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Understanding the Dynamics of Innovation in the Government Space Sector

Zoe Szajnfarber, PhD in Engineering Systems (expected in 2011)

Committee: Prof. Annalisa Weigel, chair; Prof. Edward Crawley; Prof. Daniel Hastings, Prof. James Utterback

Biography

Zoe Szajnfarber is currently working towards her Ph.D. in ESD at MIT Zoe has worked as a systems engineer at MDRobotics and Dynacon Inc; and at the European Space Agency as a researcher studying technology development in space science missions. Zoe received a B.A.Sc. in Engineering Science from the University of Toronto (2005) and S.M. degrees in Aeronautics and Astronautics and Technology and Policy from MIT (2009).

zszajnfa@mit.edu

Related Publications

Szajnfarber, Z. and Weigel, A. L., "Towards an Empirical Measure of Spacecraft Innovation: The Case of Communication Satellites," *Acta Astronautica*, 2009. (Accepted for Publication)

Szajnfarber, Z., Richards, M. G. and Weigel, A. L., "Implications of DoD Acquisition Policy for Innovation: The Case of Operationally Responsive Space," AIAA Space 2008, AIAA, San Diego California, September 2008. (Submitted to IJDAM, 2009)

Szajnfarber, Z., Grindle, A. T., and Weigel, A. L., "Instantiations of Government Space Innovation Systems: A Comparative Analysis" *International Astronautical Congress*, IAF, Daejeon S. Korea, October 2009.

Motivation (1): Space Market Creates Strategic Innovation Tradeoffs

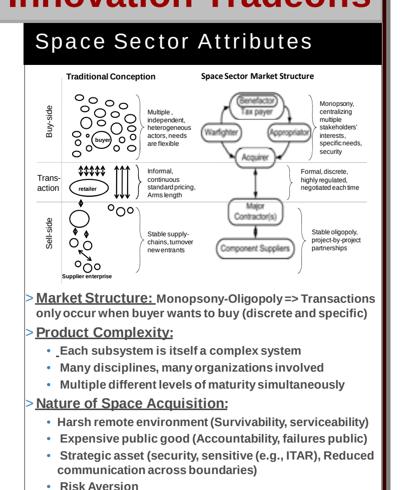
C1 Monopsony markets enforce a top-down acquisition process. Need to balance funding for within-project and exploratory technology development

C2 When representing the needs of a disaggregated buyer, the extent to which to prioritize knowledge types

C3 When integrating fragmented sell-side knowledge from the top-down, need to maintained certain amount of in-house technical expertise.

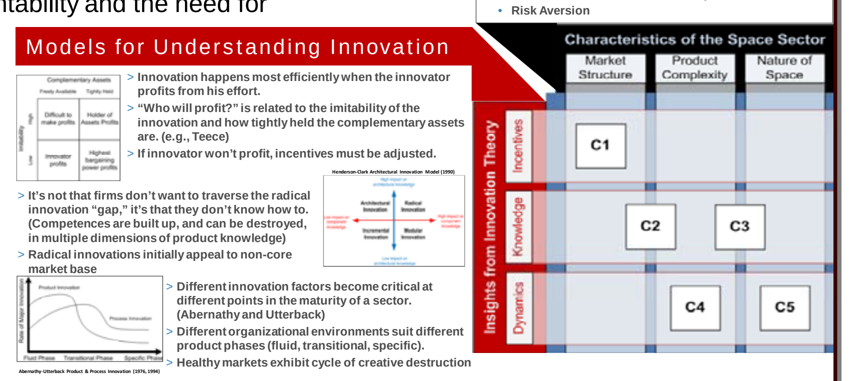
C4 The extent to which to isolation of exploratory technology development from project application

C5 Given the politicization and public visibility of space activities, how to balance accountability and the need for experimentation

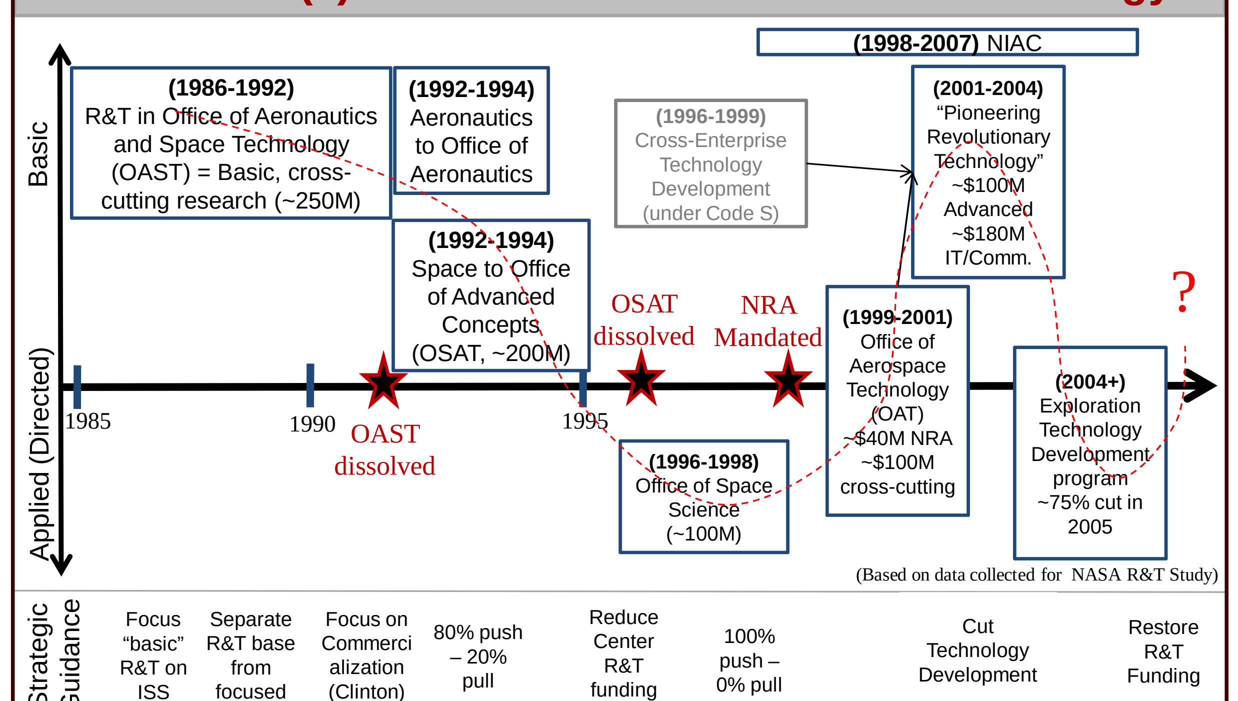


Unique market structure of space industry lacks natural dynamic of "creative destruction." ***If radical change is to happen, requires government patronage.***

(Peck and Scherer, 1962; Sherwin and Isenson, 1967; Adams and Adams, 1972)

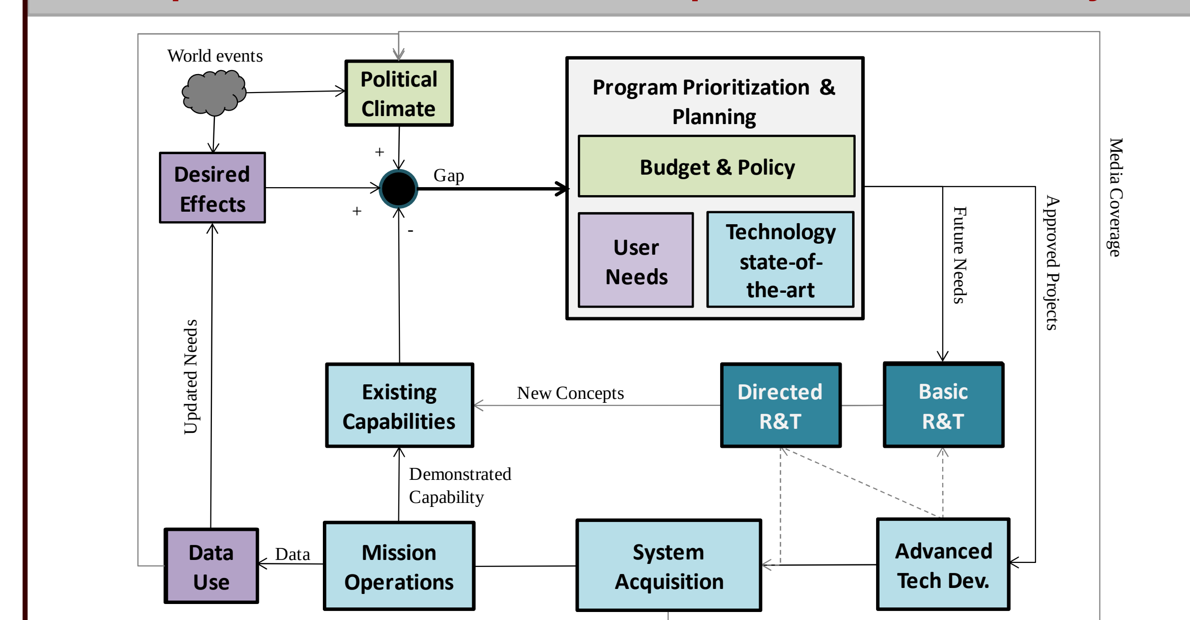


Motivation (2): Evolution of NASA Tech Dev. Strategy



While there is general recognition of a need for both "basic cross-cutting" R&T and "applied" R&D efforts, there is little consensus on what the "right" ***balance*** *is. Despite extensive* ***experimentation****, there is fundamental lack of* ***understanding*** *of innovation* ***process*** *in the space context.* ***Without understanding, tradeoff cannot be resolved.***

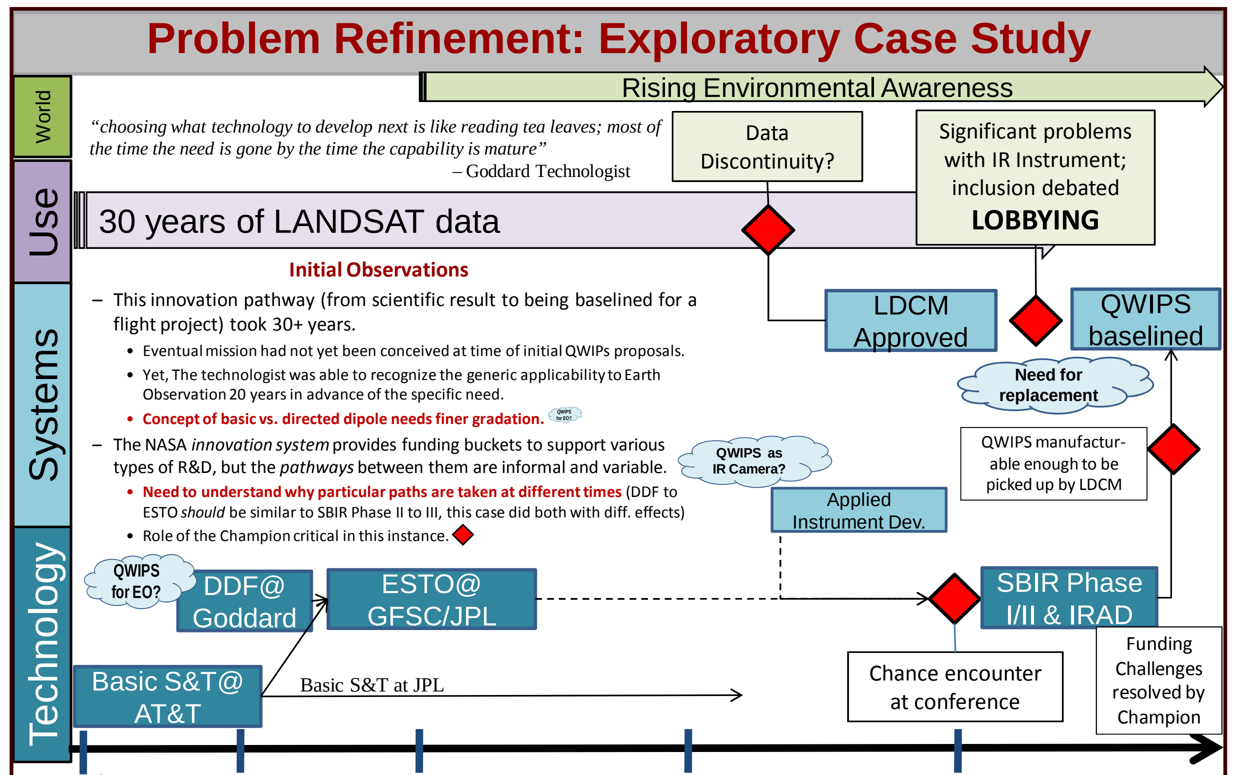
Conceptualization: Government Space as Innovation System



Def'n: Innovation is the process through which the technological ***state-of-the-art*** *(as defined by the user)* ***changes over time****. This can equivalently involve: a) generating a wholly* ***new*** *capability; b)* ***improving*** *an existing capability; or c) reducing the resources required to achieve an existing capability (e.g., making the system* ***cheaper or lighter****)*

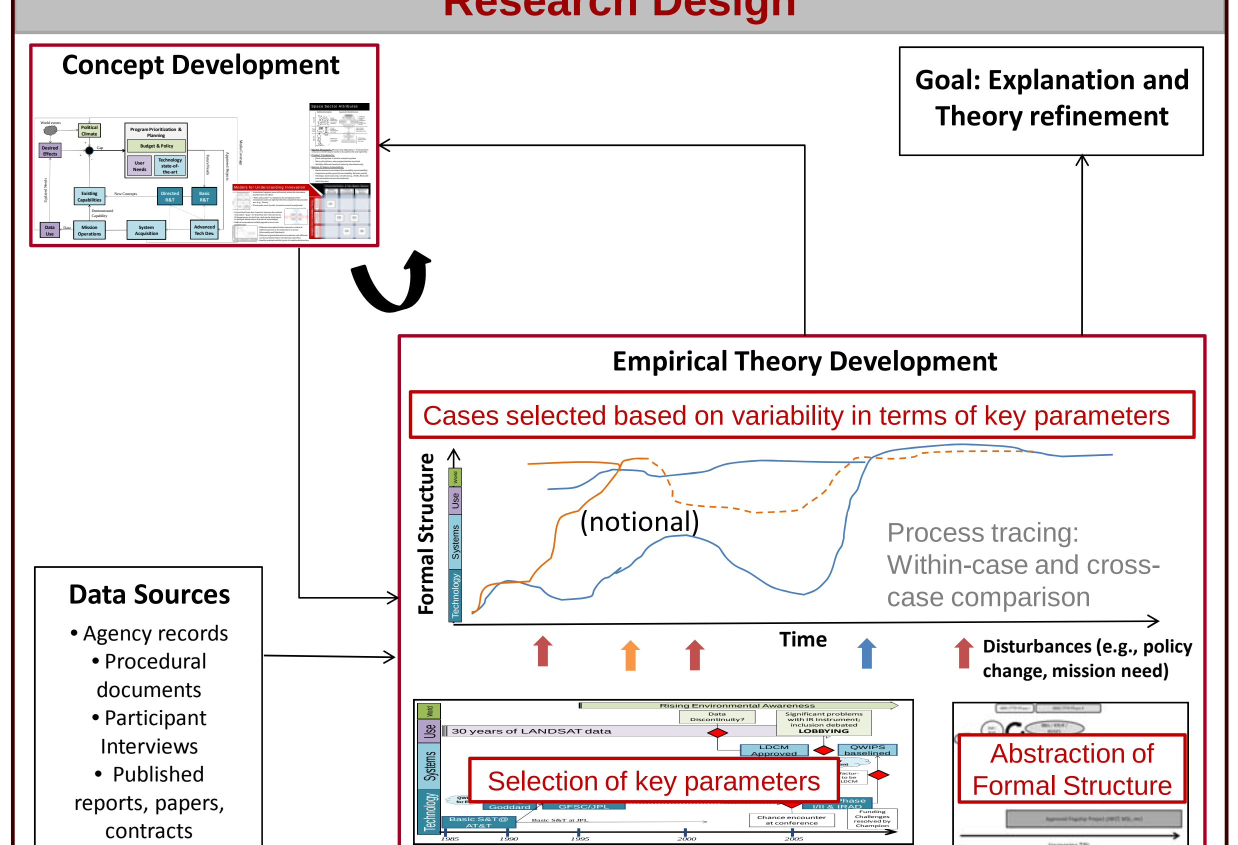
Insights from representation: 1) ***Three "development" loops*** *– technology, system, science – which have* ***mismatched time constants*** *and interact through* ***complex feedback****, perturbed by the political climate. 2) Guidance/Planning is necessarily based on* ***estimates and projections***

Problem Refinement: Exploratory Case Study



Understanding the nature and implications of the basic vs. directed S&T tradeoff requires a systems perspective, integrating both a representation of the ***formal institutional mechanisms*** *and the* ***informal "innovation pathways," studied over decades.***

Research Design



Research Status

- Currently:
  - Finalizing case selection
  - Beginning data collection
- Expect to complete process tracing by summer 2010

Potential Contributions

- New Understanding
  - Conceptualization of space agencies as innovation systems
  - Representation of formal institutional structure
  - Causal explanation of a selection of innovation pathways
- Practical
  - Basis for institutionalizing the pathways (that work).
  - Insights in the tradeoff between basic and applied R&D in government monopsonies.

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