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Combining MMOWGLI Social Media Brainstorming with Lexical Link Analysis (LLA) to Strengthen the DoD Acquisition Process

30 September 2013

by

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Abstract

MMOWGLI (Massive Multiplayer Online Wargame Leveraging the Internet), sponsored by the Office of Naval Research, is an online game platform designed to elicit collective intelligence from an engaged pool of world-wide players. In the past, the Naval Postgraduate School hosted a series of successful games including *piracyMMOWGLI* (2011), *energyMMOWGLI* (2012) and *biiMMOWGLI*(2013) which built the critical mass of players needed to find creative solutions to real-life, difficult business problems such as piracy, energy and business innovation initiatives (bii). NPS also leveraged MMOWGLI with the analytic framework of Lexical Link Analysis (LLA) to link the game data to the concepts documented in two business processes (i.e. improve DoD energy efficiency and improve future open systems architecture [OSA] strategy]. We demonstrated the synergy of using both tools to gain faster viability of new ideas to improve the acquisition process, and sorted the *idea cards* that might be good candidates for further investigation. We then determined that the majority of Navy programs are affected by (or critically dependent on) energy issues, but goals and terms are handled inconsistently. It is evident that MMOWGLI together with LLA is an important tool for comparing and considering innovative ideas using social media games to improve acquisition processes.

Keywords: Massive Multiplayer Online Wargame Leveraging the Internet, MMOWGLI, Collective Intelligence, Brainstorming Social Media, Match Matrix, Idea Cards, Action Plans, Open Systems Architecture, OSA Strategy, Lexical Link Analysis, LLA, Text Mining, Data Mining, Program Elements, Unstructured Data, Data-Driven, Acquisition Process

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and for numerous other field experiments of new technologies during Trident Warrior 2012 (TW12). He holds a PhD from Stanford University, conducting successful theoretic and field research in KM. He has served as the program manager for two major government projects of over $50 million each, implementing new technologies while reducing manpower requirements. He has served over 20 years as a naval surface warfare officer, amassing over eight years at sea and serving in four U.S. Navy warships with five major, underway deployments.

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Background

Massive multiplayer online wargame leveraging the internet (MMOWGLI), sponsored by the Office of Naval Research (ONR), is an online game platform designed to elicit collective intelligence from an engaged pool of world-wide players, thus invoking a fresh approach to gather data from a targeted community via crowd sourcing. The Naval Postgraduate School (NPS) is the primary developer of this game software. In the past, NPS hosted a series of successful games including piracyMMOWGLI (2011-present, ongoing), energyMMOWGLI (May 2012) and biiMMOWGLI(business innovation initiative MMOWGLI, July 2013) which built the critical mass of players needed to find creative solutions to real-life, difficult problems such as piracy and energy. These games were hosted by the NPS Modeling Virtual Environments and Simulation (MOVES) Institute.

We leveraged MMOWGLI game output in this effort, to elicit collective intelligence from the acquisition communities for two business processes:

1. Improve Department of Defense (DoD) energy efficiency: Studies evaluating the DoD's energy use have been conducted by the Institute for Defense Analyses, the Defense Science Board Energy Security Task Force, and JASON (an independent scientific advisory group). All three studies suggest that DoD energy inefficiency is a significant liability, a constraint on operations and a force-protection challenge. More specifically, all three studies led to two consistently held requirements to improve DoD energy efficiency: (1) By reducing energy demand, one may provide operational forces greater flexibility and reduce their dependency on logistics infrastructure, and (2) the DoD's current requirements and acquisition processes to value the technologies with the potential to improve energy efficiency (DoD Energy Inefficiency, 2012).
2. Improve open systems architecture (OSA) strategy: The assistant secretary for research development and acquisition (ASN RDA) authorized a new naval OSA strategy in November 2012 to reduce the total ownership cost of systems, encourage innovation, and more rapidly deliver needed capabilities to the warfighter. This strategy

> specifically challenges the naval acquisition workforce to institute measures to improve competition, eliminate redundant developments, and coordinate program activities that promote the reuse of tactical products across sea and air platforms. The acquisition organization is tasked to implement the strategy, however, success will require substantial changes in the Navy's business practices, organizational structures, and resource planning.

In concert with the updated strategy, Deputy Assistant Secretary of the Navy (DASN) – Research, Development, Testing & Evaluation (RDT&E) created a business innovation initiative (BII) to search for ways to overcome the inertia many of our programs of record (PoR's) suffer today. Mr. Sean Stackley (as cited in Guertin, Womble, & Bruhns, 2013), the ASN RDA said in a recent article:

"The value of an innovation initiative is to explore what business-relationship changes are needed to open up competition; incentivize better contractor performance; increase access to innovative products and services from a wider array of sources; decrease time to field new capabilities; and achieve lower acquisition and life-cycle costs while sustaining fair industry profitability." (page 667).

The *biiMMOWGLI* game using LLA is one of the ways to achieve these goals. LLA enables the graphic depiction and quantitative analysis of the captured MMOWGLI data, as explained in detail in the business innovation initiative MMOWGLI games chapter. We reveal the new knowledge discovered by those participating in this game and the ideas arising from the data linked – or not linked – to other ideas, or perhaps specific guiding documents. We are thus able to show relevance, gaps, and consistency, between all analyzed data. This has great ramifications by revealing how guidance documents may be missing certain innovations, or how they might show acceptance within the community. We show these graphic depictions, and their supporting match matrices in later chapters and in the appendices.

In the past year, we applied the methodology to link the two MMOWGLI games to the concepts documented in the two business processes. The goal of this research is to provide an innovative platform that can be deployed quickly to mobilize the intellectual capacities of the research and professional acquisition communities to provide innovation and creative ideas to address the challenges and difficulties in the two business processes. We also compare new game data with the most recent acquisition data and measure the impacts of the game data on the current state of the policies and practices in a broad range of DoD acquisition programs.

Methodology

MMOWGLI Game

The game is built using a unique, open source, software adaptation of the Institute for the Future (IFTF)-designed game to simulate a real-world "brainstorm." A player needs to register with a required game ID and email; the last name, first name and other personal identification information (PII) are not required.

The game starts with an explanation of the situation and allows a player to "Play an Idea" or "Take Action." Players can then choose to input an idea or participate in the discussion of an existing idea in the categories of "Innovate" and "Defend." The discussion can be in one of five categories: expand—build on this idea to amply the impact; counter—challenge this idea; adapt—take this idea in a different direction; or explore—something missing. Or players can ask a question, as shown in Figure 1. In the end, the system gathers collective intelligence that resides in tree-structured, color-coded sets of ideas and discussions in text format as shown in Figure 2. If an idea and its associated discussion have merit, which is determined in the combination of the player's score and the Game Master's recommendation, it is taken into a separate "Take Action" board for further planning and deliberation.

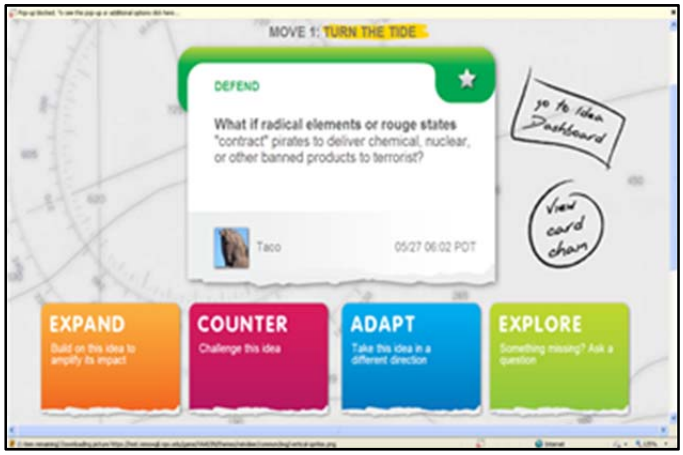


Figure 1. Categories of Ideas Based on the Styles of Responses

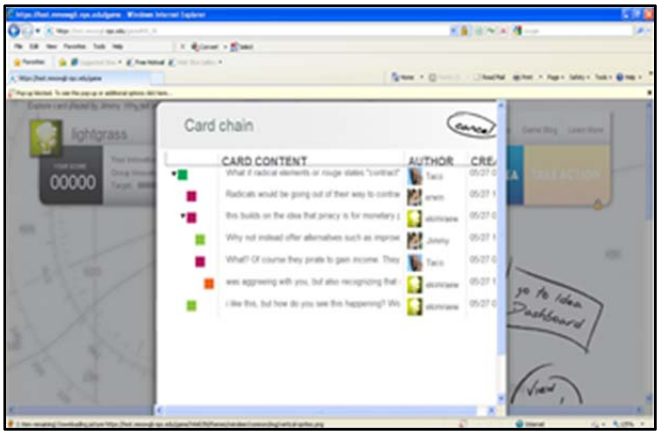


Figure 2. Ideas Collected in the Color-Coded, Tree-Structured Categories

The MMOWGLI platform is suitable for tackling a broad range of challenges for national security, multiple stakeholders, and small or large communities (e.g. corporations and research communities like the acquisition system communities). It is a configurable innovation platform that can be adapted to any scenario.

Lexical Link Analysis (LLA)

As in military operations, where the term *situational awareness* is coined, we note that that our efforts can inform awareness of analyzed data, in a unique way, that help improve a decision-makers' understanding or awareness of the data's content. We therefore define awareness as the cognitive interface between decision makers and a complex system, expressed in a range of terms or features, or specific vocabulary or lexicon, to describe the attributes and surrounding environment of the system. Specifically, LLA is a form of text mining in which word meanings represented in lexical terms (e.g., word pairs) can be represented as if they are in a community of a word network.

Link analysis "discovers" and displays a network of word pairs. These word pair networks are characterized by one-, two-, or three-word themes. Figure 3 shows a visualization of common lexical links shared between Systems 1 and 2, shown in the red box. A system, or a corpus, can be a collection of documents for an actual physical system (e.g., OSA strategies, ideas in a MMOWGLI game or simply a category of information). A node in in Figure 3 represents a word in a corpus and a link or edge represents a word pair. A word pair is a bi-gram (Manning & Schütze, 1999) word pair extracted from the corpus. Within the field of computational linguistics, an *n*-gram is a sequence of *n* items matched certain probabilistic patterns from a given text. Size 2 of *n*-gram is a bi-gram. In Figure 3, each color of a link refers to the collection of words, lexicon or features that belongs to a cluster which describes a concept or theme. In overlapping areas, nodes are lexically linked. Unlinked, outer vectors (outside the red box) indicate unique system features.

Figure 4 shows the information from three categories can be compared and Figure 5 shows the information from two time periods that can be compared. What is unique here is that LLA constructs these linkages via intelligent agent technology using social network grouping methods.

The closeness of the systems in comparison can be examined visually or using the quadratic assignment procedure (QAP; Hubert & Schultz, 1976 [e.g., in UCINET]; Borgatti, Everett, & Freeman, 2002) to compute the correlation of two sets of lexical terms from two systems and analyze the structural differences in the two systems as shown in Figure 6.

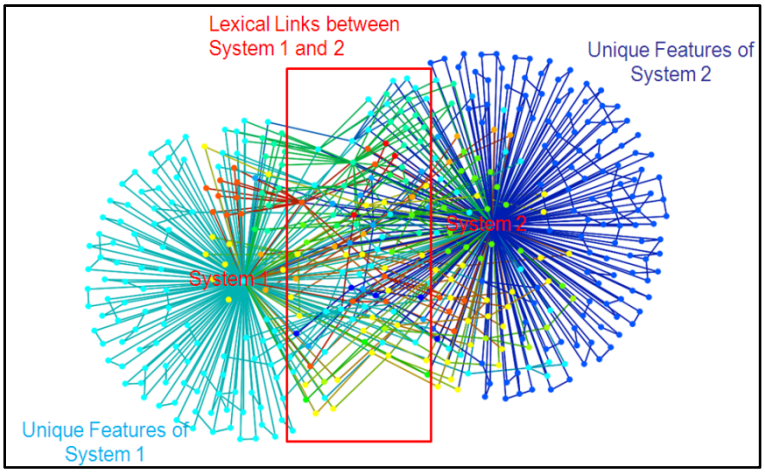


Figure 3. Comparing Two Systems Using LLA

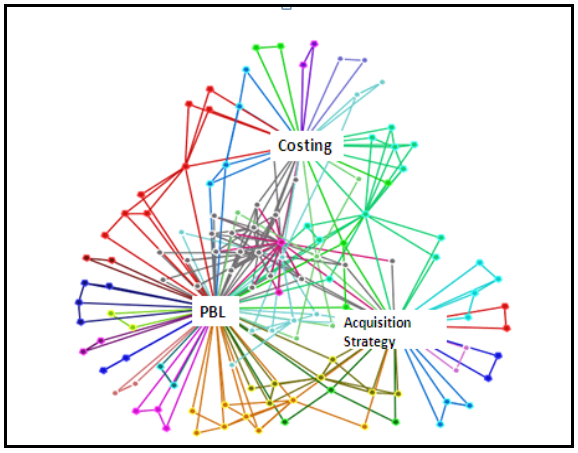


Figure 4. Comparing Three Categories

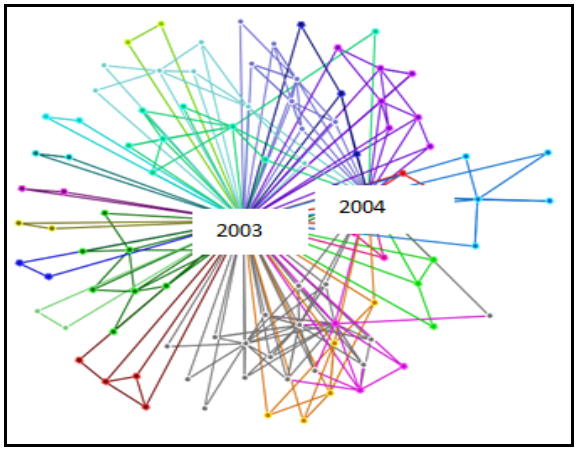
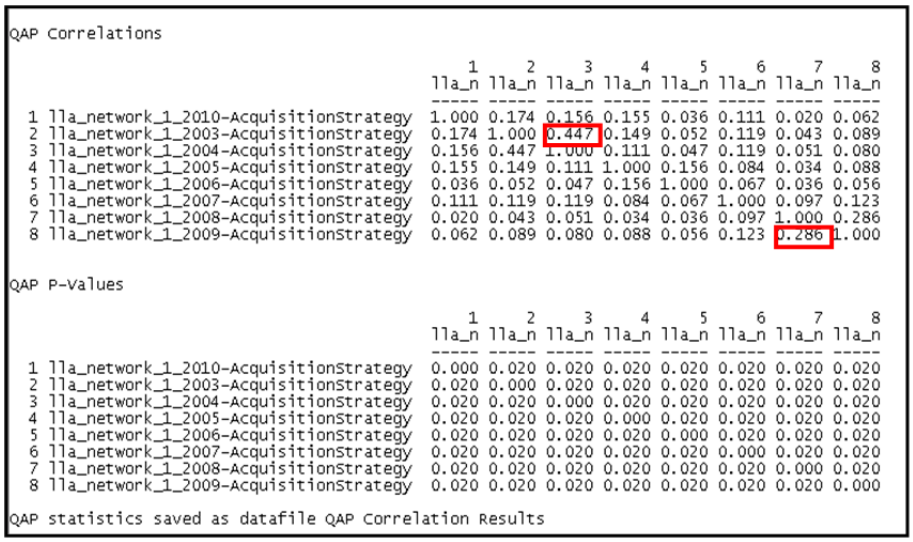


Figure 5. Comparing Two Time Periods



QAP Correlations

		1 lla_n	2 lla_n	3 lla_n	4 lla_n	5 lla_n	6 lla_n	7 lla_n	8 lla_n
1	lla_network_1_2010-AcquisitionStrategy	1.000	0.174	0.156	0.155	0.036	0.111	0.020	0.062
2	lla_network_1_2003-AcquisitionStrategy	0.174	1.000	0.447	0.149	0.052	0.119	0.043	0.089
3	lla_network_1_2004-AcquisitionStrategy	0.156	0.447	1.000	0.111	0.047	0.119	0.051	0.080
4	lla_network_1_2005-AcquisitionStrategy	0.155	0.149	0.111	1.000	0.156	0.084	0.034	0.088
5	lla_network_1_2006-AcquisitionStrategy	0.036	0.052	0.047	0.156	1.000	0.067	0.036	0.056
6	lla_network_1_2007-AcquisitionStrategy	0.111	0.119	0.119	0.084	0.067	1.000	0.097	0.123
7	lla_network_1_2008-AcquisitionStrategy	0.020	0.043	0.051	0.034	0.036	0.097	1.000	0.286
8	lla_network_1_2009-AcquisitionStrategy	0.062	0.089	0.080	0.088	0.056	0.123	0.286	1.000

QAP P-Values

		1 lla_n	2 lla_n	3 lla_n	4 lla_n	5 lla_n	6 lla_n	7 lla_n	8 lla_n
1	lla_network_1_2010-AcquisitionStrategy	0.000	0.020	0.020	0.020	0.020	0.020	0.020	0.020
2	lla_network_1_2003-AcquisitionStrategy	0.020	0.000	0.020	0.020	0.020	0.020	0.020	0.020
3	lla_network_1_2004-AcquisitionStrategy	0.020	0.020	0.000	0.020	0.020	0.020	0.020	0.020
4	lla_network_1_2005-AcquisitionStrategy	0.020	0.020	0.020	0.000	0.020	0.020	0.020	0.020
5	lla_network_1_2006-AcquisitionStrategy	0.020	0.020	0.020	0.020	0.000	0.020	0.020	0.020
6	lla_network_1_2007-AcquisitionStrategy	0.020	0.020	0.020	0.020	0.020	0.000	0.020	0.020
7	lla_network_1_2008-AcquisitionStrategy	0.020	0.020	0.020	0.020	0.020	0.020	0.000	0.020
8	lla_network_1_2009-AcquisitionStrategy	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.000

QAP statistics saved as datafile QAP Correlation Results

Figure 6. QAP Correlation via UCINET

Figure 7 shows a visualization of LLA with connected keywords or concepts as clusters, groups or themes. Words are linked as word pairs that appear next to each other in the original documents. Different colors indicate different clusters of word groups. They were produced using a social network community detection method (Girvan & Newman, 2002) where words are connected, as shown in a single color, as if they are in a social community. The algorithm clusters the words into communities based on the word pair links (edges) among the words. Traditional clustering methods typically use hierarchical clustering method (Székely & Rizzo, 2005) where edges with strong weights progressing towards the weakest ones are gradually included into the clusters. Instead, in the Girvan & Newman method, the communities are detected by progressively removing edges that are least central. For example, betweenness, defined as the number of shortest paths between pairs of nodes that run through a node (Freeman, 1977), has been studied in the past as a measure of the centrality of nodes in networks. The edges connecting communities will have high edge betweenness. By removing these edges, the groups are separated from one another and so the underlying community structure of the network is revealed. As a result, a word center is formed around a word node connected with a list of other words in word pairs. For instance, Figure 8 shows a detailed view of a theme or word group in Figure 7. The center words are “analysis, research, approach.” In this example, we use three-word such as “analysis, research, approach” to label such a group, where the top-three words are these with the highest total degree of centralities (Freeman,1979; Wasserman & Faust, 1994).

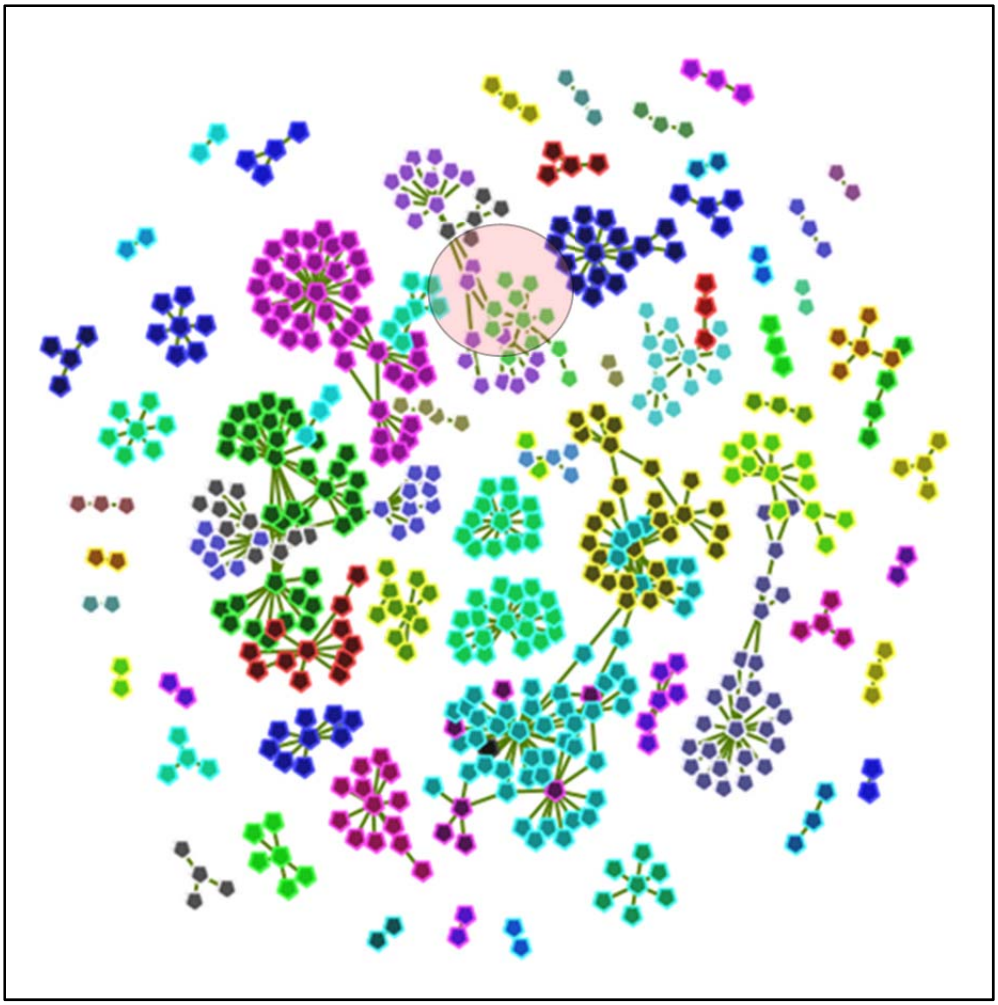


Figure 7. Word and Term of Themes Discovered and Shown in Colored Groups

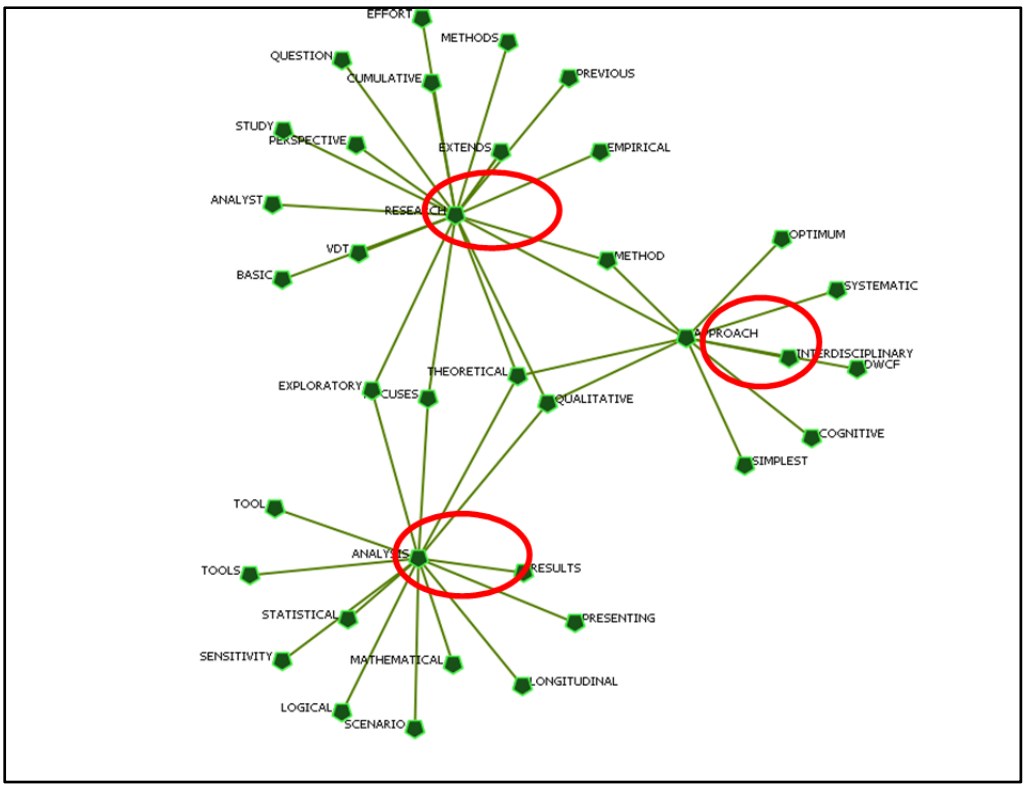


Figure 8. A Detailed View of a Theme or Word Group From Figure 7

The detailed steps of LLA processing include the following steps:

Step 1: Select word pairs based on the following bi-gram parameters:

- The probability threshold for one word next to another word in a word pair
- The minimum frequency for each individual word

Step 2: Apply a social network community finding algorithm, i.e. Newman community detection method (Girvan & Newman 2002) to group the word pairs into themes. A theme includes a cluster of lexical word pairs connected to each other.

Step 3: Compute a "weight," or an importance measure, for a theme.

Step 4: Sort theme weights by time, and study the distributions of the themes by time.

The outputs of LLA, include lexical network visualizations such as the ones in Figure 3, 4, 5, 6, 7, and 8, radar visualization, and matrix visualization (Zhao, Gallup, & MacKinnon, 2010). The word pair groups or themes as shown Figure 7 and 8, are further divided into three types according to the weights in Step 3:

- Popular (P): themes containing the highest number of mutually connected word pairs. The themes represent the main topics in a

corpus at the time. The theme represented in Figure 8 is an example of a popular theme.

- Emerging (E): themes containing the medium number of mutually connected word pairs, these themes may grow to be popular over time.
- Anomalous (A): themes containing the lowest number of mutually connected word pairs. These themes may be off-topics compared to other themes and may be interesting for further investigation.

Business Problems That LLA Addresses

As a text analysis tool, LLA typically addresses the business problems of discovering themes and topics in the unstructured documents and sorting the importance of the themes accordingly. Current methods, for example, internet search methods of ranking pages, require established hyperlinks, citation networks or other forms of crowd-sourced collective intelligence. LLA is especially useful for the data without hyperlinks and citation networks, for example, large-scale government internal documents. Furthermore, current methods typically rank the importance of the information based on their popularity. Instead, we found that in many business applications, it is useful to rank information based on emerging importance or anomalousness.

Current research of social network analysis mostly focuses on people or organizations of direct associations regardless of the contents linked. The so-called study of centrality (Girvan & Newman, 2002; Freeman, 1979) has been a focal point for the social network structure study. Finding the centrality of a network lends insight into the various roles and groupings such as the connectors (e.g., mavens, leaders, bridges, isolated nodes), the clusters (and who is in them), the network core, and its periphery (Orgnet, 2011).

One of the core innovations of LLA is to analyze the content (e.g., documents and social media communications) created by social entities (e.g., people or organizations), therefore create alternative networks, i.e. semantic networks, to the traditional social networks. The resulting networks from LLA examine both social and semantic networks in terms of the organizations and people involved in the important themes, and how semantic networks might suggest improved potential collaborations and predict future outcomes.

Implementation Details

In the past year, we continued our efforts at the Naval Postgraduate School (NPS) by using collaborative learning agents (CLAs; QI, 2009) and expanded to other tools, including AutoMap (Center for Computational Analysis of Social and Organizational Systems [CASOS], 2009) for improved visualizations. Results from

these efforts arose from leveraging intelligent agent technology via an educational license with Quantum Intelligence, Inc. CLA is a computer-based learning agent, or agent collaboration, capable of ingesting and processing data sources.

We have been generating visualizations including a lexical network visualization using various open source tools. We began by using the Organizational Risk Assessment (ORA; CASOS, 2009) tool and expanded to other tools. For example, in the past year, we developed 3D network views using Pajek (Batagelj, Mrvar, & Zaveršnik, 2011) and X3D (Reid 2011, Brutzman 2008, Web3D 2013). We also developed our visualizations radar view and match matrix view (Zhao, Gallup, & MacKinnon, 2010).

LLA uses a computer-based learning agent called CLA (QI, 2009) to employ an unsupervised learning process that separates patterns and anomalies. Unsupervised agent learning is implemented by indexing each set of documents separately and in parallel using multiple learning agents. The unsupervised agents are used because the learning data for supervised agents are expensive to obtain. Multiple agents can work collaboratively and in parallel. We set up a cluster utilizing Linux servers in the NPS High Performance Computing Center (HPC) to handle the large-scale data and secure environment in the NPS Secure Technology Battle Laboratory (STBL).

Relations to Other Methods

The LLA approach is more properly related to latent semantic analysis (LSA) (Dumais, Furnas, Landauer, & Deerwester, 1988) and probabilistic latent semantic analysis (PLSA; Hofmann, 2000). In the LSA approach, a term-document matrix is the starting point for analysis. The elements of the term-document or feature-object (term as feature and document as object) matrix are the occurrences of each word in a particular document, *i.e. A = [a_{ij}]*, where a_{ij} denotes the frequency in which term *j* occurs in document *i.* The term-document matrix is usually sparse. LSA uses singular value decomposition (SVD) to reduce the dimensionality of the term-document matrix. SVD cannot be applied to the cases where the vocabulary (the unique number of terms) in the document collection is large, for example, the number of unique terms in the DoD's acquisition documentation approach the large value that would make SVD inapplicable. LSA has been widely used to improve information indexing, search/retrieval and text categorization.

A recent development related to this method is called latent Dirichlet allocation (LDA; Blei, Ng, & Jordan, 2003), which is a generative probabilistic model of a corpus. In LDA, a document is considered to be composed of a collection of words—a "bag of words," where word order and grammar are not considered important. The basic idea is that documents are represented as random mixtures

over latent topics, where each topic is characterized by a statistical distribution (Dirichlet distribution) over the corpus.

Our theme generation from LLA is different than LDA, in which a collection of lexical terms are connected to each other semantically, as if they are in a social community, and social network grouping methods are used to group the words, and unlike LSA, our method is easily scaled to analyze a large vocabulary and is generalizable to any sequential data.

LLA is further related to tools such as PageRank (Brin & Page 1998; PageRank, 2013), Automap (CASOS,2009), AlchemyAPI (AI, 2013), Semantica (SR, 2013) for entity extraction, text analysis and sentiment analysis, WordNet (Miller,1995), and Apache Lucene(ASF, 2013), OpenNLP(ASF, 2013), and Mahout(ASF,2013), with the best of each incorporated in LLA.

Anticipated Benefits

Our LLA method provides candidate solutions to meet the critical analytic needs of the acquisition research. The key advantage is to provide an innovative near real-time self-awareness system to transfer diversified data services into strategic decision-making knowledge, specifically through:

- Automation: High correlation of LLA results—with the link analysis done by human analysts—makes it possible to save human power and improve responsiveness. Automation is achieved via computer program or software agents to perform LLA frequently – and in near real-time.
- Discovery: LLA discovers and displays a network of word pairs. These word pair networks are characterized by one, two or three word themes. The weight of each theme is determined based on its frequency of occurrence. It may also discover blind spots of human analysis that are caused by the overwhelming data for human analysts to consider.
- Validation: LLA may provide different perspectives of links. In the acquisition context, links discovered by human analysts may emphasize component and part connections that do not necessarily reflect content overlaps. Consequently, it can provide improved results in terms of trust, quality of association discovery; can help to break through different levels of the *taxonomy of ignorance* (Denby & Gammack,1999), reach across organizational boundaries, and help to improve organizational reach.

Other Use Cases

In this section we discuss other recent research efforts where LLA has been implemented to uncover meaning and depict Big Data to its users.

Discover New Knowledge Using Open Social Media Data Sources

There is a critical need for Defense Intelligence Agency (DIA) to discover new sources of information from public domains, e.g. from various social media platforms, and then link them with intelligence collected for other intelligence applications. We demonstrated how LLA can be applied to publically available social media data which might be relevant to intelligence applications. We develop a specific *persona archetype* and to analyze all available data derived from social media.

Identification of NATO Capability Requirements

We applied LLA to analyze the documents that support the current process to identify NATO capability and force requirements from the current process and supporting documents to help determine who the stakeholders are, i.e. US and Allied organizations involved in the current process, in an effort to improve EUCOM visibility and recommend new collaborations toward "Smart Defense."

DoD Acquisition Research (Gallup, MacKinnon, Zhao, Robey & Odell, 2009; Zhao, Gallup & MacKinnon, 2010, 2011a, 2011b, 2011c, 2012a, 2012b, 2013)

The US DoD acquisition process is extremely complex, where key processes must work in concert to deliver the capabilities required by the warfighters. Each process produces a large amount of data in an unstructured manner. There has been a critical need for automation, validation, and discovery to help acquisition professionals, decision makers and researchers to reveal the interrelationships among the data elements and business processes. We applied LLA to extract the links, compare the trends and discover previously unknown patterns from data of three armed-services (Army, Navy and Air Force) over the past ten years.

Multi-Agency Radiological Responses Plan and Exercise

Every year, US DHS spends large amounts of money to conduct training, exercises and simulations to prepare for emergency responses. These exercises often involve processes such as planning, organizing, directing, and monitoring activities and collaborations of multi-agencies. The activities generate large amounts of unstructured data for *sensemaking*. LLA was used for summarizing themes, concepts and discovering the order of the importance of the events.

Naval Recruiting

Facebook, Twitter, and many other social networking sites offer virtual environments for meeting possible candidates that could fit service entry profiles. Sponsored by the Navy Recruiting Command, the goal of this project was to collect and match large-scale Facebook public fan and group profiles with Navy-enlisted and officer-rating documents to improve future Navy Recruiting and advertising efforts.

Navy Chief of Information (CHINFO) (Zhao, Gallup, & MacKinnon, 2011a)

The case study involved the 2006 U.S. Coast Guard Live Fire case, when the Coast Guard planned a live fire training program in the Great Lakes area in Michigan. 980 public comments and 200 pages of public meeting transcripts, linking all associated comments, and then generating semantic networks over time by stakeholder groups. We leveraged LLA to determine how strategic communications of CHINFO proliferate through various open sources.

APAN Network and Haiti Operation Data Analysis (Zhao, MacKinnon, & Gallup, 2012b)

In the aftermath of the Haiti earthquake, U.S. military and civil organizations provided rapid and extensive relief operations. LLA was used to analyze trends in interagency synergy from data collected from these social media platforms such as Twitter, Facebook, news-feed Web sites, official PDF briefing documents, situation reports, forums and blogs from the HAITI HA/DR Community of Interest (COI) on the All Partners Access Network (APAN).

Defense Analysis

Collecting data in the area of human intelligence (HUMINT), we performed a feasibility study from approximately 1500 reports. Each report represented a separate event including post-blast information, and after-action reports from the Combined Explosives Exploitation Cell (CEXC) and data from other reporting tools used in Iraq and Afghanistan war activities as target development, civil affairs, psychological operations, engagement, or indirect fires. Our efforts demonstrated the capability to reconstruct social networks of people, places, and events, as well as to reveal trends and perhaps predict future events.

In summary, LLA discovers and displays these networks of word pairs from large-scale unstructured data. It can be installed as a search and knowledge management tool for scoring and ranking interesting information and for visualizing and reporting correlations among categories and layers of information including social, meta-data and semantic links. This effort then presents the decision maker with previously unavailable and emerging patterns and themes, as well as

unprecedented levels of analysis, thus reducing the workload and overcoming the blind spots of human analysts and providing potential automation. For example, for the recent MMOWGLI games, LLA was leveraged to identify potentially interesting information from idea card, link it, then recommend them for action plans for Game Masters.

Figure 9 shows a MMOWGLI game's content and attributes can be processed into the inputs (i.e., meta_data.txt and a directory of text files) to LLA.

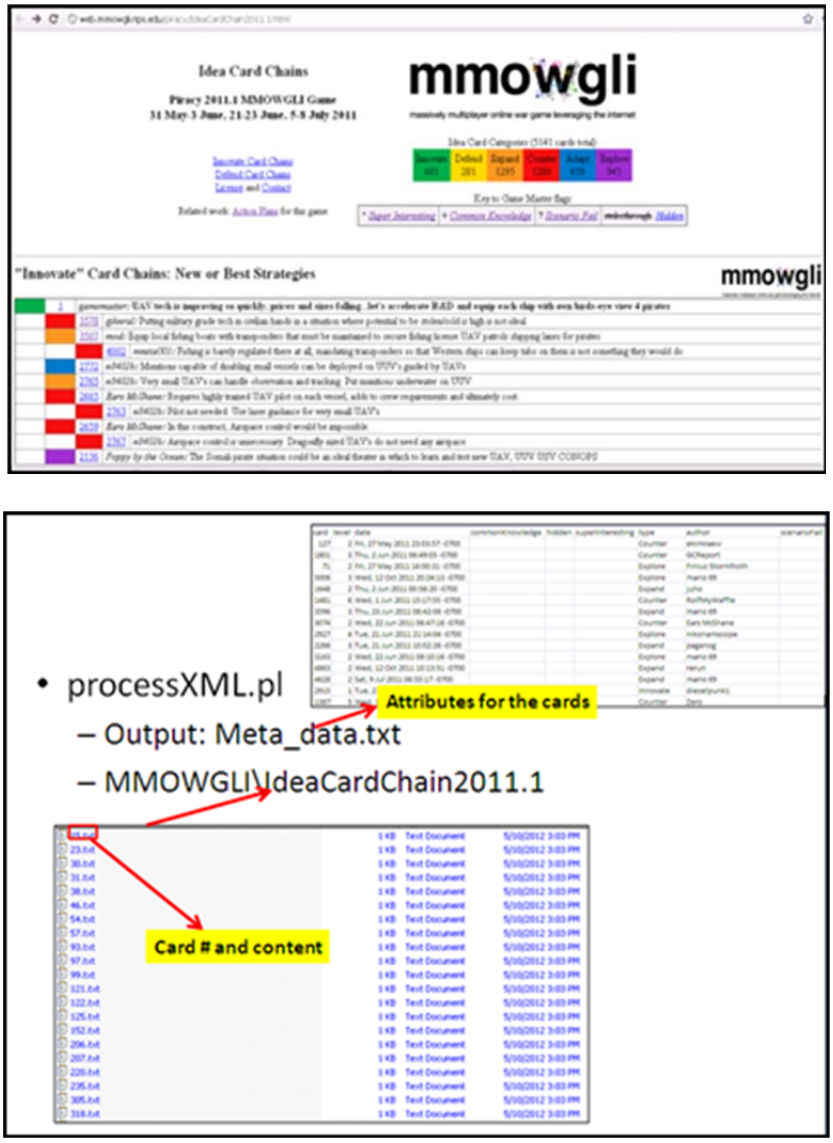
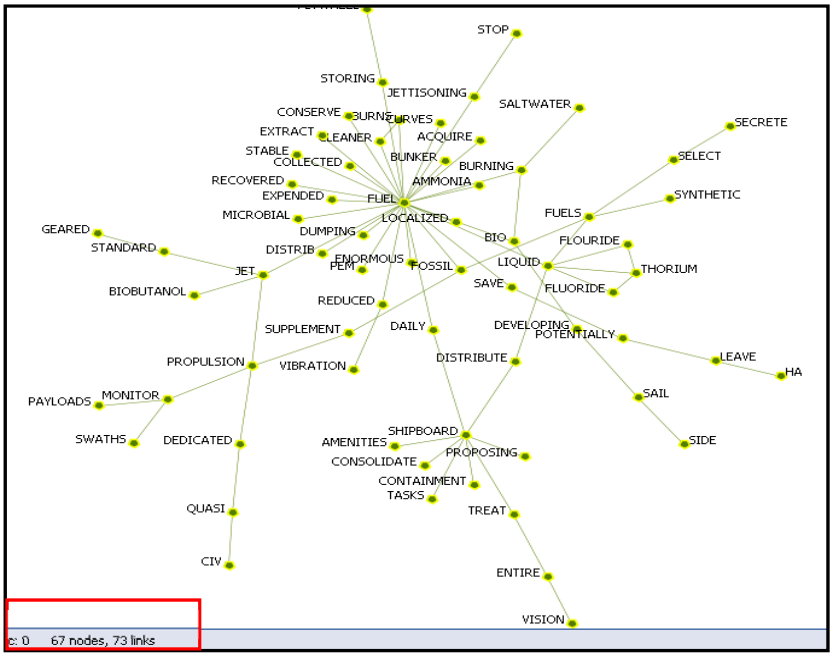


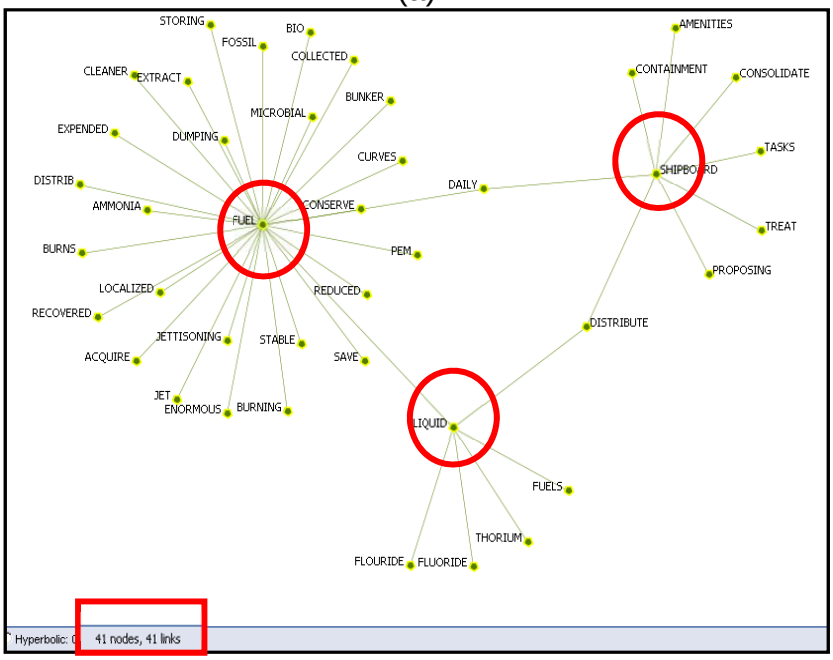
Figure 9. Idea Cards Transformed to LLA Inputs (e.g., a Directory With Files of Content of Cards and Attributes, and meta_data.txt to LLA)

Figure 10(a) shows word pair clusters using Newman community finding algorithm (Girvan & Newman, 2002) from the 1st iteration. Figure 10(b) selected

lexical terms linked to the most central nodes, for example, “fuel, shipboard, liquid” from the 2nd Iteration.



(a)



(b)

Figure 10. Iterations of the Two Steps LLA Steps Used to Group Word Pairs Into Themes

At present, LLA computer code is not available to the public and is proprietary in nature. Dr. Zhao is the originator of the software code which was used in support

of numerous government projects as explained above. Future efforts might include an exportable version of LLA.

Research Results

We applied LLA to three MMOWGLI games, specifically:

- *energyMMOWGLI* (May 2012): 560 players, ~5000 idea cards and 68 action plans
- *biiMMOWGLI* Round 1 (January 2013): 892 idea cards, 11 action plans
- *biiMMOWGLI* Round 2 (July 2013): 2674 idea cards, 15 action plans

From these games, data was gathered and analyzed by LLA to show the correlation and linkage between numerous ideas and revealed the resulting themes as discussed below.

Energy Game

In the *energyMMOWGLI* game, LLA was used to analyze the collected data (idea cards and action plans) retrieved from the following links:

- http://web.mmowgli.nps.edu/energy/IdeaCardChainEnergy2012.html
- http://web.mmowgli.nps.edu/energy/ActionPlanListEnergy2012.html

The LLA was performed through the following process:

- **Prepare acquisition data.** Collate key terms and goal statements of current acquisition programs within the congressional budget processes for use by the LLA methodology
- **Perform link analysis and correlation.** Compare the already-collected *energyMMOWGLI* results to determine action plan relevance on a program-by-program basis

As shown in Figure 11, our goal was to demonstrate the feasibility of the social media *energyMMOWGLI* game as an innovation platform that could generate valuable and unexpected contributions and solutions for improved DoD energy efficiency through the acquisition process, by linking current acquisition programs with the *energyMMOWGLI* game using LLA. We achieved this objective by performing the tasks described previously and detailed in the next section.

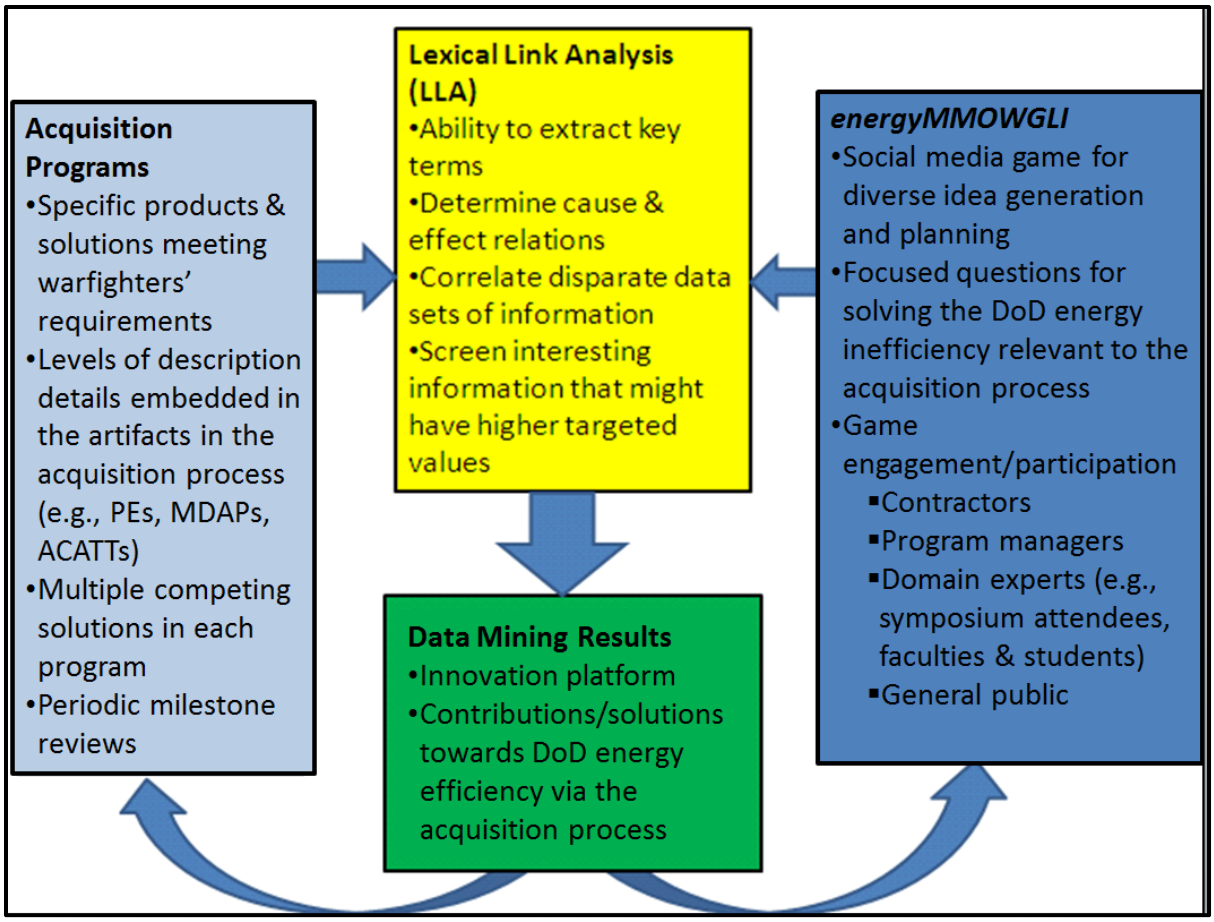


Figure 11. A Glance of the Proposal Objective

Prepare Acquisition Data

The goal here is to collate key terms from the current acquisition program in the congressional budget process. The congressional budget process documents e.g. Program Elements [PEs] from http://www.dtic.mil/descriptivesum/ were used in this task. This source is the accurate and authoritative high level of artifacts the DoD RDT&E process. We had analyzed part of these documents in the past (Gallup, MacKinnon, Zhao, Robey & Odell, 2009; Zhao, Gallup & MacKinnon, 2010,2011a,2011b,2011c,2012a,2012b,2013) in detail using the LLA method jointly with other measures such as cost, schedule, and performance.
Specifically, we collected the following most recent (2013) PEs for this project:

- http://www.dtic.mil/descriptivesum/Y2013_Navy.html
- http://www.dtic.mil/descriptivesum/Y2013_AirForce.html
- http://www.dtic.mil/descriptivesum/Y2013_Army.html

Perform Analysis and Correlation

We linked the *energyMMOWGLI* data, specifically, 38 action plans to the 224 Navy PEs to evaluate the current Navy programs relevant to the game data. Figure 12 illustrates the results of this process in a relevance and correlation matrix.

Phase I Project: Program Relevance/Correlation Matrix of MMOWGLI Game Plans – Comparison of Key Terms from Both Sources

energyMMOWGLI Action Plans (May 2012 Game Data: existing corpus)	1	2	…		37
Funded Programs via PEs					
1	x				
2			x		
…		x			
500				x	x

•Use Sample learned threshold or LLA measures of strength of correlation

Figure 12. Phase I Relevance Matrix

Figure 13(a) shows the actual match matrix sorted with Navy PEs (row) that match the *energyMMOWGLI* game data (column) based on the LLA score. Figure 13(b) shows a detailed and enlarged part of Figure 13(a). An LLA score for a PE is the total number of LLA word pairs that were matched with the game action plans.

(a)

Id	navy_2013(Online)	navy_2013	actions_10_0.73.txt	actions_11_0.76.txt
	0603724N_4_PB_2013.pdf	603724N_4_PB_2013.pdf	4631.00;CONSUMPTION ENERGY(1402.00);EFFICIENCY ENERGY(1402.00);SHIPBOARD SYSTEMS(700.00);SHIPBOARD EQUIPMENT(700.00);SAVINGS ENERGY(427.00)	9383.00;CONSUMPTION FUEL(1402.00);EFFICIENCY FUEL(1402.00);EFFICIENCY ENERGY(1402.00);SAVING ENERGY(1287.00);ENERGY NAVY(1133.00);CONSERVATION ENERGY(1066.00);CLASS SHIP(1020.00);SAVINGS ENERGY(427.00);USAGE ENERGY(244.00)
2	0601153N_1_PB_2013.pdf	0601153N_1_PB_2013.pdf	2102.00;EFFICIENCY ENERGY(1402.00);SHIPBOARD SYSTEMS(700.00)	8555.00;IMPROVING ENERGY(1440.00);EFFICIENCY ENERGY(1402.00);ACADEMY NAVAL(1311.00);SOCIAL NETWORK(1253.00);SOCIAL NETWORKS(1253.00);ENERGY SYSTEMS(1133.00);TURBINE ENGINE(763.00)

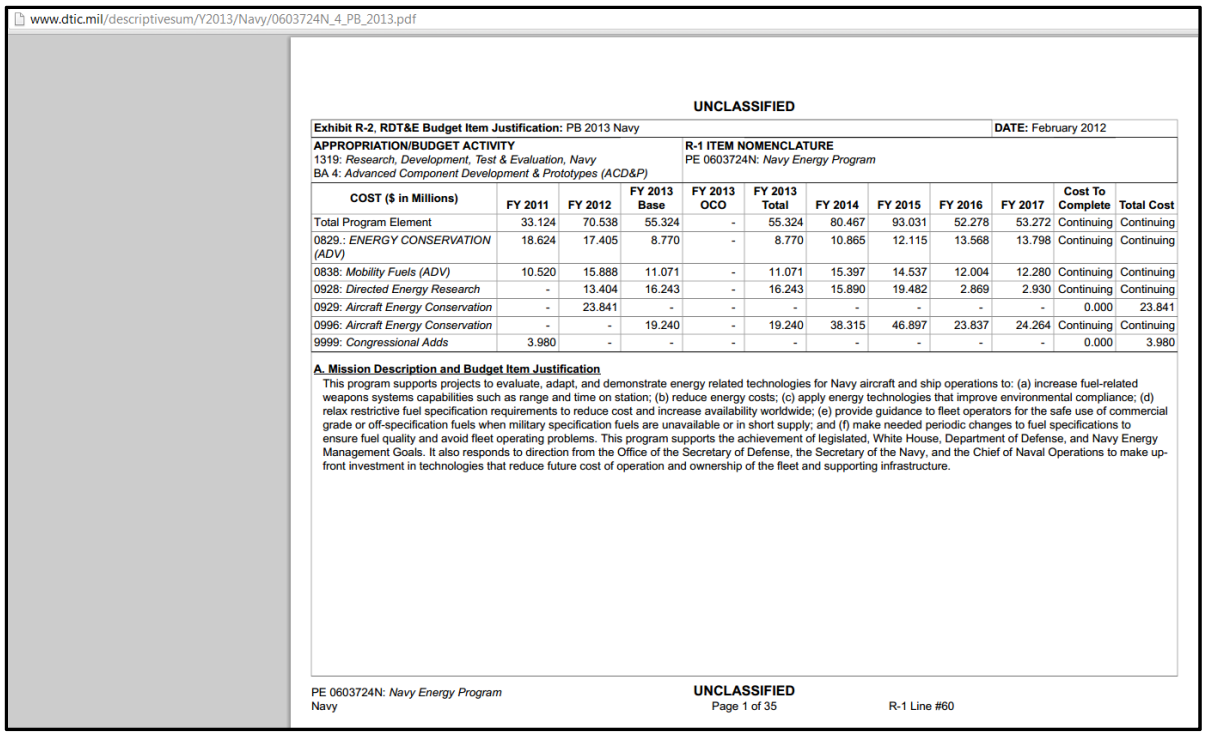
(b)

Figure 13. The Overall Match Matrix for the energyMMOWGLI Game Action Plans and 2013 Navy PEs; (b) Detail of Part (a)

The top five most relevant PEs from Figure 7:

- PE 0603724N: Navy Energy Program
- PE 0601153N: Defense Research Sciences
- PE 0602123N: Force Protection Applied Res
- PE 0603573N: Advanced Surface Machinery Sys
- PE 0206624M: Marine Corps Cmbt Services Supt

In the actual visualization of the matrix, one is able to click on the online link for the top one (PE 0603724N in Figure 13, red box) leads to the online page of the “Navy Energy Program,” which is an overall PE specifically focusing on Navy energy issues as shown in Figure 14. This validates that the LLA extracted the relevant keywords from the game data.



www.dtic.mil/descriptivesum/Y2013/Navy/0603724N_4_PB_2013.pdf

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Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Navy — **DATE:** February 2012

APPROPRIATION/BUDGET ACTIVITY
1319: *Research, Development, Test & Evaluation, Navy*
BA 4: *Advanced Component Development & Prototypes (ACD&P)*

R-1 ITEM NOMENCLATURE
PE 0603724N: *Navy Energy Program*

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	33.124	70.538	55.324	-	55.324	80.467	93.031	52.278	53.272	Continuing	Continuing
0829.: *ENERGY CONSERVATION (ADV)*	18.624	17.405	8.770	-	8.770	10.865	12.115	13.568	13.798	Continuing	Continuing
0838: *Mobility Fuels (ADV)*	10.520	15.888	11.071	-	11.071	15.397	14.537	12.004	12.280	Continuing	Continuing
0928: *Directed Energy Research*	-	13.404	16.243	-	16.243	15.890	19.482	2.869	2.930	Continuing	Continuing
0929: *Aircraft Energy Conservation*	-	23.841	-	-	-	-	-	-	-	0.000	23.841
0996: *Aircraft Energy Conservation*	-	-	19.240	-	19.240	38.315	46.897	23.837	24.264	Continuing	Continuing
9999: *Congressional Adds*	3.980	-	-	-	-	-	-	-	-	0.000	3.980

A. Mission Description and Budget Item Justification

This program supports projects to evaluate, adapt, and demonstrate energy related technologies for Navy aircraft and ship operations to: (a) increase fuel-related weapons systems capabilities such as range and time on station; (b) reduce energy costs; (c) apply energy technologies that improve environmental compliance; (d) relax restrictive fuel specification requirements to reduce cost and increase availability worldwide; (e) provide guidance to fleet operators for the safe use of commercial grade or off-specification fuels when military specification fuels are unavailable or in short supply; and (f) make needed periodic changes to fuel specifications to ensure fuel quality and avoid fleet operating problems. This program supports the achievement of legislated, White House, Department of Defense, and Navy Energy Management Goals. It also responds to direction from the Office of the Secretary of Defense, the Secretary of the Navy, and the Chief of Naval Operations to make up-front investment in technologies that reduce future cost of operation and ownership of the fleet and supporting infrastructure.

PE 0603724N: *Navy Energy Program*
Navy
UNCLASSIFIED
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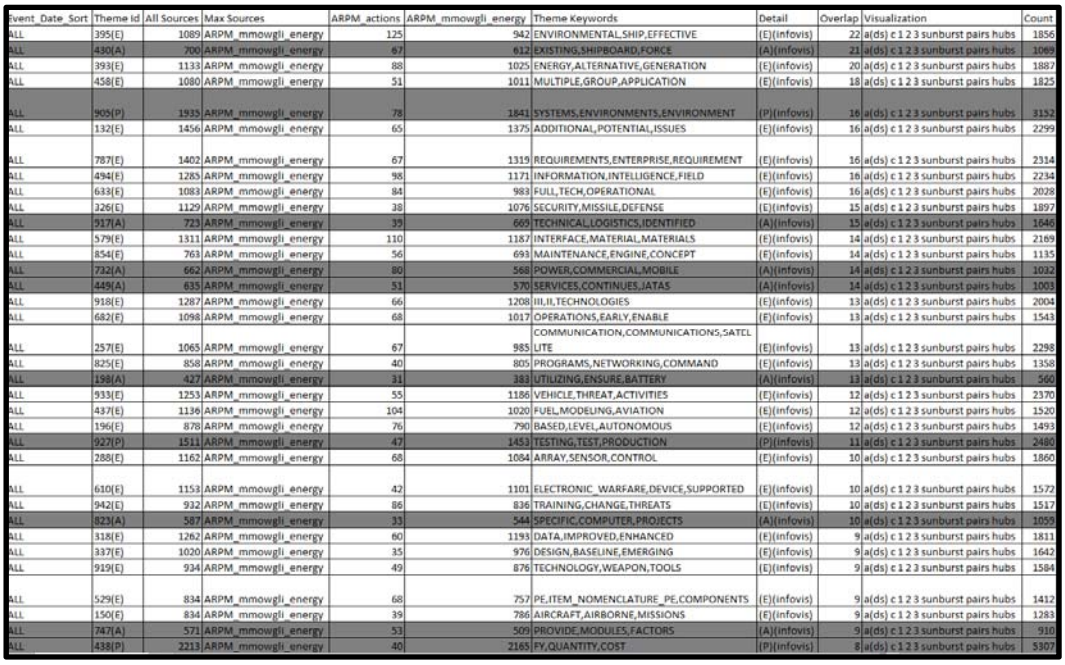
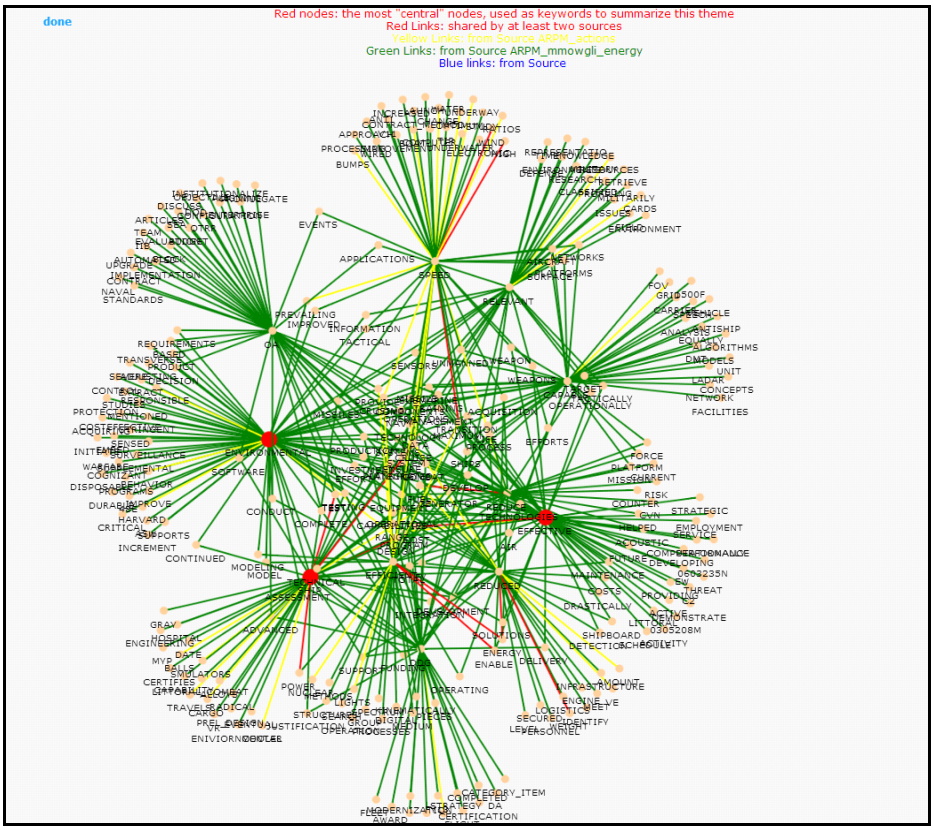
Figure 14. Navy Energy Program

The matrix in Figure 13 also shows a holistic picture of the current acquisition programs in connection with situations in which DoD is energy inefficient. Directly looking into the match matrix, as illustrated in Figure 13, can be overwhelming. For that, we applied LLA to discover the themes and divide a single match matrix into many match matrices with different themes as shown in Figure 15. For our research, a theme is a network or community of word pairs that are related to each other. To discover themes, we first applied LLA to compute word pair clusters using the Newman community finding algorithm, in which equal word pairs are treated as if in a community (Girvan & Newman, 2002). Then we select lexical terms linked to the most central nodes. For example the red nodes in Figure 16 are the most central nodes: environmental, ship and effective. The red links are the word pairs shared by both sources (i.e., PEs and MMOWGLI game action plans), the yellow links are the word pairs unique to the game data, and the green links are those unique to the PEs.



Event_Date_Sort	Theme Id	All Sources	Max Sources	ARPM_actions	ARPM_mmowgli_energy	Theme Keywords	Detail	Overlap	Visualization	Count
ALL	395(E)	1089	ARPM_mmowgli_energy	125	942	ENVIRONMENTAL,SHIP,EFFECTIVE	(E)(infovis)	22	a(ds) c 1 2 3 sunburst pairs hubs	1856
ALL	430(A)	700	ARPM_mmowgli_energy	67	612	EXISTING,SHIPBOARD,FORCE	(A)(infovis)	21	a(ds) c 1 2 3 sunburst pairs hubs	1069
ALL	393(E)	1133	ARPM_mmowgli_energy	88	1025	ENERGY,ALTERNATIVE,GENERATION	(E)(infovis)	20	a(ds) c 1 2 3 sunburst pairs hubs	1887
ALL	458(E)	1080	ARPM_mmowgli_energy	51	1011	MULTIPLE,GROUP,APPLICATION	(E)(infovis)	18	a(ds) c 1 2 3 sunburst pairs hubs	1825
ALL	905(P)	1935	ARPM_mmowgli_energy	78	1841	SYSTEMS,ENVIRONMENTS,ENVIRONMENT	(P)(infovis)	16	a(ds) c 1 2 3 sunburst pairs hubs	3152
ALL	132(E)	1456	ARPM_mmowgli_energy	65	1375	ADDITIONAL,POTENTIAL,ISSUES	(E)(infovis)	16	a(ds) c 1 2 3 sunburst pairs hubs	2299
ALL	787(E)	1402	ARPM_mmowgli_energy	67	1319	REQUIREMENTS,ENTERPRISE,REQUIREMENT	(E)(infovis)	16	a(ds) c 1 2 3 sunburst pairs hubs	2314
ALL	494(E)	1285	ARPM_mmowgli_energy	98	1171	INFORMATION,INTELLIGENCE,FIELD	(E)(infovis)	16	a(ds) c 1 2 3 sunburst pairs hubs	2234
ALL	633(E)	1083	ARPM_mmowgli_energy	84	983	FULL,TECH,OPERATIONAL	(E)(infovis)	16	a(ds) c 1 2 3 sunburst pairs hubs	2028
ALL	326(E)	1129	ARPM_mmowgli_energy	38	1076	SECURITY,MISSILE,DEFENSE	(E)(infovis)	15	a(ds) c 1 2 3 sunburst pairs hubs	1897
ALL	917(A)	723	ARPM_mmowgli_energy	39	669	TECHNICAL,LOGISTICS,IDENTIFIED	(A)(infovis)	15	a(ds) c 1 2 3 sunburst pairs hubs	1646
ALL	579(E)	1311	ARPM_mmowgli_energy	110	1187	INTERFACE,MATERIAL,MATERIALS	(E)(infovis)	14	a(ds) c 1 2 3 sunburst pairs hubs	2189
ALL	854(E)	763	ARPM_mmowgli_energy	56	693	MAINTENANCE,ENGINE,CONCEPT	(E)(infovis)	14	a(ds) c 1 2 3 sunburst pairs hubs	1135
ALL	732(A)	662	ARPM_mmowgli_energy	80	568	POWER,COMMERCIAL,MOBILE	(A)(infovis)	14	a(ds) c 1 2 3 sunburst pairs hubs	1032
ALL	449(A)	635	ARPM_mmowgli_energy	51	570	SERVICES,CONTINUES,JATAS	(A)(infovis)	14	a(ds) c 1 2 3 sunburst pairs hubs	1003
ALL	918(E)	1287	ARPM_mmowgli_energy	66	1208	III,II,TECHNOLOGIES	(E)(infovis)	13	a(ds) c 1 2 3 sunburst pairs hubs	2004
ALL	682(E)	1098	ARPM_mmowgli_energy	68	1017	OPERATIONS,EARLY,ENABLE	(E)(infovis)	13	a(ds) c 1 2 3 sunburst pairs hubs	1543
ALL	257(E)	1065	ARPM_mmowgli_energy	67	985	COMMUNICATION,COMMUNICATIONS,SATELLITE	(E)(infovis)	13	a(ds) c 1 2 3 sunburst pairs hubs	2298
ALL	825(E)	858	ARPM_mmowgli_energy	40	805	PROGRAMS,NETWORKING,COMMAND	(E)(infovis)	13	a(ds) c 1 2 3 sunburst pairs hubs	1358
ALL	198(A)	427	ARPM_mmowgli_energy	31	383	UTILIZING,ENSURE,BATTERY	(A)(infovis)	13	a(ds) c 1 2 3 sunburst pairs hubs	560
ALL	933(E)	1253	ARPM_mmowgli_energy	55	1186	VEHICLE,THREAT,ACTIVITIES	(E)(infovis)	12	a(ds) c 1 2 3 sunburst pairs hubs	2370
ALL	437(E)	1136	ARPM_mmowgli_energy	104	1020	FUEL,MODELING,AVIATION	(E)(infovis)	12	a(ds) c 1 2 3 sunburst pairs hubs	1520
ALL	196(E)	878	ARPM_mmowgli_energy	76	790	BASED,LEVEL,AUTONOMOUS	(E)(infovis)	12	a(ds) c 1 2 3 sunburst pairs hubs	1493
ALL	927(P)	1511	ARPM_mmowgli_energy	47	1453	TESTING,TEST,PRODUCTION	(P)(infovis)	11	a(ds) c 1 2 3 sunburst pairs hubs	2480
ALL	288(E)	1162	ARPM_mmowgli_energy	68	1084	ARRAY,SENSOR,CONTROL	(E)(infovis)	10	a(ds) c 1 2 3 sunburst pairs hubs	1860
ALL	610(E)	1153	ARPM_mmowgli_energy	42	1101	ELECTRONIC_WARFARE,DEVICE,SUPPORTED	(E)(infovis)	10	a(ds) c 1 2 3 sunburst pairs hubs	1572
ALL	942(E)	932	ARPM_mmowgli_energy	86	836	TRAINING,CHANGE,THREATS	(E)(infovis)	10	a(ds) c 1 2 3 sunburst pairs hubs	1517
ALL	823(A)	587	ARPM_mmowgli_energy	33	544	SPECIFIC,COMPUTER,PROJECTS	(A)(infovis)	10	a(ds) c 1 2 3 sunburst pairs hubs	1059
ALL	318(E)	1262	ARPM_mmowgli_energy	60	1193	DATA,IMPROVED,ENHANCED	(E)(infovis)	9	a(ds) c 1 2 3 sunburst pairs hubs	1811
ALL	337(E)	1020	ARPM_mmowgli_energy	35	976	DESIGN,BASELINE,EMERGING	(E)(infovis)	9	a(ds) c 1 2 3 sunburst pairs hubs	1642
ALL	919(E)	934	ARPM_mmowgli_energy	49	876	TECHNOLOGY,WEAPON,TOOLS	(E)(infovis)	9	a(ds) c 1 2 3 sunburst pairs hubs	1584
ALL	529(E)	834	ARPM_mmowgli_energy	68	757	PE,ITEM_NOMENCLATURE_PE,COMPONENTS	(E)(infovis)	9	a(ds) c 1 2 3 sunburst pairs hubs	1412
ALL	150(E)	834	ARPM_mmowgli_energy	39	786	AIRCRAFT,AIRBORNE,MISSIONS	(E)(infovis)	9	a(ds) c 1 2 3 sunburst pairs hubs	1283
ALL	747(A)	571	ARPM_mmowgli_energy	53	509	PROVIDE,MODULES,FACTORS	(A)(infovis)	9	a(ds) c 1 2 3 sunburst pairs hubs	910
ALL	438(P)	2213	ARPM_mmowgli_energy	40	2165	FY,QUANTITY,COST	(P)(infovis)	8	a(ds) c 1 2 3 sunburst pairs hubs	5307

Figure 15. Theme Discovered for Navy 2013 PEs Documents and Energy MMOWGLI Data, Sorted According to Overlapping Word Pairs From the Two Sources



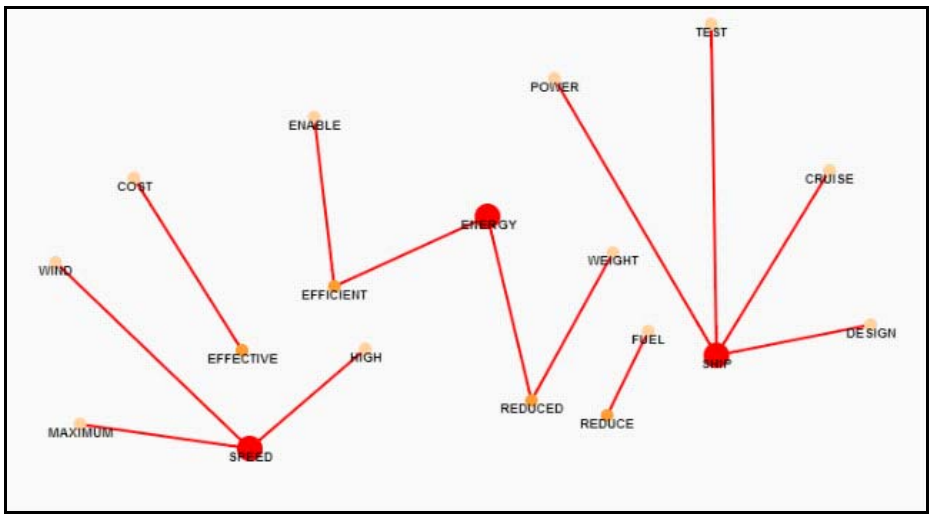


Figure 16. Theme 395(E): Environmental, Ship & Effective

A separate matrix can be constructed for each theme including the links of PEs and action plans with the word pairs that only belongs to the theme. In Figure 16, the correlation matrix for Theme 395(E) labeled as "environmental, ship & effective," has the highest number of matched word pairs. The matched PEs are sorted according to the number of lexical terms matched with action plans. For

example, the top matched PE is “0603724N_PB_2013,” titled “Navy Energy Program,” which indicates that this is a current Navy program dedicated to energy. We used this matrix to determine where opportunities reside in the current process to include energy-related elements. As is shown in Figure 17(a), two concepts, “energy efficient” (red area enlarged in Figure 17[b]) and “ship design” 9 (green area enlarged in Figure 17[c]) are dominant in this theme. They are dominant since four (action 17, 8, 18, 5 in Figure 17[b]) and two (action 9 and 6 in Figure 17[c]) out of 38 action plans contain word pairs “energy efficient” and “ship design” respectively. This seems to suggest that “energy efficient” may have to work with the concept “ship design.” However, among the 12 PEs that mention “ship design”, only one mentions “energy efficient.” (i.e., the top row in Figure 17[c], corresponding to PE 0603724N_PB_2013 -- the Navy Energy Program). This indicates there is a gap, or a DoD energy inefficiency area, and therefore, an opportunity to emphasize the concept “energy efficient” in all the PEs related to the concept “ship design.”

PE ID	PE Title	action 26	action 20	action 17	action 28	action 8	action 10	action 11	action 18	action 9	action 5	action 16	action 12	action 7	action 6	# of matched action plans
0603724N_4_PB_2013	Navy Energy Program					ENERGY EFFICIENT		GENERATOR SETS	ENERGY EFFICIENT	SHIP DESIGN	ENERGY EFFICIENT	DIESEL ENGINE			SHIP DESIGN	7
0206624M_7_PB_2013	Marine Corps Cmbt Services Supt			ENERGY EFFICIENT		ENERGY EFFICIENT		REDUCE FUEL	ENERGY EFFICIENT		ENERGY EFFICIENT					5
0601153N_1_PB_2013	Defense Research Sciences	TURBINES GAS	SPEED HIGH							SHIP DESIGN					SHIP DESIGN	4
0206623M_7_PB_2013	MC Ground Cmbt Spt Arms Sys			ENERGY EFFICIENT		ENERGY EFFICIENT			ENERGY EFFICIENT		ENERGY EFFICIENT					4
0602123N_2_PB_2013	Force Protection Applied Res			WIND SOLAR, ENERGY EFFICIENT		ENERGY EFFICIENT			ENERGY EFFICIENT		ENERGY EFFICIENT					4
0603563N_4_PB_2013	Ship Concept Advanced Design		SPEED HIGH							SHIP DESIGN				MAXIMUM SPEED	SHIP DESIGN	4
0602271N_2_PB_2013	Electromagnetic Systems Applied Research			ENERGY EFFICIENT		ENERGY EFFICIENT			ENERGY EFFICIENT		ENERGY EFFICIENT					4
0604567N_5_PB_2013	Ship Contract Design/ Live Fire T&E	TURBINES GAS								SHIP DESIGN					SHIP DESIGN	3
0603721N_4_PB_2013	Environmental Protection									SHIP DESIGN			DIESEL ENGINES		SHIP DESIGN	3
0603561N_4_PB_2013	Advanced Submarine System Development									SHIP DESIGN					SHIP DESIGN	2
0603512N_4_PB_2013	Carrier Systems Development									SHIP DESIGN					SHIP DESIGN	2
0604777N_5_PB_2013	Navigation/Id System									SHIP DESIGN					SHIP DESIGN	2
0605152N_6_PB_2013	Studies & Analysis Supt - Navy									SHIP DESIGN					SHIP DESIGN	2
0204413N_7_PB_2013	Amphibious Tactical Supt Units									SHIP DESIGN					SHIP DESIGN	2
0708730N_7_PB_2013	Maritime Tech (MARITECH									SHIP DESIGN					SHIP DESIGN	2
0605866N_6_PB_2013	Navy Space & Electr Warfare Supt									SHIP DESIGN					SHIP DESIGN	2
0603236N_3_PB_2013	Warfighter Sustainment Advd Tech		1													1
0603673N_3_PB_2013	Future Naval Capabilities Advanced Tech Dev		SPEED HIGH													1
0603640M_3_PB_2013	MC Advanced Technology Demo				GENERATOR TURBINE											1
0602114N_2_PB_2013	Power Proj Applied Research	TURBINES GAS														1
0205633N_7_PB_2013	Aviation Improvements												DIESEL ENGINES			1
0604258N_6_PB_2013	Target Systems Development													MAXIMUM SPEED		1
0603658N_4_PB_2013	Cooperative Engagement						REDUCED WEIGHT									1
0603758N_3_PB_2013	Navy Warfighting Exp & Demo										REDUCED ENERGY					1
0602236N_2_PB_2013	Warfighter Sustainment Applied Res		SPEED HIGH				REDUCED WEIGHT									1
0603573N_4_PB_2013	Advanced Surface Machinery Sys	SHIP POWER														1
0603564N_4_PB_2013	Ship Prel Design & Feasibility Studies		SPEED HIGH													1
0208058N_7_PB_2013	Joint High Speed Vessel (JHSV)		SPEED HIGH													1
0305160N_7_PB_2013	Navy Meteorological and Ocean Sensors-Space(METOC)		SPEED WIND													1

(a)

action 17	action 28	action 8	action 10	action 11	action 18	action 9	action 5
		ENERGY EFFICIENT		GENERATOR SETS	ENERGY EFFICIENT	SHIP DESIGN	ENERGY EFFICIENT
ENERGY EFFICIENT		ENERGY EFFICIENT		REDUCE FUEL	ENERGY EFFICIENT		ENERGY EFFICIENT
						SHIP DESIGN	
ENERGY EFFICIENT		ENERGY EFFICIENT			ENERGY EFFICIENT		ENERGY EFFICIENT
WIND SOLAR, ENERGY EFFICIENT		ENERGY EFFICIENT			ENERGY EFFICIENT		ENERGY EFFICIENT
						SHIP DESIGN	
ENERGY EFFICIENT		ENERGY EFFICIENT			ENERGY EFFICIENT		ENERGY EFFICIENT

(b)

action 9	action 5	action 16	action 12	action 7	action 6	# of matched action plans
SHIP DESIGN	ENERGY EFFICIENT	DIESEL ENGINE			SHIP DESIGN	7
	ENERGY EFFICIENT					5
SHIP DESIGN					SHIP DESIGN	4
	ENERGY EFFICIENT					4
	ENERGY EFFICIENT					4
SHIP DESIGN				MAXIMUM SPEED	SHIP DESIGN	4
	ENERGY EFFICIENT					4
SHIP DESIGN					SHIP DESIGN	3
SHIP DESIGN			DIESEL ENGINES		SHIP DESIGN	3
SHIP DESIGN					SHIP DESIGN	2
SHIP DESIGN					SHIP DESIGN	2
SHIP DESIGN					SHIP DESIGN	2
SHIP DESIGN					SHIP DESIGN	2
SHIP DESIGN					SHIP DESIGN	2
SHIP DESIGN					SHIP DESIGN	2
SHIP DESIGN					SHIP DESIGN	2

(c)

Figure 17. Match Matrix for Theme 395 (E)

Following the same analysis, Appendix A lists more gap and opportunity areas discovered by LLA.

Business Innovation Initiative (BII) MMOWGLI Game

Round 1

biiMMOWGLI game Round 1 was performed from January 14, 2013 to January 15, 2013. In Round 1, LLA was used to identify potentially interesting information from idea cards and action plans, link them to existing business documents and show their interrelation to domain experts. We performed two separate post-game data analyses.

- Idea cards (892) and action plans (11) were compared to the proposed OSA strategy (four pages) considered by players
- Idea cards (892) and action plans (11) were compared to the OSA contract guidebook (158 pages) familiar to most players

In Round 1, the LLA data analysis discovered the following:

- Ideas and draft action plans expressed in bii game, by anonymous players, showed strong consistency with the concepts in the Program Manager's Contract Guidebook
- Metrics indicate the draft OSA strategy triggered new and innovative ideas
- Metrics did not indicate that the OSA strategy was risky, controversial, impossible to implement etc.

LLA also discovered eight main or popular themes, reflecting common interest of the players, using the following keywords:

- Multiple support and components
- Common data, data model
- Component reuse, OSA
- Open system and business
- Systems architecture, current systems
- Specific price and fee
- Existing reusable programs
- Engineering, government and community

We also found that innovative ideas, i.e. gaps between the game data and the OSA strategy document, in the following areas (themes) listed below:

- Small and shared
- Developed and built faster
- Critical definition
- Specific price and fee
- Sponsors change and risk
- Changing requirements
- Interoperability and interfaces

Figure 18 shows one example theme detailed from the comparison of game data with the OSA strategy document. Red nodes show the top three word hubs with the most links (or, most central). Yellow word pairs are unique to action plans, green word pairs are unique to idea cards, and blue word pairs are unique to the OSA strategy document. Red word pairs are found in more than two sources.

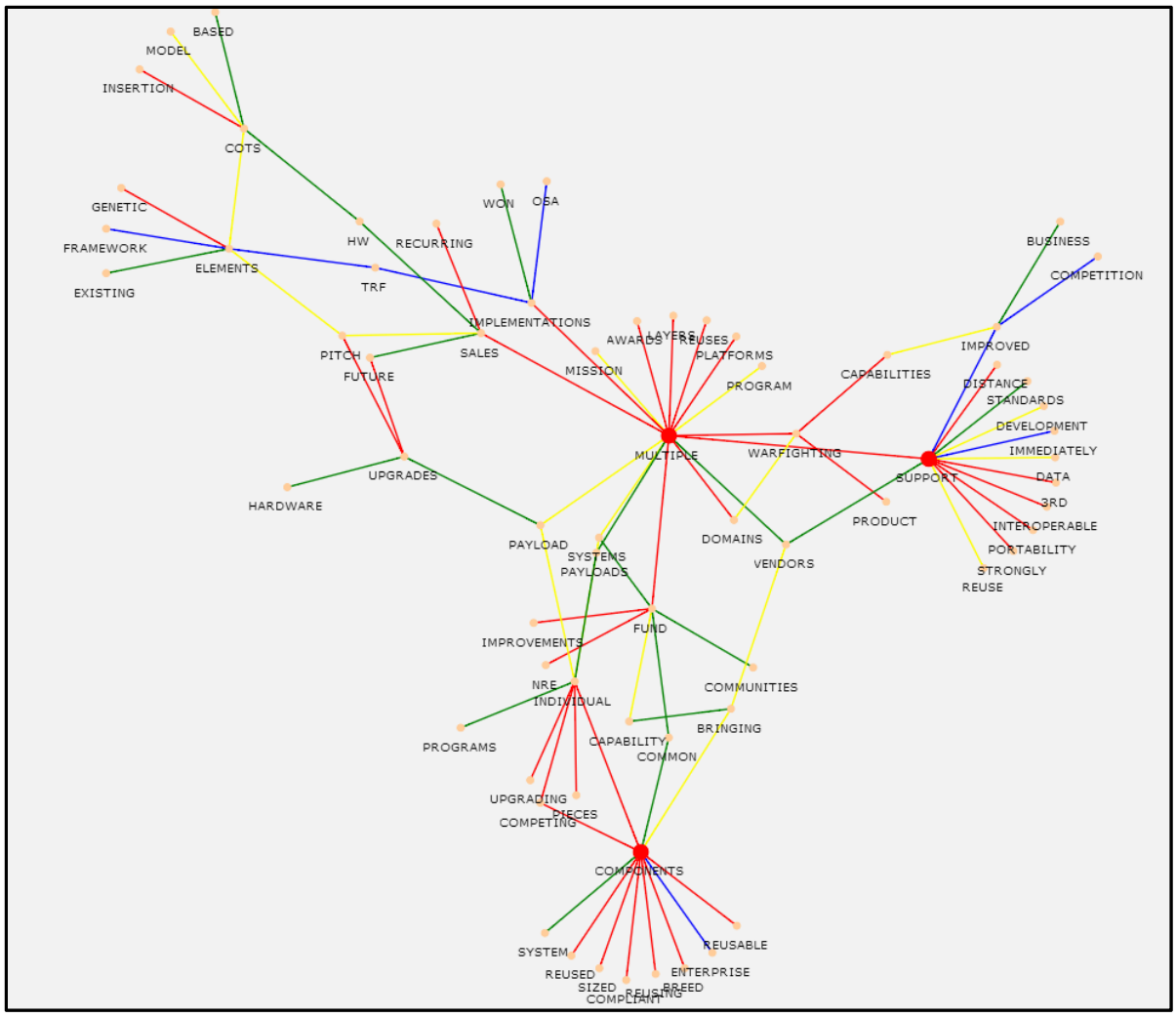


Figure 18. One Theme Matching Keywords Multiple, Support and Components

More background and summary for Round 1 of *biiMMOWGLI* can also be found in (Guertin, Womble, & Bruhns, 2013; Zhao, Brutzman, & MacKinnon, 2013).

Round 2

Round 2 of the *biiMMOWGLI* game was conducted between from July 15, 2013, to July 31, 2013. There were 2674 idea cards and 15 action plans generated.

In Round 2, we applied LLA to answer the business question we started to answer in Round 1: specifically, how might the MMOWGLI game data be used to improve future OSA strategy? We also aimed to answer the following related questions:

- What ideas discussed in the game matched with the OSA strategy documents?

- How can the related and matched ideas be used in a way that is useful for future OSA strategies?

To answer these questions in detail, in Round 2, we focused on using LLA to produce match matrices that are linked to the new OSA strategy document. We then divided the outputs of LLA into three types as shown in Figure 19:

- Popularity (P) themes: themes containing the highest number of mutually connected word pairs. These themes represent the main topics in a corpus at the time.
- Emerging (E) themes: themes containing the medium number of mutually connected word pairs. These themes may grow to become popular over time as we show later in the examples.
- Anomaly (A) themes: themes containing the lowest number of mutually connected word pairs. These themes may be off-topics compared to other topics and may be interesting for further investigation.

Event_Date_Sort	Theme Id	All Sources	Max Sources	MMOWGLI_ideas	OSA_strategy	Theme Keywords	Detail	Overlap	Visualization	Count
ALL	43(P)	281	MMOWGLI_ideas	261	18	EXISTING,FUTURE,INNOVATION	(P)(infovis)	2	a(ds) c 1 2 3 sunburst pairs hubs	341
ALL	198(P)	202	MMOWGLI_ideas	181	15	SYSTEM,SYSTEMS,OPEN	(P)(infovis)	6	a(ds) c 1 2 3 sunburst pairs hubs	251
ALL	135(P)	194	MMOWGLI_ideas	170	20	OSA,CHANGE,PERSONNEL	(P)(infovis)	4	a(ds) c 1 2 3 sunburst pairs hubs	240
ALL	189(E)	181	MMOWGLI_ideas	180	1	IP,RISK,CONTRACTOR	(E)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	210
ALL	103(E)	175	MMOWGLI_ideas	160	15	MULTIPLE,INCENTIVES,FUNDING	(E)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	196
ALL	56(E)	158	MMOWGLI_ideas	145	5	COST,COSTS,LIFE	(E)(infovis)	8	a(ds) c 1 2 3 sunburst pairs hubs	233
ALL	68(E)	157	MMOWGLI_ideas	138	15	DEVELOPMENT,SOFTWARE,DESIGN	(E)(infovis)	4	a(ds) c 1 2 3 sunburst pairs hubs	193
ALL	29(E)	148	MMOWGLI_ideas	143	4	BUSINESS,MODEL,INCENTIVE	(E)(infovis)	1	a(ds) c 1 2 3 sunburst pairs hubs	201
ALL	40(E)	143	MMOWGLI_ideas	135	7	COMMON,INFORMATION,PRIOR	(E)(infovis)	1	a(ds) c 1 2 3 sunburst pairs hubs	155
ALL	104(E)	133	MMOWGLI_ideas	127	6	INDUSTRY,COMPONENTS,CURRENT	(E)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	152
ALL	50(E)	130	MMOWGLI_ideas	126	4	CONTRACT,CONTRACTS,RFPS	(E)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	148
ALL	166(E)	126	MMOWGLI_ideas	115	10	LEVEL,PROGRAM,REQUIRE	(E)(infovis)	1	a(ds) c 1 2 3 sunburst pairs hubs	138
ALL	98(E)	125	MMOWGLI_ideas	118	5	PERFORMANCE,NAVY,GOVERNMENT	(E)(infovis)	2	a(ds) c 1 2 3 sunburst pairs hubs	152
ALL	38(E)	123	MMOWGLI_ideas	113	7	TECHNICAL,FRAMEWORK,FUNDS	(E)(infovis)	3	a(ds) c 1 2 3 sunburst pairs hubs	148
ALL	184(E)	117	MMOWGLI_ideas	115	2	REQUIREMENTS,SOURCE,INTERNAL	(E)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	160
ALL	163(E)	112	MMOWGLI_ideas	109	1	RIGHTS,LICENSE,PROCESS	(E)(infovis)	2	a(ds) c 1 2 3 sunburst pairs hubs	146
ALL	78(E)	111	MMOWGLI_ideas	100	10	ENTERPRISE,MONEY,ENABLE	(E)(infovis)	1	a(ds) c 1 2 3 sunburst pairs hubs	136
ALL	186(E)	111	MMOWGLI_ideas	103	8	REWARD,LARGE,PROVIDE	(E)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	124
ALL	209(E)	106	MMOWGLI_ideas	97	7	DESIRED,PROJECT,VENDOR	(E)(infovis)	2	a(ds) c 1 2 3 sunburst pairs hubs	122
ALL	187(A)	93	MMOWGLI_ideas	92	1	REWARDS,VICE,MEASURE	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	99
ALL	102(A)	92	MMOWGLI_ideas	91	1	TECH,IDEA,PROPOSALS	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	107
ALL	174(A)	87	MMOWGLI_ideas	76	9	QUALITY,COMPONENT,HIGHER	(A)(infovis)	2	a(ds) c 1 2 3 sunburst pairs hubs	98
ALL	7(A)	80	MMOWGLI_ideas	69	8	ACQUISITION,TESTING,FULL	(A)(infovis)	3	a(ds) c 1 2 3 sunburst pairs hubs	99
ALL	211(A)	76	MMOWGLI_ideas	67	7	METRICS,STANDARD,SIMILAR	(A)(infovis)	2	a(ds) c 1 2 3 sunburst pairs hubs	82
ALL	133(A)	74	MMOWGLI_ideas	74	0	STRUCTURE,ORGANIZATIONAL,SUCCESS	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	76
ALL	185(A)	71	MMOWGLI_ideas	58	12	REVIEW,ACQ,PROCESSES	(A)(infovis)	1	a(ds) c 1 2 3 sunburst pairs hubs	82
ALL	75(A)	69	MMOWGLI_ideas	68	1	EARLY,UNIT,TESTS	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	76
ALL	51(A)	68	MMOWGLI_ideas	68	0	PEOPLE,SOLUTIONS,CONTRACTING	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	77
ALL	61(A)	66	MMOWGLI_ideas	57	6	DATA,PROPRIETARY,MODELS	(A)(infovis)	3	a(ds) c 1 2 3 sunburst pairs hubs	107
ALL	14(A)	65	MMOWGLI_ideas	63	2	PRACTICE,HUGE,MISSION	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	73
ALL	116(A)	64	MMOWGLI_ideas	62	1	MANAGEMENT,ENSURE,CONTROL	(A)(infovis)	1	a(ds) c 1 2 3 sunburst pairs hubs	79
ALL	52(A)	62	MMOWGLI_ideas	60	2	IMPLEMENTATION,ENABLES,CONTRACTORS	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	65
ALL	97(A)	60	MMOWGLI_ideas	60	0	POST,STRATEGIC,EXPERIENCE	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	70
ALL	127(A)	58	MMOWGLI_ideas	55	2	ENGINEERING,EFFORT,OA	(A)(infovis)	1	a(ds) c 1 2 3 sunburst pairs hubs	76
ALL	204(A)	55	MMOWGLI_ideas	55	0	LONG,TERM,COTS	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	83
ALL	162(A)	46	MMOWGLI_ideas	45	1	TEAM,PROBLEM,CODE	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	52
ALL	53(A)	41	MMOWGLI_ideas	40	1	CONTRIBUTIONS,FULLY,XML	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	45
ALL	21(A)	40	MMOWGLI_ideas	39	1	BASED,FUNCTION,TREATMENT	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	46
ALL	197(A)	40	MMOWGLI_ideas	36	4	SUPPORT,MEANS,TYPICALLY	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	42
ALL	123(A)	39	MMOWGLI_ideas	33	5	NEEDED,KNOWLEDGE,RESEARCH	(A)(infovis)	1	a(ds) c 1 2 3 sunburst pairs hubs	43
ALL	183(A)	36	MMOWGLI_ideas	36	0	REQUIREMENT,START,EVOLVING	(A)(infovis)	0	a(ds) c 1 2 3 sunburst pairs hubs	38

Figure 19. Themes of Popularity (P), Emerging (E) and Anomaly (A) Discovered Using LLA in the Round 2 Idea Cards

Figure 20 shows the detail for the theme centered around “Existing, Future, Innovation.” It shows the contrast between what is only in the OSA strategy document (green) and what is only in the game idea cards only (yellow) . It also shows overlap (red) in these two data sources.

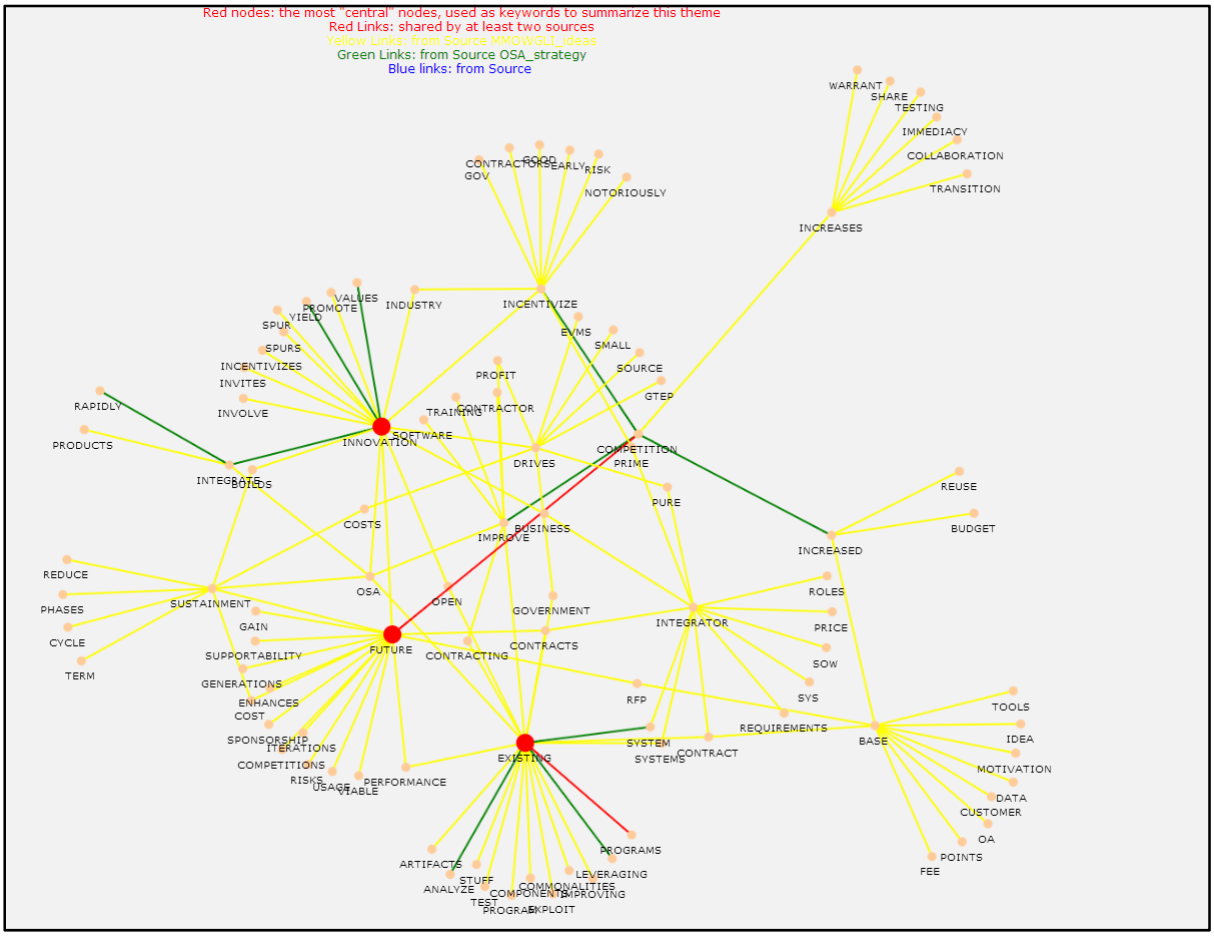


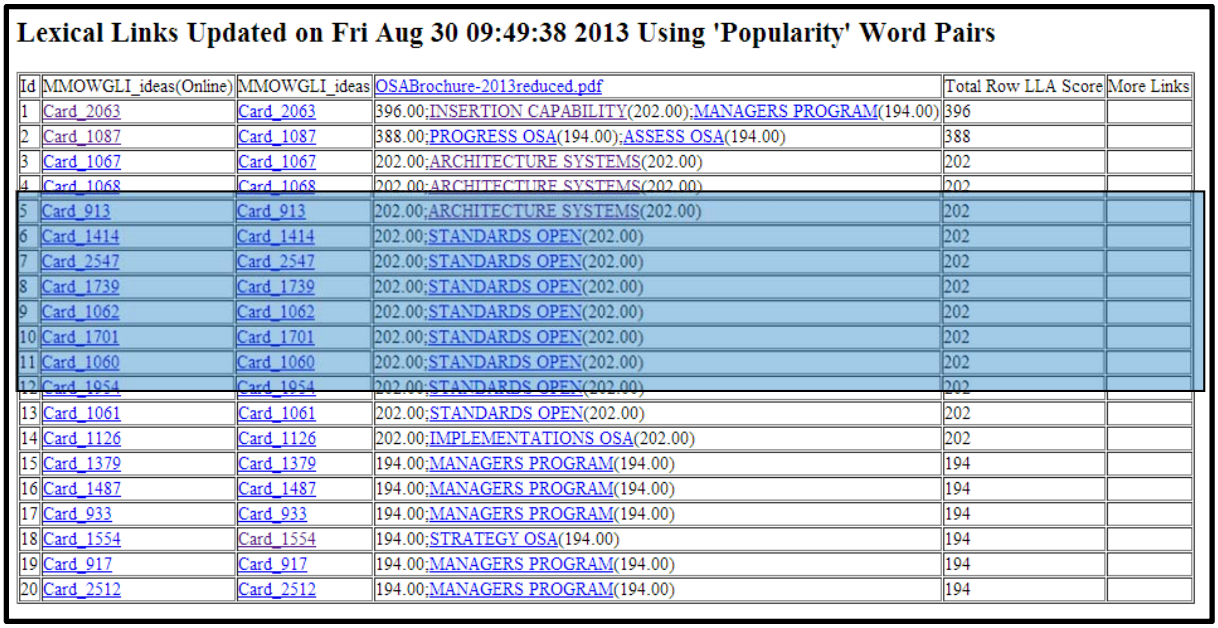
Figure 20. Theme Centered Around “Existing, Future, Innovation”

From Figure 20, we see that the game generated many new concepts (yellow links) centered on the theme. These new concept (for example, “leveraging existing,” “OSA innovation,” “incentivize innovation,” and “future supportability,” etc.) can be used to improve the future OSA strategy document. Appendix B lists the top themes in Figure 19.

Figure 21 shows a match matrix for the idea cards in the *biiMMOWGLI* Round 2 matched with the OSA strategy document, where the matched word pairs belong to the category “Popularity”. This category includes the concepts that are common knowledge to the acquisition community.

In Figure 21, clicking the link “open standards” opens the LLA search results shown in Figure 22, which identify the idea cards and the OSA strategy containing

the word pair “open standards.” One can see the cards enrich the concept “open standards” in the OSA strategy with related concepts such as “giant loyalty” (card 2547), “future roadmap” (card 1062), “common playing field” (card 1739) and “open APIs” (card 2612).



Lexical Links Updated on Fri Aug 30 09:49:38 2013 Using 'Popularity' Word Pairs

Id	MMOWGLI_ideas(Online)	MMOWGLI_ideas	OSABrochure-2013reduced.pdf	Total Row LLA Score	More Links
1	Card_2063	Card_2063	396.00;INSERTION CAPABILITY(202.00);MANAGERS PROGRAM(194.00)	396	
2	Card_1087	Card_1087	388.00;PROGRESS OSA(194.00);ASSESS OSA(194.00)	388	
3	Card_1067	Card_1067	202.00;ARCHITECTURE SYSTEMS(202.00)	202	
4	Card_1068	Card_1068	202.00;ARCHITECTURE SYSTEMS(202.00)	202	
5	Card_913	Card_913	202.00;ARCHITECTURE SYSTEMS(202.00)	202	
6	Card_1414	Card_1414	202.00;STANDARDS OPEN(202.00)	202	
7	Card_2547	Card_2547	202.00;STANDARDS OPEN(202.00)	202	
8	Card_1739	Card_1739	202.00;STANDARDS OPEN(202.00)	202	
9	Card_1062	Card_1062	202.00;STANDARDS OPEN(202.00)	202	
10	Card_1701	Card_1701	202.00;STANDARDS OPEN(202.00)	202	
11	Card_1060	Card_1060	202.00;STANDARDS OPEN(202.00)	202	
12	Card_1954	Card_1954	202.00;STANDARDS OPEN(202.00)	202	
13	Card_1061	Card_1061	202.00;STANDARDS OPEN(202.00)	202	
14	Card_1126	Card_1126	202.00;IMPLEMENTATIONS OSA(202.00)	202	
15	Card_1379	Card_1379	194.00;MANAGERS PROGRAM(194.00)	194	
16	Card_1487	Card_1487	194.00;MANAGERS PROGRAM(194.00)	194	
17	Card_933	Card_933	194.00;MANAGERS PROGRAM(194.00)	194	
18	Card_1554	Card_1554	194.00;STRATEGY OSA(194.00)	194	
19	Card_917	Card_917	194.00;MANAGERS PROGRAM(194.00)	194	
20	Card_2512	Card_2512	194.00;MANAGERS PROGRAM(194.00)	194	

Figure 21. A Match Matrix for the *biiMMOWGLI* Game Round 2 Cards Matched With the OSA Strategy Document Using Popularity Word Pairs

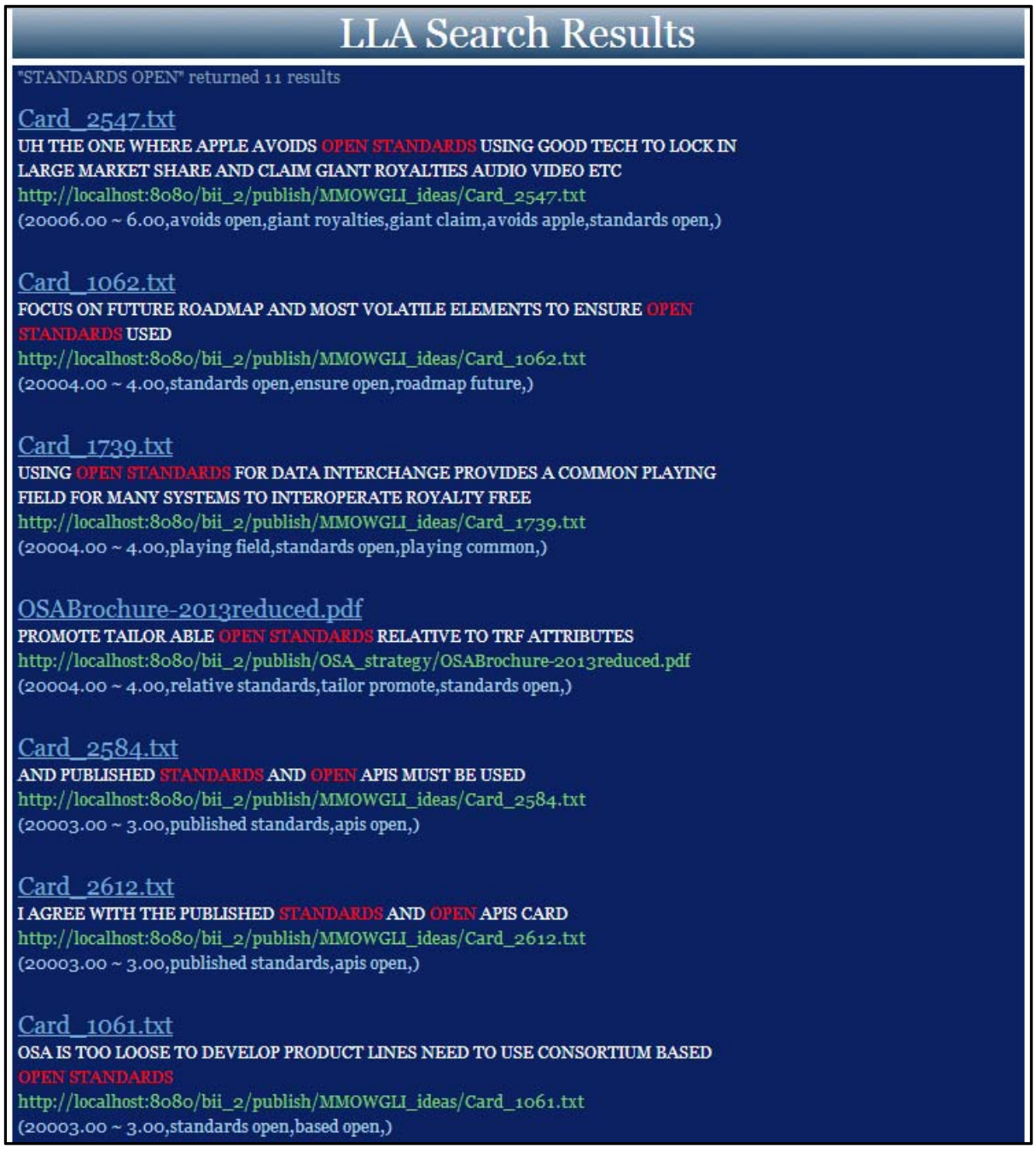


Figure 22. LLA Search Results for "Standards Open"

Similarly, in Figure 23, clicking the link "life cycle" reveals the LLA search results shown in Figure 24, and identifies the cards and the OSA strategy containing the word pair "life cycle". Additionally, the idea cards from the game enrich the concept by providing linked meanings such as "life cycle" in the OSA strategy with related concepts such as "operational scenario," "SE development " (card 2255), "sustainment cost," "business models" (card 2300), "automatic maintenance," "infrastructure support" (card 2467 marked as "super interesting" by an analyst),

"system design" (card 2481,2308), "infrastructure costs" (card 2308) and "prohibit contracts" (card 1223).

Lexical Links Updated on Fri Aug 30 09:59:05 2013 Using 'Emerging' Word Pairs

Id	MMOWGLI_ideas(Online)	MMOWGLI_ideas	OSABrochure-2013reduced.pdf	Total Row LLA Score	More Links
1	Card_1995	Card_1995	316.00;CYCLE LIFE(158.00);LIFE SYSTEM(158.00)	316	
2	Card_2255	Card_2255	316.00;CYCLE LIFE(158.00);LIFE SYSTEM(158.00)	316	
3	Card_2235	Card_2235	316.00;OWNERSHIP TOTAL(158.00);OWNERSHIP COST(158.00)	316	
4	Card_2310	Card_2310	316.00;CYCLE LIFE(158.00);LIFE PROGRAM(158.00)	316	
5	Card_2556	Card_2556	316.00;OWNERSHIP COSTS(158.00);OWNERSHIP TOTAL(158.00)	316	
6	Card_1340	Card_1340	316.00;OWNERSHIP COSTS(158.00);OWNERSHIP TOTAL(158.00)	316	
7	Card_2681	Card_2681	316.00;CYCLE LIFE(158.00);SAVINGS COST(158.00)	316	
8	Card_2667	Card_2667	246.00;FRAMEWORKS TECHNICAL(123.00);CONSOLIDATE TECHNICAL(123.00)	246	
9	Card_1495	Card_1495	158.00;SAVINGS COST(158.00)	158	
10	Card_1223	Card_1223	158.00;CYCLE LIFE(158.00)	158	
11	Card_1198	Card_1198	158.00;SAVINGS COST(158.00)	158	
12	Card_1600	Card_1600	158.00;SAVINGS COST(158.00)	158	
13	Card_1768	Card_1768	158.00;SAVINGS COST(158.00)	158	
14	Card_1598	Card_1598	158.00;SAVINGS COST(158.00)	158	
15	Card_1531	Card_1531	158.00;SAVINGS COST(158.00)	158	
16	Card_1601	Card_1601	158.00;SAVINGS COST(158.00)	158	
17	Card_1945	Card_1945	158.00;CYCLE LIFE(158.00)	158	
18	Card_2256	Card_2256	158.00;LIFE SYSTEM(158.00)	158	
19	Card_1017	Card_1017	158.00;CYCLE LIFE(158.00)	158	
20	Card_2510	Card_2510	158.00;CYCLE LIFE(158.00)	158	
21	Card_1377.superInteresting	Card_1377.superInteresting	158.00;SAVINGS COST(158.00)	158	
22	Card_1335	Card_1335	158.00;SAVINGS COST(158.00)	158	
23	Card_2050	Card_2050	158.00;CYCLE LIFE(158.00)	158	
24	Card_2467.superInteresting	Card_2467.superInteresting	158.00;CYCLE LIFE(158.00)	158	
25	Card_1467	Card_1467	158.00;SAVINGS COST(158.00)	158	
26	Card_1150	Card_1150	158.00;SAVINGS COST(158.00)	158	
27	Card_2481	Card_2481	158.00;CYCLE LIFE(158.00)	158	
28	Card_1232	Card_1232	158.00;SAVINGS COST(158.00)	158	
29	Card_1764	Card_1764	158.00;SAVINGS COST(158.00)	158	
30	Card_1555	Card_1555	158.00;SAVINGS COST(158.00)	158	
31	Card_1305	Card_1305	158.00;SAVINGS COST(158.00)	158	
32	Card_2392	Card_2392	158.00;SAVINGS COST(158.00)	158	
33	Card_1769	Card_1769	158.00;SAVINGS COST(158.00)	158	
34	Card_1538	Card_1538	158.00;SAVINGS COST(158.00)	158	
35	Card_2458	Card_2458	158.00;CYCLE LIFE(158.00)	158	
36	Card_963	Card_963	158.00;SAVINGS COST(158.00)	158	
37	Card_929	Card_929	158.00;SAVINGS COST(158.00)	158	
38	Card_1763	Card_1763	158.00;SAVINGS COST(158.00)	158	

Figure 23. A Match Matrix for the *biiMMOWGLI* Game Round 2 Cards Matched With the OSA Strategy Document Using Emerging Word Pairs

Figure 24. LLA Search Results for "Cycle Life"

In Figure 23, clicking on the link on "cost savings" reveals the LLA search results shown in Figure 25, and identifies the ideas cards and the OSA Strategy containing the word pair "cost savings". In this instance, the idea cards enrich the concept "cost savings" in the OSA strategy with related concepts such as "cost

influence, incentive plans (card 1232), evaluation criteria, CPARS review, future RFPS(card 1601), source selection(card 1467), actual cost, FOSS software, software licenses, contract execution (card 1484), program funds, cost realized, expanded funds (card 1495), etc.

Figure 25. LLA Search Results for "Savings Cost"

In Figure 26, clicking the link “data models” reveals the LLA search results shown in Figure 27 and identifies the cards and the OSA strategy containing the word pair “data models”. These idea cards enrich the concept “data models” in the OSA strategy with related concepts such as “develops subsystems,” “open data” (card 959), “achieve interoperability” (card 1854), “interoperable data ,” “monolithic data” (card 1757), “exist models,” and “data streams” (card 1626).

Lexical Links Updated on Fri Aug 30 10:13:57 2013 Using 'Anomaly' Word Pairs

Id	MMOWGLI_ideas(Online)	MMOWGLI_ideas	OSABrochure-2013reduced.pdf	Total Row LLA Score	More Links
1	Card_1856	Card_1856	87.00;SYSTEMATIC REUSE(87.00)	87	
2	Card_1291	Card_1291	80.00;DEFENSE ACQUISITION(80.00)	80	
3	Card_1967	Card_1967	80.00;ACQUISITION OSA(80.00)	80	
4	Card_1087	Card_1087	76.00;MEANINGFUL METRICS(76.00)	76	
5	Card_1554	Card_1554	76.00;METRICS OSA(76.00)	76	
6	Card_2139	Card_2139	71.00;PEER REVIEW(71.00)	71	
7	Card_2130	Card_2130	71.00;PEER REVIEW(71.00)	71	
8	Card_1491	Card_1491	71.00;PEER REVIEW(71.00)	71	
9	Card_2063	Card_2063	66.00;EXERCISE DATA(66.00)	66	
10	Card_1757	Card_1757	66.00;MODELS DATA(66.00)	66	
11	Card_1626	Card_1626	66.00;MODELS DATA(66.00)	66	
12	Card_1854	Card_1854	66.00;MODELS DATA(66.00)	66	
13	Card_959	Card_959	66.00;MODELS DATA(66.00)	66	
14	Card_1438	Card_1438	64.00;MANAGEMENT PROGRAM(64.00)	64	
15	Card_1107	Card_1107	58.00;ENGINEERING SYSTEM(58.00)	58	
16	Card_1065	Card_1065	31.00;LINES PRODUCT(31.00)	31	
17	Card_1060	Card_1060	31.00;LINES PRODUCT(31.00)	31	
18	Card_1061	Card_1061	31.00;LINES PRODUCT(31.00)	31	

Figure 26. A Match Matrix for the biiMMOWGLI Game Round 2 Cards Matched With the OSA Strategy Document Using ‘Anomaly’ Word Pairs

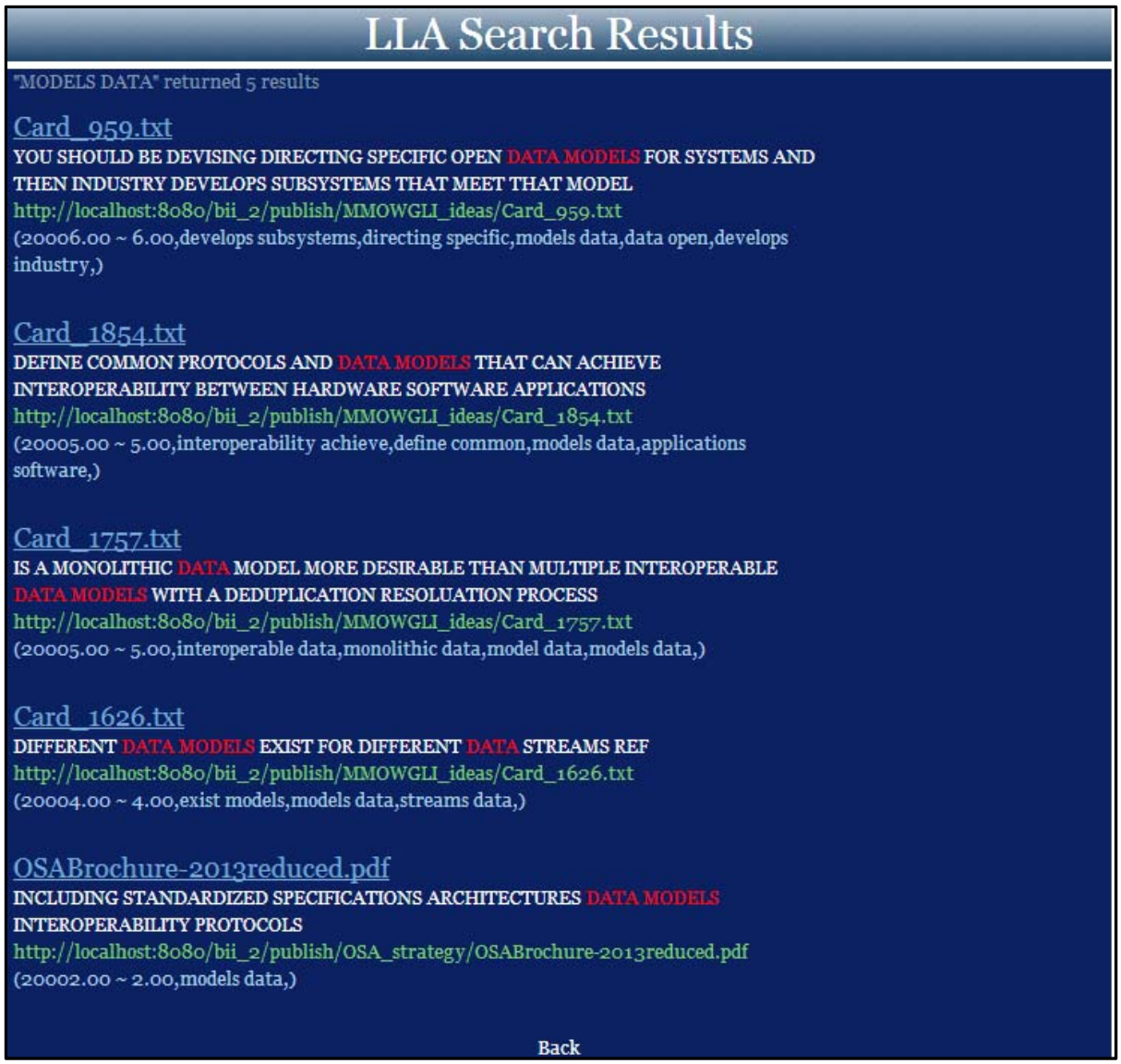


Figure 27. LLA Search Results for "Models Data"

We show here that a match matrix from LLA sorts out the most interesting idea cards that match the business processes such as the ones documented in the OSA strategy document in the *biiMMOWGLI* game. LLA provides drill-down and search capabilities to show how the concepts and ideas are presented in the original context and how related ideas enrich the ones in the links.

The linked and enriched concepts can be used as the bases to apply the collective intelligence generated from the brainstorming MMOWGLI game data to improve the existing business processes. For example, some of these concepts were included in the action plans: incentive (actions 15 and 16 about rewards and action plan 21 about profitability), life cycle and cost savings (action 28, action 21 profitability), and OSA acquisition (action 29).

The idea cards data also suggests that there could be additional topics for in-depth discussions which were not included in the current action plans. Examples include the following:

- Open standards and data models;
- Meaningful metrics, OSA metrics and program metrics; and
- Consolidated product lines based on open standards, TRF level and TRF attributes

Conclusions

We demonstrated the use of the MMOWGLI social media brainstorming platform and LLA as a combined collective intelligence platform to gather consensus. We identified new concepts reflected in the LLA word pairs that can be linked to critical variables and elements in these business processes (bii).

We used match matrices for each individual theme found through LLA to identify word pairs and used these word pairs to identify opportunities in the current processes. For example, we found that the great majority of Navy programs are affected by (or even critically dependent on) energy issues, but showed that goals and even terms are handled inconsistently. Without imposing significant operational burdens and vulnerabilities, innovative “energy efficiency” ideas from the social media game might be quickly and naturally implemented into the current processes that drive force structures, combat operations, logistics, and acquisition decisions. We identified these gaps and opportunities, which are listed Appendix A.

LLA sorts and prioritizes idea cards that might be good candidates to engage MMOWGLI action plans. For example, in the *biiMMOWGLI* game, themes discovered using LLA should be used in future MMOWGLI games to guide the action plans. As shown in Figure 28, the themes are sorted according to their relevance to the OSA strategy document: relevance defined as the percentage of the number of word pairs in the OSA strategy over the total number of word pairs (e.g. 12/71=16.9% in the first row). The last column in Figure 28 shows if the current action plans in the bii game cover a theme. As seen, some themes are covered; however, many themes can be discussion topics for future action plans or can be the basis of seed questions for future games.

Also in Figure 28, the themes with higher relevance to OSA strategy indicate consensus between the thoughts of the acquisition community and current OSA strategy. Conversely, the themes with lower relevance to OSA strategy indicate gaps between the thoughts of the acquisition community and current OSA strategy. The gap areas were discussed more in the current game than the consensus areas. Figure 28 can be used to improve the future game or OSA strategy.

We demonstrated that MMOWGLI together with LLA can be used as an important tool throughout the longer lifecycle of the acquisition process to incorporate collective intelligence from the brainstorming social media such *energyMMOWGLI* and *biiMMOWGLI* games into improve DoD acquisition processes.

Theme Id	All Sources	MMOWGLI_ideas	OSA_strategy	Theme Keywords	Overlap	Relevance to OSA Strategy	Relevance to Action Plans
185(A)	71	58	12	REVIEW,ACQ,PROCESSES	1	16.9%	No
174(A)	87	76	9	QUALITY,COMPONENT,HIGHER	2	10.3%	No
135(P)	194	170	20	OSA,CHANGE,PERSONNEL	4	10.3%	No
7(A)	80	69	8	ACQUISITION,TESTING,FULL	3	10.0%	Yes (action 29)
68(E)	157	138	15	DEVELOPMENT,SOFTWARE,DESIGN	4	9.6%	No
211(A)	76	67	7	METRICS,STANDARD,SIMILAR	2	9.2%	No
61(A)	66	57	6	DATA,PROPRIETARY,MODELS	3	9.1%	No
78(E)	111	100	10	ENTERPRISE,MONEY,ENABLE	1	9.0%	No
103(E)	175	160	15	MULTIPLE,INCENTIVES,FUNDING	0	8.6%	Yes (action 15,16 &26)
198(P)	202	181	15	SYSTEM,SYSTEMS,OPEN	6	7.4%	No
186(E)	111	103	8	REWARD,LARGE,PROVIDE	0	7.2%	Yes (action 15,16 &26)
209(E)	106	97	7	DESIRED,PROJECT,VENDOR	2	6.6%	No
43(P)	281	261	18	EXISTING,FUTURE,INNOVATION	2	6.4%	No
38(E)	123	113	7	TECHNICAL,FRAMEWORK,FUNDS	3	5.7%	No
40(E)	143	135	7	COMMON,INFORMATION,PRIOR	1	4.9%	NO
104(E)	133	127	6	INDUSTRY,COMPONENTS,CURRENT	0	4.5%	No
98(E)	125	118	5	PERFORMANCE,NAVY,GOVERNMENT	2	4.0%	No
56(E)	158	145	5	COST,COSTS,LIFE	8	3.2%	Yes (action 28)
50(E)	130	126	4	CONTRACT,CONTRACTS,RFPS	0	3.1%	Yes (action 24)
29(E)	148	143	4	BUSINESS,MODEL,INCENTIVE	1	2.7%	Yes (action 26)
184(E)	117	115	2	REQUIREMENTS,SOURCE,INTERNAL	0	1.7%	No
75(A)	69	68	1	EARLY,UNIT,TESTS	0	1.4%	Yes (action 22)
102(A)	92	91	1	TECH,IDEA,PROPOSALS	0	1.1%	No
187(A)	93	92	1	REWARDS,VICE,MEASURE	0	1.1%	Yes (action 15,16 &26)
163(E)	112	109	1	RIGHTS,LICENSE,PROCESS	2	0.9%	Yes (action 18)
189(E)	181	180	1	IP,RISK,CONTRACTOR	0	0.6%	Yes (action 18)
133(A)	74	74	0	STRUCTURE,ORGANIZATIONAL,SUCCESS	0	0.0%	No
51(A)	68	68	0	PEOPLE,SOLUTIONS,CONTRACTING	0	0.0%	Yes (action 24)

Figure 28. Sorted Themes as Candidates for Action Plans

Recommendations for Future Work

Crowd sourcing can be used to provide meaningful feedback to current business processes in cross-cutting themes such as energy reduction and the efficiency of business innovation initiatives such as OSA strategy. In the future, we plan to build the MMOWGLI game infrastructure in tandem with the LLA computational structure to reduce manual labor and maximize analyst flexibility. We will continue to work on real datasets that spur meaningful analysis, and produce further data visualizations tuned to support focused analytic queries by players and decision makers. For example, we plan to optimize the following LLA and MMOWGLI integration process for a two-week future game:

- Step 1: Request the internal documents (e.g., PE documents or a OSA strategy document) for a business process prior to the game for LLA in order to compare and generate match matrices.

- Step 2: Prepare the analysis from Monday to Wednesday in the first week, and deliver the mid-game report including initial LLA themes, images, graphs, and visualizations on Thursday night. Game Masters will assess whether the mid-game analysis appear helpful for the second week of the game. The improved and accelerated responses appear to produce incremental products that can accomplish the following:
    - Help game designers, masters, and players to view the overall effectiveness of a game: for example, how does a game correlate with an existing business process visually?
    - Help game designers design action plans from the LLA results
    - Help game players answer a query or seed question using the drill-down, search and link capabilities.
    - Help game moderators notice areas of activity with particularly high relevance using initial LLA graph images, LLA graph visualizations and analysis reports.

- Step 3: Generate the post-game report. We will focus on how to link the collected MMOWGLI game data to the business processes for the organizations involved, and build the concept and framework of the business process via reinforced learning.

We plan to design and conduct a new energy related MMOWGLI game in a two-week timeframe and incorporate the LLA analysis steps outlined previously. We also plan to incorporate the most current acquisition artifacts, for example, the congressional budget process documents and PEs from http://www.dtic.mil/descriptivesum. We also seek to measure the impacts of the game jointly with increased focus on key acquisition metrics such as cost, schedule, and performance to see if the collective intelligence enhanced through business process learning might be used to improve the current acquisition process. With the new game data, there can be new patterns of improvement. The improved awareness might be brought into the business process for a significant and visible improvement. The evidence can also be used as the measurement of the impact of the MMOWGLI game as our effort continues.
In addition, we see excellent potential in:

- Crowd sourcing to provide meaningful feedback on either cross-cutting themes (such as energy reduction/efficiency) or specific acquisition programs.

- Building the MMOWGLI game infrastructure in tandem with LLA computational structure to reduce manual labor and maximize analyst flexibility with each round
- Continuing work on real datasets that spurs meaningful (rather than toy or contrived) analysis, and produce further data visualizations tuned to support focused analytic queries by players and decision makers.
- Maintaining backwards compatibility among games to enable steady growth via the available corpus and products each year. This further enables longitudinal analysis and observability of trends and evolution over time.
- Stabilizing the data-model design of LLA computational products, which may enable future visualization improvements to be directly applied to past products
- Speedier production of LLA products which can influence fast-react game rounds or program changes as they proceed, rather than after the event. We want to reduce analysis cycles from weeks to days, and even to hours, approaching real time.
- Program-support brainstorming and collective intelligence experiments which should continue, both for proposed and current programs of record. Games, together with LLA, connecting the record of "what is reported being done" with "what do people think," all help normalize the use of concept terminology and also identify unsuspected applicability of new breakthrough capabilities.
- Overall progress and process improvements that may now be measured so that causes and effects of improvements in acquisition system cost-effectiveness and responsiveness are documented.
- Navy strategies for improving energy efficiency that needs to be handled consistently across programs. Terms of reference, metrics, opportunities all need to be addressed consciously and consistently.
- Following a series of deliberate experiments, long-term procedural improvements to the formal milestone acquisition process can be considered. For example:
    - Are program terms of reference consistent with Department-wide best practice?
    - Are all applicable energy reduction and energy efficiency techniques identified?

- Routine crowd sourcing as due diligence: subject-matter expert and public reviews (as appropriate) to accompany milestone decisions
- Has in-game or post-game analysis identified synergies among different programs that deserve further investigation?

The validation of LLA results have been validated by domain experts. For example, experts can visually examine the concepts extracted by LLA as shown in Appendix B.

In order to achieve these long time goals, it is important to continue validating the LLA method and integrating it with the crowd-sourcing MMOWGLI platform.

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Appendix A. Gaps and Opportunity Areas to Integrate the Innovative Concepts and Action Plans From the MMOWGLI Energy Game Into Current Navy Program Elements (PEs)

This appendix list the themes discovered by LLA and matches between *energyMMOWGLI* game action plans and Navy PEs. These are the opportunity areas for improving Navy energy efficiency.

Id	navy_2013(Online)	actions_10_0.73.txt	actions_18_0.71.txt	actions_26_1.44.txt	Total Row LLA Score
3	0603724N_4_PB_2013.pdf	SHIPBOARD SYSTEMS;SHIPBOARD EQUIPMENT	_	EXISTING FLEET	2100
5	0604777N_5_PB_2013.pdf	SHIPBOARD SYSTEMS	_	EXISTING FLEET	1400
6	0603512N_4_PB_2013.pdf	SHIPBOARD EQUIPMENT;SHIPBOARD SYSTEMS	_	_	1400
7	0205633N_7_PB_2013.pdf	_	SECONDARY POWER	_	1400
9	0604567N_5_PB_2013.pdf	SHIPBOARD SYSTEMS	_	SHIPBOARD SYSTEM	1400
12	0601153N_1_PB_2013.pdf	SHIPBOARD SYSTEMS	_	_	1400
15	0603581N_4_PB_2013.pdf	SHIPBOARD SYSTEMS	_	SHIPBOARD SYSTEM	1400
16	0603721N_4_PB_2013.pdf	SHIPBOARD SYSTEMS	_	_	1400
34	0604402N_7_PB_2013.pdf	SHIPBOARD SYSTEMS	_	_	700
41	0205620N_7_PB_2013.pdf	_	_	SHIPBOARD SYSTEM	700
43	0602123N_2_PB_2013.pdf	SHIPBOARD SYSTEMS	_	_	700
51	0603513N_4_PB_2013.pdf	_	_	SHIPBOARD SYSTEM	700
55	0603795N_4_PB_2013.pdf	_	_	SHIPBOARD SYSTEM	700
57	0603739N_4_PB_2013.pdf	SHIPBOARD EQUIPMENT	_	_	700

The match matrix for Theme 430 suggests that PEs mentioned the concepts “existing fleet”, “shipboard system(s)”, “shipboard equipment” and “secondary power” that might have the overall potential to engage action plan 10, 26 and 18.

- action plan 10: In this era of convergence reduce the number of shipboard systems and focus more on small computers with high capability (Android, iOS apps)
- action plan 26: Expand the use of nuclear power in the fleet and ashore
- action plan 18: Offshore basing.

Id	navy_2013(Online)	actions_10_0.73.txt	actions_11_0.76.txt	actions_17_1.08.txt	actions_18_0.71.txt	actions_22_0.63.txt	actions_28_0.86.txt	actions_34_1.00.txt	actions_35_0.82.txt	Total Row LLA Score
1	0603724N_4_PB_2013.pdf	_	ENERGY NAVY	_	ALTERNATIVE FUEL;GENERATION POWER;ALTERNATIVE ENERGY;RENEWABLE SOURCES	RENEWABLE ENERGY	_	COSTS ENERGY	ALTERNATIVE FUEL	23793
2	0603153N_1_PB_2013.pdf	_	ENERGY SYSTEMS	_	ALTERNATIVE FUEL;GENERATION POWER	RENEWABLE ENERGY	_	_	ALTERNATIVE FUEL	11330
3	0602123N_2_PB_2013.pdf	_	ENERGY SYSTEMS	_	GENERATION POWER;ALTERNATIVE ENERGY	_	_	_	_	10197
4	0602131M_2_PB_2013.pdf	_	_	_	ALTERNATIVE FUEL;GENERATION POWER	_	_	_	ALTERNATIVE FUEL	9064
5	0603573N_4_PB_2013.pdf	_	ENERGY NAVY	_	GENERATION POWER	_	_	_	_	9064
6	0206624M_7_PB_2013.pdf	_	ENERGY SYSTEMS	_	GENERATION POWER	RENEWABLE ENERGY	_	_	_	7931
7	0603640M_3_PB_2013.pdf	_	_	_	GENERATION POWER;RENEWABLE SOURCES	_	_	_	_	6798
8	0601152N_1_PB_2013.pdf	_	_	_	GENERATION POWER	_	_	_	_	4532
9	0604367N_5_PB_2013.pdf	_	_	_	GENERATION POWER	_	_	_	_	4532
10	0604274N_5_PB_2013.pdf	_	_	_	GENERATION POWER	_	_	_	_	4532
11	0603758N_3_PB_2013.pdf	_	_	_	GENERATION POWER	_	_	_	_	4532
12	0603238N_3_PB_2013.pdf	_	_	_	GENERATION POWER	_	_	_	_	4532
13	0604512N_5_PB_2013.pdf	_	_	_	_	_	_	_	_	2266
14	0206413M_7_PB_2013.pdf	_	_	_	_	RENEWABLE ENERGY	_	_	_	2266
15	0206313M_7_PB_2013.pdf	_	ENERGY SYSTEMS	_	_	_	_	_	_	2266
16	0603747N_2_PB_2013.pdf	_	_	_	_	KINETIC ENERGY	_	_	_	1133
17	0605013M_5_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
18	0203140N_7_PB_2013.pdf	MACHINE VIRTUAL	_	_	_	_	_	_	_	1133
19	0304785N_5_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
20	0604280N_5_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
21	0602271N_2_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
22	0603502N_4_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
23	0604378M_5_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
24	0604262N_5_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
25	0603237N_4_PB_2013.pdf	MACHINE VIRTUAL	_	_	_	_	_	_	_	1133
26	0605853N_6_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
27	0603611M_4_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
28	0604270N_5_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
29	0605873M_6_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
30	0206625M_7_PB_2013.pdf	_	_	STATION BASE	_	_	_	_	_	1133
31	0305231N_5_PB_2013.pdf	_	_	_	_	_	COSTS INFRASTRUCTURE	_	_	1133
32	0601153N_1_PB_2013.pdf	_	ENERGY SYSTEMS	_	_	_	_	_	_	1133
33	0605154N_6_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
34	0604800N_5_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
35	0604717M_7_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
36	0603635M_4_PB_2013.pdf	_	_	_	_	_	_	_	_	1133
37	0605812M_4_PB_2013.pdf	_	_	_	_	_	_	_	_	1133

The match matrix for Theme 393 suggests that the PEs with the concepts "Navy energy", "energy systems", "power generation", "alternative fuel", "alternative energy", "renewable sources" and "costs – energy/infrastructure" could be used good candidates to implement the innovative ideas related to action plans 11, 18, 22 and 35.

- action plan 11: Enhanced Education to Develop an Energy Efficient Fleet;
- action plan 18: Offshore basing
- action plan 22: Scaling the Small Solutions: Energy Recycling and Rethinking "The Big Fix."

Id	navy_2013(Online)	actions_10_0.73.txt	actions_12_0.52.txt	actions_15_0.50.txt	actions_22_0.63.txt	actions_25_0.88.txt	actions_26_1.44.txt	actions_32_0.50.txt	actions_4_0.76.txt	actions_5_0.56.txt	Total Row LLA Score
2	0604231N_5_PB_2013.pdf	_	_	EXPEDITIONARY NAVAL	ACTION ITEMS	_	STRIKE CARRIER	_	_	_	4320
3	0603724N_4_PB_2013.pdf	_	BOARD SHIP	_	_	_	STRIKE CARRIER	_	_	DASHBOARD ENERGY	3240
4	0206624M_7_PB_2013.pdf	_	_	_	OPERATING TIME	_	_	_	OPERATING TIME	_	2160
5	0603542N_4_PB_2013.pdf	_	BOARD SHIP	_	_	_	_	_	APPLICATION MILITARY	_	2160
8	0604311N_5_PB_2013.pdf	_	_	EXPEDITIONARY NAVAL	_	_	_	_	_	_	1080
9	0603512N_4_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080
10	0205633N_7_PB_2013.pdf	_	_	_	_	_	_	BOARD EQUIPMENT	_	_	1080
11	0603582N_4_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080
13	0602782N_2_PB_2013.pdf	_	_	_	_	OPERATING NETWORK	_	_	_	_	1080
14	0604280N_5_PB_2013.pdf	MULTIPLE HARDWARE	_	_	_	_	_	_	_	_	1080
15	0604234N_5_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080
16	0205658N_7_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080
17	0604216N_5_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080
18	0605152N_6_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080
19	0603261N_4_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080
20	0601153N_1_PB_2013.pdf	_	BOARD SHIP	_	_	_	_	_	_	_	1080
21	0602123N_2_PB_2013.pdf	_	BOARD SHIP	_	_	_	_	_	_	_	1080
22	0204152N_7_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080
23	0602750N_2_PB_2013.pdf	_	_	EXPEDITIONARY NAVAL	_	_	_	_	_	_	1080
24	0602131M_2_PB_2013.pdf	_	_	EXPEDITIONARY NAVAL	_	_	_	_	_	_	1080
25	0603581N_4_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080
26	0604230N_5_PB_2013.pdf	_	_	EXPEDITIONARY NAVAL	_	_	_	_	_	_	1080
27	0603640M_3_PB_2013.pdf	_	_	EXPEDITIONARY NAVAL	_	_	_	_	_	_	1080
28	0603235N_3_PB_2013.pdf	_	_	EXPEDITIONARY NAVAL	_	_	_	_	_	_	1080
29	0603755N_4_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080
30	0604212N_5_PB_2013.pdf	_	_	_	_	_	STRIKE CARRIER	_	_	_	1080

The match matrix for Theme 458 shows that the PEs mentioned "Naval expeditionary", "ship board" and "strike carrier," which can be good candidates to engage action plan 15 and 26.

- action 15: A global navy formed by an alliance of nation linked in real time. That way the nearest force will respond and reduce travel distances.
- action 26: Expand the use of nuclear power in the fleet.
- Related concepts include “multiple hardware,” “operating time,” and “dashboard energy”

Id	navy_2013(Online)	actions_18_0.71.txt	actions_19_0.33.txt	actions_20_1.14.txt	actions_26_1.44.txt	actions_31_1.10.txt	actions_35_0.82.txt	actions_4_0.76.txt	actions_7_0.51.txt	Total Row LLA Score
1	0603721N_4_PB_2013.pdf	_	TREATMENT WATER	SHIPS SURFACE	_	_	TREATMENT WATER	_	SHIPS SURFACE	7740
2	0603114N_3_PB_2013.pdf	_	_	SHIPS SURFACE	_	ENVIRONMENT OPERATIONAL	_	_	SHIPS SURFACE	5805
3	0604567N_5_PB_2013.pdf	_	_	SHIPS SURFACE	_	ENVIRONMENT OPERATIONAL	_	_	SHIPS SURFACE	5805
4	0602123N_2_PB_2013.pdf	UNMANNED SYSTEMS	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	5805
5	0603563N_4_PB_2013.pdf	_	_	SHIPS SURFACE	BUILT PURPOSE	_	_	_	SHIPS SURFACE	5805
6	0603573N_4_PB_2013.pdf	_	_	SHIPS SURFACE;AUXILIARY PROPULSION	_	_	_	_	SHIPS SURFACE	5805
7	0204229N_7_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
8	0603925N_4_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
9	0204228N_7_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
10	0602271N_2_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
11	0603502N_4_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
12	0204574N_7_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
13	0603261N_4_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	3870
14	0603542N_4_PB_2013.pdf	_	_	_	POWERED NUCLEAR;POWERED SHIPS	_	_	_	_	3870
15	0604518N_5_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
16	0604256N_6_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
17	0603123N_3_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
18	0603513N_4_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
19	0603860N_4_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
20	0603640M_3_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	3870
21	0604771N_5_PB_2013.pdf	_	_	_	_	_	_	_	_	3870
22	0604231N_5_PB_2013.pdf	_	_	SHIPS SURFACE	_	_	_	_	SHIPS SURFACE	3870
23	0602236N_2_PB_2013.pdf	_	TREATMENT WATER	_	_	_	TREATMENT WATER	_	_	3870
24	0602747N_2_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
25	0303140N_7_PB_2013.pdf	_	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	1935
26	0305160N_7_PB_2013.pdf	_	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	1935
27	0604756N_5_PB_2013.pdf	_	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	1935
28	0601152N_1_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
29	0206624M_7_PB_2013.pdf	_	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	1935
30	0604707N_4_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
31	0206623M_7_PB_2013.pdf	_	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	1935
32	0605853N_6_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
33	0204311N_7_PB_2013.pdf	_	_	_	POWERED NUCLEAR	_	_	_	_	1935
34	0204413N_7_PB_2013.pdf	_	_	_	_	_	_	POWERED SOLAR	_	1935
35	0603254N_4_PB_2013.pdf	_	_	_	POWERED NUCLEAR	_	_	_	_	1935
36	0605013N_5_PB_2013.pdf	_	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	1935
37	0601153N_1_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
38	0603782N_3_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
39	0305237N_7_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
40	0602750N_2_PB_2013.pdf	_	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	1935
41	0604404N_5_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
42	0603581N_4_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
43	0603758N_3_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
44	0604218N_5_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
45	0603561N_4_PB_2013.pdf	UNMANNED SYSTEMS	_	_	_	_	_	_	_	1935
46	0605863N_6_PB_2013.pdf	_	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	1935
47	0602435N_2_PB_2013.pdf	_	_	_	_	ENVIRONMENT OPERATIONAL	_	_	_	1935

The matrix for Theme 905 showed that the PEs involved “unmanned systems,” “surface ships,” “nuclear powered,”, “operational environment,” “water treatment,” which can be good candidates for engaging action plan 18, 19, 20,26, 31,35,4 and 7.

- action plan 18: Offshore basing
- action plan 19: Implement a self-sustaining support infrastructure on all Navy bases
- action plan 20: Sails on vessels, use sails that are foldable on the sides of vessels.
- action plan 26: Expand the use of nuclear power in the fleet and ashore
- action plan 31: Add “reducing energy consumption” to Battle E criteria

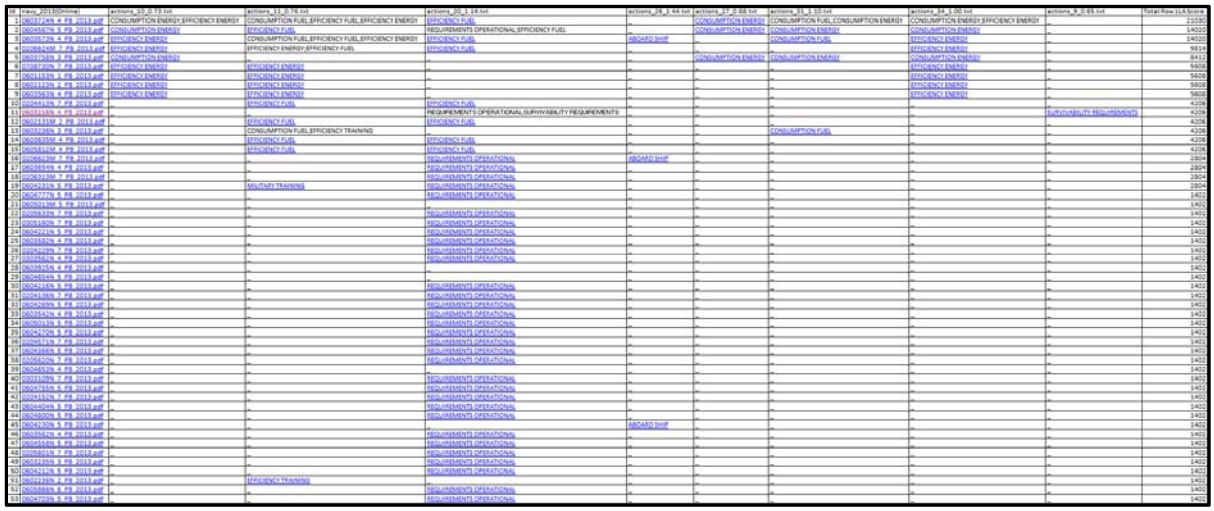
- action plan 35: Create 3D/verticle farms for use in growing biofuels, and crop for human consumption.
- action plan 4: Change small land vehicle transportation to hybrid vehicles in non-combat capacities.
- action plan 7: Install “sea brakes” that generate electricity, like a Prius. These could be used to aid in docking/slowing ships, and reduce need for tugs.

Id	navy_2013(Online)	actions_14_0.58.txt	actions_15_0.50.txt	actions_17_1.08.txt	actions_18_0.71.txt	actions_34_1.00.txt	actions_7_0.51.txt	Total Row LLA Score
1	0603114N_3_PB_2013.pdf	_	_	_	_	_	_	2912
2	0604307N_5_PB_2013.pdf	_	_	_	_	_	_	2912
3	0602271N_2_PB_2013.pdf	_	_	_	_	_	_	2912
4	0206623M_7_PB_2013.pdf	_	_	_	_	_	_	2912
5	0601153N_1_PB_2013.pdf	_	_	HARVESTING ENERGY	HARVESTING ENERGY	_	_	2912
6	0603724N_4_PB_2013.pdf	ADDITIONAL ENERGY	_	_	_	POTENTIAL ENERGY	_	2912
7	0603673N_3_PB_2013.pdf	_	_	HARVESTING ENERGY	HARVESTING ENERGY	_	_	2912
8	0603635M_4_PB_2013.pdf	_	_	_	_	_	_	2912
9	0603640M_3_PB_2013.pdf	_	FORCES GROUND	_	_	_	_	2912
10	0605812M_4_PB_2013.pdf	_	_	_	_	_	_	2912
11	0604501N_5_PB_2013.pdf	_	_	_	_	_	_	2912
12	0602236N_2_PB_2013.pdf	_	_	HARVESTING ENERGY	HARVESTING ENERGY	_	_	2912
13	0605013M_5_PB_2013.pdf	_	FORCES GROUND	_	_	_	_	1456
14	0303140N_7_PB_2013.pdf	_	_	_	_	_	_	1456
15	0604258N_6_PB_2013.pdf	_	_	_	_	_	_	1456
16	0602235N_2_PB_2013.pdf	_	_	_	_	_	_	1456
17	0603582N_4_PB_2013.pdf	_	_	_	_	_	_	1456
18	0604761N_5_PB_2013.pdf	_	_	_	_	_	_	1456
19	0605867N_6_PB_2013.pdf	_	_	_	_	_	_	1456
20	0604757N_5_PB_2013.pdf	_	_	_	_	_	_	1456
21	0205658N_7_PB_2013.pdf	_	_	_	_	_	_	1456
22	0206624M_7_PB_2013.pdf	_	_	_	_	_	_	1456
23	0101221N_7_PB_2013.pdf	_	_	_	_	_	_	1456
24	0603261N_4_PB_2013.pdf	_	_	_	_	_	_	1456
25	0204571N_7_PB_2013.pdf	_	_	_	_	_	_	1456
26	0604366N_5_PB_2013.pdf	_	_	_	_	_	_	1456
27	0205620N_7_PB_2013.pdf	_	_	_	_	_	_	1456
28	0303109N_7_PB_2013.pdf	_	_	_	_	_	_	1456
29	0602123N_2_PB_2013.pdf	_	_	_	_	_	HYDRODYNAMIC FORCES	1456
30	0603782N_3_PB_2013.pdf	_	_	_	_	_	_	1456
31	0604755N_5_PB_2013.pdf	_	_	_	_	_	_	1456
32	0206313M_7_PB_2013.pdf	_	FORCES GROUND	_	_	_	_	1456
33	0204152N_7_PB_2013.pdf	_	_	_	_	_	_	1456
34	0602750N_2_PB_2013.pdf	_	FORCES GROUND	_	_	_	_	1456
35	0602131M_2_PB_2013.pdf	_	FORCES GROUND	_	_	_	_	1456
36	0604404N_5_PB_2013.pdf	_	FORCES GROUND	_	_	_	_	1456
37	0702239N_7_PB_2013.pdf	_	_	_	_	_	_	1456
38	0604230N_5_PB_2013.pdf	_	_	_	_	_	_	1456
39	0603860N_4_PB_2013.pdf	_	_	_	_	_	_	1456
40	0602114N_2_PB_2013.pdf	_	_	_	_	_	_	1456
41	0603721N_4_PB_2013.pdf	_	_	_	_	_	_	1456
42	0604231N_5_PB_2013.pdf	_	_	_	_	_	_	1456
43	0603207N_4_PB_2013.pdf	_	_	_	_	_	_	1456
44	0603235N_3_PB_2013.pdf	_	_	_	_	_	_	1456
45	0603747N_3_PB_2013.pdf	_	_	_	_	_	_	1456
46	0804758N_6_PB_2013.pdf	_	_	_	_	_	_	1456

The match matrix for Theme 132 shows that the PEs mentioned “additional energy,” “ground forces” (e.g., PE 0602131M, PE 0603640M, PE 0206313M, PE 0602750N, PE 0605013M,PE 0604404N), “harvesting energy” (e.g., PE 0602236N: Warfighter Sustainment Applied Res; PE 0603673N:

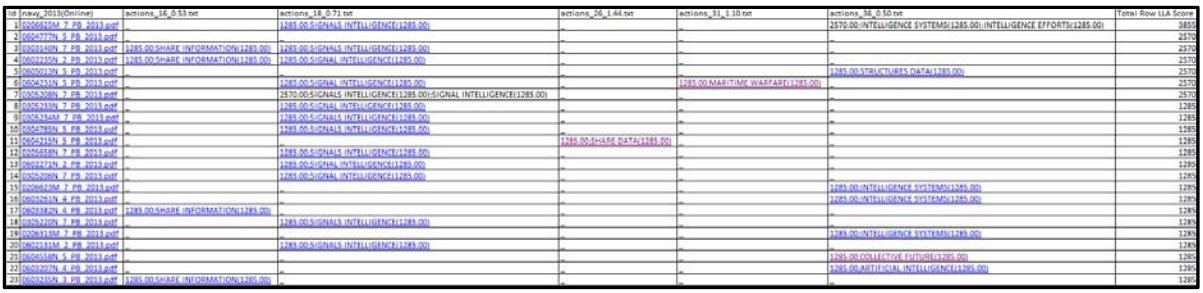
(U)Future Naval Capabilities Advanced Tech Dev; PE 0601153N: Defense Research Sciences; PE 0602123N: Force Protection Applied Res), “potential energy,” and “hydrodynamic forces,” which are good candidates to engage action plan 14,15,17,18,34 and 7

- action plan 14: Recycle everything biological into fuel.
- action plan 15: A global navy formed by an alliance of nation linked in real time. That way the nearest force will response and reduce travel distances.
- action plan 17: Energy harvesting satellites in outer space transmit energy to earth via microwave or laser beam.
- action plan 18: Create flotillas of ships and sea platforms as off shore bases in critical regions such as the South China Sea.
- action plan 34: Create an online system or suggestion card system for Navy personnel to input where they see energy savings in their job.
- action plan 7: Install "sea brakes," that generate electricity, like a Prius. These could be used to aid in docking/slowing ships and reduce the need for tugs.



The match matrix for Theme 787 suggests that “energy efficiency” and “fuel efficiency,” which can be viewed as “survivability requirements,” therefore, any PEs related to “survivability requirements” (e.g. PE 0603216N: Aviation Survivability) or “operational requirements” can be used to engage action plans 10, 11, 20, 27, 31, 34 and 9.

- action plan 9: Composite Ship Design: Explore the Use of Polymer Substrates for Improved Ship Structural Design
- action plan 10: In this era of convergence reduce the number of shipboard systems and focus more on small computers with high capability (Android, iOS apps)



Id	navy_2013(Online)	actions_16_0.53.txt	actions_18_0.71.txt	actions_26_1.44.txt	actions_31_1.10.txt	actions_36_0.50.txt	Total Row LLA Score
1	0206625M_7_PB_2013.pdf	_	1285.00:SIGNALS INTELLIGENCE(1285.00)	_	_	2570.00:INTELLIGENCE SYSTEMS(1285.00)\INTELLIGENCE EFFORTS(1285.00)	3855
2	0604777N_3_PB_2013.pdf	_	_	_	_	_	2570
3	0203140N_7_PB_2013.pdf	1285.00:SHARE INFORMATION(1285.00)	1285.00:SIGNALS INTELLIGENCE(1285.00)	_	_	_	2570
4	0602235N_2_PB_2013.pdf	1285.00:SHARE INFORMATION(1285.00)	1285.00:SIGNAL INTELLIGENCE(1285.00)	_	_	_	2570
5	0605013N_5_PB_2013.pdf	_	_	_	_	1285.00:STRUCTURES DATA(1285.00)	2570
6	0604331N_5_PB_2013.pdf	_	1285.00:SIGNAL INTELLIGENCE(1285.00)	_	1285.00:MARITIME WARFARE(1285.00)	_	2570
7	0305208N_7_PB_2013.pdf	_	2570.00:SIGNALS INTELLIGENCE(1285.00)\SIGNAL INTELLIGENCE(1285.00)	_	_	_	2570
8	0305219N_7_PB_2013.pdf	_	1285.00:SIGNAL INTELLIGENCE(1285.00)	_	_	_	1285
9	0305234M_7_PB_2013.pdf	_	1285.00:SIGNALS INTELLIGENCE(1285.00)	_	_	_	1285
10	0305785N_5_PB_2013.pdf	_	1285.00:SIGNALS INTELLIGENCE(1285.00)	_	_	_	1285
11	0604215N_5_PB_2013.pdf	_	_	1285.00:SHARE DATA(1285.00)	_	_	1285
12	0305658N_7_PB_2013.pdf	_	1285.00:SIGNALS INTELLIGENCE(1285.00)	_	_	_	1285
13	0602271N_2_PB_2013.pdf	_	1285.00:SIGNAL INTELLIGENCE(1285.00)	_	_	_	1285
14	0305206N_7_PB_2013.pdf	_	1285.00:SIGNAL INTELLIGENCE(1285.00)	_	_	_	1285
15	0206623M_7_PB_2013.pdf	_	_	_	_	1285.00:INTELLIGENCE SYSTEMS(1285.00)	1285
16	0605261N_4_PB_2013.pdf	_	_	_	_	1285.00:INTELLIGENCE SYSTEMS(1285.00)	1285
17	0603582N_4_PB_2013.pdf	1285.00:SHARE INFORMATION(1285.00)	_	_	_	_	1285
18	0305210N_7_PB_2013.pdf	_	1285.00:SIGNALS INTELLIGENCE(1285.00)	_	_	_	1285
19	0305613M_7_PB_2013.pdf	_	_	_	_	1285.00:INTELLIGENCE SYSTEMS(1285.00)	1285
20	0602131M_2_PB_2013.pdf	_	1285.00:SIGNALS INTELLIGENCE(1285.00)	_	_	_	1285
21	0604558N_5_PB_2013.pdf	_	_	_	_	1285.00:COLLECTIVE FUTURE(1285.00)	1285
22	0603207N_4_PB_2013.pdf	_	_	_	_	1285.00:ARTIFICIAL INTELLIGENCE(1285.00)	1285
23	0602235N_3_PB_2013.pdf	1285.00:SHARE INFORMATION(1285.00)	_	_	_	_	1285

The match matrix for Theme 494 shows that the PEs mentioned "shared information," "signal intelligence," "share data," "data structures," "intelligence systems," "artificial Intelligence," and "maritime warfare" might be good candidates to engage action plans 16, 18, 26, 31, and 36.

- action plan 16: Use synthetic lubricants to save 5 - 25% of energy costs
- action plan 18: Create flotillas of ships and sea platforms as off shore bases in critical regions such as the South China Sea
- Action plan 36: Become more efficient at structured, logical dialogue to find the solutions you seek

Id	navy_2013(Online)	actions_11_0.76.txt	actions_21_0.67.txt	actions_26_1.44.txt	actions_31_1.10.txt	actions_34_1.00.txt	actions_37_3.00.txt	actions_4_0.76.txt	Total Row LLA Score
1	0603542N_4_PB_2013.pdf	_	PLANTS POWER	_	_	_	PLANTS POWER	PLANTS POWER	3249
2	0603747N_3_PB_2013.pdf	TECH ADVANCED	_	GREATER EFFICIENCY	_	GREATER EFFICIENCY	_	_	3249
3	0206624M_7_PB_2013.pdf	_	_	GREATER EFFICIENCY	_	GREATER EFFICIENCY	_	_	2166
4	0604230N_5_PB_2013.pdf	_	_	GREATER EFFICIENCY	_	GREATER EFFICIENCY	_	_	2166
9	0605873M_6_PB_2013.pdf	_	_	_	_	_	_	_	1083
11	0206313M_7_PB_2013.pdf	_	_	_	_	_	_	_	1083
12	0603673N_3_PB_2013.pdf	TECH ADVANCED	_	_	_	_	_	_	1083
13	0603581N_4_PB_2013.pdf	_	_	_	PERIODS EXTENDED	_	_	_	1083
14	0204202N_5_PB_2013.pdf	_	_	_	_	_	_	_	1083
15	0604231N_5_PB_2013.pdf	_	_	_	_	_	_	_	1083
16	0603207N_4_PB_2013.pdf	_	_	_	PERIODS EXTENDED	_	_	_	1083

The match matrix for Theme 633 suggests that the PEs mentioned "advanced tech" (e.g. PE 0603673N: (U)Future Naval Capabilities Advanced Tech Dev), "greater efficiency" (e.g. PE 0603747N: Undersea Warfare Advanced Tech) and "power plants," which can be good candidates to engage action plans11, 21, and 4.

- action plan 11: Enhanced Education to Develop an Energy Efficient Fleet
- action plan 21: DOD Shore Facility Energy Independence: Explore use of Thorium-Based Reactors (LFTR-Liquid Flouride Thorium Reactor) for power generation off the grid.
- action plan 4: Change small land vehicle transportation to hybrid vehicles in non-combat capacities.

Id	navy_2013(Online)	actions_17_1.08.txt	actions_18_0.71.txt	actions_19_0.33.txt	actions_27_0.88.txt	actions_35_0.82.txt	actions_4_0.76.txt	actions_5_0.56.txt	Total Row LLA Score
1	0601153N_1_PB_2013.pdf	_	_	NATIONAL SECURITY	CYBER SECURITY	_	NATIONAL SECURITY	POSTGRADUATE SCHOOL;POSTGRADUATE NAVAL	6774
2	0303140N_2_PB_2013.pdf	SECURITY PROVIDE	SECURITY PROVIDE	NATIONAL SECURITY	CYBER SECURITY	_	NATIONAL SECURITY	_	5645
3	0602235N_2_PB_2013.pdf	SECURITY PROVIDE;SECURITY OPERATIONAL;MISSILE DEFENSE	SECURITY PROVIDE;SECURITY OPERATIONAL	_	_	_	_	_	5645
4	0604707N_4_PB_2013.pdf	MISSILE DEFENSE	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	POSTGRADUATE SCHOOL;POSTGRADUATE NAVAL	5645
5	0605853N_5_PB_2013.pdf	MISSILE DEFENSE	REGIONS CRITICAL	NATIONAL SECURITY	CYBER SECURITY	_	NATIONAL SECURITY	_	5645
6	0603229N_3_PB_2013.pdf	SECURITY PROVIDE;SECURITY OPERATIONAL;MISSILE DEFENSE	SECURITY PROVIDE;SECURITY OPERATIONAL	_	_	_	_	_	5645
7	0205604N_2_PB_2013.pdf	DEFENSE SYSTEM;MISSILE DEFENSE	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	4516
8	0603382N_4_PB_2013.pdf	DEFENSE SYSTEM;MISSILE DEFENSE	_	_	_	_	_	POSTGRADUATE SCHOOL;POSTGRADUATE NAVAL	4516
9	0204571N_7_PB_2013.pdf	SECURITY OPERATIONAL	SECURITY OPERATIONAL	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	4516
10	0605560N_5_PB_2013.pdf	SECURITY OPERATIONAL	SECURITY OPERATIONAL	_	_	_	_	POSTGRADUATE SCHOOL;POSTGRADUATE NAVAL	4516
11	0206313M_7_PB_2013.pdf	DEFENSE SYSTEM;MISSILE DEFENSE	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	4516
12	0602750N_2_PB_2013.pdf	SECURITY OPERATIONAL;MISSILE DEFENSE	SECURITY OPERATIONAL	SECURITY ENERGY	_	_	_	_	4516
13	0603727N_4_PB_2013.pdf	_	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	POSTGRADUATE SCHOOL;POSTGRADUATE NAVAL	4516
14	0603505N_4_PB_2013.pdf	DEFENSE SYSTEM;MISSILE DEFENSE	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	4516
15	0604124N_5_PB_2013.pdf	MISSILE DEFENSE	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	3387
16	0605152N_6_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	POSTGRADUATE SCHOOL;POSTGRADUATE NAVAL	3387
17	0303109N_7_PB_2013.pdf	MISSILE DEFENSE	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	3387
18	0601102N_1_PB_2013.pdf	_	ACADEMIES NATIONAL	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	3387
19	0603673N_3_PB_2013.pdf	SECURITY OPERATIONAL;MISSILE DEFENSE	SECURITY OPERATIONAL	_	_	_	_	_	3387
20	0604231N_5_PB_2013.pdf	DEFENSE SYSTEM	_	_	_	_	_	POSTGRADUATE SCHOOL;POSTGRADUATE NAVAL	3387
21	0604777N_5_PB_2013.pdf	_	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	2258
22	0605013M_5_PB_2013.pdf	_	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	2258
23	0603582N_4_PB_2013.pdf	DEFENSE SYSTEM;MISSILE DEFENSE	_	_	_	_	_	_	2258
24	0604215N_5_PB_2013.pdf	_	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	2258
25	0604756N_5_PB_2013.pdf	DEFENSE SYSTEM;MISSILE DEFENSE	_	_	_	_	_	_	2258
26	0604280N_5_PB_2013.pdf	_	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	2258
27	0601152N_1_PB_2013.pdf	_	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	2258
28	0604366N_5_PB_2013.pdf	MISSILE DEFENSE	_	_	_	FACILITY PRODUCTION	_	_	2258
29	0206625M_7_PB_2013.pdf	_	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	2258
30	0602123N_2_PB_2013.pdf	MISSILE DEFENSE	_	SECURITY ENERGY	_	_	_	_	2258
31	0304231N_5_PB_2013.pdf	_	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	2258
32	0304270N_4_PB_2013.pdf	_	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	2258
33	0602131M_2_PB_2013.pdf	DEFENSE SYSTEM	_	_	_	_	_	_	2258
34	0604727N_5_PB_2013.pdf	_	_	NATIONAL SECURITY	_	_	NATIONAL SECURITY	_	2258
35	0603573N_6_PB_2013.pdf	MISSILE DEFENSE	_	SECURITY ENERGY	_	_	_	_	2258
36	0605866N_6_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	2258
37	0308601N_7_PB_2013.pdf	_	_	_	_	_	_	POSTGRADUATE SCHOOL;POSTGRADUATE NAVAL	2258
38	0304785N_5_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
39	0605867N_6_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
40	0603114N_3_PB_2013.pdf	_	_	_	CYBER SECURITY	_	_	_	1129
41	0604307N_5_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
42	0604757N_5_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
43	0205658N_7_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
44	0204228N_7_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
45	0602273N_2_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
46	0206624M_7_PB_2013.pdf	_	_	SECURITY ENERGY	_	_	_	_	1129
47	0305161N_7_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
48	0604567N_5_PB_2013.pdf	_	_	SECURITY ENERGY	_	_	_	_	1129
49	0603790N_4_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
50	0603564N_4_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
51	0604755N_5_PB_2013.pdf	DEFENSE SYSTEM	_	_	_	_	_	_	1129
52	0605126N_6_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
53	0204152N_7_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
54	0603724N_4_PB_2013.pdf	_	_	SECURITY ENERGY	_	_	_	_	1129
55	0605864N_6_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
56	0604256N_6_PB_2013.pdf	DEFENSE SYSTEM	_	_	_	_	_	_	1129
57	0603123N_3_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
58	0603277N_3_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
59	0604771N_5_PB_2013.pdf	_	_	_	_	_	_	POSTGRADUATE NAVAL	1129
60	0603207N_4_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
61	0603755N_4_PB_2013.pdf	DEFENSE SYSTEM	_	_	_	_	_	_	1129
62	0604509N_5_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
63	0603729N_4_PB_2013.pdf	_	_	_	_	_	_	_	1129
64	0604378N_5_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129
65	0604758N_6_PB_2013.pdf	MISSILE DEFENSE	_	_	_	_	_	_	1129

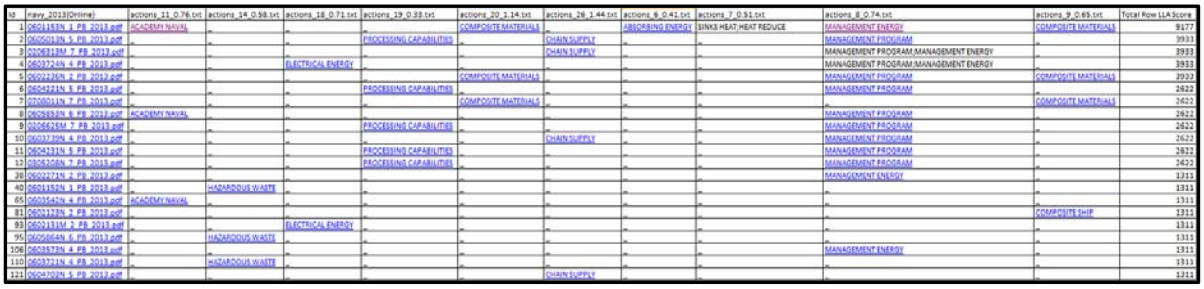
The match matrix for Theme 326 suggests that the PEs mentioned “energy security,” “missile defense,” “operational security,” “cyber security,” “national security,” and “naval postgraduate school,” which might be good candidates to engage action plans 17, 19, 4, 27, 4, 35, and 5.

- action plan 17: Energy harvesting satellites / Space based solar power.
- action plan 19: Implement self-sustaining support infrastructure on all Navy bases.
- action plan 4: Change small land vehicle transportation to hybrid vehicles in non-combat capacity.

Id	navy_2013(Online)	actions_16_0.53.txt	actions_18_0.71.txt	actions_21_0.67.txt	actions_25_0.88.txt	actions_26_1.44.txt	actions_31_1.10.txt	actions_34_1.00.txt	actions_9_0.65.txt	Total Row LLA Score
1	0603542N_4_PB_2013.pdf	_	NUCLEAR POWER	NUCLEAR POWER	_	NUCLEAR FLEET;NUCLEAR POWER;NUCLEAR NAVAL	_	_	_	3615
2	0603570N_4_PB_2013.pdf	_	NUCLEAR POWER	NUCLEAR POWER	_	NUCLEAR POWER;NUCLEAR TECHNOLOGY	_	_	_	2892
3	0205675N_7_PB_2013.pdf	_	NUCLEAR POWER	NUCLEAR POWER	_	NUCLEAR POWER	_	_	_	2169
4	0206313M_7_PB_2013.pdf	LOGISTICS SYSTEMS	_	_	STANDARDS COMMON	_	LOGISTICS MANAGEMENT	_	_	2169
5	0605013N_5_PB_2013.pdf	LOGISTICS SYSTEMS	_	_	_	_	LOGISTICS MANAGEMENT	_	_	1446
6	0702239N_7_PB_2013.pdf	_	_	_	_	_	LOGISTICS MANAGEMENT	STANDARDS DEVELOPMENT	_	1446
7	0604231N_5_PB_2013.pdf	_	_	_	_	_	LOGISTICS MANAGEMENT	STANDARDS DATA	_	1446
8	0603512N_4_PB_2013.pdf	_	_	_	_	_	LOGISTICS MANAGEMENT	_	_	723
9	0604215N_5_PB_2013.pdf	_	_	_	_	_	_	STANDARDS DEVELOPMENT	_	723
10	0604404N_5_PB_2013.pdf	_	_	_	_	_	LOGISTICS MANAGEMENT	_	_	723
11	0603513N_4_PB_2013.pdf	_	_	_	_	_	_	STANDARDS DEVELOPMENT	_	723
12	0603640M_3_PB_2013.pdf	_	_	_	_	_	_	_	_	723
13	0603561N_4_PB_2013.pdf	_	_	_	_	NUCLEAR TECHNOLOGY	_	_	_	723
14	0603235N_3_PB_2013.pdf	_	_	_	_	_	_	_	STANDARDS SAFETY	723

The match matrix for Theme 917 suggests that the PEs mentioned “nuclear power,” “nuclear technology,” “safety standards,” “logistics systems,” “logistics management,” “standards development/data,” and “common standards,” which might be good candidates to engage action plans 16, 18, 25, 26, 31,34 and 9.

- action plan 34: Create an online system or suggestion card system for Navy personnel to input where they see energy savings in their job



The match matrix for Theme 579 suggests that the PEs mentioned “energy management,” “composite materials,” “processing capabilities,” “supply chains,” “electrical energy,” “hazardous waste,” “energy absorbing,” “sinks heat,” “heat reduce,” and “naval academy,” which might be good candidates to engage action plans 8, 20, 26, and 9.

- action plan 8: Shore Energy Optimization Strategy--Recommendations for Improvements and Implementation.

The match matrix for Theme 854 suggests that PEs mentioned “turbine engine,” “diesel engine,” “energy sources,” “power sources,” and “greenhouse gas,” which might be good candidates to engage “behavior modification” related to action plans 27, 8, and 5.

- action plan 27: Upgrade Navy housing with SMART Grids to reduce energy consumption. By individualizing electricity/utility bills to single households, family users will be motivated to increase energy saving efforts
- action plan 5: Incentivize behavior to reduce electricity usage in Navy housing
- action plan 8: Update older buildings to be more energy efficient. The Navy is still using buildings that are almost a century old.

These PEs include, for example, PE 0603573N: Advanced Surface Machinery Sys, PE 0603724N: Navy Energy Program, PE 0205633N: Aviation Improvements, PE

0206623M: MC Ground Cmbt Spt Arms Sys, and PE 0605864N: Test & Evaluation Support.

Id	navy_2013(Online)	actions_11_0.76.txt	actions_18_0.71.txt	actions_21_0.67.txt	actions_23_0.67.txt	actions_24_0.54.txt	actions_26_1.44.txt	actions_27_0.88.txt	actions_7_0.51.txt	Total Row LLA Score
1	0602123N_2_PB_2013.pdf	WARSHIP ELECTRIC	_	_	MOBILE POWER	POWER MANAGEMENT	MOBILE POWER	_	SURFACE SHIP	3310
2	0603573N_4_PB_2013.pdf	_	_	SUPPLYING POWER	_	POWER MANAGEMENT	POWER SHIP	_	GENERATING POWER;SURFACE SHIP	3310
3	0206624M_7_PB_2013.pdf	_	_	_	MOBILE POWER	POWER MANAGEMENT	MOBILE POWER	_	_	1986
4	0603114N_3_PB_2013.pdf	_	STORE ENERGY	_	_	_	_	_	SURFACE SHIP	1324
5	0601153N_1_PB_2013.pdf	_	_	_	_	POWER MANAGEMENT	_	_	SURFACE SHIP	1324
6	0602131M_2_PB_2013.pdf	_	_	_	_	POWER MANAGEMENT	_	PEAK POWER	_	1324
7	0602114N_2_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	1324
8	0602236N_2_PB_2013.pdf	_	_	_	_	POWER MANAGEMENT	_	_	SURFACE SHIP	1324
9	0602747N_2_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
10	0604777N_5_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
11	0604258N_6_PB_2013.pdf	_	_	_	_	_	SURFACE FLEET	_	_	662
12	0602235N_2_PB_2013.pdf	_	_	_	_	_	_	PEAK POWER	_	662
13	0204229N_7_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
14	0602782N_2_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
15	0304785N_5_PB_2013.pdf	_	_	_	_	_	SURFACE FLEET	_	_	662
16	0603925N_4_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
17	0604756N_5_PB_2013.pdf	_	_	_	_	_	SURFACE FLEET	_	_	662
18	0604757N_5_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
19	0602271N_2_PB_2013.pdf	_	_	_	_	POWER MANAGEMENT	_	_	_	662
20	0601152N_1_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
21	0604707N_4_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
22	0605152N_6_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
23	0603506N_4_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
24	0603564N_4_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
25	0205620N_7_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
26	0605873M_6_PB_2013.pdf	CENTERS TRAINING	_	_	_	_	_	_	_	662
27	0603563N_4_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
28	0602750N_2_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
29	0603673N_3_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
30	0603581N_4_PB_2013.pdf	_	_	_	_	_	SURFACE FLEET	_	_	662
31	0603123N_3_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
32	0603562N_4_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
33	0604558N_5_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
34	0603236N_3_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
35	0603271N_3_PB_2013.pdf	_	_	_	_	POWER MANAGEMENT	_	_	_	662
36	0603640M_3_PB_2013.pdf	_	_	_	_	POWER MANAGEMENT	_	_	_	662
37	0605863N_6_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662
38	0602435N_2_PB_2013.pdf	_	_	_	WAVE OCEAN	_	_	_	_	662
39	0603747N_3_PB_2013.pdf	_	_	_	_	_	_	_	SURFACE SHIP	662

They might be good candidates to engage action plans that mention “mobile power,” “electric warship,” “training centers,” and “ocean wave.” These action plans include

The match matrix for Theme 732 suggests that the PEs mentioned “ship surface,” “fleet surface,” “power management,” “ship power,” “supplying power,” and “generating power.” These PEs include, for example,

- PE 0603563N: Ship Concept Advanced Design
- PE 0602123N: Force Protection Applied Res
- PE 0603573N: Advanced Surface Machinery Sys
- PE 0206624M: Marine Corps Cmbt Services Supt
  PE 0603114N: Power Projection Advanced Technology
- PE 0601153N: Defense Research Sciences
- PE 0602131M: Marine Corps Lndg Force Tech

They might be good candidates to engage action plans that mention “mobile power,” “electric warship,” “training centers,” and “ocean wave.” These action plans include action plans 23 and 11.

*action plan 23: Combine Global Homeporting with Localized Energy Generation Across the Globe.

*action plan 11: Enhanced Education to Develop an Energy Efficient Fleet and engage major universities to create a cross disciplinary curriculum for “energy design” in all fields for all forms of energy.

Id	navy_2013(Online)	actions_10_0.73.txt	actions_11_0.76.txt	actions_17_1.08.txt	actions_18_0.71.txt	actions_20_1.14.txt	actions_25_0.88.txt	actions_36_0.50.txt	actions_5_0.56.txt	Total Row LLA Score
1	0603724N_4_PB_2013.pdf	_	SAVING ENERGY	_	_	_	SAVING FUEL	_	SAVING ENERGY	3861
2	0602235N_2_PB_2013.pdf	_	MEDIA SOCIAL	MEDIA SOCIAL	_	_	_	_	_	2574
3	0603640M_3_PB_2013.pdf	_	_	_	PROJECTION POWER;PLATFORMS MARINE	_	_	_	_	2574
4	0604231N_5_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	RESOURCES INFORMATION	_	2574
5	0205604N_7_PB_2013.pdf	_	_	_	_	PLATFORMS EXISTING	_	_	_	1287
6	0204229N_7_PB_2013.pdf	_	_	_	_	PLATFORMS EXISTING	_	_	_	1287
7	0603114N_3_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
8	0601152N_1_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
9	0604567N_5_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
10	0605152N_6_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
11	0602651M_2_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
12	0602123N_2_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
13	0206313M_7_PB_2013.pdf	PLATFORMS HARDWARE	_	_	_	_	_	_	_	1287
14	0602750N_2_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
15	0603673N_3_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
16	0602131M_2_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
17	0603123N_3_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
18	0603573N_4_PB_2013.pdf	_	_	_	_	PLATFORMS EXISTING	_	_	_	1287
19	0602114N_2_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
20	0602236N_2_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287

The match matrix for Theme 449 suggests that the PEs mentioned “power projection,” which can be used to engage “social media” for “fuel/energy saving.”

- Action 11: Enhanced Education to Develop an Energy Efficient Fleet and engage major universities to create a cross disciplinary curriculum for “energy design” in all fields for all forms of energy.

Id	navy_2013(Online)	actions_10_0.73.txt	actions_18_0.71.txt	actions_22_0.63.txt	actions_24_0.54.txt	actions_25_0.88.txt	actions_26_1.44.txt	actions_34_1.00.txt	actions_5_0.56.txt	actions_6_0.41.txt	Total Row LLA Score
1	0603724N_4_PB_2013.pdf	_	SUPPLY FUEL	_	SUPPLY FUEL	OPERATIONS SHIP	OPERATIONS FLEET;SUPPLY FUEL	_	_	_	5490
2	0603573N_4_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	IRON BATH;IRON WORKS	_	_	CONSTRUCTION SHIP	4392
3	0204202N_5_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	IRON BATH;IRON WORKS	_	_	CONSTRUCTION SHIP	4392
4	0603721N_4_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	OPERATIONS FLEET	_	CONSTRUCTION MILITARY	CONSTRUCTION SHIP	4392
5	0603581N_4_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	KEEPING SEA	_	_	CONSTRUCTION SHIP	3294
6	0604777N_5_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	_	_	_	CONSTRUCTION SHIP	2196
7	0603512N_4_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	_	_	_	CONSTRUCTION SHIP	2196
8	0604567N_5_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	_	_	_	CONSTRUCTION SHIP	2196
9	0605853N_6_PB_2013.pdf	_	_	_	_	OPERATIONS SHIP	_	OPERATIONS RESEARCH	_	_	2196
10	0603564N_4_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	_	_	_	CONSTRUCTION SHIP	2196
11	0602123N_2_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	_	_	_	CONSTRUCTION SHIP	2196
12	0603561N_4_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	_	_	_	CONSTRUCTION SHIP	2196
13	0603725N_4_PB_2013.pdf	_	_	WORKS PUBLIC	_	_	_	_	CONSTRUCTION MILITARY	_	2196
14	0602235N_2_PB_2013.pdf	_	_	_	_	_	_	OPERATIONS RESEARCH	_	_	1098
15	0604262N_5_PB_2013.pdf	_	_	_	_	_	OPERATIONS FLEET	_	_	_	1098
16	0605152N_6_PB_2013.pdf	_	_	_	_	OPERATIONS SHIP	_	_	_	_	1098
17	0204571N_7_PB_2013.pdf	_	_	_	_	_	OPERATIONS FLEET	_	_	_	1098
18	0605873M_6_PB_2013.pdf	_	_	_	_	_	_	OPERATIONS RESEARCH	_	_	1098
19	0605154N_6_PB_2013.pdf	_	_	_	_	_	OPERATIONS FLEET	_	_	_	1098
20	0603236N_3_PB_2013.pdf	_	_	_	_	_	_	OPERATIONS RESEARCH	_	_	1098
21	0603739N_4_PB_2013.pdf	_	_	_	_	_	_	_	CONSTRUCTION MILITARY	_	1098
22	0205601N_7_PB_2013.pdf	_	_	_	_	_	_	_	CONSTRUCTION MILITARY	_	1098
23	0602435N_2_PB_2013.pdf	_	_	_	_	_	OPERATIONS FLEET	_	_	_	1098
24	0602236N_2_PB_2013.pdf	_	_	_	_	_	_	OPERATIONS RESEARCH	_	_	1098
25	0308601N_7_PB_2013.pdf	_	_	_	_	_	_	OPERATIONS RESEARCH	_	_	1098

The match matrix for Theme 682 suggests that the PEs mentioned “ship construction,” “ship operations,” “fleet operations,” “military construction,” “operations research,” which can be good candidates to engage action plans 10, 26 and 6.

- action plan 10: In this era of convergence reduce the number of shipboard systems and focus more on small computers with high capability (Android, iOS apps)
- action plan 26: Expand the use of nuclear power in the fleet and ashore

- action plan 6: Implement large umbrellas for ships to use shading to keep ships cooler and also use "carport" structures for ships docked on the pier

Id	navy_2013(Online)	actions_16_0.53.txt	actions_18_0.71.txt	actions_27_0.88.txt	actions_28_0.86.txt	actions_34_1.00.txt	actions_35_0.82.txt	Total Row LLA Score
2	0205633N_7_PB_2013.pdf	PART LIFE	SPARE PARTS	_	_	_	_	2130
3	0205604N_7_PB_2013.pdf	_	_	_	_	COMMUNICATION DATA	_	1065
4	0604280N_5_PB_2013.pdf	_	_	PROGRAMMABLE RADIO	_	_	_	1065
5	0604307N_5_PB_2013.pdf	PARTS REPLACEMENT	_	_	_	_	_	1065
6	0206624M_7_PB_2013.pdf	_	COMMUNICATION EQUIPMENT	_	_	_	_	1065
7	0605853N_6_PB_2013.pdf	_	_	GUIDANCE SUPPORTING	_	_	_	1065
8	0603542N_4_PB_2013.pdf	PARTS REPLACEMENT	_	_	_	_	_	1065
9	0206313M_7_PB_2013.pdf	_	_	_	_	COMMUNICATION DATA	_	1065
10	0602750N_2_PB_2013.pdf	_	_	_	_	_	URBAN ENVIRONMENTS	1065
11	0604503N_5_PB_2013.pdf	_	COMMUNICATION EQUIPMENT	_	_	_	_	1065
12	0604404N_5_PB_2013.pdf	_	_	_	WING AIR	_	_	1065
13	0603271N_3_PB_2013.pdf	PARTS REPLACEMENT	_	_	_	_	_	1065
14	0604231N_5_PB_2013.pdf	_	_	_	_	COMMUNICATION DATA	_	1065

The match matrix for Theme 257 suggests that the PEs mentioned “parts replacement,” “communication equipment,”, “air wing,” “communication data,” and “urban environments,” which might be good candidates for action plans 16, 18, 27,28, 34 and 35

- action plan 16: Use synthetic lubricants to save 5--25% of energy costs.
- action plan18: Offshore basing.
- action plan 27: Upgrade Navy housing with SMART Grids to reduce energy consumption. By individualizing electricity/utility bills to single households, family users will be motivated to increase energy saving efforts.
- action plan 28: Power on-board minor electronics with stationary bikes used for personnel fitness training
- action plan 34: Online Feedback & Social Networking
- action plan 35: 3D farming--Less land use and local agriculture reducing fuel use and potential location of bio-fuel crops.

Id	navy_2013(Online)	actions_10_0.73.txt	actions_11_0.76.txt	actions_16_0.53.txt	actions_23_0.63.txt	actions_24_0.54.txt	actions_26_1.44.txt	actions_28_0.86.txt	actions_34_1.00.txt	actions_35_0.82.txt	actions_4_0.76.txt	Total Row LLA Score
1	0603724N_6_PB_2013.pdf	SAVINGS ENERGY	SAVINGS ENERGY	SAVINGS FUEL	SAVINGS ENERGY	STORAGE ENERGY	854.00:SAVINGS ENERGY;CELL FUEL	_	SAVINGS ENERGY	_	1381.00:STORAGE SYSTEMS;SAVINGS FUEL;CELL FUEL	6405
2	0603640M_8_PB_2013.pdf	_	_	SAVINGS COST	_	STORAGE ENERGY	CELL FUEL	SAVINGS COST	SAVINGS COST	_	854.00:CELL TECHNOLOGIES;CELL FUEL	2989
3	0603729N_7_PB_2013.pdf	_	_	_	_	STORAGE ENERGY	854.00:CELL PROPULSION;CELL FUEL	_	_	_	CELL FUEL	1708
4	0603640N_7_PB_2013.pdf	_	_	SAVINGS COST	_	_	_	SAVINGS COST	SAVINGS COST	_	_	1281
5	0708011N_7_PB_2013.pdf	_	_	SAVINGS COST	_	_	_	SAVINGS COST	SAVINGS COST	_	_	1281
6	0206624M_7_PB_2013.pdf	_	_	ECONOMY FUEL	_	STORAGE ENERGY	_	_	_	STORAGE FACILITIES	_	1281
7	0204811N_7_PB_2013.pdf	_	_	SAVINGS COST	_	_	_	SAVINGS COST	SAVINGS COST	_	_	1281
8	0605013N_5_PB_2013.pdf	_	_	SAVINGS COST	_	_	_	SAVINGS COST	SAVINGS COST	_	_	1281
9	0603887N_6_PB_2013.pdf	_	_	SAVINGS COST	_	_	_	SAVINGS COST	SAVINGS COST	_	_	1281
10	0206625M_7_PB_2013.pdf	_	_	SAVINGS COST	_	_	_	SAVINGS COST	SAVINGS COST	_	_	1281
11	0603573N_6_PB_2013.pdf	_	_	SAVINGS FUEL	_	STORAGE ENERGY	_	_	_	_	SAVINGS FUEL	1281
12	0603739N_6_PB_2013.pdf	_	_	SAVINGS COST	_	_	_	SAVINGS COST	SAVINGS COST	_	_	1281
13	0603771N_6_PB_2013.pdf	_	_	SAVINGS COST	_	_	_	SAVINGS COST	SAVINGS COST	_	_	1281
14	0603561N_6_PB_2013.pdf	_	_	SAVINGS COST	_	_	_	SAVINGS COST	SAVINGS COST	_	_	1281
15	0604503N_5_PB_2013.pdf	_	_	SAVINGS COST	_	_	_	SAVINGS COST	SAVINGS COST	_	_	1281
16	0602235N_2_PB_2013.pdf	_	_	_	_	_	CELL FUEL	_	_	_	CELL FUEL	854
17	0604567N_5_PB_2013.pdf	_	_	SAVINGS FUEL	_	_	_	_	_	_	SAVINGS FUEL	854
18	0601153N_3_PB_2013.pdf	_	_	_	_	STORAGE ENERGY	_	_	_	CELL SOLAR	_	854
19	0602131M_2_PB_2013.pdf	_	_	_	_	_	CELL FUEL	_	_	_	CELL FUEL	854
20	0602236N_2_PB_2013.pdf	_	_	_	_	_	CELL FUEL	_	_	_	CELL FUEL	854
21	0605853N_6_PB_2013.pdf	_	EDUCATION PROGRAMS	_	_	_	_	_	_	_	_	427
22	0601758N_3_PB_2013.pdf	_	_	_	_	STORAGE ENERGY	_	_	_	_	_	427

The match matrix for Theme 198 suggests that the PEs mentioned “energy saving,” “fuel savings,” “cost savings,” “fuel cell,” “cell technologies,” “storage

energy," and "storage systems," which might be good candidates to engage action plans related to these concepts.

The matrices that resulted from this task will help design the specific questions to address the issues in a program-to-program basis to continue the *energyMMOWGLI* game with acquisition professionals on the acquisition research community in the future.

Appendix B. Visualizations for Themes Identified in *biiMMOWGLI* Game Round 2

This appendix lists sample themes in Figure 19. The red links represent the word pairs or concepts shared by the idea cards and the strategy book. The green links represent the word pairs unique to the strategy book. The yellow links represent the word pairs or concepts unique to the idea cards. Each theme is labeled using the words in the red nodes. Word pairs shared in both idea cards and the strategy are red links. Word pairs unique to the strategy book that are not discussed in the *biiMMOWGLI* game Round 2 are green links. Word pairs unique to the idea cards which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas are yellow links.

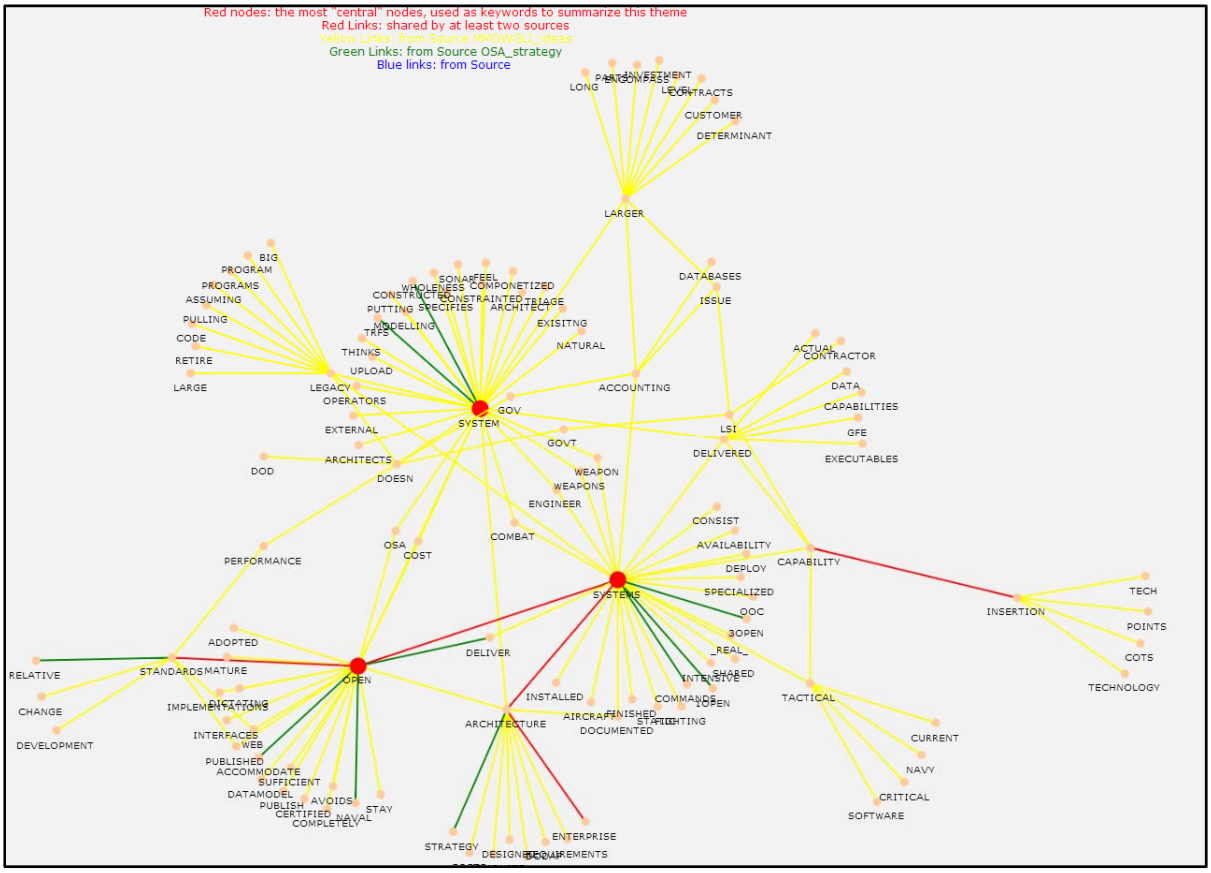


Figure B1. Theme Centered Around "Open, System, Systems"

In Figure B1 word pairs shared in both idea cards and the strategy (red links) include "open systems," "open standards," "enterprise architecture," and "insert capability." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "OOC systems," "TRFS

system," "constructed system," "relative standards," " Naval open," "accommodate open," "architecture strategy." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "combat system," "weapon(s) system," "accounting system," "systems availability," "legacy system," "technology insertion," "COTS insertion," etc.

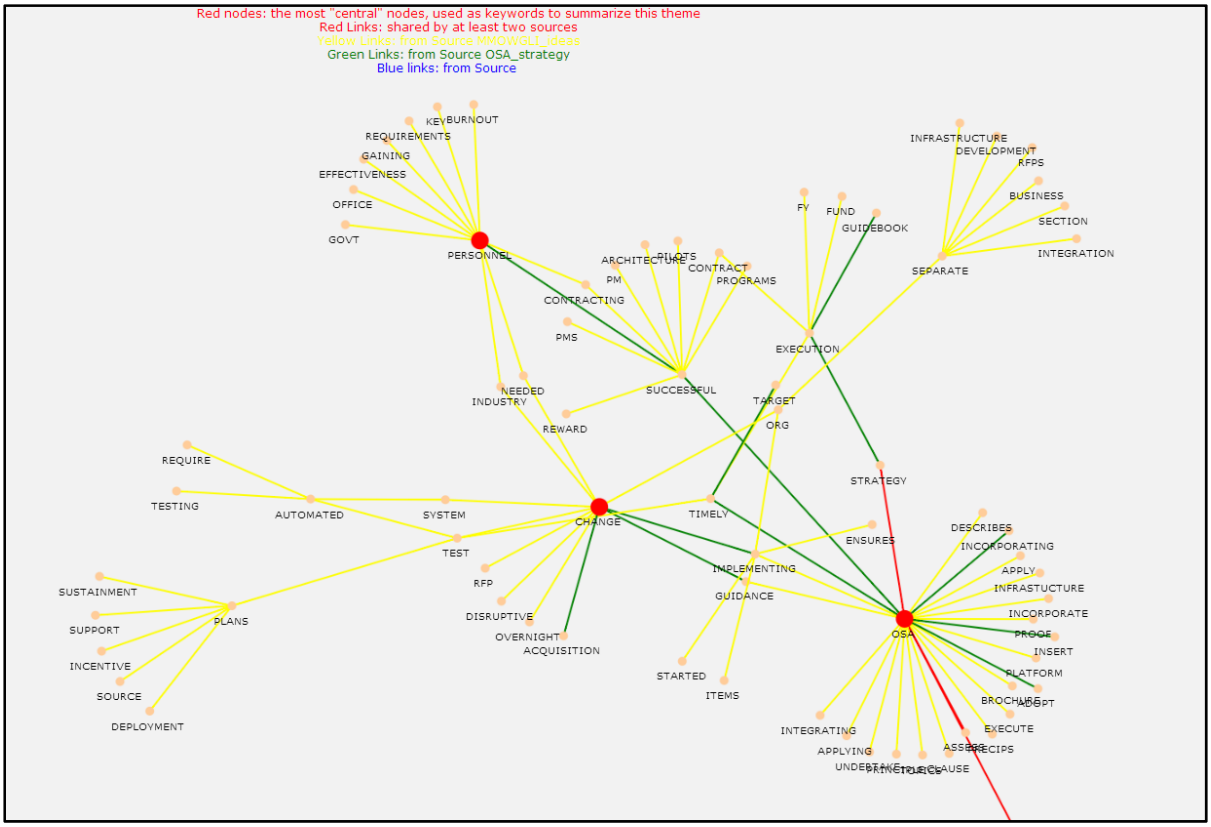


Figure B2. Theme Centered Around "Personnel, OSA, Change"

In Figure B2, word pairs shared in both idea cards and the strategy (red links) include "OSA strategy," "assess OSA," "OSA progress." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "Timely OSA," "timely target," "sponsors resource," "platform types," "strategy execution," "guidebook execution," "acquisition change," "successful personnel." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "OSA infrastructure," "OSA proof," "OSA platform," "disruptive change," "personnel burnout," "personnel requirements," and "personnel effectiveness," etc.

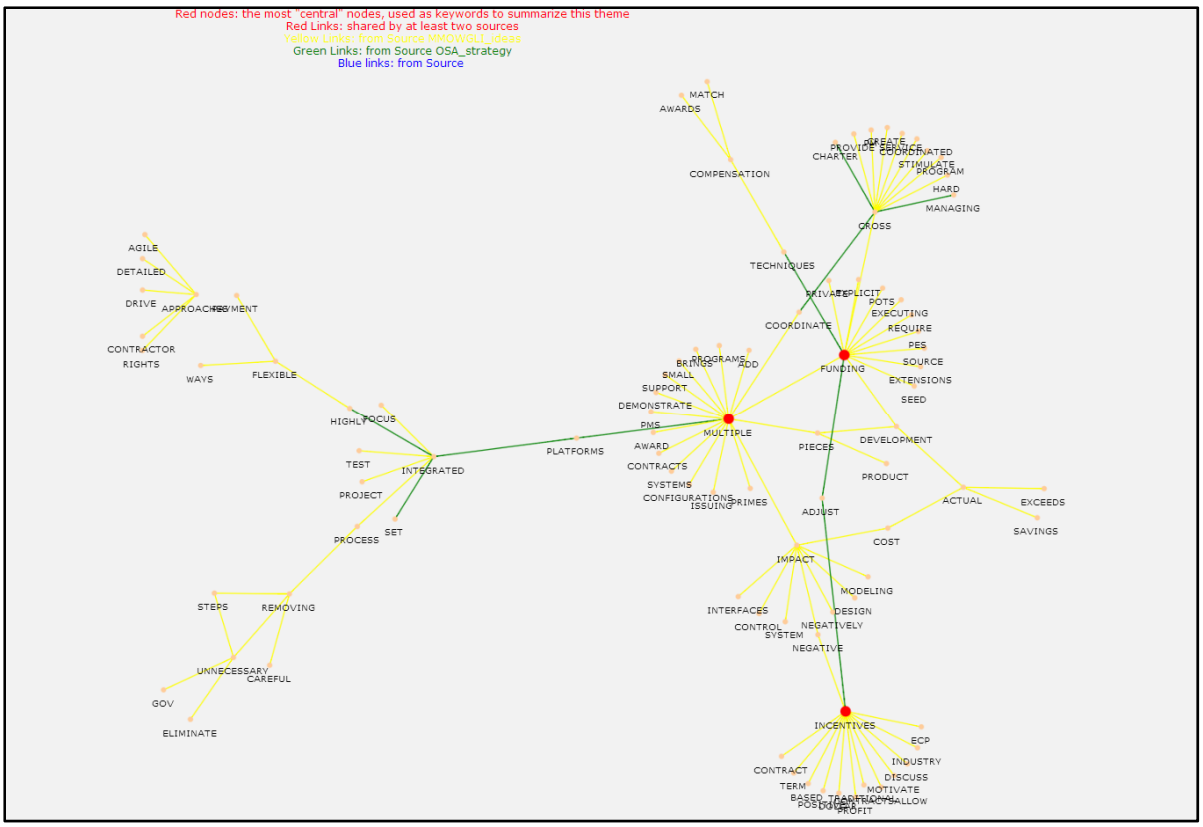
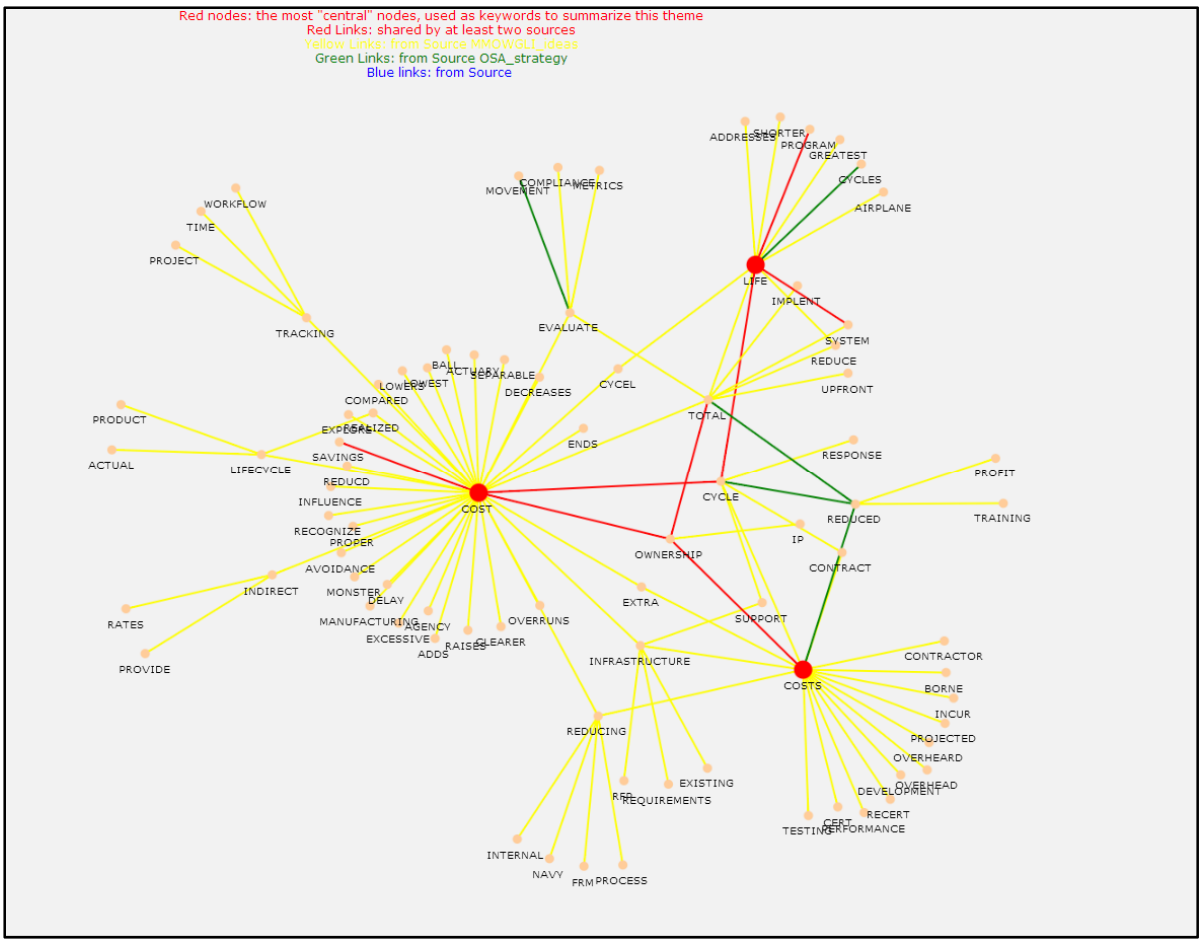
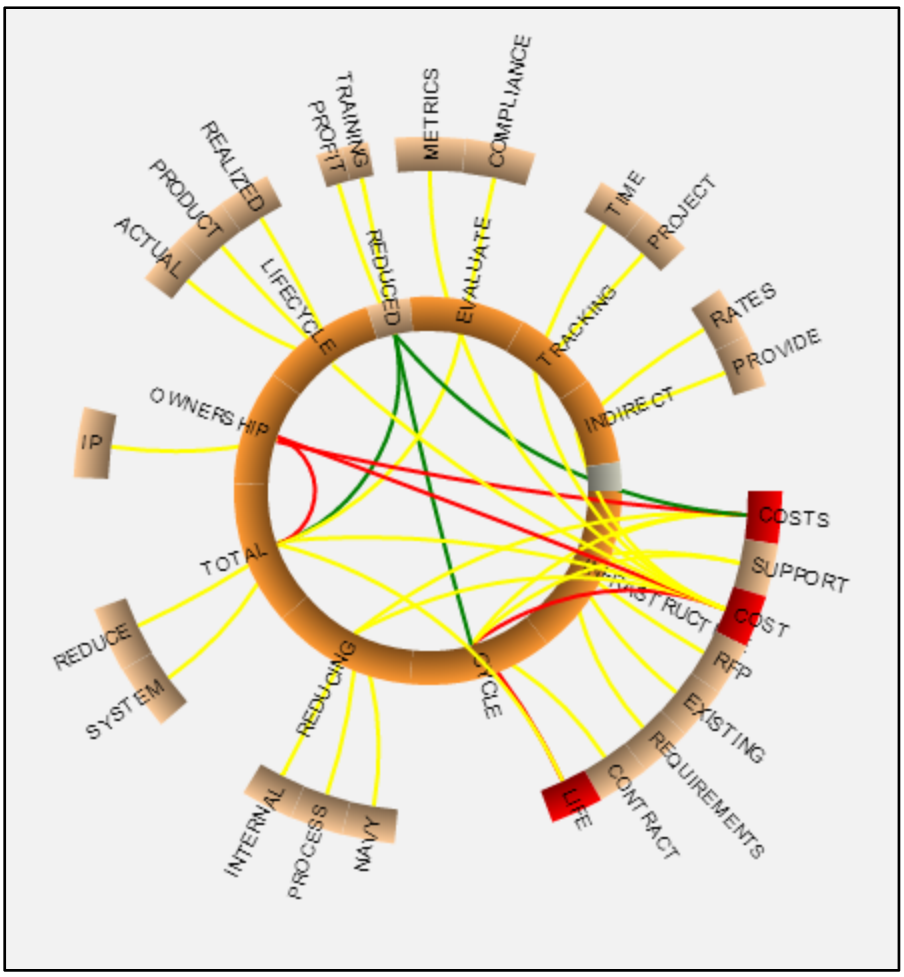


Figure B3. Theme Centered Around "Multiple Funding, Incentives"

In Figure B3, there are no word pairs shared in both idea cards and the strategy (red links). Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "adjust funding," "adjusting incentives," "integrated platform," "multiple platforms," "highly integrated." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "ECP incentives," " industry incentives," "discuss incentives," "motivate incentives," "contract incentives," "profit incentives," "incentives term," "positive/negative incentives," etc.


Red nodes: the most "central" nodes, used as keywords to summarize this theme
Red Links: shared by at least two sources
Yellow Links: from Source MMOWGLI_ideas
Green Links: from Source OSA_strategy
Blue links: from Source
ADDRESSES
SHORTER
PROGRAM
GREATEST
CYCLES
AIRPLANE
MOVEMENT
COMPLIANCE
METRICS
WORKFLOW
TIME
PROJECT
TRACKING
EVALUATE
LIFE
IMPLENT
SYSTEM
REDUCE
UPFRONT
BALL
ACTUARY
SEPARABLE
LOWEST
DECREASES
CYCEL
COMPARED
PRODUCT
EXPENSE
REALIZED
ACTUAL
LIFECYCLE
SAVINGS
REDUCD
INFLUENCE
COST
RECOGNIZE
PROPER
AVOIDANCE
INDIRECT
MONTER
DELAY
RATES
MANUFACTURING
AGENCY
EXCESSIVE
ADDS
RAISES
CLEARER
OVERRUNS
PROVIDE
TOTAL
ENDS
RESPONSE
PROFIT
CYCLE
REDUCED
TRAINING
IP
CONTRACT
OWNERSHIP
EXTRA
SUPPORT
INFRASTRUCTURE
CONTRACTOR
COSTS
BORNE
INCUR
PROJECTED
OVERHEARD
OVERHEAD
DEVELOPMENT
RECERT
CERT
PERFORMANCE
TESTING
REDUCING
EXISTING
REQUIREMENTS
INTERNAL
NAVY
FRM
PROCESS

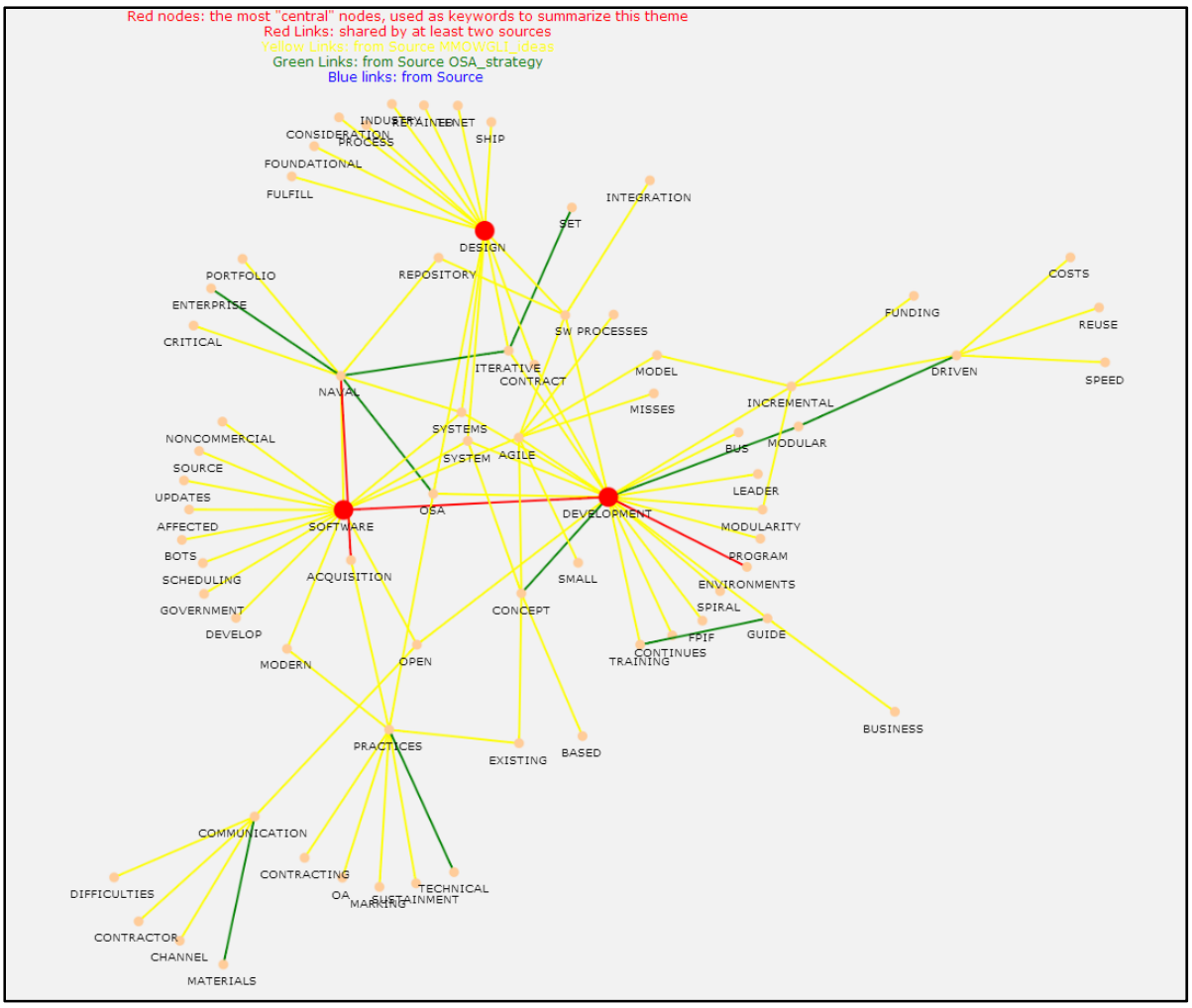
(i) (detail)



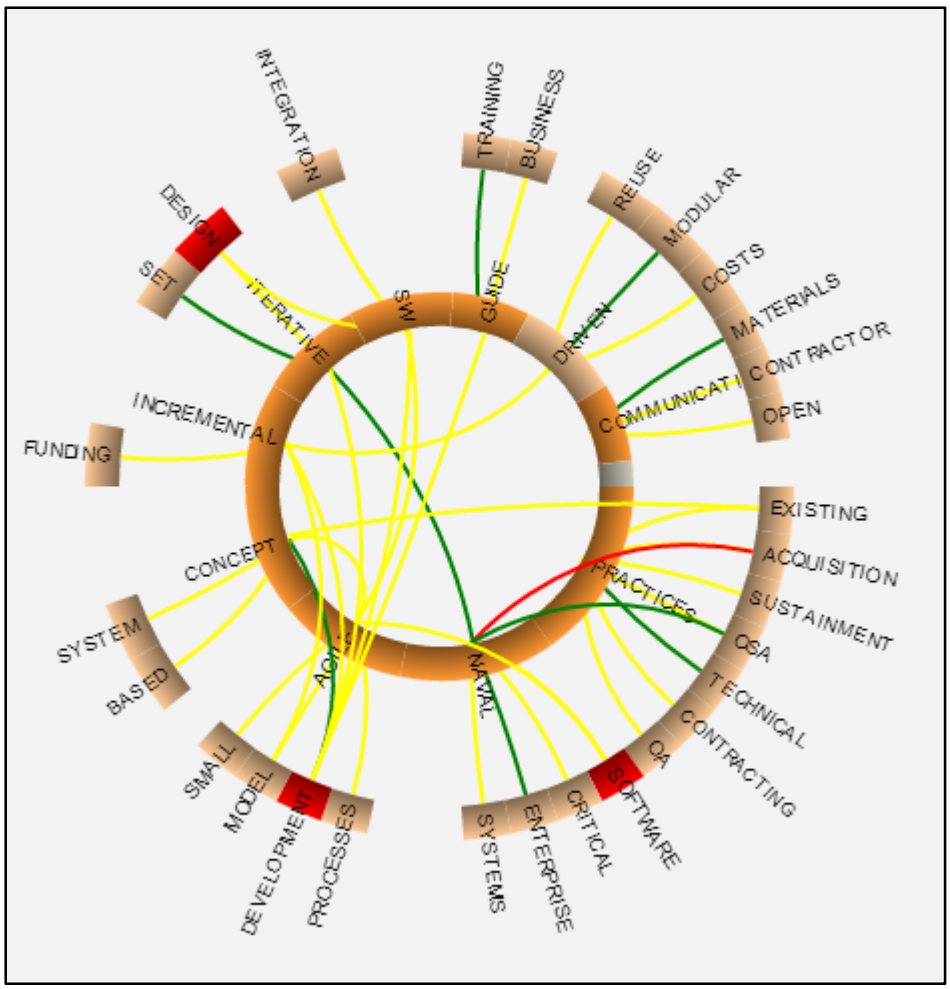
(ii)

Figure B4. Theme Centered Around "Life, Cost, Costs"

In Figure B4(i), word pairs shared in both idea cards and the strategy (red links) include "total ownership", "ownership cost(s)," "life cycle cost," "system life," "program life," "cost savings." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "reduced cycle," "reduced costs," "reduced total." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "cost tracking, "indirect cost," "cost infrastructure," "infrastructure requirements," "realized lifecycle,", "actual lifecycle," "lifecycle product," "evaluate compliance," "evaluate metrics," "contract cycle," "IP ownership," etc. When highlighting these word pairs, we used Figure B4(ii) where LLA detected more important keywords in the inner circle and more popular keywords in the outer ring.


Red nodes: the most "central" nodes, used as keywords to summarize this theme
Red Links: shared by at least two sources
Yellow Links: from Source MMOWGLI_ideas
Green Links: from Source OSA_strategy
Blue links: from Source
INDUSTRY
RETAINED
NET
CONSIDERATION
PROCESS
SHIP
FOUNDATIONAL
FULFILL
INTEGRATION
SET
DESIGN
PORTFOLIO
REPOSITORY
COSTS
ENTERPRISE
FUNDING
REUSE
CRITICAL
SW PROCESSES
ITERATIVE
CONTRACT
MODEL
DRIVEN
SPEED
NAVAL
MISSES
INCREMENTAL
SYSTEMS
NONCOMMERCIAL
BUS
MODULAR
SYSTEM
AGILE
SOURCE
LEADER
UPDATES
OSA
DEVELOPMENT
AFFECTED
SOFTWARE
MODULARITY
BOTS
PROGRAM
SCHEDULING
ACQUISITION
SMALL
ENVIRONMENTS
SPIRAL
GOVERNMENT
CONCEPT
DEVELOP
FPIF
GUIDE
MODERN
OPEN
CONTINUES
TRAINING
BUSINESS
PRACTICES
EXISTING
BASED
COMMUNICATION
CONTRACTING
DIFFICULTIES
OA
MARKING
SUSTAINMENT
TECHNICAL
CONTRACTOR
CHANNEL
MATERIALS

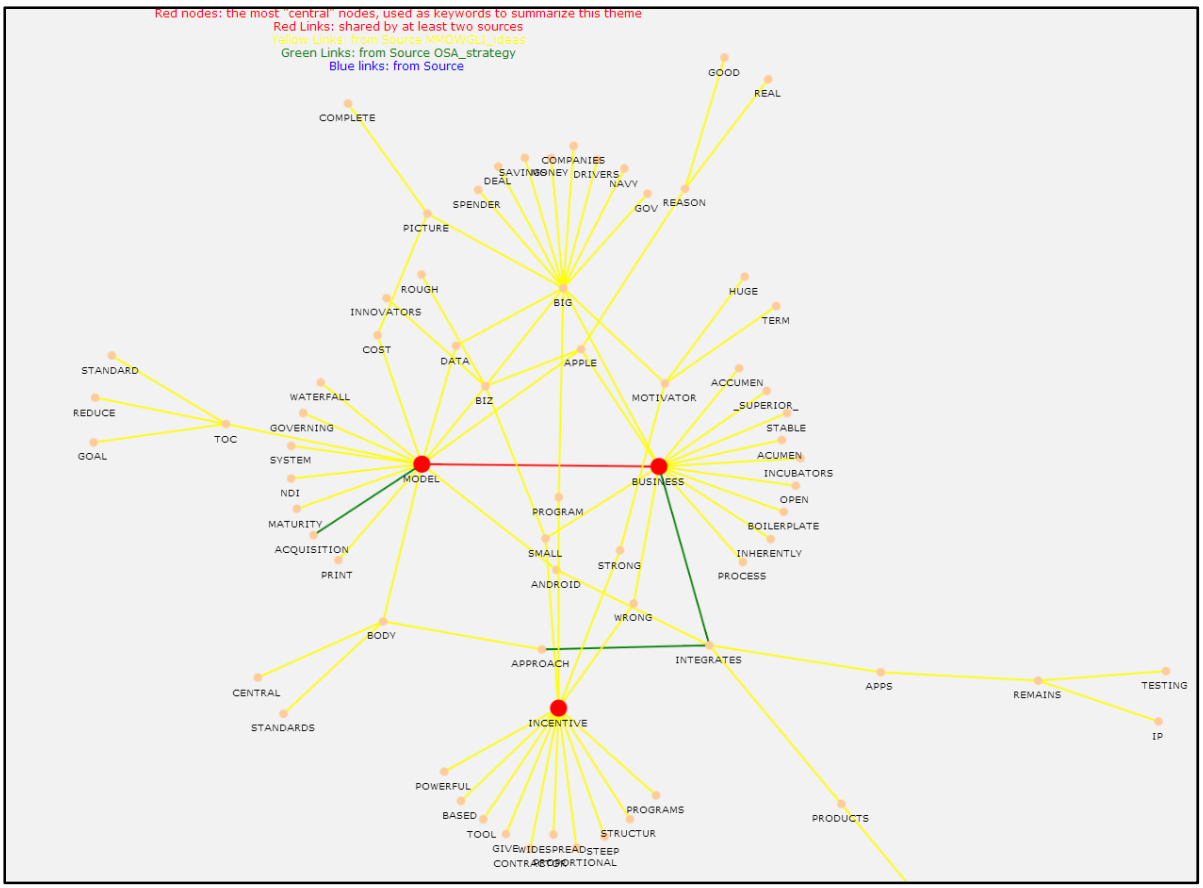
(i)



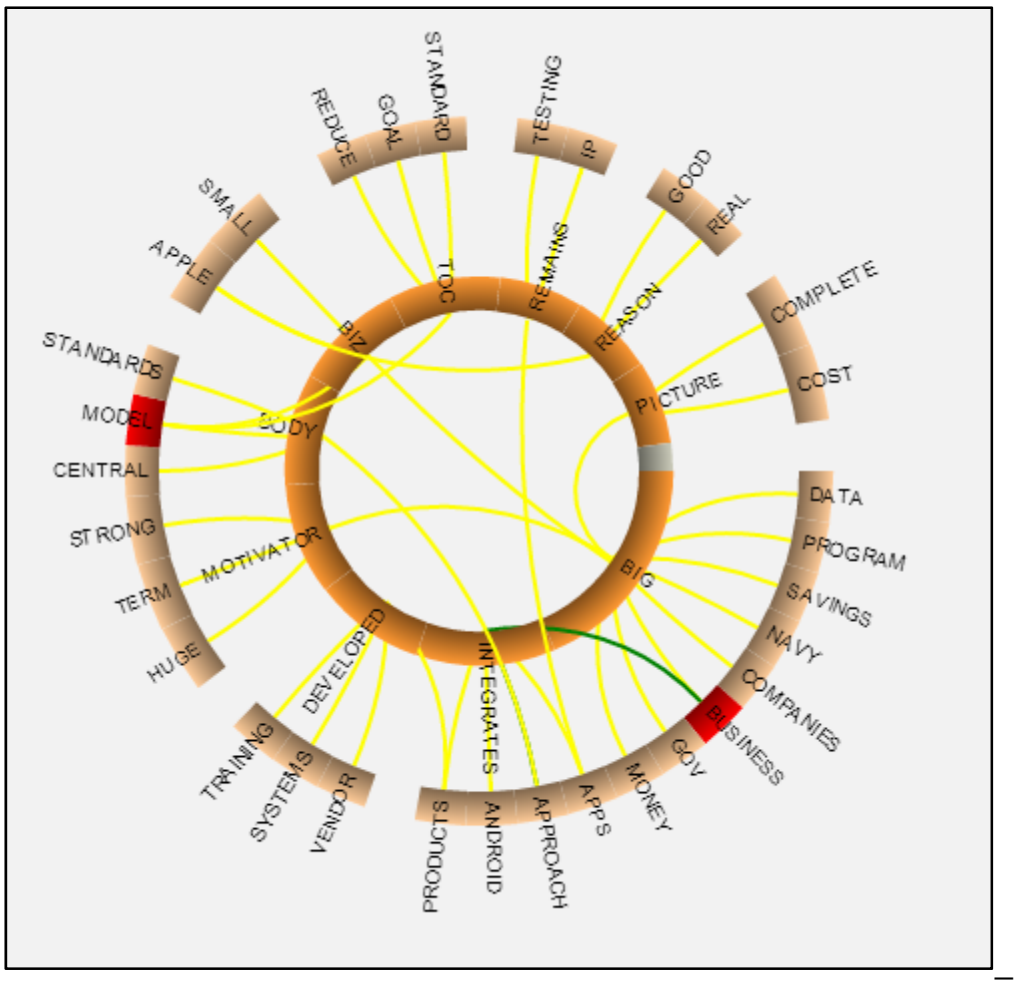
(ii)

Figure B5. Theme Centered Around "Software Development, Design"

In Figure B5(i), word pairs shared in both idea cards and the strategy (red links) include "software development," "development environments," "Naval acquisition." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "development concept," "Naval enterprise," "Naval OSA," "technical practices," "communication materials," "modular driven," "training guide," "iterative set." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "iterative development, "iterative design," "agile model," "agile development," "agile processes," "incremental development," "incremental funding," "reuse driven," "costs driven," "open communication," "contractor communication," "existing practices," "practices sustainment." etc. When highlighting these word pairs, we used Figure B5(ii) where LLA detected relatively important keywords in the inner circle and popular keywords in the outer ring.


Red nodes: the most "central" nodes, used as keywords to summarize this theme
Red Links: shared by at least two sources
Yellow Links: from Source MMOWGLI_Ideas
Green Links: from Source OSA_strategy
Blue links: from Source
GOOD
REAL
COMPLETE
COMPANIES
SAVINGS
MONEY
DRIVERS
DEAL
NAVY
SPENDER
GOV
REASON
PICTURE
ROUGH
BIG
HUGE
INNOVATORS
TERM
COST
DATA
APPLE
STANDARD
ACCUMEN
WATERFALL
BIZ
MOTIVATOR
SUPERIOR
REDUCE
GOVERNING
STABLE
TOC
GOAL
SYSTEM
ACUMEN
MODEL
BUSINESS
INCUBATORS
NDI
OPEN
PROGRAM
MATURITY
BOILERPLATE
ACQUISITION
SMALL
INHERENTLY
PRINT
STRONG
PROCESS
ANDROID
WRONG
BODY
APPROACH
INTEGRATES
APPS
TESTING
CENTRAL
REMAINS
STANDARDS
INCENTIVE
IP
POWERFUL
PROGRAMS
BASED
PRODUCTS
TOOL
STRUCTUR
GIVE
WIDESPREAD
STEEP
CONTRACTOR
PROPORTIONAL

(i)



(ii)

Figure B6. Theme Centered Around "Business Model, Incentive"

In Figure B6(i), word pairs shared in both idea cards and the strategy (red links) include "business model." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "integrates business," "integrates approach," "acquisition model." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "big data," "big program," "big Navy," "big companies," "big gov," "big savings," "big money," "integrates apps," "integrate android," etc. When highlighting these word pairs, we used Figure B6(ii) where LLA detected relatively important keywords in the inner circle and popular keywords in the outer ring.

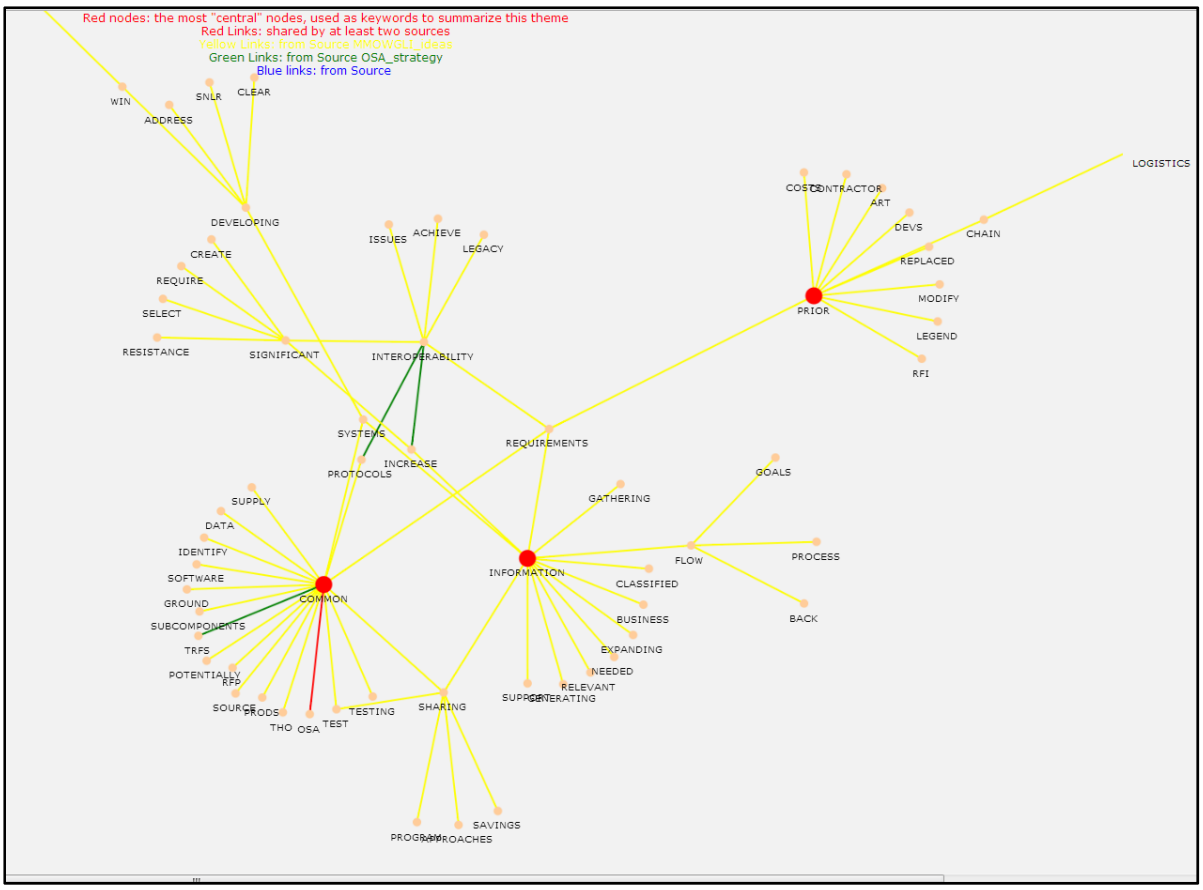


Figure B7. Theme Centered Around "Common, Prior, Information"

In Figure B7, word pairs shared in both idea cards and the strategy (red links) include "common OSA." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "increase interoperability," "interoperability protocols," "common TRFS." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "common data," "common supply," "common software," "common RFP," "common source," "common test(ing)," "common requirements," "common protocols," "legacy interoperability," etc.

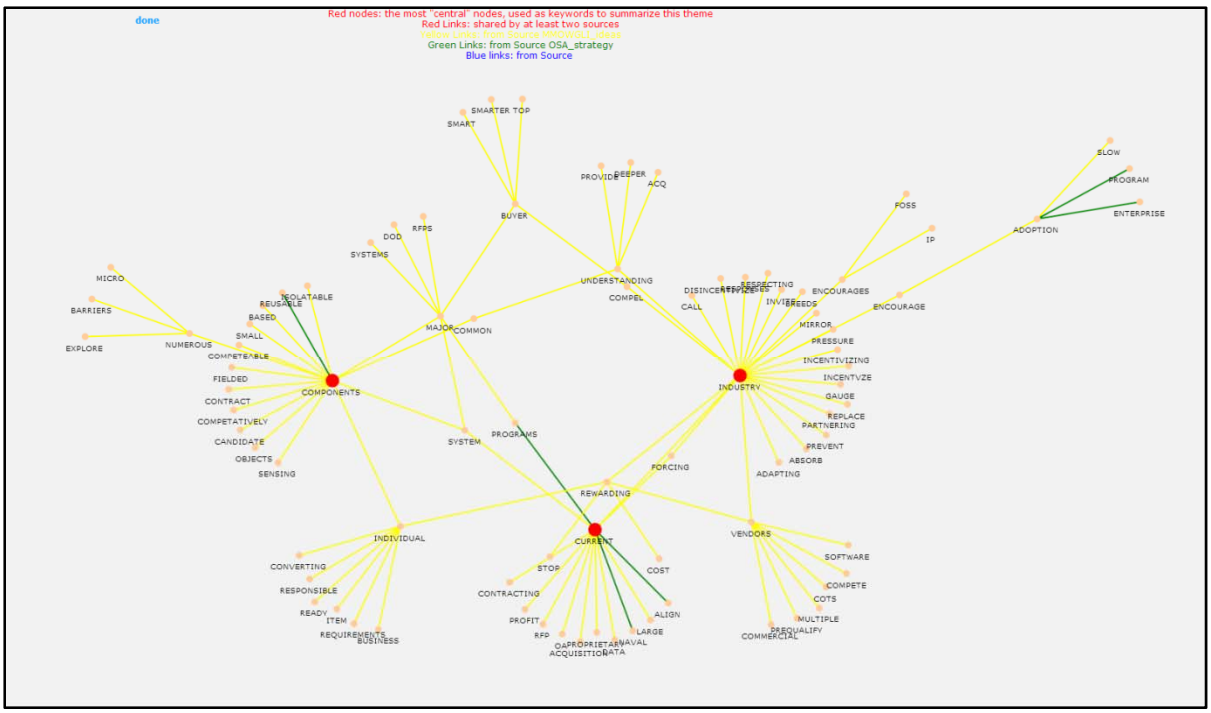


Figure B8. Theme Centered Around "Current, Industry, Component"

In Figure B8, there are no word pairs shared in both idea cards and the strategy (red links). Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "current programs," "reusable components," "enterprise adoption," "program adoption." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "current contracting," "current data," "current profit," "current RFP," "current acquisition," "current proprietary," "industry vendors," "rewarding industry," "industry understanding," "encourages industry," "encourages IP," "encourages FOSS," etc.

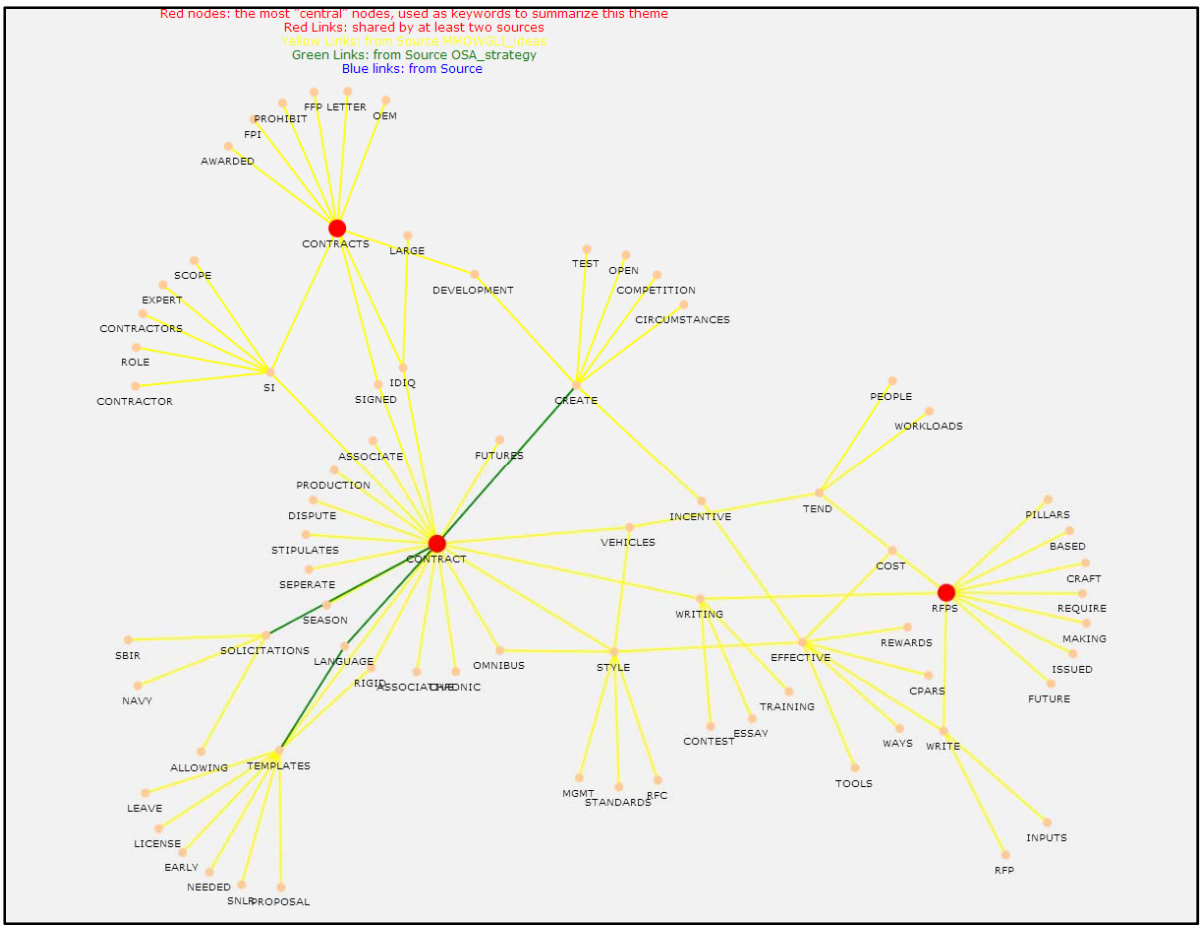


Figure B9. Theme Centered Around "RFPs, Contract, Contracts"

In Figure B9, there are no word pairs shared in both idea cards and the strategy (red links). Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "contract solicitations," "contract language," "language templates," "create contract." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "SI contract," "IDIQ contract(s)," "contract style," "RFPS pillars," etc.

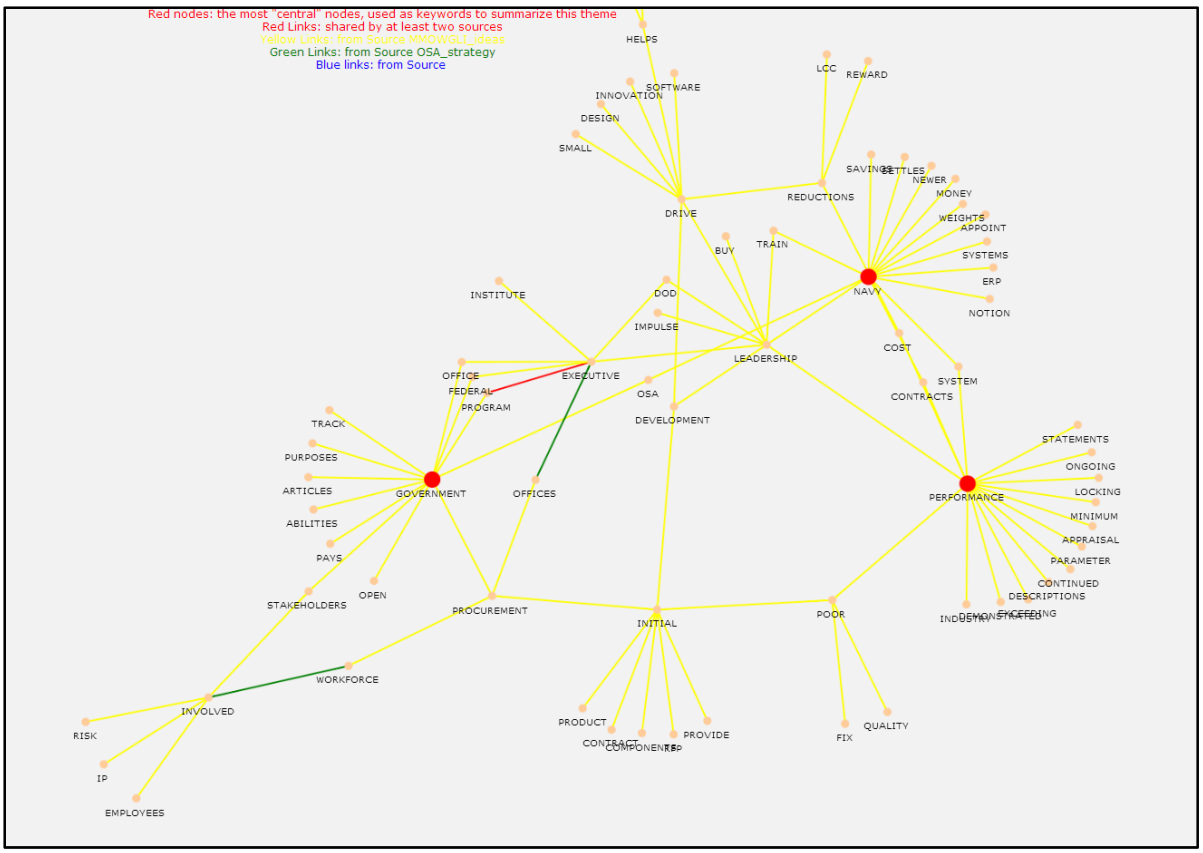


Figure B10. Theme Centered Around "Government, Navy Performance"

In Figure B10, Word pairs shared in both idea cards and the strategy (red links) include "program executive." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "involved workforce." "executive offices"." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "Naval leadership," "leadership performance," "government stakeholders," "government procurement," "initial procurement," "risk involved," "IP involved," "stakeholder involved," "employees involved," "drive software," "drive design," "drive innovation," etc.

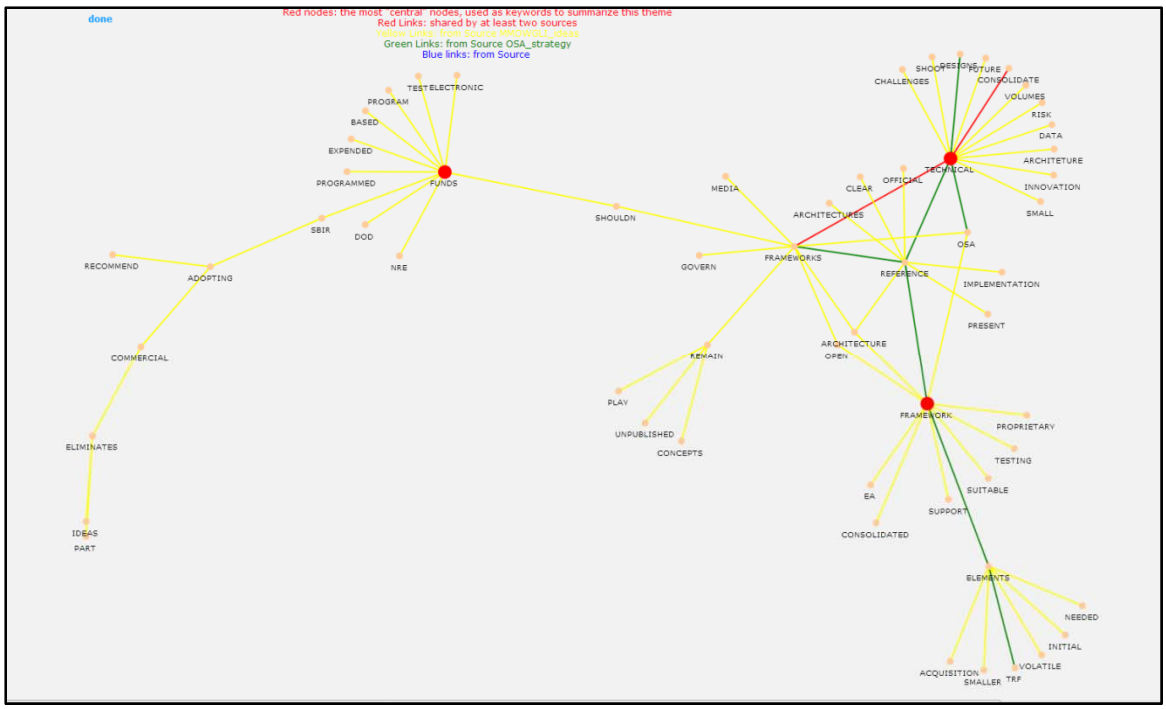


Figure B11. Theme Centered Around "Technical, Framework, Funds"

In Figure B11, Word pairs shared in both idea cards and the strategy (red links) include "consolidate technical," "technical frameworks." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "technical designs," "technical OSA," "technical reference," "reference framework(s)," "framework elements," "TRF elements," "volatile elements." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "proprietary framework, "testing framework," "consolidated framework," "EA framework," "framework support," "OSA framework," "framework architecture," "acquisition elements," "reference implementation," "open framework(s)," etc.

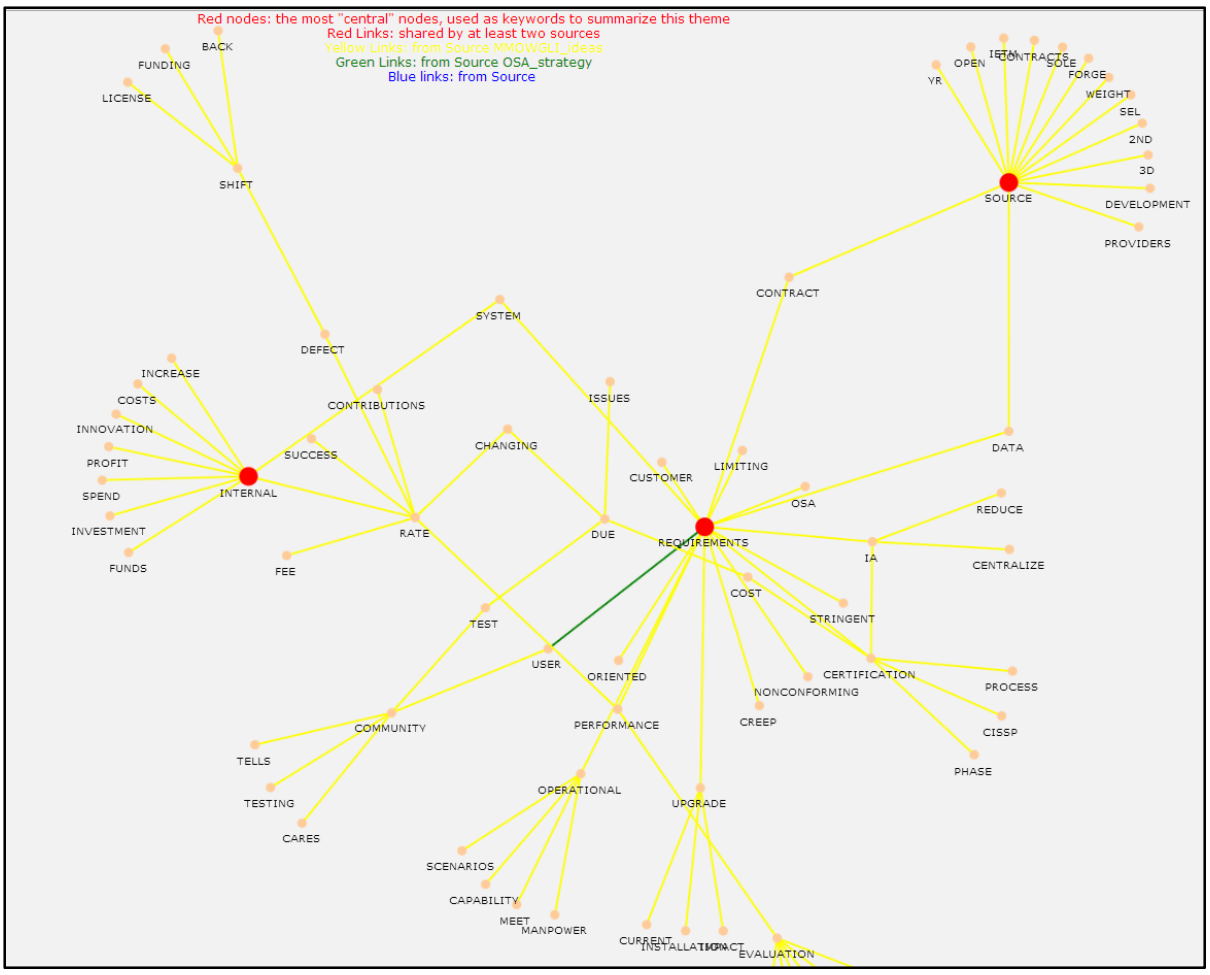


Figure B12. Theme Centered Around "Internal, Source, Requirement"

In Figure B12, there are no word pairs shared in both idea cards and the strategy (red links). Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "user requirements." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "OSA requirements," "data requirements," "nonconforming requirements," "performance requirements," "customer requirements," "system requirements," "requirements oriented," "internal costs," "internal innovation," "internal profit," "internal investment," "internal funds," "internal spend," "internal rate," "performance evaluation," "evaluation team," "evaluation metrics," "evaluation driven," "success rate," "rate contributions," "rate changing," "user community," "test(ing) community," "license shift," "funding shift," "IA requirements," "IA certification," "centralize IA," "reduce IA," "certification process," "CISSP certification," "certification phase," "operational scenarios," "operational capability," "manpower capability," "upgrade impact," etc.

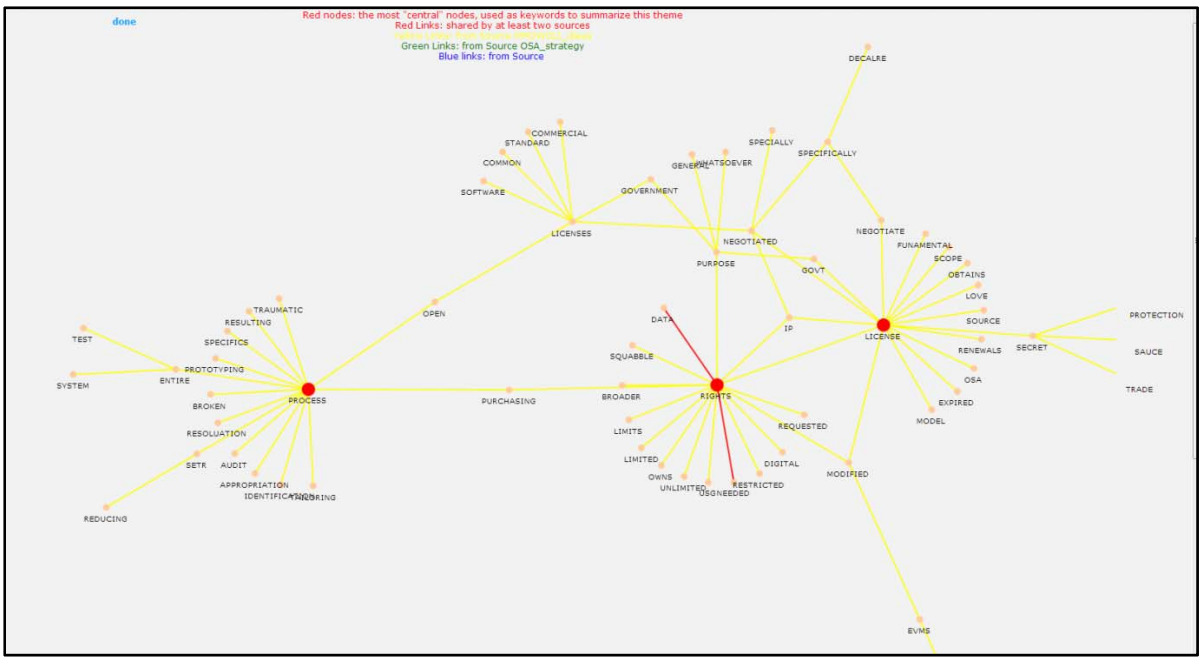


Figure B13. Theme Centered around "License Rights, Process"

In Figure B13, Word pairs shared in both idea cards and the strategy (red links) include "data rights," "restricted rights." There are no word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2. Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "(un)limited rights," "digital rights," "modified rights," "squabble rights," "IP rights," "license rights," "requested rights," "purchasing rights," "IP license," "OSA license," "license model," "negotiate(d) license," "government license(s)," "license renewal," "open licenses," "commercial licenses," "software licenses," "common licenses," "standard licenses," "purchasing process," "prototyping process," "broken process," "traumatic process," "audit process," "appropriation process," etc.

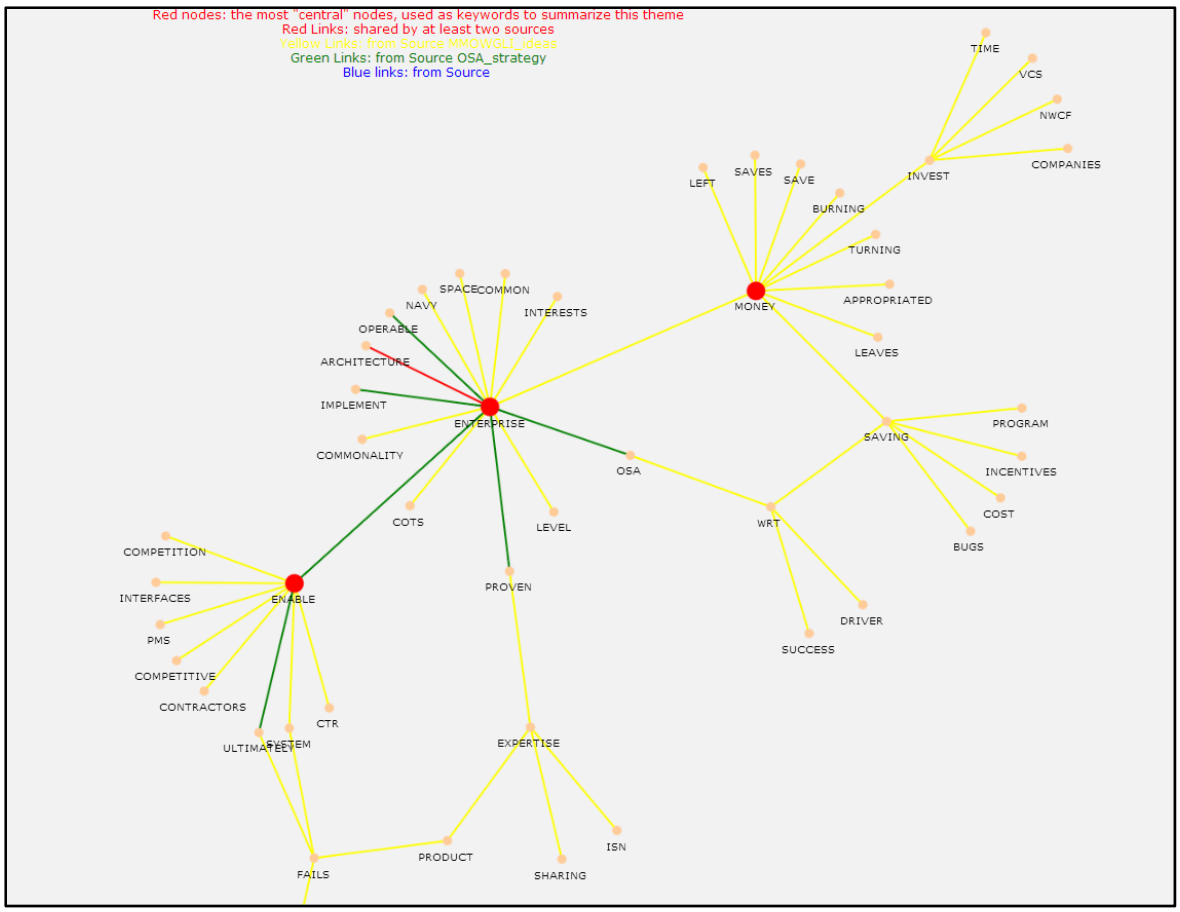


Figure B14. Theme Centered around "Enable Enterprise, Enterprise Money"

In Figure B14, Word pairs shared in both idea cards and the strategy (red links) include "enterprise architecture." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "OSA enterprise," "proven enterprise," "operable enterprise," "enable enterprise." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "enterprise money," "enterprise COTS," "enterprise commonality," "enable interfaces," "enable PMS," "enable competition," "enable contractors," "sharing expertise," etc.

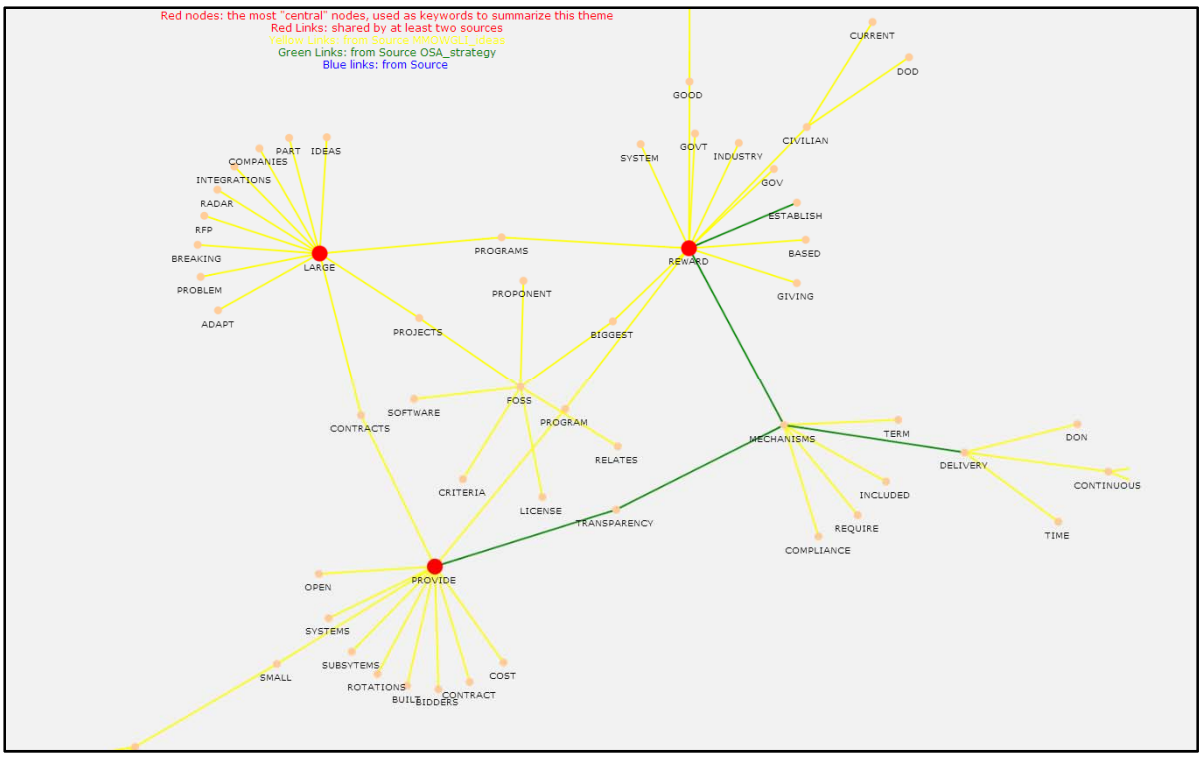


Figure B15. Theme Centered around "Provide, Large, Reward"

In Figure B15, there are no word pairs shared in both idea cards and the strategy (red links). Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "reward mechanisms," "delivery mechanisms," "mechanisms transparency," "provide transparency," "establish reward." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "compliance mechanisms," "FOSS criteria," "FOSS license," "FOSS proponent," "FOSS software," "biggest FOSS," etc.

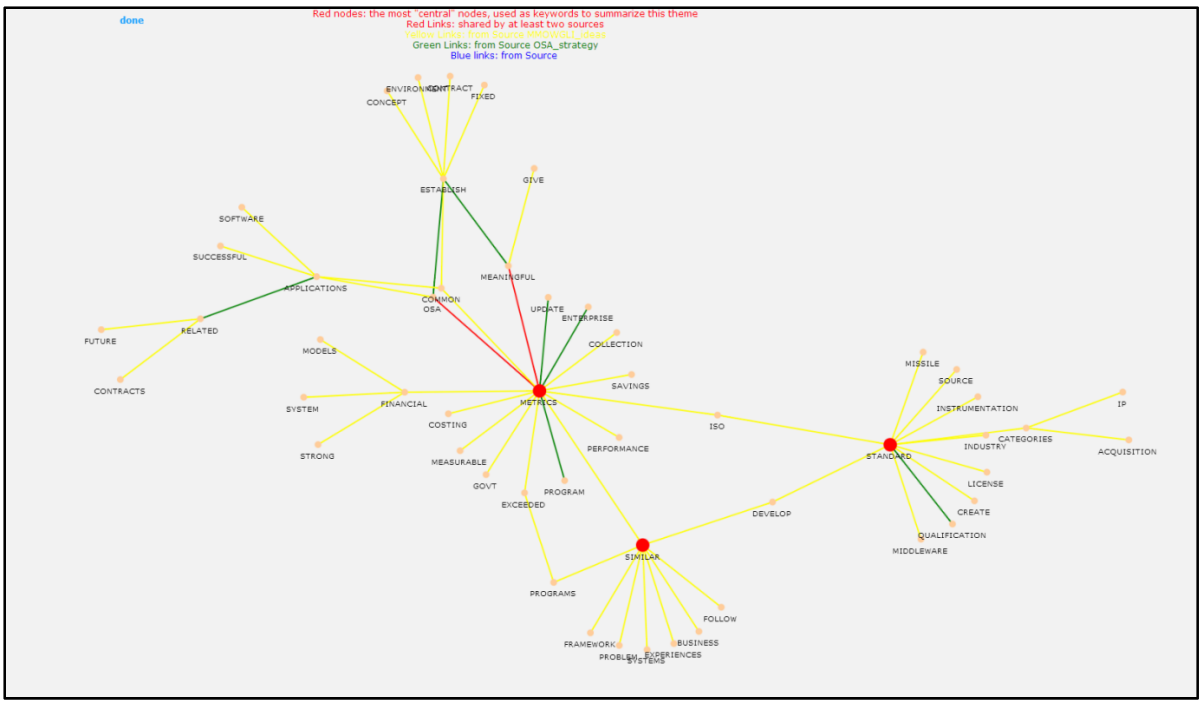


Figure B16. Theme Centered around "Similar, Standard, Metrics"

In Figure B16, Word pairs shared in both idea cards and the strategy (red links) include "meaning metrics," "OSA metrics." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "program metrics," "update metrics," "enterprise metrics," "qualification standard." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "common metrics," "metrics collection," "savings metrics," "performance metrics," "measurable metrics," "financial metrics," "ISO metrics," "ISO standard," "missile standard," "source standard," "instrumentation standard," "industry standard," "license standard," "middleware standard," "standard categories," "IP categories," "acquisition categories," "similar metrics," "similar framework," "similar programs," "similar systems," etc.

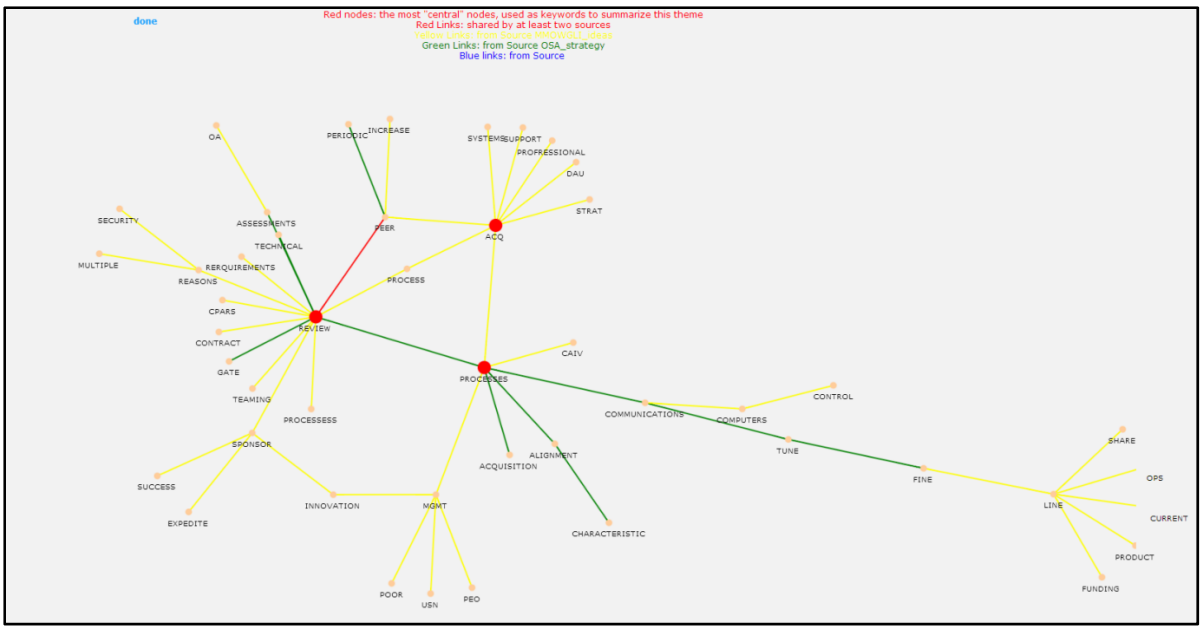


Figure B17. Theme Centered around "Review Process, ACQ"

In Figure B17, Word pairs shared in both idea cards and the strategy (red links) include "peer review." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include " review gate," "technical review," "review process(es)," "alignment processes," "acquisition processes," "communications processes,"." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "review reasons," "multiple reasons," "security reasons," "review requirements," "CPARS review," "sponsor review," "sponsor innovation," "expedite sponsor," "sponsor success," "ACQ strat," "ACQ DAU," "professional ACQ," "peer ACQ," etc.

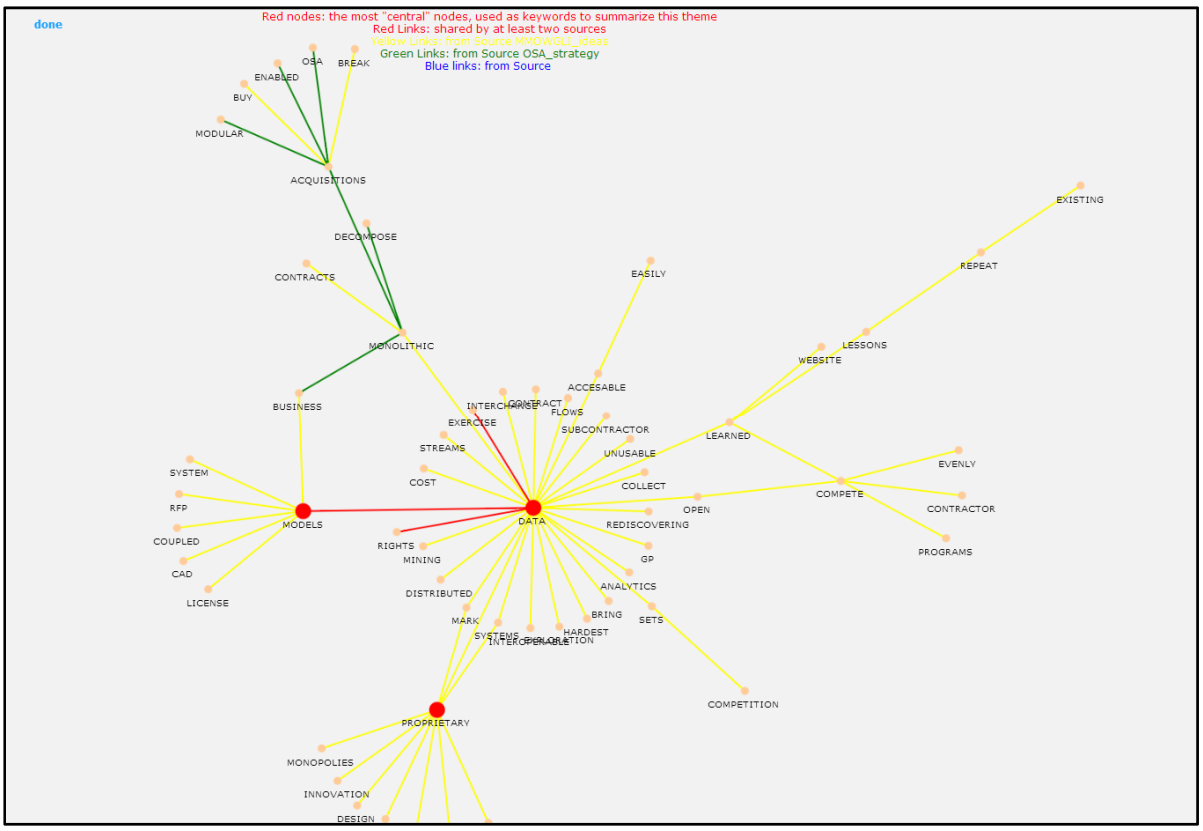


Figure B18. Theme Centered around "Proprietary, Data Models"

In Figure B18, Word pairs shared in both idea cards and the strategy (red links) include "data models," "exercise data rights." Word pairs unique to the strategy book (green links) that were not discussed in the *biiMMOWGLI* game Round 2 include "monolithic business," "decompose monolithic," "monolithic acquisitions," "modular acquisitions," "OSA acquisitions." Word pairs unique to the idea cards (yellow links) which are not mentioned in the current strategy and considered as interesting and crowd-sourced ideas include "monolithic contracts," "monolithic data," "accessible data," "proprietary data," "data learned," "open data," "data mining," "data analytics," data flows," "distributed data," 'data interchange," "data streams," "collect data," "RFP models," "license models," "coupled models," "CAD models," etc.

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