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C2 for Complex Endeavors

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**The Meydenbauer Center
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The Command and Control Research Program
www.dodccrp.org



Plenary Panel II

Empirical Analysis of Complex Endeavors

June 18, 2008



Golden Phoenix 07

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Agenda



- What is Golden Phoenix 07?
- CCRP Focus in Golden Phoenix 07
- Data Collection
- Data Reduction
- Findings
 - Connectivity (Technical Interoperability)
 - Quality of Interaction
 - Familiarity and Trust
- Conclusions



Golden Phoenix 07

Purpose and Participants (1)



- Multiple, linked training events at the tactical level for:
 - Greater Los Angeles area **police** and **sheriff** departments
 - Greater Los Angeles area **fire** departments
 - **USMC, National Guard** (limited), ARNORTH Defense Coordinating Officer and support element, **California State Military**, and USAF Reserve Liaison Officer.
- **Los Angeles County Sheriff** as Unified Area Commander (5 standing Incident Management teams in shifts)
 - Law Enforcement Mutual Aid Area C Incident Commander from **Alhambra Police Department**
 - Law Enforcement Mutual Aid Area G Incident Commander from **El Segundo Police Department**
- **Military organizations in support roles**



Golden Phoenix 07

Purpose & Participants (2)



- Scenario events span a 30-hour period immediately following a 7.9 earthquake in Los Angeles
 - Civil unrest at the Rose Bowl
 - Night riot at Hawthorne Mall
 - Civil unrest at Inglewood Forum
 - Hazmat events
 - Medical triage
- Operation Freedom Ring (independent but coordinated)
 - Lost children and pets
 - High and low bandwidth civil reachback networks
 - GIS area mapping updated by network of deployed sensors



- Complex Civil-Military Endeavors (CC-ME) are increasingly important
 - Effectiveness of CC-ME depends in large part on the quality of “collective C2”
 - Network Centric C2 (Command and Control) concepts and value chain provide the framework for analyzing the maturity and effectiveness of CC-ME
 - Lack of empirical data about CC-ME, particularly at the tactical level, inhibits programs of research, development, and training



CCRP Focus in Golden Phoenix 07 (2)



- Take advantage of exceptional access, cooperation, and support
 - Fifteen USMC Reserve data collectors
 - Unusual willingness from civilian participants to be observed
 - Cooperative collection with SPAWAR Systems Center San Diego (SSC San Diego), Interoperable Communications Technical Assistance Program (voice networks), and Naval Postgraduate School Center for Hastily Formed Networks (data and human factors)

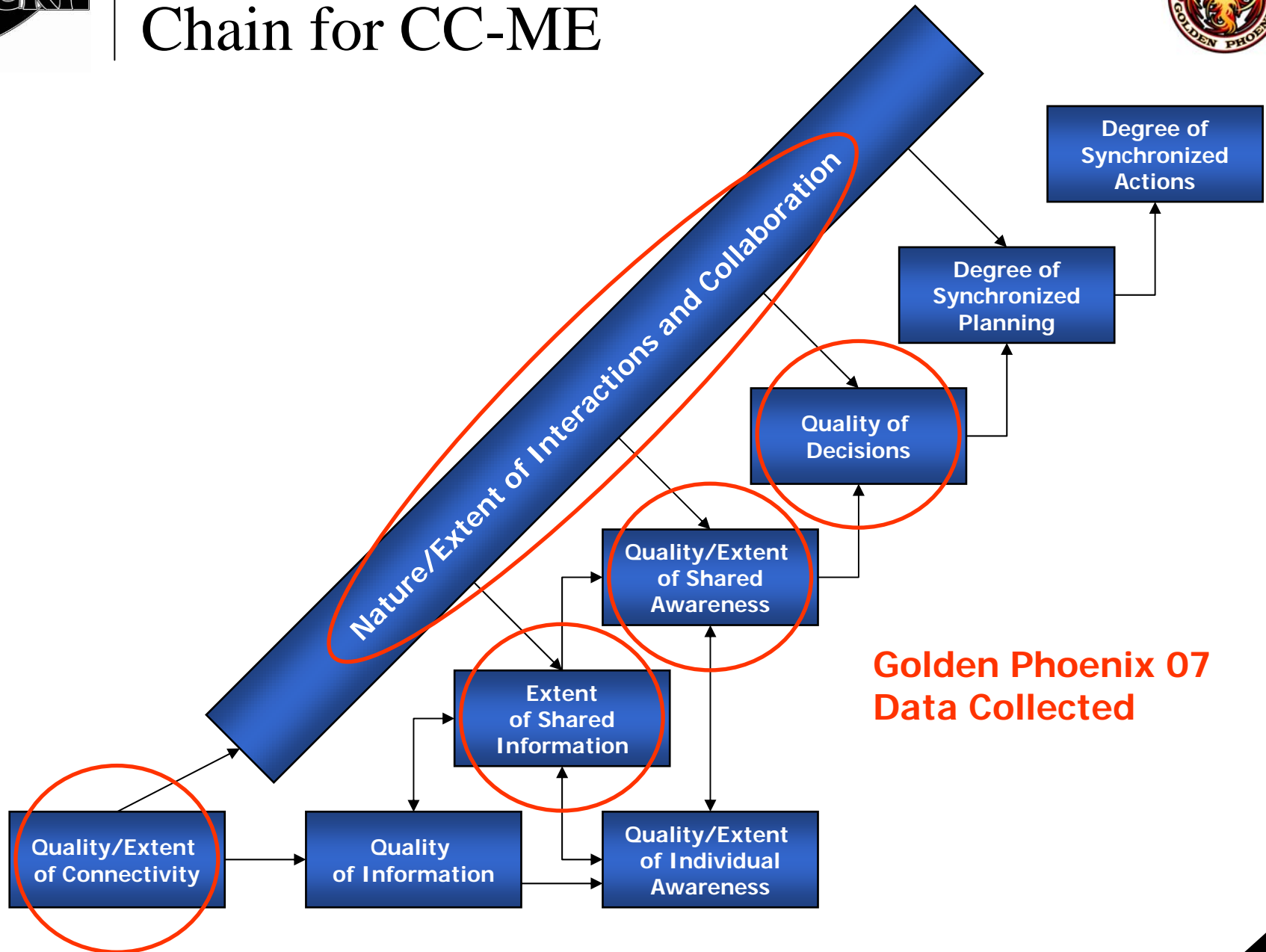


Primary Questions of Interest to the CCRP

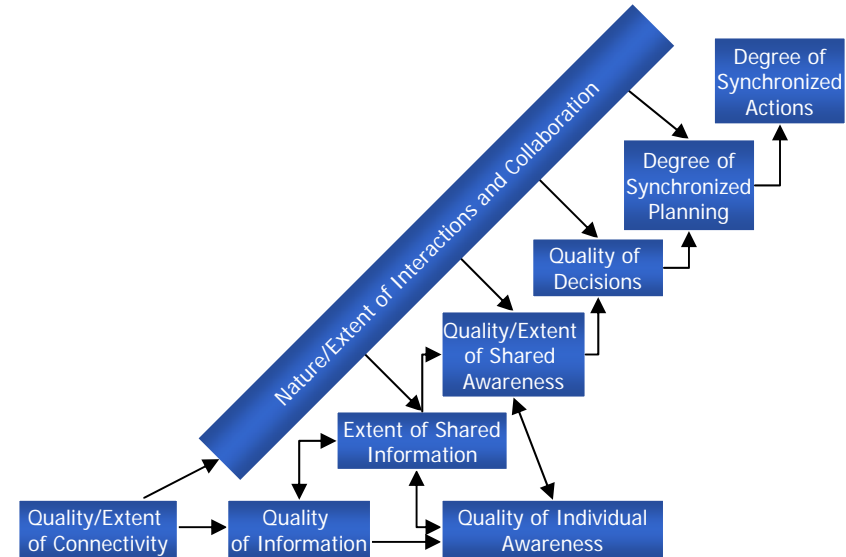


- What was the nature of the collective and individual approaches to C2 used by Golden Phoenix 07 participants?
 - Patterns of interaction
 - Information distribution
 - Allocation of decision rights
- How effective were individual and collective Command and Control?

Network Centric Value Chain for CC-ME



- Collect connectivity data for both voice and data linkages
- Collect event data on:
 - *Semantic Interoperability*
 - *Willingness or Reluctance to Interoperate*
 - *Shared Information*
 - *Shared Awareness*
 - *Collaboration*
 - *Decisions and Synchronization*



- Collect *technical interoperability* and *human factors* information in concert with the Naval Postgraduate School and Space and Naval Warfare Systems Center San Diego

Data Collected



- More than 1,600 events recorded in observer journals
- More than 200 pre- and post-event questionnaires on perceptions of organizational performance and trust
- Technical Voice Interoperability matrix developed from data recorded by SSC San Diego's Interoperable Communications Technical Assistance Program
- Technical Data Interoperability matrix developed from data recorded by NPS Center for Hastily Formed Networks
- Human Factors data collected by Australian Defense College in conjunction with NPS

- Connectivity (Technical Interoperability)
 - *Ideal* technical interoperability assumes every organization is directly connected to all other organizations
 - *Expected* planned technical interoperability determined by examining organizations' role and participation in each event.
 - *Documented* technical interoperability matrices by event for voice and data relying on collection by NPS and SSC San Diego.
 - *Scenario-based shortfalls* were observed lack-of-interactions based on scenario needs and reports from CCRP observers.

Data Reduction (2)



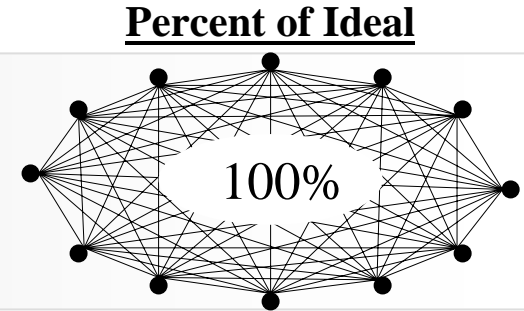
- Quality of interaction data
 - Coded from observer journals
 - Associated with meta-data including date, time, observer, location, and participants
 - Excel spread sheets developed to support analysis
- Pre- and post- event surveys
 - Responses scored and arrayed by topic and organization
 - Issues included familiarity, recognition of dependencies, organizational capabilities, and trust



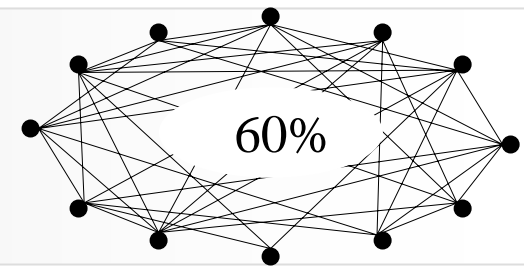
Assessment Framework for Connectivity (Technical Interoperability)



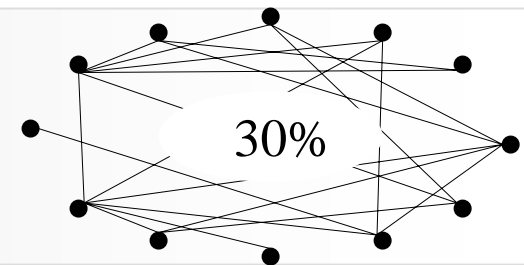
Net-centricity goal: 100% of organizations have the capability to interoperate as needed. Participants choose partners based on scenario and roles.



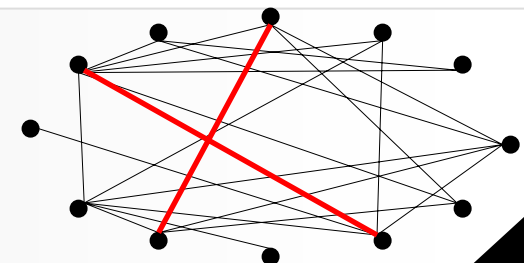
Expected interoperability: Linkages based on expectations and the nature of the scenario. Some unexpected participants complicated identifying emergency management relationships.



Documented interoperability: Linkages reported by observers from NPS, SSC San Diego, and CCRP. These represent actual linkages established.



Scenario-based shortfalls: Important expected interoperability pairs that were not present when needed during the scenario. (Shown in red).



Overall *Voice* Connectivity

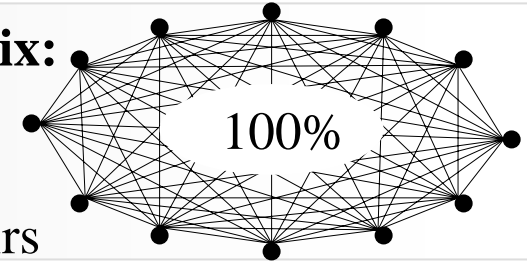


Percent of Ideal

Ideal Technical Voice Interoperability for Golden Phoenix:

(All participants capable of interacting by voice)

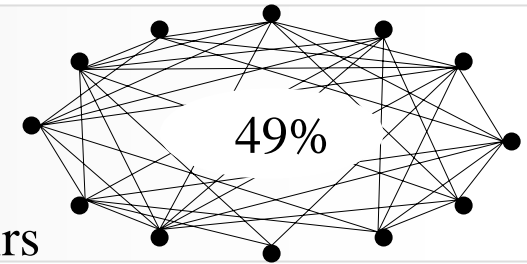
871 Organizational Pairs



Expected Technical Voice Interoperability:

(Voice linkages anticipated)

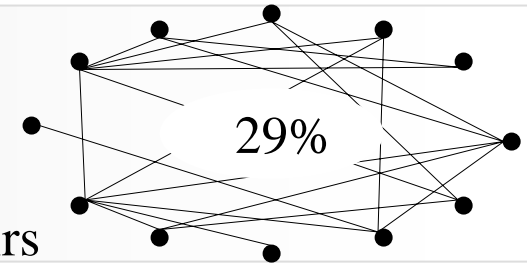
426 Organizational Pairs



Documented Technical Voice Interoperability:

(Voice linkages reported during Golden Phoenix)

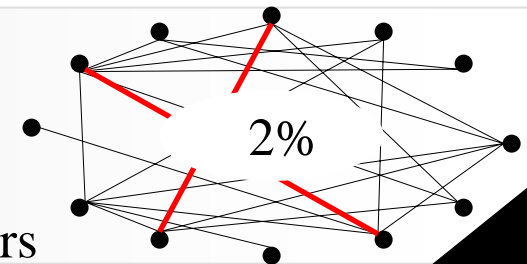
253 Organizational Pairs



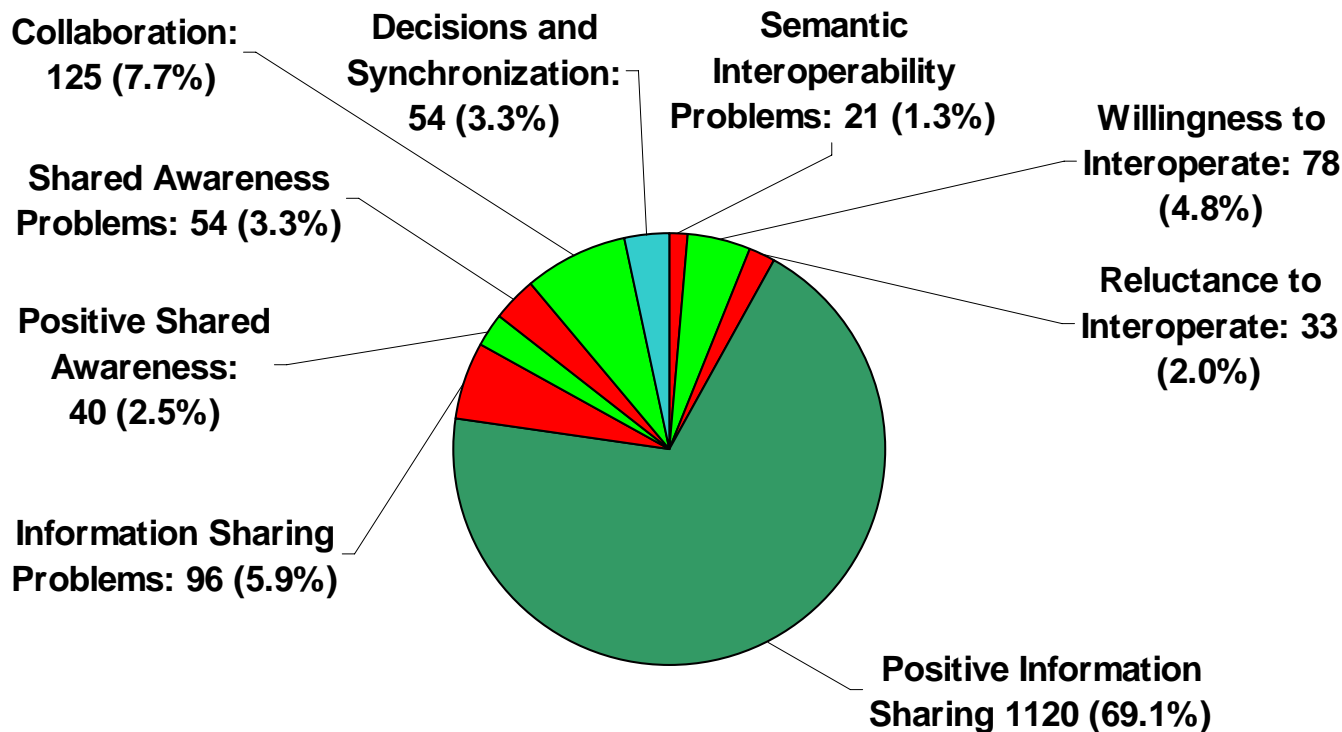
Scenario-based shortfalls:

(Expected Technical Voice Interoperability pairs needed but not present)

17 Organizational Pairs



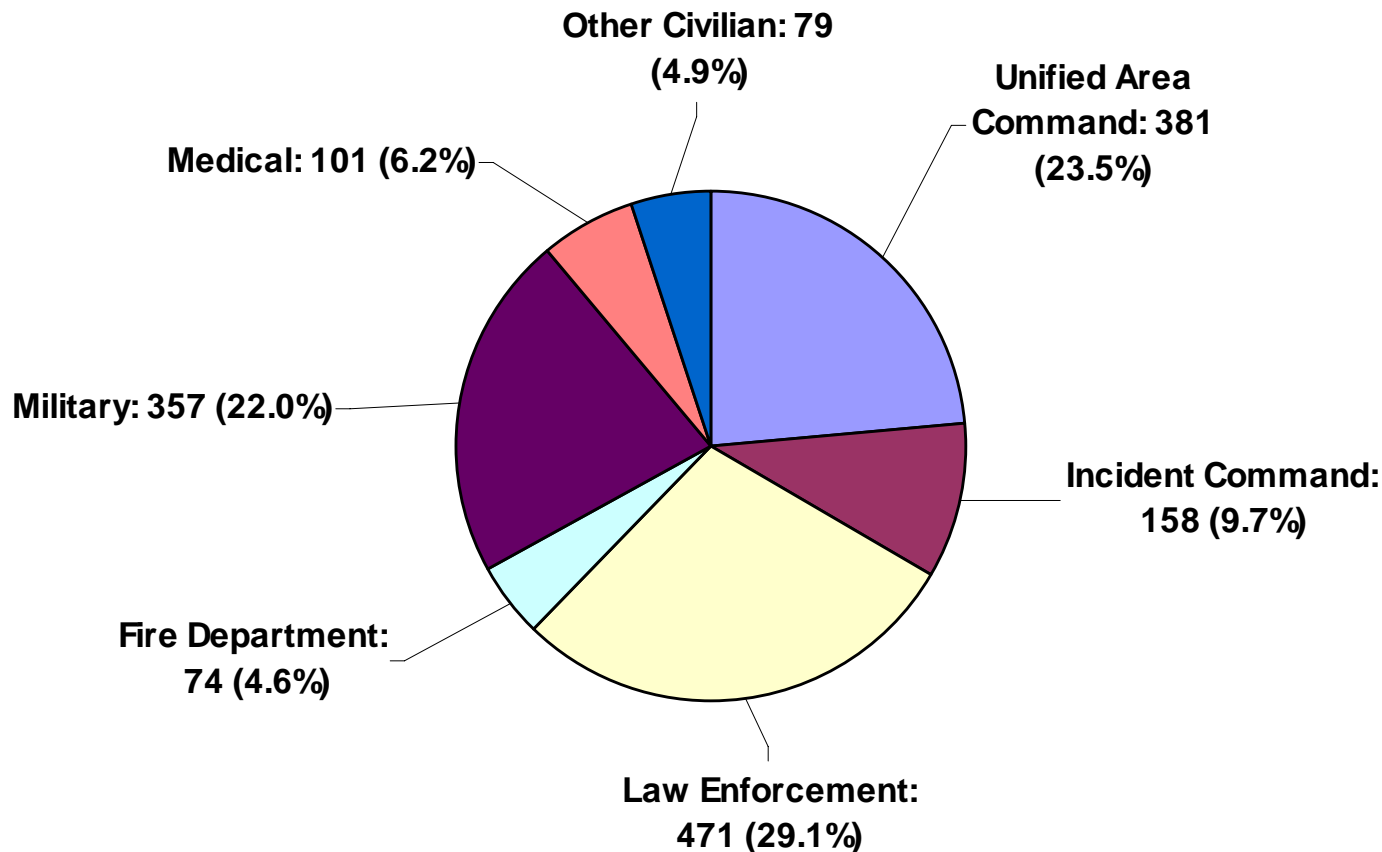
Observed Interactions by Type



- Total Interactions: 1621
- Positive Interactions: 1417 (87.4%)
- Problems: 204 (12.6%)



Observed Interactions by Organization Type





Percentage of Observed Interactions by Organizational Pairs



	Unified Area Command	Incident Command	Law Enforcement	Fire	Military	Medical	Other Civilian
Unified Area Command	7.2%						
Incident Command	2.4%	0.7%					
Law Enforcement	14.2%	7.8%	14.4%				
Fire	1.6%	1.8%	0.8%	0.4%			
Military	7.4%	3.6%	4.4%	1.4%	13.0%		
Medical	1.4%	1.5%	0.3%	2.7%	0.3%	3.1%	
Other Civilian	5.7%	1.0%	1.7%	0.0%	0.9%	0.2%	0.1%

Total Number of Observed Interactions: 1621
Mean Value: 3.6
Standard Deviation: 4.3

Positive Observations

Color	Comparison to Standard Deviation from Mean
	More than 2 Standard Deviations
	Between 1 and 2 Standard Deviations
	Less than 1 Standard Deviation

Negative Observations

Color	Comparison to Standard Deviation from Mean
	Less than 1 Standard Deviation
	Between 1 and 2 Standard Deviations
	More than 2 Standard Deviations

For all characterizations:

Mean: 3.6
Standard Deviation: 4.3

Based on distribution calculated for the entire set of observations



Semantic Interoperability: Observed Problems



	Unified Area Command	Incident Command	Law Enforcement	Fire	Military	Medical	Other Civilian
Unified Area Command	4.7%						
Incident Command	0.0%	0.0%					
Law Enforcement	9.5%	4.7%	9.5%				
Fire	0.0%	0.0%	0.0%	0.0%			
Military	38.1%	0.0%	9.5%	4.7%	9.5%		
Medical	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Other Civilian	4.7%	0.0%	0.0%	0.0%	4.7%	0.0%	0.0%

Color	Comparison to Standard Deviation from Mean
	Less than 1 Standard Deviation
	Between 1 and 2 Standard Deviations
	More than 2 Standard Deviations

Mean: 3.6
Standard Deviation: 4.3

Total Number of Observed instances of *Semantic Interoperability Problems*: 21



Observed Positive Information Sharing



	Unified Area Command	Incident Command	Law Enforcement	Fire	Military	Medical	Other Civilian
Unified Area Command	5.4%						
Incident Command	2.2%	0.2%					
Law Enforcement	15.1%	6.4%	17.2%				
Fire	1.4%	2.0%	0.4%	0.5%			
Military	3.6%	3.1%	5.5%	1.4%	14.7%		
Medical	1.6%	1.8%	0.4%	3.7%	0.4%	3.6%	
Other Civilian	5.7%	1.0%	2.0%	0.0%	0.6%	0.1%	0.1%

Color	Comparison to Standard Deviation from Mean
	More than 2 Standard Deviations
	Between 1 and 2 Standard Deviations
	Less than 1 Standard Deviation

Mean: 3.6
Standard Deviation: 4.3

Total Number of Observed instances of *Positive Information Sharing*: 1119



Observed Problems in Information Sharing



	Unified Area Command	Incident Command	Law Enforcement	Fire	Military	Medical	Other Civilian
Unified Area Command	13.4%						
Incident Command	3.1%	0.0%					
Law Enforcement	7.2%	12.4%	14.4%				
Fire	1.0%	0.0%	4.1%	0.0%			
Military	6.2%	1.0%	3.1%	0.0%	21.6%		
Medical	1.0%	1.0%	0.0%	0.0%	0.0%	0.0%	
Other Civilian	6.2%	2.1%	1.0%	0.0%	1.0%	0.0%	0.0%

Color	Comparison to Standard Deviation from Mean
	Less than 1 Standard Deviation
	Between 1 and 2 Standard Deviations
	More than 2 Standard Deviations

Mean: 3.6
Standard Deviation: 4.3

Total Number of Observed instances of Problems in *Information Sharing*: 97



Observed Positive Shared Awareness



	Unified Area Command	Incident Command	Law Enforcement	Fire	Military	Medical	Other Civilian
Unified Area Command	17.5%						
Incident Command	5.0%	2.5%					
Law Enforcement	12.5%	10.0%	10.0%				
Fire	0.0%	2.5%	0.0%	0.0%			
Military	17.5%	7.5%	0.0%	2.5%	2.5%		
Medical	0.0%	0.0%	0.0%	2.5%	2.5%	2.5%	
Other Civilian	2.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Color	Comparison to Standard Deviation from Mean
	More than 2 Standard Deviations
	Between 1 and 2 Standard Deviations
	Less than 1 Standard Deviation

Mean: 3.6
Standard Deviation: 4.3

Total Number of Observed instances of Positive *Shared Awareness*: 40



Observed Problems in Shared Awareness



	Unified Area Command	Incident Command	Law Enforcement	Fire	Military	Medical	Other Civilian
Unified Area Command	31.5%						
Incident Command	5.6%	0.0%					
Law Enforcement	7.4%	5.6%	11.1%				
Fire	0.0%	0.0%	0.0%	0.0%			
Military	9.3%	11.1%	1.9%	0.0%	9.3%		
Medical	0.0%	1.9%	0.0%	0.0%	0.0%	1.9%	
Other Civilian	3.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Color	Comparison to Standard Deviation from Mean
	Less than 1 Standard Deviation
	Between 1 and 2 Standard Deviations
	More than 2 Standard Deviations

Mean: 3.6
Standard Deviation: 4.3

Total Number of Observed instances of Problems in *Shared Awareness*: 54



- Surveys administered as follows:
 - Pre-event distributed and collected at events preceding the Golden Phoenix 07 operational period
 - Post-event surveys distributed and collected at the conclusion of discrete operational events and at Golden Phoenix 07 Hot Wash immediately after the operational period
- Survey Responses:
 - Pre-event: 71
 - Post-event: 168
 - Pre- and post-event from the same individuals: 23
- Survey results analyzed by organizational grouping



Organizational *Familiarity* and *Trust* (Overall Finding)



- *Familiarity and Trust* improved significantly between pre-event and post-event surveys for the 23 participants who completed both instruments.
- *Familiarity and Trust* declined, but not significantly, when the data from those completing only the pre-event survey were compared with those completing only the post-event survey.
 - The CCRP team believes that those completing only one survey participated only briefly (less than one day)
 - They apparently came to understand the needs for interdependence and trust.
 - However, they failed to gain knowledge of others or build trust in them.
- These data suggest that Golden Phoenix 07 provided the opportunity to increase trust and familiarity but only when participation was broad and deep.



Conclusions: Lessons Learned



- Meaningful data can be collected cost-effectively in civil-military complex endeavors:
 - That address issues crucial to Network Centric Operations
 - That span data, voice, and human performance, and the Network Centric Operations Value Chain
- Successful collection requires:
 - Professional, experienced lead team (CCRP, NPS, SSC San Diego)
 - Involvement in planning
 - High quality data collection and data analysis plans
 - Access throughout the event
 - Adequate human resources (data collectors and analytical teams)

Continuing Impact



- Golden Phoenix 07 built upon successful, but smaller, training events during Golden Phoenix 06
 - Major increases in participating civilian organizations
 - Substantial increase in the breadth and depth of scenario
 - Some lessons learned about technical connectivity from Golden Phoenix 06
- *Golden Phoenix 07 created familiarity and trust that were exploited during wild fires later in the year*
- Planning for Golden Phoenix 08 includes even more civilian agencies such as the Border Patrol, DEA, FBI, and San Diego Public Health



Questions?
Thoughts?
Puzzles?