

LEVERAGING THE INFORMATION INFRASTRUCTURE

**CRITICAL FOUNDATION
FOR BUSINESS STRATEGY**

BY RICK DOVE

Webster defines infrastructure as: “An underlying base or foundation, especially for an organization.”

In electric utilities, infrastructure typically means the equipment, systems, and wires used to generate, transmit, and distribute electricity. A utility’s business activity also has an infrastructure—one that enables and constrains value creation. Value creation relies mainly on two intangible assets: information and human capital. The right information in the right place at the right time determines how productive and effective people and processes can be. Productivity is tied to information availability and timeliness; effectiveness is tied to information quality.

As corporate managers, we need to be sensitized to the importance of critical infrastructure. Corporate infrastructure, like community and national >

infrastructure, determines and sustains identity and capability: what we are and what we can do.

At the national level, 9/11 precipitated the formation of the Department of Homeland Security—a custodian chartered to focus on critical infrastructure. A new department isn't needed at the corporate level, just a new awareness and focus. Moreover, the nature of the corporate focus must be broader. In addition to security, the corporate focus needs a proactive component, one that consolidates and amplifies the strategic leverage of infrastructure. Whether it's lowering costs, introducing new revenue-generating services, or growing through mergers and acquisitions, information access and flow has emerged as a key determining success factor.

Corporate information infrastructure has become a vital asset, but regulated utilities have been slower than most companies to recognize and respond to that. Some say this is the result of regulation; another significant factor is a management legacy of power engineering. The information technology integration mess at most utilities is well-known as a source of unnecessary business cost, a roadblock to best-practice upgrades, and a cause of business inefficiency and customer dissatisfaction; yet few have made a strategic effort to attack the problem.

"We don't know how to deal with it," is a common complaint. Remove the frustration, and what's being said is that safe, affordable migration paths are elusive. The reality, however, is that there are successful approaches and paths to consider that show the way to building an affordable, manageable information infrastructure in a legacy environment.

Three Related Imperatives

Information technology is today's leverage point for business performance, innovation, best practices, and regulatory compliance. Corporate use of information technology as strategic leverage is the first of three related imperatives, and drives the other two. The three imperatives are:

1. Leverage information technology as business strategy
2. Include and value IT department expertise in corporate decision-making bodies
3. Create trust in IT department capabilities.

These imperatives are related because you can't accomplish the first effectively if you don't have the second, and you won't do the second if you don't have the third. It's important to note that the first and third are also related because both are enabled or inhibited by the nature of information infrastructure. Leverage is the amplification of capability, which is only possible when the infrastructure enables it. Trust is the product of predictability, which is virtually impossible when the infrastructure impedes it.

Xcel Energy's former chairman, Wayne Brunetti, stated the case in a recent article in *EnergyBiz*

Magazine: "I'm not going to get linemen to climb poles any faster or meter installers to put in meters any faster. The future of productivity improvements has to do with the systems we use to plan, buy, and schedule things for our crews and our company."

Consider what's in the pipeline: Automated Meter Readings (AMRs), distributed generation, Broad-Band-Over-Power-Line (BPL), demand pricing, intelligent appliances, improved reliability automation, improved outage management, wireless-connected field crews, cyber security, Supervisory Control And Data Acquisition (SCADA) on the network, grid-connect responsibility, Sarbanes-Oxley compliance, and more. All of this is information technology-enabled and dependent. All this impacts operating cost and revenue opportunity; it is also the core of today's business performance and strategic leverage.

The potential benefits of AMRs and Outage Management Systems (OMSs) are compelling: better service and lower costs. Vendors stand ready with a variety of approaches. Many utilities have already committed and many more are weighing the alternatives.

Annual planning easily includes these programs as priorities for consideration. Budget proposals address evaluation, acquisition, and installation for both the equipment and enabling information technology. Program costs, benefits, and risks are evaluated. Cost/benefit ratios are compelling. Risks, however, are another matter.

Traditionally, the corporate IT department has been budgeted, staffed, and managed as a tactical support function. This legacy has become a risk, evidenced by increasingly common demands that companies improve governance, install IT department expertise at the board level, and include the CIO in business strategy councils. (For more information, see "Information Technology and the Board of Directors," in the October 2005 issue of *Harvard Business Review*.) Addressing this capability shortfall is the second of the three related imperatives.

The third imperative belongs to the CIO, where new skills and practices are needed. Governance (get your act together), business strategy (become an executive team player), and communication (help us understand what you know) are key skills CIOs need today.

In the area of governance, the focus is on getting information technology projects completed on time and keeping them aligned with corporate goals.

According to a 2005 Gartner survey of 1,400 CIOs, two-thirds of their companies are actually raising their IT budgets faster than their operating budgets for the first time in years.

"It's not so much that they're expecting miracles [from technology] as much as they're expecting serious contribution and significant results," says Mark McDonald, Gartner's head of executive programs

research, in a *BusinessWeek* interview.

Increasingly, McDonald notes, CEOs realize that technology, when used appropriately and in concert with changed business processes, can deliver a strong ROI. The contributions of the CIO, who must ensure the IT department is efficient and in tune with business goals, can make or break a company's performance. Accordingly, CIOs in successful organizations tend to report directly to the CEO, while in underperforming firms, they report to other officers.

Information Infrastructure

The physical part of information technology infrastructure (equipment, systems, and wires) supports information storage (databases), transformation (applications), and delivery (networks); the value-creation part is the information infrastructure. All companies have an information infrastructure. How it's constructed determines whether it does more enabling or more constraining. Unfortunately, as *BusinessWeek* reported in its *CEO Guide to Technology*, "Technical limitations and time pressures [have] often made integration a haphazard affair."

In a rush to meet deadlines, developers cobbled together direct links (point-to-point integration) to share data and business logic among applications, according to the *BusinessWeek* report, which added that the resulting cobweb of hundreds or thousands of brittle linkages "crippled the health and flexibility of most IT [information technology] architectures" because the mess must be torn apart and reassembled whenever applications change. Moreover, adapting legacy systems to communicate over modern systems such as the Internet is so time-consuming that, as *BusinessWeek* noted, "Entire generations of business opportunities (new products, alliances, mergers and acquisitions) can grow old while IT fiddles with the wiring." Unable to explain the complexity of their problem or resolve it, CIOs have found themselves on the defensive.

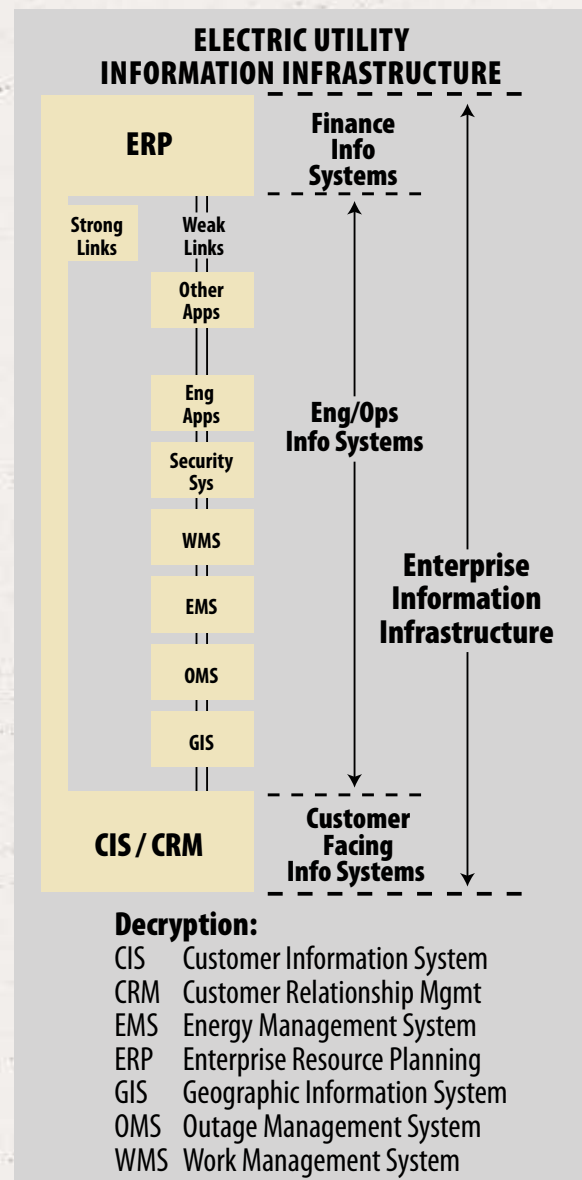
The legacy systems that must be integrated effectively today date back to the advent of automated financial management activities in the '50s. Later, in the '70s, Material Requirements Planning (MRP) expanded the scope into operations, but principally to support financial management needs. In the '80s, Enterprise Resource Planning (ERP) began extending the infrastructure across a broader base of business processes, eventually encompassing Supply Chain Management (SCM) in the '90s—but again, principally to aid financial planning and management.

More recently, marketing and sales management needs created demands for Customer Relationship Management (CRM) and Customer Information Systems (CIS). Customers are the source of revenue and the consumers of service, concepts tied closely

to the financial interests of ERP. Strong links naturally formed between these two areas and information infrastructure emerged as business process support.

Ignored in this expanding integration were the many stand-alone systems that supported various engineering and operations activities (see Figure 1). Forging infrastructure integration ties from the business side into engineering and into operations was traditionally viewed as mixing cats and dogs to no benefit—by all sides. In the '90s, however, the leverage for business performance began shifting. The need for astute management of financial resources didn't decrease—an inadequate job there can still destroy any company. Nor did the need for innovative engineering

Figure 1: Electric Utility Information Infrastructure



All companies
have an
information
infrastructure.
How it's
constructed
determines
whether it
does more
enabling
or more
constraining.

and competitive operations lessen. But all of these areas refined their internally focused improvements to diminishing returns. Continued performance improvement required better use of information. Technology made it possible, and early adopters set new performance benchmarks. Then market expectations, demands, and opportunities led others to join the bandwagon.

Engineering had their infrastructure. Operations had theirs. Neither saw the need for much internal integration, let alone the need to integrate across departments to the extent that the business side had done. However, the values of an integrated information infrastructure came to the front in the new millennium. Unfortunately, the legacy of patchwork remained a major barrier for most, and the rush to add new information technology-enabled services amplifies the concerns.

Critical Information Infrastructure

Infrastructures let organizations function. If any element of an infrastructure becomes dysfunctional, performance degrades immediately. Yet all elements of the infrastructure aren't equal; some are more critical than others.

U.S. and Russian leaders, in a terrorism workshop, provided a useful definition of critical systems as those whose:

- Rapid failure would significantly impact rescue and response efforts and lead to a catastrophic loss of life.
- Failure or significant degradation would significantly impact recovery efforts and lead to unacceptable economic consequences.

In the IT department and throughout a company's operations, few people will agree on what is and isn't critical. While everything may be necessary to continue normal functions, losing access to an ERP system for a week doesn't have the same lasting consequences as losing control of an Energy Management System for a week. Nor do the consequences of an incapacitated CRM system compared to an inoperable OMS. You must think in the extreme and imagine the worst possibilities.

The national critical infrastructure focus through the Department of Homeland Security assumes that the infrastructure only needs to be protected from attack. This is clearly not the case, as evidenced by the cascading power outage that affected 40 million people in August 2003. Fortunately, there are initiatives separate from DHS that are addressing infrastructure inadequacy, at least for the grid. These initiatives are addressing needs for better visibility, management, and response and recovery capabilities.

Waiting for the corporate version of such an infrastructure failure before addressing inadequacy is foolish. Protecting the information infrastructure from such an attack is important, but the effort also must

encompass the availability of important information that's currently isolated or weakly linked in corporate networks.

A generic information infrastructure manager (see Figure 2) should facilitate optimal restoration of service and operational functionality. A critical proactive objective is enabling safe and predictable information technology migration. The need for this was demonstrated in events such as Hurricane Katrina and in a variety of recent successful cyber attacks and mishaps.

The Obstacle Course

As the IT department has become a more important part of business, the position most

prominent in terms of visibility and performance pressure is that of the CIO, which was referred to as "Career Is Over" in a 1990 *BusinessWeek* article. The buck stops there when a major project fails. IT department projects can be quite expensive, and when they fail to deliver, some other part of the business can't perform as planned.

No specific qualification is typical of CIOs in general; every CIO position has its own specific job description. Many CIOs have degrees in computer science, software engineering, or information systems, but many are simply past programmers. Further management training and experience are often required. The cynical phrase, "Career Is Over" was due to the fact many CIOs have been fired because of their inability to fix some technical problem, or to direct the technology program of the organization to align it with the organization's goals.

The consultancy IT Cortex has gathered some sobering statistics from a variety of sources. In this compendium, one reference is the landmark study done by The Standish Group on IT project failure.

"The Standish Group research shows a staggering 31.1 percent of projects will be canceled before they ever get completed. Further results indicate 52.7 percent of projects will cost more than 189 percent of their original estimates. On the success side, the average is only 16.2 percent for software projects that are completed on-time and on-budget. In the larger companies, the news is even worse: Only 9 percent of their projects come in on-time and on-budget . . . [and] have only approximately 42 percent of the originally proposed features and functions."

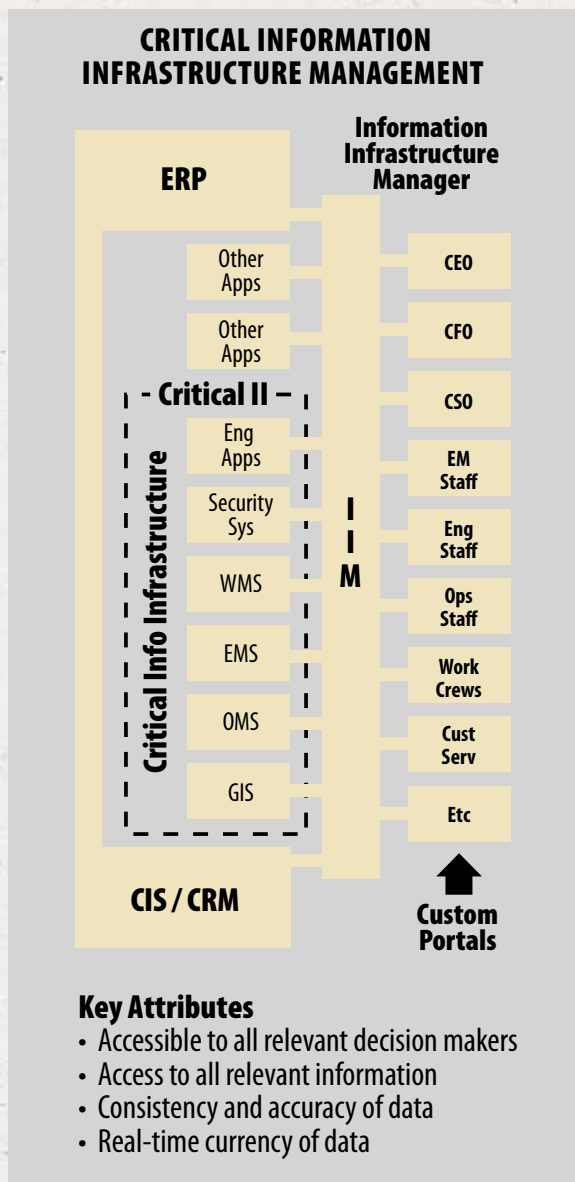
Standish statistics today paint a similar picture to that seen in results of the original 1995 study. High-visibility failures pinned on the IT department aren't just project-based.

Consider the insights of Dick Lord, CEO of The Steadfast Group and a member of the U.S. Department of Energy Office of Electric Transmission and Distribution Blackout Forum, in his keynote speech to the Australian GITA conference:

"It took no more than a simple engineering error, a software malfunction, and a communication failure to cause the largest blackout the world has ever seen—the massive power outage that hit 40 million people . . . on August 14, 2003.

"The blackout started in the area surrounding Cleveland, OH. The electric utility serving that area suffered an EMS failure several hours before New York lost its power. The EMS failure was software-related, so the IT network administration folks came in to fix it. They dutifully failed-over the errant workstation to its backup, observed proper performance for a few minutes and retreated to their stations. Eleven minutes later, that workstation also failed, with no backup. According to the records, the IT folks assigned to fixing the EMS never informed the operations folks about the problem.

Figure 2: Critical Information Infrastructure Management



Key Attributes

- Accessible to all relevant decision makers
- Access to all relevant information
- Consistency and accuracy of data
- Real-time currency of data

"For more than 90 minutes, energy management system operators watched their multiple monitors and wall screens, and seeing no new alarms, assumed everything was well with the network, even as 345,000 volt lines were dropping offline and generators shutting down. Cleveland lost power, then Detroit. Lord says the EMS operators' first real clue to the impending disaster was when the lights blinked in their control center."

This suggests that Lord blames the CIO. Some may take issue with his assessment, but the CIO is convenient.

Business and academic factions expect governance, alignment, and communication to harness information technology in service to strategy. These are necessary and timely concepts, but they don't strike the heart of the problem, nor provide the core of a solution. Enterprise information technology long ago crossed into the realm of complex systems, where engineering science is still groping for rules of order. To the rest of the company, IT department projects are a risky mystery and, too often, an expensive disappointment.

For the CIO, credibility is the issue, building trust is the antidote, project predictability is the trick, and infrastructure is the leverage point. The CIO must take the initiative. If the CEO and board don't yet recognize the strategic role of IT, taking the initiative may be more difficult, but it's all the more necessary.

A Case Study

Xcel Energy was recognized as the top IT organization in the energy and utility market by *InformationWeek* in 2004, and ranked among the top IT organizations in America. Ray Gogel, then vice president and CIO, had responsibility for Business Systems, which manages portfolio performance for Information Technology, Utility Innovations, Corporate Business Planning, and Business Processes.

In January 2005, *Computerworld* recognized Gogel as one of the business world's Premier 100 IT Leaders. Dick Kelly, now chairman and CEO of Xcel, made a telling comment as COO then:

"With the help of a strong leadership team and the talented and dedicated members of Xcel Energy's Business Systems group, Ray has turned the information technology function at Xcel Energy into a truly visionary model," Kelly said. ... "Our company is redefining the role of IT in creating business value."

Mike Carlson, Xcel's CIO, said his company's information infrastructure supports nearly a dozen strategic application areas, with the most intertwined being OMS, CIS, and Work Management.

The company just completed a five-year plan that transformed a typically chaotic interaction of information technology applications into a rational infrastructure, aligning the technology architecture and business processes.

"Now, we are working on what we've trademarked as the Physics of Process, so we can anticipate the effects of change and identify which areas of the technology footprint to address in advance," Carlson says. "The objective is to avoid those old surprises in broken legacy capabilities caused by forward migration. Technical change management is what this is. We crossed the threshold this year from firefighting to something that resembles a managed activity. In the planning phase, we ask if we can migrate within the architecture and we can maintain the integrity of the environment."

Xcel has employed Key Performance Indices (KPIs) such as standardization, time to solution, performance on delivery, and customer satisfaction, among others. One key metric tracks how many problems are identified by the technical staff as opposed to end users.

"We want to know when performance is dropping or when something stops working immediately, so corrective action can be taken before things get out of hand," Carlson says.

He added that business priorities are reflected in the disaster recovery requirements plan.

"OMS is a priority over financial management," he says. "CIS is critical for company survival, but if we're not controlling the grid, it doesn't much matter."

Xcel Energy saw the handwriting on the wall five years ago and did something about it. They built an environment of predictable, reliable, aligned information technology performance. In so doing, they created a trusted foundation for the future.

Leveraging Infrastructure

A takeaway from the Xcel case study is that they earned credibility with a focus on infrastructure in two senses: the information infrastructure and information technology Infrastructure.

The information infrastructure is what users and decision-makers relate to. It's the visible value of the IT department's effort. It either provides needed information when and where needed, or it doesn't. Individual and organizational productivity and capability are held hostage by this infrastructure. Give users new and valuable information that increases personal productivity and capability and you get their attention. Display that information consistently with existing mental models and you get a customer.

The IT infrastructure is what the IT staff relates to. It's the underlying technology and architecture that defines what is and isn't possible. This is where the reality of integration occurs and where the legacy of bad integration lurks. Not until the past is untangled and the architecture rationalized will predictable projects be possible. Attempting to consistently and continuously deliver strategic value at the information infrastructure level without an enabling IT infrastructure is impossible.

The urgency and intractability of this problem

was evident in a recent *CIO* magazine survey, which found that:

- Integration has been the top technology concern of CIOs since the magazine began doing the survey in 2002; CEOs also put it at the top of their list when they were initially surveyed in 2004.
- Three-fourths of respondents said they view information technology as strategic while 22 percent said it's a utility, and 3 percent were not sure how to describe it.
- Only 40 percent of respondents said the IT department had produced the returns they expected over the past year while 60 percent were either unsure or said the IT department failed to produce the expected returns.
- Only 34 percent of respondents indicated that the Sarbanes-Oxley Act has fostered a closer relationship between finance and the IT department (down from 48 percent a year earlier).

CEOs' three primary complaints about information technology, according to survey after survey—that it's too expensive, too slow and too inflexible—all lead back to integration. In short, the business is tired of waiting for the IT department to catch up with its demands.

Enterprise information technology lives in the realm of what's technically called complex systems—where too many interacting components with too many inter-component interactions defy predictable behavior. Complex systems are insufficiently understood by science as yet, but some engineering approaches are proving useful for information technology infrastructure.

Three general techniques are in play:

- *Enterprise Application Integration (EAI)* typically employs a common message bus accessible to all applications and a bi-directional translation module between the bus and each application typically referred to as an Extract-Translate-Load (ETL). Benefits are that it can be customized and can provide a manageable, predictable environment. Drawbacks are that it is integrator team-dependent and often risky as a grand-plan, total-replacement strategy.
- *Enterprise Information Integration (EII)* typically employs a special metadata base that catalogs and links to the data in all the other databases, and a user interface for seamless navigation through all the data. EII also can be an application integration hub if it provides bi-directional data transfers. Benefits are that EII safely integrates data without unintended operational consequences, and new application databases can be added incrementally and inexpensively. This is the technique with the lowest risk of the three, but EII capabilities are vendor-specific and may not be based on standards.
- *Service-oriented architecture* typically involves a loose

For the CIO,
credibility is
the issue,
building trust
is the
antidote,
project
predictability
is the trick,
and
infrastructure
is the
leverage point.

collection of independent application components that provide specific services. A user interface translates a user's need into calls on appropriate service components or negotiates through special broker modules to assemble a just-in-time collection of components. Service-oriented architecture is beneficial because uncoupled components can be changed, augmented, and upgraded transparently; the drawback is that the technology remains in its infancy and represents the highest-risk approach of the three.

A manageable infrastructure can readily absorb and support new strategic initiatives affordably, predictably, and quickly.

A Benchmark Information Infrastructure Manager

Of the three general techniques for building a manageable infrastructure, service-oriented architecture isn't yet a rational contender for a utility. Xcel's Carlson, for instance, says he's excited about the service-oriented architecture concept, but "We have not made a play there because we don't think we can afford to do it ourselves. Our business-software partners need to drive a collaboration on this. It's a good concept but culturally challenged so far. Business models have to be remade."

Xcel chose the EAI route in 2002, and just recently, according to Carlson, crossed the threshold of manageability. Vendors and integrators selling EAI solutions will tell you it doesn't have to take that long. They're right, if you're willing to do a scorched earth implementation. Xcel chose an incremental implementation that minimized risk and disruption, and built trust as it progressed. Xcel's Gogel in 2004 said Xcel focused on removing short-term obstacles while laying down a longer-range plan for transforming, in a phased approach, how it does business.

"Anyone who takes on the whole challenge at one time, I'd suggest, is doomed to failure," Gogel said. "Don't even think about trying this if you don't have the active sponsorship of the C-level executives—and the support of an aligned executive team. Without those components, it's impossible to expect the IT department to live up to the mission."

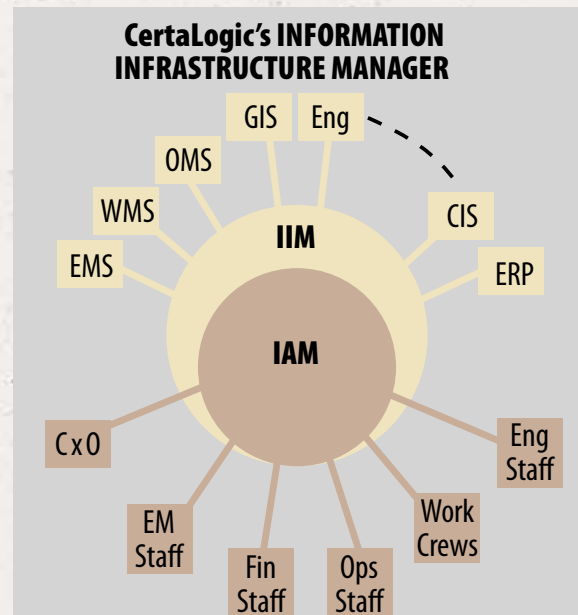
If you didn't start three years ago, and you're not comfortable with a scorched earth policy, you might consider an EII approach. EII can deliver an integrated information infrastructure in less than six months with virtually no risk, and it's fully compatible with both EAI and service-oriented architecture. That means it will continue to have value even if one of these other approaches is a longer-range strategy.

Though several vendors offer general-purpose EII, one company, CertaLogic (www.certalogic.com), employs this technique specifically as an information infrastructure manager for utilities. Now based in Boston, the company spent more than 10 years evolving this approach in South American deregulated markets.

CertaLogic's approach focuses on the critical

information infrastructure and an Intelligent Active Model (IAM) of operational status (see Figure 3). This IAM is an object-based model that provides live mirroring of operational and field asset status at all levels, all the way down to automated meters. CertaLogic's preferred implementation also subsumes

Figure 3: 4DataLink's Information Infrastructure Manager



IIM: Information Infrastructure Manager

- Integrates information across corporate and departmental databases.
- Provides seamless access across critical information infrastructure.
- Resolves conflicting data from multiple databases for accuracy.
- Matches access with authorization, and logs administrative actions for compliance.
- Enables graceful incremental migration.

IAM: Intelligent Active Model

- Translates data into information meaningful to user interests.
- Monitors critical infrastructure for preset conditions.
- Mirrors real-time condition of operations and filed-asset status.
- Traces asset-network operational connectivity on demand.
- Simulates what-if futures to facilitate repair and engineering strategy.
- Replays past events for compliance reporting and event diagnosis.

Geographic Information System (GIS) functionality internally to the IAM. (For more on IAM, see “Investment Decision Quality at Utilities: An Examination of Downward Trends and Upward Leverage,” Rick Dove, *Public Utilities Fortnightly*, February 2006).

CertaLogic calls their information infrastructure manager Network Information Manager (NIM), in reference to its IAM field-asset-network orientation. NIM isn't limited in content to network asset information and can be used to provide integrated views of virtually anything available in standards-based databases.

Graceful, incremental migration is a prime objective of infrastructure management. Ideally, incremental migration transforms an IT legacy environment into an agile yet fully integrated infrastructure one small risk-free step at a time (or at least in annually affordable increments). The transformation neither disrupts ongoing business, nor introduces unintended consequences. The transformation proceeds in a highest-returns-first sequence, rather than needing lengthy investment in new IT infrastructure before anything materializes. Finally, once initial transformation is completed, the result facilitates continuous transformation.

An EII approach, done right, isn't disruptive because nothing is disturbed or changed. Read-only links from the IIM are extended into the databases of interest. Nothing that currently happens is stopped. Databases can be added, one at a time, whenever the next increment of integration is desired. Every added database provides added information access, immediately and seamlessly, to the user.

Conclusion

North American Electric Reliability Council (NERC) says it well (see “Managing the Business Risks of Information Technology Dependencies,” NERC

Takeaways

- Information technology is today's leverage point for business performance, innovation, best practices, and regulatory compliance.
- Leverage information technology as a business strategy, have corporate decision-making bodies include and value expertise in information technology, and create trust in information technology capabilities.
- CIOs in successful organizations tend to report directly to the CEO.
- The information technology department delivers value directly; it also enables the information infrastructure that both current and future business performance depends on.
- Strategic information technology initiatives should have an infrastructure focus, with manageability, predictability, and credibility as desired outcomes.

Critical Infrastructure Protection Forum, National Electric Reliability Council):

“Computer systems increasingly are being used to enter new markets, achieve business operating efficiencies, and communicate with customers and business partners. Therefore, the reliability and security of these information systems are more important to electric utilities' competitive positions than ever before. Chief information officers are the management officials responsible for procuring and managing mission-critical information systems.”

The typical CIO grew up on the technical side. That can be helpful because governance and goal alignment are really just aspects of sound systems engineering principles, but now it is the enterprise that is the system. All the same engineering analysis and design disciplines apply, with the principle difference being that technical requirements and specifications are driven by broader business requirements and specifications rather than departmental or user requirements.

Too many intelligent solutions to the integration problem are throw-it-all-out, start-over-again projects. These can make sense on paper but, too often, stumble badly and publicly during implementation. Though project cost overruns in the tens of millions aren't uncommon, bigger costs are hidden in business disruption, delay, and unrealized expectations.

Big projects aren't the only ones that exhibit these risks. Another common approach is what could be called islands of integration. Here, the strategy is to replace some number of independent legacy applications with an integrated suite. They promise lower cost and less total business risk, but still face the unpredictable results of changing entrenched and familiar ways of conducting business.

It doesn't have to be that way. Xcel Energy made the EAI approach work and CertaLogic offers the EII approach.

So, what will it be: Career Is Over or Critical Infrastructure Officer?

Acknowledgements

I wish to thank Ray Gogel and Mike Carlson for insights into Xcel's transformation and the numerous people at CertaLogic and among their customer base who described their information infrastructure manager and Intelligent Active Model (IAM) approach. **a**

Rick Dove is industry professor at Stevens Institute of Technology in the Systems Engineering and Engineering Management department, and co-director of the Agile Systems and Enterprises graduate certificate. He co-edited the seminal effort at Lehigh University that defined agility in the early '90s as the survival need of the new millennium. His recent books include *Response Ability: The Language, Structure, and Culture of the Agile Enterprise*, and *Value Propositioning—Perception and Misperception in Decision Making*. He is chairman of Paradigm Shift International, and has extensive experience in start-up, turnaround, and interim executive management.
Email: rick.dove@stevens.edu
Website at www.parshift.com

