



IHBT develops novel method for synthesis of FEMA GRAS-approved flavouring Agent: 4-Vinylguaiacol

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P.N. Haksar Memorial Lecture By
Shri N.R.Narayana Murthy
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THE Institute of Himalayan Bioresources Technology (IHBT), Palampur, has developed a novel process for synthesis of 4-vinylguaiacol and related vinylphenols in microwave. Though reactions in microwave are not new and several reports of microwave-assisted reactions have appeared in the last 10 years, the IHBT method offers great advantage by miraculously converting a two-step process to a one-step process in an environment-friendly manner.

4-Vinylphenols are the most extensively studied class of natural compounds due to their widespread applications in food and alcoholic beverages, flavouring substances and as intermediates in the preparation of polymers and copolymers useful in coatings, electronic applications, ion exchange resins, photo resists, etc. FEMA-approved widely used flavouring 4-vinylphenols such as vinylguaiacol (FEMA GRAS NO. 2675) and 4-vinylphenol (FEMA GRAS NO. 3739) are found in a large number of natural sources but always in traces. For example, vinylguaiacol i.e. 2-methoxy-4-vinylphenol, is obtained from the pods of *Hibiscus esculentus* (ckra), *Digitaria exilis*, grapefruit juice (*Citrus paradisi*), feijoa fruit (*Feijoa sellowiana*), *Vitis vinifera*, etc. In addition, 4-vinylguaiacol is also present in coffee plants wherein out of more than 100 different chemical constituents, 4-vinylguaiacol is identified as one of the most potent odorants on the basis of aroma extract dilution analysis (AEDA).





Similarly, 4-vinylguaiacol is also found as one of the most odour active compounds in roasted white sesame seeds which are widely used as a flavouring material in food stuffs. In Europe and USA, 4-vinylguaiacol and related vinyl phenols are a daily food intake of the people. In Asia, the oil isolated from the roasted sesame seed is used in seasoning of many dishes. The interesting flavour and fragrance chemistry exhibited by 4-vinylguaiacol puts it in great demand with food, perfumery, and pharmaceutical industries.

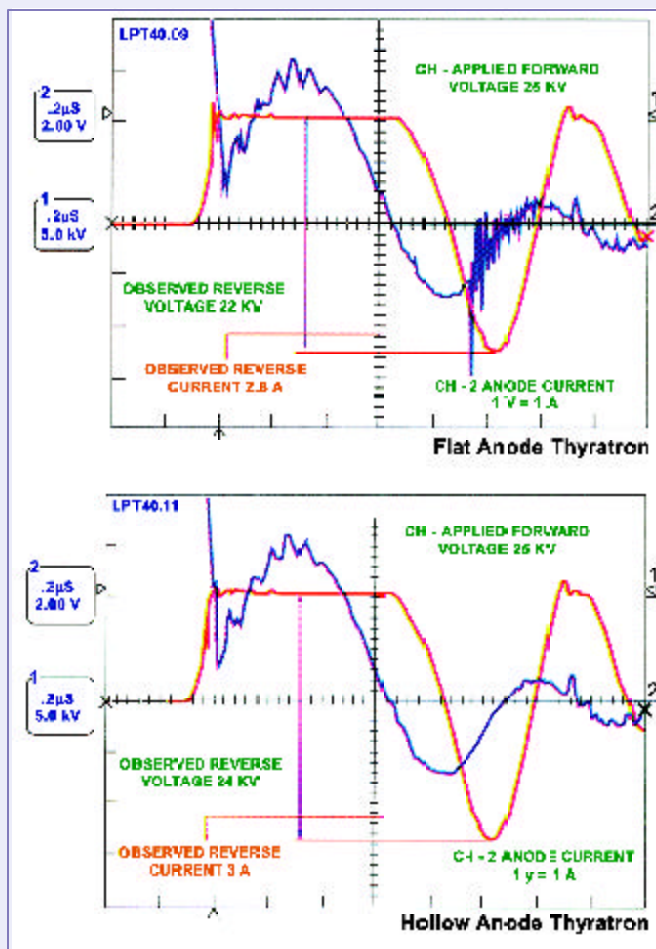
In spite of the great importance of this compound, its commercial exploitation remained limited as it is found only in traces in nature. Chemists the world over have tried to artificially synthesize this compound. However, artificial synthesis of this compound is extremely difficult as the compound has a tendency to polymerise during its preparation, adversely affecting the quality and the yield. Moreover, the reported methods of synthesis are extremely tedious, require usage of toxic and environmentally hazardous chemical reagents. This has badly hampered the prospects of such a useful compound to be explored in a number of commercial food items.

The IHBT-developed method imbibes the principles of green chemistry. Also, the protocol drastically reduces the time required for synthesizing 4-vinylguaiacol to 2-3 min making it an energy efficient process. Moreover, whereas the earlier reported methods were mainly multistep protocols, IHBT's protocol involves synthesis in one step. The ultimate success of the protocol lies in drastic reduction in the production cost of the compound from Rs120,000 to Rs 35,000 a kilo. The technology has been transferred to M/s Aroma Aromatics and Flavours Pvt. Ltd, Baddi (H.P.).

The inventors are Dr Arun K. Sinha and his two students, Shri Anuj Sharma and Shri Bhupendra P. Joshi. Initially, the process was developed on a lab scale and thereafter, upscaled and standardized before transferring it to the industry, Shri Vinod Pathania also contributed to the upscaling of the process. The invention is the result of constant motivation, encouragement and support by Dr P. S. Ahuja, Director, IHBT.

Capability Build-up on Hollow Anode Thyratrons

THE Central Electronics Engineering Research Institute (CEERI), Pilani, has developed a prototype of hollow anode thyatron, which has bipolar switching capability. This type of thyatron is different from the normal flat anode thyatron, which is a unidirectional switch and which was developed earlier by CEERI for 25 kV and 40 kV hold-off voltage capability. The normal flat anode thyatron is sensitive to high reverse voltages (10-25 kV) in typical under-damped pulse circuits. If forced to conduct in the reverse direction, arcing and permanent damage of cathode takes place, destroying the flat anode thyatron within a short duration of switching operation.



Hollow anode thyatron



The reverse conduction capability of hollow anode thyatron prototype under the influence of reverse voltages can be seen in the figure. The figure shows that the reverse current trace for the normal flat anode thyatron has lot of noise, indicating sparking. The reverse current trace in the hollow anode thyatron has no noise, indicating normal conduction between anode and cathode without sparking. The normal conduction is because of the plasma filled in the hollow anode cavity, during the forward conduction phase. The plasma was alive during the application of reverse voltage within the 100 nanosecond of the end of the forward conduction period. The plasma worked as an electron source during the reverse voltage. Normally the amplitude of the reverse current drawn is kept limited up to 50% of the previous half cycle of the forward current drawn by the thyatron. Hollow anode thyatrons are used in pulsed excimer laser systems where they efficiently handle high-amplitude under-damped ringing discharges. Other applications include medical, pulsed power and nuclear research.

R&D Activities of Luminescent Materials and Devices (LMD Group) of NPL







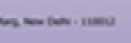
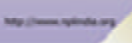
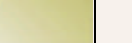
THE Electronic Materials Division at the National Physical Laboratory, (NPL), New Delhi, has a long and illustrious record of developing and offering to the country vital and wide-ranging electronic materials and devices of industrial, strategic and social relevance. The division has numerous highly commendable achievements in the field of luminescent materials and phosphors, photovoltaic materials, plasma-processed materials, electro-chromic materials, conjugated polymers, nano-structured materials, optical and polymeric thin films, advanced ceramics and high temperature super-conducting materials. It has also shouldered the essential and highly challenging tasks of developing practical and cost-effective devices using these materials — picture tubes and display panels, high efficiency solar cells, plasma based deposition and etching systems, electro-chromic windows,

thin film gas sensors, multilayer coated optical devices, super-conducting tubes and tapes, to name only a few — with resounding success. Several path-breaking successes in the frontier areas of surface physics and nano-structures add to the division's roll of honour.

The Luminescent Materials and Devices (LMD) Group has been carrying out R&D on inorganic semiconductor based phosphors and has developed advanced short decay phosphor materials for various applications such as black and white and colour TV picture tubes, electro-luminescent display panels, X-ray imaging and the long decay phosphors which find applications in warning signs, bank notes, rescue guidance systems, etc. Many of these developments have been carried out under industry-sponsored research projects. The present R&D work is devoted to the development of nano phosphors.

Luminescent Materials and Devices

The materials that are able to convert absorbed (invisible) energies like UV, β , γ , x-rays etc. into visible light are known as "Luminescent Materials" or "Phosphors".

<p>Phosphors developed</p> <ul style="list-style-type: none"> • Group II-VI Phosphors • Rare-earth Oxysulfide Phosphors • Monochrome & Colour TV Phosphors • Long Decay (LD) Phosphor based on Sulfides (~ 20 min.) and Alkaline Earth Aluminate (>720 min.) • Electroluminescent (EL) Phosphors • Nanophosphors 	<p>Applications of LD phosphors</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  Under room light </div> <div style="text-align: center;">  Glow in the dark </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;">  Clock </div> <div style="text-align: center;">  Clock </div> </div>
<p>Technologies developed</p> <ul style="list-style-type: none"> • Industrial II-VI compound Phosphors for Cathode Ray Tubes (CRT) • Fluorescent Screens for X-ray Real-Time Imaging • Long Decay Phosphor and Phosphor-coated Adhesive Tapes, Paint for Dark Vision Display Applications • Electroluminescent Displays & Devices in both Flexible and Rigid types • Cadmium oxysulfide based X-ray/ gamma ray/neutron sensitive Phosphor Screens & Electroluminescent Screens • Particle Size Analysis in the range 0.5 to 100 μm 	<p>Development of Nanophosphors</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  EL Panel (both Rigid & Flexible) </div> <div style="text-align: center;">  X-ray Imaging Screen </div> <div style="text-align: center;">  Particle Size Analyser </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;">  Organic coated phosphor </div> <div style="text-align: center;">  Nanoparticle </div> <div style="text-align: center;">  Green & blue emitting nanophosphors </div> </div>

National Physical Laboratory (A, B, C, K, Kankar Road, New Delhi - 110012) <http://www.nplindia.org>

CEERI signs MoUs with BITS, Pilani , MITS- Lakshmangarh, AMU, and Stayfresh

THE Central Electronics Engineering Research Institute (CEERI), Pilani, has signed in the recent past memoranda of understanding (MoUs) with Birla Institute of Technology and Science (BITS), Pilani; Modi Institute of Technology and Science (MITS), Lakshmangarh and Aligarh Muslim University (AMU), Aligarh.

MoU with Birla Institute of Technology and Science (BITS), Pilani

Under this MoU, CEERI and BITS shall cooperate in the field of research and academics for mutual benefit and larger social good. According to the MoU: BITS will extend facilities to the scientists, SRFs, JRFs, Research Interns and other sponsored project personnel of CEERI to obtain their M.S. and Ph.D. degrees from BITS, through their Distance Learning and Off-Campus Ph.D. programmes; BITS and CEERI will collaborate in the conduct of M.E. programmes in the areas of Microelectronics and Embedded Systems; CEERI will extend facilities to BITS students registered for Ph.D., higher degrees and first degrees, to carry out their thesis/dissertation/projects work at CEERI in the areas of interest to CEERI scientists; CEERI will extend facilities for the implementation of BITS Practice School programmes at CEERI; and Library facilities to a limited number of identified persons from the other organisations.

MoU with Modi Institute of Technology and Science (MITS), Lakshmangarh (Rajasthan)

Under the MoU, MITS and CEERI wish to promote academic, research interaction and cooperation between the two institutes. The MoU covers the following: joint sponsored research and consultancy projects within the specified areas of cooperation; The income arising out of consultancy work will be shared by the two institutes on the basis of inputs and

approved works in each institute; Exchange/ Deputation of staff; Organisation of joint conferences/workshops/courses; Sharing of facilities; Students level interactions/training; and Ph.D. registration of staff members of Research Fellows/Research Associates of CEERI at MITS.

The areas of cooperation include: Micro-electronics, Power Electronics, and Microprocessor Application and Control.

MoU with Aligarh Muslim University (AMU), Aligarh

The MoU signed with AMU covers the following: Joint Sponsored Research and Consultancy Projects within the specified areas of cooperation; Exchange/ Deputation of staff; Organisations of joint conferences/workshops/courses; Sharing of facilities; Students level interactions/training; and Ph.D. registration of staff members or Research Fellows/Research Associates of CEERI at AMU.

The areas of cooperation include: Nano-technology, Microsystems Technology, VLSI Design, Electronic Communication Systems and Networks.

MoU with M/s Stayfresh, Navi Mumbai

CEERI has signed an MoU with M/s Stayfresh, Navi Mumbai. This MoU pertains to the technology development of machine vision system for sorting and grading of mangoes under a project on 'Mango Sorter' funded by National Horticulture Board, Gurgaon (Haryana).



Bidirectional Regulation of Th1 and Th2 Cells Shanti Swarup Bhatnagar Prize-winner Dr Javed Naim Agrewala's Work

DR Javed Naim Agrewala, Scientist, Institute of Microbial Technology, Chandigarh, has been awarded the Shanti Swarup Bhatnagar Award in Medical Sciences for the year 2005 for his research contributions to the understanding of the Bidirectional Regulation of Th1 and Th2 Cells. He has developed a novel and unique vaccination strategy for inducing protective immunity in *Mycobacterium tuberculosis* infection. [CSIR News, 55(2005), 343]

Dr Agrewala, has contributed extraordinarily to the understanding of the costimulation of T and B lymphocytes for last 16 years. He has for the first demonstrated the unique role of CD80 (B7-1) and CD86 (B7-2) in the costimulation of B cells.

Evidence from a variety of studies has suggested that the B cell contact with T helper cells is important for its optimal activation and responsiveness to cytokines during antibody secretion. Activation of T cells by B cell can be mediated by antigen presentation and delivery of costimulatory signals. The best-defined costimulatory molecules to date are two structurally related proteins, CD80 and CD86. Both of these molecules play a major role in providing costimulation to T cells, leading to their proliferation, cytokine production, and development of effector functions.



The role of costimulatory molecules is very well established in the activation of T cells, but nothing has been determined about how these molecules operate in the activation and differentiation of B cells. Dr Agrewala demonstrated that the signaling through CD80 specifically inhibits whereas via CD86 enhances the proliferation and antibody secretion. Further, CD80 induces apoptosis in B cell lymphoma by up-regulating the expression of pro-apoptotic molecules caspase-3, caspase-8, Fas, FasL, Bak, and Bax and down-regulating the levels of anti-apoptotic molecule Bcl-x(L). In contrast, costimulation through CD86 augmented the level of anti-apoptotic molecules Bcl-w and Bcl-x(L) and decreased the levels of caspase-8. Thus, it may be inferred from his findings that on engagement of CD80/CD86 on antigen presenting cells with CD28/CD152 on T cells not only influence T cells but also regulates the activity of B cell. Thus on engagement of costimulatory molecules with their receptors on T cells, bi-directional costimulation occurs. After his report, the role of CD80 and CD86 in bi-directional costimulation has

been internationally recognized, authenticated and followed by many groups worldwide. It has opened a new concept in bi-directional costimulation and many groups abroad have shown that signaling through CD80, CD86, death receptor 6, CTLA-4-Ig, B7-DC, etc., can also control the function of B cells, dendritic cells and T cells. Very recently, Logue and Sha, [Nature Immunology: News and Views] have indicated that CD28-B7-1 bi-directional signaling is a two-way street to activation.

Beside his pioneering work in the field of costimulation, he has also established a novel and simple vaccination strategy against tuberculosis. This approach involves the culturing of live *Mycobacterium tuberculosis* and *Salmonella typhimurium* in macrophages, followed by drug treatment and gamma irradiation, to kill the bacteria. Notable observations seen are that on enumeration of viability of *M. tuberculosis*, it indicated a significant level of protection in the vaccinated mice after challenge with live *M. tuberculosis*. This vaccination strategy worked successfully for tuberculosis and also showed a significant decrease in mortality of mice challenged with live *S. typhimurium*. This novel and simple strategy of vaccination has attracted scientists like Dr Peter Andersen, Statens Serum Institute, Copenhagen, Denmark and Dr



Bobby Gormus, National Primate Research Center, Covington, USA to initiate work in their laboratories.

Dr Javed N. Agrewala was born on 14 May 1961. He obtained his B.Sc degree in 1980 and M.Sc in 1982, from Agra University, Agra. He did his Ph.D. in Biomedical Organic Chemistry in 1986 from S.N. Medical College, Agra. He was Postdoctoral Fellow from August 1985 to May 1987 and Research Associate, from June 1987 to May 1989 at Immunology Laboratory, Central JaLMA Institute for Leprosy, Agra. He was Scientist B from June 1989 to June 1994 at Institute of Microbial Technology (IMTECH), Chandigarh. He was Visiting Scientist from July 1994 to June 1996 at Royal Postgraduate Medical School, Hammersmith Hospital, London, U.K. From July 1996 to June 1999 he worked as Scientist C at IMTECH and Visiting Scientist, from April 2001-June 2002 at Trudeau Institute, N.Y., U.S.A. From July 1999 he has been working as Scientist E-I at IMTECH.

Dr Agrewala is recipient of New Idea Research Talent Award of CSIR. He was elected Fellow of National Academy of Sciences, India. He is awarded Fellowship of Medical Research Counsel (MRC), UK and worked at Royal Postgraduate Medical School, London, U.K. He got DBT Overseas Associateship of Department of Biotechnology, India. He was Member of American Association of Immunologists from 2002-03 and Life Member of Indian Immunology Society, Indian Science Congress and Molecular Immunology Forum. He got Postdoctoral Fellowship (PL-480) of USA. He is recipient of several other honours.

He has published 41 research papers in various journals and has one patent-Javed N. Agrewala and Naresh Sharma, Process for the preparation of a vaccine for the treatment of tuberculosis and other intracellular infections diseases and the vaccine produced by the process (2004). United States Patent No 6, 783, 765, South Africa Patent No 2002/2511 and Bangladesh Patent No 1003852. European Patent Application No PCT/IN01/00047.

Soft Nanomaterials (Gels) from Rigid Light Emitting Molecules

THE molecules shown in the picture self-assemble to form soft gels comprising nanosized fibrillar structures in organic fuels such as petrol, diesel and even in kerosene in addition to hexane, decane, etc. The driving force for these molecules to self-organize is weak interactions such as hydrogen bonding, van der Waal's and pi-interactions. This is exactly how nature creates various functional objects under aqueous conditions. Importance of the self-assembly of the molecules shown is their potential applications in molecular electronics. Self-assembly of these molecules significantly modulate the light emitting properties, electron mobility and energy transfer properties. For example, the figure shows the reversible change of light blue emission of the molecules into greenish yellow as a result of the gelation. This work by Ayyappanpillai, Ajayaghosh and coworkers of the Photosciences and Photonics Unit of the Regional Research Laboratory (RRL), Thiruvananthpuram, appeared in a leading chemistry journal (*Chemistry: A European Journal* 11, 2005, 3217-3227), where the work is highlighted in the front cover picture. The authors are currently investigating on how to control organization of the molecules to form left and right handed helical structures.



P.N. Haksar Memorial Lecture

A FRAMEWORK FOR URBAN PLANNING FOR MODERN INDIA

by

Shri N.R. Narayana Murthy
Chairman and Chief Mentor, INFOSYS



Seen on the dais (from right) are: Shri Kapil Sibal, Minister for S& T and Ocean Development, and Vice President, CSIR; Shri N.R. Narayana Murthy, Chairman and Chief Mentor, INFOSYS, who delivered the P.N. Haksar Memorial Lecture ; and Dr R.A. Mashelkar, FRS, Director General, CSIR and President, STAND

SHRI N.R. Narayana Murthy, Chairman and Chief Mentor, INFOSYS, delivered the P.N. Haksar Memorial Lecture on 'A Framework for Urban Planning for Modern India' in the Shanti Swarup Bhatnagar Sabhagraha of CSIR, New Delhi, on 19 February 2006. The lecture was jointly organized by the Society for Technology and National Development (STAND) and CSIR. The function was presided by Shri Kapil Sibal, Minister for Science and Technology and Ocean Development, and Vice President, CSIR. Dr R.A. Mashelkar, FRS, Director General, CSIR and President, STAND, gave the welcome address and Dr S.K. Chopra, Director, STAND, proposed a vote of thanks.



Presidential address by Shri Kapil Sibal



Presiding over the function, Shri Kapil Sibal said that the real difference between an ordinary man and a great man is courage. That is: “Are you able to stand up and speak against the tide? Can you change the mindset of people? ... That I think makes the difference. Today, we are talking about two such men”. “First, Shri P.N. Haksar, who while talking about brain drain once said, *“The problem is not merely of brain drain. The problem has larger dimensions. It embraces the decay and degeneration of our university system, the constant and cruel interference of politicians in the affairs of the universities, and the utter disregard to the concept of excellence. The society, which does not place highest value on knowledge and its acquisition, inevitably alienates itself from creating, transmitting and applying knowledge. This alienation leads partly to the visible brain drain, resulting in migration, and invisible brain drain, the loss of morale and*

creativity among those who stay behind in India.”

“That was the story,” Shri Sibal said, “until men like Narayana Murthy came and challenged.

They challenged it through exposure of excellence. When they worked outside the country, both Haksar and Narayana Murthy were exposed to that excellence — Narayana Murthy in France and Haksar in England. When they came back, they tried their own ways to challenge the system. They challenged the mindset of the people. The way people looked at things. When Narayana Murthy came here, he set up what people admire throughout the world. The Presidents and Heads of States have themselves communicated with me, in utter admiration of what Narayana Murthy has set up, and yet he distant himself from it with the belief, *“I have done something, let the younger generation take it over. Let me do something different. Let me contribute to the nation. Let me challenge the mindset of the contemporary world”*. This is what courage is all about,” pointed out Shri Sibal.

Shri Sibal further said, “I

have something common with Haksarji. Both of us have been the Vice Presidents of CSIR. He practiced for sometime at the bar of law, which I also did much later. I also have something common with Shri Narayana Murthy. I am essentially in the establishment, an anti-establishment man. I do like to challenge, not for the purpose of destroying the system but for the purpose of change, for bringing India into the main stream of globalization, for bringing India within the contemporary world as a power to be reckon with and to be dealt with.” Citing an example, he described, “Sometime back Shri Narayana Murthy went through the controversy of IIM. I quoted his views on education at the Microsoft function in Bangalore that higher education must function as an industry in a free market environment with a suitably regulatory mechanisms and I have to say to Shri Narayana Murthy that this whole issue the St Xavier’s case came in the Supreme Court, before 11 judges, who actually set about trying to upset Xavier’s by saying that the minority community is entitled to freedom in education... I went forward and argued before them, the problem, I said, is not the minority community has freedom, the problem is that majority does not have the freedom, and therefore, I said, the education is an industry, it is as much of business as anything else and unless we interpret the

constitution in that way we will never be able to give impetus to the forces that are released through excellence in education, and I said that investments are not coming into education because education is not treated as an enterprise.” Shri Sibal stressed, “Anything towards excellence is an enterprise. There is nothing in the world which is not an enterprise. Living itself is an enterprise. Your day to day existence, the difference between those who enjoy life and those who do not, because one considers it as an enterprise, the other does not. So I argued that education is an industry, the court rejected it. But the court five years later gave another judgement implying that there should be freedom in education. And I think, we have to fight the court and I think a time will come when ultimately we will get a verdict from the court that education is as much an enterprise as any other business.”

“But, that does not mean that in an enterprise you can not do social good. If INFOSYS is involved in making profits, it does not mean that INFOSYS is not performing its social obligations, Enterprise is not antithetical to commitment to a social cause. In fact, the country, the world and the enterprises move forward only when the enterprises realize their social commitment. That’s what Narayana Murthy wants from the education.”

Regarding the topic of the lecture, ‘A Framework for Urban Planning for Modern India’, Shri Sibal observed, “there can’t be a more relevant topic because it is the modern urban planning infrastructure which will give us an edge; which we desperately need. I do not want to go into issues with which you are familiar with and which Shri Narayana .Murthyji will be addressing. I would only like to say that we are going through very difficult times in Delhi itself because

of the lack of urban planning that we have witnessed right from 1961, when the first Master Plan was conceived. All authorities across the board, the state, the consumer, the corporation have belied the hopes of our nation by not adhering to the planning process. This is something we need to concentrate on to move forward.”

“Let me just end by quoting Mahatma Gandhi from Haksarji’s book *The Basket of Fallen Leaves: ‘No cause can triumph unless there are faithful agents to carry it through.’ ‘We are faced with lot of problems in various fields of life within the state, outside the state, within the Government, outside the Government. What we need are agents to carry it through. We need agents in Government, we need agents in civil society. I should end by saying that in Narayana Murthy we have one such agent, Narayana Murthy will carry through the cause,*” concluded Shri Sibal.





Welcome address by Dr R.A. Mashelkar

Earlier, extending a warm welcome to Shri Kapil Sibal, Shri Narayana Murthy, and the distinguished gathering Dr R.A. Mashelkar said, “It is an occasion for triple joy because this lecture is being held in the memory of a great son of India, Shri P.N. Haksar; being given by another great son of India, Shri Narayana Murthy; and being presided over by yet another great son of India, Shri Kapil Sibal.”

“P.N. Haksar was a towering personality of all times. He had worked very closely with Pandit Jawaharlal Nehru, Indira Gandhi and later with Rajiv Gandhi, in building the foundations of Modern India, in many capacities. For example, as Deputy Chairman of Planning Commission, Principal Secretary to the Prime Minister and Vice President of CSIR. However, his distinctive contribution was his concern for nurturing the scientific talent in the country and its effective utilization for national development and that is when STAND was born.”

Welcoming Shri Kapil Sibal, he said that there is a strong opinion among the S&T community, that he is the best Minister of Science & Technology, and added that we were very happy when he was elevated to the Cabinet rank.

“Shri Narayana Murthy,” Dr Mashelkar said, “is an icon for all of us. He stands tall amongst the corporate leaders, not only in India, but all around the world. He strongly believes that corporates should not only create financial capital but also social capital, work capital and ethical capital. Something he has

tried to do himself through the instrument of INFOSYS, plus so many other instruments that he has had. He stands tall because he is visionary, bold, and is prepared to speak his mind to the politicians.” “INFOSYS,” Dr Mashelkar said, “has raised the prestige of India.”

“Shri Murthy has won various prestigious honours and awards. *Business Week* has chosen him as ‘Star of Asia’ in 1998, 1999 & 2000

— a hatrick. I think no one else has been able to achieve this feat. He occupies the position as the Chief Mentor of INFOSYS, but had there been a position of Chief Mentor of India, I think, he will be eminently suited for that. So is his prestige and value.”

Recalling his first meeting with Shri Haksar, Dr Mashelkar said, “I first met Shri Haksar in 1988 at a public function in Pune, Shri Haksar had lost his sight. But in spite of this, the kind of insight, mercurial intelligence and powerful mind he had, it was absolutely unbelievable.” Later, Shri Haksar presided over the Hussain Zaheer Memorial Lecture delivered by Dr Mashelkar. There, Dr Mashelkar announced that he was going to fight the battle on Turmeric Patent, which became an historical event afterwards because it gave India new prestige in terms of its



Traditional Knowledge and set new paradigms. “So there are several such memories.” “STAND was created by him to address to concerns, and one of them was of course the loss of talented human capital from India, the so called braindrain. But now things are changing. The locus of Science and Technology is shifting away to countries like India and China. People are talking about creating new atlases. People are now coming back. According to an estimate, during last three years around 30,000 professionals have come back. I was very happy to hear the NASSCOM speech the other day, in which it was mentioned that 10 years ago around 70% of the IIT graduates used to go out. That has come down to 30% now. It is a pity Shri Haksar is not amongst us today to witness this change,” said Dr Mashelkar.

P.N. Haksar Memorial Lecture**A Framework for Urban Planning for Modern India
— Thoughts of an amateur by****Shri N.R. Narayana Murthy****Chairman of the Board, INFOSYS Technologies Ltd, Bangalore**

IT is an honor to deliver the 2005 P. N. Haksar Memorial Lecture. I thank the organizers for inviting me. Parameshwar Narain Haksar was one of the key policy planners of post independence India, and a brilliant strategist. He was the architect of India's foreign policy in the 1960s and 1970s, playing a central role in the signing of the 1971 Indo-Soviet Treaty, the Shimla accord with Pakistan, and the liberation of Bangladesh.

Haksar was known for his deep understanding of India's poor masses. In 1971, he planned Indira Gandhi's political campaign using the powerful slogan of "*Garibi Hatao*", a direct call to war against poverty on behalf of 300 million poor Indians. He was deeply concerned with the social and economic challenges facing independent India, noting that the "*need for social, economic and political*

transformation is the major issue before our country. "

I realize that the only way we can truly implement "*Garibi Hatao*" is by improving our urban areas since cities have to bear the main brunt of any economic growth. Hence, I have chosen this topic even though I have no claim to any expertise in urban planning.

The vision outlined by the Indian government in 1956 of a poverty-free India, with full employment in 25 years by 1981, still eludes us. Today, over 260 million people in India remain below the poverty line. More than 390 million people in the country are illiterate — the largest pool of illiterates in the world. Unemployment in India is estimated to be over 10%. Experts opine that India has to create jobs at the rate of ten million a year for the next five



years to merely sustain the present unemployment rate. Yet, we have been creating less than one million jobs a year. Our economic growth has not been dynamic enough to ensure sustained job creation, and to facilitate broad-based, equitable development. I believe the key to unlocking India's vast economic





potential, and creating rapid, sustainable economic growth lies in our cities. That is why urbanization and urban planning for modern India become important.

Today, we are witnessing rapid urbanization in both developing and developed economies around the world. Globally, each year, around 70 million people are migrating to cities. The rate of urbanization is especially significant in fast-growing, developing economies like India and China. It is interesting to note that, in 1950, the United States had 50% more urban dwellers than either China or India. By 2000, China had twice as many urban residents as the US, while India had 25% more.

Since the reforms of 1991, the Indian economy has grown at an annual rate of 6%, and the country is undergoing a rapid transition from a rural to a semi-urban economy. Over 30% of India's current population is urban. By 2001, over 300 million Indians lived in nearly 3,700 towns and cities across the country. The number of Indian cities with populations over one million increased from 23 to 35 between 1991 and 2003. Indian towns and cities have registered an annual population growth rate averaging 4-5%, driven by a combination of rural-urban migration and internal growth. Thus, the urban population in India doubles every 14 to 18 years.

The economists Brunn and Williams explained urbanization as "a *natural consequence of economic growth*". A country's cities are at the frontline of its economic development. Urban centers provide increasing returns to land,

labor and capital through agglomeration and economies of scale. Cities become poles of attraction for capital and labor, as businesses and individuals locate in urban areas to take advantage of higher TFP (total factor productivity). Thus, savings, investment and wealth are concentrated in cities. Clearly, cities are the "theatres of accumulation" for the country's economic activities. The UN estimates that the per capita output of cities in an economy is, on average, 10% higher than overall per capita GNP. In countries like India, it is even higher.

The contribution of India's urban economy to overall economic growth is significant. The urban contribution to GDP has increased from 30% in 1960 to 70% in 2003. As the economist David McKee points out, urban areas clearly house the strengths of national economies, and consequently, *the efficiency of national economies is impeded by anything that impairs the efficiency of the city*. An effective urban planning framework is essential to ensure sustained economic growth, and to manage the pace of urbanization through the effective supply of land, shelter and employment opportunities.

Unfortunately, urban planning in India has not been given sufficient priority. The expansion of India's cities and towns has been unplanned and haphazard. Consequently, urban India faces critical inadequacies in coping with the rising demand for resources and services. The demand exceeds the supply of clean water in cities by an average of 30%. Water degradation has led to health costs

amounting to US \$ 5.7 million every year. This is, in my opinion, an underestimate. Urban waste management systems are overstressed, with significant implications for public health. Over 40% of the solid waste generated daily in urban areas goes uncollected. Housing shortage in India's towns and cities is estimated to be around 22 million. About 22% of India's urban population lives in slums. Around 25% of the urban population is below the poverty line. Traffic congestion in Indian cities has assumed critical dimensions. While India's vehicle population increased 100-fold from 0.3 million in 1960 to 30 million in 2004, the road network increased by just eight times in the same period — from 0.4 million km to 3.3 million km.

The problem has become worse since attempts by governments to divert industry, job creation and investment into rural regions have failed in the absence of even minimal infrastructure in rural areas. For instance, 40% of rural areas even lack all-weather access by roads. About 28% of India's villages lack a primary school. A whopping 54% of villages are over five km away from the nearest health centre. Consequently, while India's urban economy grew at an average of 7.3% over the last decade, rural economy grew at an average of just 1.9%. Hence, the contribution of rural workers to GDP is less than 20% that of workers in the urban economy. Average urban income is twice that of rural income in India.

Clearly, we require radical, immediate reform in the planning and management of our cities.

Effective urban planning, as defined by the World Bank, “creates a competitive, well governed urban environment. It makes cities livable, by ensuring a decent quality of life and equitable opportunity for all residents”.

To plan cities and towns which are livable and provide equitable opportunities, urban planners have to recognize the complexity of their brief. The need of the hour is a two-pronged approach to urban planning in India. Firstly, planning should address existing, chronic shortages in urban infrastructure. It should provide accessible, low-cost infrastructure for urban residents like housing, schooling, hospitals, commercial activities, transport and support infrastructure. In addition, it should incorporate an effective framework for capacity building, and coordinate the expansion of infrastructure and services with urban growth.

Efficient land use and space planning is essential in building a livable urban environment. However, India’s archaic land regulations and property tax systems have resulted in highly sub-optimal land use. For example, India’s urban land ceiling act and floor space index (FSI) restrictions have created extremely low densities in land development. Additionally, rent-control and complex ownership regulations have prevented effective land-recycling and redevelopment. Consequently, today, FSIs average below 1.6 in urban India, compared to averages ranging from 5 to 15 in other Asian cities. Such low FSIs also result in greater energy use for transportation and cause higher

pollution levels. Such inefficient land use has created an artificial land shortage, and has led to significantly high costs for office space and housing in Indian cities. According to McKinsey, the average property cost relative to average urban income in India is the highest in Asia.

Unaffordable housing costs have contributed to the rapid growth of urban slums. India’s urban slum population has been growing at 9-10% a year. At the present rate of migration and housing development, 35% of India’s urban population will be forced to live in slums by 2030. Clearly, as the economist Michael Leaf writes, our urban policies have created “islands of homogeneity and wealth, set in a sea of diversity and poverty”.

We must encourage high-rise and high-density cities for equitable, sustainable urban development. Urban FSI restrictions must be relaxed. FSI should be raised significantly in CBDs (Central Business Districts) to create affordable office space, and make these areas accessible to small and mid-size businesses. We must replace the ‘policing’ approach to land markets with an ‘enabling’ one. Land and housing markets must be deregulated. Property tax systems must be based on land value rather than rent to improve tax collections. A supra-judicial agency must be created to quickly resolve existing property disputes.

Planning must adequately address the shortage of low-cost housing in Indian cities. It is estimated that India requires the construction of 3.6 million housing

units annually to merely address the annual incremental demand for urban housing. An example of a successful low-cost housing program is Sweden’s “Million Program”, implemented by the Swedish government in partnership with private developers between 1964 and 1974. Within a ten-year period, the program built a million low-cost dwellings for the poor. The houses were well-connected to the city through inexpensive tram systems, and provided with infrastructure like schools, hospitals and recreational facilities.

Private developers in cities may be given incentives like tax rebates to include low-income housing in their development plans. Systems for reusing public land and abandoned lots for social housing can also be incorporated. For example, in New York and in Caracas, abandoned buildings are upgraded and provided as housing to low-income families.

A key drawback of India’s urban policy is its land zoning regulations. These regulations mandate the division of cities into “business” and “residential” zones. However, these zoning laws were adopted from pre-1950 British urban planning models intended to separate polluting industries from residential areas. Today, such regulations limit the opportunity for non-polluting commercial land use which can increase economic opportunity and enhance the quality of urban life. Modern planning models such as the smart growth urban planning model suggest a “mixed land use” system. Such a system allows the planned construction of both



commercial and residential buildings around employment opportunities. Such a construction is coordinated with the development of support infrastructure and the growth of schools and hospitals. Thus, housing, commercial activity, transport and support infrastructure are developed in an integrated, “holistic” manner.

Today, the congestion of road transport in urban areas has become a critical issue. It is estimated that road congestion has cut road transport efficiency by 50% in urban areas. There has been little progress in the development of mass urban transit systems in the country. Suburban rail transit systems exist in just four of the 35 Indian cities with populations in excess of one million. Dedicated city bus services operate in just 17 cities.

Effective transport infrastructure forms the backbone of economic development in urban areas. As Prof. Paul Krugman points out, weak urban transport systems constrain economic growth, as they “*limit urban agglomeration, and reduce labor mobility and economies of scale.*” Unfortunately, there has been little focus on building efficient urban transport systems in India. Urban transit systems must satisfactorily address six key criteria: connectivity and accessibility; efficiency; safety; urban aesthetics; financial viability; and affordability. Cities must implement an urban transportation system using multiple options. Road capacity must be enhanced. There has to be accelerated development of mass transit systems using metro, light-rail, mono-rail, and bus services.

Existing shortages in road infrastructure should be addressed through the introduction of parallel service roads, and the construction of priority bus and taxi lanes. In addition, public transit systems must incorporate easy transfers between bus/air/rail terminals through a single-ticket system, valid across the transport network. Such an integrated approach - similar to the Hong Kong and Tokyo transit systems ~ increases connectivity within transit networks, eases commuting and improves efficiencies for businesses.

Enforceable, well-defined standards in infrastructure planning and development are critical to enhancing the quality of life in our cities. Unfortunately, we do not see such enforceable design and execution standards in the construction of buildings, in footpaths and roads, in support infrastructure, and in our water and sanitation systems.

Building standards should be realistic with broad enforceable guidelines and incentives for compliance beyond required norms. For instance, FSI entitlements in cities can be combined with “bonus FSI” for buildings that implement design and construction quality standards above the required norms. This has been put in practice in New York, which allows greater FSI for buildings that “enhance the public realm”.

Building standards should also mandate parking space requirements for commercial and residential units. The absence of such requirements results in overcrowding, road encroachments,

and parking on pavements. Standards for the construction and maintenance of roads should include standards for user-friendly and accessible *footpaths* to effectively connect open spaces, parks and playgrounds.

Road planning standards should include standards for related infrastructure like street lighting and signal systems for the road network. Conduits must be laid for cables, power lines and sewage systems. Such conduits eliminate repeated digging of roads and footpaths.

To improve the functioning of urban infrastructure and services, these services can be contracted out to private operators. Creating a competitive environment in providing infrastructure and services to citizens will improve service delivery and efficiency, enable improved response to urban growth, and help lower costs. The management of public services such as sanitation systems by private operators has been successfully implemented in Thailand and Malaysia. The participation of the government in these systems has been limited to a regulatory and monitoring role.

To address urban decay in cities, we must incorporate urban renewal activities within the planning framework. Urban renewal activities can help promote new commercial and housing development in ‘depressed’ areas, and the creation of ‘green areas’ and open spaces in overcrowded districts. Cities can permit “infrastructure endowments” in business districts where the

government sells “extra FSI” to developers above the existing permitted value. The funds from such endowments can be demarcated for urban renewal activities.

Local governments should actively involve multiple stakeholders — industry, civil society organizations and citizen groups - in articulating a shared vision for urban planning. For example, Brazil’s system of participatory budgeting in municipalities provides interaction between citizen councils and elected officials to decide priorities and expenditures in municipal budgets. A coordinated public-private approach to urban infrastructure can also improve the enforcement of design, execution and operational standards.

No urban planning exercise will be effective in the absence of effective governance systems. While urban governance is critical, it is often the resource in shortest supply. Urban governance in India has been weakened by complex administrative systems and highly fragmented responsibilities. Decision-making, financing and execution roles are split across state and city administrations.

In the present urban governance system, local bodies such as municipalities are responsible for providing services. However, they lack the mandate to generate financial resources to meet expenditures and take decisions on funding. Municipal areas in India generate 50% of the total revenues for state and central governments. Yet, municipalities receive less than

2% of these funds directly. Funds are collected and allocated by the state. The state governments take decisions on important issues like user charges for municipal services and property taxes. Such systems severely reduce the ability of municipal corporations to deliver effective services.

The mayor of an Indian city is elected by city councilors, typically, for a one year term. The mayor lacks executive authority. The role of the mayor is a ceremonial one, and lacks real accountability on governance issues. The municipal councils do not effectively represent urban citizens. The citizen-representative ratio in India’s urban areas averages over 4000:1, compared to a ratio of 300:1 for rural governance bodies! To ensure effective governance, cities must have a mayor who is elected directly by the citizens for a period of five years. The mayor should be supported by an urban legislative body composed of councilors who have been directly elected from the city wards. Electoral wards should be properly demarcated and defined to reduce citizen-representative ratio averages to less than 1000:1. This is essential to ensure that local governance concerns are adequately represented at the legislative level.

The legislative body, headed by the mayor, should have broad, effective authority and responsibility in all functions - financing, planning, execution and maintenance - for the city. The proposal of the Urban Renewal Mission to empower municipal bodies in tax collection and receiving funds is excellent, and should be immediately implemented.

We must link infrastructure investment and services provided towards with the payments made by the ward citizens through tariffs and taxes. This “social compact” is the key to restoring accountability in urban governance. Wards must be financially empowered through decentralized tax collection, and the authority to levy and collect user charges for services. The management of all services like electricity, water, sewage, and roads should be handled in an integrated manner at the ward level.

The urban governance system should also handle urban planning and management for the wider metropolis. This can be achieved through a council of elected mayors of the cities who are responsible for addressing metropolitan concerns such as periurban sprawl, and for the planning and expansion of inter-city infrastructure. Additionally, an advisory city committee consisting of eminent citizens and urban planners should monitor the progress of urban projects and the overall spending of funds. They must be consulted before any large project is taken up. There must be periodic surveys to assess the satisfaction level among citizens.

It is critical that the city governments ensure the financial viability of urban services. In urban India, public services realize, on average, less than 12-15% of expenditure through the recovery of costs. This is unsustainable. The pricing of services such as water, electricity and public transport must cover all effective costs incurred in providing these services. An efficient subsidy system like the



voucher system, suggested by the economist Milton Friedman, can be used to provide directed subsidy for the low-income urban households.

It is estimated that the transaction cost of issuing a building permit or a business license in India is at least 40% of the total cost of the permit/license. Such inefficiencies in administration impose significant, unnecessary costs on urban development. This has to be improved.

There must be strong incentive systems to bring in efficiency and accountability in urban administration. Accountability in urban administration can be enhanced through the financing of urban projects by accessing capital markets, credit rating of municipalities and urban infrastructure entities, and competitive score-carding of city officers. In addition, IT tools such as MIS (management information systems) can be employed to improve efficiency and help better monitoring of public service delivery.

cities and towns can make to the country's economic goals. The expansion of infrastructure and basic services into outlying areas is a necessary factor in synergizing economic growth outside existing urban centers. This can be seen in the present development of the Zhengdong district in China. The Zhengdong district is located in China's rural hinterland. To encourage urbanization, the district is being developed with state-of-the-art infrastructure for business, residential, high-tech, university and industrial buildings, and for support systems.



The urban transition of our economies must be viewed within a broad development framework. Urban strategies must be developed with an understanding of the contribution that

State governments must develop systematic regional plans to extend economic energy outside the existing urban centers. The growth of satellite townships must be encouraged through the establishment of effective arterial infrastructure networks, fast-paced transport corridors and efficient regional supply-chains.

Urban development must be part of a broader macroeconomic dialogue for economic growth. Weak national economic policies raise costs for businesses and households. They distort and limit private investment, the main source of urban wealth creation.

Today, we are in an age of rapid urbanization. The face of India's cities represents the future face of our country. Clearly, how we manage the development of our towns and cities today will shape the success of our country for decades to come. It is best to remember the words of geographer David Harvey that "*Cities are endowed with great character and with fascinating, ever-changing personalities*". It is the need of the hour to embrace intelligent, practical and effective policies for urban development and governance to transform our dynamic fast changing, urban centers into truly sustainable engines of growth.

Thank you.

Dr S.K. Chopra, Director, STAND, proposed a Vote of Thanks.