Knowledge Translation
KT4TT
Technology Transfer

Analytic Tools: Ensuring industry relevance for university-based R&D projects intending transfer.

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http://sphhp.buffalo.edu/cat/kt4tt.html

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What's this session about?

It's about clarifying the role of government-sponsored and university-based R&D projects intending to benefit society by generating innovative products and services;

- For programs intending societal benefit, the role of university R&D is within the broader context of the commercial marketplace.
- Sponsors and Investigators must subordinate their own expertise and incentives to the requirements of industry.
- The key to successful transfers of university-based technology is prior to grant engagement of corporations, and providing evidence deemed valid by industry.

Public Support for Knowledge Creation

- **Grant-based Scientific Research Programs** – 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.*

- ***Sponsored "R&D" for "S&T" Innovation*** – Generate S&E outputs for commercial exploitation to generate beneficial socio-economic impacts.
  Scholarly outputs for tenure ≠ 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); **DoEd** – 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; Innovation Framework Programme.
- **Brazil** –
  - Ministry of Science, Technology & Innovation.

Key Points about Operational Issues

- Federal grant priority/review criteria do not fully reflect standard practices for engineering development, technology transfer and industry production activities.
- Academic Grantees and “Peer” reviewers focus attention and resources on research agenda – academic incentives. No Industry presence.
- Investigators do not reserve resources for critical downstream transfer activities, as they are unrelated to short-term focus on funding research to generate publications for T&P.

Hybrid Programs: 3 Different Methods yield 3 different Knowledge Outputs

Scientific Research Method ▶

Conceptual Discovery

Engineering Development Method ▶

Prototype Invention

Industrial Production Method ▶

Commercial Product

Issues for Three Methods

- *Each Method has own rigor and jargon, and each output state is unique.*
- *Actors are trained and operate in one method and over-value that method.*
- *All methods are essential and inter-dependent.*
- *Academic & Government sectors dominate policy at expense of Industry.*

Project Mission: Integrate Concepts

- *Knowledge embodied in three distinct states:* Know role of Research, Development and Production methods in context of project – plan and budget accordingly.
- *Initiate with Industry engagement: G*overnment and academia projects intended to benefit society fail to cross gaps to becoming market innovations.
- *Apply evidence-based framework:* Links three methods, communicates knowledge in three states, and integrates key stakeholder who will determine eventual success.

Need to Knowledge (NtK) Model

- ***Orientation*** – Actors engaged in innovation “need to know”: Problem/Solution; Methods/Outputs; Stakeholder roles; and Goal in context of beneficial socio-economic impacts.
- ***Integration*** – Product Development Managers Association (PDMA) New Product Development practices (implementation); Canadian Institutes of Health Research (CIHR) Knowledge to Action Model (communication).
- ***Validation*** – Stage-Gate structure populated with supporting evidence (1,000+ excerpts) from scoping review of academic and industry literature 1985 – 2010 , along with case studies drawn from author’s experience transferring 50+ inventions.

Need to Knowledge (NtK) Model for Technological Innovations

Phases	Stages and Gates
Discovery (Research)	Stage 1: Define Problem & Solution
	?
	Stage 2: Scoping
	?
	Stage 3: Conduct Research and Generate Discoveries → Discovery Output!
Invention (Development)	*Communicate Discovery State Knowledge* ?
	Stage 4: Build Business Case and Plan for Development
	?
	Stage 5: Implement Development Plan
	?
	Stage 6: Testing and Validation → Invention Output!
Innovation (Production)	*Communicate Invention State Knowledge* ?
	Stage 7: Plan and Prepare for Production
	?
	Stage 8: Launch Device or Service → Innovation Output!
	Communicate Innovation State Knowledge ?
	Stage 9: Life-Cycle Review / Terminate? ?

NtK Model helps explain where Market Innovations come from:

- Clarifies processes and mechanisms underlying technology-based Innovation, by integrating academic & industry literature.
- Establishes linkages between three distinct methods and their respective knowledge outputs for implementation/communication.
- Offers structure to sponsors & grantees for program/project planning, implementation, monitoring and evaluation.

Problem: NtK Model lacked details on Technical, Business & Marketing Analysis

- These analyses are required throughout all three Phases, while most Grantees are only familiar with a sub-set of them.
- Technical, market and customer analyses address three different yet equally critical issues for technological innovation.
- Knowing what you don't know but need to do is critical to creating a successful transfer team.

Ireland/USA Partnership

- Dr. James Condron & Professor Eugene Coyle – School of Engineering, Dublin Institutes of Technology.
- Dr. Gerald Craddock & James Hubbard, National Disability Association, Ireland.
- Joseph Lane, Jennifer Flagg & Michelle Lockett, University at Buffalo, USA.

NtK Model’s Toolbox

Go to tools for Technical, Marketing and Customer Analyses

http://kt4tt.buffalo.edu/knowledgebase/model.php

Five Competency Categories

- Electrical/electronic engineering tools: measurement systems, design and testing systems and mass manufacturing tools.
- Material science tools: required to make the choice for a particular manufacturing material or to examine the characteristics of a potential material.
- Mechanical engineering tools: encompasses the generation and application of heat and mechanical power and the design, production, and use of machines and tools.
- Business tools: such as quantifying customer requirements, benchmarking, marketing tools, business feasibility, process improvement and return on investment.
- Inclusive/Universal Design tools: to ensure that the widest possible audience will be considered in the design process, regardless of age, size, ability or disability.

Type/Range of Tools

Electrical Engineering	Material Science	Mechanical Engineering	Business Tools	Business Tools, Ct.	Universal Design
Digital Logic Design Software	Density Measurement	Computer Aided Design (CAD)	Affinity Diagrams	Information Technology	Anthropometry (Human size)
Electronics Simulation Software	Dynamic and Fatigue Testing System	Computer Integrated Manufacturing (CIM)	Analytic Hierarchy Process (AHP)	Internal Idea Capture System	Design Exclusion Calculator
Emissions Testing	Electrical Resistivity	Material Requirements Planning (MRP)	Beta Testing	IP Agreements	Design Guide for Aging and Disability (ISO Guide 71/ CEN/CENELEC Guide 6)
Home Printed Circuit Board Manufacturing	Finite Element Analysis Tool 1: ALGOR	Six Sigma	Brainstorming	Lead User Analysis	Inclusive Design Toolkit - Disability Simulators
Immunity Testing	Finite Element Analysis Tool 2: Ansys		Brand-Equity Analysis	Market Structure Maps	SWiFT 9:2012 Universal Design for Energy Suppliers
Industrial Printed Circuit Board Manufacturing	Hardness Measurement		Business Process Re-Engineering	Multiple-Attribute Decision Analysis	Transgenerational Tools
Measurement of inductance and capacitance	Heat Capacity		Clinical Trials	Net Present Value	Universal Design Product Evaluation Tools
Measurement of Voltage, Current and Resistance	Impact System		Competitor Benchmark Matrix	Netnography	
Pick and Place Machines	Pull Tester		Concept Testing	One on One Interviews (customer visit teams)	
Printed Circuit Board Design Software	Static Hydraulic System		Conjoint Analysis	Open Innovation	
Robotic Electronic Circuit Board Testing Equipment	Strain Measurement		Critical Path Analysis	Patent Mapping	
Safety Testing	Stress Measurement		Customer Idealized Design	Product Benchmark Matrix	
SPICE (Simulation Program with Integrated Circuit Emphasis)	Thermal Conductivity		Delphi Method	Quality Function Deployment	
	Thermal Expansivity		Empirical Methods for Feasibility Testing	Suh's Design Axiom	
	Toughness Measurement		Ethnography	Surveys	
			Failure Mode Effects Analysis (FMEA)	Team-Based Knowledge Work	
			Field Testing	Technology Road Map	
			Focus Groups	TRIZ	
			Human Performance Technology (HPT)	University Research Centers	
			Idea Generation (wildest idea, morphological analysis, metaphor use)	University-Based Industrial Extension Services	

Distribution of 79 Tools by Group

Competency Groups	Number of Tools	Number of Tools with Relevance to UD	Most Common NtK Stages and Steps Where Tools are Relevant
Electrical/Electronic tools	13	3	3.5- Conduct research Stage 5- Implement development plan Stage 6- Testing and validation
Material Science tools	15	2	2.2- Perform preliminary assessments 4.2- Propose draft solution 4.3- Outline preliminary business case 4.12- Identify features and specifications 7.1- Draft preliminary bill of materials 7.2- Develop materials plan
Mechanical Engineering tools	4	2	7.4- Develop production and capacity plan 7.5- Plan and schedule engineering 7.6- Plan and schedule tool and process design
Business tools	40	31	1.1 Assess needs from relevant stakeholders 1.2- Identify problem, audience, and context 1.3- Propose plausible solution 4.6- Initiate co-development practices 4.11- Gather and analyze customer needs 6.3- Test beta prototype with consumers in field
Universal Design Tools	7	7	2.2- Perform preliminary assessments 4.2- Propose draft solution 4.12- Identify features and specifications

Screen Image of Tool Summary

Home > Knowledge Base > Six Sigma: Toolbox entry

Six Sigma

Type: Process

Description: Six Sigma is a comprehensive business management strategy focused on reducing defects to help lower costs, save time, and improve customer satisfaction. It is typically employed by large companies with more than 500 employees, and may have to be adapted to create value in smaller organizations. It seeks to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes. It uses a set of quality management methods, including statistical methods, and creates a special infrastructure of people within the organization ("Black Belts", "Green Belts", etc.) who are experts in these methods. Each Six Sigma project carried out within an organization follows a defined sequence of steps and has quantified financial targets (cost reduction and/or profit increase). A variety of quality management techniques can be used together to implement a six sigma program, including check sheets, scatter diagrams, cause and effect diagrams, Pareto charts, flowcharts, histograms, and statistical process control to name a few.

Citation: Six Sigma. (2011). Retrieved from Wikipedia, http://en.wikipedia.org/wiki/Six_Sigma. AND Heizer, J. & Render, B. (2011). Operations Management. Pearson Education Inc., Upper Saddle River.

Advantages: Ensures that the process is working at its most efficient. Minimal waste and lower costs. Usually implemented company wide, which makes the process familiar across departments.

Limitations: Can be expensive.

Regulations: ASQ: The Global Voice of Quality

Groups: Management, Marketing, R&D, Engineering, Production, Accounting/Finance, Sales

Steps: 1.5, 2.2, 4.1, 4.7, 4.10, 4.11, 4.12, 4.13, 5.3, 6.3, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11, 8.2, 9.1

Free Resources

- iSix Sigma: New to Lean Six Sigma
- Lean 6 Society

Purchase Resources

- George, M., Rowlands, D. & Kastle, B. (2004). What is Lean Six Sigma? New York, NY: McGraw-Hill.
- Tuppas - Lean Six Sigma Software with Artificial Intelligence

Related Publications

- Flagg, JA, Lockett, MM, Condron J & Lane, JP (2015). "Tools for analysis in Assistive Technology research, development and production." *Assistive Technology Outcomes and Benefits*, 9, 1, 20-37. http://atia.org/i4a/pages/index.cfm?pageID=4643

- 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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- Issues in Science, Technology & Innovation Policies.
- Three States of Knowledge – Origins, Relationships & Transitions.
- Comprehensive Model of Technological Innovation.
- Tools for Effective Knowledge Translation.
- Tools for Successful Technology Transfer.
- Tools for Achieving Invention Commercialization.
- Market Research Resources.

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