The Importance of Organizational Leadership for Creating Technology Excellence

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Critical for Business Competitiveness

In today's world, Information Technology (IT) forms the backbone of industries such as banking, airlines, and publishing, and is an increasingly important value-adding component of consumer products such as television sets, cameras, cars, and mobile telephones. IT is the dominant force enabling companies to exploit new distribution channels, create new products, and deliver differentiated value-added services to customers. In reality, there is often little difference between an organization's IT strategy and its business strategy.

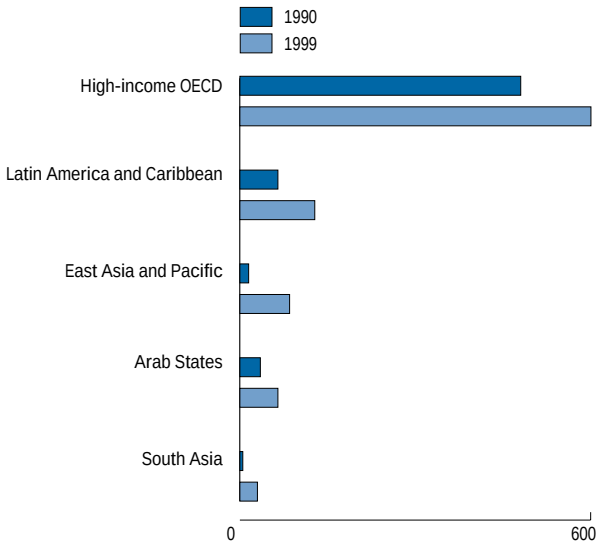
IT is critical for innovation and business competitiveness. James Brian Quinn et al. (1996) note: "A revolution is now underway. Most innovation occurs first in software. And software is the primary element in all aspects of innovation from basic research through product introduction." Even from a broader perspective, technology is today an important factor in economic growth and development of countries. In the *Global Competitiveness Report 2001–2002,* John McArthur and Jeffrey Sachs (2001) note that improvements in technological innovation (i.e., creating a new technology) and diffusion (adapting and adopting a new technology) play a central role in the economic growth of nations.

It is therefore not surprising to note that the global volume of IT services is growing at an astonishing rate. According to the International Data Corporation, global spending on IT services will grow from US$439 billion in 2001 to US$700.3 billion by 2005. The United States will lead all other nations in this category, spending US$335 billion in 2005, up from US$206.9 billion in 2001. Western Europe will spend US$192.4 billion in 2005, up from US$127.5 billion in 2001. Meanwhile, spending in Japan will grow from US$53.2 billion to US$75.2 billion.

Leadership in Technology: An Important Challenge

The Human Development Report 2001 published by the United Nations Development Program introduced a new index, the technology achievement index (TAI). There are other measures for national technological progress in the literature. Other sections of this report elaborate on the Networked Readiness Index. *The Global Competitiveness Report 2001–2002* has created indexes to measure technology development. Regardless of which index or measure is used, one fact stands out: there are large differences in the scores achieved by the richer, more developed nations and the poorer, developing nations. The gaps exist along virtually all dimensions used to construct the various indexes.

Figure 1: **Telephone Mainlines per 1,000 People**



Source: United Nations Development Program, International Telecommunication Union and the World Bank

Despite a high level of governmental awareness and previously formulated policy changes, the diffusion of technologies has proven to be painfully slow. Figure 1 depicts the progress in global telephone mainline penetration over the 1990s. At the current rate of progress, it will take South Asia more than two decades to reach levels comparable to those achieved by high-income countries. Though there are a few examples of successful, rapid penetration of new technologies such as mobile telephones in developing regions, the gaps between the developed and developing nations along key measures of technological progress are increasing, not decreasing.

The picture is grim for developing nations with respect to technological innovation and diffusion. If IT is critical for innovation and business competitiveness, it raises a fundamental question: Will firms from developing nations ever become capable of creating and sustaining the technological excellence necessary for global leadership? Or are they doomed to be followers of technological innovations created elsewhere and be trapped by a persistent competitive disadvantage?

The answers to these questions are not easy. Developing nations face many handicaps, such as lower levels of education and technology penetration and higher levels of poverty, as they attempt to compete with the more developed nations on the technology frontier. The battle is uphill right from the start. The situation may appear hopeless, but there is reason for hope.

Many developing nations are adopting a cluster strategy—that is, investing in local clusters of high technology start-ups and related educational and service institutions—and passing a set of favorable policy reforms to attract capital and talent to these clusters. A good example of such a cluster is the Multimedia Super Corridor in Malaysia. Other examples of successful clusters are the software companies in Bangalore and Hyderabad, both in India.

There is also concrete evidence that firms in developing nations can demonstrate business leadership when enabled by technology excellence. Technology itself may not provide the solution; rather, the answer may lie in the organizational context in which the technology is deployed. This paper attempts to provide some perspective on this issue by focusing on two specific examples: Motorola's software subsidiary in India and CEMEX in Mexico.

The Difficulty of Software Excellence

Developing competence in software in not easy. In addition to the ubiquitous nature of software, the amount of software code in most consumer products and systems doubles every two to three years. This increase is being driven both by escalating demands placed on the functionality of software systems and the rapid pace of progress in the enabling hardware technology. Consequently, software developers are scrambling to cope with the pressures of developing systems that are not only a couple of orders of magnitude larger and more complex than those developed a few years ago, but also need to meet ever-increasing demands for higher quality and superior performance.

Stories of the dramatic time and cost overruns of software projects are legendary in the software sector. Industry observers (Gibbs 1994) note that for every six new large-scale software systems put into operation two others are cancelled, and that the average software project overshoots its schedule by half. The industry benchmark for measuring software performance is the Capability Maturity Model (CMM 2001), developed by the Software Engineering Institute at Carnegie Mellon University, Pittsburgh in the late 1980s. The Capability Maturity Model (CMM) classifies the software capability of organizations into five levels, with level 1 being the lowest (software processes are ad-hoc and chaotic) and level 5 the highest (software processes are capable of self-improvement and incorporate the highest levels of quality).

The CMM model is widely used to assess software excellence by firms in all countries, both developed and developing. About 65 percent of all corporations worldwide are estimated to be at level 1. This means that the vast majority of software projects in these firms either fail or miss their cost, time, and quality targets by wide margins. As of 2001, only about fifty organizations worldwide have software processes rated at level 5. An organization at level 5 is not only able to deliver high-quality software projects consistently on time and within budget, but also able to predict the number of software bugs at different stages of the process and take action before the bugs actually appear (much like preventive maintenance in manufacturing).

A Success Story in India

India does not rank very high on most indexes measuring technological progress. For example, in the Networked Readiness Index,

India is ranked at fifty-four out of a total of seventy-five ranked nations. Despite its low overall position in most rankings, the Indian software industry is widely recognized as a success story—the industry is one of the few bright spots in India's economy, with local companies competing successfully with other global players. Both local political leaders such as Prime Minister Atal Behari Vajpayee ("IT is India's tomorrow" [Ghemawat 2000]) and global software luminaries such as Bill Gates ("India is likely to be the next software superpower" [Guha 1998]) have attested to the promise of the Indian software industry.

According to industry estimates Indian software services as a percentage of global software services will more than triple from 1.6 percent in 1999 to around 5.4 percent in 2004. Data released from the 2001 annual industry survey of the National Association of Software and Service Companies (www.nasscom.org) show that Indian software exports in the period 2000 to 2001 grossed revenues of US$6.2 billion and registered a growth rate 55 percent greater than the 1999 to 2000 performance. Between 2000 and 2001, Indian software exports accounted for an impressive 14 percent of the country's total exports.

Indian software competence is not just a success in terms of total volumes. More important, it is a success in terms of quality and technical excellence. During 2001, the number of quality-certified software companies from India increased to over two hundred fifty; twenty-seven Indian companies now have the unique distinction of a CMM level 5 certification. This is the highest number from any one country in the world. One of the first companies in the world to attain level 5 certification was also an Indian company—the subsidiary of Motorola in Bangalore, India.

The success of Indian software companies is no small achievement. Software is critical for business competitiveness, and competence in software continues to elude firms in much of the developed world. As stated earlier, about 65 percent of firms worldwide have software processes with the lowest level of CMM maturity. The U.S. Internal Revenue Service (Johnston 1997) has conceded that despite having spent US$4 billion developing modern computer systems, the systems "do not work in the real world." Even organizations with a history of high IT achievement are not immune from such crises. American Airlines, for example, built its reputation of IT excellence during the 1980s on the back of its famous SABRE airline reservation system, but subsequently suffered major disasters while attempting to build the CONFIRM reservation system for hotel and car rental companies such as Hilton and Budget.

A Favorable Context

For a long time, the growth of the Indian software industry was retarded by nonsupportive government regulations. Pankaj Ghemawat et al. (2000) from the Harvard Business School describe it as follows: "The growth of the Indian software industry was held back by the slow rate of computerization; the Indian government was concerned that computers might threaten job creation. Furthermore, official policy stressed an import-substitution approach: the hardware and software deployed domestically was to be developed indigenously, with imports of computers and technology allowed only when strictly necessary. Until the mid-1980s, hardware importers had to be willing to pay tariffs as high as 350 percent and wait as long as four years for import clearances. And software imports were simply banned."

The challenges faced by the Indian IT sector were mirrored in most other aspects of the economy. Restrictive state controls on virtually all aspects of import, export, and foreign ownership were the norm. A wave of nationalization of critical industries in the mid-1970s forced global companies such as IBM and Coca-Cola out of the country. Sparked by economic crisis, the government of India embarked on the first serious attempt at economic reform at the start of the 1990s. A deliberate shift was made in government policy to favor private sector initiatives. Significant changes took place in the product and capital markets. For example, industrial licensing was abolished for most sectors, thus allowing operations to evolve more flexibly. Foreign ownership of firms in India was facilitated and firms were allowed to raise debt and equity in global capital markets.

Although the software industry in India was traditionally subject to fewer controls than other sectors, the changes in the overall macroeconomic climate proved to be a big boon. Successive Indian governments, prodded by local entrepreneurs and the growing numbers of Indian software experts abroad, acted to initiate several software sector-specific reforms. These reforms included investments in new telecommunications infrastructure support and the stimulation of IT use in both public and private services. Various state governments also stepped in with initiatives to create high-tech clusters by attracting leading global and national IT firms. The clusters around Hyderabad and Bangalore in the states of Andhra Pradesh and Karnataka, respectively, are the most notable successes in this regard.

A generally favorable regulatory environment coupled with an abundance of well-trained computing graduates may have helped the establishment of several low-cost software body shops, but these factors do not explain why some Indian software firms have been able to position themselves at the world's pinnacle of software excellence. It is necessary to look in depth at one such firm to understand the drivers critical to this success.

Motorola in India: Pioneering Excellence

Motorola's experience with offshore software development in India provides a unique perspective into how a world-class

center of excellence can be created in a developing nation. Bucking the usual trend, Motorola has for over a decade assigned a unique strategic responsibility to its software development center in India. It has invested in developing the center's competence and given it some of the most challenging and mission-critical projects within the entire corporation.

The payoff has been significant. Started as a Greenfield site in 1991, Motorola India Electronics Limited (MIEL) stunned the software world by achieving in 1993 the highest possible CMM software process maturity rating of level 5 nearly two years ahead of schedule. By the mid-1990s MIEL was widely recognized for being one of only two organizations worldwide with software processes certified at CMM Level 5 maturity. Given the criticality of software for Motorola's business success, the achievements of MIEL have not gone unnoticed within the corporation: in 1994 MIEL became the first software unit to receive Motorola's Chief Executive Officer's Quality Award.

An ambitious Greenfield

Around the late 1980s, there was recognition by many in Motorola that software was going to be a big part of the future. At that time, the state of the art in software development was poor in terms of quality, cycle-time and customer satisfaction. Also, there was an urgent need to fill the estimated annual shortfall of 5,000 staff years of software skills within the corporation. So the decision was made to set up a Greenfield site outside the U.S.

When it came to putting a Greenfield together, the Motorola Software Engineering Steering Committee adopted a "clean sheet" approach. Certain questions were repeatedly asked: "How should we attack the (software) issues? How can we do it right? If we had a clean sheet, how would we do it? The discussions led to a decision to build a process-oriented entity somewhere outside the core Motorola organization with a high degree of management commitment and adequate resources.

An ambitious goal was set for the Greenfield: to start at CMM Level 3 from day one and to reach CMM Level 5 within four years. It was a daunting goal—no one else had attempted it before. Some software professionals doubted whether it was ever going to be possible to achieve level 5.

A razor-sharp focus on disciplined execution

A phased development approach with parallel development and test is standard in MIEL. Each phase is managed explicitly and rigorously by a series of quality audits, built-in causal analyses, and feedback mechanisms. Deliberate focus is placed on the extensive use of metrics. Each project team has a Software Quality Manager who is responsible for auditing adherence to key processes, helping the team in applying different quality tools, and ensuring the transfer of operational project metrics to the quality department.

The quality department is responsible for maintaining data for all MIEL projects along with other industry benchmark data. These data are utilized by project teams for making estimations for different aspects of the process such as productivity, quality, and number of defects. There is a constant focus on the adoption of rigorous management techniques during every phase of each project.

Building employee excellence

The initial team members were chosen very carefully, both in terms of skills and attitudes towards experimenting with new approaches. As additional employees were hired, MIEL followed one hard-and-fast principle: all engineers had to go through a mandatory six-week Induction Training Program (ITP) in batches of about twenty to twenty-five employees. This was seen as critical for getting all employees acquainted with MIEL's unique approach to software development and to create a common language among all employees.

Sarala Ravishankar, the quality manager of MIEL, commented on the role played by the ITP: "I would say the ITP is more a culture building exercise rather than a technical skills communication program. Techniques are taught to people, but more importantly we stress why we are doing what we are doing. As you start getting people to think about this, you create a fundamental belief in some of our systems" (Dutta and van Wassenhove 2000).

MIEL has an excellent reputation as an employer of choice among the top Indian technical universities and thus has little difficulty hiring the best talent. About 35 percent of all employees each year are fresh postgraduates from these colleges. To further nurture links with top universities, MIEL has invested substantial time and money in a University Relations Program, which sponsors university research, funds prizes for top students, cultivates links with professors, and invites students for internships.

A learning culture

Learning and sharing of knowledge play a key role within MIEL. Information about the performance of project teams is public and available to all. Project reviews are frequent and open to all. They serve as a forum, enabling everyone to constructively review and evaluate the experiences of a project team. Common problems are identified in these meetings and suggestions for improvements are given by all present. A manager characterizes it as a "common, practical learning environment, not just a theoretical process." The culture is seen to nurture creativity and openness.

Employees from different functional areas of the organization are brought together in a number of ways. An annual event is held to highlight best practices in different key process areas.

Special emphasis is put on learning from failures. Sarala Ravishankar explained, "We have had several failures. In fact I think that failure is good for the organization because that's the best and fastest way of communicating learning to the organization. If we fail in one project, we look at what are the reasons which really caused that failure. And we have a system in place which analyses those failures and spreads the learning across the organization" (Dutta and van Wassenhove 2000).

Global leadership

MIEL has established the benchmark of software excellence within Motorola's global corporation. Mohan Kumar, the managing director of MIEL, noted, "We have been successful to the point that we produce software for about one-sixth of Motorola's products by revenue. This organization is in the critical path of developments. We're core to the success of the business." Motorola groups from across the world look to MIEL for critical advice on product leadership. Roger Fordham, a former managing director of MIEL, described it thus in 1999, "We have gone through three generations in our relationships with customers. Stage 1—what do you want? You say 'I want it green, five by seven by three, and it's got to have this density.' We'll do that for you. As you evolve you come back and the customer says to you 'you know a bit more about my business now. Why don't you tell me what you think we should do?' And we have a mutual goal-setting activity. And today, we've moved on to a third generation, in which the customer is saying 'everything there is to know is known by you—so don't come to me asking me what to do. You'd better be telling me what to do.' And this is exactly what we're doing. We're telling the customer what…should be done next" (Dutta and van Wassenhove 2000).

Motorola has leveraged its success in India by starting a string of software centers in developing nations in Asia and Eastern Europe, all closely modeled on MIEL. Personnel transferred from MIEL, who bring with them valuable best-practice knowledge, have seeded these new software centers. Software has become a core competence of Motorola, thanks to MIEL.

Let us now turn to another developing country in a different part of the world: Mexico.

Mexico: Another Success Story

Mexico ranks higher than India on most measures and indexes. For example, in the Networked Readiness Index, Mexico is ranked at forty-four, compared with India's position of fifty-four (out of a total of seventy-five ranked nations). The higher rankings of Mexico are primarily due to a higher success rate in the diffusion of old and new technologies. However, if one looks at the detailed figures for technology innovation and diffusion for Mexico, it is difficult to find fertile substrate for the birth of world-class technology excellence. Unlike India, Mexico does not have a reputation for either producing top-notch computing graduates by the thousands (even though it has several excellent universities) or playing host to a booming local software industry. Despite these shortcomings, Mexico is home to CEMEX—its preeminent multinational company, a global industry leader that is also a pioneer in the application of IT and the Internet for business innovation.

CEMEX is the third largest cement company in the world and operates in four continents. While many would be hard pressed to name the two biggest cement companies in the world (France's Lafarge and Switzerland's Hocim), CEMEX has become a familiar name for most executives because in terms of profitability, CEMEX surpasses its larger competitors (in terms of cash flow-to-sales ratio). By 2000, CEMEX had achieved a ten-year EBITDA growth of 20 percent—an impressive achievement indeed. In a March 2001 article entitled "Mexico: CEMEX's stratospheric rise," *Latinfinance* had this to say: "CEMEX is the emerging market company that graduated to the big league. In just over a decade, a family run business from Mexico's north-eastern industrial capital, Monterrey, has transformed itself into a world class multinational giant" (Piggott 2001).

The critical success factors for CEMEX's rapid growth are relatively few and simple. In fact, they revolve around two concepts: market diversification and technological innovation. CEMEX has conclusively demonstrated its ability to thrive in some of the most demanding and dynamic market environments around the world—both in developed (such as the U.S.) and developing (such as countries in Latin America and Asia) nations. Central to its success in various markets has been its wholehearted embrace of new technologies. It has set the pace of technological innovation in the industry worldwide and transformed itself into an agile company that is both more efficient and more innovative in its business practices than its global competitors. Over the past decade, CEMEX has been transforming itself into an e-corporation that has earned it a place in the business media next to technology leaders such as Cisco and Dell.

CEMEX: Building an E-corporation

A top business priority

"Mexico and cement might seem to be the most unlikely combination to produce an agile, efficient, e-business pioneer. Yet CEMEX is just such a company" (Economist 2001). The annual report (2000) of CEMEX states it very explicitly—IT and e-business are among the company's top priorities:

> "The construction industry is ripe for a digital makeover, and CEMEX is leading the way, transforming itself from a conventional to a digital enterprise. CEMEX has long used information technology (IT) to streamline its operations, provide value-added customer services, and generate value for its stakeholders.

> To ensure that all its people and processes have access to the full power of the Internet, as well as the skills, tools, and networks to use that power, CEMEX is "e-enabling" every aspect of its business. **E-enabling is a top priority** [emphasis added]."

CEMEX's chief executive officer, Lorenzo Zambrano, is a firm believer in the power of IT to create business value. One of his first tasks after becoming CEO in 1985 was to create an IT department, something that CEMEX had never had. Under his leadership, IT has become core to the firm's business strategy.

Relentless focus on business value

In the first half of the 1980s, CEMEX's operations were much like what would be expected from a cement company—multiple autonomous plants, poor communication and coordination across plants, lack of real-time performance reports, frequent disruptions in mixing plant and delivery truck scheduling, and chaos caused by late customer order changes. CEO Zambrano made it a business priority to change all of that.

Extensive benchmarking was conducted with other leaders in sophisticated production and delivery methods—FedEx, Exxon and Houston's 911 emergency team—and investment was ramped up in basic infrastructure. Plant operations were automated, as well as other functions such as sales and accounting. In 1989, CEMEXnet, a satellite-based communications system linking all cement plants, was implemented. Central coordination of all plants based on real-time information was implemented. In the early 1990s, CEMEX installed a logistics system called Dynamic Synchronization of Operations, which uses the Global Positioning System (GPS) technology to link delivery trucks to a central control center.

The relentless focus has been on creating business value by delivering real-time information for operational effectiveness and higher levels of customer service. For example, CEMEX has been able to slash its delivery window from three hours to twenty minutes (satisfied in 98 percent of the cases)—a dramatic improvement of value delivered to customers when one notes that the company sells ready-mixed cement which can only survive for ninety minutes before solidifying. Notes an industry expert, "This is not just a good technology application. It's a brilliant business design" (Kaplan 2001).

Embracing new technologies for creating new businesses

CEMEX has embraced the Internet to increase its levels of connectedness, both inside and outside, with its many business partners. "CEMEX has formed multifunctional teams that are driving its digital evolution while identifying the company's best practices, incorporating them into standard platforms, and executing them throughout the organization. Their aim is to ensure that 60 percent of the company's business processes are managed on a Web-based environment by year-end 2001" (CEMEX 2000).

In September 2000, CEMEX launched CxNetworks. This company's goal is to deploy a network of e-businesses that leverage CEMEX's assets onto the Internet, and extends CEMEX's reach into areas that complement and add to its core business. CxNetworks is initially working in four areas: creating a network of construction initiatives in key markets worldwide; building Latinexus as a Pan-Latin e-procurement exchange for indirect goods and services; growing Neoris, a business solutions provider; and developing important new businesses in the logistics industry.

CEO Zambrano firmly believes that the Internet can do more than just save costs: "Our goal with CxNetworks is to become the leading provider of Internet-based business solutions for the construction industry—as well as to create new, profitable opportunities in other areas, leveraging our assets and our experience" (Zambrano 2000). CEMEX is using its leadership in IT to enter new businesses. Technology continues to be core to CEMEX's future.

Wanted: Ambition and Innovation

The overall measures do not look very promising for developing countries with respect to technological innovation and the diffusion of old and new technologies. The numerical data presented in other parts of this report only serve to emphasize the enormous challenges facing developing nations. It is obvious that a lot more must be achieved on multiple fronts, including the:

- Accelerated adoption of conventional technologies such as the telephone and PC;
- Increased penetration of the Internet and related new technologies in society;
- Reduced regulatory burdens with respect to IT import and export;
- Investment in IT education at all levels—schools, vocational colleges and universities;
- Creation of appropriate research and development facilities for IT innovation; and
- Provision of incentives for technology adoption to corporations and SMEs.

The benefits of changes championing the above are well documented, both in developed and developing nations. Countries such as the U.S. and Finland, which have the most supportive regulatory and macroeconomic conditions for technology, benefit from the highest levels of IT innovation and adoption. India, after adopting a package of technology-friendly reforms

at the start of the 1990s, saw the local software industry grow rapidly. A cluster-based strategy of creating local regions of high technology within favorable regulatory contexts has worked successfully in India, and to a limited degree in Malaysia and other developing countries. Such clusters should continue to be encouraged and the lessons and benefits from these clusters should be passed onto the broader national contexts.

Despite a high level of awareness about the need and benefits of the changes noted above, it is quite likely that progress will be painfully slow for most developing nations. Countries such as India and Mexico that need to go up the technology adoption curve the fastest, are often hampered by poverty, natural calamities, poor infrastructures, high rates of illiteracy, corruption, and political turmoil—complex factors that are difficult to change rapidly.

However, the examples of Motorola in India (MIEL) and CEMEX in Mexico provide hope. They give concrete evidence that it is possible to achieve business leadership enabled by world-class IT excellence in developing nations, despite having a less-than-ideal regulatory and macroeconomic environment. Note that this is not simply a question of using IT well or adequately. Both MIEL and CEMEX are true innovators and are at the leading edge of IT-enabled business value creation. How does one explain the successes of MIEL and CEMEX? The answer surely cannot be the companies' national IT environments, which are far below best-in-class global standards. The explanations are to be found to a large degree within the corporations themselves, in the organizational context in which these companies have chosen to deploy technology. Organizational leadership is critical for success in both of these firms.

Simple but Important Lessons

Despite their differences in country and industry domains, the critical success factors of MIEL and CEMEX are refreshingly simple and similar. At the core both firms share a burning ambition for excellence and achievement. MIEL was challenged to achieve level 5 software process maturity in 1991, a time when most software experts doubted whether any firm could *ever* reach level 5 maturity. Motorola has constantly challenged MIEL by assigning the most challenging mission-critical projects to its engineers. Contrast this to most other firms from developed nations who treat their outsourced software centers in developing nations with trepidation and assign only low-risk "code-conversion" projects to them. Like the managers of MIEL, CEO Zambrano has infused a unique global ambition into CEMEX. The company has grown from its humble Mexican roots into one of the most admired corporations worldwide. CEMEX brought IT into an industry that traditionally did not use technology strategically and fundamentally transformed the way the cement/construction business is run and customer value is created.

But ambition alone is not enough. Both MIEL and CEMEX demonstrate how top management leadership is vital for making that ambition come alive in the corporation. One of the first hires of MIEL described the role played by George Smith, the first managing director of MIEL (Dutta and van Wassenhove 2000), "George Smith had a tremendous impact on us. He taught us. I've not seen anybody else pursue a goal with the same level of dedication. He used to come to every one of us almost every day and have a chat with us on software engineering practices. I don't think that any one of us had even an inch of doubt that this would not be a success." Similarly, but for the leadership of Lorenzo Zambrano, CEMEX would still be a local Mexican cement company doing business much as it did in the 1980s. CEO Zambrano has made it possible for CEMEX to think the unthinkable: that it could be a global leader. Thanks to the innovative use of IT spearheaded by Zambrano, CEMEX is today one of the largest and most profitable cement companies with a global reach.

Also common to both leaders is the fact that they succeeded in creating the right environment to stimulate innovation and individual creativity. Despite the presence of a traditional hierarchical society in India, MIEL created an open learning culture where even junior twenty-year-old engineers felt comfortable criticizing "older" more experienced managers. This culture did not appear naturally. An engineer at MIEL recalled one of the early open project review meeting: "There was literally a fight because the project team being reviewed could not accept the comments given by others. It required a certain degree of openness to accept the different views of your colleagues, many of them junior to you. But we have come a long way from that today." As technology permeated the processes of CEMEX, "there was resistance to the changes, especially to the e-mail; but open information and easy communication together brought about a shift in the corporate culture. Knowing that they were being watched, employees began to strive for improvements. At the same time, Mr. Zambrano sought to make his managers receptive to new ideas from below. "IT frees up everyone's imagination," he [Zambrano] says. (Economist 2001)

Finally, both firms demonstrate disciplined execution and a razor-sharp focus on business value creation. MIEL collects and analyzes volumes of data on its software processes. Its dissection of operational data has become so sophisticated that it is able to predict accurately how many bugs may appear in a software project and when projects may go astray—all to ensure that appropriate corrective measures are taken well before the problems actually occur! The goal is to guarantee high quality project delivery on time and within budget. CEMEX has used IT to transform the ultimate commodity product—cement—into a differentiated service. "It isn't so much the product or the industry, it's rethinking what the customer wants and how you can respond to it in a way that's economical for the company." Discarding the traditional constraints of its sector, CEMEX has embarked upon an ambitious plan to create new businesses by

leveraging new technologies: CxNetworks aims to "leverage CEMEX's knowledge, including its industry expertise and customer focus, and to extend the company's reach into areas that complement its core business" (CEMEX 2000).

Conclusion

For the foreseeable future it is likely that developing nations will lag behind developed nations in terms of overall technology adoption and use. Notwithstanding isolated cases of rapid adoption of certain new technologies the overall lag will continue to pose challenges for governments and societies in developing nations. Significant macroeconomic and regulatory reform needs to be undertaken to improve technology infrastructures and IT adoption. Creating clusters of high technology can help to jump start and speed up the process. This is happening today, slowly but surely, in most developing nations. However, technology is also moving forward at a fast pace, and technology adoption gaps between developed and developing nations are sometimes increasing rather than decreasing.

An interesting question is why the majority of firms in India, Mexico, and other developing nations are not able to emulate the examples of MIEL and CEMEX. Surely, the explanation cannot lie in the general underdevelopment of the respective national infrastructure and technology environments. After all, both MIEL and CEMEX faced and continue to face those same challenges. The answer lies to a large extent within the firms and their respective networks of business partners. If the top management of firms in developing nations do not develop the ambition to become world leaders, they are condemned to follow in the steps of others. If firms continue to see technology as a support function, they will lag behind others who are able to grasp and exploit the strategic potential of technology. If intrafirm and interfirm business processes are not moved online and redesigned appropriately, productivity will lag behind others who aggressively move to e-enable their processes.

Competitiveness in the global arena is the result of multiple attributes, technology excellence being one of them. The examples of MIEL and CEMEX serve to emphasize the point that business leadership supported by world-class technology excellence can be found in developing nations. The critical success factors for both MIEL and CEMEX lie not in the technology used per se, but rather in the leadership and organizational context supporting the application of technology. It is the quality of the latter that contributes the most to the development of business excellence. It is important to note that there are domains where business initiatives will be hampered by low levels of technology adoption in society at large. For example, low penetration of the Internet in developing nations will make it difficult for local online retailers to become global leaders. However, the greater challenge for corporate leaders in developing nations is to be ambitious, and to create the right organizational context for technology excellence.

References

Brian-Quinn, James. *Innovation Explosion: Using Intellect and Software to Revolutionize Growth Strategies*. New York: Free Press, 1997.

Brian-Quinn, James, J.J. Baruch, and K.A. Sien. "Software-Based Innovation." *McKinsey Quarterly,* no. 4, 1996.

CEMEX Annual Report 2000.

CMM. "Capability Maturity Model for Software." <http://www.sei.cmu.edu/cmm/cmm.html> (2001).

Dutta S., and S. Srivastava. "Embracing the Net:Get.competitive." *Financial Times*/Prentice Hall, 2001.

Dutta S., and L. van Wassenhove. "Motorola India and Software Excellence: Life Beyond CMM Level 5." INSEAD Case Study, 2000.

Ghemawat, T.P., M. Patibandla, and W.J. Coughlin. "The Indian Software Industry at the Millennium." Harvard Business School Note # 9–700–036, 31 July 2000.

Gibbs, W.W. "Software's Chronic Crisis." *Scientific American*, September 1994.

Guha, Krishna. "Human Resources in the Software Industry, Survey on South Asian Software." *Financial Times*, 1 July 1998.

Johnston, D.C. "IRS Admits Its Computers Are a Nightmare." *San Francisco Chronicle*, 31 January 1997.

Kaplan, S. "Concrete Ideas." *CIO*, 15 August 2001. (Quote attributed to David Bovet, vice president and leader of the Supply Chain Management Team at Mercer Management Consulting.)

Libert, Barry D., Steve M. Samek, and Richard E.S. Boulton. "Cracking the Value Code: How Successful Businesses Are Creating Wealth in the New Economy." *Harper Business*, 2000.

McArthur, John, and Jeffrey Sachs. "The Growth Competitiveness Index: Measuring Technological Advancement and the Stages of Development." In *The Global Competitiveness Report 2001–2001*. New York: Oxford University Press, 2001.

Piggott, C. "Mexico: CEMEX's Stratospheric Rise." *Latinfinance*, Coral Gables, March 2001.

Strassmann, P. *Information Productivity: Assessing Information Management Costs of U.S. Corporations*. Information Economics Press, 1999.

Strassmann, P. *The Squandered Computer: Evaluating the Business Alignment of Information Technologies*. Information Economics Press, 1997.

"Technology: IT Services (India)." Goldman Sachs, 20 September 2000.

"The CEMEX Way." *The Economist* 16 June 2001.

Zambrano, Lorenzo. <http://www.cxnetworks.com/img/presentation%20_Ihz_cxny.PDF> (2000).