Regional Innovation in Nanotechnology: Nano-Hubs

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Abstract

There is little or no disagreement about the importance of nanotechnology innovation for national prosperity and high-wage job creation, or the crucial role that entrepreneurial startup companies and early stage investors play in advancing this innovation. Nevertheless, there remain at least two serious barriers to the realization of this potential:

1. *Affordable and quick access to scientific infrastructure and talent* which, in the case of nanotechnology, includes fabrication, microscopy and analysis tools (lithography, deposition, wet labs with hoods/drains/permits, SEM, TEM, AFM, FIB etc.) with capital costs in the $100Ks or $1Ms, annual maintenance costs in the $10-$100Ks, and a requirement for experienced and specialized expert operators in order to perform to their full capabilities. All of these assets are far beyond the reach of small and medium-sized companies, and rarely allowed as uses of funds by early stage investors. University-based labs that are open to entrepreneurial startups (and other businesses too, of course) on a fast and flexible "fee for service" basis can be a strategic asset to an innovation cluster.
2. *The well known "valley of death" problem*, which actually consists of *two* gaps: (a) between research findings and "investable" companies, and (b) between "technology push" and "market pull" orientation on the part of development teams. SBIR and STTR, while vitally important to small companies, do not solve this problem, because they do not mimic business investment processes, in particular the importance of identifying large, profitable markets and recruiting management teams capable of leading growth companies. This problem can be solved with locally and professionally managed and investor-advised "gap" funds that select projects on the basis of business potential, closely monitor translational research projects, and provide multi-faceted business assistance to newly formed companies.

Regional Nano-Hubs (aka "proof of concept centers" – Kauffman Foundation[1], or "institutes of collaboration" – National Governors Association[8]) that effectively unite the talent and resources of multiple universities in collaboration with industry and the business community can effectively lower or eliminate these barriers.

This presentation will illustrate these concepts using the ONAMI "High Tech Extension" and Commercialization Gap Fund programs as specific examples.

The ONAMI Example

I. Bootstrapping the Regional Innovation Ecosystem

Oregon has had a comparatively weak track record for venture funding and startup company exits, no prestigious private research universities, a 20-year and ongoing decline in funding for public universities, and few in-state-headquartered major companies (Nike is the most prominent; FEI though much smaller is a nanotechnology 'marquee' company). It does, however, have some of the world's leading micro/nanotechnology industry R&D and advanced manufacturing sites (e.g. Intel's lead site, HP's top technology site, Life Technologies' nanotechnology site). Even though these assets make the "Silicon Forest" a recognized high-tech region, the lack of significant "headquarters" companies has made related cluster identity and development elusive. So the "spark" had to come from the state and the university system.

Taking all of this to heart, along with an early assumption (since proven correct) that no one campus had 'critical mass' sufficient for a significant signature research initiative to succeed in a nationally competitive way, ONAMI became Oregon's first notable and nationally recognized innovation hub. As anticipated, the critical element – enabled by exceptional collaboration among both faculty and executive leadership at Oregon's research universities, together with the nearby Pacific Northwest National Laboratory – was deep collaboration among the campuses and PNNL involving facility sharing, joint faculty appointments, collaborative programs and proposals (i.e. both to the state and in response to many federal and private opportunities), student sharing and joint recruiting, user facilities accessible by businesses, and early stage commercialization funding couple with sophisticated business development assistance.

The results of this have included a) growth in research volume (5x over 6 years) and commercialization success as promised, b) significantly increased credibility with the Oregon Legislature and Governor's office, c) significantly increased credibility with high-tech industry, and d) increasing interest from early stage investors.

Based on ONAMI's experience between 2004 and 2010, four powerful ideas for translating the benefits of university-based research to the regional economy include:

1. Open use of campus core research facilities as a "high tech extension" (see **Figure 1**) resource, with fast/easy access for businesses on a fee-for-service basis, especially startups commercializing technology. As a practical matter, this is currently difficult to do in public university buildings financed with tax-exempt bonds (due to private use restrictions). But it also requires cultural and managerial adjustments, since business clients have different needs and sensitivities than researchers. However, doing this well is crucial for having a vibrant community of capital-efficient technology startups in all but a select few regions of the U.S. Even if it were feasible, it should be unnecessary for private sources to duplicate the enormous capital investment that has been made in university analytical measurement and prototype fabrication facilities. The

ONAMI-affiliated network of open user facilities is called the NWNanoNet. In addition to shared access to major tools, these facilities also allow for company tenant lab (and some minimal supporting office) space, which is very helpful for startup and spinout companies.

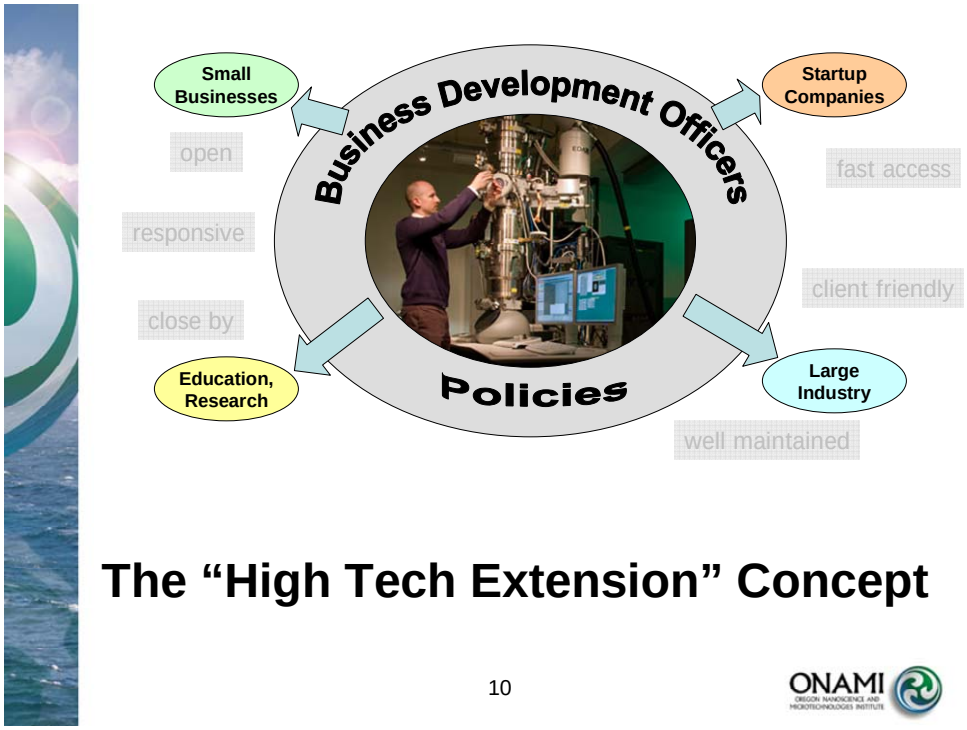

Figure 1: *Nanoscience facilities and equipment can best benefit technology development whenthey are conveniently located and easy to use by businesses. Such access is especially important tothe small and medium enterprises (SMEs) that are critical for early stage commercialization. Stateand regional economic development field staff can serve as "high tech extension" agents.*

2. Undergraduate and graduate student internships in industry- and ideally in small/startup companies that do not have sufficient cash to pay them. These internships benefit universities (relationships with industry by offering something they value), companies (try out young talent that is surprisingly good, closer relationships with relevant faculty) and students (including making them more productive in their degree work). Gap fund monies can be and have been used to pay for such valuable experiences.
3. Campus-based funding for earliest pre-commercialization prototyping. In Oregon's case, a tax credit mechanism (University Venture Development Fund) provides earliest-stage funding for ideas that may have commercial potential. The ONAMI gap fund, which works with all of the state's research universities, often co-funds projects with the UVDF or uses its results as a feeder mechanism.

4. Commercialization gap funding (see **Figure 2**) that is not captive to a single institution, but open to projects out of multiple institutions in a state or region. In the case of ONAMI and its gap fund, the motivations for this included assembling a "critical mass" for deal flow and presenting a common collaborative front to the Oregon Legislature. But this is a good idea in general – that commercialization funds not be related to "all the interesting technologies at University X" but rather "all the interesting technologies in all the regional universities relevant to Industrial Sector Y".

Technology Stage	Company Stage	Funding Source
Research Result	(NA)	NNI Grants
Proven Prototype	***Formation***	***Gap Grants (state + federal)***
Products, Sales	Development	Early Stage Investors
Product Line Expansion	Growth	Various (private)

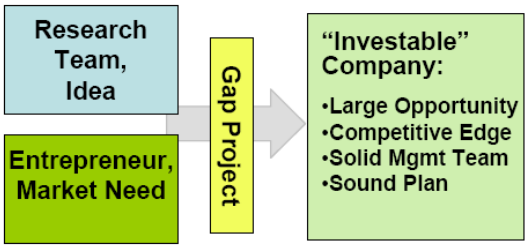

Figure 2. *State funding and possibly federal/state partnerships in "gap" funding for new ventures commercializing NNI-derived technology could accelerate commercialization by 2-4 years and also incentivize a greater focus on economic returns and job creation.*

II. Commercialization Gap Funding: Process and Performance Metrics

One of ONAMI's two major goals since inception has been commercialization. It took two years (from late 2004 to late 2006) to determine how to do this in a way that could turn a modest level of state investment (only $700K in the FY06-07 biennium) into measurable results.

Origin of the concept. We started with easy and obvious ideas like semi-annual industry affiliates or commercialization advisors meetings at which promising research technologies would be presented for comment, but were well-served by the decidedly unenthusiastic responses from our board (including at the time senior executives from HP, FEI, Pixelworks, OVP Venture Partners, and Battelle). They challenged us to do two things: 1) devote real money to commercialization and 2) hire professional management for the effort. Neither of those two things were possible at the time, but we successfully requested funds from the State of Oregon for these in FY08-09 and FY10-11, and the results have been good – in spite of exquisitely poor timing relative to early stage capital markets.

How the process works. The gap fund structure is described at http://www.onami.us/showpage.php?p=35 and the proposal submission and review process is at http://www.onami.us/showpage.php?p=36.

We have an experienced (former VP of Corporate Development at FEI Company) fund manager on contract, and have successfully recruited a Commercialization Advisory Council (CAC) consisting of partners from 3 large VC firms, 3 small/early stage VC firms, two corporate investment arms and PNNL's director of technology transfer. Five of these organizations are from outside Oregon, including Seattle (2) and San Francisco/Silicon Valley. At first, we merely hoped that (in view of our newness and Oregon's poor VC record) these investors would attend quarterly meetings once in a while as a community service. As it has turned out, attendance and interest have been very good (the fund manager and ONAMI executive director serve as a useful collector/filter for much of the most promising deal flow out of four Oregon universities), and we have gotten – as we hoped – excellent advice and market expertise that we could not have supplied ourselves.

After presentation/Q&A with teams selected to present to the CAC, we ask one question: "If ONAMI funds this project and it meets its technical objectives, can this company go on to raise outside capital and become an Oregon growth company?" If the answer is "yes", we usually start a project. We are careful to tranche the award (up to $250K) into 3-5 milestone-driven segments. Failure to meet milestones can result in cancellation of the project. The fund manager also provides ongoing business advice, including assistance with investor meetings.

Metrics for success: The most honest and feasibly tracked early-stage commercialization metrics are financial leverage (grants, customer NRE, and investor funding) at enabled startup companies and direct FTE job growth at these companies, ideally measured by the state employment division using company EINs. Longer term, of course, company revenue, investor exit parameters and further job growth are most important. It is important for public officials – who understandably only want to hear about jobs - to understand that early stage companies do not hire hundreds, and normally don't pay salaries, until they raise significant amounts of money, and even then they will tend to be careful about hiring. The better news, however, is that they will also spend significant funds on local/regional purchases, contributing to employment elsewhere in the economy. And in any case, they are the only option for true breakout opportunities that will ultimately create thousands of new high-wage jobs. All of this is why ONAMI emphasizes leveraged company funding as our leading commercialization metric.

The results so far are good. After cumulative investment commitments and expenses totaling $3.7M (leaving about $1.5M for upcoming tranches and new projects), ONAMI gap fund companies have leveraged (via founder/angel funds, SBIR and other grants, and VC investments) over $70M to date (including $50M for Home Dialysis Plus) and significantly larger amounts than that appear likely within the next year. We recently asked our CAC members for their feedback on our process and portfolio, and were surprised with how positive their assessment was.

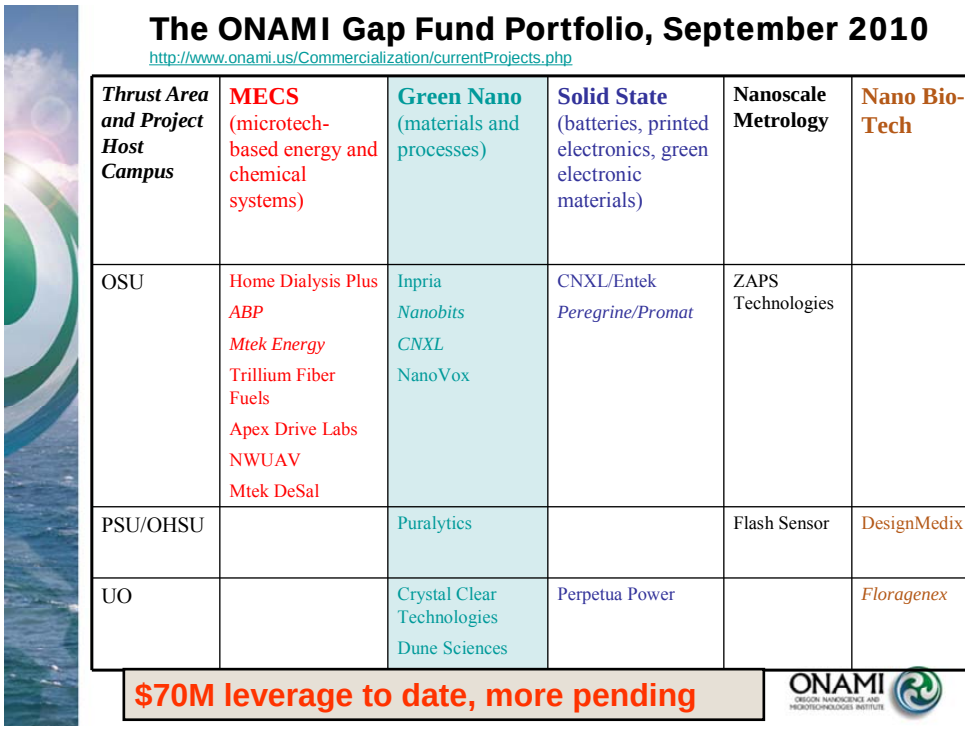

Figure 3. *The uniqueness of the ONAMI gap fund is that it is embedded in a "themed research initiative" and associated community of institutional researchers, major companies (e.g. Intel, FEI, HP, Life Technologies, Triquint), small businesses, and early stage investors.*

Our own assessment of the portfolio (see **Figure 3**, 20 projects plus 2 pending) is that 3 companies/projects are doing very well (large amounts of money raised, customer traction); 11 are making satisfactory-to-excellent progress and have great promise, but could go either way; 3 have less opportunity than we hoped; and 3 have failed. This is perhaps not terribly different from a typical early stage venture fund portfolio three years into its investment cycle. And of course this is all at a time when both early stage funding availability and VC fund performance are suffering.

Finally, we believe we are getting better at selecting and managing projects as we gain experience. The gap fund has gone from being a risky experiment, to the largest and most popular (with most stakeholders, including the Oregon Innovation Council) ONAMI program.

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