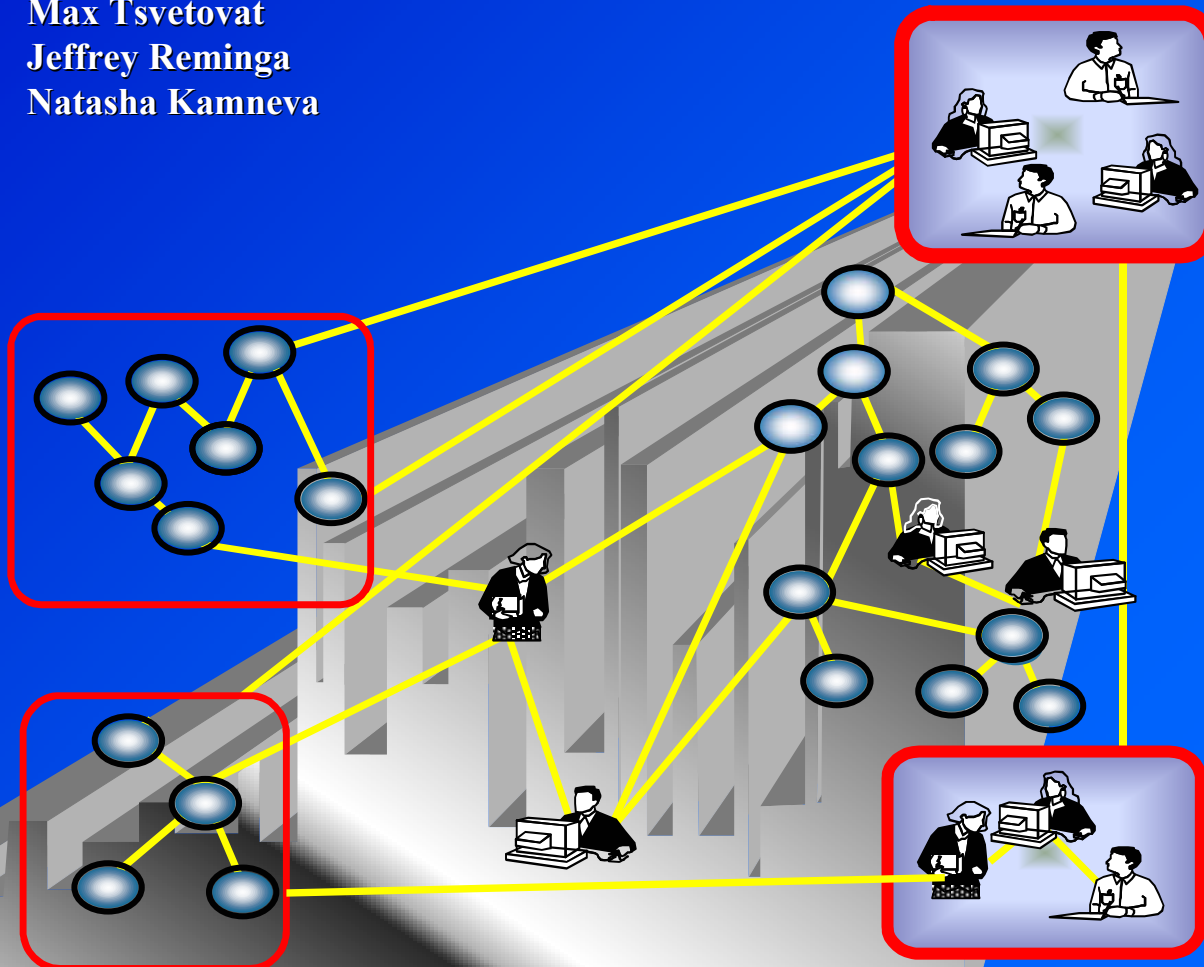




Destabilizing Dynamic Covert Networks

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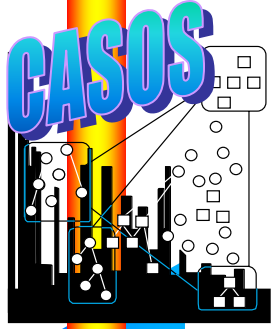
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Traditional/Western Concept



The Charismatic Leader

Consultative Council – Shura majlis



Religion/Legal

Military/Ops/Training

Finance

Media/PR

Support Network (*mainly fundraising, financial and technology / weapons provider*)

Support Cells

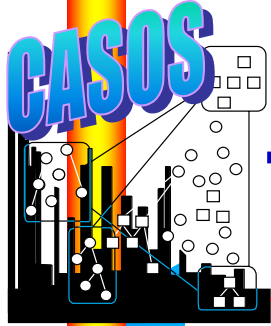
Finance

Recruitment

Training

Operational Cells

Lent by Candon, SAIC



The Network Solution – *Dis-Connect the Dots!*

	Degree	Betweenness	Closeness
1	0.417 Mohamed Atta	0.334 Nawaf Alhazm	0.571 Mohamed Atta
2	0.389 Marwan Al-Shehhi	0.318 Mohamed Atta	0.537 Nawaf Alhazmi
3	0.278 Hani Hanjour	0.227 Hani Hanjour	0.507 Hani Hanjour
4	0.278 Nawaf Alhazmi	0.158 Marwan Al-Shehhi	0.500 Marwan Al- Shehhi

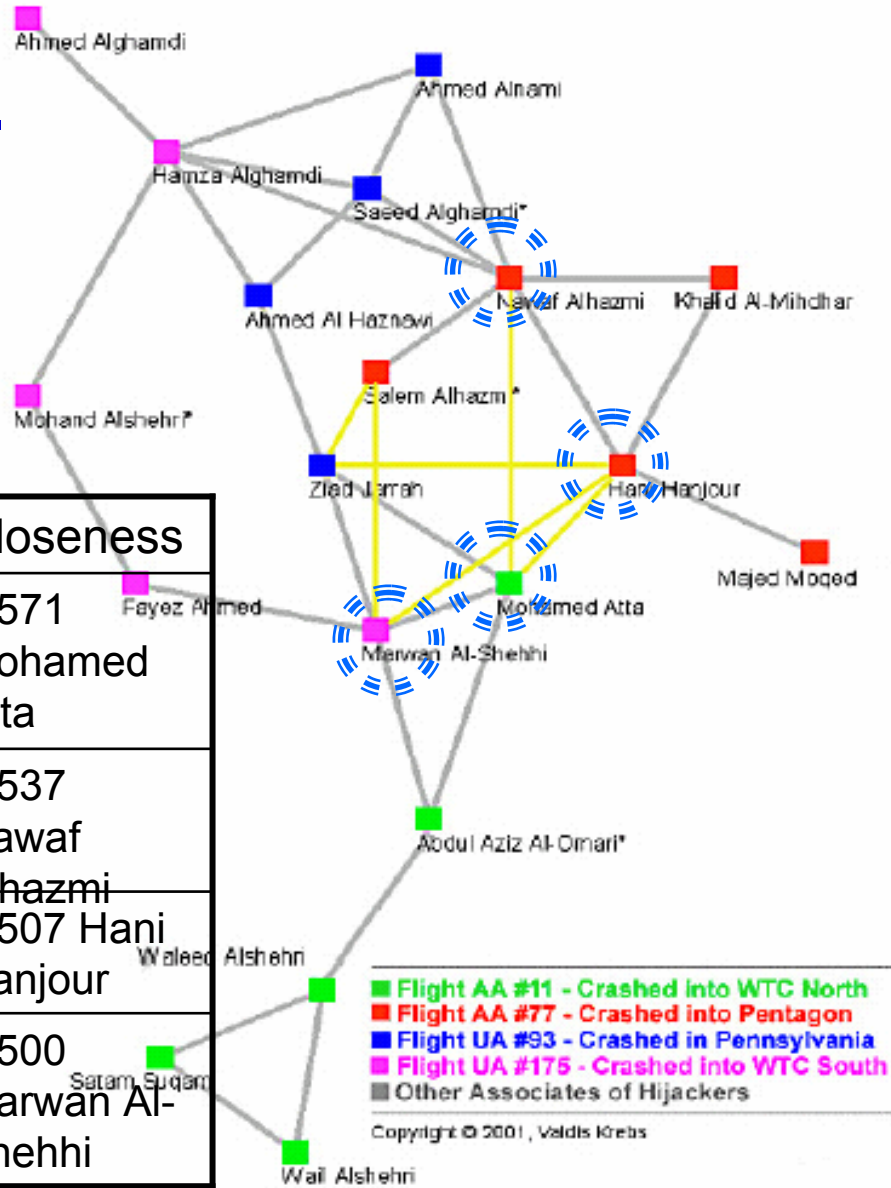
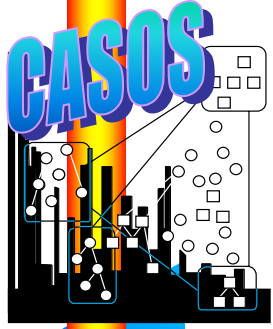


Figure 3 Trusted Prior Contacts + Meeting Ties [shortcuts]





So – why is this hard?

* The Network

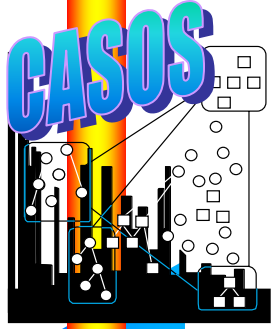
- * Vast quantities of data
- * Multi-mode – people, events, etc.
- * Multi-plex – many connections e.g. financial and authority Aliases (typos, etc.)

* The Information

- * Intentional misinformation
- * Inaccurate information
- * Out-of-date information
- * Incomplete information

* Dynamic

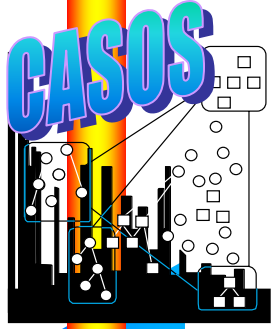
- * Learning
- * Recruitment
- * Attrition



CASOS Approach – Dynamic Network Analysis

- * Combines social networks with multi-agent modeling which results in multi-agent network modeling
- * Utilizes multiple matrices (meta-matrix) connecting people, resources/knowledge, events, ...
- * Connections among nodes are flexible and vary in strength
- * Models are complex adaptive systems considering
 - * Characteristics of agents, resources, events ...
 - * Characteristics of connections
 - * Processes for change – learning, resource consumption, tension ...
- * Develop metrics for assessing who is critical in short & long run
- * Develop metrics for assessing impact on an adaptive system
- * Empirically grounded – uses existing data for cognition, networks, ...
- * Flexible modeling – allow input at varying grain size and fidelity

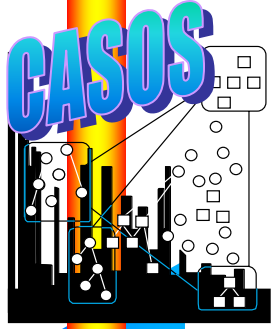




Specific Approach to Destabilizing Covert Networks

1. Identify key entities and the connections among them.
2. Identify key processes by which entities or connections are added or dropped, or in the case of connections, changed in their strength.
3. Collect data on the system (covert network).
4. Determine performance characteristic of existing system.
5. Determine performance characteristics of possible optimal system.
6. Locate vulnerabilities and select destabilization strategies.
7. Determine performance characteristics in the short and long term after a destabilization strategy has been applied



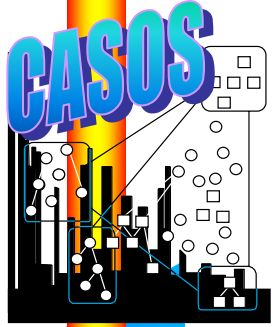


Identify key entities and the connections among them

- * Key Entities: people (agents), knowledge, resources, events, tasks, groups, and countries
- * For simplicity: people, resources, and tasks

Some Caveats

- * People
 - * Specific individuals or roles
- * In principle there are multiple relations between any two types of entities
 - * Such as money lending and authority among people
- * Data is from multiple sources and so varying in assurance, discounted for now



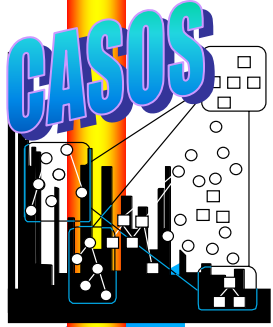
Meta-Matrix

	People / Agents	Resources	Tasks
People / Agents	Social Network	Capabilities Network	Assignment Network
Resources		Substitutes	Needs Network
Tasks			Precedence Network

Variable Design

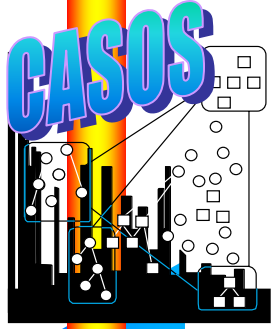
Fixed Mission





Identify key processes by which entities or connections are added or dropped, or in the case of connections, changed in their strength

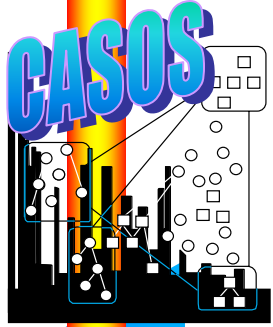
	Organizations	People / Agents	Resources	Tasks
Change Processes	Cell formation Cell destruction Cell mergers	Death Promotion Mobility Recruitment Incarceration Isolation	Consumption Acquisition	Goal Change Development of new technology Stop usage of technology Action ...



Collect Data on the System (Covert Network) - Embassy Bombing - Tanzania

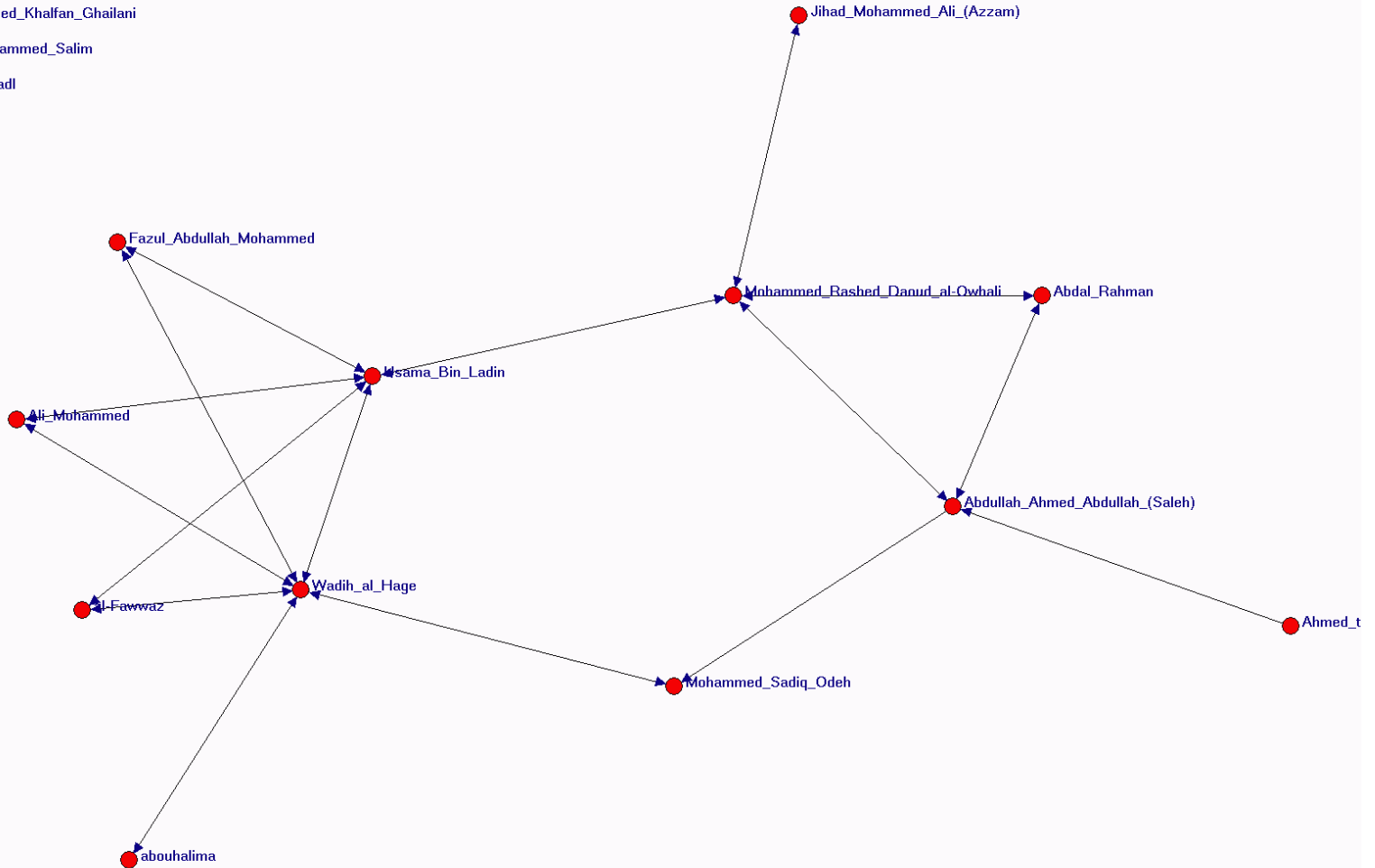
	People / Agents	Resources	Tasks
People / Agents	Social Network 16x16	Capabilities Network 16x8	Assignment Network 16x5
Resources		Substitutes 8x8	Needs Network 8x5
Tasks			Precedence Network 5x5

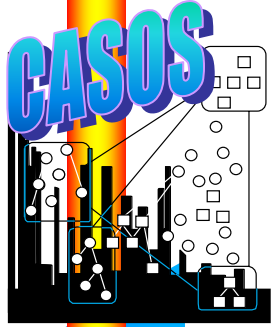




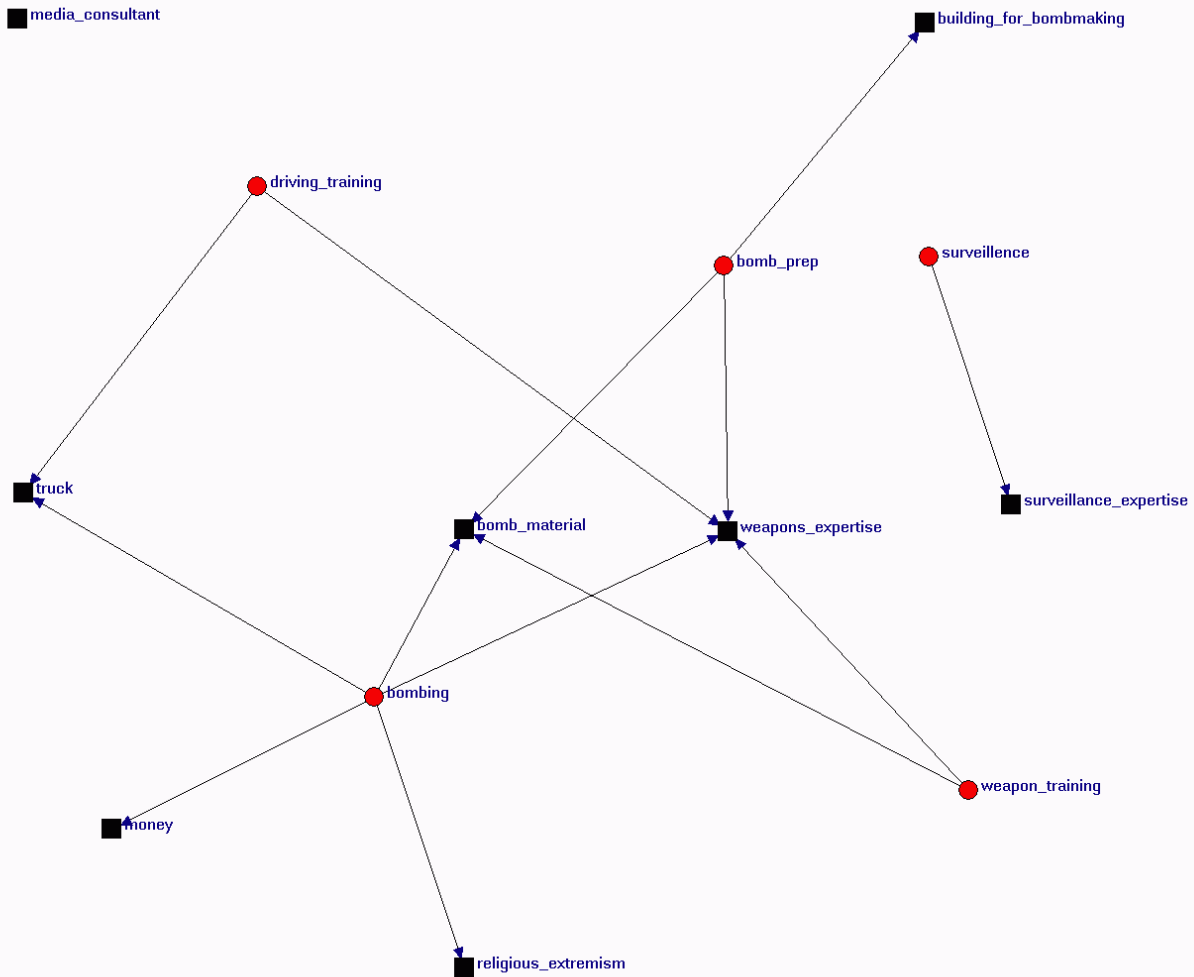
Social Network

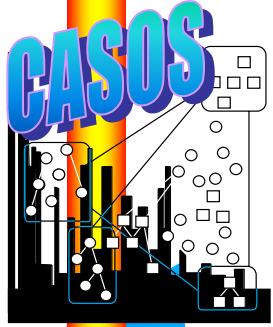
- Khalfan_Khamis_Mohamed
- Ahmed_Khalfan_Ghailani
- Mohammed_Salim
- al-Fadl





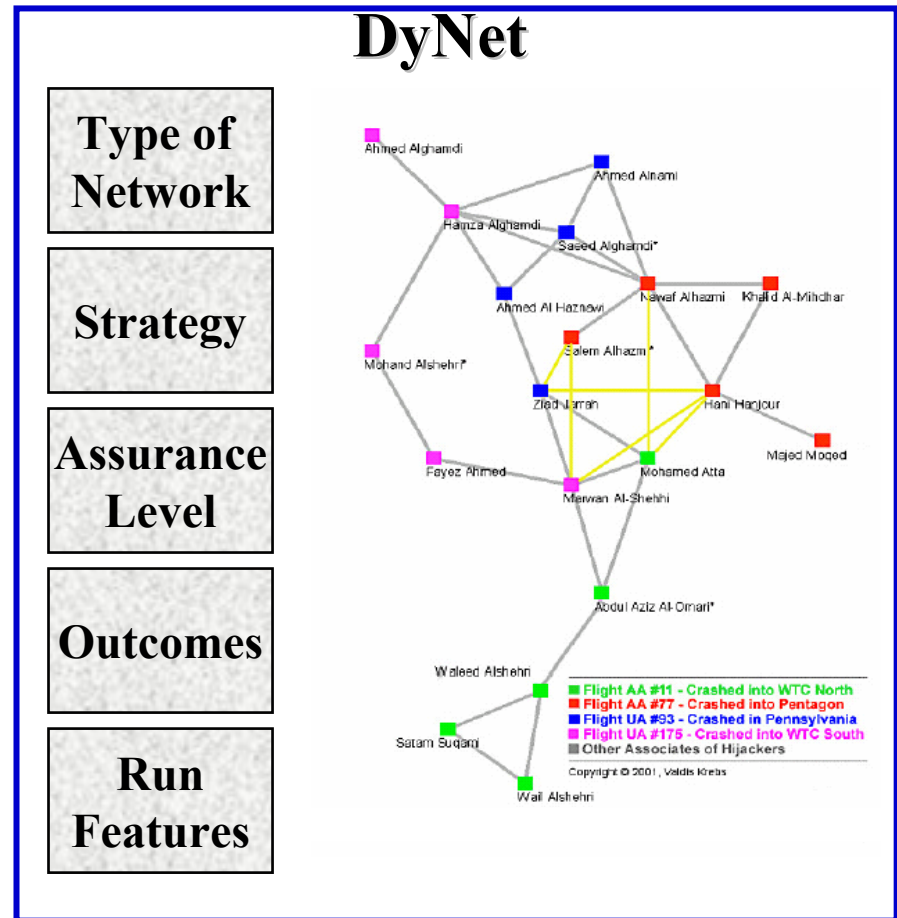
Needs Network

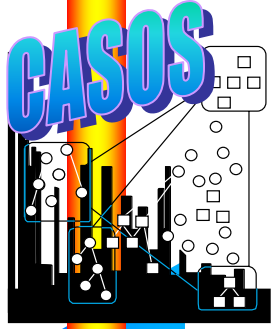




Determine performance characteristic of existing system

- * Performance as
 - * Accuracy
 - * Energy/effort
 - * Time for messages to diffuse
- * DyNet – multi-agent network simulation model
 - * Examining the evolution of networks under diverse:
 - Destabilization strategies
 - Varying levels of information assurance
- * Links to ORA
 - * Network metrics

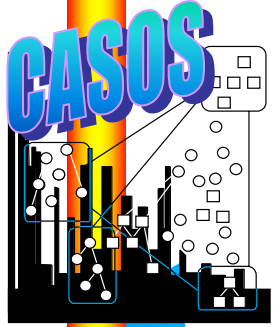




Determine performance characteristics of possible optimal system

- * Optimize Design
 - * Can be done on many variables
 - Maximize resource congruence
 - Maximize communication congruence
 - Reduce variation in cognitive load
 - Reduce variation in workload
 - * For illustration we use resource congruence
 - measures to what degree agents have resources when and only when it is needful to complete their assigned tasks
 - * Optimization is done using simulated annealer
 - * Original design .475, optimized .8 – original design not efficient
- * How distant is the new design
 - * Hamming = 88, 42% of possible links are different
 - * Random change is slightly more likely to destabilize
- * Run DyNet to see how much better than random we can do

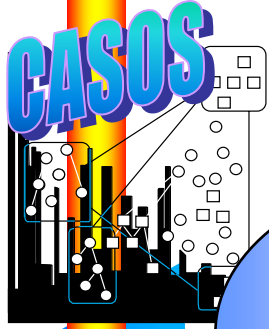




Locate vulnerabilities and select destabilization strategies

Metric	Meaning	Who Stands Out
Degree Centrality	How many others am I connect too	7 Wadih al Hage
Betweenness Centrality	How likely am I to be in the path of information	7 Wadih al Hage
Cognitive Load	How busy am I	5 Ahmed the German
Task Exclusivity	What do I do that no one else does	5 Ahmed the German





Determine performance characteristics in the short and long term after optimization

has been applied

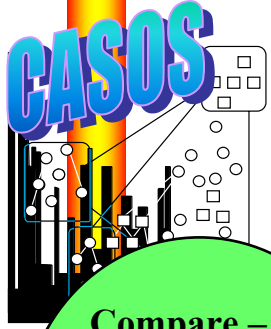
Network is better designed but less adaptive but spreads information faster

Network reduces diffusion and speed of diffusion

Using Dynamic Design for short and long term effects

Measure	Original Design	Removal of 5	Removal of 7
Hamming from Optimal	88	83	86
Resource congruence	.475	.525	.475
Performance as Accuracy – Initial Impact	78.56	78.22	82.72
Performance Recovery – Percentage Increase in Performance	95.55	89.72	93.7
Diffusion - Initial	21.62	14.70	13.27
Diffusion Recovery – Percentage Increase in Diffusion	71.23	89.05	50.88



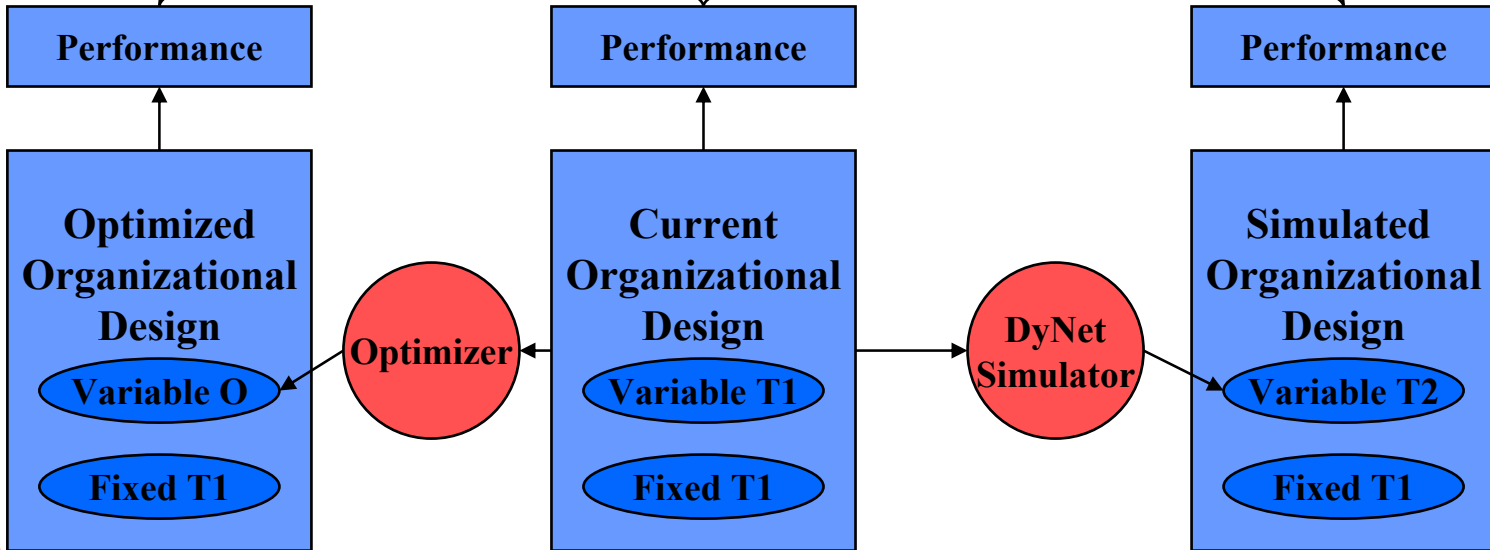


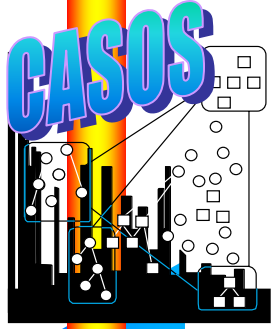
Approach to Control

Compare – How far from the optimal structure is the current structure

Compare – is the evolved performance likely to get closer or further from the optimal

Compare – is performance likely to go up or down given natural evolution





Final Comment

- * Defined Procedure for Destabilizing Covert Networks
- * Next Steps
 - * More complete optimization system
 - * Place in a decision context so can estimate impact of destabilization under different levels of stress
 - * Link this to estimates of type of network