A Framework for Technology Foresight

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Foresight, Not Forecasting

• Foresight identifies a range of plausible S&T developments within a timeframe
  – Technology applications leading to products or capabilities
  – Based on assessment of available capacity, drivers, barriers
  – Implementation requires capacity and effort
    • To overcome the barriers
    • Assisted by the drivers
RAND 2020 Foresight Study Rated Countries Based on their Capacity to Acquire Representative Technology Applications

<table>
<thead>
<tr>
<th>Needed Capability</th>
<th>Technology Applications</th>
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<tbody>
<tr>
<td>Low</td>
<td>Cheap solar energy</td>
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<td></td>
<td>Rural wireless communications</td>
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<td></td>
<td>Genetically modified (GM) crops</td>
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<td></td>
<td>Filters and catalysts</td>
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<td></td>
<td>Cheap autonomous housing</td>
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<tr>
<td>Medium</td>
<td>Rapid bioassays</td>
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<td></td>
<td>Green manufacturing</td>
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<td></td>
<td>Ubiquitous RFID tagging</td>
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<td></td>
<td>Hybrid vehicles</td>
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<tr>
<td>High</td>
<td>Targeted drug delivery</td>
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<td></td>
<td>Improved diagnostic and surgical methods</td>
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<tr>
<td></td>
<td>Quantum cryptography</td>
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<tr>
<td>Very High</td>
<td>Ubiquitous information access</td>
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<td></td>
<td>Tissue engineering</td>
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<td></td>
<td>Pervasive sensors</td>
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<td>Wearable computers</td>
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General Capacity to Acquire Technology Applications and Drivers vs. Barriers for Selected Countries

Note direction of country movement:  
- Up before right
Technology Applications for Some of These Policy Areas Are Easier to Implement than Others

- **Easier to implement:**
  - Rural economic development
  - Public health (less capacity needed than for improving individual health)
  - Resource use and environmental health
  - Individual health

- **Require same as for overall S&T capacity to implement:**
  - Military
  - Homeland security and public safety

- **Harder to implement:**
  - Economic growth and international commerce
  - Governance and social structure

*This leads to slight positional shifts up or down in the quad charts*

The Interdependency Between Foresight and Capacity Development
Foresight and the Local Context

• Who develops and implements technology applications, why, and when?
  – Determined by the “local context
  – “Local context” can be local, national, regional, or global

The local context is the social, economic, political, institutional, and cultural environment for implementation

Many Countries Pursue Foresight as a Continuing National Activity

• Japan—National Delphi Exercises
• Korea—Technology Roadmapping
• UK—Horizon Scanning and Scenarios
• Australia—Scenarios and Red Teaming
• APEC Center for Technology Foresight
  – Bibliometrics
  – Delphi
  – Expert Workshops
Recent Studies of the APEC Center for Technology Foresight

• Example 1: Technologies for Combating Emerging Infectious Diseases (EIDs)
  – Identifying, tracking, monitoring, and treating infected individuals and developing early detection and mitigation measures

• Example 2: Low Carbon Society (LCS) for Asia-Pacific
  – Policy, technical, institutional, and cooperative initiatives to undertake now to address challenges foreseen over the next 40 years due to climate change

Methodology for EID Study

• On-line survey of Asia Pacific experts
  – Key challenges from EIDs
  – Potential impacts of technology applications

• Workshops with APEC economy individuals
  – Scenarios looking out 10 years
  – Outcomes dependent on technologies
  – Identify domains for technology roadmaps
Framework for EID Study

Preventive Measures (PM)
- Filters/Membranes
- Computer-assisted Drug Development
- GM Insects / Animals
- Personal Medicine

Surveillance & Detection (S&D)
- Rapid Bioassays
- Bionano Diagnostic/Therapy
- RFID Tracking/Monitoring
- Networked Biosensors

Treatment (Tr)
- Bionano Diagnostic/Therapy
- Computer-assisted Drug Development
- Personal Medicine

Prevention of Spread (PoS)
- Filters/Membranes
- RFID Tracking/Monitoring
- Nanoscale Coatings

Methodology for LCS Study

- Experts from Africa, Americas, Asia, Europe, Oceania
- Local context characterized by important areas of consensus and non-consensus on
  - Climate change and its impacts, now to 2050
  - Developments in migration, resources, health, trade, housing, transportation
- Chronology of plausible societal, technical, policy developments by decade to 2050
  - Inputs for a scenario workshop that envisioned and examined alternative 2050 low-carbon futures
Foresight recommended policy actions to be taken in the near-term to achieve the future visions

The Local Context for a Foresight for TBNA, A Development Region Near Tianjin, China

- TBNA’s mission as mandated by China’s State Council
- China’s pressing national needs
- Drivers and barriers to technological innovation
  - In China as a whole
  - In TBNA more specifically
- Relevant capacity currently available to TBNA, both locally and more broadly
  - Research and development (R&D)
  - Manufacturing
  - S&T commercialization
Seven Technology Applications Best Fit TBNA’s Needs, Drivers, Barriers, and Local Capacity

- Improved diagnostic and surgical methods
- Cheap solar energy
- Rural wireless communications
- Genetically modified crops
- Membranes, filters, and catalysts
- Cheap autonomous housing
- Rapid bioassays
- Green manufacturing
- Ubiquitous RFID tagging
- Hybrid vehicles
- Targeted drug delivery
- Improved diagnostic and surgical methods
- Quantum cryptography
- Ubiquitous information access
- Tissue engineering
- Pervasive sensors
- Wearable computers
- Electric and hybrid vehicles
- Molecular-scale drug design, development, and delivery
- Advanced mobile communications and radio frequency identification

Foresight Methods Diamond

- Creativity: Wild Cards, Science Fiction, Simulation Gaming, Essays / Scenario writing, Genius forecasting, Role Play/Acting, Backcasting, SWOT, Brainstorming, Relevance trees / Logic chart, Scenario workshop, Roadmapping, Delphi, Survey, Citizen Panel
- Evidence: Evidence
- Interaction: Qualitative (19), Semi-quantitative (8), Quantitative (6)