Technology Transfer Principles: Methods, Knowledge States and Value Systems Underlying Successful Technological Innovation

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What's this presentation about?

It's about clarifying the relationships between related yet distinct methods for generating new knowledge.

It's about describing multiple states of knowledge, and how each relates to the others.

It's about the critical distinction between activity conducted within an organization, and activity requiring some hand-off and buy-in between organizations.

The bottom-line is that decision-makers will only invest their own futures in opportunities that offer rewards within their own personal value systems and incentive structures.

3 Key Points

1. Technological Knowledge exists in Three States:
   - ✓ Conceptual Discovery
   - ✓ Prototype Invention
   - ✓ Commercial Innovation
2. Three distinct Methodologies create Knowledge States:
   - ✓ Scientific Research
   - ✓ Engineering Development
   - ✓ Industrial Production
3. Successful STI Policies and TT Programs require clarity between -- and parity among – these core concepts.

Intra-Organizational Processes

- Knowledge embodied in any state is continuously exchanged *within* an organization, often through a systematic and deliberate process of managed communication.
- This includes knowledge in the state of enabling 'know how' regarding operational components and systems (technology).
- These internal exchanges are unremarkable because ownership, control and commitment remains consistent – *no inter-organizational transfer occurs!*

Inter-Organizational Processes

What happens when laboratory personnel are expected to 'sell' their internal knowledge to outside organizations?

- Bayh-Dole Act – shifted control from sponsor to grantee, and shifted agency perception from knowledge font to regional economic engine.

- Agency response – Create TTO/ORTA to receive internal disclosures, assess and broker external transfer/sale.

Tough Job! *How can such broker's be expected to value, protect, package, market and sell a variety of disclosures?*

Government Laboratories

Public tax dollars are allocated for both intra and inter organizational projects involving 3 distinct yet related methodologies:

- **Scientific *R*esearch** ➔ *Designed to generates objectively observed phenomena as 'new to the world' facts.*
- **Engineering Development** ➔ *Designed to demonstrate 'new to the world' functional outputs as feasible in practice*
- **Industrial Production** ➔ *Designed to create and deliver outputs as with utility to both manufacturer and consumer.*
  - Each *State* follows its own trajectory, outcome, impact.

Discovery State of Knowledge

Purpose: **Scientific Research Methodology** creates new to the world knowledge.

Process: Empirical analysis reveals novel insights regarding key variables, precipitated by push of curiosity or pull of gap in field.

Output: **Conceptual Discovery** expressed as manuscript or presentation – the '*know what*.'

Legal IP Status: Copyright protection only.

Value: **Novelty** as first articulation of a new relationship/effect contributed to knowledge base.

CONCEPTUAL DISCOVERY STATE

Labs conduct scientific research (basic, fundamental, curiosity-driven) to expand the base of fundamental knowledge.

Need for fundamental knowledge

↓

$$ to Agency Laboratory/Team

↓

Scientific Research (Basic)

↓

Conceptual Discoveries

↓

Agency Use & Journal Publication

↓

Socio-Economic Impact ???

Invention State of Knowledge

Purpose: **Engineering Development Methodology** combines/applies knowledge as functional artifacts.

Process: Trial and error experimentation/testing demonstrates proof-of-concept, initiated through opportunity supply or operational demand forces.

Output: **Prototype Invention** claimed and embodied as functional prototype - the '*know how*.'

Legal IP Status: Patent protection.

Value: **Feasibility** of tangible invention as a demonstration of the **Novelty** of concept.

TANGIBLE INVENTION STATE

Labs conduct scientific research (applied, oriented)
AND engineering development to transform conceptual discoveries into operational prototypes – *'proof of concept'*.

Need for breakthrough prototypes

↓

$$ to Agency Laboratory/Team

↓

Applied SR & Experimental ED

↓

Proof of Concept Prototypes

↓

Agency Use & IP Claims

↓

Socio-Economic Impact ???

Innovation State of Knowledge

Purpose: **Industrial Production Methodology** codifies knowledge in products/components positioned as new/improved products/services in the marketplace.

Process: Systematic specification of components and attributes yields final form.

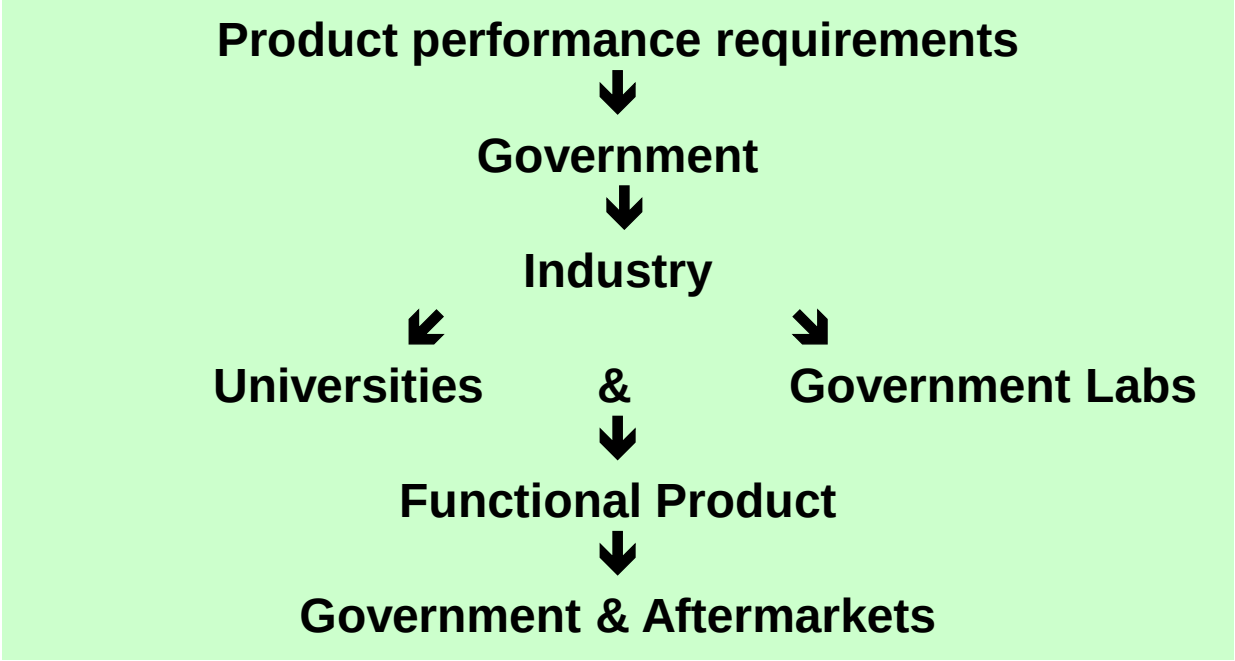
Output: **Market Innovation** embodied as viable device/service in a defined context, initiated through a commercial market opportunity – '*know why*.'

Legal IP Status: Trademark protection.

Value: **Utility** defined as revenue to company and function to customers + **Novelty + Feasibility**

COMMERCIAL INNOVATION STATE

Laboratories design, build, test and deliver next generation products – according to performance specifications – while governments serve as primary customer for resulting products.



Importance of Untangling Innovation Terms

- Each Methodology has its own rigor and jargon.
- Actors are trained and operate in one Method and tend to over-value that one Method.
- Academic & Government sectors dominate “STI” Policy at the expense of Industry – the only sector with time and money constraints. . .
- Methods are actually *inter-depen*dent, while traditional dichotomies are all *complementary* factors supporting innovation outcomes/impacts.

Let's Consider Reality!

- Market innovations come from a combination of all of the above factors.
- ROI from public investment – both social benefit and tax revenues -- comes from private sector's eventual delivery of products in marketplace.
- Society's bottom line on public investment is the creation of new net wealth at some boundary.
- Successful tech transfer efforts are very mindful of corporate requirements and incentives.

Delivering Solutions to Problems involves a flow across *all* three Knowledge States

Scientific Research ⟶ *Discovery* ⟶

Knowledge Translation ⟶ ***Utilization*** ↓

Development ⟶ *Invention* ⟶

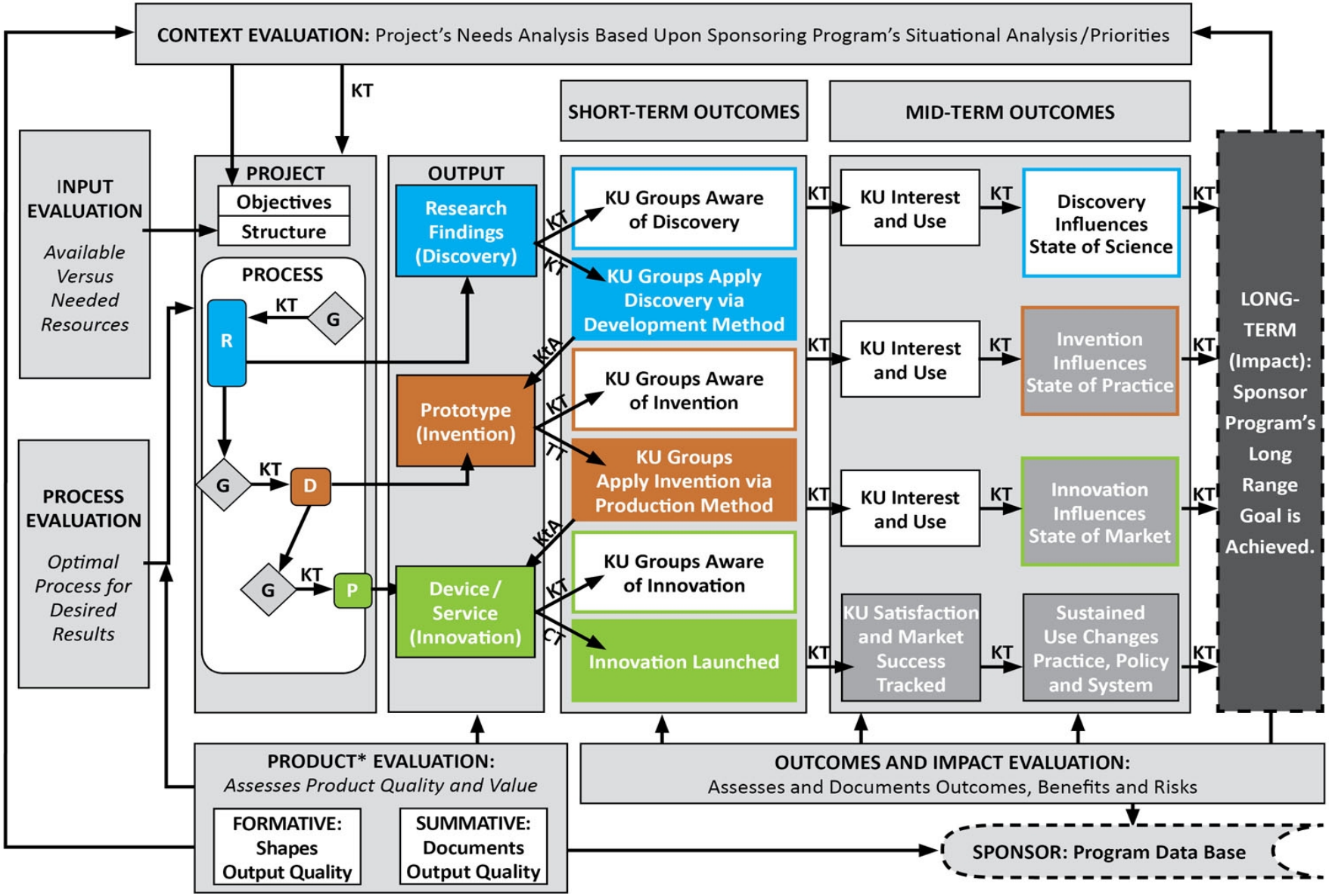
Technology Transfer ⟶ ***Integration*** ↓

Industrial Production ⟶ *Innovation* ⟶

Commercial Transaction ⟶ ***Lifecycle*** ↓

Corporate KT, TT and CT is internally managed and integrated!

Figure 7. Planning and Evaluating Technology-Based R&D: Role of KT from Beginning to End



So how do you proceed when outputs from your internal R&D are expected to have an impact outside the laboratory, project team or parent agency?

Know your goal and role

- *Scientists: Don't expect to 'transfer' conceptual discoveries; Do protect IP then translate potential application value within publications!*
- *Engineers: Don't expect to 'publish' tangible prototypes; Do protect IP then translate potential application value within invention claims!*
- *TT Brokers: Don't dismiss disclosures with small market transactions; Do apply diligence because sponsor paid up front to generate outputs!*

It Takes Two to Transfer!

- Somehow, one agency that has already expended resources in R&D to produce a prototype output . . .
- . . . Must now convince an external agency to assume ownership & control, along with continued resource investment but . . .
- . . . This is a difficult sale, especially to a company where the commitment and investment puts its own existence at risk!

The Way Forward: Integrate *Conceptual* but Differentiate *Operational*

- *Consider three distinct states:* Know role of Research, Development and Production methods in context of each project – plan and budget accordingly.
- *Engage Industry early: G*overnment/Academic projects intended to benefit society fail to cross gaps (death valley vs. Darwinian sea) to business & open markets.
- *Apply evidence-based framework:* Link three methods; Communicate knowledge in three states; Integrate key stakeholder who will determine eventual success.

Need to Knowledge (NtK) Model

Related Publications

- *Lane,JP, Godin, B.* (2013) ***Methodology Trumps Mythology****, Bridges,* Office of Science & Technology, Embassy of Austria, Washington, DC, 36. *http://ostaustria.org/programs-projects-english/event-management/2013-04-23-10-55-57/2003-2001/382-categories-all/magazine/volume-36-december-14-2012/opeds-a-commentaries/6002-methodology-trumps-mythology*

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- Flagg, J, Lane, J., & Lockett M. (2013) **Need to Knowledge (NtK) Model: An Evidence-based Framework for Generating Technology-based Innovations.** *Implementation Science*, 8, 21, http://www.implementationscience.com/content/8/1/21

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- Edquist, C, *et al* (2015). **Public Procurement for Innovation**. Cheltenham, UK: Elgar Publishing Inc. http://www.e-elgar.com/shop/public-procurement-for-innovation.

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