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

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**Abstract**

Corporations routinely conduct projects that link internal research, development and production activities to generate new or improved products and services for the marketplace. Similarly, national governments frequently sponsor technology-based projects led by university faculty or entrepreneurs to stimulate innovations with beneficial socio-economic impacts. However, the latter approach creates a gap between the rigorous R&D outputs generated by faculty or entrepreneurs, and the evidence of technical, market and customer relevance that industry requires to acquire external intellectual property. The less sponsored investigators know about these industry requirements during project planning and implementation, the larger the subsequent gap -- and the greater the challenge to technology transfer intermediaries. The paper describes an effort to support investigators who are naïve about these issues with information they need to know about industry tools available to properly conduct the necessary analysis.

**Keywords.** Product development, innovation, technology transfer, analytic tools, technical analysis, marketing analysis, business planning, customer requirements

**Background**

The Need to Knowledge (NtK) Model was created to be a static representation of a dynamic process encompassing all elements of the technology innovation process from problem validation to solution delivery [1]. Government programs funding technological R&D with the intent to generate beneficial socio-economic impacts, need to know the requirements and constraints of three related methodologies (scientific research, engineering development, industrial production), which generate new knowledge in three different states (conceptual discoveries, prototype inventions, commercial innovations), which is exchanged between stakeholders through three processes (knowledge translation, technology transfer, commercial transaction). The NtK Model's stages, gates and steps are each substantiated with evidence drawn from a scoping review of academic and practitioner literature.

The R&D programs represented in the NtK Model must address a number of challenges in the new product development (NPD) process, such as linking actors from multiple sectors, communicating across cultural barriers and integrating multiple methodologies. Participants must work to mitigate potential barriers to the successful introduction of products in the marketplace. The complexity increases when the envisioned product must address the requirements of people at various ages and representing a range of functional abilities.

This paper describes a recent effort to identify a representative set of tools necessary for conducting critical technical, market and customer analyses within the NtK Model. Adding this array of tools was necessary because the project participants trained in one of the core methodologies (i.e., scientific research, engineering development, industrial production) are not typically familiar with the tools in the others. Having the tools imbedded in the model signals the various participants about actions and analyses they need to consider and accommodate in their resource, staffing and implementation plans.

Companies vary widely regarding their level of interest in and commitment to the needs of persons with disabilities. However, the desire to broaden the customer base or increase the market share is understandably a high priority in the competitive marketplace. Applying analytic tools that support these elements of a business case, increase the likelihood of uptake and use by corporation partners in the new product development process.

# Methodology

A review of the evidence-based underlying the NtK Model’s stages, gates and steps, revealed dozens of instances requiring the application of a valid tool/instrument to conduct some type of technical, market or customer analysis. The project team classified the tools for these required analyses into four categories of required competencies. For example, designing and testing a product with complex electronics may involve several analytic tools that require the expertise of an electronic engineer to ensure the product’s technical functionality.

 The four competency categories are:

* ***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.

Descriptive categories were then established to create a template for comprehensive descriptions of each tool. The categories were standardized across the four competency groups of tools to ensure that they would have a common format for ease of display and use. The categories and their content are described in great detail elsewhere [2].

Given our focus on the field of assistive technology devices and services, we wanted to delve deeper into the analytic tools to assess the extent to which each tool contained criteria representing the criteria of Inclusive/Universal Design (I/UD). Literature demonstrates that inclusive design criteria are widely applicable across various stages and steps in the NPD process, as part of a design criteria reference set to represent and maintain a priority for end users needs at key decision gates [3]. Our prior experience in technology transfer and product commercialization proves that maximizing market share for any one product is a critical requirement to ensuring optimal return on the costs of production, distribution, promotion and support. Therefore, we added a fifth category to our appraisal of the tools listed:

* ***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.

The tools classified as I/UD were then assigned to their own competency group for two reasons. First, they were specifically developed to foster I/UD in new product development. Second, many of these tools span more than one of the other competency groups. For example, the Anthropometry tool and Design Exclusion Calculator tool offers insights to mechanical engineers for design parameters, while also used by marketing personnel to consider additional target market segments. Categorizing them under the other competency groups, could have masked the tool’s broader applicability and its explicit relevance to usability issues.

# Results

The NtK Model is now populated with tools for use where specific technical, market or customer analysis is required. The project compiled a total of seventy-nine (79) tools appropriate for the required analyses. Subsequent appraisal found that more than half (45) were relevant to I/UD in that they contributed to identifying and setting priorities for the functional requirements and personal preferences of the target consumer audiences. All of the tools are now imbedded in the NtK Model via hotlinks. The details underlying the tools can be viewed within the plain text version of the NtK Model, by clicking on any of the red toolbox icons shown at the end of stages, steps or gates:

[*http://sphhp.buffalo.edu/cat/kt4tt/best-practices/need-to-knowledge-ntk-model/ntk-commercial-devices.html*](http://sphhp.buffalo.edu/cat/kt4tt/best-practices/need-to-knowledge-ntk-model/ntk-commercial-devices.html)

# Conclusion

Sponsors and Grantees alike are finding the NtK Model and these analytic tools useful for planning, implementing, managing and monitoring on projects involving both scientific research and engineering development, to achieve outcomes with socio-economic benefit. Scholars leading such applied projects are becoming more comfortable with their role as one contributing member to a broader collective of experts all working toward a common goal.

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