

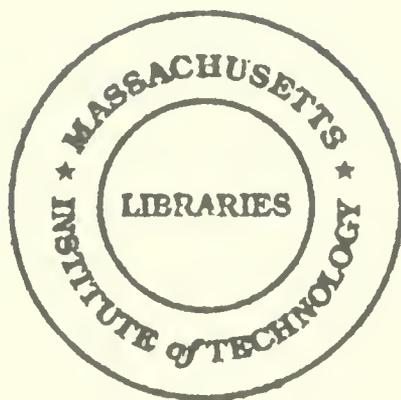
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Reconceptualizing IT

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RECONCEPTUALIZING IT

Introduction

Recently, some large companies have made some very large investments in their information technology (IT) infrastructures. For example:

- Citicorp invested over \$750 million for a new global data base system;
- Travelers Insurance replaced its expansive but aging private network with state-of-the-art high-speed lines;
- Johnson & Johnson broke with tradition by committing corporate funds to help its individual operating companies acquire standard desktop equipment; and
- Statoil presented all 15,000 of its employees with a high-end computer for home or office use.

At firms all over the world senior executives in a broad cross-section of industries are investing their time and money to shore up corporate infrastructures. In the past, many of these same executives had, in effect, given their IT units a generous allowance and admonished them to spend it wisely. Now, in contrast, they are engaging in intense negotiations over network capabilities, data standards, IT architectures, and IT funding limits. The difficulty of assessing the value of an IT infrastructure, coupled with technical jargon and business uncertainties, has made these conversations uncomfortable for most executives, to say the least. But the recognition that global markets are creating enormous demands for increased information sharing within and across firms has led to the realization that a powerful, flexible IT infrastructure has become a prerequisite for doing business.

The capabilities built into an infrastructure can either limit or enhance a firm's ability to respond to market conditions (Davenport and Linder, 1993). In order to target a firm's strategic priorities, senior executives must shepherd the development of the infrastructure (Broadbent and Weill, 1997). Sadly, most senior executives do not feel qualified to do so. As one CEO described it: "I've been reading on IT, but I'm terrified. It's the one area where I don't feel competent."

New infrastructure technologies are enabling new organizational forms, and in the process, creating a competitive environment that increasingly demands both standardization for cost effectiveness and customization for responsiveness. Most firms' infrastructures are not capable of addressing these requirements. Accordingly, firms are ripping out their old infrastructures in an attempt to provide features such as fast networks, easily accessible data, integrated supply chain applications, and reliable desktop support. At the firms which appear to be weathering this transition most successfully, senior management is leading the charge.

Over the past two years, we have done in-depth studies of the development of the IT infrastructure at fifteen major firms. We have examined their changing market conditions and business imperatives, and we have observed how they have recreated their IT infrastructures to meet these demands. This paper reports on our observations and develops a framework for

thinking about IT infrastructure development. It first defines IT infrastructure and its role in organizations. It then describes how some major corporations are planning, building, and leveraging new infrastructures. Finally, it describes the roles of senior, IT, and line managers in ensuring the development of a value-adding IT infrastructure.

What is an IT Infrastructure?

Traditionally, the IT infrastructure consisted primarily of an organization's data center, which supported mainframe transaction processing. (See Figure 1.) Effectiveness was assessed in terms of reliability and efficiency in processing transactions and storing vast amounts of data. Running a data center was not very mysterious, and most large organizations became good at it. Consequently, while the data center was mission critical at most large organizations, it was not strategic.

Some companies, like Frito-Lay (Mead and Linder, 1987) and Otis Elevator (McFarlan and Stoddard, 1986), benefited from a particularly clear vision of the value of this infrastructure and converted transaction processing data into decision making information. But even these exemplary infrastructures supported traditional organizational structures, consolidating data for hierarchical decision making purposes. IT infrastructures in the data center era tended to reinforce existing organizational forms rather than enable entirely new ones.

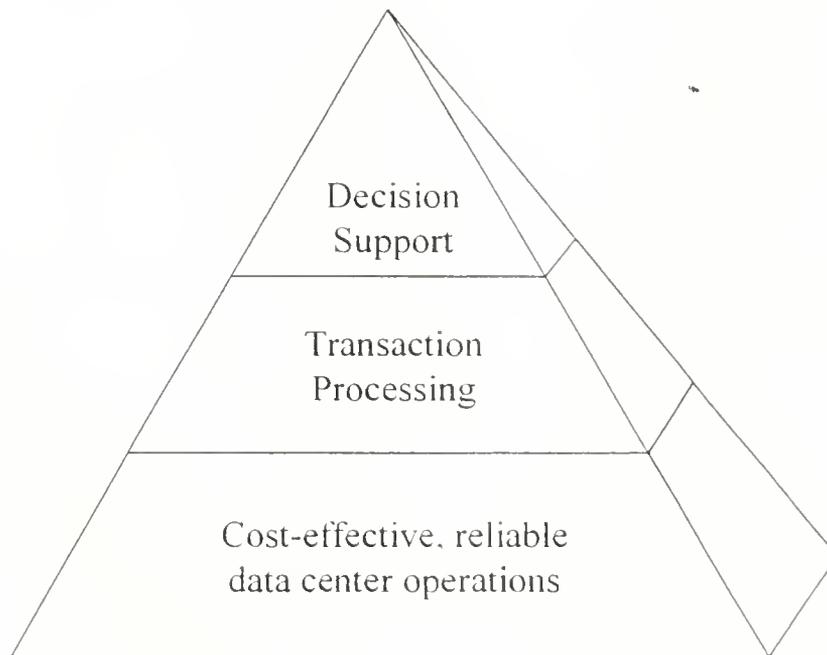


Figure 1: The Role of IT Infrastructure in Traditional Firms

In the current distributed processing era, the IT infrastructure has become the set of IT services shared across business units. Typically, these services include mainframe processing, network

management, messaging services, data management, and systems security (Broadbent and Weill, 1997). While still expected to deliver reliable, efficient transaction processing, the IT infrastructure must also deliver capabilities, such as facilitating intra-organizational communications, providing ready access to data, integrating business processes, and establishing customer linkages.

Delivering capabilities through IT infrastructure is much more difficult than managing a data center. Part of the challenge is technological because many of the individual components are immature, making them both unreliable and difficult to integrate. The bigger challenge, however, is organizational, because process integration requires that individuals change how they do their jobs and, in most cases, how they think about them.

Changing Organizational Forms and the Role of Infrastructure

Historically, most organizations could be characterized as either centralized or decentralized in their organization structures. While centralization and decentralization were viewed as essentially opposite organizational structures, they were, in fact, different manifestations of the same structure—hierarchy—in which decisions made at the top of the organization were carried out at lower levels. (See Figure 2.) Decentralized organizations differed from centralized in that more decision-making was pushed down the hierarchy, but communication patterns were still vertical and decisions involving two business units were usually made at a higher level, so that business units rarely recognized any interdependencies.

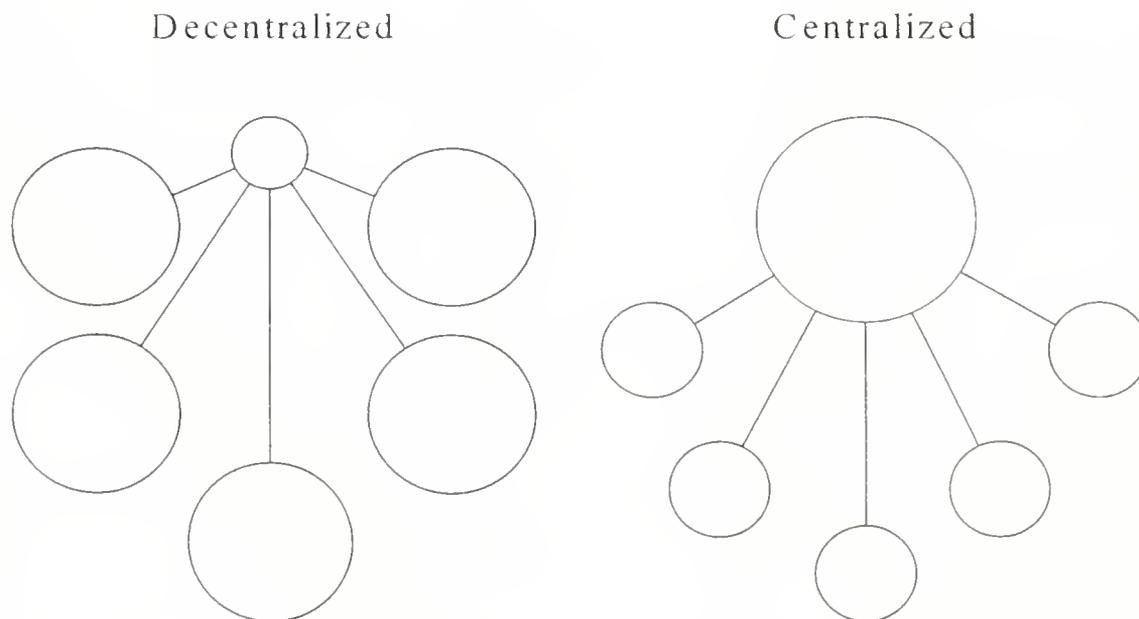


Figure 2: Traditional Organizational Models

Centralization and decentralization posed significant trade-offs in terms of their costs and benefits. Very simply stated, centralization offered economies of scale, while decentralization

allowed firms to be more responsive to individual customers. Thus, the degree to which any firm was centralized or decentralized depended upon which of these benefits offered the most value. Global markets have forced firms to both reduce cycle times and to present a single face to, and have a single view of, global customers. As a result, firms have found it increasingly important to garner the benefits of both centralization and decentralization simultaneously. Johnson & Johnson and Schneider National demonstrate how firms are addressing this challenge.

For almost 100 years Johnson & Johnson, a global consumer and health care company, achieved success as a decentralized firm (Ross, 1995a). Both J&J management and external analysts credited the autonomy of the firm's approximately 160 operating companies with stimulating innovation and growth. In the late 1980s, however, top management observed that a new breed of customer was emerging, and those customers had no patience for the multiple salespersons, invoices, and shipments characteristic of doing business with multiple J&J companies. For example, executives at Wal-Mart, the most powerful of the US retailers, noted that J&J companies were sending as many as seventeen different account representatives in a single month. In the future, Wal-Mart mandated J&J should send just one.

In response, J&J created customer teams to service each of its largest multi-business accounts. The teams consolidated data on sales, distribution, accounts receivable, and customer service from the operating companies and presented a single face to the customer. Initially, much of the reconciliation among the businesses required manipulating spreadsheets populated with manually-entered data. Ultimately, it meant that J&J would introduce complex structural changes that would link its independent operating companies through franchise management, regional organizations, and market-focused umbrella companies.

In contrast, Schneider National, following deregulation of the US trucking industry in 1980, relied upon a highly centralized organization structure to become one of the country's most successful trucking companies. Schneider leveraged its efficient mainframe environment, innovative operations models, centralized databases, and, later, satellite tracking capabilities to provide its customers with on-time service at competitive prices. By the early 1990s, however, truckload delivery had become a commodity. Intense price competition convinced Schneider management that it would be increasingly difficult to grow sales and profits.

Schneider responded by moving aggressively into third-party logistics, taking on the transportation management function of large manufacturing companies (Ross, 1995b). In order to succeed in this market, management recognized the need to organize around customer-focused teams where operating decisions were made at the customer interface. To make this work, Schneider installed some of its systems and people at customer sites, provided customer interface teams with powerful desktop machines to localize customer support, and increasingly bought services from competitors in order to meet the demands of its customers.

These two firms are rather dramatic examples of a phenomenon that most large firms are encountering. New customer demands and global competition require that business firms combine the cost efficiency and tight integration afforded by centralized structures with the creativity and customer intimacy afforded by decentralized structures. Consequently, many firms are adopting "federalist" structures (Handy, 1992), in which they push out much decision-making

to local sites. In federalist firms individuals at the customer interface become accountable for meeting customer needs, while the corporate unit evolves to become the “core” rather than headquarters. (See Figure 3.) The role of the core unit in these firms is to specify and develop the core competencies which enable the firm to foster a unique identity and generate economies of scale (Hamel and Prahalad, 1990; Stalk, Evans and Shulman, 1992).

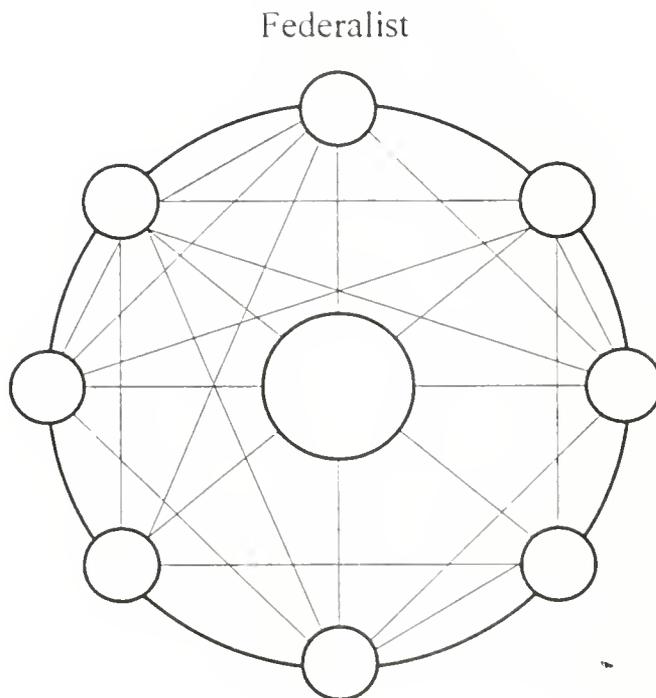


Figure 3: Federalist Organizational Model

Federalist firms require much more horizontal decision making to apply shared expertise to complex problems and to permit shared resources among interdependent business units (Quinn, 1992). Rather than rely on hierarchical processes to coordinate the interdependencies of teams, these firms utilize shared goals, dual reporting relationships, incentive systems that recognize competing objectives, and common processes (Handy, 1992). Management techniques like these require greatly increased information sharing in organizations, and it is the IT infrastructure which is expected to enable the necessary information sharing. However, an edict to increase information sharing does not, in itself, enable effective horizontal processes. To ensure that investments in information technology generate the anticipated benefits, IT infrastructure must become a top management issue.

Elements of Infrastructure Management

At the firms in our study we observed five key elements in the design and implementation of the IT infrastructure: business processes, systems applications infrastructure services, the IT architecture, and corporate strategy. These build upon one another (as shown in Figure 4) such that corporate strategy provides the basis for establishment of the architecture, while the

architecture guides decisions on the infrastructure, which provides the foundation for the organizational systems and processes.

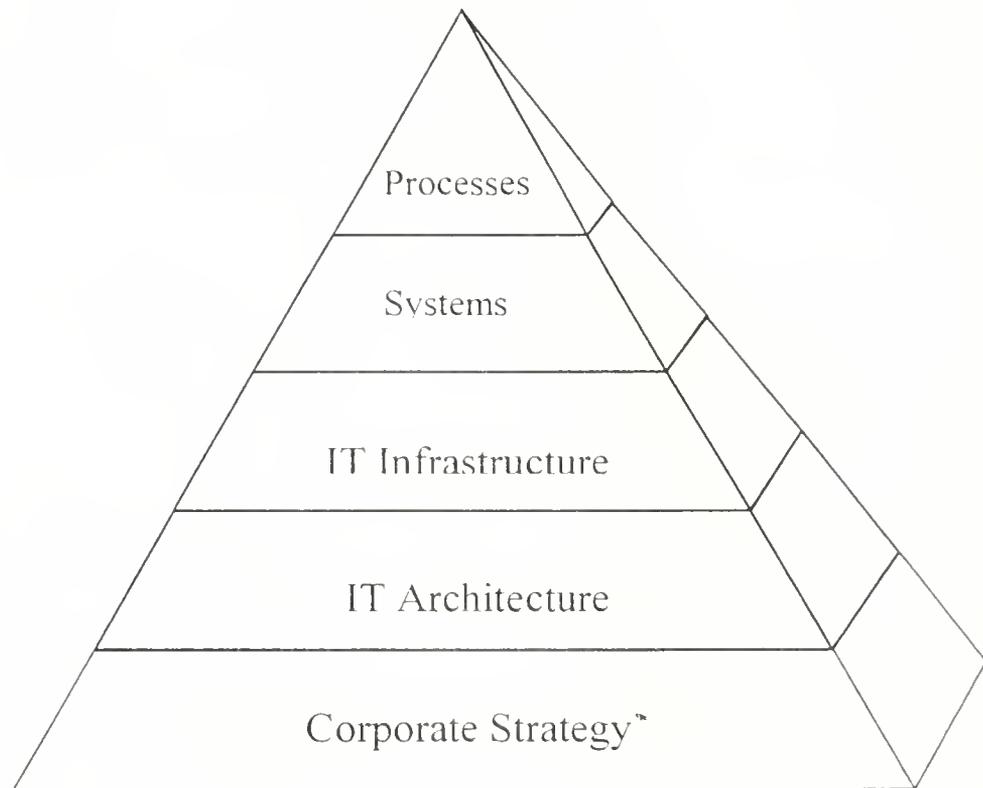


Figure 4: The IT Infrastructure Pyramid

Corporate Strategy. The starting point for designing and implementing an effective infrastructure is the corporate strategy. The strategy defines the firm's key competencies and how the firm will deliver them to customers. Many large decentralized firms, such as J&J, have traditionally had general corporate strategies that defined a firm-wide mission and financial performance goals but they allowed individual business units to define their own strategies for meeting customer needs. In the global economy these firms are focusing on developing firm-wide strategies for addressing global customer demands and responding to global competition.

For purposes of developing the IT infrastructure senior management must have an absolutely clear vision of how the organization will deliver on its core competencies. General statements of financial and marketing goals do not provide the necessary precision to develop a blueprint for the foundation that will enable new organizational processes. The necessary vision is operations-

based. It articulates organizing principles by specifying the firm's key cross-functional processes and how decisions will be made within and across those processes.

Based on a clear vision of how it would service customers, Federal Express developed its Powership product, which allows any customer, whether an individual or a major corporation, to electronically place and track an order using just about any currently available technology. Similarly, JC Penney's internal management support system evolved from a clear vision of the process by which store managers would make decisions about inventory and sales strategies. This included an understanding of how individual store managers could learn from one another's experiences. Such a clear vision of how the firm will function provides clear prescriptions for the IT infrastructure.

A corporate strategy that articulates key processes is absolutely essential for designing an IT infrastructure because otherwise neither IT nor business management can define priorities. The vision peels back corporate complexities so that the infrastructure is built around simple, core processes. This provides a solid foundation that can adapt to the dynamics of the business environment.

Some firms have attempted to compensate for a lack of clarity in corporate goals by spending more money on their infrastructures. Rather than determine what kinds of communications they most need to enable, they invest in state-of-the-art technologies that should allow them to communicate with "anyone, anytime, anywhere." Rather than determine what data standards are most crucial for meeting immediate customer needs, they attempt to design all-encompassing data models. This approach to infrastructure building is expensive and generally not fruitful (Goodhue, Kirsch, Quillard, Wybo, 1992). Money is not a good substitute for direction.

IT Architecture. The development of an IT architecture involves converting the corporate strategy into a technology plan. It defines both the key capabilities required from the technology infrastructure and the places where the technologies, the management responsibility, and the support will be located. Reflecting the vision of the core operating and decision making processes, the IT architecture identifies what data must be standardized corporate-wide and what will be standardized at a regional level. It then specifies where data will be located and how it will be accessed. Similarly, the architecture differentiates between processes that must be standardized across locations from processes that must be integrated.

The architecture debate is a critical one for most companies because the natural tendency, where needed capabilities are unclear, is to assume that extensive technology and data standards and firm-wide implementation of common systems will prepare the firm for any eventuality. In other words, standard-setting serves as a substitute for architecture. Standards and common systems support many kinds of cross-business integration and provide economies of scale by permitting central support of technologies. However, unnecessary standards and common systems limit business unit flexibility, create resistance and possibly ill-will during implementation, prove difficult to sustain, and are expensive to implement.

The elaboration of the architecture should help firms distinguish between capabilities that are competitive necessities and those that offer strategic advantage. It guides decisions on tradeoffs

between reliability and state-of-the art, between functionality and cost, and between buying and building. Capabilities recognized as strategic are those for which a firm can justify using state-of-the-art technologies, using non-standard technologies, and building rather than buying.

Infrastructure. While firms' architectures are orderly plans of the capabilities that their infrastructures should provide, infrastructures themselves tend to be in a constant state of upheaval. At many firms key elements of the IT infrastructure have been in place for 20—30 years. Part of the infrastructure rebuilding process is recognizing that the fast pace of business change means that such enduring infrastructure components will be less common.

Architectures evolve slowly in response to major changes in business needs and technological capabilities, but infrastructures are implemented in pieces with each change introducing the opportunity for more change. Moreover, because infrastructures are the base upon which many individual systems are built, changes to the infrastructure often disrupt an uneasy equilibrium. For example, as firms implement enterprise-wide systems, they often temporarily replace automated processes with manual processes (Ross, 1997a). They may need to construct temporary bridges between systems as they deliver individual pieces of large, integrated systems or foundation databases. Some organizations have tried to avoid the chaos created by temporary fixes by totally replacing big pieces of infrastructure at one time. But infrastructure implementations require time for organizational learning as the firm adapts to new capabilities. "Big bang" approaches to infrastructure implementations are extremely risky. Successful companies usually rely upon incremental changes to move them toward their defined architectures, minimizing the number of major changes that they must absorb.

Travelers Property & Casualty grasped the value of incremental implementations while developing its object-oriented infrastructure. In attempting to reuse some early objects developers sometimes had to reengineer existing objects, because new applications clarified their conceptualizations. But developers at Travelers note that had they waited to develop objects until they had perfected the model, they never would have implemented anything (LaBoda and Ross, 1997). Stopping, starting, and even backing up are part of the learning process inherent in building an infrastructure.

Systems Applications. A solid infrastructure provides a base for rapid development of new applications by both reducing the range of decisions that developers must make and facilitating integration with existing applications. The systems applications that firms are building and buying support specific business processes. In many cases, systems support current business processes, while also providing a platform for additional capabilities. Thus, systems may fill both an application and an infrastructure role. In the late 1990s three types of applications are particularly crucial: enterprise resource planning systems, web applications, and performance support systems. All three of these applications have the potential to expand the IT infrastructure.

Enterprise resource planning (ERP) systems have created enormous implementation challenges (Davenport, 1998). Despite the high cost and notable risks of ERPs, firms are investing in them to address their need for increased visibility across organizational processes. At Dow Corning, for example, an implementation of SAP is specifically intended to support standardization of global processes across its value chain. It is also expected to provide the data for global decision

making and to interface with systems bolt-ons that deliver capabilities such as bar-coding and customer service support.

Web technologies have the potential to radically change how organizations design both their IT architectures and their business processes (Hamel and Sampler, 1998). Intranet applications at firms like Ford are increasing communication within firms and allowing rapid application of systems that support internal processes (Austin and Cotteleer, 1997). Texas Instruments, Boeing, and other firms that jointly develop products and sell to businesses rather than consumers have implemented extranets for secure, cost-effective transactions. Internet applications allow firms like L.L. Bean, Charles Schwab, and The Gap to offer alternative channels for consumer purchases.

Performance support systems help firms simultaneously standardize and customize individual decision-making. At Travelers Property and Casualty, for example, the object-oriented infrastructure described earlier was initially developed to support a workstation for workers' compensation case managers. This workstation standardized routine processes, such as filing a claim, reporting to state agencies, and tracking payments. At the same time, it clarified areas where case managers should use their discretion in allowing certain types of reimbursements (LaBoda and Ross, 1997).

Organizational Processes. Traditionally, organizations viewed their key processes from a functional perspective. Managers developed efficiencies and sought continuous improvement within the sales and marketing, manufacturing, and finance functions, and slack resources filled the gaps between the functions. New technological capabilities and global markets have emphasized three very different processes: (1) supply chain integration, (2) customer and supplier linkages, and (3) leveraging of organizational learning and experience. Not surprisingly, these processes often rely on the three key systems identified in the prior section.

For many manufacturing firms, supply chain integration is a critical concern. To be competitive they must remove the excess cost and time between the placement of an order and the delivery of the product and receipt of payment. Supply chain integration requires a tight marriage between organizational processes and information systems. An ERP provides the scaffolding for global integration, but a system cannot be implemented until management can describe the process apart from the technology and many firms are connecting individual systems rather than installing large ERP systems.

Where technology allows faster or better customer service, firms are innovating rapidly. Being competitive increasingly demands leveraging technologies like electronic data interchange and the WorldWide Web to strengthen customer linkages. In some cases this has simply involved making more information available to customers, such as with on-line tracking systems. In other cases, it has involved transforming organizational processes to address customer requirements (Ross, 1995b).

Finally many firms are looking for ways to capture and leverage organizational learning. Distributed employees attempt to customize a firm's core competencies for individual customers. These employees can increase their effectiveness if they can learn from the firm's accumulated

experiences. Intranets, performance support systems and groupware technologies facilitate knowledge sharing and organizational learning but the process for making this happen are still elusive.

Firms that adapt and improve upon these three processes can be expected to outperform their competitors. It is clear that to do so will require a unique combination of a visionary senior management team, a proactive IT unit, and a resourceful work force. Together they can iteratively build, evaluate, redesign, and enhance their processes and supporting systems.

Implementing and Sustaining the Infrastructure

It is clear that the top and bottom layers of the IT pyramid are primarily the responsibility of business managers, while the middle layers are the responsibility of IT managers. Four partnership processes provide the glue between the layers as shown in Figure 5.

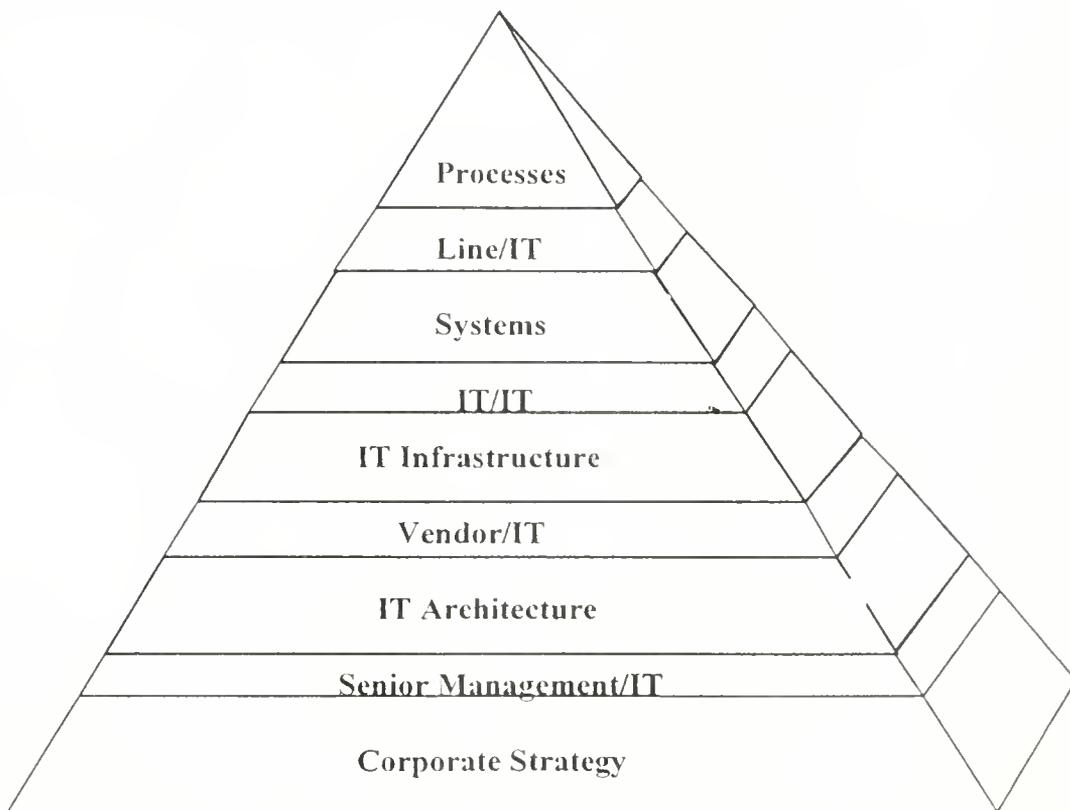


Figure 5: Partnership Processes in Infrastructure Development

Senior Management/IT Partnership. The process of moving from a strategy to an IT architecture involves mutual education of senior business and IT managers. Traditional approaches to education, such as lectures, courses, conferences and readings are all useful. Most important, however, is that management schedules IT-business contact time in which the focus of the discussion is business strategy and IT capability. At Schneider Logistics, senior business managers meet formally with IT managers for two hours each week. This allows IT management to identify opportunities while senior management specifies business priorities. Over time, they

have developed a mutual understanding and trust that fosters an effective partnership (Henderson, 1990) and targets resources strategically.

Thus, the IT architecture debate is a discussion among senior managers with insights and advice from the IT unit. Senior management articulates evolving strategies for organizational processes, while IT clarifies capabilities of the technologies. A key role of IT becomes one of explaining the potential costs of new capabilities. Typical ROI analyses are often not meaningful in discussions of infrastructure development, but senior managers need to know the size of an investment and the accompanying annual support costs for new capabilities before they commit to large infrastructure investments.

To avoid getting bogged down in arguments over who would pay for new capabilities, some firms have made “speed bump” investments. Texas Instruments, for example, traditionally funded infrastructure by attaching the cost of incremental infrastructure requirements to the application development project that initiated the need. But when the corporate network proved inadequate for a host of capabilities, senior management separately funded the investment (Ross, 1997b). In this way TI avoided the inherent delays that result from investing in infrastructure only when the business are willing to vote in favor of additional corporate taxes.

Vendor/IT Partnership. Building an infrastructure from the prescribed architecture involves piecing together individual technologies to address the required capabilities. Increasingly, these technologies are purchased rather than developed internally. As a result, the IT unit must manage its relationships with vendors to ensure, as much as possible, that new releases and upgrades address key requirements. In addition, some infrastructure services, such as desktop support, legacy systems maintenance, and data center operations, may be outsourced. The central IT unit, however, retains accountability for the provisioning of these infrastructure services. Senior IT managers should be responsible for developing and managing strategic alliances with the IT unit’s key partners.

IT/IT Partnership. Developing system applications involves building upon the technologies that make up the IT infrastructure. Infrastructure services are necessarily built upon a set of standard technologies that limit the range of technologies that corporate IT will support. This enables the centralized infrastructure unit to focus its expertise on key technologies. Applications developers must understand the value of standards so that they can, on the one hand, comply with the standards and, on the other hand, communicate specific requirements that should influence the choice of standards. Nonetheless central IT units that clearly understand their costs have an edge in partnering with their business unit counterparts because they are able explain the value of adherence to standards and the tradeoffs inherent in noncompliance (Ross, Vitale and Beath, forthcoming).

The establishment of account manager and relationship manager roles in organizations assigns a person in a business unit with specific responsibility for negotiating with the central IT unit. This role fosters negotiation in the selection of infrastructure services and standards. It can also facilitate effective use of infrastructure services by business units.

Line/IT Partnership. Although the infrastructure can enable new organizational forms and processes, the implementation of those new processes is dependent upon the joint efforts of business unit and IT management. Successful process redesign demands that IT and business unit management share responsibility and accountability for such processes as implementing common systems, establishing appropriate customer linkages, defining requirements for knowledge management, and even supporting desktop technologies. The joint accountability is critical to successful implementation because the IT unit can only provide the tools. Business unit management needs to provide the vision and leadership for implementing the redesigned processes (Davenport, 1993).

Many process changes are wrenching. In one firm we studied autonomous general managers lost responsibility for manufacturing in order to enable global rationalization of production. Ultimately, these general managers found that they were able to focus on the most important and interesting aspect of their jobs, but initially, these managers felt they had been demoted to sales managers. Another firm closed the regional offices from which the firm had audited and supported local facilities. Regional managers reorganized into cross-functional teams and, armed with portable computers took to the road to spend their time visiting local sites. In these and other firms changes rarely unfolded as expected. In most cases, major process changes take longer to implement, demand more resources, and encounter more resistance than management expects.

Implications of Infrastructure Rebuilding

We observed significant obstacles to organizations' attempts to build infrastructures that enabled the federalist organization. In particular, most of the changes that the firms were implementing involved some power shifts, which led to political resistance. Even more difficult to overcome, however, was the challenge of clarifying the firm's strategic vision and defining IT priorities. This process proved to be highly iterative. Senior management would articulate a vision and then IT management would work through the apparent technological priorities that the strategy implied. IT could then estimate time, cost, and both capabilities and limitations. This would normally lead to an awareness that the strategy was not clear enough to formulate an IT architecture. When the organization had the necessary fortitude, management would continue to iterate the strategy and architecture, but most abandoned the task midstream and the IT unit was left trying to establish priorities and implement an architecture that lacked clear management support. This would lead either to expensive efforts to install an infrastructure that met all possible needs or to limited investment in infrastructure that was not strategically aligned with the business (Henderson and Venkatraman, 1993).

Although it is difficult to hammer out a clear architecture based on corporate strategy and then incrementally install an IT infrastructure that supports redesigned organizational process, the benefits appear to be worth the effort. The Travelers' early adoption of an object environment has helped it retain a high quality IT staff, and allowed it to anticipate and respond to changing market opportunities. Johnson & Johnson's development of a corporate-wide infrastructure has allowed it to address global cost pressures and respond to the demands of global customers. Senior management sponsorship of global systems implementations at Dow Corning has enabled the firm to meet due dates for implementation and anticipate potential process redesign.

As firms look for opportunities to develop competitive advantage, they find it is rarely possible to do so through technological innovations (Clark, 1989). However, the firms in this study were attempting to develop infrastructures that positioned them to implement new processes faster and more cost effectively than their competitors. This kind of capability is valuable, rare, and difficult for competitors to imitate. Thus, it offers the potential for long-term competitive advantage (Collis and Montgomery, 1995). Rebuilding an infrastructure is a slow process. Firms that wait to see how others fare in their efforts may reduce their chances for having the opportunity to do so.

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