RSCH-15: Researcher / Industry Collaboration:

Recognizing Knowledge States & Their Value-Added Synergy

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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 and sectors.

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 Academic/Industry partnerships require clarity between -- and parity among – these core concepts.

Public Sponsorship for Knowledge Creation

- **Grant-based Scientific Research Programs** – Scholarly exploration to discover new knowledge about physical world (science/medicine):

    Grant-based Scholarship → Peer System → Publish for Tenure.

- **Contract R&D for Production Programs** – Application of S&E to deliver specified products with national value (defense/energy):

    Contract Production → Performance Specs → Sell for Profit.

\- *BOTH of these programs work well - because their respective expectations, systems and incentives are closely and properly aligned.*

"Hybrid" Programs intending Impact

- ***Sponsored R&D for S&T Innovation*** – Generate S&E outputs for commercial exploitation to generate socio-economic impacts.
  - Scholarly research designs ≠ Corporate requirements for profit
  - HYBRID programs have many problems because their expectations, systems and incentives are misaligned or even incongruent!
- **Hybrid Programs Intending Impact:**
  - **United States –** All **SBIR & STTR** Programs**;** **NSF** – Engineering Research Centers (ERC); Industry/University Cooperative Research Centers (I/U CRC); Innovation Corps (I-Corp); **NIH** – Program on Public/Private Partnerships; **NIST** – Technology Innovation Program (TIP); **ACL** – Rehabilitation Engineering Research Centers (RERC); Field Initiated Development (FID).
  - **Canada** – Natural Science and Engineering Research Council (NSERC); Canadian Institutes for Health Research (CIHR).
  - **European Union –** Research Framework Programme; Competiveness; Innovation Framework Programme.

Innovation & Impact

- Traditionally, each hybrid program defined innovation in own narrow context, unconcerned with downstream market activities or societal benefits, and comfortable in status quo budgets and paradigms. But now . . .

- National Science Board (2012) – "*Innovation is defined as the introduction of new or significantly improved products (goods or services), processes organizational methods, and marketing methods, in internal business practices or in the open marketplace.*" (OECD/Eurostat, 2005).

"Innovation" Impact implies Utility

Public support for investment in technology-based *innovations* grounded in 3 expectations:

1. New/improved devices/services with economies of scale that contribute to societal quality of life.

2. Sufficient return on investment through sales to *generate profits*, *pay taxes* and create new *net wealth* in global marketplace.

3. Benefits realized in *short-term* (5–10 yrs).

Innovation's context is Commercial Impact.

Government Funding for Innovation

Public tax dollars are allocated to universities and companies for projects involving 3 distinct yet related methodologies:

- **Scientific Research** ➔ *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.*
  - *So how do SR and ED contribute to IP in order to achieve innovations with commercial 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.

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.

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**

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 *complementar*y factors supporting innovation outcomes/impacts.

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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.

Intra vs. *Inter* Organizational Processes

- Knowledge embodied in any state is continuously exchanged and transformed *within* an organization, often through a systematic and deliberate process of managed communication.
- These internal exchanges are unremarkable because ownership, control and commitment remains consistent – *no inter-organizational transfer occurs!*
- *So, what happens when the transformation between knowledge states requires collaboration between multiple organizations and different sectors?*

Delivering solutions requires a plan to ensure knowledge flows across *all* three K States.

Scientific Research → *Discovery* →

Knowledge Translation → ***Utilization*** ↓

Development → *Invention* →

Technology Transfer → ***Integration*** ↓

Industrial Production → *Innovation* →

Commercial Transaction → ***Lifecycle*** ↓

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 task, especially when the commitment and investment puts the partners own existence at risk!

Know your goal and role

- Scientists: Don't expect to *'transfer'* conceptual discoveries; Do protect IP then translate potential value to external partners within publications!
- Engineers: Don't expect to 'market' tangible prototypes; Do protect IP then translate potential value to external partners within invention claims!
- Managers: Don't expect to *'sell'* your ideas – External partners will only *'buy'* into opportunities recognized by their own incentive systems!

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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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