Session: Networking and business aspects of the nanocenters in US. *with Neal Shinn from Sandia and Ilhan Aksay from NASA/Princeton U.*

The "Bottom Up" Nanotechnology Network.

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Taken collectively, the United States today is home to a very large number of "Nanotechnology Centers" with an incredibly varied array of missions, sponsorships, locations, and capabilities. These include the NSF-sponsored NSEC Centers built upon scientific program as well as upon societal outcomes and educational activities. These include the National Nanotechnology Infrastructure Network (NNIN) and the Network for Computational Nanotechnology, both providing an array of supporting technological capabilities. These include several major DOE Nanocenters. In addition there are centers within government and defense department research laboratories and research programs, there are numerous university-based centers, and many state and regional programs. There are many Nanotechnology Centers internationally including Italy, Germany, Ireland, Taiwan, China, Japan, Singapore, and even India. The EEC has actively created networks and collaborative programs across Nanotechnology centers within its purvue. The great majority of these centers, networks, and programs were envisioned and created through governmental or organizational entities through some form of "top-down" process. Thus the business aspects (including governmental roles such as HSE) of each center are different and do not map directly into ultimate "business" environment.

Today, across these many organizations and structures, a set of networks is evolving – building extensively on synergies, personal contacts, personal collaborations, and functional similarities across the existing institutions. There are indeed some extension of these networks into the business realm – especially through specific programs (such as Beyond CMOS being developed by the SIA) or through specific scientific or programmatic interests. Within business realm through normal business channels: industry associations, business collaborations, supplier - customer relationships etc. Within the United States, the NNI does serve as a unifying program with the National Nanotechnology Coordination Office (NNCO) to help at an abstract level. In addition, many natural networking opportunities have been discovered and are operating effectively. However, as this system increases in complexity – both in terms of centers and center structure and in terms of business aspects, effective networking will become much more difficult. Opportunities will be missed and the wheel will be reinvented. Many professional societies are active in promoting Nanotechnology-related meetings with minimal coordination. Except for the EEC, very little is happening internationally in terms of building successful networks in spite of the fact that much of the business world is increasingly structured in an international basis.

Based on these observations, there certainly should be ample opportunity to develop the tremendous potential for improved or more effective means for networking. I will suggest that networks and interactions work best when they are driven from the "bottom up" – that is when they are driven by people and forces that have strong incentive and desire to make the network work. However there are many natural barriers for the development of such networks and collaborations. Thus there are a number of important issues relating to this opportunity that warrant discussion at this point in time.

- Is it time for the development of an international professional society and/or a major Nanotechnology-based international meeting on large scale? [But we should note that, at least from my point of view, we certainly do not want to proliferate the number of either meetings or societies]. Who would take the initiative and drive this?

- Perhaps we need to think about networks built upon "business" or "application" rather than "science or technology or capability". For example could we establish networks around the following? If so how could these networks be fostered? What form of network would make sense?
    - Medicine and biology
    - Materials
    - Electronics and devices
    - Environment, Health, and Safety
    - Energy

- Are there natural leaders or leading organizations associated with business based networks? For example:
    - Materials: MRS or General Electric?
    - Electronics: SIA or IEEE or Intel?
    - Etc.

- How can we assure genuine international character in the networks that result?

- How do we balance "top down" generation of networks vs. "bottom up"? Should NNI or other organization actively generate "networks" or should we wait until these networks spontaneously arise?

These are some of the critical issues that will face the Nanotechnology community over the next several years.