KNOWLEDGE-BASED INDUSTRIES IN THE GCC REGION: PROSPECTS AND CHALLENGES

Gulf Organization for Industrial Consulting and

SRI International

Technology Opportunities

Micro/Nanotechnology and Biotechnology Opportunities for the GCC Region

Technology Opportunities

- Technology plays a key role in the development of a knowledge-based economy.
  - Generating Economic Impact
  - Meeting Industrial Needs
  - Addressing Societal Challenges

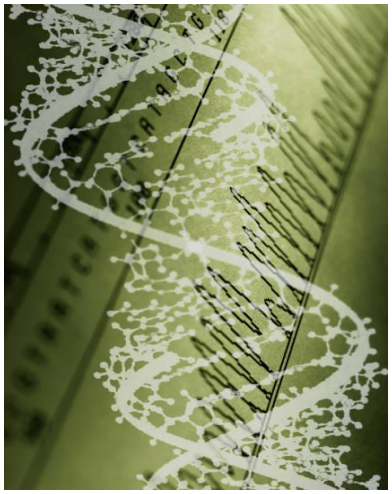
- SRI identified key biotechnology and micro/nanotechnology topics for possible development and/or application in the GCC region in six high priority sectors:
  - Petrochemicals and chemicals
  - Water technologies
  - Advanced materials
  - Energy and environmental technologies
  - Communications technologies
  - Life sciences

Micro/Nanotechnology

- At scales lower than 100 nanometers, matter exhibits unique behaviors; exploiting these behaviors is the basis of nanotechnology.
- Microelectromechanical Systems (MEMS) operate at a larger size scale, but the line between Micro and Nano technologies is increasingly blurred.
- Nanotechnology is already employed in thousands of products, from cosmetics to advanced materials.
- MEMS play a major role in everyday products such as inkjet printers, automobile airbag sensors, and video game systems and even greater potential ahead.
- Combined MEMS and Nanotechnology markets are estimated to exceed $20 billion.

Biotechnology

- Modern biotechnology is built upon a diverse set of technologies that manipulate cellular, subcellular, or molecular components in living things for use in product and process applications in many industries.
- The unifying element and foundation of biotechnology is the similarity of all life at the cellular level.
- Applications include the production of amino acids in the chemicals industry, biopolymers in the materials industry, and biopharmaceuticals in the life sciences industry.
- Biotech company revenues are currently estimated to be approaching $100 billion per year globally.



Technologies for GCC Applications

		Petrochemicals & Chemicals	Water	Materials	Energy & Environment	ICT	Life Sciences
	Nanoparticles	+++	++	+++	+++	+++	+++
	Nanoporous Materials	+++	++	++	+++	+	+
	Carbon Nanotubes	++	+	++	++	++	+
	Thin Films	+++		++	+++	+++	++
	MEMS Sensors	+++	++	++	++	++	+++
	MEMS microstructures	++	++	+++	+++	+++	+++
	Biocatalysis	++	+	+	++	+	+++
	Biosensors	+	++	+	+++	+	+++
	Biopolymers	+	++	++	++	+	+++
	Nano-biotechnology	++	+	++	+++	+	+++
	Pharmaceuticals		+		+		+++
	Health Care Technology					+++	+++

Petrochemicals and Chemicals

High Impact Technologies

Micro/Nanotechnology	
Technology	Applications
Nanoparticles	Improved Catalysts
Carbon Nanotubes	Improved Catalysts
MEMS Sensors	Fluid & Gas Analysis

High Impact Technologies

Biotechnology	
Technology	Applications
Biocatalysis	Specialty chemical production
Nano-biotechnology	Improved biocatalysis
Biosensors	Process Monitoring and Control

Water Technologies

Micro/Nanotechnology

High Impact Technologies

Technology	Applications
Nano-membranes	Nano-filtration for Desalination
MEMS Sensors	Water Quality Monitoring
Thin Films	Anti-Fouling & Anti-Corrosion Coatings

Biotechnology

High Impact Technologies

Technology	Applications
Biopolymers	Wastewater Treatment
Biosensors	Water Quality Monitoring
Biocatalysts	Waste Water Treatment

Advanced Materials

High Impact Technologies

Micro/Nanotechnology	
Technology	**Applications**
MEMS Microstructure	Materials Testing
Thin Films and Coatings	Smart Glass
Nanoparticles	Enhanced Strength Materials

High Impact Technologies

Biotechnology	
Technology	**Applications**
Biocatalysis	Mineral Extraction
Biopolymers	Biodegradable Bioplastics
Bio-nano-technology	Bio-nano-composite materials

Energy and Environmental Technologies

High Impact Technologies

Micro/Nanotechnology	
Technology	**Applications**
Carbon Nanotubes	Batteries
Nanoporous Materials	Super-capacitors
Nano-particles	Sensors for Environmental Monitoring

High Impact Technologies

Biotechnology	
Technology	**Applications**
Biosensors	Environmental Monitoring
Bio-nano-technology	Photovoltaics
Biocatalysis	Environmental Remediation

Life Sciences

High Impact Technologies

Micro/Nanotechnology	
Technology	**Applications**
MEMS Sensors	Diagnostics
Nanoparticles	Targeted Drug Delivery
MEMS Micro-structures	Lab-On-Chip

High Impact Technologies

Biotechnology	
Technology	**Applications**
Biosensors	Diagnostics
Biopolymers	Device Coatings
Biocatalysis	Enzyme-based medical diagnostics

ICT

High Impact Technologies

Micro/Nanotechnology	
Technology	**Applications**
Nanocoatings	Improved Fiber Optics
Carbon Nanotubes	Optical Switching

High Impact Technologies

Biotechnology	
Technology	**Applications**
Health Care Technology	Electronic Patient Records
Biocatalysis	Biologically Derived Nonlinear Optical Materials

KBI PROFILE OF THE GCC COUNTRIES: ASSETS AND CHALLENGES

KBI Profile of the Region

- **Common strengths emerging among the GCC member countries.**
  - Vision and commitment from the countries' leaders
  - Allocation of resources for large investments in technology infrastructure
  - Development and engagement of KBI enabling institutions

- **Common weaknesses that hinder the GCC countries' progress.**
  - Slow pace of reform in the countries' education systems
  - Inadequate public awareness of science and technology and insufficient degree of preparedness for knowledge activity
  - Overemphasis on physical assets and suboptimal allocation of resources and attention to the soft architecture of the knowledge economy
  - Risk-averse approach to investment with regard to venture capital and technology financing
  - Weak intellectual property rights (IPR) regimes
  - Lack of regional coordination of investments and scientific efforts

KBI Balance Sheet: Some Unique Assets and Challenges

BAHRAIN
New economic development strategy
Strong financial market and institutions
Labor market deregulation under way
Investment in technology infrastructure
Absence of a comprehensive STI policy
Low R&D capacity and productivity
No ownership preference for investors
Low academic-industry cooperation

KUWAIT
Relatively strong R&D productivity
Emphasis on tech commercialization
Tertiary education needs expansion
Mono-economy limits innovation
Quality of teaching needs improvement
Cross-institution collaboration absent
Absence of a comprehensive STI policy
SME policies/programs needed

KBI Balance Sheet: Some Unique Assets and Challenges

OMAN
National research strategy in place
Series of new educational ventures
New venture capital fund established
Low quality and quantity of R&D
R&D facilities and infrastructure needed
Industry-relevant curriculum required
Applied research lacks focus
Low levels of international collaboration in R&D and technology adoption

QATAR
Qatar Foundation leading the transition
Productive experiments: QSTP and QEC
New private sector investments in S&T
Innovation capacity low
SME policies and programs lacking
Technology management skills lacking
Reliance on third parties for R&D
Overarching innovation framework needed

KBI Balance Sheet: Some Unique Assets and Challenges

SAUDI ARABIA
Rapidly rising allocations for S&T
Fast build up of KBI infrastructure
Relatively strong regional R&D capacity
Some SME support programs in place, but techno-entrepreneurship missing
Venture capital absent
Low cross-institutional R&D collaboration
Weak secondary and tertiary education
Many KBI institutions, overlapping mandate

UAE
Number of KBI investments
Comparatively strong IPR regime
Relatively robust education system
Weak research emphasis in higher education and industry
Absence of a comprehensive KBI policy and framework at the national level
Human capital advantages eroding
Venture capital funding nascent
Considerable overlap in investments

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