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1-18-2009

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Sheth, A. P., Lulla, K., & Chaudhary, S. (2009). Why Gujarat Needs Much Better Higher Education & Research to Succeed in Knowledge Economy & What We Can Do About It?. . <https://corescholar.libraries.wright.edu/knoesis/274>

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Why Gujarat needs much better Higher Education & Research and what we can do about it?

Prof. Amit Sheth, with Dr. Kamlesh Lulla and Prof. Sanjay Chaudhary

White paper given to the CM, Gujarat at the Round Table on “Regulatory & Policy Reform for Higher Education in Gujarat,” in conjunction with the International Conference on “Reconnecting Gujarati Diaspora with its Homeland: Contribution to its Development with a Focus on Building a Knowledge Society” (Patan-Gandhinagar, Jan 17-19, 2009). **For significant additional details and data, please see associated presentation.**

Summary

This white paper distills the deliberations on the role of higher education and research as a key enabler of a Knowledge based Society. In particular it discusses (a) the importance of higher quality PhDs for building a knowledge society, (b) the initiatives and progress in competing economies in higher education and research, (c) where Gujarat stands in comparison, and (d) some recommendations on what Gujarat can do to enable timely progress towards building a knowledge based society and economy. These deliberations were conducted in conjunction with the International Conference on “Reconnecting Gujarati Diaspora with its Homeland: Contribution to its Development with focus on Building a Knowledge Society” (January 17-19, 2009, Patan) at presented to the CM Shri. Narendrabhai Desai at the Round Table on “Regulatory& Policy Reform for Higher Education in Gujarat” (January 18, 2009, Gandhinagar).

Importance of Research and higher quality PhD for building a Knowledge Society

Gujarat has already embarked on comprehensive development encompassing the three critical segments- agriculture, manufacturing and services (CM Modi at Vibrant Gujarat, 2009). The next phase in world economy is decidedly being transformed by Knowledge based activities. From development perspectives, two aspects of knowledge driven development needs to be recognized: (a) as exemplified by companies like Google whose market value is about one tenths of India’s GDP, the greatest wealth creation is in the 21st century is demonstrably in these knowledge-driven businesses, and (b) even for agriculture, manufacturing and services activities, the greatest growth is in the higher end, knowledge-driven activities (Figure 1). Key enablers of these components of economy are shown in Figure 2.

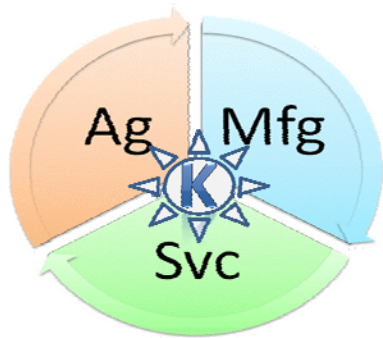


Figure 1: Knowledge-based activities is significantly increasing the growth rates of traditional parts of the economy

Agriculture	Manufacture	Service	Knowledge
Land, seeds, labor	Labor, machines, raw material	Skilled people	Highly educated people who can innovate

Figure 2: Primary enablers of different economic activities; for knowledge economy, we need people who can innovate

Innovation that drives emerging knowledge economy is shown to result from two key factors: entrepreneurship, something that Gujarat has in good supply, and research capable highly educated work force, something Gujarat sorely lacks. Many of the new knowledge-driven companies have been started by PhDs and as a spin offs of research universities (e.g., Google, Yahoo!). Figure 3 shows the capstone role of PhDs.

In response to the question, “Why few cutting edge companies in India?”, Sumir Chadha, Managing Director of Sequoia Capital India, answered: “No research at universities.” Sadly, as also noted by the National Knowledge Commission (NKC), of what “research” there is, much of it is copy cat or of poor quality. Importance of highly educated work force and research culture is underlined by these two quotes:

- "Good Ph.D. students are extreme in their creativity and self-motivation. Master's students are equally smart but do not have the same drive to create something new." (Rajeev Motwani, Professor of Computer Science at Stanford , an iconic research university).
- “The master's takes you where others have been; the doctorate, where no one has gone before. “ (Randall Stross).



Figure 3: PhDs will be critical to aspiring knowledge economies

Besides discussing importance of research-based higher education and more PhDs, we study the competition and assess current state of progress made by US and China (which Gujarat aspires to compete with), contrast it with current state in Gujarat and India, and provide some prescriptions that can enable Gujarat to succeed in building the knowledge society.

Importance placed on Research-based Higher Education by China

US, UK, Australia and China are some of the key countries that have either the tradition of or significant recent progress in developing research-based education and a workforce that can skills innovate. As an

exemplar of another developing country that is well on its way to achieve parity with developed countries through its transformative education policy, we briefly summarize the key objectives and results of China's education policy.

China's goals have been *influencing the global economy*- maintain high growth by using educational transformation as the primary mechanism for skill upgrading and raising total productivity. To achieve this goal, it set forth the key objective of (a) quintupling enrolment, (b) graduating more Ph.D. engineers and scientists in China by 2010 than in the US and (c) completing a shift from quantity to quality. The mechanisms it has used include (a) focus on elite universities, with new academic contracts that differ sharply from earlier ones, and (b) (unlike India's focus on primary & secondary education) focus on upgrading higher education. To effect a shift from quantity to quality, China has placed priority on international rankings, taken as publications in international journals, citations, and international cooperations. These measures of attainment are directly linked to institutions' funding. It is not uncommon for an annual target of three international publications to be set for faculty members, and failure means termination of employment. The results have already been impressive. Higher Education has been growing at approx. 30% per year since 1999, and the number of graduates at all levels of higher education has quadrupled in the last six years. Skilled labour supply in China now equals around 40% of that in all OECD countries. This has resulted in major implications for global trade both directly in ideas, and in idea-driven products. For example, in spite of Google's world domination in Web Search, the largest Web Search company in China is her home grown Baidu!

State of Affairs in India and Gujarat

A telling comparative statistics this- India has 157 researchers per million, China has 633, and USA has 4,526. Furthermore, while China is rapidly to catch up with USA and USA is working hard to keep its lead, India seems to be stagnating. Another telling figure is this—among top 500 universities in the World, India has two and China has 23.

The IITs were to focus on research and post graduate education to keep India on the leading edge of knowledge in science and technology and to educate PhDs who would lead R&D in India's industries and serve on the faculties. The IITs would thus have created a multiplier effect and a culture of innovation. Unfortunately, despite its success in undergraduate education, they have failed on research and post graduate education.¹ None of the IITs rank in the top 100 institutions in the world in research, and IIT professors and graduates hold few significant patents. MIT's annual research output dwarfs that of all the IITs combined. Nor are the IITs graduating enough PhD students to meet the faculty recruitment needs or those of industrial R&D centers (for example, 70-80% of PhDs at IBM Research Labs in India got their degrees outside of India), let alone create a national culture of innovation. IITs are also unable to attract good students for post graduate work.

Current situation in Gujarat is qualitatively the same as that of India. In the critical area of information and communication technology-ICT (including Computer Science & Engineering), for example, there is

¹ Kalyan Singhal, A Renaissance of the Indian Institutes of Technology (IITs), The Hindu.
http://www.hindu.com/nic/renaissance_iit.htm

only one university that has all PhD faculty and a research culture. Practically all other universities and colleges have failed in hiring and retaining faculty that have PhD and none in the ICT fields (with the exception of DA-IICT) seem capable of supporting a research culture. We produce a handful of PhDs each year and the quality leaves much to be desired. It is rare to find an academic that has international stature. The well known Gujarat saying is very apt in this context- "*kuva ma hoi to havada ma aave.*"

Prescriptions for Gujarat

Gujarat government has orchestrated impressive strides in agriculture, manufacturing and services. With the emphasis on education, as demonstrated by significant announcements made at Vibrant Gujarat 2009, the current Government has also demonstrated its serious intention to change the situation. But unless we also address research and high quality higher education, we may have the same challenge that we had in IT sector.² We feel the time is right for Gujarat to set goals with measurable outcomes. Here are two for consideration: Can we target one university in Gujarat in top 500 in the world in next 5 years? Can we target one university in Gujarat in top 100 in the world in next 10 years?

We believe the most appropriate vehicle for building a research university that best embodies the ideas discussed here is that of National University along the lines discussed by the NKC. Here is a partial list of what will it take to build such a Research University which can be considered along with excellent guidance provided by the NKC.³

- The leadership of the CM Shri Narendrabhai Modi and the support of policy makers, with the mandate to avoid the current problem of "over regulation and under governance" will be key. The CM and cognizant ministers can possibly facilitate this by enlisting the help of an industry leader whose vision matches what is presented here.
- Top academic and research leaders that are internationally recognized by the peers for its director and senior faculty positions (such people are fellows of professional societies such as IEEE, ACM, NAS; are highly cited research authors; have developed transformative technologies that have been widely adopted).
- Ensure Academic and Institutional independence. Give the University the mandate to be among top 500 in the World, top 100 in Asia and the best in India. Let merit be the only criteria for all decision including faculty hiring and promotion, and student admissions. Need and other affirmative action consideration can be used for student financial assistance. All PhD students should receive competitive financial assistantships.

² The IT companies were set up where there was available highly educated workforce and Gujarat missed out during the first decade of high growth in IT sector due to the lack of qualified work force.

³ More Quality Ph.Ds, National Knowledge Commission, December 2008.

Towards a Knowledge Society – Three Years of the National Knowledge Commission, October 2008.

- Follow a balanced research, teaching and professional service model used by practically all top research universities (Figure 4). Assign faculty responsibilities accordingly. Make research and graduate training part of faculty job requirements.
- Expect faculty and students to compete at international level (e.g., attach higher value to publications in ISI/Thomson Scientific Indexed journals and high impact conferences with less than 20% acceptance rate). Correspondingly provide resources for competitive research grants (e.g., on the models of National Science Foundation in US, China, Australia and UK) that can also support study abroad and travel for international conferences.
- Leverage collaborations with top international places and experts. Promote collaborations between industry and academic research. Recognize the importance of multi-disciplinary research and courses.

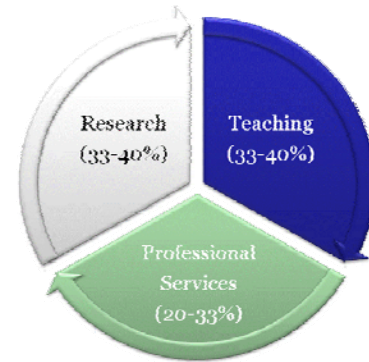


Figure 4: Necessary components of a Research University

Conclusions

We congratulate the Gujarat government under the able leadership of the CM for orchestrating its march towards balanced development, and anticipate rich returns on significant recent investments in primary, secondary and undergraduate education. We now encourage Gujarat to address the critical needs for post graduate education with emphasis on research given its pivotal role in enabling a knowledge society Gujarat seeks to usher into. Within Gujarati Diaspora, we may find some internationally recognized educators and researcher who we are sure will be delighted to play a role in meeting this challenge.

About contributors

Prof. [Amit Sheth](#) is a researcher, educator and entrepreneur. He is a Fellow of the IEEE, the LexisNexis Ohio Eminent Scholar and Director of Knowledge-enabled Information & Services Center (Kno.e.sis) at the Wright State University in Dayton, OH, USA. He is one of the best cited researchers in Computer Science (with 250+ publications and 15,000+ citations) and has started two successful companies based on his academic research. Contact: amit.sheth@wright.edu, +1-937-239-0625 (m).

Dr. Kamlesh Lulla is the deputy director of Research and Technology office at NASA Johnson Space Center in Houston, Texas. Dr Lulla trained NASA astronauts for fifteen years as the chief scientist for Earth Observations. He received NASA's Exceptional Scientific Achievement Medal in 2005. Dr. Lulla has published over 200 research papers, coauthored four books in space sciences.

Prof. Sanjay Chaudhary is a professor at DA-IICT, Gandhinagar. He has the distinction of being the advisor of first two PhDs from DA-IICT. His research areas are Distributed Computing and ICT in Agriculture. He has published three books and a number of research papers.