Complex Adaptive System of Systems (CASoS) Engineering Initiative
http://www.sandia.gov/CasosEngineering/

Development of an Agent Based Epidemiological Model of Beef Cattle

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Twenty Ninth International Conference of the Systems Dynamics Society
Washington, DC
July 24- 28, 2011

Collaboration Partners

- Sandia National Laboratories (SNL)
  - Funding: New Mexico Small Business Assistance Program (NMSBA)
  - Model Conceptualization: Robert Glass, Stephen Conrad, Aldo Zagonel, Walt Beyeler, Melissa Finley
  - Model development (student interns): Chrysm Watson Ross, John Harger
- New Mexico State University (NMSU) Extension Service
  - Clay Mathis, Robert Hagevoort, John Wenzel
- New Mexico Livestock Board (NMLB)
  - Myles Culbertson, Dave Fly, Tim Hanosh
- Ranchers representing the beef and dairy industries
  - Joe Gonzalez (Gonzalez Family Dairy)
  - Butch Mayfield (Superior Livestock/Mayfield Ranch)
  - Phil Bidegain (T4 Cattle Company, LLC)

Industry Impact of Bovine Tuberculosis

- New Mexico's Tuberculosis Free status lost in 2008

- Significant negative economic impact

  - Logistics
  - Marketing

- Need to evaluate policies

  - Minimize likelihood of outbreak
 - Protect TB free status in clear regions of NM

Complications in Tracking Tuberculosis

- Can be asymptomatic for years

- Often only discovered post mortem in meat packing plants

- Traceback from meat packing plant complicated by multiple facilities in the animal's lifecycle chain and thus a large number of potential sources and transmission points of infection.

- Expensive and difficult to test for in some facilities

- Increased viral shedding over time.

CASoS
Engineering

- Assist the New Mexico cattle industry in disease tracing and analysis to inform and evaluate prevention and mitigation for bovine tuberculosis:

  - Analyze statistical likelihoods of source, contact points and endpoint of disease propagation through stochastic network modeling

  - Given location of disease identification, identify other potential carriers

  - Cost effectiveness of identification at different points in the lifecycle chain

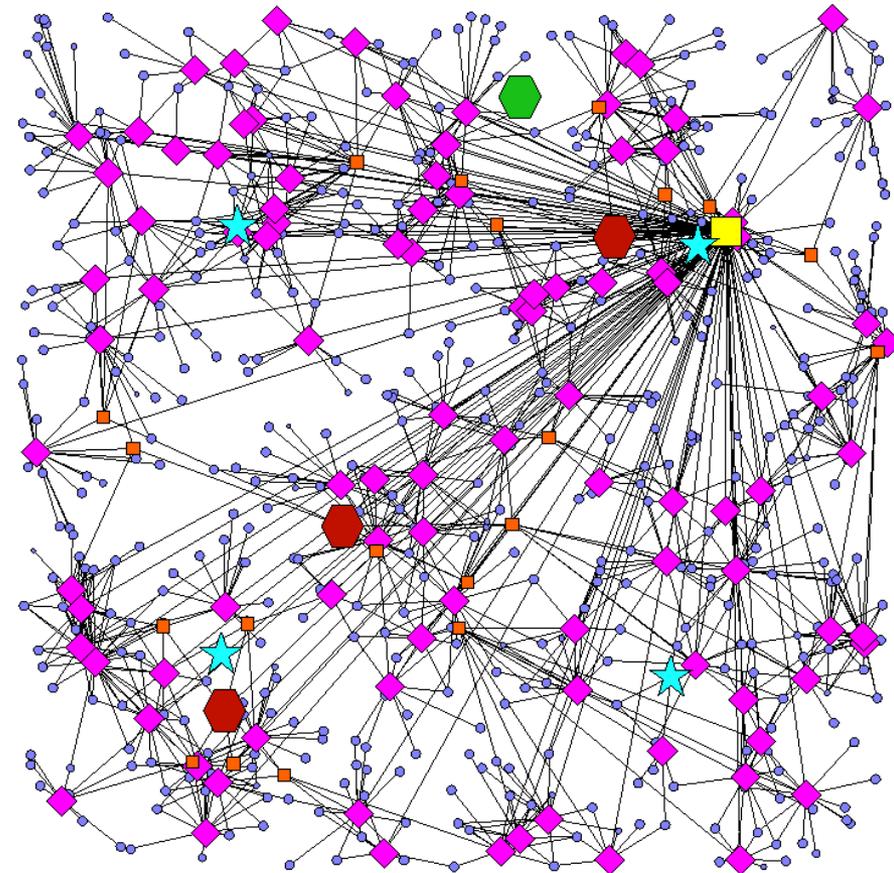 - Evaluate the effectiveness of various mitigation protocols

Beef Cattle Life Path
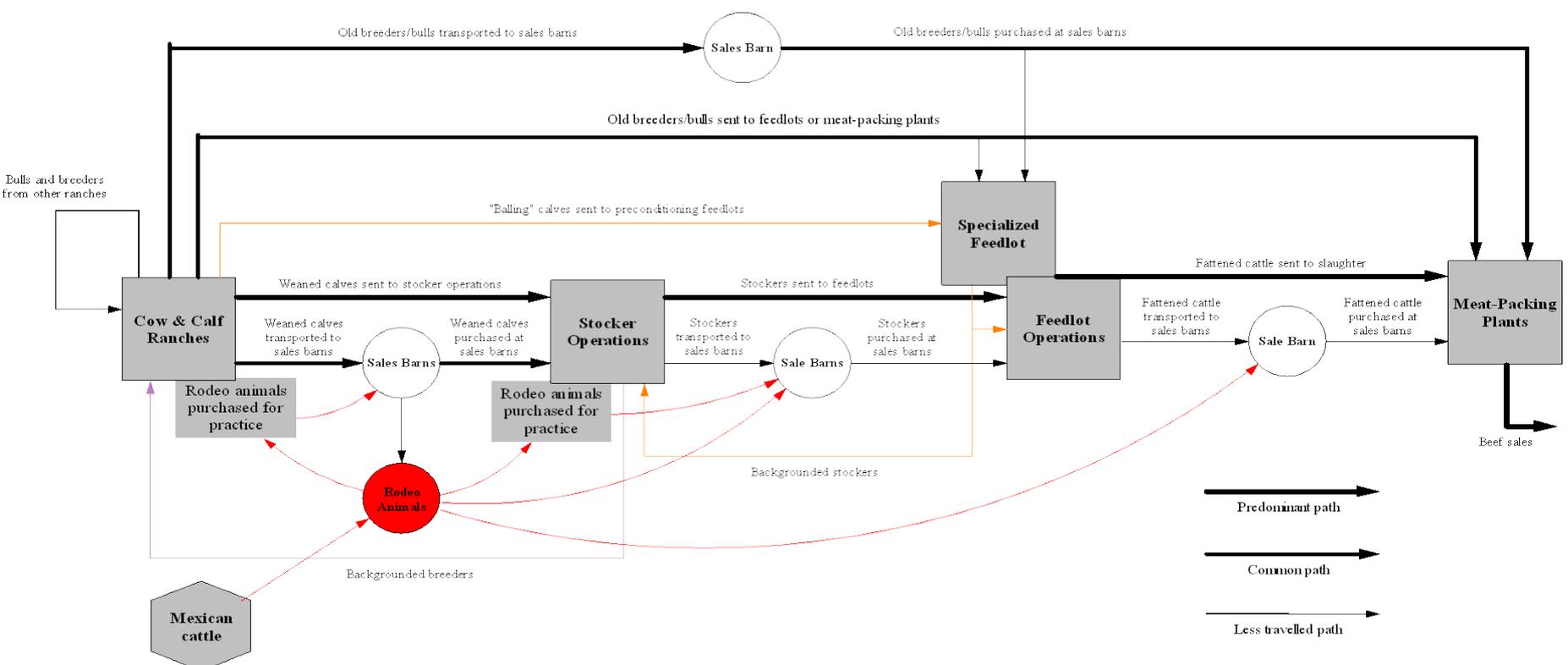
- Discrete units to inform geographic dispersion patterns

- Illuminates regional affects

- Assists with assessing effectiveness of policy boundaries

- Programmed in Java, XML, and Eclipse IDE

- Implemented modules of Loki project

Geographic vs. Abstract Networks

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