

Idaho National Laboratory Technology to Market (T2M) Final Report

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**Idaho National Laboratory
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<http://www.inl.gov>

TECHNOLOGY TO MARKET (T2M) FINAL REPORT

LABORATORY NAME: IDAHO NATIONAL LABORATORY

CUMULATIVE FUNDING: \$25,000

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PROPOSED ACTIVITIES

TOPIC AREA B: BUSINESS PLAN DEVELOPMENT, MARKETING TRAINING, AND PROFESSIONAL DEVELOPMENT

ACTIVITY 1: RESEARCHER COMMERCIALIZATION TRAINING FOR NATIONAL LABORATORY RESEARCHERS

Project Objectives: Establish a tiered Technology to Market (T2M) curriculum for basic researchers to project leads to measure the effect of technology transfer skills on project success and impact. The plan will train five researchers in basic technology transfer principles where success will be measured by assessing improvements in T2M skills and knowledge after the training is complete, likely using before and after surveys.

Activity Description: Develop and deliver in-house training for five key researchers involved in Energy Efficiency and Renewable Energy (EERE) programs to include:

- Understanding commercialization process and core principles
- Identifying industry need/receptiveness for technology adoption
- Identifying technology and commercialization networks
- Recognizing intellectual property deployment processes
- Understanding delivery options for technology such as Cooperative Research and Development Agreements (CRADA), Work for Others, licensing, spin-off businesses, and technology-based economic development agreements.

Activity Goal: Increase researcher understanding of technology transfer and marketing principles that influence developing research products for commercialization.

Deliverables and Deadlines: training program (September 30, 2015); five personnel trained and final report (December 23, 2015).

Introduction:

Idaho National Laboratory (INL) evaluated three T2M training programs to determine which would provide the best initial training to new researchers wishing to understand core marketing principles that they could integrate into the scope, schedule, and budget of new research plans. The three programs evaluated were:

Option 1: Coursera.org	Option 2: Entrepreneurial Training	Option 3: Lab-Corps
Earliest start: Available now Length: ~50-80 hours, 12-18 weeks Training Type: Massive Open Online Course Trainer: University MD professor Trainer cost: free or \$150 certification Pros: Developed from University MD Master of Technology Entrepreneurship program; ties(?) to I-Corps (Lab-Corps); freely available, access to group knowledge (~10 ⁵ students per year) Cons: Not tailored to DOE; we do not own curriculum Cost Share: Course development & delivery is free or \$150 certification; potentially can use training budget for individuals' time	Earliest start: Being Developed Length: ~10-15 hours, 10 weeks Training Type: Traditional Classroom Trainer: Technology Ventures Corps Trainer cost: TBD Pros: Developed specifically for INL, Owned and administered by INL staff, Tailored for new Principle Investigators through seasoned Program Leads. Cons: Covers mostly basic finance, market assessment, etc. May need modification to specific programs Cost Share: Course development was on previous budget; potentially can use training budget for individuals' time	Earliest start: Be Piloted Length: ~40 hours, 10 weeks Training Type: Classroom / Massive Open Online Course Trainer: INL Lab-Corps PM Trainer cost: \$4K (INL) Pros: DOE Lab Impact is developing Lab-Corps curriculum, specific to DOE Cons: Lab-Corps curriculum is just being developed; will need modification for wind; students need to engage external customers during program Cost Share: Lab-Corps is paying for curriculum development & testing at 5 DOE labs; potentially could use training budget for individuals' time

Figure 1. Three Technology to Market programs.

Each option is described below at a general course structure level with some of the pros and cons described further. Key elements of the comparison are course cost, availability, and flexibility, researcher time commitment, and value added potential at each stage of a researcher's career. For the purpose of this project, course availability, researcher time commitment, and value to an early career/new researcher were the most important factors. A longer-term consideration of this project is INL's ability to use these and other market training tools to establish a training curriculum that can build technology transfer skills in researchers starting in their early career and extending to late career project leadership. If successful, the curriculum could be ported to other laboratories in the complex.

Background:

Coursera

Coursera online programs offer multiple courses from several institutions for topics ranging from Arts and Humanities to Social Sciences. The entrepreneurial courses focus on basic principles to "Identify, Analyze, and Launch Your Startup." There are three core courses and one capstone project that result in a certificate of completion. However, the three core courses are free and

modular such that a person can take one, two, or three of the courses depending on their particular need at no cost. The flexibility and level of detail offered by Coursera fits early career, new-to-lab-research staff as an introduction to market principles. A description of each course pulled directly from their website follows.

Course 1: Developing Innovative Ideas for New Companies: The First Step in Entrepreneurship

Commitment: 3–5 hours/week

This course assists aspiring and active entrepreneurs in developing great ideas into great companies. With strong economies presenting rich opportunities for new venture creation, and challenging economic times presenting the necessity for many to make their own job, the need to develop the skills to develop and act on innovative business opportunities is increasingly vital.

Using proven content, methods, and models for new venture opportunity assessment and analysis, you will learn how to identify and analyze entrepreneurial opportunities.

Entrepreneurial mindset, strategic decision making, and business modeling are core elements of the course. Our goal is to demystify the startup process, and to help you build the skills to identify and act on innovative opportunities now, and in the future.

With this course, students experience a sampling of the ideas and techniques explored in the University of Maryland's master's degree in technology entrepreneurship, an innovative 100% online program. Learn more at <http://mte.umd.edu>.

Week 1: Introduction to Innovation and Entrepreneurship

This module includes a welcome to the course, an orientation to our teaching approach and faculty, and an introduction to the fundamentals of innovation and entrepreneurship.

WEEK 2: Entrepreneurial Mindset, Motivations, and Behaviors

This module explores entrepreneurial thinking with attention to entrepreneurial mindset, entrepreneurial motivations, and entrepreneurial behaviors.

WEEK 3: Industry Understanding

This module examines how to recognize entrepreneurial opportunities based on market conditions and industry factors.

WEEK 4: Customer Understanding and Business Modeling

This module introduces approaches to understanding customers, developing compelling solutions, and crafting winning business models.

Course 2: Innovation for Entrepreneurs: From Idea to Marketplace

Commitment: 3–5 hours/week

Develop insights on navigating the innovation process from idea generation to commercialization. Build knowledge on how to create strategies to bring innovations to market. Develop an innovation portfolio and business model canvas for your venture.

We establish a framework for examining the innovation process, and quickly transition into exploring how to successfully bring innovations to market. Key questions answered within the course include:

- What are the key indicators of innovation opportunities?
- What steps are critical for entrepreneurs to bring innovations to the marketplace?
- What innovation strategies are valuable for new ventures to establish and maintain a competitive advantage?

With this course, students experience a sampling of the ideas and techniques explored in the University of Maryland's master's degree in technology entrepreneurship, an innovative 100% online program. Learn more at <http://mte.umd.edu>.

WEEK 1: Introduction

This module includes a welcome to the course, an orientation to our teaching approach and faculty, and an introduction to the fundamentals of innovation and commercialization.

WEEK 2: Customer Discovery and Validation

This module provides an overview of the customer discovery process, and insights on customer validation. The opportunities and challenges of planning, conducting, and analyzing customer interviews are also discussed.

WEEK 3: Product Understanding and Marketing

This module explores the commercialization process with an emphasis on research-based product planning and market segmentation.

WEEK 4: Prototyping and Testing

This module introduces key principles of product (or service) prototyping and testing, and highlights tools to use in these activities.

WEEK 5: Building a Team

This module addresses how to find, hire, and motivate your employees.

Course 3: New Venture Finance: Startup Funding for Entrepreneurs

Commitment: 3–5 hours/week

This course is for aspiring or active entrepreneurs who wants to understand how to secure funding for their company. This course will demystify key financing concepts to give entrepreneurs and aspiring entrepreneurs a guide to secure funding.

Examine the many financing options available to get your new venture funded. Learn the basics of finance, valuations, dilution and non-dilutive funding sources. Understand capital structure for new ventures, term sheets and how to negotiate them, and the differences between early-stage versus later-stage financing. Develop an understanding of how to develop winning investor

pitches, who and when to pitch, how to avoid common mistakes that limit the effectiveness of the pitch, and how to 'get to the close'. Key questions answered within the course include:

- When to raise outside capital?
- What kind of investors invest by stage and where to find them?
- What are your fundraising options?
- What are the key components of the term sheet?
- How to perform company valuations?
- How to pitch to investors?
- What techniques help the entrepreneur 'get to the close'?

With this course, students experience a sampling of the ideas and techniques explored in the University of Maryland's master's degree in technology entrepreneurship, an innovative 100% online program. Learn more at <http://mte.umd.edu>.

WEEK 1: The Early Stage Investment Landscape

This session provides insights into the investment landscape, to include how investors and lenders evaluate new ventures. Key terminology and principles are addressed to provide learners without an accounting or finance background with an understanding of these areas.

WEEK 2: Sources of Capital for the Early Stage Company

This session examines the options that entrepreneurs face in where to raise their financial capital from in the early stages of their venture. From friends and family, to angel investors and venture capitalists, the pros and cons of each source of capital are explored.

WEEK 3: Getting Funded – Steps in the Funding Process

This session discusses the techniques and tools to secure funding for a new venture. This provides insights into how entrepreneurs can create a comprehensive funding strategy for their new venture.

WEEK 4: Pitching Investors and Closing the Round

This final session instructs learners on how to share their investment opportunity with investors and partners. With practical tips on the do's and don'ts of pitching, learners are able to develop a compelling story for their new venture.

Capstone Project: Entrepreneurship Capstone

Commitment: 3–5 hours/week

Integrate the tools and concepts from the specialization courses to develop a comprehensive business plan. Choose to enhance new venture concepts previously explored in specialization courses, or develop a new concept for this capstone project. Develop a comprehensive, customer-validated business model and create an investor pitch for the concept.

With this course, students experience a sampling of the ideas and techniques explored in the University of Maryland's master's degree in technology entrepreneurship, an innovative 100% online program. Learn more at <http://mte.umd.edu>.

WEEK 1: Defining the Opportunity

WEEK 2: Discovering the Customer

WEEK 3: Understanding Customers

WEEK 4: Creating the Marketing and Sales Strategy

WEEK 5: Refining the Solution

WEEK 6: Crafting the Business Plan

Technology Ventures Corporation

Technology Ventures Corporation (TVC) offers market principles training in an interactive classroom setting. This training can be directly tailored to the specific needs of the organization requesting the education. INL offered an introductory 10-week course taught by TVC representatives and local (to INL) business professionals to the general INL research staff about 3 years ago. The training had value in exposing researchers to marketing principles, but needed additional tailoring to fit within the boundaries and flexibilities of government-sponsored research. Since the course is modular, or broken into chapters, all or just a portion of the course could be taken with the primary impact being on the normalized cost per person. Because this course is taught in a classroom setting, there is more interaction and engagement with the instructor and other students, potentially allowing for a richer and deeper learning environment. With proper tailoring, this course could be ideal for the mid-career researcher working as a principal Investigator. A description of each chapter in the training pulled directly from their course material is as follows.

Chapter 1: Entering the Entrepreneurial World; Introduction to Commercializing a Product

Section outline:

- The Reasons for a Comprehensive Planning Process
- What the Investor is Looking for in Their Investment
- The Five Risks of a Start-Up Company
- The Requirements For and Components of a Business Plan

In this section we want the entrepreneur to fully appreciate the complexities and efforts required to put together a detailed and meaningful plan to achieve their desire to take an innovative idea to the marketplace. The entrepreneur will understand that the planning process ties together all parts of the envisioned organization and its processes and efforts in forming, financing, and operating an emerging or expanding technology-based business entity. The emphasis will be on having the entrepreneur understand the absolute requirement for a thorough business plan or case that will attract equity and/or grant funding, and provide a base

for marketing and selling a product. The section addresses what the investor looks for in the plan and how critical it is in the potential funding process. As a quick overview, the section briefly outlines the components of a business plan and the need for the completeness of the business plan. A brief discussion of ethics in business will express current corporate environment and concerns.

Chapter 2: Market Research and the Marketing Plan

Section outline:

- Planning and Executing the Market Research Endeavor
- Developing a Marketing Strategy and Plan
- Distilling Market Research - The SWOT Analysis The 4 P's - Product, Place, Promotion, and Price
- Forecasting Sales and Revenue -The Revenue Model and Breakeven Analysis

In this chapter we discuss the significant endeavor required in determining the market/sales potential of a product, understanding the dynamics of the marketplace, forecasting sales and revenue into a revenue model, and producing a marketing plan. At the conclusion of this chapter we want the entrepreneur to understand the complexity of the market research process; specifically, that there is not a universal service or readily available resources that can define the market or easily assess their particular product's potential. We will define the 4 P's (or elements) of marketing a product. We will walk the entrepreneur through the intricacies of the revenue model and explain how the numbers are derived and developed into a projected sales spreadsheet. The fourth section of this chapter will explain the various elements of a marketing plan, a major component of the ultimate business plan.

Chapter 3: Financial Management

Section outline:

- Raising Capital - The 3 F's, Federal/State Government Programs, Equity Investment, Debt Financing, Mergers & Acquisitions
- Understanding and Using the Financial Statements and Preparing and Using a Budget Projection and Proforma Financials
- Recognizing the Various Tax Issues and Applications
- Enterprise Valuation (What's it worth?)

This session explores raising capital by defining the various funding avenues, with a concentration on the equity funding resources. The chapter will address the 3 F's (family, friends, and fools), Federal/State Government Programs, Debt Financing, and Mergers & Acquisitions. It will define and illustrate the three principal financial statements including the balance sheet, income statement, and cash flow statement; and will explain how important it is for the entrepreneur to understand and be able to use the financial statements developed within the company. A particular emphasis will be placed on the cash flow aspects of a business venture. The chapter will also explain and provide examples of budget projections (using the revenue model) and the proforma financial statements. The third section of the chapter will explain the

various taxes facing the entrepreneur and a business entity and any unique applications relative to industry or residency of the company. The enterprise valuation section will explain the most common methods of valuation of a startup or new expanding company. We will explore the stark reality of giving up part of your hard earned efforts to an investor or partner to fully realize the market potential of your innovation.

Chapter 4: Preparing and Presenting the Business Plan

Section outline:

- Title Page
- Table of Contents
- Executive Summary
- Description of the Business
- Description of the Product and/or Service Offered by the Company
- Description of Intellectual Property Rights
- Market Description and Competition - The Marketing Plan
- Company Goals and Business Strategy
- Manufacturing Processes and Quality Assurance
- Financial Plan - The Revenue Model and the Proforma Financials
- Organization Requirements and Management
- Board of Directors/Advisors and Present Stock/Share Ownership
- Capitalization Plan - Acquisition and Use of Funds - Return to Investors
- Assumptions and Risks
- Supporting Documents and Materials

Although there are individuals and companies that are available to write your business plan, only you will be in a position to present and defend your business plan before the investor. Much of your personal and professional credibility will depend on how well you understand your product and market; your plan to commercialize the product, and the organization that will carry the endeavor. As you develop your business plan, keep in mind that the greatest beneficiary of this endeavor is not the possible funding source, whether banker or investor - it's you. Without the toil of working through this difficult process, you will be ill prepared and likely unsuccessful.

Chapter 5: Operations Startup, Monitoring, and Human Resources

Section outline:

- The Organization - Managers and Management Structure and Elements and Practices of an Effective Business Organization
- Essential Legal, Accounting, Taxation, and Record Keeping Requirements and Processes
- Essential Facilities, Equipment, Manufacturing Processes, Inventories, and Suppliers in Place
- Establishing Business Barometers and Financial Analysis Formats
- The Human Side of Business:
 - Important Factors of Success

- Job Descriptions
- Salary Planning
- Recruitment
- Making the Decision
- Start off on the Right Foot

Whatever business you are in or plan to get into, you must have an organization to support it. Sales don't just happen because you have an idea; you must develop it, fund it, produce it, promote and market it, manage it, and control it. The way you do that is through an organization - and that can be anywhere from one person to five hundred people.

Chapter 6: Attacking Equity Investors- Securities Laws, Intellectual Property, Term Sheets, and Lessons Learned

Section outline:

- Intellectual Property Issues
- Securities Laws and Regulations
- The Investor
- Term Sheet Lessons Learned

In this chapter we will explore the intricacies of intellectual property (IP) issues and what complications the entrepreneur will face in securing and applying these rights in order to attract the equity investor. We will also touch on the complicated areas of securities laws and regulations. As a general rule you as the entrepreneur will be seeking investors and that act will entail a corporate structure that will include the issuance of securities in your company. Doing this the right way and with the right planning will save you many headaches, ease the transition of investor ownership interests, and avoid potential legal problems that could destroy your company. The term sheet is the document that represents the initial understanding and the starting point of negotiation between the investor and the entrepreneur; it usually indicates a real interest on the part of the investor. We will pay particular attention to the complexities and nuances of the term sheet and indicate what to be particularly aware of in negotiating and accepting this document.

Lab-Corps

Lab Corps is a program sponsored by the U.S. Department of Energy (DOE) to help national laboratories and industry connect and speed the transfer of innovative research into the commercial marketplace. Implementation of the program assumes that relatively mature ideas and technologies exist and need the structure of a “Business Model Canvas” to identify and connect key stakeholders through an engagement framework rather than a principle-based structure. Lab-Corps does not have a foundational training option like the other options explored by INL, but instead drives a more-immediate implementation of core market ideas, particularly identifying the customer segments and value propositions for the technology of interest. The strength of Lab-Corps is its direct hands-on approach with industry interaction that offers

researchers direct input on the market needs of industry. With these considerations, Lab-Corps is best suited for experienced researchers who lead sizable areas of research and have a potential pipeline of mature ideas and technologies. An example of the “Business Model Canvas” framework is shown below.

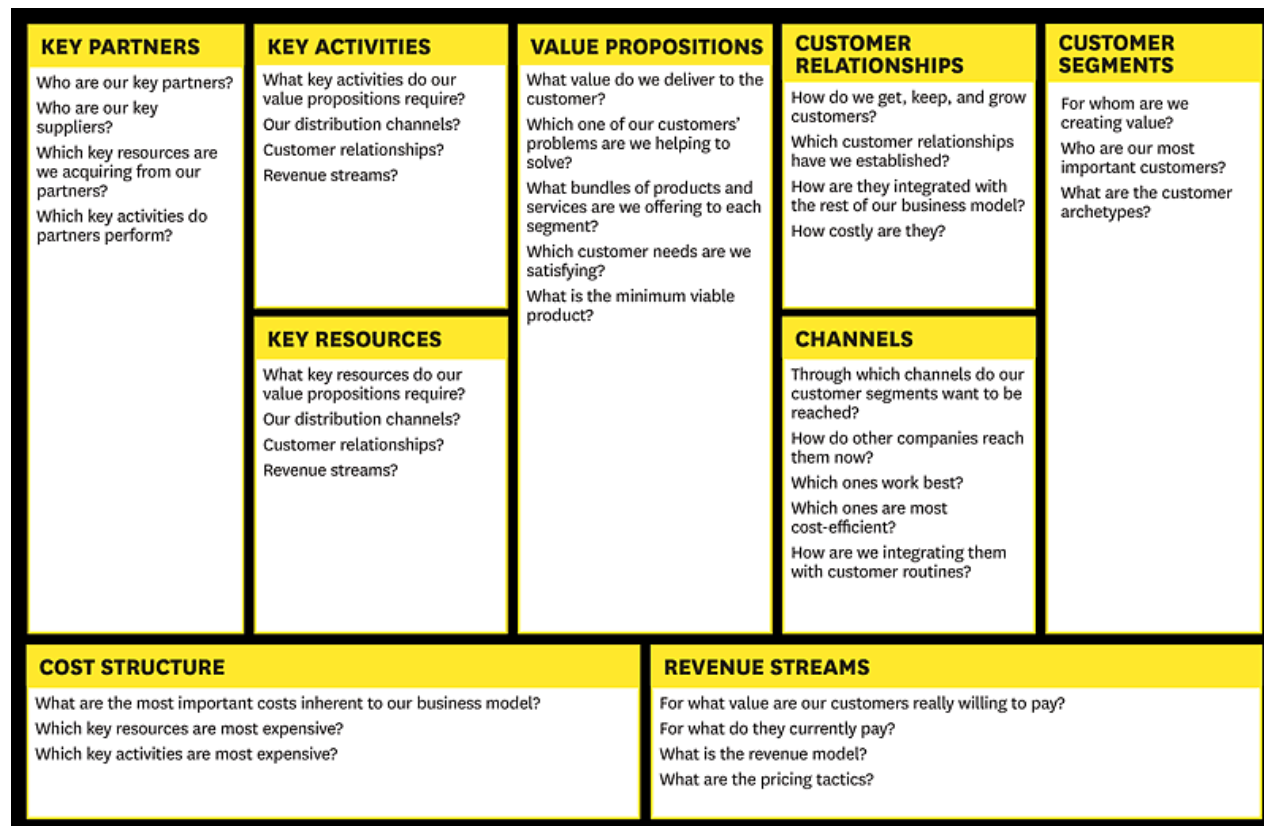


Figure 2. Example of a Business Model Canvas used as a core framework in Lab-Corps. (<https://hbr.org/2013/05/a-better-way-to-think-about-yo>).

As stated on DOE-EERE’s website, Lab-Corps was established based on the National Science Foundation's “Innovation Corps (I-Corps)” model. The current program is being established with a pilot phase lead by DOE’s National Renewable Energy Laboratory (NREL) and supported by Brookhaven National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratories with additional pilot support provided by Argonne National Laboratory, INL, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, and Pacific Northwest National Laboratory.

Results

After careful review of the three options, Option 1, Coursera.org, was chosen as this project’s pilot training program because it was immediately available (online), required no cost if certification was not required, had a reasonable schedule for completion that fit most researchers’ availability, and was most applicable to staff in their early career. The go-ahead decision was made in August to train five INL research staff in basic entrepreneurial principles

through the Coursera Entrepreneurial Program. These staff completed the course in October and have documented their before and after understanding of technology transfer principle with respect to the training provided in the first three Coursera training courses by answering the following questions,

1. What do you believe is the value of technology transfer, especially in government research?
2. What did you know about transferring technology from INL to industry before you took the training?
3. What do you know now, after taking the training?
4. What was the value of the training in terms of how you might approach technology transfer when planning research?
5. Were there parts of the training that were more valuable than others? If so, what were they?
6. Where does this training fit into the career of a government laboratory researcher (early, mid, late) and why?
7. Do you feel the concepts you learned in the training can be applied immediately in your research? What are the concepts you will apply?
8. What would be the next steps or additional training you feel you need to best apply Technology transfer principles?

Summary of researcher responses

Question 1: What do you believe is the value of technology transfer, especially in government research?

The role of a federal laboratory is to perform critical national interest research, develop and capture intellectual property, and then transfer this knowledge to U.S. industry to enhance the nation's competitiveness. To do this, it is important that we understand the principles needed to transfer research to industry. This is challenging without a clear understanding regarding the steps and process of transferring the research into industry. Primarily, the challenges are in understanding the areas of profits and investments. The research can be interesting and applicable; but if it is not profitable or marketable, it is of little use to a profit-driven entity.

Technology transfer also aides in identifying and creating knowledge and skills that provide the basis for new development. Since a private company may not have the resources and a government laboratory is not allowed to sell products or processes, the teaming of the two presents a solution to use government resources, knowledge, and skills for development and then transferring the results to private industry where it can be competed for in the general market. This technology transfer is important as a source for shared prosperity and also as a stimulant for competitive trade both nationally and internationally.

In fact, technology transfer is crucial for government research institutions. A general opinion is that the role of government research should be to fill the gaps between fundamental research performed at universities and the applied research done in industry. Currently, this gap is filled in two ways at INL. First, INL has user facilities that allow research to be performed on an

industrially relevant scale while also providing the flexibility to perform fundamental research along the way. Second, INL participates with other national laboratories to demonstrate research on a scale that cannot be done in academia and is not profitable for industry.

Thus, it is important that the research national laboratories do is targeted toward solving the problems that private industry either cannot solve or are unable to solve due to resources for the purpose of benefitting the nation or world.

Question 2: What did you know about transferring technology from INL to industry before you took the training?

New or very junior researchers generally knew the ideas and concepts around transferring technology to industry based on the premise that all projects they participated in were designed to help industry with difficult problems. However, their experience was limited and they admitted to not fully comprehend its importance. The only experience they had with technology transfer from research to industry prior to taking the training was with the general process of patenting and licensing patents to industry.

More senior researchers suggested that their knowledge and more importantly their experience was rather high. However, they too had most of their experience in the patenting and licensing process, which can be once removed from the industry limiting personal interaction.

In a couple of cases, researchers have chosen to explore technology transfer principles on their own in college, in books, or on the Internet, because they saw the intrinsic value in the information. However, they felt that applying these principles is a lot more challenging than one would think to move research to market.

Question 3: What do you know now, after taking the training?

After taking the training course the researchers felt they understood a bit better what goes into making a profitable business. Some felt the course didn't go into enough detail to make them comfortable taking research they are doing and moving toward a spin-out company. In fact, they wished it had discussed in more detail the licensing of technology to help avoid developing technology that cannot be used by industry or that cannot stand on its own as a business, but promote technology that can enhance or improve existing technology.

Generally, the researchers felt this training provided a very high-level explanation of what it takes to start a new business. It included information on everything from the mindset of a typical entrepreneur through understanding the market, including where the new technology has a role, all the way to business models. The focus was mainly for those looking to start a new business and market a new product so all of the "research" was focused on analyzing the trends and requirements of the market space the entrepreneur intends to enter. Overall, the training clearly described the importance of technology transfer as a source for shared prosperity and stimulating competitive trade both nationally and internationally.

Question 4: What was the value of the training in terms of how you might approach technology transfer when planning research?

This training held little direct value to incorporating technology transfer into the current structure of government research. In fact, the training itself was not specific enough to Renewable Energy technology to really apply to the research we do here at the laboratory, nor was it apparent as to how to apply it to every day research. However, the big picture view of the entrepreneurial world and process offered by the course did provide a better platform of understanding for how laboratory technology could be transferred. The discontinuity between the research done at a national laboratory and the view offered by this course is that the focus of this course was on doing something to break the mold or reinvent the wheel. National laboratory research rarely tries to apply technology in a new manner but rather assesses the current state of technology as a whole.

The course did change the perspective of researchers regarding how to establish research plans and priorities. They felt there was new understand that promoted a need to identify early in projects the markets that would potentially be impacted by the research. One suggestion from a researcher was to plan research projects to have similar or consistent metrics as industry (i.e., miles per gallon, efficiency, cost/kwh, etc.) This, they felt, would help establish manageable windows of time to transfer technology to industry such as 0–5 yrs, 5–10 yrs, and beyond 10 yrs, that would allow laboratory research to better decide where to spend internal research dollars.

Question 5: Were there parts of the training that were more valuable than others? If so, what were they?

The first course was generally interesting and offered content somewhat related to general technology transfer principles. The second course was a little harder to connect to laboratory research, perhaps because it took a more industry centric point-of-view. The third course however, appeared to have even less value for the government/industry technology transfer angle and more general value for any entrepreneur who is starting a new business. If a researcher were to leave the laboratory and start a new business, then Course 3 would be most beneficial.

From another perspective, the aspects of this training that held the most value to laboratory researchers was the focus on identifying, building, and utilizing a diverse team to solve problems (Course 1 and part of Course 2). This section highlighted the need for a champion or, in the terms of a national laboratory structure, an experienced peer that can help guide and direct the use of solid project management, project execution, and now technology transfer principles. This information and mindset can be easily applied at a national laboratory where research can often be diverse and change rapidly. On the other hand, the aspects of the courses that relate to business models (products, services, subscriptions/licensing, etc.) and how the mind of a successful entrepreneur functions were not relevant to transferring technology to market (mainly Course 3).

Areas of the course that helped identify and bring industrial partners to the table filled a major gap recognized by all researchers trained.

Question 6: Where does this training fit into the career of a government laboratory researcher (early, mid, late) and why?

All trained researchers felt this type of training fits into the early part of their career because of the broad overview of the information provided. The success of this training is felt to be greater and longer lasting when taught to early career staff rather than those late in their career. Though, this course had very little focus on how to develop research ideas that could be taken into a free market and focused more on market analysis, it did provide a good overview of the business world/structure and was generally enjoyable to take for early career researchers.

Speaking more specifically about this training, Course 1 has enough useful content to be beneficial to all three career levels, where Course 2 would benefit mid-to-late careers, and Course 3 benefits those who do not plan on making a career at the laboratory, but rather leaving the laboratory to pursue their own business ventures.

7. Do you feel the concepts you learned in the training can be applied immediately in your research?

Two of the five researchers said no, that their responsibilities at the laboratory could not immediately make use of the knowledge. However, they did feel that the team-building concepts (like finding people for your team from diverse backgrounds and experiences) have some applications to working in a government research environment. These concepts can be applied when they are in a position to seek out help on research projects across the laboratory complex or working on laboratory-directed research and development (LDRD), or when supporting the hiring of new staff. Furthermore, they felt that the information helps them understand why project leads and management make certain decisions.

Three of the researchers said yes, that the information and insight on business decision making and investing was valuable. They felt that aligning some of our thinking with the way industry thinks (metrics, investments, competition, etc.), as embodied in some of the training, will attract industry to work with us. These researchers felt that this training will be most applicable to their proposal writing and communications with industry partners.

8. What would be the next steps or additional training you feel you need to best apply Technology transfer principles?

Though additional training on how research can move through the government system to the commercial sector would be useful, the Coursera training was heavily industry-focused and more applicable outside of the government environment. Thus, there are two areas for follow-on:

1. Provide additional, more in-depth training on developing a business model so that technology development can be placed into context with industry thinking.

2. Identify a “champion” or mentor that can assist in applying the fundamental market principles to national laboratory research.

Conclusions:

Early career researchers found less value in the course overall than did the senior researchers, with a consensus that Course 1 and 2 had more value than did Course 3. The researcher’s experience with the training was impacted by a lack of overall fit within their career track, as evident by the comment “At the stage of early career, where a researcher’s role is to support project leads, technology transfer training has little value.” If technology transfer training were tailored to national laboratory research and incorporated into a researcher’s overall career development plan, staff might find more value in the training as a way to advance from a researcher to a principal investigator to a market/platform lead. Finally, some comments reflected that the Coursera courses had some valuable information, but it seemed disconnected from their daily activities.

Out of the three training programs INL reviewed, assuming some modifications could be made to each program to make them more applicable to the national laboratory environment, the Coursera program would fit earlier career, the Technology Ventures Corporation program would fit mid-career, and Lab-Corps would fit mid-to-late career. Out of the three, the latter two training options, Technology Ventures Corporation and Lab-Corps, have structures that allow them to be more adaptable to specific technologies. As such, these training programs could have significant elements that target wind and water technologies and the respective industry players. Results would be a structured program that provides basic-to-advanced technology transfer training to researchers that could then follow a path specific to the technology they are researching. This program could then be ported to other laboratories and made available to industry so that interfacing is clear and manageable.

For overall best results, mid-to-late career researchers experienced with specific technology development, and technology transfer and product market principles would provide mentoring to early career staff. This approach would connect the training with experience and ideally to existing industry relationships to allow for tailored transfer of government-funded technology from national laboratories to industry.

Next Steps:

INL recommends that a technology transfer training curriculum be developed that is explicitly part of a researcher’s long-term career development plan, including obtaining positions of project leadership such as principal investigator or market/platform lead. This curriculum would identify the correct level of training required for early, mid, and late career staff where technology transfer principles progress from fundamental to practical implementation. As part of the curriculum development process, additional training options, including the potential to modify any or all three of the programs evaluated in this project, would be evaluated. These modifications would include the ability to target specific technologies associated with the various DOE offices, including Wind and Water Power Technologies Office.

As a result of this project, researchers in INL's Wind and Water Power program understand the basic options and approaches of three technology transfer training options. We believe it is highly likely that these and perhaps other training options cannot only be modified and tailored to fit the career level of researcher and the specific research technologies of interest, but can also be modified to fit the needs of national laboratories and be readily ported to all laboratories in the DOE complex.