

A Model of Assistive Technology Transfer: Theory and Practice

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Abstract: The process of technology transfer has value even in small markets such as assistive technology. However, this value cannot be realized until the process is fully understood and properly implemented. This paper presents a summary model of the entire technology transfer process, and describes how the process supports the commercialization of new or improved assistive technology products. Essentially, the technology transfer process requires cooperation between multiple stakeholder groups, across a series of activities, over an extended period of time. Implementing this process as a structured method provides manufacturers with a needed resource option.

1. What is Technology Transfer?

The concept of technology transfer—in all its forms—is a popular one. However, the concept must be understood and the process must be implemented to be useful to the field of assistive technology. Unfortunately, the supporting literature on technology transfer is only in the formative stages even for elementary topics such as the definition of terms, the methods employed, measurement tools used and the roles of stakeholders.

In the absence of a solid foundation of literature, the term “technology transfer” has become synonymous with a wide range of activities. It is variously defined as a process for conceiving of a new application for an existing technology and reducing the idea to practice in a prototype;¹ as a process for converting research into economic development to include licensing intellectual property;² or even as the process of recording concepts of technology “know-how” in a professional paper or patent application.³

These various definitions seem to actually describe elements of a larger process—technology transfer in the broader sense. Combining these definitions shows technology transfer to be a complex process involving a wide range of participants in multiple inter-dependent activities.⁴ None of the individual definitions encompass this broader perspective, but each presents components of this larger process. Technology transfer remains misunderstood because of continued attempts to define the whole as only one of its parts. By understanding the entire process, and placing activity within this context, participants can use technology transfer as a strategy to achieve industrial competitiveness.

2. Technology Transfer as One Process

Figure 1 presents a model of the entire technology transfer process. It shows that technology transfer starts with an idea for a technology application and ends with a commercial product.⁵ The model's multiple activities, events and stakeholders all contribute to the one process. The sine wave in Figure 1 represents the technology transfer process as it progresses from left (technology) side, to the right (product) side.

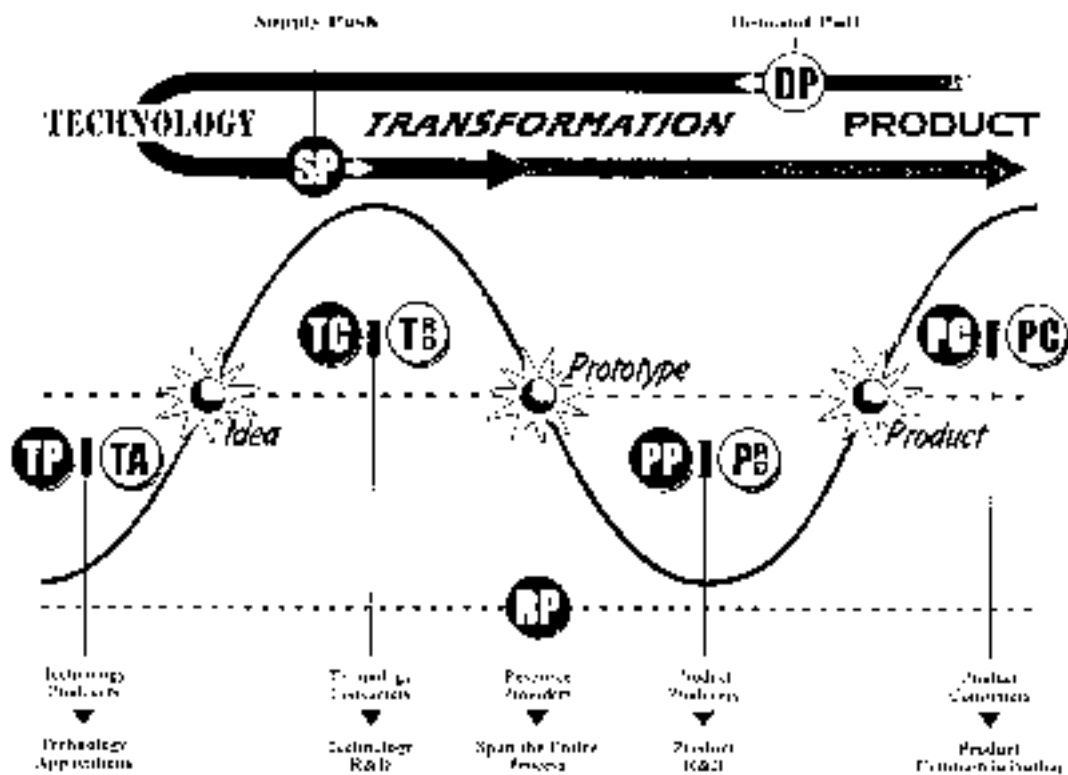


Figure 1 A Summary Model of the Elements of the Technology Transfer Process

The distinction between a technology and a product is important, because a technology is not a product, although one or more technologies are incorporated to provide a product's features and functions.¹⁰ The horizontal axis represents the environment. Activity above the axis is public and unprotected, while activity below the axis is private and proprietary. The model permits participants to establish the location of their current activity, and helps determine what needs to be done next and who needs to be involved in doing it.

3. Two Forces Initiate Technology Transfer – Supply Push and Demand Pull.

The technology transfer process can be initiated from either end of the process: "supply push" from the technology side, or "demand pull" from the product side (See arrows in Figure 1):

1) **Supply Push** means that the transfer process starts with an identified technology that is seeking an appropriate application.¹¹ In supply push, Technology Producers (e.g., inventors and researchers) can initiate a transfer by pushing new technology developments toward the Technology Consumers (e.g., manufacturers and government agencies).

2) **Demand Pull** means that the transfer process starts with an identified unmet market need which is seeking an appropriate solution.¹² In demand pull, Product Consumers (e.g., end-users and service providers) ask Product Producers (e.g., manufacturers) to meet unmet needs, which Product Producers then view as a competitive market opportunity.¹³

Regardless of the initiating force, the transfer will only succeed if the Technology Consumers or Product Producers see an opportunity to establish a competitive advantage

within their industry's marketplace, and has the research and development capability to capitalize upon the opportunity. The burden of proving the existence of a competitive market opportunity varies, depending on who is trying to convince what group.

4. Three Critical Events Delineate Progress in Technology Transfer.

Figure 1 depicts the three points of intersection between the wave and the axis in the technology transfer process. These three points of intersection represent the three critical events in the technology transfer process: idea, prototype and product.¹⁰⁰

1) The **Idea Event** is the point at which a specific idea is conceived—an idea that identifies a new discovery or existing technology and matches it to a new or novel application area (e.g., applying composite materials to mobility products).

2) The **Prototype Event** occurs when the idea for a technology application is developed into a functional prototype. The defining moment is when the prototype demonstrates that the technology concept functions as expected in reality, where the technology concept is first reduced to practice (e.g., composite material wheelchair frame).

3) The **Product Event** is when the prototype has been developed to the point where it is ready for production and distribution for the marketplace. At this point, the product's components, design and operation appear reliable and are reproducible in mass numbers. This event is typically under the control and direction of a private sector company.

5. Four Activities Underlie the Three Critical Events.

The three events described above are singular points in time, representing the end point of prior activity and the starting point for activity to follow. In Figure 1, the sine wave and horizontal axis together form boundaries around four areas—two above the axis and two below it. These four areas represent discrete activities around the three critical events:

1) **Technology Applications Activity (TA)** precedes the idea conception. The Technology Application includes the existing science and technology base and the potential applications of all technology within the field of interest—such as assistive technology. Technology Applications represents all of the individual thinking, and all of the group communication that precedes the conception of a new idea.¹⁰¹

2) **Technology Research and Development Activity (Technology R&D)** begins after the idea event. Technology R&D activity encompasses the intellectual and physical activity involved in transforming an idea for a technology application to a prototype form.¹⁰²

3) **Product Research and Development Activity (Product R&D)** commences after the prototype event. It represents the research and development activity involved in transforming a prototype device into a product ready for commercial production.¹⁰³ The transformation from prototype to product is widely known as the "valley of death" in product development literature.¹⁰⁴

4) **Product Commercialization Activity (PC)** involves rolling out a new product into the marketplace, so it naturally follows the product event. Product commercialization activity includes the manufacturing, distribution, sales and support for the product.¹⁰⁵

6. Five Stakeholder Groups Participate in the Process.

Any transfer requires a transaction between at least two parties—a producer and a consumer. All producers and consumers require resources to conduct the technology transfer process. Technology transfers in small or niche markets like assistive technology,

typically require that outside entities provide the necessary resources to producers and consumers. The technology transfer process has five stakeholder groups: two involved with production, two involved with consumption, and one resource provider group. Each group is a vital stakeholder in the technology transfer process.¹³⁷

1) **Technology Producers** develop new technologies for transfer to Technology Consumers (left side of Figure 1). Technology producers are the people who conduct the technology application activity and first generate the idea for matching a technology to a new application. The technology producer stakeholders include inventors and researchers in academic or federal laboratories and companies.¹³⁸

2) **Technology Consumers** translate the idea into a prototype technology. The technology consumer stakeholders include government agencies with a mission to apply technologies to serve national needs (e.g., defense, space exploration, veterans' health care), private sector manufacturers seeking to develop new products based on advanced technologies, or intellectual property brokers in the business of re-selling technology.

3) **Product Producers** transform technologies into products for sale to Product Consumers in the marketplace (see right side of Figure 1). The product producer stakeholders include manufacturers of products, distributors of products through domestic and international markets, and value-added retailers that offer the products for sale to consumers and provide services to support the products.¹³⁹

4) **Product Consumers** include end users and family members who acquire and use product, and professional service providers who prescribe or recommend products.¹⁴⁰

5) **Resource Providers** include government and private entities that provide financial support to fund technology transfer, government and private insurance third-party payers that fund a majority of the product purchases, programs that analyze and change policies and systems, technology transfer intermediaries providing technical expertise to conduct the transfer, and professionals providing content expertise within the transfer application area. The Resource Providers support all phases of technology transfer, so they are depicted as underlying the entire diagram in Figure 1.

The stakeholder groups Technology Producers and Product Consumers, are at opposite ends of the technology transfer process. In between them are the Technology Consumers and Product Producers, most of which are private sector manufacturers. Manufacturers are the critical link in the technology transfer process because they are the only stakeholders positioned to support the costs and benefits associated with technology transfer.¹⁴¹ They have the incentives to invest the necessary time and resources to transform a technology into a product, and the expertise and networks to make the product succeed in the marketplace.¹⁴² Despite their critical role, these manufacturers are totally reliant on the other stakeholders to complete the technology transfer process, and to comprise the marketplace.¹⁴³ For example, Resource Providers are critical for transfers of technologies lacking sufficient market incentives for the private sector to fund independently – which includes assistive technology devices and other orphan products.¹⁴⁴

7. Technology Transfer for Assistive Technology Devices

People with disabilities rely on assistive technology devices and services to sustain, regain or increase their functional capabilities.¹⁴⁵ Despite the thousands of devices on the market, each has limitations in features or functions based on technological limitations in components (e.g., materials, power cells, sensors).¹⁴⁶ Most assistive technology manufacturers lack sufficient resources for internal corporate research and development. Consequently, technological advances typically have to be transferred in from outside sources, such as Technology Producers in other fields. This is technology transfer.

Technology transfer is a viable strategy to apply novel technologies from outside sources to introduce new or improved features and functions in assistive devices. However, most manufacturers also lack the resources, incentives and networks for effective and systematic technology transfer.¹⁰ Companies need a systematic process for handling the procedural, legal and financial issues involved in acquiring external innovations, whether in the form of ideas for technologies, prototypes or products. Otherwise the cost of completing the acquisition would usually exceed its value. The field needs to develop and apply a systematic process for technology transfer, so it can become an acceptable business strategy.

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障害者支援に関わる技術移転モデル：その理論と実践

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技術移転の過程は、障害者支援工学のような小規模な市場においても有用である。しかしながら、その過程が十分に理解され適切に履行されるまでは、その価値は認められない。この論文は、一つの技術移転の全過程を要約したモデルについて提示し、さらにこの過程が、新規或いは改良された障害者支援機器の商品化をどう支えるかについて述べるものである。本質的に、技術移転の過程は、長期にわたる一連の活動を適し多数のステイクホルダーのグループ間の相互協力を必要とする。技術移転の過程を組織的な方法で履行することにより、メーカー側が必要とする資源と進捗の自由を提供することが出来るのである。