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Breaking From Tradition: India and the Path to Development

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Disclaimer

Abstract

"How could a country with more than 300 million illiterate people also have the kind of scientific human resources that bring some of the world's largest corporations to base their R&D labs in India?" (Tripathi, 2007, p.68). This question acknowledges the coexistence of two vastly different worlds within one country. On one hand, India is making significant progress on the path to becoming a developed country—one that can provide the basic fundamentals of living for its citizens while sustaining progressive economic growth; on the other hand, it must overcome challenges to this goal that relate to a crumbling infrastructure, poverty, urban sprawl, decline of rural industries, and a failed public education system. Yet, India is perhaps unique in that it maintains a steady focus of leveraging science and technology to solve its problems.

This study seeks to address whether or not India's rise represents a new model for growth. It does not compare and contrast the best methods of development, rather, it highlights the unique path India chose to take and the continual emphasis placed on the use of science and technology—not only as a mechanism for growth, but as a way to solve all of the country's challenges. It points to India's culture, education, government, and rural urbanization as the primary factors which, while influencing India's success, also represent potential barriers for sustainable economic growth. As other countries seek to follow in India's footsteps in hopes of the same rapid success, there are many lessons these countries must consider—the most evident being that science and technology only represent part of the economic development equation, not the complete solution.

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Chapter 1 – Introduction

"Perhaps, we have for too long looked to others for models of growth. We have marveled at the tigers and dragons and wondered what we could do to copy their success. But that is denying us our unique place in the world" (All India Management Association, 2003, p.3). The All India Management Association (AIMA) argues that India no longer needs to look to Asian counterparts for ways to further economic growth; in fact, India has made its way without foreign influences. With respect to economic growth, India has not followed the commonly identified Western or Eastern strategies. Traditional Western drivers of development include a cycle that begins with agriculture, an industrial revolution, and then a post-industrialized economy based in technology and services. This concept has been commonly used, as economies start within agriculture (focusing on producing crops for trade) and gradually evolve into manufacturing (industrialization) with a greater focus on production of goods. As sectors within the economy become more sophisticated, the evolution turns to knowledge or knowledge-based services that start to become primary drivers of the economy. This traditional development path has been commonly followed by countries seeking to be within the same arena as the West (United States and Europe). In contrast, the Eastern model centers on manufacturing and provides low-priced manufacturing goods to the West (Das, 2006). China offers an example of the Asian strategy, providing the low-cost manufacturing of a variety of products such as shoes, clothing, and toys, and then exporting them to the U.S. and Europe. India clearly has not followed this route; instead it has chosen to focus on science and technology, specifically high-tech skills and services. While others may consider this path unique, it can be argued that India

followed its culture and self-interest, in order to establish their own model free of substantial foreign influence. This study draws on this concept to understand India's development model as a new alternative that can be included with commonly accepted Eastern and Western methodologies of growth. This study proposes that India's path towards economic development is an alternative model for other developing countries. It uses technology as a lens to analyze India's development model, the most influencing factors of success, and the barriers to future and/or sustainable growth as a result of implementation.

Science and technology represent the foundation and essence of what India believes is necessary for current and future growth and development. As stated by India's first prime minister, Jawaharlal Nehru, "Science alone…can solve the problems [of India]…" (Nehru cited in Tripathi, 2007, p.68). India's path rests on its ability of the country and its people to harness the science and technology that is necessary to further innovation and discoveries within this collective domain across all sectors of industry. In fact, "What has been peculiar about India's development so far is that high growth has not been accompanied by a labor-intensive industrial revolution…" (Das, 2006, p.3). According to the 2007 Organization for Economic Co-Operation and Development (OECD) report on India, "Annual growth in GDP per capita has accelerated from just 1 ¼ per cent in three decades after independence to 7 ½ per cent currently, a rate of growth that will double average income in a decade" (OECD, 2007, p.9). With more than 50% of India's GDP attributed to technology services, it is clear that science and technology has helped fuel India's economic rise (OECD, 2007). Even with the current global economic recession, India's economy continues to grow steadily, hovering close to the

6% range. Despite any internal or external influences, India's economy "has continued to grow, as if on auto-pilot, ignoring…distractions" (Tripathi, 2007, p.65). India's rise and fast economic growth without elements of the traditional development model warrant analysis and further research.

Observers of India have cited the importance of the India Vision 2020 and its role to guide the country and its government to achieve developed status. "Each country needs a vision statement which stirs the imagination and motivation of all segments of the society to greater effort" (Tripathi, 2006, p.139). The India Vision 2020, developed by the Indian Planning Commission, provides such content for the country and its people. The main objective of the Vision 2020 is for India to become a developed country by the year 2020; and in order for this to occur, the vision highlights several challenges India must improve upon. The Vision 2020 promotes the importance of leveraging science and technology to advance India's goals. "Without a pervasive use of technologies, we cannot achieve overall development of our people in the years to come. […] Any nation aspiring to become a developed one needs to have strengths in various strategic technologies and also the ability to continually upgrade them…" (Kalam & Rajan, 1998, p.6). The Vision 2020 priorities cross multiple sectors, from chemical processing and engineering services to health care, biotechnology, and food processing abilities, and outline several requirements such as improving waterways, telecommunications, road transportation, and securing food sources (Tripathi, 2007). The India Vision 2020 has lead to the development of further ideas and goals within Indian society. Dr. Kalam and Rajan use the concepts from the India Vision 2020 to examine the strengths and weakness of the country and how India can achieve its goals by its self-imposed deadline.

Kalam and Rajan's analysis of the Indian Vision 2020 provides a reference point throughout this study to help understand what direction or guidance the vision provides or whether it is truly influential to the policies and decisions made within the country. India is almost at the half-way mark of the timeframe required to fulfill the original vision and priorities established. While only time will tell if India is truly able to successfully complete its quest, this study looks at the relevance of the Vision 2020 and whether or not it has made a significant impact to date with respect to India's path to growth.

The main goal for India is to be a developed country, as outlined in the India Vision 2020; which underscores the promotion of using science and technology as the foremost mechanisms that will enable India to reach its objectives. This national challenge represents a paradigm shift from a typical development cycle and illustrates how technology influences and/or accelerates such possibility. How does technology play a role to accelerate and/or be the catalyst of development? In a post-industrial world, where a standard industrial revolution might not be the best option for development (capital cost, pollution regulations, et cetera), what model is available for developing countries? With increasing concerns on global pollution, growing populations, and how developing countries can move ahead, it is important to understand alternative methods other countries can either use or modify to fit within their own culture, government policies, and development plan. This study addresses India's culture, education, IT industry, and government as contributing factors to India's success. It reviews some of the obstacles India must overcome with respect to balancing a development agenda that primarily has centered on science and technology instead of

addressing issues such as education, rural populations, and infrastructure. These obstacles represent barriers to everything for which India—its government and people—have worked very diligently over many decades. This study does not seek to discuss or compare which model of growth is best for other countries, since many factors can contribute to overall success or failure; however, it is important to explore the question and understand what makes India unique and whether or not similar principles can be applied within other developing countries to help them jumpstart or propel their economy to the next level. "Technology [is] impacting and changing lives [and] has helped [to] further drive growth and progress" (Ms. Aparna Dutt Sharma interview March 31, 2009). Whether it is science and technology, government policies, the people of India, or the Vision 2020 that is responsible for influencing growth and change, one element remains certain: the story of India's rise to become one of the fastest growing world economies has been unique, and will continue provide discussion and analysis for alternatives that other developing countries can consider.

In this study the reference to science and technology refers to the breadth and depth of both areas within India: information technology (hardware, software, and services industry), information communication technology (voice and data), and more advanced areas, such as space programs, pharmaceuticals, and bioengineering.

Chapter 2 – Review of Literature and Research

This study highlights the important role of science and technology as a basis for India's growth and development, and suggests that the Indian model is an alternative model that other countries can emulate. Underlying the use of technology for economic growth are education, infrastructure, the role of government and rural urbanization each of which have a fundamental role and must be examined in order to understand the impact of the unique path India has forged. In general, the literature and research about India evaluates the country as an emerging economy, a competitor to China and agrees that India has created its own path for development. Most research underscores the intensive focus and reliance upon science and technology as a way to solve India's problems. However, two issues remain unclear. First, will India be able to sustain current and future levels of growth, in the face of significant challenges: a failed education system, collapsing infrastructure, lack of governance, and an increasing poor population. Second, did government policy contribute to the overall rise of the IT industry or was it merely a coincident, a by-product of both investment and serendipitous events.

There are three main debates in this field that form a framework for this study. They revolve around: (a) the role of the government versus chance in the creation of India's information technology industry; (b) feasibility of the Indian model as a comprehensive strategy; and (c) the use of technology as a driver of rural economic development. The use of science and technology within India begins with the desire to become self-sufficient and viewed within the world as a strong country with an educated populace. This desire is initially rooted in the fundamentals of science, as noted with the

emergence of the Indian space program. Gradually, the fundamentals evolve to encompass technology in the form of hardware and software, then leading up to the information technology (IT) services revolution. The latter is often referred to as "blue collar" IT or "back office" services, where the level of innovation and technical expertise required to perform such tasks (such as answering services) is minimal. Most researchers speak to the need for India to further evolve out of the services industry and rely on the technological and scientific expertise within the country to make advances within these sectors that would prove value-add in the global economy. Essentially, it is about innovating and creating new technologies that can be used around the world, instead of India being the helper to propel other countries and businesses.

"During the past fifty years India's development has greatly depended on the government. It was the strength of the country and also its weakness" (Kalam and Rajan, 1998, p.288). This quote represents the primary debate regarding the role of the Indian government versus private initiatives; mainly whether the government is solely responsible for the country's current prosperity in the IT industry. Despite its considerable investment within science and technology sectors, programs, and organizations, India's development is not exclusively based upon the contributions of the government. Das (2006) argued that it is the people of India (specifically entrepreneurs) that have been responsible for the rise of the country and have contributed to overall prosperity. Das criticized the Indian government for developing a massive bureaucracy that is "…self-serving, obstructive, and corrupt…" (2006, p.5). Thus, the government is not working on behalf of the people they serve; rather they are working on behalf of

themselves and their interests. The lack of governance and ability to move the country forward is further highlighted in Chapter Seven of this study.

Das is not alone in his assessment of the inability of the Indian government to truly govern for its people. "Although the IT phenomenon owes little directly to the government, it is only fair to recognize that it was made possible…in earlier decades…by a young prime minister" (Narasimha, 2008, p.333). Narasimha describes post-independence as a period where the government pursued a policy of self-reliance in relation to science and technology organizations, projects, and policies. These projects included the establishment of the Indian Institutes of Technology (IITs) to develop a highly skilled workforce, the development of a space program that would change the view of India as a backward country, and other similar initiatives that would further promote S&T within the country. It is these initiatives that Narasimha credits the government with; which established the required foundation in order to give rise to India's IT industry. Yet, Narasimha acknowledged that the creation of India's IT service industry was unplanned and a natural occurrence of the investment of the government, coupled with the desire of its people; as the Indian government "never figured [it] in the official five-year plans" (2008, p.333). Aggarwal (2008) takes the argument a step further to describe the explosion of Indian's IT industry as "a product of serendipity" (p.17), occurring partially by design of the government and partially by accident. Aggarwal countered that the government did not plan for the rapid expansion and/or need for India's IT services—it simply occurred. Aggarwal suggested that the efforts to establish a highly skilled work force along with the following four main events contributed to the development of the IT industry: (a) foreign companies were forced to

reduce their share in Indian IT companies, and IBM left India; (b) the development of personal computers drove the import of low-cost hardware; (c) the National Institute of Information Technologies was established by three Indian entrepreneurs to train a workforce that did not graduate from the esteemed IITs; and (d) the implementation of a satellite link to the U.S. that offered Indian companies a faster way to provide software and services (Aggarwal, 2008). Aggarwal suggested that these events, coupled with the economic liberalization and globalization, contributed to India's ability to capture the IT services market.

While most researchers might agree that the government did not plan for or anticipate that the Indian economy would grow as a result of science and technology, Saraswati (2008) disagrees. Saraswati argued that the building blocks of India's IT industry are attributed to state-led development, state regulation of development, and state promotion of development. It is these three phases, which represent the foundation of the IT industry (software, hardware, and services), that have led to India's ability to become a leading provider of IT services and solutions to companies worldwide. Within state-led development, the government of India pursues a policy of indigenous-based solutions and begins the process of erecting barriers within the market to prevent foreign companies from manufacturing technology solutions to be used within the country. The second phase, state regulation of development, outlines a change within the government and creation of new policies along with the development of India's software industry. However, Saraswati's acknowledges that the software industry emerged as a natural consequence to fill the gap within the market (not a planned event). The final phase, state promotion of development, identifies the shift of control from the government to the

private sector. The role of the government changes from directing the industry to promoting Indian companies to foreign businesses and investors. The focal point of Saraswati's argument relies on the influence of the government solely on technological efforts. While researchers often point to the economic liberalization of the Indian economy in that enabled the rise of the IT industry, Saraswati countered that India would not be in the position to capitalize on the liberalization if the government had not previously invested and directed the industry as a whole. The argument highlights that the government did in fact have a primary role in the development of the IT industry within India. Further discussion and analysis surrounding the influence of the government is outlined in Chapter Four.

The second theme surrounds the ability of the Indian model as a comprehensive strategy. Mashelkar (2008) offered the argument that since post-independence, India's identity and existence centered on science and technology. Mashelkar argued that India's first prime minister not only viewed technology as a means of economic development, but also as a way to bring transformation to a "stagnant society" (2008, p.300). Technology represents the backbone of what India epitomizes and it is against this backdrop that Mashelkar outlines the four pillars of science and technology in India: techno-nationalism, inclusive growth, techno-globalism, and global leadership. Shortly after independence, India became an incubated country and was forced to create its own products, solutions, and technologies. Mashelkar identifies this as techno-nationalism and cites the development of India's space program as one example. The second pillar, inclusive growth, discusses the process of integrating technology across all sectors of the population and ensuring the entire population is incorporated within the development

process. The third pillar, techno-globalism, is the development of India's offshoring/outsourcing industry, whereby Indian talent remained in the country instead of the knowledge-drain from the country to benefit foreign companies. The final element of Mashelkar's argument is global leadership, where India has to differentiate itself as an innovator of intellectual property and indigenous companies must also take the lead with respect to research and development efforts. This last pillar outlines one of the primary focal points of this debate: in order for India to continue to grow and develop, it has to provide value-add on a global scale. It must be a leader to innovate and produce products and services that are above the standard outsourcing practice.

On the other hand, while Das (2006) acknowledged India's unconventional approach, it appears that this path has prevented India's poor and rural populations from being included in the overall growth plan. Das highlighted India's alternative path toward development: (a) relying on its own domestic market for goods and services; (b) consumption versus investment; (c) a heavy reliance on services instead of manufacturing; and (d) encouraging the development of high-tech versus low-tech skilled workforce. India's ability to skip a full industrial (manufacturing-intensive) revolution and move from an agricultural-based to service-based economy establishes the foundation to discuss the possibility of an alternative growth model. While Das praised India's unique path, at the same time he also criticized the lack of a "labor intensive industrial revolution that could transform the lives of tens of millions of Indians still trapped in rural poverty" (2006, p.3). Without a plan for transitioning rural and poor populations into the current economy, the gap between rich and poor, rural and urban will continue to widen. Not only is there concern regarding the social and economic class

divides, there is significant concern on India's ability to regain a more balanced growth agenda. Das outlined the lack of governance, a failed education system, and inability for the Indian government to provide the fundamental basics (clean drinking water, electricity, and health care) as the main downfalls to India. It is the prevalence of these factors that begin to question if India's model is really a comprehensive strategy to enable the country to move forward to achieve its goals and objectives to become a developed nation.

If India is unable to address the problems of a failed education system, collapsing infrastructure, and growing poor population, the current and future plans of economic prosperity might be in jeopardy. In a special report on India, the *Economist* (2008) focused its analysis on India's infrastructure and described that without any change or improvement, infrastructure (roads, electricity, water, et cetera) will become the constraints of the economy. The Economist compares India's problems in contrast with those of its Asian neighbors (principally China) to showcase major discrepancies that, over time if not addressed, will possibly limit any further development of the Indian economy. For example, the *Economist* references India's roads, railways, and ports which have been operating at or above capacity and thus dramatically slowing down the free movement of ability for people and goods throughout the country. Transportation is only a part of the crumbling infrastructure, as the *Economist* cites poor water sanitation, an increase of water-borne illness, and lack of reliable electrical power as equally important issues that the Indian government must deal with in order for the country to reach the levels of China and its other Asian neighbors (such as Japan). Through heavy bureaucracy and corruption, coupled with the lack of investment, the government has

failed to provide its people with the basic standards of living that are common place within the developed world. Considering the governments' current track record, there is great concern that it will be able to solve the major challenges facing the country and its people. The main issues surrounding this debate are further outlined in Chapter Seven.

Finally, the last debate addresses the ability of technology to truly have an impact within the rural areas of India. The literature regarding the use of science and technology as a primary mechanism for economic development is divided; as some believe it is more important to provide the basics for a population, while others counter that technology can bring positive impact when implemented correctly. Jensen argued that many critics overlook "…the fact that the functioning of output markets plays a central role in determining the incomes of the significant fraction of households engaged in agriculture, forestry, or fisheries production in low-income countries; for most of the world's poorest, living standards are determined largely by how much they get for their output" (2007, p.880). Thus, in areas where markets are dispersed and both transportation and communication between those markets is haphazard, technology can play a vital role to empower the individuals within rural industries. Jensen countered that the introduction of the right technology can vastly increase wages of the individuals within the industries, enhance communication flow between the markets and provide for the potential of greater growth; versus the introduction of the basic fundamentals (water, electricity, roads, et cetera). There are many rural technology projects and initiatives throughout India and as discussed in Chapter Seven, some have proven beneficial, while others fail to accomplish their objectives. If India will continue to rely on technology as a means of development for the entire country, it has to must ensure the implementation of

technologies are strategic and focused on addressing the challenges faced within rural India.

One of the main questions not completely addressed but essential to the assessment of the Indian model, relates to the direct correlation between technology and positive economic growth. Avergou (1998) described the argument relating to the diffusion of technologies (including information communication technology, ICT) within countries and the subsequent effects of this integration to understand economic benefit and impact. To shape the discussion, Avergou reviewed three main economic theories. The first theory relates to economic significance of technical innovation, which outlines the importance of technology and ICTs within an economy. However, it provides that these technologies can only have economic impact if they are able to: (a) generate new products and services; (b) decrease expense and increase efficiencies within sectors of the economy; (c) are widely accepted and adopted; and (d) generate interest as a means of comparative advantage and profitability (Avergou, 1998). Thus, within an economy relying on technology as a means for innovation, there must be tangible value that crosses all sectors of the economy, not a portion of it. For many years, India tended to compartmentalize its relationship with technology and the economy; however, as Avergou points out, technology must be widespread and offer value to have broad economic benefit. The second theory discusses the impact of increased information within an economy. Again, the argument holds true that such dispersion of information proves beneficial for economies and businesses; yet, this cannot be an indicator of overall prosperity within the country. The final theory discussed by Avergou suggests the ability of technology to promote socio-economic change. The theory relates to economies that

transition from industrial to service-based, whereby "[k]nowledge and information are the most important resources for the transformation of the economy…" (Avergou, 1998, p.5). It is during this time that an economy shifts from a heavy labor-intensive focus to a knowledge-intensive structure (within service-related jobs). India has for the most part completely eliminated the need for an industrial revolution, yet the socio-economic change can be viewed as the need for inclusive growth. Avergou argued with widespread economic globalization and increased integration of world economies, the use of technology and ICTs within countries is paramount. Despite the importance, Avergou contends that the diffusion of technology within developing countries does not guarantee any economic prosperity or development. Thus, while countries look to technology to bolster their economic development, it cannot be the centerpiece of their planning.

The majority of the literature and research surrounding India's economic growth, and rise as a country on the path transitioning from a developing to a developed nation, agree that the primary focus within the country and its government has related to science and technology. Whether it is software development, consulting services, alternative energy solutions, or contributing to pharmaceutical research, it is quite clear that India's focus centers on science and technology efforts. In spite of India's rapid expansion in the IT industry and success experienced from the boom, it seems that the country has, for too long, moved forward with an imbalanced growth agenda which has resulted in a degeneration of India's infrastructure. There is common acknowledgement throughout the literature that education and infrastructure remain the primary obstacles that will thwart India's economic growth. Kalam and Rajan draw the parallels between an uneducated population and the prevalence of poverty, while the *Economist*, other

researchers, and even participants of this study cite the poor conditions of India's current infrastructure (unreliable electricity, lack of waste water management, et cetera) that if not addressed, could adversely impact the entire country. Such agreement within the body of knowledge furthers the argument that the country and its government can no longer focus solely on a singular path, but rather, consider a more balanced growth agenda to help the country achieve its goals and objectives.

Chapter 3 – Methodology

This study is a case study that analyzes India's development through the use of science and technology. It uses technology as the primary lens to understand the events, influencers, and actions of one country and whether these factors combined represent an alternative growth model. The purpose of this study is not to compare and contrast development models, but rather to introduce the possibility of a new concept, ask questions, and potentially provide a theory that can be taken to the next level by further research. The use of India as a case study for analysis is important based on its distinguishing factors and approach to overall development (which also vary from its Asian counterparts). India focused its core efforts around science and technology and was able to use the various opportunities available (such as outsourcing) to make a considerable leap from an incubated economy to a rising Asian and global leader.

This case study is qualitative as it builds on the existing literature both on Indian development, and technology and science development engines. It then enriches this with in depth interviews with individuals who are closely involved in the economic, culture, and technology aspects of India. A total of nine participants were interviewed for this study, which provide a diverse background to obtain firsthand knowledge regarding the country, its challenges, and what India must do to become a developed country. Participants were selected from the U.S. and India based on their involvement and/or background relating to Indian business and technology sectors. The following summarizes the participants of this study, the organizations they work for, and the area of knowledge they represent.

Mr. Thom DeFranco, Vice President of Technical Services at GAVS Technologies, an Indian-based technology services firm that provides technology solutions, services and support to customers world-wide. Mr. DeFranco travels frequently to India and provides a perspective between the U.S. and Indian business cultures. Ms. Devika Devaiah, Innovation Discovery and Technology Consultant at Erehwon Innovation Consulting an Indian-based consulting company that provides innovation consulting to a broad range of companies in India and the United States. Ms. Devaiah focuses on strategic and leadership projects for her clients and provides an Indian perspective on the issues presented in this study. Mr. Ashish Gupta, co-founder and Managing Director of Helion Venture Partners, a $350 million (U.S.) independent venture fund investing in Indian companies within technology and consumer service sectors. Mr. Gupta offers a unique business and technological perspective for this study. Mr. Animesh Khan, Consultant, at Zinnov Consulting, an Indian-based company providing consulting services in the areas of Offshore Advisory, Human Capital Optimization and Market Expansion to Fortune 1000 companies. A graduate of the IIT in Delhi, Mr. Khan provides consulting and research for market expansion across a variety of industries. Mr. Bhaskaran Pallath, Manager, at the GAVS Technologies call center in India. Mr. Pallath also provided an Indian perspective and benefited from the IT services revolution that has occurred within India. Mr. Sanjay Puri, President and CEO, Optimos Incorporated, a U.S.-based company providing strategic technological solutions to governments and organizations. Mr. Puri is also the founder of the U.S.-India Political Action Committee and the Alliance for U.S. India Business. Mr. Salil Tripathi is a writer and journalist of economic, political and cultural issues pertaining to

India and other Asian countries. Within this study, both Salil's interview and article on the development of India highlight the technological, economic and political issues that the country and its government face. Ms. Aparna Dutt Sharma, CEO of the Indian Brand Equity Foundation (IBEF). The IBEF is a public-private partnership between the Ministry of Commerce and Industry, Government of India, and the Confederation of Indian Industry. The main objective of the organization is to both provide resources for investors and businesses and promote India as a destination for global investors and multinational organizations. Ms. Sharma provides a unique perspective based on her involvement in the public and private sector in India. Dr. Anupam Srivastava, Director of the Asia Program at the Center for International Trade and Security, University of Georgia. Dr. Srivastava's background is in economics and security and has provided briefings on U.S.-Asian economic and security relations to U.S. Departments of Defense, Energy, Commerce, State, & the National Security Council, and counterpart agencies. The discussions, topics, and ideas from the interviews are included in the body of this study.

The study is an initial attempt to highlight the importance of a different path to development. Moreover, technology can offer new ways to provide education, health, and energy solutions along with new techniques for smart agricultural and manufacturing production. It is possible that India's unique path can offer further discussion on how technology can greatly impact a country and its people and whether or not the same type of path can be forged for other developing countries with similar characteristics. The motivation of the study is to provide a platform whereby the body of knowledge is

engaged to further the proposed theory and develop more questions in order to take the research to the next level.

Chapter 4 – Foundation of a Tech State

Culture is a part of a country and its people, as it defines their identity and guides many actions taken on a daily basis. This section does not seek to completely analyze India's culture, but rather highlights self-reliance and technology, both which have and continue to influence India's overall growth strategy. The section also identifies the initial stages of the information technology (IT) industry within India. These predominant drivers are also echoed by Kalam and Rajan, who authored a book about the India Vision 2020: "An India aspiring to become a major economic player in terms of trade and increase in GDP [Gross Domestic Product] cannot do it on the strength of turnkey projects designed and built abroad or only through large-scale imports of plant machinery, equipment and knowhow" (1998, p.9). Kalam and Rajan further discuss the importance of using technology as a strategic asset and primary means in order to "lift our people to a new life…" (1998, p.9). While some might argue that this focus is nothing more than an inspiring vision and not feasible in practice, India has maintained this focus which has related to the implementation of many projects from government, health, and business sectors. When study participant Ms. Devika Devaiah was asked what has made India successful (in terms of its ability to become a developed country), she explained that the first Prime Minister of India insisted on self-sufficiency and established the institutes of excellence, essentially creating the foundation for India to be self-reliant and not to depend on other foreign countries or companies (interview March 31, 2009). The vision of India's first Prime Minister changed the way Indians began to think of themselves. Instead of being a supplier to the British, they would rely on their

abilities through the use of science and technology not simply to solve their own challenges and problems, but to create a knowledge-based economy. Much of the interest in India has focused on its role in service outsourcing, providing a knowledgeable and well-skilled workforce to provide services for large multi-national corporations. Yet, the picture of India as a "back office" does not do justice to India's reliance on science and technology as a means to become a completely developed country. This focus on technology and self-sufficiency has been engrained into India's culture stretching back to colonial rule.

4.1 – Influenced by Science and Technology

Under British rule, India became a supplier of primary products to the British. On one hand, this role developed a cultural psyche of what one participant in the study referred to as a "subservient mindset" (Devaiah interview, March 30, 2009), with respect to Indian abilities versus the British. On the other hand, the British created the first scientific agencies to "manage and expand their Indian empire in the 18th and 19th centuries" (Narasimha, 2008, p.331). According to Narasimha, under the leadership of the British, agencies such as the Indian Meteorological Department, grew and left a significant imprint on their Indian assistants. While the British were cultivating various agencies, it was the Indians themselves who sought to establish organizations for scientific research or technology development. In 1876 the Indian Association for the Cultivation of Science was established; in 1909 the Indian Institute of Science at Bangalore became operational (Narasimha, 2008). Then, in the 1930s the Indian National Congress, under the leadership of Jawaharlal Nehru, began to establish the framework needed for science and technology policies. These efforts, along with British

infrastructure investments in India, provided a solid backdrop for a cultural belief in both science and technology and Indian abilities: “Basic science, rather than technology or economics, was a major cultural force that changed the country’s perception of itself and its people’s abilities” (Narasimha, 2008, p.331). Science and technology became a catalyst for India’s development and the path it would follow to shed its colonial past and gain a new status as an independent, technologically driven state.

Nehru, India’s first Prime Minister, wasted no time setting forth his agenda for the country, proclaiming that science and technology would serve “…as the solution to the problems of a rich country inhabited by starving people” (Narasimha, 2008, p.331). The backbone of India’s development would not be a traditional low-level, labor-intensive industrial revolution; rather science and technology would be the strategic asset India used to elevate its nation and its people. Nehru’s centralized focus led to a scientific policy resolution, commissions, and initiatives promoting science and technology along with the development of two institutes—the Indian Institute of Technology and the Indian Institute of Management—that “…have been instrumental in creating a generation of talented professors, engineers, and entrepreneurs…” (Nobrega and Sinha, 2008, p.xv). Under Nehru’s leadership, India was incubated, shut out from the global market, and became focused on being self-reliant. According to Nehru, it was more important “to have a second-rate thing made [in India] than to rely on the first-rate thing which we have to import” (Nehru cited in Forbes, 1999, p.404). While Nehru’s statement appears to be referencing the development of an industrial revolution, the purpose related to this argument underscores the importance of India becoming self-sufficient and providing its own solutions. Nehru’s statement echoed the desire of India to break away from

colonialism and foreign control by any type. This shift represented a major turning point for India. Because the government's economic policies did nothing to encourage foreign investment or trade, the country and its people were forced to focus their efforts on finding solutions and creating what they needed. With respect to science and technology, the government assisted overall efforts as "[t]he Indian state invested more in science…than any other developing country" (Forbes, 1999, p.404). The space program represents one such investment and solution that India chose to forge on its own.

In the early 1960's the Department of Atomic Energy began the development of India's first space program. The founder of the program, Vikram Sarabhai, believed that space could help India from an economic standpoint. "Sarabhai insisted that India was not doing space for prestige…[it represented an] opportunity for India to leapfrog out of its backwardness and poverty" (Narasimha, 2008, p.332). While a space program takes time and resources (human and monetary) to develop, the point by Sarabhai is that with a program, India would be viewed as a country with educated people, a place of ingenuity, and one that is advanced—"Regardless of whether the world helped or not [India] could develop satellites" (Devaiah interview, March 30, 2009). Thus, India would shed the stigma of poverty and an uneducated populace. The space program evolved from its original roots into the Indian Space Research Organization, which developed a series of satellites for a variety of purposes—from communications and natural resource surveys to education, cartography, and meteorology (Narasimha, 2008). The vision of the space program was fulfilled: in 1975, India's first satellite was launched from the Soviet Union and then just a few years later in 1980, India was able to send another satellite into space on its own. Most recently in 2008, India launched a satellite to map the moons' surface.

India has been ranked one of the few countries in the world that "have a credible capability in space S&T" (Mashelkar, 2008, p.301). As represented by the space program, the two ideals (technology and self-sufficiency) are clearly a part of the Indian culture as discussed in the interview with Ms. Devaiah. Ms. Devaiah explained that British rule equaled a subservient mindset; however, technology and independence represented a "path to equality" and enabled "meaning for India in the world" (interview March 30, 2009).

4.2 – Government Influence

Most research on India focuses on the breakthrough of India in the early 1990s, when, the government changed its policies and reduced the barriers to entry for foreign direct investment—essentially opening the doors of India. However, Saraswati (2008) argued that the government's influence in the 1960s and 1970s established the foundation of the IT industry within India and enabled the country to be prepared for the increasing demand by other foreign companies for IT related services. Essentially, government involvement and investment enabled the industry to leverage the economic liberalization of the early 1990s. Saraswati defined the development of the Indian IT industry within three phases: (a) state-led development; (b) state regulation of development; and (c) state promotion of development. The three phases provide a broad overview of how the IT and software industries within India were developed and moved from government to private sector control. Saraswati's argument also highlights the steps the government took in order to assist the development of a sector that would grow to provide technology services for the world's software and IT needs.

4.2.1—State-Led Development

The phase of state-led development came during the 1960s with a focus on decreasing foreign influence and increasing indigenous company capabilities. The 1966 Bhabha Report (related to electronics policy), pushed the idea and recommended that "…wholly-owned Indian firms needed to emerge rapidly and advance the idea that TNCC subsidiaries established or to be established in India must dilute the majority of their holdings" (Saraswati, 2008, p.1141). These subsidiaries were foreign companies that either invested in Indian companies or established their own company within the country. More specifically, the Bhabha report recommendations were intended to increase the population's access to computers and provide access to the most advanced computer technology by the promotion of indigenous companies, not foreign entities (Saraswati, 2008). The first goal of the Bhabha report surrounded the increase of Indian investment in companies that produced advanced technologies. The government initiated the process of decreasing the authority of foreign companies in the country beginning with IBM. IBM retained a virtual monopoly of computer sales in India by its manufacturing abilities coupled with its foreign revenue from its exports. While manufacturing the latest technology in India and exporting it to other countries, "…IBM imported outdated second-hand computers [and] leased them out instead of selling them…" (Saraswati, 2008, p.1143). IBM was viewed by the Indian government as an inhibitor to enabling the country to procure (or develop) advanced computer technology. To curb this type of behavior, the government sent a dilution request, whereby, the majority equity would be held by Indian investor. IBM did not respond to the government's request and closed its operations; however, other organizations complied and thus the Internal Computers Indian Manufacture (ICIM) was established.

The second goal of the Bhabha report promoted the idea of indigenous companies providing the computer needs of the nation. This goal furthered the concept that India should be able to provide its own solutions to a problem by producing the technology required, instead of relying on foreign entities. In 1972 the Indian Department of Energy established a Minicomputer Panel to assess India's ability to produce computers internally as recommended by the Bhabha report. The Panel's assessment supported current government IT policies and suggested widespread availability of the components necessary to manufacture such computers, therefore affirming that Indian companies could, in fact, produce the computers needed (Saraswati, 2008). Initially, the Electronics Computers of India Limited (ECIL) encountered problems, in that manufacturing did not seem to be instilling the confidence of the government or its people with respect to the ability to produce computers; however, by the late 1970s, ECIL's performance turned around, as did Indian optimism. With IBM removed from the country, India had to fill the void and by doing so, it furthered the knowledge, skills, and capacity required to produce hardware and related components. This was an important step as the government continued to reinforce the point that India is just as capable of providing technological equipment as its foreign competitors. The effort by the government under the state-led development of the IT industry also provided an intangible benefit to society—as it became engrained into the culture that India and its people encompassed a country of innovators, problem solvers, and were able to differentiate themselves through technology.

4.2.2—State Regulation of Development

Two policies defined the second phase of the development of India's IT industry. The first, the minicomputer policy maintained the status quo of government regulation and influence, while the new computer policy signaled a shift in the government's approach to regulation and control of the IT industry. The minicomputer policy maintained the need for government involvement and regulation in order to promote indigenous growth in the sector of manufacturing hardware (computers). Saraswati (2008) argued that while the policy maintained outward appearance the implementation did little to further the long-term growth of the hardware industry in India. For example, the government did not provide incentives for companies, who were issued a license to develop computers, to reinvest in research and development (R&D) or other technologies (Saraswati, 2008). Also, the India DOE imported more advanced computers that were supposedly reserved for the ECIL to manufacture. Thus in practice, the policy of the minicomputer and advancing the technology hardware sector of India did not seem to be on a consistent path. Despite the seemingly haphazard attempt to grow a computer manufacturing industry, one of the unintended consequences gave rise to India's software industry. Hardware manufactures did not follow any standard to provide software for computers and as a result Indian software firms began to fill this gap. This is evident as the "growth of the domestic software industry…rose from Rs2.3 million to Rs76.9 million" (Saraswati, 2008, p.1147) in just four years from 1981–1985. In the four-year period, using current U.S. exchange rates, this is the equivalent of the software industry growing from $46,000 to $1.5 million. While the dollar value is still small in comparison, it emphasizes the rapid growth from a very small industry with minimal outlook to one that could succeed and have a positive impact on the Indian economy.

The final phase of the state regulation of development failed to reach its objectives to increase "…the access to and supply of computers…" (Saraswati, 2008, p.1147). The new computer policy came into affect shortly after Rajiv Ghandi was elected prime minister. Saraswati criticized the execution of this policy as a sole means to further Ghandi's own interests and political objectives. The entire emphasis to provide access to computers surrounded the reduction on import restrictions. For example, customs duties on hardware were reduced from 135% to 60% and software duties reduced from 100% to 60% (Saraswati, 2008). In short, the policy did not address the issues India faced with its hardware development capacity or seek new ways to enable growth; rather, by accident it provided the foundation for the software and services industry within India to start to grow and evolve. It was this action that would eventually lead India to make the leap and jumpstart a static economy.

4.2.3—State Promotion of Development

The final phase in Saraswati's paradigm saw a decline in control of the IT industry by the government and a rise of control and ownership by businesses. This phase promoted software initiatives and infrastructure. Spanning the latter half of the 1980s, the stiff barriers to foreign entry within India began to further erode. Under the guise of promoting the software industry, the Computer Software Export, Software Development and Training Policy of 1986 opened the doors of India to software importers. At the same time, quotas were replaced with tariffs to encourage greater exports (Saraswati, 2008). The government also intervened to subsidize efforts by pairing foreign customers with Indian software companies, funding events abroad, and taking the lead to promote India as a destination for clients to have software developed.

Despite the increased growth, Indian software businesses could not afford to do this on their own (Saraswati, 2008). The second piece of the final phase of high government involvement relates to infrastructure. According to Saraswati, "…the huge increase in volumes of software being exported was…dependent on the provision of advanced telecommunications infrastructure" (2008, p.1149). The Indian software companies also realized this need and lobbied the government to provide much needed infrastructure, not only for the software companies, but for the "collective good" (Saraswati, 2008, p.1149). The government established the International Packet Switching Service (IPSS) to provide the connectivity required for the software firms. Despite good intentions, IPSS was not an effective or efficient method of telecommunication infrastructure, and the DOE lobbied for the creation of Software Technology Parks (STPs) that would not only provide telecommunications, but also ensure electricity and water access.

The phases of state-led development, state regulation of development, and state promotion of development attempt to describe the trajectory of the technology and software industries within India. They highlight one of the many areas the government felt critical to India's overall success and future as an independent nation. This intense focus helped to shape India's ability to become a primary outsourcing partner for many organizations in the West. The evolution from state-controlled to private enterprise underscored the importance of science, technology, and self-reliance. While the government is the centerpiece of Saraswati's phases, it was technology that continued to spur overall growth and development and by consequence, the rapid growth of India's software industry. The leaders of the Indian government understood the importance of having a sustainable economy and one that is supported by the efforts of India, not

foreign entities. Science and technology became a way for India to focus its attention and ensure that the country would become a prosperous state, provide for its people, and break free from its colonial past.

4.3 – Individual Determinism

Saraswati's examples highlight how the government influenced development of the IT and software industry, commencing the discussion of how science and technology became a significant part of Indian culture. Nehru initiated this focus by promoting science and technology as a means to an end. He stated, "[s]cience alone…can solve the problems of hunger and poverty, of insanitation and illiteracy of superstition and deadening customs" (Nehru cited in Tripathi, 2007, p.68). For example, within one decade, India's Green Revolution enabled the country to provide food year-round for its entire population (Narasimha, 2008). Other projects, such as the Smart Card and Simputer, have continued to solve the challenges of the rural population and increase quality of life. The majority of the participants interviewed for the study believe that science and technology have greatly improved India's chances of becoming a fully developed country. This is not to say that India does not have many barriers to overcome, but the growth and explosion of science and technological efforts gave India its freedom to be a true competitor in the world and shed the lack and poverty that it once knew. What is equally important is the determination of India's people. "India is a country of entrepreneurs: It is often called the land of a million shopkeepers" (Nobrega and Sinha, 2008, p.90). This spirit has been carried out through each generation and highly resonated with participants in this study. Mr. Sanjay Puri explained that entrepreneurship is embedded in the culture and was reinforced when the Indian economy

was isolated (interview March 2, 2009). Mr. Puri further mentions that the range of entrepreneurs reaches from street vendors selling vegetables to high-tech billion-dollar consulting companies such as Wipro and Infosys. While this comparison might seem extreme, whether an individual is selling his/her goods in a street market or investing in a consulting or software business, the point is that the way of life is driven by self-sufficiency. Ms. Devaiah further emphasized the point as she explained, "there is no social security, not in any form [and I have to] create a future [for myself]" (interview March 30, 2009).

While some argue that the vision of the government and its willingness to set forth a focus on science and technology greatly benefited India, others point out that the people of India have ultimately made a difference. This is does not discount the importance of the government providing policies, rules, and regulations; rather, it emphasizes the need for both government and individuals to participate in overall growth and development. Nobrega and Sinha discuss one of the differences between India and China with respect to government and entrepreneurs: "China has many successful entrepreneurs, however, they succeed in spite of the state, and more often than not they compete with the state for resources" (2008, p.90). This is in stark contrast to India, where businesses are not faced with the same resource competition or challenges from the government. The government has to support business with economic policies that foster an environment that encourages the creation and growth of new businesses. At the same time, a country also requires entrepreneurs, innovators, and individuals with visions that can be implemented into reality for the benefit of the country. "India, I think is being driven by the desire of 1 billion people to have a better standard of living" (Mr. Ashish

Gupta, interview February 24, 2009). Mr. Gupta's comment stresses the role that culture plays within a country's overall development. Many participants of this study also echoed Mr. Gupta's sentiment: it is the people of India forging their way and taking the risks to establish businesses that further propel the Indian economy.

Chapter 5 – Overshadowed by Excellence

Many participants of this study identified the need for India to transform its education system, from primary to university education. The other issue raised by some of the participants is the need for India to expand quality education and programs to rural areas. For example, vocational training or community college centers should be set up in (or close to) villages, so individuals have the opportunity to learn new skills that can easily translate into employment opportunities. The underlying factor surrounding the education debate is lack of government. While the Indian government has increased its overall education budget, it still only represents 2.8% of the total GDP, which according to the *Economist*, is "…about half the figure in Kenya" (2009, p.3). This comparison highlights the lack of investment in its educational system. Despite its world-renowned institutes of technology and management, India's education system is in need of planning, investment, and direction in order to provide all individuals a chance to attain the skills required to be a part of current and future growth. With statistics of over 300 million people who are illiterate, India must balance education reform within primary, secondary, and university levels, in urban and rural areas. In comparison, China's literacy rate is closer to 5% of the total population of six billion people (Tanguturi and Harmantzis, p.11). Again, this shows an imbalance of focusing too much on a central cornerstone of the educational system (institutes of technology and management), instead of looking at the broader picture and benefit of providing quality education to all individuals across all sectors of society. One of India's advantages is its young population. According to President Kalam, "…the youthful age group is a veritable ocean

of talent, much of which may be latent. Imagine the situation when the entire sea of talent is allowed to manifest itself" (cited in Tripathi, 2007, p.72). With a very young population (its ocean of talent), India has a considerable workforce that can be developed across all industrial sectors. Yet, in order to have a highly developed workforce, India must recognize that this sea of talent is the country's future, and the government must take a proactive stance to develop it.

5.1 – Centers of Excellence

"No plan for the future development of the country can be deemed complete which does not provide for technical and scientific training…" (Dr. B.R. Ambedkar cited in Joshi, Pushpanadham & Khirwadkar, 2002, p.47). There is no dispute that India's higher education centers have fueled growth vis-à-vis knowledge and skills development within the science and technology fields. Established shortly after independence with the purpose of cultivating a skilled workforce, the Indian Institutes of Technology (IITs) have not only set the standard for science and technology education, but they have excelled at producing the world's most desired scientific professionals. The IITs have been a central part of India's overall growth strategy and ability to pursue further sectors beyond the call centers and other outsourcing services. In a participant interview with Mr. Thom DeFranco, when asked about why India has been successful as it relates to technology, he stated, "The only reason the IT industry exists goes back to India's education system" (interview November 18, 2008). Mr. DeFranco further explained his direct experience working with IIT graduates: "many of the [graduates] I encounter have a very technical mind and have analytical minds well suited for this industry" (interview November 18, 2008). Along with the IITs, the Indian Institutes of Management (IIMs)

were created to develop a highly skilled workforce trained for the management and policy sectors of India's economy. Together, the IITs and the IIMs represent, from one Indian's perspective, the "cream of India's intellectual system" (Devaiah interview March 30, 2009). These centers of excellence have graduated thousands of skilled professionals qualified to fulfill a variety of jobs, ranging from service-based (technical support centers, software development) positions to roles as entrepreneurs and inventors within the science and technological industry. Part of India's capacity to be a preferred choice for Western companies to outsource their call centers, technical support, and development, relates to the knowledge, skills, and talent present within Indian society. It is this large pool of skilled professionals that enabled India to slowly capture the spotlight and open the doors to a largely service-based IT sector.

While the IIT and IIM centers represent the core of India's education system and foundation of knowledge within science and technology, there is also criticism. The primary issue with respect to the IITs surrounds the "brain drain" effect that occurs once students graduate: "large numbers of IIT graduates leave India that may never return even though the government subsidized their education significantly" (Tripathi, 2007, p.69). Thus the knowledgeable and highly-skilled workforce does not provide the intended benefit as originally desired by the government. The highly skilled professionals that move abroad are not contributing to the innovation and discovery within India—they are benefiting other countries and organizations. Yet, according to a March 2009, *National Public Radio* story, young Indians living abroad (particularly those in the United States) are beginning to return to India. Part of the reason cited in the story relates to the current economic climate. "While most of the world's economies are grappling with the

recession, India's GDP still grew 7 percent last year" (Roy, 2009, p.1). Additionally, education is also viewed as a primary reason for families to return: "The education system here is excellent" (Deepa Venkatesh cited in Sandip Roy, 2009, p.2). Despite the appearance of a reverse brain drain, there remains the magnitude of graduates leaving their country to innovate and produce both scientific and technological products and solutions for other countries. Secondly, a significant downside to the IITs relates to the lack of original research or innovative developments. "Although IITs have produced CEO's…they are not known for original research […] they are not known to be incubators of entrepreneurial ideas…" (Tripathi, 2007, p.69). Within the Western university model, research and development (R&D) is not only encouraged and funded, it also holds value in the science and technological communities. It is an important part of the university culture and offers students the ability to be involved with research and discovery of new innovations. On the other hand, India's universities and IITs do not contribute to the overall foundation of innovation and intellectual property development in India. This is not to say that the Indian university system should mirror that of Western countries—it is the absence of participation and development of knowledge at the university level that is sorely lacking. The R&D centers in India are a mix of government-funded labs and private-sector investors such as Texas Instruments, Oracle, Adobe, and Microsoft. While these centers employ thousands of Indians and contribute to the knowledge base for scientific and technological research, the education centers (universities) do not participate in these advancements. "On one hand, it had political leadership committed to promoting science and technology and it invested in elite institutions that produce thousands of graduates with cutting-edge skills. But those

graduates and institutes simply could not make breakthroughs or develop technologies…" (Tripathi, 2007, p.70). Some could argue that these graduates could work in the commercial or government-sponsored R&D centers. However, the ability for universities and their students to perform primary research for the means of discovery can not only add to the overall learning environment, it can further promote the science and technology agenda purposed by the government for growth and prosperity.

5.2 – A Failed System?

The focus on higher education appears to be one of the largest obstacles that can limit India's overall growth and success. "On the bright side, India has an elite educational system that produces a small number of excellent…graduates […] On the dark side, traditional universities are in poor condition" (Narasimha, 2008, p.336). Narasimha describes an education system in shambles, from a high percentage of faculty members with no post-graduate qualifications to poor university ratings, non-credible grading systems, and lax policies relating to examinations and requirements. This type of disparity between the elite institutes and the rest of the educational centers extends beyond the university system. The debate over what India needs to accomplish in order to continue moving forward is consistent with respect to education. It is clear that while the Indian government has invested much in the educational elite, the rest of the system has suffered as a direct consequence. In an interview with Mr. Salil Tripathi, when asked about what has been overlooked by India on its path to success, he stated, "India still invests too little in primary education, so it has, on one hand, the world's biggest pool of scientific manpower, and also the world's biggest population of dropouts and illiterate people" (interview March 8, 2009). This theme surrounding India's lack of investment in

education was echoed by other study participants. In an interview, study participant Mr. Puri provided an argument for education reform, stating that there should be an alternative option to the university system, such as community college. Mr. Puri explained that most individuals do not move beyond secondary education and there are sectors within the country such as construction, energy, medical, et cetera, which are in need of more skilled professionals. Another study participant, Dr. Anupam Srivastava also echoed the sentiments of education reform, bringing the focus back to the rural areas of the country where the actual necessity of education is not as strong as in urban areas. Dr. Srivastava explained that in many rural areas, families face a dilemma between keeping children at home to work on the farm versus sending them off to school. Given the current conditions, does attending school truly benefit a child's future? Essentially, families question the value an education will provide and whether or not the lack of additional family-based labor is worth it for their children to obtain a second-rate education. Dr. Srivastava also believes that vocational schools and programs should be provided in order to enable individuals in the rural population to become skilled in trades such as masonry and carpentry—skills that will help them obtain jobs and fill the gaps within different industry sectors of the economy. When a country cannot provide basic education, whether through the government or private sector, the divide in population between the skilled and unskilled has a higher probability of widening, leading to negative consequences such as political unrest and/or a strain on social service resources. This is not to suggest that all individuals should be trained in science and technology, rather that India must take a stance to improve its public education system, as according to Das, "The government's most damaging failure is in public education" (2006, p.5). As

a result of this failure, the private sector has become the educational system of choice for primary and secondary education. Das highlighted that the private schools range from elite boarding schools to small teaching rooms in local shops, yet in a study conducted by Pratham, an Indian nongovernmental organization, "…16 percent of children are now in private primary schools [and the] kids scored 10 percent higher on verbal and math exams than their peers in public schools" (2006, p.5). However, if families cannot afford the expense of a private school, their children will not receive the same type of education as those attending a private institution. Yet, the true issue surrounds the inability for the government to provide a free education system, whose students can compete with those attending the private school system. The government has failed to enact policies and the means to ensure that all Indian children can have a chance at a better life and education no matter if they live in rural or urban areas. Das argued it is the Indian people who "are finding solutions to their problems without waiting for the government" (2006, p.5). Das further argued that the Indian people (not their government) are the ones making solutions and solving their problems, at the same time, individuals can only do so much without leadership, investment, and direction from the government. India must provide a better model of education that will provide quality schools, teachers, and information to students of all levels across all sectors of society. With an ever-increasing population, India does not have time to waste fixing a dysfunctional system.

5.3 – Education and the Vision

Kalam and Rajan discuss the critical importance of furthering the Indian population through education: "The lack of educational opportunities…perpetuates poverty" (1998, p.301). Despite India's vision on paper, it has been unable to truly

implement the policies required to provide educational opportunities that are equal to those provided in the private sector. The Indian Institutes of Technology and Management have enabled India to produce the talent and levels of skill required for a segment of Indians to seek better lives abroad and also to provide a highly educated workforce pool for companies seeking to outsource their call centers and other functions to India. The disparity between the educational systems—public, private, and centers of excellence—underscores the paradox found within India. According to Narasimha, "…even private-sector industry, which needs more scientists and is willing to pay well, cannot find the right people for their laboratories. Clearly, the present educational system is not training the right kind of graduates in sufficient numbers" (2008, p.336). Furthermore, universities in India should be part of the knowledge and innovation development. Tripathi (2007) discusses the mixed reaction of Indian nationals who are worried about the increase of predominately Western firms setting up R&D centers in India. The concern is whether India will be the true beneficiary of such establishments, or if "…talented Indians [will be] lured from government labs by the higher salaries at multinationals…[and] lose interest in Indian challenges and issues" (Tripathi, 2007, p.71-2). The university system should be an inclusive part to solving the same challenges and issues that the R&D centers of the Indian government are attempting to solve. Involving the education system can produce not only an array of talent for India, but possibly innovative ideas that can further advance India and its people. Often universities are a forum to express ideas and discover and explore solutions that might be considered too expensive or unrealistic in a government or private lab.

Kalam and Rajan argued that within the Indian Vision 2020, the focus on the educational system entails the need to have quality centers of education in rural areas: "Indians should be provided access to first-rate education and skill development opportunities. This cannot be done by the prevalent methods of village schools or other schools and institutes in towns and cities" (Kalam and Rajan, 1998, p.301). Kalam and Rajan further discuss that rural villages will have centers that will be connected via information communication technology (ICT) to nearby urban areas, in order to provide access to high standards of education. Kalam and Rajan do not detail how this will be accomplished nor do they explain how these village centers will truly benefit the people and improve the primary education system. It is important for government to have a vision and direction for its country; however, if the vision cannot articulate how to solve a literacy crisis or provide quality education at the primary, secondary, and university levels, then what good is the vision to enable a country to reached developed status? Other countries seeking the same unconventional path as India to become a developed nation must also pay attention to the basics required for the population. India has "300 million-plus people who cannot read or write" (Tripathi, 2007, p.72) and it is issues such as this that must be addressed in a full-scale manner to enable full inclusive growth, produce a productive society, and provide the ability for all people to reach their potential. While "people will continue to grow despite the government" (Devaiah interview March 30, 2009), in order for India to completely fulfill its vision of a developed society that is based in science and technology, it must invest in its education system on all levels (primary, secondary, and university) and seek ways to expand

vocational and community college programs for individuals to acquire new skills that can be put to use as India moves forward on its path to growth.

Chapter 6 – Making the Leap

"But what is most remarkable is that rather than rising with the help of the state, India is in many ways rising despite the state" (Das, 2006, p.1). The underlying spirit of entrepreneurship and the willingness of India's people to be successful appear to overshadow any vision that the government may have for the country. In fact, participants in this study overwhelming pointed to the people of India, not the government, when asked what has enabled India to be successful. The sense of entrepreneurship and the drive for individuals to attain a better life is only part of the equation. Das argued that India's path to success (transitioning from a developing to developed country) has been unique and far from the traditional Eastern or even Western strategies. It was this argument that has brought increased attention to India and the manner in which it has been able to quickly transform itself from another developing country to a potential global technology leader—all without emulating a specific model. India has made several leaps over the past decade, steadily encouraging and fostering the environment for economic growth. How was India able to make the transforming economic leap? Will other countries seeking the same path attain similar results?

In an interview with Dr. Srivastava, he explained the progression of events between post independence to the liberalization of Indian's economy in 1991. According to Dr. Srivastava, during post-independence, the Indian government invested in the country. Subsequently, government leaders adopted five-year plans (from the Soviet Union), along with annual targets that became a baseline to measure and reassess the progress being made. The Indian economy still remained incubated up through the 1980s

when “Indian protectionism prolonged the inefficiencies of the private sector” (interview March 10, 2009). It is important to understand that India was not fully part of the global economy prior to the 1990s as the concept of self-reliance and protectionism was still maintained by the government. On the positive side, the development of goods and services internally versus a high export economy sustained the domestic market and also sheltered India from the variables within the global economy. Das noted that India’s economy grew 6% per year from 1980 to 2002 and then 7.5% from 2002 to 2006, maintaining a strong and steady performance for over two decades. Das further argued that India made a path that fit its culture, workforce, and vision for the country. From five-year plans and lack of foreign investment to investing heavily in science and technology efforts, India’s government chose a path that was best suited to sustain independence and enable the people to gain the knowledge and understanding required to promote Indian industry. While some critics may argue that this type of isolationism can only hurt economic development in the long-term, it offers a unique opportunity for India to establish an internal foundation and skilled workforce necessary to become a global IT leader.

India’s economic liberalization in the early 1990s represents a significant change in how the government viewed foreign countries, businesses, and the need for India to become an integral part of the world economy. This change was the turning point that most researchers and even participants of this study cited as the main reason India was able to jumpstart its transition process to become a developed country. During this period, India’s government implemented a series of economic reforms that opened the doors to India, making it easier for foreign companies and countries to invest and conduct

business within the country. Without such action from the government, India probably would not have benefited as greatly from the IT services revolution. According to Tripathi (2007), the most significant changes that occurred were related to the Indian government stopping the micromanagement of the economy and implementing the following policies: (a) permitting foreign firms to own a majority stake in subsidiaries; (b) creating an environment for expanding trade by decreasing tariffs, including those related to capital goods; (c) simplifying the process that made it easier for money to flow in and out of the country; (d) streamlining the business environment by increasing the limits to raise capital, closing unprofitable business units, and enabling businesses to expand their operations without seeking government approval; and (e) strengthening the countries patent laws along with complying with the World Trade Organization requirements. After many years of internal focus and lack of an environment conducive to foreign investment, the Indian government changed its policies and allowed India to be a more active participant in the global economy. However, despite the liberalization, India continues to rely on indigenous investment, as Tripathi discussed; due to the "domestic capital formation…in India, [it] is less reliant on foreign investment than is China" (2007, p.65). Unlike China which considerably relies on foreign investment, India continues to pursue a balance between the types of investment within its borders. While India has created an environment attractive to foreign investors as well as fostered partnerships with other governments and entities for infrastructure and nuclear energy investments, clearly India has not removed its stance on developing its own industries, companies, and skilled workforce; yet, it has witnessed the benefits of foreign investment

within its own borders. The liberalization that occurred within India during the early 1990s, established the foundation for an economic boom to occur vis-à-vis IT services.

6.1 – Niche Market

Tanguturi and Harmantzis discussed that while India and China are rivals in the technology sector, "India is recognized for its service industry, i.e., Information Technology Enabled Services (ITES). In India, it is the availability of millions of low-cost English-speaking professionals [which attributes to the growth]" (2009, p.11). Tanguturi and Harmantzis also discussed that India's advantage directly relates to its skilled workforce; it is this workforce coupled with the economic liberalization that enabled India's service revolution. According to Mr. Puri, India could not traditionally compete with Asia and was able to carve a niche in the IT services sector. This niche market could offer services to Western-based companies seeking technologically savvy, English-speaking professionals. Aggarwal (2008) described that India's outsourcing revolution began in the late 1990s with the Y2K problem facing the U.S. and other developed countries. He explained that the problem was related to legacy software written in older languages such as COBOL, and "India was one of the few countries that could still provide a sufficient number of…programmers" (Aggarwal, 2008, p.18) to make necessary software changes in light of the demand. Despite the increase of Indian programmers in the U.S., companies could not upgrade their software fast enough and "started outsourcing large amounts of programming and maintenance work to India" (Aggarwal, 2008, p.18.). After Y2K passed, the U.S. economy along with the dot-com boom suffered a downturn, and U.S. companies began to look for low-cost alternatives for their software and technology needs. Ms. Devaiah also mentioned in her interview

that the 1990s, especially the looming Y2K problem, brought forth an IT revolution for India. The influx of foreign companies needing services to fix their systems before the year 2000 enabled India to rise to a new level on the world stage. According to Ms. Devaiah, this IT revolution "opened up a whole new set of job opportunities [for Indians] and changed who you were seeing as an Indian globally" (interview March 30, 2009). Davies (2004) provided an overview of how India was able to transform the outsourcing (offshoring) industry by securing the two most important assets: (a) human resources and (b) a business-friendly environment. Davies (2004) explained that India has been able to secure a comparative advantage by producing qualified, English-speaking professionals that are able to address the issues of the global IT market. Davies' second point related to the development of a business-friendly environment that would, through tax incentives and lower operating costs, encourage foreign businesses to transfer their operations to India. For example, in 2003, "the annual cost of an experienced call center agent in the U.S. was about $43,000 [whereas in] India, the direct equivalent was about $6,200" (Davies, 2004, p.1). While this is a direct comparison of employee cost, the savings that companies reported by outsourcing their back-end processes to India was significant: "GE Financial Services and American Express claim to have saved over $450 million by taking BPO offshore…" (Davies, 2004, p.1).

The rise of India through the services sector opened India to the world. Ms. Sharma stated that the IT revolution and liberalization of Indian's economy provided Indian businesses with an understanding of what it meant to be a global player. She explained that the increased focus on India and its capacity to expand "unleashed the spirit of entrepreneurship and other industries [began] to take up the same path"

(interview March 31, 2009); thus the IT revolution influenced the abilities of other sectors within the Indian economy. India's success as an IT service provider spawned a new middle class and contributed to overall growth within the economy. Ms. Devaiah mentioned in her interview that as India became more successful, the people working in the industry also benefited, and this translated into a new consumption-fueled middle class. The explosion of growth that India experienced within its niche market inevitably enabled the country to "leap-frog" within its development cycle by moving ahead of the traditional linear path from agriculture to manufacturing to services. This leap was vastly different from the traditional Asian and even Western models of growth. However, the debate of the correct models of growth and the economics associated with development is not the focal point of this study; rather, it is to highlight the unconventional path that India has taken to jumpstart its economy from a closed nation to one that is providing global IT solutions and services.

6.2 – The Next Evolution

India's success as a low-cost provider of technology services is something that other countries will seek to emulate, pulling from India's leadership. India must continue to evolve in order to promote continuous, sustainable growth; specifically, "India has to keep moving on an escalator" (Dr. Srivastava interview March 10, 2009). Dr. Srivastava explained that India has a limited amount of time to be the primary outsource service provider that other companies turn to for their needs. The business of outsourcing is cyclical in nature as companies are always looking for the least expensive alternatives; thus India must continue to scale and evolve to meet the needs of current and future customers. For example, Dr. Srivastava mentioned that some of the larger service

provider companies within India are shifting their model to a “one stop shop” approach, or are offering diversified products to reach a varied client base. Taking a step beyond the outsourcing model, most important to India’s continuous economic growth is its ability to become a dominant force within the science and technology sectors. The shift that India must make to move beyond the traditional service model is apparent. It is just a matter of time before another country will become “the next India” in terms of providing low-cost, back-office services. In fact, Egypt is quickly poised to take the spotlight from India, becoming an outsourcing hub for European, Middle Eastern, and even Indian companies. According to the 2009 AT Kearney Global Services Location Index, “Egypt today is the sixth most attractive offshoring destination in the world” (Wipro Infotech, 2009, p.38). Wipro (a $5-billion IT solutions and services provider) states in an article that their company is shifting close to 20% of its work to Egypt based on “attractive subsidies being provided by the government…not to mention the abundance of skilled professionals” (Wipro Infotech, 2009, p.38). While the article states that the company’s outsourcing efforts will only serve customers in Middle Eastern areas, it does raise a critical question as to whether or not India is losing its strength in the outsourcing/offshoring industry given new competition from other countries that are also relying on technology as a means of economic growth and development. Egypt has used technology, specifically information communication technologies (ICT) as a catalyst for growth and overall development within the country. Over the past three years ICT has been Egypt’s fastest growing sector, receiving over $6 billion U.S. in investment since 1998 (Golia, 2007, p.48). Egypt has a media satellite in space, six million Internet users, a massive customer base for which mobile phone companies vie, along with multiple

technology parks, similar to Bangalore (India's Silicon Valley). The ICT industry has brought Egypt an explosion of growth and investment, and "has offered a largely youthful population a glimpse of a different and possibly better, digital future" (Golia, 2007, p.48). Not only is Egypt providing a foundation for foreign companies to set up outsourcing centers, it is also extending the use of ICTs to rural areas of the country. Several projects within Egypt are underway to test the use of WiMax, a wireless technology that will attempt to expand connectivity and use of ICTs throughout the country. Yet, despite the explosion of technology growth, "…approximately 72.5m inhabitants [of Egypt] still lives on less than $2 per day" (Golia, 2007, p.49), and the education system suffers from overcrowding and teachers that are not adequately compensated (Golia, 2007). Golia argued that while the use of ICTs within Egypt has not brought a comprehensive change within the country (in that there is still a divide between urban and rural, and rich and poor) it "…has lent a progressive sheen to a 25-year-old regime…"; and it is this progressive stance, investment, and reliance on technology that can enable Egypt to become a primary provider of technological services. Egypt is one example of other developing countries that are analyzing India's direction with its IT industry (specifically services); in order to determine if they are able to emulate the same model and produce the same results to help jumpstart their economic growth. With a rise of other countries seeking follow the same path, India is at a turning point where it must reinvent itself and progress beyond the IT services revolution of the past decade in order to keep moving up the escalator and secure its ability to sustain and drive economic development. "To make [a] value-added leap, India's IT sector will have to concentrate not just on providing process services but on developing and differentiating its customer

solutions with its own intellectual property…" (Wallace, 2008, p.3). The concepts of value-add, intellectual property, and differentiating the products and services in India can be summed up with one term—innovation.

Innovation is a key theme that was consistently repeated during the research process when participants were asked: what does India need to focus on, not only to continue growth, but to have sustainable growth? India must provide value not only to its own country but to the world. This is important, as for much of its history, India has and continues to develop solutions specific for its own domestic market. Innovations developed must be broad-reaching and transferable to other countries. Yet, the innovation and R&D investment is not directly coming from Indian companies. "The major reason that India's science infrastructure is not related to markets is because the policy environment removes some of the incentives for the private sector to invest in innovation" (Tripathi, 2007, p.70). Tripathi further explained that the government-run R&D centers focus more on short-term domestic market objectives versus looking at long-term strategies that can be applied in domestic and global markets. However, two of the areas that appear to be expanding across markets and fueling new innovations are the biotech and pharmaceutical industries. According to Dr. Srivastava, Indian and U.S. companies are working together on the development of low-cost pharmaceuticals for the developing world (interview March 10, 2009). He explained that this is one area where India is adding value and participating in the development of cutting-edge technology, which can be expanded beyond India's borders. Dr. Srivastava also explained new technology developments in India that have the ability to accelerate lab-based clinical trials and thus decrease the time to production and increase the release of beneficial

medicine (interview March 10, 2009). Tripathi also highlighted this new effort within the industry: “Indian companies are achieving significant success with production of generic drugs for export” (2007, p.70). Tripathi discussed that Indian pharmaceutical companies and labs are investing close to 15% of their revenue in R&D, which pales in comparison with IT firms such as Infosys, which reportedly only spent 1% of revenue in R&D. The biotech and pharmaceutical industries in India emphasize the important shift that needs to take place across all sectors within the country. It is no longer enough to be an outsourcing provider; rather, as most participants of this study along with India’s observers have suggested, the country and its people must be innovators to again differentiate themselves from the competition. The future for India lies within the ability to gain knowledge and create unique solutions that can be applied in other markets.

Nobrega and Sinha (2008) discussed what they call “the next wave” of growth drivers that will continue to distinguish India from its competitors. They discussed a variety of sectors to watch within India, from fashion and entertainment to financial services, agribusiness, and renewable energy. While multiple sectors will play a role to drive India’s growth, the most important sector for further discussion relates to renewable energy (especially considering the recent nuclear energy agreement between India and the United States). In fact, many of the participants of this study cited energy and India’s ability to produce alternative energy sources as the next area of innovation that can greatly benefit the country and its people. Mr. Puri discussed that efforts within renewable energy would not only provide new job opportunities, they would signal a shift in the perception of India from an outsourcing center to a country that is capable of providing true value both internally and at a global level (interview March 2, 2009). An

example of this development is India's growing expertise in the development of biodiesel. The Indian government identified two indigenous trees that could be used within the process of developing biodiesel (Nobrega and Sinha, 2008). The government has planned for the production of 13 million tons of alternative fuel, such as biodiesel, on an annual basis. This shift from petro-based fuel to alternative fuel "…will result in a savings of $5 billion annually on imports of crude oil" (Dr. R. Mandal, cited in Nobrega and Sinha, 2008, p. 139).

The other significant part of the renewable energy equation will not only fulfill India's ability to innovate, but also provide clean, reliable energy for the entire country. Study participant Mr. Animesh Khan discussed in an interview that India has the systems in place for clean energy that will enable the country to contribute to the global economy by providing knowledge of green solutions to other countries (interview April 21, 2009). Thus with the shift of investment and focus on scalable energy solutions, India would have the knowledge (know-how) to work with other countries, governments, and organizations to provide clean, alternative energy solutions. This could offer India another niche market to be able to produce solutions that not only benefit India, but provide alternatives to other developed and developing countries. Thus, India is able to further itself and add increasing value within a global market. Recently, Devasis Majumdar the chairman and managing director of the Indian Renewable Energy Development Agency announced that the government is "likely to spend over Rs 1 lakh crore on setting up power plants based on renewable energy sources by the end of 2011-12" (IBEF, 2009, p.1). The U.S. equivalent of this investment is $1 trillion. During the same conference, Manish Verma, the Balasore district collector, discussed that India has

the capacity to generate over a million megawatts of power from hydro sources, however, this has not begun due to various bottlenecks (IBEF, 2009). Verma also discussed the need to invest in solar power as a means of providing reliable electricity to all people and sustaining the development process and strengthening India's capacity to keep pace with current growth trends. The Indian government has also taken steps to further expand its nuclear power capacity as a means to contribute to the variety of alternative energy sources. According to Dr. Srivastava and Dr. Gahlaut, the Indian government has "…set the ambitious target of increase nuclear power…to 63,000mW by 2032, in order to sustain a GDP growth of about 8%" (2009, p.7). With current infrastructure limitations and projects being conducted throughout India, the Indian Department of Atomic Energy (DAE) "is simply not in a position to meet this capacity addition…by itself…" (Srivastava and Gahlaut, 2009, p.7). The gap in India's capacity to produce the targeted nuclear power provides an opportunity for the country to work with foreign investors and develop long-term partnerships that can assist India in fulfilling its energy independence goals.

"India has long believed in self-reliance…[yet, in] the context of today's rapid globalization…India must promote itself as an equal partner" (Chidambaram, 2007, p.60). Chidambaram argued that India must participate in joint projects and efforts relating to science and technology, reaching out beyond the tendency for protectionism and self-reliance. This type of cooperation can enable India to be viewed as an equal in terms of knowledge and abilities as they relate to various science and technological advances. India's culture of protectionism gave way in the early 1990s to economic reforms that helped to transform the country's economy and greatly enhanced the

opportunity to become a developed country. While India has made much progress over the past decade, other countries such as Egypt have followed suite, using technology as a means for overall growth and development. India must evolve out of being a dominant outsourcing provider to a country that has the capacity to provide innovative solutions and products to other countries and businesses. Whether this innovation comes from the pharmaceutical, IT, or energy sectors, it is clear that India must continue to evolve, grow, and scale to further sustainable economic growth.

Chapter 7 – Managing a Balanced Agenda: Inclusive Growth and Infrastructure

"[T]he challenge to bridge the digital divide has as much to do with politics as economics" (Kofi Annan, cited in Tripathi, 2006, p.145). One of the main points in the argument surrounding the digital divide relates to diminishing the accessibility gap between the urban and rural, rich and poor. Yet, this divide represents more than just lack of access with respect to technology; it is as Annan refers an important factor for overall growth, development, and perhaps even sustainability. This is not to suggest that the implementation of technology will automatically signal economic growth; rather, it is a means to initiate innovation and begin to decrease the disparity in countries such as India that represent two worlds (developed and developing) in one country. India's IT revolution has not been limited to urban areas, as the innovation and desire to use technology to impact and change lives has been key to developing "unique solutions to overcome the challenges routinely faced [in everyday life]" (Ms. Sharma interview March 31, 2009). Many participants in this study cited various innovative projects (such as the Simputer and Smart Cards) that extend technology to rural areas of India and not for the sake of simply providing technology; rather, for the ability to truly solve problems and fuel continuous growth as a natural consequence of the technology. Ms. Sharma explained that five to seven years ago the focus and efforts within India were just about growth. However, there is a realization in the country that growth will be a mirage without the entire population; extending the importance of both urban and rural areas in contributing to the overall goals and objectives of India. It is a realization that the majority of the population cannot be left behind nor can India truly achieve its vision

unless it incorporates the entire country in the movement of growth, not simply a segment of it. According to Chidambaram, "…the [Indian] government has made a concerted effort over the years to develop technology that can contribute to rural economic development. The impact of these efforts…has not been very significant" (2007, p.60). To help correct the deficiency, the Indian government established the Rural Technology Action Groups (RuTAGs), with the purpose to provide feasible solutions to problems identified by other organizations or governmental agencies within India. Currently, there are three RuTAGs established in the Indian states of Chennai, Dehradun, and Guwahati (Chidambaram, 2007). Once a problem has been identified, the RuTAGs work in concert with the IITs, IIMs, and other institutes and organizations to develop and implement a solution. Chidambaram describes some projects including upgrading water mills, improving food processing technology, and enhancing manufacturing processes for traditional medicinal products. The focal point of these projects is to create specific solutions for rural industries (such as agriculture, fishing, and local manufacturing), thus producing a dual benefit: (a) increasing efficiencies within the industry, such as enhancing information flows; and (b) enriching the lives of those participating within the industry by empowering them with information and/or technologies that directly translate into improvement of the task or function they are performing. This type of program is one example of how India is working to ensure a more inclusive and proportional growth within rural areas. During Ms. Sharma's interview, she also explained that corporate social responsibility has recently taken on a more visible role in the social development process. With India's culture and tradition rooted in the caste system, corporate (or even individual) social responsibility is a new paradigm. It is however, needed in order to

further smart, innovative solutions to close the gap within Indian society. This will not occur overnight and will require joint ventures, public-private partnerships, and the willingness to see India and its people as one moving toward the same goal. While India might be criticized for producing indigenous products and solutions, it appears that this is one area of benefit to rural India. Ms. Sharma explained that the innovations and projects in rural areas are tailored to Indian need. Thus, the attempt is to introduce new technologies and products in a manner that will be of use to the population. India has made several advances in the areas of rural urbanization, focusing on key specific projects to increase the livelihood and enable the entire population to be a part of and contribute to the countries overall growth and development.

R.A. Mashelkar echoes the same sentiment arguing that science and technology can be used for inclusive growth, which will increase productivity within a limited cost. Mashelkar identifies inclusive growth as the period where a country includes a previously excluded population in the development and growth process. "This means making S&T work on behalf of the poor of India, combining equity and excellence, creating products…suited to those at the bottom of the pyramid and to the needs of India's lower-middle class" (Mashelkar, 2008, p.300). He further discussed that the only type of technologies that will have the greatest impact to promote economic growth and development are those with economic importance. Economically important technologies include the following: (a) process technologies, whereby the technology helps to increase efficiency and provide a comparative advantage to produce a good or service; (b) product technologies, which center on the overall well-being of a population such as medical treatment; and (c) enabling technologies, which aim to reduce transaction costs between

buyers and sellers through facilitating information sharing and exchanges (Mashelkar, 2008). As Mashelkar identifies, it is critical to not only select the right technologies for developing countries, but to ensure those technologies are with the purpose of furthering overall growth. The use of technology as a means of economic growth requires a focus centered on selecting the right type of technology based on a specific challenge that needs to be solved for the population. India has taken steps to forge the gap between rural and urban populations, seeking alternatives that will foster growth and productivity among the lower and lower-middle class. The use of information communication technologies, kiosks, cellular phones, and other innovations has slowly begun to facilitate the transformation of certain areas. This type of inclusive growth will take some time and continual pressure to break down the caste system along with internal barriers to entry. To bring increased prosperity and inclusiveness to the rural areas of India, science and technology have to be strategic assets within the rural areas, not simply a by-product of political ventures.

7.1 – Bridging the Divide

"Now it is time for technology to play its role in transforming rural India" (Karnik, 2008, p.1). The presence of science and technology efforts is not new to the rural India; in fact, the Green Revolution transformed the agriculture industry and enabled India to be self-reliant and to produce enough food for its population. This revolution was powered by science (Karnik, 2008). There have been and continue to be a variety of projects focused on the types of economically important technologies that will transform rural India. However, Karnik argued that the divide between rural and urban India is not shrinking—it is growing. For example, Karnik described areas where

"irrigation is from wells, the simple technology for the pump to be automatically switched on when power is available…so common in cities—is still rare in villages" (2008, p.1). Karnik also discussed several other uses of technology in rural areas such as village kiosks (providing Internet and other services to villagers) and the use of cellular phones to conduct transactions for business; these are viewed as positives but must also be more scalable and reliable (accessibility, cost, electricity). Karnik argued that there is a gap between "villagers and technologists" (2008, p.2); it is this gap that must be addressed in terms of understanding the needs of rural populations and then providing solutions to alleviate their problems. If technological solutions being offered in villages across rural India do not solve specific problems or improve lives, then how does technology actually benefit those individuals? Technology-based solutions do not have to exciting in order to work for rural areas and other developing countries; they must simply meet the basic needs—whether that is an automatic water pump or a generator for power—in order to be successful. The following summaries provide snapshots of the various projects that attempt to bridge the divide between urban and rural India, showcasing the benefits and challenges in pursuing technology as a mechanism for rural growth.

7.1.1—The Bhoomi Project

According to Thomas, "[the] Bhoomi Project at its core, reflects the essence of the right to information movement in India" (2008, p.4). The project showcased the way in which technology could provide access and vital information to individuals that were previously isolated from their government. The Bhoomi project represented transparency and sustainability for famers whose land and ownership rights are essential to their

livelihood. "For all those involved in subsistence agriculture in India, the [computerization] of land records enabled their right to information" (Thomas, 2008, p.5). Initiated by the Indian government in the late 1990's and completed in March of 2002 the project was heralded a success for its following achievements: (a) 20 million land tenure records were computerized for the state of Karnataka; all of the records belonged to 6.7 million land owners; (b) the records included important data such as crops, irrigation, yield, and mortgage; (c) the records could be accessed via 176 kiosks situated in sub-districts throughout Karnataka; and (d) access was based on biometric identity (Thomas, 2008). Despite the success in increasing transparency of land rights and ownership and providing a technology-based solution, the Bhoomi project has been criticized for its isolated nature and lack of integration with other government agencies and organizations. "As a networked technology, ICTs work best when…integrated into information flows occurring at a variety of levels" (Thomas, 2008, p.7). Thomas argued that the more integrated the technology is across agencies and sectors the greater the positive impact and increased flow of information to those individuals that previously did not have that level of access. The Bhoomi project was solely sponsored by the Revenue Department of Karnataka, which did not coordinate or consider working with other agencies to expand the breadth and depth of services to be offered to villagers. Instead of bridging the project across other departments allowing for growth of information and data exchange, the project was only developed to maintain land records. Thomas mentioned that one of the larger visions for the program included the ability to attach social identity; thereby a land owner could also use the system to apply for loans and conduct other business not readily accessible in rural areas. However, this type of integration was never

completed. One of the major deficiencies with the project related to the data within the system. "The computerization of these land records was not preceded by a thorough clean up of records, many of which had been 'mutated' through corrupt dealings" (Thomas, 2008, p.7). As a result of the lack of data clean-up and validation, the same issues that land owners had to contend with were simply transferred to an electronic system. Thus the project did not attempt to resolve conflicts or outstanding issues, such as the sale of a farmer's lands without his consent, because the information was not verified or corrected prior to the entry of records in the system. Instead of taking the opportunity to validate the data and attempt to resolve conflicts within the old system; all of the same problems and issues were simply transferred into an electronic format.

The Bhoomi project also underscored the impact of the lack of fundamental basics that are required to facilitate the use of technology. "The lack of electricity has led to dysfunctional Bhoomi kiosks that are unable to deliver on a key promise of computerization-immediacy and prompt delivery of documents" (Thomas, 2008, p.7). When villagers traveled to a local kiosk only to find it out of service, it was more than just an inconvenience, it was a loss of time and money for the trip. There was also a loss of confidence that developed based on the inability for the technology to deliver the information and records as it had promised. This became disruptive and frustrating for farmers who were trying to determine their rights and/or purchase new land to expand their farms. The Bhoomi project serves to question the need for such innovations in an area that does not have the electricity required for the project. The idea of providing quick and easy access to land records is a good idea; yet the question remains as to whether or not this is completely useful to improve the lives of the farmers. Granted,

land records are vital to ensuring ones land and obtaining new land to expand the agricultural production; yet, does that really translate into an increased benefit for these villagers? Perhaps it would have been more beneficial to use technology to improve agricultural production or expand the types of services offered beyond land records.

7.1.2—The Gyan Ganga Project

The Gyan Ganga project was initiated to "…establish one-stop telecenters that provide a range of services—e-development, e-health, e-governance, e-education" (Thomas, 2008, p.8). Unlike the Bhoomi project, Gyan Ganga was a joint venture between the Government of Gujarat, the information technology unit Gujarat Informatics Ltd, n-Logue (a private firm), and local service providers along with kiosk operators (Thomas, 2008). The purpose of the telecenters was to provide individuals the ability to gain access to services and information at one location versus having to visit various offices or centers. Essentially, the project aimed to centralize the core services to which an individual might need access at any given time. Surprisingly the main strengths of the project were the underlying technology used within the kiosks to offer access, the knowledge of kiosk managers, and the use of uninterruptable power supply units for the kiosks. Unfortunately, the overall benefits of providing a variety of services (such as e-governance and e-health) were overshadowed by a variety of weaknesses within the project. The Gyan Ganga project was assessed by Indian Institute of Management and despite the project's intent and capacity to provide a range of services to villagers (versus the Bhoomi project), "[t]he weaknesses far outweigh the strengths" (Thomas, 2008, p.9). The shortfalls identified ranged from a lack of delivery of all of the services promised, to use of the caste system to prevent women and lower castes from accessing the kiosks, to

using the kiosks for digital photography which became popular since the villagers could not access the majority of the services that were originally intended (Thomas, 2008). Gyan Ganga was also unable to deliver the promise of electronic land records, which was one of the main identified requests of the villagers. While the concept seemed favorable to provide villagers access with all of the information they needed, from land records to medical information, the project fell acutely short and as a result both interest and confidence of the villagers waned.

Thomas argued that the Bhoomi and Gyan Ganga projects represented innovative methods to use technology and bridge the access gap, yet they were unable to truly foster the proposed benefit. The Bhoomi project represents the need for information, in this case land records, to be made readily available for villagers in an efficient format. The Bhoomi project has it merits for using technology as a vehicle to deliver the land records; however, it did not completely solve any of the main challenges faced by villagers with respect to their land ownership. On the other hand, the Gyan Ganga project appeared to take on a broader aspect by connecting villagers with multiple services in the nearby towns and urban centers. Despite its intent, the project failed to truly achieve its original goals and objectives. Thomas did not discount the projects or the intent to positively change the lives of those who were to access the systems, but he did criticize the way the projects were implemented and the isolationism. He advised that these types of projects must be scalable, have adequate backing, have an integrated versus singular focus, be supported by the local individuals using the system(s), and equitable (in terms of access). The projects discussed by Thomas also highlight the continual need for infrastructure developments in rural areas. The Bhoomi and Gyan Ganga projects emphasize that these

types of efforts and project implementations must have the goal of providing tangible benefit by improving the lives of those accessing and using the technology. As Karnik discussed, technology has a place in the economic development of rural India, but the use of technology must be smart and have a positive impact.

7.1.3—The Fishermen of Kerala

The case study of the Fishermen of Kerala attempts to highlight the positive effects of using technology (in this case, information communication technology or ICT) as a way to improve the flow of information within an industry. Kerala is a state in India that is predominately a fishing region. According to Jensen (2007) the fishing industry directly employs over one million people, making it the primary staple of the economy for all involved. Prior to the introduction of cell phones, fishermen were unable to know the price they could receive for their catch from the various markets along the coast (Jensen, 2007). As it was too risky to travel further along the coast to distant markets (cost of travel with the uncertainty of a buyer and the price), most fishermen would sell their daily catch at markets close to their home location. However, Foss and Couclelis explained that "when the home market was saturated due to a high volume of catches in the area, late-arriving fishermen sometimes found no buyers and had to dump their catch in the sea" (2009, p.136). Jensen used data collected across the coastal markets to describe an inefficient system which includes significant price variation and limits the abilities of both buyer and seller. With respect to price variation, Jensen noted that one coastal market, "Badagara has a price of zero while Chombala and Quilandi, both within fifteen kilometers, have prices of 9.9 and 9.8 Rs/kg, respectively" (2007, p.882). Using current exchange rates the prices would equate to $0.20 U.S. per kilogram of fish. In

Jensen's example, a fisherman headed for Badagara would not take in as much profit for the catch as a fisherman selling at Chombala or Quilandi. The other issue relates to fishermen who arrive to the market with a catch, but there are no buyers. Again, Jensen pointed to Badagara with 11 fishermen dumping their daily catch while 27 buyers in the area were looking to make a purchase. Thus, while the fishing market had been operating in the same fashion for many years, there was a lack of information flow between the fishermen and buyers in the market which led to waste, loss of potential (for buyer and seller), and an uneven distribution of growth within the industry.

The solution to Kerala was the cellular phone. Beginning in 1997, cell phone service was introduced in a phased approach over the course of three years. The phone service was installed directly in coastal cities, offering service radius of 25 miles and enabling the use of phones by the fishermen located in boats up to 30 kilometers from the shore (Jensen, 2007). Adoption of the cell phone by local fishermen and traders was immediate as soon as service became available and by "2001 over 60 percent of fishing boats and most wholesale and retail traders were using mobile phones to coordinate sales" (Jensen, 2007, p.883). With the introduction of the mobile phone technology, fishermen were able to check prices at various markets to determine not only the best price for their catch, but whether or not there were buyers. The improvements as a result of the project included price dispersion and a decrease in wasted catch: "price dispersion among different coastal markets was reduced from 62% to 69% of the mean price less than 14%, and wasted catch was reduced from 5% to 8% of fisherman on any given day to zero" (Foss and Couclelis, 2009, p.136). Thus the cell phone provided value to those involved within the fishing industry of Kerala by enabling the exchange of vital

information, solving not only the challenges of the fishermen, but of the traders and wholesale buyers looking to purchase a daily catch.

The evidence is clear that the introduction of technology to Kerala was an overall benefit to the parties involved. The project highlights the importance of using the right technology based on the challenges being faced within a particular area. It is about implementing smart, sustainable technology that will empower the people or provide opportunity for them to expand a particular product or industry. This project took a different approach versus the Bhoomi and Gyan Ganga to provide a solution that was truly needed, realistic, and ultimately proved to be successful for all those involved.

7.2 – "No Water, But a Mobile Phone"

As illustrated in the Bhoomi, Gyan Ganga, and Fishermen of Kerala projects, the individuals might not have water, electricity, or even proper roads to transport their products, but they do have technology (kiosks or mobile phones). During Ms. Devaiah's interview, when discussing the effects of technology within rural areas, she mentioned that individuals have "no water, but a mobile phone" to highlight the complexity of Indian society along with the penetration of technology projects within rural areas (interview March 30, 2009). When participants of this study were asked what India has overlooked on its quest to become a developed country, the results were mixed. Yet, the predominate theme among the answers centered on the basic fundamentals—education, electricity, infrastructure, and bridging the social class divide—that India needs to improve upon in order to reach its goal of becoming a developed country. The disparity within India was described by Mr. DeFranco: "You will see a high-end car driving down a poverty-stricken village road with livestock…" (interview November 18, 2008). This

type of challenge is nothing new to Indians as Ms. Devaiah explained that when driving within the city, one has to navigate through roads filled with livestock, pedestrians, bicyclists, and other vehicles (interview March 30, 2009). Again, the examples point to the need for India to balance its agenda between achieving economic development and providing its people with primary necessities in order to continue to improve society as a whole. Jensen referenced the argument that critics will often make with respect to ignoring the fundamentals within a country in favor of technology: "Many critics argue that investments in ICTs should not be a priority for low-income countries, given more basics needs…" (2007, p.880). Yet, Jensen argued that in certain low-income countries or even villages within countries, the livelihoods of the population are rooted in various industry markets such as agriculture or fishing, where the introduction of the right technological solutions (as in the case of Kerala) can make a positive contribution to improving the lives of the individuals working within the local industries. Thus, technology, Jensen argued, is equally important to help increase the information flow between the buyers and sellers within those markets. Certainly on the path towards development there will be areas overlooked or put aside in favor of overall growth. However, there must be a balance within a country to be able to push forward a growth agenda and at the same time be able to provide its population with basic necessities.

7.2.1—Infrastructure

"It is common knowledge that India's infrastructure is in bad shape" (Nobrega and Sinha, 2008, p.96); it is this infrastructure that can potentially threaten the current growth of India and also represents one of the main barriers to overall success. For example, the *Economist* reported that it "takes an average of 21 days to clear import

cargo in India [whereas] in Singapore it takes three" (2008, p.1). India's Jawaharlal Nehru Port in Mumbai, which handles 60% of India's cargo, only has the capacity to handle nine vessels at a time, whereas in comparison, the main port of its Asian counterpart, Singapore, handles up to 40 vessels (*Economist*, 2008). The disparity reported by the *Economist* between India and Singapore is quite striking and stresses the importance of the fact that technology is only part of India's economic development, and the imbalance plaguing the country must be adjusted in order to achieve permanent, sustainable growth. This imbalance was echoed by one of the study participants, Mr. Puri, who stated that "infrastructure has not kept pace with growth" (interview March 2, 2009). He further explained that in cities such as Bangalore there are "shiny new buildings," but to view the roads, transportation, and infrastructure elements, it "does not add up" (interview March 2, 2009). However, the government has begun to center its focus on improving all sectors of India's infrastructure.

According to Nobrega and Sinha, the Indian government is implementing new measures to improve the infrastructure within the country. "Even the most ardent socialists within the government know that without dramatic improvements to the country's roads, ports, railways, power grid, irrigation channels, and airports, it will not be possible to sustain the current rate of economic growth" (Nobrega and Sinha, 2008, p.97). In 2007, the Indian government started a program called the Public-Private Partnership for Infrastructure Investment and Development that will over time invest close to 8% of India's GDP per year (Nobrega and Sinha, 2008). This project highlights India's shift of balance from a growth-only agenda to one that seeks to fix a crumbling infrastructure that can no longer keep up with the pressures of the current pace of

development. Without roads, products cannot be easily transported nor can items quickly move from one market to another. One of the study participants, Ms. Sharma, also mentioned the shift within the government to focus on infrastructure improvements. Ms. Sharma stated that the Golden Quadrangle project is a massive road development project that will connect the north, south, east, and west corridors of the country. She stated that this project is not only improving infrastructure it is also creating opportunities for employment and playing a role to further spearhead change across the country (interview March 31, 2009). Nobrega and Sinha (2008) described this project as the equivalent of the U.S. connecting Chicago with Orlando by building a six-lane highway, developing additional cross-country highways, and improving the road system, all within the span of five years.

While roads and highways represent the primary mechanism of transportation in India, only half of the transportation equation of people and products relates to roads; the other relates to its trains and railway systems. "India…has the second-largest system in the world, with 1.6 million employees…[and transporting] 15 million people every day" (Nobrega and Sinha, 2008, p.98). India has projected that within five years, freight transportation will increase to 1.1 million tons per year with a passenger count of over 8.4 billion people per year (Nobrega and Sinha, 2008). With such a dramatic increase in a relatively short timeframe, the India Railroad Authority plans to invest over $56 billion over the next five years in various projects for new tracks, passenger cars, and high-capacity freight cars as well as modernizing current train stations. In addition, the Railroad Authority is considering building a high-speed rail system to transport people over greater distances in shorter times. Both projects (India's roads and railway systems)

are a tremendous undertaking; however, it is a lesson for other countries that are in the same position as India. Infrastructure can be one of the primary elements overlooked within a country due to lack of investment and overall cost to repair and build new roads and highways; yet, if the country does not maintain a balance and/or plan to address inadequate infrastructure, it can be faced with higher expense and less time to fix the problems, as in the case of India.

As the Indian government is working to overhaul its roads and railways, it is also laboring to improve all twelve of the countries airports along with its sea ports. "Indian airports are considered by global standards to be some of the least efficient" (Nobrega and Sinha, 2008, p.101), lacking the most common features such as night landing systems, cargo-handling systems, and terminal capacity for multiple airlines. Nobrega and Sinha (2008) compared the magnitude of overhauling India's 12 airports to the U.S. constructing two airports the size of Chicago O'Hare with the capacity to handle 85 million passengers, along with ten additional airports the size of Dallas, Fort Worth with the capacity to handle up to 45 million passengers, all to be completed by 2012. Moreover, India's sea ports are crucial to its trade flows, and by 2012, it is estimated that India's ports will be able to handle a 50% increase in capacity from 660 million to 1.3 million tons. In addition, the new Port Community System will provide "…interconnectivity for all of the 12 major ports in the country…[linking] the various stakeholders, such as shipping agents, exporters, importers, banks and terminal operators…" (Nobrega and Sinha, 2008, p.101). The new system will allow India to reduce its current time to unload ships from days to a matter of hours, as performed by its Asian counterparts. This type of improvement enables India to expand its trading

capacity and truly function as a developed nation with a strong infrastructure to handle current and future growth. These types of improvements are important to the Indian economy as a whole. If its Asian counterpart can unload ships and begin transporting goods within a matter of hours and it takes India days to complete the same task, India is at a significant disadvantage with its trading flows (both importing and exporting).

Compounding India's infrastructure issues surrounds the lack of adequate and reliable electrical and water systems. "India needs modern infrastructure, but power is the key to it all" (Luis Miranda cited in Nobrega and Sinha, 2008, p.106). Nobrega and Sinha (2008) discussed that large sectors in India still suffer from brownouts and remote areas either do not have electricity or conversely, if they do, it is not consistently reliable. The *Economist* quoted a World Bank report that stated, "…9% of potential industrial output in India is lost to power cuts. Some 600m Indians have no…electricity at all" (2008, p.2). Many of the participants in this study pointed to the energy shortfall within India and the need for better solutions to provide efficient, reliable, and environmentally friendly energy. Nobrega and Sinha described India's progress towards providing such a basic necessity as being mixed. For example, in the areas of power distribution, "more than a third of all power generated fail[s] to reach consumers" (Nobrega and Sinha, 2008, p.106). Some critics argue that part of the problem concerns the corruption and bureaucracy within the system, while others point to the lack of a national power grid to transmit power evenly across various sectors. One of the largest challenges India faces with respect to increasing electrical power relates to attracting investors. Investors have become wary of the high risk associated with electrical power investments as "state governments, which control most of the sector like to give [electricity] away…or allow it

to be stolen" (*Economist*, 2008, p.3); thus it would be the state governments and their recipients that would directly benefit; not the original investors or the population who receive the electricity. To respond to such concerns, the Indian central government attempted to reform the sector by separating power generation, transmission, and distribution; yet according to the *Economist*, these reforms have not been enforced and most states simply ignore the new laws (2008). For those states, such as in north Delhi where the distribution has been separated, "the theft rate has dropped from 48% to 18%" (Economist, 2008) and power distribution and reliability has improved. The Indian government needs investors to help finance the additional electricity requirements along with the means to adequately distribute it. However, if the Indian government cannot guarantee that the electricity will be provided, not stolen or given away for free, there is really no incentive for investors to participate. Without investor participation, it is possible that India can fall further behind other countries that are able to purchase and efficiently distribute reliable electrical power.

7.2.2—ICT Infrastructure

While there is no doubt that physical infrastructure (roads, ports, transit systems, et cetera) is important within a country, so too, is the ICT (Information Communication Technology) infrastructure system. It is this system that provides the network, services, and equipment for local Internet, foreign data connections, land phone, and cellular phone lines—in essence all of the critical elements that are needed for a country to be connected via voice and data communications. India has made progress with its ICT infrastructure having "…the 10th largest network in the world" (Tripathi, 2006, p.142), but there are still gaps with respect to widespread networks and connectivity (more so in

the rural areas). According to Mr. Puri, companies in India have built campuses that are self-contained with the required data connections necessary to conduct business with companies around the world; however, he added that not all companies can afford to implement and therefore must rely on what is available. The Indian government reports that "[a]t the current pace, the target of 500 million connections by 2010 is well within reach" (Government of India, 2009, p.245). These connections relate to both wired and wireless network access throughout the entire country. The tele-density figures reported by the Indian government show a significant overall average increase from 12.7% in 2006 to 35.6% in 2009. Viewed separately, rural tele-density witnessed an increase of 13% and urban areas saw an 83% increase (Government of India, 2009, p.245). The Indian government also reiterated its commitment to bridging the gap by providing broadband access to rural areas of the country. In January 2009, the government reached an agreement with Bharat Sanchar Nigam Ltd. (a primary telecommunications company in India) to provide wired connectivity with connection speeds of 512 kbps and the capacity to handle voice, data, and video traffic (Government of India, 2009). The government is reaching out to investors to further propel the telecommunications industry, provide for additional connections, and establish the infrastructure required for continual increase in telephone and Internet services. For example, the IBEF reports that Sistema Shyam TeleServices Ltd, a joint venture with Russian-based telecommunications carrier Sistema and the Indian company Shyam, will invest over $5.5 billion U.S. over the next five years in India (IBEF, 2009, p.1-2). Other wireless and wired providers are also following suite. It is possible that with these continued investments and plans to improve the ICT infrastructure across India (both urban and rural areas), it can achieve its

goals by the year 2010 to provide broadband connections for "all secondary and higher secondary schools; all public health care centers..." along with achieving rural tele-density of 25% and increasing broadband subscribers to 40 million (Government of India, 2009). While the government appears committed to attaining various ICT goals ensuring that both urban and rural areas have access to affordable and reliable voice and data services, the outlook of how that will impact India is uncertain. India's actual network readiness performance in comparison with other Asian countries is not on par with the ability for India to meet its goals and objectives.

According to the 2009 World Economic Forum's Global Technology Report, India has had a mixed performance with respect to its network readiness. While India has experienced tremendous growth in the telecommunications sector, the World Economic Forum assessed India with a network readiness position of 54, which is behind China, being ranked at 46. This score reviews a variety of factors within a country such as population, Internet users, bandwidth availability, infrastructure, and governance, to name a few. India's rank demonstrates that while the entire ICT market is growing, there remains a gap in adoption of technology at the individual level, along with an ICT infrastructure that requires further investment and improvement to enable saturation. "There are fewer than three PCs and only seven Internet users for every 100 inhabitants…the quality of the infrastructure environment is poorly rated…despite India's ranking 3rd worldwide for the availability of scientist and engineers and 27th for the quality of its research institutions" (World Economic Forum, 2009, p.20). The network readiness assessment further highlights the disparity and imbalance within India. For a country to be ranked third in the world for its scientific workforce, yet lack the

awareness, affordability, and adoption of technology throughout the population speaks to the overarching agenda of focusing on very specific areas within the Indian economy. India has put its investment and strength within its niche market and subsequently ignored the larger picture relating to the promotion of technology across all sectors of the population. This type of action has now forced India to catch up to other countries that have been able to integrate technology (specifically ICT's) throughout their populations, not within a division of it.

If India is unable to fix its failing infrastructure, the prospects of continuous and sustainable economic growth are threatened. India will not be able to compete with other countries who have found a way to balance the growth agenda along with providing the basic fundamentals for its population and foreign investors. Infrastructure is part of the means required for economic development. Without transportation means (roads, ports, railways, and airports) people and products cannot move throughout the country. By the same factor, without reliable energy, water, and telecommunications, how can a country expect to grow and expand? India has set forth very ambitious goals to improve all areas of its infrastructure; without continued focus, investment, and willingness to make these improvements happen, India might not meet its short term goals within the next few years (2010 and 2012) or its long-term vision by 2020.

7.3 – Consequences of Success

The consequences of success can be positive and negative. On one hand, India has succeeded in elevating its status in the global economy and has potential to be a world leader in IT solutions. Yet, as a result of a growth-focused agenda and furthering India's quest to become a developed nation, several areas including infrastructure, rural

populations, and even urban populations have been neglected. Several participants in this study mentioned the importance for India to address its poor population which represent close to 60% of the total (Mr. Puri interview March 2, 2009). Mr. Puri mentioned that only 16% of India's GDP is based on agriculture and with a decrease in this sector, questions arise: What will these individuals do? How can they best transition their skills into a new economy? The issue of agriculture in India is a large debate. According to a recent *National Public Radio* story (Zwerdling, 2009), farmers who have been planting the same way since the Green Revolution are finding it more difficult to irrigate and water their fields. "Government studies show that farmers have pumped so much groundwater to irrigate their crops that the water table is dropping dramatically, as much as three feet every year" (Zwerdling, 2009). Zwerdling reported that farmers were forced to hire a drilling company to dig new wells at least 200 feet deep for water, when historically water could be easily found. Some of the farmers have turned to organic farming; however, the investment and yield do not equal enough income to sustain such practices and so far the results have varied. One farmer explained that on the positive side, "[o]ur rice yields under the organic system are almost as good as before…[a]nd we're spending much less money on inputs" (Sharma cited in Zwerdling, 2009). Conversely, Sharma explained that other higher yield crops such as wheat have fared poorly (Zwerdling, 2009). Agriculture is one example of a primary industry on which rural India relies for economic growth; however, this industry has been in slow decline and is not at the level during the former green revolution. According to study participant, Mr. Ashish Gupta, "we have [a] massive population with lots of poor who have to be moved along or else all will be lost" (interview February 24, 2009). India has to address

the growing class divide between the rich and poor, and it is not a task that can be handled with the relative ease and expediency that it has experienced with economic development. The transition of the rural population underscores the critical need for education, training, and planning by local government to enable a smooth transition for those living in rural areas.

India's poor population is not solely limited to the rural areas of the country. "If India fails to get a handle on its new urban areas, it could be saddled with more bottlenecks and inefficiencies that could doom the country to years of subpar growth" (Dharmakirit Joshi cited in Barta and Pokharel, 2009, p.1-2). Therefore, India not only has to account for the incorporation of its rural population within the overall development plan, it must also contend with a new problem of megacities and explosion of urban populations. Major cities such as Bangalore and Mumbai have become epicenters of growth, attracting not only foreign investors and companies to establish corporations, but also individuals from rural villages seeking a better quality of life. India has 25 of the world's fastest growing urban centers, compared to China, which has only eight (Barta and Pokharel, 2009). While on the outset it might appear that the growth of such "megacities" is a good sign in terms of urban development, it is proving to be more disastrous for India. For example, Barta and Pokharel reported that the northern state of Uttar Pradesh, Lucknow, once known for its monuments and gardens, now has "more than 780 slums, overflowing sewage pipes and streets choked by gridlock" (2009, p.1). Lucknow's population is currently 2.7 million and the city continues to add more than 150,000 residents each year; other large cities across India are no different. Lucknow represents the consequences of a deficient system, lack of planning, and years of neglect

creating a compounding problem of inadequate infrastructure that is unable to handle a significant population expansion. Lucknow is only one city; yet, the magnitude of this problem can potentially jeopardize India's future if the government cannot, in a timely manner, address poverty and lack of the basic fundamentals. Although city slums are not a new phenomenon in India, there is an increase of the urban population living in squalor conditions. "[M]any advocates hoped India's modernization would reverse slums' growth. Instead, the opposite appears to be happening" (Bara and Pokharel, 2009). One of the main issues identified by Bara and Pokharel (2009) as to why the urban squalor is only getting worse involves the governance of Indian cities. According to Bara and Pokharel, Indian cities are "…managed by a bewildering array of government bodies that don't always coordinate activities" (2009, p.2). For example, in Lucknow the city is led by an elected mayor and 110-Muncipal Corporation (similar to a city council) who provide oversight for the city's basic services; yet, their authority is constrained by the multiple government agencies and bodies that also function in the city. One such agency is the Lucknow Development Authority, charged with developing new housing and road projects. Once the projects are complete they are transferred by the Authority to the Municipal Corporation for management. Bara and Pokharel (2009) discussed that often the Municipal Corporation does not have enough funding to maintain such projects and is never consulted about the project; therefore the Municipal Corporation is not prepared to handle the various requirements of the projects completed by the Authority. The disconnect within local government, lack of city planning, and insufficient funding has resulted in cities being unable to provide basic services nor the capacity to handle the dramatic increase of individuals seeking business and employment opportunities outside

of rural villages. To help combat this issue, the Jawaharlal National Urban Renewal Mission (JNURM) was created to provide infrastructure assistance to cities like Lucknow. Under this program, a fund of $12.5 billion U.S. has been set aside to provide grants of up to 90% of infrastructure project expenses (Nobrega and Sinha, 2008). Lucknow is scheduled to receive $150 million for projects relating to sewage, waste water treatment, and other improvements. Lucknow city officials were reported that they believed the funding would cover all of the waste water and sewage needs; however, critics remain skeptical that Lucknow will be able to continue to grow and expand despite the current project. "Either way, the money is far short of the more than $960 million Lucknow needs to spend on roads, water and other projects" (Barta and Pokharel, 2009, p.4).

India's infrastructure problems, whether on a national or city scale, represent one of the major hurdles that must be addressed if India expects to continue its current level of economic growth and reach the status of becoming a developed nation. The other issue that parallels this problem is the exodus of the rural population moving to megacities in search of a better standard of living. Without proper intervention and planning by the government (on a national, state, and local level) the slums will continue to grow and so too will the divide between the rich and poor. The Indian Vision 2020 views all of the infrastructure and division challenges as a necessity to address; however, the vision does not outline the need for local governments to be more effective or to coordinate projects and services, nor does it speak to the needs of the population growth in major cities. The vision does encourage the development of alternative and sustainable energy sources for both urban and rural areas; yet, a vision is not enough if it cannot be

properly implemented. For too long, India's focus has centered on growth and prosperity within a limited sector of the country and this imbalance has forced India to become reactionary to the crumbling infrastructure throughout the country. While some have argued that Indians will continue to prosper and become successful despite the government, the private sector cannot shoulder the complete responsibility of providing the necessary and basic fundamentals of a country. The Indian government has planned to invest billions in roads, ports, railways and other projects to improve the lives of its people and provide a standard environment for foreign investors and companies seeking to conduct business in India. Whether or not India will be truly successful with its current projects will largely depend on capability of the government to provide leadership, direction, and coordination across all of the agencies involved.

Chapter 8 – Conclusion

"India is now at the beginning of what may be the most amazing transformation of a free market economy in modern history" (Nobrega & Sinha, 2008, p.236). Nobrega and Sinha argued that India will be the real success story out of Asia, not China. The authors compare India to a boulder, as once it starts rolling it keeps going and building momentum. "For many years the economy remained stagnant and resistant to change, stifled under the misguided direction of a socialist government and a command economy—but now it's starting to move" (Nobrega & Sinha, 2008, p.234). This analogy can be flattering as it suggests that India is just realizing its own economic potential and has the capacity to continue to grow and transition into a developed country. However, a boulder can also be destructive and as this study identifies, India must be able to balance its development agenda to prevent further internal damage and disparity which will diminish India's economic power. India's rise as the outsourcing epicenter is the story that attracts the attention, but it is not the complete story of India's capability and determination. Since its independence in 1947, India has continually moved forward, establishing the foundation required to eventually become a developed country. India did not follow the models that have worked for its Asian neighbors. Instead, India has molded its path to its own needs and has reflected a standing culture of self-reliance and promotion of indigenous solutions for the challenges faced by the country and its people.

The catalyst and driver for growth has been primarily centered on science and technology efforts. During the British colonial rule, the science and technology platform was established, yet it was up to India and its leaders to further expand the reach and capabilities of the country and its people. India's early leaders were greatly influenced

by science and technology and believed that these elements were the cornerstone to India's growth and development. This influence was also carried out in subsequent government policies and initiatives. For example, the first prime minister created the Indian Institutes of Technology in order to have a highly trained workforce that could further advance India's scientific position. Today, the IITs (and IIMs) are world-renowned and graduates are respected for the knowledge and skills they possess. Science and technology was not merely a political concept, rather it became a reality and engrained within India's psyche. India invested more in science and technological efforts than other developing countries; it created a viable space program, provided food security for its population through the Green Revolution, and contributed talented engineers to other IT organizations around the world. Second to this technological focus is the spirit and ingenuity of India's people. Shortly after independence, Nehru proclaimed that it was important for India to solve its own problems, even if it meant making a product that might be second rate in comparison to what India could import from other countries. Nehru established the foundation that India must, on its own, become a nation capable of providing for its people. It was a chance for India to distinguish itself not as a former British colony, but as an independent nation that could sustain itself. Many observers have referenced India as the "land of a million shopkeepers," and this spirit continues to drive the country forward: "…what will really give the Indian economy and society a strategic boost is the fact that such a large portion of the populace are natural entrepreneurs" (Nobrega and Sinha, 2008, p.236). One of the first lessons to take away is the importance of leadership and culture of a country. India has demonstrated how influential these factors are within their economic and societal growth models. A country

must first look within its own borders for the talent and skills needed to move forward. This is not something that can occur within a few years; rather, as shown with India, it takes decades. India might have been able to reap benefits from its investment sooner had it not continued the policies of protectionism; yet, it was this very protectionism that forced India and its people to solve the country's immediate problems and establish a platform to become a viable leader within the science and technology industry.

Despite India's success, the government has been "the strength of the country and also its weakness" (Kalam & Rajan, 1998, p.288). Kalam & Rajan discuss the imbalance of power within the government, whereby agencies created are not empowered to implement the government's agenda. This type of imbalance has been perpetuated to the local and state levels of government as referenced in Chapter Seven with respect to the issue of megacities. The lack of coordination and balance of power throughout all of the levels of government can lead to inefficiencies, waste, and corruption, which will do nothing to further India's growth and development agenda. In fact, many participants of this study did not completely credit the Indian government for the country's success. Das also argued that it is the people and not the government of India that has elevated the transformation of the country into the third-fastest growing economy. "But what is most remarkable is that rather than rising with the help of the state, India is in many ways rising despite the state" (Das, 2006, p.1). Such criticism of the government is not without merit, as India is currently unable to provide all sectors of the population with the basic fundamentals such as reliable electricity, transportation, and clean drinking water. "In the midst of a booming private economy, Indians despair over the lack of the simplest public goods" (Das, 2006, p.4). In addition to the lack of adequate infrastructure, critics

of the government also point to a failed public educational system that cannot provide the basic level of education required for students at the primary, secondary, or university levels. Finally, compounding the issue of education and infrastructure is India's incapacity to combat poverty in rural and urban areas. In the early 1990s, the government took the required steps to free India's economy and fostered an environment conducive to foreign investment and trade—this same type of focus should be taken internally within the government. This is the second lesson to be learned, in that the government must review its internal workings and take the steps necessary to create an organization that is responsive to the needs of its people, and will work together to implement policies to improve the lives of its population.

Overshadowing the discussion of India's transformation is the Vision 2020. The purpose of the vision was to provide a way for the government to understand all of the factors and priorities that must be addressed before India can claim developed status. While some may argue that a vision is necessary to inspire and set the overarching goals of a country, it is not the impetus for change required for countries to start on the path of development. Actually, when asked about the Vision 2020, many participants in this study were only familiar with it based on the publicity from the Indian government, and many doubt that the entire population is aware of this statement. It is not completely clear in this research project whether or not the Indian government considers the vision important or uses it as a basis for new policies and programs. The challenges identified by the Vision 2020 are the same reflected in current research: education, infrastructure, poverty, and governance—all in need of reform for India to continue to realize the same levels of success it has thus far. The magnitude of the impact the vision had on the

country and its people is unclear. However, it is clear that the strong sense of independence, entrepreneurship, and focus on using science and technology to solve India's problems have had an impact on India's progress in transition to a developed country. A vision can inspire people, but without action, inspiration can do nothing to further the progress of a country. It is important for other countries analyzing how India has skipped an industrial revolution to recognize that the India Vision 2020 is only a part of the whole process. It is more important for a country's leadership to set the overall goals and direction and empower the government to implement policies that are conducive to balanced growth. As in the case of India, the focus has solely been on growth, which has helped India to achieve greater economic gains; yet, it has also caused increased strain and pressure on India's infrastructure, educational system, and a growing poor population that do not have the skills or resources to obtain a better life.

This study has attempted to outline whether or not India offers an alternative model for growth that other countries could adopt. As shown with Egypt, many countries are following the same path by improving their technological infrastructure and education surrounding the skills required to provide software and high-tech solutions to other businesses. Based on its reforms and increased technology capacity, Egypt is being labeled the "next India" in terms of its ability to become a dominant outsourcing hub. This does not surmise that Egypt followed India's lead, but rather there is increased attention within developing countries to harness science and technology as a means of jumpstarting the economy and providing new opportunities for the population. The question remains as to whether or not the next model of growth will be the Indian model. Some argue that India does not have any model at all: the country's economic growth is a

by-product of the entrepreneurs that have driven the country forward. However, in reviewing all of the factors closely, India has successfully been able to by-pass the traditional or commonly used models of growth. Therefore, India's rise and economic success could be an alternative model that other countries might adopt. This does not assume that all countries will have the same type of success as India. Instead of attempting to copy what works for other nations, countries must closely evaluate the skills, resources, and advantages that can be leveraged to promote economic growth. One of the major downfalls to India's model relates to the intense focus on science and technology within the high-tech sectors, as opposed to a balanced growth path within high-tech, medical, agriculture, and other industries. While science and technology are necessary and can provide many benefits to a country and its people, they can only be part of a complete development solution. Critics argue that developing countries should only concentrate on the fundamental basics, such as providing clean drinking water, electricity, and health care; yet, as in the case of the Fishermen of Kerala, technology helped to transform their industry and became a strategic asset for all parties involved within the market (buyers, sellers, and distributors). The illusion of technology is that once implemented it becomes the vehicle to improve the lives of those around it. With telecenters and kiosks, it is assumed that people will benefit since they will have access to the Internet and services from the government, but this is not necessarily true, as illustrated in the Gyan Ganga project. The question remains: How will the introduction of the Internet improve the lives of rural villagers? In short, technology must improve the business, transactions, and flow of information to make an impact. In the case of India, it started with a proclamation that India would use science and technology to solve all of its

problems. India followed that path for several decades, developing centers of excellence, investing in space programs and research centers, and furthering the concept that the answer resided in science and technological efforts. India did not completely consider the effects on its infrastructure, mass movement of populations looking to urban centers for a better life, or how to reform a public education system to meet growing demands. Technology alone cannot prove the solution to these factors, and countries seeking to follow in India's footsteps need to learn from the lessons from India to avoid the same pitfalls. Again, only time will tell if India can truly meet the government's vision of becoming a developed nation by 2020. There are many challenges, billions of dollars, and the entire vision of one country and its people at stake, for India to succeed and take its place as a leader in the world.

In summary, this study represents an overview of the first few phases, or chapters, of the Indian model of development. It has provided the history leading up to India's rise, the areas where the country experienced significant growth, and the consequences of this type of model. Despite the implication that India represents an alternative model, more time will be required to fully assess this observation. India is at its half-way mark to the year 2020 and has currently planned many infrastructure projects set to be completed by the year 2012. Essentially, India's story of a developing nation transforming into a developed country is still in the writing and a thorough evaluation of the next chapter will be necessary to provide a clear picture and analysis of the Indian model of development. Observers will be closely watching India over the coming years to understand how it will address the obstacles in its path, if it will be able to continue

with a steady or increased paced of growth, and when it will become a developed country.

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The author argues that India's IT industry is truly a product of "serendipity," where success occurred mostly by accident and assisted by design of the governments initiatives. The article briefly traces the rise of the Indian IT industry, starting with Tata Consulting Services through the boom of the Y2K, and the impact of globalization that has enabled India to continue to grow and expand its industry. Aggarwal uses the following three elements to assess the future of the Indian IT industry: (a) export of IT services, (b) domestic use of IT services, and (c) import of IT products and services into India. Aggarwal suggests that as India's economy becomes more integrated with the global economy, there will be increased opportunities for foreign companies to import their goods and services to India, along with similar benefit for Indian companies to export the same to Western and Eastern countries.

The relevance of the article provides a counterpoint that India had planned its economic growth through the rise of its IT industry. The article also provides reference to the influencing factors of the industry and the areas that need to be addressed to sustain or even continue the level of growth. Aggarwal is the co-founder and chairman of Evaluserve, Inc.

All India Management Association. (2003, February). India's new opportunity–2020. [Online]. Retrieved August 18, 2009 from http://www.ibef.org/download/IndiaNewOpportunity.pdf

The India New Opportunity–2020 report mirrors the India Vision 2020, sharing the same ideals for India to become a developed country by the year 2020, along with having the capacity to also become a knowledge-based nation. The report is a more recent effort that encompassed participant involvement from the government, academic, and business sectors, to not only analyze India, but to also provide a framework of reference that can be used to take action. The report identifies six main action items to increase demand for India's services along with six areas to increase supply of the same. The report cites a variety of scenarios and plans that can help improve India's growth, the events that need to occur for this to take place, and the manner in which India's growth over time will compare to other developing countries.

The use of the article in the study provides recent evidence on the continual emphasis of India becoming a developed nation by the year 2020 and applying the same type of principles as defined in the India Vision 2020. The All India Management Association is an organization established to support the government and industry of India. It is comprised of various professionals from around the country and is actively involved in the development of government policies that influence India's business environment.

Anand, G. (2009, April 28). World News: India's infrastructure funds all. The Wall Street Journal (Eastern edition), p.A8. [Online]. Retrieved August 18, 2009 from ProQuest, http://proquest.umi.com.dml.regis.edu/pqdlink?did=1689390031&Fmt=3&clientId=18958&RQT=309&VName=PQD

The article discuses recent issues relating to foreign investment waning with respect to India's infrastructure projects. Anand reports that many companies that were originally looking at Indian investment have been damaged by the global financial crisis, and "debt-heavy" investment projects (that is, infrastructure) are no longer as attractive as they used to be. The article discusses the grave situation India could face if it lacks the required investment: "without expanding its inadequate, unreliable power supply and crumbling roads, airports and ports, the [country]…could stall" (p.1). The article describes the financial effect that India might witness as a result of the global financial crisis and inability of the government to fund all of the required projects. This article is important as it provides a different perspective with respect to India's infrastructure, while also validating the issues and challenges discussed in this study.

Avergou, C. (1998). How can IT enable economic growth in developing countries? *Information Technology for Development, 8*(1), 15. Retrieved May 22, 2008, from Academic Search Premier database.

Despite the fact that the article was written nearly ten years ago, it describes the correlation between technology and economic growth, laying a foundation for developing countries. The article showcases the ongoing debate of how developing countries can reach a more developed status by means of technology and economic growth. The article discusses ICT, infrastructure, innovation, and highlights the concept of socio-economic change through information technology. More specifically, "[k]nowledge and information are the most important resources for the transformation of the economy…" (p.5).

The article focuses on the development of ICTs within a country, and concludes that while ICTs are necessary for countries to participate in the global economy on their own, ICTs cannot create or sustain economic growth. The relevance of this article showcases the argument of

technology as a focal point of development, the challenges developing countries face, and the fact that a balanced approach is needed. The author, Dr. Avergou is a professor of Information Systems at the London School of Economics and Political Science and specializes in information systems in developing countries.

Barta, P. & Pokharel, K. (2009, May 13). Megacities threaten to choke India. The Wall Street Journal (Eastern edition), p. A1. [Online]. Retrieved August 18, 2009 from ProQuest, http://proquest.umi.com.dml.regis.edu/pqdlink?did=1707711501 &Fmt=3&clientId=18958&RQT=309&VName=PQD

The article discusses the rapid development of new urban areas within India. Barta and Pokharel explain that India has "25 of the worlds 100-fastest growing urban areas" (p.1), to which China pales in comparison with only eight cities. The authors further explain that India's new "megacities" are placing a burden on local governments and infrastructure. The authors use Lucknow, India, to describe the issues faced within the multiple megacities. Lucknow, once known for its gardens and mosques, is now known by the presence of over 700 slums, mostly inhabited by rural migrants. The article discusses the severe challenges relating to inadequate sewage services, traffic gridlock, and lack of basic necessities that are no longer capable of supporting a growing population.

The authors also point to an ineffective government, whose multiple agencies fail to coordinate projects and as a result are unable to continue the maintenance and oversight required to ensure project success. Furthermore, local governments do not provide adequate city planning in order to strategize for future growth and determine what would be required to support such expansion. The article highlights a new issue that India must face as more and more individuals migrate from rural to urban areas in search of a better life. Yet, as the authors explain, with the lack of governance and an infrastructure that can no longer support increased growth, India's future (if these problems are not addressed) is questionable.

The relevance of this article for the study is to provide a very recent example of the problems and issues facing India. It also underscores that the same issues identified by the government in 1998 (in the India Vision 2020) have not been fully addressed nor plans made to solve them.

Chidambaram, R. (2007). Indian innovation. *Issues in Science & Technology, 24*(1), 59-62. Retrieved September 24, 2008, from Academic Search Premier database.

According to the author, "[t]he key for India in sustaining its economic development over a long period is to become scientifically advanced, and ultimately to become a global innovation leader" (p.59). While the author

addresses that science and technology (S&T) progress is complex to measure, the article provides a snapshot of India's current progress with S&T. The author divides the progress into eight main sectors: technology foresight, rural technology delivery, academia-industry interaction, the automotive sector, small and medium enterprises, innovation ecosystem, recruiting new scientist, and directed basic research. The author discusses the developments of India within each sector and addresses basic challenges that the country must overcome.

The article provides a snapshot of the "innovation" sectors of India—what is working, what needs improvement, and areas that might not be so obvious when one considers S&T progress. The article does not outlay steps for the government of India to consider within each sector; rather it is a broad and encompassing overview of areas that need to be addressed in terms of technical foresight and development. The author is a principal scientific advisor to the government of India.

Das, G. (2006, July). The India model. *Foreign Affairs, 85*(4), 2-16. Retrieved May 18, 2008 from Academic Search Premier database.

According to Das, "The most notable thing about India's rise is not that it is new, but that its path has been unique" (p.1). The author points out that India did not follow the path of its Asian counterparts, nor did it follow a Western approach to economic development, rather the country leapfrogged into the technological services (mainly outsourcing) arena. The article describes India's path from a colonial country, post-independence economic suppression to becoming one of the largest economies in the world. The author addresses the notion of India's jump from an agricultural-based economy directly to a service/technological-based one, thus imploring the question of whether or not an industrial revolution is necessary as part of the development cycle.

The author makes a point to downplay the government's role in India's success, instead pointing to the individualism and the spirit of entrepreneurship as setting the stage for the country's overall development. The relevance of the article regards the discussion around India's economic growth, a new development revolution, and how the culture (people of India) influenced this change within their own country.

Despite the author's attention on the role individuals played in India's current economic success, the turning point acknowledged within the article came from the "liberalization" of India's economy, through which the long-closed doors to the country were opened to foreign investors. The article attempts to position India's success as nothing new; however, that attitude seems to undercut the countries accomplishments. The author

has a strictly business viewpoint, as Das is the former CEO of Procter & Gamble India.

Davies, P. (2004). "Chapter 3: India and the global services revolution". *What's this India business? Offshoring, outsourcing and the global services revolution.* Nicholas Brealey Publishing. Books24x7. [Online]. Retrieved August 23, 2009 from http://www.common.books24x7.com/dmi.regis.edu/book/id_7937/book.asp

According to Davies, "Some 30 years ago, India worked out that if it was ever to become a developed country, it first had to be an information technology country" (p.1). This provides an explanation as to the rise of the information technology industry and tremendous focus by the government and private sectors. Chapter Three of Davies' book provides a brief overview of how India was able to become a dominant outsource and offshore provider to a variety of foreign organizations. The chapter outlines the low cost incentives for call centers, coupled with a well-trained, English-speaking workforce. Essentially, as Davies explains, India had all of the right pieces come together at the right time. This argument is counter to that of some researchers who claim the industry grew by accident. The article brings to the study an explanation of the IT services sector and the manner in which India was able to become a leader within the offshoring and outsourcing businesses.

Dutta, S. & Mia, I. (2009). The global information technology report 2008-2009. World Economic Forum. [Online]. Retrieved August 18, 2009 from http://www.insead.edu/v1/gitr/wef/main/fullreport/index.html

This comprehensive report provides detailed information about each country's network readiness. Network readiness helps define a country's adoption of technology (Internet access, computer, et cetera). The report was used specifically to understand India's ranking in comparison with other countries. The report highlights the same types of issues as discovered within the study that India needs to overcome (education, infrastructure, et cetera). The main issue identified for India is despite a heavy focus on technology and large R&D centers, the report finds that "there are fewer than three PCs and only seven Internet users for every 100 inhabitants" (p.20). The report also sheds light on the work India must undertake from a network readiness perspective to increase awareness, adoption, and affordability of some of the basic technological assets within a country.

The relevance of the article to the study provides current information as to how other organizations assess India's technological readiness beyond the business level of R&D centers and outsourcing services. The report highlights the importance of having technology used across the population, not just in one segment. The World Economic Forum is an

independent, international non-profit organization who strives to help countries balance growth with social development.

Economist. (2008, December 13). Creaking, groaning, infrastructure is India's biggest handicap. *Economist*. Retrieved August 18, 2009 from Academic Search Premier database.

The *Economist* article discusses the current status of India's infrastructure. More specifically it describes all elements of the country's infrastructure (roads, electricity, et cetera) as being the primary obstacles to India's future growth and development. The article provides insight into the plans of the government to increase overall investment (close to $475 billion U.S.) in various projects; however, it questions where the government will obtain the money. The article also highlights government inefficiencies with respect to state owned and operated electrical companies. The *Economist* argues that in areas where local governments' privatized electricity the market was more equipped to provide adequate and reliable power to their customers.

The article shifts away from infrastructure to discuss India's education system. Again, the *Economist* is critical of the government's ability (or rather lack thereof) to provide an equitable system that will educate children of all ages in both urban and rural areas. The article attempts to highlight the major problems facing India centering on infrastructure, yet, at the same time it seeks to identify the government as one of the main obstacles to overall growth and development within the country. The *Economist* is a weekly magazine that focuses on international economies and business news.

Forbes, N. (1999, June). Technology and Indian industry: what is liberalization changing? Technovation, 19(6-7), 403-412. Retrieved September 12, 2008 from Elsevier ScienceDirect database http://www.sciencedirect.com/science/article/B6V8B-3WK38C1-8/2/6334afdc7d53ea45bf0fbd722e415961

This article looks at India before and after the 1991 economic liberalization of the country's economy. Specifically, the author concentrates on information technology and industrial competiveness as a means to gauge overall performance, the changes brought forth by liberalization, and what remains to be accomplished. Forbes briefly outlines India's technology policy and the "national innovation system" prior to 1991; table two of the article highlights the old and new policies that directly impact technology within the Indian industry. Forbes discusses research and development (R&D) within India, how industries obtained technology, and the focus on indigenous growth. Forbes points out that during this period one does not see the same pattern as in East Asia, with a high concentration of industrial development; rather, "[t]he

contrast with India is striking, and reflects the difference with which the government pursued a policy of self-reliance…" (p.407).

Forbes addresses the Indian market after 1991, as the Indian government effectively opened its doors to foreign investments. The article reviews the influx of foreign direct investment (FDI) and the role within the technology industry. The focus of the article shifts to analyzing the progress from a macro and micro view along with reviewing how the industry restructured itself after the FDI—including the prevalence of higher levels of R&D by private industry. Forbes concludes that the Indian example showcases the "complexity of building technical capability"(p.411), whereby India invested early in technology and research but remained autonomous, limiting its overall capacity to produce innovative products (no incentive within the market to do so).

The author's point of view appears to promote further liberalization of the Indian economy to expand the capacity of technology within the country versus a state of protectionism. The author acknowledges the strides that have been made, but seems to believe more could have been done had the act of liberalization been performed sooner. The author is a consulting professor at Stanford University in the Science, Technology and Society Program, and the Director of Forbes Marshall, an engineering company based in Poona, India.

Foss, S. & Couclelis, H. (2009). Throwing space back in: a tale of Indian fisherman, ICT and travel behavior. Journal of Transport Geography, 7, 134-140. [Online]. Retrieved July 26, 2009 from Elsevier ScienceDirect database http://www.sciencedirect.com/science/article/B6VG8-4VDSCTK-2/2/bf4248b7babeb7ca10617b58f06a723c

Foss and Couclelis use the Fisherman of Kerala case study to argue their theory regarding the adoption of information communication technologies when populations or industries are challenged by space and geographical distances. The article discusses the main objectives of the Kerala case study and also outlines how the introduction and subsequently implementation of cell phone technology enabled the fisherman to travel greater distances. Thus, in the case of Kerala, geographic barriers that previously limited the fisherman and entire industry became non-existent.

While this article is from a geographic perspective, it is important to understand the impact of the Kerala case study and how technology influenced the local fish industry success. The article promotes the importance of using ICTs to bridge any geographical barriers that might inhibit the movement of information and/or individuals of certain areas. The article provides a differing viewpoint with respect to how technology

can be used to improve the lives of those in rural or geographically displaced areas.

Gahlaut, S. & Srivastava, A. (2009, February). *U.S.—India cooperation in advanced technologies: implication for India's integration into the strategic trade control regime.* Center for International Trade and Security, University of Georgia. For presentation at the ISA Annual Conference, New York, February 2009.

Gahlaut and Srivastava highlight the importance of the U.S. and India partnership and cooperation with respect to advanced (nuclear) technologies. While the article is more policy-focused, discussing the framework surrounding the U.S.–India agreement, it does provide insight into India's plan for nuclear energy and alternative power sources. The article also outlines India as a global partner in advanced technological projects and willing to work with other countries and companies in science and technology efforts. The relevance of the article provides an understanding of the policy efforts and cooperation being formed for India to move forward on an international level with its nuclear programs. It also highlights the importance of India forming strategic partnerships with developed nations.

Dr. Gahlaut is the Director of the South Asia Program at the University of Georgia and Dr. Srivastava is the Director of the Asia Program at the Center for International Trade and Security at the University of Georgia.

Golia, M. (2007, July). Egypt and the new digital age. *Middle East*. Retrieved September 3, 2009 from Academic Premier database.

Golia reports on the explosion of the ICT market within Egypt. The article highlights the transformation from a time where the "national phone company…could take a decade to grant landlines" (p.47) to a period where "six million Internet users are online [and] three mobile phone providers are vying for a massive customer base" (p.47). Golia describes a new country where the emergence of ICTs has opened the doors of employment opportunities for the population and has positioned Egypt to be an outsourcing destination for Middle Eastern and European companies. The article does not directly reference India; however, there are parallels between India and Egypt with respect to the use of technology to build new industries.

The article also discusses efforts within Egypt to extend the delivery of ICTs to rural areas through the use of WiMax, a wireless technology. Golia reports that several investors such as Intel Corporation and U.S.AID have funded pilot projects in several schools, clinics, and villages to test out the capabilities. The article has been beneficial to the project to provide a snapshot of how other countries are approaching technology as a

mechanism of growth and development. The article further explains that India's position as an outsourcing leader might diminish as other countries (such as Egypt) put in the place the infrastructure, technology, and skilled workforce required for companies to outsource their projects and services.

Government of India. (2000). Information technology action plan. National Task Force on Information Technology and Software Development. [Online]. Retrieved June 10, 2008 from http://www.indianembassy.org/special/itplan-2000.htm

The Government of India expresses its desire to transform its people's life and become a knowledge based society. It believes information technology is a central component to accomplishing those two goals. The document outlines the main plans of the Indian Government to bolster information technology within the country, by focusing efforts on infrastructure (ICTs), increased investment in information technology software and service centers, and a major focus on people in terms of accessibility to technology and computer literacy.

While the document is not an exact policy, per se, it offers an overview of the government's approach to technology, people, timeframes, and the ability to measure results of the proposed actions. It is relevant to this study to provide a background regarding how the government of India approaches technology policies.

Government of India, Ministry of Finance. (2009). Economic Survey 2008-2009. Section: Energy, Infrastructure and Communications. [Online]. Retrieved August 18, 2009 from http://indiabudget.nic.in/es2008-09/infra.htm

The Government of India highlights its continual goals of improving the lives of its people through the expansion of ICTs. The section discusses the growth of the current industry, the policy objectives of the current five year plan, and the importance of foreign direct investment to help propel the increase of ICTs throughout the country. The use of this section within the study provides current data with respect to what the government of India is planning in the areas of ICTs over the coming months and years. It also provides a brief overview of the industry and compares the availability and growth of technology across urban and rural areas of the country.

Indian Brand Equity Foundation. (2009, September 7). Indian to spend over Rs 1 lakh crore on renewable power by 2012. [Online]. Retrieved September 7, 2009 from http://www.ibef.org/artdisplay.aspx?cat_id=114&art_id=23843

This article summarizes the events at a recent seminar on renewable energy attended by Indian corporations along with the Indian Renewal

Energy Development Agency. The article discusses Indian's commitment to providing alternative energy sources, including the investment of $1 trillion U.S. in power plants. The recent information highlights the potential change within the country to start solving the major infrastructure related issues facing the country. One of the main speakers of the event cited the correlation between reliable energy and sustaining current economic development efforts. The relevance of this information to this study provides recent data that highlights current events being discussed by the government and private sector.

Indian Brand Equity Foundation. (2009, June 19). Telecommunications. [Online]. Retrieved August 22, 2009 from http://www.ibef.org/artdisplay.aspx?cat_id=114&art_id=23398

In this article, the Indian Brand Equity Foundation provides a snapshot of the Indian telecommunications industry. IBEF describes the overall growth in the market along with foreign investments across mobile phone services and general infrastructure improvements. The article discusses new policy initiatives by the government along with the projection for the current five year plan which is set to expire in 2012. In short, the article gives a small glimpse into the recent events within the industry. The use of the article within the study provides recent data on India's telecommunication industry and the types of foreign investment that will help sustain and increase overall telecommunications growth. The IBEF is a public-private partnership between the Ministry of Commerce and Industry, Government of India, and the Confederation of Indian Industry. The organization seeks to promote and advance the economic interests of India to other countries and businesses worldwide.

Jensen, R. (2007, August). The digital divide: information (technology), market performance, and welfare in the south Indian fisheries sector. Quarterly Journal of Economics, 122 (3), 879-924. Retrieved August 9, 2009 from Business Source Premier database.

In this case study, Jensen counters the commonly held belief that developing countries should only focus on providing the population with the basic fundamentals prior to investing in ICTs. Essentially, Jensen argues that the investment in strategic ICTs for the promotion of improving the lives of those working in various industry markets (agriculture, fishing, forestry, et cetera) are of equal importance. Jensen claims that "for most of the world's poorest, living standards are determined largely by how much they get for their output" (p.880). Jensen describes that oftentimes in developing countries the producers and traders are limited to certain geographical areas and therefore limited by the price in the local market (or in some cases, the producers make nothing at all as a result of high saturation). Jensen argues that the ability to provide more

efficient means of communications (through ICTs) can improve the lives of those reliant on a specific market or trade.

Jensen highlights his point in the case study of Kerala, India which has a massive fishing industry. Jensen describes scenarios where fishermen had to dump their daily catch because they were too late to their local market, when just a few miles away there were not enough fish for all of the traders. Without communications, fishermen did not want to take the risk to travel to further coastal markets as they did not know if they would obtain a good price for their daily catch. Jensen describes the process of the introduction of cell phones within the industry for both fishermen and traders. The net result enabled the fishermen to know the prices in the market and where they could sell their fish. This also helped the traders to ensure they were able to purchase the fish required for their customers. This article helps to underscore the important role technology, specifically ICT, has within a developing country.

Joshi, S., Pushpanadham, K., & Khirwadkar, A. (2002, July-Sept). Knowledge management through e-learning: An emerging trend in the Indian higher education system. International Journal on E-Learning, 1 (3), 47-54. [Online]. Retrieved February 13, 2008, from General OneFile via Gale: http://find.galegroup.com.dml.regis.edu/itx/start.do?prodId=ITOF

Joshi, Pushpanadham, and Khirwadkar discuss the importance of education in the context of the Indian government's push towards becoming a knowledge-based society. Core to the concept of a knowledge-based society is education and the ability to produce a highly skilled workforce. The article outlines the educational system as of 2002 and also identifies the challenges India must address in order to "compete at the leading edge of the world's economic activity" (p.48). The article does not address the India Institutes of Technology or Management, rather, the public education system. This is an important distinction as it shows that within seven years, the government of India is still facing the same challenges with the education system as has been previously identified.

The article also highlights the use of ICTs as a mechanism to maintain the teaching and learning process within the educational system. For example, the authors discuss the concept of online learning within universities to expand programs, along with the ability for students in various areas to take advantage of educational opportunities. The article highlights the importance of improving the educational system in India and the integration of technology to expand opportunities. The article does not reference any information about the authors with exception to their affiliation with the University of Baradoa in India.

Kalam, A., & Rajan, Y.S. (1998). India 2020 a Vision for the New Millennium. London: Penguin Books.

Kalam and Rajan provide an in-depth look at the India Vision 2020. The book discusses India's strengths, weaknesses, and areas of improvement for the country to attain developed status by the year 2020. Despite the book being published in 1998, the India Vision 2020 is often referenced in research discussing India's economic growth and provides a detailed resource with respect to how India visions itself for the future. The book also addresses the main challenges of infrastructure, education, poverty, and healthcare as important issues the government and its people must solve. The book provides further evidence to India's reliance on the use of science and technology as a means of growth, development, and part of the solution to India's challenges. In fact, Kalam and Rajan discuss science and technology as an Indian strategic asset and one that no country can discount if the path is toward developed status. Essentially, the Vision 2020 was written as the technological "blueprint to make India a developed country" (inside cover page).

The authors are both Indian scientists. Kalam was responsible for the development of India's first satellite launch vehicle and has worked closely with the government of India for many years. Rajan has also worked as a scientist with the government, was involved with the space program, and previously served as the senior technology advisor to the Confederation of the Indian Industry and Executive Director of TIFAC.

Karnik, K. (2008, March 13). Technology for rural India. The Economic Times. [Online]. Retrieved July 26, 2009 from http://economictimes.indiatimes.com/articleshow/2859967.cms?prtpage=1

Karnik argues for the use of viable technologies within rural India. The author acknowledges the lack of basic fundamentals in rural areas, yet also points to the need for technology to bridge the digital divide and empower the rural populations. For example, Karnik discusses the use of technologies for water purification or even a pump with a time-sensor (common in Indian cities) that would automatically distribute water. Karnik also addresses the gap between those that develop technologies and projects for rural India and the rural populations themselves. He suggests that projects being developed for rural India need to consider the actual need, industry, and how the population can receive economic improvement as a result of the technology. Essentially, Karnik's argument is for the use of smart, economically viable technologies to enable the lives of the people in rural areas. Karnik is the former president of NASSCOM.

Koh, W., & Wong, P. (2005, March). Competing at the frontier: The changing role of

technology policy in Singapore's economic strategy. Technological Forecasting and Social Change, 72, (3), 255-285. Managing Emerging Technologies in Asia. [Online]. Retrieved March 22, 2008 from Elsevier ScienceDirect database http://www.sciencedirect.com/science/article/B6V71-4DGYJS7-1/1/b9740cdbd2dee86d7fb1a78b2dce5929

The article discusses the importance of technology and government-related policies to economic development. In this case study, the authors use Singapore as the example of how one country can use technology to become an innovation-based economy. While the article does not center its attention solely on knowledge, innovation is a key element to developing new knowledge (for example, scientific breakthrough, new technology, et cetera). The article examines the role of government policy towards technology, specifically with the intent to stimulate the internal technology infrastructure comprised of education, research organizations, and protection of intellectual property rights.

The authors compare other countries' (the U.S., Japan, China, E.U., et cetera) approaches in comparison to Singapore to highlight both strengths and weaknesses on a global level. Then, the authors discuss the primary elements of Singapore's approach to education, research, and intellectual property rights. Similar to the Das article, the authors point out that the continued success of Singapore is largely incumbent upon the entrepreneurship spirit. The government can help foster a more technologically centric environment for development, but it cannot uphold the ongoing development without the participation of individuals.

The article is relevant in the overall discussion of technology as a focal point of development, as it showcases the ability of a smaller country to be on a path to compete with other Asian and Western technological power houses (for example, the U.S., Japan, Finland, et cetera). From a research perspective, it validates the use of a case study to analyze a country's development path and also provides a possible scope to analyze particular government policies regarding technology. Koh is a professor at the School of Economics and Social Science at Singapore Management University and Wong is a professor at the NU.S. Business School at the National University of Singapore.

Kumar Pattnaik, B. (2005). Impact of globalization on the technological regime in India: aspects of change. *Perspectives on Global Development & Technology, 4*(1), 63-82. [Online]. Retrieved May 23, 2008, doi: 10.1163/1569150053888263

The author discusses the shift of India from a research and development viewpoint. Specifically the author discusses technology trends with respect to industrial research, academic technological research, and research and development within the manufacturing industry, such as

software and management. The article references the impact of the inward-focused approach that did not permit other corporations or governments to invest in India. The author charges that the wave of globalization forced the breakdown of the barriers and enabled India to be a competitor on the world stage.

Kumar discusses the dramatic change after India shifted its focus to the positive returns that research and development has had on the country. In fact, the author believes globalization strengthened India's capacity to become a technological leader and enabled the growth and expansion of research and development across three main sectors. The article highlights one of the main elements discussed within a knowledge-based society—research and development. The article can be used to illustrate how India has invested in its R&D efforts and what it needs to do in order to continue on the path of becoming a knowledge-based society.

Kumar Pattnaik is a professor of sociology at the Indian Institute of Technology.

Mashelkar, R.A. (2008). India science, technology and society: The changing landscape. Technology in Society, 30(3-4), 299-308. Retrieved June 20, 2008 from Elsevier Science Direct database http://www.sciencedirect.com/science/article/B6V80-4SPSHG9-3/1/f855669baf5dfc6bbfafaad3cb4e844b

The article looks at the development of knowledge within developed and developing countries based on economic standing and indigenous science and technology capacity. The author provides a matrix as a visual guide for the comparison, in which developed countries (such as the U.S., Europe, and Japan) are considered the highest in both categories; however, India is positioned in the lower quadrant as an "Innovative Developing Countr[y]" (p.299), categorized by low economic strength but high science and technology capability. The author discusses four pillars of science and technology in India: techno-nationalism, inclusive growth, techno-globalism, and global leadership. According to the author, it is these pillars that have helped shape the advances of India in the 21st century.

The article provides a different way of viewing science and technology within India and the world. It seeks to position India as a country on the path towards leadership within the developed world. While the article gives its readers a high-level overview, it seems to ask the same types of questions that other researchers have asked regarding what India needs to do in order to become a more powerful economic and technological force in the world. The discussion of the article centers on old technology (super computer) versus challenging the nation to be innovative in new technologies and sciences. While the author speaks to the importance of

economics, he does not discuss how technology can affect economic growth or how India can bolster both areas of the matrix.

The article frames the world within a single diagram correlating economic power with science and technology capability, illustrating that only a high combination of both will lead India into a developed status. This article provides an Indian perspective regarding where India fits in the developing world and how technology has influenced the government, its policies, and the country. The author, R.A. Mashelkar, is a CSIR Bhatnagar Fellow and the current President of the Global Research Alliance. Mashelkar has been an intricate part of the Indian government and involved in shaping science and technology policies.

Nath, V. (2000, April). Heralding ICT enabled knowledge societies way forward for the developing countries. [Online]. Retrieved May 18, 2008 from http://members.tripod.com/knownetwork/articles/heralding.htm

This article takes a specialized approach towards the development of knowledge-based societies by focusing on ICTs as the catalyst of such development. The author discusses the importance of ICTs as linkers and drivers of knowledge-based development in supplying and delivering information, accessing communication, and ultimately, connecting a country to the world. The article highlights the barriers to the development of ICTs and the policies for the public and private sectors that need to be established. The article tries to balance the divide of the developing and developed world and uses India as an example of success and Africa as an example of a continent trying to catch-up.

The author questions the feasibility of developing countries that "remain much isolated—economically, socially and culturally…" (p.1). The author argues that the body of knowledge must have a better understanding of the barriers that exist for developing countries and the challenges they face to jump into a knowledge-based development path. Some of the main barriers include culture, access to technology, infrastructure development, and even education as it pertains to technology. While this article provides examples of the challenges that developing countries face, it relies too heavily on ICTs and does not take into account the other facets of developing a knowledge-based society. The article was published on the Internet and while Nath uses credible resources for his study (Harvard Institute for International Development, Human Development Report, et cetera), Nath is classified as a consultant. The article was written when Nath was an Inlaks Scholar at the London School of Economics.

Narasimha, R. (2008). Science, technology and the economy: An Indian perspective. Technology in Society, 30(3-4), 330-338. [Online]. Retrieved June 20, 2008 from Elsevier Science Direct database http://www.sciencedirect.com/science/article/B6V80-4SNHP0W-1/1/f3bbc461508e229d827ad17dbdae2764

The article questions the role technology has played within the Indian economy. Specifically the author points to stark contrasts where technology has been used as a divider within the country, but at the same time a catalyst for overall growth. The author discusses India's development (key focus on technology) in three main phases: (a) early post independence where a strong science and technology infrastructure was built; (b) 1980 to 2000, when India opened its country to foreign investment and turned its interest to technology services (outsourcing); and (c) "the new century", whereby the government's focus has shifted to technology and rapid growth, and the consumer need for technology has also increased.

The author discusses a brief history of science and technology within India from post-colonialism to the present day. One of the interesting points made within the article is the focus and infrastructure provided even from the British government regarding science and technology. The roots of such interest appear to have helped India with the technological revolution of the 1990s and a shift to providing services to other countries. The author attributes most of the current success to the private sector and entrepreneurs versus the government and its policies. It is the private sector and the elites that have mostly benefited from the economic gains of technological advances and not India as a whole.

The article is relevant to the study as it highlights the growth of the country from post-independence to present day in terms of science and technology. It provides the ability to understand from a historical perspective the infrastructure and policies that were established, laying the groundwork for India's success. The author seeks to combine technology and economy and discusses the various economic policies and growth rate of India during the three main phases. It is clear that the author views India as a growing country with major challenges to overcome before it can even consider itself to be a science and technology leader within the world. The author, Roddam Narasimha, currently serves on the Scientific Advisory Council to the Prime Minister of India, has held visiting professorships within the U.S., and has a strong interest and background in aerospace. The article was written from a past-to-present perspective, through which India has overcome challenges and made progress, yet the author is realistic, acknowledging that India has some time to go before it can claim a developed country status.

Nobrega, W. & Sinha, A. (2008). Riding the Indian Tiger. New Jersey: Wiley & Sons.

Nobrega and Sinha discuss India from a business perspective as they have written their book to "give businesspeople and other interested readers an exciting look at the 'new India'" (p.vii). The new India is a representation of current economic growth, rising middle class population, and new opportunities to further propel India as one of the world's fastest-growing economies. Nobrega and Sinha describe how India came into its position and further support their argument that India will eventually outperform China based on democracy, determination, and demographics. The book views India as a free market that is well-positioned to become a powerful country in years to come. Nobrega and Sinha also discuss the major challenges relating to India's infrastructure, which underscore the argument that infrastructure has been one element that is India's biggest threat. The book further outlines the industries that will take India to the next level after the IT services revolution, and provides an understanding of the different business cultures for organizations seeking to conduct business in India.

The book provides readers with a different view on India, one that is rooted in democracy, a free market system, and has been economically successful. The country is viewed as a place of opportunity and driven not by the government, but rather by the millions of entrepreneurs who are striving for a better life. Both authors believe that India will be the success story out of Asia.

Organization for Economic Co-Operation and Development. (2007). OECD Economic Surveys, India. Volume 2007/14.

The OECD Economic Survey on India provides an overview of India's economic climate as of 2007, challenges to sustainable and increased growth, along with analysis of the many industrial sectors (such as IT services) within the country. The report offers data for each of the sectors, overall economic growth and recommended changes India should consider to attain sustainable growth. OECD outlines some of the same issues as referenced within the report and provides relevance with respect to data collected on India's economy. The OECD is an organization with a membership of 30 countries committed to democracy and a free market economy. The OECD promotes sustainable economic growth, financial stability, assisting other countries on their path to development and contributing to growth in world trade.

Roy, S. (2009, May 19). A brain drain in reverse, back to India. *National Public Radio*. [Online]. Retrieved August 4, 2009 from: http://www.npr.org/templates/story/story.php?storyId=104252712

Roy reports on the lives of three young Indians who decided to return to their country amidst a global economic crisis. One of the primary reasons cited for Indians returning relates to growth and stability of the Indian economy in comparison to Western countries. While the story only highlights three individuals, it serves as an example of a possible trend of knowledge returning back to India instead of the brain-drain that is typically encountered once Indians graduate from universities. This article provides a counter-argument to India's brain-drain, one of the many criticisms of the IITs and IIMs. While a brief news radio story, it assists with the explanation of what is currently happening in India and how the global financial crisis has had positive consequences in terms of increasing India's pool of highly educated workforce.

Sanjay, B.P. Opportunities and risks for India in the knowledge society. [Online]. Retrieved September 12, 2008 from http://lirne.net/resources/netknowledge/sanjay.pdf

This brief article discusses the "euphoria" surrounding the concept of the movement towards knowledge based societies, as economies move away from "agrarian to industrial to information societies" (p.202). The author suggests that this movement path might be true for many economies and countries, but it is not the case for India. The article addresses the focus of India's government on technology, with such initiatives as "IT for the Masses"—the purpose being to drive development vis-à-vis technology and ICTs in all sectors of society (both urban and rural). The author questions the focus on technology development when the country has many social issues to contend with, such as high levels of illiteracy. Knowledge is the other issue discussed in the article, whereby the author argues as to whether or not Indian scientists and technologists "can access knowledge on an equitable basis" (p.205); primarily based on intellectual property rights in the developed world. The author believes that on a macro level India should be careful with conducting development solely through technology and lessen its infatuation with technology.

Saraswati, J. (2008). The Indian IT industry and neoliberalism: the irony of a mythology. Third World Quarterly, 29(6), 1139-1152.

The author argues that the studies and recent "explosion of interest" in India's IT industry "has given the impression that the industry is a new phenomenon" (p.1139); however, the author points out that the success of India's IT industry can be traced to pre-1991 liberalization efforts. The main focus of the article is to stress the importance of government intervention, policies, and achievements in the development of IT in the 1970s and 1980s. Specifically, Saraswati attempts to refute the current analysis that seems to downplay the history of India's focus on science and technology.

Saraswati identifies three historical periods that can be attributed to the development (or even success) of today's Indian IT industry: (a) the first period starts in 1970 and is defined by state control; (b) the second period begins in 1977 with the election of the Janata party and the focus of indigenous policy which faded into the objective of increasing computers within the country; and (c) the final period of analysis starts in 1986 with the organization of the software industry and its growing influence on overall policy and direction. The concentration of the article is solely on the efforts of the Indian government to promote, direct, and generate growth within the IT industry. Saraswati mentions that if the government would intervene to the level it has with the IT industry, other areas would also see improvement.

The article seeks to provide an answer to the heightened interest of India and the country's rise via the IT industry and argues that the 1991 economic liberalization is only a part of the entire story. The article discusses the history of India's technology policies and work within an incubated state. Jyoti Saraswati is a professor at the University of Oxford in the Department of International

Tanguturi, V. & Harmantzis, F. (2009) *ICT infrastructure in two Asian giants: A comparative analysis of China and India*. [Online]. Retrieved July 31, 2009 from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1085928

Tanguturi and Harmantzis provide a comparative analysis of the ICT infrastructures of India and China. The article attempts to outline the strengths and weaknesses of both countries as they relate to technology with respect to economical, political, educational, and social factors. The authors analyze the state of both countries' ICT infrastructure, tele-density, cell phone usage, and the liberalization of the markets. The authors compare India and China on three main factors: awareness, availability, and affordability of ICT technologies. In their analysis, the authors identify China being advanced in all three areas, with India only benefiting from a pool of educated, English-speaking professionals that service the outsourcing sector. Tanguturi and Harmantzis discuss India's lack of infrastructure as a major downfall to enabling the country to reach the same levels as China has in a short period of time.

The article draws attention to the two fastest growing countries in Asia: India and China. Many researchers focus on these countries as the next dominant countries in the world; however, part of their success also relates to their saturation of ICTs and ability to use technology within their economic growth model. The authors conclude that while India has made overall progress, it must work to catch up to its counterpart. Tanguturi is a research fellow at the Institute for Infocomm Research in Singapore and

Harmantzis is an affiliate professor at the School of Technology Management.

Thomas, P. (2008, January 18). Bhoomi, Gyan Ganga, e-governance and the right to information: ICTs and development in India. Telematics and Informatics In Press, Corrected Proof. [Online]. Retrieved March 22, 2008 from Elsevier ScienceDirect database http://www.sciencedirect.com/science/article/B6V1H-4RM7MX6-1/1/ba384ee2d8d01f2474c162438e596858

This article discusses the use of ICT projects throughout India in an attempt to bridge the rural areas into mainstream technology use. The article states that "India, accounts for 60% of the ICTs projects in Asia…" (p.2). With such a high level of government-based, private-based, and joint initiatives, it would seem that India and all of its peoples should, for the most part, be on the way towards a higher level of access to information technology and the use thereof. However, the author argues that India's ICT projects are wrought with major challenges, some of which include corruption and most of which center on the traditional culture (limitations around gender, class status, privilege, et cetera).

The article describes two main projects: (a) the Bhoomi project, a state-based initiative in Karnataka, India, to digitize all of the land records in the state and provide access to the information via computer kiosk and biometrics (fingerprint) authentication; and (b) the Gyan Ganga project, a joint state and private sector initiative in the Indian state of Gujarat with the attempt at bringing several electronic forms of information (e-health, e-government, education, et cetera) to the rural masses. The article provides a broader understanding of the projects, the successes, and the major challenges that must be dealt with. The author brings to light the issue of culture and engrained traditions that can overshadow the intent to bring India and all of its peoples into the technological mainstream.

The relevance of the article surrounds the understanding of how India can have the most ICT projects in the Asian region, but not be at the same level of countries like Japan in terms of overall technological growth, access, and use. The most important themes of this article are the culture and traditions of India, which can impede initiatives based in the public and/or private sectors. Thomas is an associate professor at the School of Journalism at the University of Queensland in Australia. Thomas coordinates research at the school with a focus on communication, social change, and the political economy of India.

Tripathi, M. (2006, September). Transforming India into a knowledge economy through information communication technologies—current developments. The International Information & Library Review, 38 (3), 139-146. International Information Issues: Selected Papers from the American Society for Information

Science and Technology Special Interest Group. [Online]. Retrieved May 23, 2008, from Elsevier ScienceDirect database, http://www.sciencedirect.com /science/article/B6WGP-4KNKH1J-3/1/331b2a81c490502fda7ee63b69fe2f0c

The article uses ICT as a basis for measuring India's success and required areas of improvement to becoming a knowledge-based economy. The article discusses that the development of ICTs within India can play a "pivotal role" to transforming the economy. While this may indeed be true, the article points to several challenges that India must overcome. First, the majority of the population and local economies are in rural agricultural areas. Second, there needs to be a greater emphasis on education, access to power, and inclusion of indigenous content within the applications and Internet. Finally, India needs to have a better system of universities and education centers for research, and must lessen the overall bureaucracy associated with these systems on local, state, and national government levels.

The article discusses that while India has made progress (tenth largest network in the world, seventh in the world for personal computer penetration); it still has a long way to go in order to reach its vision of becoming the first knowledge state. The article suggests that there should be greater coordination and cooperation among government, private, civil, and non-government agency stakeholders in order to ensure success of India's goal.

The author's credentials are unknown; however, the article was retrieved from an information sciences academic database. The author uses many references including documentation from the World Summit on the Information Society, National Association of Software and Services Company, OECD, and other articles covering the topic of knowledge society and India.

Tripathi, S. (2007). India's growth path steady but not straight. *Issues in Science & Technology, 23*(3), 63-72. Retrieved September 24, 2008, from Academic Search Premier database.

The article discusses the growth of India since 1991, when according to the author, "India stopped micro-managing its economy" (p.63) and effectively instituted macro policies that not only encouraged foreign investment, but also made it easier to conduct (and maintain) business in India. Table one outlines a comparison of capital flows in India from 1992–93 to 2004–05, which shows the capital inflow in 2004–05 has greatly improved. The article furthers the discussion on investment by pointing out that India has a higher than average formation of domestic capital, making it less reliant on foreign direct investment versus its Asian neighbors (for example, China and Japan).

The article discusses the comparisons that are made between the Chinese and Indian development paths. The author acknowledges that China is "far ahead of India in having built much superior infrastructure" (p.67) and by attracting millions of dollars in foreign investment. Yet, the author also points to India's self-sufficiency and reliance on entrepreneurship to promote the economy. The article shifts in tone as it discusses the focus of the government on science and technology and the somewhat lofty goals of the Vision 2020 plan for India. The author discusses the education system, research and development initiatives, technology infrastructure (ICTs), and the internal resource power with respect to science and technology developments.

The article provides an analysis of how India grew in the past few years and whether or not it is able to truly transform itself into a developed country. The author questions India's ability to be successful if it cannot look beyond the technological focus of science and technology—yet the author believes India's dreams are worth pursuing. The author is a writer and journalist based in London.

Utz, A. (2005, April 26). India and the knowledge economy leveraging strengths and opportunities. Knowledge for Development Program PREM Learning Week. World Bank Institute. [Online]. Retrieved May 18, 2008 from http://info.worldbank.org/etools/docs/library/138921/India%20KE%204-25-05.pdf

This resource is a presentation given during a week-long session at the World Bank. The presentation is a summary of the book (*India and the Knowledge Economy, Leveraging Strengths and Opportunities*) co-authored by Anuja Utz, who discusses India's focus on the development of a knowledge-based economy. The presentation provides a general overview of India's economic growth path from 1950 to present, and covers general economic strengths and weaknesses in comparison to other countries in the Asian region. The presentation shifts to outlining "four pillars of the knowledge economy." The four pillars include an economic and institutional regime, education and training, an innovation system, and information infrastructure.

The presentation highlights India's performance to date, main strengths, and areas of improvement in each of the four pillars of the knowledge economy. The presentation concludes with a summary that identifies four main economic development paths for India. The paths are based on current track growth, accelerated growth or the worst-case: that India would fail on its knowledge-based path. The presentation provides a general overview of India on a global and regional scale in terms of a knowledge-based development path. It provides key statistical measures

and benchmarks that can be used or further explored as a means to showcase how other non-governmental organizations are tracking knowledge development.

Venkata Subramanian, K. (2003, June). India as knowledge society. [Online]. Retrieved September 20, 2008 from http://www.eduwatchindia.com/Issue_3/india.pdf

The article discusses the focus of the Indian government on becoming a knowledge-based society. The author quotes Prime Minister Shri Atal Bihari Vajpayee, "A knowledge based society will enable us to leap-frog in finding new and innovative ways to meet the challenges of building a just and equitable social order…" (p.39). The article maintains general agreement with the direction of the government and does not seek to counter the claims. Essentially the article is an overview of the goals that the Indian government seeks to pursue. The four main "Science Envelope Goals" include (a) an innovation goal, which aims at strengthening the importance of building a culture of innovation; (b) an economic goal, where new knowledge and technology will drive the growth of the Indian economy; (c) an environmental goal, focusing on the importance of protecting the environment as it relates to sustainable development; and (d) the social goal, considered to be the most important as it references the alleviation of poverty in India.

Overall the article seems to concentrate on the goals and objectives of the Indian government, which seeks to become a knowledge superpower. The article seems to outlay all of the plans the government has, but does not really address how the government (or even the private sector) should make the goals a reality. The article can be used as a reference for the direction of the government, but not as a critical analysis of the how or why. The author, Dr. K. Venkata Subramanian, is a member of the Union Planning Commission in New Delhi and is also a member of the Task Force on the Development of India as Knowledge Society.

Wallace, R. (2008, February 25). India rides growth wave into new age of tech globalization. *Electronic Engineering Times*. Retrieved September 24, 2008 from LexisNexis Academic database.

The article discusses the growth of India within the context of a recent event: the Indian Leadership Forum in Mumbai. The author highlights that India is positioned to emerge "…not just as the region's business and technology leader, but as a more powerful player in the global IT sector" (p.1). The author highlights the IT focus within the country and expectations that India will evolve from a services-only model to an innovative and knowledge-based model—actually developing intellectual property and delivering as a value-add into the world versus being an

outsourcing center. The article makes cross comparisons with India, China, and Israel as technology hubs and provides examples where India's model of development is being copied by other countries. For example, the author quotes a Pakistan official outlining Pakistan's goal to establish research and development centers as a path to technology development, a goal which is similar to the steps India took many years ago.

The article uses quotes and segments from business and government officials to showcase the strengths and weaknesses of India in its path towards development. Also, it highlights the importance of globalization: India cannot be on its current trajectory and still rely on indigenous growth. Rather, India needs to broaden its outlook to be able to provide technology, innovative products, and value-add to businesses around the world. The article provides a very basic overview and insight into different events, businesses, and players within the technology-driven development.

Wipro Infotech. (2009). Egypt: Through the Eyes of Indian IT. [Online]. Retrieved September 3, 2009 from http://www.wipro.in/newsroom/wiprointhenews/NC_EgyptGSMCjuly2k9.pdf

While this article is from the Wipro Company, it provided insight from a company based in India that is looking to Egypt for part of its outsourcing operations. The article outlines Egypt as one of the sixth most attractive offshoring destinations due to the attractive environment for foreign companies that the government created coupled with a strong ICT infrastructure and skilled professionals. The article further discusses Egypt's strategic placement near Europe and the Middle East (much closer than India), providing a prime location for Egypt to grow its offshoring/outsourcing business to companies within those regions.

The most interesting aspect of the article surrounds the fact that it is an Indian company looking at Egypt. If a multi-billion dollar Indian corporation will transfer part of its operations to Egypt, then it raises a valid point regarding how long India has to continue its lead within the same industry. The author of the article is unknown.

Zwerdling, D. (2009, April 14). 'Green Revolution' trapping India's farmers in debt. *National Public Radio*. [Online]. Retrieved August 21, 2009 from http://www.npr.org/templates/story/story.php?storyId=102944731&ps=rs

In the second of a two-part series, Zwerdling reports on the new challenges farmers are facing as a result of the Green Revolution that occurred in the 1960s and 1970s. Zwerdling explains that during this revolution of farming in India, farmers began using high-yield seeds, developed irrigation systems, and also used pesticides and other chemicals

to protect the crops. While the Green Revolution was praised as a success and enabled India to feed its people, the consequences are materializing several decades later.

Zwerdling discusses that the high-yield seeds used by Indian farmers required a significant amount of water compared with traditional farming methods and crops. Thus, famers had to use wells and ground water to irrigate their fields to meet production demands. Zwerdling states that as a result of many decades of this type of farming, the consequences relate to diminishing ground water. For example, he explains that wells must be drilled at least 200 feet in the ground before any water is reached. The lack of readily available water, a growing population, and an agricultural industry that is no longer capable of producing the same yields it did nearly three decades ago can lead to the same crisis in which India found itself prior to the first Green Revolution.

Zwerdling, D. (2009, June 1). In India, bucking the 'Revolution' by going organic. *National Public Radio*. [Online]. Retrieved August 21, 2009 from http://www.npr.org/templates/story/story.php?storyId=104708731

Zwerdling reports on a new trend among some Indian farmers who are shedding the farming of the Green Revolution and integrating organic farming techniques. Zwerdling highlights one farmer, who during the peak period of the Green Revolution was making a profit, as crops were yielding more each year. However, after two decades of repeating the same cycle, the farmer had to keep investing more in fertilizers and pesticides, thus dwindling away at any profit to be made.

Zwerdling reports that nearly 300,000 farmers have switched to organic farming techniques in an attempt to reverse land degradation and make a profit with their new yields. Yet, Zwerdling poses the main question underscoring this debate: "What's the most sustainable way to grow enough food?" (p.1). Zwerdling reports that organic farming results are mixed, though some farmers are hopeful that this will prove to be the way of the future. The article describes some of the natural or unforeseen consequences as a result of relying on technology as a primary means of fixing a problem. It also sheds light on a new challenge that might face India in a few years, if organic farming does not provide a way for a sustainable agricultural industry that can produce enough food for the country.