THE ROLE OF RUBBERS IN A MANUFACTURING ECONOMY: EMERGING OPPORTUNITIES FOR INDIAN INDUSTRY

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OUTLINE

- Manufacturing economy : The growth drivers
- Rubber science and technology : Birth of an industry
- Rubbers in manufacturing sector
- Building an innovation ecosystem : Some thoughts

INDIA IN 2014 : STRENGTHS

- Strong fundamentals of economy
- Robust domestic consumption
- Favorable demographics
- Expanding middle income group
- Large domestic savings (>35%)
- Growing urbanization
- More young people in colleges and universities

GREAT INDIAN ENIGMA : LARGE POTENTIALS, POOR REALIZATION

INDIA IN 2014 : CONCERNS

- Deceleration of economic growth
- Supply-demand imbalance
- Crash of global commodity prices
- High domestic inflation / high interest rates
- Growing fiscal deficit / subsidies
- Weak pace of economic reforms
- Weak Indian Rupee

NET RESULT : WEAK INVESTOR SENTIMENTS

KEY INNOVATION DRIVERS FOR INDIA

- Democracy : Raucous, cacophonous and chaotic
- Demography : open minded, irreverent and rebellious
- Diversity : Language, ethnicity, religion, food habits and dress
- Adversity

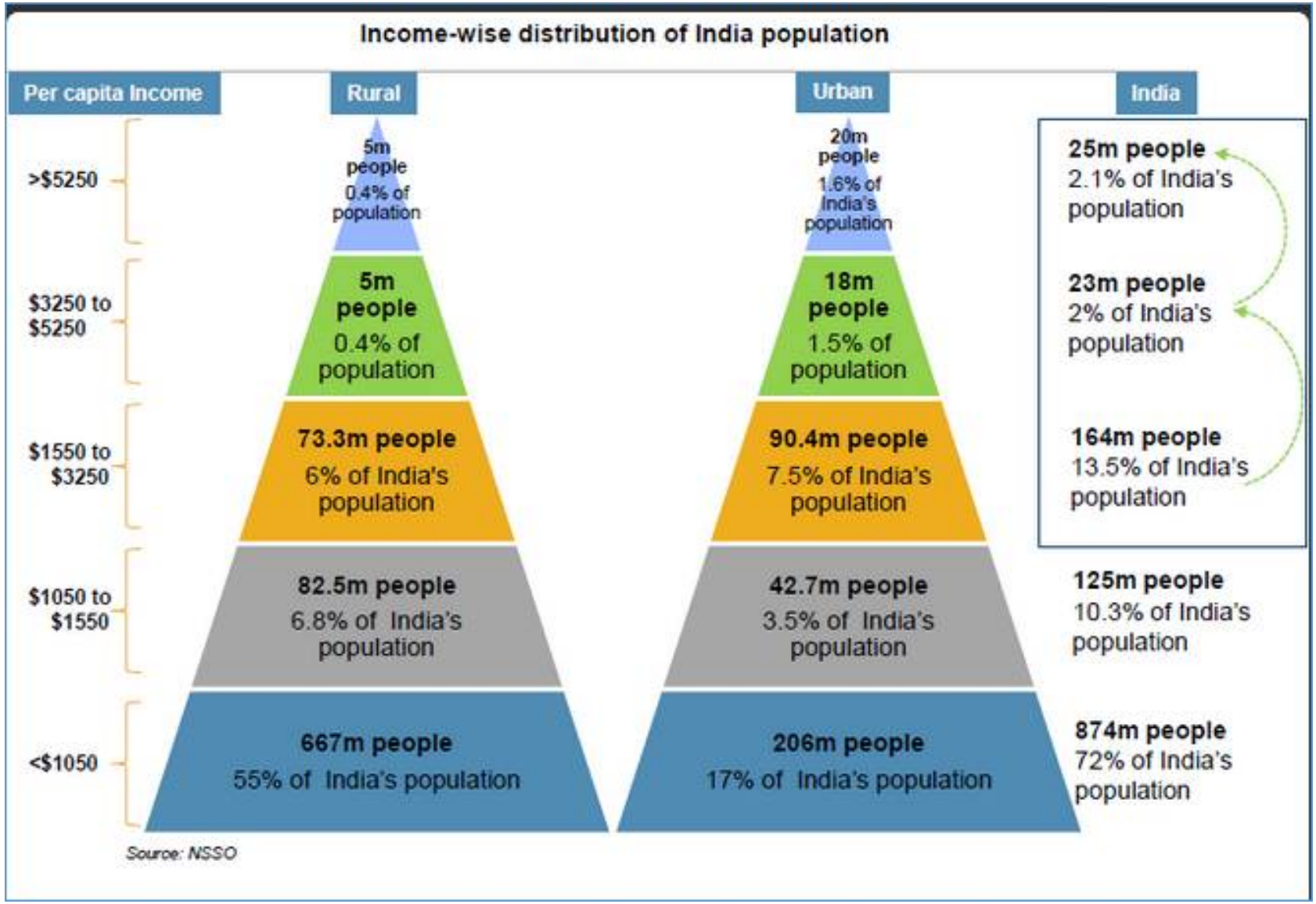
DIVERSITY SPURS CREATIVITY AND INNOVATION
INDIA HAS NATURAL ADVANTAGES WHEN IT COMES TO DIVERSITY

INDIA IN THE DECADES AHEAD

- Three trillion dollar economy by 2025
- Unique demography; 400 million Indians born after 1991, 600 million below 24 years, 113 million below 5 years, 26 million babies born every year, 200 million above 60 years (by 2030)
- 70% of global work force will be Indians by 2025, born between 1980-2000 (Gen Y). Gen Y would have had far greater access to resources and education; dual income households
- Manufacturing as a share of GDP from 15 to 25% in the next decade (Make in India)
- Manufacturing already contributes to 50% India's exports; MSME's will emerge as an engine of growth (employment, exports)
- Consumer merchandize to grow from US $ 500 billion to US $ 2000 billion by 2020
- Largest internet / mobile / banking user population in the world by 2025

CONVERGENCE OF ASPIRATION IN LIFESTYLES IN RURAL AND URBAN INDIA

THE BULGING INDIAN MIDDLE CLASS



RUBBER SCIENCE AND TECHNOLOGY : BIRTH OF AN INDUSTRY

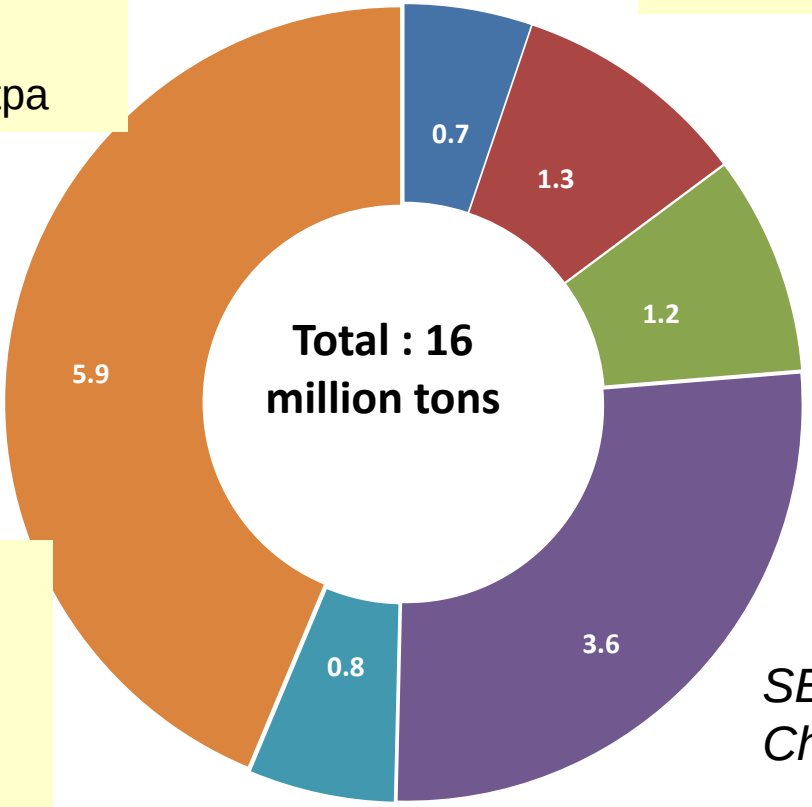
- Synthetic rubbers were the product of post war renaissance in chemical industry; an example of the familiar adage, “necessity is the mother of invention”
- The fifties and sixties saw the introduction of many rubbers and elastomers that changed the face of human civilization
- From early curiosities rubbers and elastomers became an indispensable part of our daily living

GLOBAL SYNTHETIC RUBBER SUPPLY

Synthetic Rubber (India)

E-SBR : IOC 120 ktpa
RIL 150 ktpa
Butyl : RIL 100 ktpa
BR (Co, Ni) : RIL 100 ktpa

Natural rubber (India)
Production : 800 ktpa
imports : 325 ktpa



Global Rank
Automobiles : 7
Two Wheelers : 1
Commercial Vehicles : 4

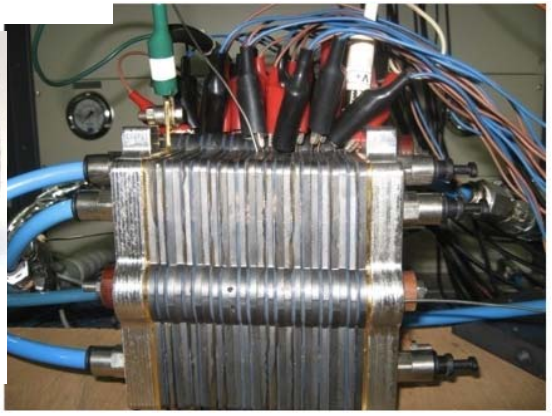
SBS : 2.1 million tpa
Chloroprene : 0.4 million tpa

RUBBERS AND ELASTOMERS : FROM A VISIBLE TO AN INVISIBLE MATERIAL

- In the early years, advances in rubber science led to objects that you could see, touch and feel
- However, increasingly rubber is becoming invisible
  - Energy harvesting, conversion and storage devices (LED lighting, batteries, solar and wind energy)
  - Consumer electronics
  - Soft touch interfaces
  - Sports / leisure goods
  - Formulated products (adhesives, coatings, lubricants, construction chemicals etc)

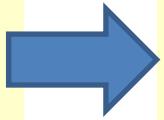
DEMANDING PROPERTIES AND AESTHETICS IN DESIGN

RUBBER MATERIALS : FROM VISIBLE TO INVISIBLE

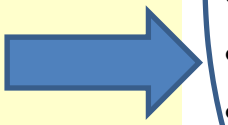


MEGATRENDS USEFUL FOR PREDICTING THE FUTURE OF TECHNOLOGY

- Consumer habits & demands
- Demographics
- Population
- Climate Change
- Economic growth
- Disposable income
- Infrastructure
- Urbanization
- Constrained natural resources



- Foods & nutrition
- Public health hygiene
- Energy
- Water
- Transportation
- Environment
- Housing
- Education
- Livelihood
- Safety and protection
- Sustainability



- Energy
- Energy efficiency
- Light weight materials
- Lower water footprint
- Lower carbon footprint
- Materials based on renewable resources

COMMODITY AND ENGINEERING RUBBERS

- **COMMODITY**
  - Natural
  - Synthetic (SBR, IIR, PBR)
- **SPECIALITY**
  - Nitrile Rubber
  - Sulfochlorinated / chlorinated polyolefins
  - EPDM/ poly (Isobutylene)
  - Poly(chloroprene)
  - TPE's
  - Silicones
  - Poly(sulfide)s
  - Fluorinated rubbers
  - Acrylic rubbers
  - Poly(epichlorohydrin)s
  - Poly(norbornene)s and Poly(octenamer)s
  - Chemically modified synthetic/natural rubbers
  - Rubber blends
  - Conducting Rubbers

Access to a host of materials with diversity of properties

NATURAL AND SYNTHETIC RUBBERS : CHEMICAL MODIFICATIONS

- Chlorination / Bromination
- Hydrogenation
- Ozonization
- Sulfonation
- Epoxidation
- ‘Ene’ reactions

It is always not necessary to modify the bulk. For some property improvements, modification of surface is enough !

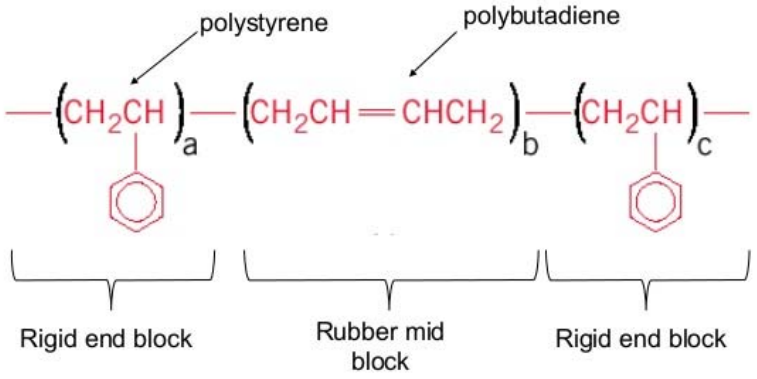
DIVERSE TOOL BOX FOR PROPERTY MODIFICATIONS

CLASSES OF RUBBERS IN APPLICATIONS

- Solid rubber
- Emulsions/lattices
- Liquid/functional rubbers (HTPB, carboxylated lattices)
- Thermoplastic elastomers
- Rubber modified thermoplastics

THERMOPLASTIC ELASTOMERS (TPE)

- Copolymer of polystyrene and butadiene rubber



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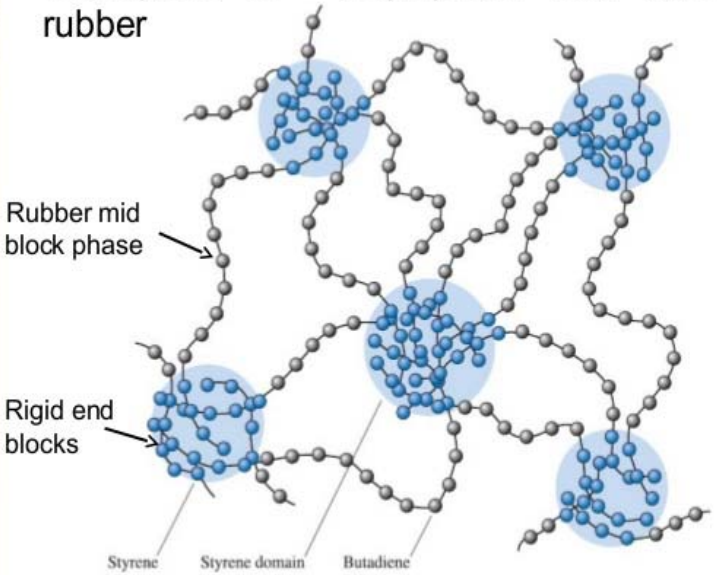
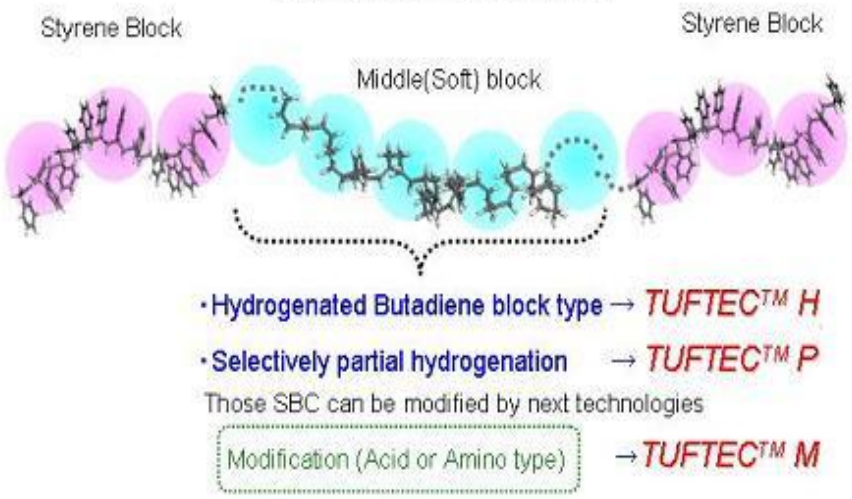


- Dynamically vulcanized elastomer – plastic blends
  - EPDM/PP
  - NR/PP
- Elastomer thermoplastic blends
  - NR/Nylon
- Block copolymers
  - SBS / SEBS
  - SIS

Fig. Structure image of TUFTEC



SYNTHETIC AND NATURAL RUBBERS: QUEST FOR SUSTAINABILITY

- **SYNTHETICS**

  - Monomers/Building blocks from renewable resources
    - Isoprene (Genencor/Good year, Glycos Biotechnologies)
    - Isobutylene (Global Bioenergies/Gevo/Lanxess
    - 1,3-Butadiene (Global Bioenergies/Synthos)
  - Materials
    - Regulatory compliance (safety, emissions, fuel economy etc.)
    - Additives and processing aids (sustainability, safety)
    - End of life issues (recycling, reuse, disposal)

- **NATURAL**
  - Enhance biodiversity of cultures
  - Strategies for combating adverse effect of climate change
  - Safety in use (latex allergy)

ENGINEERING ELASTOMERS

- High temperature resistance
- Resistance to heat aging/ozone
- Superior abrasion
- Oil resistance @ high temperatures
- Chemical stability
- $O_2/N_2/CO_2$ barrier properties

ENGINEERING (HIGH PERFORMANCE) APPLICATIONS

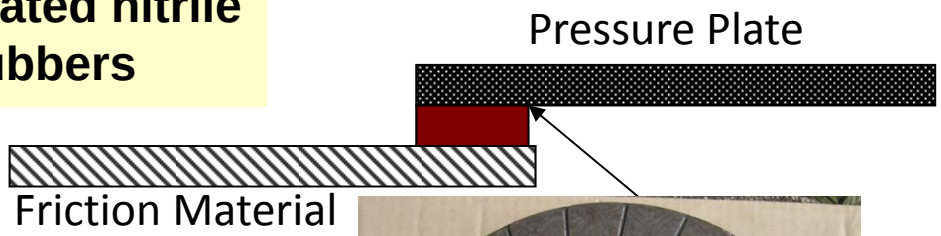
- Sealants/ Adhesives/ Coating
- Vibration / shock / noise dampening materials
- Corrosion protection
- Abrasion and friction reducers
- Electrical and thermal insulation
- Belts / hoses / gaskets
- Solid fuels in aerospace / missile applications
- Self healing structures

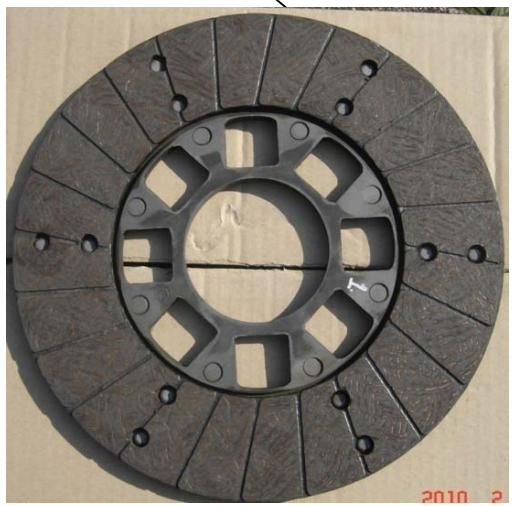
RIVET FREE ADHESIVE BONDED CLUTCH DISKS

The clutch disc is sandwiched between the pressure plate and a flywheel. In the operation of clutch, the pressure plate and the clutch disc undergoes engaging/disengaging cycle. During this process, pressure plate is pressed against the friction material and the friction material undergoes wear. In order to have a better control and smooth operation of the clutch, a cushioning is provided with small steel spring plate which has a bend with a spring action.

Presently, the friction material and the spring plates are connected to the front plate with the help of rivets

High performance epoxies cured with amine terminated nitriles or hydrogenated carboxyl terminated nitrile rubbers





Lap Shear Strength, 150 ° C
(ASTM D 1002-05)
Amine terminated NBR : 16-20 kg/ sq.cm
Hyd. Carboxyl NBR : 10-12 kg/ sq.cm

Improved Adhesives Composition and Uses Thereof, US Appl.13/877226; WO 2011/ 000688; Ind.Pat. Appl.2361/DEL/2010

MANUFACTURING GROWTH SECTORS

- Transportation (railways, automobiles/vehicles)
- Construction : Buildings, bridges and roads (modularity, energy efficiency, durability)
- Defense and aerospace
- Public health / sanitation and hygiene
- Leisure and recreational goods

INDIA AND INNOVATION

(Source : Cornell U, INSEAD and WIPO)

- India ranks 66th amongst 142 economies on innovation capacity and efficiency. Switzerland #1, UK #3, USA #5, Ireland #9

- India's strengths: Gross capital formation, investment in new business, industrial cluster development, growth rate, IT exports, creative goods export

- India's weakness : Political stability, ease of starting a business, human capital, school life expectancy, teacher : pupil ratio, knowledge absorption capacity, poor IP culture, poor branding; poor design and engineering skills

INDIA HAS TO TRANSITION FROM A "FACTOR" DRIVEN TO "EFFICIENCY" DRIVEN AND ULTIMATELY "INNOVATION" DRIVEN ECONOMY

COMPETITIVE ADVANTAGE

- Innovation Capacity
- Scale and Reach
- Talent

DIFFICULT TO ACQUIRE, DIRECT AND MANAGE

A CLUSTER APPROACH TO INNOVATION

Philosophy

- A group of companies with common objectives decide to form an Innovation Cluster with a defined and shared innovation agenda
- Small, decentralized and easily manageable
- Industry owned, resourced and managed
- Shared investment and costs
- Leverage available public funds and incentives
- Located preferably next to an academic center of excellence to take advantage of students and faculty resources

Focus

- *Product design and engineering*
- *Quality systems and processes*
- *Material selection and cost performance optimization*
- *LCA, regulatory and sustainability issues*
- *Precompetitive R&D*
- *Global information gateway*

Resources

- *Computational*
- *Information*
- *Material data bases*
- *Design tools*

COMPETITIVE ADVANTAGE IN MANUFACTURING
KEY QUESTIONS

Today	In the future
Which customers do you serve today?	Which customers will you serve in the future?
Through what channels do you reach customers today?	Through what channels will you reach customers in the future?
Who are your competitors today?	Who will your competitors be in the future?
What is the basis for your competitive advantage today?	What will be the basis for your competitive advantage in the future?
Where do your margins come from today?	Where will your margins come from in the future?
What skills or capabilities make you unique today?	What skills or capabilities will make you unique in the future?

Every morning in Africa, a gazelle wakes up. It knows it must run faster than the fastest lion or it will be killed. Every morning a lion wakes up. It knows it must outrun the slowest gazelle or it will starve to death. It does not matter whether you are lion or the gazelle. When the sun comes up you better start running.

Christopher McDougall, Born to Run: A Hidden Tribe, Super athletes, and the Greatest Race the World Has Never Seen

WE CERTAINLY DO NOT HAVE THE LUXURY OF STANDING STILL !


1950 - 2010
Celebrating Sixty
Years of Science
THANK YOU