NAVSEA WARFARE CENTERS NEWPORT

Sensors & Sonar Systems DEPARTMENT

Innovation Strategies for Affordable Readiness

Presented to the

NDIA 10th Annual Systems Engineering Conference

25 October 2007

Presented By

Thomas C. Choinski

Emergent and Transformational Systems Division Head

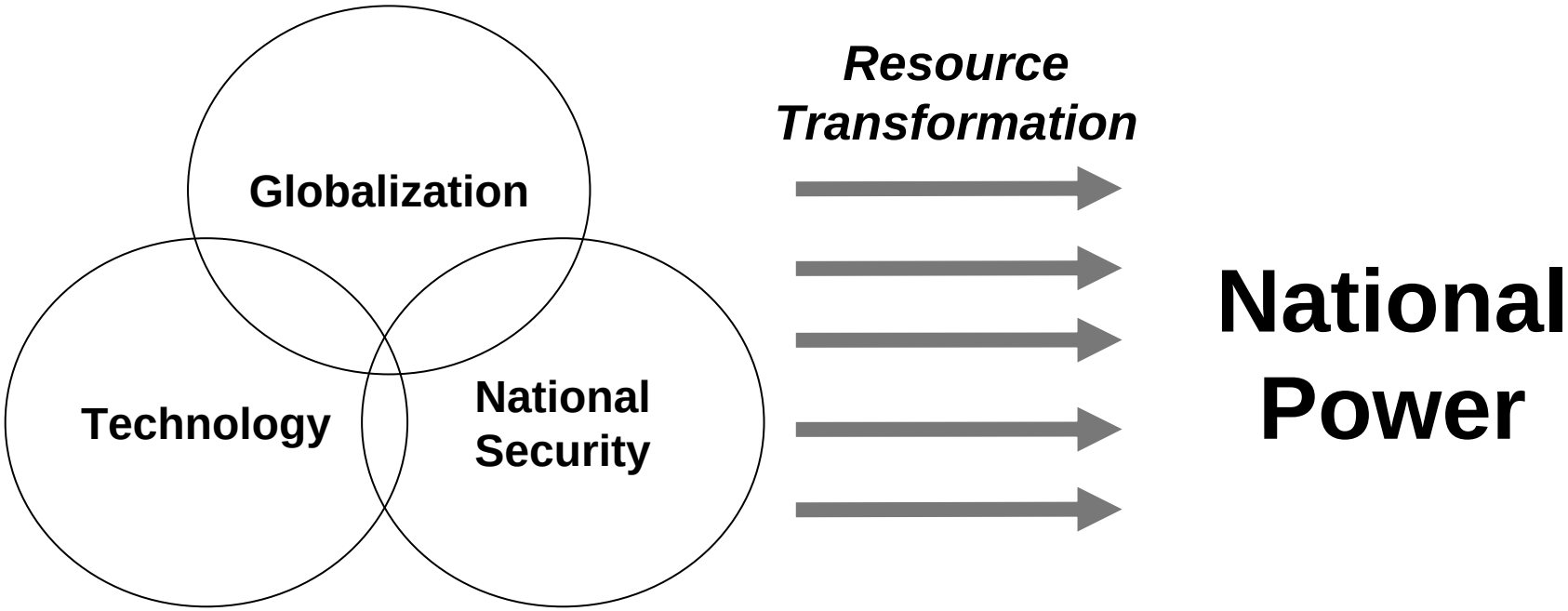
(401) 832-8141 ChoinskiTC@npt.nuwc.navy.mil

Naval Undersea Warfare Center Division, Newport RI

Innovation for Readiness

The greatest benefits of globalization will accrue to countries and groups that can access and adopt new technologies.

CIA's National Intelligence Council
Mapping the Global Future, 2004



References:

Tellis, Ashley J, Janice Bially, Christopher Layne and Melissa McPherson, *Measuring National Power in the Postindustrial Age*, RAND Report MR 1110, 2000, ISBN 0-8330-2792-1

Lehman, Ronald F., *The Center for Global Security Research*, http://www.llnl.gov/

Innovation Equation

Innovation = f(Invention, Militarization/Commercialization, Diffusion)

Definitions

Invention **covers all efforts aimed at creating new ideas and getting them to work.**

Militarization/Commercialization **(exploitation) includes all stages of commercial development, application, and transfer [transition], including the focusing of ideas or inventions towards specific objectives. Commercialization also includes evaluating those objectives and transferring research and/or development results for eventual broad-based utilization.**

Diffusion **is the process in which an innovation is communicated through certain channels over time (and adopted) among the members of a social system.**

Reference:

Michael E. McGrath, *Product Strategy for High Tech-Technology Companies: How to achieve growth, competitive advantage, and increased profits*, Richard Irwin, Inc., 1995, p. 217.

Roberts, Edward B., *Generating Technological Innovation*, New York, Oxford University Press, 1987, p. 3.

Innovation Strategies
(Invention and Commercialization)

- **OPPORTUNITY DRIVEN (Requirements Pull)**
  1. ***Identify general opportunities by listening to specific customer needs.***
  2. ***Identify opportunity by generalizing a solution to a specific problem.***
- **PREDICTION DRIVEN (Technology Push)**
  3. ***Identify opportunities based on the declining cost of technology.***
  4. ***Identify new applications for emerging technology.***
  5. ***Look for opportunities at the intersection multiple emerging technologies.***
- **TECHNOLOGY DRIVEN (Science and Technology, S&T)**
  6. ***Efficiently search for solutions to perceived problems/opportunities.***
  7. ***Stumble over a technology breakthrough.***
- **SYSTEM DRIVEN (Science and Technology, S&T)**
  8. ***Organize design components together in a new way, using many core design concepts in a new architecture.***
  9. ***Link significant resources from different disciplines, businesses and government agencies.***

Reference: **Adapted from Michael E. McGrath, *Product Strategy for High Tech-Technology Companies: How to achieve growth, competitive advantage, and increased profits*, Richard Irwin, Inc., 1995, p. 217.**

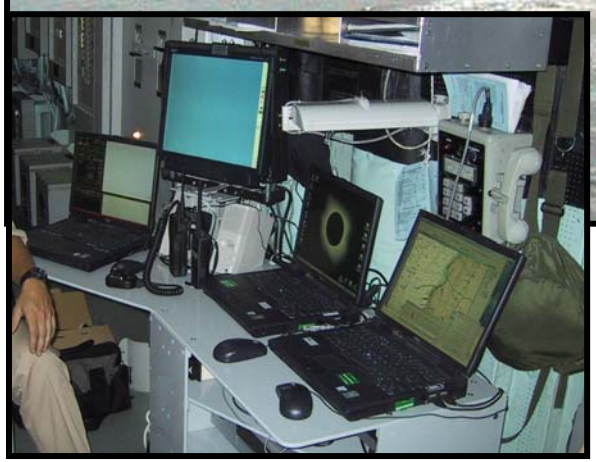
Rapid User Focused Invention and Militarization

Rapid Radical Invention/ Commercialization = ***Opportunity Driven Specific Customer Need and CONOPS*** + ***Prediction Driven Technology Intersection***

Affordability from the intersection of existing military technologies:

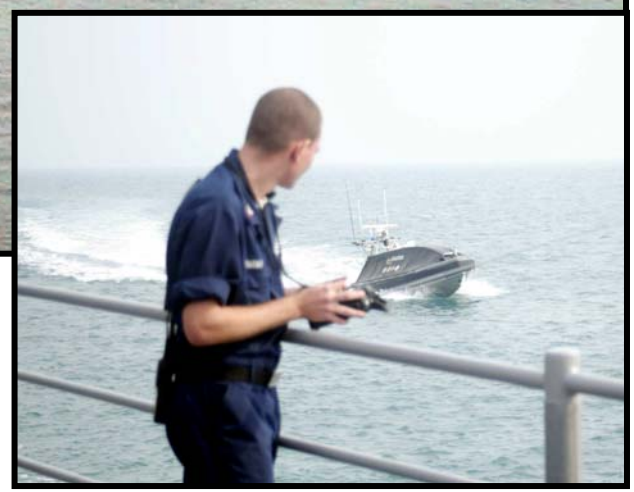
- ***Reliability***
- ***Maintainability***
- ***Training***
- ***Support Infrastructure***
- ***Compatibility***
- ***Familiarity***
- ***Reduced Technology, Cost and Schedule Risk***
- ***Economies of Scale from Multiple Applications***

User Focused Example: Spartan Scout Unmanned Surface Vessel

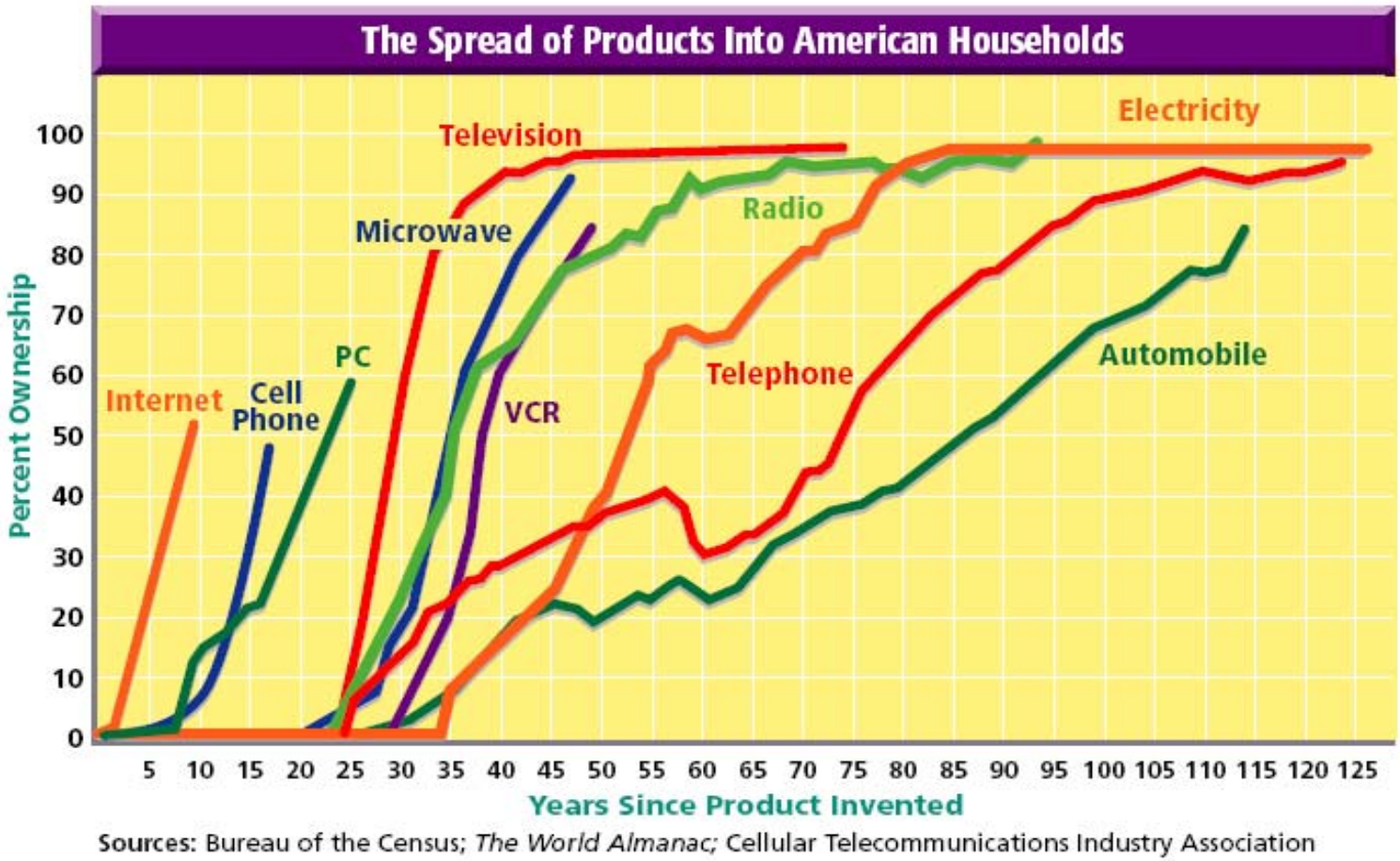


Workstation

Manual Control for L&R Ops



Diffusion of Technology Has Accelerated



Sources: Bureau of the Census; *The World Almanac;* Cellular Telecommunications Industry Association

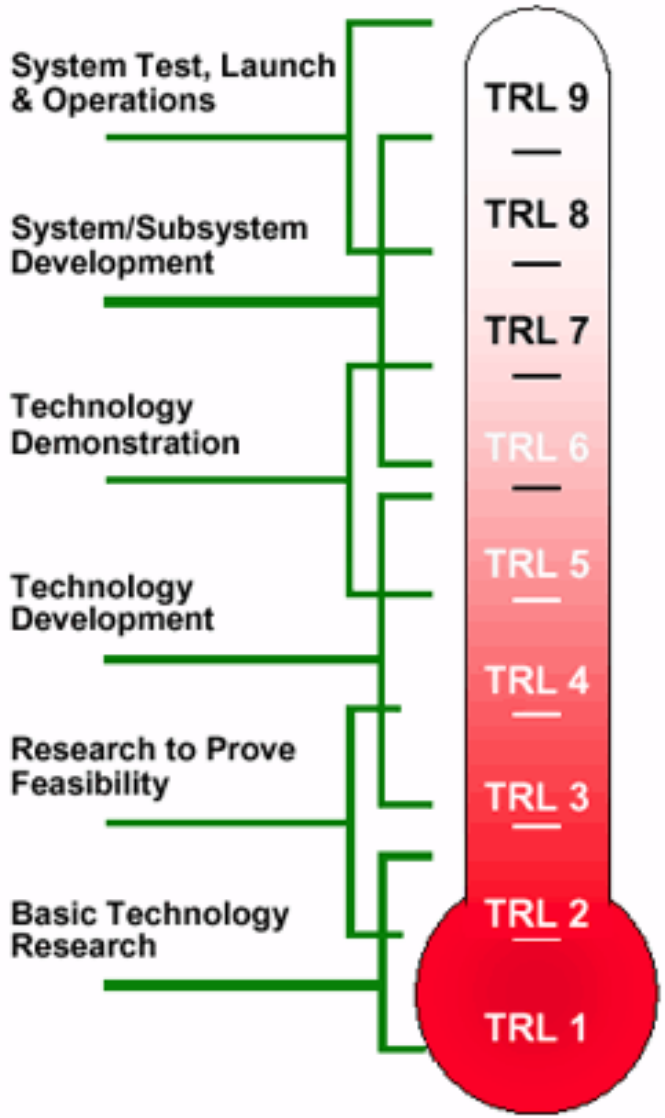
Rapid diffusion of innovation is the challenge.

Technology Readiness Levels vs. Attributes for the Diffusion of Innovation

The TRL system was adopted by the NASA space program for project tracking and management and was incorporated in NASA's 1991 Integrated Technology Plan.

There are nine different TRLs:

1. **Basic principles observed and reported**
2. **Technology concept/application formulated**
3. **Critical function proof of concept**
4. **Component validation in laboratory**
5. **Component validation in relevant environment**
6. **System prototype in relevant environment**
7. **System prototype in operational environment**
8. **Actual system completed and qualified via T&E**
9. **System proven through mission operation**



Reference: http://www.asc.nasa.gov/aboutus/trl-introduction.html

***Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs*, DoD 5000.2-R, 5 April 2002**

Perceived Attributes for the Diffusion of Innovation

1. ***Relative advantage***, **the degree to which an innovation is communicated as being more cost effective than the innovation it supersedes**
2. ***Effectiveness***, **the degree to which an innovation is communicated as being relatively more capable in achieving an ideal end state**
3. ***Observability***, **the degree to which the results of an innovation are communicated as being visible to others**
4. ***Trialability***, **the degree to which an innovation is communicated to allow experimentation on a limited basis**
5. ***Complexity***, **the degree to which an innovation is communicated as being relatively difficult to use**
6. ***Compatibility***, **the degree to which an innovation is communicated as being consistent with past experiences, existing practices, and needs of potential adopters**

Reference:
Rogers, Everett M., *Diffusion of Innovation*, Free Press, 2003.
Dearing, James, "An Exploratory Tool for Predicting Adoption Decisions," Science Communications, Vol. 16, No. 1, September 1994, 43-57.

Perceived Attributes for the Diffusion of Innovation

7. ***Reliability***, **the degree to which an innovation is communicated as being consistent in its results**
8. ***Divisibility***, **the degree to which an innovation is communicated as allowing incremental implementation of its components**
9. ***Applicability***, **the degree to which an innovation is communicated as having more than one use, or having use in more than one context**
10. ***Commutability***, **the degree to which an innovation is communicated as exhibiting a complementary relationship with other innovations**
11. ***Radicalness***, **the degree to which an innovation is communicated as being different from existing innovations**

The innovation-decision process is essentially an information seeking and processing activity in which an individual is motivated to *reduce uncertainty* about the advantages and disadvantages of the innovation.

Reference:
Rogers, Everett M., *Diffusion of Innovation*, Free Press, 2003.
Dearing, James, "An Exploratory Tool for Predicting Adoption Decisions," Science Communications, Vol. 16, No. 1, September 1994, 43-57.

Diffusion Assessment Example

Attribute	Intent or Perception (1-7)	Comment
Applicability	1	Highly Applicable, high utility
Reliability	6	Not strongly communicated
Compatibility	1	Compatible with existing concepts of operation
Divisibility	2	Alternate options communicated
Radicalness (reverse coded)	5	Communicated effort as being different
Complexity (reverse coded)	2	Not highly complex (context dependent)
Trialability	1	Use of systems in experimentation strongly emphasized
Observability	4	Not strongly communicated
Effectiveness	2	Analysis used to determine performance
Commutuality	1	Complementary nature strongly articulated
Economic Advantage	5	Not strongly communicated
Total	30	
Avg	2.73	

Reference:
Dearing, James, "An Exploratory Tool for Predicting Adoption Decisions," Science Communications, Vol. 16, No. 1, September 1994, 43-57.

Innovation Strategies for Affordable Readiness Summary

- **Respond to emerging threats with innovation:**
  - Invention
  - Militarization/Commercialization
  - Diffusion
- **Develop affordable products rapidly by:**
  - Identifying opportunity driven concepts via specific customer needs
  - Developing prediction driven products based on the intersection of technologies
- **Focus on diffusion attributes:**
  - Incorporate readiness levels as part of diffusion attributes
  - Reduce uncertainty for end users through the 11 attributes
  - Assess innovative concepts and products to determine the potential for diffusion