

Andhra Pradesh: Lessons for Global Software Development

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Although relatively unknown, the Indian state of Andhra Pradesh is a key facet of the global IT industry, both as a source of skilled software professionals and as one of the most innovative sites applying IT for social development.

The information economy is formed not of nations but of regions or cities that are networked through people, investment, and telecommunications to further some aspect of global technology development.¹ Boston, Silicon Valley, Hsinchu, Bangalore, and Shanghai are key hubs in this global economy, where entrepreneurial plans, government policy, and technology innovation combine to create new businesses, markets, and economic realities.

The strong connection between these often quite distinct regions is the intricate architecture that supports global technology development, which means that local issues are never just local. Business strategy, policy decisions, education investments, and social well-being in one location *do* affect other regions. National statistics often hide such relationships, which are critical for the global IT industry. The specific realities and interconnections of such regions determine how the global industry evolves and thus how IT can drive development in very different environments.

Andhra Pradesh (AP), India, is one region that deserves attention. Its place within the global software industry over the past decade makes it an interesting subject for understanding the regional connections and developments of information industries like software. In part, AP is important because the flow of people, ideas, and investment is already quite strong, particularly with other regions like Silicon Valley. Equally important, AP exemplifies how a software industry can emerge from the ground up, with firms managing global software development and local politicians pressing for IT-based growth while trying to win elections in a predominantly rural, decidedly undigital society.

The details of AP's growth provide useful lessons for both established and emerging regions. A closer examination of AP's IT evolution reveals important insights into how regional connections function, how they reflect global software industry patterns, and how software itself can promote economic and social development.

Table 1. Top 10 Andhra Pradesh IT exporters in 2001-2002.*

| Firm | Exports (rupees Crore) |
|------------------------------------|---------------------------|
| Satyam Computer Services Ltd. | 363.44 |
| Wipro Ltd. | 339.05 |
| GE Capital International Services | 294.28 |
| Infosys Technologies Ltd. | 125.63 |
| Tata Consultancy Services | 115.00 |
| Prithvi Information Solutions Ltd. | 108.78 |
| Visualsoft Technologies Ltd. | 102.64 |
| Infotech Enterprises Ltd. | 84.32 |
| Satyam GE Software Services Ltd. | 71.00 |
| Intelligroup Asia Ltd. | 56.00 |
| Total | 1,660.14 |

*Based on figures from *Growth of IT Industry 2001-2002*, Software Technology Parks, Hyderabad, 2002.

Table 2. Top IT export areas.*

| Area | Percentage of total exported IT services |
|-----------------------------|--|
| IT-enabled services | 24.11 |
| Application software | 20.42 |
| System software | 12.51 |
| Application reengineering | 7.88 |
| E-commerce/Web applications | 7.47 |
| CAD/CAM/GIS | 7.44 |
| Consultancy services | 7.03 |
| Communication software | 5.43 |
| ERP/client-server | 4.85 |
| VLSI and embedded software | 2.86 |

*Based on figures from *Growth of IT Industry 2001-2002*, Software Technology Parks, Hyderabad, 2002.

PROFILE

AP is just a state within a nation. Even with a population roughly equivalent to Germany's and a capital the size of Chicago or London, it has no embassies or consulates, no military, and no seat at the World Trade Organization. Like much of India, AP is poor, with an average annual income in 2000 of approximately \$600. Almost 70 percent of the population is still rural, and a large percentage lack basic amenities like electricity and piped water. Illiteracy is a serious concern, with roughly 40 percent of the population still unable to read.

On the surface, AP would hardly seem a likely location or significant resource for the global software industry, yet it has been a supplier of skilled software labor for more than a decade. It is also one of the most innovative sites in applying IT for better governance and social development. The combination of these contradictions makes AP a valuable example of how the software industry functions and affects distinct regions worldwide.

People as a pathway

AP's people are its strongest avenue into the global software industry. The deep pool of software professionals has attracted investment by some of the leading companies in the world: Microsoft, Oracle, Nokia, Infosys, Wipro, and Vanenburg in Hyderabad. Local companies—Satyam, Infotech, Catalytic, and Portalplayer—have created innovative business models, services, and products. In combination, these IT firms employ 70,000 AP citizens, and each software job produces an estimated five other jobs.

That these companies have chosen Hyderabad is no accident. Since at least the mid-1980s, AP has been a source of skilled professionals for both domestic software centers like Bangalore and foreign centers like Silicon Valley. Rough estimates suggest that 25 to 40 percent of all Indian software professionals in the US are from AP.

Southern Indian states produced most of the Indian software professionals over the past decade, and the largest percentage are from AP. During 1998 and 1999, for example, more than 95,294 Indians came to the US on H-1B visas (visa for non-US professionals who want to work in the US), mainly to work in the IT industry.² AP accounted for roughly 25 percent (24,215) of these, or 11 percent of all H-1B workers in the US during the peak of the IT boom, according to the US consulate in Chennai.

AP's human ties—and the ties between specific regions—become even more apparent in the context of Silicon Valley. In mid-2001, the northern California Indian H-1B population was roughly 100,000, or approximately 22 percent of all H-1B holders in the US. Of these, 25,000 were from AP, and these exclude the estimated 100,000 permanent Indian residents in Northern California and the 1.7 million permanent Indian immigrants in the US overall.³

Exported services

The emergence of Hyderabad as a leading site of software development and services has only enhanced these human networks. In 1991, AP had seven firms exporting 200,000 rupees (Rs)—less than \$10,000—of software. By March 2002, 755 foreign and domestic firms exported 28.550 billion Rs (+\$700 million) in software products and services⁴—roughly 9 percent of all Indian software exports.⁵

The leading exports listed in Table 1 demonstrate both the increasing scale of the regional industry and its scope across homegrown, Indian, and global partnerships.

Table 3. Indian national trends in export delivery models.*

| | 1999-2000 | 2000-2001 | 2001-2002 |
|---------------------------|-----------|-----------|-----------|
| Onsite | 57 | 56 | 47 |
| Offshore | 35 | 39 | 49 |
| Products and unclassified | 8 | 5 | 4 |

*All figures are percentages taken from *Indian IT Software and Services Directory*, Nasscom, New Delhi, 2002.

Table 2 shows the mix of leading export activities, which represents a diversity of investments and skills. The increasing importance of IT-enabled services as a source of regional growth is a relatively new aspect of the local industry, which itself covers a range of services, from back-office operations to sophisticated engineering design partnerships.

DECISIONS FOR GLOBALIZATION

Initially, AP provided software professionals primarily because it lacked local innovation or work opportunities. In the past decade, the state government has worked hard to change that by establishing world-class university and research facilities in Hyderabad, such as the Indian School of Business and the International Institute for Information Technology.

Such institutes rise from the same human networks that have shaped software, with links between institutions and professionals worldwide supporting their evolution. The institutes and supporting networks in turn provide local opportunities that once were available only by attending the Indian Institutes of Technology or by working or studying in the US. Now both local firms and leading global companies draw on and support these new initiatives, providing opportunities for leading-edge work and career paths in AP that did not exist just five years ago.

This rapid growth underscores the importance of local AP events in structuring global and industry ties. Even outside national immigration rules or global industry trends, local developments can shape the overall software development structure. AP initiatives to develop local research, innovation, and employment affect the overall software industry. One of these trends is in the location of software development. Even with the flow of professionals to the US, AP software exports are now predominantly offshore, created in Hyderabad; 77 percent of exports were through datacom facilities, with only 22 percent through onsite work. As Table 3 shows, this is consistent with overall national trends toward increased offshore work, but at a greatly accelerated pace.

These trends could very well foreshadow the future direction of the Indian industry overall. Evaluating how AP's government and firms address the challenges of global software management, provider-client interactions, access to markets, and innovation probably contributes more to understanding the software industry's future direction than immigration or national policy debates. In a globalized economy, a specific *company-level* dom-

inance in the software market is distinct from the dominance of specific regions or nations.

One trend that seems apparent is the structuring of software development in multiple sites across business models or sectors. This trend prompts two important observations. First, while India is famous for outsourcing and moving services offshore, quite a bit of global software development occurs within global firms, not global markets.

Each of the Hyderabad companies in Table 1 is linked to a network of global production within the same company. Second, software development, by nature, stresses interaction and communication among developers and markets, which pushes all firms, US and Indian, toward a similar mixed-development model.

Consider these statistics from a list of 25 US companies that hired workers on an H-1B visa in 1999 to 2000:⁶

- four were Indian software companies that were also in the top 10 for both domestic and export sales in India;
- six were founded by Indian nationals with major operations in India; and
- nine were global IT, consulting, or telecommunications firms with major operations in India.

Thus, overall, 19 of the 25 firms combined some aspect of Indian and US software development.

This shouldn't be surprising. As the US economy became more global over the past decade, so did the workforce. The number of H-1B and L-1 (intra-company transfers) visas issued in the US increased from 184,972 in 1991 to 724,039 in 2001, but L-1 visas increased faster as a percentage of the total—from 38 to 47 percent.⁷

Thus, globalization is happening within the software industry in a way that involves complex changes.⁵ These changes reflect both the unique complexities of software development and the increasing maturity of the Indian software industry.

Individuals who once moved between companies or regions are now moving within firms, which makes labor movement far less a temporary solution and more a part of a company's overall development structure and business strategy. Managing the evolving production networks and flows of individuals and building a global corporate culture are major software industry challenges.

Key E-Government Initiatives

Andhra Pradesh has launched a series of projects and programs that have attempted to extend the IT benefits to the majority of the population, even if they are not direct technology users or owners. More information on these programs is available at www.ap-it.com/ and at the government portal (www.aponline.gov.in/).

- **Chief Minister's executive information system.** Online database, implemented in 1998, provides information on electricity, water, health, finance, and so on, which decision makers use to gauge the daily progress of various infrastructure projects and government services statewide.
- **AP statewide area network.** Network backbone, implemented in November 1999, Apswan provides a 2-Mbps fiber connection between the central government and the state's 25 regional districts.
- **Computer-aided administration of Registration Department (CARD) program.** Statewide system, piloted in 1998, streamlines the process of granting land titles and paying land taxes. The process, inherited from the British and still done by hand in many parts of India, had previously taken months to complete, but now is completed in AP while citizens wait. The final implementation at all 387 statewide offices was complete in March 2003.
- **Fully automated system for transport (FAST) program.** Electronic system piloted in May 2000 for issuing drivers' licenses at three centers in Hyderabad. The scale implementation to 35 sites statewide was completed in January 2002. The system processes drivers' license applications in a day and lets citizens choose from available drivers' license numbers.
- **eSeva program.** Piloted in December 1999, the program established centers for bill and tax payments and for applications to receive government licenses and services. The scale implementation of 27 sites in Hyderabad was completed in August 2001, with full statewide expansion to all 117 municipalities in 2003. Centers have processed more than 6.3 million citizen transactions worth Rps. 1,906 Crore.
- **Smartgov program.** A centralized database system, launched in November 2002, integrates the information of each government division to improve efficiency and transparency. Currently with 30 centers in Hyderabad, the program aims to expand to 48 new towns in 2003.

In 2000, for the first time, local software employment in AP equaled H-1B visa holders leaving for the US. As Indian firms have grown in size and experience, access to clients and markets has pushed them to move from a pure onsite or offshore base to one with deeper ties to the US and other global markets. Satyam, AP's leading local software company, has 12 global development centers: five in India, four in the US, and three in Europe and Asia.

Regional firms increasingly need a permanent presence in global markets to access labor, innovation, and clients. Hyderabad will continue to be a primary source of professionals for the global industry, but increasingly that interaction will begin at home through a local company or development center.

Equally important, Indian firms like Satyam will become significant employers within the US and

other key markets as they develop local innovation, domain knowledge, and sales and marketing capacities in key markets like the US, China, and Europe.

The evolution of the US and Indian software industries is intimately linked through these new regional relationships. How well both countries understand and manage these relationships will be a central aspect of innovation, human resources, and industry strategies in the next decade.

EMPOWERING POLICIES

Software has clearly made a serious impact on AP's economy. Given the recent Nasscom forecast of 34 percent annual growth in the Indian software industry through 2008, this impact will only increase.⁸

The larger question is, how has the industry improved AP's quality of life in general? Clearly, it has transformed the options of the 70,000 individuals directly involved in software, and it has added a major source of new economic growth and foreign exchange earnings. But the larger transformation—the way AP used IT for overall development—is the truly significant achievement.

Much of AP's transformation in the past decade is due to its government's innovative, professional policies, which have placed IT at the center of local social and political development. AP was one of the first Indian state governments to advocate that IT can and should be linked directly to better governance and quality of life. It is this policy leap from facilitating a regional software industry to promoting IT as a social change agent that separates AP from many other regions worldwide.

At the heart of these policies is the simple idea that "IT is SMART"—a tool to make government "simple, moral, accountable, responsive, and transparent." In keeping with this focus, AP has launched a series of e-government projects and programs, listed in the "Key E-Government Initiatives" sidebar, that have attempted to extend the IT benefits to the majority of the population, even if they are not direct technology users or owners. Their outlook goes beyond the standard digital-divide discussion, recognizing that in a democratic state with real social and economic challenges, IT and the software industry must have a practical and demonstrable impact on real quality-of-life issues.

FROM TECHNOLOGIES TO METHODOLOGIES

The successful implementation of these key government initiatives is a considerable accomplishment, given that large-scale software development and IT implementations have a significant failure

rate universally, even in the most advanced or sophisticated environments. AP's success in much less sophisticated surroundings demonstrates impressive skill in envisioning and executing challenging technology projects and in applying IT for development.

As Figure 1 shows, AP departed from the traditional e-government methodology, which tends to emphasize technology and downplay change management. Instead, AP's model deemphasizes technology and focuses on processes, particularly change management.

Although any summary of such complex, interwoven lessons is admittedly somewhat arbitrary, AP programs clearly have demonstrated four foundational aspects of process and vision.

Grow e-governance projects organically

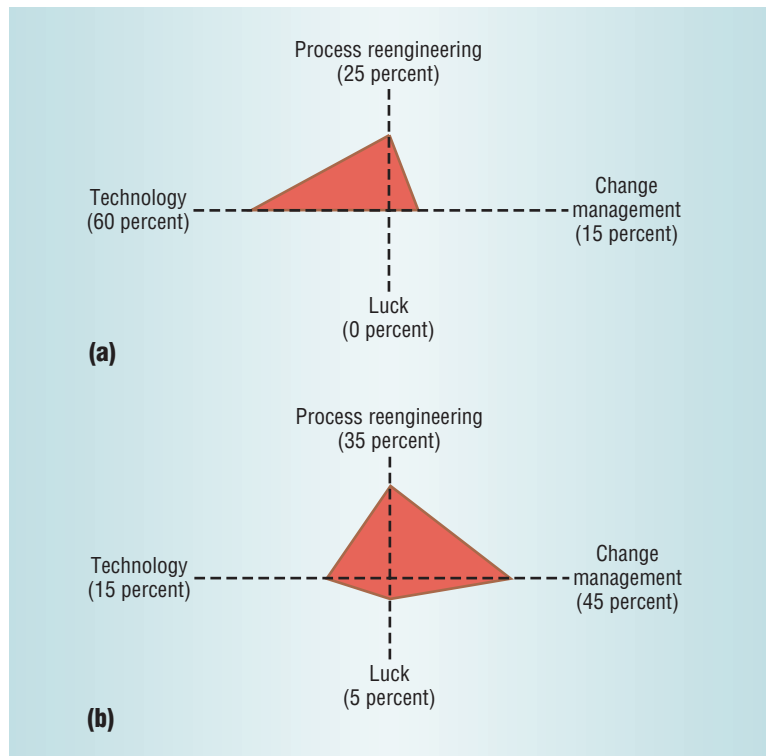
Solutions must be built from the ground up, incorporating local knowledge, stakeholder views, and practical constraints. Only recently have AP initiatives shifted focus from e-government (internal government operations) to the larger picture of e-governance (external relationships with citizens). The overarching strategy is to solidly establish IT in government before moving to the more complex issue of government and citizen interaction.

Relatively simple initiatives like institutionalizing the use of e-mail for all government officials become extremely important when viewing the long-term sustainability and success of e-government projects. On both an individual project level and through the evolution of the overall e-government initiatives, AP built its process, technical, and management skills incrementally and consistently over the past five years, focusing first on increasing the quality of services and infrastructure, then turning to more ambitious citizen-centered programs.

Emphasize solutions for organizational and social change, not technology

The main effort in a successful project is not technology, but organizational change, particularly change management. In Figure 1a, the traditional e-government distribution of effort, the focus is overwhelmingly on technology, with limited concern for change management and no real possibility of risk. In Figure 1b, however, the distribution of effort is more balanced and the focus shifts to organizational and process questions as the central factors.

In each of the AP government's key initiatives, reengineering the process and managing change were central to success, even when the technolo-



gies were relatively simple. The best example of this is the CARD program, which involved straightforward PC, database, and CD back-up technologies, but required that project leaders understand and manage change in a century-old, leather-bound book-centered, manual-entry system.

Make the central issue access, not ownership

Rather than developing solutions that involved making each citizen a technology owner, the AP government initiatives began by focusing on citizens' normal use patterns. Most citizens still go to the government to pay a bill or get a driver's license, for example, and use the same process except that the service provided is more efficient and transparent. Approaches that emphasize the need for technology ownership and then service access would have faced numerous challenges with far fewer benefits, as is clear from the numerous failed or stalled digital-divide initiatives worldwide.⁹

The goal for government is to improve the access of citizens to essential information and services they deem valuable. The AP government's release of annual school test scores online—scores that determine university admission—produces long lines at village Internet kiosks. The value to citizens is the information, how their children did, not ownership of the technology that gives them access to that information. This principle guides all AP e-government initiatives: Focus on improving the quality of the citizens' daily lives, not on disseminating hardware.

Figure 1. E-government diamond. In (a) the traditional model, technology receives the majority of the focus, with little consideration of process or environmental risks. In (b) AP's model, the focus shifts toward process reengineering and change management, focusing on key aspects to define, manage, and execute complex, large-scale IT government projects.

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Recognize the importance of public-private partnerships

Government has a critical role in facilitating, and even opening, new markets and opportunities, but the private sector has a central role in sustaining the project and in developing and managing innovative technology. Although AP has not solved the eternal debate about how to balance the public and private sectors, at least it has developed a process for thinking through the importance and limits of the government's role in IT projects.

AP approaches the development of digital infrastructures the same as it would any infrastructure project. When private investment fails to materialize because of risks or entry barriers, the government steps in to make investments that create a market for the public good. However, once the government establishes a market space, the pace of innovation, the management demands of daily IT operation, and the demands of long-term sustainability push for private-sector involvement, especially in an environment with competing demands on resources, time, and money. This approach has guided both the scaling of existing projects like eSeva and the establishment of more recent efforts like Smartgov.

LOOKING AHEAD

Andhra Pradesh does not have a clear, safe path to future development. The overall environment—regional, national, and global—still presents formidable challenges. Perhaps the greatest of these is how to institutionalize and expand both the regional industry and e-government initiatives now that the start-up phase is over.

The past five years have established solid ground for future growth. Many universities and some of the most recently formed companies are beginning to operate at full capacity, producing new graduates, innovative services and products, and an expanded global presence that are having a positive effect on the regional environment. Along with overall global trends, this future growth will continue to promote AP as a central software-development location in the global economy.

The government is also looking to facilitate future growth. As Table 2 shows, a key effort is the promotion of IT-enabled services. In 2002, the government launched the AP First program, which actively promotes AP as a preferred global destination for multiple IT-enabled services through new education, investment, and administrative initiatives. The

expansion of biotechnology is also a focus, and anchor efforts like the ICICI Knowledge Park and the S&P Biotechnology Park are under way.

Efforts to promote IT-enabled services and biotechnology reflect the focus on building synergy with the software industry's existing domain knowledge and expertise in bioinformatics, IT infrastructure and security, and global research and design services. Software growth, in essence, provides a general model for evolving new information industries like biotech or advanced design services, much like other regions around the globe.

Many of AP's e-government programs are just beginning to fully take root, and they should have a significant impact in a relatively short time. More important, the government has continued to keep learning and innovating.

Because of the national bias in statistics or in framing economic questions, we know much less about AP than its present and future developments warrant. AP is already intimately networked with multiple regions, institutions, and companies. As such, the question is not the strength of these ties, but their overall future evolution and architecture.

AP's government has been faithful to its original "IT is SMART" idea, keeping IT as a tool for more transparent and democratic government and avoiding the temptation to view the technology as transformative in and of itself. Real change in culture and organization is occurring and must go on if overall social and economic growth is to continue. AP offers an example of best practice in technology development and management, and its links to the regional software industry give its citizens a chance to apply such knowledge in very real and practical ways.

The e-government programs are important, not only because they offer lessons and models, but also because their results will directly affect a region that exports \$450 million of software to the US annually, sends out thousands of students and professionals worldwide, and is an integral part of many leading software firms' global operations.

It is reasonable to say that AP's overall social well-being and economic growth are key to the growth of the global software industry in general and of specific regions like Silicon Valley and Boston in particular. Understanding how regions work, interact, and think, whether in Silicon Valley or Hyderabad, is central to understanding the architectures of our global world. ■

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