Developing a STEM cooperative extension service

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I was recently invited to attend a meeting at the White House Office of Science and Technology Policy (OSTP) as part of the *Nation of Makers* initiative. I heard from representatives of several government agencies (e.g. OSTP, NSF, NASA, SBA, USAID, NEA, etc.) and from many makerspace organizers (e.g. small community non-profit makerspaces, commercial makerspaces, publicly funded makerspaces in schools and libraries, and larger makerspaces with significant state and industry support).

Several common themes emerged which included:

1. A strong message from the administration that the innovation, entrepreneurship, discovery, and education happening in makerspaces around the country is seen as very important to the future strength of the US.
2. Recognition that there is significant research and development happening in makerspaces including basic scientific research as well as applied research targeting local, national, and international problems.
3. Confirmation that most Makerspaces have similar challenges including communication (both internally and externally), organization (largely due to lack of a well documented, inclusive, robust, and developed community of practice), administration (typically handled by paid staff which is not common in most makerspaces), and financially sound business models.
4. Acknowledgment that there is no realistic or systematic way for many makerspaces to leverage federal grants or other resources.

It is clear that merely convening this group of nearly 200 makerspace organizers was a significant catalyst to a very action-oriented community. There are regional meetups being developed, information being shared, and plans being formulated. There has been a flurry of activity after the meeting much of which seems currently centered around developing a professional society or trade organization which would help with item 3 above.

Andrew Coy, our host and the White House Senior Advisor for Making, encouraged us to look closely at the 4H system as a possible model to follow. There are government (national, state, and local) components, non-profit arms, and a strong educational/workforce development piece. I took this to heart, and further considered the larger agricultural cooperative extension service.

I found there to be a compelling parallel narrative. First, I'll summarize my (surely incomplete) understanding of agricultural extension services.

The establishment of land grant universities began in the late 1800's in response to a national need to stay competitive in the agricultural and industrial revolution. The mission was to develop a workforce with practical skills (in addition to the classical university curriculum of the liberal arts). When the cooperative extension services were established soon afterward, they were strongly tied to research and education in both land grant universities. County-based extension agents served as a liason between small farmers and the trained research scientists at the land grant universities. Farmers had the first hand experience (e.g. boll weevils are killing my crops) and the extension agents could connect them to expert resources (e.g. entomologists and biologists). It is worth noting that one of the reasons the extension service has remained successful over a hundred years and through many political and economic cycles is that they also work with large agri-businesses (e.g. corporate seed companies) as well as serving community needs (farmer's markets and urban gardeners).

How does this relate to our current narrative? Consider that developing an innovation ecosystem to fuel small business is a current national need (compare to developing robust agriculture). The tools used in this ecosystem are advanced manufacturing such as 3D printing, inexpensive yet powerful electronics, open source hardware, cloud based

computing and analytics infrastructure, and a creative, supportive, interdisciplinary and diverse community. This is the environment one finds in makerspaces and at many startup companies (compare to family farms). In addition to the government, there are also large technology companies (including computing, biotech, and energy) who are interested in interacting with the maker movement. What is missing is the infrastructure for capital investment and a clean pipeline for technology transfer to markets.

I am proposing a STEM cooperative extension service similar to the well-understood service in USDA. It could be based in Research I institutions that have already established a strong record of research and education in Science and Technology. Note, these may or may not be land grant universities. Instead of being housed in USDA, perhaps such a service could live in the Department of Commerce? Or another executive level organization?

The national level should be skeletal, with most of the investment going to STEM extension offices in states and universities and used to fund STEM extension agents regionally. Perhaps instead of counties, agents are based in metro areas, cities, or other functional regions to better align with the micro-local nature of the maker movement.

Like their counterparts in agriculture, these agents would act a liason between the general community and the STEM knowledge concentrated at the universities. They would work with both larger corporate entities (how can we establish an employee mentorship program) or individual members of the community (my 3D printer isn't working). Some of the local extension agents may even be housed in makerspaces but others could be in libraries, schools, local government, or even existing county extension offices.

Like their counterparts in agriculture, STEM extension agents would help develop teams and communities, assist in business plans, change management, project management, communication, etc. They would also need to understand advanced STEM concepts to help with design, development, and analysis. As such, this could provide additional alternative career paths for students interested in STEM which may attract additional interest from under represented groups when compared to the traditional STEM careers.

The 4H program student who grows a winning pumpkin to show off at the county fair has the natural analog of the robotics student who shows off their creation at a Maker Faire. It also could be a way to tie together existing Science Fairs and other events which are ad hoc. In particular, STEM cooperative extension agents can, as part of their mission, help inspire youth to continue their education especially those underrepresented in STEM fields.

This is a VERY ROUGH IDEA and I am writing this summary as a 0th draft. I think it has merit in that it provides missing infrastructure (financial, organizational, etc.) connecting those on the leading edge of innovation (makerspaces, startup companies, etc.) to those with resources who want to support them, in a familiar framework which has been shown to be successful. The existing agricultural cooperative extension service has both competitive grants as well as formula funding (since some states have more agricultural need than others) and there may be a similar non-uniform density of resources in a STEM extension program. In particular, having a base level of funding allows for sustainability of the best programs which the competitive proposals produce. Note that corporate funding can also be targeted at STEM extension services in addition to government funding.