

The Global Economic Future and the role of Indian IT in creating it

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President Simmons, Mrs. Ogden, Dean Vohra, Prof. Varshney, Prof. Gutmann, other faculty members, students and guests, thank you very much for giving me this opportunity to deliver this year's Stephen A. Ogden Jr. '60 Memorial lecture. It is a great pleasure to be at this famous, Ivy-league campus. President Wayland's words, spoken more than 150 years ago, that this university should be a place where every student might study what he chose, all that he chose, and nothing but what he chose, have made this a unique place of learning. I thank the President for declaring 2009 – 2010 as the year of India. Coming from a family of teachers, my heroes and she-roes, borrowing the word "she-roes" from Maya Angelou, are students, teachers and researchers. You are my heroes and she-roes for a very simple reason – you believe in the power of questioning assumptions and inferences to advance knowledge. I am often reminded of the Chinese proverb, "He who asks a question remains a fool for a minute; He who does not remains a fool forever." Therefore, I thank Dean Vohra for this invitation to be here amongst you, the thinkers.

I have chosen to speak on a topic that has contemporary global relevance and that will highlight how Indian Information Technology (IT) can play a role in it. I will speak on what the aspirations for a global economic future should be and how Indian IT can be an active participant in that vision. When I think of global future, I get thoughts about many dimensions of global future – political, economic, health, technological, sustainability, peace, religion or spirituality and happiness. There are many indices for measuring our progress and one of the best-known indices is the Human Development Index that measures overall development in health, education and economic dimensions. However, it is clear that all these dimensions, excluding happiness and spirituality, are subsumed in economic and political progress. In the end, the goal of progress and development is generally agreed to be creating a vibrant democracy. The aspirational future for a system of governance was best summed up by President Roosevelt in his *Four Freedoms speech* when he said that an ideal democracy is one where every individual has four freedoms – freedom of expression; freedom of religion or faith; freedom from fear; and freedom from want. I believe in democracy. As Winston Churchill said, democracy may not be the best form of government, but the alternatives are worse. Democracy is about achieving the collective aspirations of a nation and not that of a few vested interests. Democracy mandates openness for discussion and debate, and generally brings out the

best idea. Democracies provide the best platform for addressing the basic needs of every citizen - education, health care, shelter and nutrition. A democratic setup creates equal opportunities for everyone to better his or her life. It also averts disasters as eloquently argued by Amartya Sen.

It is now accepted by most people that the four freedoms articulated by President Roosevelt are possible only through regulated and compassionate capitalism practised in an environment of democracy. The failure of communism, socialism and dictatorships in ameliorating the lives of people, with former Soviet Union, India and Venezuela taken as examples, and the gradual but clear conversion of communist regimes in countries like China and Vietnam to state-directed capitalism are good data points that buttress this theory. However, most countries that have made economic progress have taken two different paths to achieving economic freedom. Countries like China decided to first achieve economic progress and then look towards progress in the political dimension. Let us remember that even Deng Xiao Ping, former Chinese leader who ushered in state-directed capitalism in China once said, "Democracy is our goal but the country must remain stable". On the other hand, countries like India have embraced democracy first and then the goal of economic progress.

Bringing global economic progress is a huge challenge. While the developed world has to maintain its life style and improve it, the developing world has to make huge leaps in improving its economic well-being. All of this has to be done without endangering our planet. Right from the time of David Ricardo, it has been accepted that a country leveraging its competitive advantage in trade with another nation has a good chance of improving its economic status. Thus, globalization has played an important role in the economic progress of most developing countries.

What is globalization? I will define it at two levels. At the macro level, it is about frictionless flow of capital, services, goods and labour across the globe. It is also about global sharing of ideas, knowledge and culture. It is about creating a shared concern and plan for global issues like poverty, AIDS and the environment. At the microeconomic or firm level, it is about sourcing capital from where it is cheapest, sourcing talent from where it is best available, producing where it is most efficient and selling where the markets are, without being constrained by national boundaries. Thomas Friedman first used the term 'flat world' to popularize the power of globalization. A flat world is a world that facilitates globalization to flourish. Globalization provides opportunity for every nation to offer the best value-for-money products and services in the global bazaar without being restricted by bureaucracy, political hindrance or xenophobia. It provides a corporation with an opportunity to hire the best talent in the world, and to list on the

best stock exchanges of the world. A globalized corporation is different from a multinational corporation (MNC). An MNC, generally, starts a subsidiary in a country to produce and sell in that country alone. A globalized corporation, on the other hand, produces its products for the entire world in a country or a region where it is cheapest to produce. In a typical globalized corporation, product development takes place where human talent and innovation are best; production takes place at the factories situated in countries where it is most cost-effective to produce; and sales take place in countries with adequate disposable incomes.

Globalization has indeed advanced significantly in industries where a corporation from a country or a region has a distinctive, monetizable competitive advantage to offer in the global market. Examples abound. The computer industry, investment banking, the hospitality industry and the education sector are all clear examples of the prominent market share that the US has in the global bazaar, thanks to the distinctive competitive advantages and brand positions built up by US companies and universities in these sectors.

Reebok and Niké are pretty good examples of globalized corporations. During the early eighties, these pioneers of modern sports shoes realized the huge market potential for such shoes in advanced markets, and the tremendous cost efficiency, quality and productivity of labour in countries like Taiwan and South Korea. They hired brilliant designers in the USA to design leading-edge sports shoes, got them produced in Asian countries, hired brand experts and star brand ambassadors in G-7 countries to create powerful brands, and gained huge sales. The result was a huge win for customers since they got world-class shoes at competitive prices.

Air travellers in the US going from La Guardia airport to Ithaca flying Embraer aircraft from Brazil; well-known Wall Street companies running heart-beat systems designed by Indian software companies; the Indian companies and the Indian operations of companies like Intel, GE, CISCO and Texas Instruments filing over a thousand patent applications with the US patent office in the year 2004 alone; and sophisticated electronic gadgets like iPods, manufactured in China, filling the shelves of Best Buy in the US are all good examples of the global integration and the contribution of the developing world to the global economy. Thanks to globalization, the developed nations have gotten best-value-for-money in the global bazaar and the developing countries have created lots of jobs and helped millions escape poverty.

Globalization has become possible thanks to technology, particularly Information and Communications technologies. Internet, e-mail, video conferencing and collaboration

software have overcome the barriers of distance and time zones, and enhanced opportunities for virtual teams to work productively.

The story of success in globalization is also the story of innovation by developing countries to overcome barriers of constraints in serving the global markets. Let me turn to the specific example of how India used innovation to leverage the power of globalization to produce high quality software, on time and within budgeted cost for global clients, particularly those in G-7 countries. In the eighties, when we went to our US prospects to sell our expertise in large-scale software development, most prospects were sceptical whether US companies and Indian companies could work together since India and the US were 9.5 hours to 12.5 hours away from each other. That literally meant India and the US were as different as night and day! So, we came back, started discussions on how to overcome this huge problem and indeed convert this disadvantage to a huge advantage. The result was the unleashing of two major innovations – the 24-hour-work-day and the Global Delivery Model (GDM), both of which have become hugely successful models for remote, large scale software development. In fact, GDM and 24-hour-work-day have brought about a revolutionary change in productivity and quality of software development in the world. In my opinion, these two ideas are the most seminal contributions from India to the world in recent times. These ideas rank on par with the lean manufacturing concepts introduced by Japan in the fifties.

The 24-hour-work-day concept combines the prime time (7 am to 7 pm of a working day) of the staff of a company A with the prime time of another company B located in a time zone 10 to 12 hours away from company A to create a near 24-hour-work-day. In other words, the workers of company B will be busy delivering productivity even when the workers of company A are sleeping! This reduces the time-to-market for innovations of company A and improves its competitiveness. For example, this concept is extremely useful in real-time removal of bugs in a software system and in running relays in software development among virtual teams. Such productivity relay systems require complex technology-based systems that have been designed and implemented by Indian IT companies.

Global Delivery Model (GDM) leverages the power of software factory approach for remote, customized software development. GDM splits tasks in a large software project in to two classes. The first class of activities have a high level of interaction with the customer. Activities like requirements definition, installation of the developed software at customer site, training the customer in using the developed software, and rapid reaction warranty belong to this class. The second class of activities has low interaction with the customer. Activities like architecture, detailed functional design, detailed

technical design, programming, testing, performance engineering, documentation and long-term warranty belong to this class. Such activities can be taken up from scalable, talent-rich, process-driven, technology-enabled and best-value-for-money development centers in countries like India. In a typical project, about 20% to 30% of the total effort is delivered at customer site while 70% to 80% of the total effort is delivered from remote, cost-competitive development centers. Therefore, using the GDM model, customer gets better-value-for-money software on time and within budgets 95% of the time compared with 45% success rate using the traditional models developed during the seventies.

Indian firms have continued to invest in improving their GDM infrastructure. They have installed processes and technology to recruit and train a large number of professionals in software development, to enhance the quality of remote customer interaction, to foster innovation in software development and manage complex technology efficiently. They have also invested heavily in quality standards like the Capability Maturity Model (CMM) of the Software Engineering Institute at Carnegie Mellon University, in Six-Sigma and Malcolm Baldrige models, in productivity tools, and in leadership development initiatives.

In fact, the 24-hour-work-day and GDM have proved so successful that many major multinationals including IBM, Citigroup, HP, Accenture and Cap Gemini have adopted this model and scaled up their investments in people, physical infrastructure, systems, tools and technology in their development centers in India. Just as Japanese manufacturing companies embraced Deming's ideas of quality in the fifties, the Indian software companies have taken to quality standards like CMM Level 5 - the highest level of quality certification called the *Optimising level* in large-scale software development. In fact, about 65% of software companies certified to be at Level 5 of CMM are estimated to be from India. These companies have continued their quest to retain their lead by constructing world-class campuses, through focus on training, through further initiatives in quality and productivity, and by starting new services like the Business Process Outsourcing, Modular Outsourcing, Infrastructure Management Services, and Systems Integration.

Leveraging the 24-hour-work-day and GDM concepts, the Indian software companies have played a seminal role in developing and managing several mission critical applications for corporations and public governance systems for several advanced countries. These include design of digital switching systems, management of underground train systems, development of real-time trading systems, design of critical

aircraft components, management of advanced supply-chain systems, systems for merchandizing for the fashion industry, implementation of tax collection and e-governance systems, and business processing and help-desk support for most services including medical, tourism, legal and tax services. The Indian companies have added value to over 450 of the Fortune 500 clients in the US, to clients in over 100 countries, reached a revenue of US\$ 50 billion last year (perhaps over US\$ 250 billion if you normalize it for lower per-capita revenue productivity for work performed in India), and have created high disposable income jobs for over 2 million professionals in India. It is fair to say that the sun never sets on an Indian software company!

Let me now turn to what an ideal economic future should be for the world and the role of Information Technology in it. An ideal economic future should offer opportunities for every individual on this planet to obtain decent education, healthcare, nutrition and shelter, and live in comfort, peace and harmony, and with hope and happiness. The issues that threaten such a future are: changing demographic profiles with rich countries experiencing shift towards a decrease in productive age people and emerging countries like India experiencing demographic dividend or an increase in productive age people; scarcity of water, energy and other natural resources; warming of the planet; threat of new microorganisms that affect our health, the escalating time and cost of introducing new drugs, and increasingly expensive medical treatment models; and discontent resulting from huge divide between the rich nations and poor nations, and the threat of terrorism. I believe most terrorists come from nations that have lost hope in economic emancipation. Let us remember Aristotle's words that poverty is the mother of revolution and crime

Most of these concerns can be addressed through new technologies that we see on the horizon and those that our scientists and technologists are focussing on in their laboratories in the universities and in companies. Let me talk in brief about some techno-trends that will alleviate the concerns that I raised earlier.

Genomics-based bio-technology and pharmaceutical research will unleash new drugs specific to individual needs with reduced cycle times. IT has already played a major role in mapping of the genome and will play continued role in new drug discovery. Several Indian software firms are collaborating with western firms in the area of genomic databases, genetic algorithms and accelerated clinical trials. The scarcity of medical and surgical skills in developing nations and the need to reduce response times to critical patients in developed nations will make remote surgery and medical consultation increasingly common. Mathematical models for drug-simulation will weed out many

drugs early in the development process, and reduce the time and cost of drug discovery and approval process from the current standards of 10 years and an expense of at least a billion dollars. Nanomachines will be used to deliver special drugs to specific places in the human body to kill cancer cells as well as repair heart and other organs without any invasive surgeries. These advances will become possible, thanks to the application of Nano, IT, imaging and communications technologies. There is considerable work going on in improving agricultural productivity through genetically-modified grains. Such agricultural products will have a longer shelf life, will be richer in vitamins, proteins and nutrients, and will have higher resistance to pests. They will be a boon to developing nations.

There will be greater focus on alternate energy sources like solar energy and non-fossil-based energy. Nano solar cells will become popular, thanks to their small sizes. Using advanced computer models, large power generators will be networked on intelligent, national and international smart grids on the one hand while smaller, locally-generated power sources will share their excess power using such networks. Cars running on compact, high-power batteries will become popular. These cars will have advanced computer models driving complex instruments to make driving easy and safe. Mobile energy units with high capacity and miniature sizes will become popular. The current emphasis on Greentech and cleantech will be accelerated to reduce carbon emission in buildings and in automobiles.

Ubiquitous computing is a paradigm in which real time devices, computing and communication technologies combine to provide any-time and any-where access to information and analytics to blur the distinction among office, home, relaxation and entertainment environments. This paradigm will be enabled by grid computing and cloud computing, low cost broad band networks, miniaturization, tagging devices and reduced cost of computing. The ability to run complex computer models on hand-helds with data coming instantaneously from huge corporate databases will accelerate mobile decision making for corporate executives. Advances in computing will lead to intelligent appliances like refrigerators that produce shopping lists and telephones that have yellow pages inside and food packaging that tells the oven how to cook the dish. Advances in the use of white spaces in wireless spectrum will lead to reduced cost of bandwidth. Smart tags technologies will bring enhanced productivity to both corporations and individuals.

National, institutional and individual security will receive a boost with advances in robotics, night vision, pattern recognition and war-gaming technologies. Quantum

encryption is likely to enhance security by creating a unique key for each message and irrevocably altering the signal at any attempt to intercept the message.

Water is a scarce commodity in most nations. Filtering, processing, waterless washing, and making desalination of water cheaper will receive further boost in research laboratories. Indeed, the biggest concern of most nations today is making available the required supply of water to citizens at affordable rates. There are fears that the next world war may be fought because of water. Here again, computer models will play an important role in optimum use of water.

Development, upgradation, and maintenance of information systems that enhance the competitive strength of corporations worldwide will be accelerated. Given that computer hardware and software platforms are evolving rapidly, and that new business models are being introduced, it is extremely important that corporations take the lead in embracing such technologies to improve their differentiation in the market place.

Development, upgradation and maintenance of public information and e-governance systems that enhance the quality of service, improve transparency and accountability of governmental institutions worldwide will become more widespread. This need is even greater in the developing world where there are hardly any e-governance systems.

We can sum up the challenges of the global economic future essentially as improving opportunities for education, healthcare, nutrition, shelter, peace, harmony, comfort, fairness and justice for every citizen of this planet.

Every one of the advances I mentioned above requires complex computer modelling, development of new software platforms and applications, re-engineering of existing applications, maintenance of large, complex software systems, and new models of collaborative development of software and remote process management technologies. Such an ambitious research and development agenda cannot be achieved without a huge global talent pool well versed in IT. This is where India, the GDM, the 24-hour-work-day and the collaborative distributed software development concept will play an important role in shaping the economic future of this planet. India is well placed to continue to serve as the software development center and the business process management center of the world due to the following reasons:

First, India, thanks to its huge population and focus on higher technical education, has become a reservoir of technical talent. Infosys alone recruited over 25,000 software professionals last year and trained them at their central facility. It is a well known fact that there is a shortage of over 200,000 software professionals in the US alone. Every year, India produces 450,000 engineers while the USA produces 70,000 engineers a

year, perhaps of a higher quality. Several global corporations have realized the importance of sourcing this global talent. For example, General Electric (GE) has set up an R&D laboratory, the largest R&D centre of its kind outside the USA, in Bangalore. Over 1,000 GE researchers work on leading-edge solutions out of this facility. Microsoft has established a R&D facility in India. Manufacturing firms like Ford and Boeing see India as critical for improving their global supply chain through IT.

Second, the demographics of the West will result in a large number of old people and retirees in the next twenty-five years. There is likely to be shortfall of labour even for basic services. For example, the share of the US population of people aged sixty-five and older is projected to increase from 10.7 per cent in 2003 to almost 14 per cent in 2015. These retirees would require services with very efficient cost structures since their post-retirement disposable incomes will be low. Countries like India with a demographic advantage can provide many such business services—accounting, legal, tax advice, travel and hotel bookings, medical appointments and medical analysis—remotely at a fraction of the cost in the USA.

Third, globalization enhances the competitiveness of corporations. In competitive markets like the USA, corporations are forced to continually improve their efficiency, trim their costs and reduce the product prices to obtain a larger market share. This is possible only if corporations can leverage the power of the flat world by moving some of their functions to less expensive places in the world. Such competitive positioning requires reduction of cycle times and improvement of productivity through 24-hour-work-day models. Such a move enhances the profits of corporations in developed nations so that they can employ more labour in their headquarter countries, pay them better compensation, and invest more in R & D. Thus, it is a win-win-win proposition for corporations, local labour and the outsourced countries.

Fourth and most importantly, the Indian educated middle class has an excellent work ethic. In multi-time zone serving industries like the global software services industry and the global business process management industry, ability to serve in shifts and work outside office hours several times a week, ignoring the traditional norms of work-life balance, is a critical success factor. The Indian software professional understands this well and has done an outstanding job in satisfying his / her customers. I must salute him / her.

I am reminded of John Lennon's words that dreaming alone is just a dream and a dream we dream together has better chances of becoming a reality. Creating such a reality is not easy but it is only dreams that make progress possible. Therefore, I am very optimistic that nations will dream together and work together leveraging their

competitive advantages to make life better for all residents of this planet. In this aspirational goal, India's role as the software development center and the business process management center of the world will continue to be critical.

Thank you.