improving the IT asset may be desirable to leverage a wide range of current and future IT plans. For example, improving infrastructure reliability may enhance the effectiveness of a series of IT initiatives. Improving the quality of clinical data may be essential to respond to a series of performance reimbursement initiatives. These changes may not be driven by a specific organizational strategy but may be driven by an understanding of a portfolio of current and future organizational needs.

ASSET COMPOSITION AND OVERVIEW

The IT asset consists of the following elements:

- *Application systems*, which are composed of the software that is used to support the work performed by organizational staff and, potentially, organizational affiliates and business partners. Examples include provider order entry, outpatient scheduling, managed care applications, and collaboration tools.
- *Technical architecture*, which makes up the base technologies (networks, programming languages, operating systems, workstations, and so on) that form the foundation for applications and the manner in which these base technologies are put together.
- *Data*, which include all the organization's data, data analyses, and access technologies.
- *IT staff*, which includes the analysts, programmers, and computer operators who manage and advance IT in an organization, the organization of the staff, and staff attributes (for example, agility or ability to innovate).

These various asset components, designed, developed, and managed under the leadership of the CIO, are the organizational IT resources that can and should be directed toward furthering organizational strategies and advancing the organization's abilities to achieve its goals. The differences between a strong asset and a weak asset can be significant. Applications that provide superior support of organizational processes are more of an asset than those that do not. IT staff who are skilled, motivated, and well organized are more of an organizational asset than staff who are not.

Each component contributes to the overall effectiveness of IT and the ability of an organization to achieve its goals; each component contributes in different ways. Strategies and plans are required to ensure the component is thoughtfully conceived, well developed, robust, sustained, and making significant contributions. IT asset strategies may look like this:

- "Given the continued pressure to improve care quality and efficiency, we need to streamline our care processes and ensure that our care is evidence-based. We need to implement an EHR that supports our core processes and provides a rules engine to enable the delivery of the best evidence at the point of care."
- "Due to significant environmental uncertainty, we may need to have more agile applications and infrastructure. Our agility strategy will involve creating a loosely coupled technical architecture with well-defined interfaces between layers and components."
- "We need to create a more responsive and more service-oriented IT organization. Our strategy will involve decentralizing our development and implementation teams and locating them at our affiliated hospitals."
- "We need to measure the quality and cost of our care across our delivery system. We will develop standard definitions of a small set of quality measures and create an IT department to provide analytical support for those data."

In the following sections, each IT asset component will be defined, its characteristics will be described, and a series of considerations will be presented that can be used to guide the organization as it defines asset strategies.

APPLICATION SYSTEMS

Application systems are software used by the organization in the course of performing organizational activities. There are two major types of application software. Specialized application software is intended for use by a well-defined set of workers performing a reasonably narrow set of tasks. Examples of specialized application software include scheduling systems, clinical laboratory systems, managed care contract analysis systems, and EHRs. General-purpose application software is intended for use by a broad set of workers or users, although the specific use can be narrow. Examples of general purpose application software include word processing, spreadsheets, and collaboration tools.

Application System Characteristics

Application systems should exhibit the following characteristics:

- *Improvement.* They should improve existing operations and activities. Processes and activities should be more efficient and effective as a result of the implementation of application systems. Accounts receivables' days should be lower. Medication errors should be fewer. Laboratory test turnaround should be faster.
- *Support.* They should provide superior support to critical processes and activities. Not all processes are created equal, nor are they equally important strategically. For processes and activities that contribute more to organizational prowess than others, the application systems support should be more than good; it should be superior.
- *Integrity.* These systems should behave with integrity. They should perform as expected, consistently and quickly. Errors in the application software should be few or nonexistent. System performance (for example, response time) should enhance and not interfere with work.
- *Agility.* The application systems should have some agility. In other words, it should be reasonably efficient, effective, and timely to alter the application to respond to the needs for evolution. This response can be in the form of frequent vendor upgrades or tools that enable the organization to change the application easily and safely.

- *Efficient implementation and support.* Implementing and supporting the application should be efficient. The cost of managing the application on an ongoing basis should be modest relative to the value of the application. Application efficiency strategies can involve changing platforms to reduce support costs or standardizing an application across a delivery system in an effort to reduce application maintenance costs.

Organizations will ask themselves, "Do we have a good pharmacy system? Scheduling system? Patient care system?" To a large degree, the answer depends on how well the system fares when assessed against the application system characteristics.

Observations on Application Support of Processes

The characteristics of most importance are the degree to which the application enables and supports the improvement of organizational processes. In most cases, we should be able to measure the impact of the application on the organization, and that impact should serve as a rough assessment of how well this asset is performing. At times this measurement is difficult or misleading. (For example, what is the measurable value of electronic mail?) We also recognize that the system, by itself, does not cause improvement. The system must be properly implemented, and organizational changes (such as reengineering the processes to be supported by the system) may need to be made. Nonetheless, it is the impact on the organization that serves as the best measure of this asset component. A comparison of an application's features with those of another application or with an idealized application is not an appropriate measure of an application's worth unless that comparison is clearly linked to value to the organization.

Organizations should exercise appropriate caution when confronted with the giddiness that often occurs when new applications appear in the market or when confronted by the suffocating euphoria that can surround applications when the industry or organization lacks experience in implementing, operating, or demonstrating the value of these applications. The landscape is littered with examples with very large hype-to-value ratios. That is not to say that these applications have no value or that one cannot find settings that

have happy users. However, real experiences have a way of changing euphoria to sobriety.

Organizations should look carefully, thoughtfully, and warily at the precursors or assumptions that will determine the value of major applications. Here are three examples:

1. The value of business intelligence (BI) systems is directly related to having clear information needs on the part of senior management, senior management interest in conducting impromptu analyses and queries with reasonable frequency, and a base of high-quality, well-integrated data. None of these precursors is inherently present in a large number of organizations.
2. Enterprise-wide scheduling across a geographically dispersed delivery system presumes that a patient (or a provider's staff) in one locality is as likely to schedule an appointment with a local specialist as to schedule an appointment with a specialist in a locality twenty miles away. This presumes a series of factors are present, including: some degrees of freedom of patient movement; some knowledge on the part of the referring provider of the skills and existence of a wide range of specialists (and assessment that these specialists possess equivalent skill and deliver equivalent care and service); and some exceptional rationalization of care by the health system.
3. The value of insurance electronic data interchange (EDI) is highly correlated with the ability of a provider organization's payers to receive a transaction, the degree of EDI integration with provider applications, and the ability of provider staff to act on responses received from the payer.

An existing, working application should be replaced only as a last resort. The industry appears to replace applications too frequently, often citing new technologies and application features. Of course technologies advance, as applications do, and become better over time. However, application replacement is expensive, time-consuming, and subject to opportunity costs that are often not well assessed or value gains that are insufficient. Replacement will occur, but the rationale for replacement must be very

compelling. A replacement cycle that is too frequent actually retards organizational advancement because it diverts resources to areas where the gain is marginal.

Having the same application system across the enterprise has the same inherent value as having one's children dress identically. Sameness has no intrinsic value. However, a common system can be a catalyst for developing common organizational processes and common data across the enterprise and may be necessary to consolidate a function across multiple organizations. It should be clear, however, before one pursues commonality, that the value of commonality is compelling from the perspective of return on investment. Developing common processes and data across several organizations is very hard work. Several health systems have also found that the organization-wide consolidation of functions has resulted in fewer cost savings than planned, a degradation in service performance, and a reduction in function responsiveness. This does not mean that consolidation or commonality of processes is bad. Rather it means that the rationale should be compelling and stripped of naiveté. We should remember that a common application does not actually lead to common processes and data.

Application System Strategy Examples

Application system strategies are varied; examples of this variety are presented in the sections that follow and include forming departments, vendor relationships, and technologies for delivering applications to the desktop.

Clinical Informatics Research and Development Partners HealthCare has established a department within IT known as Clinical Informatics Research and Development (CIRD). This department is managed, and largely staffed, by physicians, nurses, and others who have formal clinical training, educational backgrounds, and work experience in computer science and medical informatics. The group has several roles, three of which are related to application system strategies:

1. To provide design leadership for complex clinical information systems designs, such as the entry of a structured outpatient progress note or the entry of a complex medication order

2. To conduct research (funded through federal grants and industry partnerships) on advanced clinical information system topics such as clinical decision support, natural language processing to create structure from unstructured text, and assessment of the complex value that results from EHRs
3. To manage the development and maintenance of computer-based medical knowledge such as decision support rules and data vocabularies

This department and these roles are intended to materially improve the ability of Partners' clinical information systems to improve the processes of care. The department accomplishes this goal by supporting the definition of application capabilities, identifying application features that have a significant ability to improve care, and assisting in prioritizing applications. The creation of this department was the result of a strategic conclusion that the organization's ability to have *A-plus* application support of care delivery would be materially enhanced by the existence of an applied research and development group.

Vendor Relationships Health care organizations have several general strategies for vendor relationships. The organization may commit itself to a vendor's product line or engage in a *best of breed* strategy or adopt some mixture of the two. For example, an organization may rely upon financial systems from Oracle and purchase ancillary systems from niche vendors.

A single vendor commitment enhances the likelihood of system integration and reduces the complexity of vendor management. However, the vendor's offerings may be uneven across applications, and once the commitment has been made to the vendor, organizational leverage over the vendor may decline.

Some organizations and vendors have entered into agreements in which they share business risk and reward. If the system is intended to reduce costs in the outpatient clinic, both the organization and the vendor can share in the savings. Although such an arrangement may enhance vendor commitment to a successful implementation (with a broad definition of implementation) and assist in ensuring that critical system capabilities are present, such

arrangements can be complex and require the organization to give the vendor some of the management responsibility formerly possessed exclusively by the organization.

These approaches to vendor relationships can be the result of application system discussions that attempt to *optimize* a complex set of trade-offs. A single-vendor approach can be more efficient and may emphasize application integration as a major contributor to support of organizational processes. A best-of-breed approach, in contrast, may accept less efficiency to optimize support for departmental processes. Sharing of business risk and reward with a vendor is a strategy designed to enhance the application's support of organizational processes.

Software as a Service Software as a Service (SaaS), a relatively new phenomenon, enables organizations to *lease* the use of a software application and turn over the management of the application's technology infrastructure to the SaaS provider. Using the SaaS model, a health care organization can deliver an application, such as a practice management system, without having to establish and manage the data center component of the application and hire the associated technical staff.

The subscription approach enables the organization to remove the need to expend the often large amount of capital necessary to install and implement an application. However, sharing the application with other organizations can mean that specific customizations to the application either cannot be made or are expensive to effect.

A decision to use SaaS can be the result of an application system discussion that emphasizes efficiency (for example, lower up-front cost to obtain an application) and accepts some level of reasonable limitations in process support.

TECHNICAL ARCHITECTURE

Technical architecture is often discussed by IT vendors and their customers. One hears statements such as, "We use a cloud-based architecture," "Our products are based on a relational database architecture," and "Our organization uses a best-of-breed architectural strategy." Statements like these confuse

architecture with design. All information systems have been designed, and their design can be presented, discussed, and classified. One can talk about the location of the database in the system or the distribution of the application processing across computers or the extensibility of applications over the Internet. One can label different classes of designs with the term *architecture.* For example, applications that separate processing power between a *master* and a *slave* processor have a client-server architecture.

Although these classes of designs can be very important and often demonstrate insight and progress, they have no context. An organization doesn't know if cloud-based or service-based architectures, for example, are good, bad, or neutral. IT professionals at times equate the column inch in the trade press or trade show decibel levels devoted to a class of designs with *goodness.*

A more helpful definition of architecture is as follows: technical architecture is the set of organizational, management, and technical strategies and tactics used to ensure that platforms have critical, organizationally defined characteristics and capabilities. There are two major types of platforms: infrastructure and clusters of applications.

Infrastructure is composed of the base technologies used by an organization, such as servers and networks, and the manner in which they are put together. *Clusters of applications* are suites of applications that are generally viewed as being part of an integrated package such as Microsoft Office, Lawson financial applications, and Siemens clinical information systems. The suites have components and are put together in specific ways.

Architecture Characteristics and Capabilities

For both types of platforms (although the remainder of this section focuses on infrastructure), an organization may decide that the critical architecture characteristics are as follows:

- *Supportability*. The organization can efficiently and effectively provide day-to-day support of the infrastructure; for example, it can answer user questions, troubleshoot problems, perform backups, make minor enhancements, and run batch jobs.

- *Reliability.* The infrastructure has excellent uptime, works fast, and behaves predictably.
- *Potency.* The infrastructure uses technologies that allow the organization to buy lots of units of bandwidth, storage, and processor power for as little capital per unit as possible. Potency also means the organization has to develop applications and manage the infrastructure with powerful tools.
- *Agility*. The organization can replace major components of the infrastructure easily and with minimal disruption to other components. For example, the organization could change its server vendor and not have to change its server operating system or applications. Also, an application that runs in a browser may be able to ignore the workstation, or a standardized transaction interface can ignore the specific technology of the receiving application. Agility also means IT can respond to the needs of the organization relatively rapidly and efficiently, as when adding a new remote site or adding new fields to the database.
- *Integrability.* The infrastructure eases, as much as possible, the integration of applications, data, and components of the infrastructure. Techniques such as having a common organization-wide workstation, reusable services (in the sense of service-oriented architecture to be discussed in Chapter Eight) in the development of applications, incorporation of industry messaging standards, and implementation of a common network protocol support integrability.
- *Security.* The infrastructure has technologies that enable the organization to protect its infrastructure and applications from misuse and threats such as viruses, phishing, and loss of data on a stolen mobile device. In addition, security refers to the ability of the organization to recover from a disaster such as a fire in the computer room or major loss of power.

Architecture capabilities are attributes of the infrastructure that can be leveraged by a wide range of applications or that can represent a narrow but significant addition to *what one can do.*

Capabilities can generally be stated with sentences beginning with "we can" or "we will be able to." Examples are as follows:

- We will be able to provide access to radiology and pathology images from any workstation in the organization.
- We can offer access to our clinical information systems using mobile devices.
- We will be able to exchange clinical data with other providers in our region.
- We can provide context-sensitive access to knowledge resources.

In light of the architecture's characteristics and capabilities, is the fact that an application is *cloud-based* good or bad? It depends on whether that design in general, and the application's specific implementation of it, enhances or detracts from the organization's ability to achieve its goals. If the cloud-based infrastructure can improve reliability and agility, then it is good. If the cloud infrastructure is insecure and hinders the ability of the organization to deploy clinical decision support, then it is not so good.

Technical Architecture Strategies

Architectural strategies are composed of four major elements. The first element is statements of desired characteristics that are clear and, where possible, measurable. What does agility or supportability mean to us? How would we know if reliability or supportability has been improved? Could we measure it? The statements should be robust; in other words, the statement will endure as the specific products change and evolve. For example, an organization's definition of supportability should survive the industry's movement from one operating system to another. The changes in products should enhance the ability of the organization to realize the desired characteristics, but the definition of the characteristics doesn't change.

The second element is statements of desired capabilities that are clear. To how much of the globe do we want to provide access, and is this access to all of our applications or some of them? Does image access need to provide diagnostic quality images or not? Capability statements should also have an associated statement of value. Why would one want to invest the time and

energy to provide these capabilities? How will patient care or administrative effectiveness be improved?

The third element is the statement of specific components, such as Cisco network equipment, that will form the building blocks of the architecture. These components have features that enable them to be more reliable, supportable, and so on. As the organization upgrades its components or shifts to new components, it should understand how each change enhances its ability to improve characteristics or capabilities. This is particularly true when the change is expensive and possibly disruptive. For example, how does a move to open source software enhance supportability or reliability? What important capabilities will mobile devices provide?

The fourth element is the approaches to putting together or fitting the components such that the whole achieves the desired characteristics and delivers the desired capabilities. One can engineer a very unreliable network or a very reliable one. One can engineer a network such that the movement of images cripples the performance of other applications or is not noticeable by the users of the other applications. The same components may also be engineered to arrive at different designs such that the resulting system is service-based or not.

The approaches to fitting can be very diverse. Examples are as follows:

- The organization can standardize on a workstation (or database or development language) to enhance supportability.
- Fault tolerance, disk mirroring, and rigorous application testing methodologies can all improve reliability.
- Internal development of applications, standardized interfaces, and the selection of market-standard operating systems can all enhance agility.
- The choice of commodity technologies or an aggressive technology replacement cycle (for example, 40 percent of the workstations are replaced every year) can improve potency.
- Network segmentation can enable image movement.
- A virtual private network service or the Internet can provide some forms of global access.

The approaches for fitting run the gamut from choices of technology to adoption of standards to engineering of component relationships to staff support mechanisms to technology obsolescence tactics to organizational policies regarding technology heterogeneity.

Changes in Characteristic and Capability Importance The importance of architectural characteristics and capabilities can change or vary. Importance can be influenced by *today's issues.* If an organization has significant reliability problems, that attribute will be appropriately viewed as deserving the full attention of IT management, even if that attention detracts from efforts to improve agility. If the technology is to be applied in an area of great uncertainty, such as engaging patients using Web 2.0 technologies, then agility is very important. Once the use of Web 2.0 technologies becomes mature, then agility becomes less important.

Importance can be influenced by the nature of organizational work. If the technology is to support core transaction activities that are used directly by customers, as in the case of airline reservations, then reliability and supportability become of paramount importance.

In general, when the nature of an organization's business seems to be on the edge of significant change, the technical architecture should be examined to see if the relative importance of characteristics and capabilities needs to change. For example, organizational efforts to expand its patient service area or focus heavily on improving care quality can increase the emphasis on extensibility of applications and reliability, respectively.

Technology change is generally continuous and accelerating. However, the technology change that matters to an organization is the change that surrounds the technologies it is using or intends to use. An organization may see little relevant technology change in some segments, despite sweeping changes in the technology industry.

Component choices and fit approaches will also change as new technologies and techniques enable the organization to consider new architectural strategies. Service-based architectures and high performance, high availability servers are examples of such technologies. New technologies often present

characteristic trade-offs (for example, agility may be improved, but reliability is a problem) and capability trade-offs (for example, providing global access may hinder the development of a highly secure environment).

Although the choices, fit approaches, and relative importance of characteristics and capabilities will change, the definitions of technology architecture characteristics and capabilities adopted by an organization tend to be static for long periods of time.

Technical Architecture Strategy Examples

Two examples of technical architecture strategy, the Partners technical strategy function and Partners selection of an application platform, are discussed in the paragraphs that follow.

Technology Strategy Function A senior technology strategy function was established at Partners. The technology strategy function is an outgrowth of a strategy discussion on technical architecture, specifically on the need to create an ongoing mechanism for architecture strategy development. The function has several objectives, including the following:

- To develop strategy for major technology platform moves (for example, a move to platforms that enable a lighter application footprint on desktop devices)
- To evaluate and report on emerging technologies, their industry diffusion, and potential value to Partners
- To provide ongoing assessment of business drivers and technology trends
- To establish an annual agenda of technology areas to be explored

This function is overseen by the three groups:

- The executive committee reviews and approves major technology strategy recommendations from the operations group, reviews assessment of emerging technologies by the evaluation group, and defines the agenda for major technology moves. This committee is composed

of Partners CIOs, senior IT managers, and principal technologists. The Partners chief technology officer chairs the committee.

- The operations group develops the technology strategy and manages the handoff of that strategy to various infrastructure groups, for example, to the group that manages the data network. This group works with CIOs and senior IT managers to set and define the exploration agenda.
- The evaluation group conducts in-depth assessments of emerging technologies. These assessments can involve discussions within industry research organizations and with technology vendors and experimentation with new technologies. This group is composed of technology analysts.

Current technology priority areas are as follows:

- Agile application delivery models, such as interorganizational delivery of applications and services, device independence, single sign on, and session management
- Management of consumer IT, such as the iPhone, that are in use in the enterprise
- Mobile strategy, such as use of these technologies for clinical and administrative applications, event notification, and development strategies
- Federated or delegated identity management, for example to support interorganizational applications, services, data exchange, and security
- Unified communications and collaboration to support distributed work, tele-meeting, and the integration of messaging and collaboration

Application Platform Partners bases its clinical information systems on Intersystems Cache, an application platform. Cache includes a development language, a database management system, and operating system capabilities needed to manage large-scale process interoperability. This choice (not meant to imply

an endorsement of the product) illustrates several infrastructure characteristics and serves as an example of mapping characteristics to specific features of a technology.

The platform, when engineered in conjunction with network and server technologies, is able to provide very high availability (reliability). If a process loses a connection to a server, it will automatically attempt to establish another connection through another path.

Cache has been integrated with Web services, desktop and server operating systems, Oracle and SQL Server, mobile devices, and electronic data interchange. In addition, Cache programs have been wrapped to appear as Java, Com, and XML objects for the purpose of code integration.

The platform has been scaled to respond to very large transaction processing demands; for example, it performs an average of 50 billion cross-platform reads and writes of programs and data every day. Applications, based on the platform, can be delivered to small sites (such as the office of a solo practitioner) and large sites (such as a nine hundred-bed academic medical center), which is an example of agility.

The Cache platform was chosen for its ability to meet a set of infrastructure characteristics: reliability, integrability, and agility.

DATA

The data component of the IT asset is composed of the following:

- Data recorded on some medium
- Organizationally defined data-coding conventions, standards, and definitions, such as systematized nomenclature of medicine (SNOMED) codes, ZIP codes, and standards for identifying whether a physician is a primary care provider or not
- Policies, procedures, and management mechanisms that guide the capture, *cleaning*, and use of data
- Technologies that capture, store, and support the access and analysis of data (for example, database management systems and BI software)

Data Characteristics

Organizational data have five critical characteristics:

1. *They must be accurate*. Data that are accurate capture, with tolerable error, the *true* state of some phenomenon, activity, or thing. If the data say that 24 percent of a provider organization's patients are subscribers of one health plan, that data should be a fair reflection of the truth.
2. *They must be timely.* The interval between the time when someone wants to make a decision or check the status of an activity and the time of the availability of the data should be short relative to factors such as the pace of change, the organization's ability to move with a certain speed, and the urgency of dependent decisions.
3. *They must be easily understood*. Data should have a definition that is consistent and comprehensively understood by all users of those data. An *encounter,* for example, should have a common definition throughout the enterprise.
4. *They must be accessible*. Decision makers should be able to access, with minimal difficulty, the data they need to make decisions and monitor activities.
5. *They must be efficient*. The capture, transformation, and reporting of data should be efficient.

These desired characteristics are not particularly controversial. One can develop other characteristics, but no one would dispute the usefulness of accurate, timely, well-understood, accessible, and efficiently gathered data.

Despite this consensus, the quality of data in most organizations is often relatively poor. The major contribution of BI systems was for most organizations to point out the exceptionally poor quality of organizational data. Executives found they were able to bring forth, with the touch of a button, multicolored graphs of garbage.

Data may be the most unforgiving component of the IT asset. If the organization implements lousy application systems or unreliable technologies, it can replace them. If the organization hires someone who is incompetent,

it can remove the person. But if the organization allows poor-quality data to enter into its systems or develops an ill-conceived coding scheme, it may not be able to correct the problem.

Data Strategies

There are four major areas where strategies regarding data are necessary. The first is the definition of what data to collect for the purpose of analysis. This is a complicated matter; the answer depends to a very large extent on organizational definitions of strategy, critical success factors, key environmental variables, and essential performance areas. Data can be gathered to assess market share, financial performance, care outcomes, cost of care, conformance of care to protocols, appointment availability, and patient satisfaction. All of these areas (and others) involve discussions of specific data elements, data definitions, sources of data, acceptable data error rates, users of data, and confidentiality of data.

The second area involves the definition of which data should be standardized throughout the enterprise and which standards should be used. In some areas, the standardization choices are constrained; for example, general accounting practices have a significant influence on the definition of data on financial performance, and Medicare requires that specific coding schemes be used for the diagnosis placed on the claim. In some areas, the organization may have great latitude of choice in defining the data, for example what constitutes the organization's market share, although the choices, again, have very different ramifications.

The third area is the identification of data management and access technologies. Technologies and techniques are varied, and the industry is often awash in discussions on data management technologies. The air is full of new buzzwords and trendy terms such as data mining, data warehouses, data marts, and business analytics. While there is hype, these techniques and technologies do have important distinctions and contributions.

The fourth area is the development of organizational mechanisms and functions to manage data and perform activities designed to improve the characteristics of the data component of the IT asset. These mechanisms are often decentralized; for example, finance manages data on financial performance, marketing may manage data on market share and patient satisfaction, health

information management is responsible for coding of procedure and disease data, and quality assurance may manage data on outcomes.

Regardless of the responsibility distribution, organizational leaders should recognize that developing and maintaining high-quality data requires all of the following:

- *Staff who are responsible for managing data quality*. These staff document data meaning and ensure data integrity by developing and enforcing data management techniques (such as data dictionaries, initial and retrospective data entry checks, and edits) and by supporting official databases. Responsibility means their job descriptions are explicit about these tasks. These staff can be asked to oversee data that is generated externally and used by the organization.
- *Senior management support.* Data quality involves changes in applications, work processes, and budgets to support the data quality and management functions. Data quality often requires that those who enter data undertake additional work for the benefit of someone else who is *downstream.* Ensuring high-quality registration data may offer little immediate advantage to the registration clerk but is terribly important to the accounts receivable clerk.
- *A recognition that, whereas technology can be sexy, managing data quality is generally not*. Trying to determine how an organization managed to perform a hysterectomy on a twenty-year-old male, as the data indicate, requires the skills of a good detective and often involves the drudgery of a stakeout. This work is not always exciting. Nonetheless, a work's appeal to workers has never been a good predictor of its importance.

Data management should also include developing, maintaining, and making widely available the inventory of data resources and specifying the terms and conditions under which one organizational unit may have access to another's data (Levitin and Redman, 1998).

Data Strategy Examples

Two examples of data strategies are presented in the sections that follow. The first discusses the creation of a BI center of excellence, and the second briefly examines knowledge management.

Business Intelligence Partners HealthCare is establishing a BI center of excellence (Glaser and Stone, 2008).[1] This center has two core components, the BI platform and BI-related roles and responsibilities.

BI formally refers to the information technology platform and associated tools used to gather, provide access to, and analyze data about organization operations and activities. The platform is composed of a set of information technologies that are often represented as a stack, with one set of technology on top of the previous sets. Using technologies from several vendors, a stack with the following features was implemented:

- *Infrastructure.* The organization's servers, operating systems, workstations, and networks.
- *Data acquisition.* The core transaction systems (for example, payroll, accounts receivable, outpatient registration, and EHRs that are the sources of the data used by BI analyses software).
- *Data integration.* The software used to extract data from source systems and to normalize or *clean* the data and link data from disparate source systems.
- *Data aggregation and storage.* The repository of data that results from the data integration process. This repository can store both detailed data and summaries of data.
- *Data analyses.* The analyses software used to query the repository and to run reports and conduct data modeling and *what if* scenarios. This software is often called BI by software vendors.
- *Portal.* The interface used by management and analyses staff to interact with the BI stack.

Although the technology is a critical component of BI, it is not a sufficient component. Partners had to establish specific roles, which were defined as follows:

- *Data stewards* are responsible for developing the policies and procedures that govern data. They must understand operational and business process and data requirements. They must develop policies and procedures that acknowledge these requirements but also protect the quality of the data; this can be tricky. For example, physicians may decide to not use

coded problem lists because it *takes too much time*, but coded problem lists are essential for high-caliber BI analyses of care quality.

- *Data owners* are the individuals and functional groups in the organization that generate the data. Example data owners are medical records ownership of procedure code assignment and outpatient registration ownership of patient demographics. Data owners are responsible for implementing the policies, procedures, training, and systems that are defined by data stewards and that are needed to enforce organizational definitions of data and standards for data quality.
- *Business users* are those who use the results of the analyses and often perform the analyses themselves. The business users are responsible for learning how to use BI tools and for understanding the strengths and limitations of the data. They should also ensure that a proposed analysis will address the questions the analysis is intended to address.
- *Data managers* are the IT staff who manage the BI stack. They ensure that the tools are of high quality, the ongoing operations of the BI stack (for example, backup) are performed, training is provided to users, and counsel is given for business users who have questions about the data or an analytical strategy. The data managers develop data schemas, identify preferred source transaction systems for data, and understand the limitations of the organization's data.

Knowledge Management Under the IT asset taxonomy, knowledge assets such as clinical decision support logic, data coding schemes, and computer-based care guidelines would be considered forms of data. From the Partners perspective, knowledge management is concerned with ensuring that key clinical data (such as medications) are coded using appropriate vocabularies and terms and that clinical decision support logic and guidelines are well developed, kept current, and are accessible to clinicians and IT EHR developers.

Although knowledge management is different in character and complexity than managing data as an asset, the two areas have considerable overlap. The areas covered by development of a knowledge management strategy and the steps taken are similar to those covered by a data asset strategy discussion (Davenport and Prusak, 1998).

At Partners HealthCare, a series of strategic initiatives were targeting physician order entry adoption, quality improvement, disease management, patient safety, and medical cost management (see Chapter Six for a more thorough discussion of these initiatives). As part of these initiatives, a medication safety steering committee was formed. This committee formed two subcommittees, a medication knowledge committee and a medication systems committee. These two subcommittees initially focused on improving the ability of computerized provider order entry (CPOE) to improve medication safety (Glaser and Hongsermeier, 2006).

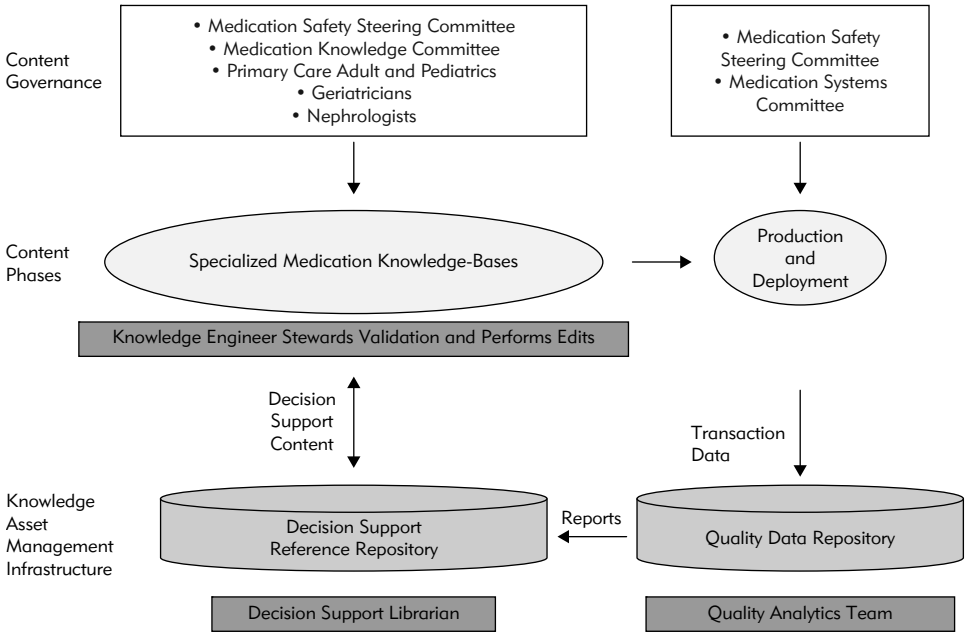
A careful inventory by the two subcommittees of the current state revealed there were nonuniform medication decision support practices across the hospitals and that a bottom-up approach to decision making was impeding progress toward the sharing of best practices enterprise-wide. For example, specialized pediatric, geriatric, and renal dosing decision support logic was maintained by a Partners-level pharmacy team but was in production at only one hospital site. In other cases, the decision support logic was inconsistent across sites and had not been kept current.

To address this problem, the medication knowledge committee assumed responsibility for developing the set of best practice medication safety clinical decision support. This logic was stored in a *decision support reference repository.* This repository contained a library of all decision support rules, the bases (literature and clinical consensus) for these rules, and the individuals or teams responsible for keeping the rules current. The medication systems committee assumed responsibility for ensuring that logic was implemented uniformly across the hospital CPOE systems. In addition, the medication systems committee analyzed resulting order patterns (using data from the quality data repository) to determine physician compliance with the logic. These compliance analyses were fed back to the medication knowledge committee to guide any necessary logic refinements. Figure 3.1 provides a high-level diagram of theses subcommittees and the repositories.

Observations on the Data Asset

For most providers data has been a secondary consideration. Data is often seen as less worthy of investment than areas such as equipment, buildings,

Figure 3.1 Knowledge Management and Maintenance Process



and IT support of clinical, operations, and finance processes. Most IT discussions about applications focus on improvements in important processes such as ordering tests, generating a claim, or scheduling a patient.

Process improvements and investments in buildings and equipment will always be important. However, the management of data deserves the same level of importance. Increased pressure on providers to measure and report the quality, safety, and efficiency of their care and the growing adoption of interoperable EHRs will lead to much more sophisticated uses of data.

IT STAFF

The staff component of the IT asset has three major aspects:

1. Attributes of the staff
2. Core staff capabilities and competencies
3. Organization of the staff

Staff Attributes

High performing IT staff have several general characteristics in common, including the following:

- *They execute well*. They deliver applications, infrastructure, and services that display a sound understanding of organization needs. These deliverables occur on time and on budget and earn high marks for professional comportment from others involved in the project.
- *They are good consultants*. They advise organizational members on the best approach to the application of IT given the organizational problem or opportunity. They advise when IT may be inappropriate or the least important component of the solution. This advice ranges from help desk support to systems analyses to new technology recommendations to advice on the suitability of IT in furthering an aspect of the organizational strategy.
- *They provide world-class support*. Information systems require daily care and feeding and problem identification and correction. This support needs to be exceptionally efficient and effective.
- *They stay current with their expertise*, keeping up-to-date on new techniques and technologies that improve the ability of the organization to apply IT effectively.

A wide variety of techniques can assist IT management in their efforts to improve staff attributes. These techniques include staff's ability to manage projects and an organization's ability to ensure staff are current in their expertise. For example, education programs on new technologies and enrolling staff in project management certification classes improve staff attributes.

Staff Attribute Strategy Examples

We shall look at two major strategic issues regarding staff attributes, attraction and retention of staff and outsourcing.

Attraction and Retention of Staff If the organization has high performing staff it would be well served to hold on to those staff. The market for talented and experienced IT staff will be competitive for some time (National Research

Council, 2001), and the infusion of Medicare and Medicaid meaningful use incentives will increase demand for staff.

Recruitment and retention strategies involve making choices about the work factors and management practices that will be changed and how they will be changed to improve the ability to recruit and retain staff. For example, should the focus be on salaries or on career development or on physical surroundings or on some combination of these factors?

For example, Partners IT managers were asked to identify the factors that make an organization a great place to work, and then rated Partners IT against those factors. The following factors were identified by the managers:

- Salary and benefits
- The physical quality of the work setting (for example, well-maintained surroundings)
- The caliber of IT management
- The amount of interesting work
- The importance of the mission of the organization
- Opportunities for career growth
- The adequacy of communication about topics ranging from strategy to project status
- The reputation of the overall organization and IT

The results of the managers' ratings of Partners IT against these factors are presented in Table 3.1. On the basis of these scores, Partners IT leaders decided to focus on the following improvements:

- Establishing more thorough and better-defined career paths and development programs for all staff
- Improving training opportunities, ranging from brown bag lunches with invited speakers to technical training to supervisory training to leadership training
- Reviewing work environment factors such as parking, free amenities such as soda, and office furniture

Table 3.1 Partners IS Staff Scores of Work Environment

	A	*B*	*C*	*D*	*F*
Compensation and benefits	1	14	12	3	0
Work environment	4	17	4	3	2
Good management	6	13	8	3	0
Interesting work	12	2	0	0	0
Mission	17	12	1	0	0
Career growth	4	19	5	2	0
Communication	0	8	15	2	5
Status of organization	17	10	3	0	0
TOTAL	61	95	48	13	7

- Improving communication through mechanisms such as a monthly e-mail from the CIO, videotaping staff meetings for access through streaming media, and regular breakfasts hosted by the CIO and deputy CIO

These steps are important. Fundamentally, people like to work where the job is challenging and meaningful. They prefer places where they like their coworkers and respect their leaders. They stay in jobs longer when they are proud of the organization, its mission, and its successes.

Outsourcing A second strategic issue surrounds the ability of outsourcing or task sourcing to obtain staff with needed expertise and experience. Outsourcing can also be a strategy to address issues of core staff capabilities and competencies.

Experiences with full outsourcing have been mixed (Strassmann, 1997), with a significant number failing to deliver expected cost reductions and service improvements. Partial outsourcing or task sourcing of such things as deployment of workstations or security intrusion detection appears to be more effective. These partial outsourcing arrangements enable organizations to obtain expertise and competencies that may not be viewed as core organizational competencies (although necessary competencies), address temporary

staff needs, or obtain staff that the organization cannot afford or is unable to hire. Examples of such outsourcing practices include selective rather than total outsourcing, sourcing decisions jointly made by IT managers and senior leaders, and inviting internal IT bids for the "sourcing business."

Core Capabilities and Competencies

IT staff who execute well and provide excellent consulting and other support are very important. However, organizations should identify a small number of areas that constitute core IT capabilities and competencies. These are areas where getting an *A-plus* matters. The strategic question involves the definition of these core capabilities and the development of plans to establish A-plus competencies.

For example, Partners HealthCare System defined three areas of core capabilities: base support and services, care improvement, and technical infrastructure.

Base Support and Services This category of core capabilities included three subcategories:

- Operational management and support of a high performance technical infrastructure
- Frontline support (for example, device problem resolution)
- Project management skills

These capabilities are probably important in all IT organizations. Activities to strengthen staff proficiency include training, definition, and monitoring of key metrics of service performance, creation of a project management office, and continuous investment in technologies that provide the necessary management tools (for example, network diagnostic software).

Care Improvement Central to the Partners agenda was the application of IT to improve the process of care. One consequence was to establish, as a core IT capability, the set of skills and people necessary to apply IT innovatively to medical care improvement. An applied medical informatics function was established to oversee a research and development agenda. (This function was discussed earlier in this chapter as an application system strategy.) Staff

skilled in clinical information systems application development were hired. A group of experienced clinical information system implementers was established. An IT unit of health services researchers was formed to analyze deficiencies in care processes, identify IT solutions that would reduce or eliminate these deficiencies, and assess the impact of clinical information systems on care improvement. Organizational units that possessed unique technical and clinical knowledge in radiology imaging systems and telemedicine were also created.

Technical Infrastructure Partners recognized the critical role played by having a properly conceived, executed, and supported technical architecture. Hence, infrastructure architecture and design continued to serve as a core competency. The technology strategy function discussed earlier in this chapter was created. Significant attention was paid to ensuring that extremely talented architectural and engineering talent was hired along with staff with terrific support and management skills.

IT Organization

There are three aspects of the IT organization for which strategies must be developed:

1. The definition and formation of departments or major functions
2. The form of the IT structure (for example, matrixed or flat)
3. Attributes of the IT organization as a whole (for example, agility)

Departments and Functions There are multiple considerations in defining the departments or major functions within an IT organization. Example departments include financial application implementation and support, telecommunications, telemedicine, and decision support. One of the primary strategic considerations is the *organizing unit or concept.* One can organize around any of the following:

- Sites or members of the health system (for example, dedicated IT staff to support each member of the health system with a site CIO)
- Infrastructure and platform support (for example, a unit of staff responsible for implementing and supporting the health system network or a specific platform, such as Unix machines)

- Applications or application suites (for example, financial systems or patient care systems)
- Processes (for example, a unit of IT staff responsible for systems support for all outpatient scheduling and registration activities across the health system)
- Classes of care (for example, inpatient, subacute, and primary care)
- IT research and development (for example, the investigation of new technologies)

IT Organization Structure The strategic discussion surrounds the selection of organizational form (centered on organizational structure), the reasons for selecting it, and methods of ensuring the form mirrors the organization's overall form. The conclusions about form often *fall out* of the discussions about the organization of the IT units.

Attributes of the IT Organization IT organizations, like people, have characters or attributes. They can be agile or ossified. They can be risk-tolerant or risk-averse. These characteristics can be identified, and strategies to achieve desired characteristics can be defined and implemented. Although organizations can have any number of characteristics, we will briefly discuss two, agility and innovativeness, which are illustrative of any organizational characteristic and are generally viewed as desirable.

An *agile* organization would probably possess many of the following attributes:

- The ability to form teams quickly. This implies some level of *slack* in resources and the ability to *halt* initiatives currently in progress as members of that initiative are included in the new team.
- Appropriate *chunking* of initiatives such that there are multiple points along the initiative when the project could be stopped and still deliver value in its stopped state. For example, the rollout of an EHR, which may call for ten clinics per year, could be stopped temporarily at four and still deliver value to those four clinics.
- Decision-making forums, such as IT steering committees, that are able to make decisions and obtain resources quickly.

An organization that emphasizes agility will also attempt to create agile platforms; for example, it will select and implement applications that have potent tools to enhance the applications rapidly. It would also try to create loosely coupled architectures that provide efficient and standard interfaces between applications and enable applications to be replaced without causing significant changes in other applications.

An innovative organization could have characteristics such as these:

- Reward systems that encourage new ideas and successful implementation of innovative technologies and applications
- Punishment systems that are loath to *punish* those involved in experiments that failed
- Small grants that can be obtained outside of the normal budget process to fund the pursuit of interesting ideas
- Dedicated research and development groups within IT

Our discussion of organizational characteristics has not been all-inclusive; for example, we have not discussed a service-oriented IT organization. Moreover, ample literature exists on the topic of molding and creating organizational cultures that have desired characteristics.

Health care organizations and IT leaders should recognize that IT organizational attributes and cultures are created, intentionally or not, through the combined acts, speech, and behavior of its members. IT leaders mold culture every time they speak or don't speak, act or don't act, reward or punish, and hire or fail to hire.

IT organizations will struggle if they attempt to create a culture or character that is significantly different from that of the rest of the organization, particularly if members of IT have to interact with other members of the organization on any routine basis. The two different cultures are at risk of rejecting each other, often for reasons no more solid than "they [staff] are different."

Strategies should identify and define important organizational attributes and carry out management initiatives deemed necessary to establish those attributes. Strategizers should recognize that attributes change takes time and can be very difficult.

Observations on the Staff Component of the IT Asset

All elements of the IT asset are important. The failure or suboptimal condition of any element impairs the ability of IT to advance the organization. Each element needs strategic discussions and strategies directed toward improving it. Nonetheless, of all components of the assets, staff is the most important. Staff can create or alter all the other components, and the quality of the resulting creation depends heavily on the quality of the staff. The quality of the staff is not simply the quality of the IT talent (as good as it might be). The staff must be organized well, have A-plus competencies, and have all the desired attributes.

THE CHIEF INFORMATION OFFICER

The role of the Chief Information Officer (CIO), and the need for one, has been much discussed in the IT and management literature and at conferences over the past three decades. The CIO is regarded as the executive who would successfully lead the organization in its efforts to apply information technology to advance its strategies. The CIO can be viewed as a critical component of the IT asset.

In health care, surveys, such as those conducted by the College of Healthcare Information Management Executives (Glaser and Kirby, 2009), have chronicled the evolution of the health care CIO. This evolution has included debates on CIO reporting relationship, salaries, titles, pedigrees (from outside health care or not), and the role of the CIO in organizational strategic planning.

A good CIO can be a significant asset to an organization. The CIO can:

- Be a major contributor to organizational strategy development and apply business thinking and strategy formation skills that extend beyond his or her IT responsibilities.
- Help the organization understand the potential of IT to make real and significant contributions to organizational plans, activities, and operations.
- Be a leader, motivator, recruiter, and retainer of superior IT talent.

- Ensure that the IT asset is robust, effective, efficient, and sustained.
- Ensure that the IT organization runs effectively and efficiently.

Earl and Feeny (1995) conducted a study of CIOs who "added value" to their respective organizations. They found that the value-adding CIOs exhibited the following behaviors:

- Obsessively and continuously focus on business imperatives so that they focus the IT direction correctly.
- Have delivery track records that cause IT performance problems to drop off of the management agenda.
- Interpret, for the rest of the leadership, the meaning and nature of the IT success stories of other organizations.
- Establish and maintain good working relationships with members of the organization's leadership.
- Establish and communicate the IT performance record.
- Concentrate the IT development efforts on the areas of the organization where the most leverage is to be gained.
- Work with the organization's leadership to develop a shared vision of the role and contribution of IT.
- Make important general contributions to business thinking and operations.

Earl and Feeny (1995) also found that the value-adding CIO, as a person, has integrity, is goal-directed, is experienced with IT, and is a good consultant and communicator. Organizations that have such a CIO tend to describe IT as critical to the organization, find that IT thinking is embedded in business thinking, note that IT initiatives are well focused, and speak highly of IT performance.

Organizational excellence in IT doesn't just happen. It is managed and led. If the organization decides that the effective application of IT is a major element of its strategies and plans, it will need a very good CIO. Failure to have such talent will severely hinder the organization's aspirations.

OBSERVATIONS ON THE IT ASSET

IT strategic plans invariably center on the applications that need to be implemented to further organizational goals. Although that focus is not inappropriate, these plans often give insufficient attention to describing the activities and resources needed to advance the non-application portion of the asset. (Moreover, the application portion of the plan is often an inventory of systems to be implemented with little analyses of fundamental characteristics of the application asset.)

On the one hand, one should not conclude that a solid infrastructure, terrific staff, well-crafted infrastructure, and high-quality data are a substitute for the need to deliver applications. On the other hand, it is difficult to deliver applications properly and consistently if the asset is in poor shape. In an analogous fashion, one may be able to force one's dreadfully out-of-shape body to hike twenty miles, but one might not be able to hike twenty miles day after day until the body's fitness is improved. Money invested in enhancing the overall asset (which is analogous to becoming more physically fit in this example) can deliver more of a return than money invested in an application (which is analogous to a twenty-mile hike with an out-of-shape body).

IT plans need to devote serious attention to the steps that will be taken to improve infrastructure agility, improve staff skills, and enhance data quality. These plans require serious strategic thinking. Ill-conceived analyses or half-baked strategies surrounding plans for data or technical architecture can severely impede an organization's progress.

In addition, as was seen in the BI, knowledge management, and in other examples, strategies for one type of asset invariably require companion strategies in another asset. For example, strategies for the data asset (BI) also required changes in the staff asset and in the technical infrastructure asset.

Several studies have observed the strong, individual components of an IT asset and also the strong, collective components of an IT asset. For example, Feld and Stoddard (2004) identified three principles for effective IT investments and management:

1. *A long term IT renewal plan linked to corporate strategy*. Organization's need IT plans that are focused on achieving the overall organization's strategy and goals. The organization must develop this

plan and remain focused on its execution, often over the course of many years.

2. *A simplified, unifying corporate technology platform.* This IT platform must be well architected and must be defined and developed from the perspective of the overall organization rather than from the accumulation of perspectives from multiple departments and functions.
3. *A highly functional, performance-oriented IT organization.* The IT organization must be skilled, experienced, organized, goal-directed, and responsive; it must also continuously work on establishing great working relationships with the rest of the organization.

Feld and Stoddard also noted that the responsibility for developing and implementing these principles lies with the organization's senior leadership.

SUMMARY

In Chapter Two we discussed the process of aligning organizational strategies with IT initiatives. In this chapter, we were concerned with the IT asset. The asset is composed of applications, technical architecture, data, and IT staff. The IT asset is put in use to deliver the needed support for the organization's strategy.

The IT strategy discussion must include a review of the asset and determine if the asset's health, characteristics, and directions are sufficient. An overall strategy can point to changes needed in each asset component and the need to integrate different asset components. Each element of the asset is unique, and the discussions surrounding the element will center on different considerations.

KEY CONCEPTS

Application system characteristics

Chief information officer

Data characteristics

Electronic Data Interchange

Infrastructure

IT staff strategic components

Technical architecture capabilities

Technical architecture characteristics

DISCUSSION QUESTIONS

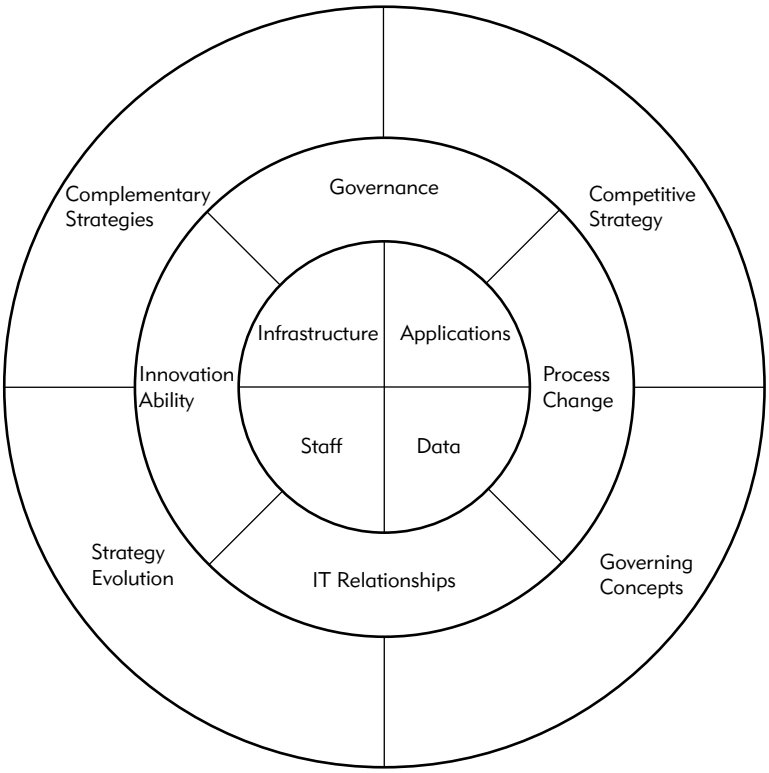
1. Assume a large hospital has a strategic goal of improving the performance of its revenue cycle. What are some of the IT asset strategies that might result?
2. Assume an integrated health system wanted to improve the efficiency of its IT asset. What strategies might it undertake?
3. How might the CIO role in an organization that viewed IT as a necessary but undesirable expense be different from the CIO role in an organization that wanted to use IT to transform care?

4

Information Technology-Centric Organizational Capabilities and Characteristics

The scope of IT Strategy, introduced in Chapter One, has three fundamental components that must be considered by organizations when applying strategic thinking (see Figure 4.1). In Chapter Three we discussed the first component or inner circle; the Information Technology asset (IT asset). For the organization to achieve effective leverage of IT it must develop IT asset strategies. In addition to the IT asset, organizations should examine organizational factors that have been shown to have a significant bearing on IT effectiveness. These factors, making up the second component or middle circle of IT-centric organizational capabilities and characteristics, include IT governance, IT relationships, innovation ability, and change management. In this chapter we discuss two of these factors, *managing process change* and *IT governance.* We then review the results of a series of studies of organizations that applied and used IT effectively. This chapter notes that a strong IT asset is insufficient. An organization must also excel in areas such as change management if it is to achieve desired gains from IT investments.

Figure 4.1 IT Strategy Scope



Inner circle: The IT asset

Middle circle: IT-centric characteristics and capabilities

Outer circle: IT strategy considerations and conclusions

MANAGING CHANGE

A majority of IT initiatives involve or require change in organizational processes and structures or in the roles of individuals or services provided by the organization. IT-enabled or IT-driven organizational change has several possible origins:

- The new IT system has capabilities different from those of the previous system, and so the workflow that surrounds the system has to change and the tasks staff perform have to change. For example, if a new electronic health record (EHR) automatically generates letters

for patients with normal test results, then the individuals who used to generate these letters will no longer have to do this task.

- The discussion surrounding the desired capabilities of a new application can lead to a reassessment of current processes, workflow, and distribution of tasks across staff and a decision to make changes that extend well beyond the computer system. For example, the analysis surrounding a new patient accounting system might highlight problems that occur during registration and scheduling (such as failure to check insurance coverage during appointment check-in) that hinder the optimal performance of patient accounting. In this way a new system becomes a catalyst for a comprehensive set of changes.
- The health care organization's strategy may call for significant changes in the way the organization operates and delivers care. For example, the organization may decide to move aggressively to protocol-driven care. This transformation has extensive ramifications for processes, roles, and workflow and for the design of applications. New IT systems will be critical contributors to the changes needed, but they are not the epicenter of the change discussion.

Change management is an essential skill for the leaders of health care organizations. Although the need for this skill is not confined to situations that involve implementation of major applications, change management is a facet of virtually all such implementations.

The management strategies required to manage change depend on the type of change. As one moves from modest to transformative, the magnitude and risk of the change increases enormously, as does the uncertainty about the form and success of the outcome.

Managing significant change has several necessary aspects, including the following (Keen, 1997):

- Leadership
- Language and vision
- Connection and trust
- Incentives
- Planning, implementing, and iterating

Leadership

Change must be led. Leadership, often in the form of a committee of leaders, must take responsibility for the following change-management tasks:

- Define the nature of the change.
- Communicate the rationale and approach to the change.
- Identify, procure, and deploy necessary resources.
- Resolve issues, and alter direction as needed.
- Monitor the progress of the change initiative.

This leadership committee needs to be chaired by an appropriate senior leader. If the change affects the entire organization, the CEO should chair the committee. If the change is focused on a specific area, the most senior leader who oversees that area should chair the committee.

Language and Vision

The staff who are experiencing the change must understand the nature of the change. They must know what the world will look like (to the degree that this is clear) when the change has been completed, how their roles and work life will be different, and why making this change is important. The absence of this vision or a failure to communicate the importance of the vision elevates the risk that staff will resist the change and through subtle and not-so-subtle means cause the change to grind to a halt. Change is hard for people. They must understand the nature of the change and why they should go through with what they will experience as a difficult transition.

Leaders might describe the desired outcome of efforts to improve the outpatient service experience (the vision) in this way:

- Patients should be able to get an appointment at a time that is most convenient for them.
- Patients should not have to wait longer than ten minutes in the reception area before a provider can see them.
- Our providers should communicate clearly with patients about their disease and the treatment that they will provide.

- Our providers should not have to spend unnecessary time and effort with administrative and insurance-related tasks that detract from patient care.

These examples illustrate a thoughtful use of language. They first and foremost focus on patients. But the organization also wants to improve the lives of its providers. The examples use the word *should* rather than the word *must* because it is thought staff won't believe the organization can pull off 100 percent achievement of these goals, and leaders don't want to establish goals that can be seen as unrealistic. The examples also use the word *we* rather than words like *you*. *We* means this vision will be achieved through a team effort and that those hearing this message will have help from leadership.

Connection and Trust

Achieving connection means that leadership takes every opportunity to present the vision throughout the organization. Leaders may use department head meetings, medical staff forums, one-on-one conversations in the hallway, internal publications, and e-mail to communicate the vision and to keep communicating the vision. Even when leaders start to feel ill because they have communicated the vision one thousand times, they have to communicate it another one thousand times. Much of this communication has to be done in person, where others can see the leadership; it is not effective for leaders to hide behind an e-mail. The communication must invite feedback, criticism, and challenges.

Members of the organization must trust the integrity, intelligence, compassion, and skill of the leadership. Trust is earned or lost by everything leaders do or don't do. Members must also trust that leaders have thoughtfully come to the conclusion that the difficult change has excellent reasons behind it and represents the best option for the organization. Organizational members are willing to rise to a challenge, often to heroic levels, if they trust their leadership. Trust requires that leaders act in the best interests of the staff and the organization and that leaders listen to staff and respond to the organization's concerns.

Incentives

Organizational members must be motivated to support significant change. At times, excitement with the vision will be sufficient incentive. Alternatively, fear of what will happen if the organization fails to move toward the vision may serve as an incentive. Although important, neither fear nor rapture is necessarily sufficient.

If organizational members will lose their jobs or have their roles changed significantly, education that prepares them for new roles and for new jobs must be offered. Bonuses may be offered to key individuals, awarded according to the success of the change and for each person's contribution to the change. At times, frankly, support is obtained through old-fashioned horse-trading; if others will support the change, you will deliver something that is of interest to them (for example, space, extra staff, or a promotion). Incentives may also take the form of awards (for example, plaques and dinners for two) to staff who go above and beyond the call of duty during the change effort.

Planning, Implementing, and Iterating

Change must be planned. These plans describe the tasks and task sequences necessary to effect the change. Tasks can range from redesigning forms to managing the staged implementation of application systems to retraining staff. Tasks must be allotted resources, and staff who are accountable for task performance must be designated.

Implementation of the plan is obviously necessary. Because few organizational changes of any magnitude will be fully understood at the outset, problems will be encountered during implementation. For example, the new forms may fail to capture some necessary data. It may appear that the estimate of the time needed to register a patient is wrong, and long lines may be forming at the registration desk. It may turn out that the plan forgot to identify how certain information would flow from one department to another.

These problems are in addition to the problems that occur, for example, when task timetables slip and dependent tasks fall idle or are in trouble. If implementation of the application were to be delayed and so would not be ready when staff move to a new building, we would wonder how best to

proceed. Iteration and adjustment will be necessary as the organization learns about glitches with new processes and workflows.

Summary of Managing Change

For an organization to be effective in leveraging IT to further its goals, leaders must be effective at managing change (Wager, Lee, and Glaser, 2009). This is particularly true when the IT agenda is ambitious, such as when implementing a comprehensive EHR in an effort to materially transform care processes.

Effective change management requires not only that the formal design of the organization (business processes, roles, and incentives) be addressed but also the political (power bases) and cultural (shared values, beliefs, and traditions) aspects of the organization. These three areas (formal design, political, and cultural) must change in concert for the IT-enabled change to be effective (Woerner and Ross, 2007).

GOVERNANCE

Governance refers to the principles, processes, and organization that govern IT resources (Drazen and Staisor, 1995). Strategies regarding governance must address several questions, including the following:

- Who sets priorities for IT, and how are those priorities set?
- Who is responsible for implementing information systems plans, and what principles will guide the implementation process?
- What organizational structures are needed to support the linkage between IT and the rest of the organization?
- How are IT responsibilities distributed between IT and the rest of the organization and between central and *local* IT groups?
- How is the IT budget developed?
- What principles will govern the IT asset?

At its core, governance involves determining the distribution of the responsibility for making decisions, the scope of the decisions that can be

made by different organizational functions, and the processes to be used for making decisions. Developing answers to the questions of governance can be a complex exercise.

Governance Characteristics

Well-developed governance mechanisms have several distinct characteristics:

- *They are perceived as objective and fair.* No governance mechanisms are free of politics, and some decisions will be made as part of *side deals.* Nonetheless, governance should be viewed by organizational participants as fair, objective, appropriately public in its deliberations, and possessed of integrity. The ability of governance to govern depends on the willingness of organizational participants to be governed.
- *They are efficient and timely*. Governance mechanisms should arrive at decisions quickly, and the governance process should be efficient; bureaucracy should be eliminated as much as possible.
- *They evolve appropriately*. Governance will change as the organization and its environment changes. The advent of the World Wide Web a decade ago had an impact on IT governance leading to Internet strategy committees; these committees rarely exist today. The growing development of health information exchanges will require new governance mechanisms to respond to interorganizational IT issues.

Linkage of Governance to Organizational Strategies

Governance should be heavily influenced by basic strategic objectives; for example, a desire to have care integrated across a continuum has ramifications for the design of governance. Some examples of governance derived from a strategic objective are presented in the sections that follow.

Governance to support the integration of a health system might adopt the following objectives:

- Priorities should be developed by a central health system IT committee to help ensure the perspective of overall integration; initiatives that support integration should be given a higher priority than those that do not.

- IT budgets that are developed locally are subject to central approval.
- The IT plan must specify the means by which an integrated infrastructure and application suites will be achieved and the boundaries of that plan. For example, local organizations are free to select from a set of patient care system options, but whatever the selection, the patient care system must interface with the health system's clinical data repository.
- A centralized IT group must exist, and it has authority over local groups.
- Members of the health system are constrained in their selection of applications to support ancillary departments to those that are on an *approved* list.
- Certain pieces of data, such as payer class or patient problems, and certain identifiers, such as patient identifier and provider identifier, have to use a common dictionary or standard.
- All health system organizations must use a common security infrastructure.

Governance to oversee care transformation across a multi-hospital health system might do the following:

- Form an executive committee led by the CEO and a senior clinician to oversee the transformation process. Subcommittees addressing care guideline development, clinician incentives, and implementation of the EHR should report to this committee.
- Ask the executive committee to provide updates to a quality committee made up of board members.
- Establish an EHR committee led by the CIO and a senior clinician who might have work groups devoted to tasks such as application design, training, support models, and implementation sequence. Each hospital might have parallel work groups to address their unique issues and challenges.

- Within this framework, provide the executive committee with the authority to approve changes in project scope and budget and to resolve problems; provide hospital work groups with the authority to design local EHR customizations within guidance established by the electronic health record committee

Developing governance structures and approaches requires strategies that are driven by the need to achieve certain organizational objectives. Governance should not be developed purely for the purpose of performing some normative task; for example, all organizations have IT steering committees composed of a broad representation of senior leaders, and therefore so should we. An organizational objective of being locally responsive might mean that no central steering committee would exist or that its powers would be limited. Moreover, although one organization can learn from the governance structures established by other organizations, it must structure itself to reflect its culture, competencies, and needs.

Examples of Governance Strategies

Several examples of governance strategies are discussed in the following sections. These include strategies on the split between central and local responsibilities as it applied to IT, the presence of an IT committee to offer recommendations to the board, and changes to the IT budget.

Central and Local Responsibilities Partners HealthCare undertook an examination of its IT governance structure shortly after its formation. A critical question (typically faced by any organization with a corporate function and local business units, such as hospitals) was, "What responsibilities should be given to corporate IT, and what responsibilities should be given to the IT groups supporting local business units?"

The answer to this question must account for trade-offs between ensuring business units have the flexibility to respond to local conditions and meet local operating budget goals and ensuring the overall ability to integrate the system and achieve system-wide efficiencies. The answer must recognize that the needs of community hospitals are different from those of academic medical centers. The answer must also understand that this is not purely a

question of reporting relationships; in this case the local IT groups report to the central IT group.

The following operating principles for information systems were developed. The corporate IT function would have the following roles:

- Ensure functioning of a common core of applications and infrastructure.
- Determine Partners-wide integration agenda.
- Fund core operations function, Partners-wide IT projects, and IT research and development.
- Support and execute local integration initiatives.
- Set minimum standards.
- Deliver applications and new solutions.
- Recommend Partners-wide IT capital budget.
- Undertake research and development with a focused agenda of *breakthrough* high-value approaches and techniques.

The business unit IT functions would have the following roles:

- Determine local *islands* of integration needs, priorities, pace, business case, and project funding.
- Determine local applications needs, priorities, pace, business case, project funding, and implementation needs.

In essence, the IT function was very centralized. Business units would establish local plans and priorities (and fund them). The corporate function would execute those plans within the context of standards and an overall integration agenda.

IT Committee of the Board The Partners Board recognized the critical contribution of IT to Partners strategies and ongoing operations. Realizing that the normal board agenda might not always allow sufficient time for discussion of important IT issues and that not all board members had extensive experience in IT, the board formed a committee of board members who were seasoned IT professionals (for example, IT academics and CEOs from the IT industry).

This committee would inform the board of its recommendations and assessments. The board improved its ability to govern IT by ensuring that thorough discussions of IT issues and strategies occurred at the trustee level.

The charter for this committee encompassed four responsibilities:

1. Review and critique IT application, technical, and organization strategies.
2. Review and critique overall IT tactical plans and budgets.
3. Discuss and provide advice on major IT issues and challenges.
4. Explore opportunities to leverage vendor partnerships.

Committee meeting agenda items have included the following:

- Assessments of the value of clinical information systems
- Long-term plans for the organization's financial systems
- IT staff recruitment and retention issues
- The annual IT budget

IT Budget Development In 1999 Partners made a change to the IT budget process. That change led to users (rather than IT staff) defending requests for new applications. The change also eliminated the separate IT budget discussion and merged that discussion into the overall organizational budget discussion.

This change was designed to achieve several objectives. The first objective was to shift the responsibility for defending and obtaining funds for new applications from IT to user management. This required members of the user management team to defend the expense and commit to the value in a room full of their peers. It also required members of the user management team to believe in the need for the system so much that they might be willing to forsake other budget needs in their areas. Second, merging the IT budget into the overall budget discussion meant that the IT budget was no longer *protected.* IT requests had to compete with requests for new equipment or additional nursing staff. This meant the organization's leadership had to determine the value of an IT investment relative to other investments, which gave leadership the latitude to increase or not increase the IT budget in any year given the needs of the entire organization.

Observations on Governance

The examples of governance we have just discussed reflect management actions that clarify or change IT decision rights. No portfolio of decision rights is permanent; an arrangement of rights solves some problems but runs the risk of creating other problems. Governance that emphasizes efficiency may achieve efficiency, but it may hinder innovation. Governance that emphasizes speed of decision making may sacrifice political support for the decision because the governance was less inclusive.

Decision rights can be distributed across multiple groups and functions with no one group making all IT-related decisions. Weill and Ross (2004) identify five major categories of decisions (see Table 4.1). These categories are as follows:

1. IT principles that are high-level statements of how IT should be used (for example, to improve patient care or to be a low-cost provider)
2. IT architecture is part of the IT Asset discussion reviewed in Chapter Three
3. IT infrastructure that is the specific technologies chosen to implement IT applications and base technologies

Table 4.1 Distribution of IT Decision Rights

Types of Decisions	*Decision Responsibility*
IT principles—high-level statements about how IT is used	Executive committee
IT architecture—set of technical choices to guide the organization	IT organization
IT infrastructure strategies—technical infrastructure needed to deliver reliable, secure, and efficient services	IT organization
Business applications—process of identifying needed applications	Executive committee
IT investment and prioritization—mechanism for making decisions about project approvals and budgets	Operations management

4. Business applications that refer to how decisions are made about application priorities
5. IT investments and priorities that refer to decisions about project approvals and budgets

Table 4.1 illustrates that members of different groups can be assigned responsibility for these categories.

Moreover there is no one way to design IT governance (Brown and Grant, 2005). Sambamurthy and Zmud (1999) note that three factors influence IT governance approaches:

1. Overall governance structure and style
2. Economies of scope, such as diversity of products and markets and whether growth has happened organically or through mergers
3. Absorptive capacities, which are reflected in the level of IT knowledge and in the sophistication of the organization's leadership and management

Ross and Weill (2002) argue that regardless of the form of governance, six IT decisions should be made by management and should not be left in the full control of the IT organization:

1. How much should we spend on IT?
2. Which business processes should receive our IT dollars?
3. Which IT capabilities need to be company-wide?
4. How good do our IT services really need to be?
5. What security and privacy risks will we accept?
6. Whom do we blame if an IT initiative fails (that is, to what degree do we hold the users accountable for IT projects)?

These decisions are management decisions and not strictly decisions that belong to the IT organization. Management abdication of its decision responsibilities places the organization at risk. As well-meaning and competent as IT department staff might be, their decisions might not be fully aligned with the organization's direction.

Finally, good IT governance matters. Weill and Ross (2004) conducted research (comparing organizations with similar strategies) that showed that organizations with superior IT governance mechanisms had more than 20 percent higher profitability than those organizations with poor mechanisms.

STUDIES OF FACTORS CONTRIBUTING TO EFFECTIVE IT USE

Several studies have examined organizations that have been particularly effective in the use of IT. Determining effectiveness is difficult, and the studies have defined it differently. Definitions have included organizations that have developed information systems that defined an industry (for example, SABRE, the first airline reservation system); organizations that have the reputation of being effective over decades (such as Bank of America); and organizations that have had instances of exceptional IT innovation (such as the Federal Express packaging tracking system).

These studies have attempted to identify the factors or attributes of these organizations that have created the environment in which effectiveness occurred. In effect, the studies have sought to answer the question, "What organizational factors help certain organizations to develop remarkable IT prowess?"

If an organization understands these attributes and desires to be very effective in its use of IT, it is in a position to develop strategies to create or modify its attributes. For example, one attribute is the strength of the working relationships between the IT function and the rest of the organization. If that relationship is weak or dysfunctional, strategies and plans can be implemented to improve the relationship.

We shall review four of these studies.

Financial Executives Research Foundation

The Financial Executives Research Foundation sponsored a study, conducted by Sambamurthy and Zmud (1996), on factors that led to the development of visionary IT applications. *Visionary applications* help managers make decisions, introduce new products and services more quickly and frequently, improve customer relations, and enhance the manufacturing process. Visionary

IT applications seek to transform some of a firm's business processes in *frame breaking* ways: the reengineering of core processes dramatically or radically. These applications create a variety of benefits to businesses that not only affect their current operations but also provide opportunities for new markets, strategies, and relationships.

The study had findings in several areas: visionary applications, the justification process, facilitating investment in visionary IT applications, and the rationale for justifying visionary IT applications.

Visionary Applications Visionary applications focused on leveraging core business operations, enhancing decision making, improving customer service, and speeding up the ability to deliver new products and services. These applications were developed as *platforms* that enabled the business to handle multiple work processes. An example of such a platform in health care is the EHR.

The Justification Process Visionary projects required the participation of four key players. *Envisioners* conceptualized the initial ideas for a project. *Project champions* were instrumental in selling the envisioners' ideas and value to senior executives. *Executive sponsors* provided champions with seed funding and political support. *IT experts* supplied the necessary technical vision and expertise to ensure the idea would work.

Facilitating Investment in Visionary IT Applications Several factors facilitate investment in visionary applications:

- A climate must exist that enables employees to have the power (and the support) to undertake visionary applications that often carry significant personal and organizational risk.
- Mechanisms need to exist to invest continuously in IT technical infrastructures.
- Coordinating mechanisms must be established to bring together envisioners, project champions, executive sponsors, and IT experts.
- The role of the CIO, in addition to that of an envisioner and IT expert, was to ensure that the envisioners' proposal furthered the interests of the business, to serve as architect and advocate for the corporate IT technical infrastructure, and to serve as the architect of IT-related coordinating mechanisms.

Rationale for Justifying Visionary IT Applications Visionary IT applications were generally defended using two distinct strategies: their contribution to critical work processes or their support of a primary strategic driver. In addition to the discussion and analysis that would surround one of these two strategies, prototypes, best-practice visitations, and consultants would often be used to further organizational understanding of the proposed initiative.

Ross, Beath, and Goodhue

Ross, Beath, and Goodhue (1996) examined the factors that enable organizations to achieve long-term competitiveness in the application of IT. They identified the development and management of three key IT assets as critical to achieving a sustained IT-based competitive advantage: IT human resources asset, the technology asset, and the relationship asset.

Highly Competent IT Human Resources A well-developed IT human resource asset is one that consistently solves business problems and addresses business opportunities through information technology. This asset has three dimensions:

1. IT staff members had the technical skills needed to craft and support applications and infrastructures and to understand and appropriately apply new technologies.
2. IT staff members had superior working relationships with the end user community and were effective at furthering their own understanding of the business and its directions, cultures, work processes, and politics.
3. IT staff members were responsible (and knew they were responsible) for solving business problems. This orientation went beyond performing discreet tasks, and led IT staff to believe they *owned* (and had the power to carry out) the challenge of solving business problems.

The Technology Asset The technology asset consists of sharable technical platforms and databases. The technology asset had two distinguishing characteristics:

- A well-developed technology architecture that defined the rules for the distribution of hardware, software, and support
- Standards that limit the technologies that will be supported

Failure to create a robust architecture can result in applications that are difficult to change, poorly integrated, expensive to manage, and unable to accommodate organizational growth (Weill and Broadbent, 1998). These limitations hinder the ability of the organization to advance. IT resources, efforts, and capital can be consumed by the difficulty of managing the current base of infrastructure and applications, and relatively modest advances can be too draining.

The Relationship Asset When the relationship asset is strong, IT and the business unit management share the risk and responsibility for effective application of IT in the organization. A solid relationship asset is present when the business unit is accountable for all IT projects, top management leads the IT priority-setting process, and business unit and IT staff work collaboratively on projects.

The study noted the interrelationships between the assets. IT and user relationships are strengthened by the presence of a strong IT staff. A well-developed, agile infrastructure enables the IT staff to execute project delivery at high levels and be more effective at solving business problems.

McKenney, Copeland, and Mason

McKenney, Copeland, and Mason (1995) studied the factors that allowed managerial teams to create and implement innovative information systems. They were particularly interested in examples where the resulting information systems became the dominant design in a particular industry. They studied American Airlines, Bank of America, the United States Automobile Association, Baxter Travenol/American Hospital Association, and Frito-Lay. Their study came to interesting conclusions in several areas including quality of the management team, evolution, and capitalization of innovation.

Management Team All IT innovations were led proactively by a management team driven to change its processes with strategic use of information technology. The management team had to encompass three essential roles:

1. The CEO or other senior executive who was both a visionary and a good businessperson. This person had sufficient power and prestige to drive technological innovation.

2. The *technology maestro*, often the CIO, who had a remarkable combination of business acumen and technological competency. The CIO must deliver the system and recruit, energize, and lead a superb technical team.
3. The technical team who understood how to apply the technology in innovative ways and was capable of developing new business processes that leveraged the technology.

In addition to exceptional competency in each role, there was a rare chemistry between the players in the roles. A change in a role's incumbent often stalled the innovation. This suggests that a great CIO in one setting may not be a great CIO in another setting.

Evolution of the Innovation The innovative systems evolved over time and generally went through several phases:

1. A business crisis developed, such as Bank of America being overwhelmed by the volume of paper transactions, and a search began for an IT solution.
2. IT competency was built as research was conducted in search of potential IT solutions, particularly the application of new technology.
3. The IT solution was planned and developed.
4. IT was used to restructure the organization and processes and to lead changes in organizational strategies.
5. The strategy evolved, and the systems were refined. Competitors began to emulate the success.

In these phases, the capabilities of the technology heavily influenced and constrained the operational changes that were envisioned and implemented. This series of phases occurred over the course of five to seven years and reflected the magnitude of the organizational change and also the time required to experiment with, understand, and implement new information technology. This interval suggests that CIO (or CEO) average tenures of three years or less risk thwarting the organization's ability to make truly innovative IT-based transformations.

Capitalizing on IT Innovation A particular IT innovation was identified by the organization, early in the life of the technology, as being the breakthrough necessary to resolve the business crisis or challenge. In the cases studied, the breakthrough was the transistor, time-sharing, and cheap mass storage. Today the technology might be the semantic interoperability or mobile devices.

Weill and Broadbent

Weill and Broadbent (1998) studied firms that consistently achieve more business value for their information technology investment. Their study noted that these organizations were excellent or above average in five characteristics: greater top management commitment to information technology, less political turbulence, more satisfied users, integrated business information technology planning, and more IT experience.

Greater Top Management Commitment to Information Technology The leadership of the organization was committed to the strategic and effective application of IT. This commitment was widely known within the organization. Management participated actively in IT strategy discussions, thoughtfully assessed the business contribution of proposed IT investments, and provided seed funding to innovative and experimental IT projects.

Less Political Turbulence IT investments often serve to integrate processes and groups throughout the organization. Political conflict reduces the likelihood and success of interdisciplinary initiatives. IT investments can require that the proposals of one part of the organization be funded at the expense of other parts or other proposed non-IT initiatives. Political turbulence can reduce the likelihood that such *disproportionate* investments will occur.

More Satisfied Users If the organization's staff have had good experiences with IT projects, they are more likely to view IT as something that can help their endeavors (rather than as a burden).

Integrated Business Information Technology Planning Organizations that do a very good job at aligning the IT plans and strategies with the overall organizational plans and strategies will be more effective with IT than those that do not align well.

More Experience Organizations that are experienced in their use and application of the technology and have had success in those experiences will be more thoughtful and focused in their continued application of IT. They will have a better understanding of the technology's capabilities and limitations. Users and their IT colleagues will have a better understanding of their respective needs and roles and the most effective ways of working together on initiatives.

Summary of Studies

The four studies discussed in this chapter—The Financial Executives Research Foundation study; Ross, Beath, and Goodhue; McKenney, Copeland, and Mason; and Weill and Broadbent—suggest that organizations aspiring to effectiveness and innovation in their application of IT must take steps to ensure the core capacity of the organization, for IT effectiveness is developed such that high levels and sustained progress can be achieved. Development of this capacity is a different challenge than identifying specific opportunities to use IT in the course of improving core processes or of ensuring that the IT agenda is aligned with the organizational agenda. As an analogy, a runner's training, injury management, and diet are designed to ensure the core capacity to run a marathon. This capacity development, which is focused on the runner's overall fitness, is different from the discussion of the strategy of running a specific marathon, which must consider race-specific variables such as the nature of the course, the competing runners, and the weather.

Though reaching somewhat different conclusions (resulting to a degree from different study questions), the four studies reached consensus in the following areas: the value of leadership, the value of relationships, and the effects of political turbulence.

Individuals and Leadership Matter It is critical that the organization possess talented, skilled, and experienced individuals. These individuals will occupy a variety of roles, including CEO, CIO, IT staff, IT user, and middle manager. These individuals must be strong contributors. Although such an observation may seem trite, too often organizations, dazzled by the technology or the glorified experiences of others, embark on technology crusades and substantive investment in technology for which they have insufficient talent or leadership to successfully implement.

Leadership in these studies was essential. This leadership is needed on the part of organizational senior management (or executive sponsors), the CIO, and the project team. This leadership understood the vision, communicated the vision, was able to recruit and motivate a team, and had the staying power to see the innovation through several years of work and disappointments, setbacks, and political problems.

Relationships Are Crucial In addition to having strong individual players, the team must be strong. There are critical senior executive, IT executive, and project team roles that must be filled by highly competent individuals, and great chemistry must exist between the individuals in the distinct roles. Substituting team members, even involving a replacement by an equally strong individual, can diminish the team. This is true in IT innovation just as it is true in sports.

Political Turbulence Political turbulence diminishes the organization's ability to develop a healthy set of relationships among organizational players.

Technical Infrastructure Enables and Hinders Transformation New technologies can provide new opportunities for organizations to embark on major transformations of their activities. This implies that, although CIOs must have superior business and clinical understandings, they must also have a superior understanding of the technology. This should not imply that CIOs must be able to rewrite operating systems as well as the best system programmers, but it does mean they must have an excellent understanding of the maturity, capabilities, and possible evolutions of information technology. Several innovations occurred because the IT group was able to identify and adopt an emerging technology that could make a significant contribution to addressing a current organizational challenge.

The studies stress the importance of well-developed technical architecture. Great architecture matters. Possessing state-of-the-art technology can be far less important than relying upon a well-architected infrastructure.

The Organization Must Encourage Innovation The organization's (and the IT organization's) culture and leadership must encourage creativity and experimentation. This encouragement needs to be practical and goal-directed; there

must be a real business problem, crisis, or opportunity, and the project needs budgets, political protection, and deliverables.

Creating visionary applications or industry-dominant designs or an exceptional IT asset takes time and a lot of work. The organizations studied by McKenney, Copeland, and Mason often took five to seven years for the innovation to fully mature and for the organization to recast itself.

The applications and designs will proceed through phases that are as normative as the passage from infancy to adulthood. The creation of visionary and innovative applications or designs, like the maturation of a human being, will see some variation in the timing, depth, and success of moving through phases.

Evaluation of IT Opportunities Must Be Thoughtful The visionary and dominant-design IT innovations studied were analyzed and studied thoroughly. Nonetheless, the organizations engaged in these innovations understood that a large element of vision, management, instinct, and *feeling* guided the decision to initiate investment and continue investment. An organization that has had more experience with IT and more successful experiences will be more effective in the evaluation (and execution) of IT initiatives.

Processes, Data, and Differentiation Formed the Basis of the Innovation Innovations were directed to focus on those core elements that form the basis for achieving an IT-based advantage, which include significant leveraging of processes, expanding and capitalizing on the ability to gather critical data, and achieving a high level of organizational differentiation. Often an organization pursued all three core elements simultaneously. At times the organization evolved from one basis to another as the competition responded or as the organization recognized new leverage points.

Alignment Was Mature and Strong The alignment of IT activities and business challenges or opportunities was strong. It was also mature in the sense that this alignment depended on close working relationships rather than on methodologies.

The IT Asset Was Critical Strong IT staff, well-crafted architecture, and a superb CIO were critical attributes. There is substantial overlap between the factors identified in these studies and the components of the IT asset.

Observation on IT-Centric Characteristics and Capabilities

In his seminal book *Good to Great*, Collins (2001) identified companies that made and sustained a transition from being a good company to a great company. His research noted these companies had the following consistent orientations to IT:

- They avoided IT fads but were pioneers in the application of carefully selected technologies.
- They became pioneers when the technology showed great promise in leveraging that which they were good at doing (their core competency) and that which they were passionate about doing well.
- They used IT to accelerate their progress toward becoming a great company. That is, IT was implemented after the vision had been set and the organization had begun to move to that vision. IT was not used to create the vision and start the movement.
- They responded to technology change with great thoughtfulness and creativity, driven by a burning desire to turn unrealized potential into results. Mediocre companies often reacted to technology out of fear, adopting it because they were worried about being left behind.
- They achieved dramatically better results with IT than rival companies using the exact same technology.
- They rarely mentioned IT as being critical to their success.
- They *crawled, walked, and then ran* with new IT even when they were undergoing radical change.

These orientations parallel several points made in this and previous chapters. Great organizations understand how to manage change, are focused and thoughtful in their choice of new technologies, and had superior leadership.

SUMMARY

Chapter Two was concerned with strategy formulation. We discussed the process of aligning organizational strategies with IT initiatives. Chapter Three reviewed the IT asset and discussed strategies for strengthening that asset and ensuring that the asset was responsive to the organization's direction.

In Chapter Four we noted that if the IT asset is one critical component of strategy formulation, implementation, and execution, then IT-centric characteristics and capabilities are the other. Change management and governance are foundational, and several studies of IT effectiveness have identified additional IT-centric organizational attributes that have a significant influence on effectiveness in using IT to further organizational strategies and goals.

KEY CONCEPTS

Change management

Factors contributing to effective IT

IT governance

DISCUSSION QUESTIONS

1. Critique a change process you have experienced in your organization. Comment on strengths and weaknesses of the change process.
2. Describe the IT governance approach in your organization. What steps would you take to improve governance?
3. If an organization had a poor relationship between its IT department and the rest of the organization, what steps might it take to improve the relationship?
4. If an organization had a superb approach to ensuring the assessment of IT opportunities was thoughtful, what structures (for example, committees and processes) would you see?

5

Strategy Considerations and Conclusions

Chapter Two discussed the alignment of the organization's overall strategy with its IT strategy. Chapter Three focused on the IT asset and Chapter Four discussed important IT-centric organizational capabilities and characteristics.

In these chapters we reviewed lessons learned about the strategic application of IT across a range of industries and organizations, and we continue that learning in this chapter as we summarize important strategy considerations and conclusions that should be understood by organization leaders as they shape their IT strategy. This chapter will discuss the following considerations:

- Complementary strategies
- The realization of IT-enabled value
- Strategy evolution
- IT as a way to enhance competitive position
- Governing concepts

These considerations will reiterate and extend topics we discussed in Chapters One through Four.

COMPLEMENTARY STRATEGIES

Complementary strategies are organizational initiatives that do not involve the IT asset per se but are needed for the IT strategy to succeed.[1] In earlier chapters we discussed the need for the complementary strategies associated with managing organizational change. In this section we expand our discussion of complementary strategies.

Complementary strategies come in two basic forms. They can enable the organization to be broadly more effective in applying IT and in realizing its value across a wide range of initiatives, and they can be designed to improve the success of a specific initiative (Glaser, 2009).

Broad Leverage

There is no tidy categorization of broad leverage strategies. All of these strategies are intended to improve overall organizational IT competency. We discussed several key strategies in Chapter Four, which included improving governance, strengthening relationships between the IT department and the rest of the organization, and engaging in thoughtful innovation.

Other broad strategies can be defined. For example, organizations that expect to engage in significant levels of IT research and development can develop strategies to improve their ability to manage industry collaborations through establishment of business development capabilities, processes for managing intellectual property, and means to avoid conflicts of interest. Providers who anticipate the need to compete on the basis of the costs of care using IT may develop strategies that foster broad competency with process change techniques such as LEAN, which is a production practice that considers the expenditure of resources for any goal other than the creation of value to be wasteful.

Most of the time broad leverage strategies result from an understanding that a set of strategies points to the need to elevate some aspects of organizational competency. A strategy that calls for significant, multifaceted

investments in IT points to the potential need to improve IT governance to help with prioritization. A strategy that illustrates the need to improve the performance of core organizational processes points to the need for change management skill.

At times the broad leverage strategies result from an understanding of the nature of the IT industry and technology. For example, the broad adoption of personal, mobile devices might point to an organizational need to be better at protecting confidential information.

In this chapter we discuss a broad leverage strategy that results from the leadership observation that for most of the health care industry, the technology and applications being implemented today are available to all industry participants, including competitors. Any provider organization can acquire and implement systems from Eclipsys, Cerner, GE, Epic, or Siemens. Why would one provider believe its electronic health record (EHR) could provide an advantage if its competitor can buy the same system?

This insight might indicate that an advantage could be obtained if one or both of two things were to happen. First, one organization might do a more thoughtful and effective job than its competitors at understanding and then effecting changes in processes or data gathering associated with the system to be implemented. The application does not provide an advantage, but the way it is implemented does. We see the difference execution makes every day in each of our lives. The quality of execution makes the difference between a great restaurant and a mediocre one or between a terrific movie and a terrible one. In neither case is the idea (for example, "Let's make meals and sell them") or the fact that one responds to the idea (for example, "We've hired a cook and purchased silverware") the advantage. It is the manner of execution that distinguishes. To a degree this advantage is a result of process change prowess, but it can also result from process innovation.

Second, one organization might be consistently able to outrun the other. If an organization is able to develop the means to implement programs and processes faster or for less cost, it may be able to outrun its competition, even if its implementations, one-for-one, are of no higher quality than those of its competitors. Perhaps over a certain period of time one organization implements four applications, whereas the other implements three. Or perhaps for

a given amount of capital, one organization implements five applications, whereas the other implements three.

In these examples, the organization concludes it needs to strengthen its ability to improve and differentiate its processes from competitors and develop approaches to rapid (and inexpensive) implementation of application systems.

Initiative-Specific Strategies

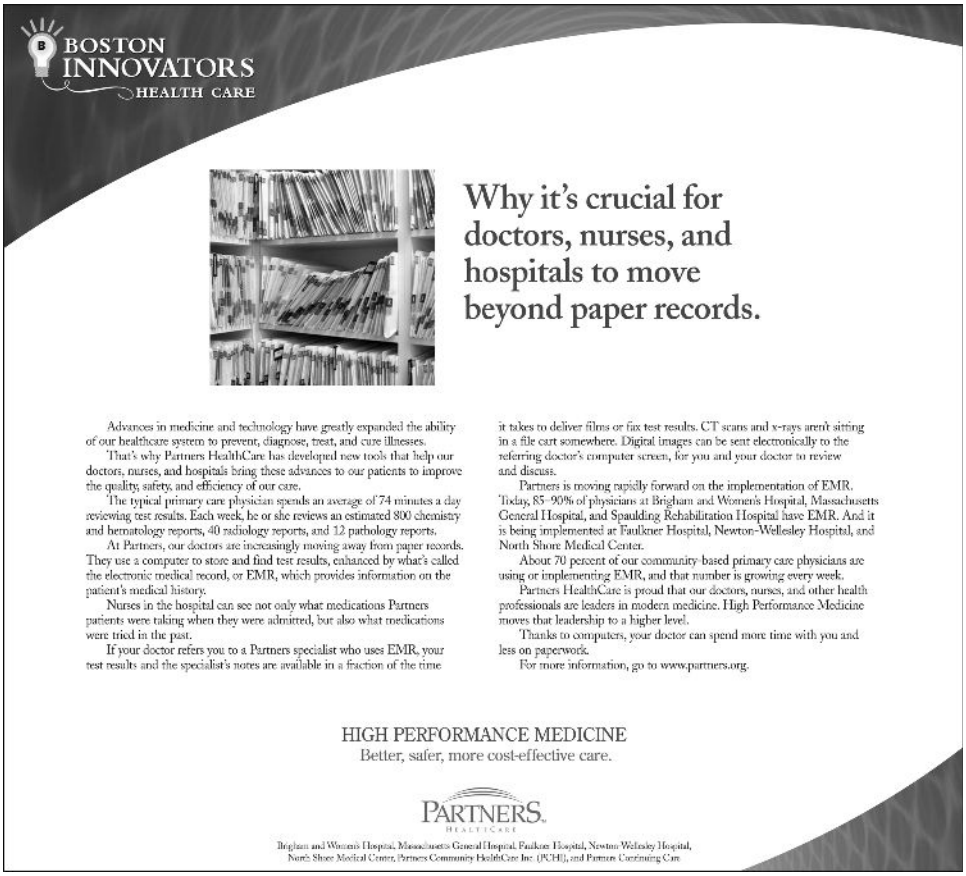
Initiative-specific strategies result from an examination of the factors, conditions, and relationships that should or must exist if a proposed IT initiative is to succeed. For example, a strategy of improving the quality of care through disease management will lead to IT asset initiatives and other complementary strategies, such as potentially increasing the number of primary care providers. A strategy of growing market share will call for IT responses and the development of joint clinical programs with affiliates.

Two examples from Partners HealthCare should help to illustrate initiative specific strategies.

In 2004 Partners decided to implement the EHRs across its network of community-based and academic medical center physicians. (This strategy is discussed in more detail in Chapter Six.) This application was seen as an essential contributor to organizational strategies to reduce care costs, improve care quality, and increase the safety of care. Motivating physicians to fully use the EHR (for example, motivating physicians to use ePrescribing rather than scripts) can be challenging. In addition, the costs of an EHR can cripple community physician interest.

Partners had pay-for-performance incentive arrangements with its regional health plans. As part of its contract negotiations it obtained a financial reward for physicians who used an EHR. (The government has pursued a similar path with its *meaningful use* incentives.) This reward would not fully cover the costs of an EHR, but it did significantly drop the cost hurdle. These arraignments were accompanied by a media campaign (for example, newspaper advertorials) to signal Partners EHR intentions to its patients and providers (see Figure 5.1). Eventually Partners informed its physicians they must use the EHR if they were to be included in its managed care contracts; the carrot had become a stick.

Figure 5.1 Partners EHR Advertorials



This set of strategies (advertorials, incentives, and mandates) was an essential initiative-specific complementary strategy to the organization's EHR efforts. The complementary strategy involved implementation of a diverse and evolving set of EHR adoption incentives.

In 1996 the Health Insurance Portability and Accountability Act (HIPAA) required the use of standard electronic exchange of health insurance transactions, such as eligibility determination, between providers and health plans. Partners determined this capability had no strategic value and, in fact, should be viewed as a commodity (Glaser, DeBor, and Stuntz, 2003).

In effect, electronic insurance transactions should be viewed as analogous to e-mail. Having e-mail does not distinguish one organization from another; one therefore wants the cheapest e-mail possible assuming some standard set of defined features and functions exists.

Moreover, Partners realized the value of an exchange increased significantly as the number of participants increased and that regional health plans and other providers faced similar exchange needs and might be interested in working together to create this exchange capability. The result was a regional consortium of providers and health plans, the New England HealthCare EDI Network (NEHEN), which pooled resources and created a shared health insurance transaction infrastructure. This pooling established a critical mass of exchange participants, and was able to achieve the exchange scale necessary to cover a majority of patients seen in Partners hospitals, clinics, and physician practices, which enabled the amortization of costs across as many participants as possible. The resulting infrastructure enabled HIPAA compliance and kept the insurance transaction costs well below commercial offerings.

The strategy of creating the NEHEN collaborative was an important complementary strategy to the organizations' needs to obtain this exchange capability.

Summary of Complementary Strategies

The development and execution of an effective IT strategy does require that the organization identify and prioritize application initiatives and establish an IT asset direction. However, it also requires that the organization examine and develop strategies for its IT broad and initiative-specific complementary strategies. Broad complementary strategies are developed through discussions about how to make the organization more effective in its IT efforts. Initiative-specific strategies arise from an assessment of initiative critical success factors and the determination of the best course of actions to tackle those factors.

THE REALIZATION OF IT-ENABLED VALUE

The reason organizations invest in IT is to achieve value.

This value is diverse. The outcomes can be tangible and intangible, and the value can be improved care delivery or positioning the organization

for the future. IT can support a strategic direction or the more *mundane* improvement of operations.

In previous chapters we discussed a wide range of considerations that must be understood if desired value is to be achieved. These considerations outlined the need for the organization to address a broad set of areas that includes the IT asset and organizational characteristics and capabilities.

We extend our discussion about achieving value in the following section.

IT Is a Tool

We must always remember that IT has no magic properties. In particular, the technology cannot overcome poor strategies, inadequate management, inept execution, or major organizational limitations. For example, a system that reduces the size of the nursing staff may not make the salary savings desired if the average number of nurses on an inpatient unit is too small; there will be too few nurses to lay any of them off.

Information systems are tools. If the objectives of the building are not well understood, its design is flawed, the carpenter is unskilled, or other tools are missing, the quality of the hammer and saw is irrelevant. IT is necessary but not sufficient.

IT Value Requires Multifaceted Management

For IT to be effective, many variables must be addressed. For example, if one had an objective of going from New York to California, then an automobile might be proposed. However, for the automobile to be effective, roads are needed, traffic conventions must exist, gas stations must be present, and automobile repair shops are likely to be required. In the absence of these other variables, the likelihood that a person can get from New York to California in the automobile is very low.[2]

The importance of addressing these considerations should not be underestimated. Organizations have learned that the impact of IT on care does not appear to have very predictable outcomes. Some studies have shown a decrease in errors after implementation of Computerized Physician Order Entry (CPOE) while others have shown an increase in errors. Some studies illustrate improvements in care quality following EHR adoption, whereas

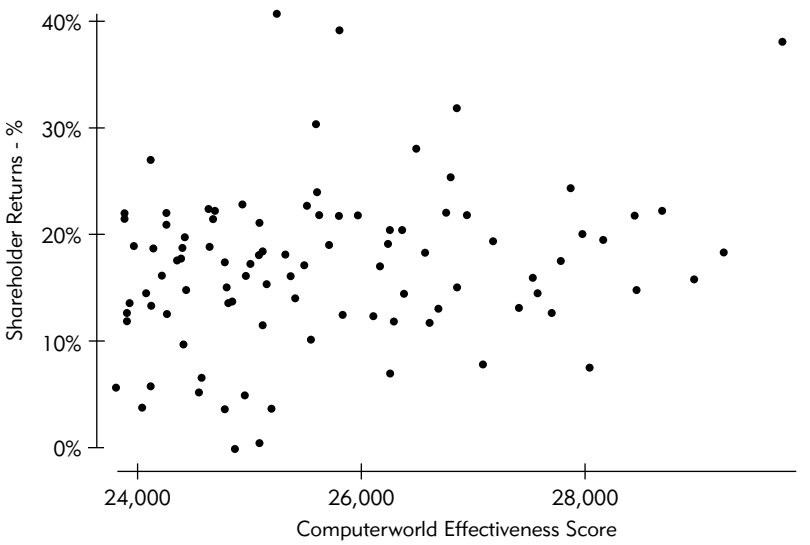
other studies show no improvements in quality. Some analyses have indicated reduced costs of operations follow EHR implementation, whereas other analyses do not find these reductions. There is no technology determinism.

A study by Strassmann (1997) examined the relationship between IT expenditures and organizational effectiveness. Data from *Information Week*'s survey of the top one hundred best users of information technology was used to correlate IT expenditures per employee with profits per employee. Strassman concluded there is no obvious direct relationship between expenditure (as measured by the Computerworld Effectiveness Score, a proprietary method for determining the utilization of IT) and organizational performance (as measured by shareholder return on equity) (see Figure 5.2). This finding has been corroborated in several other studies (Keen, 1997).

The fact that there is no correlation between investment and outcomes is attributable to the fact that some organizations did a nice job of managing all of the variables and did see an improvement in performance. Others did a poor job and did not see an improvement.

For the EHR to achieve any objectives, the organizations need the technology and also leadership, an ability to effectively change processes, a means

Figure 5.2 Relationship Between IT Investment and Organizational Performance



to provide training and ongoing support, and approaches to measuring objectives and engage in ongoing tuning of the application and care processes. Moreover, specific capabilities of the technology are needed in addition to *an EHR.* For tools to be effective, a number of factors or variables, including the tool, must be present, and these variables must *fit* together.

Any organization that overlooks the need to establish and manage all these variables faces a high likelihood of disappointment and a waste of money and effort. Any statement similar to "If we implement CPOE we will reduce our medication errors" exhibits limited understanding. The organization may have a great strategy, but this misunderstanding will ensure execution if the strategy fails to deliver the desired gains.

We have discussed many of these variables, including the IT asset, IT-centric capabilities and characteristics, and complementary strategies. To these variables we need to add the variables that have a very significant impact on implementation of the technology such as sound project management, effective clinician engagement, solid vendor partnership, and thoughtful workflow redesign.

Contributors to Value Loss

The organization may understand the need to manage multiple contributory variables, and it may have good plans and capable management. However, despite this, IT value can dissipate. There are several reasons for dissipation:

- Inadequate homework or unwarranted optimism by project proponents overstated the value and underestimated the costs of the initiative.
- Organizational change encountered too much turbulence causing project leaders to scale back their ambitions or make compromises that kept the peace but diluted the promise.
- The technology that seemed so alluring turned out to have major limitations and problems.
- The organization forgot to make someone accountable for realizing the value and relearned that someone has to manage value into existence.
- The project team made several major mistakes that led to cost and timetable overruns.

Steps can be taken to help mitigate value dissipation factors. Project proposals can be subjected to very rigorous review. Postimplementation audits of value results can be conducted. Technology can be soberly assessed.

Organizations should be aware of dissipation factors since they can erode the contribution of IT. Moreover, many of these factors can be managed such that the risk of occurrence is modest or the occurrence is detected early and leads to tolerable erosion. Some erosion is inevitable.

Progressive Achievement of Value

Those developing the organization's IT strategy should also understand that value is achieved over time. There is no computer genie who shows up the day after *go live*, waves her wand and, shazam, value descends across the organization. Brown and Hagel (2003) make three very important observations about value.

First, extracting value from IT requires innovation in business practices. If an organization merely computerizes existing processes without rectifying (or at times eliminating) process problems, it may have merely made process problems occur faster. In addition, those processes are now more expensive because there is a computer system to support. Providing appointment scheduling systems may not make waiting times any shorter or enhance patients' ability to get an appointment when they need one.

All IT initiatives should be accompanied by efforts to materially improve the processes the system is designed to support. IT often enables the organization to think differently about a process or expand its options for improving a process. If the process thinking is too narrow or too unimaginative and the organization settles for an expensive solution that achieves minimal gain, the potential value will not be realized. For example, if Amazon.com had thought the Internet enabled it to simply replace the catalogue and telephone as a way of ordering something, it would have missed ideas such as presenting products to the customer based on data about prior orders or enabling customers to leave their own ratings of books and music.

Second, IT's economic impact comes from incremental innovations rather than from *big bang* initiatives. Organizations will often introduce very large computer systems and process change *all at once.* Two examples of such big

bangs are the replacement of all systems related to the revenue cycle and the introduction of a new patient care system over the course of a few weeks.

Big bang implementations are very tricky and highly risky. They may be haunted by a series of technical problems. Moreover, these systems introduce an enormous number of process changes that affect many people. It is exceptionally difficult to understand the ramifications of such change during the analysis and design stages that precede implementation. A full understanding is impossible. As a result, small, medium, and (at times) large problems can occur after implementation, and the organization can be overwhelmed. The implementing organization risks material damage. This damage destroys value. It may set the organization back, and even if the organization grinds its way through the disruption, the resulting trauma may make the organization unwilling to engage in future ambitious IT initiatives. In contrast, IT implementations (and related process changes) that are more incremental and iterative reduce the risk of organizational damage and permit the organization to learn. The organization has time to understand the value impact of phase n and then can alter its course before it embarks upon phase n + 1. Moreover, incremental change leads the organization's members to understand that change and realizing value are together a never ending aspect of organizational life (rather than something to be endured every couple of years).

Third, the strategic impact of IT investments comes from the cumulative effect of sustained initiatives to innovate business practices in the near term. If economic value is derived from a series of thoughtful, incremental steps, then the aggregate effect of those steps should be a competitive advantage. Most of the time, organizations that wind up dominating an industry do so through incremental movement over the course of several years (Collins, 2001). Persistent innovation by a talented team, over the course of years, will result in significant strategic gains. The organization has learned how to improve itself, year in and year out. Strategic value is a marathon. It is a long race that is run and won one mile at a time.

Summary of the Realization of IT-Enabled Value

The pursuit of value requires sound linkage to the organization's strategy. It also requires an IT asset that is capable of achieving value and staff who can

reengineer processes and applications that deliver superior support to critical processes. In addition the pursuit of value requires that the organization understand IT is a tool, value requires multifaceted management, value can dissipate, and value is often best realized incrementally.

STRATEGY EVOLUTION

Strategies evolve. They evolve because the environment changes, the industry changes, and organizations learn as they go. This education leads to alterations in plans. As the organization's strategy evolves so does the IT strategy.[3]

At times the evolution cannot be anticipated. Few people would have predicted the impact of the World Wide Web or the recent collapse of the stock and credit markets. It is difficult to factor *unknown but major phenomenon* into strategy formulation and implementation. The organization must hope it reacts well (and doesn't overreact or underreact) to unforeseen events and that it has the patience and judgment to sort through the noise and see the emerging reality.

At times this evolution can be seen with at least some clarity. Most providers expect that accountability for care performance will increase and that chronic diseases will afflict a larger portion of the population. The foreseeable evolution is generally factored into the development of the strategy and its evolution.

Sometimes strategy evolution can be anticipated because it is clear the current strategy will run its course. For example, a provider may conclude its efforts to increase market share have been successful and further increases are not necessary or prudent. Cost-reduction efforts may have gone as far as they can go for the time being.

IT strategy must react to unforeseen developments (such as reduced capital budgets during the financial crisis), and IT is usually factored into foreseeable evolutions. One aspect of evolution (completion of the course of an IT strategy) is discussed next.

This evolution will occur once the current intense focus on EHR implementation is largely behind the organization. At some point, and this is true of all system implementations, the implementation is done. What does an organization do then?

To be fair, the organization will not really be done. There are invariably *bolt on* applications that remain to be implemented and new technologies, such as new mobile devices, that may still be in the rollout phase. However, the long, expensive, and difficult task of implementing an EHR may be largely complete.

If organization members have completed an implementation, such as CPOE, what should they do next?

It is hard to believe these providers will have arrived at the peak of health care information technology existence. They can go no further. They can lay off all of their IT staff except the data center staff. The organization need merely apply application upgrades from time to time.

However, if implementation of the EHR can be considered *Phase I*, then there must be a new phase, a *Phase II.* We have observed that Phase II has three major classes of activity that include the continuous improvement of processes resulting from implementation, the leveraging of data generated by the implementation, and the extension of the implementation outside the jurisdiction of the health care organization.

Continuous Improvement of Processes

The organizational imperative to relentlessly and continuously improve core processes of care, operations, and the revenue cycle never ends. Process change is not only an important component of EHR implementation, it is also an important activity after EHR implementation. With the EHR in place, the organization can now apply the technology to facilitate change.

Moreover, implementation does not mean problem lists are complete, all medications are written using order entry, or health maintenance reminders are being followed. Adoption does not mean that care has been improved.

Phase II will involve ongoing efforts, now EHR-enabled, to improve core processes. The organization must have mechanisms to identify process improvement opportunities, teams that can effect needed changes, and a means to measure the results.

Phase II will require efforts to ensure the implemented EHR is being used effectively. The organization will need to provide ongoing training, approaches to integrating EHR use into the workflow, and data to measure the effectiveness of use (for example, the percent of radiology orders that are written electronically).

Leveraging of Data

Implementation of the EHR will result in the steady accumulation of potentially large amounts of patient data. This data can be leveraged. Potential leverage opportunities include the following:

- Support of analyses needed by continuous process improvement efforts
- Development or extension of pay for performance contracts (for example, contracts can change from incentives that reward an appropriate number of visits by a diabetic to incentives that reward achievement of hemoglobin A1c targets
- *Pharmaco-vigilance*, that is, the early detection of medications that result in severe adverse effects
- Comparison of differences in outcomes between different, competing medical products and medications
- Support of clinical research, perhaps through integration of genomic and EHR data

Phase II will require mechanisms to identify and assess data leverage opportunities, staff skilled in data analyses, staff skilled in care or operations analyses, information technology to support business intelligence activities and feedback loops into applications, and workflow improvement efforts to increase the quality and completeness of data capture.

System Extensions

The EHR can be extended outside the walls of the organization. There are three major types of extension.

First, the EHR can be extended to patients. Personal health records (PHR) and remote monitoring of the chronically ill can be implemented. Second, the organization's EHR can be integrated to varying degrees with the EHRs of other organizations to support clinical affiliations. This extension might involve the electronic exchange of clinical data or the use of one organization's EHR by the other. Third, the EHR can be extended to support very specific workflows such as ePrescribing transaction integration with pharmacies and pharmacy benefits managers.

Phase II means the organization has developed interoperability strategies, understands how to manage information technology infrastructure that is shared with other organizations, and has identified the best approaches to using the EHR to involve patients more directly in their care.

Observations About Strategy Evolution

Three observations can be made about Phase II and about strategy evolution in general.

First, planning for Phase II must start while the organization is in Phase I; aspects of Phase II need not wait for Phase I to be completed. If continuous process improvement is a key activity of Phase II, then the EHR technology being implemented in Phase I must be chosen such that it provides the rules and workflow engines needed in Phase II. The leveraging of the data and PHR implementation can begin well before every outpatient clinic and physician office has an EHR.

Second, there are parallels to these phases in other industries. The airline industry initially focused on online reservation systems. Once that was done, the industry began to appreciate the ability to leverage data (frequent flier programs and yield management systems) and the value of system extension (systems to manage baggage movement between carriers and the ability to check in to a flight from home).

Third, the mature forms of Phase II are generally not well understood. For example, organizations often embark upon a program of *clinical transformation* and implement EHRs as a foundational element of that transformation. Unfortunately the transformation term implies that, once transformed, you cannot be any better. The orientation of the transformation can be, and often is, based on an incomplete understanding of what the particular process change entails; process change being by nature a changing constant that has no end in any organization.

Significant aspects of data leverage are not well understood. Although there may be impressive clinical research and pharmaco-vigilance opportunities, these opportunities are largely hypothetical. EHR data can have a myriad of problems that make such leverage opportunities problematic. Many of the leverage opportunities today are visions rather than proven realities.

Although there is much discussion of PHRs, there is not a mature understanding of their value. Similarly, the country is struggling to find models that enable the widespread sustainability of health information exchanges (HIEs). EHRs, PHRs, and HIEs are discussed in Chapter Nine.

Summary of Strategy Evolution

Strategies evolve. For the evolution that cannot be anticipated, the organization must work hard to thoughtfully respond. For the evolution that can be anticipated, strategies can reflect the evolution. A form of this anticipation is when the strategy reaches a natural closure point; in such a case, development of a new strategy after the current strategy must be discussed so the organization is well positioned for the next phase.

GOVERNING CONCEPTS

Governing concepts refer to how the organization views a particular IT challenge or opportunity. We first reviewed these concepts in Chapter One. These concepts have great power since they frame management's understanding of the challenges and opportunities they confront. For example, an organization can view the EHR as a necessary expense that will cost physicians time. Or it can view the EHR as an essential contributor to efforts to transform care. The concept chosen will determine whether the EHR is viewed as a critical strategic response or not. The organization can view employee use of Internet-based social networking sites as a drain on productivity or as a means for employees to engage in useful interactions with colleagues and patients. The concept chosen will determine whether use of such sites is supported or prohibited.

Governing concepts also illuminate a wide range of subsequent decisions. To help illustrate the importance of these concepts and their wide-ranging impact we will discuss applications using the concept of foundations.[4]

A foundation provides the broad ability to perform a *never ending* series of application-leveraged small, medium, and occasionally large advances and improvements. There are several examples of application foundations.

Provider order entry systems can be used as a foundation to improve physician decision making. Once implemented, the organization can, on an

ongoing basis, introduce a series of decision support rules and guides. These rules can address medication safety issues, improve the appropriateness of test and procedure orders, and assure that data relevant to an order are displayed to the physician. These rules and guides can be implemented over the course of many years. No single rule may turn the tide in an organization's efforts to improve care. But in aggregate they can be leveraged to effect significant improvements.

The outpatient EHR can be used as a foundation to improve care processes. The organization can, on an ongoing basis, introduce modules that improve health maintenance, referrals, medication order effectiveness, and the capture of billing documentation. In aggregate, these changes can provide significant improvements in outpatient care.

Software to support patient-provider communication can be used as a foundation to more closely engage the patient in their care. The software can be used to support the management of diabetes, help patients manage their medications, provide information to address health care questions, and support development of communities of people with a chronic disease.

This view of applications as foundations has several ramifications and illuminates several subsequent decisions regarding the foundation's ongoing management, future development and extensions, assessment of ROI, and determination of the need for replacement.

Implementation Never Stops

There may be a flurry of intense effort as the foundation is laid. The initial introduction of provider order entry and the electronic medical record is difficult work that requires great skill and significant resources. However, once the foundation has been laid, implementation continues as the foundation is leveraged.

If implementation never stops, then management and clinical mechanisms must exist to manage the ongoing implementation. These mechanisms must continuously identify the next area to be leveraged, ensure that the requisite analyses are performed, install needed software modifications and enhancements, and reengineer relevant processes. In effect, these processes and mechanisms must continue the tasks that one sees prior to going live.

Architecture Becomes Very Important

The foundation must be able to support an implementation that never ends. The foundation must be able to evolve gracefully. Tools that enable rule development, the safe addition of local modifications, the incorporation of new data types and coding conventions, and the efficient interoperability with other systems become essential. The foundation must be able to capitalize upon new technologies in a manner that is efficient and minimally disruptive.

In many ways, the architecture, technologies, and tools that enable ongoing implementation may be more important than the current functionality of the application.

The Request for Proposal (RFP) Becomes Less Important

The RFP involves the organization stating all of the application features and functions that it needs or perhaps ever will need. The RFP process implies that all functionality ever needed must be understood and defined. Although one should try to understand up front as much as one can about the functionality that is needed, there is little likelihood one can anticipate all that will be needed.

The view of a foundation leads one to try to implement functionality in a continuous series of modest-sized *chunks.* The organization learns during and after each implementation of a chunk, and this learning makes it smarter about the nature of the following chunks. In effect, one has an ongoing incremental learning process rather than one large "cramming for a test." Over time, this learning process and iterative implementations will result in a large amount of functionality. But that functionality, given the iterative and incremental nature of its implementation, is likely to be rooted in a deeper understanding of what is needed.

This learning process iteratively defines functionality requirements. The utility of the RFP that attempts to comprehensively define functionality needs before there is organizational experience with the application is diminished. The utility of the RFP that attempts to understand the ability of the architecture and technology to enable iterative learning becomes elevated.

Determining ROI Is Difficult

Assessing the *return on investment* of a foundation is a more difficult exercise than determining the ROI of an application. The organization may understand the ROI of the proposed next step, but it may not know how to calculate an ROI of a to-be-determined series of an indefinite number of steps. Although the ROI analysis should never conclude the ROI cannot be assessed because "we don't know how we'll evolve," it is inherently difficult to state the outcome of a never ending implementation. Despite the analytical challenges posed, the organization is much more likely to see a return if it views its task as the implementation of a foundation than if it views its task as the serial implementation of individual applications.

Foundation replacement ought to be rare if the application suite is effectively evolving as the organization changes and matures in its understanding of the ways to apply the system. Foundation replacement would occur under one of four unusual circumstances:

1. The vendor goes out of business and the support disappears.
2. A new vendor arrives with products that have dramatically superior capabilities or lower costs.
3. There has been a serious failure of the foundation to incorporate new technologies.
4. The care or business model upon which the foundation is based undergoes such radical change that the foundation becomes useless. For example, a foundation built for a home for a family of four would be useless if the decision were made to change the structure into an apartment building.

Summary of Governing Concepts

Governing concepts have great power (for good or for ill). An incorrect or limited core view of an information technology or its uses can blind an organization to the potential for significant gain. A view that is too infatuated with a technology can lead the organization on a path toward disappointment. A thoughtful view can provide significant guidance.

These concepts are important because they determine if an organization will invest in information technology or not. And they are important because they can illuminate a wide range of additional understandings and decisions. For example, the ramifications cited in this section (such as the concept that implementation never ends) would not necessarily have been understood if the EHR were viewed conceptually as "an application." An important strategic question that should be posed early in the IT discussion is, "Are we thinking about this the right way?"

THE COMPETITIVE VALUE OF INFORMATION TECHNOLOGY

The national health care information technology discussion is centered on furthering the adoption of interoperable EHRs.[5] At times, this discussion is viewed with suspicion by those provider organizations that have made significant investments in clinical information systems. The board and the leadership of those organizations may believe that widespread adoption of interoperable EHRs will remove a competitive advantage they have achieved through their own IT investments. For example, local physicians can access test results and images electronically from the hospital's systems, but a rival hospital cannot offer the same capabilities.

Organizations holding this belief should remind themselves of the lessons learned by many organizations in many industries over many years as a result of the pursuit of IT as a source of competitive advantage.

Competitive strategy involves identifying goals in ways that are materially superior to the ways a competitor has defined them (formulation). Lipton's 1996 research showed that a competitive strategy also involves developing ways to achieve those goals and capabilities that are materially superior to the methods and capabilities of a competitor (implementation). The conclusions of formulation and implementation discussions should recognize that IT can enable a significant improvement in organizational performance and assist in achieving an advantage, especially when it is used to leverage core organizational processes, to support the collection of critical data, or to differentiate between organizational products and services.

Leverage of Organizational Processes

Information technology can be applied in an effort to improve organizational processes by making them faster, less error prone, less expensive, and more convenient. However, improved organizational performance through process gains is not an automatic result of IT implementation.

The right processes must be chosen. The leverage of processes is most effective when the processes being addressed are critical, core processes that customers use to judge the performance of the organization or to define the core business of the organization.

For example, patients are more likely to judge a provider organization on the basis of its ambulatory scheduling processes and billing processes than they are on its accounts payable and human resources processes. Making diagnostic and therapeutic decisions is a core provider organization process that is the backbone of its business.

Organizations must also examine and redesign processes. If underlying problems with processes are not remedied, the IT investment can be wasted or diluted. IT applications can result in existing processes continuing to perform poorly, only faster. Moreover, it can be harder to fix flawed processes after the application of IT since the *new*, IT-supported process now has an additional source of complexity, cost, and ossification to address: the *new computer system.*

IT can be applied to effect significant process improvements if processes are chosen wisely and are reengineered skillfully.

Rapid and Accurate Provision of Critical Data

Organizations define critical elements of their plans, operations, and environment. These elements must be monitored to ensure the plan is working, service and care quality are high, the organization's fiscal situation is sound, and the environment is behaving as anticipated. Clearly data is required to perform such monitoring.

In addition to monitoring, data can be used to guide management actions. Airlines use data on passenger use to effect real-time adjustment of fares. Internet-based retailers use purchase data to target their advertisements.

However, obtaining and reporting critical data is not easy.

Data quality may be limited and incomplete. For example, while physicians are using an EHR, they may not be recording all of a patient's problems, and many of their entries are free text. There may be confusion about which patients belong on specific physician panels. There can be significant disagreements about the definition of *a visit.*

Using IT to improve performance through the capture of critical data requires addressing process problems that hinder data capture, developing user incentives to record good data, and engaging in difficult conversations about data meaning.

Product and Service Differentiation

IT can be used to differentiate and customize products and services. For example, supermarkets send information to customers about upcoming sales. This information is often based on knowledge of prior customer purchases. Hence, a family that has purchased diapers and baby food will be seen as a household with young children. Information on sales of products directed to young parents will be sent to that household and not to households in which the purchase patterns indicate a single male. The supermarket is attempting to differentiate its service by helping the household plan its purchases around *specials.*

Customization and differentiation often rely upon data. Effective customization presumes that we know something about the customer. Differentiation assumes that we know something about the customer's criteria for evaluating our organization so we can differentiate our processes, products, and services in ways that are deemed to have value.

Customization and differentiation often center on organizational processes. These processes can be made distinctive, but this requires a solid understanding of the needs of patients, providers, and other customers.

Leveraging IT to differentiate products and services requires that organizations address process and data issues and have insight into customer needs and desires.

Obtaining and Sustaining an Advantage

It is very difficult to obtain a competitive advantage based solely on the implementation of a particular application or technology. Competitors, noting the

advantage, are quick to attempt to copy the application, lure away the original developers, or obtain a version of the application from a vendor who has seen a market opportunity in the success of the original developers; a sufficient number of these competitors will be successful. Often their success may be less expensive and faster to achieve than the first organization's success was because they learn from the mistakes of the leader. Moreover, the advantage rarely results from the system since most of the time advantage results from skilled process changes that tackle complex problems with data and processes and thoughtfully understand how to differentiate a business from its competitors.

The advantage does not come from the application system. In an industry where most applications can be purchased from a vendor, it is almost impossible for the application to provide an advantage. If you can buy an EHR from vendor X, so can your competitor, and any advantage is short-lived.

Moreover, the fact that an organization has implemented an EHR does not mean it has achieved a competitive advantage over a rival that has not implemented one. In fact, it may have hurt itself relative to its competitor. Its performance may be no better, yet it may have reduced its operating margin and shrunk its capital because of the costs of the EHR.

Some organizations can achieve an advantage that persists because they leverage some other assets that are quite difficult for their competitors to also garner. Such assets can include market share, access to capital, brand name recognition, and proprietary know how. For example, a well-known academic medical center may be able to leverage its brand name and base of foreign-born physicians, who trained at the medical center, to establish a telemedicine-based international consultation service. However, few provider organizations have such differential assets.

Lacking these assets, any sustained IT-enabled advantage occurs because the organization is continuously more effective at process change and gathering critical data than its competitors and because an organization is able to effect performance improvements faster and more efficiently than its competitors.

McAfee and Brynjolfsson (2008) note a significant separation in the spread in gross profit margin between the companies performing at the top 25th percentile in their industry and the companies performing at the 75th percentile—an indication of the spread between winners and losers. This is illustrated in

Figure 5.3 Profit Performance Differences in High IT Use Industries

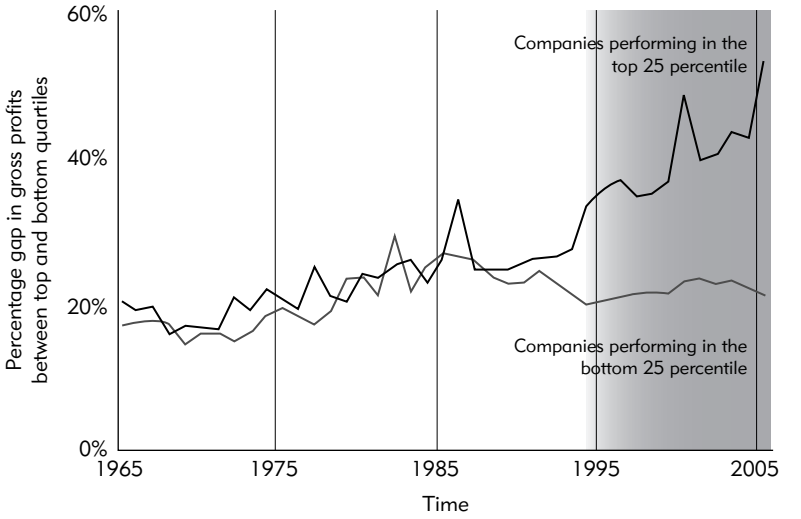


Figure 5.3, which shows the percentage gap in gross profits during the period of 1965 and 2005 for these two groups. The shaded area indicates the last ten-year period measured (1995–2005) during which the profit margin gap between winners and losers was widening. This gap was most notable in industries that invested heavily in IT. McAfee and Brynjolfsson's explanation was that IT has become more potent in its ability to leverage process improvement and information management. This potency enabled organizations that were more effective in applying technology to outdistance their less effective competitors.

Competitive Baggage

The pursuit of IT as a source of competitive advantage can result in excess baggage, which can take several forms.

Significant investment in capital that causes an increase in capital costs and in IT operating budgets (depreciation and interest) can erode margins. If several competitors are making similar investments, they may all arrive at a position where the customer sees better service or lower prices, but none of the competitors has developed systems that truly differentiate one from the other. Despite this lack of differentiation, the competitors may very well

have all reduced their margins through their costly investments. ATMs are an example (Lake and others, 1998). No bank distinguishes itself because of its ATM capabilities. Customers, however, are better off. The banks must now carry the cost of operating the ATMs and funding periodic upgrades in ATM technology. For the health care provider, investment in Web-based consumer content may have a similar outcome.

IT Arms Race

Organizations can find themselves in an IT arms race in which prudence has fled and conversation regarding the competitive value of IT has been replaced by the innate desire to *out feature* the competitors. The original thoughtfulness surrounding the use of IT to improve processes of care, expand market share, or reduce costs has been replaced by ego.

Organizations, overly sensitive to the IT market and grasping for an advantage, can pursue new technologies and ideas well before the utility of the idea, if any, is known. These organizations do not want to be left behind in pursuit of the latest technology, or they may fear ending up in the trashcan of also-rans. A very large number of ideas, technologies, and management techniques fail to live up to their initial hype.

Summary of the Competitive Value of IT

Information technology itself cannot provide a competitive advantage that is sustainable for a long time. In general, competitors can acquire similar technology in one to two years or less. IT can provide an advantage if it is used to thoughtfully improve core processes, provide critical data, and support product or service differentiation. Any pursuit of an IT-based advantage should understand the risks of the IT *hangover* and be wary of allowing this pursuit to devolve into a pointless feature and capability race.

SUMMARY

The strategic application of information technology begins with a linkage of the organization's strategy to its IT strategy. That link will identify IT asset-related initiatives and needed changes to governance and IT-centric capabilities and characteristics.

Table 5.1 Linkage Between the Characteristics of IT-Successful Organizations and the IT Strategy Scope

Characteristic of Organization	*Correlation to IT Strategy Scope*
Implemented a consistent platform across the organization, for example, a common EHR	Corresponds to the IT Strategic Scope (Figure 1.1) component of the IT asset centering on the application but would also include infrastructure, data, and IT staff.
Innovated a better way to do the work by leveraging that platform	Corresponds to the IT Strategic Scope component of organizational capabilities and characteristics centering on change management and the organization's ability to innovate.
Propagated those successful innovations across the organization	Corresponds to the IT Strategic Scope components of strategy considerations and conclusions centering on the understanding of IT value and complementary strategies.

As they engage in IT strategy, formulation, and implementation, organizations must be knowledgeable about a series of IT strategy considerations and conclusions such as complementary strategies, the nature of IT value, strategy evolution, governing concepts, and IT use as a source of competitive advantage.

McAfee and Brynjolfsson (2008) conducted research into IT investments that provided a competitive difference. Table 5.1 shows the characteristics they found to be associated with successful organizations:

KEY CONCEPTS

Complementary strategies

Governing concepts

IT as a way to enhance competitive position

Realization of IT-enabled value

Strategy evolution

DISCUSSION QUESTIONS

1. What initiative-specific complementary strategies might accompany an initiative to significantly increase the use of a provider organization-sponsored personal health record?
2. Many IT investments result in real but intangible value such as improved decision making or communication. Discuss steps an organization might take to assess or *measure* the value of these kinds of investments.
3. Discuss how an organization that views itself as an innovator might develop different IT strategies than an organization that views itself as a conservative adopter of new technologies and practices.
4. Pick an example of how an organization outside of health care uses IT to improve a competitive position; discuss how that effort might inform competitive use in health care.

6

High Performance Medicine

We've come a long way since Hippocrates. Rising health care costs are applying external financial pressure on health care providers; models of care are shifting to team-based delivery of care; patients are receiving care from multiple providers across multiple places of service; and the uncovering of knowledge and development of technological innovations in the field of medicine continues to grow at unprecedented rates. As the inability to schedule appointments, long waits, short visits, and insufficient patient education and follow-up outline the landscape of today's medicine, the delivery of quality, safety, and efficiency in medicine ceases to depend only on the care delivered by physicians. Patient care now extends beyond the clinical encounter.

Partners HealthCare, a nonprofit integrated health care system, came to be founded in 1994 in response to this changing landscape. Founded by two academic medical centers, Brigham and Women's Hospital (BWH) and Massachusetts General Hospital (MGH), it has grown to include multiple providers such as community-based and hospital-based practices, specialty

facilities, and community health centers. The organization is able to leverage its multiple affiliates to provide patients with integrated delivery of care across the continuum of care.

Nevertheless, leveraging a health system to improve care is complex. The foundation of Partners brought with it a consolidation of the IT infrastructure, including systems, such as EHRs, and IT departments, across all of its entities. Yet consolidated IT infrastructure is only one aspect of the multifaceted definition of clinical integration. In Partners HealthCare's initial years, the various members shared a common overall board and capital allocation process, and modest steps were taken to improve care. However, in the spring of 2003 a set of five *signature initiatives* were unveiled by Partners HealthCare leadership as their strategy for the next leap in improving quality, safety, and effectiveness of medical care. Each initiative identified a different dimension of care, and a team was assigned responsibility for its execution. These initiatives were to turn an integration of separate members into an organized health care delivery system. By the fall of 2006, these initiatives had evolved into a framework for the next generation of patient care excellence, High Performance Medicine (HPM).

The five core strategic initiatives are as follows:

1. Investment in quality and utilization infrastructure through implementation of information systems with decision support
2. Enhancement of patient safety by reducing medication errors system-wide
3. Enhancement of uniform high quality by measuring performance to benchmark for selected inpatient and outpatient conditions
4. Expansion of disease management programs by supporting activities for certain patients with chronic illnesses
5. Improvement of cost effectiveness through management of utilization trends and analysis of variance

Each initiative is undertaken by a team responsible for meeting the objectives of HPM through specific methods and approaches outlined by each initiative. Although the first initiative focuses on IT, all the initiatives build

on information systems and demand a broadening of the role of the IT contribution. We will now look at each initiative in detail and highlight the role IT plays in achieving uniform high-quality patient care, maximum patient safety, and improved cost efficiency across Partners.

HPM TEAM 1: INVESTMENT IN QUALITY AND UTILIZATION INFRASTRUCTURE

This first initiative recognizes information systems as fundamental to the improvement of care delivered by Partners. Partners views electronic health records (EHRs) and Computerized Physician Order Entry (CPOE) as essential contributors to the efforts to transform care. The initial focus of this team was to lay a foundation that could be leveraged across a wide range of health care delivery entities; this focus consisted of the implementation of CPOE in all hospitals and EHRs across all outpatient settings. These applications, enhanced with decision support, improved care processes and physician decision making.

In a study led by Bates and others (1994), the incidence and nature of adverse drug events (ADEs) at BWH and MGH were examined. This study showed that 23 percent of ADEs were preventable. Analysis conducted at BWH on the use of CPOE showed it led to a 55 percent reduction in errors (Bates and others, 1998). Partners' leadership recognized that quality improvement can be achieved through the reduction of medical errors in hospitalized patients and that a provider order entry system was necessary.

Achievement of 100 percent CPOE adoption and use across all Partners' entities became a priority. Through CPOE, physicians would be exposed to decision support that would enhance safety and efficiency as they wrote prescriptions. For instance, decision support can automate a check against patient drug allergies, preventing the ordering physician from prescribing a drug the patient is allergic to. CPOE would additionally provide access to the patient's complete medication list.

To achieve full CPOE implementation, Partners negotiated for incentives in its pay-for-performance contracts for the percentage of inpatient medication orders written electronically. To support implementation, CPOE was

used to provide physician profiling on the use of electronic prescribing. As a result, Partners achieved full CPOE implementation in its community hospitals and academic medical centers by the end of 2007.

EHRs have also been shown to improve the quality of health care delivered. Chaudry and colleagues (2006) found that implementing multifunctional EHRs could achieve three gains:

1. Reduce care costs by decreasing inappropriate utilization of care.
2. Increase the safety of care by reducing medication errors and providing decision support at point-of-care.
3. Improve care quality by enhancing monitoring capacity for disease conditions and care delivery.

Implementation of a common outpatient EHR across Partners network of members was performed in two phases. During the first phase the focus was on the adoption of EHRs. During the second phase the focus was on maximization of EHR use.

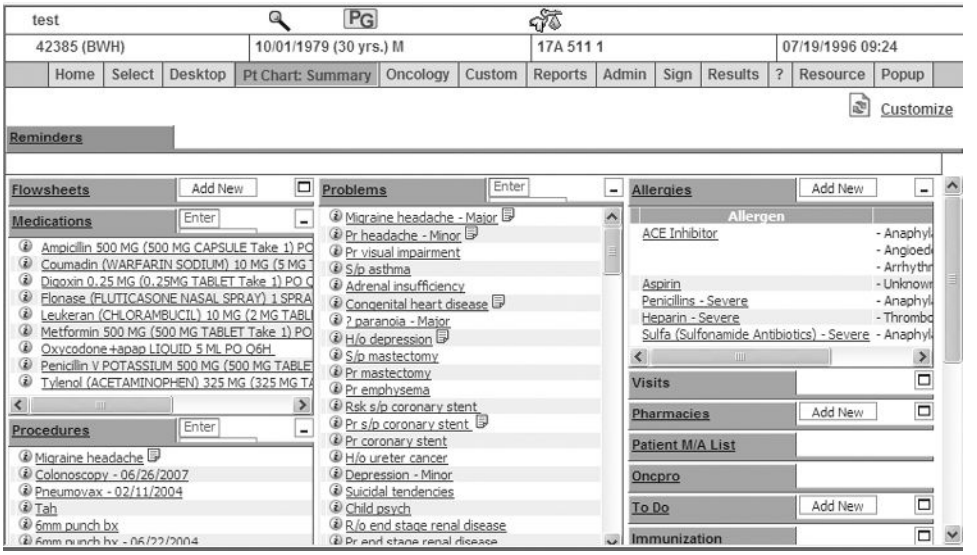
The first phase (achieving the broad adoption of EHR) faced two challenges, determining which EHR to support and expanding adoption in the outpatient setting.

BWH and MGH began using the Longitudinal Medical Record (LMR), an EHR that was conceived and developed at Partners. Figure 6.1 is a screenshot of the LMR default summary screen for a test patient that provides links to forms containing more detailed patient information such as immunization history and medication list. This EHR has the benefit of being developed in-house, thus reducing cost and improving turnaround of upgrades. In addition, in-house development benefits from leveraging Partners research centers to evaluate the EHR's performance and suggest directions for future EHR component development.

Although using a common platform would reduce the complexity of achieving integration across sites, there was a modest outpatient EHR legacy to contend with. Some sites had already invested in outpatient legacy systems prior to integration into Partners HealthCare, which required the support of multiple EHRs as part of a successful strategy to expand into community practices.

Not surprisingly, EHRs represent a significant financial burden for physicians. To help overcome the considerable financial hurdle of implementing

Figure 6.1 Partners Longitudinal Medical Record



an EHR, Partners negotiated for incentives to be built into its managed care contract with its regional health plans and leveraged a complementary strategy (discussed in Chapter Five). This offered financial rewards to physicians who used the EHR, which helped offset some of the financial burden of undertaking such an implementation.

Adoption of technology in health care organizations is facilitated by financial incentives. However, two additional components are necessary for a successful adoption strategy: transmission of an organization-wide message of intent and facilitation of support during the process of adoption. These two initiatives came into play during the second phase; their goal was to maximize the full and effective use of EHRs. Beginning in March 2007, the second phase consisted of three efforts:

1. Turning the incentives for EHR use into disincentives for nonuse
2. Budgeting of resources to provide additional training in EHR use for physicians
3. Demanding that all prescriptions be ordered by computer

The Partners board passed a resolution that required the use of an EHR by the end of 2008. The use of an EHR was necessary for physicians to stay in the network and to be included in its managed care contracts. The 75 percent of physicians who were using EHRs by the end of 2006 became 100 percent by the end of 2008. A similar approach is being implemented in federal initiatives to foster nationwide EHR adoption (see Chapter Nine).

Health care provider education of the EHR is necessary to ensure use. When federal regulations were relaxed in 2007 around the provision of financial assistance that hospitals could provide physicians, Partners chose to invest in additional health care provider education.

HPM TEAM 2: THE PATIENT SAFETY INITIATIVE

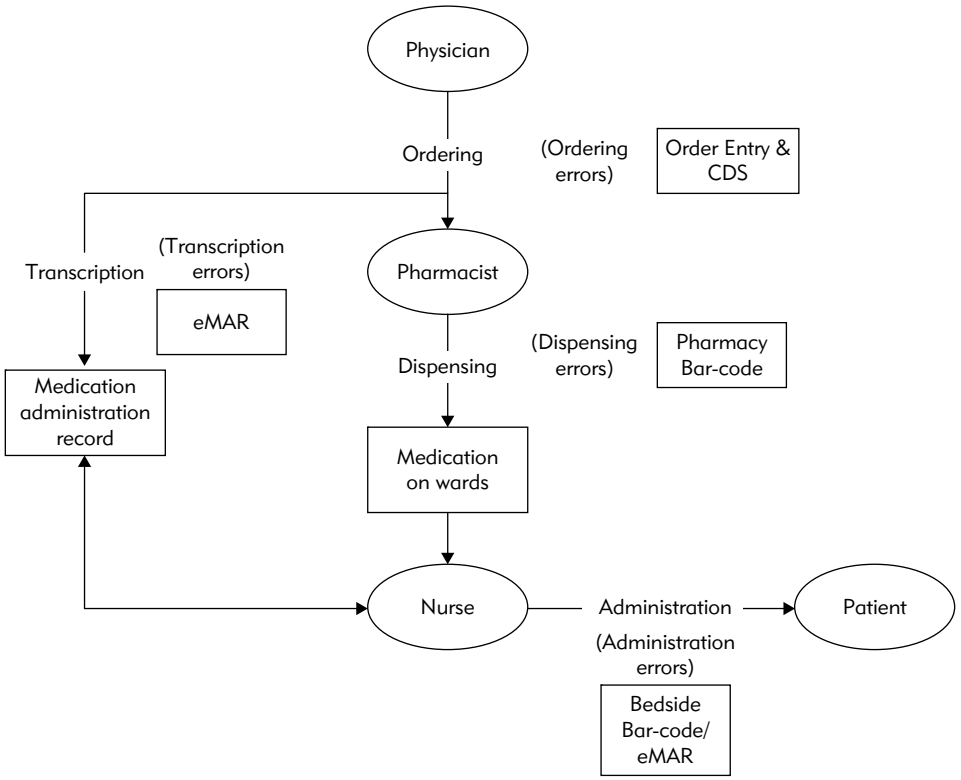
The second initiative is focused on improvement of patient safety; in particular, the safety of medication management. Following are a core set of medication management approaches that, if properly handled, can lead to a significant reduction in medication errors:

- Implementing decision support in e-Prescribing
- Improving clinician-to-clinician communication by keeping medication administration records
- Implementing bar coding to ensure the right patient is receiving the right drug at the right dose
- Event monitoring to identify indications if a patient is not responding well to a particular medication
- Providing a series of alerts regarding, for example, patient allergies and when it is the right time during the day to administer medication given the physician's orders.

Complementing implementation of decision support in e-Prescribing (as described in the first initiative) is the integration of medication administration systems. In addition to the preventable ADEs that were found to occur at the time of ordering, 11 percent of serious medication errors were found to occur during administration of medication (Poon and others, 2010). The

patient safety initiative attempts to reduce medication administration errors by linking medication ordering with its administration through introduction of the electronic medication administration record (eMAR) and bar coding. The eMAR eliminates the need for the paper medication record by storing patient medication information; eMAR makes it accessible to multiple system components. Scanning bar codes on the medications and on the patient ID bracelet ensures the nurse is delivering the correct medication to the correct patient. BWH began implementing the eMAR in combination with bar coding technology in inpatient areas as part of a closed medication process. Figure 6.2 illustrates the core process behind medication prescribing, the types of medication errors that can occur (shown in parentheses), and the technologies implemented at Partners to address these errors (shown in boxes).

Figure 6.2 Partners Medication Prescribing Process and Information Systems



The barcode or eMAR system was shown to reduce administration errors with potential for harm by 51 percent (Poon and others, 2010). Maviglia and others (2007) have shown that eMAR resulted in annual savings of $2.2 million.

HPM TEAM 3: THE UNIFORM HIGH-QUALITY INITIATIVE

Diabetes, one of the seven most common chronic diseases, accounts for an estimated $1.3 trillion annually in health care costs (Winterfield, 2009) and is expected to at least double in prevalence in the next 25 years (Huang and others, 2009). The American Heart Association estimates the cost of heart disease in the United States to account for 64 percent of the estimated $430 billion cost for cardiovascular disease.

The mission of the HPM Uniform High-Quality Initiative team is to improve the reliability of care across Partners by ensuring that key patient populations, specifically those with pneumonia, heart failure, diabetes, and those in need of tobacco treatment, reliably receive all recommended interventions. Following are six key efforts necessary toward improved reliability of care:

1. Identification of patients with the diagnosis of interest
2. Measurement of performance of care delivered to the patients of interest
3. Provision of decision support that highlights opportunities for improvement of care delivery
4. Documentation of patient intervention
5. Tracking of patient populations, analysis of the data captured to measure improvement, and comparison to available benchmarks
6. Management of disease-specific pay-for-performance contractual obligations

Partners implemented systems and software based on the six key efforts to improve patient care. Development of software was critical to the support of many of the key efforts. Once implemented for one disease, similar applications could then be extended to other diseases of interest.

Identification of the patient population requires a patient registry. Registries can pull information from inpatient or outpatient sources to facilitate identification of a patient who is a smoker or a diabetic who would benefit from intervention.

Decision support software is implemented to highlight opportunities for improvement in the care delivered to the identified patient. The inpatient EHR can, through decision support, bring to the physician's attention any patients who have not received all the recommended interventions for a diabetic such as eye exams and HbA1c and LDL screening. Decision support software can also identify which measures are not at normal ranges and alert physicians to the need for corrective actions at point-of-care.

As a result of implementation of these systems for improving diabetes care, Partners saw a rate of improvement that exceeded most hospitals across the nation and exceeded the national 90th percentile on all diabetes care process measures. However, development of these systems will continue through expansion of registry management capabilities and extension of decision support.

HPM TEAM 4: DISEASE MANAGEMENT INITIATIVE

More than 70 percent of U.S. health care spending is attributed to patients with chronic conditions. The disease management initiative targets these patients and focuses on providing personalized care.

Patients with chronic illnesses, in contrast to otherwise healthy patients presenting with acute conditions, require care that is significantly more complex. For instance, the diagnosis and care of patients with chronic cardiovascular disease involves primary care physicians, cardiologists, cardiac surgeons, vascular surgeons, diagnostic radiologists, interventional radiologists, and nurses, which makes these patients particularly vulnerable to errors introduced by transitions of care. In addition, patients bearing more than one chronic illness are treated by even more specialists throughout the course of their care.

Partners HealthCare has vast experience in devising strategies to manage chronic diseases and uses a number of approaches to manage patients

with high-cost conditions, such as cardiac disease. The mission of the HPM Disease Management Initiative team is to improve quality and provide cost-effective care to its complex chronic illness patients by developing and further expanding disease management programs for patients with multiple chronic conditions. The team does so by using IT to assist in the following ways:

- Identify high risk patients.
- Monitor identified patients.
- Connect patients with highly personalized systems of care proven to improve outcomes.

A set of initiatives has been rolled out by this team to attain these goals and includes Partners HealthCare Connection, Predictive Modeling, Identify and Connect, Heart Failure Registry, and Population Manager.

Partners HealthCare Connection

Informed and motivated patients who are active participants in their care are able to improve disease outcomes and reduce unnecessary hospitalizations. Partners HealthCare Connection was instituted as a way to promote the encouragement of patient self-management. This program, started in August 2004, was designed to provide information and support targeted at Medicaid patients with multiple chronic conditions by assigning them *health coaches.* Health coaches, qualified registered nurses with specialized training, provide telephone-based intervention, serve as care coordinators, and provide internal support to targeted patients by facilitating information and resources to help them to make good health care decisions. This program leverages existing Partners IT to achieve the following goals:

- Identify eligible patients through its patient index.
- Build referrals into the EHR.
- Leverage the EHR to provide coordination of care and longitudinal patient support.

The first step is enrollment of the patient in the program. Two pathways lead to patient enrollment: clinician referral and identification via administrative data. Clinical referral is done directly through the *referral button,*

which is built into Partners EHR. If a patient is identified as eligible for the program via search capabilities designed to sift through administrative data, the patient's physician is contacted electronically. This program has led to decreases in hospital and emergency room (ER) use by these patients and also to improvement in patient satisfaction.

Predictive Modeling

Administrative data is useful in identifying high risk patients. However, predicting if a particular patient will benefit from a particular intervention is more challenging. The disease management initiative has implemented the use of predictive modeling to identify patients who would most benefit from each of its disease management programs. Predictive modeling leverages third-party predictive modeling software with supported internal analytical resources to perform analysis on a combination of Partners' billing information and clinical data from the EHR. This analysis proactively determines the likelihood of a patient being at risk for high use of health care services. Each disease management program uses a combination of predetermined risk scores and factors that are used to tie an identified patient to the most effective disease management program.

Identify and Connect

The Identify and Connect Program, instituted by HPM Team 4 at Partners' acute care hospitals, is for heart failure patients. Its goal is to ensure that all patients with heart failure are identified at the time of hospital admission and offered longitudinal outpatient support to reduce the risk of rehospitalization. Once identified, the patients are triaged by registered nurses who assess patient needs and expectations and choose a disease management program that is appropriate for them. Identification and care coordination of these patients is entirely dependent on the EHR and patient indices.

Heart Failure Registry and Population Manager (HF-RPM)

The uniform high-quality and disease management initiatives complement each other. One notable collaborative effort of the two teams is the heart failure registry and population manager (HF-RPM). HPM Team 3 was interested

in identifying patient populations and in making sure all core measures were gathered. For instance, when patients with heart failure leave the hospital they must have undergone an echocardiogram, have beta blockers prescribed, and have received smoking cessation education. The HF-RPM is a heart failure registry application that runs clinical data through a predictive algorithm to identify potential heart failure inpatients in near real time and to connect patients to the appropriate discharge services, such as telemedicine or home care.

The approach for identifying potential heart failure inpatients has been one of incremental improvement. Originally, patients were identified based on a handful of key measures, and a nurse would manage the list of patients and make sure they were referred to the appropriate follow-up care, often post-discharge. This process was manual, largely site-specific, and did not scale well.

HF-RPM leverages significantly more data than was used for the original identification method. It pulls data from the Partners clinical data repository and leverages non-coded data through implementation of natural language processing. This process, executed three times a day, doubles the number of patients identified with heart failure, and does so while the patient is still in the hospital. Educating patients regarding their post-discharge options while they are still in the hospital is significantly easier and more effective than connecting with them once they depart.

HF-RPM has resulted in decreased preventable readmissions, improved workflow and system efficiencies, and has contributed to the enrichment of the population data available for clinical decision making and research. The next steps of this initiative are to formalize the process of heart failure patient identification around the various Partners clinical applications and to create a steering committee that will develop decision support rules to further streamline the process.

HPM TEAM 5: THE TREND MANAGEMENT INITIATIVE

The rise in costs of pharmacy and radiology tests is as sure as death and taxes and is, along with death and taxes, a large source of concern for health care organizations. The mission of the trend management initiative team is to

mitigate the impact of these rises in costs through improvements in clinical processes (at Partners sites) through introduction of a decision-support system focused on more cost-effective treatment and diagnostic decisions and reporting of physician resource use.

In the previous initiatives, we have seen decision-support software being leveraged to aid the physician in clinical decision making that improves the quality of the care delivered. In this initiative the point-of-care decision support provides evidence-based guidelines that enable physicians to make cost-effective choices when ordering prescriptions and high-cost radiology procedures.

Partners IS expanded its outpatient drug formulary program to display, through color-coding, recommendations for which pharmaceuticals and tests should be ordered first. The color-coded recommendations are: green, which identifies the lowest cost and, all else being equal, is the preferred option; yellow, which identifies a reasonable cost option; and red, which identifies a high cost option that would generally be a brand-name pharmaceutical).

The following additional functionality was implemented into the outpatient EHR:

- A similarly color-coded bullet next to each drug in the prescribing grid
- A reminder that appears at time of prescribing that indicates the patient's co-pay amount for each drug
- An alert for a few specific types of drugs that makes suggestions for more cost-effective options

Partners also introduced radiology management software that offers decision support when ordering high-cost imaging tests such as nuclear cardiology or MRIs through the radiology order entry system. When a test is ordered, the software will review the patient's symptoms and make a determination on the appropriateness of the test. The system would then either let the order go through, suggest a preferred alternative, or offer a consulting radiologist's contact number.

Another practice introduced by HPM Team 5 is the reporting of physician resource use. This allows physicians to see where they stand on resource use in comparison to their colleagues. The goal of this effort is to identify and correct overuse and misuse of radiology testing for patients with particular

conditions. Organizations that implement initiatives to address issues of quality and efficiency in health care delivery require a mechanism by which to assess improvement. This mechanism depends on the implementation of HIT that stores and displays the data to support the reporting necessary for these assessments. In Partners HealthCare, the prevalent use of order entry systems allows for the tracking and storage of the data, which facilitates generation of these reports.

HPM GOVERNANCE AND CHANGE MANAGEMENT

As mentioned in Chapter Four, there are factors other than the IT asset that have a significant bearing on the effectiveness of the IT implementation. HPM is an initiative that impacted the organization both broadly and deeply, affecting a large array of beneficiaries (such as clinicians, patients, patients' families, and so on) and impacting deeply rooted core processes and workflows. As Partners CEO's number one initiative, the transformative change it effected on the organization demanded the creation of a supporting governance structure that would support HPM strategy development and execution and the change management necessary to ensure its success.

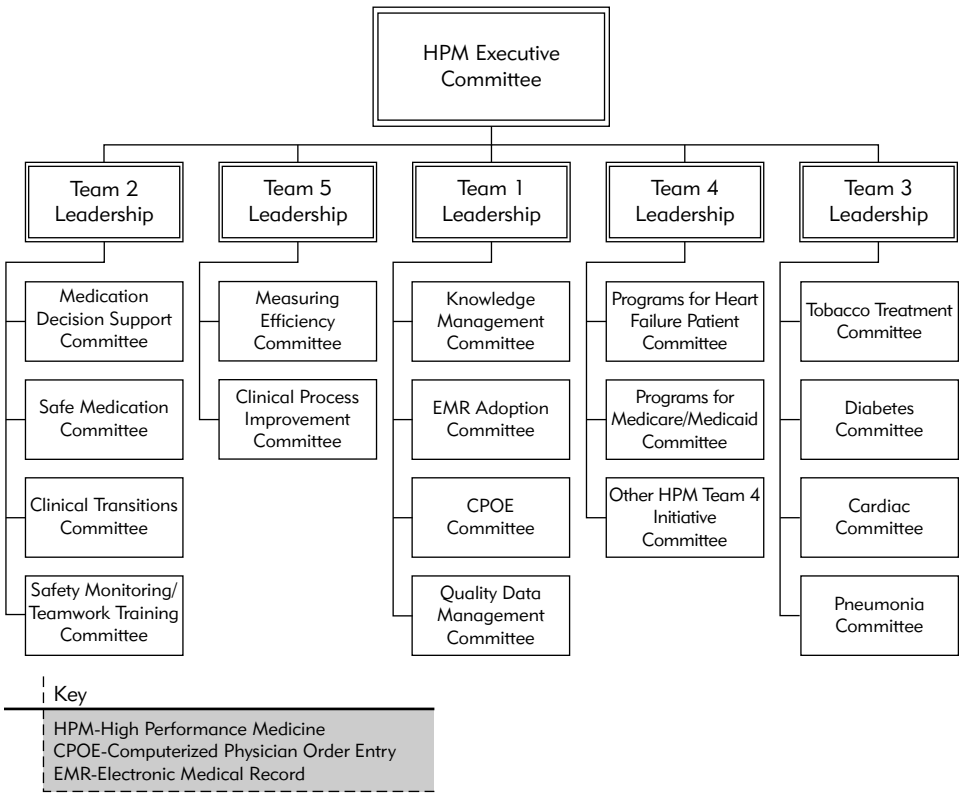
The governance of HPM activities at Partners HealthCare evolved into the following current form:

- The HPM Executive Committee, composed of quality management executives, provides overall direction on strategies and priorities, including IT, and approves final budgets. In addition, this committee is responsible for board meeting updates and communications regarding progress of the HPM initiative.
- Each team has team leaders and project managers who review and approve the IT strategies that are derived from the team's goals.
- Each initiative within a team has a committee composed of a chair or physician leader and contacts for each Partners affiliate that is involved in the initiative.

For instance, Team 1 is composed of four committees, each focused on a strategic initiative that was identified as responding to an organizational goal by the HPM Executive Committee and team leaders. These committees focus on CPOE, EHR adoption, quality data management, and knowledge management. Each committee is responsible for development of the IS infrastructure applications that address the committee's focal initiative. This includes decisions on the applications and data themselves, as well as the staff necessary for implementation. Figure 6.3 illustrates the IT governance structure of HPM.

Each team and the HPM Executive Committee have formal liaison and coordination roles with other Partners patient care committees and with

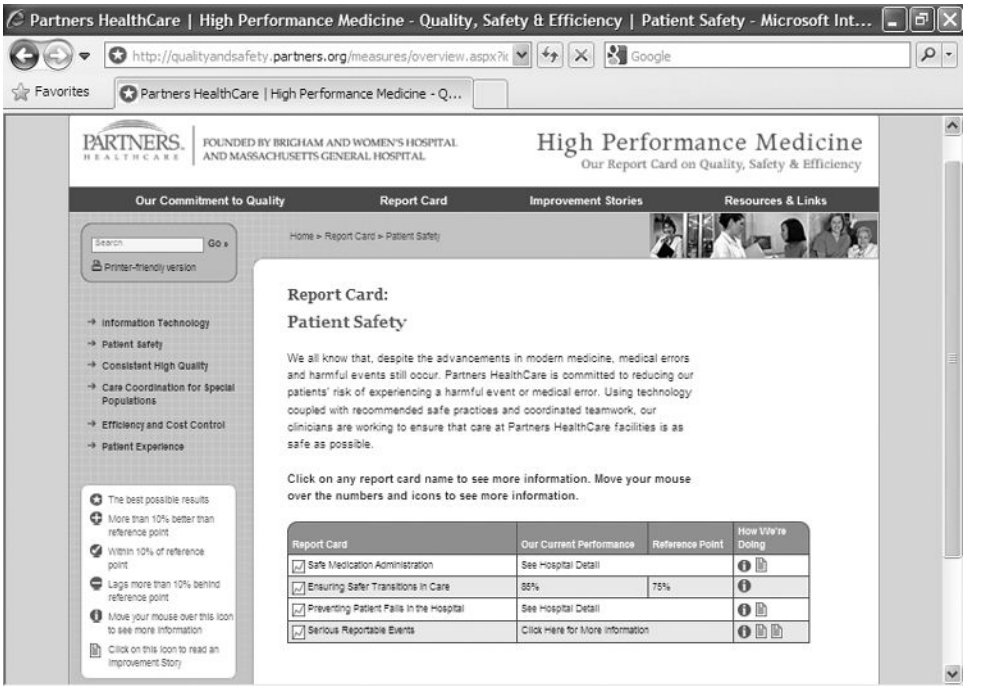
Figure 6.3 HPM Governance Structure



individuals responsible for care delivery and improvement. The members and their clinical staff deliver the day-to-day care, and this delivery is guided in part by the strategies and plans of HPM. This liaison or coordination structure ensures business unit independence without sacrificing the system-wide view of the initiative.

One of the necessary aspects in successful change management is leadership. Leadership must monitor progress and evaluate results. HPM represents an unusual organizational effort in that its results are made available to the public, which impacts multiple beneficiaries. To track the progress of HPM initiatives in improving patient care, Partners implemented report cards that are accessible to the public on the Internet. The report cards show the impact of the efforts in the five areas of HPM. The reference unit for each category that is subjected to a performance rating varies from nationally recognized

Figure 6.4 HPM Patient Safety Report Card



benchmarks, when available, to internally derived goals. Using these report cards, Partners Healthcare evaluates the impact of its initiatives and allows leadership to target areas that might need an alteration in direction or resolution of issues. Figure 6.4 shows an example of Partners report card on patient safety.

SUMMARY

There is a growing gap between the care that can be delivered and the care that is delivered as physicians are challenged to keep up with advances in practice and still keep full workloads of patient care. High performance medicine is a framework of initiatives aimed to narrow the gap between advances in technology and delivery of care. Through the implementation of care delivery programs and associated IT infrastructure, tools, and governance models to support them, Partners has shown how the knowledge explosion can be managed to improve quality, safety, and cost.

KEY CONCEPTS

Disease management initiative

Heart failure registry and population manager

High performance medicine

Identify and connect

Partners Healthcare Connection

Patient safety initiative

Predictive modeling

Trend management initiative

Uniform High-Quality Initiative

DISCUSSION QUESTIONS

1. What are some IT strategies that might be pursued by an organization seeking to improve the quality of their medical care?

2. It took more than a common board, a capital allocation process, and a consolidated IT infrastructure to turn an integration of providers into an organized health care delivery system. Identify three IT challenges an organization seeking to become an organized health care delivery system faces. Discuss possible solutions to each challenge.
3. Discuss an IT governance structure that might be adopted by an organization seeking to become an integrated health care delivery system; imagine the organization is mindful of the importance of business unit independence.

7

Personalized Medicine

As medical understanding evolves, patient health becomes increasingly dependent on clinicians leveraging these advances. Current clinical medicine focuses on the patient's clinical manifestation of disease through symptoms and signs, medical and family history, and clinical data from labs and imaging (often referred to as the patient's phenotype). However, two patients with similar symptoms and personal characteristics may respond differently to the same treatment due to differences in the genetic makeup that are not captured by current clinical assessments. If a patient's genetic makeup were taken into account, clinicians would be able to further personalize treatments and ensure optimal medical outcomes. The advent of genomic medicine introduces the hereditary aspects of diseases into the physician toolbox for clinical diagnosis and treatment.

Personalized medicine, the use of a patient's genetic and molecular characteristics for the diagnosis and treatment of disease, can be considered "an extension of traditional approaches to understanding and treating disease, but with greater precision" (Abrahams, 2009). It includes *genetics*, the comparative study of single genes in related organisms and the effects of environmental

interactions; *genomics*, the study of an organism's full DNA sequences (genomes); and *proteomics*, the study of proteins in a cell and their function. Personalized medicine allows for the identification of treatments targeted to the uniqueness of each patient specifically guided by information from personalized medicine tests.

Patients' genetic or genomic data, which includes genetic variants, protein, and metabolic markers, can now help clinicians deliver better health care in the following ways:

- By guiding the selection of drugs and treatments most likely to benefit the patient
- By helping to determine the proclivity or susceptibility or predisposition to (and prognosis of once-diagnosed) conditions and diseases
- By guiding the selection of therapy to optimize preventive health care for the patient

New diagnostics that identify specific genetic variants (mutations) or molecular assays (used for molecular profiling) that measure levels of certain proteins may be used to tailor medical treatments including medication and dosage selections as well as specific therapies or preventive measures. Individuals considered to be at higher risk for developing a disease (based on protein, gene, or metabolite profile information) can be offered lifestyle advice or medication aimed at preventing the predicted illness.

Determining diagnosis and targeting treatment based on these diagnostics may profoundly improve the effectiveness and efficiency of medical care.

PARTNERS HEALTHCARE PERSONALIZED MEDICINE AND IT

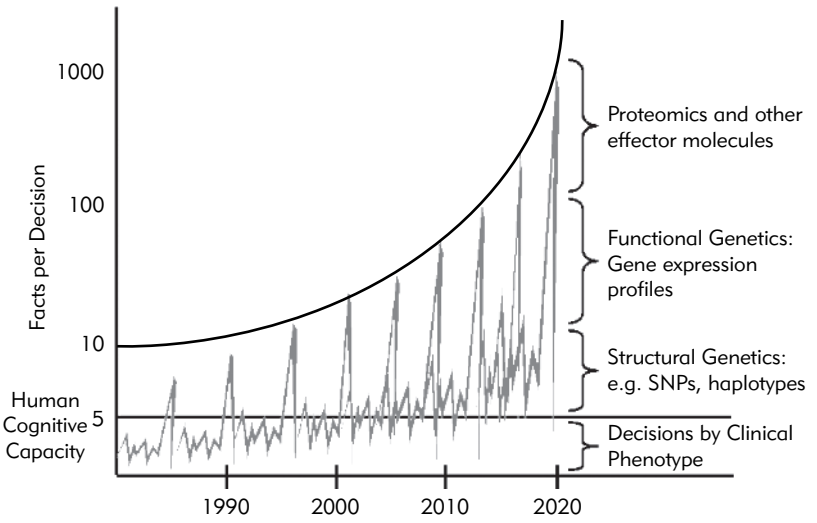
Recognizing the potential impact of genetic, genomic, and proteomic tests on medical care, Partners HealthCare, in collaboration with the Harvard Medical School, formed the Harvard Partners Center for Genetics and Genomics (HPCGG). HPCGG was established to provide leadership in research into the genomic and proteomic bases of disease and the introduction of personalized medicine into clinical practice.

In 2003 Partners HealthCare Information Systems (Partners IS) and HPCGG formed a partnership with Hewlett-Packard (HP) with the conviction that the success of advancing research and the introduction of genetic or genomic technologies into clinical medicine will depend largely on the development of strategically sound supporting HIT platforms.

The IT implications of the advent of genetic or genomic medicine are particularly evident in the exponential rise of our knowledge of proteomics and gene expression profiles. The numbers of facts introduced that may affect any clinical evaluation are significantly more than a human being can realistically comprehend. The increase in disease-specific tests and the corresponding drop in test costs set the stage for a new age of medicine with significant challenges for the clinician.

HPCGG understood that effective delivery of personalized medicine would require new IT capabilities that would enable the clinician to manage a likely stunning volume of information about their patients. Figure 7.1 illustrates the projected growth of number of facts needed to be considered

Figure 7.1 The Demise of Expert-Based Practice Is Inevitable



per decision as discoveries are made over time. It also highlights where the human cognitive capacity levels off. As more discoveries are made and genomic clinical applications become more prevalent, the basic elements of diagnosis in clinical medicine will change to incorporate this new information. In addition, IT advances in storage and processing capacities will be necessary to cope with the significant analytical demands of personalized medicine research. The HPCGG IT efforts concentrate around the construction of IT infrastructure that will support both research and clinical workflows.

FRAMING THE STRATEGIC RESPONSE

The Partners personalized medicine IT strategy was framed by three core perspectives.

First, Partners had a competitive opportunity to leverage its clinical and research strengths through integration of those strengths. The data from clinical practice can be used to further research. And research results could be moved quickly into clinical practice.

Once the strategic value of integrating personalized medicine research and clinical practice was recognized, the focus became on framing IT initiatives that would effectively achieve integration of these two activities in a way that would lead to the leveraging of genetic or genomic information in clinical care. It became clear that "the application of health IT to support the effective integration of genetic/genomic information in routine clinical care will require . . . transmission capabilities to connect the patient, laboratory, clinician, and researcher" (Glaser and others, 2008).

Second, the IT needs of personalized medicine research and the integration of genetic knowledge into clinical care is very complex and represents very new territory. We are just beginning to understand the organization and structure of genomic and proteomic data, the necessary bioinformatics methods for analyzing research data, the form of personalized medicine decision support, the kinds of exchanges between research and practice that are necessary, and the potential impact of this integration on research and practice. Because of the large amount of uncertainty, Partners decided to

implement an agility strategy of initial IT support that would be further iteratively developed as the requirements of research and patient care and the successful integration between them unfolded.

The necessary IT infrastructure would need to be shared across the clinical and research environments to enable common use of data, operations support, patient privacy management, and test result interpretation methods. An enterprise system that could span these two environments would allow for the exchange of information and serve as the underlying support for processes specific to research and patient care. Although initial support work toward the integration of these environments could be pursued, it was difficult to frame a mature IT response; many dimensions had to be taken into account, and these dimensions were evolving rapidly.

Third, although the understanding of the needed IT support for personalized medicine was immature, Partners had to start its efforts somewhere. The efforts began with a focus on supporting the workflow of the research environment, the workflow of the clinical environment, and the workflow that was common to both.

This workflow-based strategy had to consider the multiple sets of end-user constituencies and their unique and common requirements. For example, a bird's-eye view of both environments affords us the understanding that molecular, genetic, and genomic medicine requires the management of vast amounts of data. It is the interpretation of the raw data generated by the research laboratories that gives rise to diagnostic tests used in the clinical setting. If the applications of these findings in diagnostic medicine are to be effective and efficient, interpretation of these vast amounts of raw data must be automated. The clinical organization requires organizational linking of genomic medicine data to other health information. It became clear that a primary workflow challenge for both research and clinical care rested in managing a vast volume of data that would only grow in volume and complexity over time.

Workflow assessment requires that one understand the core processes and data requirements that make up the two environments. For instance, the question must be asked, "What are the core processes and information management tasks that are essential for the functioning of each environment?" A view of the main workflow within each environment illuminates

the underlying core processes and underscores the specific strategies necessary to integrate them.

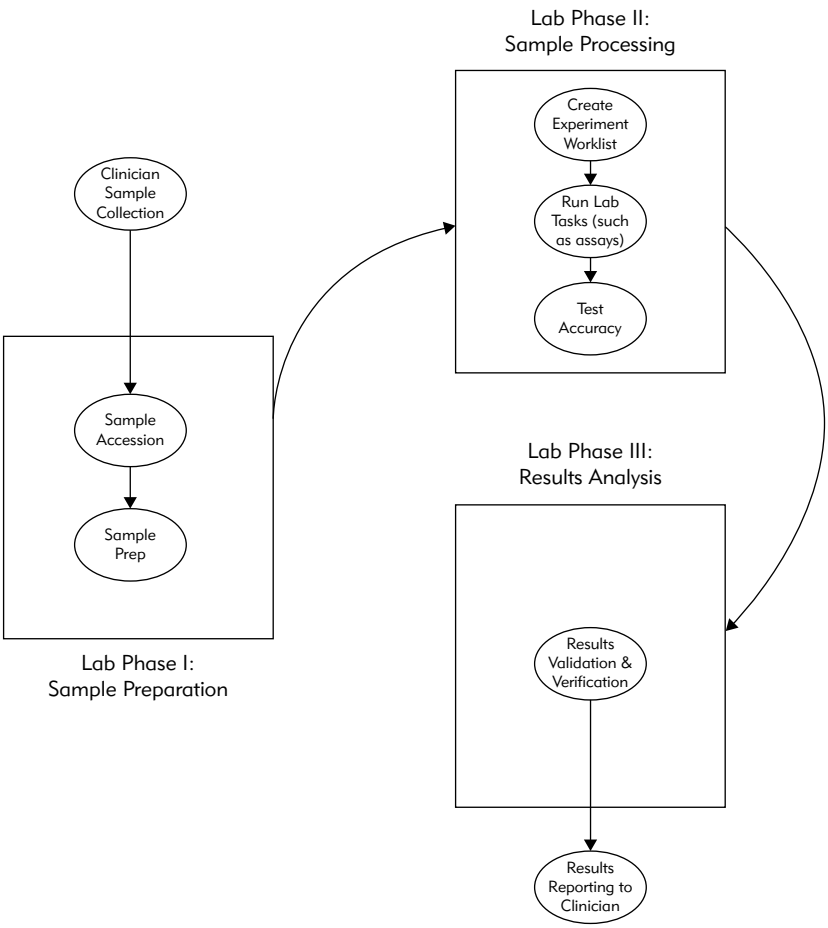
THE WORKFLOW PROCESS

Researchers and clinicians, on a daily basis, experience very different workflow challenges. Although the need for accessing genetic or genomic data is shared, there are vast differences as to how each professional views the data. This will impact how data is stored and presented. For example, a clinician needs to have a patient-centric view of any diagnostic tests, whereas technicians and geneticists require case-centric views that focus on a particular laboratory measure and the steps that lead to its generation. Researchers often deal with study-centric views, and a particular study may leverage data that is generated by multiple organizations.

Research Environment Workflow Structure

Molecular diagnostic laboratories, where genetic and genomic data are generated, depend on software systems called laboratory information management systems (LIMS) for the streamlining of laboratory workflow. This workflow includes sample management, user tracking, process automation, facilitation of communication, report generation, query support, ensuring or facilitating the structuring of genetic or genomic data, and the maintenance of its integrity across process flows. A high-level view of a laboratory workflow is illustrated in Figure 7.2. LIMS are highly configurable and can be customized to the needs of a particular lab. The use of any given LIMS is particular to each laboratory, its instrumentation, and its testing portfolio. (For example, the LIMS' needs for performing a test of gene sequences are different from those for performing protein expression tests.) A particular laboratory may have slightly different needs that need to be configured or may decide to implement a different LIMS. Organizations that operate multiple laboratories or HIT efforts that seek to connect various laboratories will need to be able to interact with different LIMS. They will also need to allow for the initiation of a new LIMS and for the retirement of an existing LIMS.

Figure 7.2 Lab Process Workflow



An organization with the need to link and integrate multiple laboratories and their technologies would need to provide infrastructure with the following features:

- Supports multiple LIMS.
- Is agile and enables the incorporation and retirement of LIMS, regardless of vendor.

- Provides the ability for LIMS to exchange data as appropriate with study databases and EHRs.
- Provides a centralized authentication, authorization, and password management interface.

Once the investigator has performed the desired genetic or genomic tests, test data must often be integrated with data derived from the electronic health record. This genotype-phenotype integration is particularly important for research that seeks to determine if a specific set of genes is associated with the occurrence of disease, the progression of disease, or the effectiveness of disease treatments.

This analysis require the existence of a research data repository that integrates the two classes of data, enables the creation of data marts to support specific studies, and provides tools that support the researcher's analysis of the data.

Clinical Environment Workflow Structure

Support of personalized medicine-based clinical care requires the same LIMS infrastructure we have just discussed. The infrastructure that supports genetic tests for research also can support genetic tests for clinical care.

Partners clinical settings rely on the EHR for day-to-day health care delivery. Clinicians rely on the availability of test results and other patient clinical data in the EHR for routine patient care. In addition, clinicians leverage computerized ordering of tests and clinical decision support to help guide their diagnoses and prescriptions through the EHR. Genetic or genomic diagnostic results would need to be made available in the organization's EHR for clinicians to apply more personalized care. The EHR, with the proper data protection mechanisms, would need to be linked to a structured reporting mechanism of genomic or genetic tests. Also, clinical decision support centered on genetic or genomic data would need to be incorporated to support physician diagnoses and treatment plans.

An organization with the need to link and integrate the clinical setting would need to exhibit the following behaviors:

- Incorporate clinical data into the EHR and provide a human readable view of the results

- Develop clinical decision support
- Develop computerized ordering of genetic or genomic tests

Workflow Integration

An organization linking the research and clinical arms of genetic medicine would need to implement a system that encompasses the differences, leverages common needs, and also facilitates dependencies between research and clinical environments. The data transmission capabilities must specifically solve the need to share data that is viewed, stored, and analyzed in ways that are often very different. That is, the processing of data required to make it useful for a clinician (a human who reads with a focus on clinical implications) is different from that for a researcher who may need data to be encoded following certain standards for analysis or workflow management. Data transmission capabilities need to allow for a smooth transition of data between research and clinical components in the following ways:

- Tying existing underlying IT infrastructure specific to research and clinical care where appropriate.
- Facilitating handoffs and ensuring data integrity across these exchanges, given that there are common data access needs but different perspectives of data. (For example, both clinicians and researchers need knowledge bases that record the significance of genetic and genomic variants.)
- Incorporating the different views and workflows of each environment.
- Retaining adaptability as the type of data is rapidly evolving and requires the IT underpinnings to be upgraded continually.

Once workflows are broadly understood, the needs of end users can provide more specifics for the approach to the IT strategy.

THE END USERS

Development of an IT infrastructure designed to substantiate the promise of personalized medicine spans research laboratories and clinical settings. The IT initiative, which connects personnel across many settings, facilitates

access, provides security and privacy safeguards, provides data storage, and supports transmission capabilities. The initiative affects multiple constituents of the organization, each of whom plays a role in the advancement and application of personalized medicine. Partners IS and HPCGG identified five main constituent end users and explored the requirements of each in performing their roles in the advancement of personalized medicine and its applications. End users included clinicians, clinical geneticists, patients, researchers, and laboratory personnel.

Clinicians

For clinicians to optimize the clinical utility associated with genetic, genomic, and proteomic diagnostic tests they must have access to information regarding the tests and the significance of the results. Furthermore, clinicians need the simultaneous ability to order tests in combination with active notification of test results in a format that is readable by humans.

As with other diagnostics, the growth rate of new information is too large for clinicians to be consistently and fully aware of what is available for their patients. Clinical decision support will need to be expanded to facilitate clinician diagnostic actions with respect to personalized medicine. This clinical decision support needs to include drug warnings, assistance in the determination of genomic-based medication, prescription choices and dosing, and alerts on new diagnostic tests that might be beneficial to their patients.

Clinical Geneticists

Clinical geneticists take on the role of interpreters between the research and the clinical arm. Their role is to update genetic or genomic databases that store variants and their phenotypic correlates, as well as to generate reports on patient diagnostic tests. To fulfill their role, clinical geneticists need access (read/write) to the databases as well as IT support to streamline report generation.

Patients

Patient-centered care and patient empowerment have an important place in genetic or genomic medicine. As with other clinical information, patients need access to their medical records, provision of security and privacy safeguards

on their personal health data, and systems that facilitate the coordination of care that take into account their genetic or genomic profile across the continuum of care. In addition, patients will rely on counseling regarding the implications of their genetic profile. The current disease management experience that follows the diagnosis of a condition is trivial when compared to decision making following a risk-stratified prognosis based on genetic predisposition. How do patients go about making decisions when they receive a prognosis that indicates they have a 60 percent likelihood of having dementia by age sixty? Clearly, information regarding the implications of their genetic profile and decision-making guidance will need to be provided to patients.

Clinical Researchers

To facilitate the discovery of new diagnostic tests and variant determination, researchers need to effectively navigate the plethora of databases and raw data. Their success requires the following: access to databases that contain variant-specific interpretations, access to appropriate study-specific computational capability and storage, search functions to identify existing available patient samples, and access to genetic, genomic, and phenotypic information that is IRB regulated and privacy-protected. Additionally, they require the support of a study management system that allows the creation of new studies, management of access lists, addition of samples, and the ability to order analyses from any one of the laboratories that provide them.

Laboratory Personnel

The daily running of molecular labs is no small task. Laboratory personnel have a need for IT infrastructure that coordinates workflow and ensures quality control and data integrity. In addition, within the context of a unified research and clinical set of applications, laboratory personnel need integration with enterprise systems to facilitate clinical and research result reporting, handoffs across laboratories, customer interactions, and processing of financial data. Finally, to optimize laboratory processing, laboratory personnel require integration of variant databases with other genetic data.

Once the constituents' requirements are understood, these are incorporated into the automation and streamlining of all aspects of the life cycle of

the advancement of genetic or genomic medicine. Incorporation includes biomarker discovery, clinical tests, and application of the new knowledge in the form of clinical decision support.

IMPLEMENTING THE IT STRATEGY

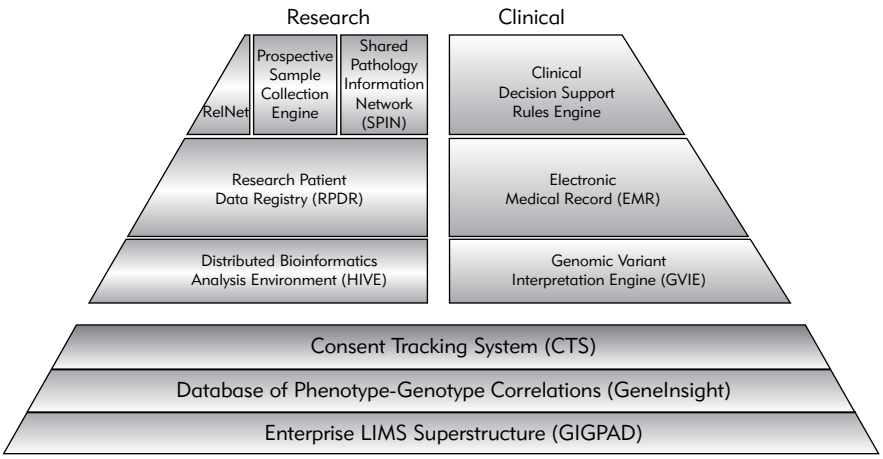
The HPCGG personalized health care vision for incorporating genetic or genomic knowledge and technologies into clinical medicine to improve health care delivery led to the development of the Partners IS/HPCGG Model Genomics Information Technology Architecture. This model, the brain child of three years' collaboration between Partners IS, HPCGG, and HP, attempts to capture all the IT capabilities needed to carry out the advancement of genetic medicine within a health care organization.

Between research and clinical institutions there is a symbiotic cycle that includes the application of discoveries made by the research institutions onto the clinical institutions. It also includes the leveraging of clinical data, such as the identification of patients who qualify for clinical studies by the research organization. The application systems portion of the IT asset included a set of enterprise applications that are shared in order to link the clinical and research organizations. In addition, IT functions specific to research and clinical domains were found necessary to continue to support their unique efforts. The existing HPCGG and Partners IS enterprise information technology architectures were leveraged and linked to create an HPCGG enterprise-wide IT architecture model that resembles a pyramid. Figure 7.3 illustrates the high-level view of the application stacks that underlie the model.

As seen in Figure 7.3, the stacks are broken down into three main categories:

1. Research Environment IT: Components or functions that pertain to the research environment
2. Clinical Environment IT: Components or functions that pertain to the clinical environment
3. Enterprise IT: Components or functions that span both research and clinical environments

Figure 7.3 Partners IS–HPCGG Model Genomics IT Infrastructure



Within each category, multiple components contribute functionality necessary to fulfill the end goal of translational medicine. We will now describe each of the components that make up these stacks in detail.

ENTERPRISE IT

Three functions were identified that needed to span both the research and the clinical environments:

1. Possessing the ability to assay samples to obtain genetic or genomic data and support the integration of specific LIMS
2. Being able to access knowledge bases that record and facilitate determination of the significance of genetic or genomic variants
3. Being able to streamline consent tracking

Enterprise systems were created that address each of these needs respectively: the Gateway for Integrated Genomic-Proteomic Applications and Data (GIGPAD), the database for genotype-phenotype correlations (GeneInsight), and the consent tracking system (CTS).

The Enterprise LIMS Superstructure Strategy

HPCGG created an enterprise LIMS superstructure called Gateway for GIGPAD that addressed the challenges identified with linkage of the various labs that support the research and clinical arms of genomic medicine. Introduced in April 2004, it serves as a platform providing access to and facilitating the creation and organization of genetic, genomic, or proteomic data.

GIGPAD's key functions include the following:

- Serves as a single interface point for all encapsulated LIMS. Thus, it integrates individual LIMS in a common platform that also allows for the construction of custom LIMS for laboratories (when commercial and open source offerings are insufficient).
- Provides a common user interface available to external users facilitating their interaction with laboratories.
- Handles authentication and authorization of external users and coordinates workflow that involves multiple laboratories.
- Supports both research and clinical environments.
- Manages processes that do not vary significantly across laboratories.
- Enables the transformation of research findings into clinical tests and integrates structured genetic or genomic data into the EHR.
- Incorporates tools for technicians and geneticists.

GeneInsight

Clinicians need access to diagnostic test reports (human readable reports) bringing their attention to the medical significance of genetic variants identified for their patients. Trained geneticists formulate these reports based on their interpretation of test results. These structured genetic tests, conducted by the HPCGG Laboratory of Molecular Medicine, need to seamlessly integrate into the EHR for clinician access. Reports must be standardized (that is, genetic results must be stored in a standardized, constructed manner) if workflow is to be streamlined. This standardization reduces variability and facilitates clinician understanding and storage in the EHR. HPCGG addressed this need by creating a tool to interpret and structure the data in

the knowledgebase and to link it with an EHR enhanced to accept and store this data.

The discovery of correlations between an identified genomic variant (mutation) and a clinically relevant fact (symptom or clinical test value) led to development of diagnostic tests where the variant of interest can be identified for a particular patient. HPCGG recognized the value of maintaining a phenotype-genomic variant correlation database that linked specific mutations with specific clinical facts. This database presented a few challenges, including the following:

- Keeping the database up-to-date due to rapidity of discoveries of variants and their meanings
- Centralizing the current heterogeneous databases where correlations are recorded
- Maintaining data that lacked a common data model structure for identified genomic variants and phenotype-genomic variant correlations

HPCGG developed GeneInsight, a database that provides data structures to associate diseases, genes, variants, and tests relative to clinical diagnosis. Test developers load the data as tests are developed. GeneInsight is updated by geneticists whenever they encounter new variants in a patient.

Consent Tracking System (CTS)

A mutual challenge shared by both researchers and clinicians is the need for unified consent tracking. Patient participation in clinical trials mandates their education regarding study risks and potential benefits. Signed consent by the patient allows their participation. An important aspect of consent tracking is that patients may withdraw their consent at any time. To withdraw, the patient must contact the designated study staff member. The mediation of consent acquisition, due to the nature of the study or physician workload, is executed in an unstructured manner by physicians or study staff. Variability in patient participation recruitment represents a significant hurdle. To streamline the consent process so as to facilitate consent tracking, reduce patient participation variability, and decrease duplication efforts, the HPCGG is developing an enterprise-wide CTS.

CLINICAL ENVIRONMENT IT

The functions that pertain only to the clinical side include the requirements identified for clinicians and clinical geneticists. These include access to the variant database GeneInsight, the Genomic Variant Interpretation Engine (GVIE), and EHR enhancements such as storage and structuring of genetic data and clinical decision support.

Genomic Variant Interpretation Engine (GVIE)

HPCGG constructed the Genomic Variant Interpretation Engine (GVIE), a genetic results reporting tool that assists clinical geneticists in generating patient reports on identified variants. Furthermore, it guides geneticists in the entry of unidentified variants into the database (GeneInsight). HPCGG identified the following requirements of the clinician and clinical geneticist constituencies:

- Access to and editing of genetic or genomic databases to assist in results reporting
- Streamlined result reporting mechanism that assists clinical geneticists in the generation of patient reports on identified variants
- Integration with Partners EHR

Clinical Decision Support (CDS)

An important goal of leveraging genetic or genomic data is to provide real-time assistance to clinicians when making clinical decisions. For example, genetic tests providing pharmaco-genomic information determine how an individual will respond to a medication. The addition of CDS tools can flag a drug order if the drug or dosage is contraindicated by the patient's genomic profile.

Partners identified three components necessary to enable a scalable clinical decision support system for genetic or genomic medicine:

1. A knowledge repository such as GeneInsight
2. A clinical decision support rules engine
3. A knowledge event handler for the propagation of newly discovered knowledge of a variant so that patients who have been previously identified to have the variant can benefit from the new discoveries

Development of these three components needs to address the challenges posed by the large amounts of semi-structured data and the rapid rate of discovery of new information that must be incorporated into the rules base.

EHR Enhancement

Genetic information integrated into an EHR requires structuring of genetic data to store, retrieve, index, and associate it with other clinical data. Moreover, additional interfaces are required to support the capture of genetic diagnostic test results.

Genetic or genomic data can lend itself to exceptional forms of misuse when compared to other clinical data. For example, genetic tests may reveal a patient's predisposition to a disease prior to development of disease symptoms. Genetic tests also create implications for similar predispositions for the patient's biological family members. State and federal regulations require heightened protection for this type of data. For this reason, HPCGG has made considerations for the protection against misuse of genetic data and created a separate portion of the clinical data repository (CDR), a database component of the EHR. Tighter access restrictions prompted a special genetic module to separate the reports for genomic or genetic tests from the other clinical data. The services stored in this module allow only the ordering physician to access the data and require supplemental authentication for interface access.

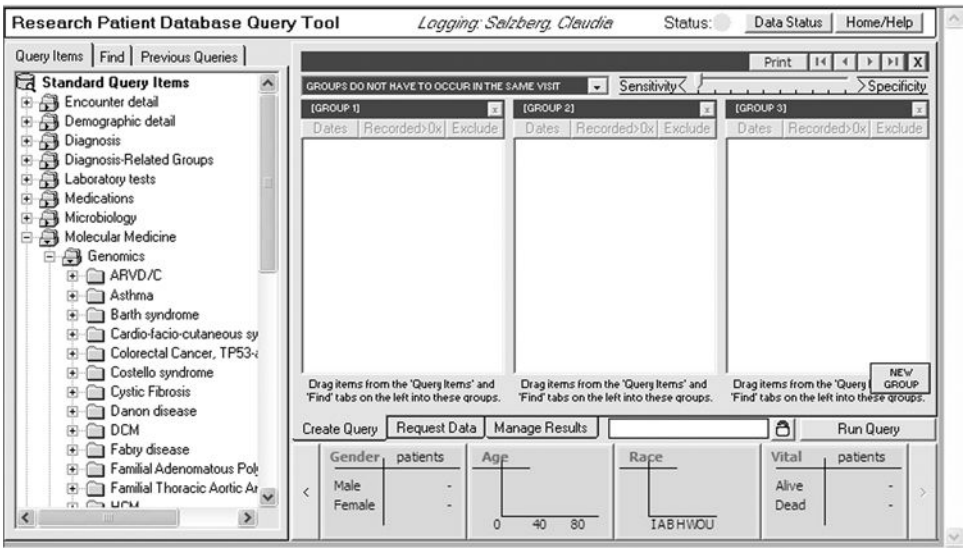
RESEARCH IT

The overall IT strategy included functions pertaining only to the research arm. These functions revolve around access to data, facilitation of search capabilities on this data, and automation of data gathering for research studies. The functions include the research patient data registry (RPDR), distributed bioinformatic analysis environment (i2b2, informatics for integrating biology and the bedside hive), shared pathology information (SPIN), and the prospective sample collection engine (Crimson).

Research Patient Data Registry (RPDR)

A significant obstacle facing clinical research is obtaining patient data. Patient privacy concerns demand all research protocols undergo review and approval

Figure 7.4 Partners RPDR



from an internal review board (IRB). This often creates a catch-22 because researchers need to analyze data to determine the likelihood that a sufficient cohort of patients exists prior to obtaining IRB approval. The RPDR (Figure 7.4) serves as a warehouse of demographic and clinical data from Partners affiliates for research purposes. Currently, the RPDR contains more than 3.5 million patients. It is a database that interfaces into the clinical systems, extracts data, and encrypts anything that can identify patients, making data effectively de-identified. In addition, the RPDR provides a query tool that allows researchers to submit search criteria to identify the approximate size of their study cohort. If researchers decide, based on preliminary results, that their study is worth pursuing, the IRB process is initiated with hopes of approval for the collection of the actual clinical data. If IRB approval is obtained, the RPDR data can be downloaded into the researcher's study-specific data mart.

Distributed Bioinformatic Analysis Environment (I2B2 Hive)

Genomics research of the future demands on the order of thousands of patients to identify variants of significance. With a sizable overhead of

approximately $2,000 per patient, the cost of running clinical trials presents a significant challenge. The thousands of patients generate billions of facts that need to be sifted through. The acceleration of translating genomic and clinical findings into diagnostic tools or other functional uses is highly dependent on the availability of access to existing EHR-based patient data and on automated analytical analysis capabilities.

There are many challenges to linking research and clinical organizations. Use of EHRs (including the type of EHR and the degree to which it is used) across the clinical organization can be highly variable. In addition, it is difficult to predict how EHRs may need to evolve in the future, and so it is important to retain a certain amount of adaptability around any solution that seeks to integrate them. Research organizations wishing to access clinical data require it be stored and presented in formats that are often quite different from formats used to address the data's original clinical purpose. In addition, genomic medicine has significant data protection concerns that require tighter protection than other clinical data.

To address these issues the i2b2 Center is developing a scalable computational framework that lends structure to clinical data, with appropriate privacy and data protection safeguards, for the support of research functions. The i2b2 is funded by the National Institutes of Health through the National Centers for Biomedical Computing grants. Leveraging the organization's experience with RPDR and with an eye toward the future, the strategic initiative focused on designing a scalable framework that provides bioinformatics tools and translation capabilities (such as natural language processing) to be used by organizations who wish to link their EHR data to support personalized medicine research.

Once the organization's EHR is linked, i2b2 provides an interface to identify sets of patients of interest to particular research studies and allows for exploration of phenotypic facts of interest about the patients identified through query support.

Shared Pathology Information (SPIN)

Another research challenge is the need to access particular tissue or blood samples. Pathology labs' excess samples are banked for research purposes and,

with appropriate IRB approval, researchers can access these samples for their studies. However, the challenge arises when searching the repository banks, often across organizations, for the specific sample needed by the researcher. SPIN is an Internet-based solution that performs the following functions:

- Provides query tool for sample searches.
- Allows multiple institutions to include their sample banks.
- Facilitates sample access in a HIPAA-compliant manner.

Prospective Sample Collection Engine (Crimson)

The prospective sample collection engine (Crimson), which is under development, will give researchers the ability to prospectively request samples by defining the criteria that would benefit their study. Crimson will interface with pathology labs and the researchers' request for samples, which will allow the appropriate excess samples to be retained for the requested study.

SUMMARY

Personalized medicine offers the potential to improve clinical outcomes. To accelerate development of personalized medicine, an undertaking that is groundbreaking, complex, and poorly understood, Partners formulated a strategic response that involved integration of existing technologies and the development of new ones.

Recognizing the uncertainty regarding the mature form of the IT response to personalized medicine, three core IT strategies have governed the Partners approach:

1. The integration of clinical and research personalized medicine capabilities
2. The pursuit of an iterative approach to developing the needed systems
3. An initial focus on the workflow needs of the researcher and the clinician

The result was the Partners IS HPCGG Model Genomics Information Technology Architecture described earlier in this chapter. This architecture

addressed the application, data, and infrastructure elements of the IT asset needed to support personalized medicine.

The partnership between Partners IS, HMS-Partners HealthCare Center for Genetics and Genomics, and HP brought together the necessary expertise and systems to undertake this complex integration with large data management needs. In addition, federal grants were obtained from the National Institutes of Health to form i2b2. The i2b2 focused on development of analytical tools needed by researchers.

The pursuit of an industry partnership and academic collaborations enabled Partners to introduce additional resources and expertise to the challenge. These additions helped ensure the decisions regarding iterations were as thoughtful and well constructed as possible. This strategy of forming partnerships became the fourth core IT strategy.

KEY CONCEPTS

Consent Tracking System (CTS)

Gateway for Integrated Genomic-Proteomic Applications and Data (GIGPAD)

Distributed Bioinformatic Analysis Environment (I2B2 Hive)

Genomic Variant Interpretation Engine (GVIE)

GeneInsight

Personalized medicine

Research Patient Data Registry (RPDR)

Shared Pathology Information (SPIN)

DISCUSSION QUESTIONS

1. Personalized medicine offers the potential to improve clinical outcomes. What might be the IT strategy and considerations of a small community hospital seeking to incorporate personalized medicine?

2. What measures might an organization use to assess the value of implementing personalized medicine?
3. The characteristics and capabilities of the various components of the IT asset change in relative importance based on the nature of the IT undertaking. What characteristics and capabilities become more important when undertaking an IT strategy seeking to implement innovative technology?

8

Service-Oriented Architecture for Electronic Health Records

As members (hospitals, physician practices, health centers, and non-acute providers) joined Partners they brought their clinical information systems with them. The result was a set of systems from a diverse collection of vendors and a substantial base of internally developed systems. This diversity did not add up to an integrated whole.[1]

Partners is a federated health system, and each of its members was allowed to maintain its own brand and identity. Each member was given financial and care quality goals, but members had great latitude in how they met the goals. During Partners early years, the result was modest pressure to integrate care across the entities. Although Partners had implemented a common network infrastructure across the members, consolidated the IT departments, and implemented a Partners-wide enterprise master patient index and clinical data repository, the core member clinical information systems were largely unchanged and remained largely unintegrated.

As a result of high performance medicine (discussed in Chapter Six) some of this diversity was narrowed. High performance medicine introduced a common outpatient EHR, a means to support the transition of care and consistency for some clinical decision support logic and types of data. Nonetheless, the hospital-based EHRs remained diverse, and integration of Partners members across the continuum of care and the consistency of data and logic was suboptimal. Figure 8.1 provides a visual summary of the heterogeneity of clinical systems at Partners. The table columns correspond to individual members of the Partners network and the table rows correspond to components of the clinical systems. The cells contain the suppliers of the applications.

This heterogeneity posed several problems for Partners, including the following:

- A provider using a system in a hospital would not have data from other Partners settings integrated into that hospital's results repository. Therefore, a hospital Computerized Physician Order Entry (CPOE) system that checked drug-allergy combinations would not be aware of an allergy recorded at another hospital.
- Partners-wide changes to data or logic, such as the implementation of ICD-10 codes, requires multiple changes in multiple systems. These changes are expensive and also extend the elapsed time needed to make the change.
- Data was not consistently defined outside of a narrow core limiting analysis opportunities.
- Decision support logic was inconsistent, which led to inconsistent care practices.

These problems led to a strategic decision to reduce the variability of clinical information systems and increase the degree of system integration. Moreover, it was determined that the reduction strategy should be conducted in a way that enabled Partners electronic health records (EHRs) to prepare for the future that will involve personalized medicine, new payment models, and advances in the evidence base of medicine. Although this decision was made, Partners leadership realized there was not a strategic reason to standardize care processes and data across all entities. Moreover, the transition to

Figure 8.1 Heterogeneity of Partners HealthCare Clinical Information Systems

August 2009	BWH	MGH	DFCI	NWH	FH	SH/Charter	UH/Charter	SRH	SKRH	PHC	PCHI	McLean
Inp CPOE	PHS	PHS	PHS	Meditech	Meditech	Siemens	Siemens	Meditech	Siemens	N/A	N/A	Meditech
Inp MAR-nonbar	N/A	N/A	N/A	Meditech	Meditech	Siemens	Siemens	Meditech/CF	Siemens	N/A	N/A	Meditech
Inp eMAR-bar code	PHS	PHS	N/A	Meditech	Meditech	Siemens	Siemens	Meditech/CF	Siemens	N/A	N/A	TBD
Inp Nsg Assessment	MVICU	MVICU	N/A	Meditech	Meditech	Siemens	Siemens	Meditech	Siemens	N/A	N/A	Meditech
Inp Nsg Notes	MVICU	MVICU	N/A	Meditech	Meditech	Siemens	Siemens	Meditech	Siemens	N/A	N/A	Meditech
Flowsheets	MVICU	MVICU	LMR	TBD	TBD	TBD	TBD	TBD	N/A	N/A	LMR	N/A
Consult (Inp)Notes	MVICU	MVICU	TBD	TBD	TBD	TBD	TBD	TBD	TBD	N/A	N/A	TBD
Inp Progress Notes	MVICU	MVICU	N/A	TBD	TBD	TBD	TBD	TBD	TBD	N/A	N/A	TBD
Inp H&P	MVICU	MVICU	N/A	TBD	TBD	TBD	TBD	TBD	TBD	N/A	N/A	TBD
Anesthesia Record	MVOR	MVOR	N/A	TBD	TBD	TBD	TBD	TBD	TBD	N/A	N/A	N/A
Amb Chemo CPOE	N/A	PHS	PHS	TBD	PHS	PHS	PHS	N/A	N/A	N/A	N/A	N/A
Amb CPOE-MEDs	LMR	LMR, OnCall	LMR	LMR, GE		LMR	LMR	LMR	TBD	N/A	LMR, GE	TBD
Amb Nursing Notes	LMR	LMR, OnCall	LMR	LMR, GE		LMR	LMR	LMR	LMR	(PTCT) Meditech	LMR, GE	TBD
Amb Visit Notes	LMR	LMR, OnCall	LMR	LMR, GE		LMR	LMR	LMR	LMR	N/A	LMR, GE	TBD
OncAmb eMAR	N/A	PHS	PHS	TBD	TBD	TBD	TBD	N/A	N/A	N/A	N/A	N/A
ED CPOE	PHS	PHS	N/A	PICIS	Meditech	MedHost	MedHost	N/A	N/A	N/A	N/A	N/A
ED visit notes	TBD	EDIS	N/A	PICIS	Meditech	MedHost	MedHost	N/A	N/A	N/A	N/A	N/A
ED tracking	BWH	EDIS	N/A	PICIS		MedHost	MedHost	N/A	N/A	N/A	N/A	N/A
EHR Viewing and Repository	BICS, CDR/RV	CDR/RV	BICS, CDR/RV	Meditech, CDR/RV	Meditech, CDR/RV, BICS	Siemens, CDR/RV	Siemens, CDR/RV	Meditech, CDR/RV	Siemens, CDR/RV	Meditech, CDR/RV	CDR/RV	Meditech
Op Notes, D/C Sum	BICS, CDR/RV	CDR/RV	N/A	Meditech, CDR/RV	Meditech, CDR/RV, BICS	Siemens, CDR	Siemens, CDR	N/A	N/A	N/A	N/A	N/A
Pt Computing	PG	PG	PG	PG	PG	PG	PG	TBD	TBD	TBD	PG	TBD
KEY	BWH = Brigham and Womens Hospital				MGH = Massachussetts General Hospital				SH = Salem Hospital			
	Charter = Physician Organization				NWH = Newton-Wellesley Hospital				SKRH = Shaughnessey-Kaplan Rehab Hospital			
	DFCI = Dana Farber Cancer Institute				PHC = Partners Home Care				SRH = Spaulding Rehabilitation Hospital			
	FH = Faulkner Hospital				PCHI = Partners Community Healthcare, Inc.				UH = Union Hospital			
	Each cell contains a different color to indicate which source-vendor, internal development, or vendor application version is used.											

below the timeline (0.5 and 1) indicate the number of IT staff needed to implement the project.

more integrated systems should minimize capital costs and disruption to near term demands for EHR progress.

The strategic questions became, "How should Partners pursue integration of its inpatient, outpatient, and non-acute care electronic health records?" And, "How does it balance integration progress without causing material disruption of other clinical system priorities, such as achieving meaningful use?"

FRAMING THE STRATEGIC RESPONSE

At the foundation of the strategic response to these questions were two insights.

The first was to view applications as composites of components or services. A service can perform discrete functions or provide access to data. Examples include services to identify patients, provide decision support, manage the problem list, retrieve data and render presentations for flowsheets and records, and retrieve and detect allergies. These services could be obtained from different sources. In effect, an electronic medical record is not an application; it is a collection of integrated services. Figure 8.2 illustrates the various components of a clinical application and the source responsible for its development, be it internal to the organization or licensed from a vendor. This view is known as a *service-oriented architecture* (SOA).

The second was the realization that one could describe applications as having three tiers. The first is data. The second is clinical decision support

Figure 8.2 A Service-Oriented Architecture View of the EHR

Note Documentation Source: Internal development	ePrescribing Source: Vendor
Referral Source: Internal development	Lab test ordering Source: Vendor
Patient Identification Source: Vendor	User Authentication Source: Partners enterprise software

and workflow logic. And the third is workflow software with a user interface, such as documentation systems. An organization could arrange the services described above according to the tier they supported. Partners had significant interest in targeted commonality in the first two tiers and modest interest in standardization of the third tier.

The primary strategic response was to view the EHR as a composite of services and to target key services for commonality while enabling the rest of the applications to be diverse. Partners could develop or acquire services and insert them into the existing base of applications, advancing commonality and integration one service at a time. The specific services chosen and their sequence could be driven by specific strategies; there was no normative sequence or normative pace.

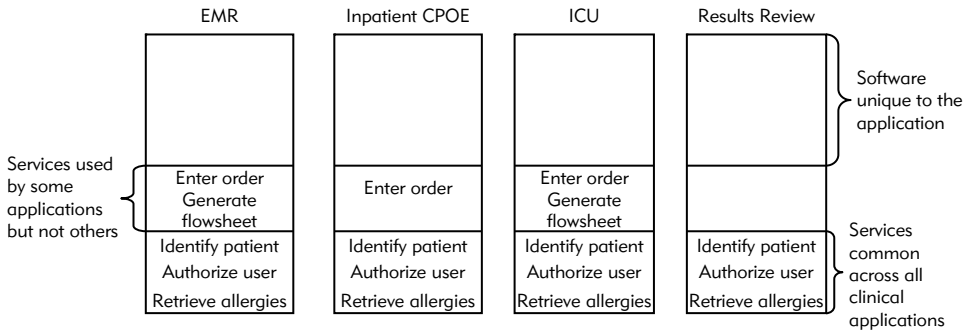
THE POTENTIAL VALUE OF SOA

A service orientation enables one to use the same application component or logic across a wide range of applications. For example, many applications use the same patient identification service or the same component for filing and retrieving patients' medications. This provides the ability to achieve targeted standardization across a suite of applications. Sometimes an organization would like to standardize pieces of its applications or specific types of data but does not want to engage in whole-scale replacement of application suites.

An application can be composed of services that are common with other applications and services that are unique to that particular application (see Figure 8.3). This ability to compose an application from existing services and new services should significantly reduce the time required to develop and maintain applications. A new application need not recreate functions that can be *borrowed* from other applications.

An organization may decide that advances have been made in the approach or technology behind a specific service. For example, advances have been made in rules engine or workflow engine technologies. The organization would like to leverage these advances and, through SOA, is in a position to remove and replace that technology without having to disrupt the remainder of its applications or its application suite.

Figure 8.3 Services Enable Targeted Standardization



Services can improve interoperability across heterogeneous systems. Services have well-defined interchange protocols, known as *contracts*, where the parameters between the service consumer (the workflow application) and service provider (for example, the allergy service) are clear, and abstracted from any underlying native technology implementation. For instance, a patient identification service expects parameters such as name, date of birth, and medical record number to be supplied. The service may carry out extremely sophisticated matching operations internally, but this complexity is shielded from the calling application (or consumer). The consumer expects only a list of candidate patients to be returned, in accordance with the agreed-upon contract established a priori.

Such an approach to services enables an organization to ease the challenge of integrating third-party applications with its core application suite and of integrating with systems from other organizations (for example, to determine eligibility or retrieve clinical data from a Health Information Exchange (HIE).

Overall, SOA offers the potential to achieve three critical organizational objectives:

1. Targeted standardization
2. Efficiency in application development and integration of third-party applications

3. Agility through enabling faster application development or acquisition, effecting targeted standardization, and enabling new technology incorporation in a way that minimizes the need to engage in extensive application replacement

THE CHALLENGES OF SOA

Although having exceptional promise, Partners was wary of claims that SOA will fix all that ails the health care information technology industry.

Many vendor-supplied applications are not well suited to an SOA environment. Substantial investments in sizable base of application software that is installed in hundreds of client sites make it difficult to justify the recasting of that legacy base using a service-oriented architecture. Moreover, vendor research and development resources are often directed to immediately pressing needs to increase functionality rather than to increase the agility of the applications. This reality is understandable.

Some vendors have done a reasonable job of *wrapping* portions of their applications so certain aspects can be treated as services by other applications. For example, a wrapper may enable an IT group to retrieve data using SOA conventions layered on top of a legacy application. However, the effectiveness and extent of this wrapping is variable across the industry.

Convincing the leadership of an organization to invest in SOA technologies or to replace existing applications with ones that are very effective adherents to SOA precepts can be difficult. One of the harder jobs of the CIO is to explain IT concepts, like SOA, to a bright but not IT-conversant board. Although goals such as agility are very important, they are intangible. It is therefore harder for a leadership team to justify investing in technology to improve targeted standardization when it is easier to justify investments that make physicians happy or at least happier. In addition, the leadership can be confronted with a difficult choice when one system is SOA-compliant and another is not but has superior functionality.

Managing an SOA environment requires new skills and orientation for the organization's IT group. Viewing applications as collections of services takes some getting used to. New standards and design patterns must be

introduced into the development process. Services must be managed with respect to security, version control, performance, auditing, and monitoring, and these issues must be managed at a more fine-grained level than at the level of applications or network access.

SOA is an emerging technology. As a result, many vendor offerings of SOA environments are immature. SOA hype can be deafening and can drown out the whimpers of a feeble offering. Most IT groups are unsure how they would evaluate the market and the SOA offerings of one infrastructure vendor over those of another.

Health care SOA standards are embryonic. SOA standards are emerging across all industries. And through federal efforts, health care–specific standards are likely to be seen in the intermediate term. However, these standards are not in place now.

APPROACHING THE SOA STRATEGY

There were several different approaches for pursuing an SOA-based approach to the integration of Partners EHRs:

- Partners could create some number of enterprise services (such as allergy checking) that all legacy applications would leverage, allowing a centralized maintenance and consistency of these services.
- Applications could be developed internally using a variable mix of these enterprise services. These enterprise applications could either complement or replace existing applications and reduce the disparity of the existing EHR portfolio.
- A common, SOA-enabled, vendor-supplied EHR could replace a significant part of the existing systems. SOA would allow Partners to leverage commercial packages for basic or mature features and functions while keeping or adding differentiating features through internal development. Moreover, that mix could be managed dynamically, whereby the information systems department would replace a no-longer differentiating module with a mature commercial application and keep focusing its internal capability on truly unique development.

- Partners could enter into a partnership with a traditional EHR vendor or a system integrator to co-develop an SOA-enabled EHR. By itself, this option spans a wide range of alternatives.

These alternatives range from creating services to be used by existing (but unchanged) applications to creating services and consolidating workflow software through internal development to creating services and consolidating workflow software with a vendor-supplied EHR core to co-development of services and/or workflow with a vendor.

These core approaches to SOA were considered individually and collectively. (Partners could do more than one approach.)

THE SOA STRATEGY

Partners chose to begin with the pursuit of the first approach (begin to create a core set of services), the second approach (initiate creation of internally developed applications using services, as exemplified by the longitudinal medical record discussed in Chapter Six), and the fourth approach (formed a partnership with Siemens).

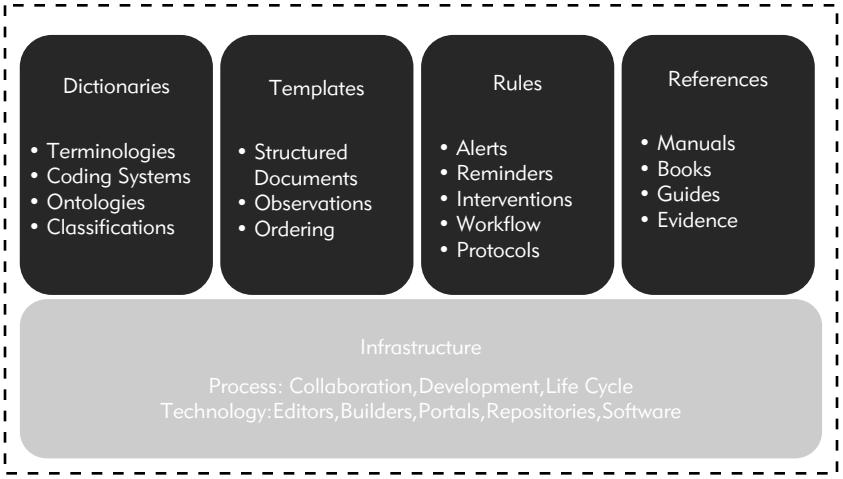
To pursue this strategy, Partners had to address its IT asset, IT-centric characteristics and capabilities, and several of the strategy considerations discussed in Chapter Four.

Layers of SOA Architecture

Partners IT staff defined the EHR SOA architecture as including five layers:

1. A presentation layer that enabled applications to be accessed from a wide range of devices and to use sophisticated presentation and interaction techniques
2. The applications layer that includes capabilities such as documentation of care, entering an order, and graphing test results
3. The SOA infrastructure layer that provided communication between services and processed events, such as a panic lab test result, that require physician notification

Figure 8.4 SOA Knowledge Layer

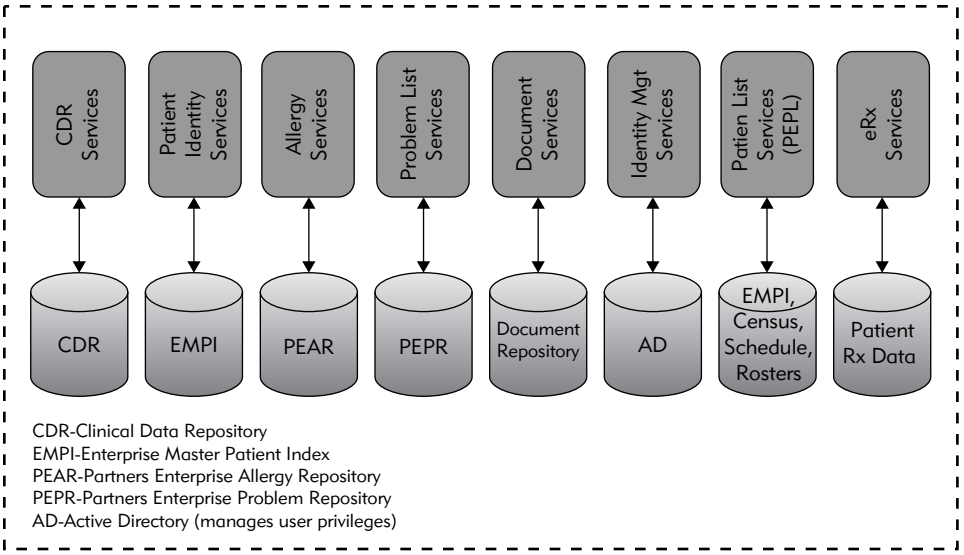


4. The services layer that provided access to patient data such as problems, allergies, and medications
5. A knowledge layer that included clinical decision support logic and the coding structures used to capture clinical terms (such as SNOMED) to represent patient problems

To illustrate in more detail the composition of each layer, Figure 8.4 presents the knowledge layer. In that layer are dictionaries of codes and terms, order sets and documentation templates, clinical decision support rules, and knowledge resources such as PubMed. Also in that layer are technologies that support the ongoing development of knowledge, such as collaboration tools that enable clinicians to work together to develop new guidelines, order sets, and other knowledge assets. These technologies were briefly discussed in Chapter Three.

Figure 8.5 shows the services layer. In that layer are various types of patient data, such as allergies and physician notes, with services that enable that data to be stored and retrieved. This layer also includes data services that make available a provider's list of patients (PEPL), the enterprise master

Figure 8.5 SOA Services Layer



patient index, and services that determine the identity of EHR users and the application capabilities they are authorized to use.

Figures 8.4 and 8.5 are chosen to not only illustrate the specifics of each layer but also to highlight the IT response to the strategic insight that Partners-wide standardization was focused on patient data and clinical decision support. To respond to that insight, these layers were separated from the rest of the stack, and initial SOA initiatives focused on those layers.

Staff

Several teams were formed to develop, manage, and implement these services. These teams were made up of members of the Clinical Informatics Research and Development department (discussed in Chapter Three) who were responsible for service design and ensuring that knowledge was developed and managed. Other staff formed included developers from the Application Development department, who would create the services and

members of the Enterprise Services department, who managed the clinical data repository and provided expertise and infrastructure needed for the data services layer.

Using a *request for information* (RFI) process, Partners entered into a strategic SOA co-development relationship with Siemens. The partnership worked jointly to define and develop services of common interest. Siemens shared Partners vision of a service-oriented architecture approach to EHRs. The jointly developed services would be used for both Partners systems and Siemens products.

For Partners, the co-development approach had a primary objective of leveraging the Siemens medical informatics and development staff. In effect, the Siemens relationship enabled Partners to apply more staff resources to the work. In addition, Partners and Siemens worked out a relationship, whereby Partners might financially benefit from Siemens' market success with its EHR.

Data or Knowledge

The development of data services required identification of the standards that should be used to code the data. For example, what standards should be used to represent medications, their ingredients, and families? The choice of leveraged standards that had been developed and adopted by the health care industry involved discussions with clinical staff and business intelligence staff.

Partners developed structures and processes for defining clinical decision support rules (knowledge). An example of these structures and processes was described in Chapter Three. These processes defined decision support rules and other knowledge assets, such as documentation templates and order sets that would be standard across Partners. Where redundant knowledge assets were already present, these processes determined which of the existing assets would become the standards.

Governance

To manage the SOA initiative, an Enterprise Clinical Services Executive Committee (ECS) was established. This Committee, composed of IT leadership, developed the SOA roadmap and addressed design, implementation, and support issues. The Committee worked with a wide range of Partners'

clinical committees, including the HPM Executive Committee (discussed in Chapter Six), the Medication Safety Steering Committee (discussed in Chapter Three), and other IT organization groups.

Across Partners, several application groups expressed interest in using the developed data services. For example, a development group in radiology wanted to create a mini-EHR (for use by radiologists to look at patient data while they examined diagnostic images). This group wanted to pull data such as problems and prior procedures from the data services. A process was established and managed by the Health Information Management department to review these requests to ensure the requests served a useful clinical or operational purpose and that the use would protect patient privacy.

A joint Partners-Siemens Executive Committee was established to manage the relationship, identify a common agenda, and address issues and problems that occurred.

Complementary Strategies

The relationship with Siemens had the core objective of accelerating the SOA program's progress through the leverage of Siemens resources. In addition to the resources, Siemens market urgency of getting products into the market added an accelerator. In effect, the relationship with Siemens was a response to a strategic question, "How can we move the SOA program faster?"

SUMMARY

The SOA strategy is an example of several aspects of our discussions in Chapters One through Five.

The conclusion that Partners needed to achieve greater consistency in its clinical data and decision support rules involves the formulation of strategy. In addition, using an SOA to achieve this goal involved strategy formulation.

The various architecture, staff, data, and governance steps outlined above were the result of the implementation portion of the strategy discussion.

These strategy discussions had adopted the governing concepts of viewing applications as collections of services and the applications as having three tiers that could be targeted almost independently.

The SOA approach to an application platform represented several architectural conclusions. The agility of the Partners EHR could be improved for the following reasons:

- Services could be added or changed in almost any sequence or at any pace. One could develop the allergy service before the problem service or vice versa. One could have a week between service implementation or a year. One could integrate these services into existing applications quickly or slowly. Implementation of services had the property of providing high levels of agility.
- The ability to add new services without major changes to the rest of the platform also added agility. For example, Partners is developing a service to store patient genetic information and provide risk assessments based on genetic profiles. These services can be *plugged into* the existing SOA framework in a relatively straightforward fashion.

The integrability of the platform was also improved by providing a common set of data and logic across all applications within Partners. In addition, these services could be used by other organizations that shared many patients with Partners. Therefore, integration across organizational boundaries could be improved.

The SOA approach was a result of the desire that, "We want our systems to have common patient data and decision support logic that is consistent." That is, our desire was for an architectural capability.

The staff asset changes involved forming teams and adding staff talent to manage the knowledge layer. The data asset changes largely centered on treating data as being provided through a service layer. The SOA effort led to significant improvement in the processes surrounding management of the knowledge base and resulted in consolidation of a diverse set of knowledge assets that were scattered across applications; these assets have now been brought under one management structure.

The Siemens relationship was developed as a staff asset strategy and as an initiative-specific complementary strategy to enable the Partners IT organization to move faster in its development of services.

The Partners SOA strategy is fundamentally a technology architecture strategy. That strategy was derived from an overall strategy, and the SOA strategy required a wide-ranging set of strategic responses.

KEY CONCEPTS

Application layer

Data layer

Service-oriented architecture

DISCUSSION QUESTIONS

1. If an organization has narrowed its choice of applications to one that has superior functionality but does not conform to the organization's architecture strategy (versus an application that has mediocre functionality but conforms to the architecture), what factors should the organization consider as it makes a decision?
2. Compare the relative pros and cons of a strategy to ensure high degrees of integration between systems using a single vendor strategy versus an SOA-based strategy.
3. Under what conditions might an organization decide to develop a leading-edge operations strategy by adopting a new information technology or technical architectural approach?

9

Health Care Reform

The U.S. health care system, commonly faulted for failing to provide high quality and safe care, is also plagued by exorbitantly high costs. Inadequate quality, performance, efficiency, and access to care are cited as the most prevalent challenges facing our country's delivery of health care. Care reinvention and payment reform are two of the main vehicles by which the country may address these problems.

Health information technology (HIT) has been recognized for its potential to decrease costs, improve health outcomes, coordinate care, and improve public health. In 2004 President Bush issued an executive order calling for the widespread adoption of electronic health records (EHRs) and initiated efforts to spur HIT adoption through the development of standards. In 2008 an implementation plan was established to attain near-universal adoption of EHRs by 2014. These efforts culminated in February 2009 when President Obama established the American Recovery and Reinvestment Act (ARRA), which launched broad federal initiatives to foster the development and adoption of HIT via investments in HIT infrastructure, access, capability, and use. Collectively known as HITECH (Health Information Technology for

Economic and Clinical Health), these provisions under ARRA incentivize physician and hospital adoption. In addition, the Patient Protection and Affordable Care Act (PPACA), signed into law on March 30, 2010, is a package containing major health care law changes, many of which will have an impact on HIT.

Although our broken system of health care is multifaceted in nature (and has many proposed improvement solutions), in this chapter we discuss reform through changes in delivery systems by covering two alternative solutions, new care models and payment reform. We focus on the care model and payment reform provisions of the health care reform bill passed in 2010.

We will also discuss national and state health information technology initiatives. And finally we focus on the effects and implications of these initiatives on the IT strategy of health care provider organizations.

NEW MODELS OF CARE

Efforts to transform the country's health care system have generated a number of new care model proposals that address the lack of coordination of care and poor performance of the U.S. health care delivery system. Of these, two have gained the strongest support and have also spurred interest in the design of pilot implementations known as accountable care organizations (ACOs) and the Patient-Centered Medical Home (PCMH).

Accountable Care Organizations

ACOs represent the alignment of incentives and accountability measures for providers across the continuum of care (Rittenhouse, Shortell, and Fisher, 2009). The goal of an ACO is to foster the integration of care across providers (physicians, nurse practitioners, and others) and settings (hospitals, skilled nursing facilities, and others), covering the continuum of care (inpatient, outpatient, and others) over time. The PPACA provides provisions for establishment of an ACO based on integrated medical groups or delivery systems where providers are part of an umbrella governance and legal structure that extends the boundary of accountability for quality and cost of care beyond the individual medical practice.

Multiple ACO models fulfill the specifications for joint responsibility of care across providers and organizations. For instance, in one model specialty groups may join efforts and integrate care delivery with a hospital to become an ACO. In another model an existing organized delivery system may decide to leverage its existing integration and become an ACO. To qualify as an organized ACO, the provider groups must fulfill a set of requirements as stipulated by the Secretary of Health and Human Services. For government-funded care (PPACA Sec. 3022) these requirements include the following:

- Accountability for the overall care (including its quality and cost) of assigned Medicare beneficiaries
- Implementation of legal, leadership, and management structures to support necessary treatment, payments, clinical processes, and administrative systems
- Adequate participation of primary care physicians to cover assigned beneficiaries
- Promotion of evidence-based medicine
- Performance reporting on quality and cost measures
- Coordination of care such as through the use of tele-health, remote patient monitoring, and other such enabling technologies
- Demonstration of commitment to patient-centeredness and promotion of patient engagement

In an ACO, compensation for care is based on provider improvement of clinical performance and efficiency as seen through quality and cost control in care delivery. Although there are multiple payment models that promote value rather than volume, the prevalent payment framework established for an ACO is a gain-sharing mechanism built on top of the standard Medicare fee-for-service model. In this system the provider is compensated on a yearly basis for successful spending management through bonuses. These bonuses are determined by cost savings as measured against prospectively established benchmarks of expected per capita expenditure. To qualify, the provider must comply with predetermined quality standards.

HIT plays a central role in the successful implementation of an ACO. As mentioned at the start of this chapter, one requirement for eligibility is to support processes that relate to quality and coordination of care and that leverage technologies such as tele-health and remote patient monitoring. An ACO can include organizations that are not physically or electronically integrated, and their success will depend on widespread implementation of inter-organizational, interoperable EHRs. In addition, the ACO payment model, which is based on delivery of quality care, demands that the ACO have the data that demonstrates compliance with those quality standards.

Patient-Centered Medical Home

The PCMH is a model of care that seeks to provide comprehensive primary care throughout the lives of patients by facilitating partnerships between all providers who are involved in patients' care delivery, the patients, and, where appropriate, the patients' families. In this model one provider or care organization orchestrates the care and can be viewed as the patient's *medical home.*

The PCMH consists of a combination of principles and guidelines. On March 2007 a group of physician societies released the Joint Principles of the PCMH believed "to improve the health of patients and the viability of the health care delivery system" (American Academy of Family Physicians, 2007). The principles' aims include the following:

- Provide each patient with a personal physician who provides first contact, continuous, and comprehensive care
- Facilitate collaboration among physician-led teams
- Gear orientation of care toward every stage of a person's life and toward all types of care
- Provide coordinated and integrated care across all places where care is delivered
- Support practice capabilities that ensure quality and safety
- Provide patients with enhanced access to care
- Base payment on PCMH payment framework

The PPACA provides provisions for creation of a program to provide grants for training programs related to PCMH (Sec. 5301) and for establishment of community-based, interdisciplinary, interprofessional (such as medical specialists, nurses, pharmacists, and others) health teams that support development of medical homes. These health teams must support "safe and high-quality care through evidence-informed medicine, appropriate use of health information technology, and continuous quality improvements" (Sec. 3502).

Both the PCMH and ACO depend on HIT that can support core principles, in particular, care coordination, population management, and the engagement of patients and families. As we will see later in this chapter, the success of this new model of care will depend on implementation of HIT components such as EHRs, health information exchanges (HIE), and registries to facilitate care delivery according to the guidelines stipulated by the purchaser of care. In fact, the PPACA eligibility for grants to establish health teams requires a demonstrated capacity to implement and maintain HIT that meets the requirements of certified EHR technology (Sec. 3502). In addition, the ability to perform all of these functions will tie into federal HITECH incentive payments discussed in the National and State Health Information Technology Initiatives section in this chapter.

PAYMENT REFORM

Payment influences the quantity and quality of health care services rendered. Payment systems have a direct effect on clinicians and hospitals; they impact the hours physicians work, the type of procedures physicians order and perform, and the number of patients they see (Roberts and others, 2004). In general, successful payment reform must be such that providers are rewarded for behavioral changes to the way they deliver care. Financial incentives must focus on the delivery of quality care, patient experience, patient safety, and cost-containment.

The current *fee-for-service* payment model has financially rewarded an increase in the volume of procedures rather than an increase in the quality of care delivered. Many alternatives to the fee-for-service model are being

considered, with growing support on the use of *bundled payments* that are used for *episodes of care.*

Reforms in payment models demand a redefinition of the conceptual approaches to delivery of care and raise structural questions regarding the concept of an episode and the attribution of accountability for all care delivered during that episode (Hussey and others, 2009). Episode-based payments, as payment reform, strive to broaden the context around patient health care needs. The anticipated effect is to provide higher performing, more efficiently integrated care such as that envisioned by the Joint Principles of the PCMH.

An episode payment assigns a price for all services delivered to a patient during a defined episode of care, specifically composed of all inpatient and outpatient care the patient received to address a given condition. This payment structure incentivizes providers to coordinate patient care and reduces costs incurred through redundancy in services and tests. PPACA itemizes the provisions for the establishment of a demonstration project to evaluate the use of bundled physician and hospital payments to encourage integrated care (Sec. 2704). In addition, it provides guidelines to develop a national, voluntary pilot program to improve patient care and achieve savings through the use of bundled payment models (Sec. 3023).

Payment reform provides the incentives and basic approach to both care and practice transformation whose aim is to improve outcomes and lower costs. New care models depend in large part on implementation of payment reform that would encourage providers to coordinate patient care to provide more efficient treatment.

NATIONAL AND STATE HEALTH INFORMATION TECHNOLOGY INITIATIVES

In 2001 the Institute of Medicine (IOM) released *Crossing the Quality Chasm,* a momentous report detailing an agenda for redesigning the twenty-first century health care system. The proposal urged all health care constituencies including policymakers, purchasers, regulators, health professionals, health care trustees, management, and consumers "to commit to a national statement of purpose for the health care system as a whole and to a shared

agenda" to raise the quality of care (2001). Serving as a lynchpin, this report stimulated federal and state initiatives to redefine health care and support new models of care as priorities of health reform. This report also stimulated initiatives to implement foundational health care information technology.

National Initiatives

The ARRA provides hundreds of billions of dollars to the health care sector. In particular, an estimated $25 billion has been invested toward the adoption and expansion of HIT and EHRs. The nationwide use of EHRs is central to the implementation of payment reform and new models of care. Recognizing this, HITECH has as its main goal to encourage adoption of EHRs via Medicare and Medicaid incentive payments to eligible physicians and hospitals.

Of consequence to EHR implementation is the opportunity for hospitals, physicians, and other eligible providers to earn incentives for the adoption and "meaningful use" of "certified electronic health record (EHR) technology." Beginning in 2011, incentives can be received through the demonstration of meaningful use of certified EHR technology. By 2015 these incentives are slated to become penalties for those who do not achieve meaningful use. In response, health care organizations will need to consider assessment of selected EHRs against certification criteria, and contractual commitments with EHR vendors will need to account for interoperability, certification, and meaningful use (Pechette, 2010).

National health reform will not only draw on the singular capabilities of an organization's EHR but on the combined digital information from multiple organizations' EHRs through an HIE. Among the benefits of achieving cohesive interoperability between organizations at local, state, and national levels are improvements in health care quality, patient safety and accessibility, and efficiency through the following commitments:

- Offer clinicians timely and complete medical data at the point of care.
- Reduce delays associated with paper-based requests, referrals, and reporting of results.

- Enable reduction of redundant services, thereby improving health care quality, efficiency, and performance.
- Reduce the number of medication-related adverse events.
- Enable aggregation of data at the population level to facilitate secondary uses of the data and public health-related efforts such as biosurveillance, clinical research, and quality reporting.

To fully achieve the timely and optimal exchange of clinical and nonclinical data across unaffiliated providers, organizations must first be adopters of robust, standards-driven EHR systems that support the direct provision of care and enable the communication of patient data. As such, under the auspices of the ARRA, federal efforts have been set to align and define certification criteria and standards to assure the interoperability of adopted systems and establish means to apply these criteria and standards through regulatory and enabling activities. The inter- and intraoperability of EHR data exchange would facilitate achievement of better care coordination that is not constrained by organizational boundaries. HITECH seeks to attain the goal of universal adoption of HIE by 2015.

The Nationwide Health Information Network (NHIN), a collection of standards, protocols, legal agreements, specifications, and services that enables the secure exchange of health information over the Internet, will begin by acting as a *network of networks* that tie together mid-size to large regional and state-based health information exchanges that offer a high degree of technological sophistication and the ability to securely exchange electronic clinical information across local exchanges.

In addition, regional extension centers (RECs) have been established to foster adoption, with priority given to hospitals and small primary care practices that serve the uninsured, underinsured, or medically underserved.

State Initiatives

State governments, as a source of funding, licensing, and regulation in the health care system, have a stake in containing the precipitous growth of health care expenditures and improving care quality. Health care costs represent a significant component in state budgets. Many of the resources

offered by the ARRA are directed to state governments in an effort to promote acceptance of HIT.

In 2010, HITECH awarded $564 million to cultivate widespread adoption and sustainable implementation of HIE by the states. These state-level efforts are necessary to develop and implement strategic plans that will sustain the creation of policy and governance capacity, as well as technical strategies to support digital connectivity between and among health care providers. States will also be responsible for ensuring measurable progress in exchange use.

State-level efforts are also stipulated in PPACA, which provides a state option for the provision of health homes for Medicare beneficiaries with chronic conditions. A new Medicaid state plan option allows enrollees with certain chronic conditions to designate a provider, a team of health care professionals, or a health team as their health home. A proposal for the use of HIT for the provision of "health home services . . . and improving service delivery and coordination across the care continuum (including the use of wireless patient technology to improve coordination and management of care and patient adherence to recommendations made by their provider)" will be included in state plan amendments (Sec. 2703).

THE EFFECT OF HEALTH CARE REFORM ON IT STRATEGY

The health care provider is confronted with three external factors that will have a significant impact on its strategic plans for IT:

1. The advent of new care models that emphasize care coordination and accountability across care settings
2. Payment reform that rewards quality, safety, and efficiency and promotes the new care models
3. Significant federal government investment in EHRs and the interoperability infrastructure in the form of state-based HIEs.

Any health care organization strategy cannot help but conclude investments in HIT are necessary if the organization is to capitalize in these factors. In crafting its overall strategy the organization might use the joint principles

Table 9.1 IT Strategy to Respond to Payment Reform and New Care Models

Goal	*IS Initiatives*
Increase quality of care by providing continuous, comprehensive, and integrated delivery of care.	• Integrate all settings of the health care system and the patient's community.
Reduce costs by substituting low-cost providers who are competent to perform services.	• Develop data analysis capabilities that enable the organization to assess the costs of alternative care settings. Model the implications of moving the treatment of patients to other settings. • Implement a clinical decision support system (CDSS) that identifies options for alternative, lower cost treatments and sites of care.
Strengthen management and care support for populations of patients with chronic and complex diseases.	• Enable nonphysician team members to identify and proactively track and manage patients with chronic and complex conditions. • Improve analysis capabilities to include software that supports the identification of patients who are at greater risk of needing care.
Facilitate the determination of accountability for patient care across multiple providers in multiple settings.	• Facilitate accountability for the broad spectrum of a patient's needs by redefining the governance structure around care delivery and implementing management systems that support this structure. • Invest in systems that use data to identify trends in physician expenditures per patient per month. • Improve the quality of clinical data.

developed by The Joint Commission to serve as guidelines to improve quality of care and reduction in costs of care. Institutions seeking to become medical homes may use the guidelines to outline organizational goals. Using those principles, the linkage to the IT strategy may look like the strategy outcome presented in Table 9.1.

THE EFFECT OF HEALTH CARE REFORM ON THE IT ASSET

Patient-centered care reorientation and changes in payment methods that shift the focus of health care delivery goals toward the improvement of outcomes and lowering of costs place new demands on EHRs and other health information technology components (Bates and Bitton, 2010).

The primary IT asset ramifications of care reorientation center on applications. Specifically, EHRs, personal health records (PHRs), and HIEs grow in importance, and the critical application capabilities change in emphasis. The change in emphasis will significantly concentrate on implementation of an EHR or, if one is already implemented, in ensuring its EHR has the needed capabilities.

The Electronic Health Record

The EHR has taken on many definitions and thus is a fluid and shifting idea. Guided by an IOM-defined framework for the possible functions of an EHR, DesRoches and others (2008) identified four domains that, when incorporated into the IT asset, are considered to constitute a fully functional EHR. These domains include the following:

- Recording of patient clinical and demographic data
- Viewing and managing results of laboratory tests and imaging
- Managing of order entry
- Supporting clinical decision support

Although clinical functionality is critical, the new models of care and payment may require that the organization hold a parallel foundational view

of the EHR as a repository of data that can be leveraged for payment purposes or quality assessments.

The World Health Organization (WHO) views the EHR as a reflection of the entire health history of individuals throughout their lives, regardless of the providers who delivered care or the health care setting attended. A more data-centered explanation of an EHR emphasizes the importance of the data providers have access to at point of care and during the course of treatment, as a more defining quality (Glaser, Markell, and Stone, 2010).

Whether it is viewed from the perspective of a collection of functionalities or from the perspective of the type of data it serves, the EHR reflects the models of care organizations support. With alterations in models of care as seen with the PCMH and ACOs, EHRs will need to expand in functionality and also strengthen data integrity and management capabilities.

As the focus of the care paradigm matures to encompass the continuum of care across clinical settings, data received from multiple providers (as well as from the individual patient) will expand the definitional boundaries of the EHR. New links will need to be created to connect to other EHRs and PHRs for purposes such as to transmit clinical data to consulting physicians and to route the prescriptions.

Bates and Bitton (2010) state that improvements to quality, safety, and efficiency from the implementation of transformative models of care such as PCMH depend on the realignment of the current capabilities of EHRs. They outline the following seven domains of the EHR in need of development as critical to the success of new care models surrounding the reinvention of primary care:

1. *Clinical decision support*. The development of interactive tools that use patient data, a knowledge base, and inference engines to aid physicians in clinical decision making. Clinical decision support could aid providers in identifying lower cost provider substitutes, such as nurses, to execute tasks they are competent to perform. A further application of clinical decision support could be the diagnostic identification of high risk patients who require greater care (Glaser and others, 2010).

2. *Registries*. Population-based tools that facilitate management of patients with specific conditions such as cancer. Registries associated with EHRS will also support management of the quality and costs of care delivered to populations with chronic conditions (Glaser and others, 2010).
3. *Team care*. Communication tools and functions that support multi-provider, team-oriented care such as incorporating into the EHR the ability to record a health team's common goals revolving around patient care and to track the progress of their health.
4. *Care transitions.* Communication tools and functions that support tracking and follow-up of transitions of care.
5. *PHRs.* Encourage patient self-management.
6. *Tele-health technologies.* Tools that facilitate real-time conduct of clinical encounters between patients and clinicians, or the forwarding of clinical data for clinician interpretation in a different geographic location.
7. *Measurement*. Capabilities for quality and efficiency measurements to enable internal care improvement and transparency.

The Personal Health Record

What is the role of IT in enabling patients to become active participants in the new patient-centered health care delivery systems? One IT strategy might involve increases in provider investments in PHRs to encourage patient self-management.

The PHR, which can take many forms, is an electronic record of the patient's health information that is made available to the individual patient. The PHR is described by Tang and colleagues as running the gamut between stand-alone records created and maintained by individuals, to more tethered systems where an individual has access to a provider-acquired and managed EHR or patient portal (Tang and others, 2006). PHRs are examples of patient-centered applications that hold the potential to improve health care costs, quality, and efficiency. Through the PHR patients may engage in

disease and wellness management programs by tracking their vital signs and laboratory results, communicating electronically with caregivers, accessing trustworthy health information on treatment options, and managing follow-up appointments.

The main value of the PHR lies in its connection to providers and other stakeholders in the health care delivery process (Kaelber and Pan, 2008). When the PHR is linked to an organization's EHR, patients can become involved in effective management of their health. It is likely the widespread adoption of EHRs may accelerate the use of PHRs by extending the electronic health record into patients' home and work settings.

Kaelber and Pan (2008) define the primary PHR roles as fitting into the following four categories:

1. *Information collection.* Functions that allow patients to enter personal health information and functions that aggregate data from multiple external sources related to the individual's health (for example, payer data, test results, prescriptions, and so on)
2. *Information sharing.* Functions that allow multiple users or data sources to view data stored in the PHR
3. *Information exchange.* Functions that allow multiple users to engage in exchange transactions with others
4. *Information self-management.* Functions that allow patients to manage their health through monitoring (for example, blood pressure or glucose levels) or education

Applications that enable the linkage between PHRs and EHRs will need to focus on data exchange, the support of transactions to request appointments or to refill prescriptions, and asking questions of providers. In addition, for patients seeking access to health information or insurance coverage, the applications will need to focus on content delivery capabilities, such as consumer health references (Glaser and others, 2008).

As we discuss in the Data Management and Access section, IT strategies will need to overcome some of the identified barriers to PHR adoption, such as patient privacy and data ownership concerns.

Health Information Exchange (HIE)

Central to the achievement of new care models and payment reform is the exchange of clinical data between providers as needed to support a patient's care. This could involve the exchange of a discharge summary between a hospital and a non-acute facility or the exchange of patient history between the primary care provider and the consulting physician. These exchanges can be supported by an HIE.

As mentioned earlier, HIE policies, implementation funds, and governance structures are supported by federal initiatives and developed and implemented by the state. Recognizing the federal support, IT strategy may decide to leverage the HIE to achieve the data exchange needed by its care model strategies. Use of the HIE will involve more than connecting an EHR to the exchange. It will also require providers to engage with the regional and statewide HIE discussions and implementations to ensure sound health information exchange agreements regarding the structure of the data and the rules, regulations, and processes for its exchange and use. EHRs will need to comply with and support the standards identified by the federal government.

Health information exchange introduces new data privacy demands. HITECH contains new privacy and security requirements for EHRs and information exchange. These requirements extend previous federal law (Health Insurance Portability and Accountability Act, more commonly known as HIPAA) and state security and privacy laws.

Although the core of the IT asset response is applications (EHRs, HIEs, and PHRs) there are also strategies for the technical architecture.

Technical Architecture

The primary technical architecture impact centers on the integration of these applications across multiple providers.

All the efforts mentioned place a strong importance on, and even assume the existence of, the EHR and the organization's ability to integrate its internal clinical systems. It is difficult to manage a patient's disease across a continuum or exchange clinical data with other organizations if a provider has no internal integration of patient data. A wide range of internal integration efforts have taken place at Partners HealthCare.

One of the first steps toward linking patient data across care settings is the establishment of master *patient indices.* Patient indices enable a consolidated view of patients by providing a crosswalk that links the various medical record numbers given to a patient by the diverse providers who are members of Partners. Partners HealthCare faced a similar need when they looked to implement IT support necessary to sustain clinical integration across all Partners entities. As a common problem, each of Partners entities had their own distinct medical record and clinical systems. One of the critical IT components necessary to support clinical integration was establishment of the Enterprise Master Person Index (EMPI).

In addition to linking patient data, other technical architecture consequences include implementation of a security infrastructure that enables secure communication between organizations and the means to ensure authentication of participants in a health information exchange.

The Importance of Data

EHRs, PHRs, and HIEs are pivotal to the successful implementation of payment reform alternatives and the new models of care. These fundamental components are only as good as the data they contain. Furthermore, the data is only as good as how well it reflects the care provided and the manner in which it was delivered. The strategic importance of data, commonly underappreciated, will only become more significant as we implement payment changes and shift our definitions of care delivery. For example, if payment is based on conformance to chronic disease protocol, the organization must have data that illustrates how well it conforms to that protocol.

The need to implement accountability of care, the expansion of technology from hospital-centric to cross-jurisdictional integrated systems, and the growing necessity to capture longitudinal data pertaining to a patient, have all led to an increase in data complexity. Poor quality data will not only limit the usefulness of the applications we have discussed but it will hinder financial analysis, performance measurements, quality measurements, and claims processing.

Episodic bundling of data requires association of patient encounters by disease. The encounters will no longer be limited to single clinical settings and will span the full range of patient services (such as laboratory services, medications,

office visits, and hospitalizations) across multiple organizations. This expansion in scope and time frame further increases the complexity of the data.

In Chapter Three we defined four major areas where strategies regarding data are necessary: (1) defining data to collect for the purposes of analysis, (2) defining data standardization and its use throughout the enterprise, (3) identification of data management and access technologies, and (4) development of organizational mechanisms and functions to manage and improve data. In this section we explore how changes in payment structure and delivery systems impact each of these four areas.

Defining Data (for Analysis) To assess the impact of payment reform or health care reform, organizations will become increasingly interested in understanding costs, quality, and efficiency of care. The process of defining the data to be collected will be driven by diverse needs that include the identification of at-risk patients, the assessment of market share to gauge the impact of new models of care, and the production of care improvement measures (Glaser and others, 2010).

Defining Data Standardization (for the Enterprise) For data to be useful, an EHR must have uniform data terminologies, particularly if the data is to provide measures for analysis such as quality assessment or if it is to be exchanged successfully across heterogeneous systems; for example, the transmission of an operative not from an acute care hospital to a rehab hospital.

Standardized formats and interfaces for connecting to the HIE will have to be implemented according to specifications defined by state and federal initiatives. Reporting of data from aggregate sources depends on standardized technologies and data sets and reinforces the need for both state and federal initiatives working in unison to facilitate these common goals.

Identifying Data Management Technologies As mentioned, EHRs are only as good as the data they contain. If the EHR does not have high-quality data that is constructed, validated, and accessible to the clinicians, its value becomes diminished. These technologies must support several classes of access and analysis activity; a provider's retrieval of data about a specific patient, a provider's management of a cohort of patients, an organization's assessment of its care performance, and a public health agency's analyses of the health and health care of a population.

Connecting to an HIE introduces intricacies with regard to the propagation of changes in data across institutions. Methods to manage propagation of data and updates to that data will need to be established.

Developing Mechanisms for Data Management Development of organizational mechanisms and functions to manage data and perform activities designed to improve the characteristics of the data component of the IT asset.

Data entry is an important aspect of data management. The usefulness of data for exchange or analysis depends on how data is structured and entered. This usefulness will require front-end processes that use common data specifications across multiple institutions or interfaces that ensure consistency in data quality prior to exchange.

Data exchanges across participants in an HIE, as well as the connection of PHRs to EHRs, will undoubtedly place additional weight on the importance of data management. Data ownership and privacy concerns will require the statement of the specifics of terms and conditions that surround privacy regulations, data ownership, availability, and use. Clinician and patient concerns regarding violations of privacy are significant. These concerns constitute one of the barriers to adoption of EHRs. Changes in privacy and security regulations (such as those encompassed in HIPAA) that address these concerns require changes to data access controls, encryption, and audits.

Moreover the organization may need to examine its *business intelligence* capabilities to ensure its platform (discussed in Chapter Three) possesses the analysis capabilities necessary for the organization to manage its care across episodes and multiple organizations and to assess the financial performance of the organization relative to the new payment models.

THE EFFECT OF HEALTH CARE REFORM ON GOVERNANCE

Currently most provider IT governance has a scope defined by the organization's boundaries. In the future, governance will have to expand beyond these boundaries.

The new care models will require that a provider organization coordinate care with other provider organizations. Other organizations may vary by type of patient, and there may be significant coordination with some organizations and modest coordination with others.

This coordination will lead to data interdependence between these organizations (as a result of HIEs) and may lead to shared application software such as collaborative care applications. This interdependency and sharing will require governance structures that bring together multiple providers to make decisions on topics ranging from the annual budget and mutually desired enhancements to shared data and systems.

Deployment of HIEs is highly challenging and demands very coherent IT strategies. Participation in HIE will demand a shift of IT strategy where providers engage in regional and state-wide HIE discussions and implementations to ensure successful integration of the organization into the greater network of care delivery. These new governance requirements will need to address coordination of the IT plans of organizations participating in the HIE. For example, an EHR upgrade by one organization can have an impact on other exchange participants.

SUMMARY

The very nature of health care delivery as we know it is experiencing a revolution. In the midst of a national effort to reign in the chaos of volume-driven, fragmented, and uncoordinated care (and the high costs associated with it), health care providers are contending with external pressures to change the way they deliver care. This change in orientation will have a significant impact on the organization's IT strategy.

The shift to models of care and payment that emphasize quality of care, care coordination, and accountability across care settings creates a need to implement quality assessment and reporting tools, interoperable systems, new data privacy and security frameworks, and new standards and certification frameworks. Federal initiatives are supporting investment in EHRs in the near term; in time this support will evolve into penalties for non-adherence. In turn, state initiatives are supporting the promotion of health information exchange.

The success of these endeavors depends on the expanded adoption of HIT functionalities that lead toward more collaborative-ware type applications, widespread adoption of EHRs, and implementation of HIEs. The applications that support payment reform and new models of care will need to realign in response to changes, as there is still much to be learned, and implementation efforts are still in early stages.

KEY CONCEPTS

Accountable care organizations

Bundled payments based on episodes of care

Clinical decision support system (CDSS)

Fee-for-service

Nationwide Health Information Network

Patient-Centered Medical Home

Regional extension centers

DISCUSSION QUESTIONS

1. Organized health care delivery systems, such as Partners HealthCare or the VA, have high rates of HIT adoption when compared to smaller or independent providers. What have current federal initiatives to effect HIT adoption in smaller and independent providers learned from organized health care delivery system strategies?
2. Identify and discuss an effective IT strategy for an organization seeking to become an ACO. What kind of process changes might this introduce into the organization? What are the main potential contributors to value loss of such an undertaking?
3. Discuss how your organization's IT applications can be leveraged as foundations to support or advance PCMH-based models of care.

10

Population Health

The birth of the public health movement lies in the cradle of industrialization and urbanization. The nineteenth century witnessed an era of devastating cholera epidemics throughout Europe that spurred early health professionals into establishing campaigns to address the growing disease threats and to mobilize public and government action. It witnessed the shift from an ineffective passive and persuasive approach at both data gathering and mobilization of action to an increasingly more effective active and compulsory approach. This active and compulsory approach became a trend that consistently colors the evolution of public health initiatives.

From its inception, public health evidence has been of a numerical nature, relying on the quantification of medicine. Today, public health is fundamentally dependent on the development and implementation of information strategies and technologies. These are in turn dependent on the widespread implementation and interoperability of integrated databases that contain necessary, reliable, and complete data.

As clinicians are challenged to leverage emerging scientific and technological advances in their practice, public health specialists are challenged to

leverage data and analyses for public health purposes. Information technology can help manage the data overload and enable the recognition of bioterrorist threats, the outbreak of a new disease, the limited access to health care on the part of a particular subpopulation, or the tracking of immunizations at a population level.

Engagement of the health care sector in priorities stipulated by public health have often been relegated to a second plane of importance as the immediacy of the patient overrides the potential and future effects of reporting to public health agencies. However, the advancement of regional and data exchanges among health care organizations and public health offices is an evident federal priority in the health care reform dialogue. The American Recovery and Reinvestment Act (ARRA), Health Information Technology for Economic and Clinical Health (HITECH), and Patient Protection and Affordable Care Act (PPACA) are authorizing federal spending in support of electronic health record (EHR) adoption and health information exchange (HIE) development in ways that support public health interests. In particular, the PPACA establishes a program at the Centers for Disease Control and Prevention (CDC) that will award grants to assist public health agencies in the improvement of infectious disease surveillance and response frameworks, including information systems (Sec. 4304).

Population health monitoring and response is dependent on the integration of multiple institutions and professions, including epidemiologists, statisticians, informaticists, public health practitioners, and health care providers. Health care providers in particular play a fundamental role in public health as the main source of data and the most effective recipient of the ensuing analysis for application and public dissemination. Public health organizations rely on provider and laboratory reporting to bring attention to clinical indicators of potential disease outbreaks. Public health organizations will then follow up with the necessary case investigations.

EHRs and health information exchanges are indisputable components in the technical infrastructure of health care organizations supporting comprehensive health care delivery. Population health as a whole requires effective leveraging of these components and data.

GOALS OF POPULATION HEALTH

The purview of population health is the prevention, rather than treatment, of disease through surveillance of cases and promotion of healthy behaviors. In addition, it seeks to limit the disease burden of communities and effect community-wide prevention initiatives in the face of infectious disease outbreaks.

Public and population health offices include government and research entities. At the highest levels countries have government public health agencies or health ministries that are responsible for devising policies and programs to respond to domestic health issues. United States public health agencies include the U.S. Public Health Service (PHS) led by the Surgeon General and the CDC. The public health front line is composed of state and local health departments that are responsible for deploying public health initiatives, raising population awareness, and enforcing policy.

Public health offices gather data about various measures that are associated with the health of the public (for example, vaccination compliance, obesity, and cancer rates) and in turn generate programs, educational and otherwise, to monitor and address issues of growing concern. Therefore, public health activities often center on information collection, analysis, management, and dissemination.

The Institute of Medicine (IOM) report, *Future of Public Health in the 21st Century*, identifies three core functions of public health:

1. *Assessment.* The collection of relevant and up-to-date public health information (for provision to the public, health care providers, and policymakers)
2. *Policy development.* The leveraging of data to inform policymakers at local, regional, and national levels
3. *Assurance.* The institution of setting goals and priorities to ensure quality and timeliness of public health services

All three of these functions are enabled or facilitated through connection of the EHR to public health information systems. For instance, often the

assessment of population health status is attained through measures such as surveys, vital statistics reporting, and paper-based systems, none of which provide real-time data collection capabilities (Kukafka and others, 2007) for surveillance and event functions. The integration of clinical data sources (such as the EHR) to support public health interests (such as epidemiological and syndromic surveillance) would greatly enhance current systems and allow for early event detection and rapid response and reporting.

POPULATION HEALTH AND HEALTH CARE PROVIDERS

Public health information systems have been limited to providing domain-specific support and to a dependency on the manual, paper-based, and often voluntary submission of data by health care providers. For instance, a group focused on epidemiology will gather public health data and keep it in function-specific formats that cannot be easily accessed by other groups.

Communication between health care organizations and public health offices has been broadly relegated to the civic good will of physicians and dependent on the manual submission of forms by clinicians, whose efforts are not tied to reimbursement. The lack of interoperability between the public health systems and clinical systems has only served to exacerbate what is already a frustrating process for health care providers who are often asked to submit the same information to different offices, each with its own format (Orlova and others, 2005). These manual, voluntary submission standards are prone to duplication of efforts and incomplete reporting as clinicians selectively report to local health departments or state health departments (Fine and others, 2006).

Public health forms constitute just one of many documentation demands on clinicians, and completing these forms may take time away from taking care of patients. Unless mandated by either law or hospital regulations, public health forms will be placed secondary in importance to a patient's immediate need for treatment and care, much to the expense of public health interests.

In addition to the clinician's form-filling burden leading to low compliance rates, Fine and others (2005) identified a gap between pediatric hospital CIOs' belief in the importance of health care organization compliance with public

health interests and their own knowledge of reporting requirements. Most CIOs believed health care organization compliance was very important, but few understood what the reporting requirements were. This gap exists alongside the fact that the health care organization maintains electronic data that can contribute to programs such as communicable disease surveillance or disease registries.

Bidirectional communication between health care providers and public health practitioners can enable the use of epidemiological data in decision making; that is, information regarding disease trends can be incorporated into clinical decision support systems (CDSS) to provide estimates of the likelihood of disease. Fine and others provide an example of how a health care organization can benefit from interconnecting with public health surveillance systems by factoring community-level disease trends into clinical decision support when estimating disease likelihood (Fine and others, 2007). Fine and others found that epidemiological context improved the performance of a clinical prediction rule in distinguishing aseptic from bacterial meningitis. Investigation has also demonstrated that incorporation of local, population-level disease incidence of pertussis into decision models supports the value of integrating large-scale public health data sets with clinical data to improve diagnosis in clinical practice (Fine and others, 2006).

The use of computerized clinical decision support can also help increase the screening rates of identified high risk groups. Steele and others (2005) have shown that the encoding of CDC-published guidelines recommending screening high risk groups for latent tuberculosis infection by raising an alert increased the rate of screening by clinicians.

THE EFFECT OF POPULATION HEALTH INTERESTS ON IT STRATEGY

The health care provider is confronted with four external factors that will impact its strategic plans for IT:

1. Certification criteria to support achievement of meaningful use by eligible providers related to the capability of providing electronic submission of clinical results to public health agencies

2. Federal and state government laws and regulations requiring electronic submission of clinical data for public health interests
3. Federal investment in the development of interoperable public health information systems that will become part of the interoperable infrastructure of state-based HIEs
4. Research findings that demonstrate use of epidemiological findings has a positive impact on the quality and efficiency of health care delivery

IT strategy may look like the strategy outcome presented in Table 10.1.

IT Asset

The main users of EHRs are clinicians, and the main purpose of EHRs is to help manage patient care. EHRs are most commonly touted for allowing for the coordination of a complex array of services and for the electronic checks to reduce medical errors. In turn, HIE is generally focused around the

Table 10.1 IT Strategy to Respond to Population Health Interests

Goal	*IS Initiatives*
Increase quality of care by incorporating epidemiological findings in clinical diagnosis.	Implement CDSS that incorporates epidemiological data from the bidirectional exchange of clinical data to biosurveillance systems. Develop automated reporting methods of cases from lab to infection control practitioners or directly to public health departments.
Improve physician satisfaction by reducing the reporting burden.	Develop automated reporting capabilities that enable the organization to export clinical and lab data to biosurveillance systems and disease registries. Automate delivery of laboratory data to infection control practitioners.
Increase compliance with state guidelines for reporting cases to public health offices.	Incorporate CDC public health guideline recommendations and immunization guidelines into clinical decision support system.

exchange of clinical data between providers of care. However, public health goals would be well served through thoughtful leveraging of these technologies and incorporation of the EHR as a component of the public health IT infrastructure through HIE. For instance, HIE can allow for the integration of Laboratory Information Management Systems-based laboratory data with diagnostic data from clinicians to further investigate trends when cases of infectious diseases are identified.

Chute and Koo (2002) state that public health information should exhibit the following properties:

- Data related to health are collected once in a standard format and then used for multiple health-related purposes.
- Required public health reprint is done automatically as a by-product of health care.
- Data collected for one public health function are available and accessible to all public health functions that are entitled to them.
- All applicable data are geocoded automatically at the point of capture.

EHRs and HIEs EHRs and HIEs offer the infrastructure the necessary capabilities for activities such as early detection and monitoring of infectious disease outbreaks. For example, electronic reporting would increase the timeliness of the reports as compared to physicians taking time to report by phone or fax. The tying of public health information systems to an HIE would yield better statistics that would allow faster recognition of disease outbreaks.

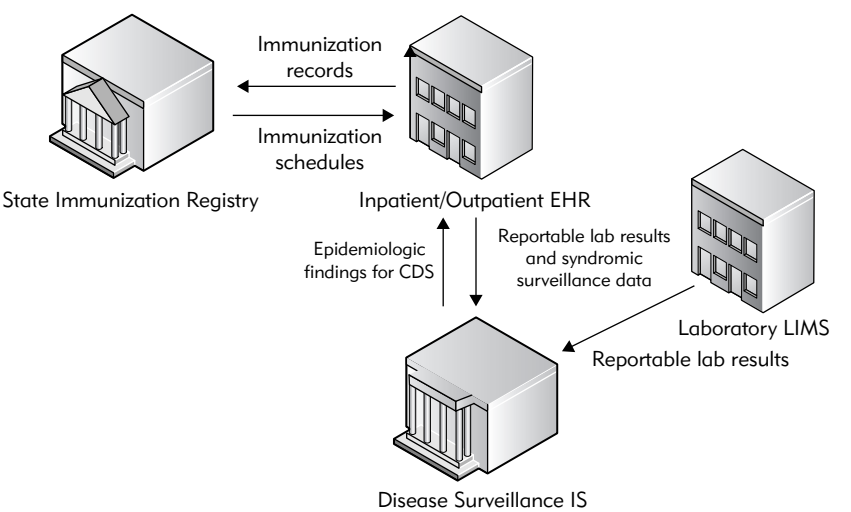
Without the interoperability enabled by HIE, there can be no horizontal integration of state or nationwide disease reporting. In addition, HIE enables the linking of data that provides additional insights necessary for public health assessments. For example, if physician disease reports were linked to lab ordering reports, public health specialists would be able to validate trends between the reports.

The electronic exchange of health care and public health data is challenged by business policies as well as state privacy and security laws. However, meaningful use criteria for public health supports incorporation of HIE capabilities implicit in the functions and services offered in health departments under the auspices of population health.

Federal Initiatives and Meaningful Use It is argued that limiting EHRs and HIEs to encounter-based information is insufficient in providing a comprehensive view of the health of the population as a whole (Hinman and Ross, 2010). Current federal policy is elevating population health issues in importance and providing financial incentives to develop and adopt technologies that support population health.

In particular, the HIT Policy Committee of the Office of the National Coordinator (ONC) identified improvement of population and public health as one of its health outcomes. Meaningful use criteria support the electronic exchange of three main data sets that include immunizations, reportable lab results, and syndromic surveillance. Hospital EHRs will need to have the capability of providing electronic submission of reportable lab results. These lab results will need to be in alignment with state and local law requirements. Both hospitals and other health care providers will need to have EHRs that support the electronic submission of data to immunization registries as well as the electronic submission of syndromic surveillance data to public health agencies in accordance with applicable laws. Figure 10.1 illustrates the exchange of public health data that can be automated between public health institutions and health care organizations.

Figure 10.1 Health Information Exchanges Between EHR and Public Health IS



We will be looking at the role of health care organizations in response to the meaningful use criteria as it applies to population health and to advancement of the following public health initiatives:

- Disease monitoring and surveillance
- Chronic disease
- Immunization registries

DISEASE MONITORING AND SURVEILLANCE

Public health organizations strive to reduce the impact of infectious diseases and therefore to reduce the morbidity and mortality associated with these diseases. The foundation of public health surveillance and disease control lies primarily on effective communicable disease reporting and secondarily on analysis of surveillance data and integration with decision support. Public health surveillance is important in maintaining a baseline reference of endemic diseases (whose presence is constant within a certain geographic area or population) and for rapidly identifying epidemic diseases (that spread rapidly in a particular geographic area or among a particular population). There are two types of surveillance: *passive surveillance*, where clinicians and laboratories report information to public health organizations, and *active surveillance*, where the public health organization takes direct action in collecting the information.

Surveillance systems rely on the clinical data that is collected at hospitals, emergency departments, and laboratories. Data can include the following:

- Changes in the frequency of outpatient visits (potentially representing an increase in population-wide, flu-like symptoms).
- Results of and changes in the rate of submissions of clinical lab tests. (For example, an increase in the submission of stool samples might indicate a gastrointestinal disease outbreak.)
- The request of certain medications that indicate the presence of a disease. (For example, Rifampin, Ethambutol, and Streptomycin in combination will highlight a case of tuberculosis that might require investigation.)

State-level initiatives aimed at increasing control over infectious diseases implement laws, regulations, guidelines, and mechanisms for the reporting of specified diseases diagnosed in inpatient and ambulatory settings such as emergency departments. Laboratories must also report identified cases of communicable diseases. As mentioned previously, these mechanisms are largely manual and rely on the completion and submission of state-based communicable disease reporting forms. The timeliness of the reporting (based on guidelines as to the time between diagnosis and report submission) is critical to identification and mobilization of response efforts.

The CDC often relies on voluntary reporting by health care providers, laboratories, vital statistics offices, and state health departments to maintain a national picture of certain diseases. Data reporting to the CDC and state health departments is often achieved through transmission of files via Internet uploads or fax. For example, the Influenza Division of the CDC created an Influenza Provider Surveillance Network in which sentinel providers (such as state departments) report laboratory-confirmed seasonal influenza cases.

In 2009, in response to state mandates on lab reporting, Partners HealthCare Systems built a high-volume interface to enable high volumes of data and test results on reportable diseases (such as STDs, tuberculosis, and gastrointestinal diseases) from five of its affiliates to the Massachusetts Department of Public Health (MDPH). The MDPH created a Web service hospitals could call to transmit their data. Partners built an automated solution leveraging its existing lab data repository and in-house expertise of a third-party vendor platform. A rule engine sifts through the lab data and reports only on those results that match the data that is associated with communicable diseases. With this solution Partners is able to send updates every three to eight hours and achieve near real-time automated reporting and processing on the order of 250,000 messages each day. An average of eighty messages each day are passed from all Partners sources on to the MDPH. This allows MDPH to get the earliest possible warning on potential epidemics without increasing clinician reporting burden, to streamline the intake in a central repository, and to improve the reliability of the reporting received.

CHRONIC DISEASE

Chronic diseases are the leading cause of disability and death across many states. Population health interventions may focus on multiple factors that contribute to chronic diseases, such as tobacco use and socioeconomic and clinical factors. The first step lies in identification and education of chronic disease-bearing subpopulations (Kukafka and others, 2007). Current federal support for chronic disease programs includes establishment of support through the PPACA to expand and enhance the epidemiology of Congestive Heart Failure (CHF), including organization of a National Congenital Heart Disease Surveillance System (Sec. 10411).

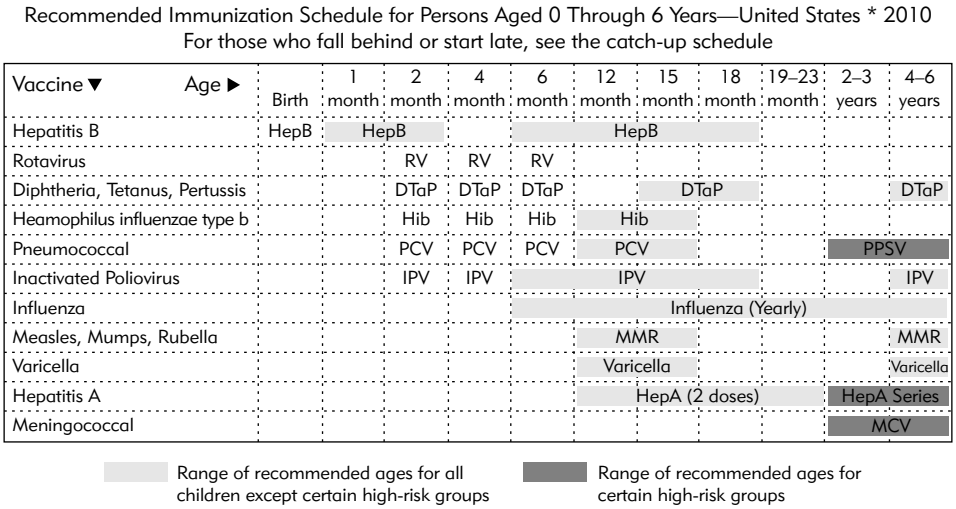
Health information systems can have significant impact on population health initiatives surrounding chronic disease patients. Chapter Six describes a few Partners initiatives undertaken by the disease management team of its high performance medicine framework that illustrate how clinical information systems provide for the effective identification and management of chronic disease patients.

IMMUNIZATION REGISTRIES

The CDC maintains immunization practice guidelines that are annually reviewed by the Advisory Committee on Immunization Practices and that outline the recommended vaccine schedules for children and adults. Figure 10.2 illustrates one such schedule for persons aged zero through six years of age for 2010. Moreover, most state public health offices require the reporting of immunizations to patients less than nineteen years of age. Health care providers respond to state-level mandates of health code reporting requirements. Billing or clinical information systems may be leveraged to extract the necessary data, although this is often achieved through the submission of forms, electronic or otherwise.

Multiple public health initiatives exist whose goal is to maintain population immunization information systems. These registries maintain immunization status and records of its members. Although many immunization information systems have some degree of ability to interact with

Figure 10.2 Immunization Guidelines Example



EHRs through weekly batch uploads, few do so seamlessly in real time (Hinman and Ross, 2010).

Incorporation of an HIE into the framework of the state health information system allows for the centralization of immunization records and automates the process of updating immunization events for a given patient. In turn, providers benefit, as they no longer have to handle immunization record requests. At the state level, the benefit lies in elimination of preventable diseases in the state as well as elimination of overimmunization.

The CDC guidelines have been identified as prime targets for dissemination into EHR systems as electronic alerts (Rippen and Yasnoff, 2004). As of May 2010, at the Brigham and Women's Hospital (BWH) and Massachusetts General Hospital (MGH) outpatient EHR, the Longitudinal Medical Record (LMR) had incorporated CDC guideline alerts for immunization schedules. The LMR provides a link with direct access to all CDC-recommended vaccination schedules based on age group. In addition, CDS implements rules for flu vaccines and pneumovax status, highlighting suggested actions for clinicians. For example, if a patient older than sixty-five years of age is identified to be at high risk and has not received a pneumovax vaccine, the clinician will be reminded upon login to the patient's record in the LMR.

SUMMARY

Health care reform efforts recognize the importance of population health in ensuring the overall health care of the country. This is evident in many of the initiatives that authorize spending and in the inclusion of health information interoperability with public health organizations.

The integration of provider EHRs with laboratory and population health information systems will facilitate real-time reporting, giving investigators of disease outbreaks the necessary lead time to roll out disease control efforts and education campaigns.

Health care organizations will need to implement EHR functionality that supports population health interests and to evaluate the beneficial impact of bidirectional data exchange.

KEY CONCEPTS

Disease monitoring and surveillance

Immunization registry

Laboratory information management systems

Meaningful use

Office of the National Coordinator

Public health

DISCUSSION QUESTIONS

1. Strategy evolution, Phase II of IT implementation efforts, has three major classes of activity: continuous improvement of processes, leveraging of data, and system extension. Discuss ways that Phase II of recent IT implementations can be directed to address public health interests in your organization.
2. The characteristics and capabilities of the various components of the IT asset change in relative importance based on the nature of the IT undertaking. What characteristics and capabilities are especially important to an organization that must increase its emergency preparedness?

11

Synthesis of Information Technology Strategy

The chapters in this book have covered two major areas.

Chapters One through Five (the first area) discussed the broad range of IT strategy and reviewed the linkage of organizational strategy to the IT strategy, the IT asset, organization-centric IT characteristics and capabilities, and IT strategy considerations.

Chapters Six through Ten (the second area) examined specific examples of IT strategy. These examples largely drew upon the experiences of Partners HealthCare and covered high performance medicine (HPM), personalized medicine, service-oriented architecture (SOA), health care reform, and population health. Each of these chapters touched on aspects of the material covered in Chapters One through Five.

In this chapter we bring these two areas together, and compare the examples using the IT Strategy Scope framework illustrated in Figure 1.1, where the core focus of the IT strategy is the IT asset (applications, infrastructure, data, and IT staff) represented by the inner circle, contained within the capabilities

and characteristics that enable organizations to be effective in their IT pursuits (IT governance, IT relationships, innovation ability, and change management) represented by the middle circle. These two areas are in turn contained within the conclusions and considerations for IT strategy (the need for complementary strategies, the need to manage IT-enabled value into existence, and the nature of IT as a source of competitive advantage) represented by the outer circle.

IT ASSET

All of the examples discussed in Chapters Six through Ten had to address all components of the IT asset because changes to the IT asset are the central outcome of IT strategy development.

Applications

HPM pointed to the need for an electronic health record (EHR) and for medication administration systems. SOA addressed application characteristics of agility and integrability. Personalized medicine determined that Gateway for Integrated Genomic-Proteomic Applications and Data (GIGPAD) needed to be created. The work on new care models identified the need for disease registries and collaboration software.

In general, the application asset discussions for each example focused on supporting core processes, such as medication ordering or care coordination. The SOA example also had a process orientation, but it viewed processes as having distinct elements and common elements and as using services to support the common elements. For example, the processes of procedure ordering and population management have distinct application capability needs, but both need to have access to a patient's medication list.

In several cases the strategic discussion led to a decision to internally develop the applications. This decision occurred when it was determined there was limited understanding of the mature form of the application and that achieving maturity would involve a series of prototypes and early efforts that would evolve based on feedback and real use. This limited understanding applied to personalized medicine but did not apply to several

systems implemented through HPM, such as Computerized Physician Order Entry (CPOE) for community hospitals.

In two cases the application strategy focused on partnerships. SOA leveraged a codevelopment relationship with Siemens. For personalized medicine, i2b2 created open source software that is now used by several dozen academic health centers. In both cases the application asset strategy discussion concluded that applications would achieve maturity faster if the financial resources and expertise of others could be brought to bear.

One way to determine the strategic importance of a specific application is the number of times that application appears as an important contributor across diverse strategies. All of the examples require implementation of the EHR, and the EHR is an important contributor to all of the examples. On the other hand GIGPAD's contribution is confined to one strategic example. The centrality of the EHR means it should receive a healthy amount of organizational IT resources. The centrality also means governance of the future direction of the application will be challenging since a lot is being asked of the application.

Infrastructure

Personalized medicine identified computational clusters and very large storage capacities as essential to achieving the goals of the research component of the strategy. HPM discussions highlighted the importance of a very high reliability and high performance infrastructure given the increased dependence of care provision on these systems. The SOA effort determined there was a need for system software that could manage the security and version control of services along with technology to support the messaging between services.

At times a specific IT strategy does not point to an unusual or material change in infrastructure capabilities and characteristics. However, when these changes are identified they are often diverse across strategies. For example, SOA requires integrability, personalized medicine requires potency, and HPM requires reliability. An overall infrastructure challenge can be delivering targeted infrastructure capabilities and characteristics without having to require that all of the infrastructure address that need. For example, although

personalized medicine may require high performance computing, a departmental application does not, and it would be expensive and pointless to supercharge the departmental application.

IT Staff

HPM required the addition of IT staff to provide EHR-centric workflow analyses, application development, support, and training. Personalized medicine required the recruitment of staff with a reasonable understanding of genomics and a core of medical informatics and bioinformatics talent.

SOA necessitated staff who understood the concepts and technologies in the SOA space. In addition, SOA was very dependent on medical informatics staff who could guide the design of services such as a medication service. (For example, how should families of medications and medication ingredients be represented in our applications?)

The staff asset discussion may note that, although all staff are important, some staff are more important than others. While not explicit in the discussion of the examples, four classes of staff have elevated importance to the organization:

1. Staff who are applied across several strategies. For example, medical informatics staff were important contributors to all of the examples cited in Chapters Six through Ten.
2. Those staff members who would be regarded as the *chief smart persons* in a domain that is strategically important. In the examples, a small number of people provided the intellectual and creative IT leadership for the initiative.
3. Staff who are very skilled at managing complex initiatives. Strategy is important, but execution can be more difficult. Staff who can manage great ideas into existence are essential.
4. Managers who inspire, lead, and manage well are essential if the overall IT asset is to be defined correctly, planned for, implemented, and evolved.

Data

The data asset was a factor in all the examples. However, the focus of the data strategy was diverse. SOA was concerned with the vocabularies and operations on the data (for example, retrieve data, which would be performed in data-oriented services such as allergy identification, prescriptions, problems list, and immunization services).

Personalized medicine examined conventions for storing genomic and proteomic data. This initiative is also beginning to grapple with the challenge of changes in data meaning over time. For example, the importance of a mutation, previously captured from a patient, may not be known until years later when new discoveries emerge from clinical research. How does one handle new insights into data meaning that occur over long periods of time?

As was discussed in Chapter Nine, episode and bundle payment mechanisms place a significant importance on data with regard to care costs, quality, and safety. This data must often be integrated across the boundaries of provider organizations.

The various strategies covered the gamut of the data asset; change in data models (to address change in reimbursement), development of vocabularies and data structures (for SOA and personalized medicine), and the expansion of the boundaries of data to include new types of data (adding clinical decision support rules as a class of data for HPM). Although the range of impact on the data asset was wide across the examples, the overall core outcome was the very significant elevation of the strategic importance of data in the eyes of the organization.

IT-CENTRIC ORGANIZATIONAL CHARACTERISTICS AND CAPABILITIES

All the specific examples of IT strategy had to establish the basic elements of governance. A committee provided oversight of the initiative and prioritized projects, addressed issues and problems, refined the direction of the initiative, and communicated with others. In every example, individuals were appointed who had accountability for management of the initiative.

The scope of the governance structure was diverse and was largely determined by the near- and intermediate-term contribution of the initiative to the organization's strategy and its impact on current operations.

HPM touched the daily life of virtually all physicians and nurses at Partners. Hence the HPM Executive Committee was composed of clinical quality leaders who engaged in frequent consultation and communication with a diverse set of clinician leaders and leadership forums. The HPM complementary strategy (discussed in Chapter Five) of managed care contract incentives and eventual mandated use of the EHR involved discussions with the Partners Board given the impact of these decisions on payer relationships and medical staff relationships.

On the other hand, the SOA initiative centered on a rearchitecting of Partners clinical information systems that included replacing current clinical databases and interfaces with services. Although the results of the rearchitecting were visible to clinical staff, the effort had limited direct impact on provider workflow or income. As such, the governance of SOA was composed of the IT chief technology officer (CTO), chief information officers (CIOs) from several of the Partners member hospitals, and technology and medical informatics leadership. And although the SOA program was discussed by the board and in a wide range of internal forums, governance was limited to the IT organization.

The governance approach was also influenced by formulation of the HPM strategy to improve care delivery. As such, the composition of governance forums and leadership were largely drawn from the medical and nursing staffs. SOA was formulated as an application characteristic and infrastructure retooling. Hence the SOA effort was managed by the Partners chief technology officer. Personalized medicine had a person responsible for the research component (depicted in Figure 7.3) and another person responsible for the clinical component. This represented the formulation of personalized medicine as a parallel but intertwined strategy of advancing research and patient care.

The scope and extent of necessary change management varied across the examples. SOA required changes in the skills of IT developers and analysts and the staff that supported systems software. Personalized medicine (at the

time of the writing of this book) had not made its way broadly into the routine provision of care. Both of these examples (SOA and personalized medicine) involved modest and *narrow* change management.

HPM touched the work life of the vast majority of clinicians. However, HPM was accompanied by somewhat modest process redesign. Although the introduction of the EHR did require extensive communication with providers and the training and support needed to acclimate to the EHR, the change effort did not require extensive process change, organizational rearrangements, and role alteration.

Accountable care organizations (ACOs) and other new care models are likely to require extensive change management. ACO formation generally involves the strengthening of physician skills and capabilities for managing populations of patients. Decisions may be made that shift care responsibilities from physicians to other health professionals. Providers who previously have had loose referral relationships may form more integrated relationships involving shared risk. These kinds of changes are deep and difficult, placing a material emphasis on change management.

GOVERNING CONCEPTS

The governing concepts applied to the formulation and implementation of the IT strategies in the examples were critical and diverse.

HPM is an example of a traditional but important concept that IT can be leveraged to improve the quality, safety, and efficiency of inpatient and outpatient care processes. HPM led to the use of decision support logic to reduce medication errors. Data that is generated by an EHR can be analyzed to understand variations in care and identify best practices. This overall concept is widely embraced by the health care sector.

HPM was also founded on the principle of targeted, incremental, and ongoing improvement of care. Several provider organizations will use IT in an effort to achieve relatively quick, broad, and deep care transformation. Implementation of an EHR is accompanied by (and generally led by) an organizational effort to *transform care* across all care settings and across a large set of care processes.

HPM, in contrast, established a foundation of outpatient EHRs and inpatient CPOE that did not attempt to simultaneously effect broad change. Rather, HPM focused on installing an IT foundation (see Chapter Six) upon which a never-ending series of care improvements could be initiated. HPM provided an initial set of efforts targeted to specific care improvement goals, such as to reduce the cost of medications.

HPM involved choosing between the governing concepts of broad transformation versus an ongoing series of targeted improvement efforts that leveraged an electronic health record foundation.

SOA was based on the governing concept of applications as collections of components or services. Moreover, SOA envisioned the integration of applications as being based on the shared use of a core set of data-oriented services (for example, a problem repository) and logic-oriented services (for example, comparing two medication lists) as distinct from the alternative approaches to achieving integration by using a common application suite or by relying extensively on interfaces.

Personalized medicine noted that care will be increasingly based on knowledge of a patient's genome and proteome. However, the personalized medicine IT strategy also recognized that use of personalized medicine in care delivery is very early and there is much that is not known. For example, there is limited understanding of how to present a series of genetic test results to the physician, and the coding conventions for proteomic data are not standardized.

As a result, the personalized medicine initiative was framed as *experimental* with initial efforts involving tight linkage between researchers, clinicians, and informatics staff; partnerships were pursued to assist with funding and the provision of needed expertise. A significant portion of the IT work was based in an academic group and involved medical informatics and bioinformatics staff who had significant academic training and *real* clinical, research, and operations experiences.

These examples illustrate the exceptional power of governing concepts. A view of care improvement through IT as a quick, broad, and deep set of changes would have resulted in a very different HPM formulation and implementation set of strategies. A view of applications as monolithic suites would have not led Partners to embrace SOA.

Governing concepts tend to revolve around two major axes. The first is the interpretation and understanding of factors external to the organization. Medical practice based on knowledge of a patient's genome is interpreted to have a potentially dramatic impact on care delivery. The information technology industry is seen as moving to SOAs.

This interpretation requires that the organization identify reasons a factor has importance. Concerns about health costs and quality will lead to greater societal demand for accountability, and therefore ACOs are likely to become fixtures of the health care sector. Application agility and integrability will increasingly be critical characteristics as the organization tries to do more with IT in a constrained budget environment.

The second axis is the nature of the organization's approach to the first axis. The organization can decide that it must experiment and learn since the external factor is not well understood and the organization has the time to learn. Or the organization can decide to wait until maturity arrives and then pursue its plans.

The organization can decide that deep change is best accomplished incrementally, or it can decide that it must move quickly and decisively. Either choice of change reflects a belief about how best to accomplish change.

COMPLEMENTARY STRATEGIES

Complementary strategies center on creation of an organizational capability or external environmental context that enables or supports a strategic IT initiative to succeed.

The complementary strategies in the examples were diverse. HPM initiated changes in payer incentives to physicians, encouraging them to adopt EHRs. Personalized medicine and SOA leveraged existing Partners business development capabilities to help form external partnerships. A provider desiring to be a Patient-Centered Medical Home could decide to actively support state HIE efforts, since data exchange capabilities are essential for these homes.

There are several categories of complementary strategies. One category focuses on increasing the financial reward or business or clinical value from the IT initiative. Increasing reimbursement for EHR and leveraging business

development skills to provide royalty or equity *upsides* to codevelopment arrangements are examples. Any organizations or individuals are interested in a financial return from their investment, and the return can be a significant motivator for those who must bear the expense and difficulty of IT implementation and use.

A second category centers on improving the efficiency or *time to market* of the strategy. Formation of the New England Healthcare EDI Network (discussed in Chapter Five) created a collaboration that developed an insurance transaction exchange infrastructure. This collaboration reduced the costs of all participants through amortization of the infrastructure costs and the reduction in coordination effort. The collaboration also enabled the development of exchange capabilities to move faster since conversations took place in one forum rather than in many forums.

The third category emphasizes the ability of the initiative to innovate. Establishing the personalized medicine initiative as a joint academic and clinical undertaking brought academic collaborations and openness and deep investigator and industry talent to the initiative. This academic tone and culture encourages experimentation and innovation. Personalized medicine is an example of an IT strategy where progress is needed, but the mature form of the initiative is unclear and the path to that form is uncertain. Experimentation will be necessary as the organization evolves incrementally.

A fourth category would focus on removing significant barriers to the IT strategy. These barriers can be diverse. Limitations in information technology may hinder a strategy. For example, the processing and storage demands for research into the genomic bases of disease can be startling. The high costs of medical devices for home use can prevent widespread use of these technologies for chronic disease management. In cases such as these, partnerships with industry can strive to create the next generation of technology.

Regulations can serve as barriers. For example, until recently it was illegal in several states to sign a prescription electronically. In some states patients have no legal right to see a copy of their medical records. These regulatory and legal barriers may need to be removed or mitigated, and a complementary strategy can involve the organization working with other organizations with similar needs to effect changes in the law.

The presence or absence of a sufficient installed base of applications can also serve as a barrier to the fulfillment of IT strategy. Population health interest in faster access to data from physician practices is currently hindered by the low adoption of EHRs. Therefore, the population health community was very active in promoting its needs as items in the initial definitions of meaningful use.

STRATEGY EVOLUTION

All of the examples demonstrate strategy evolution. HPM moved from implementation to effective use of EHRs. Personalized medicine is beginning to move from experimentation to introduction in clinical settings such as oncology. SOA is moving from service creation to service implementation.

Strategy evolution results from a small number of factors. At times the evolution is a consequence of a strategy having gone as far as it can go. The organization asks itself, "Now what?" The strategy evolution situation discussed in Chapter Five is an example of the accomplishment of one strategy and the creation of that strategy's successors. Once EHR implementation has been completed the organization moves on to strategies that leverage that accomplishment through care improvement, secondary use of data, and heightened emphasis on engaging the patient in the care process.

At times the organization's context influences its evolution. For example, the SOA strategy reflects a broad information technology industry movement toward service-oriented architectures. IT suppliers were offering technologies that supported service creation and management. Diverse industries such as banking, transportation, and retail were discovering ways to use services to augment their legacy IT investments. This industry context brought an understanding of the potential gains of using SOA that could be realized by Partners.

Accountable care organizations and new care models are an outcome of efforts by the health care sector to establish new care provision arrangements and reimbursement systems that would lead to material gains in care efficiency and quality. With a broad industry movement along these directions, in some ways Partners had no choice but to develop strategies that enabled it to move with the health care tide.

Advances in science were illuminating the relationship between people's genetic makeup and their likelihood of disease and treatment response. These broad and profound advances highlighted an evolutionary opportunity.

Evolution will also occur because the organization learns as it implements its strategy. Some initiatives will be successful, whereas others will have limited value. Management, monitoring the progress of its strategy, will alter its course. Generally course corrections are tactical. At times, however, course corrections are more substantive and will require new strategies. Such strategy evolutions can result from initially imperfect strategies or can occur when the organization learns it does not have the competencies needed to execute its original plan and needs to find a plan that plays better to its strengths.

THE REALIZATION OF IT-ENABLED VALUE

In all of these examples IT-enabled value was being pursued. The value was diverse and included reductions in medication errors, increases in efficiency of reporting to public health agencies, and enhancements in care quality analyses.

This diversity was largely centered on improving organizational performance, including tangible and intangible improvements in core processes and information management. However, a central focus of the IT strategy examples was increasing organizational competence in realizing value from a particular class of IT.

Implementation of the outpatient EHR established a foundation that would enable Partners to be more effective and efficient in effecting an ongoing set of improvements to care quality, safety, and efficiency. SOA was intended to improve the ability of Partners to integrate applications and efficiently develop new applications. Personalized medicine established a portfolio of clinical and research applications and infrastructure that would allow Partners to be more effective in obtaining research grants and tailoring its care based on information about a patient's genome.

Just as a strong IT asset can enable the organization to be more effective across a wide range of IT undertakings, many IT strategies have a dual intention: to provide near term gains in performance and to increase targeted

organizational IT competencies that can be leveraged in future initiatives. For example, SOA enables Partners to not only achieve near term improvements in application integration but also to be more competent in minimizing the cost and time of future application integrations.

At times the organization will decide to be an early adopter of technology or to pursue an IT initiative for which there is little industry experience. Why would they do this? Being an early adopter is expensive. The organization *learns the hard way* about the maturity of the technology and about the ability of the technology to provide value. Those organizations that are fast followers or late adopters have the benefit of learning from the pioneers and of avoiding many of the pioneer's mistakes.

There can be a strategic value to being an early adopter. In the examples, the pursuit of SOA and personalized medicine are examples of early adoption. Early adoption can be intelligent when the following criteria are satisfied:

- The technology or its use holds great strategic promise.
- The organization seeks to mold the direction of the technology (which it can so long as the technology is immature and so long as it is assisted by industry and grant partnerships).
- The organization desires to attract a nucleus of talent (that finds the innovation to be exciting and professionally rewarding) and to begin to develop experience and expertise with the technology.

The organization has decided competence in an IT area is strategically critical and, by being an early adopter, the organization will have an advantage if it can attract the necessary talent, mold the direction of the technology, and acquire competency before others do. The value of this competency can dwarf the value achieved by near term improvement in processes and information management.

This type of value must be managed if it is to be sustained. For example, pursuing the acquisition of in-house innovative competencies will require implementation of talent retention strategies once the technology reaches a level of maturity and begins to be adopted by other organizations.

In addition, the organization that decides to be an early adopter of a technology can improve the strategic value of this initiative through complementary

strategies. The creation of business development capabilities that engage in intellectual property and venture activities will allow the organization to further leverage the value of innovative technology. For example, an organization that succeeds in molding the direction of an innovative technology might decide to engage in licensing strategies or to develop a monitoring program to identify new, related patents before launch.

Finally, leveraging this type of value may involve strategy evolution. For example, the organization might decide to leverage its nucleus of talent by providing consulting services to organizations that are fast followers (or late adopters) and are seeking to learn from the pioneer's experience.

IT AS A WAY TO ENHANCE COMPETITIVE POSITION

An important strategic understanding sat at the foundation of the strategy of HPM. Although Partners HealthCare will always strive to be efficient and reduce the costs of the care it delivers, it will never be the lowest cost provider in its service area. If nothing else, Partners research and teaching missions will require that it bear costs for which it may never be fully compensated. On the other hand, Partners has a reputation for very high-quality care, a reputation that has been earned by its founders, Brigham and Women's Hospital and Massachusetts General Hospital.

In addition to specific care improvement goals, such as improving medication safety, the HPM investments were targeted to provide the IT foundation necessary to engage in process changes needed to effect ongoing improvements in quality (for example, managing patients with complex chronic diseases). In addition, HPM emphasized expanding the ability of Partners to acquire and analyze data on its care quality that would lead to an understanding of where to focus the next wave of care improvement efforts.

Partners would remain competitive if it were able to strengthen (and prove) its reputation for quality. HPM was envisioned as advancing that position.

SOA was envisioned to enable Partners application development to move faster and be more efficient due to the reuse of specific services for new

applications. Such speed and efficiency gains should enable it to be more competitive in applying IT strategically.

In a similar fashion, personalized medicine foresaw the implications of care based on knowledge of a person's genome and proteome. Diagnoses, predictions, and treatments based on this information could enable extraordinary improvements in care quality and efficiency. Therefore, an early investment in this area was seen as strengthening the competitive position.

Moreover, increasingly large amounts of federal government- and industry-sponsored research were being directed to support understanding of the relationships between the genome and proteome and between disease and treatment efficacy. For Partners to remain a competitive research organization, it would need to invest in the related research infrastructure.

Personalized medicine also had a unique ability to provide a competitive opportunity by leveraging the synergy between patient care and research. For example, Partners faces competition from community hospitals that often deliver terrific secondary care for lower costs. The majority of Partners patients need secondary and not tertiary care. Therefore, it faces very real competition for most of its patient care business. Partners also faces competition from independent clinical research organizations. These organizations can often conduct this class of research faster and for less money than Partners can.

In some ways Partners does not have differential competitive assets for the delivery of most patient care and the performance of an important class of research. However, if Partners can effect a synergy between its care and its research it would have a differential asset. Community hospitals do not perform research. Clinical research organizations do not perform care.

Personalized medicine (as seen in Figure 7.3) is based on an effort to effect a synergy between care delivery and clinical research where leveraging EHR data reduces the cost and increases the rapidity with which research is conducted. The rapid transfer of research knowledge into routine practice could enable care quality and efficiency to be significantly higher. Personalized medicine represents an effort to become more competitive through the creation of process and data synergy between core capabilities and assets.

SUMMARY

Across a range of IT strategy examples one sees the linkage of the organization's strategy to its IT strategy, initiatives designed to alter the IT asset, efforts to improve organization-centric capabilities and characteristics, and the judicious use of strategy considerations developed from the lessons of others.

One also sees significant diversity across these strategy examples. All of the examples required governance, but the governance approaches were different. Governing concepts were very important for most of the examples, but the concepts were diverse. Some examples involved significant technical infrastructure change while others did not.

IT strategy development will never be a cookbook exercise. The ability of IT to be effectively applied across a very wide range of strategies, contexts, and organizational needs means that the strategic application of information technology in health care organizations will always require skill, thoughtfulness, and art. Nonetheless we hope the discussion of the framework and the strategy examples introduced at the beginning of this book provide insight and hope and significantly improve the ability of the health care field to use IT to improve care.

DISCUSSION QUESTIONS

1. Compare and contrast the IT asset strategies that might result from an organizational strategy of becoming an accountable care organization with a strategy to become a low-cost provider of care.
2. Compare and contrast the IT change management and governance requirements of an organizational strategy to form an integrated delivery system that has high degrees of process and data standardization across all aspects of care, versus a delivery system that emphasizes local autonomy except for high degrees of standardization for oncology and cardiac service lines.

3. Compare and contrast the possible evolution of a provider's IT strategy in a reimbursement climate that tightly regulates provider payment with a reimbursement climate that makes the patients shoulder a very large portion of the costs of the care they receive.
4. Compare and contrast how a small community hospital might use information technology to improve its competitive position, versus how a large academic medical center might use IT to pursue a stronger competitive position.

NOTES

Chapter 3

1. This section adapted with permission of Healthcare Financial Management Association from Glaser, J. P., and Stone, J. "Effective Use of Business Intelligence." *Healthcare Financial Management*, February 2008, 62(2), 68–73.

Chapter 5

1. This section adapted with permission of Healthcare Financial Management Association from Glaser, J. "The Importance of Companion IT Strategies." *Healthcare Financial Management*, April 2009, 63(4), 38–42.
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Chapter 8

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GLOSSARY

Accountable care organizations	Models of care that foster integration and coordination of care across providers and settings while promoting accountability for overall care of the patient.
Application system characteristics	Properties that applications should possess (for example, supportability and agility).
Bundled payments	Payments that assign a price for all services delivered to a patient during a defined episode of care.
Change management	The ability to manage significant change in organizational culture, processes, and/or business models.
Chief information officer	The executive who is responsible for leading the organization in its efforts to apply information technology to advance its strategies.
Complementary strategies	Organizational initiatives that do not inherently involve the IT asset but are needed for the IT strategy to succeed.

Data characteristics	Attributes that the organization's data should possess (for example, accuracy and timeliness).
Factors contributing to effective IT use	Organizational factors that facilitate organizations in developing remarkable IT prowess; factors include leadership, the relationships between the IT department and the rest of the organization, and the ability to innovate.
Formulation	Decisions about the mission and goals of the organization and the activities and initiatives it will undertake to achieve them.
Governing concepts	How the organization views a particular IT challenge or opportunity.
High performance medicine	A Partners HealthCare initiative to improve the quality and effectiveness of medical care. This framework is made up of five teams, each of which holds responsibility for meeting one of five core strategies.
Implementation	Decisions about how an organization structures itself, acquires skills, establishes organizational capabilities, and alters organizational processes to achieve the goals and carry out the activities defined during the formulation of its strategy.
Information technology asset	The core focus of IT strategy (includes applications, technical architecture, data, and the IT staff).
Internal organizational characteristics and capabilities	IT-centric organizational attributes that have a significant influence on the effectiveness of an organization in applying IT.
IT as a way to enhance competitive position	The identification of goals in ways that are materially superior to the ways that a competitor has defined them, and the development of ways to achieve those goals and capabilities that are materially superior to the methods and capabilities of a competitor.
IT governance	The distribution of the responsibility for making IT decisions, the scope of the decisions that can be made by different organizational functions, and the processes to be used for making decisions.

IT staff strategic components	Areas of the IT staff that require strategy; attributes of the staff, core staff capabilities and competencies, and organization of the staff.
IT strategies based on assessment of strategic trajectories	Deriving the IT strategy from a review of long-term visions for the organization.
IT strategies based on continuous improvement of core processes and information management	Deriving the IT strategy from assessments of core process performance and gaps in information needs.
IT strategies based on examination of the role of new technologies	Deriving the IT strategy based on the potential contribution of new information technologies.
IT strategy derived from organizational strategies	Deriving the IT strategy directly from the organization's goals and plans.
Linkage	Ensuring the organization develops its information technology (IT) goals, activities, and plans in a way that leverages the organization's ability to carry out its overall strategies.
Patient-Centered Medical Home	Model of care that facilitates partnerships between all providers involved in the patient's care delivery.
Personalized medicine	Use of a patient's genetic and molecular characteristics for the diagnosis and treatment of disease that allows for the identification of treatments targeted to the uniqueness of each patient.
Public health	The practice of preventing disease and disease-burden of communities through surveillance, promotion of healthy behaviors, and community-wide disease outbreak prevention and health access initiatives.
Realization of IT-enabled value	Steps that organizations should take to ensure the IT investment delivers the desired gains in organizational performance.

Service-oriented architecture	An approach to putting together applications that views applications as composites of reusable application pieces. These pieces perform a well-defined function and have well-defined specifications for integrating that piece with other pieces.
Strategic vectors	Different perspectives and approaches used by the organization to determine its IT investment decisions.
Strategy	The determination of the basic long-term goals and objectives of an organization, and adoption of the course of action and the allocation of resources necessary to carry out those actions.
Strategy evolution	The change in IT strategy that will occur over time because of changes in the environment, completion of current strategies, and organizational learning.
Technical architecture capabilities	Attributes of the infrastructure that can be leveraged by a wide range of applications or represent a narrow but significant addition to *what one can do.*
Technical architecture characteristics	Properties that the IT infrastructure should possess (for example, reliability and supportability).

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