# EMERGING ISSUES AND RECOMMENDATIONS FOR TECHNOLOGY TRANSFER AND COMMERCIALZIATION IN A GLOBAL MANUFACTURING ENVIRONMENT

## INTRODUCTION

We are entering a new era of global competition that demands U.S. corporate, academic and government leaders' attention to our research and innovation resources and how they can be leveraged to increase U.S. manufacturing, corporate and entrepreneurial capacity. University-based technology transfer, commercialization and industry collaboration are generating growing interest as powerful innovation tools for universities to disseminate technology and knowledge and to share assets, for corporations to accelerate the commercialization of innovations, and for the nation to leverage its valuable resources to reinvigorate the economy and create jobs. The escalating interest, in part, stems from the recognition that academic institutions play a growing central role in regional and national economic development. The scientific and technological assets, and know-how emanating from universities, federal laboratories, medical and other research institutions, form a powerful base that can usher in a new, globally competitive era in U.S. manufacturing and technology.

The Bayh-Dole Act, which allows university and other non-profit ownership of the inventions resulting from federally-funded research, has contributed to the formation of some of the nation's top technology firms. As the innovation ecosystem evolves and new technologies emerge, it is prudent to consider the other policies, incentives, and structures that best support university-industry collaboration to mutually benefit all parties and to accelerate the discovery-to-innovation process needed to compete in a global innovation economy.

To remain a leading player in the global innovation economy, the United States must restore its position in advanced manufacturing, develop a

workforce that is better prepared to meet global technological challenges, and accelerate the rate at which it translates research and intellectual assets into economic benefits. The simultaneous challenges arising from the U.S. economic downturn and growing Asian competition demand that we leverage all economic resources available to the United States, especially the nation's stellar research institutions and the once-dominant industrial and technological sectors.

This brief document is intended to summarize some of the key issues and recommendations for government, academic, and corporate leaders based on participant discussion at the April 2010 Roundtable on "Accelerating Innovation by Enhancing University-Industry Collaboration and Optimizing Commercialization of University Innovations." Additional input was provided by other national experts who submitted brief discussion on their top issues. The Roundtable was jointly sponsored by the Council on Competitiveness (CoC) and The University of Akron. It was part of the U.S. Manufacturing Competitiveness Initiative, a two-year project of the CoC, that is bringing together a dynamic cross-section of America's top public and private sector leaders to advocate for a comprehensive set of policy solutions that will make the U.S. the most fertile and attractive environment for high-value manufacturing.

The CoC Manufacturing Competitiveness Initiative is examining the entire manufacturing enterprise system, from ideas and concepts to research and development, design, logistics, supply chain, and the regulatory and trade environment. It also is looking at the next generation of challenges and opportunities such as energy, global health, and other areas in which manufacturing will play an enormous role. The CoC, UA, and other distinguished organizations are partnering to convene a series of roundtables that will contribute important insights and ideas to the Council's policy roadmap, to be released at a National Manufacturing Summit in 2011.

For more than two decades, the CoC has led the national and international policy debate on competitiveness issues, including the role of technology as a core driver of long-term prosperity – from its seminal work in the early 1990s on *Critical Technologies*; to our path breaking *Going Global* effort that benchmarked the globalization of R&D capabilities in five industry sectors; to the nation's first "National Innovation Summit" at MIT in 1998; and, to the nation's first National Innovation Initiative and agenda in 2004. Through initiatives like these – in addition to the Council's latest efforts in this space, public-private partnerships, publications, conferences and extensive leadership networks – the Council provides national leaders with first-to-the-world insights on the issues that are changing the world's competitiveness equation.

The University of Akron (UA) is a national leader in regional economic development, research, innovation and technology transfer. The UA Research Foundation (UARF) works closely with industry to provide a broad range of nationally-recognized innovation, technology development, commercialization and intellectual property services. Through initiatives such as the University Park Alliance, UA is revitalizing the community into a greener, more entrepreneurial environment. The Austen Bioinnovation Institute in Akron, a collaboration between UA and the regional medical school and hospitals, promotes medical innovation. As a key member of CoC's Executive Committee and Chair of its Regional Leadership Institute Steering Committee, and through other national boards, UA and President Proenza provide national and international leadership.

Innovation Associates (IA) contributed to the development of the Roundtable and produced this document in conjunction with CoC and UARF. For two decades, IA has forged ground breaking services in innovation, technology transfer, entrepreneurship and economic development. In addition to Roundtable discussion and other input for national experts, this document draws from IA's National Science Foundation (NSF) sponsored reports – *Technology Transfer and Commercialization Partnerships* and *Accelerating Economic Development through University Technology Transfer*. The document also builds on the work of numerous CoC programs: Energy Security, Innovation & Sustainability (ESIS) Initiative; Technology Leadership and Strategy Initiative (TLSI); and High Performance Computing (HPC) Initiative.[1]

In this document, we provide a summary, recommendations, and brief discussion of selected issues. The discussion and recommendations reflect input from participants in the Roundtable and additional national experts. A list of Roundtable participants and the additional experts appears at the end of this document.

## SUMMARY OF ROUNDTABLE DISCUSSION

Technology transfer and commercialization activities operate as part of a larger environment in which globalization and the implications from globalization are ever-present. Increasing globalization means that technologies flowing from U.S. universities and other research assets may or may not result in benefits to U.S. corporations and ultimately to U.S.

[1] Council on Competitiveness reports cited can be found at www.compete.org; Innovation Associates' reports cited can be found at www.InnovationAssociates.us.

workers, depending on the relative value of the commercialization pathway, production capabilities, and market considerations.

Roundtable participants express concern that countries competing with the U.S. are doing what the U.S. should be doing more of; that is, investing in research and education and stimulating innovation, technology, and advanced manufacturing and services. It may be time for the U.S. to rethink the way it formulates and carries out research and industrial strategies.

National strategies that provide incentives for increased investments in research, talent, and the creation and retention of manufacturers and other corporations, particularly in critical domains, are needed to strengthen U.S. manufacturing and job creation. Targeted tax incentives to stimulate research and the capitalization of startups, entrepreneurs and small innovation businesses are especially useful. Improving coordination and leveraging innovation and entrepreneurship programs across federal agencies, and between federal and state programs, are needed to increase efficiencies in current programs.

To develop effective strategies, industry and government leaders need the data as well as an understanding of the elements that contribute to best practices. Current information is not sufficient and better metrics are required by policy makers and administrators to identify and replicate effective practices, particularly those innovation and entrepreneurship practices that contribute to positive long-term economic impacts.

Universities are increasingly recognizing their role as “anchors” for regional job creation and economic development. Some are restructuring in order to make economic development a greater priority, and are providing greater incentives and rewards for faculty and students to engage in technology transfer and commercialization. They are implementing a wider array of entrepreneurial programs including mentoring, commercialization funds, and angel networks. And they are forming more internal and external linkages between technology transfer, entrepreneurial programs, corporate relations, and manufacturing extension.

While research universities now invest in technology transfer and commercialization functions, they often lack sufficient funding and expertise to achieve the full benefit of commercialization related activities. On average they devote less than one percent of their research budgets to commercialization. Many universities also continue to focus on achieving royalty income as a primary objective, that ultimately is realized by only very few universities.

Building entrepreneurial capacity and long-term relationships with corporations and corporate partnerships in research, commercialization and entrepreneurial activities, in the long-run, may be the more effective technology transfer strategy along with the training and movement of personnel. Most Roundtable participants strongly believe in preserving Bayh-Dole in its current form. However, it is also important to examine whether the full potential of university created intellectual property and expertise is being achieved, and how various forms of university-industry partnerships can be strengthened to the mutual benefit of industry, universities and their stakeholder communities.

Universities have a broad “tool chest” of research and talent assets available that present partnering and knowledge transfer opportunities. Principles of open innovation are increasingly used at academic research institutions and industry as a way to expand knowledge transfer and wealth creation.

Other research institutions including federal laboratories and medical institutions represent major sources of research and innovation for potential corporate partners. Such institutions have similarities as well as differences from academic institutions. In the case of the federal laboratories, greater direction and incentives from federal agencies to the laboratories’ contract operators would go a long way in promoting more corporate partnering, particularly partnering with small businesses and manufacturers.

Roundtable participants view talent development as a fundamental and critical underpinning for technology transfer and commercialization. Since “talent”, particularly STEM (science, technology, engineering and mathematics) is well covered under other initiatives we only briefly address it here. But we want to note its importance and voice concern over the current state of U.S. education and training. There also is consensus among Roundtable participants to expand H-1B visas and grant immediate citizenship to those earning advanced degrees in areas critical to U.S. manufacturing and corporate growth in emerging fields.

We applaud efforts of the current federal administration in devoting greater attention to technology transfer, innovation, and entrepreneurship. We hope that the recommendations and discussion here will result in policies and practices that improve the climate for innovation and entrepreneurship and will lead to appropriate programs, initiatives and incentives that promote our nation’s valuable research resources and make U.S. manufacturers and corporations more globally competitive.

# RECOMMENDATIONS

The recommendations represent the collective views of the Roundtable participants and do not necessarily represent the views of all participants. Recommendations also reflect input from additional national experts who were not able to personally attend the Roundtable but who submitted their "top three" issues and recommendations. Recommendations are divided into three major areas: (a) Forming Effective Federal and State Policies, (b) Strengthening University and Research Institution Structures, and (c) Enhancing Corporate and Research Institution Partnerships. Roundtable participants and others considered those recommendations marked with asterisks as particularly important. Highlights of Roundtable discussion and issues follow.

## Forming Effective Federal and State Policies

1. **Develop strategies and consistent programs for manufacturing technology deployment*:** Declining U.S. manufacturing capacity, in part reflects the lack of recent national attention and strategic prioritization devoted to manufacturing. Federal and state funding, and program strategies should reflect a renewed commitment to developing and deploying advancements in manufacturing.

2. **Increase federal support for technology commercialization*:** Roundtable participants and additional experts feel that there is not enough consolidated effort in federal agencies aimed at stimulating and supporting technology commercialization. This includes broad support for business assistance in startups and small businesses and manufacturers in programs such as SBIR, SBIC, MEP, TIP and others. It includes support for effective state technology and entrepreneurship programs that now face budget cuts, and for implementation of new commercialization or "proof-of-concept" centers. The federal government should not prescribe a specific type of center but rather allow states and communities to develop and implement centers that reflect their needs and leverage their resources.

3. **Institute and make permanent tax credits to promote R&D, intellectual property (IP) development and startups*:** A variety of tax credits can be used to spur new innovation, technology transfer, and manufacturing advancements in small manufacturers and startups. Roundtable participants highly recommended:
    a) Implementing a tax credit to help small businesses cover some of the costs of university technology transfer transactions;

b) Supporting permanent research and development (R&D) investment tax credits; and
c) Instituting tax credits for individuals (angels) to spawn investment in university (and potentially other) start-ups.

4. **Strengthen NIST's Manufacturing Extension Partnership (MEP) and university/federal laboratory relationships*:** MEP is encouraged to strengthen its efforts to establish relationships with universities and federal laboratories, and to leverage its network in the 50 states to promote transfer and adaptation of new manufacturing innovations stemming from university and federal laboratory technologies.

5. **Reform International Traffic in Arms Regulations (ITAR) regulations that unnecessarily restrict export of defense-related products and services*:** ITAR regulations implement provisions of the Arms Export Control Act and many Roundtable participants feel that these regulations unduly hamper technology transfer opportunities that can lead to manufacturing exports.

6. **Avoid over-reaching of the federal government on conflict of interest*:** The federal government role should be one of stimulating and supporting technology transfer and commercialization and not prescribing relationships between research institutions and corporations. Universities and other research institutions and corporations should have maximum flexibility in structuring their relationships.

7. **Support efforts to identify metrics, and to target and disseminate information on best practices*:** Leaders require more and better data and information in order to develop tools and programs that most effectively promote innovation and commercialization. Universities, federal laboratories and governments require better metrics, particularly to assess long-term economic impacts, and better information on best practices and the elements that contribute to those best practices.

8. **Preserve and protect Bayh-Dole*:** Most Roundtable participants feel strongly that the Bayh-Dole Act should be preserved. At the same time, they recognize that some research institutions may not be applying Bayh-Dole as effectively as possible. Further examination of such applications as well as improvement in its implementation may be appropriate.

9. **Reimburse small businesses for some expenses related to licensing research institution IP:** Reimbursement of at least some IP procurement and transaction expenses related to university licensing would encourage small businesses and small manufacturers to work more closely with universities and other research institutions. Suggestions range from instituting a cost-sharing initiative through state technology programs to providing tax incentives to a SBIR-type support.

10. **Build bridges between federal laboratories, academic research institutions, and industry, particularly small business and manufacturers:** Federal agencies, particularly the U.S. Department of Energy, need to encourage and fund federal laboratories to more actively engage with academic research institutions and industry, particularly small business and manufacturers in order to increase transfer and adaptation of laboratory-based technological advancements. Federal agencies should review, and restructure, where necessary, laboratory management contracts to promote technology transfer and economic development.

11. **Fund strategically focused research:** Funding strategically focused research, particularly research that is inter-disciplinary, long-term and consistent across agencies, provides a powerful base for future commercialization in targeted areas of vital interest to national competitiveness. Focused research in manufacturing and energy are two areas of immediate interest. At the same time, there should be a reasonable balance in funding other valuable research areas since commercial advancements often come from unexpected sources.

12. **Leverage and coordinate federal government and federal-state relationships:** Federal government agencies need to more effectively coordinate innovation and commercialization programs across agencies in order to insure maximum leverage and results. In addition, federal agencies should pro-actively identify and coordinate their programs with related state and community programs designed to support innovation and entrepreneurship. In light of diminished funding of state innovation and entrepreneurship programs, additional federal support may be considered since these programs provide a critical regional base that federal government programs build on.

## Strengthening University and Research Institution Structures

1. **Place greater focus on translational research and technology development*:** University leadership should place greater emphasis on translational research and applying university-based innovations to the commercial sector. While not diminishing the value of fundamental research, university leadership should send a clear message of support including the provision of tenure and promotion incentives to further encourage faculty and researchers to pursue translational research, technology transfer and commercialization.

2. **More effectively vet and triage university invention disclosures based on commercial potential*:** Often universities do not have the necessary resources, expertise or appropriate tools with which to base commercial decisions. Corporations and research institutions should work together to vet and triage university invention disclosures, and develop and institute appropriate tools.

3. **Encourage open innovation*:** Open innovation is becoming increasingly important in research institutions' ability to source knowledge and innovations from wherever the innovations emerge. This approach ultimately improves the end result through access and application of a wider range of innovation and research advancements. Universities, industries, and other research organizations should collectively and individually use the open innovation principles of sourcing innovations from all sources that can benefit their stakeholders, in addition to the continued licensing and exploitation of their own innovations.

4. **Reduce transaction costs for industry*:** A deterrent for manufacturers, particularly small manufacturers to apply university-based innovations, is the transaction cost associated with licensing the technologies. Universities and governments should identify and institute targeted ways to reduce these costs. One way is for research institutions to offer sliding scales that reduce licensing costs for small business and manufacturers. In addition, higher education institutions should institute industry collaborative teams that can respond quickly and decisively to meet specific small business and industry needs outside the traditional licensing process.

5. **Increase support for entrepreneurial programs including mentoring*:** In order to provide the infrastructure needed to help form spin-offs, universities should strengthen and support entrepreneurial programs including mentoring and entrepreneur-in-

residence programs and early-stage capital linkages. These programs can be invaluable to new and growing enterprises.

6. **Shift from a transactional to a relationship orientation*:** Universities, federal laboratories and other research institutions should shift from viewing corporations as a means to sponsor research and purchase licenses to one of forming true partnerships in the research and commercialization process. Research institutions and corporations mutually gain from developing long-term collaborations; and through these collaborations, universities most often receive greater financial return over the long-run.

## Enhancing Corporate and Research Institution Partnerships

1. **Improve university and federal lab training on commercialization and interactions with industry*:** Most university faculty and students, and federal laboratory researchers have little understanding of how to work with industry and how to commercialize research-based innovations. Better understanding of the commercialization process and of industry needs and culture potentially would increase commercialization rates in universities, research institutions, and federal laboratories.

2. **Improve points of entry for corporations:** Universities, federal laboratories, and other research institutions should have a central, visible, and easily accessible portal for corporations and others to identify ongoing research and technologies available for commercialization, entrepreneurship and small business assistance.

3. **Make technologies available to companies through a universal system:** University, federal laboratory and other research institution technologies that are available for commercialization should be made available to interested parties through a national, universal system. The system ideally would facilitate easy identification and assessment of commercial potential.

# ISSUES

## Global Competition and Its Implications

Increasing global competition is placing greater pressure on U.S. research institutions to step up their research and technology transfer activities to promote U.S. corporate competitiveness. There is concern that U.S. corporations are increasingly reaching out to foreign universities and research institutions for their intellectual property. Roundtable participants believe that greater U.S. corporate partnering with international academic institutions in part reflects the interest of the U.S.-based corporations in establishing a greater presence in emerging markets. But there are other, more disturbing potential reasons that U.S.-based corporations are partnering with international academic institutions, and these reasons have implications for U.S. research, IP, education, regulatory and immigration policies. Corporate representatives point to the rapidly growing research strengths of foreign institutions, particularly in some emerging areas such as energy. For example, one corporate representative refers to their working relationship with research institutions in Asia because of the Asian researchers' extensive and advanced technical knowledge in producing carbon nano-tubes from bio-based materials less expensively and of equal or higher quality than in the U.S.

> *We've had to waive some manufacturing requirements because companies were not able or lacked the capacity to manufacture in the U.S. … But with renewed U.S. policy and funding for manufacturing, and new technologies, it would help advance many types of technology.*
> *- Steve Ferguson, National Institutes of Health*

Another reason that is cited for U.S. corporate collaboration with foreign research institutes is the declining availability of scientific and technological talent in the U.S., and the concern that this gap is growing. In addition to the widespread consensus on improving the full range of talent in the U.S., there is also consensus on expanding foreign talent in the U.S. This includes expanding H-1B visas and tying citizenship to advanced degrees in areas critical to U.S. economic growth in emerging fields.

Foreign governments not only are increasing targeted research but are also providing aggressive incentives for U.S. corporations to invest in the research and retain the resulting intellectual property (IP). In Singapore, for example, the government offers incentives to fund basic research and augment current research, and allows the corporation to retain the specific IP that results. The government retains the right to license the IP in a

broader field of use. Even the National Institutes of Health (NIH) now conducts about 15% of its licensing agreements with non-U.S. companies and there is growing interest in licensing early-stage technologies from India and China to address local markets.

More information and data is needed on the competing research and IP frameworks of other countries and why U.S. corporations are reaching out to research institutions beyond the U.S. Further examination of the comparative IP and regulatory environments, tax and other business incentives, and talent is needed.

## Talent

While there are many national initiatives that focus specifically on talent, we would be remiss not to touch on it here as a fundamental, underlying element that supports and impacts all aspects of research, commercialization and manufacturing. Corporations and research institutions alike express major concern about the full continuum of talent that is currently, and in the future will be available to them. Education must start in the early years and not only focus on science, technology, engineering, and mathematics (STEM) but also on instilling a skill set that integrates STEM with business, communication, and entrepreneurial skills.

> *We are very concerned about skills and who will be the researchers and innovators in the future. We need "T-shaped" people – deep technologically with a broad inter-disciplinary and business background … We are concerned about who will be there to feed the innovation pipeline*
> - *JoAnn Winson, IBM*

There is growing concern about the mismatch between corporate employment needs and the availability of skilled employees to meet those needs. Even in a period of high unemployment, corporate leaders say that they cannot find the skill sets needed. This situation is further exacerbated by the declining number of foreign students who disproportionately study science, engineering and medicine and are increasingly returning to their homelands after graduation. Corporate representatives believe that the remedy to this mismatch involves multiple solutions including (a) increasing education efforts at all levels, (b) retraining workers, and (c) insuring that skilled foreign students are permitted to work in the U.S. and are fast-tracked to citizenship.

University leaders also call for corporate leaders to communicate clearly and work with educational institutions on designing curriculum to match the specific skill sets needed for today and the future.

## Strengthening University Structures

As corporations are becoming increasingly mobile, communities are turning to universities and other research institutions to generate and anchor regional economic activity. Universities are evolving into major economic development players and academic leaders are exploring new and expanded territory. This territory increasingly involves technology transfer, commercialization and entrepreneurship.

What are some of the elements that create strong university structures to support the institutions' expanded role? University leadership can promote technology transfer, commercialization and other innovation activities by sending a clear, consistent message to its faculty about the importance of economic engagement, and providing internal incentives that reward engagement in collaborative research, commercialization and entrepreneurship. Those incentives involve hiring and advancement that credit faculty for corporate commercialization and partnering activities. Moreover, as university leadership changes, there is an even greater need for sending a consistent and unambiguous message.

> *Rather than a conflict of interest between university and corporate communities, we need a" synergy of interest" or a "confluence of interest" …. If we could simply reverse our thinking, we could get our perspectives more closely together.*
> - *Luis Proenza, The University of Akron*

Linking corporate relations, technology transfer, and entrepreneurial activities, including incubation and research parks, provides added value by coordinating and leveraging these normally disparate functions. One of the biggest changes that we see is the designation of a senior administrator (e.g., Vice President for Economic Development) with the responsibility for a range of economic engagement activities. A clear portal for business entry to university resources, both organizationally and virtually via web access, also sends a message to corporations that they are welcome as potential partners.

While there is increasing attention to university technology transfer, most universities devote surprisingly little funding to these activities. Less than one percent of the university research budget goes into turning science into intellectual property. University leadership may want to reexamine their budgets in relation to the institution's emerging roles in technology transfer and commercialization. At the same time, state and national policy makers, and corporate partners may want to consider greater incentives and investments as university budgets become increasingly constrained.

Corporate representatives express multiple concerns regarding their interactions with universities in commercializing university research. These concerns range from technology transfer offices obstructing the formation of close research relationships by insisting on overly specific, formalized documentation too early in the research process to misunderstanding or insensitivity with regard to corporate needs and time lines. Another common concern is that university technology transfer practices do not differentiate between different types of technologies and industries that require different IP considerations. Some of these concerns stem from miscommunication and some from differing missions and goals. Some by technology transfer personnel with narrow market and technology experience. While corporate goals and culture differ from that of universities, it is possible to find common ground. By increasing interactions between universities and corporations through a variety of activities, technology transfer disconnects can be minimized.

Research institutions must be able to strike a balance between being able to capture and manage their IP and yet operate flexibly enough to accommodate corporate concerns. These concerns often revolve around the valuation of commercial outcomes that may be quite nebulous and may not be realized for many years. There are two major valuation concerns: (a) timing – corporations often are reluctant to enter into agreements in very early stages where the outcomes are not clear and the end product is five to ten years away, and (b) complexity – a specific innovation may be a small part of an much larger end product/process, and the relative utility and value of the innovation may be unclear, particularly in early development stages. One university is working on a “fair return model” in which they ask potential corporate partners what they believe is a fair return if they successfully commercialize the IP. An agreed amount is paid instead of a strict up-front license. Universities and corporations alike would benefit from exercising flexibility and developing models for collaboration that are viewed by both parties as a win-win.

## Open Innovation

Universities and corporations are increasingly embracing the concept of open innovation. Open innovation allows connectivity among all potential contributors to a research issue and taps into a wide range of potential innovators that are not restricted within the walls of a specific institution. All gain through the application of external as well as internal ideas and pathways.

In addition, open-source practices promote access to source materials and innovations that allow others to build on and improve the originating innovation. In order for open sourcing and open innovation to work, universities and research institutions must be willing to relinquish rights to the technologies that they develop and forego potential short-term licensing revenue. A compromise may be to grant exclusive licenses for a specific field of use rather than a wider field and therefore open the technology to a multiplicity of applications that respect the specific field but do not limit the broader technological application. Open sourcing and open innovation are philosophical shifts away from the current research and licensing practices of most U.S. universities but are being viewed by some academic leaders with growing interest.

## Enhancing University-Industry Collaborations

Over the last decade, industry funding as a percentage of university research expenditures has declined. While there are many likely reasons including the more rapid increase in federal research dollars, one reason may be that corporations do not believe that they are receiving enough value to make their investments worthwhile. There also are indications that universities may not value corporate research as highly as government research funding. From a commercialization aspect, corporate funding of university research is particularly important since it builds a potential commercialization bridge. Corporate representatives comment that universities are often anxious for industry to come into universities, not just for the funding, but to help them provide application-specific focus for the university research, and to provide practical knowledge to faculty and students.

> *There is a lack of understanding … a false impression that universities are not responsive to and cannot act quickly enough to meet industry needs. This can be overcome by communication and strong leadership both in industry and universities.*
> - *Steven McKnight, National Science Foundation*

For research institutions and corporations, understanding each other's values and culture may be the most essential and difficult element in forming fruitful collaborations. How do universities and corporations increase their understanding of each other? Relationship building between research institutions and corporations requires mutual understanding and trust that is built over time. The more interactions that universities and corporations have through a variety of activities, the more likely it will be that the understanding and trust grows.

In addition to technology transfer and commercialization, universities have a virtual "tool chest" that can be used to interact with corporations and entrepreneurs, and to assist manufacturers. Some of the entrepreneurial tools include incubators, research parks, business plans, mentoring, commercialization and acceleration funds, and angel networks. The "tool chest" also includes manufacturing extension services, some of which pre-date the national MEP and are now part of MEP's national network.

Faculty consulting and personnel exchanges between universities and industries remain important tools that benefit both parties through a two-way knowledge transfer and builds the foundation for other relationships. Student internships also promote a two-way knowledge transfer and builds relationships.

Asset-sharing can involve the university providing a wide variety of data and information services to corporations, including library, analytic, technology assessment and characterization services. University centers such as EDA centers can provide regulatory and export assistance, trade adjustment, and outreach. Development of talent, including customized training programs, is of course part of the university's core mission and always a primary point of interaction between industry and universities.

At the University of Akron, retired local industry executives work with the University Research Foundation at no cost to link industries in the region and nationwide to the university. At the Georgia Institute of Technology, Entrepreneurs-in-Residence mentor startups. At the Massachusetts Institute of Technology, industry representatives mentor and judge applicants for business plan competitions. At other universities, industry representatives serve on advisory boards, participate in personnel exchanges, and host university startups through on-site and virtual incubators. All of these activities help build relationships that involve a two-way transfer of knowledge and pave the way for commercialization activities.

## Overcoming the "Valley of Death"

The "valley of death" is a term used to describe the gap between research developed in research institutes and resulting products and processes that are market-ready. The "valley of death" mainly involves two areas – very early-stage funding and business assistance.

Early-stage capital is becoming increasingly scarce. As venture capital becomes more constricted due to the recent financial crisis, it also is becoming more risk adverse, further widening the gap in early-stage capital.

In response, some universities are creating acceleration or commercialization funds that provide small amounts, usually $25,000-$100,000, to move research to a closer-to-market stage.

At the federal level, the SBIR and STTR programs remain the major tools for funding small technology businesses and startups. Other programs such as DOE's pilot program – Energy Efficiency and Renewable Energy (EERE) also are experimenting with a small technology commercialization fund. State programs have stepped in to fill the gap in early-stage funding by capitalizing "fund-of-funds" and other initiatives; but because of recent state budget crises, many of these programs now are threatened.

*The federal government should consider a trial program that makes block grants to regional associations that would provide entrepreneurs with small amounts of proof-of-concept funding ($10,000-$25,000) to develop inventions and ideas emanating from research institutions.*
- *Wayne Watkins, The University of Akron*

Angels remain one of the best sources of early-stage capital. Many national experts believe that we should implement tax incentives to stimulate more angel activity as well as identify effective mechanisms to match angel investments with potential commercial opportunities. Some universities have developed or link closely with community and state angel networks to provide early-stage funding for their university-based entrepreneurs.

Mentors, particularly entrepreneurs-in-residence, who are successful entrepreneurs, provide invaluable assistance to budding entrepreneurs at universities and elsewhere. The most successful models combine early-stage capital with mentoring by successful entrepreneurs.

Proof-of-concept centers are receiving increasing national attention and there are successful models at MIT, Georgia Tech, USC and NIH's National Cancer Institute. Some professionals are suggesting that the federal government provide "proof-of-concept" supplements to federal research grants in which the additional funding would used to accelerate the transition from research discovery to a "market ready" stage. While Roundtable participants encourage the exploration and implementation of these centers, they warn against any national program that might be overly prescriptive and assume that "one model fits all" environments. Any national initiative in this area needs to be flexible enough to take into account different types of technologies that may require different financing paths, and that leverage various local environments and resources.

## Special Issues Facing Small Businesses and Manufacturers

Small business and manufacturers often have more difficulty than larger corporations in accessing and commercializing innovations based at research institutions. One of the major obstacles is cost. Technology transfer offices usually require up-front funding, and this is difficult for most small businesses. One suggestion from a small business representative is for the federal government to implement a "mini-SBIR" grant that would reimburse universities for the patent costs licensed to a small business, rather than burden the small business with licensing fees to cover the costs. Also suggested is for universities to become more pro-active in helping small businesses secure SBIRs/STTRs. Suggestions for a central university portal to facilitate business access also would disproportionately benefit small businesses and manufacturers that find it difficult to navigate through universities and research institutions. Reducing transaction costs to small businesses and manufacturers through simplified licensing agreements based on generally accepted industry-university licensing provisions would speed up negotiations and encourage more small firm interaction.

> *We need to understand better the needs of small manufacturers in terms of transferring new technologies … And we also need to be able to improve navigating the university system in a more systematic way to find potential solutions to meet those needs.*
> *- Steve Thompson, Manufacturing Extension Program*

While some universities have long-standing, manufacturing extension services to assist small manufacturers, many of the extension services focus on helping firms meet international standards or institute specialized practices such as lean manufacturing or energy savings. Only recently has transferring and adapting new technologies developed in research institutions been considered a tool to advance U.S. manufacturers, particularly small manufacturers. MEP currently is building a set of tools to better understand the technology needs of manufacturers in the area of new proprietary products and processes.

There are several issues that particularly affect small manufacturers: (a) the cost of applying new technologies, especially if any IP is involved, (b) the expertise to apply new technologies, and (c) an understanding of the value of applying new technologies, and the willingness to do so. Because of increased global competition and rapidly changing technological developments, many small manufacturers are being forced to diversify and convert their products and venture into unfamiliar territory. The question remains about who are the drivers and facilitators of this type of

transformation, and what current resources in research institutions can be brought to bear?

## Federal Laboratories

Federal laboratories have some of the same issues as universities that involve collaboration with industry and IP, and sometimes have additional issues and restrictions related to national security. Small businesses and manufacturers in particular are often unaware of the technological resources and services available from federal laboratories, and they have more difficulty accessing the technologies and services than their larger counterparts.

> *We focus more on partnering with industry as a critical step in successfully transferring technologies … You need an intermediary, and we act as that intermediary.*
> - *Thomas Ballard, UT-Battelle, Oak Ridge National*

Some labs have actively pursued private sector relations and entrepreneurial initiatives including developing incubators and research parks, but most of these initiatives are very modest and represent a miniscule amount of the laboratories' operating and research budgets.

Federal laboratories respond to direction from their federal agency funders, and it will take renewed federal leadership for the labs to more actively engage in technology transfer and entrepreneurial activities. Improving industrial collaboration, particularly with small businesses and manufacturers will only happen if federal agencies require that contractors which operate the DOE labs, the largest of the federal laboratories, more actively develop and implement technology transfer, business assistance and entrepreneurial activities and provide the funding to facilitate implementation. This direction from the top would go a long way in helping firms access valuable new and improved innovations. With the advent of a director for technology transfer in DOE, we are hopeful that there will be a new opportunity to address enhanced corporate partnering, particularly for small business and manufacturers.

## Federal and State Policies

What are some of the federal actions that can be taken to transfer and commercialize technologies that will assist U.S. manufacturers and other U.S. corporations and entrepreneurs?

As we noted previously, research is the underpinning for technology transfer and commercialization. Currently, there is no integrated mechanism at the federal level that addresses industrial research needs in a coordinated, strategic way. The U.S. is one of the few industrialized nations that does not have an innovation strategy and a coordinated, coherent federal research portfolio. A corporate representative describes it as a "system of benign confusion." While some policy makers question whether the U.S. should have an "industrial policy," the reality is that the U.S. is losing ground against those countries that do.

Federal research also too often reflects outdated priorities and realities. The nation's research portfolio must be flexible enough to adjust to and reflect evolving needs. Strategies also should reflect direct and on-going input from Fortune 100 corporations and also from smaller manufacturers and growing technology businesses. At the same time, we need to strike a balance in research funding.

*Where the federal government has seeded activity, states and universities have stepped in, but they are not going to be able to afford to sustain that level of activity. There absolutely should be more connections between what the states and universities are trying to do and the federal government programs.*

- *Dan Berglund, State Science & Technology Institute*

All agree that research funding must remain strong if the U.S. is going to remain competitive. In some cases, it will mean increasing funding in strategic areas such as energy. Corporate representatives and others believe that any federal action should involve greater incentives in the tax code. All agree on making R&D tax credits permanent and examining ways to strengthen them. Others suggest that the tax code should be used to provide more incentives for the private sector and individuals to invest in both university research and in entrepreneurs spinning out of that research. Some suggest instituting greater incentives for patent pooling and patent donations. While others suggest that the R&D tax credits should also be used to provide incentives for talent development in emerging fields. Angel investment credits have been used successfully in some states and it is suggested that similar incentives be implemented nationwide. One of the challenges for federal policy makers is to strengthen research, innovation, and technology transfer and at the same time, recognize and account for the different needs of various sectors and types of industries.

Corporate, university and state representatives alike describe national innovation policies and initiatives as a "cobbled-together jigsaw puzzle". This refers both to the national programs that are spread across different agencies in an incoherent way and to the disconnected array of federal,

state and local programs. For more than 20 years, states have developed technology programs that support research, innovation and entrepreneurial activities through local non-profit organizations, universities, and other research institutions. These programs often are designed to add value to or fill gaps in federal programs. Ohio's Third Frontier, Pennsylvania's Ben Franklin Partnerships, and New York's Centers-of-Excellence are examples of these programs. As state programs increasingly face severe budget cuts, it is even more critical that federal and state programs coordinate and leverage each other.

Every now and then a major wake-up call comes from an ad-hoc initiative such as the "Gathering Storm" that prompts federal action. But perhaps it is time to develop research and innovation strategy on an on-going basis that is more consistent and coherent.

*Every few years we get a wake-up call and realize that our students can't compete or that we're losing a technology race to a "developing" country. Perhaps it is time that we rethink how we develop and carry out national policy in research, education, innovation and entrepreneurship to promote a clearer , more coordinated and targeted approach.*

- *Diane Palmintera, Innovation Associates*

**Metrics and Best Practices**

In order to develop more effective policies and initiatives in federal agencies, state programs, and universities, we need better data and information than is now available. This includes a full range of metrics on innovation, technology transfer, and entrepreneurship efforts in federal and state programs, federal labs, and universities.

Metrics shape our innovation and entrepreneurship programs. Incomplete, inaccurate or misplaced data will contribute to less than optimally effective programs. Universities often judge technology transfer outcomes on royalty income and therefore technology transfer offices tend to focus on royalty income as a primary goal. Metrics that capture the return on investment of longer-term, university-corporate collaborations or open innovation might alter the way that corporate relations and commercialization activities are conducted. This is also true for state programs that focus primarily on jobs rather than taking into account longer-term economic expansion, and for federal programs that rely on metrics that reflect limited, short-term outcomes. Some current initiatives underway in this area include the National Science Foundation's examination of its R&D statistical collection, and the Association of Public and Land-grant Universities work on capturing economic impacts derived from university economic development and related programs.

In the same vein, we are limited by our knowledge of the elements that contribute to best practices in the U.S. and worldwide. Ad-hoc efforts by the Council on Competitiveness, National Academies of Science, the Milken Institute, SSTI, Innovation Associates and others over many years have attempted to target the elements that contribute to successful innovation, technology transfer and entrepreneurship programs. But an expanded, on-going effort is needed to determine the most effective strategies and outcomes worthy of replication. We also would benefit from experimentation and implementing pilot projects that test various new and yet unproven tools to promote technology transfer, commercialization and entrepreneurship.

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