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A Simple Temporal Network for Coordination of a Collaborative System-of-Systems*

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Project Goal

- Sandia's Z Machine serves a variety of stakeholders from many different HED communities (e.g., defense, academic, Dynamic Materials Properties, Inertial Confinement Fusion, Fundamental Science).
- Many of the activities integral to a Z experiment ("shot") are knowledge processes, and many of these are *Emergent Knowledge Processes* (**EKPs**), "involving intellectual activities, expert knowledge, and diverse people in unstructured and unpredictable combinations" (Markus et al., 2000).
- Many of the workers involved in a Z experiment have independent management and organization, often with volunteer-type participation, forming a classic *Collaborative System-of-Systems* (**SoS**) (Maier 1998).

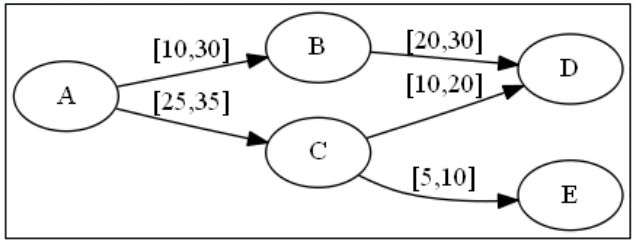
These traits make planning and scheduling Z experiments a *hard* problem!

Research question:

Can we help coordinate workers by producing reliable schedule information even when so much of the work is unpredictable?

Solution outline

- Simple Temporal Networks (Dechter 1991) provide a method by which minimum and maximum times between individual events can be defined, forming a Directed Acyclic Graph of events that can be scheduled in time.

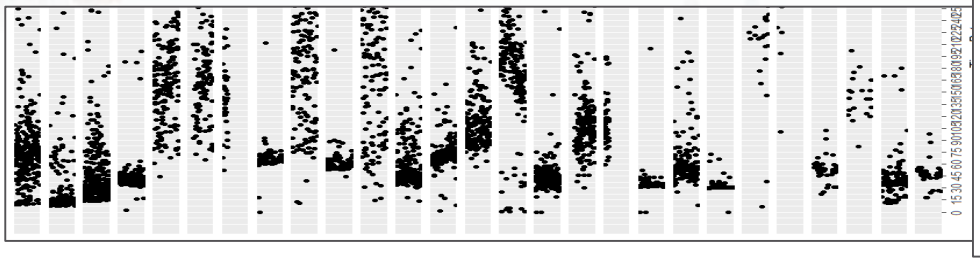


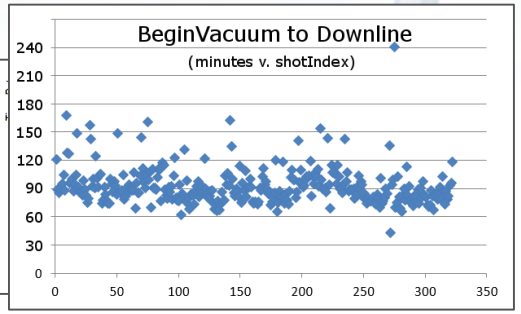
- In a **System-of-Systems** comprising **Emergent Knowledge Processes**, *maximum times* between activities cannot be established (due to ramifications of: unstructured/unpredictable combinations, emergent outcomes, independent organization, and volunteer-like participation).

> *Minimum times* between activities can be established. Activities can then be scheduled for their earliest possible times, which provides consistently reliable, actionable information for workers.

Conclusion

- Data was analyzed from electronic signals of machine state throughout hundreds of Z experiments to determine minimum possible times between various machine states.





- A template Simple Temporal Network was defined for a general Z experiment, with activities scheduled for their earliest times on shot day: