Delta Research Co.

Two First National Plaza
20 S. Clark Street, Suite 620
Chicago, IL 60603
312-332-7539

MEASURING THE EFFECT OF GOVERNMENT R&D ON TECHNOLOGY DEPLOYMENT AND USE:

A PRACTITIONER'S PERSPECTIVE

Thomas M. Pelsoci, Ph.D.
tpelsoci@deltaresearchco.com

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PROBLEM STATEMENT

Identifying the prospective benefits of government R&D programs requires an assessment of the

- Likelihood of technology deployment and
- Isolating the contribution of government R&D.

DEPLOYMENT

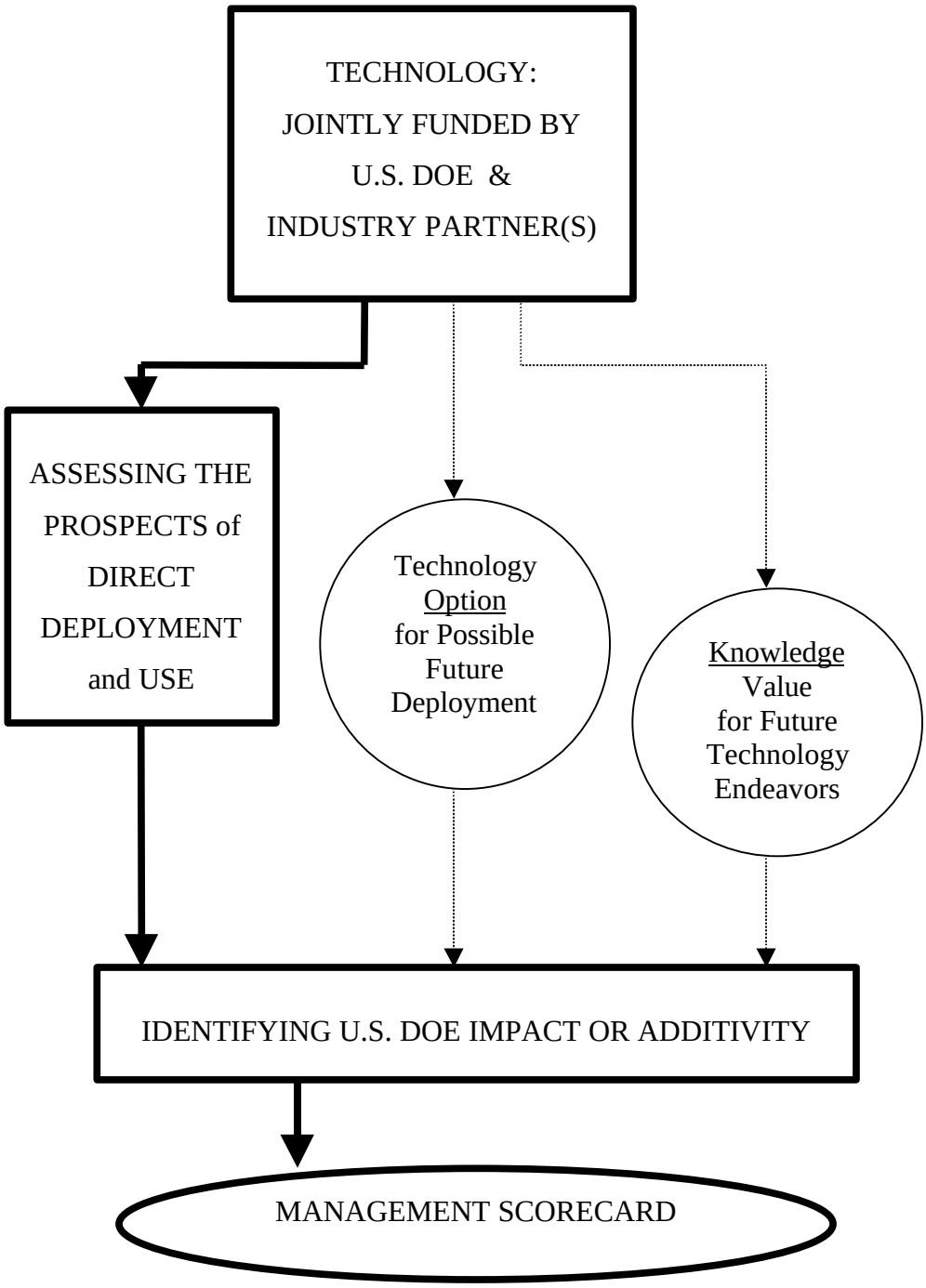
Deployment or full commercial implementation is the result of private sector decisions, motivated by considerations of profitability and competitive advantage.

Potential barriers include (1) Chain of events, leading to commercial implementation, is long and complex and deployment is not assured, even if the technology works and the economics are attractive, (2) Economic benefits may be generated over a life cycle, as opposed to shorter capital budget planning horizons, and (3) Technologies may have "public goods" character.

While control over implementation is a private sector decision, a failure to commercialize is a significant risk to DOE's management scorecard.

ISOLATING DOE CONTRIBUTION

Once near term deployment is likely, DOE's relative contribution can be estimated using alternative approaches. (1) A static approach attempts to allocate credit for prospective benefits by asking how much of a fixed pie of BTU and cost savings should be attributed to government, to industry and other partners? (2) A more dynamic approach could shift the paradigm by asking what may be the shape of the larger pie, implicit in the synergies that public–private partnerships can generate, and how should these expanded benefits be allocated among DOE and its partners?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ASSESSING THE
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IDENTIFYING U.S. DOE IMPACT OR ADDITIVITY
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FIRST CHALLENGE:
WILL TECHNOLOGIES BE DEPLOYED?
HOW TO ASSESS THE PROSPECTS?

What are sources and limits of DOE's influence over deployment?

Could the analyst benefit from lines of inquiry typical of investors, venture capitalists and bankers? Are these lines of inquiry practical & permissible?

Is there a clustering of industry partners and types of projects?
Is clustering likely to facilitate general insights at high levels of abstraction?

PROSPECTS FOR DEPLOYMENT

SOURCES OF DOE INFLUENCE

DOE can influence deployment patterns by funding

- R&D programs
- Economic studies
- Environmental assessments
- Technology outreach initiatives
- Technology transfer activities

LIMITS OF DOE INFLUENCE

Private sector partners control deployment decisions. Their decisions are shaped by the company's

- Business model and corporate strategy
- Competitive market conditions
- Regulatory environment
- Possibly deteriorating financial condition
- Possibly changing corporate ownership

These private sector forces, shaping commercialization decisions, are not primarily technical in nature.

PROSPECTS FOR DEPLOYMENT

LINES OF INQUIRY USED BY INVESTORS

Could lines of inquiry, used by investors and bankers for investment decisions and performance tracking, constitute a useful and permissible approach for DOE?

SOME QUESTIONS ABOUT THE INDUSTRY:

Is the industry operating in depressed markets?

Is it experiencing financial strain?

Are there high rates of mergers & acquisitions?

Does M&A generally enhance the financial strength of companies?

Has industry deployed new technologies in the recent past?
Of comparable risk levels? Incremental or radical innovations?

Are competing technologies being considered?

Average industry break-even point for plant operations?

Can plant managers risk new technologies?

When DOE is challenged to arrange full scale demonstration projects, does that suggest something significant about deployment risk?

PROSPECTS FOR DEPLOYMENT

LINES OF INQUIRY (CONTINUED)

Industry partners are motivated to assume the risks and the costs of new technologies by the expectations of profitability and competitive advantage.

While it is generally conceded that technology is an increasingly important source of value, it is an intangible source of value and there is substantial management uncertainty about financial returns from technology investments and innovations.

SOME QUESTIONS ABOUT THE COMPANY:

Does corporate management have an interest in technology?

Is management experienced in implementing new technologies?

Does the champion of the new technology have sufficient organizational standing?

Does the firm have the financial capacity to deploy?

Are competing technologies gaining a following?

Could the above lines of inquiry be useful elements in assessing deployment prospects? Could DOE benefit from above type of commercial realism?

PROSPECTS FOR DEPLOYMENT

CLUSTERING OF PARTNERS & PROJECTS

DOE PARTNERS COME FROM MANY INDUSTRIES:

Commercial & residential building sectors

Paper, glass and chemicals

Metals and automakers

Electric & gas utilities

Petroleum companies

Venture capital startups

TECHNOLOGIES RANGE FORM

Large infrastructure projects to smaller projects for retail products

Long lead time projects to “low hanging fruit”

High risk projects to projects with lower risk profiles

Does variability by industry, technology, and risk profiles mitigate against cross-cutting generalizations based on clusters?

SECOND CHALLENGE:

ASSESSING GOVERNMENT CONTRIBUTION

"Perhaps the most difficult analytical problem is assigning to DOE a portion of the overall benefits of an R&D program that properly reflects DOE's contribution…the Committee found no reliable way to quantify DOE's contribution in most cases and doing so remains a methodological challenge for the future" National Academy, Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000, (2001)

ALTERNATIVE APPROACHES

While difficult, the attribution of benefits is central to an assessment of DOE contribution and cannot be avoided.

Different approaches may be tried, including:

Dividing-up a static pie of BTU and cost savings

Expanding the pie to include a broader range of cross-cutting benefits and more "public goods" benefits, as long as these can be quantified (improved access, reliability, health benefits from environmental actions, etc.)

Possibly, differentiating benefits provided by DOE and its partners

GOVERNMENT CONTRIBUTION

DIVIDING UP A STATIC PIE

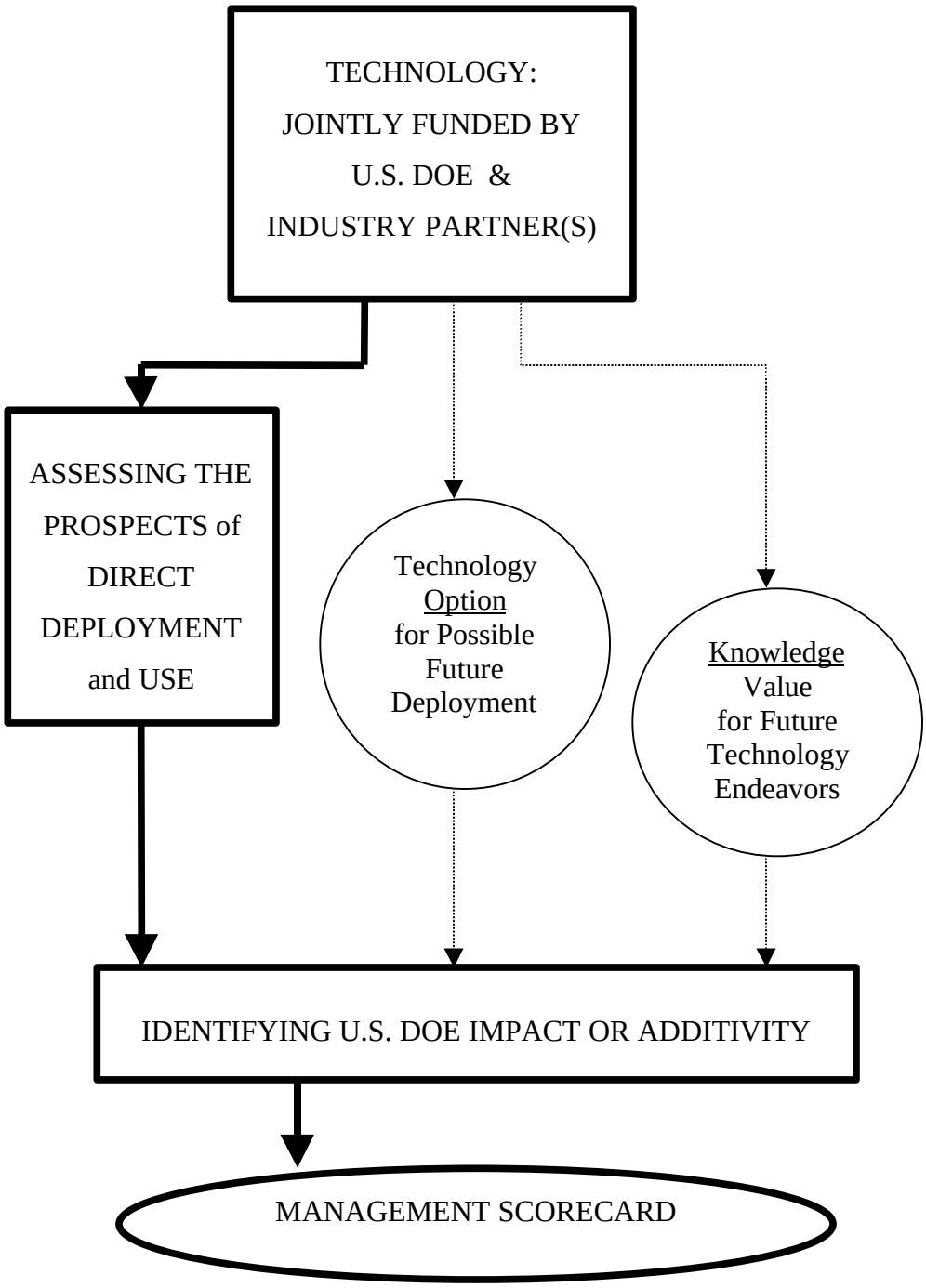
This can work, depending on the characteristics of the industry partner:

> Relative to smaller and medium size partners, DOE can provide R&D funding, substantial technical capabilities and a project management framework. When smaller companies clearly lack these capabilities, crediting DOE could be straightforward.
>
> When deployment is facilitated by the formation of an industry consortium (in otherwise competitive industries), DOE's role as a catalyst of consortium formation could lead to the lion's share of credit for prospective benefits. The whole thing might not have happened without the DOE initiative.

SHIFTING THE PARADIGM: A BIGGER PIE

Attribution of benefits can become more difficult when partners are successful global corporations with substantial technical capabilities of their own.

> In these cases, would it be helpful to expand the paradigm beyond BTU and cost savings to cross-cutting benefits and "public goods" benefits that might not have resulted from pure private sector investment?
>
> DOE could then take the greater share of credit for cross-cutting and "public goods" benefits, in addition to its proportionate share of BTU and cost savings.
>
> Even if all benefits are attributed in proportion to investments, a larger pie (credible and properly quantified) would indicate greater DOE impact.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POSSIBLE CONCLUSIONS

Tracking the variety of market forces, shaping technology deployment decisions, could improve DOE visibility of deployment risks.

Improved visibility could be useful for (1) Identifying the prospects of near term deployment and (2)Measuring the contribution of DOE programs.

A paradigm shift for measuring DOE contribution begs the following questions:

> *Do we need to develop better methods for identifying cross-cutting benefits and "public goods" benefits that may not currently be captured in GPRA Data Sheets?*
>
> *Do we need to develop better methods for quantifying such cross-cutting and "public goods" benefits?*