SCIENCE & TECHNOLOGY & 21ST CENTURY ARCHITECTS AND PLANNERS FOR SUSTAINABLE DEVELOPMENT

1st Convocation Address

by

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SCIENCE & TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT

I am delighted to participate in the 1st Convocation of School of Planning & Architecture, Bhopal. I greet the Chairman, Board of Governors Ms. Sunita Kohli, Director, Dr. Vinod Singh, Faculty, Students and other distinguished guests. I take this opportunity to congratulate all the Faculty members, Students and staff of this Institute and all those who have contributed in promoting good educational standards in this institute.

My heartiest congratulations to the graduating students who are passing out from the portals of this prestigious institution. As you walk into the open world, you will realise the strength you have gained through the quality education imparted to you by this dedicated faculty of world class.

My dear young graduates,

You are graduating at the time when our nation is surging forward in all fields. The knowledge that you have gained, the opportunities and options that you have affords you the freedom to choose your area of interest, the choice many of your previous generations did not have. You are empowered by knowledge, and now have to fortify it with your personal qualities like honesty, hard work, sincerity and integrity and to top it

all - with a sense of pride to serve the Nation. I am quite confident that you will have the most rewarding experience in the years to come.

Knowledge is the foundation on which India needs to build and grow. Who else could help India if not you young engineers with right qualifications? Quality education is the foundation on which India must build her destiny. Our country is built with the intellectual brains. Students are the Country's future. Inculcating the right values is as important as nurturing their academic excellence.

On this momentous occasion in your life, I would like to share some thoughts for your personality development. Friends, if you want to gain true success in your life as techno-manager you must inculcate some abilities to remain competitive in this dynamic world.

- Be creative. Enhance your thought process and learn to innovate. In today's competitive world only those who have original ideas survive. Depend on your own work and intuition rather than borrowing others ideas.
- Be curious and observe things carefully. There is no end to the learning process. With the academic distinction you are receiving today, you are already a proven learner. Continue your learning into future and let the learning curve scale up year by year as you progress.

- Be enthusiastic in work. Remember that perpetual cheerfulness is a force multiplier and you will be motivating many others with your enthusiasm.
- Never get upset and run away from problems. You are armed with knowledge and confidence to face and solve the problems. Break any problem into smaller problems, get the solutions of the parts and then integrate the solutions to obtain the solution of the bigger problem. In the universe there always exists a solution for every problem and remember that no lock has been made without a key.
- Set your goals clearly and work to achieve them. Without goals your voyage would be lost in the sea without a compass. Maintain your focus on the end goal while keeping an eye on the critical issues. It is very important to win the war not only the battle.
- Be ethical and maintain highest standards of professional excellence and personal integrity. You are all bestowed with high intelligence quotients. It is equally vital to develop the emotional and spiritual quotient.
- Move ahead with grit and determination despite the minor hurdles and failures that you may encounter in your path to success. Fear of failure is the greatest single obstacle to success in life.

- Lead from the front setting an example and striving to serve others. Develop empathy and concern for others. Try to find happiness in the success of others and learn to share credit.
- Be wise in choosing - every choice matters. “Choice” is the most powerful tool that you have in your lives. It enables you to go from who you are today to who you want to be tomorrow.
- Improve the decision making capabilities through risk assessment. Remember that risk and returns often move together. Avoid catastrophes through analytical thinking. As engineers, you all must know what you should not do before you learn what you should do. Always question why and how?
- Assume full responsibility and take lead in showing the direction to others. Learn entrepreneurship. Learn how your knowledge can be put to best use. Engineering is application of scientific knowledge. Bridge the gap between science and technology through innovative ideas.
- Inculcate the habit of design, build and test methodologies to get complete firsthand knowledge on the products.

- Learn to model and simulate before you realize the product. You recreate many unknown scenarios and their cascading effect on others without losing time and money.

Science and Technology for Sustainable Development:

If we take stock of growth of technology on a time scale over the centuries, and understand its human impact we will realize that we have to give equal importance to each & every segment of technology for the security and well-being of our mighty nation. Be it - National Security, Energy Security, Space Security, Economic Securityand growth, bio diversity, environment, living standards which include food security and health care. And each one of these hinges on the basic premise '***Knowledge economy'***; with "***Sustainability***".

The phenomenal growth that changed the life style of humans in the past two centuries has been primarily due to the ability to change the forms of energy from one to other. This has led to industrial revolution thus leading to rapid economic and scientific expansion. But this also came with the cost of high utilisation of energy and high

consumption. As the sources of energy are getting limited, we need to improve the efficiencies and the question arises how do we ***sustain*** this.

The divide that exists between the rich and poor countries, the developed and developing countries was mainly due to the ability to put effective use of energy and technology that led to industrial revolution and prosperity. Today, to maintain the economic edge over others, the technology is denied in every discipline of science including medicine. As we learn to manipulate the natural resources to meet our comforts, the dynamic nature of this universe forces balancing changes that pose difficulties in different forms. The vulnerability of humans has also increased with economic development and globalisation that are fast depleting our resources and effecting ecology. How do we ***sustain this development*** without affecting the nature??

Sustainability implies meeting current human needs, while preserving the environment and natural resources needed by our future generations. The perceptions of sustainability vary across regions and nations. However, as per a broad agreement, the goal of sustainability is to foster a transition towards development paths that meet human needs while preserving the earth's life support systems and alleviating hunger and poverty. That is, *sustainability integrates the three pillars – environmental, social and economic pursuits*.

In the wake of changing Technological, Environmental, Social and Economic conditions, it is necessary that we should reorient ourselves from ***development*** to ***sustainable development***. The role of Science & Technology in sustainable development is viewed in a new way with emphasis on technologies for empowerment like education, information, communications etc., and environmental sustainability like Sustainable Agriculture, Clean and Renewable Energy, Improved Resource Efficiency. The focus of technologies in sustainable development is whole systems.

That '***knowledge is strength***' is a well known fact. The progress of a nation is quantified by its achievements in Science & Technology. We are ideally poised to become a knowledge power with a large resource of intellectuals, high calibre academicians and scientists and a growing middle class who have assigned top priority to education.

Here, I would like to quote what our honourable former Prime Minister Dr Manmohan Singh said, "*It is our scientific capabilities that will determine our ability to overcome challenges which lie ahead in areas such as climate change, clean energy, environment friendly technologies, water management, affordable health care, food security and biotechnology. Solutions must be found in timely manner and then must move out of the*

laboratory quickly and find wider acceptance". The view endorsed by the Prime Minister on ***Sustainable Development***.

21st Century Engineers, Architects, Planners and Sustainability:

The dawn of the new era, the 21st Century World has presented greater demands on engineers than ever before. Engineers are faced with the challenge of performing in a 'global environment' with ever-changing business models, shorter product life cycles, competitive conditions & uncertainties and emphasis on Sustainability and Sustainable Development. This requires special effort to include Social, Economical and Environmental features in the development path.

Further, as the engineers create & build new products & systems with better Technologies and Process, they will be at the forefront of 'change' and are required to lead the change process. To lead the change and change process, the Indian Engineer is required to have a vision of the future, under complexities of 'Global competition'. Foremost in this vision would be the challenges of meeting the needs of a 120 crore people in the environment of scares and limited resources. As the Nation is expecting the

results faster, the engineer faces challenge of acquiring, developing, innovating suitable and appropriate Technologies & Resources for production and distribution of goods and services.

UN has identified for us the six major transformations:

- An **Energy Revolution** bringing >80% Reduction in CO_2 emissions.
- **Food System** transformation to achieve 70% increase in food production.
- Achieve sustainable URBAN LIVING (PURA)
- Adapting to and preparing for **world of 9 billion** (population)
- Protect, Restore and sustain **Bio-Diversity**.
- Strengthen Global Governance: Public-Private Partnership – INCLUSIVE

FOUNDATION OF SUSTAINABLE DEVELOPMENT

- Transformations can be achieved through sustainable development.
- Tools will be technology and human resources.
- Emphasis has to be on INNOVATION, CREATIVITY and **Education & Training**.
- We have to transform engineering to sustainable engineering.

TRANSFORMATION OF ENGINEERING

Traditional Engineering	Sustainable Engineering
Considers the object	Considers the system in which the object will be used
Focuses on technical issues	Integrates technical and non-technical issues
Solves the immediate problem (Now)	Strives to solve the problem for indefinite future (for ever)
Considers the local context (User)	Considers the global context (planet)
Assumes others will deal with politics, ethics & societal issues	Acknowledges the need for engineers to interact with experts in other disciplines related to the problem.

HOLISTIC AND TOTAL LIFE CYCLE APPROACH FOR PRODUCT DEVELOPMENT

21st Century engineer has to adopt complete life cycle approach to product development.

- Integrate technical and non-technical issues.
- Solve the problem for ever in the context of Planet earth.
- Pre-manufacturing
  - Material Extraction
  - Material Processing.

Manufacturing

Use

- Post-use
  - Retirement
  - Treatment and Disposal.
- We have to work for **6R approach and Recover, Recycle, Redesign, Reduce, Re-manufacture, Re-use**.

SUSTAINABLE DEVELOPMENT STARTS FROM DESIGN PHASE COVERING

- Functionality
- Manufacturability
- Minimum Environmental Impact
- Minimum Resource Utilisation – (Energy, Material)
- Recyclability and Re-manufacturability

- Societal Impact:
  - Operational/ Personal Safety
  - Ethical Responsibility
  - Health Effects.

SUSTAINABILITY ELEMENTS OF MANUFACTURING PROCESS

It should have the following attributes:

- Minimum material waste – Lean manufacturing
- Minimum energy consumption
- Environmentally friendly – Green manufacturing
- Operational Safety
- Personal Health
- Reduced Process Chain – Near Net Technologies (Additive Manufacturing)

SUSTAINABILITY DEMANDS SETTING UP GREEN FACTORY – LEAN AND CLEAN

- User Sustainable process of Manufacturing
- Minimum carbon footprint
- Uses Green Logistics
- Includes Re-manufacturing & Recycling
- No pollution.
- Uses Minimum Energy & Materials
- Embeds Complete Product Life Cycle
- Minimum waste.

FOR HIGHER EDUCATION, SUSTAINABLE DEVELOPMENT IS BEING INTEGRATED INTO

- Academic Curriculum
- Student Life
- Research
- Professional Development
- Mission's operations and Planning
- Community Outreach and partnership programmes
- Public Awareness Programmes
- Finally through a Legislation
- Education is the key driver to achieve this transformation.

ATTRIBUTES FOR THE 21ST CENTURY ENGINEER TO ACHIEVE SUSTAINABLE DEVELOPMENT

He should possess:

- Strong **Analytical Skills**
- **Creativity**
- Good **communication** skills
- Excellent **Leadership** abilities.
- **Mission Management** skills
- **Professionalism**&**High Ethical Standards**.
- Dynamic/ Agile/ Resilient/ **Flexible**
- **Life Long Learner**
- Solving Problems in a **Socio-Technical**&**Operational Context**.

This would require considerable changes in the 'Core' Curriculum and transforming the path of 'Science and Engineering through Education" to "*Education through Science and Engineering*" wherein the emphasis would be on Three Pillars of sustainability i.e.Ecocentricity, Sociocentricity and techno-economic centricity.

ADAPTIVE LEADER. **TECHNOLOGY: CHOICES FOR SUSTAINABILITY**

- 21st Century Engineers have to find Innovation in '**NATURE**'

- Design Products the "NATURE'S WAY"

- Birds Flight seen by Designers (Flapping wings, No propulsion)

- We created ALL metallic, fix-wing, Guzzling tonnes of fuel & polluting atmosphere, require high maintenance.

- Let us design the way birds fly.

- No or minimum energy consumption, self-healing, self-diagnostic and green.

- Require application of Bio-engineering, Molecular Engineering, Information and Cognitive Technologies to replicate Mechanisms that exist in nature.

- Follow design – simulate – manufacture – test and evaluate. Repeat the cycle till we achieve desired performance and sustainability parameters.

CHOOSING WHAT YOU ARE ENGINEERING FOR
ENGINEERS CANNOT BE NEUTRAL

- Technology choice should be such as to leave “No Net Impact” and meet the needs in terms of affluence.

- Technology that provides luxury but leaves High Net Impact should be shunned.

- Engineers have to learn “NO” to such choices in the Process of Development.

HOLISTIC PRINCIPLES OF LEADERSHIP

Attributes:

- Provides Resources to promote creativity and innovation.
- Facilitates Sustainability outcomes.
- Knows how to work with conflict/ tension/ expansion
- Invites diverse voices/ opinions
- Engaging Experts as collaborators for optimal impact
- Learn Unlearn and Learn
- Cultivates Inclusion
- Values Contributions to the betterment of Mankind
- Upholds Highest Ethical Standards

FINALLY, HE IS A "SERVANT LEADER" FOR EMPLOYEES, CUSTOMERS AND COMMUNITY.

SPIRITUALITY AND SUSTAINABILITY

Friends,

- God Created the Biological or natural world. Man created an artificial world by misusing technology advances. Artificial world embedded in biological world.

- Biological world is developing slowly while artificial world growing faster

- Differential growth rate strains both the worlds. Inability to live together is called by Lutmann: "THE ECOLOGICAL DILEMMA" OF PRESENT AGE.

- Biological world self organise through the ecological relationships between space, earth, living beings, ocean.

- Artificial world has created a hyperspace consisting of Society, Science, Technology and Economy. Artificial world has problem due to poor communication in its dimensions of hyperspace leading to.

    - Human Environments are being Turbulent.
    - Fractured societies with increasing conflicts
    - Consumerist societies leading to environmental hazards.

Question: How to Establish communication within each world and within the two worlds?

- Man who is the common factor has to discover the common language of communication.

- Engineers have to use the language of sustainability and follow the SHASTRA perspective to establish the communication and maintain equilibrium.

HAND PRINT

- Friends, the need of the hour is to use Education for Sustainable Development (ESD).

- "**Hand Print**" is a measure of ESD.

- Indulge IN Action that decreases the **HUMAN FOOT PRINT**.

- Friends let us join to increase OUR **HANDPRINT** through Innovation, Creativity and Education and create a sustainable Planet.

- Increase your **Handprint** – **Decrease** Your **FootPrint**.