NATIONAL CHEMICAL LABORATORY

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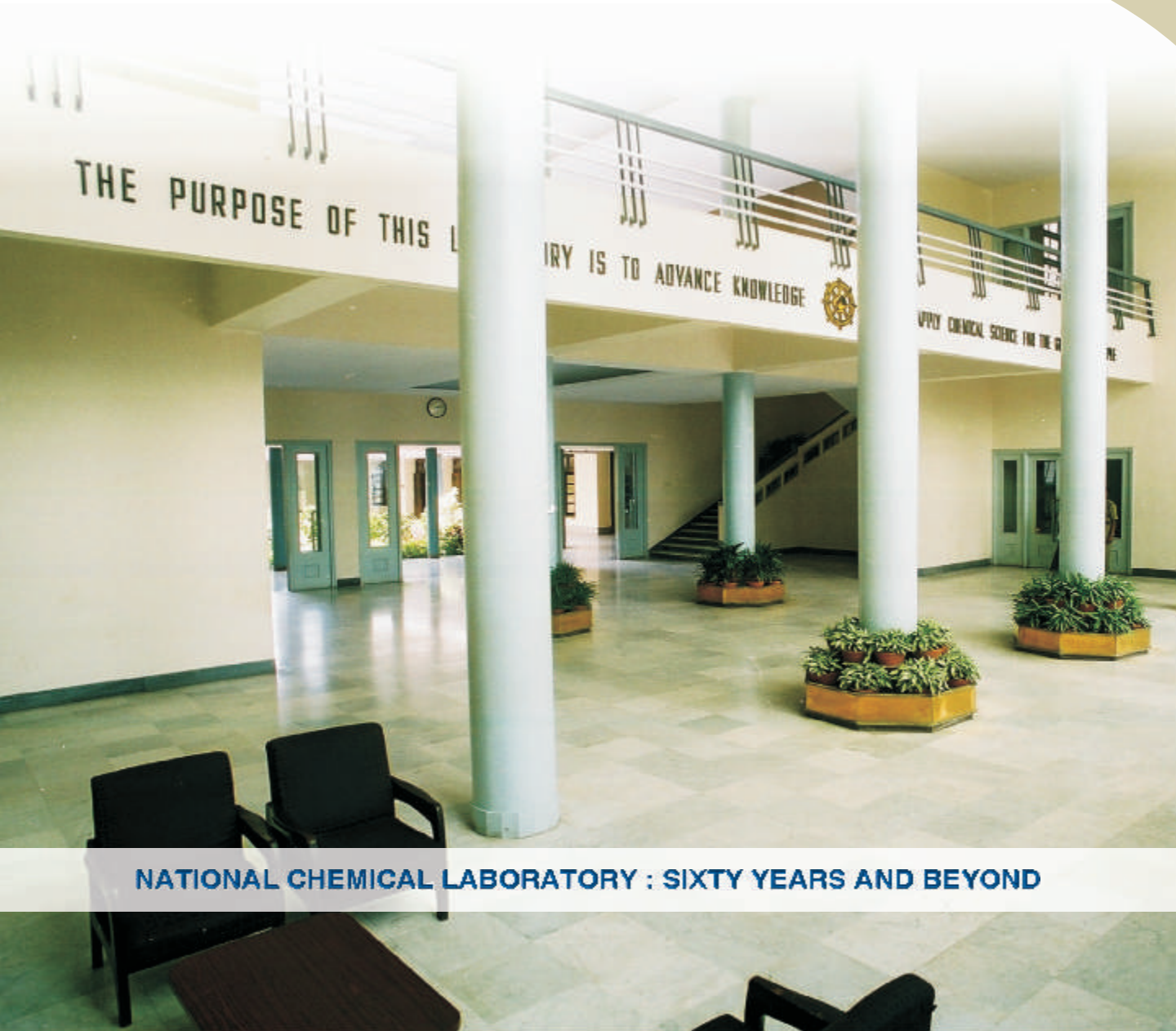


NATIONAL CHEMICAL LABORATORY : SIXTY YEARS AND BEYOND

The Beginning

The National Chemical Laboratory (NCL) of the Council of Scientific and Industrial Research (CSIR) came into existence in the year 1950, giving shape to the extraordinary vision of Pandit Jawaharlal Nehru. Nehru's vision of science as a truly endless frontier was all encompassing; his belief that science and technology was a tool for the development of India was total; and his commitment to the growth of science was passionate. Pandit Nehru said, "It is science alone that can solve the problems of hunger and poverty; of vast resources running to waste; of a rich country inhabited by poor people."

Nehru's vision was translated into reality by Sir Shanti Swarup Bhatnagar, the founder of CSIR and its first Director General. Between 1945 and 1948, Dr Bhatnagar with his indefatigable energy laid the foundation of seven research laboratories. The Foundation Stone of NCL was laid on April 6, 1947, a full six months before India became independent by Shri B.G Kher, the Prime Minister and Minister for Education, the Government of Bombay in presence of Shri C. Rajagopalachari, Member for Industries and Supplies, Government of India and the President of CSIR Society. The construction of the magnificent building was completed in 1948. Pandit Nehru inaugurated and dedicated the laboratory to the nation on January 3, 1950, twenty three days before India became a Republic.

Establishment of CSIR- NCL was an important milestone in expanding traditions of scientific research in India in the twentieth century. At the time of its creation, NCL was considered a symbol of the future greatness of India as a nation. NCL continues to be an enduring symbol of the very best in scientific research and has assiduously maintained over the past six decades the highest standards of scientific excellence, both, in basic and applied sciences and technology.

NCL Vision

To be a globally recognized and respected R&D organization in the area of chemical and related sciences and engineering

To become an organization that will contribute significantly towards assisting the Indian chemical and related industries in transforming themselves into globally competitive organizations

To become an organization that will generate opportunities for wealth creation for the nation and, thereby, enhance the quality of life for its people

The Journey of Six Decades : Sustained Excellence and Contributions to Nation Building

Sixty years is a significant milestone in the history of an institution. NCL has had a distinguished lineage of leadership who has guided its destiny at various turn of history. With its rich tradition of excellence in scientific research it has nurtured the best minds of India. It has continuously transformed and reinvented itself to meet new challenges at the turn of every decade. Successive leadership of NCL has encouraged a culture of sustained pursuit of excellence. Scientists of NCL have excelled in their domains of research and have won several laurels and peer recognitions. One of our distinguished former Directors has been elected Fellow of Royal Society, London (FRS) and a foreign member of the US Academy of Sciences, exclusively based on scientific contributions made at NCL. As many as six individuals have been recognized by Padma Awards by the Government of India. Twenty five scientists have been elected to the prestigious Indian National Science Academy (FNA) and fourteen scientists are winners of the Bhatnagar Prize.

NCL has contributed significantly to the growth and development of the Chemical industry in India. It has partnered research with some of the largest companies of the world. Many of the processes and products that have come out of NCL have been successfully commercialized by industry, both, for domestic consumption and exports.

NCL, today boasts of over 200 PhD scientists, and about 300 technical supporting staff. In addition, about 450 students are pursuing their PhD degree and about 250 students with a Master's degree in science are working on various projects on short term assignment. NCL is a rich provider of high quality human resources in chemical and related sciences and engineering to both academia and industry. Its alumni, in excess of 1700 PhDs, occupy positions of eminence in industry, academia and the government.

Evolution of NCL

1970 – 1990
- NCL catalyzes the birth of the agrochemical and generic drug industry
- Import substitution, reverse engineering and technology transfer
- Funding exclusively from CSIR as grant to laboratory

1990 – 2000
- India's economic collapse and beginning of deep seated economic reforms
- Steep increase in dollar – rupee parity
- Public funding to CSIR under stress; budgetary grants severely cut
- NCL takes a loan from World Bank to upgrade laboratory facilities with a commitment to pay the principle plus interest over a ten year period (1995 – 2005) from commercial earnings
- Indian industry's interest in reverse engineering shrinks since Indian market open up to global competition based on low import tariffs
- NCL ventures into contract research (fee for service model) with global companies ; global companies offer to NCL new learning opportunities increased visibility and credibility
- NCL emerges as a trusted industry partner
- NCL's External Cash Flow grows with attendant prosperity

2000 – 2010
- NCL begins participation in major public-private partnership projects under NMITLI umbrella
  - Hydrodesulfurization of diesel (2000)
  - Defunctionalization of carbohydrates to value added chemicals (2000)
  - Steam and authothermal reformers for H2 production (2001)
  - Fuel cell materials and systems (2003)
  - Value addition to bagasse (2003)
  - Polymer grade L(+)-Lactic acid from sugarcane juice (2004)
  - Creating value out of glycerin obtained as by product of biodiesel manufacture (2007)
- Greater focus on technology transfers / IP licensing
  - L(+) Lactic acid from sugarcane juice (2010)
  - Prefractionation of Bagasse to cellulose,hemi-cellulose and lignin (2008)
  - Epichlorohydrin to Aditya Birla Group (2008)
  - Biodiesel to Benefuel Inc. (2007)
  - ATBS to Vinati Organics Limited (2004)
  - THPE to Excel Industries Limited (2003)
- Greater emphasis on end to end solutions; Demonstration of technologies on ground
- Reduced emphasis on pure contract research; Reducing overdependence on income from overseas
- Consortium approaches, leveraging start-ups and creation of NCL Innovations and Venture Center to create future value out of early stage discoveries

Beyond Sixty : The Context and the Content

While past accomplishments of NCL have been exceptional and praise worthy it must, however, now look into the future. Over the past sixty years science and technology in India has matured and we are now counted amongst the front ranking nations of the world in terms of our capacities and potentials for innovation. Indian industry is fast maturing and growing in, both, size and geographies. India is being increasingly looked at as a crucible for creating new innovations by both Indian and global companies.

The challenges faced by India as a nation is indeed very daunting. In every area, whether it is health, environment, water, energy, transportation or manufacturing India needs substantial innovation to provide solutions to multiple stakeholders across a wide matrix of price and performance. If these solutions have to be found within reasonable time frame, science and technology must become more focused and eventually result in products or processes. Products and processes must move out of the laboratory and reach the market gaining wide customer acceptance. The only proof of success in research and technology is when a consumer is ready and willing to pay for an innovation.

It is, therefore, important for NCL to once again rededicate itself on this historic occasion. The research agenda of the scientists and the scientific groups of NCL must align itself more intimately with the national agenda.

NCL will continue to sharpen its focus on core science in the disciplines of its interest. This is an essential pre-requisite. Without scientists capable of working in the frontiers of science, no benefits from science can flow to the society. So core science and engineering in chemical and related sciences shall remain as its foundation. We call this level 1.

However, a mere foundation does not make an edifice. On this foundation we must build an inter-disciplinary network of thematic programmers. Themes that are relevant to NCL are advanced and functional materials, hybrid materials, bio-inspired materials, synthetic biology, bio-resource technologies, bio-transformation, bioactive molecules, catalytic processes, scientific computing across multiple length and time scales, etc. These can be termed as level 2. These themes will demand more interdisciplinary research with larger interface between chemistry, biology, material science and engineering. NCL has created thematic Centres of Excellence (CoE) around some of these areas to bring together scientists and engineers working across departments and provide them a common vision.

Such interdisciplinary networks, both formal and informal, will lead to focused efforts to address issues such as clean and affordable energy resources, better understanding of diseases, lower cost therapeutics, cleaner water, more efficient and cleaner processing technologies, sustainable building block for materials, converting waste to wealth, etc. This is level 3. Impact on society and public good can be realized only from level 3 efforts. We live today in a utilitarian world. Our stake-holders will increasingly expect S&T to create value in society. However for level 3 to be effective in delivery, one must build solid competencies in level 2 and a robust foundation in level 1.

NCL's strategy in recent years is to consciously build research diversity in level 1 and create level 2 competencies. It is believed that with these efforts, NCL will be better prepared to make an impact on the needs of our society. NCL hopes to define and execute a few programmes in a mission mode with a view to demonstrate its collective strength.

NCL Guiding Principles And Values

To be deeply committed to the success of our stakeholders

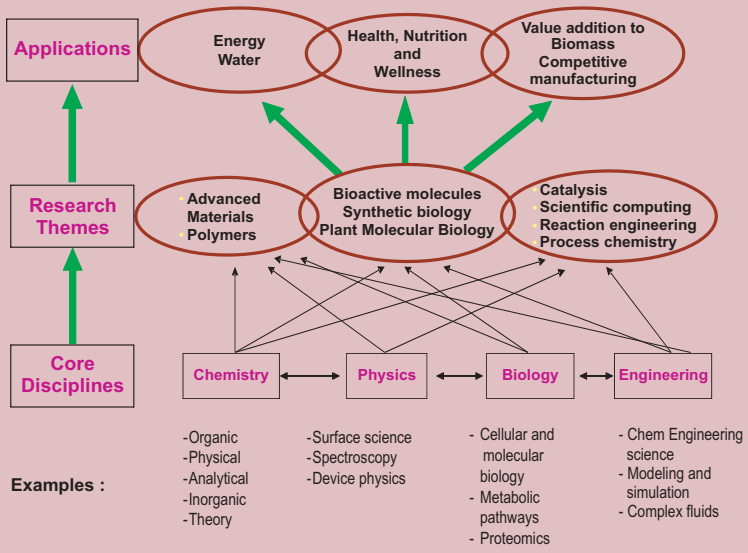
To create and sustain a self driven and self managed learning organization with a high degree of internal and external transparency

To encourage a culture of collective and principle-centered leadership

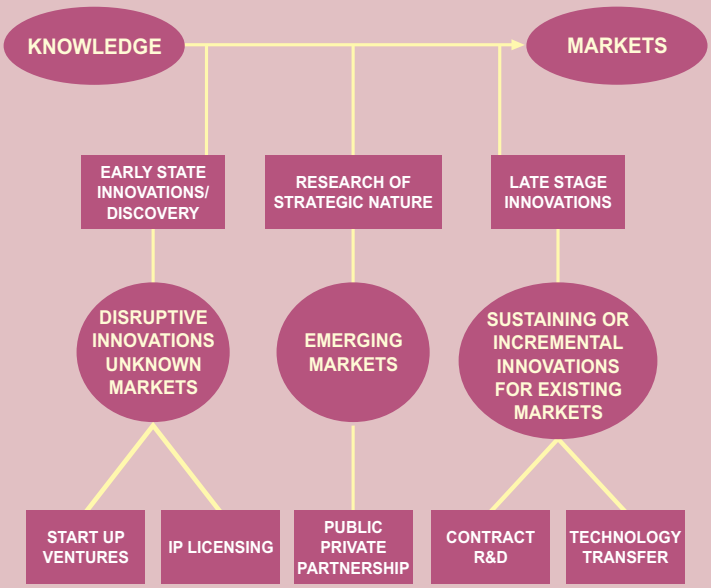
To value the dignity of the individual and deal with people with a sense of fairness and without bias, prejudice or favor

To nurture the highest standards of integrity and ethical conduct

Linking Core Science To Applications



Linking Knowledge To Markets



With this perspective in view NCL has over the past few years commenced building new research platforms in the area of energy (hydrogen and solar), value added chemicals and materials from agricultural wastes and bio-resources, cleaner technologies for chemicals and more efficient processes for fine chemicals based on novel catalysts and chemical engineering principles.

NCL also needs to remain competitive as well as be an attractive destination for a large number of scientific professionals who want to make science as a career and to a large number of young students who wish to pursue their Ph.D. degree. NCL has a distinct obligation to train the next generation of scientific talent, especially, in interdisciplinary areas related to innovative technologies. Scientists of NCL are also increasingly engaging themselves in teaching advanced courses in science and engineering. Research and teaching will become even more closely entwined in the years to come.

With an objective to provide greater opportunity for teaching at all levels, CSIR has provided generously 92 acres of land in its campus to house the Indian Institute of Science Education and Research (IISER), Pune. NCL and IISER will build close synergy in education and research, creating mutual value to the faculties in both the institutions.

Partnerships, both with industry as well as public institutions, are essential for NCL to create wealth in the society. NCL already has a high reputation of being a credible research partner with both Indian and global industry. Many of its recent successes in technology transfer have been a consequence of public-private partnerships. NCL proposes to strengthen such partnerships through creation of dedicated joint centres or ventures of research with industries around key platforms. NCL has set up focused

research partnerships with Institute of Genomics and Integrative Biology, New Delhi (IGIB), Indira Gandhi Center for Atomic Energy Research, Kalpakkam (IGCAR) and Indian Institute of Science Education and Research, Pune. (IISER). Such public-public partnerships strengthen level 1 competency in basic science and open up new learning experiences for both scientists and students.

The core purpose of any scientific enterprise is to create wealth out of the knowledge it creates. However early stage discoveries or innovation are the most difficult to commercialize in view of large technology risks and market uncertainties. Disruptive innovations will require a completely different translational model to convert knowledge to wealth.

To facilitate this process a new campus, called, NCL innovation Park has been created. This campus will become home to public-private-partnership initiatives of CSIR. This campus is also home to a Section 25 Not for Profit Company, called Entrepreneurship Development Center (Venture Center). Venture Center is a Technology Business Incubator created with seed funds and facilities provided by Department of Science and Technology and CSIR with the avowed purpose of facilitating spin offs and promoting S&T driven entrepreneurship. CSIR is also currently in the process of conceiving an Innovation Complex at NCL Campus which is intended as a world-class innovation eco-system. This is proposed to be built using a PPP model that will leverage CSIR strengths to develop and efficiently take new technologies to the market.

The area in and around NCL is thus emerging as a powerful innovation cluster and will be home to a large number of research and technology professionals as well as young students. We envision CSIR –NCL as an institution with enduring values of excellence devoted to acquisition (research), transmission (teaching) as well as application and exploitation of knowledge (technology).

NCL Future Vision

Crossing Intellectual Barriers
- Use the best global bench marks

Serving National Agenda
- Relate to the national agenda

Innovating for Industrial Competitiveness
- Participate in the global knowledge economy

Redressing National Shortfalls
- Remain socially relevant

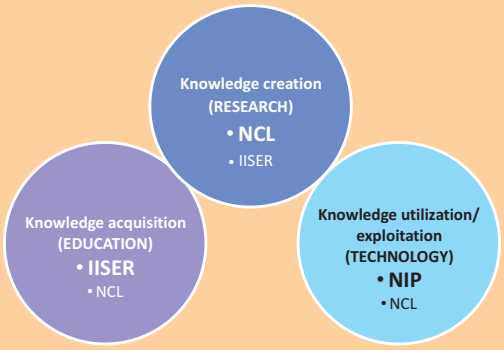
To Create An Institution With Enduring Values of Excellence Devoted to Acquisition, Transmission and Application of Knowledge

Today's Science Seeding Tomorrow's Technologies

- Advanced and functional materials including nanomaterials
- Nano-structured materials and catalysis for energy conversion and storage (electrochemical, solar)

  Novel hybrid materials for harvesting solar energy
- Environmentally friendly polymers
- Biomaterials, tissue engineering and bio-conjugates for therapeutics
- Catalysis, chemical engineering and computational science to leverage clean technologies
- Establishing sustainable and /or renewable feedstocks for chemical manufacturing
- Harnessing modern biology to create a more sustainable chemical industry
- Selective separation processes for a diverse range of applications

Emerging Eco-System in NCL Campus



EMERGING INNOVATION CLUSTER AROUND NCL

OVER 1000 STUDENTS PURSUING Ph D DEGREE

NCL Inovation Park Venture Center

OVER 500 RESEARCH FACULTIES IN CHEMISTRY, PHYSICS, BIOLOGY, MATHEMATICS AND CHEMICAL ENGINEERING

Indian Institute of Science Education and Research

PUNE

Industry Research Partners

A TRUE HOTSPOT FOR INNOVATION WITH A SUPPORTIVE ECO - SYSTEM

"There is only one approved method of assisting development of science and that is, picking men of brilliance, backing them heavily and leaving them to direct themselves; even small groups around gifted men would be able to deliver the goods better than high investment intensive large institutions built with mediocre men"

J. B. Conant
President, Harvard university

National Chemical Laboratory
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