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Building a "Soft Region" on Hard Legacies: The Development of an Informational Society in Andhra Pradesh, India

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I) Abstract

Andhra Pradesh is quickly developing into the third site of the South Indian "Silicon Triangle". Regional government initiatives over the last six years have propelled the region from virtual non-existence to an increasingly central node of software development in the global economy. These efforts have been propelled by revitalized regional institutions that have built on national development legacies and global trends. This raises three central issues. First, what forms do information technology (IT) development initiatives take in contrast to previous development efforts? Second, how do global and national trends structure such regional initiatives? Finally, how do IT economic initiatives impact upon and structure social and cultural interactions?

Each of these questions is at the heart of understanding information technology-focused regional initiatives that are increasingly a central, if not well understood, aspect of development efforts globally. IT industries like software have unique production processes and business structures that rely on being embedded within innovative and human resource-based environments. These unique aspects have framed the organizational and expansion patterns of the industry in quite distinct ways from previous forms of industrialization. Both positive and negative national legacies, in essence the legacies of previous forms of industrial policy, have been key resources upon which such an innovative environments have been established. These dual national legacies and the unique demands of IT production have shaped the management and building of new regional institutions and social structures. It is exactly these regional policy and institutional innovations that will be central determinate of the long-term viability of the software technology cluster.

Andhra Pradesh is an ideal case through which to understand the social and economic impacts of IT exactly because it highlights the recognition that viable IT economic strategies are inherently linked to social transformations. This is seen in the combination of three facets of the regional initiative: the replication of national resources on the regional level, the building of unique regional capacities, and the fostering and capturing of private initiatives. The key aspect of each of these initiatives is that they form an organic whole that is essential to developing the long-term viability of the software-focused strategy in Andhra Pradesh. This long-term viability, as reflected in the nature of the initiatives themselves, goes beyond the mere fostering of "information industries or economies", but entails the reformulation of social and political relations around an "information society". In this way, Andhra Pradesh offers insight into the social and economic framework within which new social relations are being structured within India and other regions around the world as they pursue new models of development.

II)   Overview: Building an "Information Economy" within Global and National Spaces[1]

On the southeastern coast of India, the state of Andhra Pradesh is undertaking a dramatic experiment in building what can justifiably be called an information society. Over the last six years the state government has propelled Andhra Pradesh form virtually anonymity to being a central location of software investment and development within the global economy. Yet, for most of the 1990s, no one would have foreseen the possibilities of development in Andhra Pradesh in general, let alone development centered on one of the most dynamic and leading industries of the coming century.

The relative success of the Andhra Pradesh development initiative challenges several widely held conceptions of the state's role in promoting development under a global, information-driven economy. Essentially, Andhra Pradesh is attempting to move directly from a rural to an information economy, but it is doing so by skipping any form of industrialization including high-technology manufacturing. Understanding the resources that the region has drawn on to both formulate and establish this development initiative is crucial to understanding if such policies can be replicated in other parts of India or the world. It also offers insight into the linking of information technology economic strategies to "information society" models as a means to promote widespread economic and social development that are fundamentally different than previous national variants.

The 1999 Indian Human Development Report highlights both the dramatic failures of Indian national development strategy and the overall environment in which the regional software initiative has been formulated in the state of Andhra Pradesh.

Of households:
➢ Average income is $600/year (PCI is $126/year).
➢ 58% earn under $500 dollars/year.
➢ 63% have electrical connections.
➢ 31% have piped water.
➢ 15% have indoor plumbing.

Of the population overall:
➢ 21% earn less than $49/year (the Andhra Pradesh poverty line).
➢ 35% is urban.
➢ The overall literacy rate (7 years +) is 50.2%, with a ratio of 65 women for every 100 men.

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[1] This paper stems from fieldwork conducted in India in 1999/2000.

➢ 8% complete matriculation level (high school), with a ratio of 44 women for every 100 men.

Yet, a central dichotomy of regional development in Andhra Pradesh is that the failure of national development to promote wide and equitable development have not limited a successful IT regional development strategy. In actuality, the skewed nature of national development has provided many of the most positive resources around which the regional strategy has been built. Legacies including investments in key military research institutions, targeted IT infrastructure, world-class universities, engineering and scientific human resources combined with constitutional established policy and financial divisions provided essential factors enabling and structuring the development of the regional strategy (Eischen 2000c). The key point is that the legacies of national development are only failures when judged from a traditional state-centered industrial viewpoint. Under national liberalization and the expansion of software production globally in the early 1990's, these distortions became strengths around which IT-focused development could be considered as not only desirable but also possible given the demands and needs of the global environment.

III) Regional Development Strategies, Information Technology and Social Transformation

Theories of the informational economy and society are well outlined (Amin 1994, Webster 1995, Castells 1996, Dicken 1998, Held et al 1999). Elaborating from these general theories, it is possible to develop a matrix of the basic features "information regions" or "technopoles" have that support knowledge or information focused development initiatives in general (Castells and Hall 1995, De Vol 1999 and 2000, Mytelka 1999). Such a matrix details factors that support IT or software focused regional development as well as the features, if any, that can be carried over from pre-existing development strategies.

In general, IT focused development strategies should focus on three simultaneous goals: reindustrialization as linked to a constant transforming of comparative advantage, regional development to insure equitable and broad growth, and the building of synergy to create new economic opportunities and vitality (Castells and Hall 1995). In practice these goals evolve within the categories of public policy, comparative location benchmarking, and social infrastructure development. The state is the central catalyst in each of these aspects. "State and local governments, public policies, and the interaction between private and public sectors are crucial for the genesis, expansion, and the fortification phases of high-tech development (De Vol 2000:3)." In terms of a simple matrix in which to evaluate

the factors that support information regions and strategies, the above list can be distilled to five factors whose "genesis, expansion and fortification" are central to the fostering of a high-technology region:

1) research centers,
2) investments to jump-start development,
3) human-capital development,
4) capital and institutions for the commercialization of research,
5) a governing and institutional culture and social environment that promotes development.

Hidden within each of these factors is a double quantitative and qualitative characteristic surrounding the aspects of genesis, expansion and fortification of IT initiatives. The quantitative aspect involves fairly direct infrastructure and institutional initiatives that can be measured by standard investment measures. These quantitative aspects are exactly those supplied by the national legacies discussed above and that have been crucial to the genesis of the regional strategy. The qualitative aspect involves the nature and quality of the institutions, cultures and relationships developed around the regional initiative that insure its expansion and fortification.

Like most development initiatives, it seems clear that while the initial kernel (or genesis) of an IT regional strategy may be quantitatively measured, long-term success lies in the qualitative aspects of research, investment, human capital, commercial networks and governance structures. As such, IT regions are inherently social projects, involving the building of new social norms and institutions in order to insure long-term comparative advantage. This dynamic is exaggerated in the case of Andhra Pradesh by the focus on software, the most virtual and knowledge-driven of information technologies, as the central focus of regional development. Thus, understanding regional development in Andhra Pradesh involves understanding both the nature of IT processes and industries as well as regional policies that have focused on building the institutional structures to support a qualitative change in the regional environment.

a) Linking Information Technology to Social Practices and Institutions

Information technologies (IT) are increasingly one of the central determinates of the direction and pace of economic and social change in the global environment (Castells 1989, Eischen 2000b, Dicken 1998, Held et al 1999). However, the role that IT plays in this environment is often undefined or misconstrued. Information technologies have a very specific and distinct social basis that shapes their development as a process, product and

industry (Agre 1997, Kelly1998, Lessig 1999, Mitchell 1998). As such, IT is much more than just an infrastructure for transmitting information or increasing the speed and geographic spread of communication.

IT processes deal directly with the creation, manipulation, commercialization and distribution of knowledge and information in the global environment (Armour 1999, Negroponte 1995). This basic process is facilitated by the algorithmic patterns that are at the core of information technologies, enabling the manipulation of diverse information in its digital and algorithmic forms. This basic process shapes both the products produced and the organizational characteristics of IT industries. In other words, IT industries like software develop around the need to produce and commercialize information in specific products.

This structure of IT, which is very different previous manufacturing or industrial processes, helps detail many of the patterns in the global environment. For example, "information" focused economic initiatives are by definition specifically created to integrate and operate within global networks of production, immigration, innovation and competition (Karolak 1998), the basic patterns that structure the generation and production of information products. IT industries, because they are based around information and knowledge-based production practices, create organizations and institutions that operate in the global environment very differently than past economic models. One of the central characteristics of IT industries like software is the need to capture or control the sources of unique information that drive innovation and competition globally. Such sources of competition mean the networking of diverse regions across the globe to capture unique characteristics and sources of information (Eischen 2000b). Software in this way is about the control of flows of information and the specific skills to handle that information, rather than the capturing of fixed, defined and pre-determined resources (Eischen 2000a).

The unique development processes, resources and geographic organization of information-driven industries are central to understanding global processes. The uniqueness stems from the role of information as both a product and input of the process itself, and not how that knowledge is necessarily applied in a specific technological format. It is important to recognize that information production processes actively structure organizational and institutional policies and practices on a local level. In other words, the advantages and challenges of information increasingly shape the strategic and organizational choices of governments, firms and social actors, whether conscious or not

(Lessig 1999, Agre and Schuler 1997). This means that the building of a software industry and policy in Andhra Pradesh has impacts far beyond pure economic considerations alone.

b) Producing Information: Defining and Understanding IT Production Patterns

Information technologies are increasingly structuring the global environment, not simply because they "compress time and space" and enable a greater extensivity and speed of interaction (Held et al 1999), but rather because IT as a process, product and industry defines how information is produced and translated into power and profit on the "shop floor" (or cubicle) level. Organizational and institutional structures form to maximize this type of production and transformation of information. In this way, information development processes are the way in which micro and macro levels are connected in a global knowledge-driven environment. This helps understand how information-focused industries like software organize and produce social and economic goods in an information society. It also helps explain the creation of new social and institutional patterns that will develop in Andhra Pradesh around the establishment of an IT strategy. A simplified typology of the key aspects and implication of IT can be outlined as follows (Eischen 2000b):

➢ A process that is organized around the definition, generation, manipulation and transmission of information into socially and economically applicable forms.
➢ The social nature of domain knowledge, that is the place and context specific nature of information, insures that specific regions and culture (either by historical accident or plan) will play a significant role as resources and locations for IT industries.
➢ Because it is socially structured and often determined, the production of predominately information-based products will take the form of craft-like production where tacit information and synergies are essential.
➢ Value-added will be relatively greater in the designing or mapping the algorithmic patterns of a process, that is in the ability to define and model a process than in its actual implementation, manufacture or replication.
➢ Flexible organizational forms, especially networked forms, that are able to efficiently and rapidly manage the flows of information (both its creation and applications) and manage "information or knowledge workers".
➢ Production and firms will increasingly be globally defined, though product markets will remain fragmented.

c) Information Technology as Embedded Knowledge and Culture

IT describes the general process through which social and economic trends overlap and interconnect within the information economy. As simultaneously a process, product and industry, IT is an essential feature in the global environment for transforming and linking together local social knowledge and information, and thus culture and economics. In this way, the specific features of IT outlined above, particularly the need for locally specific domain knowledge, represents one of the essential mechanism through which local information is linked into global economic and social patterns (Geertz 1983). Information technologies like software thus are incredibly flexible and

dynamic processes, not only comprising how information moves in the global environment but also embedding such knowledge in the technologies themselves. As such, IT— whether in biotechnology, software, telecommunications or multimedia — builds on existing institutions and norms while simultaneously creating new patterns that slowly intertwine and transform these existing social relationships.

Exploring the implications for societies of these broader global patterns requires detailing the opportunities and challenges presented by the shift to information-focused processes, products, norms and institutions. Regions like Andhra Pradesh should be considered within a framework of the general patterns that initiate and support information industries and production processes. In the case of Andhra Pradesh, the choice of software as a central focus of government policy and economic strategy represents a social model quite different than previous forms, even if it is not recognized as such. This means that focusing on software is not just a simple choice of industry or policy, but a transition to a new pattern of social and economic relationships.

d) *From Information Economy to Information Society*

Andhra Pradesh highlights three unique facets of the regional initiative: the replication of national resources on the regional level, the building of unique regional capacities, and the fostering and capturing of private initiatives. The key aspect of each of these initiatives is that they form an organic whole that is essential to developing the long-term viability of the software-focused strategy in Andhra Pradesh. This long-term viability, as reflected in the nature of the initiatives themselves, goes beyond the mere fostering of "information industries or economies", but entails the reformulation of social and political relations around an "information society". In this way, Andhra Pradesh offers insight into the social and economic framework within which new social relations are being structured within India and other regions around the world as they pursue new models of development.

IV) The Extension, Incorporation and Building of National Legacies into New Institutions in Andhra Pradesh

Given the challenges posed by the software production structures and the inherited national capacities, it is essential to understand the steps Andhra Pradesh has undertaken to both to both build an environment for long-term growth of the IT industry as well as address the potential limitations of software as a driver of regional development. The

uniqueness of Andhra Pradesh strategy rests on the local resources, capacities and institutions that have spurred regional development relative to other regions nationally. This regional advantage is supported by a real understanding of the innovative environment, that is the qualitative aspects of an IT regions, that software regions require combined with the extension, incorporation and building upon specific national legacies.

Overall the Andhra Pradesh regional strategy focuses on the development of a "hi-tech habitat" that develops the infrastructure, partnerships, regulation, financing and social norms that will create an innovative region over the course of the next two decades (AP First 2000). Key investments have been made that seek to build the infrastructure that will be the architecture within which software and IT development can take place. Such infrastructure investments are supported by new partnerships with national, regional, private and international institutions for both expertise and financing. Such partnerships and initiatives have been directly supported by regulation within the space of control delineated under the Indian constitution. These partnerships have also involved the capturing of national institutes to operate within regional objectives, either incorporating them into regional development networks and coalitions or directly framing their policies to match regional initiatives. The hope is that such initiatives will create a synergy that will create an overall environment of innovation, fostered by creating an environment in which talented individuals will stay in the region and overseas Andhras will return and establish new ventures[2].

The overall direction of the regional strategy is important, but it is also essential to detail the specific new institutions being created that support the initiative. Some of these build directly on national legacies, others are pure regional innovations and others are directed by private firms and individuals. Overall, they provide evidence

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[2] A primary example of this overall process has been the $850 million dollar Hyderabad Information Technology Engineering Consultancy (Hi-Tec) City was built in partnership with L&T Engineering, an Andhra Pradesh based firm, and the Andhra Pradesh Investment Corporation (APIC), a public corporation. The government provided 158 acres of land in return for an 11% equity stake in the project. When seeking foreign investment for this software park, the state worked with Satyam, only the second Indian software company to list on the NASDAQ. The firm has a large state of the art campus over an hour and a half away from Hyderabad, with employee housing, golf course, direct satellite uplinks and its own helicopter pad. When Bill Gates visited Andhra Pradesh to evaluate the potential of the state as an investment site, the government took him directly to the Satyam Campus. The decision to locate in Andhra Pradesh was further promoted by Andhras in leading management positions in Microsoft itself. Financing for such projects has come from both internal financial reforms and international or private financing. The best example of this came in June of 1998 when the World Bank extended its first state level loan in India to Andhra Pradesh. The $350 million loan was slated for infrastructure programs in both roads and computers.

of the sustainability and reach of the software focused development strategy in building on the basis of the innovative region as established by national legacies.

a) Replicating and Capturing National Institutions and Resources: Filling in the Gaps of National Development

Much of the effort in Andhra Pradesh over the last six years has focused on replicating key national institutions or capturing existing national capacities to regional goals. Much effort has been focused on developing regional models of national institutions and capacities that have spurred development in other regions throughout India. While national legacies did provide key resources to initiate development, there were gaps in this inheritance when compared with other regions nationally. In addition, existing national institutions became captured and transformed into *de facto* if not *de jure* regional institutions. Key developments along these lines have been:

➢ Software Technology Parks, Hyderabad
   Originally begun as a national program for targeted investment in telecommunications across India to support existing software firms, the STP in Andhra Pradesh has become an integral part of the regional initiative, promoting software investment in Andhra Pradesh in direct competition with other regional STP centers in India. It has also become a lead partner with the state in expanding STP services (telecommunications, single window clearance) to new urban-regions throughout Andhra Pradesh, hoping to capture investments and small local software start-ups funded through new state sponsored venture capital.

➢ HI-TEC (Hyderabad Information Technology and Engineering Consultancy) City
   The HI-TEC City is the premier example of regional investment in creating a software technopole. The park, modeled after initiatives like the Electronics City in Bangalore, has been central to gathering new investments to the region overall, including Microsoft, Metamore and Oracle. As such, the Hi-Tec City has had an impact beyond these direct investments, and has served as the kernel around which software will develop in the region overall. Companies such as Motorola, Wipro and Baan Infosys have undertaken new or expanded investments in Hyderabad and are building campuses near the Hi-Tec City. The overall planning has focused on geographically linking through urban land policy new investments in software campuses, leading universities and research centers, new housing initiatives, and telecommunication and transportation infrastructure around which the software industry will expand region-wide.

➢ Indian Institute of Internet Technology (IIIT)
   The IIIT is a paired investment to the HI-TEC City. The aim is to build from the ground up an institution equivalent to the six existing Indian Institutes of Technology and Science found in other regions throughout India. The IIIT has drawn investments from many of the same firms investing in the software park. Specific investments include: the Microsoft School of Software Technology, the Oracle School of Advanced Software Technology, the Metamore School of Excellence in Software Methodologies, and the IBM School of Enterprise Wide Computing.

➢ Indian School of Business (ISB)
   The Indian School of Business is being constructed on a site next door to the IIIT as a local variant of the five Indian Institutes of Management. The school is the idea of Rajat Gupta, a managing director of McKinsey & Co. The $80 million dollar school was original scheduled to be built in Mumbai, but was moved to Andhra Pradesh after strong advocacy by government officials. The school is being formed in partnership with the Wharton School of Business at the University of Pennsylvania and the Kellogg Graduate School of Management at Northwestern.

➤ The Institute of DNA Finger Printing
A new nationally funded research institute specializing in basic research and development in DNA fingerprinting, molecular diagnostics, and bioinformatics. It is also the bioinformatics national node for the European Molecular Biology network (EMBnet), the national center for bioinformatics services including biomolecular sequence databanks, macromolecular structure databank, and genome databases, as well as a graduate school in all fields of the life sciences. The institute as such fits in perfectly with the regional focus on developing knowledge-based industries backed by institutions to generate new research and skilled human resources.

➤ Management Skills to Run Government Programs
One of the truly extraordinary aspects of the development initiative in Andhra Pradesh has been the implementation of innovative government projects developed and implemented by career bureaucrats and local based national research institutes. The capturing and directing of these national management and research schools to local needs is one of the key factors in establishing the management skills to direct the regional development initiative.

b) Building Regional Institutions and Capacity: Understanding Knowledge-based Production and Innovation

Adaptation of existing resources and the building of local models to fill in gaps in the national legacies have been combined with unique regional initiatives. These demonstrate that there is a real understanding that long-term success of the regional initiative depends on building regional innovative capacity around knowledge focused production and applying such skills to all aspects of economic and social development. One of the central features of these projects is their search for global best practice. Regional planners have freely borrowed or adapted program from successful initiatives in India, Southeast Asia, Europe, and the US. They have also created programs that themselves are models for other regional initiatives. Key programs include:

➤ AP Biotechnology Park
Like the HI-TEC City, the park is designed to be a focus for commercialization of biotechnology research and manufacturing as well as provide a basis for the application of biotechnology to agricultural needs within the state. The park is set up explicitly to generate "synergy with other technology-based companies and public research organizations, creating opportunities for networking, collaborations and technology exchange".

➤ Andhra Pradesh Technology Promotion and Development Centre
This government project provides a central location to help local industries and entrepreneurs to reach and compete in global market place through technology innovation and the meeting international standards. It is directly modeled on the Steinbeis Foundation for Economic Promotion in Baden Wurttenberg, Germany designed to help SMEs in technology acquisition and global sales. The Centre operates at the central node of a network of dozens of regional and national research institutes and firms.

➤ Apparel Export Park
The park is focused on the expansion of textile exports in the region. It is directly linked to the National Institute of Fashion Technology and the Apparel Training and Design Centre that offer new technologies, design and human resources to the park.

➤ Venture Capital
The government has created local VC funding totaling Rs. 15 Crore (approximately $4 million at current exchange rates)[3] that will be privately managed. This has been supplemented by regulations that will allow banks to invest in VC funds and tax-pass through benefit to avoid double taxation, irrespective of the form of venture capital.

➤ Regional "SMART" Initiatives
Not only has the regional initiative captured needed management and research resources from national institutions, it has focused them on programs that have been integral to creating an overall regional strategy in Andhra Pradesh. This combination of national skills, local domain-knowledge and international best practice used to apply IT to very real problems is one factor that separates Andhra Pradesh from other regional efforts. The regional government philosophy is framed around the concept that "IT is SMART", meaning that IT is a political necessity to make government Simple, Moral, Accountable, Responsive and Transparent. IT is at the heart of these goals, so that the population as a whole will benefit through improved governance. In this way, the conception of information technology is much broader than just an "information economy", but is viewed as an integral part of governance and society overall. Key programs include:

- The Chief Minister's Information System (http://www.andhrapradesh.com):
  This provides information on electricity, water, health and taxes among others through the Internet in order to gauge the daily progress of the various infrastructure projects and government services on a statewide basis.

- APSWAN Fiber Network:
  The backbone of a information and video conferencing network that is used for daily conferences between the central government and the 25 regional districts in the state, focusing on local issues and problems. The state is also experimenting with video-conferenced criminal trials in order to maximize scarce judicial resources.

- The Computer-Aided Administration Department (CARD) program:
  This has streamlined the process of granting land titles and paying land taxes on a statewide basis. These various processes, inherited from the British and still done by hand in many parts of India, had previously taken months to complete, but now is done while citizens wait.

- The Twin Cities Integrated Services (TWINS) program:
  Has created IT centers throughout the state where eighteen services are provided to the public. Birth and death certificates, drivers licenses and welfare cards are done while citizens wait. The system also allows for the payment of basic utility bills.

- Rural Internet Community Centers:
  An agreement with WorldTel to provide Internet access in the state to provide real-time and accurate prices to farmers, eliminating traditional brokers.

- SKIMS (Secretariat Knowledge and Information Management System):
  This project is designed to develop a centralized system that efficiently manages and integrates the information and knowledge of the each government bureaucracy in order to improve efficiency and transparency.

- Janmabhoomi Program
  A rural initiative designed to combine financial and materials support with local community management and labor to develop educational, transportation and basic services infrastructure.

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[3] While not large when compared with VC funds in the US (which can be as large as a billion dollars), 15 Crore is large by Indian standards. The federal government VC fund designated for all of India has only 100 Crore in funding. To match the same relative commitment as the regional fund, the national fund would have to be 12.5 times larger.

c) *Private Initiatives and Networks: Capturing Synergy*

In addition to these government initiatives there have been the development of private initiatives that have

supplemented, and in some cases provided models for, regional initiatives.

➢ The "Talking Heads"
A local network of CEOs established by returning Indian executives to model the process of dialogue and
networking that occurs in other regional IT centers like Silicon Valley, Austin and Seattle. They serve as an
unofficial advisory board for regional policies and an entry point into global corporate, financial and human
networks.

➢ Satyam Corporation
Satyam as one of the leading software firms in India has provided a general pattern of development that the
government has explicitly followed. The company has built up an entire infrastructure, in essence a corporate
city, devoted to software development that is a model of IT based business within the region and the country.
This is combined with a business culture that is distinctly local and global simultaneously. Satyam was the
second Indian firm listed on the NASDAQ, but retains it global headquarters in the countryside an hour and a
half outside the capital city of Hyderabad. It seeks to be a global company, yet has been an active and even
leading force in the development of a regional software industry.

➢ ICICI Knowledge Park
This is a private R&D park and network, developed by the International Credit and Investment Corporation of
India, the only universal Indian bank, designed to facilitate research and technology exchange between
universities, research institutes and the private sector. It has linkages with all the major national institutes in
Andhra Pradesh, all of the IITs and IIS, the International Centre for Genetic Engineering & Biotechnology,
Delhi and the National Institute of Immunology, Delhi

➢ ALEAP Industrial Estate
The country's first industrial estate exclusively for women entrepreneurs developed by the Association of Lady
Entrepreneurs of Andhra Pradesh (ALEAP) as a non-profit venture with support from the national government.
It has served as a model for APIIC, the state agency charged with developing other industrial parks in the
region.

V) Policy Implications: Understanding the Dichotomies and Possibilities of IT Regional Development

The case of Andhra Pradesh opens up a window on in which to consider both how IT development strategies are

initiated and sustained as well as how these initiatives play out over the long-term. Both aspects create dichotomies

that need to be carefully understood in order to evaluate the establishment of new regional IT strategies and the

ability of such initiatives to generate widespread economic and social development. In terms of the basis for

initiating a regional IT strategy, the dichotomy revolves around the central role of national legacies in both

providing resources for such a strategy and the inherent limits and challenges included in such legacies. The case of

Andhra Pradesh clearly highlights this tension. National legacies played a key role in establishing the resources that

the region drew on to establish a credible and viable software cluster. However, such legacies limited the policy choices around such an IT strategy, given the failure of national industrial policy, and left dramatic social inequalities and challenges for the region to face.

In terms of the choice of developing a software cluster, the dichotomy is that software, by its unique production and organizational forms, both fails to directly address these social inequalities and is the region's best hope for overall economic development in the coming decades. The structure of a software cluster directly builds on or even exaggerates the social inequalities inherited from the national development model. Yet, software in its increasing dominance as a central global industry, its knowledge-based production process, its ability to absorb and valorize local knowledge and its relatively unique economics also offers an excellent, in relative terms to other industries, chance for long-term regional growth.

Developing sustainable regional initiatives that can recognize and address these dichotomies requires understanding software (or IT more broadly) as not a product or an industry, but a production process that epitomizes knowledge valorization within a global, networked innovation driven environment. The implication for regional development thus revolves around: 1) creating regional innovation systems that support the constant evolution of products, services and firms (Malecki and Oinas 1999), and 2) understanding the process by which such regional innovation systems link local and global knowledge into circuits that apply to multiple facets of regional development. Using the case of Andhra Pradesh, the rest of this section works through these dichotomies to draw out policy implications for regions promoting IT clusters.

a) Developing Regional IT Initiatives: National Legacies and Regional Innovation

Andhra Pradesh has not only created a software industry in a state that is 70% rural, 40% illiterate and was bankrupt in 1995, but also has clearly pointed out key factors for future states seeking to promote software-based development. One of the central ironies of the software focused strategy in Andhra Pradesh is that policies and institutions that were weaknesses under national or industrial conceptions of development – chiefly skewed educational systems, lack of basic infrastructure, skewed legislative initiatives, and regional factionalism – have become strengths under the regional model. National legacies have provided the exact regional infrastructure and

linkages to the global economy that created the basis for establishing Andhra Pradesh as a site of global software development. By 1999 Andhra Pradesh had 15,000 software professionals in 192 firms, with the number of companies growing by 70% a year.[4] Every individual firm interviewed in Andhra Pradesh, local or global, reported individual annual growth rates of at least 100%. Legacies derived from national development created multiple resources and capacities that the region has drawn on to initiate this economic growth.

However, understanding whether national development policies were sufficient but merely poorly implemented (leaving space for policy decentralization alone) or overall inadequate and flawed (limiting the effectiveness of the new regional project), is crucial to analyzing how strongly historic legacies shape regional development projects over time. In other words, what role is there for the region in a regional development strategy initiated from national legacies? Is it sufficient to market the national legacies inherited, as Andhra Pradesh clearly has done, or are more fundamental policy and institutional changes necessary to build a regional software cluster? Clearly, real benefits can be derived from economic and political decentralization without signaling a fundamental solution to very durable development challenges. The importance of Andhra Pradesh is that policies undertaken over the last six years clearly indicate that national legacies alone are not sufficient condition to generate long-term development or address the short-comings of the failed national strategies. Regional initiatives are crucial to building and sustaining regional development, especially when focused on the building of regional innovation capacity.

Andhra Pradesh has targeted specific investments in infrastructure, telecommunications and education that institutionalize and expand on many of the most crucial national legacies. The investments that Andhra Pradesh has pursued, as exemplified by the Microsoft investment, have focused on capturing not only leading firms, but leading products that form central technologies of the future like Windows NT, Motorola's Digital Signal Processing designs or Oracle's Enterprise Resource Planning software. Furthermore, the strategy has focused not only on attracting investment, but also on linking business investment to additional investments in education and research. The creation of the IIIT and ISB are essential programs that insure the long-term commitment of firms to the region, as well as the capacity to develop the innovative and human resource base that will insure the state's place in global economy. These investments are also complex alliances between the state, firms, local and international

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[4] Interview Joint Director Kumar, STPH

universities, and non-resident Indians, guiding these institutions to become spaces for global best practice and innovation.

b) Software as an Engine of Regional Growth: Addressing the Limits and Possibilities of Software

The tension within a software focused strategy is that through the process of building on and adapting national legacies, the dichotomies of this inheritance may become institutionalized in support of the new IT initiative. Even more significant is the possibility that such a software-based development project may expand the negative aspects of these legacies as resources and policies focus on developing the innovative environment that supports a software cluster. Under these conditions, there is serious potential for a permanent digital divide (where access to technology, education and income are highly correlated), not between nations or regions, but between social classes, cities or even neighborhoods, as inequalities around education, quality of life, basic services and infrastructure are reinforced.

The overall social transformations linked to the general process of industrialization – the rise of a middle-class, urbanization, consumerism, increased gender equity, expanded literacy, social movements – that have accompanied high-technology hardware industrialization (Lubeck and Eischen 1998, Rasiah and Best 2000) has yet to be established as the default pattern for software focused strategies. In contrast to previous hardware centered strategies, there is no clear trend or method that has demonstrated the capacities and policies states should develop to manage these challenges (Digital Economy 2000, Lessig 1999). The formation of new software clusters globally has replicated the labor and firm agglomeration patterns that have characterized the industry's development in places like Silicon Valley (Benner 2000). The most established of these regional centers of software development – chiefly in Ireland, Israel and Karnataka – have come to replicate the social and economic tensions present in Silicon Valley,[5] starting from a significantly lower level of development and with much weaker mechanisms for social protection.

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[5] While outside of the analysis here, the social and economic patterns surrounding the software industry are clearly visible in other regions and industries, including Los Angeles (Film), San Francisco (Biotechnology and E-Commerce), Austin (Computers and ICs), New York (Finance), Bombay (Film), Hong Kong (Finance, Ecommerce, Film). The social implications of software clusters might be well informed by drawing on the careful analysis done of these other regional economies.

Strong and socially consensual policies are needed to embed such developments in the broader society rather than merely set up a parallel social and economic reality. If such policies do not exist, the risk is that the general spread of social and economic development will remain relatively stagnant, while new institutions and targeted investments link small sections of the society to the global economy. In Andhra Pradesh, it is unlikely that export focused and FDI driven software can generate sufficient growth to address all of the state's challenges. 15,000 software professionals and 70 million dollars in exports are not sufficient to address the challenges of inequality in a population of 80 million with 17 million people living below the state poverty line. The ability of governments to generate policies that distribute and maximize the gains from a software focused strategies, while maintaining the organizational and social structures that provide those gains, will be one of the greatest challenges to regional IT initiatives.

VI)   The Hidden Possibilities in Information-based Development Strategies

There are possibilities inherent in and unique to software that may address this possible institutionalization of inequality. The opportunity around software, and industries following software production patterns, is that local knowledge is needed and valorized within the production process itself. Regions should recognize that they are really developing a mastery of knowledge based production processes, and not software as an industry. In other words, focusing on synergy and developing the basic structures that promote an "ecology of innovation" will produce economic and social development far outside of just software. Software is and will remain increasingly at the center of IT, however, it is the blending of software with other industries and domain knowledges that produces the real dynamism in the global economy. Understanding this opens up the real possibilities for regional development strategies. Existing industries and research centers, from media and film to agriculture and education, can become an integral part of a successful strategy, expanding the impact of the development process and insuring its sustainability over time. All of this combined will establish the embedding of local knowledge into broader national and global processes, while giving some possibility that the most negative social and economic divisions are ameliorated.

The essential point for policy, and one that Andhra Pradesh epitomizes, is that within software the space for building the innovative capacities of the region and addressing social inequality can and should be linked. Building

an innovative environment means creating synergy between various sectors of the economy and society that can generate both the resources and ideas that produce new innovation. Adapting software and IT to local needs provides exactly such a synergistic environment in which local knowledge is valorized on a global level, and global skills are applied to local needs. This is the unique opportunity provided by a software-focused strategy. While much of the analysis of globalization and the information society (Castells 1996, Gordon 1994, Held et al 1999, Amin 1994) has established the macro patterns of innovation, networks and flexibility, they have been unable to adequately explain why or how such forces play out at the micro-level. Defining and clarifying the nature of IT processes like software helps explain why information is valuable and how it is structured and valorized in the global economy on a micro-level. This process of commercialization (or transformation into authority) of information creates strong similarities in production processes across software, biogenetics, film, music, academia, media, design, architecture and finance. More importantly, it is also increasingly dominant in high-tech hardware manufacturing, production of consumer goods, government, military and basic educational settings.[6] As such, a software strategy properly conceived provides a basis to transform regional industries and impact on global markets.

VII)   Lessons for Regional IT Development: Legacies, Adaptation and New Knowledge Industries

In evaluating the possibilities for sustained development, all of the basic factors outlined in the matrix are essential. Clearly understanding a region's inheritance, both positively and negatively, shapes how a regional IT strategy will be initiated based on the existence of these factors. The sustainability of the strategy over time depends on the local adaptation of these resources to address both the challenges of the legacies and the impact of the IT strategy itself. Addressing both of these challenges means linking different knowledge industries, skill and markets to revitalize

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[6] A short thought experiment helps highlight this difference. Consider a development strategy focused on developing a rice cooker for export in the current environment. A traditional industrial focused strategy would focus on labor-cost, export markets, access to capital and access to raw materials in order to generate employment and export earnings. However, an information strategy would focus on linking such development to a broader synergistic innovative strategy. This would mean that the design of the rice cooker would involve the use of CAD and CAM tools, possible locally developed. Producing the highest value added products would entail incorporating IC and software features as well as embedding basic Internet connectivity. This would require market knowledge of multiple markets and local standards. Even the basic production process of the rice cooker itself, to avoid pure labor-cost competition, would most likely entail the Just-In-Time supply chain management and Total Quality Management (including work teams). These basic features of information management would entail the use of regional, and most likely, international telecommunications, especially the Internet. Even more possible is the use of the Internet as a central sales channel, perhaps even involving "build to order" processes or B2B management. While none of these may occur, the nature of competition within the global environment means that they must at least be considered and included for long-term sustained development initiatives.

existing industries and develop new market opportunities. Institutionalizing such synergy should be the goal of the overall development strategy. Such institutionalization and the capturing of sectoral convergence involve social as well as economic transformations. In this way, viable IT strategies are about creating "information societies" and not information industries.

The case of Andhra Pradesh highlights how various egovernance, education, infrastructure and investment policies overlap to build new markets, address social inequality and build a new social contract around an IT focused strategy. The building of the IT initiative in Andhra Pradesh seems to demonstrate that regional planners do understand the dichotomies and opportunities considered above. They have both built on and adapted national legacies to insure that the initiative reproduces and expands the initial educational, research, infrastructure and management capacities that underlined the initial start of the strategy. The strategy has consciously sought to develop synergy between various types knowledge based industries in order to dynamically reinforce the overall innovative capacity of the region. In many ways the region has directly sought to build an "information region" that incorporates the general patterns that structure development in the global economy into all social, economic and political facets of the region. In this way, the initiative has built institutional bridges between organizations and local needs.

A central example of this process has been the e-governance initiatives. These projects, by using local skills and knowledge, will gradually expand the market for local software products, as the government and society expand their capacities and demand for IT. A small example of this is that the entire computer system for the IIIT is run by local university graduates using Linux. This promotes both Andhra Pradesh as a regional center of software skill, but also offers the ability to apply such skills to other local institutions and needs. Another examples include the development of a successful apparel industry reinforced by the use of local IT skills, professional design, unique national and regional cultures, and IT infrastructure. Global software technologies and architectures can also directly feed into the regional Telugu film industry that serves eighty million people locally as well as the global Telugu diaspora. In each of these, the successful regional software strategy links regional government, culture and industry with global trends that reinforce and feed off regional initiatives.

Overall, the software development strategy in Andhra Pradesh is the ideal example of learning by doing, using and interacting on both a local and global level simultaneously. While the actual outcome of these policies remain to be seen, they are a prime example of the role regional governments can play in building synergy around knowledge-based innovation on a regional level. It is exactly such policies that will be the central determinant of success of the regional initiative in promoting sustainable and widespread economic and social development over the coming decades.

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