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Working Through Outsourcing: Software Practice, Industry Organization and Industry Evolution in India

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Abstract
Current debates surrounding "outsourcing" and "offshore" limit our understanding of the dynamics of services in the global environment by failing to 1) carefully define terms and 2) delineate key differences in production architectures, practices and regional impacts. Defining offshore and outsourcing is important because such definitions inform the unique structure of services in general and software services in particular. They also open a pathway to understanding similarities or differences with new IT enabled-services. The changing nature of the definitions is really a reflection of questions surrounding the costs and benefits of variations on how services are developed globally.

This paper begins by considering definitions of "offshore" to work through the unique aspects of IT services, and how they have affected the evolution of specific regions in the global economy. A central case to begin to evaluate these issues is the emergence and evolution of the Indian industry. While very well known, revisiting the Indian case through the lens of the state of Andhra Pradesh helps synch actual industry evolution with current myths and realities of offshore development. The Indian case also highlights general trends that indicate the limits and possibilities for offshore and outsourced IT services in the global industry through the end of the decade. The final section concludes with a consideration of what such industry patterns indicate for the regional growth and development through offshore production.

1. The Evolution of "Offshore": Defining Terms and Mapping Change[1]

In general terms, both outsourcing and offshoring are neither new nor unique. Globalization has consistently been driven by both, and key sectors of the IT industry — integrated circuits, computer assembly, hard disk drives, computer components — began the offshore and outsourcing trend almost 35 years ago.[2] Many of the key global electronics sites including Singapore, Malaysia, Taiwan, Mexico and Korea began with initial investments by US and Japanese manufacturers in first offshore and then outsourced production. The general pattern of FDI and outsourcing has continued while locations like China have emerged as new sites of IT production, driven in large part by cost concerns and global competition.

It would be easy to assume that information technology (IT) services are the most recent sector to follow the same global industry organization. However, IT services are different, in the organization of their work, the global evolution of the industry, and equally important the definition of what is meant by outsourcing and offshoring. Simply working through the evolution and meaning of the terms is a helpful step to understanding the evolution of outsourcing and offshoring as a practice.

Offshore — or offshoring — as a common term in business or in the news is relatively new.[3] Historically, foreign direct investment or global sourcing held the same meaning. Clearly, the negative connotation — indicating the loss of skilled-jobs in advanced economies to emerging regions — is even more recent. The historical antecedent here seems to be hallowing out or more recently "free trade" or even just globalization. The current usage of the term in both cases, however, is linked directly to the offshoring of IT services. Offshoring has become shorthand for the loss of high-end IT services in economies like the US to emerging regions like India. It is far less common for textile or IT manufacturing jobs to be labeled as "offshoring", though such job losses far exceed the actual losses in services and have a far longer history.[4]

Originally, offshore as terminology for global sourcing began with the emergence of Indian firms in the software services space. For Indian firms, global clients could either be served on-site (at the clients location) or offshore (remotely from India). As a sign of the need for clear definitions, from an Indian national development perspective "offshore" work is actually nationally based work. However, as will be detailed below, the initial industry momentum began with the claiming of revenue earned "onsite" by Indian firms as national exports for India. Over time, Indian firm's business models began to incorporate (and even rely on) mixes of onsite and offshore work for profitability. With the majority of work occurring in the US, onsite work for

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[1] I would like the thank the participants of *The Software Industry in the Developing World Workshop* at Yale University on February 20th to 22nd for comments and discussion that were insightful and dynamic in developing the discussion made here.

[2] K.Eischen & P. Lubeck (2000) "Silicon Islands and Silicon "Valles": Informational Networks and Regional Development in an Era of Globalization," in *New Frontiers of the 21st Century*, N. Klahn, Editor, Mexico D.F.: La Jornada, 2000

[3] "Offshoring" as a term did not occur in the San Jose Mercury News for the first time until August 23rd, 2003, in the Wall Street Journal until November 7th, 2002, and the New York Times until January 6th, 2003. In terms of "offshore" services, the Wall Street Journal published more articles on the subject in 2002 alone than it had in the previous 15 years.

[4] See the discussion, for example, in Catherine L. Mann *Globalization of IT Services and White Collar Jobs: The Next Wave of Productivity Growth*, International Economics Policy Briefs December 2003, Number PB03-11, www.iee.com

Indian firms became associated almost exclusively with North American outsourced software services.

From a US perspective, the greater concern during most of the 1990s was not "offshoring" but "outsourcing" of previously in-house software services to Indian firms performing onsite work. Debates have centered specifically on the use of the H1-B visa program — the short-term visa program for US employers to bring in skilled labor — by both US and Indian firms. Even when US firms kept work in-house, the H1-B visa program enabled them to supplement a permanent workforce with short-term contract labor. As such, though work was never physically moved offshore, the question of outsourcing and employment were always at the center of discussions. This is the one key example of the importance of defining terms. Outsourcing has a much longer history in IT services than "offshoring", with the initial Indian role in outsourcing linked to geographical location in the US, using either 1) Indian professionals working within existing US firms on temporary visas (in essence the outsourcing of labor), and 2) Indian professionals employed by Indian firms performing onsite work for US firms (in essence the outsourcing of services).

This background provides the framework for the current definition that has evolved over the last four years to increasingly incorporate new IT-enabled services (ITES) or business process outsourcing (BPO). This has increasingly garnered the most attention, and though it has incorporated the language of software or traditional IT services, it is a significantly different type of business. While software services do involve a range of activities from traditional maintenance to application development, ITES involves an even broader range of services from simple data-entry and call centers to much more advanced legal and financial services, engineering and R&D partnerships. And while software services have had a significant outsourcing component, ITES has seen far greater FDI by foreign firms in India following an "insourcing" strategy that more closely resembles traditional offshore investments for global manufacturing. In other words and somewhat simplified, ITES has a much greater tendency for "offshoring" while ITS (or software services) has a much greater tendency for "outsourcing".

The key aspect to keep in mind is that the simplicity of the "offshore" definition can hide the complexity of the actual industry and practice. The geography of production, the structure of the contractual market relationship, and actual nationality and legal status of labor is all variable by both product and sector. The costs and benefits of offshoring and outsourcing in both established and emerging regions is variable depending on perspective. Indian firms for example are much more dependent on trends in services outsourcing than they are on offshoring, while the overall impact on Indian development is much more complex. Given this, the operating definition here will follow the Indian business perspective. Offshore and onsite are defined by the physical or geographical relation to the market and client. This distinguishes the geography of IT services from who actually performs the work and the nationality of the firm. This is an essential starting point to understand both the evolution of specific industries like India, as well as evaluate the future direction of both outsourcing and offshoring.

The Vocabulary of Indian Services

1. *IT Services*: Incorporates both software services and IT-enabled services.
2. *Software services*: Direct software and systems services, ranging from maintenance to systems integration and application development.
3. *IT Enabled Services*: IT supported business services, ranging from data processing, call centers, back-office/business processing to engineering and R&D. Equivalent to *Business Process Outsourcing (BPO).*
4. *Outsourcing*: Contracting out work to a third-party firm.
5. *Exports*: Foreign exchange earnings for software services regardless of location
6. *Offshore*: Work done at contractor's site.
7. *Onshore*: Work done at client's site.
8. *Bodyshopping*: Contract labor working at client location.
9. *H1-B Visa*: Common work visa used for temporary employment in US IT sector.
10. *L1 Visa*: Common work visa for foreign firms to bring employees to work in their US based offices.
11. *Insourcing*: Direct investment in offshore facility.

The rest of this article builds on these definitions to work through the unique aspects of IT services, and how they have affected the evolution of specific regions in the global economy. The definitions are important because they arise from the unique structure of services in general and software services in particular. The confusion or changing nature of the definitions is really a reflection of questions surrounding the costs and benefits of variations in the architecture of services globally. These basic development architectures serve as essential starting point for any analysis, which then opens the way to evaluate these issues in light of the emergence and evolution of the Indian industry. While very well known, it is worth re-visiting the Indian case to synch actual industry evolution with current myths and realities of offshore development. The Indian case also highlights general trends that indicate the limits and possibilities for offshore and outsourced IT services in the global industry through the end of the decade. Before turning to India, however, it is important to understand the industry evolution that provided the impetus for outsourcing and offshoring as it stands today.

2. Software's Perpetual Crisis

The software industry — or more specifically software production — has evolved under a seemingly perpetual crisis of quality, productivity and labor shortages for most of its modern history. The 1968 NATO conference on software — coinciding exactly with the emergence of an independent software industry — gathered to consider general concerns and management issues linked to a pending "software crisis". The "crisis" being the increasing demand for software in an environment of limited skilled-labor and low software quality. The conference produced widespread agreement around the clear need to prevent the crisis through the development of "software engineering".[5]

[5] *Software Engineering: Report on a Conference sponsored by the NATO Science Committee*, Garmisch, Germany, 7 th -11 th October, Peter Naur and Brian Randell, Editors (1968).

The significance of the conference is twofold. First, the predominance of the "software crisis" from the very inception of the industry to the present — through transformations in technology, organization, markets and products — reinforces the importance of explaining software development and its impact within the industry. Second, the NATO conference and subsequent professional debates establish a clear framework in which to consider software development or practice. The "crisis" itself is driven by market demand for software, limited skilled labor, poor quality and low productivity. The solution to "software manufacture" is "engineering", the application of sound engineering theory and practice to software production. In other words, the contemporary independent software industry emerged under a clear call for the rationalization of software development.

The persistence of the "software crisis" over 35 years after its initial definition raises the question as to the success or limits of this rationalization. Rationalization — "the introduction of predictability and order –machinelike order – that eliminates all questions of how work is to be done, who will do it and when it will be done"[6] — has been a central hallmark of industrial society and manufacturing throughout the 20th century. Questions of labor, quality and productivity have found solutions through increased application of engineering, organizational management and technical innovations that are applicable as general principles of modern production and management across industries. Arguably, it is the rationalization of production that underlies the ability to so effectively outsource and offshore hardware manufacturing over the last three decades. Yet, the tensions surrounding software quality, productivity and labor remain key concerns today, indicating that software has not and may be amenable to rationalization.

The essential factor in this limitation is the software development process. The software development architecture — the practice of making software — structurally limits the potential rationalization of overall production. [7] The central factor is the dynamic, non-scientific, tacit knowledge, informational resources around which the industry is structured. The role of domain-knowledge as the essential "input" translated to coded form in software products underlies the communication structures driving agglomeration for productivity, limiting product quality and the incessant demand for skilled labor. In other words, rationalization is bounded by the structure of production. This bounded rationalization requires agglomeration within the production process and near final-markets to maximize productivity and quality.

This structural limitation weakens assumptions of similarity with other manufacturing industries or global organization patterns, and pushes for a more refined understanding of software production. Unlike hardware industries like integrated circuits or hard disk drives structured around global production networks, the structure of software practice limits a pure labor cost analysis of location, activity and benefits. A focus on labor cost alone to explain the industry organization and globalization fails to incorporate or explain the significant differences in quality and productivity between developers, firms and regions. Bounded rationalization has and will continue to structure the organization of the industry, which is visible in its evolution and the emergence of new regions of software development in locations like India.

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[6] Lindy Biggs (1996) *The Rational Factory*. Baltimore, Maryland: John Hopkins University Press: 6

[7] K.Eischen, "Software: An Outsider's View" *Computer*, May 2002; K.Eischen "Mapping the Micro-Foundations of Informational Development: Linking Software Processes, Products and Industries to Global Trends" in *The Digital Challenge: Information Technology in the Development Context*, Krishna and Madon, Editors, Ashgate, December 2003

3. Rules of Thumb: Myths and Realities of Software Practice[8]

To summarize the overall structure of software practice, it is helpful to consider long-standing, studied and accurate "rules of thumb" of software practice. The informational basis of software practice results in one very specific spatial impact upon the structure of the industry that deserves special attention. Geography is important for structuring software development through location of labor, knowledge and markets. It is equally important in terms of the interaction of the software development factors themselves. In spite of the hype that has attended the development of the Internet and globalization, distance matters, particularly for communicative, information-driven processes like software. Simply, software development domain-knowledge, productivity and quality are maximized when developers are co-located near each other and their final markets.

1. Distance Matters

The issue in all software development, but especially in distributed software development, is "coordination, communication and management," and distance impacts each of these. And "distances need not be global to be important. In fact, being in another building or on a different floor of the same building, or even at the other end of a long corridor, severely reduces communication."[9]. Findings have shown that distance greater than 30 meters or delays greater than 500 ms begin to affect communication and coordination.[10] Case studies have shown that "same-room" co-located software teams have double the average corporate levels of productivity, [11] and almost three times the industry average.[12] Importantly, the expanded productivity corresponded with increased developer, management and client satisfaction. [13] Multi-site projects take 1.5 times longer to report and address problems, while modifications take 2.5 times longer to complete.[14]

2. Adding people doesn't help improve productivity[15]

In fact, adding additional people to a software project actual decrease productivity and quality, causing further slippage of deadlines and increases in cost. The essential factor driving this is the increase in the lines of communication, essentially a perverse Metcalf's law effect.

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[8] Glass, Robert (2003) *Facts and Fallacies of Software Engineering*, New York: Addison-Wesley.

[9] *Overview* by Herbsleb and Moitra, in James D. Herbsleb and Deependra Moitra, editors, Global SW Development *IEEE Software* March/April 2001, pages 16-86., page 17.

[10] Gary M. Olson and Judith S. Olson (2003) Mitigating the Effects of Distance on Collaborative Intellectual Work, *Economics of Innovation and New Technology*, Volume 12(1), 27-42.

[11] Gary M. Olson and Judith S. Olson (2000) Distance Matters, *Human-Computer Interaction*, Volume 15, 139-178: 145.

[12] Stephanie D. Teasley, Lisa A. Covi, M.S. Krishnan, Judith S. Olson (2002) Rapid Software Development through Team Collocation, IEEE Transactions of Software Engineering, Vol. 28, No. 7, July: 677.

[13] Stephanie D. Teasley, Lisa A. Covi, M.S. Krishnan, Judith S. Olson (2002) Rapid Software Development through Team Collocation, IEEE Transactions of Software Engineering, Vol. 28, No. 7, July: 678.

[14] J.D. Herbsleb, Audris Mockus, Thomas Finholt and Rebecca Grinter, "An Empirical Study of Global Software Development: Distance and Speed," *Proc. Int'l Conf. Software Eng. 200*1, IEEE CS Press, Los Alamitos, Calif., 2001, p. 81-90. A report of a Lucent in-house development project on three continents and four countries.

[15] Glass, Robert (2003) *Facts and Fallacies:* 16.

3. People are the central aspect to SW success and quality.[16]
Methodologies, tools and organization all matter much less than the supply and access to quality skilled software developers. This

4. Efficiency stems from good design more than good coding.[17]
The overall architecture of the system, both initially and overtime, is a far greater determinant of long-term interaction than is great programming skill. Great programmers cannot overcome bad design in product, service or method.

5. The best programmers are up to 28X as productive as the worst programmers.[18]
It is not only that programmers are key to software success, but also accessing the best programmers is the central challenge. This factor is essential to understanding both the industry demand for labor and the organizational structures to access the best talent globally. One great software developer even at US$ 110,000 is a bargain compared to inexpensive, but average developers.

6. Work Environment and Regional Environment Matter[19]
While people are central to the overall success of a project, firm and regional environment matter. As indicated above, programmers within the same firm perform better closer to final markets, clients and colleagues, as well as within specific regional environments.

7. *The distinction between product and maintenance (for quality or difficulty) is false.*
This is basically the 60/60 rule. 60% of all software development cost is maintenance and 60% of maintenance requires new programming through feature enhancement.[20] Any belief that outsourcing or offshoring can only occur for "simple" maintenance tasks requiring low-levels of skills is wrong. Equally wrong, however, is the belief that maintenance can easily move offshore because it is maintenance. All software services are subject to the same demands for labor, production and agglomeration that drives all software.

These rules of thumb are exactly that because they capture the essence of software practice is simple consistent "best-practice" concepts, not universal and consistent "laws". They consistently are demonstrated in some form in almost all research on software practice and arguable are central factors, even when hidden, within debates of "outsourcing" and "offshoring". Bringing these to front explains the development architectures that structure firm and industry evolutions, and establish a distinct starting point to consider new aspects to global services like ITES.[21]

[16] Glass, Robert (2003) *Facts and Fallacies:* 16.
[17] Glass, Robert (2003) *Facts and Fallacies:* 139-141.
[18] Glass, Robert (2003) *Facts and Fallacies:* 14-15.
[19] Glass, Robert (2003) *Facts and Fallacies:* 139-141.
[20] Glass, Robert (2003) *Facts and Fallacies:* 115-120.
[21] See for example ACM's Queue *Distributed Development* Issue, Vol. 1 No. 9 - December/January 2003-2004

4. The Limits of Offshore and The Consistency of Software Practice[22]

The central tension in software, as is clear in the rules of thumb, is between the need for access to skilled-labor and the need to agglomerate development. The inherent limits on the rationalization of the development process — stemming from the informational, domain-knowledge fundamental non-science, non-engineering resource of industry which drives the translation of knowledge to coded form — underlies the quality and communication structures driving agglomeration. The increasing demand for software's specific qualities — persistency, update speed, deliberate flexibility, applicability to action, and emulation qualities — places software at the center of an increasing range of applications, which in turn places software practice and its limits at the heart of both IT and non-IT economic sectors.

The demand for software has consistently outpaced the gradual rationalization or improvement in the development process. However, it is important to remember that the rationalization of the development process, the increases in quality and productivity, have not led to a more distinct division of labor or the "manufacturability" of software. These improvements have come in the technical structure of software. The fundamental creative process of software development — the translation of specific knowledge-domains to algorithmic and binary form to address ever increasing complex problems — maintains skilled craft labor at the heart of the process. The real key to the rationalization of production is the standardization, codification and inflexibility of knowledge domains. This may be possible at some level, but given the fundamental dynamic nature of software's basic resource — social interactions, organizations and institutions — it is arguable that the process will always be inherently limited.

Historically and currently as is the case in "offshoring", debates surrounding software have focused on labor as the central question and issue. A true understanding of the issue of rationalization has been sidelined or opted off as a matter of discipline and definition. However, the focus on labor, while important misses the equally or more significant point of agglomeration. Labor is important and does have ramifications for discussions around global software and services. The continued rise of outsourcing is a significant trend in the constant demand for labor and the limits on managing the software development process. The recent trends toward the use of J1 as opposed to H1-B visas represents a significant and fundamental shift in the structure of global software labor markets, de-emphasizing market or intermediary functionaries within labor networks and shifting the focus to internal firm movements. These changes are significant and have impacts on the structure of firms in the global market, and they are also strongly universal movements shaping both US and Indian firms, large and small, entrepreneurial or established within the software industry.

However, without a consideration of agglomeration, these changes cannot be fully explained nor can a full understanding of the evolution of the global and Indian software industries be established. Arguably the moves above are not driven only by the cost of labor, and even if they are it is within the demands of agglomeration. Agglomeration drives software practice through two key aspects: 1) the need for communication within the process for innovation, quality and efficiency, and 2) the need for communication with end-users, clients and markets with specific domain-knowledge.

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[22] K.Eischen, "Software: An Outsider's View" *Computer*, May 2002; K.Eischen "Opening the "Black Box" of Software: The Micro-foundations of Informational Technologies, Practices and Environments", *Information Communication & Society*, Issue # 6.1, March 2003

While the rise of regional software centers in India demonstrates the agglomeration tendencies of the software industry around skilled-labor and for improved productivity, it also demonstrates the limitations of such patterns when separated from agglomeration near clients and markets. For Indian firms, the cost effectiveness of the onsite/offshore software development is seriously limited by added expenses for communication and transportation as well as declines in quality and productivity. The final result is very far from the "24/7 global development model" that is commonly believed to exist or hoping to exist.[23] Even more importantly, Indian firm quality and productivity varies dramatically across regional locations, creating a constant tension between accessing skilled-labor and maximizing cost savings. This is also true for global firms in India. One key example is the increasing presence of foreign global development centers within India. Just like sites within their national markets, these centers focus on specific and full product and research lines, and do not generally participate in global production network as in hardware manufacturing. And even with dedicated, agglomerated development, such centers are magnitudes less productive than their home market centers and individuals.

Such patterns are central to the organization of the industry and consistent across regions and nations. While a software developer may be 10 times as expensive in Silicon Valley as in India, they are also up to 16 times as productive. Such differences occur within national boundaries as well. Silicon Valley software developers are consistently twice as productivity as the US national average. Last year alone, average software pay was US$ 110,000 in Silicon Valley, with average value added of US$ 201,900 compared to US$ 99,600 national average in the same industry clusters. Between 1990 and 2003, value-added increased 4.6% annually in inflation adjusted terms against a 1% average nationally.[24]

Even more important is that an Indian engineer moving to Silicon Valley from India, even within the same firm, has significant increases in productivity. As such, the architecture of software development frames the outsourcing question through the issue of geography. The Indian industry will continue to be shaped by national and global firms 1) accessing skilled labor for internal labor markets (bringing skilled developers to their highest value-added global locations), 2) minimizing overall process costs and not just labor expenses, and 3) moving globally, especially for Indian national firms, to access specific domain-knowledge and clients.

The importance of software practice on the geography of outsourcing can be more clearly seen with a relatively simple example that looks at Infosys, one of the leading Indian software services firms. Looking at Infosys' costs from a recent California tax petition, onsite (US) based labor is 9X as expensive as Indian labor, while generating only 2.3X as much revenue. This seems to reinforce the standard "offshore" argument. However, it is significant is that this is revenue per capita, which is a rough proxy of productivity in a service industry like software. In other words, onsite Infosys workers actually are 2.3X times as productive as their Indian counterparts working within the same firm, even on the same project.

[23] See for example the discussion in Legace, Martha (2004) *The Outsourcing Revolution*, 2004, HBS Working Knowledge, February 2, http://hbsworkingknowledge.hbs.edu

[24] JointVenture Silicon Valley Index, Multiple Years, www.jointventure.org

***Infosys Costs and Margins*[25]**

	Onsite	Offshore
Per Capita Revenue (US$)	137,400	59,100
Per Capita Cost (US$)	72,924	7,992
Cost of Service %	53.07%	13.52%
Gross Profit %	46.93%	86.48%

Clearly, this is not the 10 to 16 cost and productivity differential suggested above,[26] but it is consistent without the overall framework suggested by software practice. If we start to add in the additional costs of the productivity differentials, as well the additional communications costs (teleconferencing, travel) and the costs of quality we develop a clearer picture of outsourcing and offshoring potential.

Additional Costs from Software Practice (US$)

	Labor Cost	Cost of Communication	Cost of Distance	Cost of Quality	Total
		20%	232%	200%	
Onsite	72,924	0	0	0	72,924
Offshore	7,992	1,598	18,541	15,984	44,116

Beginning with the base labor cost of 7,992 given by Infosys, additional costs radically change a pure labor analysis of the benefits and location of outsourcing:

- 20% additional *cost of communication* (a conservative estimate),
- a 2.3X adjustment for productivity (which we can call the *cost of distance*)
- the additional expense (through double the time needed) of correcting errors (the *cost of quality*).

Essentially, offshoring costs you more in communications costs, the distance lowers productivity and lessens quality, and then takes you twice as long to fix. The end result is that a truer estimation of onsite/offshore cost differentials is about 1.65. In absolute terms, the cost savings of outsourcing offshore become roughly 38%, dramatically different but consistent with the standard industry "rule of thumb" which anticipates real cost savings of moving offshore of between 20 and 40%.

While this still represents significant cost savings, reapplying this "labor cost" to Infosys' margins radically alters the business logic of offshore work. Offshore costs jump to 75% of revenue and gross margins drop to 25% and make onsite work much more appealing.

[25] Infosys Technologies (2003) California Franchise Tax Board 25137 Petition, March 28th

[26] The difficulty and lack of standardizations in measuring software productivity creates lack of comparable data. The Joint Venture measurements indicated above are actually a value-added calculation, not the revenue/labor measure far more commonly used within the industry for cross-company and industry sector comparisons.

	Onsite	Offshore
Per Capita Revenue (US$)	137,400	59,100
Per Capita Cost (US$)	72,924	44,116
Cost of Service %	53.07%	74.65%
Gross Profit %	46.93%	25.35%

Like many aspects of services and software in particular, this example is more informative than definitive. The assumptions that Infosys bills equivalently for onsite and offshore, that the additional costs are individually (as opposed to project based) or that employees are equivalently skilled and working on equivalent projects are all reasonable but not a given. The more central point is that this dynamic of software practice operates for not only Indian firms moving to the US, but also for US firms moving to India. The geography of software practice is about the agglomeration of developers and the closeness to final markets and clients.

A few key factors come into play looking at future trends for all firms considering both outsourcing and offshoring. The base cost of professionals in India is fundamental. Even a doubling of the nominal salary without corresponding increases in productivity (which are not clearly individually derived but inherent in the software practice), quickly begins to shrink the cost differential. Equally important, the one cost that can be controlled by offshore operations — in the sense that it is not an inherent limitation built into software development — are the cost of communication and infrastructure. Both are variable and not fixed, but impact directly on the bottom-line of offshore operations. Subtle shifts in either of these factors impact on the logic of offshore. The rise in Indian wage costs or the costs of telecommunications or rent in Bangalore or Mumbai play a significant role in the economics of offshoring, given the limitations inherent within software practice.

5. Global Ties: India and the USA

The rise of India as a central feature of the global software industry corresponds with attempts to meet increasing industry demands within the constraints of limited rationalization. While the industry in India began with a few key foreign investments in Bangalore around IC design, the real momentum arose from the immigration patterns of individuals and the offering of skilled labor via “bodyshopping” to firms in the US. The driver of this — consistent with the constraints of software development — was not labor cost, but access to skilled-labor. Declining enrollments by US citizens within engineering professions, the increasing expansion of foreign enrollments at US universities, the growth of US demand, and the limits on Indian domestic industry opportunities combined to create a demand for new sources of skilled-labor for the US software industry. Immigration provided a central resource of new labor, without having to address key problems of productivity or quality that would arise with disaggregated production. In this sense, the US software industry experienced a *constrained globalization* through extended networks of immigration, whether educational, individual or market based through “bodyshopping” firms.

With the rise in quality of the offshore environment, improved management capabilities and new government policies tailored specifically for software, the limits of this first constrained globalization opened spaces for more formal investments within India. In part, such investments were driven by new business models of Indian firms — both domestic and non-resident — seeking to maximize profits by combining "onsite" and "offshore" as in the Infosys example above. Additionally, global firms began to locate development centers within India to access the highest quality labor at the lowest search and employment cost. The combination of these trends — maximization of cost savings, access to labor at the source, and the benefits of agglomerated production — underpinned the emergence of new regional sites of software within India. The mid-1990s witnessed the rise of new centers of software development beyond Bangalore, most importantly Hyderabad, Andhra Pradesh. These centers fed off the initial immigration networks — the state Andhra Pradesh having been a central producer of Indian labor to the national and global market for over a decade — to begin to agglomerate software development within southern India.

6. Global Ties: Silicon Valley and Andhra Pradesh

Hidden within Indian national statistics and software industry numbers, the state of Andhra Pradesh, India and its capital city Hyderabad, play an increasing role in the global software industry.[27] Andhra Pradesh's 80 million people are equivalent to the population of Germany, and the population of Hyderabad at six million makes it one of the fifty largest cities in the world, roughly equivalent to Chicago or London. However, it is just one state within India. Economically — and like much of India — Andhra Pradesh is poor. In 1999/2000 the average annual household income was roughly $600, with almost 70% of the population still rural, with a large percentage lacking basic amenities like electricity and piped water. Illiteracy is still a major problem with roughly 40% of the population still unable to read.

In spite of these statistics, Andhra Pradesh has been central to the global and local software industries as a supplier of skilled-labor for more than a decade. Perhaps more importantly, it is also increasingly a key site of software development, and one of the most innovative sites applying IT for better governance and social development. As such, the evolution of Andhra Pradesh is a very good point to begin to understand the architecture of the global software industry.

Since at least the mid-1980s, Andhra Pradesh has been a source of essential skilled professionals to both domestic software centers like Bangalore and foreign centers like Silicon Valley in the US. The lack of regional detail in national statistics makes quantifying these flows of people difficult, with estimates ranging from 25 to 40% of all Indian software professionals in the US being from Andhra Pradesh. However, it is clear that the southern Indian states have produced the majority of software professionals in India, and Andhra Pradesh the majority of these over the last decades. As one example, during 1998 and 1999, over 95,294 Indians came to the US on H1-B visas, predominately to work in the IT industry.[28] Andhra Pradesh accounted for roughly

[27] Unless otherwise noted, this information comes from fieldwork in Andhra Pradesh, India during May and June of 2002.

[28] U.S. Immigration and Naturalization Service *Characteristics of Specialty Occupation Workers (H-1B) May 1998 to July 1999*, February 2000; U.S. Immigration and Naturalization Service *Characteristics of Specialty Occupation Workers (H-1B) October 1999 to February 2000*, June 2000

25% (24,215) of these, or 11% of all H1-B workers in the US during the height of the IT "boom".[29]

On a regional basis the ties are even stronger if we look at the case of Silicon Valley. As late as mid-2001, the northern California Indian H1-B population stood at roughly 100,000, or approximately 22% of all H1-B holders in the US. The percentages above suggest that a minimum of 25,000 were from Andhra Pradesh. And these numbers do not take into account the estimated 100,000 permanent Indian residents of Northern California, nor the 1.7 million permanent Indian immigrants in the US overall.[30] National statistics either don't count or hide these very specific regional ties between the US and India, especially in industries like software that are structured around the demand for skilled labor. The essential aspects is that talking about software and the rise of India is talking about the importance of human networks, which in turn means talking about the evolution of Andhra Pradesh.

7. The Evolution of Onsite and Offshore: From Human Networks to Regional Development

The skilled-professional networks have underpinned and been supplemented by the emergence of Hyderabad as a leading site of software development and services over the last decade. This emergence has basically come from nothing. In 1991, the state had 7 firms exporting 200,000 Rs. (less than US $10,000) worth of software. By March 2002, 755 foreign and domestic firms exported 28.550 billion Rs. (US $700+ million) worth of software products and services.[31] This is roughly 9% of all Indian software exports.

The list of companies in Hyderabad contains some of the best in India and the world, including Satyam, Infosys, Wipro, Microsoft, Oracle and Nokia. Local companies — including Catalytic, Portalplayer, Infotech and Vanenburg — have created innovative business models, services and products. In combination, these IT firms employ 70,000 people in Andhra Pradesh, and it is estimated that each software job produces five other jobs in the state.

Top Ten Andhra Pradesh Exporters in 2001-2002[32]

Firm	**Value (Rs. 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	*1660.14*

Note: Top Ten are 58.14% of all exports.

[29] Personal Communication, US Chennai Consulate for Southern India.
[30] 2000 United States Census
[31] Software Technology Parks, India, Hyderabad, *Growth of IT Industry 2001-2002*, 2001.
[32] Software Technology Parks, India, Hyderabad, *Growth of IT Industry 2001-2002*, 2001.

The mix of leading export activities represents the diversity of these leading firms, investments and human 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 wide-range of services ranging from back-office operations to quite sophisticated engineering design partnerships.

Top Ten Export Areas[33]

Area	**%**
IT Enabled Services	24.11
Application Software	20.42
System Software	12.51
Application Re-engineering	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 & Embedded SW	2.86

8. Regional Environments and Global Ties

It is clear that the patterns of global ties are different for software than for other industries[34], with the limits of software practice structuring the geography and interactions of firms and the industry overall. While Andhra Pradesh has been a central provider of professionals to the global industry, much of this original movement was from a lack of local educational or work opportunities. This has changed significantly in the last decade. Hyderabad has seen the establishment of new world-class educational facilities, including the Indian School of Business and the International Institute for Information Technology.

Such institutes are built around the exact same human networks that have shaped software, with links between institutions and professionals worldwide supporting their establishment and evolution. These provide local opportunities that had previously only existed at the Indian Institutes of Technology or in the US. The regional software industry expansion, from both local firms and leading global companies, provides local opportunities for world-class work and career paths, many which did not exist even five years ago.

Such developments underscore the importance of local Andhra Pradesh events in structuring the very global and industry ties outlined above. Even outside of national immigration rules or global industry trends, local developments have impacted on the overall structure of software development. One of these trends is toward offshore development as opposed to onsite work. Even with the flows of professionals to the US, Andhra Pradesh software exports have become predominately digital, with very little onsite consultancy done. By 2002, 77% of exports were through datacom facilities, with only 22% through onsite work. These patterns — while

[33] Software Technology Parks, India, Hyderabad, *Growth of IT Industry 2001-2002*, 2001.
[34] K. Eischen, "Mapping the Micro-Foundations of Informational Development: Linking Software Processes, Products and Industries to Global Trends" in *The Digital Challenge: Information Technology in the Development Context*, Krishna and Madon, Editors, Ashgate, December 2003

reflective of the overall direction in the Indian industry — exceed the national averages by large measure.

National Trends in Delivery Models[35]

	1999-2000	2000-2001	2001-2002
Onsite	57%	56%	47%
Offshore	35%	39%	49%
Products & Unclassified	8%	5%	4%
Total	100%	100%	100%

This, remembering that Andhra Pradesh is a more recent and emerging center of software, arguably may foreshadow the future direction of the overall Indian industry. It is also why the story of Andhra Pradesh is important to revisit. How Andhra Pradesh governments and firms address the challenges of growth, global software management, provider-client interactions, access to markets and innovation are probably of greater importance to understanding the future direction of the software industry than immigration or national "outsourcing" policy debates would suggest. In other words, Andhra Pradesh is both indicative of the move "offshore" but also the limits or form of the movement.

One trend that seems apparent is the structuring of software development in multiple-sites across business models or sectors within global firms. There are two aspects to this. First, while India is famous for the outsourcing and the moving of services offshore, quite a bit of global software development is occurring within global firms and not global markets. In other words, each of the Hyderabad firms listed above — both Indian and global — is linked into some network of global organization within the same company. Second, the interactive, communicative nature of software development and markets pushes all firms — US or Indian, service or product — towards similar global development models. In other words, and in spite of the "offshore" numbers for Andhra Pradesh, most firms with a presence in Andhra Pradesh also have a significant presence throughout India and the world.

One example requires re-examining the well-known list of leading US H1-B visa users in 1999 to 2000.[36] What is interesting but often not noted is:

- Four out of the 25 were Indian software companies, who also happen to be in the top ten in domestic and export sales in India.
- Six of the 25 were founded by Indian nationals with major operations in India.
- Nine of the 25 were global IT, consulting or telecom firms with major operations in India.

Overall, 19 out of 25 leading firms combined some aspect of Indian and US software development. This shouldn't be surprising. As the US economy globalized over the last decade, so have the flows of workers. While the absolute number of H1- B and L-1 visas issued in the

[35] NASSCOM (2002) Indian IT Software and Services Directory, New Delhi: NASSCOM.

[36] Adapted from *Leading Employers of Specialty Occupation Workers (H-1B): October 1999 to February 2000* U.S. Immigration and Naturalization Service, June 2000, http://www.ins.gov/graphics/services/employerinfo/h1top100.pdf

US increased from 184,972 in 1991 to 724,039 in 2001, intracompany transfers (L1 visas) increased faster as a percentage of the total to 47% from 38%.[37]

In other words, while the structure of software practice has always pushed firms to go "onsite" while the demands for labor have pushed them to go "offshore", these interactions are increasingly being moved from markets to within firms, creating a more formal organization of software development. These changes reflect both the unique complexities of software development and the increasing maturity of the Indian software industry. Given the statistics for Andhra Pradesh exports above, human networks and flows are changing in importance. Global software organization changes the flows of individuals from between countries to within firms, making labor movements far less about temporary solutions than parts of an overall development structure and business strategy. Managing these production networks, flows of individuals and building a global corporate culture is a major industry challenge for both Indian and US firms and professionals.

An inflexion point can be said to have happened around 2000. That would be approximately the year in which local IT employment in Andhra Pradesh equaled H1-B visa holders leaving for the US for the first time. As Indian firms have grown in size and experience, access to clients and markets has pushed them to move on from a pure onsite or offshore base to one with deeper ties to the US and other global markets. Satyam, the leading homegrown Andhra Pradesh software company, has twelve global development centers. Both Infosys and Wipro have their global R&D headquarters in Silicon Valley. TCS is actively pursuing joint-research partnerships with universities around the globe. As firms increasingly go global, they need access to global markets with a permanent presence in those markets. The trend appears to signal that Hyderabad will continue to be a key source of professionals for the global industry, but increasingly that interaction will begin at home through a local company or development center.

9. By the "Numbers": Trends of Outsourcing and Offshore

The increasing centrality of software within the global economy is clear. However, in spite of this importance and global scope, software's unique organizational structure resists traditional forms of globalization and disaggregated production. In actuality the industry has globalized fairly slowly and in relatively minor fashion compared with other industries, specifically other IT hardware sectors.

In 1999, the global IT services market was estimated at UD$ 365 billion, with only 6% or US$ 21.9 billion of this cross-border export related.[38] In other words, IT services are significant business, but the actual "offshore" component is relatively small. This did, however, give Indian firms almost 18% of the globalized IT services market, by far the largest share but not overwhelming dominance either in global services or in the IT industry overall. By 2003, India held only 2% of the global IT services market totaling US$ 385 billion.[39] The globalized aspect of IT services has been forecast to reach US$ 91.25 billion by 2010 or roughly 20% of all IT services. Maintaining their current market share will give Indian firms approximately US$

[37] U.S. Immigration and Naturalization Service non-immigrant statistics, 2000 and 2001. http://www.immigration.gov/graphics/aboutus/statistics/97excel/table_39.xls, http://www.immigration.gov/graphics/aboutus/statistics/00yrbk_Temp/TempExclTables/Table38.xls, http://www.immigration.gov/graphics/aboutus/statistics/TEMP01yrbk/TEMPExcel/Table38.xls

[38] Software Sector Report, Indiainfoline, 2001

[39] "Potential exports of $44bn beckon Indian IT services", *SiliconIndia*, January 21, 2004.

16.425 billion in export revenue by the end of this decade. At its current market share, this would give Andhra Pradesh almost US$1.5 billion in exports alone.

Such growth is important and will have a serious impact upon India. It does not indicate, however, that "offshoring" will dominate global IT services or that even a majority of services can be "offshored". A recent survey by Forrester indicated that of US Fortune 1,000 firms, over 60% are doing nothing or just beginning to investigate moving offshore. Less than 5% have established a global sourcing strategy and spend more than 40% of their IT budgets offshore.[40] Outsourcing is a different story. One recent estimate by the Yankee Group indicates that outsourcing is 11 percent of the IT market—or about $150 billion globally.[41] A Datamonitor estimate gives a lower total of the global outsourcing market of US$ 119 billion in 2003. More significantly, Datamonitor indicated that only 1.4% of the total (US$ 1.66 billion) actually involving offshore delivery.[42]

While such numbers are widely divergent and highly susceptible to base assumptions, like most estimates involving the IT or software industry, the trends do seem clear. Outsourcing is clearly a significant sector in the global IT industry, but actual "offshore" delivery is and will most likely remain limited. Focusing on India and exaggerating the "offshore" movement hides more significant trends and patterns shaping the overall industry. While India captures the spotlight, it only has an estimated 650,000 IT workers that are roughly equivalent to 1.8 percent of worldwide IT revenues and workforce. In contrast, the US has roughly 5 million IT workers and 50% of the global market. Even more telling, IBM's annual US$15 billion in outsourcing services revenue[43] alone is 20% larger than the target exports for the total Indian industry in 2003-2004.

On one hand, such numbers indicate that there is huge potential for growth over the coming decade, for both specific economies like India and new, emerging regions. However, as suggested above, the slow, global expansion of such services is also indicative of more fundamental issues linked to the nature of IT services with inherent limits on the ability disaggregate production. Software services outsourcing will continue to be a significant sector within the global industry, but long-term growth for Indian service firms requires a global presence in specific regions near final markets and clients. The importance of this "global" expansion and the limits of actual "offshoring" or cross-border work is part of the explanation of the rise of IT-enabled services.

10. Beyond Software: The Importance of IT-Enabled Services

The open question is the significant difference in "offshore" work in Andhra Pradesh in contrast to Indian national averages, and the limits on "offshoring" indicated above. The year 2000 inflection point is significant part of the explanation for multiple reasons, some of the most

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[40] DataMonitor, *09 Dec 2003, www.datamonitor.com*

[41] Legace, Martha (2004) *The Outsourcing Revolution*, 2004, HBS Working Knowledge, February 2, http://hbsworkingknowledge.hbs.edu

[42] Andy McCue, Offshoring still "small beans" despite outsourcing boom silicon.com, January 21, 2004. Admittedly, this "global" component seems exceptionally low (given a rough estimate of 3.5 billion in offshore work in India alone), raising numerous questions around the assumptions behind this calculation. However, the overall trend and point are still valid, with no estimate placing the "overseas" aspect of services greater than 6% currently.

[43] Wall Street Journal, "New IBM Jobs Can Mean Fewer Jobs Elsewhere", William M. Bulkeley, March 8, 2004.

interesting actually hidden within the national and regional statistics. While most of the discussion for India references the "IT services industry", like the statistics for Andhra Pradesh, this covers a wide-range of activities from back-office operations to application development and IC design. Essentially, much of the growth in offshore production in Andhra Pradesh signals the dramatic growth in IT-enabled services beginning in the year 2000. In other words, the increasing "offshore" aspect of the local industry reflects the local expansion and importance of ITES (back-office operation, call centers etc.) as opposed the sudden expansion of the offshore software services. Both firms and the government supported this growth as they sought to manage the transition from the Y2K bug, Euro conversion and the end of the IT boom. It also offers specific insights into the weakness of software services as a driver of regional growth.

Clearly, the growth of the IT or software industry within India has provided serious growth in a leading technology sector for a country that had until the early 1990s missed out on most of the high-technology global expansion. However, it is probably not enough to drive overall growth and economic development in the country. Even after the extensive IT boom of the late-1990s, India's share of total global exports reached only .9% in 2001, up from .6% in 1995. This gave India a per capital export ratio of US$ 60, six times less than Brazil and three and a half times less than China.[44]

On a regional level, the limits of software as a driver of growth also became apparent with the "perfect storm" conditions of 2000 and 2001. After having gained international recognition by attracting Microsoft to establish a software development center in its flagship technology, Andhra Pradesh officials realized that overall growth was not being driven by such investments. By 2002 after almost four years in Hyderabad, Microsoft's development center employed approximately 100 individuals. A 100% growth rate, but insignificant in an economy of 80 million individuals. Higher levels of growth required much greater volumes of investment and employment generation. An increasingly important sector has become IT-enabled services.

The benefits to Andhra Pradesh were significant and immediate. Driven in large part by initial investments by GE in 1999 and 2000, as well as increasing investments by local firms seeking new revenue streams, by 2002 ITES was the leading export sector from Andhra Pradesh. The second phase of the Hi-Tech City technology park has been almost exclusively dedicated to ITES. In contrast to the slow expansion of software services, major ITES or BPO single investments generated up to 1000 jobs within a year of establishment. By the end of 2002, Andhra Pradesh officials had established a specific governmental program, APFirst, to facilitate ITES, and most leading software services firms has established ITES operations or divisions to spur growth.

These trends explain the dramatic divergence between national and local onsite/offshore trends listed above. The dramatic and sudden growth of ITES in Andhra Pradesh underpins the move toward offshore work, which almost by definition is entirely data or telecom based. As ITES expands in India, overall offshore numbers will tend to converge with the regional statistics in Andhra Pradesh, with the 80/20 percentage a natural equilibrium between onsite/offshore for ITES services.[45]

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[44] World Trade Organization, International Trade Statistics, 2003

[45] Evalueserve-NASSCOM (2003) *The Impact of Global Sourcing on the US Economy 2003-2010*, NASSCOM: New Dehli

In contrast to software services, however, ITES is both radically different and similar. Obviously, competition within the sector for firms and firms is far more direct and greater with fewer "domain-knowledge" barriers to entry. The extensive experience of ITES in defining work process and maximizing mobility both within national markets like the US and globally provides a proven model for growth offshore. Regions with strong, inexpensive workforces and good infrastructure will be able to move into ITES, especially within the most rationalized, defined work sectors. For Indian firms, with expertise in managing systems and clients remotely with extremely high "uptime" and quality standards, the move into ITES builds on core competencies without the limiting constraints inherent in software development.

However, longer term success for both regions and firms will require increasing sophistication and movement into new sectors of expertise and professional services — R&D, engineering, consulting, legal, health and financial — requiring greater interaction and sophistication with global partners or global clients, raising costs and organizational demands. In other words, long-term competitive advantage begins to raise the same challenges around knowledge and markets that structure growth within the software services sector.

11. ITES as a Driver of Growth?

The current emphasis on ITES raises two significant issues. The first issue is the difference between software services and ITES. The structure of software practice detailed above, specifically the demand for skilled labor and agglomeration to maximize productivity, limits the growth of offshore development. As indicated above, most of the leading Indian software services firms have extensive onsite operations globally. Satyam, the leading Andhra Pradesh based firm and one of the top five software firms in India, has seven global development centers outside of India. Four of these centers are in the US alone, with one each in Europe, Japan and China. They have also recently established a Asian regional headquarters in Singapore and made a significant investment in Malaysia's Multimedia Corridor in order to access local government contracts. They are also aggressively pursuing acquisitions to enter or strengthen access in new markets.

Such strategies are not unique. Firms like Wipro and Infosys not only have their global R&D headquarters in Silicon Valley, and have on average a third of their staff in their major market, the US. Such trends occur within the bounded rationalization of software development. The essential feature is that the structure of software practice pushes for firms to near final clients, reflecting a general pattern of industry organization for both Indian and global firms. The regional agglomeration itself, driven by both access to labor and the agglomeration of production, repeats the geographic patterns that are visible within the US and global industries generally. Equally important, the benefits of such developments are also constrained by the limits of the regional environment, the distance from clients and the limited domain-knowledge of final markets. As such, both US and Indian firms reflect and follow similar organizational and global patterns.

This is clearly seen looking at the long-term trends of individual firms. While the Indian national statistics indicate a slow trend toward more "offshore" work and the Andhra Pradesh regional statistics show a dramatic shift offshore, Infosys as one example has actually increased its "onsite" exposure over the last five years.

Infosys Onsite/Offshore Work Split 1997-2002[46]

	1997	1998	1999	2000	2001	2002
Onsite	19.70%	22.60%	25%	32.50%	34%	34%
Offshore	80.30%	77.40%	75%	67.50%	66%	66%

ITES in contrast, especially in its data-entry and call-center aspects, faces no such constraints. Traditional analytic frameworks from manufacturing like labor cost, infrastructure and rationalized work processes fit much better with understanding and predicting the direction of ITES than software services. As such ITES arguably has much more in common with traditional IT electronics globalization. On the positive side, ITES has the potential to be a much more general driver of growth, or at the very least to open growth to wider section of the local population. As such, it has the potential to a driver of middle-class growth that has been seen in China, Taiwan, Singapore and Malaysia — growth, however, driven by services and not manufacturing. A single investment from GE or Citibank in a specific region may have the potential to have an overall impact similar to an Intel investment in Penang or Costa Rica, driving not only direct employment but also overall growth in the regional economy. The open question is what actually ITES services bring and require from a region, both in terms of a local network or production and innovation, as well as potentials for upgrading. The ease of movement of ITES, the very basis for its sudden expansion in India away from rural areas in the US or the British midlands, is an indication that such issues are non-trivial.

This signals the second issue of longer-term growth, and this raises question concerning the negative aspects of the similarity to manufacturing. Software services — driven by domain-knowledge, skilled-labor and unique process management skills — provide a competitive advantage to Indian firms that is difficult for other regions to quickly or successfully emulate. ITES, in contrast, makes issues of infrastructure and labor-cost much more central determinates of location, raising the overall competitive environment both in the near and longer term. While Andhra Pradesh, for example, has sought to distinguish itself from other regions within India, its move into ITES has immediately brought it directly into competition internationally with traditional strong-holds of ITES like the Philippines. Even longer term, new regions within India like Kerela — with good infrastructure and high rates of literacy — pose serious challenges to long-term growth in Andhra Pradesh.

Looking at the industry characteristics in India from 2000 and 2001 does indicate the challenges of these issues within ITES. Clearly growth in employment and revenue is significant: 55% employment growth and 70% revenue growth. However, on a deeper level of analysis it becomes evident that even with ITES growth and value are dramatically different across sectors.

[46] Infosys Technologies (2003) California Franchise Tax Board 25137 Petition, March 28th

Indian IT Enabled Services[47]

	1999 - 2000		2000-2001	
	Employed	Revenue (Rs. Crore)	Employed	Revenue (Rs. Crore)
Customer Interaction Services including Call Centres	8,600	400	16,000	850
Accounting/Data Entry/Data Conversion including Finance & Accountancy/HR Services	15,000	950	19,000	1,350
Transcriptions/Translation Services	5,000	120	6,000	160
Content Development/ Animation/Engineering & Design/GIS	15,000	820	27,000	1,600
Other services including Remote Education, Data Search Market Research, Network, Consultancy & Management	1,400	110	2,000	140
Total	**45,000**	**2,400**	**70,000**	**4,100**

By 2001, transcription services provided 9% of employment but only 4% of revenue. On a per employee basis, the revenue was only half of the next closest sector, call centers. These "interaction services" provided 23% of employment, but only 21% of revenue. On a per employee basis, call centers generated 9% percent less in revenue than the overall Indian average. Not surprisingly, the highest revenue/employee come in higher skilled and value added sectors like research, consultancy and design. Sectors with a strong overlap with the domain-knowledge and skilled professional patterns needed in software services, signaling that many of the same challenges may exist for their expansion as well.

IT Enabled Services	1999 - 2000			2000-2001		
	Total Employment %	**Total Revenue %**	**Revenue/ Employee (Rs/emp.)**	**Total Employment %**	**Total Revenue %**	**Revenue/ Employee (Rs/emp.)**
Customer Interaction Services including Call Centres	19%	16.67%	465,116.28	23%	20.73%	531,250.00
Accounting/ Data Entry/ Data Conversion including Finance & Accountancy/ HR Services	33%	39.58%	633,333.33	27%	32.93%	710,526.32
Transcriptions/ Translation Services	11%	5.00%	240,000.00	9%	3.90%	266,666.67
Content Development/ Animation/ Engineering & Design/GIS	33%	34.17%	546,666.67	39%	39.02%	592,592.59
Other services including Remote Education, Data Search Market Research, Network, Consultancy & Management	3%	4.58%	785,714.29	3%	3.41%	700,000.00
Total	**100%**	**100.00%**	**533,333.33**	**100%**	**100%**	**585,714.29**

[47] NASSCOM (2001) Indian IT Statistics 2001, NASSCOM: New Dehli

The most significant surprise, however, is the importance and structure of financial and HR services. It provides a significant portion of the overall employment, is the only sector with generating a greater portion of revenue than employment, and provides even greater per employee revenue potential than research or consultancy.

The key points to emphasize, even with somewhat dated information, is that 1) even within the ITES sector specific industries present a different set of economic, resource and development questions that are non-trivial, and 2) the greater the move away from defined, rationalized processes the closer strategic and policy questions move toward similar issues and challenges of the software services sector. Much of the discussion on the ground in India is focused on "moving-up" the software services value-chain, which requires moving into consulting, management, engineering and design within specific domains (manufacturing, finance etc.). Whether moves into these sectors via ITES strengthens or detracts from these efforts remains to be seen. What is clear is that government policy and firm strategy is much more focused on revenue and employment, and supporting that growth than considering the much more intangible, challenging and uncertain growth of such higher-value added sectors.

12. From Specific Cases to General Trends

As I have detailed elsewhere, [48] software contrasts with hardware development on multiple levels beginning with production patterns and extending through government policy. Such patterns can be extended when considering software and IT-enabled services, moving away from specific industry developments in India or Andhra Pradesh to work through the overall impact for regional development within the contrasting frameworks of ITS and ITES. Beginning with production, it is possible to see how many of the basic informational patterns structuring software development are fundamentally different for IT-enabled services. Differences in labor quality, rationalization and basic resources all impact upon overall product and competitive patterns, and longer-term organizational patterns within each sector.

[48] K.Eischen (2000) *Information Technology: History, Practice and Implications for Development*, Working Paper 2000-4, Center for Global, International and Regional Studies, University of California, Santa Cruz.

Contrasting Software Services and IT Enabled Services

	ITS	*ITES*
Production or Shop-floor Processes	1. A process that is organized around the definition, generation, manipulation and transmission of information into socially and economically applicable forms. 2. The primary source of information will be domain-knowledge. 3. A tacit, subjective and interpretive design practice, difficult to rationalize. 4. The division of labor will be weakly defined, with skilled-human labor the central constraint on productivity and growth.	1. A process organized around the interaction and transmission of pre-defined facts, situations and scenarios. 2. The primary source of information will be pre-defined, factual and database-driven. 3. An explicit, rule-bound and information/fact-based systems work practice, easy to rationalize. 4. The division of labor will be strongly defined, with semi-skilled-human labor and costs (both labor and infrastructure) the central constraint on productivity and growth.
Product and Competitive Patterns	5. Value-added will be greater in the design, that is in the ability to define and model a process, than in its actual implementation, manufacture or replication. 6. Products will have both functional and expressive qualities. 7. Market competition will focus on products and not process. 8. The knowledge embedded in products will institutionalize social norms, and result in limitations derived from their non-rational production, the complexity of processes being mapped, and the social assumptions.	5. Value-added will be greater in execution, that is in the ability to efficiently and inexpensively provide services, with labor and infrastructure cost central. 6. Products will have functional and fixed qualities. 7. Market competition will focus on process and not product. 8. The knowledge embedded in products will institutionalize specific social norms, especially the organization of data, but these will take a generic form derived from the rationalized and fixed process.
Organizational Patterns	9. Monopolies will tend to occur, both through the establishment of standards and the drive of firms to control innovation, product cycles and distribution. 10. Firms will tend to be vertically integrated and dominant in specific knowledge domains, but globally networked to efficiently manage information flows and information or knowledge workers. 11. Regional sources of knowledge, especially culture, will play a significant role. 12. Economic growth and development will center on the development, control, management and location of domain-knowledge. 13. Flows of individuals will tend to predominate, as carriers of tacit knowledge and skill, with labor markets increasingly global.	9. Competition will be rule-bound and generic, limiting dominant third-party firms or overall market dominance by firms or regions for extended periods of time. 10. Firms will tend to be vertically integrated with an internal-process focus, within global production strategies and networks. 11. Specific organizational or national sources of knowledge, especially culture, will predominate through the rationalized and generic nature of the domain-knowledge. 12. Economic growth and development will center on the development, control, management and location of generic semi-skilled labor and infrastructure. 13. Flows of investment will tend to predominate, underlying firm investments and infrastructure development, with labor markets increasingly national or regionally based.

As I've argued elsewhere,[49] there are similarities across informational sectors, driving general and consistent patters between "informational" and "materials" -driven environments that

[49] K.Eischen "Mapping the Micro-Foundations of Informational Development: Linking Software Processes, Products and Industries to Global Trends" in *The Digital Challenge: Information Technology in the Development Context*, Krishna and Madon, Editors, Ashgate, December 2003

structure possibilities for development.[50] ITES comprises a central contradiction for regions like India. Overall it moves regional development in a much more classic development trajectory, much more similar to offshore or globalized manufacturing. This has the potential to be a real engine of growth similar to earlier regional developments in Malaysia, Taiwan, Singapore, Hong Kong and increasingly China.

Patterns Operating in Informational and Material Driven Environments

General Patterns	Informational	Material
Institutional Mechanisms, Norms and Flows Structuring the Environment	➢ Migration ➢ Local and Firm Investment ➢ Innovation networks ➢ National and regional policy ➢ Private-public partnerships ➢ Entrepreneurial firms-global firm linkages	➢ Fixed Local labor resources ➢ National and global investment trends ➢ Production networks ➢ National and regional policy ➢ Global firm – national and regional government linkages
Production: Processes, Products and Industries Patterns	➢ Tacit, innovation-driven and informational processes. ➢ Products embedded and defined by social-knowledge. ➢ Global markets and regional, networked production for industries	➢ Explicit, rationalized, quantified processes. ➢ Products embedded and defined by scientific knowledge and physical limitations ➢ Point-to-Point National markets and regional production
Local Processes and Structures Interacting with the Environment	➢ Regional economic and social networks ➢ Unique local knowledge/information ➢ Regional governance institutions and capacity ➢ Unique social capital ➢ Unique cultural practices ➢ Regional educational and scientific institutions	➢ Regional and national investment and infrastructure ➢ Access to standardized knowledge, technologies and norms ➢ National governance institutions and capacities ➢ Generic cultural practices ➢ Regional educational and scientific institutions

It also simultaneously moves firms and regional development strategies away from the slow accumulation of managerial, technical and domain-knowledge capacities that are essential competitive advantages and form a basis for regional, dynamic growth tailored to emerging markets. The natural tendency of agglomeration inherent within informational industries establishes resources and capacities that are inherently difficult to replicate.

As but one example, agglomeration drives software practice through two key aspects: 1) the need for communication within the process for innovation, quality and efficiency, and 2) the need for communication with end-users, clients and markets with specific domain-knowledge. The internal debate within Microsoft concerning outsourcing reflects the tension between the need for labor and the need to agglomerate production within the corporation, specifically at Redmond. The general consensus at Microsoft is that outsourcing is not possible, even in a very limited sense, because innovation and quality require the agglomeration of development in Redmond. This does not mean that Microsoft has not nor will not expand globally. It has and will continue to do so, driven by the need to access labor but within the constraints of agglomeration. Internal agglomeration explains the structure of Microsoft, its basic commitment to agglomerating

[50] Following John von Neumann's 1949 statement on the future of technology: "Science, as well as technology, will in the near and farther future increasingly turn from problems of intensity, substance, and energy, to problems of structure, organization, information, and control."

production to the highest degree in Redmond, with specific dedicated research, development and service centers established globally. As indicated above, the cost of labor within India and globally is significant only to the extent that disaggregating development decreases quality, efficiency and innovation.

The second factor is of greater concern for the overall development of the Indian industry. The history of global labor movements has demonstrated that Indian firms have been the important users of H1-B visas. This is perfectly consistent with the need to access and serve clients in their major markets. A more significant factor is that Indian firms, as they move up the value-chain, will need to consistently interact with clients and end-users directly. This will push for the agglomeration of development near final customers. It is to be expected that such development will require Indian firms to invest heavily overseas, establishing a global presence. However, it has been consistently surprising how weak the links between Indian firms and key customer markets in the US are for the majority of Indian firms. The inability of more Indian firms to fully move product development offshore, missing both the access to clients and the quality and productivity of the US environment is also surprising.

The central question here is the degree in which the quality and efficiency of this distributed system is overcome by the lower costs of labor back home. In other words, the Indian industry faces the same limitations as it globalizes as global firms do when establishing a presence in India. The best firms in India will manage this transition, but the majority of firms face serious challenges.[51] As such, if domestic markets fail to develop, agglomeration tendencies will push Indian firms to establish themselves globally, limiting the growth of the domestic firms unable to make this expansion.

This is particularly important in the case of the global expansion of other industries that pose final markets for software services firms. China, for example, poses both an expanding domestic market and an increasingly competitive export platform. In all sectors, software will be an increasingly important component. Accessing these markets and moving up the value-chain, in either services or products, will require the agglomeration of firms near their final customers. One possible outcome is for Indian firms to increasingly be based in China, expanding the size of Chinese exports, just as global firms currently do in Ireland. This is a pattern that is consistent for software services, except where monopolies exist in the case of products. But even in products, agglomeration still requires firms to bring production together.

13. In Sum: Myths and Realities of Development Architectures

The overall lessons of the emergence of both software services and ITES in India suggest a range of possible directions. It is doubtful that software services or ITES can be the sole driver's of growth in India or other emerging economies without the full expansion of local markets. While there remain significant opportunities for growth, even with the most conservative estimates, longer term more fundamental and sustained development will require the development of local markets that incorporate and extend the skills built through both the software services and ITES sectors. Such trends are already partially evident in the application of IT to e-government

[51] As one indication of this, the top ten firms in Andhra Pradesh account for 58% of exports, raising serious issues about the viability of the remaining 745 firms in the local industry. Such patterns are indicative of national patterns as well.

services, the expansion into biotechnology and health care, and the attempts to directly address social and economic development through innovative technology solutions.

Software services will increasingly be a global activity, but long-term growth for Indian firms requires a global presence in specific regions not the presence of the global industry in India. The central tension in software is between the need for access to labor and the need to agglomerate development. The inherent limits on the rationalization of the development process — stemming from the informational, domain-knowledge fundamental non-science, non-engineering resource of industry which drives the translation of knowledge to coded form — underlies the quality and communication structures driving agglomeration. The fundamental creative process of software development — the translation of specific knowledge-domains to algorithmic and binary form to address ever increasing complex problems — maintains skilled craft labor at the heart of the process. The real key to the rationalization of production is the standardization, codification and inflexibility of knowledge domains. A process that is easier to accomplish for ITES, but also lowers the barriers to entry for new regions and firms in the global market.

The recent trends toward the use of L1 as opposed to H1-B visas represents a significant and fundamental shift in the structure of global software labor markets, de-emphasizing market or intermediary functionaries within labor networks and shifting to internal firm movements. These changes are significant and have impact on the structure of firms in the global market. They are also seemingly universal movements shaping both US and Indian firms, large and small, entrepreneurial or established. They are also not present for the majority of ITES activities. In other words, investment by US firms like Microsoft in India to access the best and most skilled labor, doesn't have an equivalent for the majority of IT enabled entry-level services. Labor cost, not quality or access is the central driver of ITES.

However, returning to the ever-changing definition of "offshore", there is also a natural tension inherent within IT services that contrast firm success with national growth. Simply, geography, business success, local employment and economic growth are not clear synchronized for India or any other global player. For software services, the Indian industry will continue to be shaped by national and global firms 1) accessing skilled labor for internal labor markets (bringing skilled developers to their highest value-added global locations), 2) minimizing overall process costs and not just labor expenses, and 3) moving globally, especially for Indian national firms, to access specific domain-knowledge and clients. For ITES, the questions of geography and domain-knowledge matter far less for those sectors most dependent on cost and infrastructure and thus most easily transferred to new regions. As specific aspects of competitive advantage become greater with movements into higher-value added services, the unique benefits of ITES — wide-spread employment opportunities, significant regional economic impacts, extensive "offshore" production— become much more difficult to foster and facilitate.

From a US point of view, defining terms and understanding trends is equally important. The global expansion of India will entail, most similar to Japanese auto firms, increasing investment, employment and operations in the US. However, this is premised on the continuation of the US as a central market for software services. Arguably of much more concern, given the actual trends in the US economy on both a national and regional basis (see *Defining Job Losses and Movements* below) is the integration between services and manufacturing for innovation and growth. On one hand, the growth of new markets in China and India provide opportunities for

US firms. However, the nature of services pushes all firms to be near their final markets. Just as Indian firms will go global to grow, so will US firms to meet new and expanding markets.

Defining Job Losses and Movements

The widely cited Bureau of Labor Statistics estimate of 2.9 million private sector job losses in the US since March 2001 hides two important factors. First, 80% (2.3 million) of the job losses are in manufacturing and not services. Of the 600,000 services jobs lost, roughly 100,000 (or 3.4% of all job losses) are in the information technology sector.[52] Second, rough estimates based on Forrester projections[53] indicate the number of these job losses linked to "offshoring" at roughly 17% (or 493,000). While there is no indication of how many of 100,000 IT job losses were actually due to offshoring, even if every single job was lost to offshoring it would still only explain 20% of the actually offshore movement, if Forrester is roughly accurate.

Even more importantly, these national trends in job losses are reflected on the regional level. Recent California Employment Development Department data show total 25,100 jobs lost in Santa Clara County in the heart of Silicon Valley during 2003.[54] These job losses were led by manufacturing (13,600), professional & business services (4,500), government (4,300), construction (2,300), information (1,400) and trade, transport and utilities (1,400). Approximately 60% of the losses in manufacturing were in computer and electronics products. Clearly IT jobs, but not the jobs commonly associated with offshoring to India. Outside of this, the majority of jobs losses are linked to cyclical patterns linked to the overall health of the economy (government, construction, trade & transport). Information and business services do signal serious job losses, but again it is unclear if these are directly traceable to offshore movements as opposed to the same forces driving losses in Silicon Valley generally.

On the other hand, it remains unclear on the benefits to both regions and firms of having some full development cycle within physical or organizational boundaries. New industries like bioinformatics require equal doses of both software and biology and machine tools. Regions like Silicon Valley provide this level of depth and breadth both through individuals, universities and firms that produce innovation and solutions around new opportunities. The open question is what impact does the outsourcing and offshoring of parts of the overall network have on the region and firm? These are new questions that academics, policymakers and firms are not accustomed to asking, measuring or addressing. Even simple patterns, the offshoring of customer support for example, raises quite interesting questions when the direct contact with your customers is moved one step away. This may have none or major impacts on firm competitiveness. Most likely it will be somewhere in the middle and depend entirely on the sector, the company and type of knowledge needed and generated.

These opportunities and contradictions signal why services, even though global, are not equivalent to well-established manufacturing centered offshore development models. Even within the IT industry, global services represent unchartered territory. Services can and will go global, but understanding how, why and with what limitations — particularly the actual differences rather than assumed similarities to past industries and trends — is the essential aspect

[52] Bureau of Labor Statistics (2003) http://www.bls.gov/news.release/cewbd.t01.htm
[53] Forrester Research (2002) *3.3 Million US Services Jobs To Go Offshore*, November 11, http://www.forrester.com
[54] State of California Employment Development Department (February 27, 2004), Labor Market Information Division, http://www.calmis.cahwnet.gov

to formulating long-term regional growth and development. What we do know, however, is quite clear.

- IT-enabled services are more likely to be offshored but maintained within global firms through FDI.
- IT services are more likely to outsourced but geographically localized and client-driven.
- Location matters for domain-knowledge driven industries like software services, with geography central to productivity, quality and ultimately cost.
- The geography of production for software will always be driven by final markets and clients. The question is who is employed and the nationality of firms is much more difficult to predict, and analysis needs to separate out regional benefits of location versus the immediate benefits of employment or ownership.
- People matter for all services, but different skill sets and capacities differentiate software services from enabled-services, which in turn structure choices of policy, investment and long-term regional capacity building.
- Domain-knowledge matters, and long-term success requires the accumulation of specific and deep domain-knowledge and its application to local problems and solutions.
- Much domain-knowledge for software, unlike for ITES, cannot be bought or institutionalized, creating both significant barriers to entry as well as significant firm and regional competitive advantage. Meaning that once such domain-knowledge is captured it cannot be easily outsourced and becomes a source of specialization.
- ITES can generate real growth for countries like India that have missed the IT manufacturing boat. It is, however, still the IT manufacturing boat, with the same challenges and issues that even successful regions face moving into higher-value added, domain-knowledge, informational growth sectors.
- India's current advantage in ITES is strong, but longer-term advantage is much more suspect, given the potential for new regions to emerge and compete purely on labor and infrastructure costs and quality.

The overall lessons of the emergence of both software services and ITES in India suggest a range of possible directions within this basic architecture. It is doubtful that software services or ITES can be the sole driver's of growth in India or other emerging economies without the full expansion of local markets. While there remain significant opportunities for growth, even with the most conservative estimates, longer term more fundamental and sustained development will require the development of local markets that incorporate and extend the skills built through both the software services and ITES sectors. The innovation that will drive this success requires careful planning and development that balances both immediate benefits with key policy and investments for the future.