Modeling Innovation and Entrepreneurial Ecosystems

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Lessons from a decade of modeling ecosystems

1. Networks are hard, and people don't like them

2. Ecosystems are larger, more complex, and more connected than people realize - or want them to be (*see # 1*)

3. Our definitions are still fuzzy, and our metrics are still bad

4. Interpreting network graphs is *still* a bit like reading tea leaves (*Maryann Feldman*)

... but the images are still cool

Network model of Atlanta, GA innovation ecosystem circa 2008-2010. Image created by C. Scott Dempwolf, January 2013.

Ecosystems are Complex Adaptive Systems

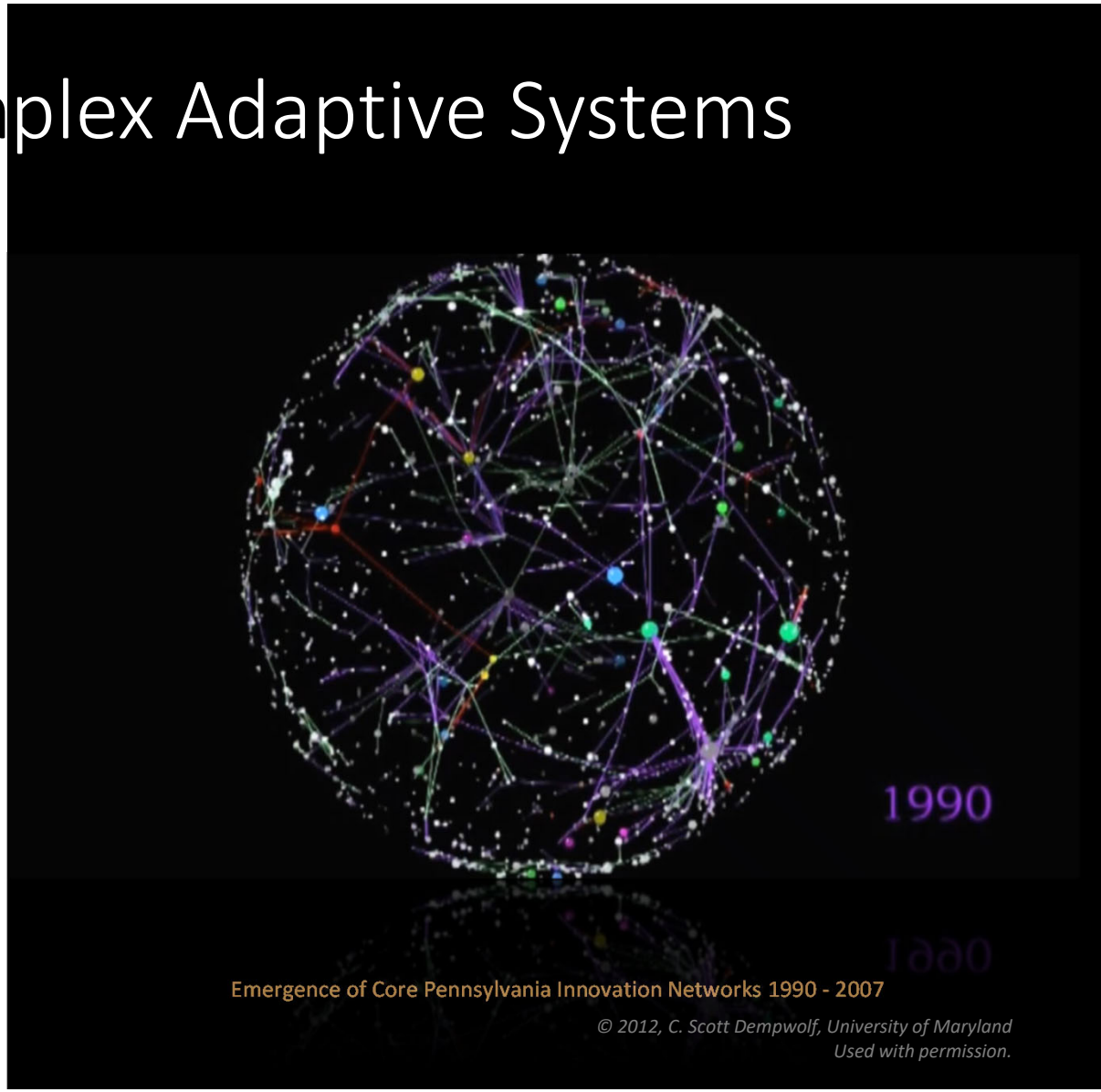
An *innovation ecosystem* consists of many ***networks of agents*** involved in multiple ***innovation processes*** within a loosely bounded ***spatial environment***. Agents engage in discrete innovation events, ***assimilate*** new information about the ecosystem, and ***adapt*** to changing conditions, giving the ecosystem properties of ***emergence*** over time.

<u>Presentation outline</u>

- The Innovation Process
- Events
  - What are events?
  - What are prerequisites for events?
  - What are the products of events?
- Events and Networks
- Events, Data, and Analytics

➔ What can communities do to leverage federal opportunities?

- Examples & Eye Candy



Emergence of Core Pennsylvania Innovation Networks 1990 - 2007

Good models start with precise definitions

We define innovation as a process that transforms research and discovery into new products in the marketplace.

The innovation process is comprised of sequences of discrete innovation-related events. Events are activities or projects, for example.

Events are connected to each other by knowledge flows or idea flows (knowledge flow is a widely used term; Pentland (2014) uses idea flow. They are generally equivalent)

INNOVATION

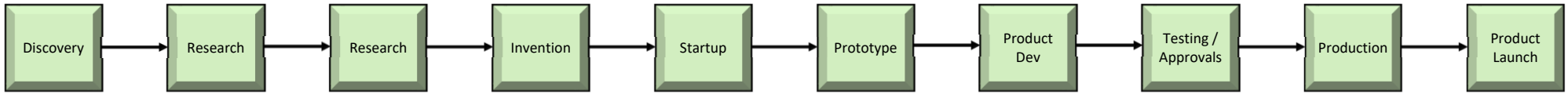
time →

INNOVATION

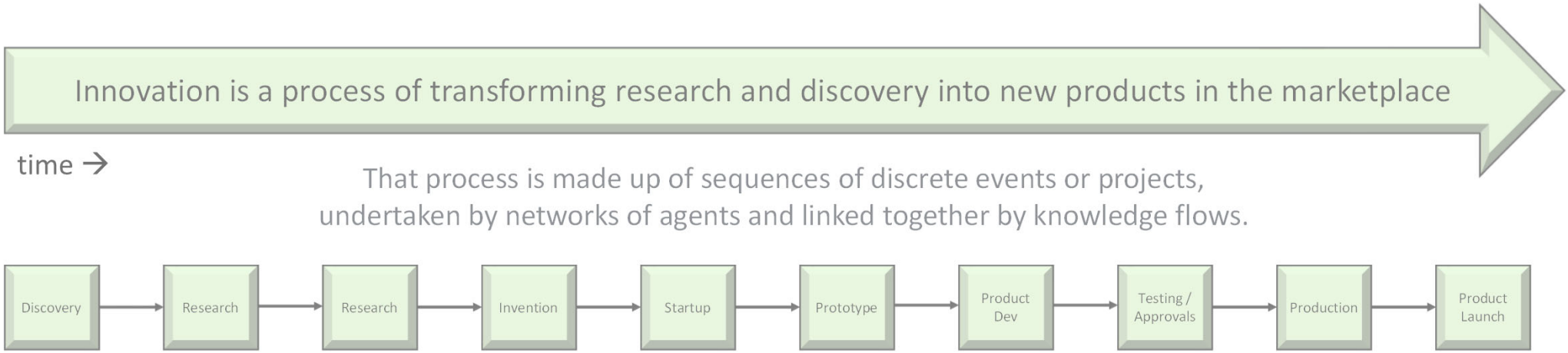
Innovation is a process of transforming research and discovery into new products in the marketplace

time →

That process is made up of sequences of discrete events or projects,
undertaken by networks of agents and linked together by knowledge flows.



INNOVATION



A s s i m i l a t i o n

Simultaneously, agents are also engaged in a continuous process of learning and assimilating new information, along with perceiving new opportunities and threats in the innovation ecosystem.

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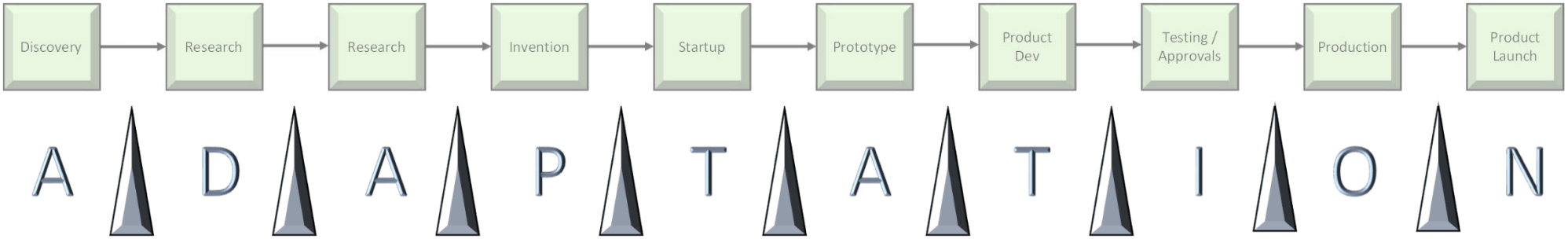

The process of agents defining 'what's next' – the next project – and implementing it is a manifestation of adaptation

Assimilation

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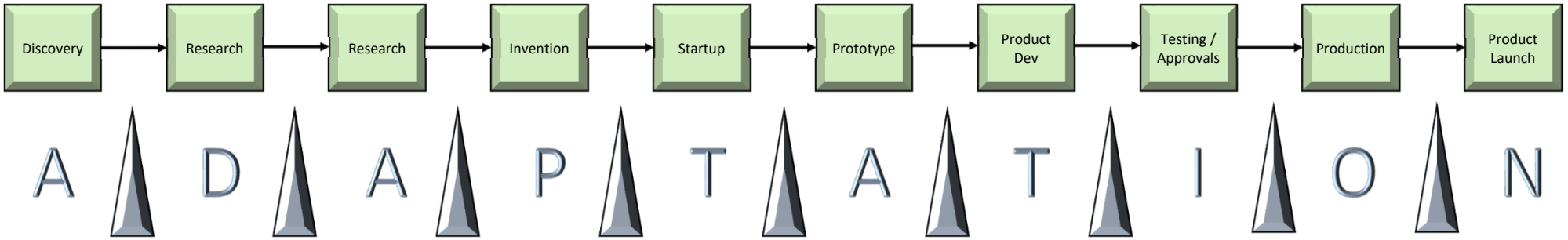

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A s s i m i l a t i o n

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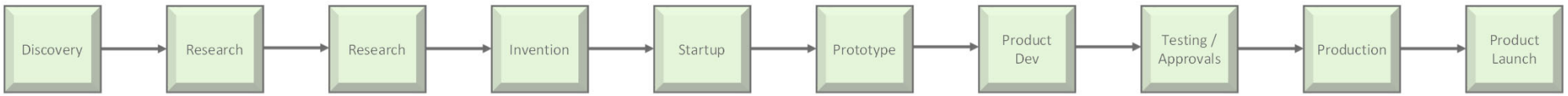
Events

Events are discrete human interactions

- They occur in time with beginnings and endings
- They involve networks of people
- They are linked to one or more places
- They are about one or more ideas
- They use and produce artifacts (documents, publications, IP, equipment, prototypes, etc.)



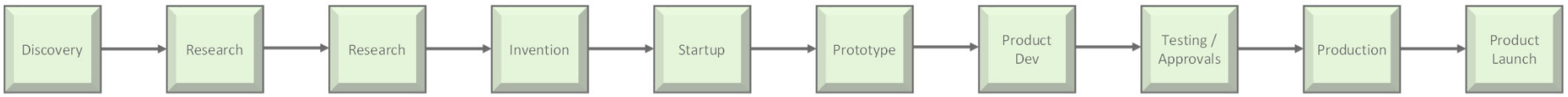
Events (from an information perspective)

Events are discrete human interactions (what)

- They occur in time with beginnings and endings (when)
- They involve networks of people (who)
- They are linked to one or more places (where)
- They are about one or more ideas (why)
- They use and produce artifacts (how)

➔ Events are well-suited for data collection

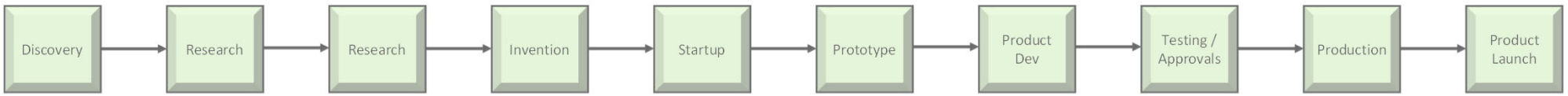
➔ Each event represents a statistical observation



Event Prerequisites

For events to occur, regions must organize the following:

- A latent network of people
- One or more locations
- One or more reasons or purposes
- Resources
- A schedule, agenda, or plan



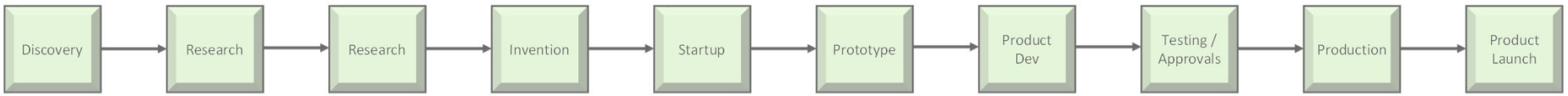
Event Products / Outcomes

Innovation-related events produce the following:

- New knowledge or ideas (codified and tacit)
- Experience (tacit knowledge embedded in people)
- Artifacts - documents, publications, records, data, prototypes, IP, agreements, plans, etc.
- A residual event network

➔ These become inputs for future events

➔ A community's "latent network" is mostly the aggregate of all residual event networks



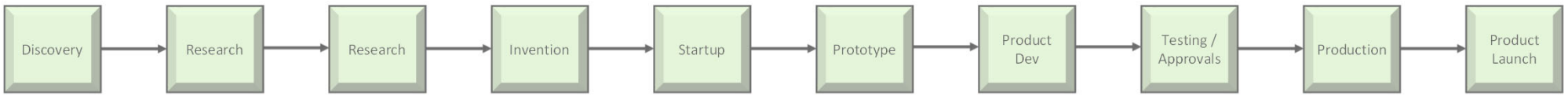
Events (from a data perspective)

Events are well-suited for data collection

- Each event represents a statistical observation
- Events typically produce records with at least some of the relevant data
- Event data are often used for evaluation purposes too
- We can mine existing data from past events to approximate residual networks, artifacts, and resources

➔ There is a lot of existing data

➔ Events have the potential for much more data generation



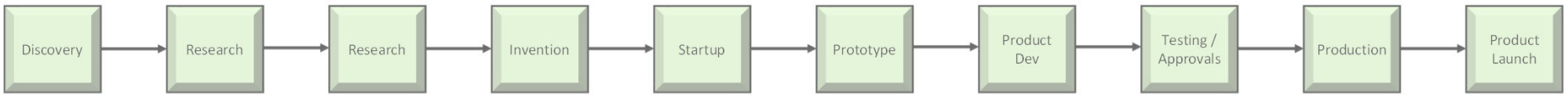
Agents, events, and networks

Events are conceived, sponsored, and carried out by ***networks of agents***.

For each event, all the agents involved form a temporary ***event network.***

Event networks are created or drawn from the larger ***latent*** (***residual) network***. In the abstract, the residual network consists of every agent and every relationship.

When an event ends the event network ends as well. However, the relationships, social capital, trust, etc. 'imprints' onto the residual network. The relationships, experiences, and memories are preserved in the residual network after the event ends (hence the name *residual*).



Communities and innovation ecosystems

Within the residual network communities form over time. With respect to innovation these may be work or professional communities, or communities of practice, for example. Some communities may be built up by multiple event networks layered over time.

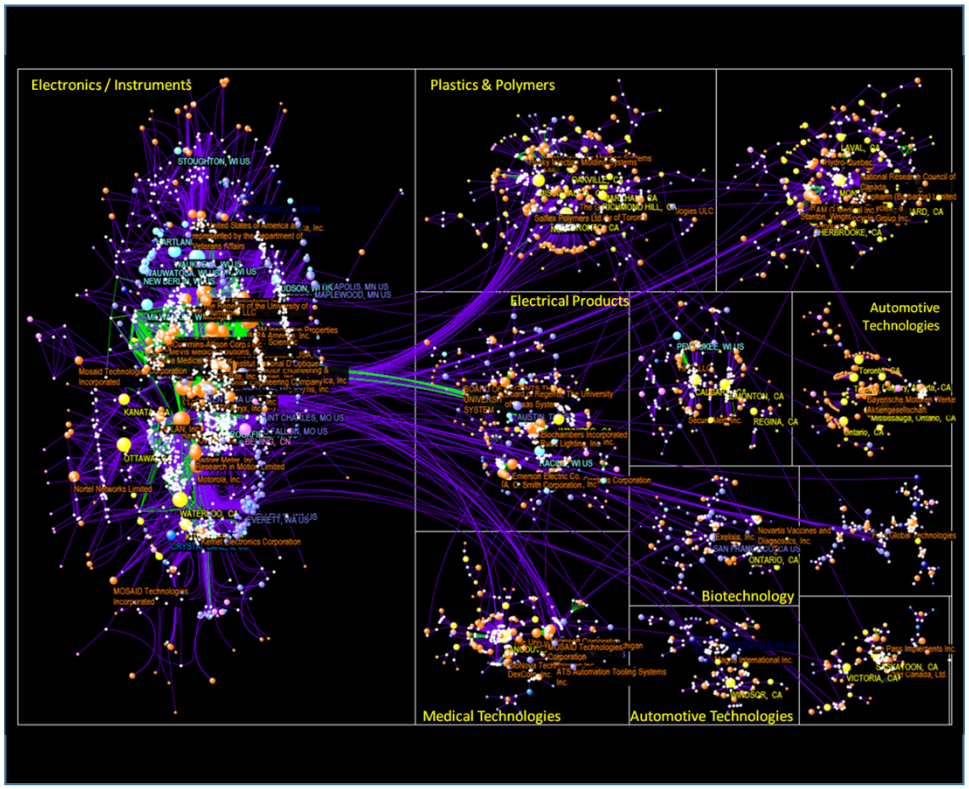
Communities that form around innovation in a particular geographic place or loosely bounded environment form what we refer to as innovation ecosystems or innovation and entrepreneurial ecosystems.

We define innovation ecosystems as networks of agents engaged in innovation-related activities or events within a loosely bounded spatial environment.

We recognize innovation ecosystems as Complex Adaptive Systems (CAS) subject to all the characteristics and behaviors associated with CAS.

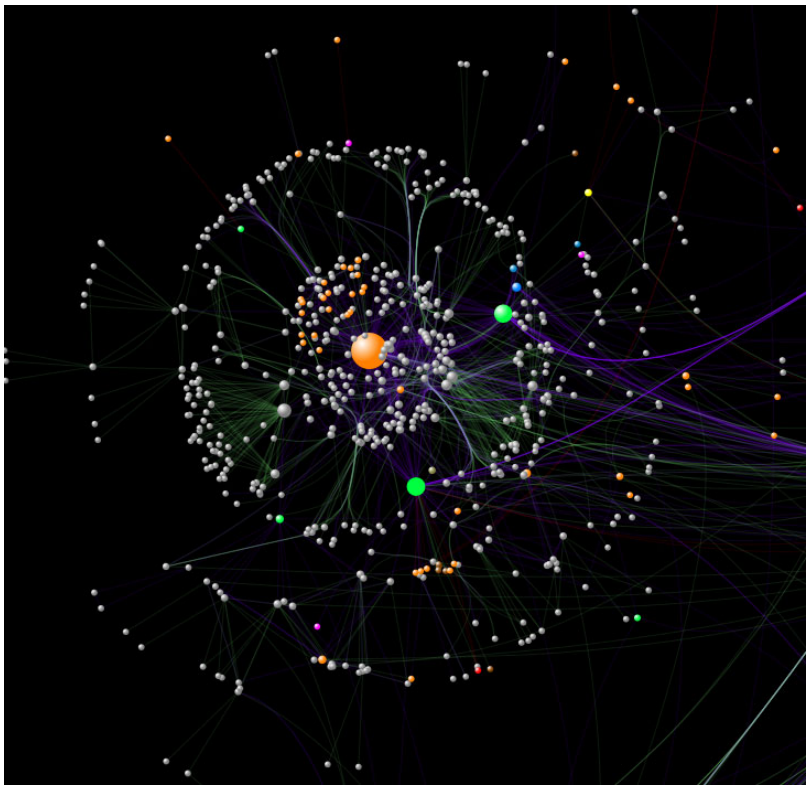
Early network visualizations with manufacturing focus:

Robust clusters and tiers in the supply chain



Great Lakes region manufacturing innovation networks (2012)

Illustrating complex innovation structure of bi-national (US – Canada) manufacturing clusters; and evolving cluster structures



Westinghouse innovation network, Pittsburgh PA (2012)

Illustrating concentric layers that tend to reflect supply chain tiers in manufacturing and procurement.

Leveraging Federal Resources

What can regions do to improve their ecosystems and readiness for future events?

1. Know their latent / residual network and consider modeling it
2. Know their latent / residual resources and consider modeling them
3. Identify gaps or holes in the latent network and create events to bridge or fill them
4. Identify resource gaps and develop strategies and / or partnerships to fill those gaps
5. Understand that networks are unconstrained by geography. This is especially important for smaller cities, rural regions, and specialized emerging ecosystems. If the necessary talent or resources are not available locally, find them and build your network (with events)
6. Be conscious of, and conscientious about, data collection with your events

Thank You!

More examples and supplemental slides follow

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