Accomplishing Technological Innovation in AT:

How the outputs from three methods can combine to generate beneficial socio-economic impacts.

Joseph P. Lane, Director
Center on Knowledge Translation for Technology Transfer
http://kt4tt.buffalo.edu
University at Buffalo, SUNY, USA

Dr. Maria de Mello, President
Technocare Inc.
www.technocare.net.br
São Luís, Brazil

Workshop Objectives

1. Participants will be able to distinguish between three methodologies (scientific research; engineering development; industrial production), and compare the states of knowledge they generate.
2. Participants will be able to discuss examples of literature supporting each of the nine Stages of activity and nine Decision Gates, and explain their importance.
3. Participants will be able to describe and discuss at least one technical and one marketing tools relevant to each of the three Stages of activity.

Workshop Schedule

Hours	Topics	Presenter(s)	Objectives
9 - 10	Overview of STI Policy Problems and Solutions	Lane & de Mello	1 - 3
10 – 11:30	NtK Model – Rationale and Components	Lane	1
1 - 2:30	Evidence from Academic and Industry Literature	de Mello	2
3 - 4	Tools for Performing Required Analyses	Lane	3
4 - 5	Discussion of Utility to AT Stakeholders	Participants	1 - 3

PART 1: 9 – 10am

STI Policy Overview

What's this talk about?

- It's about spending public monies in R&D programs which are supposed to generate socio-economic benefits – it's <u>not</u> about the merit of basic science.
- It's about achieving the *publification* of technology-based outputs from government sponsored R&D activity – it's <u>not</u> about the red herrings of publication or privatization.
- It's about *realetical* induction from 25 years of doing and observing others doing – it's <u>not</u> about theoretical deductions about innovation by armchair scholars.
- It's about *clarification* of terms and constructs underling innovation by grounding them in logic and methods – it's <u>not</u> about obfuscation through rhetoric and reflexivity.

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; Competiveness; Innovation Framework Programme.
- **Latin America & Southeast Asia** - ????

What are these Hybrid programs saying?

- *That academia is better equipped than industry to deliver value for money?*
- *That tenured/career employees should dictate the rules of innovation for the private sector?*
- *That corporations are devoid of ideas for new products and services?*
- *That students and small businesses have the primary insight into societal needs?*
  - Yet these absurd premises remain unchallenged.

Why?

- ***(Mis)Alignment of Funder Expectations, Processes and Actor Incentives:***

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

  Mixed Model = *Mixed Message?*

  Contract-based Production → Performance Delivery System → Sell for Profit.

You can't get there from here!

Knowledge Translation K4TT Technology Transfer

Even newest government models lack utility (description, explanation, prediction, control).

(http://www.ott.nih.gov/PDFs/NIH-TT-Plan-2013.pdf)

Silly Metrics based on Vague Models

- $\sum (R + D) / GDP = \text{Innovation}$
- $\sum (95\%R + 5\%D) \neq \sum (5\%R + 95\%D)$
- $\sum (X\%R + Y\%D) \neq \text{Products/Services}$

Such measures co-mingle inputs, ignore key factors, and ignore causal links.

False Dichotomies/Erroneous Contractions

- *Supply/Science/Technology Push vs. Demand/Market/Society Pull*
- *Research & Development (R&D)*
- *Science & Technology (S&T)*
- *Discovery/Insight/Invention/Innovation*
- *Scholarly vs. Societal: Outputs/Outcomes/Impacts*
- *Expenditures & Bibliometrics vs. New Net Wealth*
  - Counting what is countable vs. Counting what matters.

So why do they persist?

- The largesse of public funding since the 1940's shifted power and influence over budgets from corporate to non-corporate sectors.
- The distortion of V. Bush's national R&D proposal by entrenched agency interests.
- The perpetuation of false paradigms by beneficiaries in government and academia.
- The lack of appreciation for unintended consequences by corporations and public:
  - Military/Industrial vs. Academic/Bureaucratic Complex

Innovation & Impact

- Traditionally, each sector defined terms in own narrow context, unconcerned with downstream market activities or broader societal benefits, comfortable in status quo budgets and paradigms. But that applecart is tipping . . .
- 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 sustain company, pay taxes and compete globally to generate new net wealth.
3. Benefits realized in short-term (5–10 yrs).

Innovation’s context is Commercial Impact.

Commercial Market is path to Utility

- Industry survives in competitive system by translating knowledge into market utility through Production methods (beyond R&D).
- Utility = Money to Seller / Function to Buyer.
- No $ale – Research discoveries are freely published and globally disseminated, while Development prototypes lack commercial hardening or economies of scale.

R and D outputs ≠ Market Innovation.

Importance of Untangling Terms

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

Relational Attributes from Literature

Episteme	Techne	Phronesis
Know what	Know how	Know why
Science	Engineering	Industry
Research	Development	Production
Intellectual	Technological	Commercial
Long term	Mid term	Short term
Concept	Prototype	Product
Novelty	Feasibility	Utility
Translation	Transfer	Transaction
DISCOVERY	INVENTION	INNOVATION

Knowledge Translation K T 4 T T Technology Transfer

Substituting Methods for Madness

- *Establish Terms, Definitions & Proofs:* These are essential yet currently absent from STI Policy.
- *Acknowledge Knowledge States & Transitions:* Methods of knowledge creation and output state attributes dictate opportunity and constraints for knowledge kernel.
- *Apply proper strategies to transitions between Knowledge States:* Ensure that models, methods and metrics underlying Knowledge Management systems are congruent and designed to communicate information based on rigor and relevance, *not on rhetoric*.
- Apply the scholarly values of demonstration, replication, skepticism and peer review to all elements and actors.

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.

Part II: 10 – 11:30am

NTK Model Elements

Stage/Gate Model

3 Phases, 9 Stages & 9 Gates

Steps, Activities, Tips

Literature & Tools

"Translating Three States of Knowledge: Discovery, Invention & Innovation"

Lane & Flagg (2010)

Implementation Science

http://www.implementationscience.com/content/5/1/9

Socio-Economic Impacts via Innovation

- *R&D projects intending to benefit society need to broaden definition of knowledge beyond traditional academic perspective.*
- *3 related methods (R, D & P) generate knowledge in 3 different states; discoveries, inventions & innovations.*
- *Challenge: Justify investment of declining public funding under shorter timeframes, by delivering intended impacts!*

Three Methodologies are each designed to generate new knowledge in different *"States"*

- Scientific Research methodology ►

  Conceptual Discovery – state of gas (diffuse).

- Engineering Development methodology ►

  Prototype Invention – state of liquid (malleable).

- Industrial Production Methodology ►

  Market Innovation – state of solid (fixed).

Discovery State of Knowledge

Purpose: **Scientific Research** methods create 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** methods combine/apply 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** methods codify knowledge in products/components positioned as new/improved products/services in the marketplace.

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

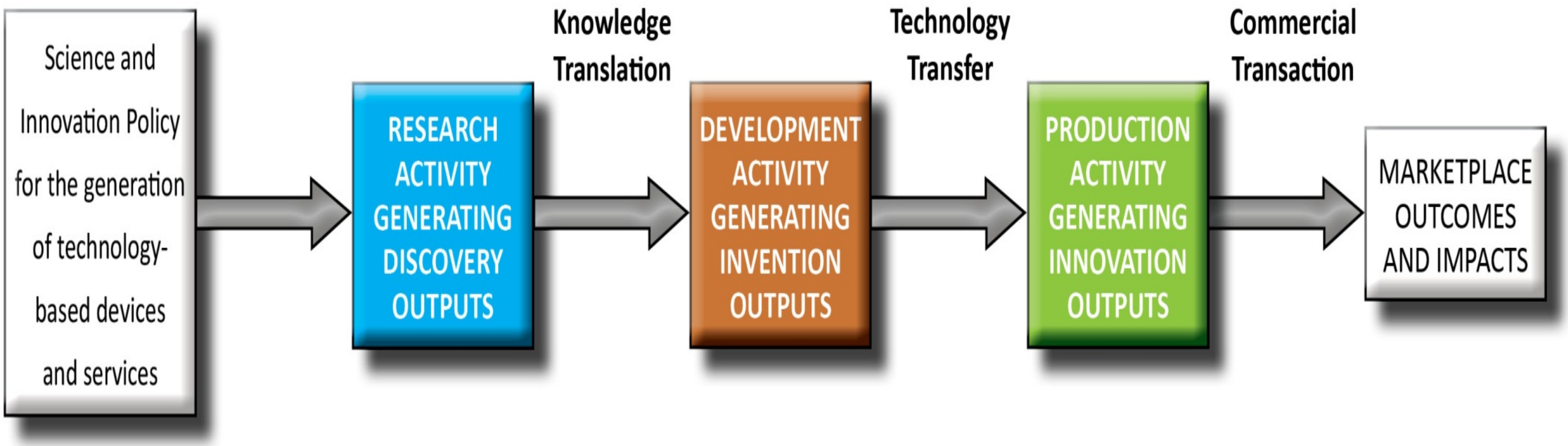
Output: **Market Innovation** embodied as viable device/service in a defined context, initiated through a commercial market opportunity – '*know why*.'

Legal IP Status: Trademark protection.

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

3 Strategies for Communicating/ Transforming Knowledge across 3 States

✓ Knowledge Translation – *From SR to ED*
✓ Technology Transfer – *From ED to IP*
✓ Commercial Transaction – *From IP to Public*



Why are these Methods & States important to STI Policy?

- National policies and programs are increasingly focused on generating socio-economic benefits; *Yet* economies and budgets are contracting.
- These benefits are seen as chiefly arising from technological innovations; *Yet* we lack accurate models of knowledge creation, transition, implementation.
- Dominant theories and practices are seriously flawed in most nations – *Only* China is explicitly positioning R&D investment as business oriented and market driven.
  - *L. Yonxiang, Science & technology in China: a roadmap to 2050. Strategic General Report of the Chinese Academy of Sciences, (Beijing: Springer/ Science Press, 2011)*

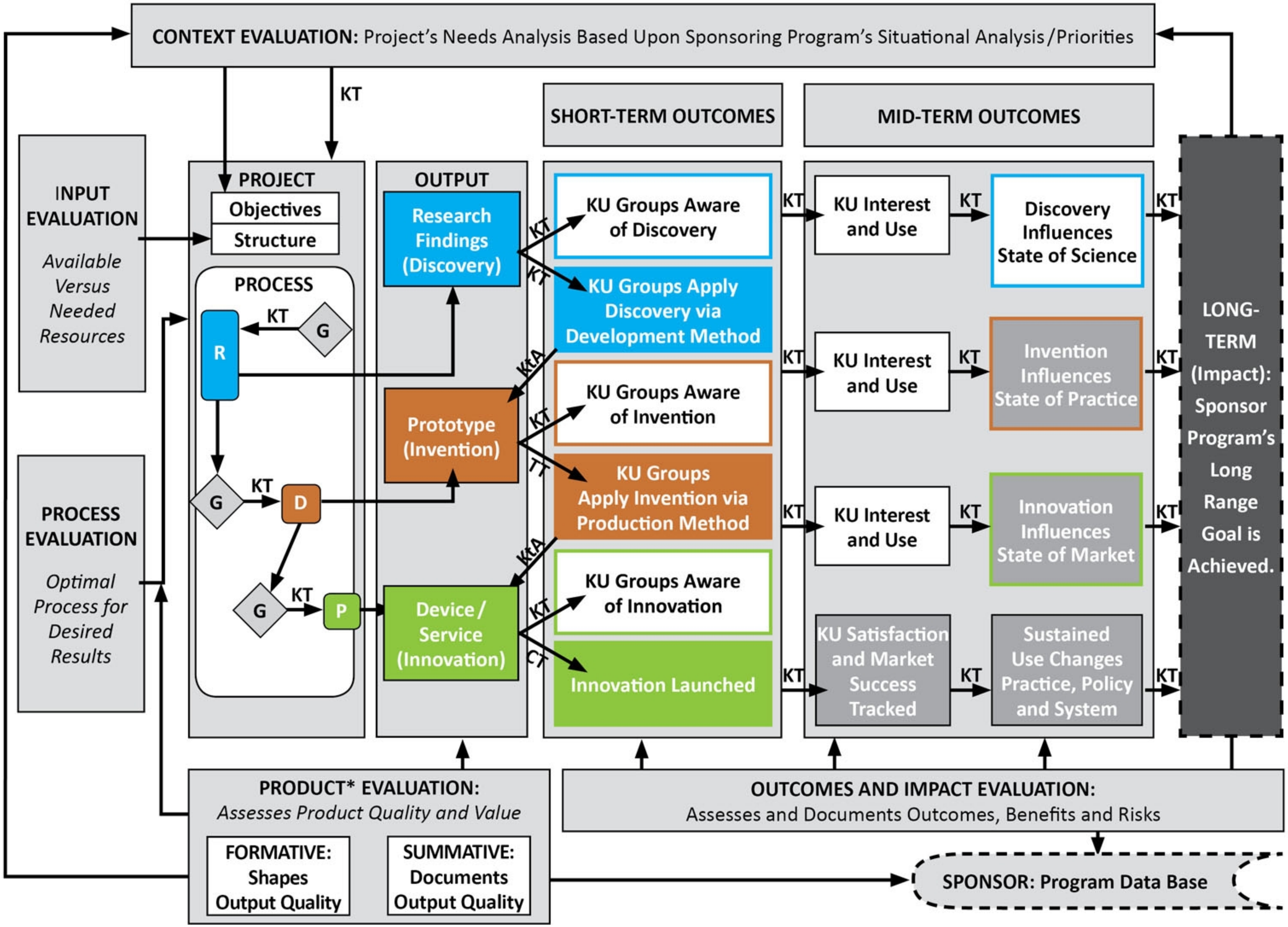
"Modeling Technology Innovation: How the integration of science, engineering and industry methods combine to generate beneficial socio-economic impacts."

Stone & Lane (2012).

Implementation Science

http://www.implementationscience.com/content/7/1/44/

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



Knowledge Translation KT4TT Technology Transfer

"Need to Knowledge (NtK) Model: an evidence-based framework for generating technological innovations with socio-economic impacts."

Flagg, Lane & Lockett (2013).

Implementation Science

www.implementationscience.com/content/8/1/21/

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 ,
  - along with links to tools for completing recommended technical and market analyses .

Elements of NtK Model

- Full range of activities includes 3 Phases, 9 Stages & Gates, Steps, Tasks and Tips.
- Supported by primary/secondary findings (scoping review of 250+ research and practice articles), and A/T case examples.
- Logic Model orientation – "Begin with the end in mind" (Stephen Covey), and work backwards through process to achieve it.

Evidence Milestones	*Research Discovery*	*Development Invention*	*Production Innovation*

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?	?

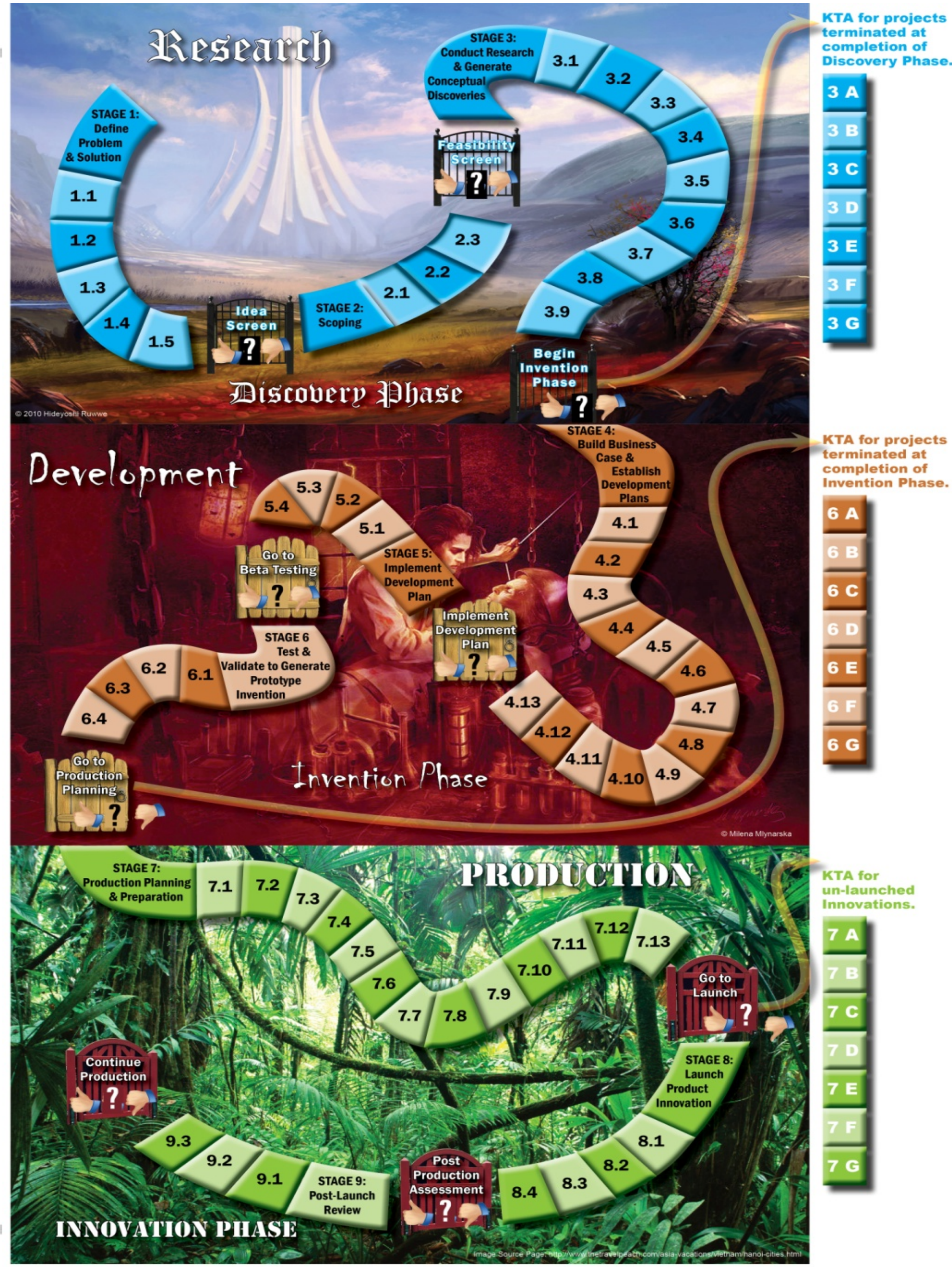
Outputs/Outcomes/Impacts from R or D Methods are distant from Socio-Economic Impacts

Milestones	Research	Development	Production
Identify Opportunity	Knowledge Gap in Literature	Supply Push or Demand Pull	
Project Output	Journal Publication	Patent Issued	
Stakeholder Outcome	Discovery Use & Citation	Practice / License	
Claim Impact			Societal QoL & Industry Economic Stature

Knowledge Translation KT4TT Technology Transfer

“Gamification” of Technological Innovation

Progress through three Methods of Knowledge Generation, and the effective Communication of three Knowledge States, may be circuitous and iterative, punctuated and prolonged, risky and unpredictable, yet still be planned, implemented and accomplished through the deliberate and systematic efforts of key stakeholders.



NtK Model Utility

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

Need to Knowledge Model

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

Part III: 1 – 2:30pm

Review of Academic and Industry literature supporting elements of the NtK Model

Lessons from Literature

- Literature from both Industry and Academia converge on "Best Practices" in New Product Development, where due diligence supplants *ad hoc* approaches and tests assumptions.
- Steps/Activities/Tips all point toward Best Practices validated through numerous iterations under a variety of field conditions.
- Stage/Step level activity do not require a linear progression, but Decision Gates cannot be properly addressed without them.

NtK Model Key Findings

Evidence base of Academic and Industrial Literature since 1985

PDMA NPD Handbooks

Stage/Gate Structure

CIHR KTA Model

Scientific Method

Need to Knowledge (NtK) Model

Literature Review to Identify Supporting Evidence

Keyword Searches: 12,692 articles

Inclusion Criteria Applied: 298 articles

Review of Abstracts for Relevance: 212 articles

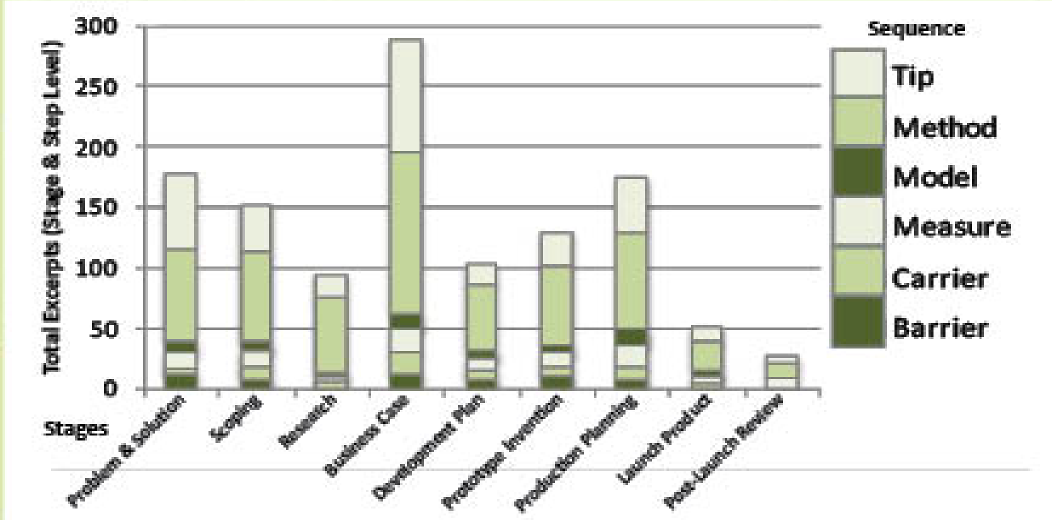
Review of Articles for Key Lessons: 1208 excerpts

Information Gathered from Each Article

- Citation, Annotation, Potential User Groups
- Relevant work settings, Study methodology
- Excerpts classified by:
  - Placement within NtK model
  - Type of information: method, model, measure, barrier, carrier or tip
  - Primary Excerpts: Author's conclusions
  - Secondary Excerpts: Paraphrased conclusions from prior publications

NtK Model Components

- **3 Phases -** represent activities/decisions to generate outputs in three states
  - **9 Stages and 9 Gates** (537 excerpts)
  - **58 Steps** (674 excerpts)
  - **70 Tips** (71 excerpts)
- **3 KTA cycles** (264 excerpts) - stakeholder mechanisms for moving knowledge from one state to another



TOOLS
Embedded at Step level

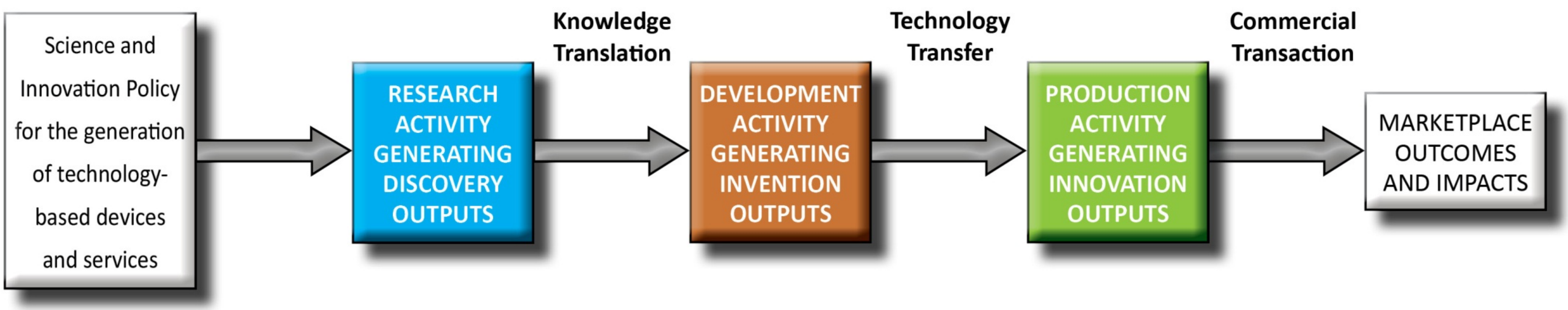
RESOURCES
- Publications
- Tech Transfer Template
- Modules/Guides

CASE EXAMPLES
Embedded at Stage level

Knowledge Base
- Search for citations or excerpts
- Search by: Keyword, Knowledge User Group or Settings

In the past year, NtK Model Used/Noted by:
- PDMA - The Source
- Technology Transfer Tactics
- NIDRR Grantees
- AAATE, ATIA, CIHR

Knowledge Communication – *3 Strategies for 3 States*



Delivering Solutions to Problems involves progress across three Knowledge States

Research → *Discovery* →Translation → Utilization ↓

Development→ *Invention*→ Transfer→ Integration ↓

Production → *Innovation* → *Transaction* → Lifecycle ↓

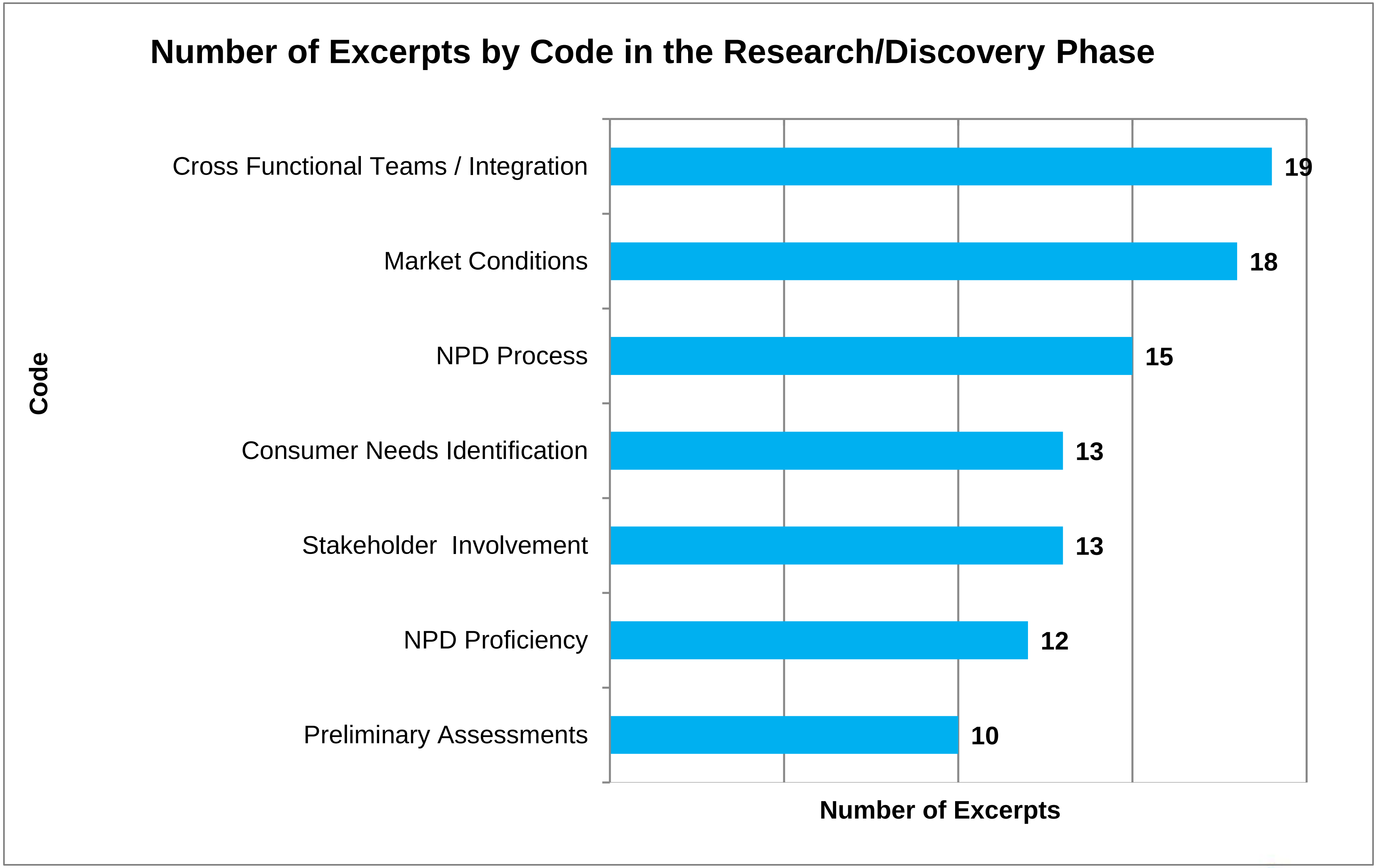
Evidence from Scoping Review

- *Literature Search; Scoping Review & Narrative Synthesis.*
- *Over 800 excerpts from over 200 academic and industry journal articles substantiate stage/gate model.*
- *Excerpts cluster differently for each Phase of R/D/P.*
- *Review aggregated findings: http://kt4tt.buffalo.edu/knowledgebase/research.php?model=3*

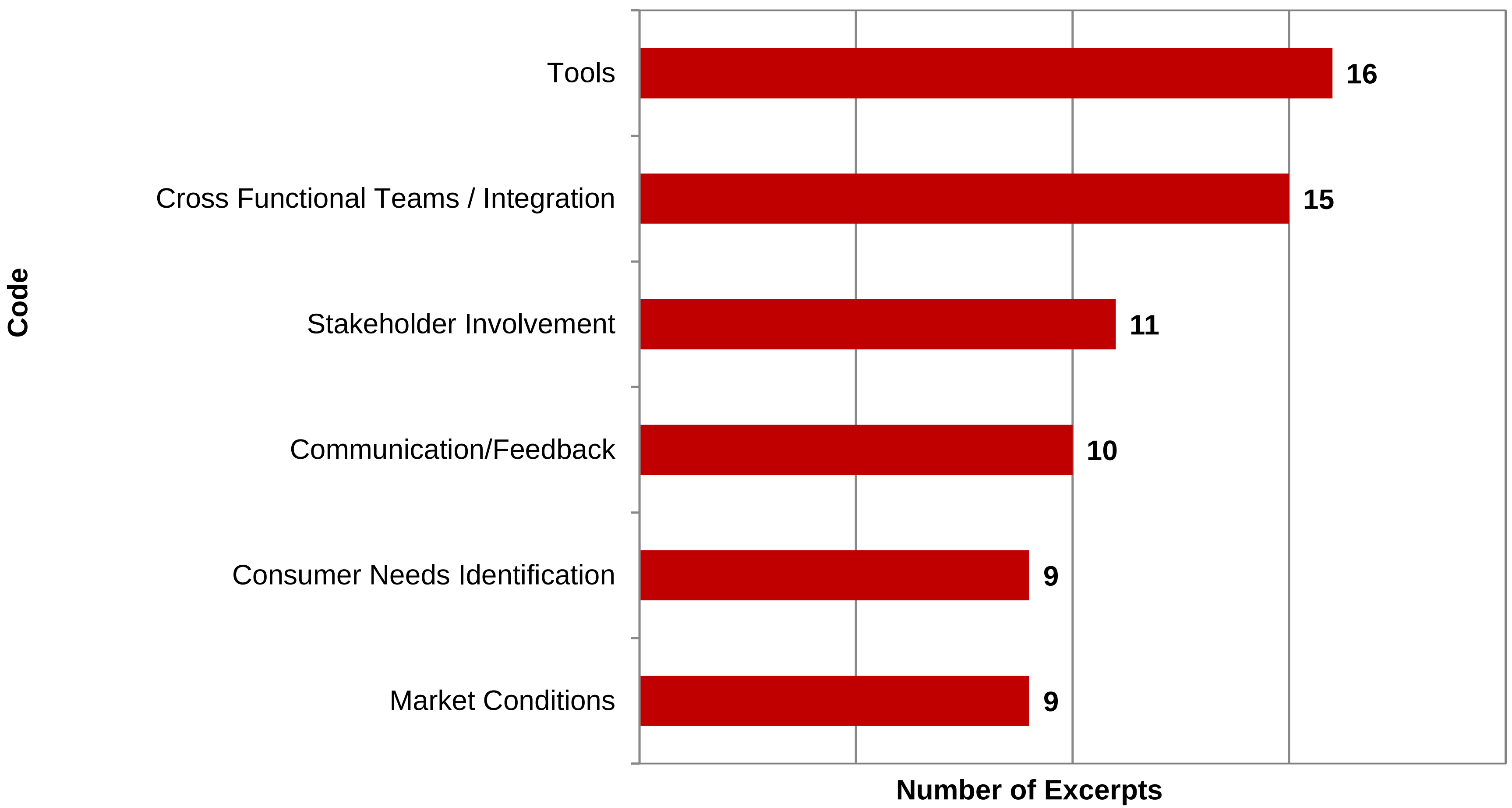
Search Evidence Base

- *Search evidence base by keyword:*

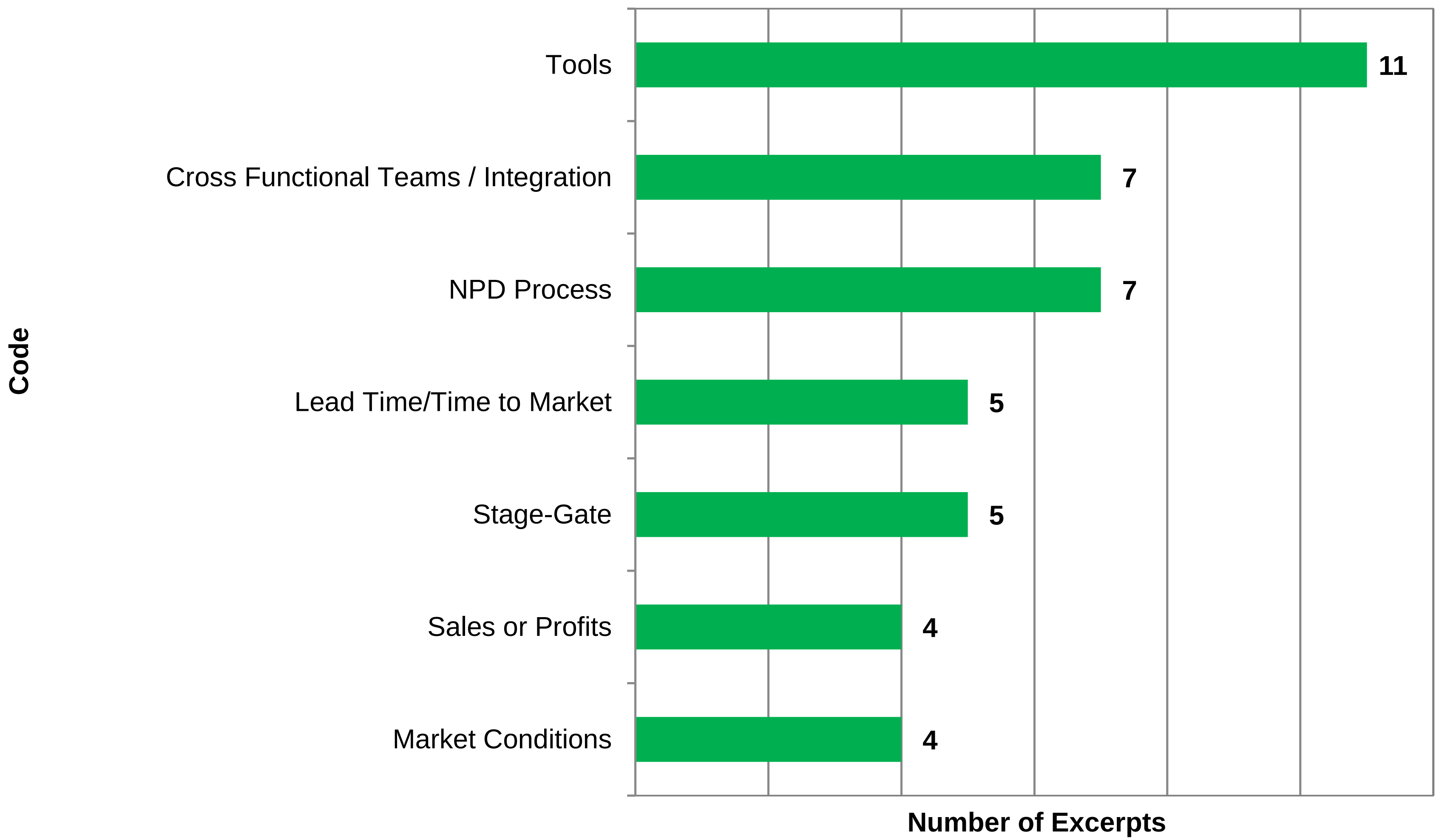
http://kt4tt.buffalo.edu/knowledgebase/search.php


Number of Excerpts by Code in the Research/Discovery Phase
Code
Cross Functional Teams / Integration
Market Conditions
NPD Process
Consumer Needs Identification
Stakeholder Involvement
NPD Proficiency
Preliminary Assessments
19
18
15
13
13
12
10
Number of Excerpts

Number of Excerpts by Code in the Development/Invention Phase



Number of Excerpts by Code in the Production/Innovation Phase



Part IV: 3 – 4pm

Tools for Technical,

Business and

Marketing Analysis

NtK Model’s Toolbox

Tools for Technical, Marketing and Customer Analyses

Requirements for Technical & Marketing Analysis

- Analyses are required throughout all three Phases, while 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 team.

NtK Model's Toolbox

Go to tools for Technical, Marketing and Customer Analyses

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

The Need to Knowledge Model for Commercial Devices and Services

The Need to Knowledge (NtK) model is a guide to innovation for technology-based commercial devices and services. It connects the academic research process with industry standards for new product development to improve the quality and relevance of applied research project outputs so that they are more likely to generate socio-economic outcomes and impacts.

The NtK includes three Phases- Discovery, Invention, and Innovation- each with Activity Stages and Decision Gates. The NtK also includes opportunities to conduct knowledge translation to improve communication and information sharing between parties in academic, industry and government sectors.

How can The NtK Model help me?

Comments, Questions, Suggestions? We want to hear from you!

See also the interactive gameboard version of the model.

Follow the images to view supporting evidence for each entry.

Follow the images to view tools related to each step.

Supporting Evidence for the entire Need to Knowledge model. (Please note: information provided here is different from information provided under specific stages, steps, gates or tips, as it applies to the new product development process as a whole.)

Stage/Decision Gate	Activity Steps	Tips
Phase I- Research The Research Phase (Stages and Gates 1 through 3) involves conducting primary and secondary market research to identify end users. unmet needs and assess the feasibility of envisioned solutions to those needs. The scientific research methodology may then be used where necessary to generate new-to-the-world findings that address unmet needs and/or lend themselves to the proposed solutions. The Research Phase output is new knowledge in the state of Conceptual Discoveries, represented as the results from market, business, and technical analyses, scoping reviews of existing scholarly literature, or findings from original scientific research studies.		
Stage 1 - Define Problem and Solution: Define the problem from the perspective of the eventual target consumer. Then describe the solution in objective *"new to world"* terms, not subjective *"new to me/us"* terms. The problem/solution set may represent an improvement in the features/functions of current market offerings, or it may represent an entirely new category of feature/function enabled by some new technological capability. Pill crusher example 	• 1.1 Opportunity for importing information via Knowledge Translation: Assess need for device or service with sufficient and detailed input from all relevant information sources and potential user groups (i.e. Manufacturers; Clinicians; Consumers; Policy/Funders; Brokers; Researchers). • 1.2 Identify a problem (need) in terms of functional limitation or environmental barrier, and also identify intended target audience for solution. Identify this project's specific context for both problem and solution. • 1.3 Propose plausible solution (goal) to problem in the form of a new/improved device or service. Then ask and answer Key Question: *Why does the envisioned solution to the validated problem not yet exist?* • 1.4 Determine scope of project (role of); and expected project results (output) as conceptual discovery from scientific research, prototype invention from engineering development; or commercial device/service innovation from production.	• Limit disclosure of information regarding solution and document all original thinking related to solution). • Scope of project determines segments of KT4TT model involved with research generating discovery, development generating invention and production generating innovation level outputs. • Consider resources, timelines, and partners when defining path to market. • Opportunity for Universal Design (UD). Be mindful that the problem might be shared by others.

The Need to Knowledge Model for Commercial Devices and Services

The Need to Knowledge (NtK) model is a guide to innovation for technology-based commercial devices and services. It connects the academic research process with industry standards for new product development to improve the quality and relevance of applied research project outputs so that they are more likely to generate socio-economic outcomes and impacts.

The NtK includes three Phases- Discovery, Invention, and Innovation- each with Activity Stages and Decision Gates. The NtK also includes opportunities to conduct knowledge translation to improve communication and information sharing between parties in academic, industry and government sectors.

How can The NtK Model help me?

Comments, Questions, Suggestions? We want to hear from you!

See also the interactive gameboard version of the model.

Follow the images to view supporting evidence for each entry.

Follow the images to view tools related to each step.

Supporting Evidence for the entire Need to Knowledge model. (Please note: information provided here is different from information provided under specific stages, steps, gates or tips, as it applies to the new product development process as a whole.)

Stage/Decision Gate	Activity Steps	Tips
Phase I- Research The Research Phase (Stages and Gates 1 through 3) involves conducting primary and secondary market research to identify end users. unmet needs and assess the feasibility of envisioned solutions to those needs. The scientific research methodology may then be used where necessary to generate new-to-the-world findings that address unmet needs and/or lend themselves to the proposed solutions. The Research Phase output is new knowledge in the state of Conceptual Discoveries, represented as the results from market, business, and technical analyses, scoping reviews of existing scholarly literature, or findings from original scientific research studies.		
Stage 1 - Define Problem and Solution: Define the problem from the perspective of the eventual target consumer. Then describe the solution in objective *"new to world"* terms, not subjective *"new to me/us"* terms. The problem/solution set may represent an improvement in the features/functions of current market offerings, or it may represent an entirely new category of feature/function enabled by some new technological capability. Pill crusher example 	• 1.1 Opportunity for importing information via Knowledge Translation: Assess need for device or service with sufficient and detailed input from all relevant information sources and potential user groups (i.e. Manufacturers; Clinicians; Consumers; Policy/Funders; Brokers; Researchers). • 1.2 Identify a problem (need) in terms of functional limitation or environmental barrier, and also identify intended target audience for solution. Identify this project's specific context for both problem and solution. • 1.3 Propose plausible solution (goal) to problem in the form of a new/improved device or service. Then ask and answer Key Question: *Why does the envisioned solution to the validated problem not yet exist?* • 1.4 Determine scope of project (role of); and expected project results (output) as conceptual discovery from scientific research, prototype invention from engineering development; or commercial device/service innovation from production.	• Limit disclosure of information regarding solution and document all original thinking related to solution). • Scope of project determines segments of KT4TT model involved with research generating discovery, development generating invention and production generating innovation level outputs. • Consider resources, timelines, and partners when defining path to market. • Opportunity for Universal Design (UD). Be mindful that the problem might be shared by others.

Toolbox entries for Step 1.1: Opportunity for importing information via Knowledge Translation: Assess need for device or service with sufficient and detailed input from all relevant information sources and potential user groups (i.e. Manufacturers; Clinicians; Consumers; Policy/Funders; Brokers; Researchers).

Business Tools

- Affinity Diagrams
- Brainstorming
- Customer Idealized Design
- Delphi Method
- Ethnography
- Focus Groups
- Internal Idea Capture System
- Lead User Analysis
- Netnography
- One on One Interviews (customer visit teams)
- Open Innovation
- Team-Based Knowledge Work
- Patent Mapping

Affinity Diagrams

Competency group: Business

Type: Map

Description: A map or model for organizing customer needs data generated from any voice of the customer process. In this process the 'need' statements are organized into groups that go together in some logical means of organization.

Citation for Description: *Affinity diagram*. (2011). Retrieved from Wikipedia, http://en.wikipedia.org/wiki/Affinity_diagram.

Units: Collated information from all of the Voice of Customer Data that has been generated

Advantages: Method of organizing the needs of the customer into functional groups. Information is available to all members of the new product development team.

Limitations: Poor organization of the bundles can lead to misinformation about the actual needs of the customer.

Target Audience: Top management, Marketing, R & D

Relevant to Universal Design: Yes

Stages and Steps:

1.1, 1.2, 1.3
2.2
4.11
5.3
6.1, 6.3

Free Resource: Leanyourcompany. (n.d.). Using affinity diagrams to make sense from brainstorming. Retrieved from http://www.leanyourcompany.com/methods/Using-Affinity-Diagrams.aspLeanyourcompany. (n.d.). Using affinity diagrams to make sense from brainstorming. Retrieved from http://www.leanyourcompany.com/methods/Using-Affinity-Diagrams.asp..

Stage 4 - Begin Development Effort: Build business case for commercial product/service & establish engineering development plan. Lids Off Jar Opener example 	• 4.1 Identify and approach key Co-Development partners, again under signed Non-Disclosure Agreements. Ask them to answer the Key Question from Step 1.3: *Why does envisioned solution to problem not yet exist?* • 4.2 Layout proposed engineering-based solution to problem • 4.3 Outline preliminary business case that is based on path to market outlined in Step 1.5.	• Conduct more detailed marketing, technical and consumer assessments based on refined idea for application of discovery.
	• 4.4 Implement Intellectual Property (IP) strategy in collaboration with patent attorney, technology transfer office, or relevant agents.	• Discuss IP protection options with technology transfer office/patent attorney.
	• 4.5 Assess regulatory, reimbursement and any related requirements for envisioned product/service.	• Develop understanding of design, pricing, and timing implications of requirements imposed by FCC,FDA (510k), HIPPA, Medicare/Medicaid, etc.
	• 4.6 Initiate key co-development practices with partners.	• Identify and assess external partners. • Establish formal relationship with external partners. • Nurture relationship to ensure successful collaboration.
	• 4.7 Assess project resource requirements and availability. • 4.8 Generate engineering implementation plan.	• Review needs for staffing, funding, and time. • Identify potential distribution outlets.
	• 4.9 Prepare proposal to secure necessary project resources.	• Obtain funding from SBIR (Phase II) grant or investors.

Toolbox entries for Step 4.2: Layout proposed engineering-based solution to problem

es

Business Tools

- Failure Mode Effects Analysis (FMEA)

rences

Universal Design Tools

- Anthropometry (Human size)
- Design guide for aging and disability (ISO Guide 71/ CEN/CENELEC Guide 6)
- Inclusive Design Toolkit - Disability Simulators
- SWiFT 9:2012 Universal Design for Energy Suppliers
- Transgenerational Tools
- Universal Design Product Evaluation Tools

Material Science Tools

- Density Measurement
- Dynamic and Fatigue Testing System
- Electrical Resistivity
- Hardness Measurement
- Heat Capacity
- Impact System
- Pull Tester
- Static Hydraulic System
- Strain Measurement
- Stress Measurement
- Thermal Conductivity
- Thermal Expansivity
- Toughness Measurement

Dynamic and Fatigue Testing System

Competency group: Material Science

Type: Measure

Description: Fully-integrated dynamic and fatigue testing systems incorporate servo hydraulic, servo-electric and linear motor technologies. These test instruments cover a broad range of fatigue, dynamic, and static testing applications. Applications include high-cycle fatigue, low-cycle fatigue, thermo-mechanical fatigue, crack propagation and growth studies, fracture toughness, bi-axial, axial-torsional, multi-axial, high strain rate, quasi-static, creep, stress-relaxation, and other types of dynamic and static tests. Samples of materials or components undergo a range of tests in order to assess how a component will behave in various environments.

Citation for Description: Instron. (2012). Instron Products: By Product Type, Dynamic and Fatigue Systems. Retrieved from http://www.instron.co.uk/wa/product/Dynamic-Fatigue-Test-Systems.aspx

Units: Fatigue under various dynamic conditions

Advantages: Will give a clear indication of life span of a component and how it will behave in extreme environments.

Limitations: Will cost a couple of prototypes which will be deliberately broken.

Regulations: International Organization for Standardization. (2011). ISO Search Standards: Fatigue Testing. Retrieved from http://www.iso.org/iso/search.htm?qt=Fatigue+Testing&searchSubmit=Search&sort=rel&type=simple&published=true

Target Audience: Engineering, R & D

Relevant to Universal Design: No

Stages and Steps:

2.2
4.2, 4.12
5.2, 5.3

Free Resource: Walterbai. (2009, March 5). Dynamic Fatigue Testing Machines - SWISS MADE [Video file]. Retrieved from http://www.youtube.com/watch?v=XKJtS27DMtY

Purchase Resource: Instron. (2012). Instron Products: By Product Type, Dynamic and Fatigue Systems. Retrieved from http://www.instron.co.uk/wa/product/Dynamic-Fatigue-Test-Systems.aspx

Stage 4 - Begin Development Effort: Build business case for commercial product/service & establish engineering development plan. Lids Off Jar Opener example 	• 4.1 Identify and approach key Co-Development partners, again under signed Non-Disclosure Agreements. Ask them to answer the Key Question from Step 1.3: *Why does envisioned solution to problem not yet exist?* • 4.2 Layout proposed engineering-based solution to problem • 4.3 Outline preliminary business case that is based on path to market outlined in Step 1.5.	• Conduct more detailed marketing, technical and consumer assessments based on refined idea for application of discovery.
	• 4.4 Implement Intellectual Property (IP) strategy in collaboration with patent attorney, technology transfer office, or relevant agents.	• Discuss IP protection options with technology transfer office/patent attorney.
	• 4.5 Assess regulatory, reimbursement and any related requirements for envisioned product/service.	• Develop understanding of design, pricing, and timing implications of requirements imposed by FCC,FDA (510k), HIPPA, Medicare/Medicaid, etc.
	• 4.6 Initiate key co-development practices with partners.	• Identify and assess external partners. • Establish formal relationship with external partners. • Nurture relationship to ensure successful collaboration.
	• 4.7 Assess project resource requirements and availability. • 4.8 Generate engineering implementation plan.	• Review needs for staffing, funding, and time. • Identify potential distribution outlets.
	• 4.9 Prepare proposal to secure necessary project resources.	• Obtain funding from SBIR (Phase II) grant or investors.

Design guide for aging and disability (ISO Guide 71/ CEN/CENELEC Guide 6)

Competency group: Universal Design

Type: Design

Description: Best designed products or services avoid the need for explanatory information. Instead, their appearance conveys important information, for example safety warnings need to be available to all users of a product or service. This set of tables allow the design for the widest range of users, by examining how a product or service complies to clauses on information, packaging, materials, installation, user interfaces, maintenance, storage and disposal and the built environment.

Citation for Description: Described by Authors

Advantages: By using these various tables, an examination of how a product or service is compliant with accessibility standards.

Regulations: Tiresias. (2009). CEN Guide 6: Guidelines for standards developers to address the need of older persons and persons with disabilities. Retrieved from http://www.tiresias.org/research/guidelines/CEN%20guide%206/introduction.htm

Target Audience: Engineering, R & D

Relevant to Universal Design: Yes

Stages and Steps:

4.2
5.1

Free Resource: Tiresias. (2009). 7 Tables of factors to consider to ensure standards provide for accessible design. Retrieved from http://www.tiresias.org/research/guidelines/CEN%20guide%206/clause7.htm

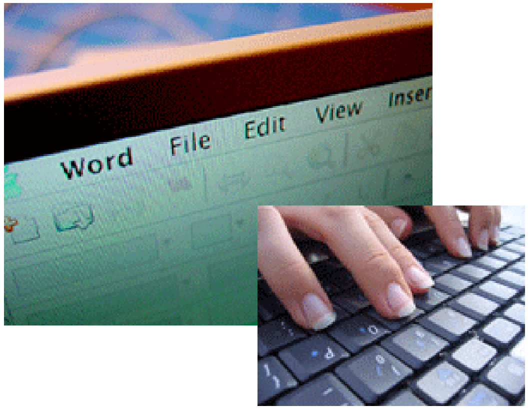
In this section:

- Researchers
- Research projects
- Researchers' publications
- ICT devices
- ICT standards
- Design guidelines
- Scientific & technological reports
- Serial publications
- Sources of funding
- Selecting partners for research projects
- Links
- Add / update information

Scientific and Technological Reports

Scientific and technological reports are listed under the following subjects:

- Ambient Intelligence
- Assistive devices and ICT systems
- Biometrics
- Braille and tactile data
- Hearing impaired
- Icons
- Inclusive design
- Interactive digital television
- Introductions to technologies
- Keypads and user interfaces
- Labelling and packaging
- Mobility and orientation
- Public access terminals
- Smart cards
- Standards
- Telecommunications - Accessibility
- Telecommunications - Policy
- Transport
- Typefaces



Other research

Stage 7 - Production Planning and Preparation: Determine final manufacturing processes pricing and marketing strategies, and test launch activities. UpStop Wheelchair Braking System example 	• 7.1 Draft Preliminary bill of materials.	• Create assembly structure overview.
	• 7.2 Develop materials plan.	• Detail parts; assess and plan for required lead times. • Maintain the preliminary bill of materials (BOM).
	• 7.3 Estimate market needs and costs for production. • 7.4 Develop production and capacity plan.	• Generate detailed list of manufacturing operations (routers) for production process.
	• 7.5 Plan and schedule engineering.	• Utilize material requirements planning system to ensure adequate inventory of raw materials needed for manufacturing will be available. • Add engineering design to Bill of Materials as lowest level item. • Create a router showing where engineering is needed. • Review high-risk areas in design and create alternatives if needed.
	• 7.6 Plan and schedule tool and process design.	• Identify need for new tooling (jigs/fixtures) or manufacturing processes. • Add tooling and equipment requirements to bill of materials. • Create routers for completing tool design and process implementation. • Identify critical areas or bottlenecks.
	• 7.7 Review costs using preliminary Bill of Materials.	• Determine if changes to bill of materials are required based on production process requirements.
	• 7.8 Review IP protection and obtain final approval from regulatory and reimbursement agencies - as needed.	• Begin 501(k) pre-market approval with FDA or other means of demonstrating safety and effectiveness as required. • Develop user manuals, marketing literature.
	• 7.9 Finalize distribution logistics.	• Deploying physical product requires inventory for point of sale, sales rep demonstration and re-stocking through distribution network.
	• 7.10 Finalize marketing and sales plans.	• Choose name (trademark) for product/service. • Create user manuals & marketing literature.

nces

Toolbox entries for Step 7.10: Finalize marketing and sales plans.

Business Tools

- Human Performance Technology (HPT)
- Quality Function Deployment
- Critical Path Analysis

Universal Design Tools

- SWiFT 9:2012 Universal Design for Energy Suppliers
- Universal Design Product Evaluation Tools

Mechanical Engineering Tools

- Six Sigma

Human Performance Technology (HPT)

Competency group: Business

Type: Process

Description: Human Performance Technology (HPT), a systematic approach to improving productivity and competence, uses a set of methods and procedures -- and a strategy for solving problems -- for realizing opportunities related to the performance of people. More specific, it is a process of selection, analysis, design, development, implementation, and evaluation of programs to most cost-effectively influence human behavior and accomplishment. It is a systematic combination of three fundamental processes: performance analysis, cause analysis, and intervention selection, and can be applied to individuals, small groups, and large organizations.

Citation for Description: International Society for Performance Improvement. (2011). What is HPT?. Retrieved from http://www.ispi.org/content.aspx?id=54.

Advantages: Through careful application of human performance technology principles, many overheads and redundancies within a process can be eliminated.

Limitations: This type of activity is usually performed by SME's and larger companies, and can be expensive and time consuming.

Target Audience: Top management

Relevant to Universal Design: Yes

Stages and Steps:

4.5
7.10

Free Resource: Pershing, J. A. (2006). Handbook of human performance technology. Pfeiffer. Retrieved from http://books.google.ie/books?id=qwZEZeP8HgkC&pg=PA830&lpg=PA830&dq=advantages+and+disadvantages+of+Human+performance+technology&source=bl&ots=aCDEVkyxMG&sig=CMzAYDL

Purchase Resource: International Society for Performance Improvement. (2012). Performance technology toolkit. Retrieved from http://www.ispi.org/content.aspx?id=1168.

About ISPI

- Why PI?
- What Is HPT?
- Mission, Vision & Goals
- Code of Ethics
- Leadership
- Committees/Task Forces
- Staff
- Donations
- Planned Giving
- Advertising
- Policies
- Contact

Home > About ISPI

What Is HPT?

Human Performance Technology (HPT), a systematic approach to improving productivity and competence, uses a set of methods and procedures -- and a strategy for solving problems -- for realizing opportunities related to the performance of people. More specific, it is a process of selection, analysis, design, development, implementation, and evaluation of programs to most cost-effectively influence human behavior and accomplishment. It is a systematic combination of three fundamental processes: performance analysis, cause analysis, and intervention selection, and can be applied to individuals, small groups, and large organizations.

How Does HPT Work?

HPT uses a wide range of interventions that are drawn from many other disciplines including, behavioral psychology, instructional systems design, organizational development, and human resources management. As such, it stresses a rigorous analysis of present and desired levels of performance, identifies the causes for the performance gap, offers a wide range of interventions with which to improve performance, guides the change management process, and evaluates the results. Taken one word at a time, a description of this performance improvement strategy emerges.

Human: the individuals and groups that make up our organizations
Performance: activities and measurable outcomes
Technology: a systematic and systemic approach to solve practical problems

Principles of Human Performance Technology

Human Performance Technology (HPT) has been described as the systematic and systemic identification and removal of barriers to individual and organizational performance. As such, HPT is governed by a set of underlying principles that serve to differentiate it from other disciplines and to guide practitioners in its use.

1. **HPT Focuses on Results or Outcomes**
   Competent practitioners are *focused on results* throughout their assignments. They are not predisposed to a set of solutions. They apply their knowledge of what is required for performance at all levels and their consulting and communication skills to:
   - Help clients and stakeholders define what they want to accomplish.
   - Guide clients in how to convert results into measurable terms.
   - Help clients stay focused when unrelated information and needs surface.
   - Challenge assumptions to uncover important priorities.
   - Facilitate discussions about the worth of a problem in terms of costs, human energy, or risk.
   - Help clients weigh the risk of unanticipated outcomes.
2. **HPT Takes a Systemic View**
   Competent practitioners *take a systemic view* of their work. This requires them to identify the subsystems that make up the total organization. They look for and recognize that a change in one area will affect other areas. They consider how the dynamics in society, the marketplace, workplace, work, and workers affect the desired outcomes. They use their knowledge of systems theory and their consulting and communication skills to help clients recognize:
   - How functions are interdependent.
   - That a change in one area or system will affect other systems.
   - The relationship between internal practices and the marketplace and society.
   - The difference between symptoms and causes.
   - The impact of misalignment of goals and practices.
   - How decisions and misalignment affect the ability to be competitive in the marketplace.
3. **HPT Adds Value**
   This Competent practitioners *add value* by using their expertise to facilitate the process in ways that result in better decisions, higher quality work by their team, and a higher quality end product. They:
   - Ensure that the project team considers an appropriate range of solutions and the implications before taking action.

Summary: NtK Model Utility

- 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.

Summary: NtK Model Value

- **Technology Grantees:**
  - Proposal structure – Review Panel liked.
  - RERC Tech Transfer/ SBIR Phase III Plans.
- **Program Sponsors:**
  - Assess proposals; Track progress.
  - Compliance enforced – Funding continuation?
- **Organizations:**
  - PDMA’s “The Source”; Tech Transfer Tactics;
  - CIHR; CEUD; DIT; ATIA; AAATE.

Knowledge Translation
KT4TT
Technology Transfer

ACKNOWLEDGEMENT

The contents of this presentation were developed under a grant from the U.S. Department of Education, NIDRR grant #H133A130014.

However, the contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the Federal Government.

Part V: 4 – 5pm

Group discussion:

NTK Model's utility for AT field;

Utility for STI Policy in general.