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Facilitating Technology-Based Knowledge Utilization

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This issue of* FOCUS *presents a framework for integrating two distinct processes: knowledge translation (KT) and technology transfer (TT). The integration permits stakeholders involved in technology-based research and development activities to identify and coordinate their respective roles, and to optimize the eventual use of research by industry for production purposes.

The KT process is designed to communicate the value of conceptual knowledge, while the TT process is designed to transform this value into tangible outcomes. The espoused value of both processes is facilitating the use of research-based knowledge by target audiences. The assistive technology (AT) field must link both processes in order to increase the outcome of technology transfer activities, as demonstrated by the appearance of new or improved products in the marketplace.

Sponsored programs may generate innovative outputs, identify target audiences, anticipate various forms of use, and even deliver the knowledge through multiple approaches. All are necessary, but even collectively, are not sufficient to make use happen. Lomas's perspective on facilitating knowledge use asserts that diffusion, dissemination, and implementation are three related phases. All three form a process of increasingly active communication reflecting more focused intent, with each subsequent phase dependent on the success of its predecessor (Lomas, 1993). Knowledge producers who shift from diffusion to dissemination have changed their intent toward communication outcomes, reflected in changed behavior from passive to active. However, evidence shows that this shift on the part of the producer is not sufficient to prompt knowledge users to shift their intent and behavior from passive awareness of the knowledge to its active use. The successful transmission of knowledge from producer to potential user can only predispose the user to change behavior by raising awareness about the opportunity to change. The use of tailored dissemination only predisposes and is not sufficient to prompt action (Green, Eriksen, & Shor, 1988).

The author has verified these findings in practice. Decisions and actions to apply (implement) knowledge come from the attitudes and behaviors of the user.

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KT4TT

Center on Knowledge Translation for Technology Transfer

Definitions

Assistive technology device means any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities. (Technology-Related Assistance for Individuals with Disabilities Act of 1988, Section 3. Definitions.)

Knowledge translation is a multidimensional process designed to ensure that new, research-based knowledge ultimately improves the lives of people with disabilities. The process is active: it accumulates information; filters it for quality, rigor, and relevance; and recasts it in language that is easily understood by and accessible for the intended audience. KT includes the transfer of products and devices from the research and development setting to the commercial marketplace (NIDRR, 2006).

Technology transfer is a process of transforming an idea for the novel application of a technology into a viable product (Lane, 2003).

The Rehabilitation Engineering Research Center on Technology Transfer (T2RERC) experienced this reality on a regular basis over a span of 15 years. No matter what was done to "lead the horse to water," any lack of action on the part of the targeted knowledge user was a reminder that "you can't make the horse drink" (Lane, 2008).

What triggers implementation from the user's perspective? The field of marketing has long focused on tools and techniques to prompt action by targeted consumers. Literature on persuasive communication distinguishes between a set of five general attributes that influence any audience's awareness of new knowledge (Table 1, left column) and a set of five specific attributes that contribute to shifting user intent and prompting action (Table 1, right column) (Lomas, 1993; Winkler, Lohr, & Brook, 1985).

A second concept relevant to facilitating knowledge use involves knowledge boundaries. Knowledge boundaries lie at the point of intersection between the flow of knowledge to users and the reception of knowledge by users (Carlile, 2004). Knowledge boundaries fall into three progressively complex types; each type represents increasingly complex processes. The less complex capacities are required in order to move up in complexity, as shown in Table 2.

Table 1. Attributes to Create Awareness or Facilitate Use

Attributes to Create Awareness	Attributes to Facilitate Use
The source or originator of the message	Influential person as the prime source, reinforced by messages about value of change from multiple internal and external channels
Channel used to communicate the message	Personalized interaction as the channel, with message presented in user-friendly formats, language, and style, and repeated over time
The content of the message	Message grounded in local experience and setting to show it is feasible, adaptable for trial
Characteristics of the audience	Opinion leader as the initial audience and candidate for early adoption, representing the local need to consider the change
The setting where the message is received	Local, informal settings where users can test the concept and weigh risk(s) to incentives and disincentives

Table 2. Knowledge Boundary Types and Processes

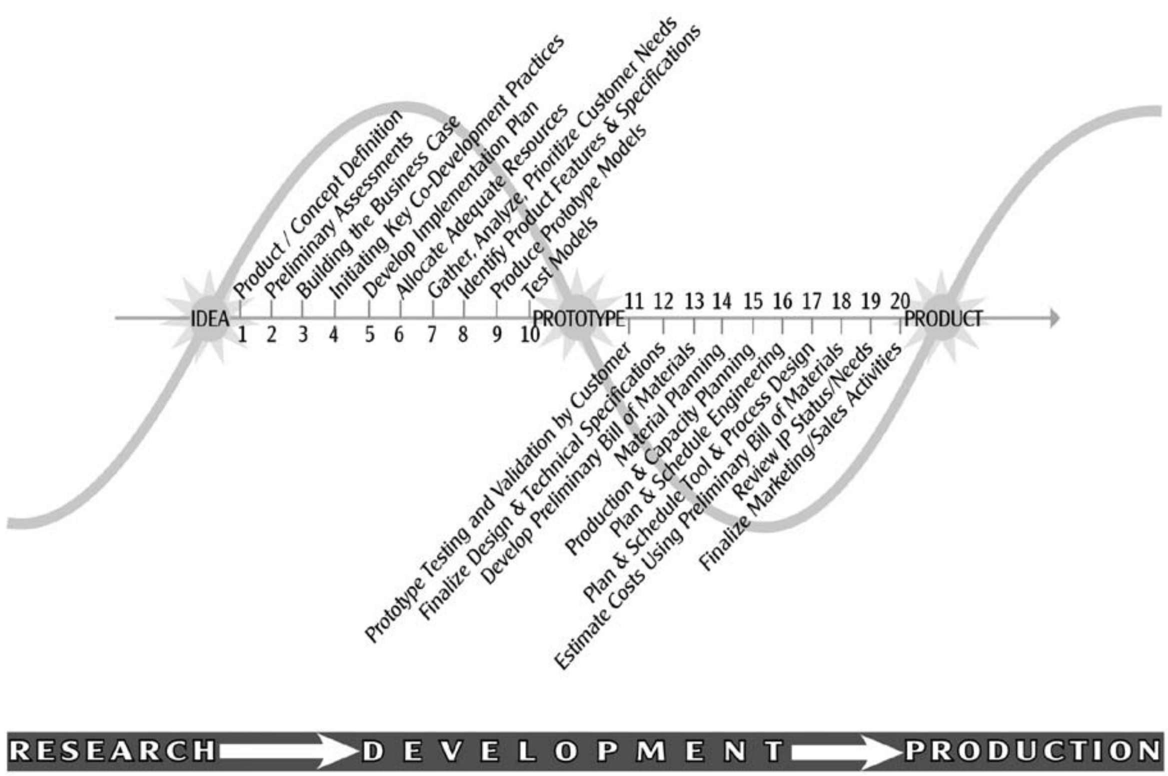
Knowledge Boundary Type	Knowledge Boundary Process
Syntactic – Information Processing model, with a common lexicon to cross the boundary	**Transfer** – The common lexicon requires stable conditions; destabilized by novel information
Semantic – Community of Practice model, where novel information is reconciled through shared meanings or shared mechanisms	**Translation** – Interpretation required to maintain effective communication, while revealed barriers require carriers
Pragmatic – Creative Abrasion model, where novelty generates competing interests that must be resolved via negotiation	**Transformation** – Create new knowledge by integrating existing knowledge "at stake" along with the value of the innovation

Research, Development, and Production as a Continuum of Use

Government sponsors technology-based research and development with two objectives in mind: (1) to increase the base of scientific knowledge and expand the depth of theoretical understanding; and (2) to apply the knowledge base in the creation, testing, and demonstration of technology-based prototypes. Neither of these efforts yields goods and services for the marketplace. That requires a third activity: product development and production by industry.

Consequently, facilitation of technology-based knowledge utilization requires a model that encompasses scholarly research and development as well as industrial development and production. A Research, Development, and Production (RDP) Model provides a reference framework for each stakeholder, and indicates how their contributions fit within the

Figure 1. The Research, Development, and Production (RDP) Model: 20-Step Product Development Process



Adapted from Kahn, Castellion, & Griffin (2004).

overall process. Knowledge translation in the context of technology transfer becomes a prolonged effort involving bi-directional communication to ensure that knowledge users participate because they see their self-interests represented and valued.

The Technology Transfer Process

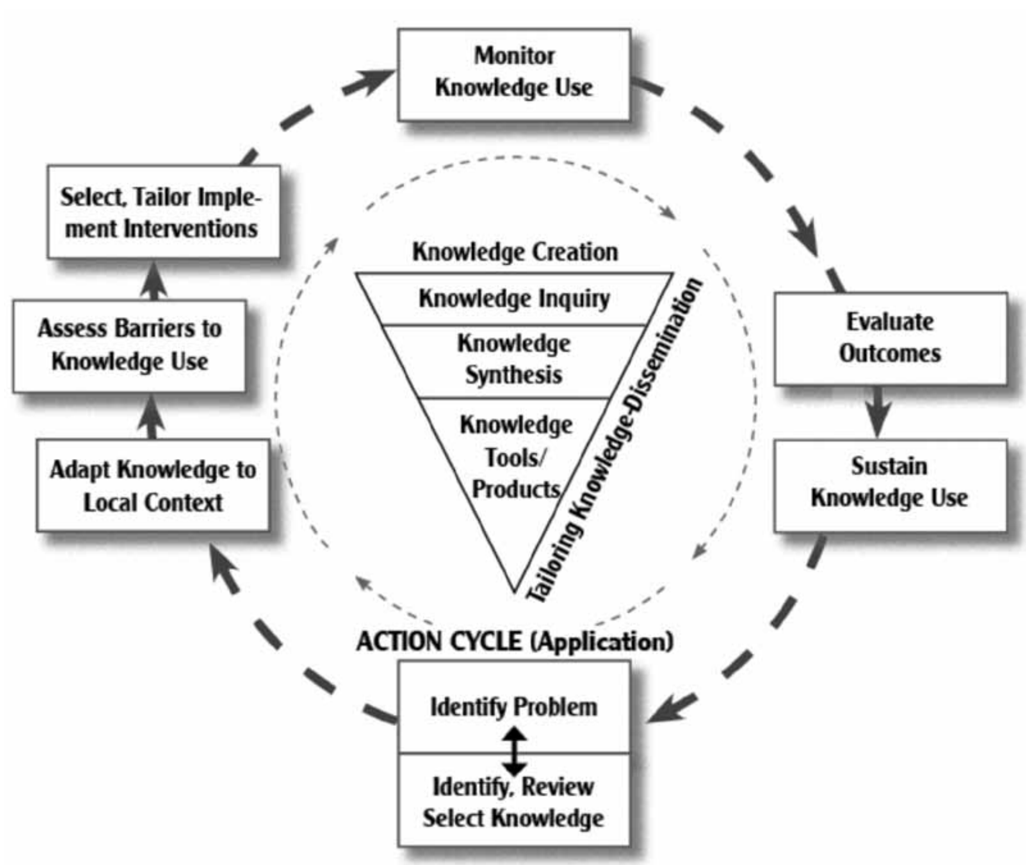
Transferring knowledge into something concrete (a product or service) is a challenge that encompasses multiple steps, each requiring successful completion to reach the final goal. The RDP Model spans all activity from the initial conception of an application of knowledge (Idea Event), through its embodiment in tangible form (Prototype Event), to its commercial production (Product Event).

The process of transferring an idea into a product is presented in Figure 1 as 20 critical steps identified by the Product Development Managers Association (PDMA) (Kahn, Castellion, & Griffin, 2004). These development steps fall between the conclusion of the research process and the commencement of the device or service release into the marketplace. The first 10 steps transform the conceptual idea generated by research into a proof-of-concept prototype. The last 10 steps transform the prototype into a final product form.

The Knowledge Translation Process

To address this broader RDP Model, the Knowledge to Action (KTA) Model (Graham et al., 2006) is integrated with technology transfer concepts drawn from industry (Lane, 1999). The KTA Model focuses on action and is highly relevant to the field of assistive technology, where the standard industry practices of new product (or service) development and delivery

Figure 2. The Knowledge to Action (KTA) Model



From: "Lost in Knowledge Translation: Time for a Map?" by I. D. Graham, J. Logan, M. B. Harrison, S. E. Straus, J. Tetroe, W. Caswell and N. Robinson, 2006, *The Journal of Continuing Education in the Health Professions, 26*, 13–24. Copyright © 2006 The Alliance for Continuing Medical Education, the Society for Medical Education, the Society for Academic Continuing Medical Education, and the Council on CME, Association for Hospital Medical Education. All rights reserved. Retrieved from http://www.jcehp.com/vol26/2601graham2006.pdf. Reprinted by SEDL/NCDDR with permission.

must be applied to generate the desired impacts for intended beneficiaries. The premise of the KTA Model is that KT deals with three inter-related issues: making users aware of knowledge and facilitating its use, closing the gap between what we know and what we do, and moving knowledge into action.

As shown in Figure 2, the KTA Model depicts these issues as components of a knowledge creation funnel and a knowledge application action cycle (Graham et al., 2006). The needs of users are to be incorporated as knowledge is adapted for specific use. The phases in the KTA Model can influence each other, and refinement is a natural outcome of the process (Sudsawad, 2007).

Table 3. Integrating KT and TT to Facilitate Knowledge Utilization

KTA Knowledge Creation Funnel	Key KT Concepts	Integration of KT & TT in Operational Terms	Strategies to Facilitate Utilization
Identify stakeholders and establish shared understanding of KT process	Knowledge Production System (KPS) & Knowledge Utilization System (KUS); KT and TT models	Synthesize KT knowledge within KTA Model; then reconcile with TT model, methods, and measures	Source of message: send expert message through professional organization
KTA Action Cycle			
1. Identify knowledge need (integrated KT) or validate knowledge value (end-of-grant KT)	Research-based knowledge outputs; New knowledge = innovation?	Validate innovations as outputs from technology-related research projects	Content of the message: true innovation with value to members
2. Placing useful knowledge in specific context of problem	Knowledge diffusion, transfer, utilization; five organizational capabilities for use	Profile value systems of targeted knowledge-user categories	Audience characteristics: opinion leader via organization
3. Assess barriers and identify carriers to overcome them	Three levels: individual, organization, and sector; transactional attributes of user and knowledge	Identify specific barriers and carriers for innovations in context of targeted users in each category	Opinion leader: local setting and norms; feasible, flexible, testable
4. Tailor intervention to known barriers and target audiences	Diffusion, syntactic, transfer/ Dissemination, semantic, translation/ Implementation, pragmatic, transformation	Create communication vehicles tailored to each target audience for delivery through multiple modes	Channel used: user-friendly message delivered via multiple channels over extended period
5. Monitor and measure knowledge utilization	Three types of knowledge use: instrumental, conceptual, and strategic	Pre- and post-tests of users; and/or secondary source evidence of utilization	Recognize need for change: value knowledge as change agent
6. Determine the impact of use and assess costs involved	Cost-benefit to KPS and to KUS, as well as value to targeted beneficiaries	Calculate cost of KT intervention and benefits of outcomes and impacts	Mid-term: collect quantitative/qualitative evidence of value
7. Sustaining knowledge use: recapitulates steps 4–7	New area of KT interest: Literature on public policy and systems change	Use cost-benefit results to promote movement from end-of-grant KT to integrated KT	Long-term: generate more evidence of value; promote KT change to KPS system

The Integration of KT and TT Models

The prior discussion of the RDP Model and the KTA Model focused on the path of technology-based knowledge innovations arising from research, development, and production activities. Now, we turn our attention to outcomes and impacts that require action to implement knowledge use.

Achieving these outcomes and impacts through knowledge utilization requires an operational version of an integrated model.

Table 3 shows how the KTA Model's knowledge creation funnel and action cycle (column 1) intersect with key concepts from the KT and TT literature (column 2). These key KT and TT concepts still require additional integration (column 3) before they can be applied in operational terms to facilitate knowledge use. To promote use, the operational model cannot stop with the knowledge creation funnel. Instead, the steps in the KTA's action cycle must also be expressed in operational terms applied by the knowledge users. The established models, methods, and measures of technology transfer offer such operational terms (column 4).

Table 3 suggests the relationships among existing models (column 1), existing theories (column 2), and new methods (column 3), and how they all might converge to facilitate the desired outcome of knowledge utilization by target audiences (column 4). From this perspective, columns 1, 2, and 4 refer to the current state of the science of KT and TT.

Column 3 represents the emerging research agenda in relation to integrating technology transfer with knowledge translation. For example, column 3 suggests that integrating KT and TT in operational terms was important in creating an operational KT model. One approach is to create a parallel linear model from the circular KTA Model, based on the linear RDP Model that includes the PDMA's 20 steps of technology transfer. Such a linear model preserves the dynamic aspects of the KTA Model while permitting model builders to identify analogous activities along the KTA and RDP models.

Such analogous activities may occur at different points in the progression through the respective models. However, the technology transfer models and methods established through industry practice may be applicable within the models and methods of KT activity. Indeed, the Center on Knowledge Translation for Technology Transfer (KT4TT) is engaged in integrating both KT and TT concepts into a single stage-gate model representing all of the stages and steps required within each of the three related phases of activity (research, development, and production).

The project is also conducting a scoping review of the available literature from academia and industry to identify evidence supporting the model. The preliminary review of several hundred articles shows a consensus that any technology-based project intending to generate a device or service for the marketplace must begin with a validated problem and a viable solution. In TT parlance, the consensus favors a demand-pull approach of starting with a need, rather than a supply-push approach of delivering a solution and then looking for a relevant problem.

This position has implications for the application of KT processes. Technology-based projects involve applied research and development by definition. Researchers are recognizing the value of KT for communicating their findings to target audiences (known as end-of-grant KT) and for collaborating with stakeholders during the research process (integrated KT). Those engaged in applied research may also apply KT to better receive communications from their stakeholders about needs and problems awaiting technology-based solutions (prior-to-grant KT).

The Center on KT4TT has posted the evolving model and supporting literature review in progress at (http://kt4tt.buffalo.edu/knowledgebase/model.php). This material will be considered in greater detail within a subsequent *FOCUS* issue.

References

Carlile, P. R. (2004). Transferring, translating and transforming: An integrative framework for managing knowledge across boundaries. *Organization Science, 15*(5), 555–568.

Link to abstract: http://orgsci.journal.informs.org/cgi/content/abstract/15/5/555

Graham, I. D., Logan, J., Harrison, M. B., Straus, S. E., Tetroe, J., Caswell, W., & Robinson, N. (2006). Lost in knowledge translation: Time for a map? *The Journal of Continuing Education in the Health Professions, 26*(1), 13–24.

Retrieved from http://www.jcehp.com/vol26/2601graham2006.pdf

Green, L. W., Eriksen, M. P., & Shor, E. L. (1988). Preventive practices by physicians: Behavioral determinants and potential interventions. *American Journal of Preventative Medicine, 4* (Supplement), 101–107.

Kahn, K. B., Castellion, G., & Griffin, A. (Eds.). (2004). *The PDMA handbook of new product development (2nd ed.).* Hoboken, NJ: John Wiley & Sons.

Link: http://www.pdma.org/shop_pdma_description.cfm?pk_store_product=12

Lane, J. P. (1999). Understanding technology transfer. *Assistive Technology Journal, 11*(1), 5–19.

Link to abstract: http://69.89.27.238/~resnaorg/ProfResources/Publications/ATJournal/Volume11/Volume11.1/TechTransfer.php

Lane, J. P. (2003). The state of the science in technology transfer: Implications for the field of assistive technology. *The Journal of Technology Transfer, 28*(3/4), 333–354.

Link to abstract: http://www.springerlink.com/content/g43710txp7617036/

Lane, J. P. (2008). Delivering on the 'D' in R&D: Recommendations for increasing transfer outcomes from developmental projects. *Assistive Technology Outcomes and Benefits*, Fall, 1–60.

Link: http://www.lulu.com/product/paperback/delivering-on-the-d-in-rd-recommendations-for-increasing-transfer-outcomes-from-developmental-projects/4123227

Lomas, J. (1993). Diffusion, dissemination and implementation: Who should do what? *Annals of the New York Academy of Science, 703*, 226–237.

Link to abstract: http://www3.interscience.wiley.com/journal/119298621/abstract

National Institute on Disability and Rehabilitation Research (NIDRR). (2006). News from NIDRR Fall 2006 [Electronic Communication].

Sudsawad, P. (2007). *Knowledge translation: Introduction to models, strategies, and measures.* Austin, TX: SEDL, National Center for the Dissemination of Disability Research.

Retrieved from http://www.ncddr.org/kt/products/ktintro/

U.S. Congress. *Technology-Related Assistance for Individuals with Disabilities Act of 1988 as amended in 1994* (PL 100–407 and 103–218).

Retrieved from http://www.handinet.org/tech_act.htm

Winkler, J. D., Lohr, K. N., & Brook, R. H. (1985). Persuasive communication and medical technology assessment. *Archives of Internal Medicine, 145*(2), 314–317.

Link to abstract: http://archinte.ama-assn.org/cgi/content/abstract/145/2/314

KT4TT

The 5-year **Center on Knowledge Translation for Technology Transfer (KT4TT)** project (http://kt4tt.buffalo.edu) was awarded to the University at Buffalo (SUNY), Center for Assistive Technology (CAT) on October 1, 2008. SEDL and Western New York Independent Living, Inc., are partners in the project. SEDL's role focuses on utilization-oriented methods of dissemination, training, and technical assistance to effectively communicate with knowledge producers and knowledge users. This *FOCUS* Technical Brief is a product of the SEDL-KT4TT partnership.

The project focuses on three key outcomes:

Improved understanding of the barriers preventing successful knowledge translation for technology transfer and ways to overcome the barriers

Advanced knowledge of best models, methods, and measures of knowledge translation and technology transfer for achieving outcomes

Increased utilization of these validated best practices by NIDRR's technology-oriented grantees

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NCDDR's scope of work focuses on developing systems for applying rigorous standards of evidence in describing, assessing, and disseminating outcomes from research and development sponsored by NIDRR. The NCDDR promotes movement of disability research results into evidence-based instruments such as systematic reviews as well as consumer-oriented information systems and applications.