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# Analysis of Additive Manufacturing Communities of Interest

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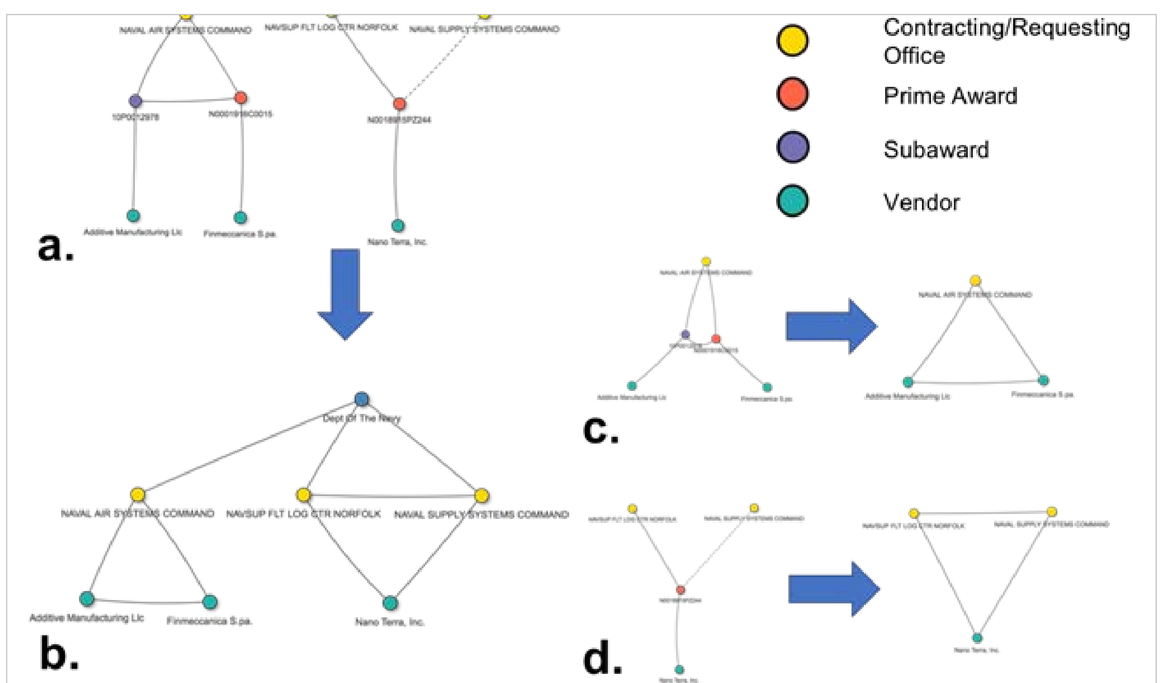
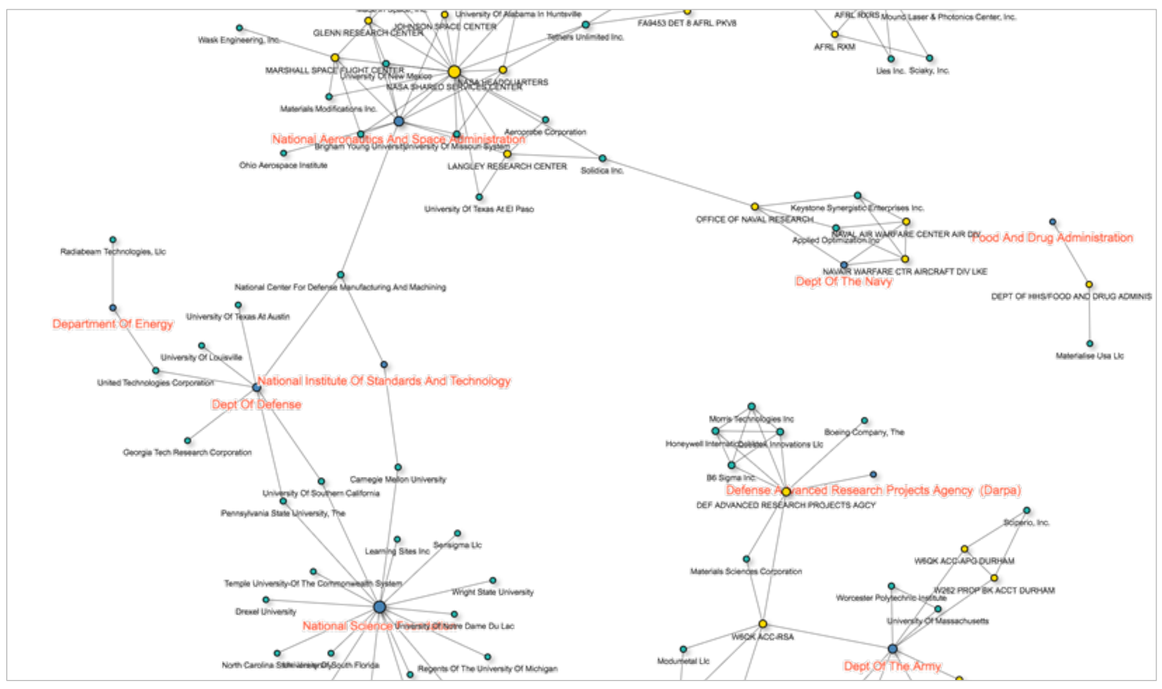
## Research Questions

Research will seek to answer the questions:

- A - What are the key nodes and clusters in the social network of additive manufacturing communities of interest?
- B - What are the ties that link together members of these formal and informal networks?
- C - How could we more effectively bridge together individuals and clusters within the social network of Navy innovators (from the deck plates up) with the larger innovation community of interest in the area of additive manufacturing?
- D - How can we measure the growth and effectiveness of the Navy Innovation Network and the larger innovation community of interest in the area of additive manufacturing to enhance collaboration?
- E - Can we longitudinally measure the impact that formal and informal innovation networks have on enhancing the Navy's effectiveness and rapid prototyping of additive manufacturing capabilities?
- F – What strategies would be best suited to connect additive manufacturing innovation communities of interest to those best placed to adopt new ideas for rapid prototyping in the private sector?




*Example contract network (top) and folded network (bottom) within the Department of the Navy*



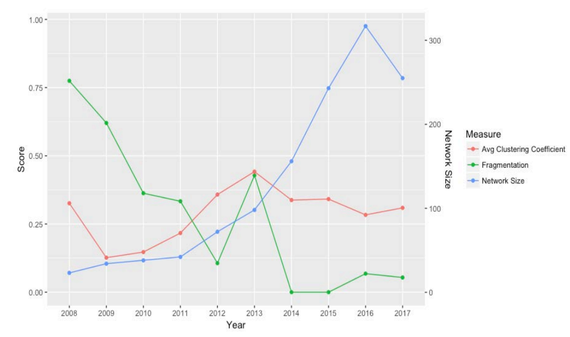

*Funding network from 2013, nodes colored by type and sized by degree centrality*

## Methodology

- Researchers gathered funding data from various US Navy and other Service/Agency databases.
- Social network analysis (SNA) was used to longitudinally determine how fragmentation and clustering among Agencies, Offices and Vendors working on additive manufacturing evolved over time (2008 – 2017).
- Latent Direchlet Allocation (LDA), a machine learning algorithm, was used to help determine where clusters formed around specific topics, or where there were potential areas for collaboration.

## Findings and Conclusions

- Key nodes were identified by selecting nodes with low constraint. Structurally, nodes with low constraint have the most potential to facilitate the exchange of ideas or information about additive manufacturing by coordinating with a variety of different Agencies, Contracting and Requesting Offices, and/or Vendors.
- Clusters were identified within the overall Additive Manufacturing Network by analyzing contractual connections among Agencies, Contracting and Requesting Offices, and Vendors and by extracting sub-networks based on project topics.
- Overall, from 2008-2017 the additive manufacturing network has been increasing in size and decreasing in fragmentation.




*Measures for each year's network Fragmentation and Local Clustering over time.*

## Recommendations

- Increasing clustering of Agencies, Contracting and Requesting Offices, and Vendors around specific topics of interest across the whole of government could help eliminate redundancies or increase cost effectiveness.
- Analyzing network topography measures and specific research topics over time could enhance the Navy's ability to improve efficiency by optimizing resources and potentially contribute to the rapid protoyping of additive manufacturing technologies.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