



Turning Lists into Capabilities

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Overview

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The Challenge

IC Perspective

Why is it Crucial To Focus Intelligence > 15+

<i>Effectiveness of threat mitigation</i>	Very Effective	Effective if lucky on intelligence	Ineffective/expensive
<i>Risk of technical surprise</i>	Low to medium	High	Very High
<i>Effectiveness of intelligence collections tools</i>	Good for R&D direction	Low because development concealed and hard to collect against	Good for <i>deployed</i> system
<i>Maturity of technology</i>	Now to 5 years basic R&D, published work	5-15 years IOT&E, SAP, D&D, little to no OSINT	15 + Emerges as deploying system

Conclusion: Stay on the left side of the bathtub



The Challenge

Defense Science Board Perspective

“With so much technology in the world markets, the DoD has yet to organize and staff accordingly. The DoD does not know what it does not know and to date has yet to construct solutions or processes to overcome this important barrier. **There are no systemic and enterprise-wide mechanisms to determine how global technologies can be used to enhance military capabilities or how these technologies can be used against the United States by potential adversaries.”**



The Challenge: Pace of Technology

“Moore’s Law” → Computing doubles every 18 months

“Fiber Law” → Communication capacity doubles every 9 months

“Disk Law” → Storage doubles every 12 months

Defense Acquisition Pace

F-22 Milestone I: Oct 86 IOC: Dec 05*

Comanche Milestone I: Jun 89 IOC: Sep 09

* Computers at IOC are 512 X faster, hold 65,000 X bits of information than they did at MS I

**Technology growth is non-linear...
Acquisition path has been linear**



Bottom Line Up Front

- **Ho: Capability is derived from**
 - **Knowledge**
 - **Imagination**
 - **Resources**
 - **Time**

The greatest challenge is with “imagination.” What process can be used to apply imagination to the generated knowledge (lists)? What organization is responsible for imagination? How does “the system” deal with organizational threatening imagination?



Definitions

NIC National Intelligence Priorities Framework

Emerging and/or Potentially Disruptive Technologies:

Discovery, development **or exploitation of advanced technologies or combinations of advanced technologies by foreign states or non-state actors that could threaten U.S. military forces or national security interests. The foreign technology base of adversaries and competitor nations. Science and technology plans, policies, programs, and facilities that could lead to emerging or disruptive technologies. Globalized trends in research in civilian advanced technologies.**

Development and/or application of technologies that could lead to asymmetric warfare threats to U.S. forces or critical U.S. infrastructure. Special focus on integration of information technology, biotechnology, materials science, and/or nanotechnology.

Definition of Disruptive Technology

The Textbook Definition



- **Coined by Christensen*** to describe a new, lower-performance (but cheaper) new product that can be improved more rapidly, so that performance outpaces the product it is replacing
- **Key concepts:**
 - Greater performance than previous product
 - Replaces (drives) old product out of market

* *"The Innovator's Dilemma"*, 1997

Disruptive Technology

The Non-Textbook Definition



- Lower cost and lower initial performance does not matter
- What matters is rapid evolution from old, stable technology to new, dominating technology
- A technology surprise that gives a competitor an advantage
 - Business - Technology that overturns market
 - Military - Technology that causes a fundamental change in force structure, basing, and capability balance
- Disruptive Technologies can be intended or unintended - but both represent change
- Disruptive Technologies may arise from systems or enabling technology



Definitions

NIO/ST Perspective

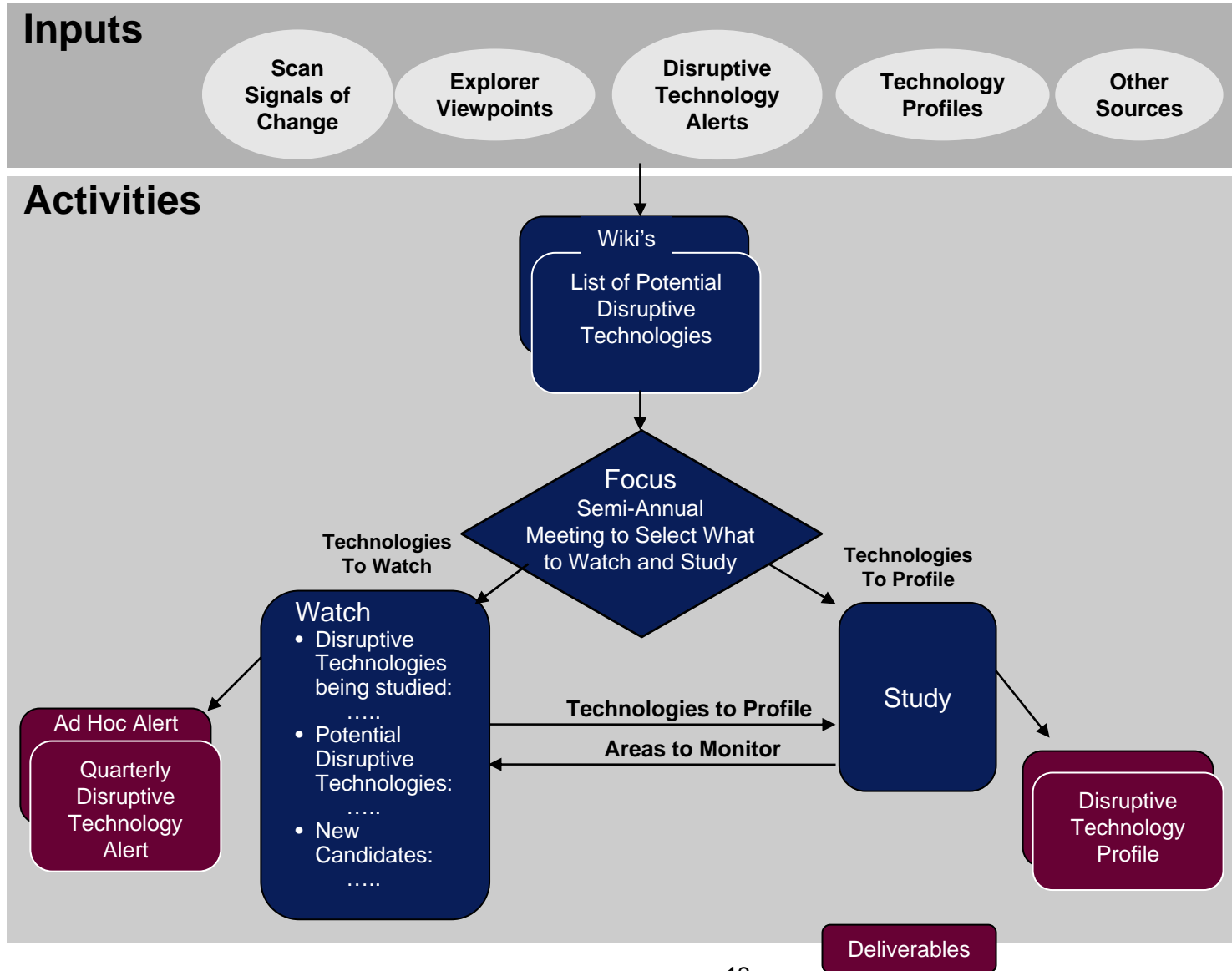
Those emerging technologies and integration capabilities identified as most significant to **advance or degrade US security broadly defined. Must cross the **“major” threshold of interest** – if not satisfactorily resolved would result in a noticeable but temporary degradation of US geopolitical, economic, military power or social cohesion.**



Process Initiatives

- **NIO/ST tasking to the Scientific and Technical Intelligence Committee**
 - STIC Serves as NIPF Manager
- **NIO/ST contract efforts with SRIC-BI and Institute for the Future**
 - Targeted at Civil Technologies
- **DIA Partnership with the National Academies**
- **DoD Service Intelligence Centers**
 - Targeted at Military Technologies
- **CIA Initiatives**
 - Organizational and Partnerships with Businesses
- **NSA – Institute for Analysis**

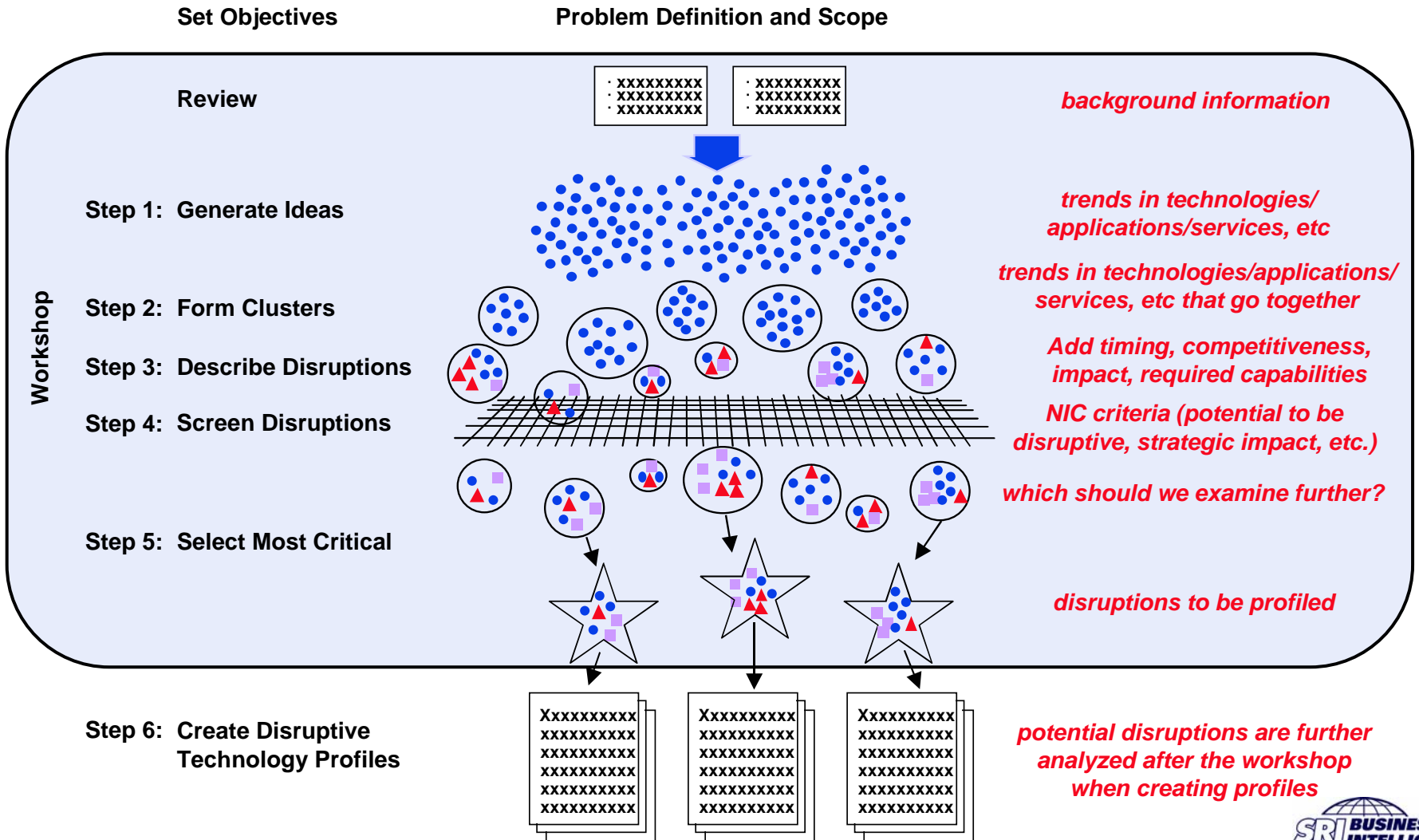
Overall Process for Identifying and Monitoring Disruptive Technologies



NIC and SRIC-BI:

- Identified two potentially disruptive technologies to watch and study based on current SRIC-BI Explorer coverage
- Developed templates for the disruptive technology profile for the quarterly alerts to update changes in technologies being watched and studied
- Prepared a profile on human embryonic stem cells (HESC)
- Prepared two quarterly alerts on HESC (profiled technology) and ocean energy (watch technology)

Task 3: Disruptive Technology Workshop— Example Process Flow





Process Initiatives

But in the end, by and large, the processes give you lists.

What do you do with the lists?



Lists

CIA/OTI/SAG

Global Technology Scenarios Through 2015: America's Game to Lose

Views From a Panel of Experts (OTI IA 2001-083, November 2001)

Tier 1 – High Impact

- **Gene Therapy**
- **Wireless Communications**
- **Image Understanding (Automatic Target Recognition)**
- **Cloned or Tailored Organisms**
- **MicroElectricalMechanical Systems (MEMS)**
- **Nanotechnology**

Tier II – Enablers

- **Optical Communications**
- **Regenerative Medicine**
- **Efficient Software Development**
- **Sensor Webs**
- **Advanced Materials**



Lists

RAND 2020

The Global Technology Revolution 2020

RAND National Security Research Division (2006)

Implementation and Technology Feasibility:

Hybrid Vehicles

Rapid Bioassays

Rural Wireless Communications

Targeted Drug Delivers

Ubiquitous Information Access

Ubiquitous RFID tagging

Improved Diagnostic and Surgical Methods

Quantum Cryptography



NIC

Lists

STIC Emerging Technology Landscape

- **Remote, Accelerated, Instant Learning**
- **Personalized (smart) Bioeffects and Bioweapons**
- **Tagging, Tracking & Locating Devices, Systems, Capabilities**
- **Cheap, Clean, Distributed Energy Sources and Energy Harvesting**
- **Understanding and modeling the brain**



NIC

Lists

SRIC-BI 2025 Disruptive Civil Technologies

- **Clean Coal**
- **Biofuels and bio-based Chemicals**
- **Biomedical Breakout**
 - **Healthspan and Lifespan Extension**
- **Energy Storage Materials**
- **The Internet of Things**
- **Personal Robots**



Lists

NIO/ST Civil Technology List

- **Advanced Energy Techniques** (inexpensive solar energy systems, hybrid automobiles—particularly "series" hybrids)
- **Advanced Information Process and Management Capabilities** (widely available telephone and Internet connectivity—both wired and wireless, ubiquitous radio frequency identification (RFID) tagging of commercial products and individuals; pervasive sensors, wearable computers, quantum cryptography)
- **Advanced Medical Techniques** (rapid bioassays, targeted drug delivery therapies, tissue engineering, improved diagnostic and surgical methods)
- **Technologies to facilitate human sustainability and quality of life** (genetically modified (GM) crops, filters and catalysts, autonomous housing, green manufacturing processes)



Examples

What to do with a list?

- **Turn it into a scenario**
- **Craft a credible path from today to:**
 - Where we want to go, or
 - What we might face
- **“Plausible” vs “Probable”**
 - Driving forces
 - Technology maturation
 - Programmatics (dollars, commitment, resources, events)
 - Supporting Infrastructure
 - Cultural acceptance



Examples

Scenario 1 – Energy Markets Collapse

- **Two technology breakthroughs occur in the near term (w/i ten years)**
 - Energy Storage greatly improves
 - Bio-Fuels
- **Bio Fuels allow the use of existing infrastructure – particularly diesel/jet fuel**
 - Energy storage takes 85% of personal automobile travel off of petroleum fuel and onto the electrical grid
 - Long Haul Truck, Train, and Aviation migrate to biofuels
 - With government incentives, automobile infrastructure begins a radical transformation that takes 10 years to compete
- **Petroleum based Energy Markets for transportation collapse**
 - Regulation/social concern for environment preclude a return to petroleum fuel for transportation



Examples

NIC Scenario II – Touch Labor Markets Collapse

- **Two enabling technologies and market drivers create an unforeseen opportunity**
 - Aging populations begin a wide spread use of “proxy-bots”
 - Next generation internet allows for real-time control of remote devices with video/tactical/audio feedback
- **Touch labor goes on the net**
 - Begins with service economy (security, cleaning, cooking)
 - Migrates to manufacturing
 - 24/7 facilities begin operation with the “labor” coming from sources all over the world
- **Marginal cost of labor plummets and local labor markets collapse**



Examples

NIC Scenario III – Demographics go Non-Linear

- **Biomedical breakthroughs transition medicine from “treating the disease” to “preventing human system degradation”**
 - Widespread use of sensor to track body functions and provide very early indications of trouble
 - “Wal-Mart” Physicals (cheap, ubiquitous, high resolution)
 - Preventative medication targeted at food
- **In developed countries, human productivity and lifespan significantly increase**
- **Governments and societies struggle with existing “retirement” and “social insurance” systems based on outdated demographics**

Lists to Capabilities

Is this a profound idea or fortune telling?





Lists to Capabilities

Who provides the imagination?

- **Intelligence Community**
- **Think Tanks / Science Boards**
- **Users**
- **Academics**
- **Developers**
- **Contractors**
- **Futurists**
- **Politicians**
- **Fortune Tellers**

**The Proverbial Integrated Product Team –
aka, “all of the above”**



Lists to Capabilities

Defense Science Board

“To summarize, a number of different types of execution agents, each with distinct core competences and cultures and governed by different rules sets and incentives, are required to meet conflicting demands: top-down versus bottom up, long development time versus quick response time, requirements-driven versus innovation-driven, DoD-specific technologies versus commercial technologies, and planned-for threat versus newly emerged threat.”



Lists to Capabilities

Some Suggestions

- **This is a multi-discipline problem**
 - **Technical skills/knowledge**
 - **Programmatic sensitivity**
 - **Operational utility**
- **Scenario approach provides value added**
 - **Discipline**
 - **Can we really get there from here**
 - **Are the individual steps plausible**

Intelligence Community Willing to Help!

Questions?



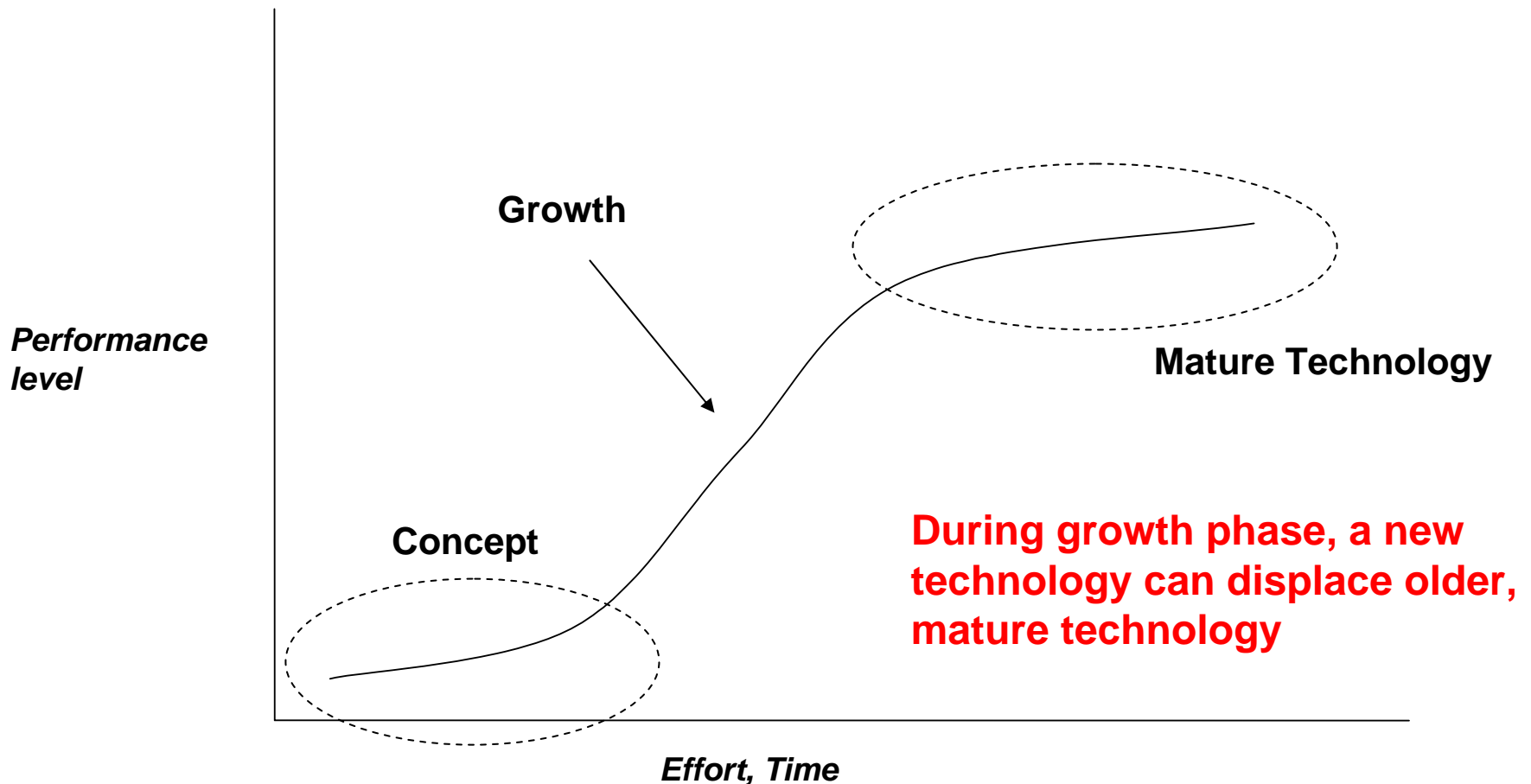
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A Final Concept Technology S-Curve



Most Technology maturation follows S-curve:

Initial Discovery, “Product-ization”, then Incremental Improvement



Changing Security Environment

- Four Challenges -



Irregular

- ❑ Unconventional methods adopted by non-state and state actors to counter stronger state opponents.
- ❑ (e.g., terrorism, insurgency, civil war, and emerging concepts)

Catastrophic

Higher

- ❑ Acquisition, possession, and use of WMD or methods producing WMD-like effects against vulnerable, high-profile targets by terrorists and rogue states.
- ❑ (e.g., homeland missile attack, proliferation from a state to a non-state actor, devastating WMD attack on ally)

Traditional

- ❑ Military capabilities and military forces in long-established, well-known forms of military competition and conflict.
- ❑ (e.g., conventional air, sea, land forces, and nuclear forces of established nuclear powers)

Disruptive

- ❑ International competitors developing and possessing breakthrough technological capabilities intended to supplant U.S. advantages in particular operational domains.
- ❑ (e.g., sensors, information, bio or cyber war, ultra miniaturization, space, directed-energy, etc)

Lower

LIKELIHOOD

Lower

Higher

VULNERABILITY

Uncertainty is the defining characteristic of today's strategic environment

Shift to “Transformational Technologies” Investment Priority Changes from PBR05 to PBR06

