Cultivating And Nurturing A Culture Of Innovation In Federal Agencies

By Mojdeh Bahar and Robert Griesbach

Innovation Ecosystem

An entity with the following characteristics should be a vital player in the innovation ecosystem:

It has a budget of over $141 billion per year for research. Its institutions consist of 14 research entities spanning all scientific disciplines, covering the entirety of the research and development (R&D) continuum from basic research to applied science. It operates in each of the 50 United States. It has Nobel Prize winners among its scientists, and it has funded prize-winning research (Stein, 2018). A large majority of its senior scientists are fellows in their respective scientific disciplines.

These are some of the characteristics of the federal research and development enterprise in the United States that play a vital yet understated role in the innovation ecosystem.

What is an Innovation Ecosystem?

The term "ecosystem" was first coined in 1935 by Arthur Roy Clapham, a British botanist, to emphasize the importance of transfer of materials between living organisms and their environment (Tansley,1935; Stuart, Matson and Mooney, 2002). While the term has been used in biology and ecology to refer to a biological community of interacting organisms and their physical environment, its use was later expanded. In 1993, James F. Moore used the term "business ecosystem" to describe the interactions of organizations and individuals in the business world (Moore, 1993).

The term has since become part of the everyday vernacular and is widely used to refer to a complex network or interconnected system, a system of relationships. In the innovation space, "ecosystem" and its associated biological analogies are used to emphasize interactions, connectedness and interdependence among the many actors (biotic or living) and other factors (abiotic or non-living). While both the words "system" and "ecosystem" have been used to capture this complex network, some have a preference as to which term is most appropriate. Whichever term is used, the interconnection among the elements and enabling innovation remain important characteristics, which are implied in both definitions. A unique characteristic of the innovation system or ecosystem is the coupling of "resources available to the knowledge economy with resources generated by the commercial economy" (Jackson, 2011).

Many concepts have been used to explain how multiple elements may interact and affect one another in strengthening innovation. Geographic location, identity of players, access to capital, a trained workforce, service providers, and the relationships among the players are all important factors. For example, the term "agglomeration" emphasizes that innovative activity occurs in spatially concentrated areas. In other words, proximity of elements, *e.g.*, laboratories, venture capitalists (VCs), and service providers all affect innovation (Carlino and Kerr, 2014). In another paradigm, the terms "clusters" or "blocks" describe geographic concentrations of firms in related lines of business, all affecting innovation (OECD, 2007). The Triple Helix Initiative emphasizes a system in which government, industry, and academia together and with overlapping goals and vision drive innovation (Ranga and Etzkowitz, 2013).

Characteristics of the Innovation Ecosystem

Whatever the model, an innovation ecosystem is a dynamic and collaborative system that functions as a whole with interdependent parts. It can be closed or open, have different players with varying roles and can be local; circumscribed to a particular city; a region within a state such as Silicon Valley and Research Triangle Park; or regional, encompassing multiple states such as the BioHealth Capital Region that includes Northern Virginia, Central Maryland, and Washington DC.

Parts/Players in the Innovation Ecosystem

There are many different players in this ecosystem, each essential to its sustainability. There are:

- Public and private research institutions such as research universities, federal laboratories, and research foundations;
- Institutions of higher education, including community colleges, colleges, and universities;
- Entrepreneurs who are the founders of business ventures and those who aspire to start and grow new businesses;
- Talented people who can help the companies grow;
- Manufacturers of goods who convert ideas into tangible embodiments that can be used by the consumer or customer;
- Technical support services such as attorneys and accountants who will memorialise the formation

of business entities and assure their economically viable operation;

- Businesses encompassing micro-entities, small and medium-size enterprises and large corporations;
- Economic development entities, public or private, at the city, county or state level;
- Financial resources such as seed funds, angel investors and VC firms that fund entrepreneurial activities at different stages;
- Non-Profits and foundations that play an increasingly important role in supporting entrepreneurial activities aligned with their mission. Some of these entities are affiliated with universities; others support the mission of federal agencies; and yet a third group are independent funders of research;
- Incubators and accelerators enable the inception and gradual launch of a business endeavor. While historically the term "incubator" referred to a physical space housing or hosting early stage companies, today they offer a suite of services necessary for efficient operation of its companies; and
- Ecosystem builders or connectors are individuals and institutions that champion entrepreneurs and the ecosystem. A person working in any of the capacities described above can be an ecosystem builder or connector. Usually, connectors have a holistic approach and can identify potentially synergistic relationships and help in the formation of those relationships. Professionals working in technology transfer offices at universities and the federal laboratories, scientists, and business savvy individuals working in strategic alliances or business development departments are also connectors by the virtue of their jobs (Kauffman Foundation, 2020).

Access to and Interactions in an Innovation Ecosystem

Ensuring access to the ecosystem is vital for individuals or entities to be able to participate in the ecosystem. In its *Entrepreneurial Ecosystem Building Playbook*, the Kaufmann Foundation uses "onramps" or "access points" to explain this point (Kauffman Foundation, 2020). Taking this analogy further, there are multiple access points to the ecosystem: one can get on the road at different points and head in the same direction as others who are already travelling on the same road. Once on the road, intersections offer yet another powerful image for coming together and interacting. These intersections enable and facilitate communication and collaboration among different players, ideas and resources. In a strong ecosystem, the culture is built on collaboration, cooperation, trust, and reciprocity (Kauffman Foundation, 2020). What further strengthens the ecosystem are the players' narratives about themselves and their ecosystem. These narratives help form and inform others' perception of each ecosystem. Silicon Valley, Research Triangle Park, and Boston's Bio-corridor are examples of these ecosystems with a strong, consistent narrative.

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Federal Government and the Innovation Ecosystem

The federal research and development budget (Table 1) is over $141 billion per annum divided among the research agencies. About 28 percent of this budget is used for research conducted within the federal research enterprise (intramural), and the remaining 72 percent is used to support research at colleges, universities, non-profits, businesses, etc. (extramural).

Table 1. Summary of the FY 2019 Budget for all Agencies

Total R&D	Intramural	Extramural							
		U.S. and U.S. Territories							
		Industry	Industry Administered FFRDCs	University and Colleges	University Administered FFRDCs	Other Nonprofits	Nonprofit Administered FFRDCs	State and Local Government	Foreign
141,500.9	39,565.0	43,577.8	5,457.6	33,359.2	6,130.6	8,880.1	3,283.4	435.4	811.7

Figure 1. Federal Government Players

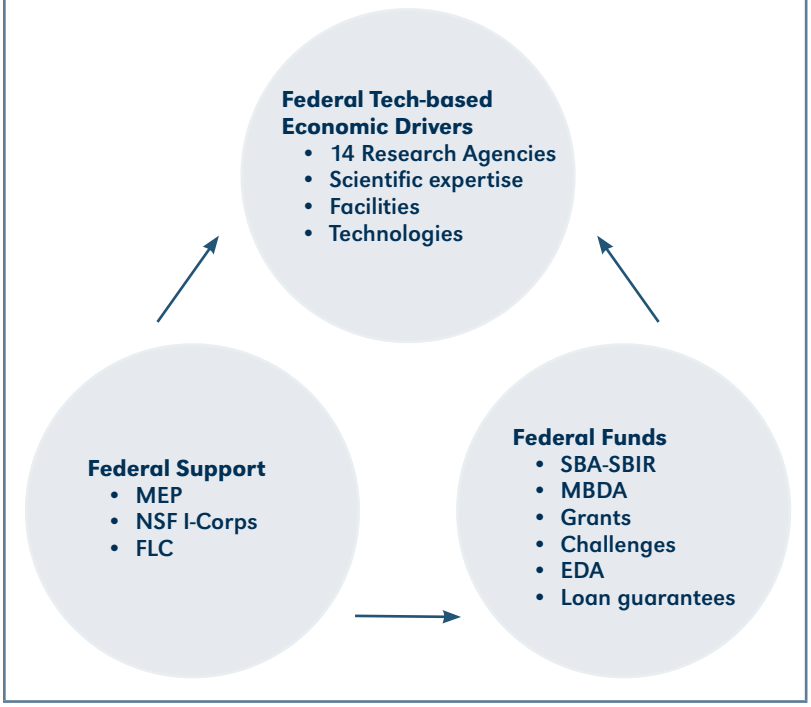


Figure 1 represents some of these different players. In the federal sector, 14 research agencies can be considered technology-based economic drivers, while other agencies and programs serve to provide support through funding and programs to sustain and support innovation (top circle). The granting agencies (circle on the right) provide financial support to universities as well as small businesses and other federal resources provide programmatic and technical support (circle on the left). For example, the Manufacturing Extension Program at National Institute of Standards and Technology supports manufacturers, programs in the USDA's Rural Development offer programs in support of rural businesses and farms, and the National Science Foundation's Innovation Corps (I-Corps) provides entrepreneurial training to federal grantees to facilitate commercialization of extramural inventions.

Assessing Your Institution's Role—Establishing a Baseline

If the ecosystem in its entirety is a completed puzzle, which piece of the puzzle do you or your organization represent?

- Do you offer funding?
- Do you have technologies?
- Do you or your staff have unique scientific expertise?
- Do you have facilities?
- Do you have programs that support entrepreneurs?

Building Your Institution's Role Within an Ecosystem

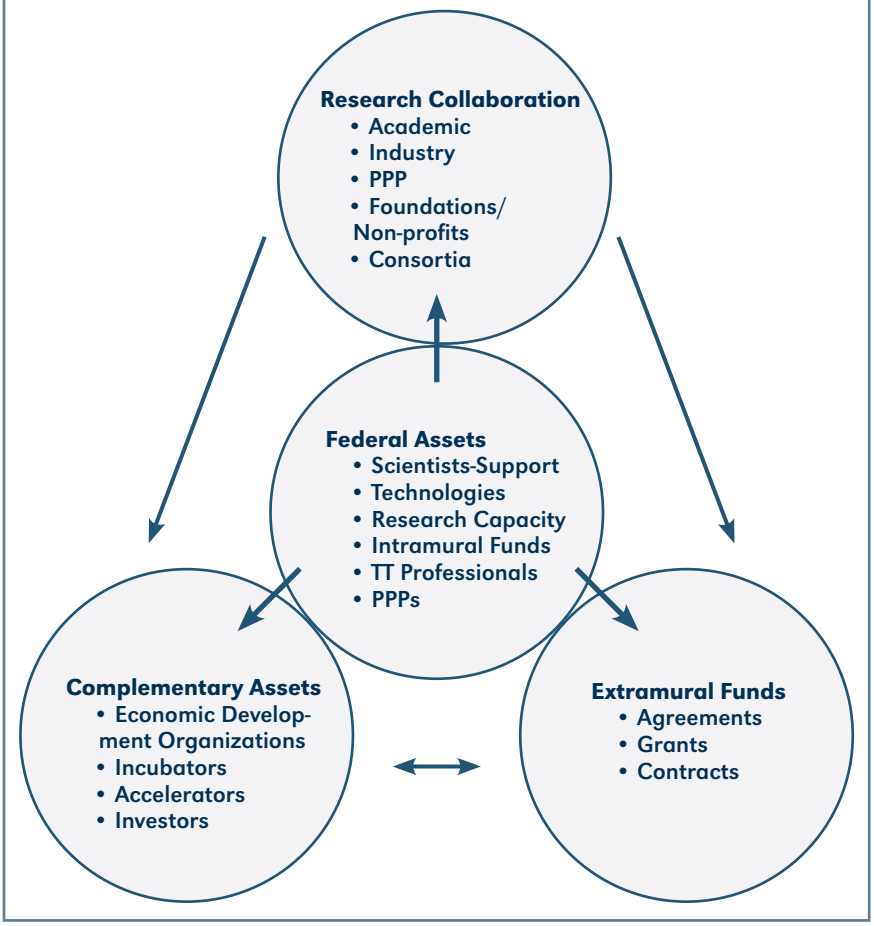
Both academic research institutions and public research entities, *i.e.*, federal and national laboratories, have technologies as well as scientific expertise. Some academic research institutions and federal laboratories have unique facilities. Increasingly, both public and private research institutions provide programs that support entrepreneurs. These programs can range from courses in innovation and entrepreneurship and entrepreneur-in-residence programs to technology transfer offices and entrepreneurial academies. These programs within the research entity market and license technologies and support and encourage the formation of start-ups or spin-offs.

Federal dollars are also a great source of funding of research as well as seed funding through Small Business Administration grants, the Small Business Innovation Research program, and the Economic Development Agency's Office of Innovation and Entrepreneurship i6 grants, among others. Also, matching funds are available at the state level, such as from the Maryland Technology Development Corporation (TEDCO), and the local level, such as from the Montgomery County, Maryland's Montgomery County Economic Development Corporation (MCEDC).

Once an entity's role in the ecosystem is identified, it is important to communicate this role to other entities and to find common goals that can be achieved through connection or collaboration. There are many ways to enhance an entity's role in the innovation ecosystem, such as raising awareness of the organization and all the offices and units that play a role in the innovation economy, understanding the roles of all the other players in the local ecosystem, and learning about practices in your sector and other sectors. These efforts will help connect the organization with different players, and thus increase the possibility of interaction, which may result in collaboration. Figure 2 shows the many ways in which the federal agency can connect to other players in the innovation ecosystem to increase the possibility of adoption of its research outcomes.

1. Awareness of your organization and establishing relationships with all offices that play a role in the ecosystem: In a federal laboratory, other than the technology transfer office, there are units that

Figure 2. Federal Government Connections



focus on funding to small businesses such as SBIR and Small Business Technology Transfer ("STTR") programs, as well as offices focusing on industrial partnerships or industry relations. There may also be external foundations supporting the agency's mission. Some laboratories are part of an innovation hub or a member of one or more public-private partnerships. Knowing of the existence of each of these components and learning about their function can enhance the impact of the federal laboratories' research.

Similarly, universities may have offices of industrial partnerships, associated foundations or sponsored research offices that are separate, though complementary, to the technology transfer functions.

2. Once internal players and those with complementary functions within your organization have been identified, collaborations, both internal and external, can be encouraged. When apprised of the value of collaboration, scientists and potential collaborators are more likely to pursue them. Therefore, education and training to engage internal scientists (in-reach) and educating stakeholders (outreach) is a priority. Having convinced the scientists and industry partners of the value of collaboration, initiating contact, engagement and building relationships will follow. In forming relationships, it is essential that the research enterprise be strategic about interactions and transactions.

3. Creating a culture of collaboration is only a first step. In order to identify partners and projects, the possibility of positive collisions needs to be increased. It is likely that scientists find collaborators at scientific meetings, conferences, professional societies, interdisciplinary programs and centers of excellence at a university as well as networking initiatives. Following up with potential collaborators is an essential part of building relationships.

4. The federal research enterprise has 14 research agencies with distinct missions. Each agency may have its own unique characteristics and different practices, procedures and innovation models. Sharing and learning best practices across the federal research enterprise and research universities is an important step in enhancing the ecosystem. It can also increase the number and quality of tools used to achieve the organization's goals.

5. While research entities (federal labs or universities) are major players in the innovation economy, they are by no means the only players. Consequently, it is essential that like-minded organizations and those with complementary missions be identified. For example, each jurisdiction in the United States is home to an entity whose primary goal is economic development. These organizations can be at the state, county or city level. While they have a broad set of functions, they are great partners for research organizations and possible businesses that work with federal or academic scientists. In some cases, the economic development organization may have specific programs for collaborations or licensing of federal or academic technologies.

Building Your Organization's Role within an Innovation Ecosystem: A Brief Case Study

One example of a baseline assessment leading to

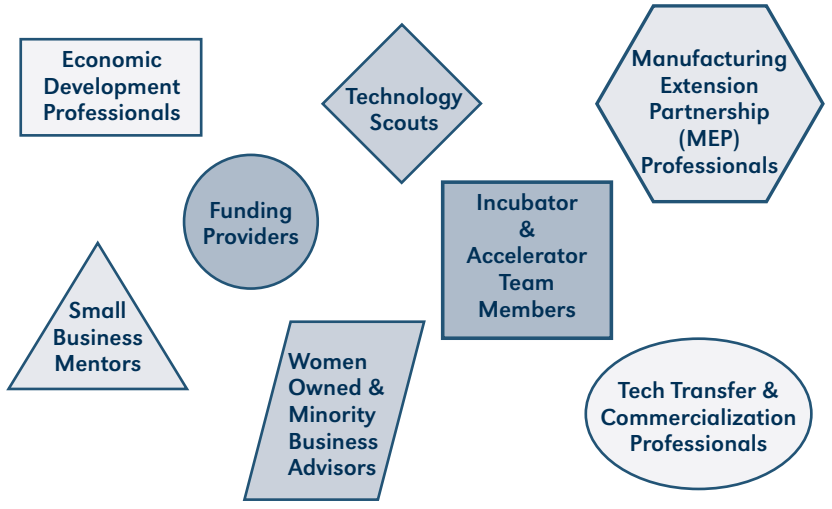
establishing itself in an innovation ecosystem is the USDA Agricultural Research Service (ARS). Although replete with scientific expertise, technologies, and some unique facilities, the intramural research components of the USDA do not have the resources or the authority to provide its licensees with the marketing, manufacturing, and fiscal resources (complementary assets) needed for the licensee's businesses to be successful. Consequently, the USDA-ARS established the Agricultural Research Partnership (ARP) Network to provide those complementary assets. By combining ARS research expertise with complementary capabilities and talents of partnering organizations, the ARP Network stimulates economic growth through technological advancements. The network members are all players in the agricultural innovation ecosystem: venture capital firms concentrating on agricultural innovations, agricultural accelerators and incubators, economic development entities, technology scouts, mentors, and other federal support programs. ARP helps extend the reach of the USDA through its members and their respective constituents. It also enables the partnering of the members with each other and further provides a platform for accessing services and products (see Figure 3).

Where to go from here?

If your research entity wants to establish itself as a player within a local or regional innovation ecosystem, the checklist below may be useful:

- Get to know all the components within your organization that are related to innovation;
  - » Does your organization have a small business unit?
  - » Do you have a sponsored research arm?
- Outline all the possible roles that your organization can play;
  - » Do you have facilities?
  - » Do you have funding?
  - » Do you have technologies?
  - » Do you have experts?
- Inventory your organization's connection to the innovation ecosystem (survey and use as baseline);
  - » How does your organization connect to the local and regional innovation ecosystem?
  - » How did this connection come about?
  - » How could your organization strengthen this connection?
  - » In a perfect world, how would this connection help technology transfer? The organization? The community? The nation?
- Keep apprised of strategic initiatives within your organization;
  - » What would strategic initiatives look like in your organization?
  - » What would strategic initiatives be for the state or region in which your organization is located?
  - » What would strategic initiatives look like at a national level?
- Get buy-in and manage up: getting the right people involved.
  - » Who are the points of contact within your organization for connections to the local, regional, or national innovation ecosystem?
  - » Who are the decision makers?
  - » What are their priorities?
  - » How would a connection to the ecosystem positively impact these priorities?
  - » Which other units could be involved in affecting these connections?
  - » How would a connection to the ecosystem positively impact these units?

Figure 3. Members Of The Agricultural Research Partnership



Conclusion

The role of both universities and federal laboratories in supporting economic development activities has become more important in recent years. Many universities report on income generated, number of start-ups or spin-offs created, and number of jobs created, among other metrics. Federal laboratories

also have a role to play in economic development. They also report on income generated, companies formed, and jobs created. In fact, the Stevensen-Wydler Innovation Act of 1980 enumerates economic goals as one of the goals of technology transfer for federal labs. It also mandates the establishment of an Office of Research and Technology Applications at each lab and encourages that the labs link to components of the innovation ecosystem, industry and state and local government (15 USC § 3710).

Creating a culture of innovation within federal laboratories and universities is essential for the progress of science. Linking the laboratory or university to all other players in the ecosystem helps to translate the scientific research outcomes into products and services that can be used by the public. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=3658488*

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