



Acquisition Research Program: Creating Synergy for Informed Change

A WEB SERVICE IMPLEMENTATION FOR LARGE-SCALE AUTOMATION, VISUALIZATION AND REAL-TIME PROGRAM- AWARENESS VIA LEXICAL LINK ANALYSIS

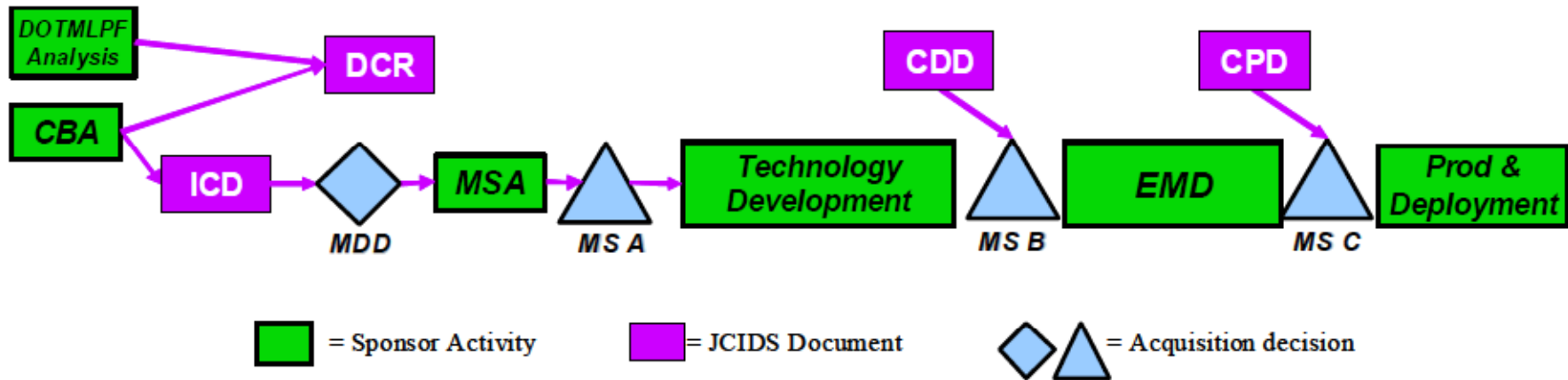
May 11, 2011

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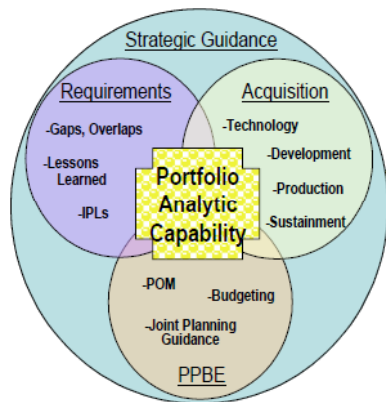
Research Associate Professors, Distributed Information Systems
Experimentation, Naval Postgraduate School



Critical Needs: Automation, Validation and Discovery



JCIDS Process and Acquisition Decisions
(From J-8 CJCSI 3170.01G)(JCIDS, 2009)



- Multiple Portfolio Views:**
- Systems vs. Capabilities
 - Investment vs. Capabilities
 - System Context
 - Highly dependent programs (Joint Enablers)
 - Procurement Optimization
 - S&T vs. future needs
 - Sustainment Efficiency
 - Market Value

- Data is too voluminous, unformatted and unstructured!
- Need automation
- Extract relations among PE, MDAP and ACATII
- Extract costs





Research Questions

Conceptual: 1) Can the information that emerges from the acquisition process be used to produce overall *awareness* of the *fit* between programs/projects/systems and *needs* for which they were intended?. 2) If a higher level of *awareness* is possible, will that enable system level regulation of programs/projects/systems for improvement of the acquisition system?

Focused: 1) Based on the normal evolution of documentation and current data-based program information, can requirements (needs) be connected to system capabilities? 2) Can requirements gaps be revealed?

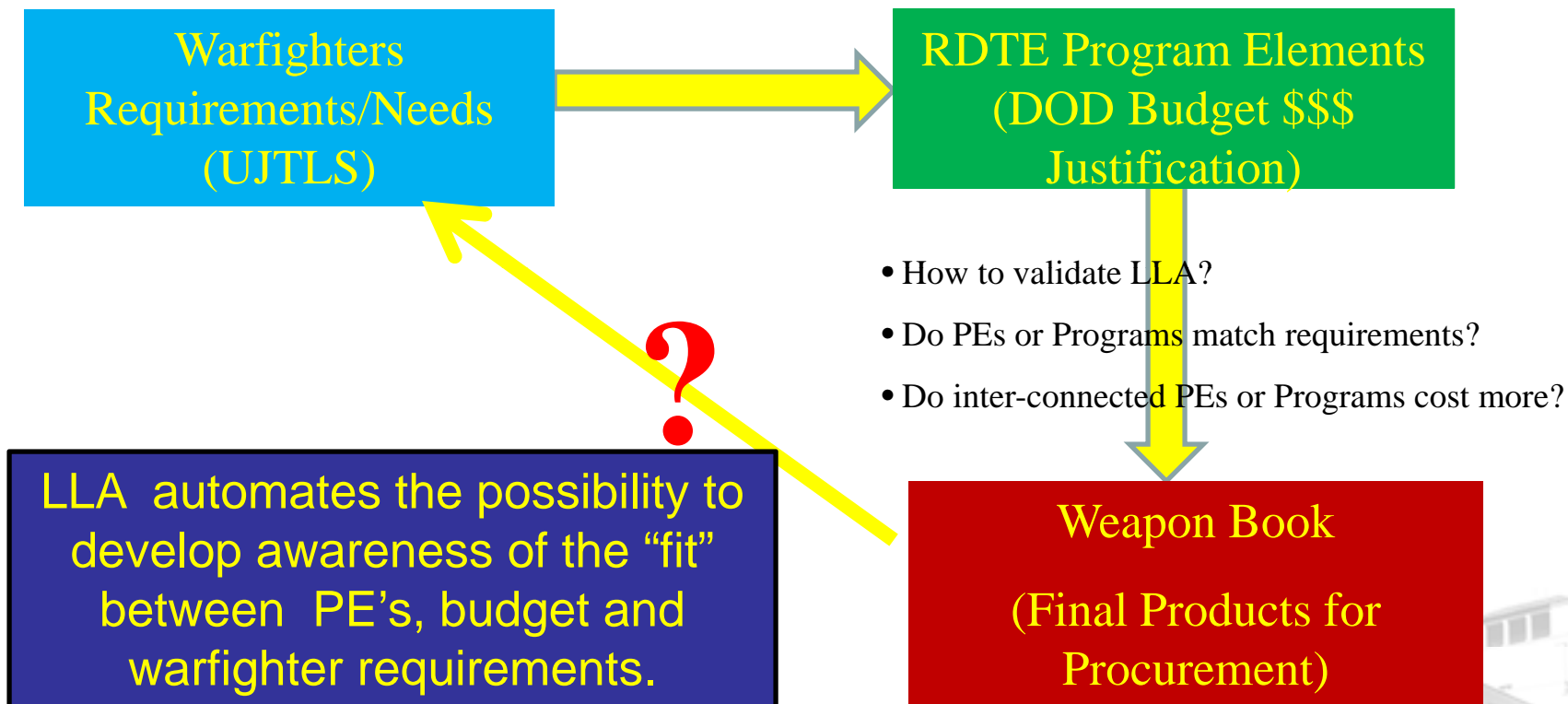
Theory development: Is there a correlation between system interdependency (links/relationships) and development costs?

Methodology: Is it possible to use natural language and other documentation (roughly, unformatted data) to produce visualization of the internal constructs useful for management, through lexical link analysis (LLA)?





LLA Methodology Can Help!





Data Sources

- PEs: <http://www.dtic.mil/descriptivesum/>
 - 8 years (2004-2011) and three services
- UJTLs:
<http://www.dtic.mil/doctrine/jel/cjcsd/cjcsm/m350004d.pdf>
- Weapon books
 - http://comptroller.defense.gov/defbudget/fy2008/fy2008_weabook.pdf
- Others
 - <http://www.fas.org/man/dod-101/sys/land/wsh2007/index.html>
 - <http://www.acq.osd.mil/ara/am/sar/>



UNCLASSIFIED

Exhibit R-2a, RDT&E Project Justification								DATE				
BUDGET ACTIVITY 05 System Development and Demonstration (SDD)								PE NUMBER AND TITLE 0604602F Armament/Ordnance Development		PROJECT NUMBER AND TITLE 5361 Stores-Aircraft Interface		
Cost (\$ in Millions)		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost to Complete	Total	
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate			
5361	Stores-Aircraft Interface	0.000	0.000	6.685	0.000	0.000	0.000	0.000	0.000	Continuing	TBD	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0			

In FY 2010, Project 5361, Stores-Aircraft Interface (new), efforts were transferred from PE 0605011F, RDT&E for Aging Aircraft, Project 654685, Universal Armament Interface (UAI), in order to properly fund the maturing technology.

(U) **A. Mission Description and Budget Item Justification**
 Universal Armament Interface (UAI) is an Air Force initiative to develop, enhance, and implement standardized interfaces in aircraft, weapons and mission planning to support integration of weapons independent of aircraft Operation Flight Program (OFF) cycles. UAI is currently being implemented on the F-15E and F-16 Block 40/50 aircraft, Small Diameter Bomb (SDB) I and II, Joint Direct Attack Munition (JDAM), Joint Air-to-Surface Stand-off Missile (JASSM) and Precision Guided Munitions Planning Software (PGMPS). Additional aircraft and weapons have program plans to implement UAI. The UAI program office is responsible for development and enhancement of the standard, provision of certification tools (test assets) and implementation support to aircraft and weapons.

 The UAI efforts were transferred (1) to ensure continued funding for UAI through the FYDP (PE 0605011F will be zeroed out in FY 2010 due to higher Air Force priorities), and (2) to properly fund the maturing technology. The new project number is established to provide greater visibility into UAI's budget. Funding UAI via the Arm/Ord PE will ensure that platform and weapon program offices have the support required to implement and update UAI.

 This program is in Budget Activity 5 - System Development and Demonstration (SDD) because it supports armament integration, an SDD-type activity.

(U) **B. Accomplishments/Planned Program (\$ in Millions)**

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost to Complete	Total Cost
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate		
(U) ICD Dev/Updates										5.702
(U) UAI Common Component										0.746
(U) Certification Tool										0.197
(U) Total Cost							0.000	0.000	0.000	6.685

This is not a new start; these efforts were performed under PE 0605011F, RDT&E for Aging Aircraft, in FY 2008 and FY 2009.

(U) **C. Other Program Funding Summary (\$ in Millions)**

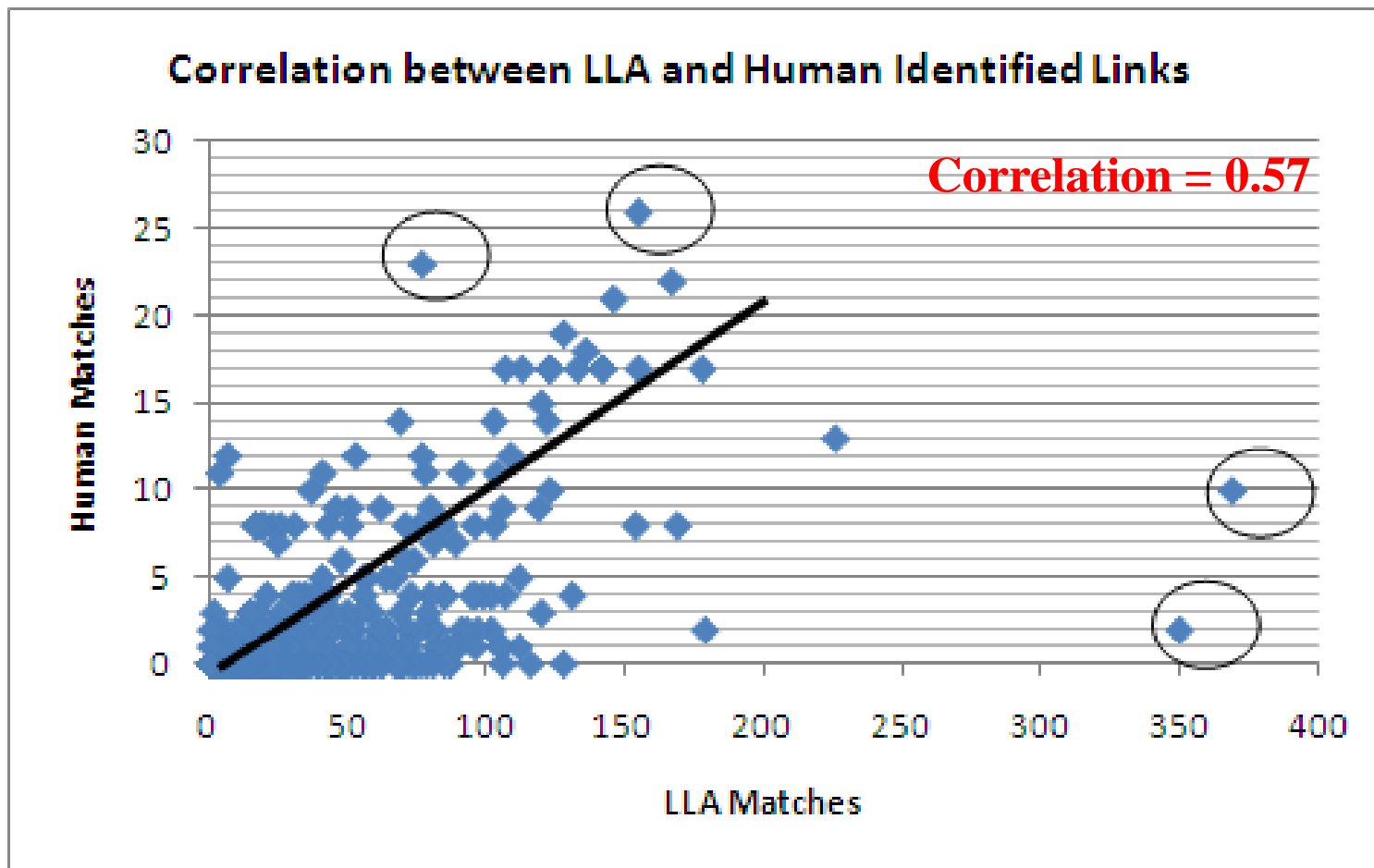
	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost to Complete	Total Cost
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate		
(U) N/A										

(U) **D. Acquisition Strategy**
 In December 2004, under the authority of a class Justification and Approval (J&A), the UAI program office awarded individual Cost Plus Fixed Fee (CPFF) contracts to Boeing, Lockheed-Martin, Northrop-Grumman and Raytheon. These four vendors are the Original Equipment Manufacturers (OEMs) for approximately 90% of the Department of Defense' platforms and weapons. Each OEM is responsible for a different piece of the total UAI requirement based on its platform or weapon expertise.

0604602F references 0605011F Forward Link
 0605011F referenced by 0604602F Backward Link



Phase I Results: Validation of LLA





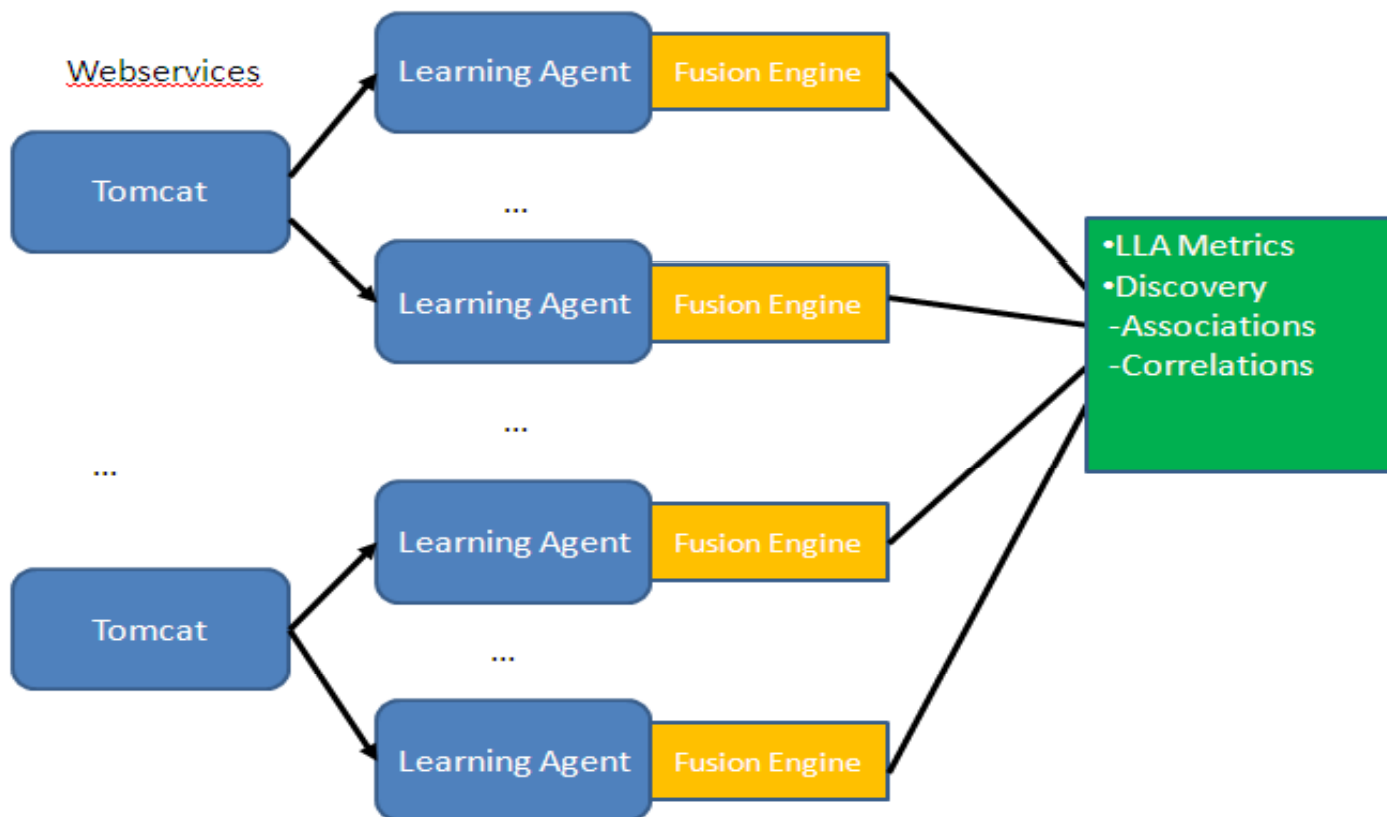
Phase II Objectives

- Apply LLA to larger-scale data and wider applications and employ parallel computing and dynamic, 3-D visualizations.
- Apply LLA to become a real-time operational capability of program awareness; the results of which could be periodically updated and presented in a web service.

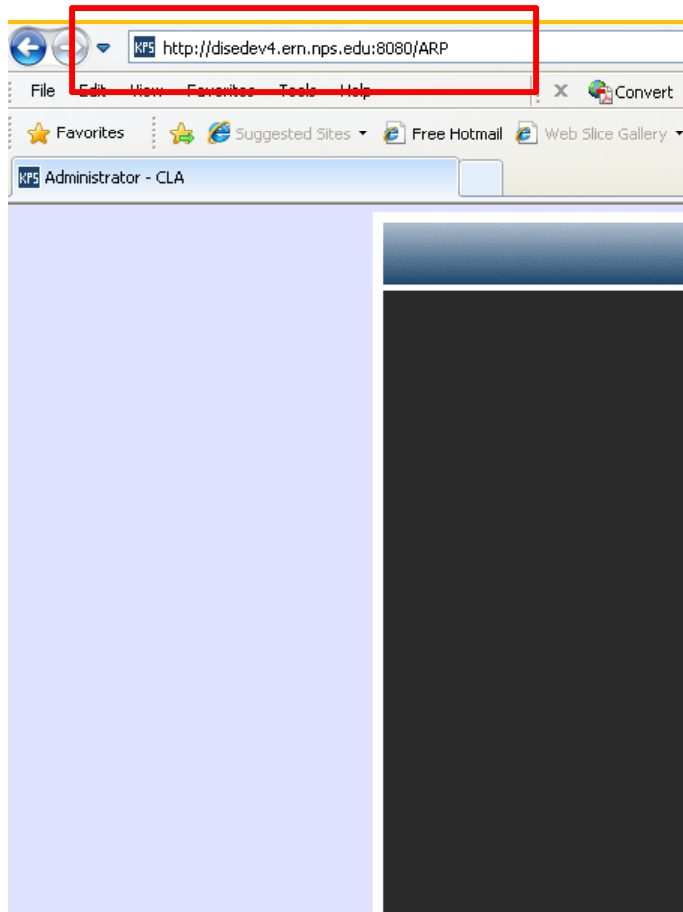




Initial Results for Phase II: Web Service Design



Web Service



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Save Delete Fuse

Fuse

One Click Mining

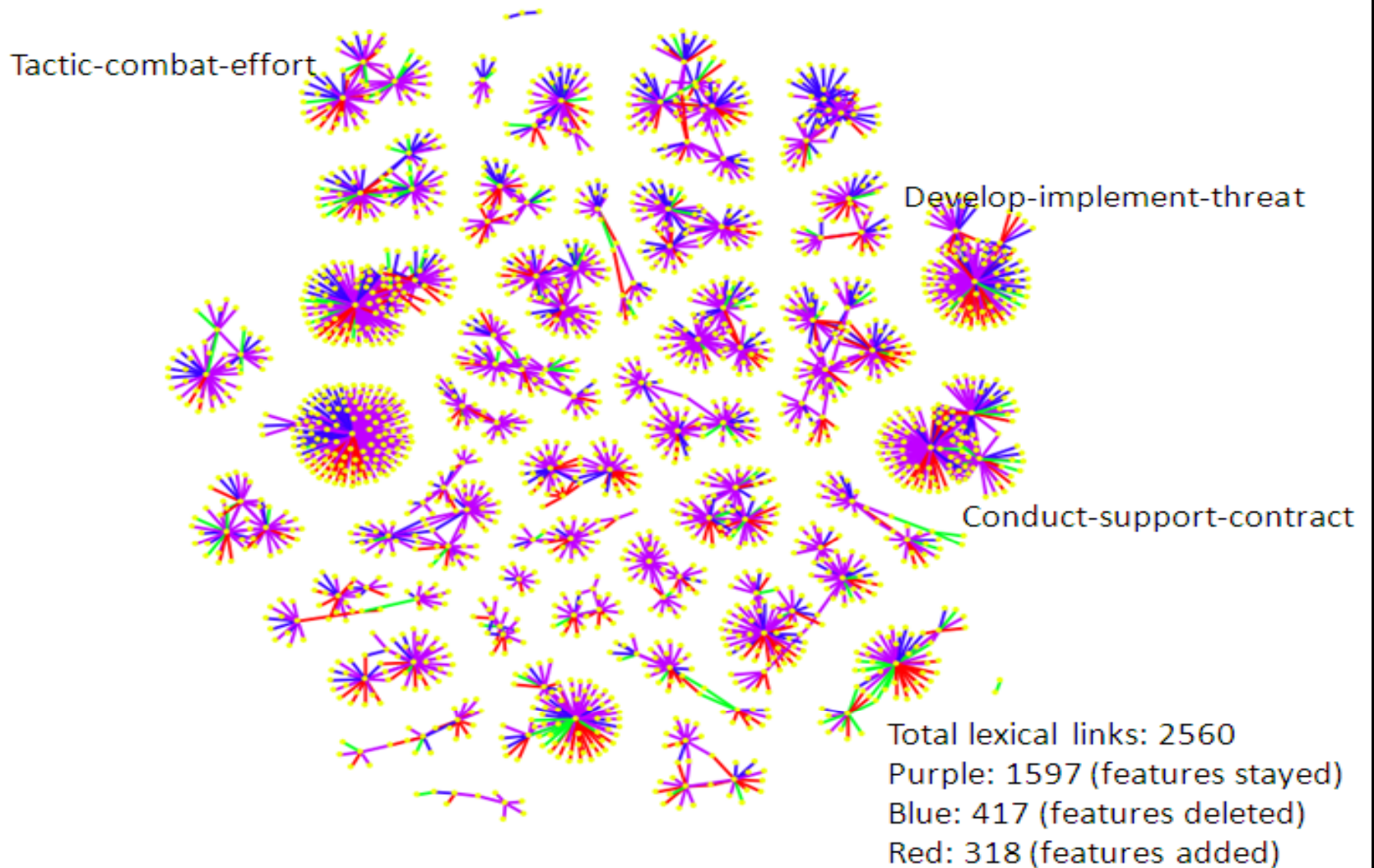
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Path to Data:

[Back to Admin](#)

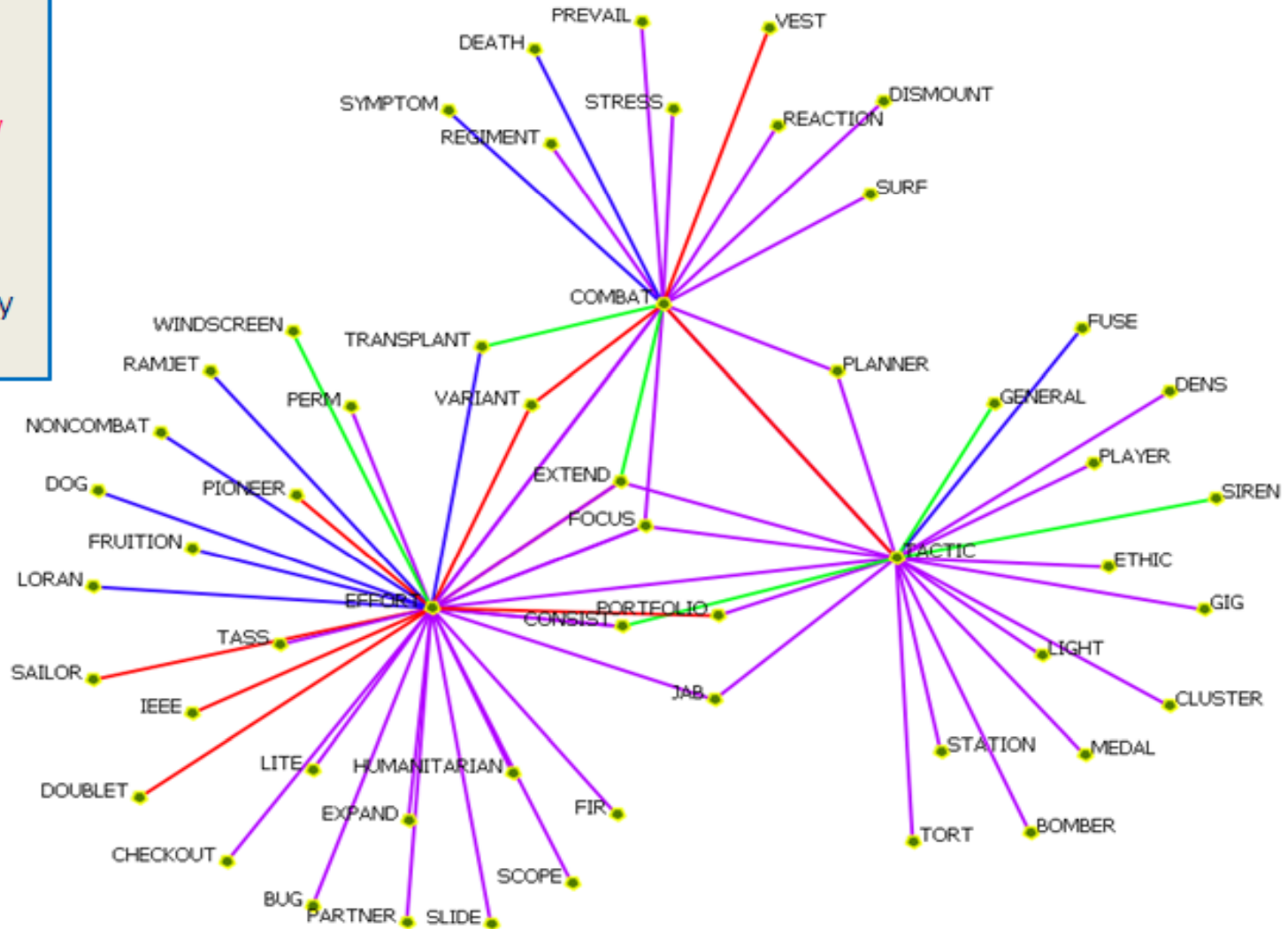


Themes , Topics Discovery, System Feature Clusters



Drill Down to Detail

Purple:
common links
in more than
two years
Red: links only
in 2011
Green: links
only in 2010
Blue: links only
in 2009



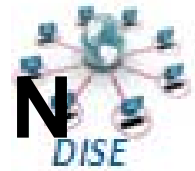


Social Network of PEs

- PE 0603721N is linked the PEs identified by human analysts :
 - 0602435N: Ocean Warfighting Environment Applied Research
 - 0602782N: Mine and Expeditionary Warfare Applied Research
 - 0601153N: Defense Research Sciences
 - 0603235N: Common Picture Advanced Technology

APPROPRIATION/BUDGET ACTIVITY	PROGRAM ELEMENT NUMBER AND NAME	PROJECT NUMBER AND NAME	
RDTENBA 4	0603721N/ENVIRONMENTAL PROTECTION	9204/Marine Mammal Research	
FY09: (U) Continue mitigation methodologies for monitoring, new technology and risk assessment through passive acoustic monitoring; active acoustic monitoring; improved tag development; alternative monitoring; defining risk assessment variables; model risk assessment and determine mitigation effectiveness.			
	FY 2007	FY 2008	FY 2009
Acoustic Source Propagation	0.150	0.085	0.113
RDT&E Articles Quantity	0	0	0
FY 07: (U) Continue investigation of acoustic source propagation through 3-D modeling of multiple acoustic sources.			
FY08: (U) Continue investigation of acoustic source propagation through 3-D modeling of multiple acoustic sources.			
FY09: (U) Continue investigation of acoustic source propagation through 3-D modeling of multiple acoustic sources.			
C. OTHER PROGRAM FUNDING SUMMARY: (U) Related RDT&E: Office of Naval Research (PE 0601153N / PE 0602435N / PE 0602782N / PE 0603235N) (U) Related RDT&E: Strategic Environmental Research & Development Program (SERDP) (U) Related RDT&E: National Oceanographic Partnership Program (NOPP)			



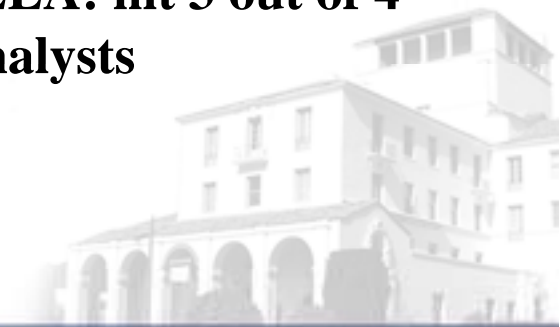


Links to PE 0603721N Identified by LLA

1	0603721N	
2	0000012.74;JET--	0602787A
3	0000012.52;SEDIMENT--	0601102A
4	0000012.43;CLEAN--	0603804A
5	0000011.78;DESTRUCT--	0602203F
6	0000010.77;SHIELD--	0602102F
7	0000010.48;JET--	0601102F
8	0000010.33;CLEAN--	0604804A
9	0000009.67;DESTRUCT--	0604645A
10	0000008.90;SHIELD--	0604231N
11	0000008.49;UNIFORM--	0206313M
12	0000008.15;GAIN--	0603789F
13	0000008.06;ARLINGTON--VA,NJ;RIGOR--	0605013A
14	0000007.94;ARLINGTON--VA,NJ;LABOR--	0603747A
15	0000007.93;CONTENT--	0602202F
16	0000007.72;GAIN--	0603001A
17	0000007.69;JET--	0603790F
18	0000007.68;SHIELD--	0603640M
19	0000007.36;JET--	0603216F
20	0000007.11;SHIELD--	0602601F
21	0000007.11;CLEANUP--	0603728A
22	0000007.05;FINISH--	0605857A
23	0000006.98;UNIFORM--	0601104A
24	0000006.89;SHIELD--	0603005A
25	0000006.73;SEDIMENT--	0602236N
26	0000006.63;ARLINGTON--	0305204A
27	0000006.62;UNIFORM--	0604601A
28	0000006.62;CONTENT--	0602702F
29	0000006.60;DESTRUCT--	0604759F
30	0000006.59;FINISH--	0604661A
31	0000006.55;GOVT--	0604240F
32	0000006.43;GAIN--	0602120A
33	0000006.34;DESTRUCT--	0601153N
34	0000006.22;GAIN--	0604321A
35	0000006.13;SEDIMENT--	0602435N
36	0000005.98;EXPECT--	0602204F
37	0000005.88;STORM--	0207601F
38	0000005.85;GAIN--	0603231F
39	0000005.85;GAIN--	0303140F

52	0000005.01;NORMAL--	0207410F
53	0000004.98;DESTRUCT--	0603004A
54	0000004.93;LABOR--	0605801A
55	0000004.87;CONCERN--	0602747N
56	0000004.86;SHIELD--	0603561N
57	0000004.86;JET--	0603236N
58	0000004.80;SHIELD--	0603235N
59	0000004.76;JET--	0602618A
60	0000004.76;DESTRUCT--	0604660A
61	0000004.75;NORMAL--	0305206F
62	0000004.65;AGREEMENT--	0207418F
63	0000004.61;GAIN--	0604805A
64	0000004.56;JET--	0605805A
65	0000004.54;ARLINGTON--	0203758A
66	0000004.45;BREED--	0207451F
67	0000004.40;GOVT--	0604215N

Top 100 links by LLA: hit 3 out of 4 links by human analysts





Blind Spots and Cross Services

Top 4 PEs linked to PE 06043721N	Titles	Semantic Links Identified by LLA
0602787A	Medical Technology	Jet lag, jet fuel exposure
0601102A	Defense Research Sciences	Destruction, containment in water, soil, and sediments resulting from military activities
0603804A	Logistics and Engineer Equipment	The Army fights with clean fuel and drinking water
06032203F	Aerospace Propulsion	Non-destructive test, fuels and lubrication





Current Practice: Budget Change Sorted Using LLA Links from PEs to PEs

(Data used in 2008 vs. 2009, total ~450 PEs for three Services)

LLA links from PE to PE	Average Budget Change from 2008 to 2009 (in term of percentage change for each PE)	Total Budget Change in Millions
>10	14%	(\$558)
<=10	40%	\$434

- Reduce budget for PEs with more links with other PEs
- Allocate resources to avoid overlapping efforts, emphasize on new and unique efforts
- P-value =0.0557



Current Practice: Budget Change Sorted Using LLA Links from PEs to UJTL



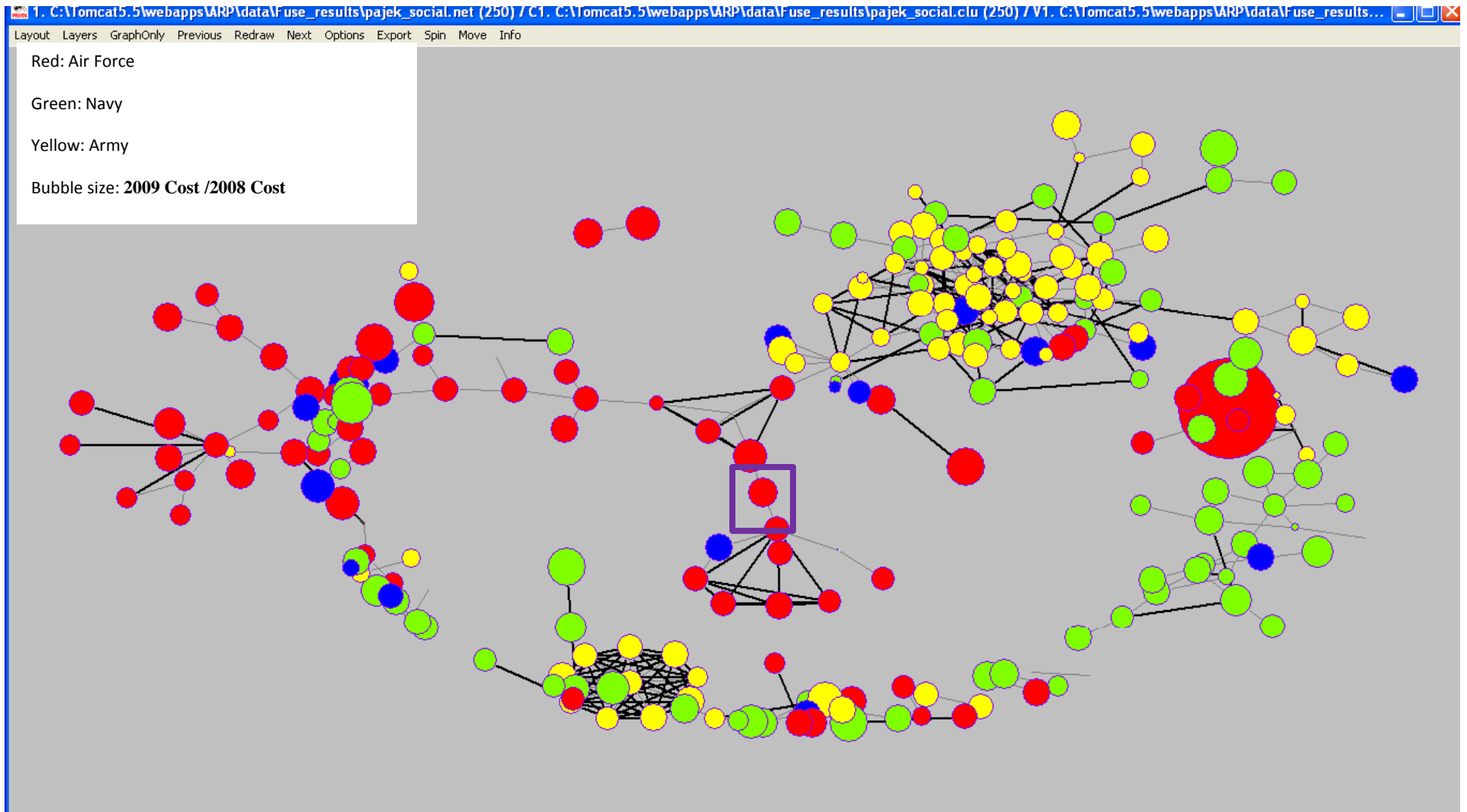
(Data used in 2008 vs. 2009, total ~450 PEs for three Services)

LLA links of PE to UJTL	Average Budget Change from 2008 to 2009 (in term of percentage change for each PE)	Total budget change in millions
>1	10%	\$735
<=1	29%	(\$859)

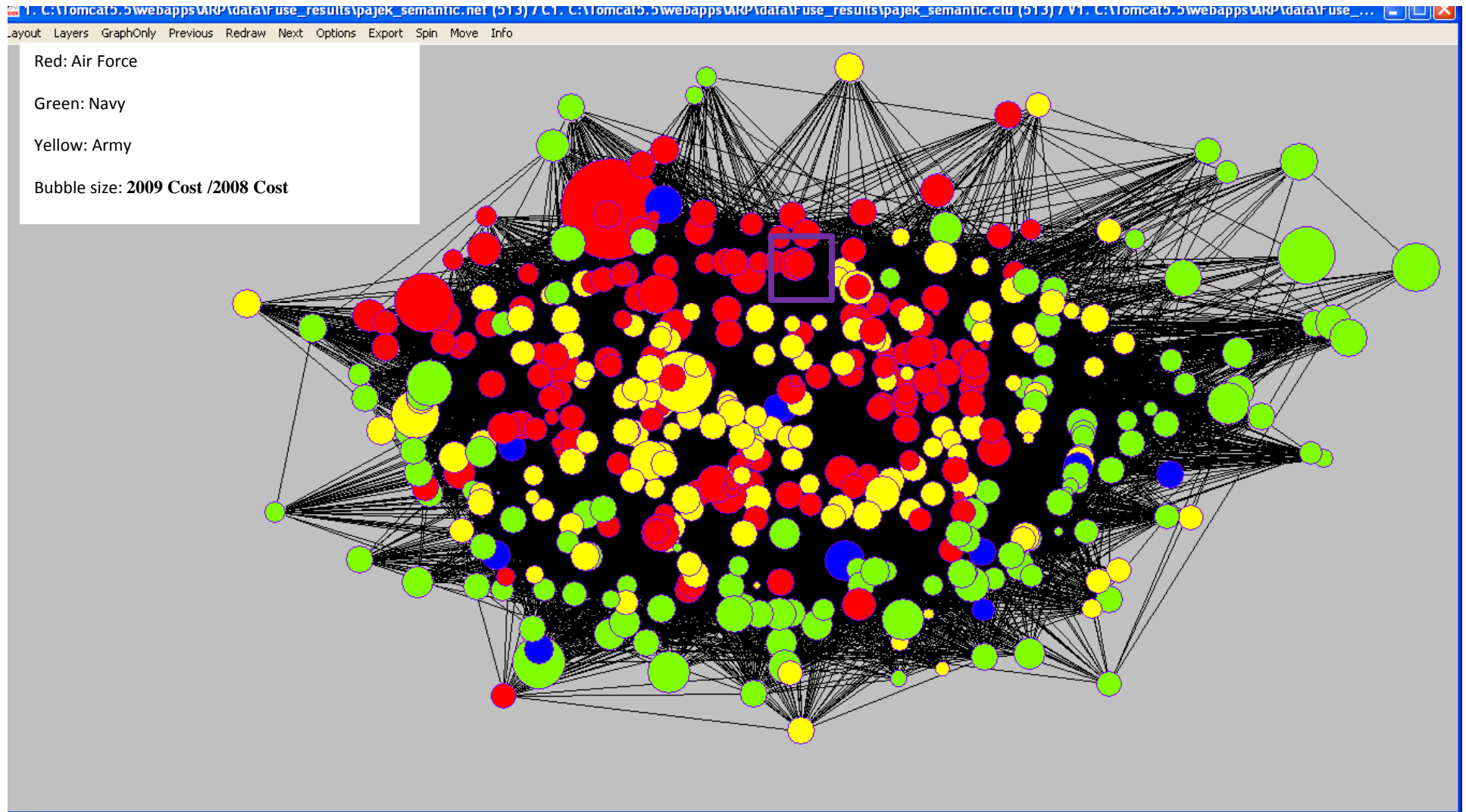
- Fewer numbers of LLA links observed, gaps between RDT&E and warfighters requirements do exist
- Warfighters' requirements need to be considered as priorities, cut was done on expensive programs such as MDAPs, instead as a general discipline or doctrine
- P-value=0.002



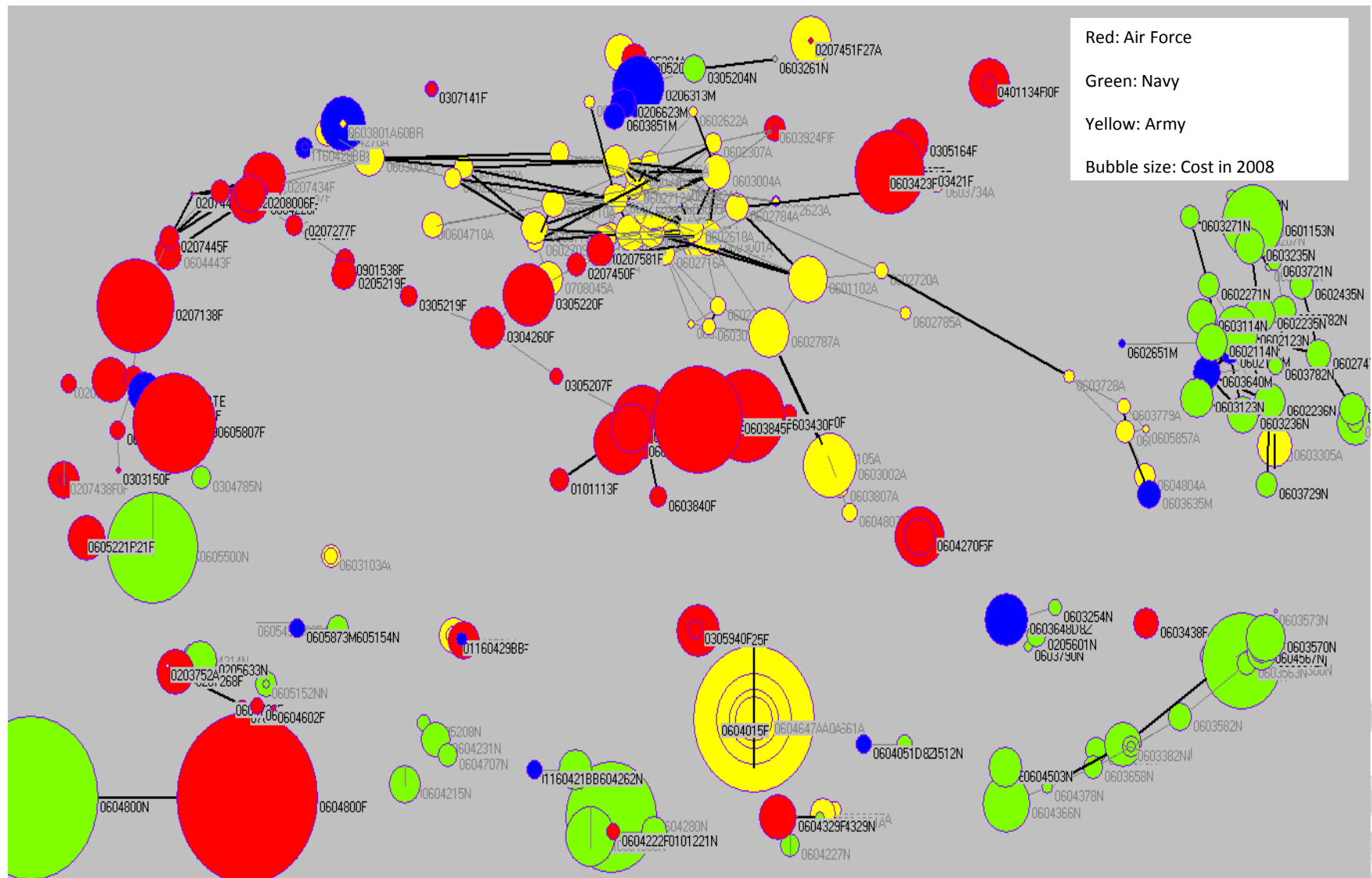
Social Network (Manually Identified Links): Size of Nodes - 2009 Cost /2008 Cost



Semantic Network (Lexical Links): Size of Nodes - 2009 Cost /2008 Cost



Demo and 3-D Visualization





Conclusion, Future and Opportunities

- Such program-awareness needs to be checked more frequently with field practice
- Our LLA service provides tools and evidence to adapt the field practice of acquisition professionals to better resource management to meet warfighters' needs
- Secretary Gates said the Pentagon must get “more bang for its buck and shift its focus to the military's needs for the future” (Hedgpeth, 2010)
- Opportunities for new acquisition workers could be to reduce the overall inefficiency of the 10% vs. 29%, instead of just focusing on the MDAPs

