Energy RD and Policy: “Embracing” Failure

John F. Kennedy School of Government
Cambridge, Massachusetts
March 18, 2008
Creativity, Innovation and “The Six Levers”

• Creativity – Generating and Developing New Ideas
• Innovation – Bringing Ideas to Market

The Six Levers of Innovation

Constancy of Purpose in Technology Programs
Adhering to Aggressive Development Goals
Using Broad/Multiple Approaches
Increasing Focus vs. Spreading Thin in Business Extensions
Upgrading Adequacy of Science Base
Achieving Business/Technology Interspersing
Innovation Systems

Creativity / Risk / Uncertainty / Time

Success

Failure

Outcomes

Processes

Forces

Ideation
- Idea Generation
- Exploration

Screening
- Feasibility
- Financial Attractiveness
- Modification

Development
- Preliminary Dev.
- Detailed Dev.

Commercialization
- Demonstration
- Scale-up
- Commercialization

© John E. Johnston 2008
Failure and Its Basis

Fact – violating the laws of thermodynamics
Knowledge – inadequate / incomplete information
Learning – inadequate / incomplete assimilation of knowledge and facts
Complexity – unpredictability of the interactions and responses of all internal and external agents

The chief cause of technical failure is ignorance of fact or lack of knowledge
The chief cause of business and policy failure is complexity coupled with a lack of adaptive learning

© John E. Johnston 2008
A World of Portfolio Choices

- tar sands, tight gas, LNG, gas to liquids, advanced vehicle systems, hydrogen production, carbon capture and sequestration (evaluation), cogeneration, freight transport efficiency, methane emissions
- oil shale (evaluation), biodiesel and biofuel research, coal gasification, carbon capture and sequestration, lignocellulosic biofuels, wind (evaluation)
- LNG, tar sands, coal gasification, carbon capture and sequestration, tight gas, solar, wind, hydrogen, lignocellulosic biofuels
- oil sands, oil shale, tight gas, solar, wind, coal gasification, gas to liquids, lignocellulosic biofuels, CO₂ capture and sequestration
Portfolio Objective

Objective:
Achieve an optimal balance of:
• Commercial success – revenue, earnings, cash flow, return on investment
• Sustainable competitive advantage – long term viability
• Risk

The preference for Optimal Balance over the Optimum Balance reflects two essential realities:
1. The complexities of the operating environment
2. The unpredictability of failure

These Two are Coupled and the Core Subject of This Talk
Why Most Things Fail

Observations

- After initial start odds of business failure are size independent
- For the top 100 firms between 1912 and 1995 “…disappearance or decline was almost three times as likely as growth”
- Corporate failure follows a power law expression entirely analogous to biological extinction

Conclusions

- Despite our unique ability to anticipate and plan extinction is as pervasive a feature of business as it is in biology
- It is “as if” firms acted at random to achieve goals – and often fail
- The underlying cause is massive uncertainty and complexity

The Role of Complexity

- Failure arises as an outcome of the complex interactions between interconnected agents: firms, consumers, regulators
- The magnitude of effects is not predictable by the size of the perturbation
- Businesses and biological systems exist in complex dynamic environments and their ability to understand them is limited
- Adaptive strategies must be rapid and robust
  - Failure is to be expected and learning from it should be planned for as a adaptive strategy

“…Intent is not the same as outcome…”
Learning and Adapting

• Humans learn from experience and adapt by projecting into the future – prospection – simulation
• Accurate prospection requires similar consequences and contexts in both present and future – rarely achieved
• Consequently simulations are:
  – *Unrepresentative*: we chose the worst or best case to epitomize the past experience that informs future prospection
  – *Essentialized*: we ignore facts that at the moment don’t seem relevant
  – *Abbreviated*: we tend to emphasize the short term consequences of events in the future both positive and negative – we don’t expect to adapt
  – *Decentralized*: we underestimate the influence of present and future contextual factors on the desired consequences in prospection.
• Sharing and testing simulations with others may improve accuracy
• Explicit models are a powerful tool for sharing and testing prospection
  – Testable, expandable, adaptable
  – Source of key metrics

Understanding / Modeling Technological Change


© John E. Johnston 2008
Improving the Odds and Embracing Failure

The scientific, technical and engineering arena
- Fail early – fail often
- Focus on fundamentals
- Expand experimentation with modeling

The organizational arena
- The “Six Levers of Innovation”
- Engage leadership without regard to position
- Provide education, experience and culture

The market arena
- Modeling
- Use strategic networking and partnering

The policy arena
- Modeling
- The “Six Levers of Innovation”
Policy Focus

- Constancy of Purpose in Technology Programs
- Upgrading the Adequacy of the Science Base
- Using Broad / Multiple Approaches
- Adhering to Aggressive Development Goals
- Increasing Focus vs. Spreading Thin in Business Extensions
- Achieving Business / Technology Interspersing

Make Policies, Their Application and The Results Transparent and Broadly Available
In Memory of
Nathaniel J. Mass

With Thanks to
Nazeer Bhore, Andy Kaldor, Marianne Mintz, John Riganati,
Daniel Sperling, and especially Cathleen Higgins

© John E. Johnston 2008