

# A Roadmapping Perspective: Science-Driven Technologies

**Global Advanced Technologies Innovation Consortium**  
**Zurich**  
**September 26, 2002**

Richard E. Albright  
[realbright@albrightstrategy.com](mailto:realbright@albrightstrategy.com)  
(973) 539-9025

# Key Points

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- **Roadmaps and Roadmapping**

Help people link, communicate and execute plans.

Clarify the unknown future and provide information for intelligent decisions.

- **Science and Technology Roadmaps**

Enable teams to plot a future path, linking applications, technical challenges, and technology development.

Make clear communication with sponsors and stakeholders.

- **Innovation with Roadmaps**

Coordinate across domains for sharing of technologies and collaboration in developing and adopting new technologies.

Manage research and innovation portfolios.

# Roadmaps and Roadmapping

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## A Roadmap

- is the view of a group of how to get where they want to go, or achieve their desired objective. (*Discipline*)
- helps the group make sure the capabilities to achieve their objective are in place at the time needed. (*Focus*)

## Roadmapping

- is a *Learning* process for the group.
- is a *Communication* tool for the group.

# Types of Roadmaps \*

- **Science and Technology Roadmaps**
  - Technology Futures, Bibliometric methods
- **Industry & Government Roadmaps**
  - Semiconductor (SIA), NEMI Component Roadmaps
  - Industrie Canada
  - Aluminum, Glass, Forging
- **Corporate/Organization Roadmaps**
  - Manufacturing Roadmaps
  - Component Roadmaps
  - Product-Technology and Platform Roadmaps

## Key Objectives:

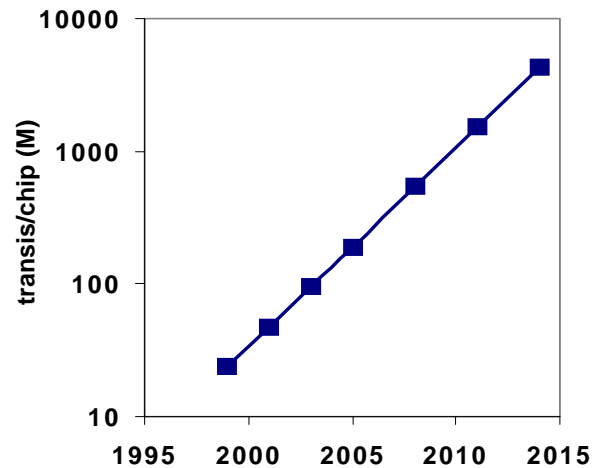
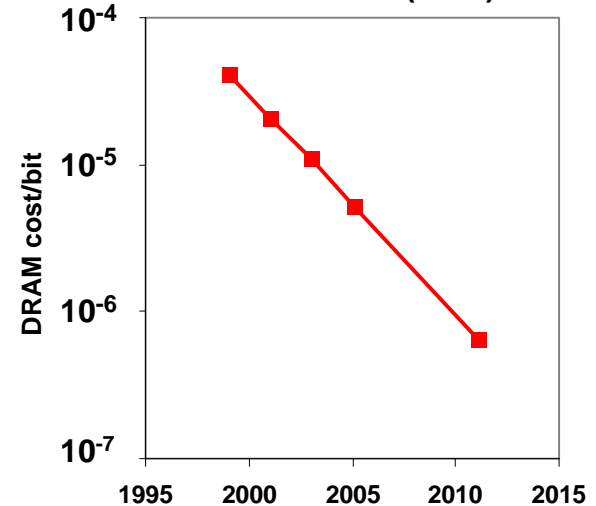
Identify or Set a Future Direction, Technology Assessment

Set Industry Direction, Coordinate Execution

Set and Monitor Direction, Coordinate Execution, Portfolio Management

*\* Roadmaps can represent the need, current/planned capability or both*

The National Technology Roadmap for Semiconductors (1999)



# Science and Technology Roadmap

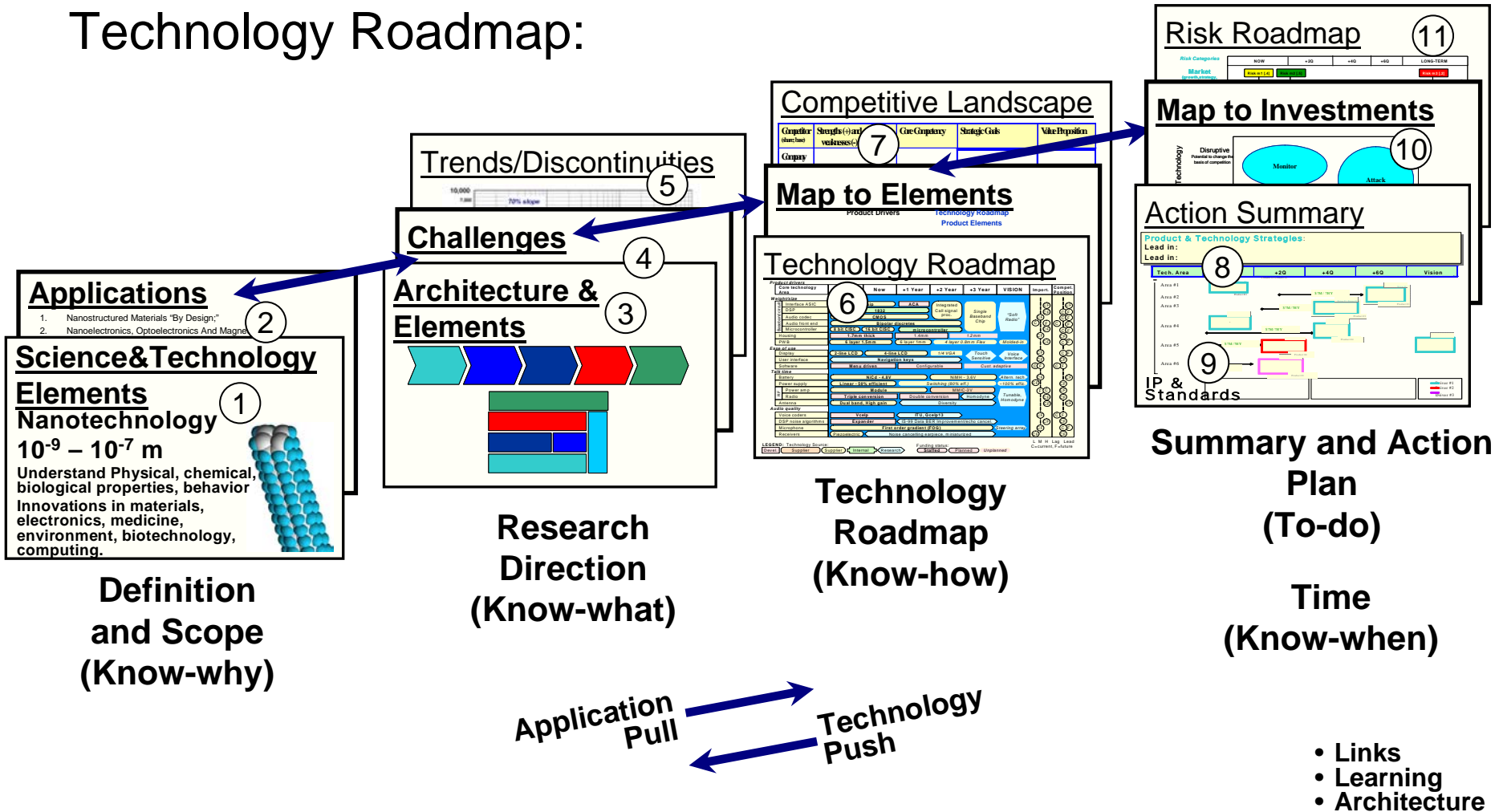
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A Science and Technology Roadmap includes:

<b>Definition &amp; Strategy</b>	<b>1. Science and Technology Elements</b>	<b>Make up and define the scope of the field.</b>
	<b>2. Technology Applications</b>	<b>Where and when the technologies will become innovations (be used) – the “whys.”</b>
<b>Direction</b>	<b>3. Architecture</b>	<b>How the elements fit together and interact.</b>
	<b>4. Challenges</b>	<b>Objectives and performance targets for technology elements – the “whats.”</b>
	<b>5. Trends and Discontinuities</b>	<b>Performance and growth trends, experience curves, potential disruptions.</b>
<b>Technology Roadmap</b>	<b>6. Technology Element Evolution</b>	<b>The technology roadmap – the “hows.”</b>
	<b>7. Competitive Technical Position</b>	<b>Competitive approaches to challenges. Competitive technologies.</b>
<b>Action Plan</b>	<b>8. Action Plan</b>	<b>Technology strategy, resources and timing of investments in technologies – the “to-do’s.”</b>
	<b>9. Intellectual Property and Standards</b>	<b>Needs/barriers/actions to gain access, protect, influence.</b>
	<b>10. Technology Investment Map</b>	<b>Priorities of technology investments</b>
	<b>11. Risk Roadmap</b>	<b>Key indicators of risks to plans. Track for need to change.</b>

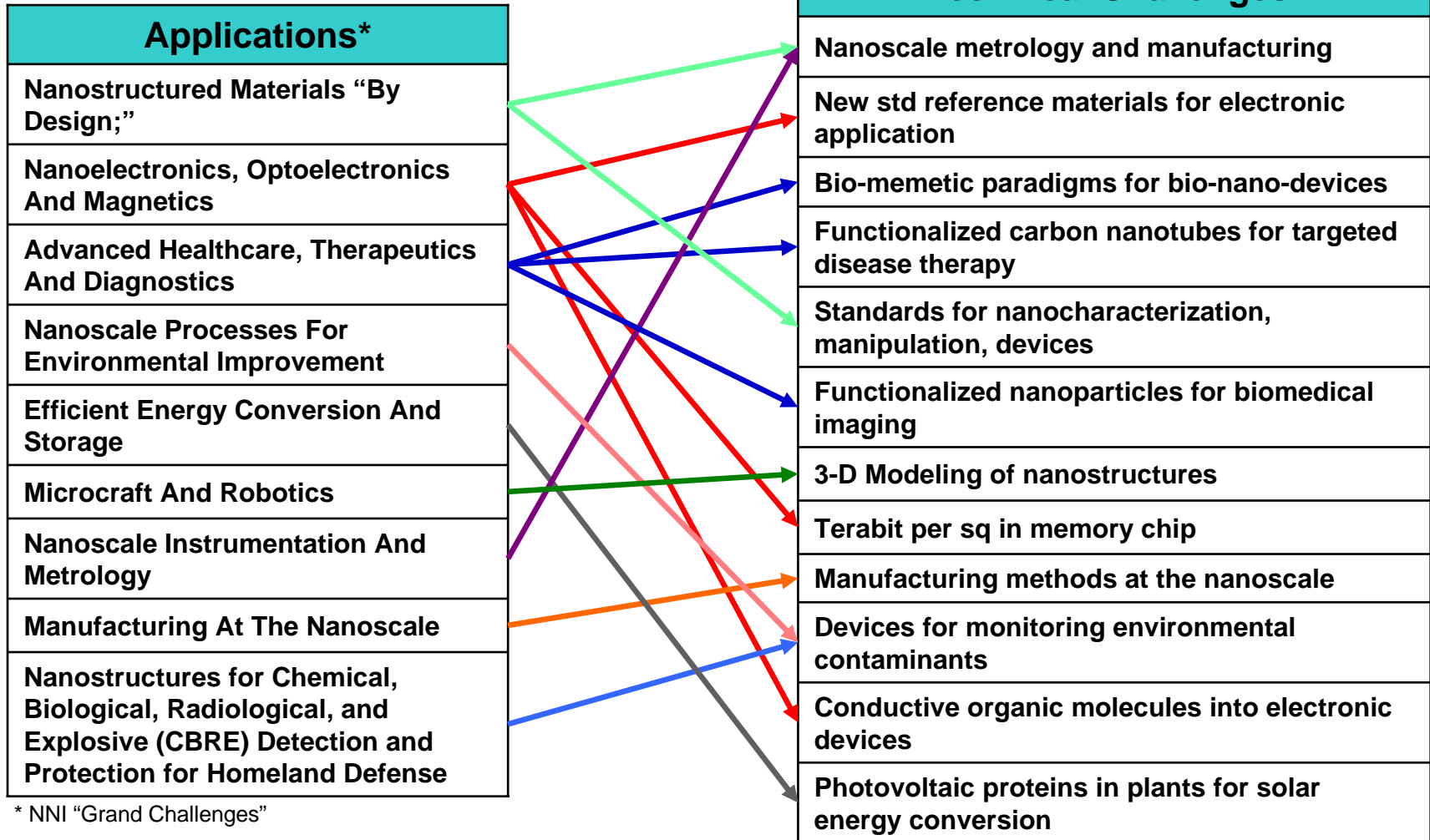
# Science and Technology Roadmap

A template for a Science and Technology Roadmap:



# Linking Applications to Challenges

## Example: Nanotechnology



\* NNI "Grand Challenges"

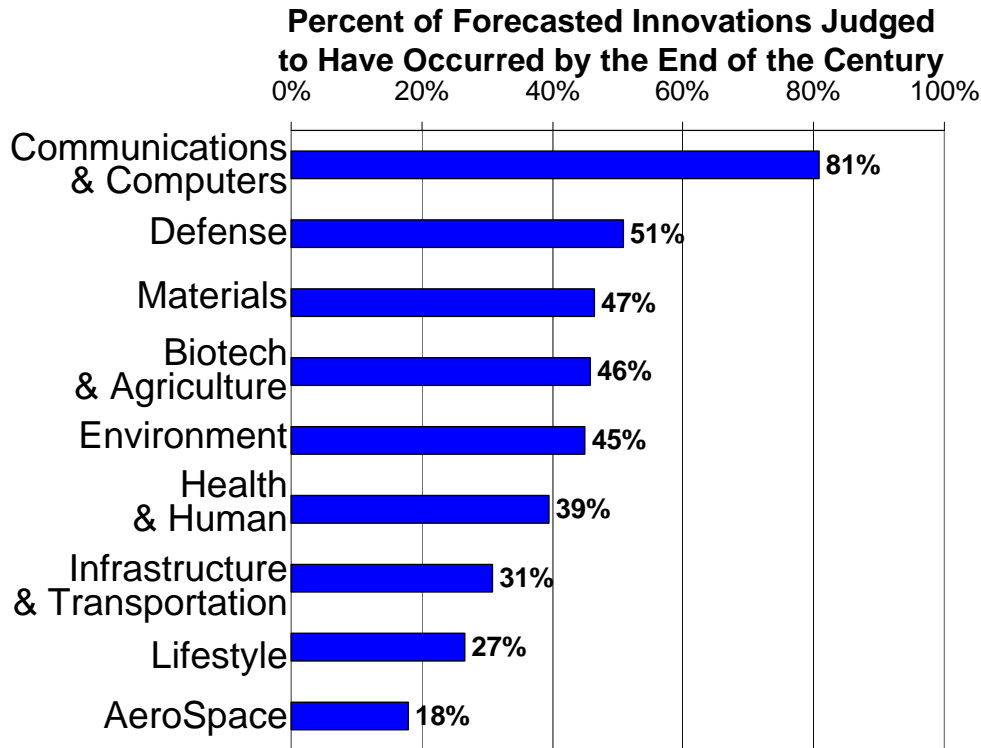
(Source: US National Nanotechnology Initiative, FY 2003 Challenges and Objectives, June, 2002)

\* Selected NNI Objectives

# The Power of Learning and Experience

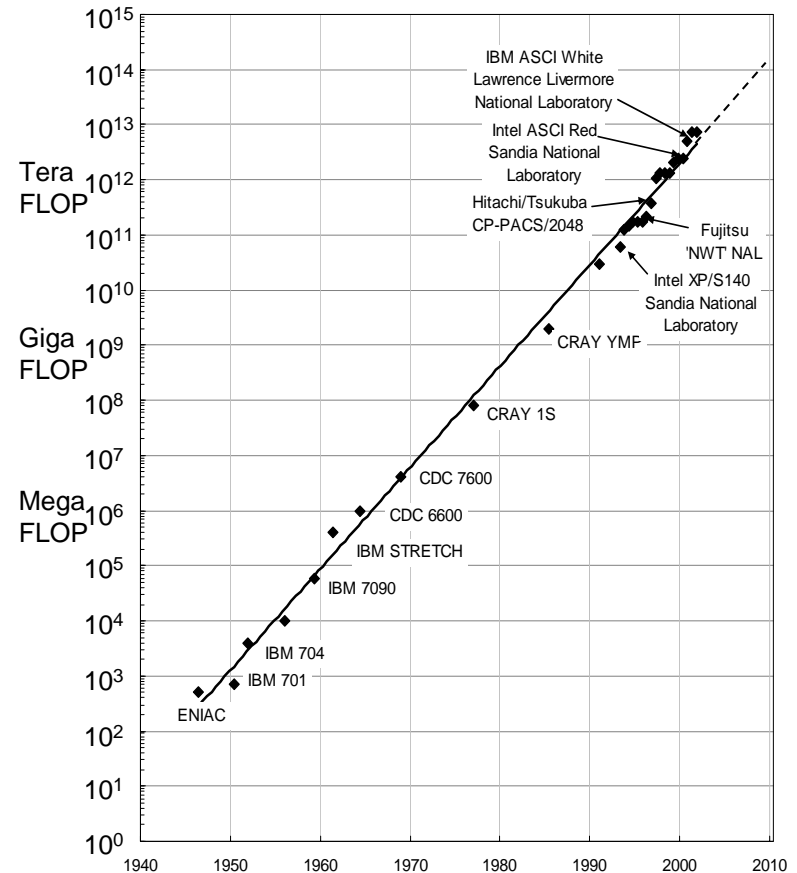
Of One Hundred Technical Innovations Very Likely in the Last Third of the Twentieth Century (Herman Kahn & Anthony Weiner, 1967), Only the forecasts in Computers and Communications were better than 50% correct...

Two interrelated drivers are identified.



R. E. Albright, *What Can Past Technology Forecasts Tell Us About the Future?*, Technological Forecasting and Social Change, Vol. 69 No. 5, pgs. 443 – 464, June, 2002.

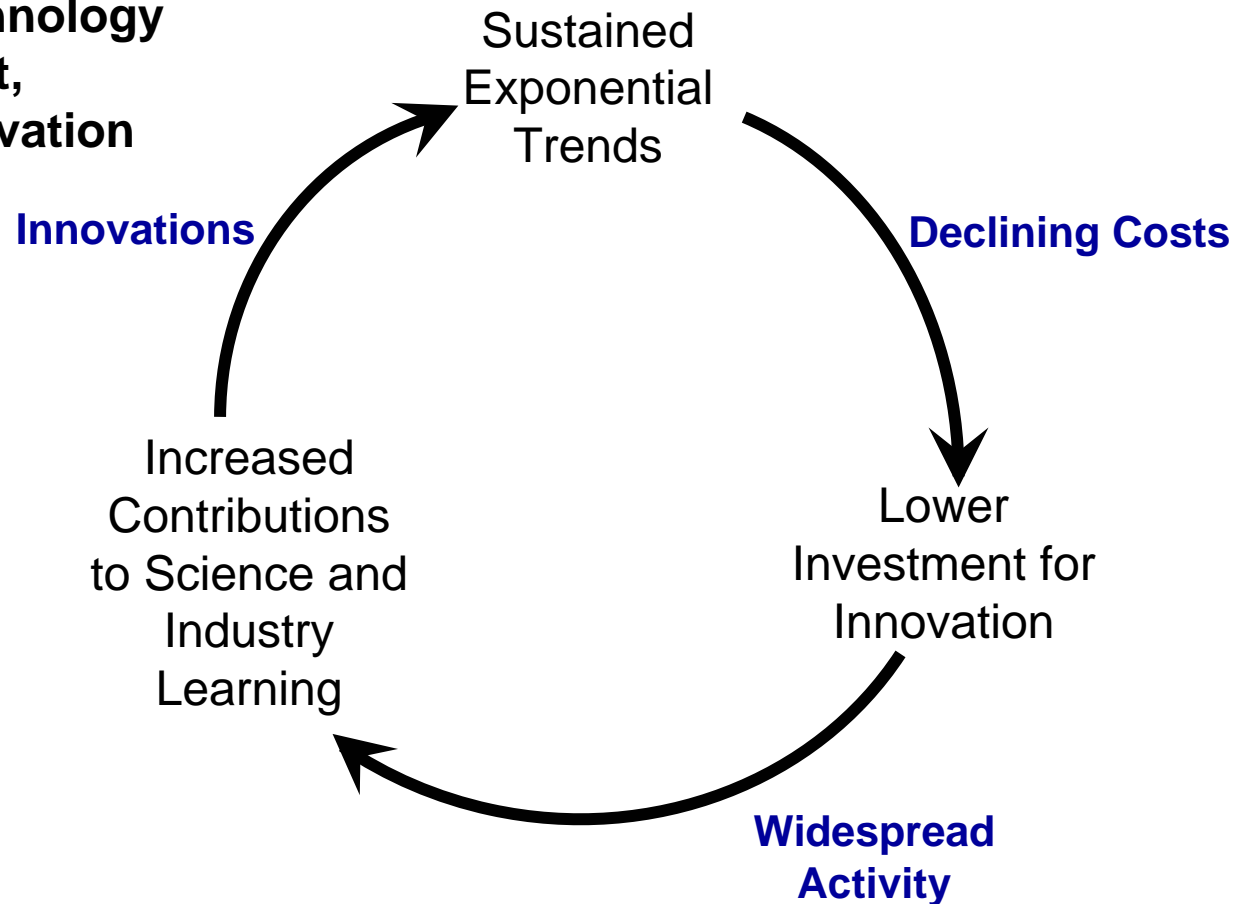
**Driver 1: Sustained, long-term exponential trends of growth in capabilities and performance/cost...**



**The power of the fastest computers has grown exponentially since the 1940's**

# Exponential Trends Sustain Learning and Innovation

**Driver 2: Sustained technology trends lower investment, creating a positive innovation loop.**

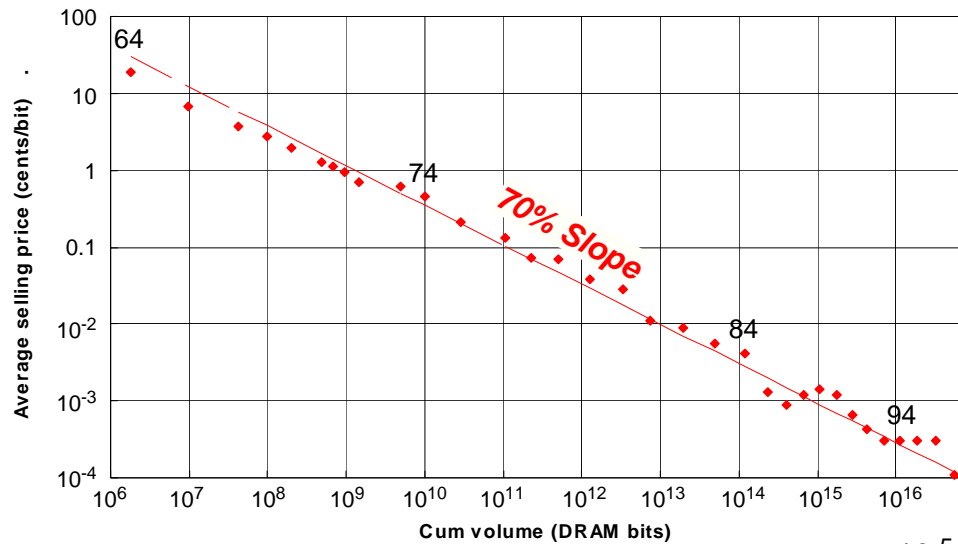


***For forecasting and target setting in Roadmaps...  
Identify and characterize technologies that will sustain exponential growth***

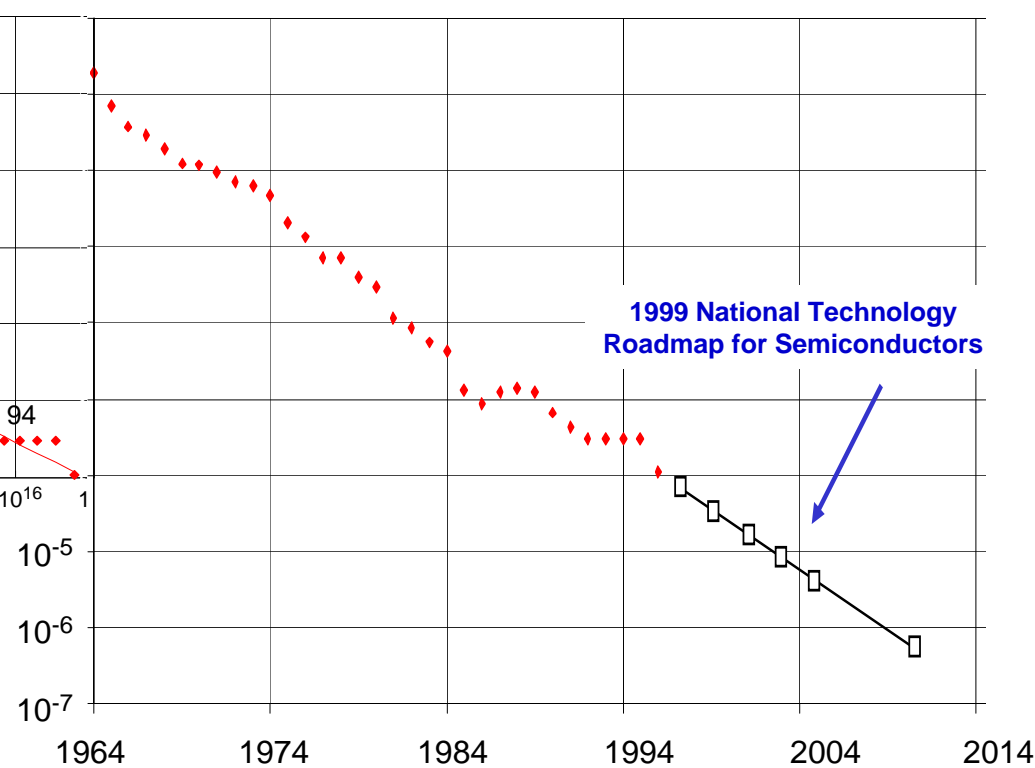
# Using Experience:

## Example – Semiconductor Memory (DRAM)

### Experience Curve

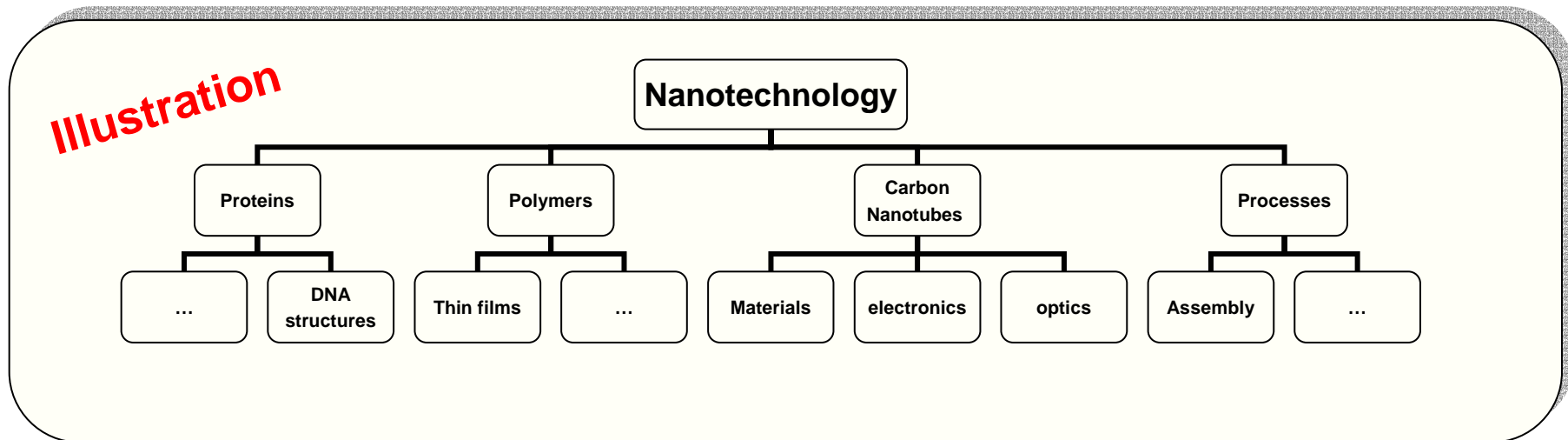


### Learning Curve



# Roadmap of Roadmaps Needed...

- Science driven technology fields are complex – with many applications and technologies (e.g., nanotechnology, biotechnology)
- Including many overlapping subfields.
- To manage the complexity, construct a nested framework, a “Roadmap of Roadmaps.”



# Why Roadmap Science and Technology?

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- Roadmapping is just **good planning**.
- Roadmaps **link** innovations and applications with research and technology decisions.
- Roadmaps reveal **gaps** in research, technology, and innovation plans.
- Roadmaps **prioritize** investments based on drivers.
- Roadmapping helps set better **targets**: more competitive and more realistic.
- Sharing roadmaps allows **strategic** use of technology across applications.
- Roadmapping **communicates** research, technology and innovation plans to team members, sponsors, and stakeholders.
- Roadmaps provide a **guide** to the team, allowing the team to recognize and act on events that require a change in direction.

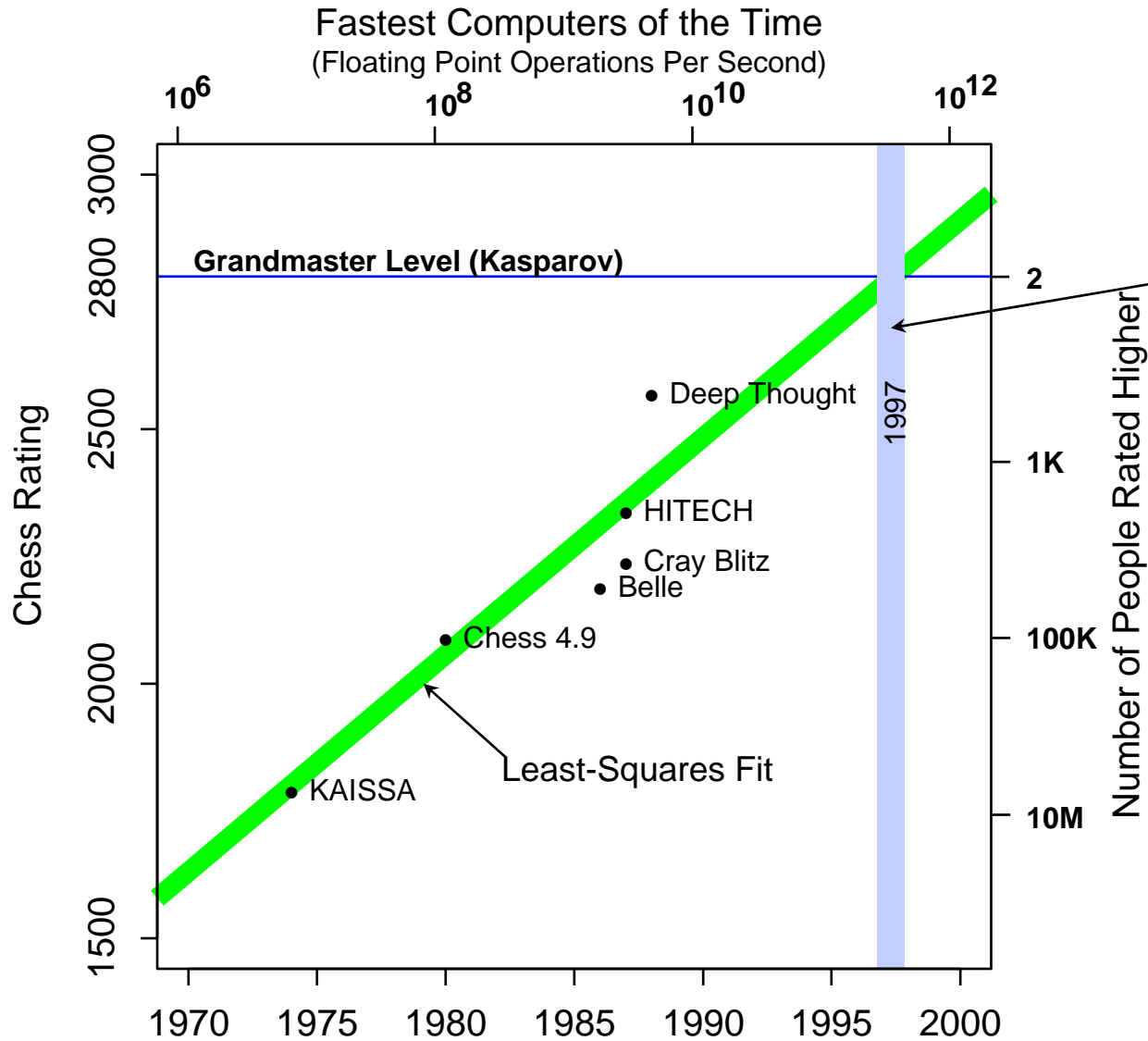
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# Summary:

**Discipline & Focus**

**Learning & Communications**

# Application of Learning: Computer Chess



Garry Kasparov vs. Deep Blue  
May, 1997

Source: Monroe Newborn,  
**Computer Chess: Ten Years of Significant Progress**, Advances in Computers, Vol.29, 1989, p. 239.