Designing Command and Control: A systems Theory View of Health Emergency Response

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What's the problem we're trying to solve?

Ultimately, things like HA/DR are about decision-making

- These may be decisions about:
  - Resource allocations
  - Priorities
  - Response options

Decisions are the products of the organization

- Those decisions rely on the flow of information
- That information ultimately relies on systems

Three Questions

How do I organize optimally?

How do I optimize information flow?

How do I architect and engineer IT solutions?

Bonus Prerequisite Question:

How do I even model the problem space?

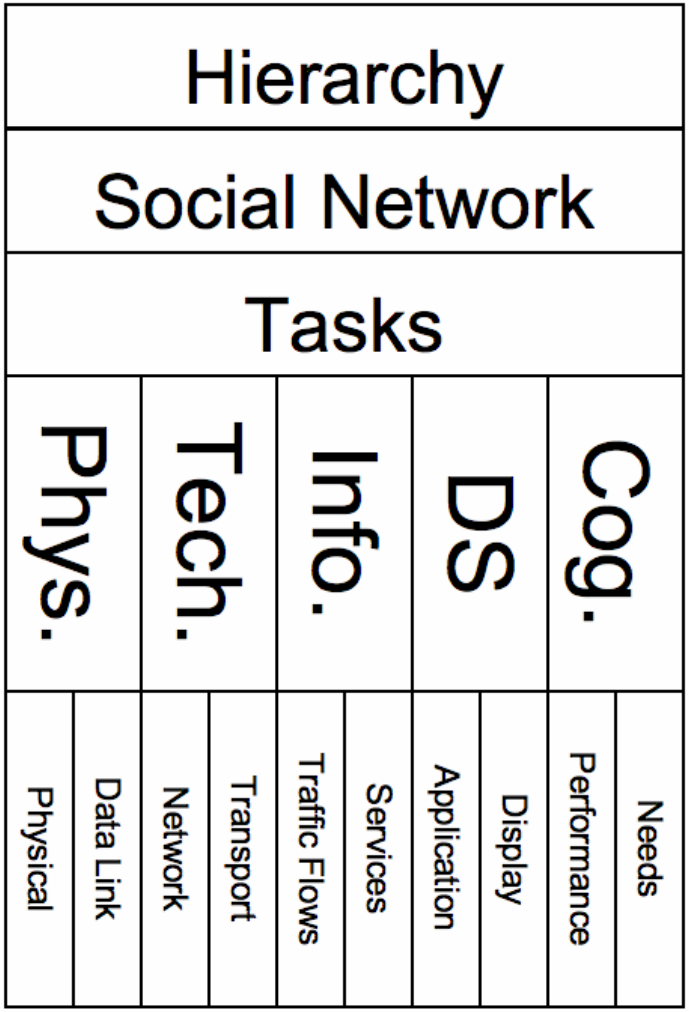
O-I-T Model

Organization	Tasks	Cognitive	Needs
			Performance
		Decision Support	Display
			Application
		Information Svcs.	Services
			Traffic Flows
		Technological	Transport
			Network
		Physical	Data Link
			Physical

Hierarchies and Networks

The problem space is even more complex, of course, since "Organization" is (at least) a bifurcated problem.

- The formal hierarchy is what you find on the organizational charts, and
- There also exists a social network that moves within, beneath and around the formal hierarchy
  - This is often said to be "How things *actually* get done"



Major Theoretical Bases

Contingency Theory

- Galbraith, et al.

Task-Technology Fit

- Goodhue

Social Networking Analysis

Systems Theory

Multiple Criteria Analysis

Criteria and Parameters

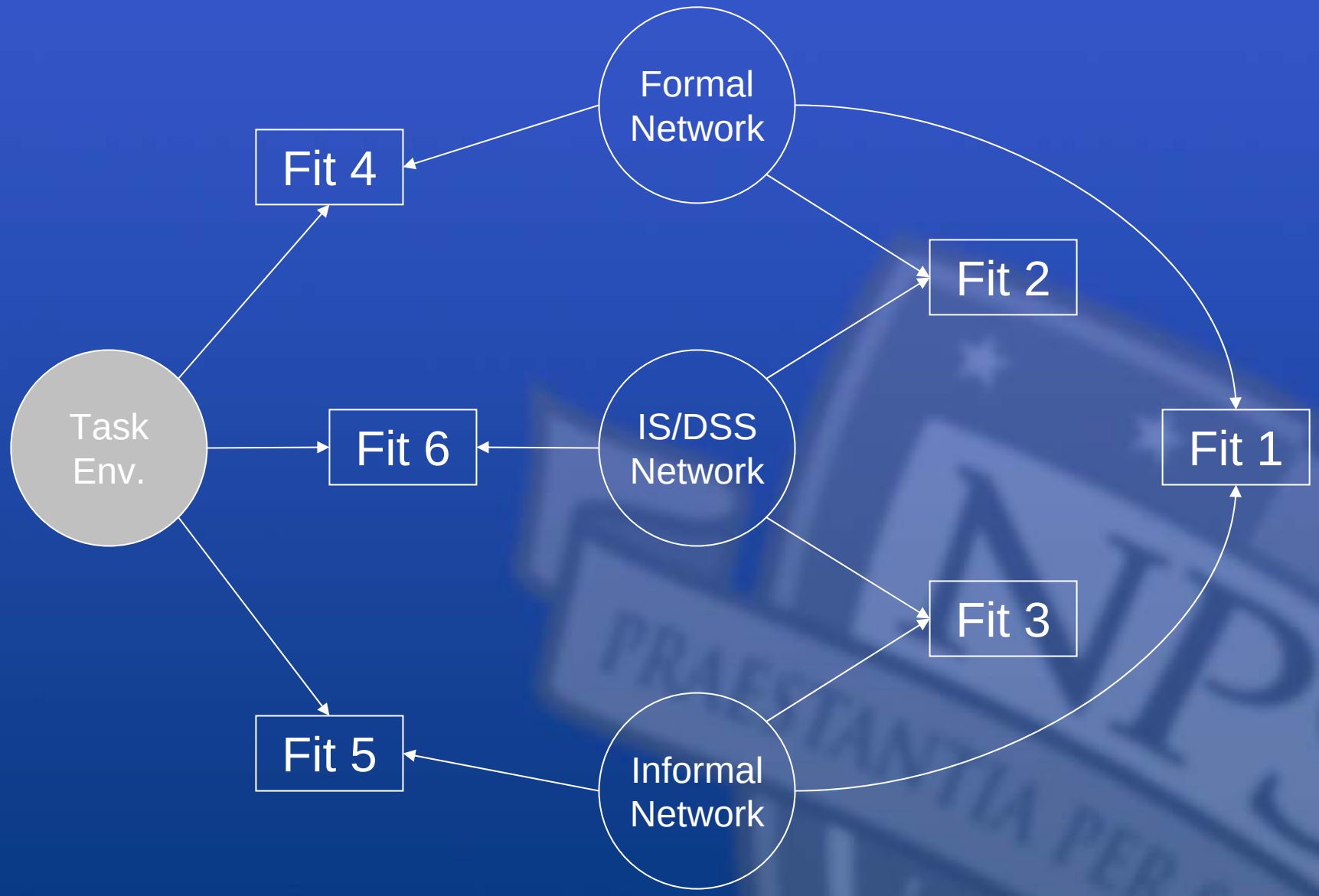
Performance Criteria:	
Cost	Dollars
# of Personnel Required	#
Space required	Sq. Ft. or Buildings/rooms
Time to make decisions	Minutes
Quality of decisions	Qual.
Time to realize a decision point	Minutes
Missed decision points	#
Network parameters:	
Network link density	#
Betweenness	#
Closeness	#
Centrality	#
Size of Clusters	#
Size of Network	#
Length of informal information chain	#
Length of formal information chain	#

Design Parameters (observational):	
Number of data pulls executed/required	#
Number of people contacted to make a decision/length of information chain	#
Percentage of decisions made within a cell	%
Percentage of decisions made without escalation	%
Number of cell elements participating in decision-making	#
Size of cells	#/ea.
Heterogeneity of cells	Qual.
Frequency of contact within the cell	1/min
Duration of contact within the cell	Minutes
Use of the information system	Qual.
Frequency of contact outside the cell	1/min
Duration of contact outside the cell	Minutes
Number of times a single piece of information must be entered into a system	#

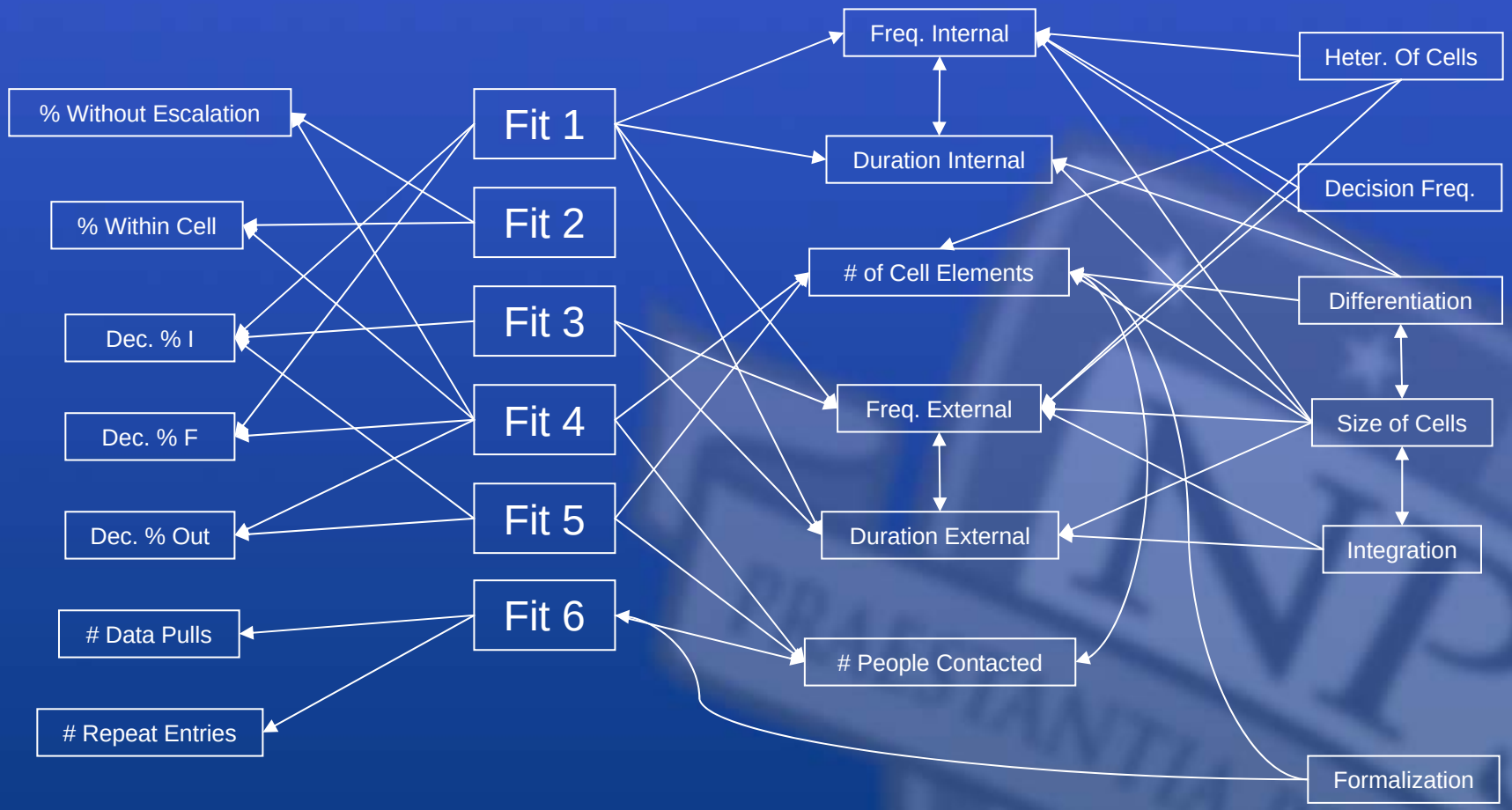
Parameters, cont.

Database scope	Qual.
# of different datasets	#
Decision frequency	1/min
Formalization	Qual.
Differentiation	Qual.
Integration	Qual.
Decision mechanism: % of decisions made using IS	%
% of decisions made within formal hierarchy	%
% of decisions made within informal organization	%
% of decisions made outside all known organizations	%
Scope of Information System (Local->Global)	Qual.
Timing (Continuous->Long periodic)	1/min

Network Fit


Formal Network
Fit 4
Fit 2
Task Env.
Fit 6
IS/DSS Network
Fit 1
Fit 3
Fit 5
Informal Network

Org. Design


% Without Escalation
% Within Cell
Dec. % I
Dec. % F
Dec. % Out
Data Pulls
Repeat Entries
Fit 1
Fit 2
Fit 3
Fit 4
Fit 5
Fit 6
Freq. Internal
Duration Internal
# of Cell Elements
Freq. External
Duration External
People Contacted
Heter. Of Cells
Decision Freq.
Differentiation
Size of Cells
Integration
Formalization

Experimentation

Tabletop

- Small Scale, Low Fidelity, High Control

Follow-on(s)

- Growing Scale, Med. Fidelity, Med. Control

TOPOFF

- Large Scale, High Fidelity, Little Control

Alternative Methods

Artificial Neural Networks

Simulation

Other Organizations

Questions?