A CYBER MEDIA Publication
The Authority on the Future of Technology
VOL. 2 NO. 7 | JULY 2010

Rs 100

Technology Review

MIT'S MAGAZINE ON INNOVATION
INDIA EDITION

www.TechnologyReview.in

Calling the technologists to develop ingenious and elegant technologies and solutions that matter to India.

THE GRAND CHALLENGES FOR TECHNOLOGISTS IN INDIA

p30

India's Simple Technology Challenges

FEW COMPLEX PROBLEMS THAT AWAIT SIMPLE SOLUTIONS.

In the last few decades India's technologists have helped the country enter many elite clubs. These include the handful of nations that can make their own communication satellites, launch vehicles, frontline fighter aircraft, mission to the moon, intercontinental ballistic missiles, powerful parallel computers ... the list goes on.

The paradox of India has been that at the same time the country has the largest number of illiterates in the world, houses one-fourth of the world's diabetes patients, wastes more than 40 percent of fruits and vegetables grown, has highest road accident rate with smallest vehicle numbers, abysmally poor water and sanitary conditions, and so on.

Have the technologists failed the nation? Or is it the failure of the country's planners to offer suitable challenges to the tech community to get the best out of them? Or is it a mix of both?

It is clear that many of the complex problems facing the citizens of India could be minimized with simple solutions. Early in June, I was picking the brains of Samir Brahmachari, director-general of CSIR, India's largest chain of publicly-funded laboratories set up to conduct industrial research more than 60 years ago. One of his laboratories have developed a variety of food items that can remain edible even in the zero gravity of outer space. Or packaged foods that can withstand the extremely cold conditions in Siachen Glaciers and help our Indian soldiers satiate their hunger.

But Brahmachari has thrown another challenge to the country's scientists and technologists: give me the solution that will help carry basic vaccines without any refrigeration to the interior areas of Thar Desert in Rajasthan where summer temperatures hover near the 50 degree Celsius mark. This, if possible, he says will save the lives of thousands of babies and prevent them from being unhealthy. The vaccination percentage in this desert region hovers around the 50 percent mark compared to the national average of 75 percent. Obviously, the solution has to be cost effective too.

There is another gigantic challenge related to women's health. Annually Indian women use nearly 2,800 million pieces of absorbent hygiene products (sanitary napkins). Only a third of these are made in the country and the rest are imported. It is an annual market worth over Rs 1,000 crore. But the sad part is that due to high costs, only 4.5 percent of the women have access to these basic hygiene products compared to 80 percent or more in the developed nations. Over 300 million women in the age group of 11-54 will have to be provided this basic hygiene product and this alone will reduce disease prevalence among them by more than a half. To make this happen, India will need to produce a stupendous 58,000 million pieces of absorbent hygiene products in a year.

Only a major technological breakthrough can help convert this into a reality. Cost is the key factor. An inventor has reportedly managed to reduce the unit cost of a piece to Rs 2. But if the cost can be further reduced to Re 1, the market for this product, and hence access, will easily increase hundredfold. Who can do this to solve this key national health issue?

Many more such questions were asked and debated in one of our recent editorial meetings at *Technology Review* India. We did not have the answers. But we were confident that if all the technological innovators and technology enthusiasts put their heads together, solutions to many of the urgent issues facing the country will emerge in the near future. We did not waste much time. And the project, "The Grand Technological Challenges for India" was initiated. Editors at TRI approached over 100 experts and more than 40 of them readily compiled the major technological challenges that need immediate solutions.

In this first Anniversary Issue of the India Edition of *Technology Review*, we have thrown 10 shortlisted challenges to the country to find quick answers *(see "The Grand Challenges for Technologists in India," p.30)*. It does not mean that these are the only challenges facing the nation. We intend to address the remaining ones too in the coming issues. *Technology Review* India will offer full protection to the intellectual property of everyone who will provide solutions. Appropriate mechanisms will be worked out in the next few weeks to ensure this in a variety of ways.

My request to all the technologists and esteemed readers is that let us all rise to the occasion and attempt to solve these simple problems in our backyard even as our nation prepares to send a manned mission to Mars. Please write to me at sureshn@cybermedia.co.in – *Narayanan Suresh.*

SECTIONS

The Grand Challenges for Technologists in India

After a successful exercise of recognizing India's top young innovators, India TR35, *Technology Review* India is now anchoring Project TRI Grand Challenges aimed at finding innovative technologies and solutions relevant to solving some of the most urgent challenges facing the nation.

By TRI EDITORS

THE BUZZWORD today is "innovation." Innovation in health care, engineering, sustainable energy, security, water management, and so on. The question is how do we build a sustainable civilization? How do we ensure the health and security of the citizens? How do we provide an environment for happy living in the modern world? Experts from the industry, academia, and policy makers help us meticulously formulate the Grand Challenges for the Indian technologists.

OBJECTIVE

The core list of technological challenges created by *Technology Review* India (TRI), we hope, will give the technologists enough reason, passion, and challenge for solving the problems that are of utmost importance. This initiative is to jointly mobilize the best brains in the country to come together on a common platform and find effective solutions. We hope to interact with all the stakeholders in the country to discuss the solutions that can change the face of the world in general and India in specific. The objective is to generate useful new ideas that could have a widespread impact on the technological temper in general. The goal is to take these ideas, prototypes, and pilots to the next level of commitment and execution. A panel of experts, comprising of technology evangelists and policy makers, will brainstorm, deliberate, and select the winners in October 2010.

CRITERIA

We have used the following criteria in selecting the grand challenges.

Importance to technologists: Does the question address a cutting-edge research challenge that can significantly advance the efforts to achieve global sustainability?

Relevance to decision-makers: Will the answer to the question help devise actions to alleviate the problems facing the nation and help in promoting sustainability.

Leverage: Does the question involve a scientific or technical breakthrough that can be carried forward?

PROCESS

Phase-I (May to July 2010)

The editorial team of TRI requested the experts to share with us a minimum of two challenges that they think India is grappling with and needs priority attention. They have also been asked to mention which/what/how technologies and technologists can help solve those problems. TRI editors evaluated the responses to arrive at the top 10 areas of focus.

Phase-II (August-October 2010)

TRI will solicit solutions from teams drawn from the industry and top-rated technology institutes during August-September 2010.

TRI will host a "Grand Challenges" event and webinars to create the awareness, engage thought leaders, and seek and source ideas that will help shape the future of technology in the specific areas with authority.

TRI will constitute an expert's committee comprising members from India and global evangelists to evaluate the solutions.

The experts committee will select the winners of the Grand Challenges in October/November 2010.

Phase-III (November-December 2010)

TRI to profile the winning solutions/teams in November/December issue.

This project aims to catalyze all the stakeholders of the country—the decision-makers in government, the private sector, non-governmental organizations, investors, technologists, academia—to achieve the economic, social, and environmental goals.

PAPER SUBMISSION REQUIREMENTS

Abstract submissions are to be sent to us before September 15, 2010. The abstracts are to be submitted to the TRI Grand Challenge editor, Srinivas Chandan (srinivasch@cybermedia.co.in).

Once TRI editors accept the abstract, you will be asked to provide more information on the solution.

The paper will be evaluated on the basis of the content and the concept of the project; the level of innovation compared with the current available state-of-the-art technologies; usefulness to the user and novelty; the project's potential for realization in practice.

The contest is open to all participants who are eighteen (18) years of age or older and mostly as teams and any personal data of the participants collected by TRI will only be used for the purposes of this contest. All participants retain ownership of any software/tool/product that they develop or any other intellectual property rights they create.

The other details are being worked out and we will keep you posted on the same in the subsequent issues.

If you have any questions with regards to the project, please feel free to contact Project Editor at srinivasch@cybermedia.co.in or +91-80-43412000.

HEALTHCARE

Accessible Rural Healthcare

MAKING RURAL HEALTHCARE THROUGH TELEMEDICINE AFFORDABLE AND ACCESSIBLE.

CHALLENGE 1

PRIORITY RESEARCH QUESTIONS

How to make specialized healthcare accessible to 25,000 PHCs in the next two years?

How to reduce the total cost of consultation to less than Rs 10 per session?

SEVENTY PERCENT of Indian population is in rural India and majority of the places in the rural areas lack hospitals, physicians, and medical equipment. Most of the rural Indians do not have access to critical medicines. Preventable and curable diseases dominate morbidity rate. Rural people spend more on treatment as compared to urban citizens.

India's rural health centers are critically short of trained medical personnel. The country has less than 25,000 primary health centers (PHCs) and these are in poor conditions. According to the National Rural Health Mission report nearly eight percent PHCs do not have a doctor, while nearly 39 percent run without a lab technician and over 17 percent of these do not have a pharmacist, though the PHCs are supposed to have one medical officer supported by paramedical staff.

Further, PHCs in some states do not have adequate labor rooms and operation theaters. While not a single PHC of Uttar Pradesh's 3,660 PHCs has either a labor room or an operation theater, only 13 percent of Bihar's 1,641 PHCs have labor rooms and operation theaters. The figures in Chhattisgarh are 20 percent and 10 percent respectively.

There are approximately 4,000 community health centers (CHCs) that are supposed to provide specialized medical care, but the state-of-affairs is not better either. Less that 60 percent of the positions for surgeons and physicians are vacant. Similarly, 50 percent posts for pediatricians, obstetricians, and gynaecologists are not yet filled. There is a shortfall of 70.2 percent specialists at the CHCs. The report says there is a huge challenge to meet the shortfall for rural health infrastructure, specially the manpower.

DATA SHOT

25,000

Primary health centers in India

Innovation in technology can play a key role in reversing the scenario of both accessibility and manpower shortage. Convergence of telecommunications and IT has changed the life of a rural citizen in the past few decades and now convergence of cloud computing and wireless technologies could be useful in improving the quality of healthcare at affordable rates to rural India. Technologies like Rural Participatory Sensing (RuPS) and Wireless Sensor Networks (WSNs) can be very useful.

Since medical practitioners along with basic facilities such as clinics, medicines, hospitals, and diagnostic laboratories are not available in many rural areas of India—and these areas are located considerably far from each other and occupied by smaller communities in each location—setting up permanent facilities is not economical. Solutions that enable doctors located in a "central specialty center" to attend patients from multiple remote locations through a unique "hub and spoke" model are seen as an alternative. These centers in rural places are to have basic diagnostic equipment and an appointed paramedic who will conduct the physical examination and facilitate virtual (audio-video) consultation with a doctor on-line.

Another major issue is the electricity. Less than 10 percent of the households in the rural villages have electricity. The issue then is looking at technologies that are portable. Rural healthcare, no doubt, is an important challenge to address. The key questions that need to be answered include: Which telemedicine applications can change the prevailing scenario? What adaptation strategies are needed to increase the adoption and bring down the cost of treatment? How are changes in ecosystems going to affect the treatment and health of the rural citizens? To answer these questions we will need technology advances and better observation systems. TR

HEALTHCARE

Smart System for Maternal Healthcare

IMPROVE THE USEFULNESS OF MATERNAL HEALTHCARE THROUGH PORTABLE DIAGNOSTICS AND A SMART SYSTEM.

PRIORITY RESEARCH QUESTIONS

What are the technologies that can help reduce India's share of global burden of maternal deaths to less that 5%?

What are the smart healthcare systems that can help register 90% of all pregnancies?

MEETING THE maternal health challenge requires expanding current obstetric care to cover facets such as transport and storage of blood and efficient means of delivering antibiotics. Additionally, current diagnostic imaging techniques are being extended to include fetal abnormalities. These challenges are applicable for both urban and rural constituencies, but more so in the rural areas.

The risk of a woman dying as a result of pregnancy or childbirth during her lifetime is about one in six in some parts of the world. The Millennium Development Goal is to reduce the maternal mortality by 75 percent by 2015. India alone accounts for a quarter of the global burden of maternal deaths with nearly 136,000 women dying annually due to causes related to pregnancy and childbirth. Besides lack of affordable and accessible facilities, the major causes of maternal deaths are hemorrhage, puerperal sepsis, complications of abortion, obstructed labor, and hypertensive disorders associated with pregnancy.

A household survey by Urban Health Resource Center (UHRC) in collaboration with the Johns Hopkins Bloomberg School of Public Health, USA and Chhatrapati Shahu Ji Maharaj Medical University, Lucknow, conducted between October 2007 and March 2008 in Meerut, found that only 60 percent pregnancies were registered with a health facility. The survey covered 15,025 women who had a live or still birth in the three years preceding the survey– referred to as recently delivered women (RDW). The women were drawn from 44,888 households across 45 slums within the city. Of the 60 percent registered pregnancies, 59.4 percent pregnancies were registered within first three months, 21.7 percent between 4-6 months and 18.9 percent after six months of gestation. Among those who registered, private facility was the preferred place of registration for more than 40 percent pregnant mothers. Around one-fourth of the mothers approached a government facility and another one-fourth of mothers registered with a NGO run health facility. Early registration of pregnancy with a healthcare provider facilitates assessment of health and nutritional status of the mother and to obtain their baseline information on blood pressure, weight, and more. An early contact with a health provider also helps to screen for complications early and manage appropriately by referral as and where required.

DATA SHOT

25%

India's share of global burden of maternal deaths.

An important reason for not availing health services from government facilities was absence/poor functioning of public facilities in the vicinity. Service usage of public facilities by pregnant women was also low because of shortage of staff especially lady doctors; shortage of medicines including IFA tablets; lack of diagnostic services; poor referral system; unfavorable timings of the facility that does not suit the working slum women; long queues in the higher level facilities; impolite attitude of health center staff towards slum women; and lack of privacy. Pregnant mothers seek quality health care services that are easily accessible.

The survey findings highlight the need for simple, affordable, and cost effective interventions that can be implemented to improve maternal health care in the slums and other rural areas. These can be technical as well as operational interventions. Technical interventions include promoting safe motherhood practices at the household and at community level in the slums. TR

Efficient Solar Technologies

ADDING 16,000 MW CAPACITY WILL REDUCE PV MODULE COSTS BY ONLY 20 PERCENT. PV MODULES ACCOUNT FOR 50-70 PERCENT OF THE COST.

INDIA'S CURRENT per capita energy consumption is among the lowest in the world. Its current generation capacity is 147 gigawatt. Based on growth estimates, India will need to add 280 GW by 2022. In some states, the supply shortage is over 20 percent. Based on these statistics, conventional energy resources will not be able to meet the demand and so alternate energy sources are needed. India is blessed with high solar insolation, over 300 clear, sunny days. We need to make the most of this opportunity. Our 2022 energy requirements can be met by utilizing just 1 percent of the incident solar radiation. The Government will have to play its role in making India a leader in solar energy development at affordable prices.

The major challenges with current solar technology are the poor efficiency of solar cells and their high manufacturing costs. To achieve widespread solar power generation in India, there is a need to (a) focus on both photovoltaic and solar thermal technologies; (b) innovate in three domains – effectively capturing sun's energy, efficiently converting it into useful forms, and economically storing it.

Technologists can focus on at least three areas of innovation—novel inexpensive materials (beyond silicon), efficient energy conversion schemes, and improved storage mechanisms. Recent developments in nanotechnology have the potential to enhance conversion efficiencies—use of novel materials like nanocrystals that reduce heat loss or one-dimensional nanostructures like nanorods that improve charge transport. Pathways to improve storage include mimicking photosynthesis, using sunlight to power the hydrolysis of water and generating hydrogen fuel, using fuel cells, and phase change materials.

In order to meet the energy requirements, it is now mandatory to start using renewable resources. The existing cost and possible electrical efficiency is still a challenge.

DATA SHOT

280 GW

India's generation requirement by 2022.

PRIORITY RESEARCH QUESTIONS

How to make solar-PV based power 50% cheaper than the current costs?

How to increase grid-interactive solar capacity to 100 MW?

Solar cells is a growing field for active research and must be grabbed by technologists, scientists, or academicians in India in near future.

Cost-effective photovoltaic (PV) technologies are the key for large-scale deployment of solar cells capable of producing clean energy. Although conventional planar crystalline PV cells can provide good efficiencies, they are cost intensive. Solution to this problem can be addressed using a low-cost photostable material, namely TiO_2 with the help of band structure engineering in order to increase the spectral absorption.

The Government of India already has a range of policies targeting solar energy: R&D on solar technologies; support for utilization of various kinds of solar-PV and solar-thermal systems for rural and urban applications; and feed-in tariffs for grid-interactive solar power generation. While these programs have led to substantial progress in the demonstration and deployment of solar systems in India, we still have a long way to go. Just to take an example, worldwide solar-PV capacity was estimated to be more than 16,000 megawatts (MW) of which about 13,000 MW is grid-connected. In comparison, India's solar-PV capacity was estimated to be about 112 MW of which only about 2 MW is grid-connected. Thus, the enormous potential of solar energy in the country, while alluring, remains relatively unrealized. TR

ENERGY

Power-saving Conventional Systems

INCREASING ENERGY EFFICIENCY OF CONVENTIONAL SYSTEMS.

INDIA FACES a gigantic energy crisis. However, there is a crying need to protect the environment to ensure that we leave a healthy environment to our future generations. The need of the day is to innovate and make more efficient machines that consume lesser energy. Technologies like energy-efficient motherboards, super hybrid engine, and energy processing units ensure lower consumption of power than conventional products. These are some of the ways to conserve energy.

According to the Bureau of Energy Efficiency (BEE), India's energy efficiency is the fifth lowest in the world, but there is room for substantial energy savings. The industrial sector consumes about half of the total commercial energy available in India and 70 percent of this is by energy-intensive sectors like fertilizers, aluminum, textiles, cement, iron and steel, and paper and 15-25 percent of this is avoidable.

The report says that 5-10 percent of energy saving is possible simply by better housekeeping measures. Another 10-15 percent saving is possible with small investment like low cost retrofits and use of energy efficient devices and controls. The saving is much higher if high cost measures are included (major retrofit, process modifications). Industry and transport sectors have the highest potential for energy savings.

While there are already some energy efficiency measures like ban on import of second-hand machinery such as sponge iron plants and paper mills, there is also support for use of cleaner fuels, co-generation, and tapping waste heat for process heat. There is also a need to adopt sub-sectoral technology options for large-scale energy savings. The way forward is to improve the energy efficiency by over 30 percent compared to the present levels.

Further, BEE has been promoting the use of high-quality CFLs to domestic consumers for about Rs 15 per lamp, a rate comparable to that of incandescent bulbs. This CFL price is currently Rs 80-100 per lamp and is the stumbling block in its penetration into households. It targets replacement of about 400-million incandescent bulbs in use in the country, leading to a possible reduction of about 6,000 MW of electricity demand and about 24 million tons of carbon dioxide emissions every year.

BEE has also launched Energy Conservation Building Code and Energy Efficiency in Existing Building Scheme (ECBC). The scheme sets minimum energy standards for commercial buildings. These codes define norms of energy requirement per square meter of area and takes into consideration the climatic regions of the country where the building is located. The major components of the building which are being addressed through this code are walls, roofs, and windows; lighting systems, HVAC systems, electrical distribution systems, and water heating and water pumping systems. Mandatory compliance of the ECBC is expected to yield annual saving of approximately 1.7 billion units .

India is also moving ahead with plans to create a market in energy efficiency credits modeled on carbon emission cap-and-trade schemes, which officials estimate could be worth Rs 74,000 crore a year by 2015. The plan is to help energy-intensive firms set energy efficiency targets. Those firms that exceeded the targets would be awarded credits that they would be able to sell on power exchanges to those companies that fail to meet their targets. All these clearly indicate that technologies in the conventional systems can be revamped to take advantage of. TR

PRIORITY RESEARCH QUESTIONS

How to lower the power consumption and improve energy efficiency by 30%?

New technologies that can lead to 1 billion units of annual savings?

DATA SHOT

5

India's energy efficiency rank from the bottom.

Clean Potable Water

HOW TO ENSURE SUPPLY OF QUALITY WATER TO ALL?

INDIA HAS an even bigger water crisis than the energy shortage. India like many other nations will face a dire water crisis in the coming years. According to some experts, in India, we treat only 33 percent of the wastewater that is produced. Most of the wastewater flows into the rivers, polluting them. Treating water will require people to become conscious of the problem. It will need new technologies, innovative techniques, and new engineering designs to tackle the problem.

For millions of people in rural India, shortage of clean drinking water is a reality that they face every day. The dynamic balance in the aquatic ecosystem is upset by human activities, resulting in contamination of water. Impoverished populations are the most severely affected by this problem. The focus now is on development of technologies for low-cost sunlight driven water purification and effluent treatment as most of the conventional methods are either not appropriate or environmentally compatible. Since accessibility of water is unevenly spread across India, development of technology for the "rain-on-demand" also becomes essential.

The hurdles that need to be overcome are water scarcity, contamination of ground water by excess fluoride, arsenic, iron, nitrates, heavy metals and even pesticides besides turbid and polluted nature of surface water. Some routes for water conservation are rain water harvesting, equitable water distribution, and prevention of pollution through proper sanitation. Technology leads for water purification are flocculation and coagulation, adsorption, membrane technology such as reverse osmosis (RO) for ground water purification and ultrafiltration (UF) for surface water clarification.

Sustenance of pilot plants in villages has proved to be a challenge due to power related problems, improper operation and maintenance, and internal politics. Moreover, there are no appropriate solutions yet for comprehensive disposal of reject and regeneration solutions coming from RO and adsorption systems. Feasibility of using thermal (solar) evaporators or chemical precipitation methods for reject disposal in village conditions is low. Regular monitoring of water purification plants, adequate training of operators, and affordable water price could help solve some of these problems.

Compact hand pump operated UF systems could be useful for treatment of surface water in flood hit areas or interior rural belts which lack electric power but have access to river (canal) and pond water. Disposable adsorbent or UF membrane kits which can operate on overhead tank pressure would also be useful for domestic application. A simple combination of microfiltration (MF) and ultraviolet light/ozonation could produce potable water in regions with river water resource.

The second major challenge is achievement of zero discharge in industries especially in terms of liquid wastes. Industrial wastewaters and municipal sewage cause enormous harm to the environment by contaminating ground, surface, and sea water sources. Every industry must establish a well defined strategy for effective water utilization, reuse, and effluent treatment.

Further, Indian agriculture is over dependent on irrigated water and loses about 80 percent of this because of crops like sugarcane and rice. The challenge is, therefore, to develop technologies that can reduce water consumption and increase clean water generation. TR

PRIORITY RESEARCH QUESTIONS

How to treat 100% of the wastewater that is produced?

How to achieve zero-discharge of liquid wastes from the industries into water bodies?

Simple water purification technologies that hardly need any dependency on electricity?

DATA SHOT

33%

Amount of wastewater that is treated.

EDUCATION

Smart Learning

ENHANCING TEACHER EFFICIENCIES AND MONITORING LEARNING OUTCOMES IN SCHOOLS.

PRIORITY RESEARCH QUESTIONS

How to make education useful and reduce the talent gap by 50%?

How technology can substitute the need created by shortage of 2 00,000 schools?

How to increase the quality of teaching so that the number of PhDs go up to 1%-level?

EDUCATION IS at cross roads today. Though the number of institutes have gone up significantly, most of them unfortunately provide an average education. Education has also become far more expensive and the wages are not able to justify the fees. There is hardly any correlation between a typical college degree and a career opportunity. These are some of the reasons why there is a significant talent crunch. A recent report published by the Confederation of Indian Industry (CII) and the Boston Consulting Group (BCG) has estimated that India would face a "talent gap" of more than 5 million by 2012, as existing educational institutions do not impart employable skills. Policy initiatives are being taken to account for restructuring school education system, creating higher educational institutes including IITs, IIMs and others, formulating skill development policy, and so on.

But the challenge is how does one nourish quality talent, rapidly develop the infrastructure, and provide an enabling innovation environment? While India has ample supply of talent, it is largely trainable in nature, not employable. This leads to incremental training costs and increased downtime for the industry which is global in nature. Some gaps in talent suitability exists, however, they are being addressed through strong provider-level initiatives and industry-led programs. Development of tier-II/III cities to support major delivery locations is imperative, along with upgrading the overall quality of talent pool.

Some of the key issues related to quality education include innovative classroom processes, enhancing teacher accountability, developing and strengthening the institutional capacity to monitor learning outcomes and evaluate the impact of interventions, and strengthening the role of local bodies and industries in educational institution management, financial support and ongoing process training. The focus should be on problem-solving.

How does one achieve this when access to education itself is a concern? Most parts of the country lack good schools, teachers, and the basic infrastructure. CBSE estimates shortage of 200,000 schools. Only 1 percent of the students go for the post graduation and 0.1 percent for PhDs. Almost 20 percent of the engineering graduates are unemployed. A McKinsey report finds only 25 percent engineers, 15 percent finance grads and less than 10 percent of the other grads employable. The reason is shortage of quality teaching staff. While most of the government schools and colleges lack accountability and trained staff, the private schools have shortage of trained staff and a very low teacher-student ratio. The content is not in sync with the latest developments and industry trends. The focus is on reproducing content and not on conceptual understanding or learning to learn.

DATA SHOT

5million

India's talent gap by 2012.

Some of these challenges can be overcome by adopting innovative technologies like the broadcast medium, webcast over internet, and content over the mobile phone. This is a possible way to rapidly expand the reach. It can help improve teacher quality and productivity through teaching aids, demos, and video, online refresher courses for teachers, and a big online teaching community. Tools like authoring, reviewing, and publishing help in content enrichment. The focus should be on developing technologies that help improve teacher efficiencies and learning outcomes. TR

ENVIRONMENT

Solid Waste Management

URBAN INDIA IS LIKELY TO FACE A MASSIVE WASTE DISPOSAL CRISIS IN THE YEARS TO COME

INDIA'S URBAN population is about 350 million currently, mostly living in a few large cities and over 30 metropolitan cities and responsible for producing 65 million tons of waste. In India, the amount of waste generated per capita is estimated to increase at a rate of 1-1.33 percent annually. It is estimated that the total waste quantity generated by the year 2047 would be approximately 260 million tons per year. It is estimated that if the waste is not disposed off in a more systematic manner more than 1400 sq km of land would be required in the country by the year 2047 for its disposal.

Almost 90 percent of the total wastes are managed through land-filled mechanism, requiring around 1200 hectare of land every year with an average depth of 3 m. Though most of these cities have solid waste management (SWM) systems, it isn't a well-developed system yet. The equipment and machinery in use are general purpose type or that which have been adopted from other industry. This results in poor utilization of the resources and lowering of the efficiency. Though there have been attempts to adopt the technology developed in other countries like highly mechanized compost plants, incinerator-cum-power plants, and compactor vehicles, these attempts have not yielded good results as the solid waste composition in India is much different from the countries where the technology was developed.

Out of the total expenditure on SWM, around 90 percent is spent on manpower. The SWM system is unplanned and is operated in an unscientific way. Neither the work norms are specified nor the work of collection staff appropriately supervised. The vehicles are poorly maintained and no schedule is observed for preventive maintenance. Due to shortage of financial resources, the vehicles are often used beyond their economical life resulting in inefficient operation. Further, there is no coordination of activities between different components of the system. The cumulative effect of all these factors is an inefficient SWM system.

DATA SHOT

65million

tons of waste generated by 350 million urban population.

PRIORITY RESEARCH QUESTIONS

About 90% of solid waste management is by land-filling mechanism. How to bring it down to 30%?

Manpower accounts for 90% share of managing SWM system cost. How to reduce the manpower expenses component to less than 25%?

How to convert 90% of the solid waste into useful forms like fertilizers?

In the current scenario, a given unit of waste takes about 24-36 hours before reaching the large dump yard typically located in the city outskirts. However, the decomposition starts within 8-12 hours that causes spreading of foul smell in the communities. This is non-hygienic, spreads disease causing virus, and importantly indicates losing of an energy source, methane gas, into atmosphere.

Today, SWM system is being conceptualized as a decomposition and power generation device that can be installed next to each collection point in a typical community of about 500 families. This unit when operated for 8 hours per day can process expected average daily waste of about 2 tons to generate 200 KWH of electric power and about 1.5 tons of liquid and solid fertilizer. The inorganic waste like glass, metal and plastic is automatically segregated by the device before starting to process. The savings are expected to cover the device maintenance and employ a caretaker. The related benefits are that the underpaid labor needn't spend their days at dump yards in an unhygienic manner and there is saving on fuel as trucks to transport waste to dump yard can be avoided.

Increasing urban population will make waste management a difficult task to handle in the near future if a new approach is not designed and created. TR

SECURITY

Datamining for Internal Security

BUSINESS INTELLIGENCE AND DATAMINING WILL HELP IN PREEMPTION.

WITH OVER 22 percent rise in crimes in major cities, coupled with the growing menace of naxalite and terrorist attacks over the past decade, safety and security has and will continue to be the key point of discussion in India. Solutions for tackling this menace revolves around developing better collaborative intelligence through analyzing crime data received from various sources, understanding patterns, predicting the occurrence of future strikes, and mitigating them before they occur. Collective intelligence combined with the power of business intelligence and data mining are technologies that can be deployed in this area. Public sector solutions to ensure efficient deployment of resources are also imperative for securing higher safety standards.

The recent terrorist and naxalite attacks in India have raised many questions about the country's intelligence tools and capabilities and the ability of the government to detect such threats. Today technology programs can provide total information-awareness for preemption and help in countering a threat. Technologies can assist in the detection of terrorist groups through language translation, data search with pattern recognition and privacy protection. The collaborative reasoning and decision support technologies would allow analysts from different agencies to share data.

One of the major bottlenecks in the Indian security system is the timely availability of data. Intelligence gathering is done by federal government agencies and also by the police forces in all the states. Under the Indian governance system, maintenance of law and order is primarily a subject to be handled by the states. The role of federal agencies is limited. Cost effective solutions are required to ensure that the data gathered by various agencies flow seamlessly between the various agencies at the federal and state level.

According to information available, the boat that carried the terrorists from Pakistan who were involved in the 26/11 attacks in Mumbai was spotted and followed for sometime by the Coast Guard and Naval authorities off the Gujarat coast. Due to systemic flow, the information about boat and its suspicious nature did not reach the Mumbai police in time. Had they known, the police forces in Mumbai would have been better prepared for the terrorist onslaught. The solutions have to include both efficient technological tools to communicate in real-time thousands of such things our law enforcers come across routinely. The persons handling intelligence tasks should be enabled to analyze and draw appropriate, actionable intelligence. Secure networks are required to link all police information in real-time, and take quick action.

Another major requirement is a robust database structure that will integrate the various databases and come up with predictive intelligence.

Data mining is one of the key features of many internal security programs. It can be used to identify terrorist activities, tracking money transfers and communications, and accessing travel and immigration records.

While technological capabilities are important, there are other implementation issues like quality of data, interoperability, and privacy which may influence the success of a project. India is a strong force in the information and communication technology (ICT) but for its technology prowess to be harnessed, India needs to adopt an e-governance policy and infrastructure. The adoption and use of security measures more particularly empowering judiciary and law enforcement agencies with the knowledge and use of cyber forensics and digital evidencing will play a great role. TR

PRIORITY RESEARCH QUESTIONS

How to bring down the growth rate in crimes to single digit?

How to make the information from various agencies available in real-time and in a secure way?

DATA SHOT

22%

Rise in number of crimes in major cities.

AGRICULTURE

Saving the Food

SOLUTION TO THE IMPEDING FOOD CRISIS IN THE COMING YEARS THROUGH IMPROVEMENTS IN FOOD PROCESSING TECHNOLOGIES.

INDIA LOSES close to Rs 60,000 crore worth of agricultural food items due to lack of post harvesting infrastructure such as cold chains, transportation, and storage facilities. The inadequate storage facilities are resulting in rotting of tons of food grains and rendering it unfit for human consumption as well as for animals. India lost about two lakh metric tons of wheat and rice in April and May alone. The Food Corporation of India lacks adequate storage capacities in many states.

All this in spite of the fact that India ranks second worldwide in farm output and the agriculture and allied sectors like forestry and logging. India is also the largest producer of milk, cashew nuts, coconuts, tea, ginger, turmeric, and black pepper in the world. It is the second largest producer of wheat, rice, sugar, groundnut, and inland fish. It is the third largest producer of tobacco and accounts for 10 percent share of the world fruit production, leading the world in the production of banana and sapota. Despite all these, we are yet to tap the complete potential of our yields. Food wastage and food processing are the two areas of concern.

The food processing sector—mainly comprising fruits and vegetables, milk and milk products, beer and alcoholic beverages, meat and poultry, marine products, grain processing, packaged or convenience food and packaged drinks—is a highly fragmented industry. The unorganized segment accounts for over 70 percent of the output in terms of volume and 50 percent in terms of value. Though the organized sector seems comparatively small, it is growing at a much faster pace.

The installed capacity of fruits and vegetables processing industry is about 2-3 million tons but the processing of fruits and vegetables is lesser than 3 percent share of the total production in the country.

India has the highest livestock population in the world and India's dairy industry is considered as one of the most successful sectors. The total milk processing in India is around 35 percent, of which the organized dairy industry accounts for 13 percent.

DATA SHOT

Rs 60,000 crore

India's agricultural food loss.

PRIORITY RESEARCH QUESTIONS

How to reduce the food produce wastage by 70%?

How to increase the share of processed food to 20% level?

While the processing level of buffalo meat is estimated at 21 percent, poultry is estimated at 6 percent while marine products are estimated at 8 percent.

Processing of grain includes milling of wheat, rice, and pulses. We have over 91,000 huller rice mills and 45,000 sheller (modern) rice mills; nearly 1,000 roller flour mills and about 2.6 lakh small flour mills; dal mills number over 10,000. In the oilseeds-based industry, there are over 16,000 oil mills, nearly 800 solvent extraction plants, over 600 refineries and 200 vanaspati units. There are over 600 sugar factories and 4,000 cotton ginning and pressing plants.

Some of the key constraints identified by the food processing industry include poor infrastructure in terms of cold storage and warehousing; inadequate quality control and testing infrastructure; inefficient supply chain and involvement of middlemen; high transportation and inventory carrying cost; and high packaging cost.

The broad questions to discuss include innovations that are needed to promote agriculture; the methods for advanced storage and distribution of food grains; use of technology for collection of data and prediction ahead of time, besides other things.

The key solution to this problem is to deploy planned and efficient supply chain management that will minimize wastage and meet demands effectively. IT solutions in the area of supply chain management, demand planning, and business intelligence implemented at the national level are the key technologies that will help in resolving the problem. TR

INFRASTRUCTURE

Smart Civic Administration

MUNICIPALITIES FIND IT DIFFICULT TO MAINTAIN LARGE CITIES, PRIMARILY DUE TO LACK OF AN EASY MECHANISM TO CAPTURE THE PAIN POINTS.

THE OVERALL infrastructure in India, be it physical connectivity or basic utilities like power, ports and highways, is inadequate and constrains most of the industries. While strides are being made to improve the physical infrastructure, especially in the metros, compared to other developing economies this is a critical area where India needs to improve. Although several public-private partnerships in this area have been launched successfully, more of them should be undertaken to bring world-class infrastructure to India in a timely, efficient, and cost-effective manner.

The urban infrastructure primarily comprises transportation, roads and bridges, energy, financial management, water management, communications, waste management facilities, and earth monitoring and measurement networks. Since the past two decades while the urban growth has been exploding, the quality of urban life has deteriorated. There is an urgent need for creating a vibrant, efficient, and sustainable urban infrastructure. It is the combination of technological applications and government will which forms the basis for adequate urban planning for sustainable architecture.

It's really a tough task for the government to provide efficient basic civic services. Though it understands that e-Governance schemes are a good way to provide a quick, transparent and reliable citizen-centric service, the challenge is which technology to adopt, how to make them accessible to citizens living in different topographical zones, and how to secure data and information.

Take for example the efforts of Bangalore traffic police to improve the traffic situation. The Bangalore traffic police have the challenge of managing more than 35,00,000 vehicles and the traffic is growing annually in the 7–10 percent range and most of the roads are operating above their capacity and the travel speed is less than 15 kmph during the peak hours in central areas. There are hardly any parking spaces for vehicles and the department has limited number of policemen.

Its project, B-Trac, is a multi-pronged strategy by the police to improve the traffic situation in the city. It uses an integrated approach. It uses IT enabled monitoring features through surveillance and enforcement cameras; intelligent transportation systems for automated signaling, vehicle actuation, signal progression, and area traffic control; its traffic dissemination system consists of traffic scan system which is using GIS for evaluating traffic congestion, variable messaging system, and parking information system; it follows IT-enabled enforcements using Blackberry and has a traffic automation center, and an integrated complaint monitoring system.

Again if "services can be improved by citizen's inputs to the administrative organization" is an axiom then identifying a communication channel is the key. This channel should be easy for the citizen to provide information about the pain-points; available all the time; and easy for the administrative organization to collect data and channelize it through their existing infrastructure.

This channel would definitely empower the citizens of neglected parts of the city to voice issues and inputs directly to the administrative organizations. Additionally, the expenses incurred to get information about the city's problem areas, for future planning and development, would reduce or in a idealistic scenario not be required. How is this possible? Marry technologies! Use the mobile phone for the all time availability and provide a natural language speech/text interface for citizens to communicate their problems. TR

PRIORITY RESEARCH QUESTIONS

How can we make the administration responsive to provide effective services 24/7?

How do we make our cities smarter with integrated systems and reduce energy consumption by 50%, traffic density by 50%, and crime by 50%?

DATA SHOT

15kmph

Travel speed on Bangalore roads at peak time.