SAND2011-7999C

The Diverse Variables To Consider When Planning and Assessing Public Research Portfolios

Atlanta Science & Innovation Policy Conference
September 15, 2011

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Parts of work presented here was completed for the U.S. DOE Office of Science and Office of Energy Efficiency and Renewable Energy by Sandia National Laboratories, Albuquerque, New Mexico, USA under Contract DE-AC04-94AL8500. Sandia is operated by Sandia Corporation, a subsidiary of Lockheed Martin Corporation. Opinions expressed are solely those of the author.

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Motivation for describing considerations of RTD portfolio assessment more broadly

- Current policy and program rationale and assessment for research, technology development and deployment (RTD) programs and portfolios
  - use a limited and fragmented picture of the innovation process
  - which provides incomplete or inaccurate answers to questions.

- To improve design, management, and assessment of these
  - Use systems view with focus on technology sector
  - Take broad view of arenas of RTD and their connections
  - Integrate views of RTD and market diffusion
  - Organize thinking about differences in RTD portfolios, organizations, and circumstances

Theories that guide our thinking

Research Team

- Management of innovation literature

Research Organization

- Organizational innovation theories
- Research Profiles theory

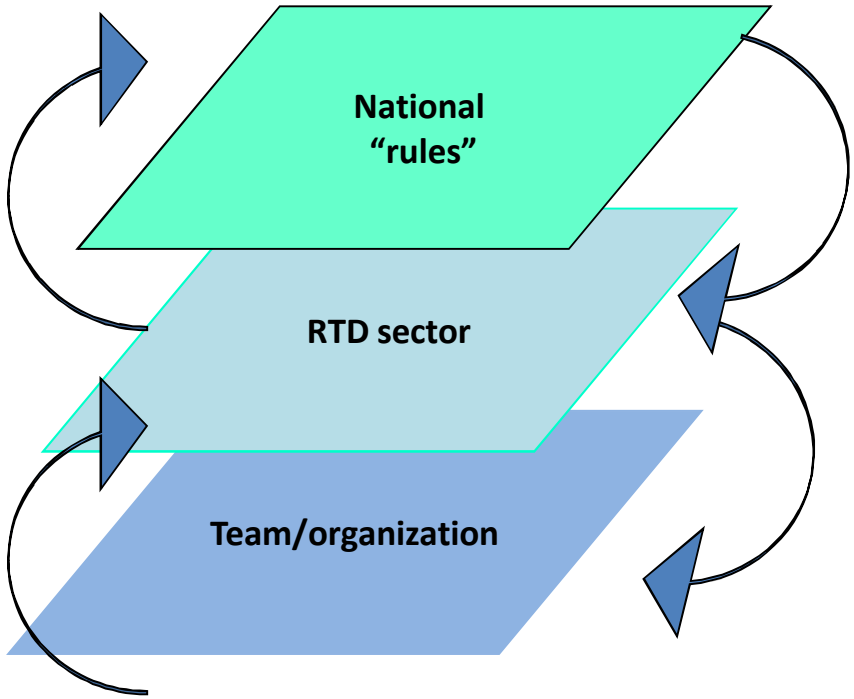
Science/technological Sector

- Idea Innovation Network on RTD process
- Network theories
- Sector economic models
- Life cycle model of R&D Policy Analysis

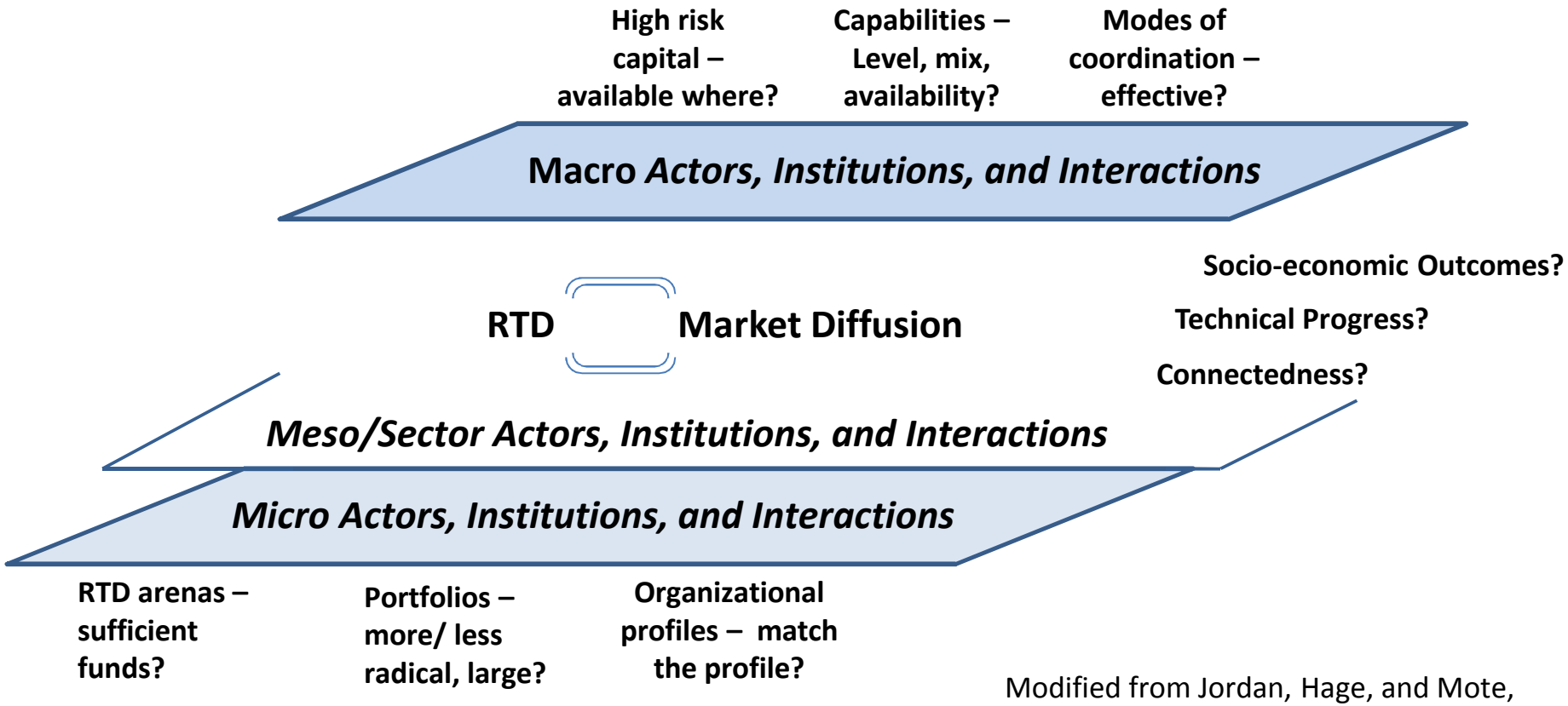
Market Sector –Diffusion theory

Take a systems view, with focus on the Meso level (RTD sector)

- Meso level connects macro with micro
- Bottlenecks to innovation can be spotted more easily here
- Mission and policy decisions are often sector specific
- Policy impacts differ by sectors because sectors differ in
  - Amount of investment by RTD arena
  - Rates of technical change



For example, one framework for assessing an innovation system, with 9 sets of indicators



Modified from Jordan, Hage, and Mote, January 2008.

Meso Level: Considerations of RTD arenas and their connectedness

There is increasing differentiation of arenas in the innovation process.

For successful introduction of new product/ mission solution

- Manufacturing, quality research can't be ignored
- RTD advance can occur in one or more arenas
- Ideas move between arenas
- Inter-organizational networks transfer tacit knowledge

The idea innovation network: Hage and Hollingsworth (2000), modifying Kline and Rosenberg (1986)

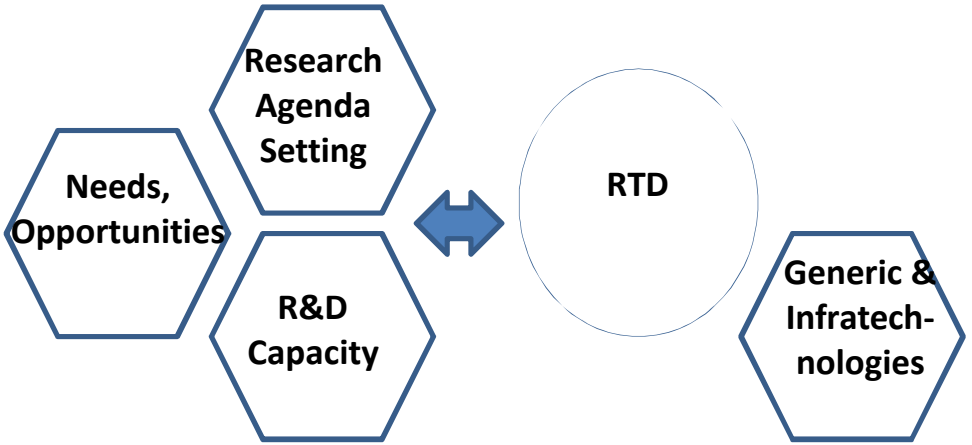
Meso Level:
Other considerations related to RTD

Needs and Opportunities: in business models, policy incentives, opportunities such as paradigm shifting research advance.

Research Agenda Setting: Influences RTD by defining problems, adding understanding, or calls for joint planning.

Research Capacity: science base or knowledge pool, R&D facilities, tools and techniques, educated R&D workforce, networks of researchers.

Generic and Infratechnologies: Technology infrastructure, such as new materials or standardized measurement specifications, that reduce in risk or provide complementary components.



Sources: Jordan 2010, Tassey 2007, Canadian Academy of Health Sciences return on investment framework 2009.

For example, questions to ask about an RTD portfolio at Sector level

- What is overall sector socio-economic performance (new sales in product mix, speed to develop, how radical/broad)?
- What are the expected outcomes of this portfolio, and in what time frames?
- Has past work had an impact, and is current work targeted to these outcomes and making progress? What are current priority needs?
- What is the role of various parts of this portfolio in relation to others funding related or similar initiatives?
- Do the science fields and technology development areas have the capacity and resources to achieve objectives, excellence, and seize opportunities?
- Are the interfaces among researchers and between research and the private sector who must pick it up effective?

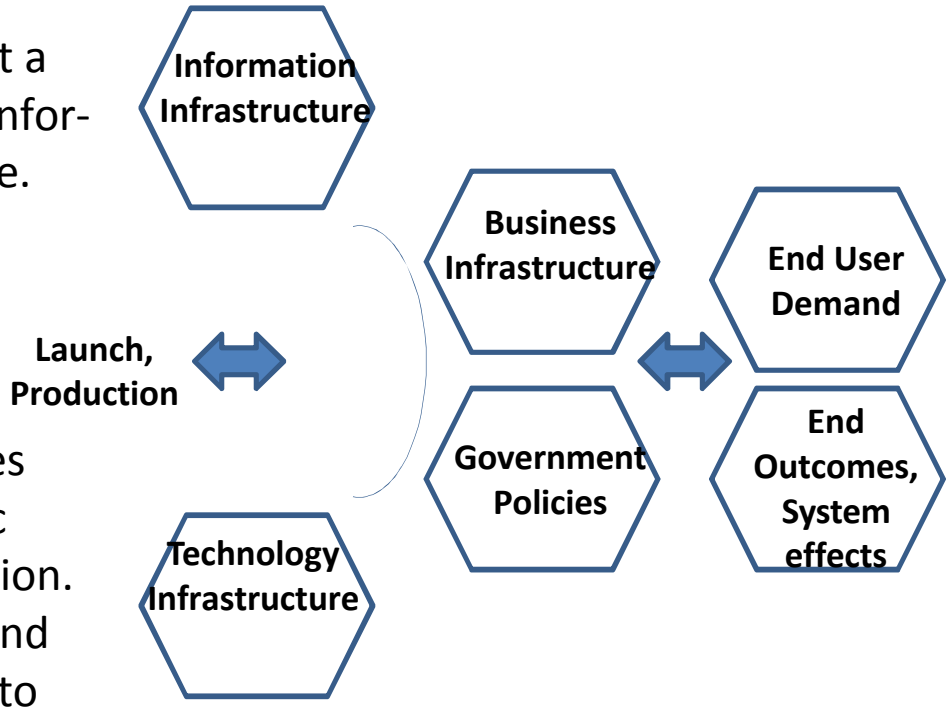
Meso Level: Considerations for assessing the likelihood of market diffusion

Information Infrastructure: Personnel who create, advance, or package knowledge about a technology or market; Delivery channels so information is available, accessible, implementable.

Business Infrastructure and Risk Reduction: Individuals/firms willing and able to finance, produce, distribute, sell, and maintain the technology, product or process.

Government Infrastructure: Agencies/entities that change structure and operation of public policies/programs to help/hinder tech. adoption.

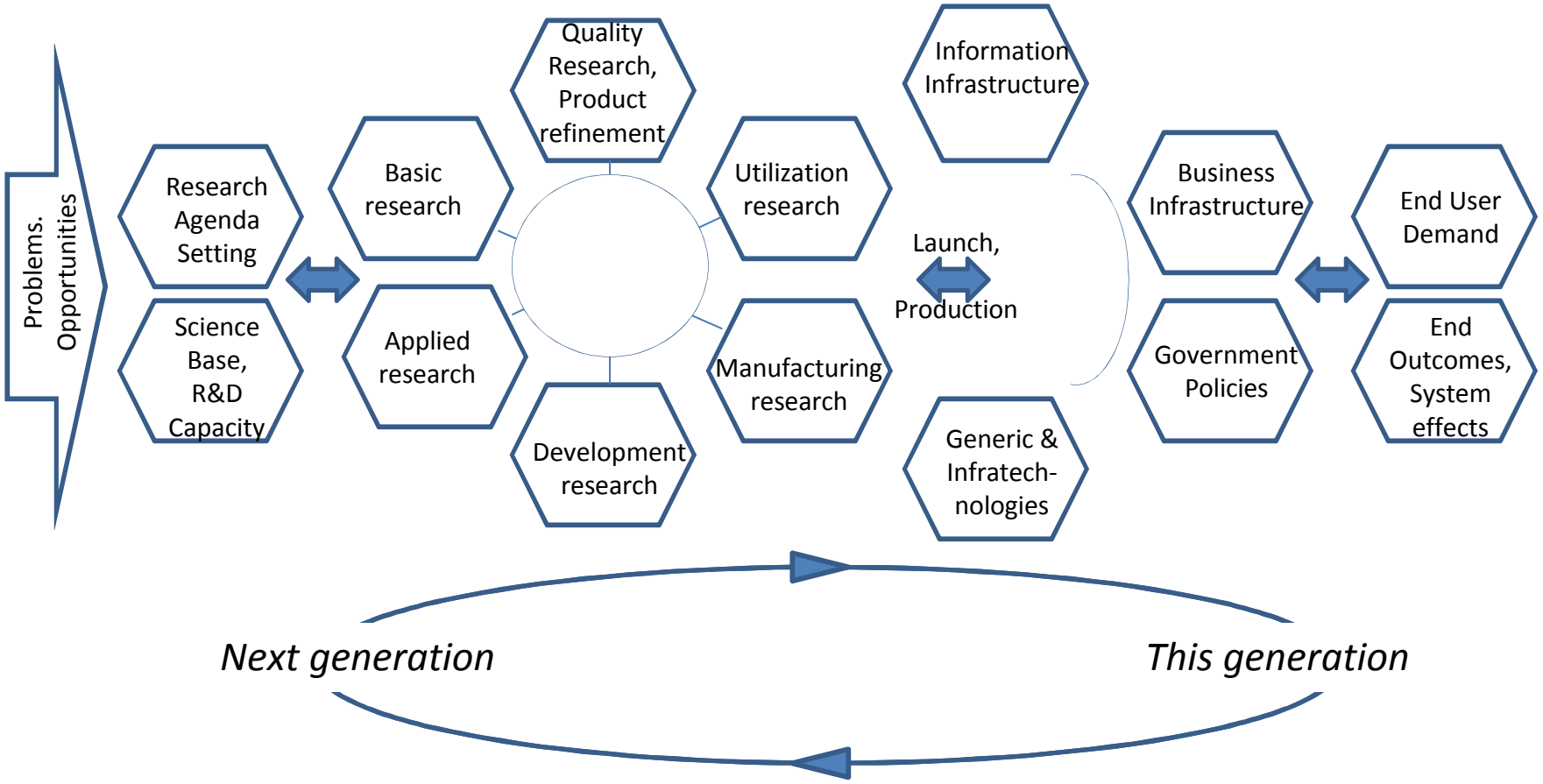
End User Demand. Process through which end user individuals/organizations are convinced to try, and then continue to use, a technology.



Source: G Jordan, 2010

End Outcomes and Systems Effects. Adoption of product leads to ultimate desired outcomes. Along the way there are multiple planned and unintended effects on this R&D and market, with spillovers to other technologies and markets.

Putting RTD and Diffusion together in one diagram



Source: G Jordan, 2010

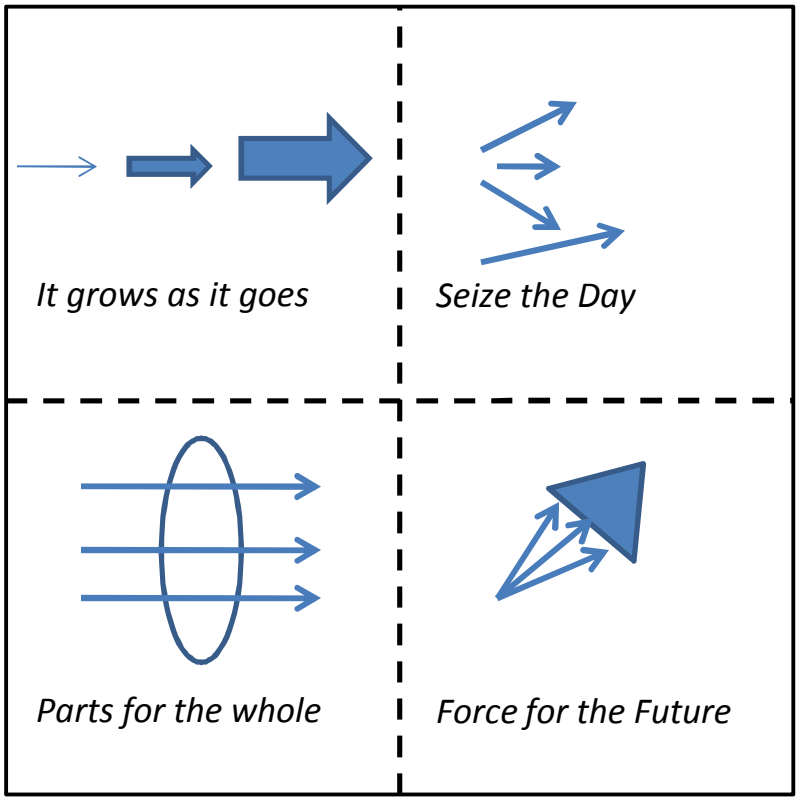
Turning to the Micro level, questions to ask about an RTD portfolio

- What is overall organizational business strategy and performance against that strategy?
- What are RTD objectives?
- What is the role of various parts of this portfolio in relation to other parts funding related or similar initiatives?
- What are characteristics of the RTD undertaken (size, how radical/broad)?
- Should the portfolio shift because of changes in the technology (barriers or opportunities) or in the business or external context?
- Do the organizational characteristics (strategy and structure) of the organization match the type of RTD work they have chosen to do?

Example of Micro level considerations, a framework for organizational portfolio strategies

Narrow focus
Small size

Consolidation focus
Lower risk
Specialized teams
Intra organizational



Growth focus
Higher risk
Diverse teams
Inter organizational

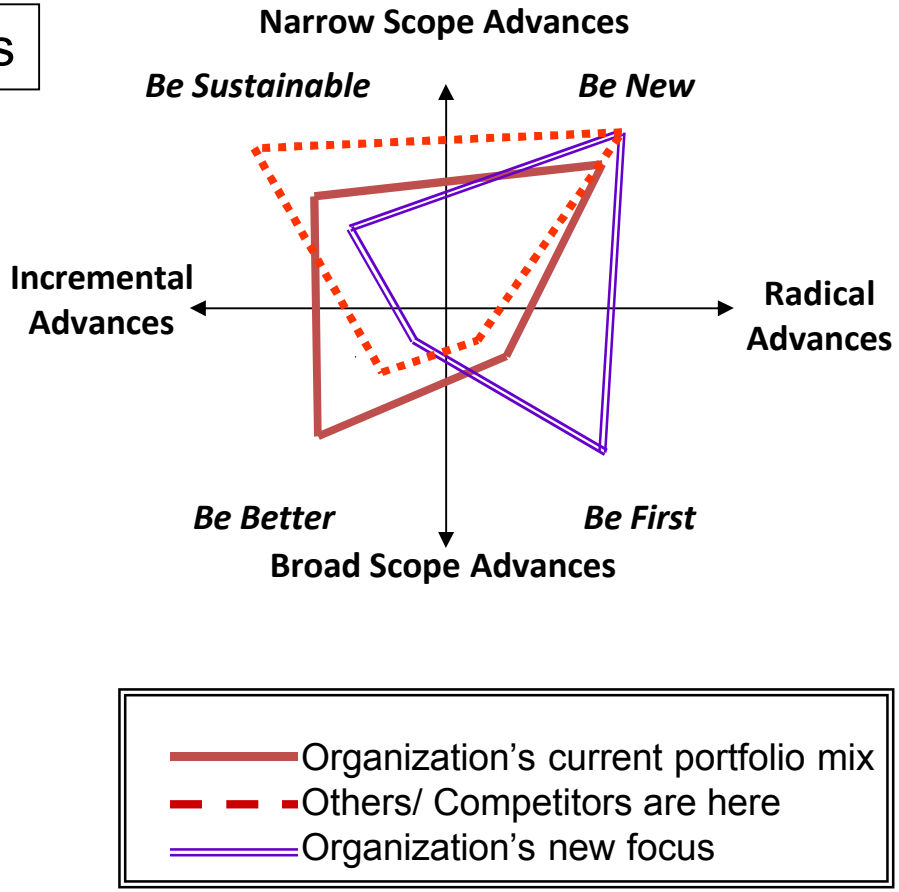
Broad focus
Larger size

Sources:
G Jordan, Research Profiles 2006, 2011;
VanDevender 2003

Research Profiles can inform decisions about mixed portfolios, showing trade offs, movement between profiles

Sample scenario of strategic choices

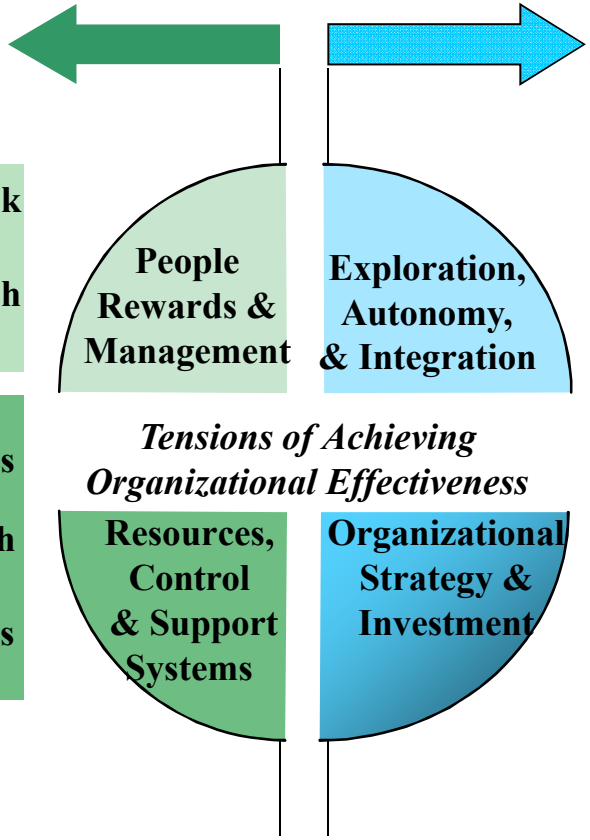
- Spot an innovation in a component of the system that could provide opportunity for strong first mover effects if can used to breakthrough with a new lighting system (e.g. LED)
- Technical challenges are numerous, so need to continue looking for breakthroughs in several areas of underlying basic science questions
- Internal resource constraint requires moving resources, in this example from incremental research



Micro level considerations include RTD organizational effectiveness. Balance of tensions among attributes depends on context.

Important for ALL types of research

Particularly important for more radical innovation



Rewards for Research/Work

Value of Managers of Research

Quantity & Quality of Resources

Organizational Support for Research

Coordination by Managers

Autonomy

Exploration

Internal Collaboration/ Integrate Ideas

External Collaboration/ Integration

Agile, Long term Investment

Focus with Clearly Defined Goals

Sources: G Jordan, Research Environment study, 2003, 2006
Cameron and Quinn 1999

Contextual Considerations include four aspects of the external environment

- **Technical (**presence or absence of necessary research tools or technologies, the stage or maturity of the research or technology, and the degree and speed of widespread technical change)
- **Social/demographic** (the culture, such as the society's values and preferences, and the structure of society, such as shifts in age distribution, future availability of trained scientists)
- **Legal, Regulatory, and Political Environment** (State and Federal government laws, regulations, or policies and political pressures; can be simple or complex, strict or flexible, reasonable or unreasonable)
- **Economic Environment** (trends, including overall national prosperity, levels of Federal funding for R&D, and availability of funding; the level of competition for funds; cost of the research infrastructure)

Is the state of the environment for Labs/a field of research …

- Very stable or very dynamic (changing rapidly)
- Very predictable or very unpredictable (hard to anticipate the nature/direction of change)
- Generally favorable or unfavorable?

Source: G Jordan, Research Environment study, 2003, 2006

Summary and conclusions

For portfolio assessment and planning we have

- examined both RTD arenas and market diffusion
- organized and characterized variables at the meso and micro levels that could be considered
- suggested that considering combinations of variables could improve both assessment and planning

Building on

- a systems view of research assessment
- a theory-based framework that emphasizes blockages to innovation
- generic logic models of the RTD and diffusion processes

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