FALL 2002 VOL.44 NO.1
SMR092

MITSloan
Management Review

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Building IT Infrastructure for Strategic Agility

REPRINT NUMBER 4416

Building IT Infrastructure for **Strategic Agility**

Recent research indicates that managers at top-performing companies are able to identify the nature and array of initiatives they may need to implement, then determine the unique combination of IT service clusters necessary to create that agility.

Peter Weill, Mani Subramani and Marianne Broadbent

Senior executives make few choices more critical than deciding which IT investments will be needed for future strategic agility. As it has become increasingly clear that those choices can significantly enable or impede business initiatives, managers must anticipate future strategic moves and make often-complex assessments about how the IT infrastructure must adapt to support the enterprise. Although the goal is to create a unified IT infrastructure that supports long-term, enterprisewide strategies while being responsive to the demands of business-unit strategies, investments by different business units are often made independently. These independent investments are often of a short-term, catch-up or bleeding-edge in nature, and the resulting technologies are often incompatible. Overinvesting in infrastructure leads to wasted resources that weigh heavily on the bottom line. Underinvesting (or worse, implementing the wrong infrastructure) translates into delays, rushed implementations, islands of automation and limited sharing of resources, information and expertise by business units.

Infrastructure investments (say, an enterprisewide customer database or communications network) are often shared across many applications, business initiatives and business units. But sharing requires negotiation about how much infrastructure is needed, who pays for it and who should be responsible for it. To what extent should the IT infrastructure be standard, shared and available enterprisewide? To what extent should infrastructure be customized for individual business units? In what areas should infrastructure capabilities be industry leading? New research indicates that

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getting the IT-infrastructure balance right requires collaboration by the heads of business lines and IT professionals. And the payoffs can be considerable — despite lower short-term profitability, enterprises building appropriate infrastructures have faster times to market, higher growth rates and more sales from new products.[1]

Executives need a framework for making informed decisions about IT infrastructure. To that end, we examined 180 electronically based business initiatives in enterprises that were among the top three in their industries and studied their IT-infrastructure choices. We were able to identify, first, the specific infrastructure capabilities needed for different types of strategy-related business initiatives and, second, whether they were within individual business units or within a central group and made available across the enterprise. (See "About the Research.") The key finding: In leading enterprises, each type of strategic agility requires distinct patterns of IT-infrastructure capability. And any company that can determine the type of agility it will need for specific business initiatives is more likely to make sensible infrastructure investments.

About the Research

We analyzed data from four studies of the infrastructure needs of leading enterprises implementing different electronically based strategic initiatives. All the enterprises were among the top three in their industry by market share and were typically top performers (on the key measures of return on assets, revenue growth and margin).

The four studies gathered details from 180 business initiatives in 118 businesses in 89 enterprises from 1990 to 2001.* Detailed interviews, extensive questionnaire data and personal visits to more than 90% of the enterprises were supplemented with data obtained by phone and e-mail, resulting in an exceptional source of data and insights.

Our data analysis applied quantitative techniques to the questionnaire and the collected financial information. All relationships described from the quantitative analysis were statistically significant, and no claims of causality are made. The qualitative techniques were applied to the interview transcript data and included detailed pattern analysis.

*The data come from P. Weill and M. Broadbent, "Leveraging the New Infrastructure: How Market Leaders Capitalize on Information Technology" (Boston: Harvard Business School Press, 1998); P. Weill, M. Broadbent and A. Goh, "Client Infrastructure Services: A Study of the Management and Value of PC and LAN Infrastructure," research report, Center for Management of IT, University of Melbourne Business School, Melbourne, Australia, October 1997; P. Weill and M.R. Vitale, "Place to Space: Migrating to E-Business Models" (Boston: Harvard Business School Press, 2001); and E. Birge, N. Wendt, P. Weill, M.L. Markus et al., "Justifying and Funding IT Infrastructure," white paper, The Concours Group, February 2001.

The average enterprise spends more than 4.2% of revenues annually on information technology.[2] Overall, those investments account for more than 50% of the total capital budget. Although the components of infrastructure are commonly available, the management processes needed to implement them flexibly are less evident. About 55% of the IT budget goes toward the complex fusion of technology, processes and human assets that comprises infrastructure.[3]

Once a company's infrastructure is in place, there is a potential payoff: Competitors need long lead times to emulate the new business initiatives that the infrastructure enables. But there is also a cost: As with infrastructure investments in people or real estate, IT-infrastructure investments involve a trade-off between profit levels today and tomorrow, especially if the resulting infrastructure is not flexible or not exploited. On the other hand, tailored, strategy-enabling infrastructure can be reused for many business initiatives while also reducing time to market.

Many enterprises comprise more than one business and need infrastructure investments at multiple levels — corporate, individual business-unit and public infrastructure. (See "IT Infrastructure Can Be Deployed at Multiple Levels.") Whether to place the IT infrastructure capability in individual business units or make it enterprisewide is a strategic decision. For example, a company may want one contact point for customers across multiple business units. By integrating information from separate units, the enterprise can take full advantage of a customer's transaction with one part of the business and cross-sell related products and services. For example, State Street, a $3.6 billion financial-services enterprise serving more than 90 markets in 23 countries, moved from a strategy of independent business units to a companywide strategy called One State Street. The bank created a shared-IT-services unit to support its innovative business units, enabling an improved customer experience. Centralizing activities enabled the company to take advantage of economies of scale as well as shared development capability and faster time to market.[4]

An integrated IT infrastructure combines the enterprise's shared IT capabilities into a platform for all business processes. The extent of the infrastructure capability depends on the business needs. For example, the executive vice president of customer service at Delta Air Lines describes Delta's integrated IT infrastructure as Delta's "digital nervous system." He says, "If we were to have a change in our operations control center — let's say a canceled flight — with one or two entries, that information would be pushed into all of the operating and customer groups. … So the real power behind the digital nervous system is having the ability

to push the technology out into ways that would make it easier for customers who do business with us."[5]

IT Infrastructure as Services

The leading companies we studied tended not to establish their infrastructure through a few large one-time IT investments, but gradually, through incremental modular investments. It is useful to think of those modules as service bundles. IT infrastructure is, of course, not simply a compact disc in a yellow box marked Norton Antivirus or even a comprehensive SAP billing program, but a collection of reliable, centrally coordinated services budgeted by senior managers and comprising both technical and human capability.[6] Indeed, business managers, who often have trouble determining the value of the technological and human components of IT infrastructure, can readily recognize and value a service that integrates the two — for example, the provision of a fully maintained laptop computer with access to all company systems and the Internet. A service can be specified, measured and controlled in service-level agreements and can be comparison-priced in the marketplace.

The services concept has advantages for the IT group, too, because infrastructure services remain relatively stable even when technical components change. A local-area-network (LAN) service that was needed five years ago will likely be needed five years from now. Although the technology components — the personal computer, the server and the network — may change, the service and the service-level agreement are stable.

Seventy Services in Ten Clusters In analyzing the infrastructure services of the 89 enterprises in our study, we identified 70 different services in 10 clusters of IT-infrastructure services.[7] (See "An Integrated IT Infrastructure With Ten Capability Clusters.") The first six clusters comprise the *physical* layer of IT-infrastructure capability.

Cluster 1: channel-management services. Enterprises increasingly link to customers and business partners through electronic channels. Usually the channels include a combination of physical outlets (say, point-of-service devices in bank branches), Web sites, e-mail, physical mail (scanned in), interactive voice response, wireless devices and ATMs. Integrating all the channels to deliver a single picture of the customer's relationship with the enterprise is a challenge.

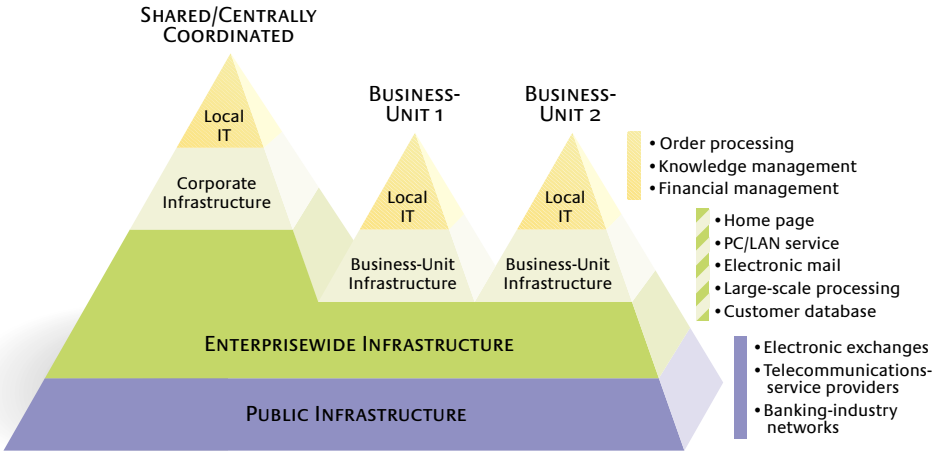
A typical bank has numerous customer channels developed at different times on different technology platforms. Data definitions for common fields such as customer name or product name may have been developed independently, leading to incompatible data architectures.

To integrate different channels and thereby to offer a level of service that is a differentiator, some banks are investing heavily in data-warehouse systems, Web services, middleware and translation tables. But when that level becomes the norm, companies will have to do more to differentiate themselves. Similarly, cellular-phone-service provider Sprint PCS is currently one of the few companies that can provide daily updates to customers who want to know the number of minutes left on their cellphone plans. An even higher level — providing customer updates accurate to the minute — is technically challenging, but will eventually become the new service differentiator.

Cluster 2: security and risk-management services. Security and risk-management services provide protection for the enterprise's brand, reputation, data, equipment and revenue stream. Security becomes critical for interactions with customers and

IT Infrastructure Can Be Deployed at Multiple Levels

Many enterprises comprise more than one business and need infrastructure investments at multiple levels — corporate, individual business-unit, enterprisewide and public infrastructure. The type of strategic initiatives pursued will often determine the level at which a particular investment should be made.



partners via integrated electronic channels. Digital security boils down to a management decision about the level of acceptable risk balanced against the cost to achieve the level of protection. Security-and-risk services include firewalls, policies for remote access, encryption and use of passwords — as well as disaster planning and recovery. Ensuring business continuity following such disruptions as a natural disaster, terrorist attack or power outage is part of the capabilities.

Cluster 3: communication services. Electronic interactions with customers and partners occur through communications services, which typically include a network linking all points within an enterprise and providing the gateway to electronic channels. Communications services may include video, voice and voice-over intellectual property. And connected to the backbone network are local-area networks for particular regions or business units.

Cluster 4: data-management services. A key asset in an electronically connected business world is data on customers, products, processes, performance and capabilities. Enterprises strive to manage data assets independently of applications, making them available enterprisewide to promote initiatives such as new-product development and cross-selling. Large storage facilities or storage-area networks are required to ensure access, and many enterprises have adopted data warehouses and Web services to summarize key information from decentralized databases. Data assets that aid decision making can be accessed through intranets or electronic-reporting techniques such as executive-information systems and e-mail distribution lists. Knowledge-management services that identify and codify knowledge or point to individuals possessing key knowledge are also part of this cluster.

Cluster 5: application-infrastructure services. On top of the data sits a cluster of infrastructure applications that are standard across the enterprise and support such areas as accounting, human-resource management and budgeting. Some enterprises choose one enterprise-resource-planning (ERP) package, and that becomes part of the application's infrastructure. Others standardize and consolidate business units' applications into a shared-services group or a common application run independently. The aim is to reduce costs, increase reliability, enable standardization and encourage the integrated operation of multiple business units.

Cluster 6: IT-facilities-management services. IT-facilities management coordinates and spans the physical-infrastructure layers, providing services such as servers, large-scale processing, and creation of an environment for developing new systems. IT-facilities management adds value by integrating the five other physical-infrastructure layers.

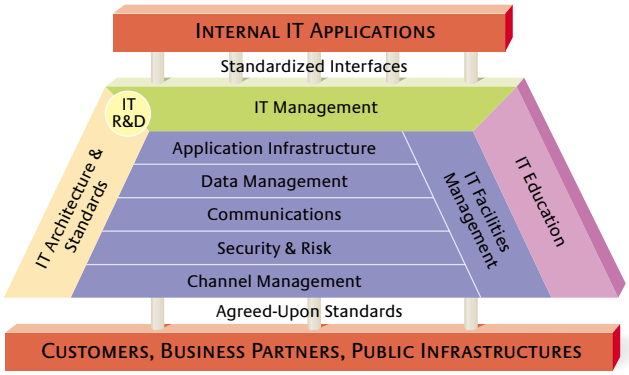
In addition to the six service clusters that constitute an enterprise's physical IT-infrastructure capabilities, there are four clusters that represent management-oriented IT capabilities.

Cluster 7: IT-management services. IT-management services coordinate the integrated infrastructure and manage its relationships with the business units. Typically management services include information-systems planning, project management, service-level agreements and negotiations with vendors. The cluster has strong links to the architecture-and-standards cluster.

Cluster 8: IT-architecture-and-standards services. This cluster comprises the core policies that govern the use of information technology and that determine how future business will be done.[8] Spanning the physical layers of infrastructure services, the IT architecture needs constant review to meet strategic needs. For example, UPS publishes application-program interfaces for

An Integrated IT Infrastructure With 10 Capability Clusters

The research identified 70 IT services* in 10 capability clusters. Six clusters comprise the physical layer of capability (shaded purple), and the remaining four comprise the management-oriented capabilities. Clusters that share a border depend strongly on one another. Thus IT R&D is linked to IT Management and IT Architecture and Standards.



* For a detailed list of the 70 infrastructure services and for more information, please access http://web.mit.edu/cisr/www/html/infraservices.html

tracking packages, and ERP producers incorporate the code into their logistics modules. Then users of ERPs who are potential UPS customers can link to UPS services seamlessly.[9]

The increasing use of electronic means to integrate different players in the value chain raises the stakes for setting and implementing architectures and standards. Determining the IT architecture calls for senior-management involvement because of the complexity of simultaneously addressing issues created by business uncertainty and technological change.[10] Evolving over time, a good architecture documents detailed definitions of the recommended standards and identifies acceptable options. Each architectural decision that enforces specific technical choices must incorporate the underlying business logic so that the standards can evolve as business conditions change. For many enterprises we studied, it was sufficient to specify architecture and standards. For others, enforcement of architecture and standards was critical.

Both the management-services cluster and the architecture-and-standards cluster must interact with the IT-research-and-development cluster (discussed below) to leverage new technologies that have high potential value.

Cluster 9: IT-education services. IT education and training are IT-infrastructure capabilities too often neglected. This cluster includes training in the use of the enterprise-specific technologies and systems plus education for managers about how to envision, invest in and use IT to create business value. We found that those enterprises that spent a higher percentage of their budgets than industry average on training had lower total costs per workstation and superior business-process performance.[11]

Cluster 10: IT R&D services. The IT-research-and-development cluster includes the enterprise's search for new ways to use IT to create business value. R&D services are typically industry- or enterprise-specific and build on the more generic work of the research companies that track technology trends.

For example, a $15 billion retail group in our sample had a team of retail IT specialists who traveled the world looking for new technologies that might create value. They investigated technologies for self-service checkout lanes and video shopping carts. When we talked with them, the group was looking into digital price tags on store shelves updated by signals carried over lightwaves from fluorescent fixtures connected to a server. Clearly, in order to implement such technology, senior management would have to authorize the necessary changes in pricing, merchandising and logistics processes.

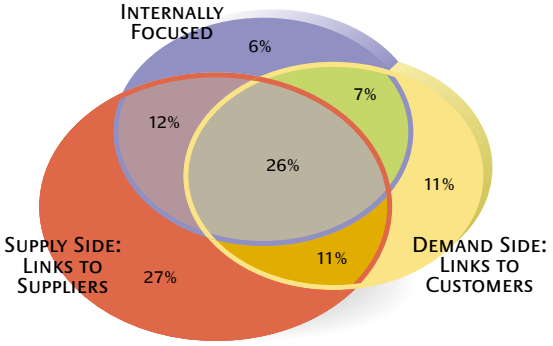
Matching Capabilities to Strategic Direction

Strategic agility is defined by the set of business initiatives an enterprise can readily implement. Many elements contribute to agility, including customer base, brand, core competence, infrastructure and employees' ability to change. Organizing and coordinating those elements into an integrated group of resources results in an enterprise capability,[12] which, if superior to that of competitors, becomes a distinctive competence.[13]

Our research demonstrates a significant correlation between strategic agility and IT-infrastructure capability.[14] This suggests that if managers can describe their desired strategic agility, they then can identify the IT-infrastructure service clusters that need to be above the industry average — and thus can create a distinctive competence. Although none of the enterprises we evaluated had all 70 services we've identified, those with the highest degree of strategic agility had more services in each of the 10 clusters, broader implementations of each service and more demanding service-level agreements.[15]

Distribution of Initiatives Throughout the Value Net

The business initiatives studied fell into all three major categories of the value net: supply-side focused, demand-side focused and internally focused. Some 56% of initiatives covered at least two categories and 26% combined all three.



Classifying Initiatives To understand the impact of IT infrastructure on strategic agility, we studied common electronically based business initiatives. We classified each initiative by its position on the value net, type of exchange and type of innovation:

Position on the value net. The view of a value chain as a process that moves goods from suppliers to customers — with the enterprise adding value at various stages — needs rethinking. Information technology, having dropped coordination and transaction costs as well as the cost of searching for goods and

services, has created a richly interconnected system better described as a value *net.*[16] Through technology, each participant can communicate more easily with other participants; the reality is less like a chain than three intersecting circles representing demand-side, internally focused and supply-side initiatives. (See "Distribution of Initiatives Throughout the Value Net.")

In our study, for example, a Web site to disseminate the request for, and submission of, tenders for a water utility's engineering works was classified as a supply-side initiative. In contrast, a manufacturer's monitoring of retail flooring-product sales to reduce lead times and inventory was classified as a demand-side initiative. The institution of all-digital workflow at a publishing house was an internal initiative.

The type of exchange: B2B or B2C. Identifying the type of exchange involved in a business initiative helps determine the different IT infrastructures required.[17] Business-to-business initiatives generally involve a small, focused customer set with large transaction volumes per customer, periodic consolidated payments and significant customization of products and services — such as the business-to-business steel-trading portal in our study. In contrast, business-to-consumer initiatives typically involve large numbers of individual customers with intermittent transactions, lower dollar values per transaction and online electronic payments linked to each transaction — such as the U.S. Postal Service's invoicing and bill payment initiative included in our study. Both B2B and B2C initiatives are likely to involve significant use of customer, product and financial data.

Enterprises with the highest degree of strategic agility had more services in each cluster and broader implementations of each service.

Type of innovation: for products or markets. An initiative can be innovative either in terms of the product or the market or both. Nearly half the initiatives we studied involved electronically based implementations of existing products in existing markets — for example, the online catalog for hospital orders set up by an implantable-medical-device manufacturer. In contrast, 32% of initiatives were new products in new markets — such as a U.S. hospitality company's reverse-auction site for U.K. hotel-room bookings.

The three dimensions of classification, when applied together, provide a good deal of insight into the IT capabilities required for a given initiative. Consider two in our study: a Web site for pubs to purchase products from a brewer, showing stock levels, pricing, order tracking, cost comparisons and customized promotion deals; and an online reservation system to streamline bookings at franchisee and co-owned hotel properties. Both would be classified as B2B, existing-product-and-market, demand-side initiatives. However, the brewer's site did not integrate directly with its internal systems for production and scheduling, whereas the hotel parent company coordinated all booking and room availability centrally, providing a single view of availability and pricing to the customer, and a single view of cost control and asset utilization to management. Therefore, the latter is both a demand-side *and* internal initiative, requiring firm-wide infrastructure and much more standardization.

Capabilities Critical to Each Position on the Value Net After classifying the business initiatives, we examined the extent of IT-infrastructure capabilities in terms of cluster and location in the enterprise. Then, by identifying statistically significant correlations[18] we determined the relationship between the enterprise's infrastructure capabilities and its ability to implement its business initiatives.[19]

Supply-side capabilities. In the supply-side initiatives we studied, the critical enterprisewide cluster was IT-architecture-and-standards. Having enterprisewide architecture and standards allowed linking of independently developed systems, reducing disparities and creating purchasing economies. Interestingly, all other important clusters were at the business-unit level, suggesting that supply-side initiatives were typically business-unit specific. The applications-infrastructure and data-management clusters were critical in enabling supply-side initiatives in business units. Despite the potential for enterprisewide services for IT management and communications, they, too, were provided at the business-unit level. That pattern at top-performing companies suggests that typically supply-side initiatives are sufficiently different among business units that the extra effort of sharing services across units cannot be justified. For many enterprises, supply-side initiatives are just quicker and easier at the local level. Enterprisewide implementation requires either a top-down directive or a chief information officer demonstrating that enterprisewide work will cost the units less.

Internally focused capabilities. For internally focused initiatives, IT architecture and broadly enforced standards are again key. Initiatives for streamlining internal processes must coordinate,

Infrastructure Competencies for Types of Business Initiatives

Each initiative studied was classified by its position on the value net, type of exchange and type of innovation. As shown below, each of those factors dictates which capability clusters are crucial for agile implementation of the initiative, and whether the implementation should be local or enterprisewide. Among top-performing businesses, only the IT-architecture-and-standards, security-and-risk and IT-facilities-management clusters were consistently found to be applied enterprisewide.

	Position on the Value Net						Type of Exchange				Type of Innovation			
	Supply		Internal		Demand		B2B		B2C		Products		New Markets	
IT Capability Cluster	Firm-wide	Bus. Unit	Firm-wide	Bus. Unit	Firm-wide	Bus. Unit	Firm-wide	Bus. Unit	Firm-wide	Bus. Unit	Firm-wide	Bus. Unit	Firm-wide	Bus. Unit
Channel Management				■		■						■		
Security & Risk Management					■			■	■				■	
Communications		■		■										
Data Management		■		■	■				■					
Application Infrastructure		■		■				■						
IT Facilities Management					■			■	■				■	
IT Management		■		■				■	■					
IT Architecture and Standards	■		■		■									
IT Education											■			
IT Research and Development						■	■			■		■		

link and standardize systems enterprisewide. However, other critical infrastructure clusters that support initiatives to streamline internal processes — applications infrastructure, data management, channel management and communications — are provided at the business-unit level. That is true for IT-management capability, too, which suggests that services in that cluster are also business specific.

Demand-side capabilities. On the demand side, new initiatives again rely heavily on enterprisewide IT architecture and standards — the only enterprisewide cluster important for all three parts of the value net and one of the hardest competencies to develop and implement. Also important for demand-side activities is enterprisewide security-and-risk capability — which is critical when the enterprise gives external users access to its systems and data — and IT-facilities-management capability. Given that customer response is difficult to predict and traffic volumes vary wildly, facilities-management capability helps manage the risk that one unit's underperformance on a demand-side initiative will affect the corporate image or the brand franchise. Also, the centralization of activities enables oversight of the often unstable startups that companies rely on to provide new technology. Finally, it permits capturing lessons learned across multiple business units.

For demand-side initiatives, we also found the channel-management and IT R&D clusters important at the business-unit level. Establishing effective channel linkages means addressing complex interfaces with different customer segments and is tackled most effectively by the unit that is in direct contact with a particular segment. Similarly, given the variety of contexts of successful customer initiatives, IT R&D needs tailoring by individual business units to resolve the complexities of integrating the electronic channels.

Our research shows that industry leadership in implementing IT initiatives requires high-capability IT infrastructure in all three realms of the value net and that high levels of competence are essential in every cluster but IT education. However, the integrated infrastructure needed for strategic agility does not have to be enterprisewide. (See "Infrastructure Competencies for Types of Business Initiatives.") Only the IT-architecture-and-standards, security-and-risk and IT-facilities-management clusters were found to be enterprisewide. IT management, applications infrastructure, communications, IT R&D and channel management were often provided at the business-unit level.

Notably, there is a conflict inherent in data management. For internal and supply-side initiatives, data management is best provided locally, but for demand-side initiatives, data management is needed enterprisewide. Those companies that are able to resolve the conflict often create a federal structure for data by identifying which elements (say, product, financial, customer or process data) are best managed at which level. Then for each element, they name data custodians to define, clean, manage and share their information.

Capabilities Critical to Each Type of Exchange B2B and B2C initiatives require different patterns of high-capability infrastructure both in terms of which clusters are key and whether they are enterprisewide or local. Nearly 75% of initiatives we studied had a B2B component; only 35% had a B2C component. B2B initiatives tend to focus on converting conventional interactions to IT-enabled transactions. B2C initiatives, however, are often associated with enterprises breaking new ground — providing new products or entering new markets.

Given the differing market orientations for the initiatives, the infrastructure services supporting them are also different. For example, reflecting the considerable variation of operating contexts underlying B2B interactions, all high-capability-infrastructure clusters tend to be managed at the business-unit level. For B2C, such capabilities are centrally coordinated, with the emphasis on uniformity across business units to provide a consistent electronic front to customers.

Capabilities Critical to Each Type of Innovation We found differences in infrastructure capabilities depending on whether a company was pursuing initiatives in new products or new markets. In new-product initiatives, R&D and channel-management clusters were mostly local, with only one high-capability infrastructure cluster being enterprisewide. In contrast, new-market initiatives required enterprisewide service clusters for security and risk and also for IT-facilities management.

Investing in IT Infrastructure for Strategic Agility

The evidence from leading enterprises indicates that implementing different types of electronically based business initiatives requires different high-capability IT infrastructures. Strategic agility requires time, money, leadership and focus — and an understanding of which distinct patterns of high-capability infrastructures are needed where. Getting the right balance is difficult. Underinvesting reduces strategic agility and slows time to market. Also, infrastructure investments usually must be made before investments in business applications because doing both at the same time results in infrastructure fragmentation. But if the infrastructure is not used or is the wrong kind, a company is overinvesting and wasting resources.

Investing in IT infrastructure is like buying an option.[20] If used successfully, infrastructure enables faster time to market; if not, it will prove an unnecessary cost. Successful enterprises get the infrastructure balance right because they make regular, systematic, modular and targeted investments in IT infrastructure on the basis of an overall strategic direction. The successful companies we studied had a clear picture of their overall infrastructure capability and how each incremental investment contributed to it.

To ensure that investments in IT infrastructure support the organization's strategic goals and business initiatives, we consider it critical for the enterprise's most senior executives to understand which specific IT-infrastructure capabilities are needed for which kinds of initiatives. That way, they can have some assurance that the investments they make today will serve the strategies of tomorrow.

ACKNOWLEDGMENTS

Center for Information Systems Research (CISR) sponsors, particularly CISR patron Gartner, enabled our research. Also contributing were Jeanne Ross from CISR; Eileen Birge and Nancy Wendt from the Concours Group; and Marcus Blosch, Ellen Kitzis, Barbara McNurlin, Andrew Rowsell-Jones and Roger Woolfe from Gartner.

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7. The starting point was a list of 25 infrastructure services and a cluster of eight infrastructure services as well as the services described in M. Broadbent and P. Weill, "Management by Maxim: How Business and IT Managers Can Create IT Infrastructures," Sloan Management Review 38 (spring 1997): 77–92. Channel management was added to include the ability of the enterprise to support a direct electronic connection to the customer via a variety of channels. The set of 70 services was validated in interviews with more than 50 businesses over a period of five years.

8. For two excellent discussions of information technology architecture, see P.G.W. Keen, "Every Manager's Guide to Information Technology," 2d ed. (Boston: Harvard Business School Press, 1995); and M.J. Earl, "Management Strategies for Information Technology" (London: Prentice-Hall, 1989). In addition, see J. Ross and P. Weill, briefing, "Stages of IT Architecture: Pursuing Alignment and Agility," MIT Sloan School of

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9. J.W. Ross, "United Parcel Service: Delivering Packages and E-Commerce Solutions," working paper 318, MIT Sloan School of Management Center for Information Systems Research, August 2001, http://web.mit.edu/cisr/www.

10. To reach this description of information-technology architecture, we have drawn on the written work of, and discussions with, a number of people, including Peter Keen, Margrethe Olson, Michael Earl, Stewart Neimann and B. Robertson-Dunn.

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14. We focused on what IT infrastructure was needed to implement the set of strategic initiatives the company desired to implement. We did not assess the success of those initiatives but rather whether the enterprise could implement the initiatives given the infrastructure.

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18. To identify the infrastructure capability required we correlated the ability for the enterprise to implement a set of IT enabled initiatives with their pattern of infrastructure capability. Statistically significant positive correlations (i.e., 5% or less likelihood to be caused by chance) indicate the above industry average IT infrastructure capabilities that were present in enterprises that led in their ability to implement a particular type of IT enabled initiative (see "Infrastructure Competencies for Types of Business Initiatives").

19. A word of caution: We based our analysis on ten years of research on top-performing companies and offer probably the best available data, but using the past to predict the future always has risks. One risk is that newer technologies will radically change the dynamics. Nevertheless, we think people often overestimate the speed of introduction and impact of new technologies (look at e-business, wireless, EDI, ERPs, CRM) in large enterprises. Large enterprises usually introduce new technologies in small amounts each year rather than make radical changes. There are at least three reasons: They can't absorb change any faster; the new technologies are risky and often fail to have the desired impact; the enterprise has to link the new technology with each tentacle of its legacy systems.

20. M. Amram and N. Kulatilaka, "Real Options" (New York: Oxford University Press, 1998).

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