**CENTER DIRECTORS ON INTERDISCIPLINARY COLLABORATION**

Brent Shanks, Director – Center for Biorenewable Chemicals (CBIRC), Iowa State University, ERC Class of 2008

Your question really speaks to educating everyone involved. I am not sure that I would describe the biologist’s view as discovery. I would characterize it more as exploratory research. By contrast, the engineering research view would be driven by the goal (I think equivalent to what you have described as control or functionality delivery). The collaboration “clicks” when the life scientists understand that the explanatory research can be directed to the solution of problems and the engineers understand that the knowledge gained by the life scientists can be exploited to achieve the goal. I think this is the confluence of providing a context for the research and a climate of mutual respect. To do this you need to:

* Provide a clear context for the interaction, so that each can see where they fit in.
* Always, always have ongoing education on the value and contribution of each viewpoint, so that all are respected.
* Assure that any collaborative project has the potential for each researcher to still exist within their technical community; i.e., the collaborative project must give each researcher opportunities that can still be valued within their research sphere.
* Find researchers that are at least open to the possibility of collaborating across these areas.

Pietro Perona, Director – Center for Neuromorphic Systems Engineering, Caltech, ERC Class of 1995

My experience is this: You need to be both organized and disorganized in your pursuit if you wish to succeed. Let me explain. You need to have a goal in mind that is both ambitious (e.g., interface brains to machines to allow people who are paralyzed to operate robots to take care of themselves) and vague (different types of paralysis, many ways to interface brains and machines, many signals that you can measure, many technologies possible for electrodes). This way, many people get to work towards the same goal and each one of them can do so semi-independently, tackling different aspects and following their curiosity and intuition. This way there is that blend of collaboration, competition, parallel play, and collaboration that makes for a fertile and fun environment. When something “gives”—i.e., a major advance is made, everyone will notice and people will regroup to follow the most promising approach.

So here are my summary points:

* Have a big goal, both challenging and worthwhile
* Recruit people who are smart, creative, and energetic and with complementary skills
* Encourage everyone to go about it as they see fit (including whether to collaborate or not)
* Make sure that everyone talks to everyone else (retreats, etc.)
* Draw the team together once a year on what has been achieved (e.g., in a retreat).

Bob Nerem, Director – Georgia Tech/Emory Center for the Engineering of Living Tissue. ERC Class of 1998

Research is a people business and interdisciplinary research requires having the right mix of people intellectually—individuals who by nature of their personality have the characteristics of being "good neighbors" in terms of intellectual interactions among these individuals as well as social interactions. These social interactions can be fostered through "community building" events—i.e., retreats, dinners, wine and cheese receptions, etc.

Phil Stewart, Director – Center for Biofilm Engineering, CBE, Montana State University, ERC Class of 1990

Working in contiguous space is one of the truly critical advantages for success in interdisciplinary science and engineering. We have been lucky at the Center for Biofilm Engineering to occupy some of the prime real estate on campus. Here we have students and faculty from a dozen different departments mingling together on a daily basis and sharing resources. Of course, bacteria in biofilms figured this out a long, long time ago. Diverse microorganisms coexist in close proximity where they cross-feed and communicate.

Keith Roper – Bioengineer in industry and faculty at the University of Arkansas, as well as a former ERC PD

My recommendations can be summarized as follows:

* Immersion:
	+ Absorb the language, perspectives, and patterns unique to life science and engineering paradigms.
	+ Surround your team with mentors.
	+ Listen and converse.
* Wonder:
	+ Explore emerging frontiers which offer dramatic possibilities where evidence and expectation diverge.
	+ Challenge your assumptions.
	+ Imagine and ask.
* Endeavor:
	+ Take action where capabilities meet opportunities.
	+ Balance commitment and adaptation to advance.
	+ Nurture what grows well.