

Federal Reserve Conference on Innovation & Higher Education

***“From Ideas to Innovations: Moving Technology toward the Marketplace
Through National Labs and Universities”***

**Carl F. Kohrt
President & CEO, Battelle**

November 17, 2006

Thank you for that kind introduction. It’s a pleasure and a privilege to represent Battelle at this prestigious Conference.

So far you’ve heard – in exquisite detail, I expect – a number of presentations regarding the value of university-based research to the processes of commercialization and economic development. My hope here is to give you some additional information about our university-based research relationships, and augment that with some insight from our work with national laboratories.

About Battelle

Before I share some observations and anecdotes about our experience with moving technology toward the marketplace, I’d like to give my comments some context and – for those of you who may not know much about us – briefly describe Battelle.

Simply put, we’re a global science and technology enterprise that explores emerging areas of science, develops and commercializes technology, and manages laboratories for customers. Here are some key items of interest:

- We're a non-profit 501(c)(3) charitable trust formed in 1925;
- Our research and development activity totaled \$3.8 billion in 2006;
- We oversee more than 20,000 employees world-wide, including the national labs we manage or co-manage;
- We're involved with more than 5,000 projects for about 1,500 industrial and government clients; and
- We return a minimum of 20 percent of our profits to the community to meet our obligations as a charitable trust – the remainder is re-invested.

Our business is organized into three distinct segments:

- *Laboratory Operations*, which include the five national labs we manage or co-manage for the U.S. Department of Energy (Pacific Northwest National Laboratory; Brookhaven National Laboratory; Oak Ridge National Laboratory; National Renewable Energy Laboratory; and Idaho National Laboratory). These are focused on discovery but all provide user facilities and access to unique experimental tools including two of the five national nano-science facilities and light sources;
- *Research and Development* – now called *Battelle Science and Technology International* – in which we apply science and technology to challenges in areas like homeland security, life sciences and infectious diseases, and energy, environment, and advanced nanomaterials; and
- *Battelle Ventures*, an independent venture fund, which helps move technology into the marketplace and develops spin-out ventures as part of our overall business portfolio.

Battelle isn't an ubiquitous name – we don't manufacture household commodities, and you won't see our name on consumer products, but we're behind a number of the technologies and items you see in the marketplace. One of the best-known examples involved independent inventor Chester Carlson, Battelle, and a company called Haloid. They collaborated to develop a

process called “xerography” which, of course, led to the office copier machine and the Xerox Corporation.

Other Battelle innovations include:

- Fuel rods for the Nautilus – the world’s first nuclear-powered submarine;
- Pioneering work on the technology that led to the compact disc;
- Fiber optic advancements for telecommunications;
- Medical equipment such as high-efficiency inhalation devices to treat pulmonary diseases;
- Holograms for credit cards and metal sandwich coins for the U.S. Mint;
- A variety of new materials and chemicals from renewable and non-petroleum sources such as soybeans; and
- High-tech innovations for Operation Desert Storm.

The Case for Collaboration: National Labs and Universities

That’s a “snapshot” of Battelle and a few examples of practical technology-based innovations we’ve helped bring to the marketplace. True innovations, of course, almost never occur in a vacuum. That’s why, throughout our history, many Battelle innovations have come about through our alliances in both industry and academia.

Many good things can, and do, occur through collaboration. But before the real work can begin, common ground between the collaborators must be established. And reaching that common ground often requires a change, or at least a compromise, in what are sometimes very different organizational cultures and values.

Many of the failure modes experienced by Battelle in venturing and by me earlier in my professional life stem from not understanding these interfacial cultural dynamics. Let me briefly explain. From my vantage point as the CEO, Battelle consists of three distinct cultures: the first culture is one of scientific discovery – often curiosity-driven, conspicuous in the national labs,

and very similar to good research universities in many ways. Contemporary knowledge regarding market needs, time-to-market, or costs to scale up is often not cultivated or even necessarily valued. The “coin of the realm” is frequently peer recognition, peer-reviewed publications, research grants, facilities, etc. Patents, so-called directed research, or opportunities to leave tenure or the institution for a risky start-up tend to be less desirable options for most of the research staff or faculty who are already living their life’s dream.

The second culture at Battelle is one of product-development. Here, it is the delivery of a mission-critical solution on time and on budget to customers or collaborators who care that turns their emotional or professional “crank.” The coin of the realm, in this culture, is teamwork, and an ability to integrate ideas from any source to solve interesting and practical problems. These staff are often willing to let others define the problem for them while they focus on delivering the unexpected solution.

The third distinct culture has to do with venturing and commercialization. I will describe our experiences in more detail shortly. Suffice it to say, this culture values ideas only if they can be used to solve a real market need, in a timely fashion, for someone willing to pay for the distinct economic advantage it provides. Economic return on one’s investment is the true “coin.” Often, it is organizational leadership and knowledge of the markets being served more than the technology per se that is most important to success in this culture.

Hence, I consider my real title at Battelle to be the “CCC,” or the Chief Culture Cop, as much as being the CEO!

Before I describe how we deal with these issues in a constructive manner, let me share a telling example of culture that comes from Oak Ridge National Laboratory – and which implies that these cultural norms are long-lived and hard to change.

In 1960, a group of Oak Ridge National Laboratory scientists developed an instrument to study charged particles from the atomic nucleus. It wasn’t long before scientists at other universities and research centers began asking ORNL to supply them with their own detectors, which ORNL

chose not to do. As a result, a group of ORNL employees formed Oak Ridge Technical Enterprises Corporation (ORTEC) to produce the instruments, and the company went on to succeed beyond what any of the original members could have imagined.

Looking back on the experience, Hal Schmitt, a retired nuclear physicist from ORNL and one of ORTEC's founders, identified the barrier that in some circles is still an obstacle to commercialization. Schmitt said, "*There was a kind of underlying attitude that said, in effect, any association by a scientific researcher with the business world was crass, and, basically, was to be avoided.*"

Fortunately, most national labs and universities have since embraced the practical application of research through technology transfer and commercialization. As a result, labs and universities contribute to our quality of life and economic competitiveness, generate high-quality research and intellectual property, and participate with their industry partners in the resulting revenue stream.

Commercialization: the "Rules of Engagement"

Now – what do we see as the "rules of engagement" for laboratories, universities, economic development entities, and others who want to commercialize technology?

First, it's necessary to *recognize the three "engines" of innovation – intellectual, commercial, and venture*. The intellectual "engines," or sources of ideas and intellectual property, include national laboratories, universities, and research alliances. The conversion "engines," which translate ideas into prototypes or processes, are typically organizations like Battelle or other industrial partners that specialize in "applied" science. And commercial "engines," like Battelle Ventures, determine contemporary marketplace potential and begin the commercialization process.

Second, understand that *no organization or university is an island*. Whether developing breakthrough products, launching new companies, or stimulating economic development,

collaboration is essential. Remember that innovations frequently come from unexpected sources, especially in a technology-driven, knowledge-based economy. Pay attention to where science and technology, economic development, and the market intersect – and never underestimate the potential value of those “intersections.” For example, some consider the interface between ultra-high speed computing and systems biology as the key to transforming an observation-based science like biology into a predictive-based science akin to the transformation of the physical sciences in the last century. If true, the treatment of human disease will move from a focus on populations of people to individuals to cellular mechanics with commensurate changes in products, delivery systems, and outcomes.

Third, acknowledge that *multi-organizational synergy* – especially industry-university collaboration – is crucial to the process. Even though we often help bridge the gap between business and university research, Battelle still needs collaborators. For example, we established a limited liability company – Brookhaven Science Associates, LLC – with SUNY Research Foundation and Stony Brook University through which we co-manage Brookhaven National Laboratory. Such alliances, which also include the major Northeast research universities, can support regional and nationwide resources like Brookhaven’s National Synchrotron Light Source with its applications in nanoscience, advanced materials, medicine, and biology. It’s also available as a user facility for both university and industrial research.

Of the many lessons we have learned as part of the commercialization process from national laboratories and universities, there are perhaps three that have emerged as the most important.

The first lesson has to do with devising strategies for lab-based intellectual property that demonstrate the viability of the concept. I’ll use a football analogy to show how *moving from the idea stage to the market means surviving the so-called “Valley of Death” of innovation.*

Imagine the commercialization process taking place on a football field. Up to the 20 yard line is where most government-funded IP – including university research – starts out as a seminal idea. From the 50 yard line to the “goal line” of financial success is where working prototypes are developed and industrial team-mates “move the ball” by funding the technology and the

economically viable innovations. The critical gap, or the “Valley of Death,” is between the delivery of IP at the 20 yard line, and the “proof of concept” at the 50 yard line. Without a good game plan, you’ll never make it to mid-field, let alone the end zone.

The second lesson has to do with reaching the limit of your expertise and knowing when you need help. Universities and labs – and for that matter, R&D organizations like Battelle – typically *can’t operate and succeed like venture capitalists without assistance*. They tend to overestimate the value of the IP to others, underestimate the time-to-profitability, and have limited understanding of or access to broad networks leading to viable marketing and experienced business leaders.

The third concerns leadership – we’ve found that tested leadership in the venture area is often more important than the technology itself. An experienced leader can analyze market potential without “ownership” issues compromising his/her objectivity, attract “other people’s money” – especially for early “seed” investments, and can sell the idea to investors and potential acquirers.

The Role of Battelle Ventures

Let me now share some lessons Battelle and I have learned along this journey from “ideas to money.”

Beginning in 1996, Battelle embarked on a concerted effort to spin-out venture-backed companies based on Battelle-owned technologies. An internally staffed organization was established to select, nurture, and sell the resulting set of companies – now referred to as Portfolio I. The experience base and governance structure was not unlike that used by many university tech transfer departments or even large for-profit companies. While not a disaster, Portfolio I fell short of our expectations for the following reasons:

- Internal staff had limited connectivity to the external venture capital networks which in turn restricted deal flow, sources of capital, and access to or knowledge of potential acquirers;
- The technology was overvalued and the role of industry-savvy business leadership was undervalued;
- Other people's money was not leveraged properly, which kept Battelle's ownership above 85 percent of total equity – an unnecessarily high financial risk; and
- Limited market knowledge and experience obscured true market valuations.

So, upon my arrival in 2001, we stabilized Portfolio I, and started a second seed and early stage fund, now called Battelle Ventures I, by recruiting nationally-known experts to operate it for us.

Although we're very familiar with technology development, we needed some "adult supervision" from those who were more knowledgeable about what might or might not work in the marketplace. We also ensured the governance structure adhered to standards in the top quartile early funds.

Battelle Ventures I is a \$150 million investment fund which – although independent of Battelle – provides seed and start-up capital primarily to businesses that will benefit from technology Battelle owns, controls, or influences. When considering an investment opportunity, Battelle Ventures looks for:

- Proprietary technology that solves a real problem;
- Management with industry-relevant experience;
- A large, growing, and verifiable market; and
- Measurable milestones.

Like any experienced venture investor, the Battelle Ventures process tries to avoid the “Valley of Death” I mentioned a moment ago by demanding answers to questions like:

- Who’s the customer?
- What is the problem they need to solve?
- How is the problem being addressed currently?
- How can BMI technology solve their problem *significantly* better?
- What’s the “value proposition”?
- Is there a company formed to commercialize?
- If so, is the management experienced in the market?
- Is there a valid business model and “go-to-market” strategy?

The answers to these questions will suggest what course of action is most appropriate: “spinning-out” the technology; working with current Battelle or laboratory licensees; or “injecting” new technology through strategic partnerships or alliances or contract R&D partnerships.

But perhaps most surprising to most researchers is the time dimension. Battelle Ventures, as a seed and early investing fund, finds that liquidation of a successful investment occurs on average around five to seven years after the first investment. Given our focus on opportunities capable of yielding \$100M or more upon sale, a portfolio company should be realizing at least \$20M or more in revenue at the time of sale. Working backward from, say, a sale of the company six years after the first investment, the company really has only about two years to develop a saleable product and four years to develop the requisite \$20M in annual revenues.

Most university and national lab IP and ideas are not ready for a two-year product development cycle at the time we or Battelle Ventures show up. Rather, they may need six to eighteen months of help to bridge that gap from the 20 to 50 yard line. We may provide that gap-filling or maturation funding, but with some very specific milestones. Hence, the idea that a researcher has six or seven years to work on a business project is a misconception. They have in fact had no more than two years in practice before the real world imposes market discipline.

At this point in time, Battelle Ventures I is on track with 16 companies so far in its portfolio, and plans to begin Battelle Ventures II are in the works.

Technology Transfer at Oak Ridge National Laboratory

Let's turn to the national labs. All five of the national labs we manage or co-manage for DOE have mechanisms to pursue technology transfer and commercialization. The Pacific Northwest National Laboratory's web site, for example, even features a designated link for "available technologies." In the interest of brevity and detail, however, I'm going to focus my discussion of lab-based technology transfer on ORNL.

I should point out that our co-managing arrangement of ORNL is itself a partnership between the University of Tennessee and Battelle, together with formal board membership by six other Southeastern research universities. Since UT-Battelle assumed management responsibilities, we have worked together to make ORNL not only a first-rate center for scientific research, but "business-friendly" as well.

I'm confident we're on the right track. Alex Fischer, ORNL's Director of Technology Transfer and Economic Development, who has had several years in the business and governmental worlds outside of the Laboratory, confirms that the Lab has "*...started down the cultural journey...*" that has encouraged "*...our researchers' willingness to talk about and engage in commercialization.*" This, of course, is without undue interference in their pursuit of more fundamental scientific endeavors which support the lab and the DOE mission.

That "cultural journey" has been transformed into a "guided tour" of commercialization opportunities. Since UT-Battelle became ORNL's managing contractor in April, 2000, the Lab has developed a number of programs to encourage and assist affiliated start-up companies. Those programs include part- and full-time entrepreneurial leave, business assistance and, potentially, venture capital through Battelle Ventures and Innovation Valley Partners – a fund tethered side-by-side to Battelle Ventures.

ORNL also provides technology maturation funds to help prepare the inventions for licensure. Researchers have two sources of tech maturation funding: one is government dollars generated by revenues ORNL receives from previously licensed technologies, including royalties, and the other is “privately funded technology transfer,” (PFFT) funded by UT-Battelle, which receives the returns from a technology after it is licensed. These private funds are sometimes supplemented by corporate dollars from Battelle and matching investments from the University of Tennessee, or direct funding by Battelle Ventures to help bridge the gap from idea to actual demonstration.

In the past six years, ORNL has helped generate 61 start-ups. Of those, 56 qualified to be part of a UT-Battelle-funded program called the “Center for Entrepreneurial Growth” which provides business counsel, financial planning, marketing assistance, and other aid to companies in their formative stages. Of the 56 companies that have participated in the CEG since it began, 36 are still in business.

For companies interested in accessing unique expertise or equipment to resolve their particular research challenge, ORNL offers three primary mechanisms. First, if a potential industrial customer wants to contract with ORNL to solve some specific problem, a *work-for-others agreement* is likely to be the preferred mechanism. Second, if an industrial firm wants to collaborate with ORNL and share in the costs of joint research, a *cooperative research and development agreement*, or “CRADA,” would be appropriate. Third, if a company wants to send its own staff to use ORNL’s equipment and facilities to conduct experiments or characterize a material, they would probably enter into a *user agreement*.

Currently, Battelle and Battelle Ventures offer an alternative way for interested parties to navigate a large number of laboratories at one time. In many cases, Battelle Ventures will introduce an existing company to one or more labs so that Battelle or lab technology can be “inserted” and thereby accelerate its growth. Often, an equity position is then taken for this contribution.

I, as well as others in this audience, am well aware of the current complexities of the DOE-imposed processes. Battelle and DOE continue to collaborate on improved processes that will foster even more access to the important assets by others.

I'd like now to shift our discussion from our work with national labs to our university relationships, and I'll focus specifically on our neighbor to the north in Columbus – OSU.

Battelle and The Ohio State University: Neighbors and Collaborators

As you've heard me say, Battelle is involved in alliances and collaborations with multiple colleges and universities, and probably none are more complex and far-reaching than those we have with The Ohio State University. And OSU, like most major universities, is a tremendously powerful economic engine in its own right before the potential impact of research and IP commercialization is even considered. Before we examine some of our collaborations, consider the effect an institution like OSU has on the local and the state-wide economy:

- As of the fall of 2004, OSU employed almost 23,000 Ohioans on both a full- and part-time basis which represented a total payroll of over \$1.6 billion annually. This is in addition to the more than 12,000 part-time student employees whose wages exceeded \$183 million.
- In fiscal year 2004, OSU purchased over \$346 million in goods and services with more than \$203 million of that going to Ohio vendors.
- Again, in fiscal year 2004, OSU spent more than \$259 million on major construction projects with more than \$225 million of that going to Ohio vendors.
- In addition to the “multiplier” effects of employee, student, and visitor spending, there's another statistic especially relevant to our discussion. According to U.S. Commerce Department Bureau of Economic Analysis estimates, every \$1 million expended supports

32 jobs in the local community. That means OSU's research and development programs representing half a billion dollars per year support more than 17,000 jobs.

These statistics confirm the substantial "baseline" impact a major university has on its local and regional economies. However, the research expertise and resources available at an institution like OSU are potential economic development "muscles" that have yet to be fully flexed.

Battelle formalized a strategic relationship with The Ohio State University late in 2004. Linking two of Columbus's largest research assets enables both of us – Battelle and OSU – to share staff and facilities, engage in joint research projects, and pursue economic development projects that will generate benefits for Central Ohio and beyond. Put simply, we can do more together than we can separately.

Today, Battelle and OSU share more than 40 projects involving education, public policy, entrepreneurship, technology commercialization, homeland security, bioproducts, advanced cancer diagnostics and therapeutics, medicine, energy, and environmental issues. As you might expect from that list, we're working with several OSU colleges including Medicine, Agriculture, Engineering, Math/Physical Sciences, Business, and the Arts.

We expect the long-term synergy created by the Battelle-OSU alliance to be permanent and far-reaching. For example, we anticipate using it to improve the regional environment for a robust research and technology workforce, to attract technology-oriented companies to Central Ohio, and to cultivate fertile ground for new companies to start up, grow, and thrive. The Battelle-OSU alliance is also one cornerstone of a local initiative which seeks to build a research and technology "corridor" along State Route 315 in Columbus.

The "corridor" has already attracted nearly \$78 million of public-private funding under the State of Ohio's Third Frontier Program during the past three years, which includes:

- The Ohio Bioproducts Innovation Center which will harness the ability of Ohio's agricultural industry to produce high-value specialty chemicals from sustainable feedstocks (more about this in a moment);
- An advanced diagnostic/therapeutic program to develop new approaches for more effective treatment and prevention of lung cancer; and
- The Cardiovascular Biomedical Enterprise, which is developing products to enable earlier detection and treatment of cardiovascular disease.

In addition, nearly \$40 million in new collaborative efforts were proposed at the close of 2005, including:

- The Food Safety and Biosecurity Center (to be located at OSU), which would bring government, academia, and industry together to protect our nation's food pipeline and – in the process – leverage the presence of nearly 1,000 agri-business entities in Ohio; and
- The Personalized Medicine Center for Acute and Chronic Disease (also to be located at OSU), which will synthesize medical records information and post-genomic research to serve as a trusted clearinghouse for health care providers.

Nanotechnology: Another Industry and Academic Alliance

We also participate with OSU and other universities in research and development alliances which focus on nanotechnology platforms. Our collaboration with universities, industry, and other organizations supports the National Nanotechnology Initiative (NNI) in its effort to advance nanoscience and commercialize new products. We've assembled a Battelle Nanotechnology Innovation Alliance which includes:

- National Renewable Energy Laboratory;
- The Center for Nanophase Materials Sciences at Oak Ridge National Laboratory;

- The ESML Interfacial and Nanoscale Science Facility at the Pacific Northwest National Laboratory;
- Idaho National Laboratory; and
- Battelle's R&D labs in Columbus, Ohio.

The Alliance is succeeding on many fronts. For example, in 2005, the Alliance supported OSU, the University of Akron, and the University of Dayton to win a \$22 million grant from the State of Ohio to establish the *Center for Multifunctional Polymer Nanomaterials and Devices*.

Another linkage with OSU resulted in an \$11.6 million grant to establish the *Ohio BioProducts Innovation Center* which I mentioned earlier. The Innovation Center is a collaboration of industry and academic research dedicated to creating new materials solutions for the chemical and plastics industries using renewables like corn and soybeans. OSU leads the Center's academic consortium which includes 11 Ohio institutions of higher learning and six additional universities from other states.

This year, the Battelle Nanotechnology Innovation Alliance is working with OSU, the University of Toledo, Bowling Green State University, the five national labs we manage or co-manage, and several companies to establish a *Center for Photovoltaics Innovation and Commercialization* that is being designed to actively create alliances with other universities, federal labs, and industry.

Conclusion

For more than 75 years, Battelle has marshaled science and technology to produce practical innovations and solutions with "real-world" applications. Our collaborations with national labs and colleges and universities have been an integral part of that process, both in the U.S. and overseas. Most recently, this has culminated in a joint venture in Japan, and a research organization with Korea University called "Battelle at KU."

Collaborations, in fact, will assume an increasingly larger role in bringing new ideas and technologies to the marketplace. In a world where communication, access to intellectual

property, and the movement of capital are almost instantaneous, no organization can be entirely self-sufficient; collaborations and alliances play to the strengths of the participants.

Our nation's leadership, and perhaps even our economic viability, depends on the willingness and ability of businesses, industries, research institutions, and colleges and universities to work together. Collaborative excellence at the intersections of science, technology, and the marketplace holds the key to our future.

Thank you for inviting me to participate in this Federal Reserve Conference. I'll be happy to address any questions you may have.