COMPETITIVENESS OF INDIAN CHEMICAL INDUSTRY: SOME THOUGHTS

Dr. S. Sivaram
National Chemical Laboratory,
Pune-411 008, INDIA

Tel : 0091 20 2590 2600
Fax : 0091 20 2590 2601
Email : s.sivaram@ncl.res.in
Visit us at : http://www.ncl-india.org

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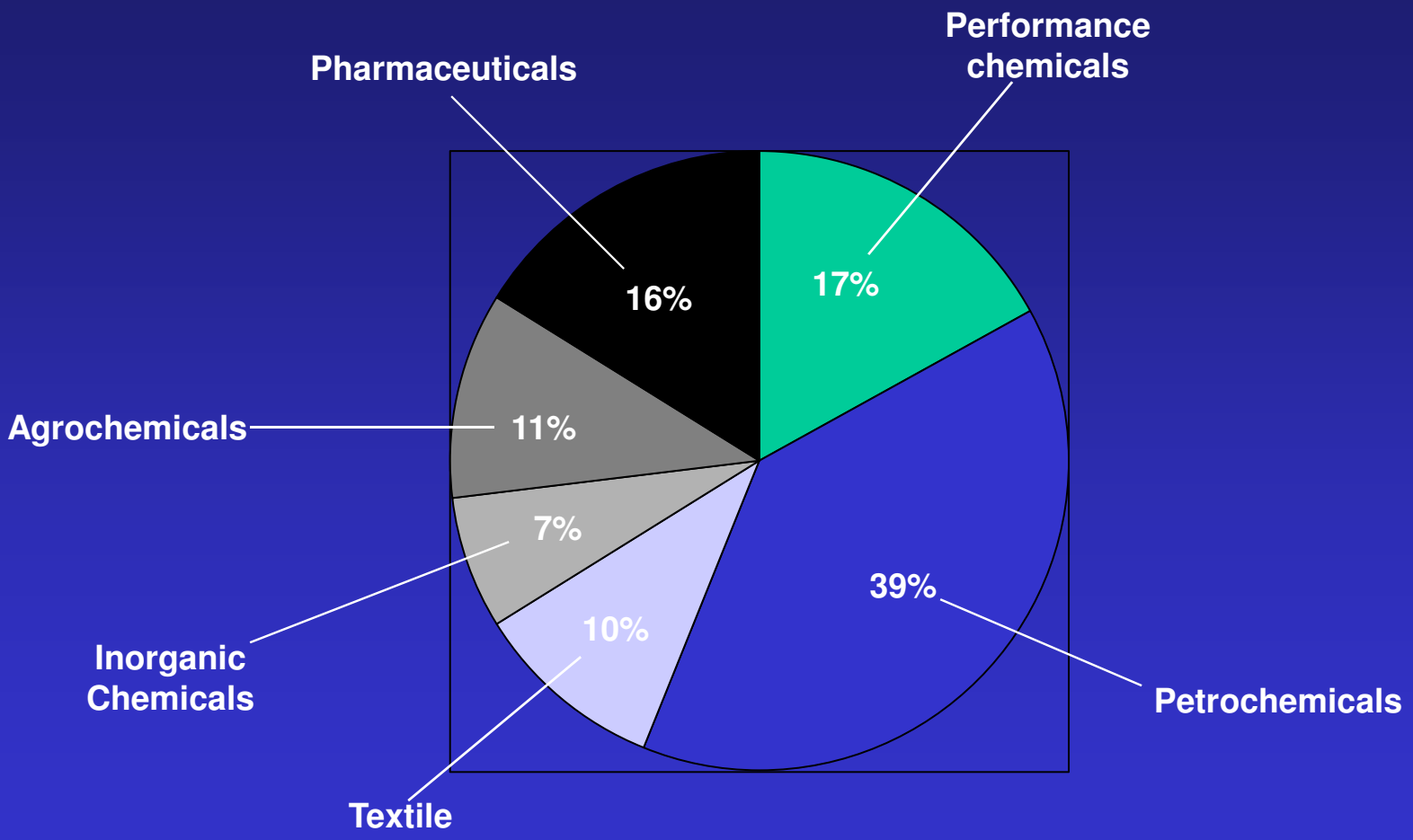
WORLD CHEMICALS MARKET

A THREE TRILLION $ INDUSTRY



CHANGING TOPOGRAPHY OF CHEMICAL INDUSTRY

- **Globalization of business**
- **Shifting manufacturing geographies**
- **Growing concerns for sustainability**
- **Changing customer expectations driven by new demographics**
- **Changing work force requirements**
- **Impact of ICT**
- **Industry consolidation**

FORCES OF CHANGE IN THE CHEMICAL INDUSTRY

- **Unprecedented rise in fuel and raw material costs**
- **High cost of new product introductions; difficulties in identifying new growth platforms**
- **Increasing regulatory (environment, health and safety) frameworks**
- **Faster technology diffusion / commoditization of products leading to quicker price / margin erosion**
- **Supply chain is taxed by breadth of markets, products and geography**
- **Increased global segmentation in terms of technology providers , low cost producers and large domestic markets**

Chemical industry is a mature industry, Innovations are largely incremental in nature. Disruptive innovations are becoming scarcer and scarcer

NEW BUSINESS MODELS FOR GROWTH

• Lowest cost producer in the industry (operators) • Company that achieves higher margins by differentiating its offerings through technology or service to customers (solution provider) (*Accenture*)	• New product developer • Application developer • Systems solution provider • Process technologist • Value chain integrator • Low cost producer (McKinsey)

INNOVATION DILEMMA

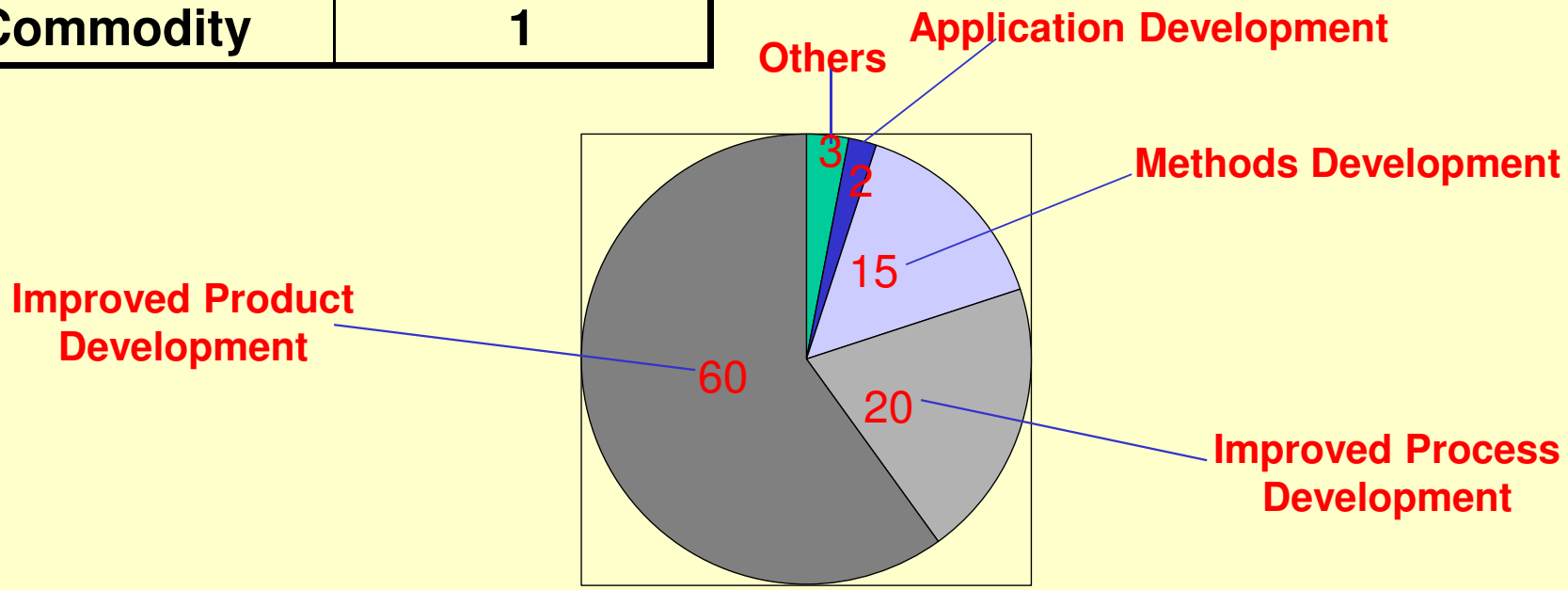
Dilemma	Strategies
• Competing solely on price, pushes operating margins progressively down • High margin business leads to poor share holder value	• Manufacturing efficiency • R&D / Innovation efficiency • Flexible R&D strategy • Embracing uncertainty

Challenge : Implement a hybrid strategy; successfully manage a commodity like business while simultaneously developing and seeking new business models

GLOBAL CHEMICAL INDUSTRY : R&D INVESTMENTS

Type	% Annual Sales
Specialty chemicals	3
Diversified companies	2
Commodity	1

Nature	% spending
Basic	11
Applied	32
Development	56



ICIS Chemical Business
October 13-19, 2008

THE INDIAN CHEMICAL INDUSTRY

- **Fragmented and low capacity**
- **Low capital/technology intensity**
- **Relative unfamiliarity with catalytic processes involving reactor types other than batch stirred tank reactors**
- **Threat of horizontal transfer of technology**
- **Limited in house technology development strength**
- **Inadequate attention towards quality and consistency**
- **Lack of deep pockets to sustain business cycles**
- **Poor product marketing skills, especially in global markets**

INDIAN CHEMICAL INDUSTRY: CONCERNS

- **Branded as low cost supplier/outsourcing/contract manufacturing entity for fine and specialty chemicals**
- **Innovation deficit; few new product offerings based on proprietary knowledge / IP. Low R&D intensity with the exception of drugs and pharmaceutical sector**
- **Conventional engineering practices**
- **Poor application development skills, especially for specialties**
- **Talent deficit; chemistry and chemical engineering education no longer considered fashionable; serious issues of talent retention/flight**

Chemicals and chemical industry is not perceived as sexy as Biotechnology or IT

CHEMICAL INDUSTRY : 2020 TECHNOLOGY VISION

- **Reduce feed stocks losses to waste / byproducts by 90%**
- **Reduce energy intensity of processes by 30%**
- **Reduce emissions including CO_2 and effluents by 30%; move towards zero discharge goals**
- **Increase use of renewable resources as building block for chemicals ; combine judiciously chemical and biological processes to achieve sustainability goals**
- **Small/ modular chemical plant designs for enhanced safety and reduced quantities of inventory storage**
- **Increase the conversion of stoichiometric processes to catalytic processes; batch to continuous processes**
- **Understand better the impact of chemicals and materials on environment, safety and human health**

RESEARCH PLATFORMS FOR CHEMICAL INDUSTRY

- **Clean Technology**
  - **Solid catalysts**
  - **High specificity / atom economy**
  - **Green solvents**

- **Chemistry in Unusual Media**
  - **Supercritical CO2 and water**
  - **Aqueous media**
  - **Ionic liquids**
  - **Reaction in dispersions, suspensions and emulsions**
  - **Solid state reactions**

- **Industrial (white) Biotechnology**
  - **Bio-catalysis and bio-transformations**
  - **Bio-based building blocks for performance chemicals**
  - **Fermentation processes**

Contd….

Contd….

RESEARCH PLATFORMS FOR CHEMICAL INDUSTRY

- **Chemistry Toolboxes**
  - **Chiral switches / single enantiomers**
  - **Microencapsulation**
  - **Synthetic chemistry tool boxes (e.g. Suzuki coupling, catalytic hydrogenation, metathesis, click chemistry etc.)**
  - **Crystal engineering and polymorphmism**

- **Unusual Reaction Conditions**
  - **Photochemistry / photocatalysis**
  - **Electrochemistry**
  - **Microwave**
  - **Sono-chemistry**
  - **Plasma**

Contd….

Contd….

RESEARCH PLATFORMS FOR CHEMICAL INDUSTRY

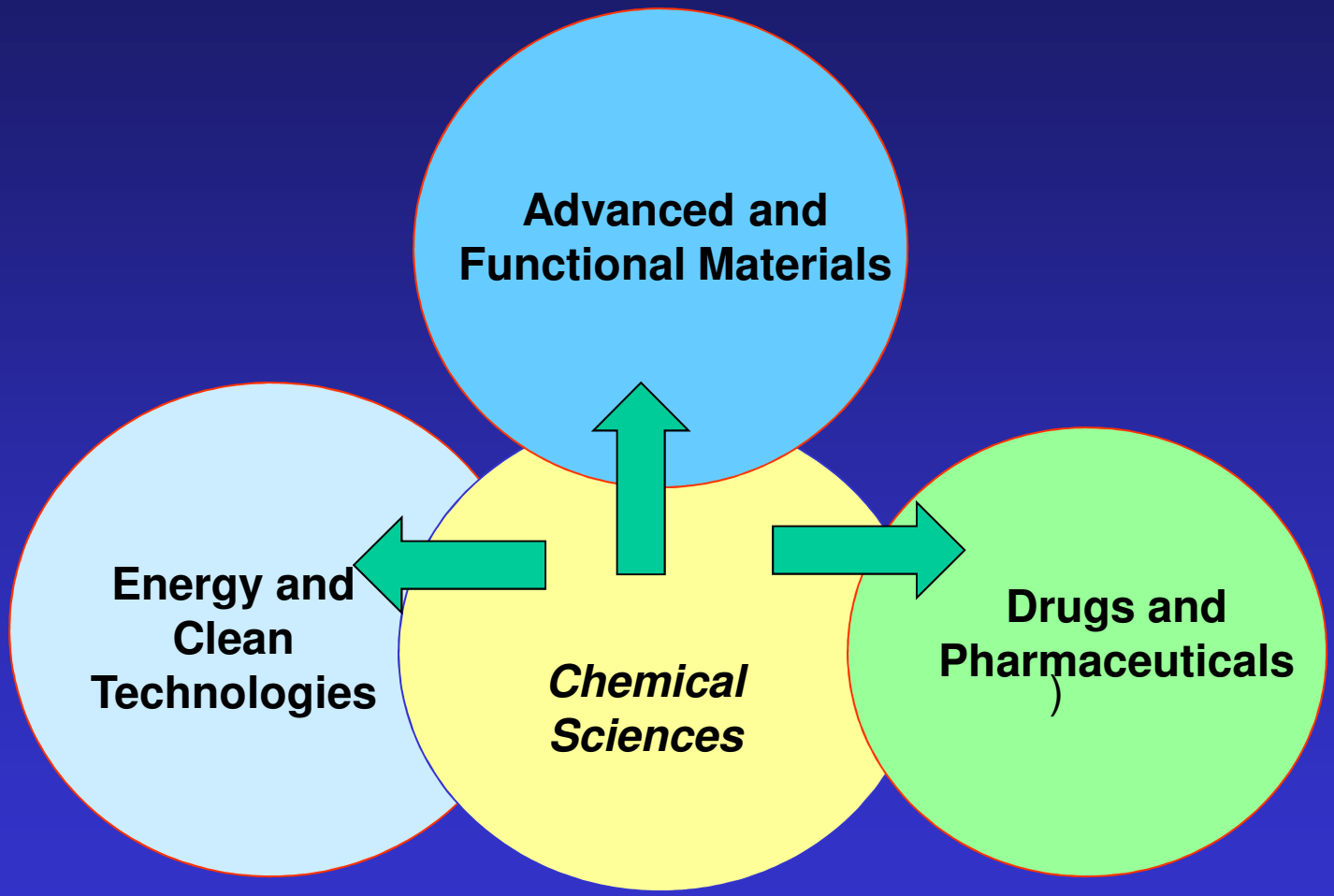
- **New Processes / Product Strategies**

  - **Chemical product engineering**
  - **Micro-reaction engineering**
  - **Novel reactor and mixer designs**
  - **Novel separation processes especially membrane based processes**
    - **Computational modeling, simulation and visualization**
  - **Process intensification / smaller footprint of process plants**
  - **Modular and mobile manufacturing**
  - **Energy and water use efficiency**
  - **Effluent and waste minimization**

TODAYS 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

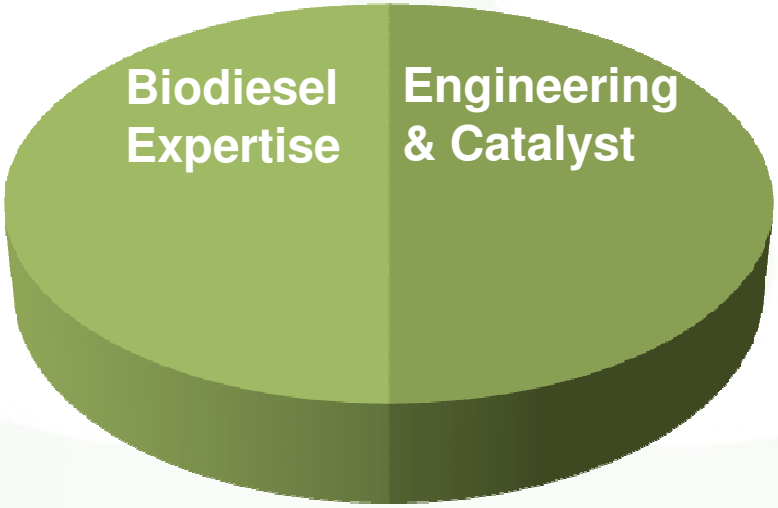
CHEMICAL SCIENCE : A CORE SCIENCE FOR MANY EMERGING TECHNOLOGIES



COMPETITIVENESS OF THE CHEMICAL INDUSTRY : SOME THOUGHTS

- **Identify multiple product capabilities from the same set of facilities**
- **Examine chemicals which are single vendor item in the global market**
- **Look for chemicals that can be manufactured in existing facilities with incremental capex**
- **Identify chemicals of strategic nature which are under technology embargoes**
- **Look for opportunities where improved purities of currently produced chemicals can open up new market opportunities**
- **Focus on formulated products**
- **Identify chemicals where India has unique raw material advantages**

Management Expertise



Strategic Partners

- One of largest catalyst producers in world
- 5,000 person, publically traded company
- Global production capacity

- Market leader for crude oil dewatering using electrostatic separation
- Co-developed novel method for separating biodiesel & glycerin

- One of the world's largest catalytic research institutes
- Government backed institute with over 200+ PhD's
- Focus on catalysis since 1980

Ravi Randhava, PhD. – CTO
- Founder of Xytel – 700+ world wide process engineering company
- Focus on solid catalyst technology development

UF MEMBRANE TECHNOLOGY : FROM CONCEPT TO MARKET

- **Discovery of a unique process to control membrane porosity**
  - **Reject smallest known pathogenic species (virus);**
  - **Still be able to operate at tap water pressure (0.4 bar)**
- **Prototype preparation, demonstration & performance evaluation**
  - **Designed various easy to use prototypes**
  - **Demonstration & rigorous performance evaluation**
- **Technology transfer**
  - **Technology licensed to Membrane Filters India Ltd., Pune, a start up enterprise incubated at NCL**
  - **Product in the market since 2007; Current sales turnover of the company ~ US$ 15 million**

POROUS POLYETHYLENE IMPLANTS – IN THE MARKET!

Start-up company
www.biopore.in

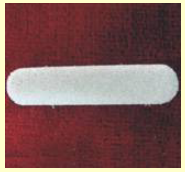

Sphere with suture tunnels


Orbital floor plate


Floor plate (part non-porous)

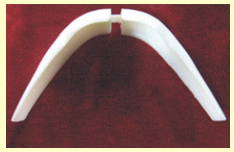

Orbital rim


Malar implant


Nasal augmentation sheet


Mandibular implant


Nasal dorsum


Chin implant


Pterional implant


Mastoid

Celebrating Sixty Years of Science

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SIGNIFICANT OPPORTUNITIES FOR DISRUPTIVE INNOVATION EXISTS. HOWEVER, TODAY'S CHEMICAL SCIENCE WILL REQUIRE A COMPLETELY DIFFERENT TRANSLATIONAL MODEL TO CONVERT KNOWLEDGE TO WEALTH

STRATEGIES FOR COMPEITITIVENESS

- **Volume** → **Value**
- **Specifications** → **Functions**
- **Composition** → **Provide solutions**
- **Products** → **Services**

1950 - 2010

Celebrating Sixty Years of Science

THANK YOU