Emerging Technology + International Security

17.449

Erik Lin-Greenberg

Assistant Professor of Political Science

Massachusetts Institute of Technology

Recap

- Technology
  - Hardware
  - Software
- Innovation
  - Sustaining Tech
  - Disruptive Tech
- Innovator's Dilemma
- Open vs. Closed Innovation
- Patterns of military innovation

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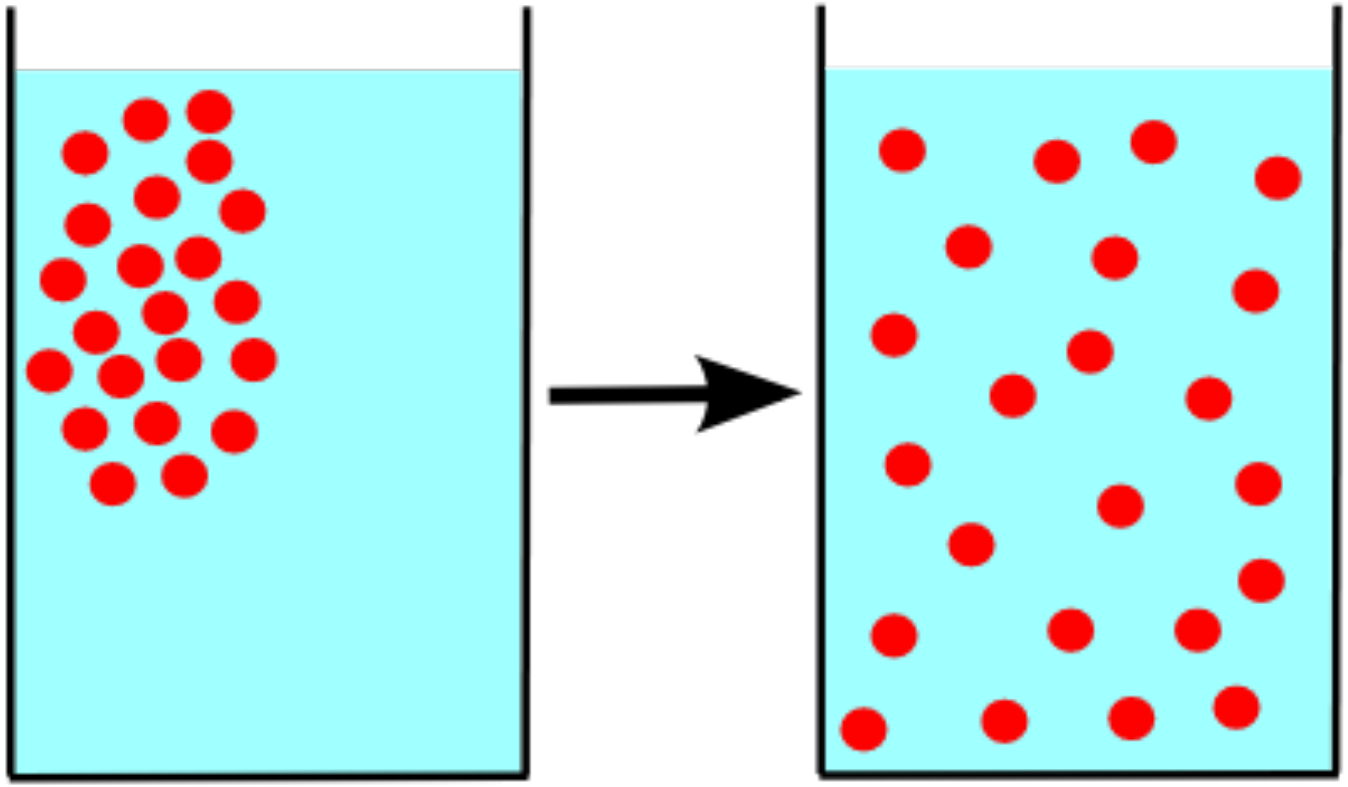
Diffusion of Innovations



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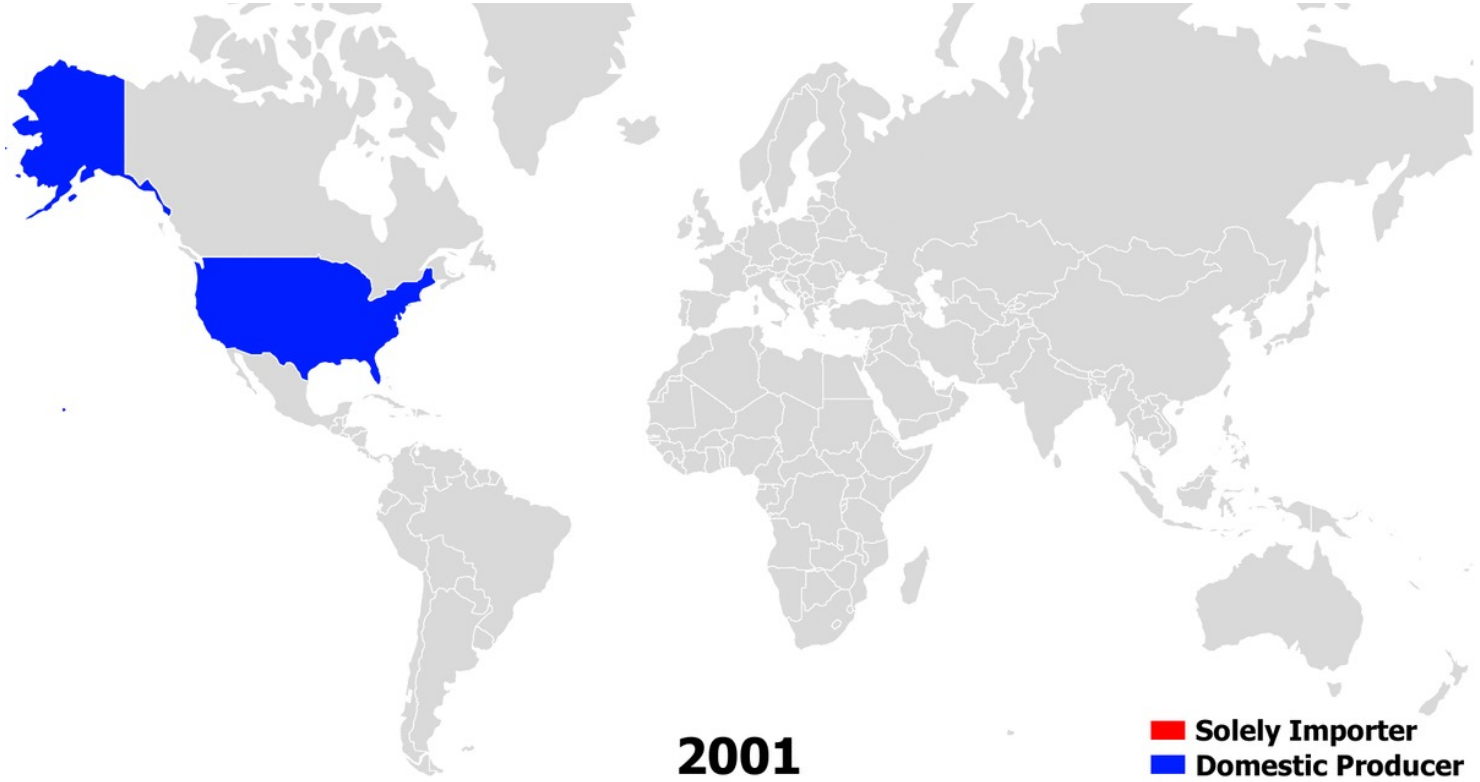
Within organizations



Horowitz, Michael C., Joshua A Schwartz, and Matthew Furrmann. From "China Has Made Drone Warfare Global: The United States Must Join the Market or Be Left Behind." *Foreign Affairs*, November 20, 2020. © The Council on Foreign Relations, Inc.. All rights reserved. This content is excluded from our Creative Commons license. For more information, see https://ocw.mit.edu/help/faq-fair-use/.

Across organizations

Diffusion of innovations

Dependent Variable

Independent Variable

Innovation

- New method, idea, practice, or device/object
- Changes existing ways of doing things
- Innovation doesn't always succeed
- What leads to variation in diffusion/success?

Innovation

- Relative advantage
  - Relative to technology it supersedes
- Compatibility
  - With values, experiences, and needs
- Complexity
  - Difficult or easy to use?
- Trialability
  - Possibility of limited experimentation
- Observability
  - Visibility and salience

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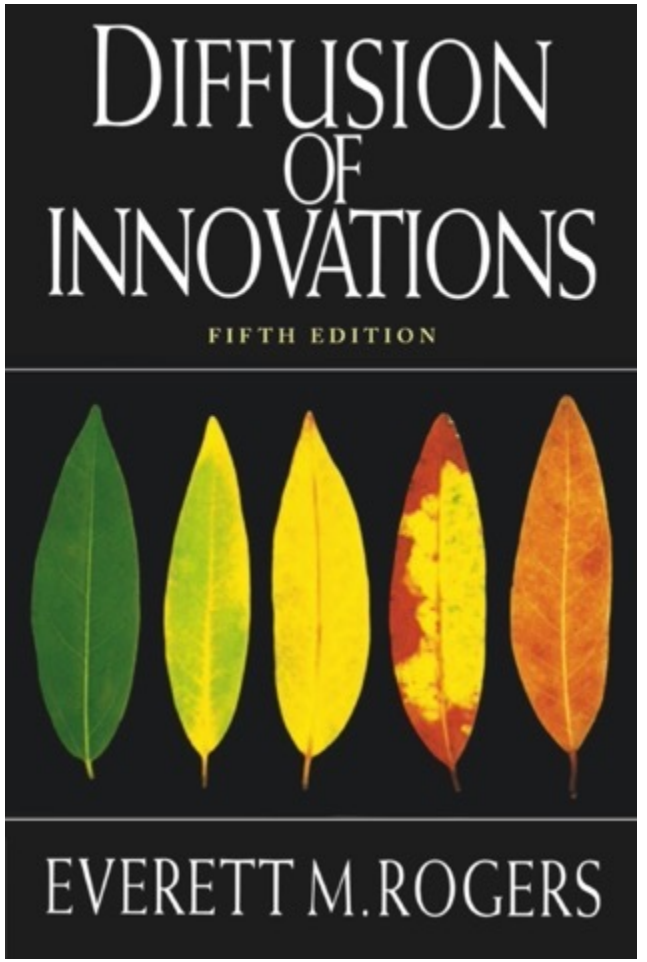
Innovation: Diffusion

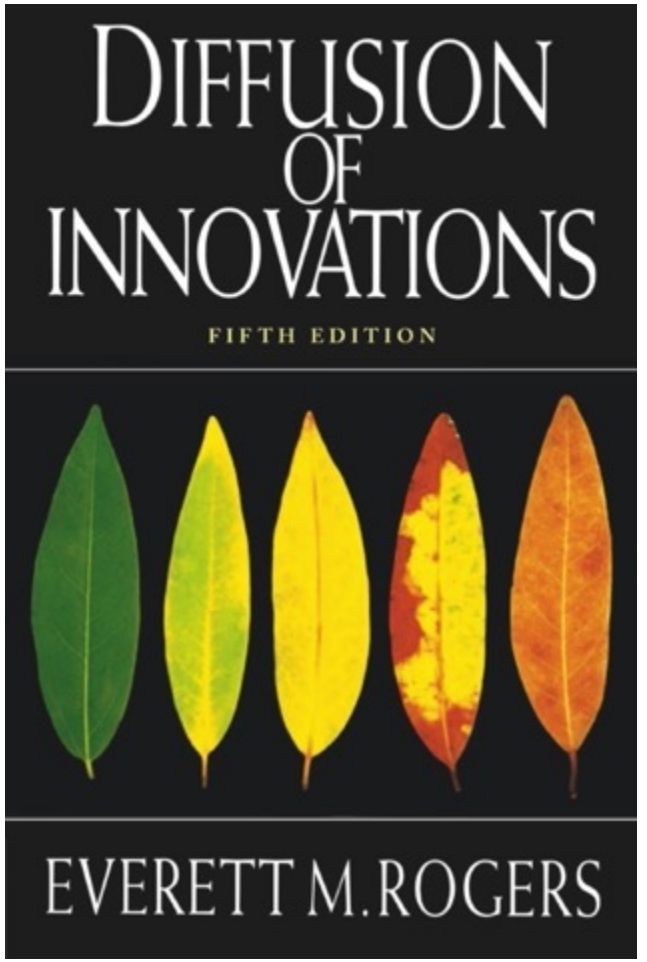
- Rogers: Professor of communication
  - Studied agricultural innovation

Diffusion:



Innovation: Diffusion

Diffusion: process by which an innovation is communicated through certain channels over time among the members of a social system.



Innovation: Diffusion

- Communication Channel
  - Means of transmitting message from one user to another
  - Creates awareness (visibility)
  - Mass media + interpersonal channels
    - Technology and human networks matter
    - Homophily vs. heterophily (language, culture, etc.)

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Innovation: Diffusion

- Time
  - Innovation-decision process
    - Knowledge of innovation
    - Persuasion (favorable or not)
    - Decision
    - Implementation
    - Confirmation
  - Late vs. Early adopters
  - What affects variation?
    - Connectedness
    - Ability to deal with abstraction
    - Intelligence/Education

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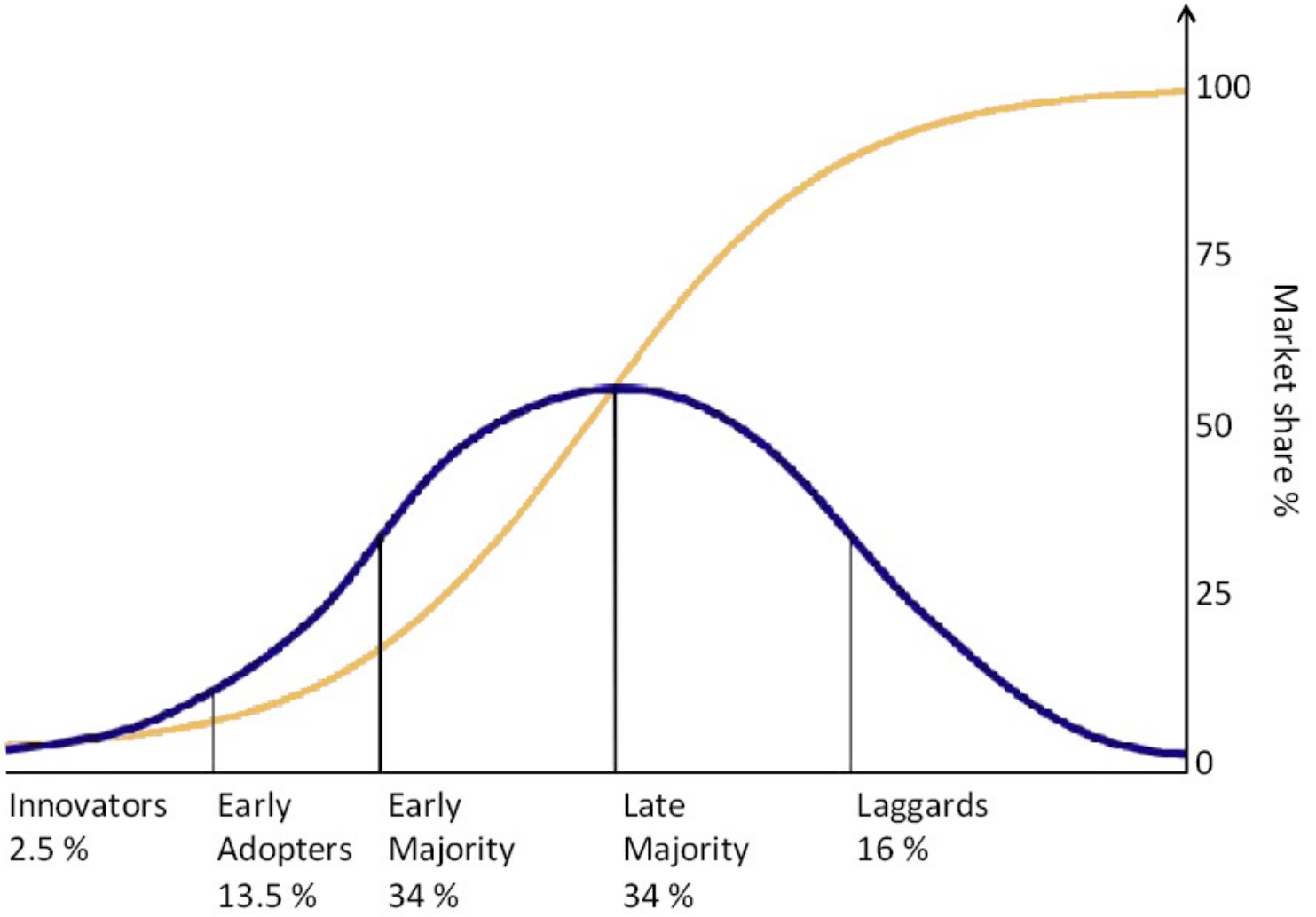
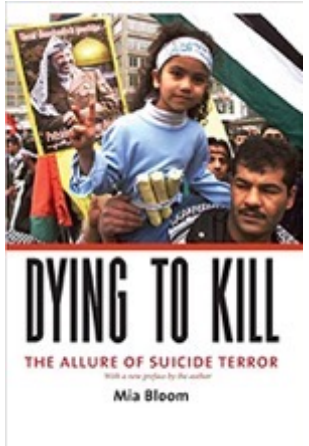
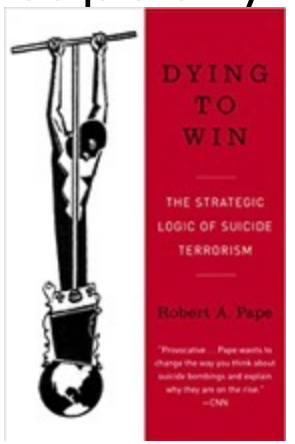
Innovation: Diffusion



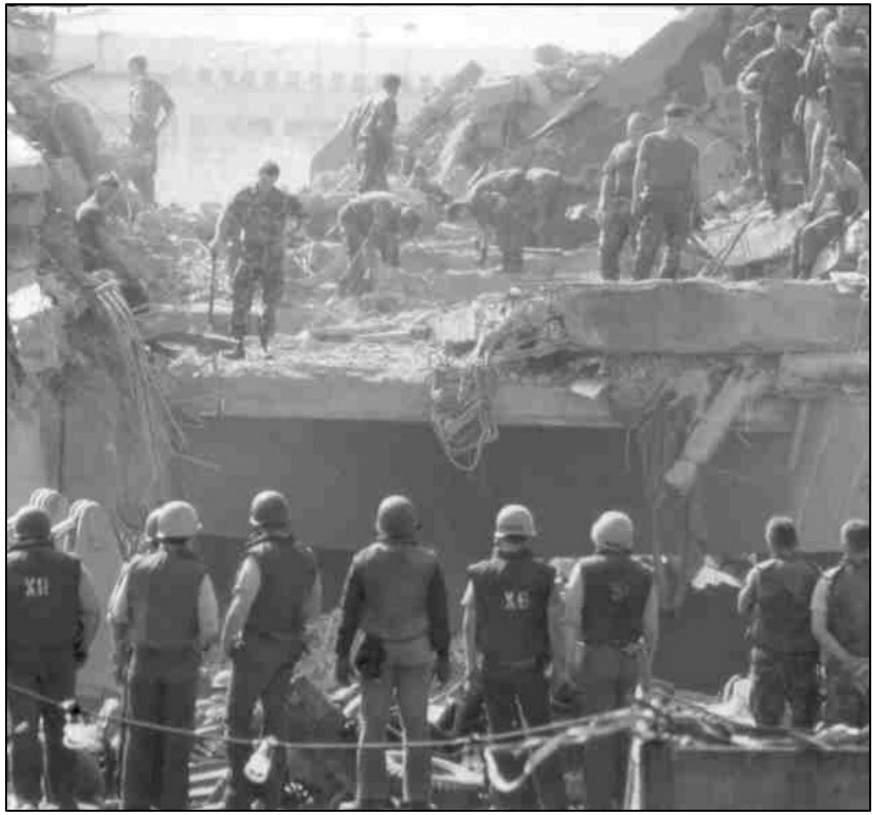
Innovation: Diffusion

- Social System
  - Interrelated units (individuals, states, organizations)
  - Norms
  - Opinion leaders have connection to change agents
    - Earned and maintained–technical capacity + influence





Innovation: Diffusion



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Innovation: Consequences of Diffusion

- Desirable vs. undesirable
  - Drones: Lower risk vs. moral hazard
- Direct vs. indirect
  - Military development under the shadow of nukes
- Anticipated vs. unanticipated
  - Unexpected effects of climate engineering

Diffusion of Military Innovations

Major Military Innovations

Military Innovation: Concepts + Definitions

- Major military innovations (MMI): Major changes in the conduct of warfare, relevant to leading military organizations, *designed* to increase the efficiency with which capabilities are converted to *power*.

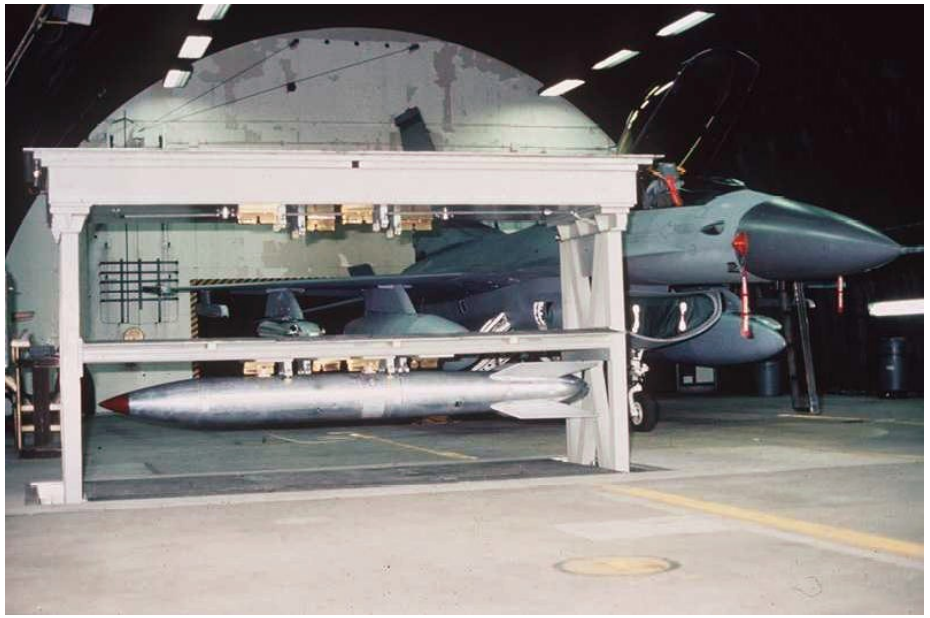
- Conduct of warfare: How great powers organize their militaries and plan to fight wars. *Character (not nature) of war.*

Military Innovation: Concepts

- What might a state do once exposed to an innovation?
  - Rational actors that seek security in an anarchic system

- Internal responses
  - Adopt innovation
  - Counter innovation

- External responses
  - Neutrality
  - Alliances (Balance vs. bandwagon)



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Adoption-Capacity Theory

- What's a theory?

- Two key factors:
  - Financial intensity
  - Organizational capital

- Financial intensity
  - Cost per unit of technology
  - $: Commercial (Open) < Military (Closed)
  - Lower costs=more experimentation

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Adoption-Capacity Theory

- Organizational capital
  - Intangible (software): assets need to respond to changes in warfare
  - Critical task focus → Broader is better
  - Openness to experimentation
    - Skunk Works
  - Organizational age

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Adoption-Capacity Theory

Financial Intensity Hypothesis

The *greater* the financial intensity required to implement the innovation, the *slower* the spread of the innovation at the *system level* and the *lower the probability* that a *state* will attempt to adopt the innovation.

Adoption-Capacity Theory

Organizational Capital Hypothesis

The *greater* the organizational capital required to implement the innovation, the *slower* the spread of the innovation at the *system level* and the *lower the probability* that a *state* will attempt to adopt the innovation.

Adoption-Capacity Theory: System Level

First/Late-Mover Gains Hypotheses

First movers should experience relative gains in power proportional to the length of their monopoly over the MMI.

Late adopters will face lower barriers to adoption, giving them a relative power edge over first/early adopters once adoption occurs.

Adoption-Capacity Theory: System Level

- Supply side theory: Ignores why states innovate

Level of organizational capital required to implement MMI	Level of financial intensity to implement MMI: Low	Level of financial intensity to implement MMI: High
Low	• Fast diffusion • Short term/small impact • Short first mover advantage • Chem Warfare	• Medium diffusion • Risks reinforcing global balance • Relatively shorter first mover advantage • Relatively benefits existing powers • Nuclear weapons
High	• Medium diffusion • Risks reordering power balance; threatens existing powers • Relative longer first mover advantage • Blitzkrieg, suicide terrorism	• Slow diffusion • Substantial/long-lasting disruptive impact on balance of power • Relatively longer first-mover advantage • Carrier warfare

A-C Theory: Alternate explanations

- Horowitz addresses (preempts) several alternatives to adoption-capacity theory
- Strategic competition
  - Fails to explain variation
- Norms
  - Compatible, but incomplete (variation, drivers of innovation convergence)
- Culture
  - Risks endogeneity: culture of openness coded on innovation success?
  - Overlap between cultural and domestic/organizational logics

Cultures of Military Innovation

- Adamsky tackles strategic culture

- High Context
  - Indirect communication
  - Collectivistic
  - Polychronic (many things at once)
  - High power distance
  - Holistic and deductive
  - Better at recognizing RMA
- Low Context
  - Direct communication
  - Individualistic
  - Monochronic (one thing)
  - Low power distance
  - Inductive/Narrow understanding
  - Worse at recognizing RMA

Defined diffusion

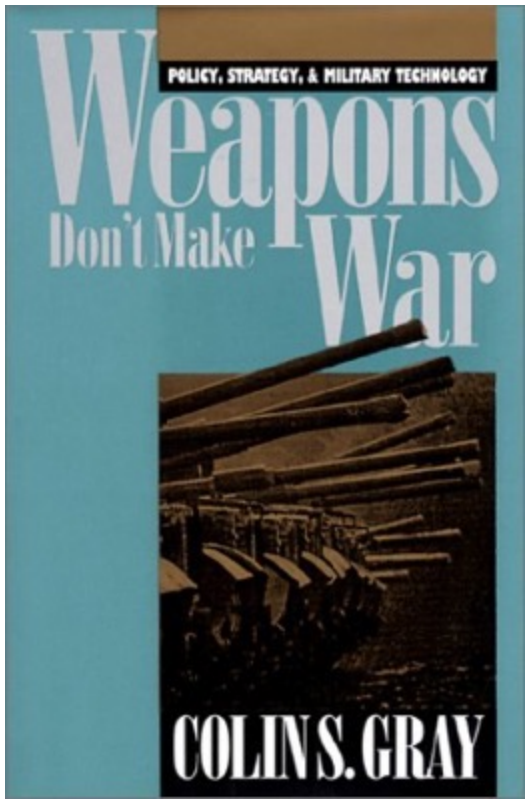
Determinants of diffusion
(General and military)

Adoption-capacity theory

Looking Ahead

- Pivot to technology as an independent variable

- Key themes and theories:
  - Offense-Defense Balance
  - Revolutions in Military Affairs
  - Technological determinism



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