NPS-LM-13-C10P05R03-061

EXCERPT FROM THE

PROCEEDINGS

OF THE

TENTH ANNUAL ACQUISITION RESEARCH SYMPOSIUM ACQUISITION MANAGEMENT

Improving DoD Energy Efficiency: Combining MMOWGLI Social-Media Brainstorming With Lexical Link Analysis (LLA) to Strengthen the Defense Acquisition Process

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Published April 1, 2013

Approved for public release; distribution is unlimited.
Prepared for the Naval Postgraduate School, Monterey, CA 93943.

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The research presented in this report was supported by the Acquisition Research Program of the Graduate School of Business & Public Policy at the Naval Postgraduate School.

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Preface & Acknowledgements

Welcome to our Tenth Annual Acquisition Research Symposium! We regret that this year it will be a "paper only" event. The double whammy of sequestration and a continuing resolution, with the attendant restrictions on travel and conferences, created too much uncertainty to properly stage the event. We will miss the dialogue with our acquisition colleagues and the opportunity for all our researchers to present their work. However, we intend to simulate the symposium as best we can, and these *Proceedings* present an opportunity for the papers to be published just as if they had been delivered. In any case, we will have a rich store of papers to draw from for next year's event scheduled for May 14–15, 2014!

Despite these temporary setbacks, our Acquisition Research Program (ARP) here at the Naval Postgraduate School (NPS) continues at a normal pace. Since the ARP's founding in 2003, over 1,200 original research reports have been added to the acquisition body of knowledge. We continue to add to that library, located online at www.acquisitionresearch.net, at a rate of roughly 140 reports per year. This activity has engaged researchers at over 70 universities and other institutions, greatly enhancing the diversity of thought brought to bear on the business activities of the DoD.

We generate this level of activity in three ways. First, we solicit research topics from academia and other institutions through an annual Broad Agency Announcement, sponsored by the USD(AT&L). Second, we issue an annual internal call for proposals to seek NPS faculty research supporting the interests of our program sponsors. Finally, we serve as a "broker" to market specific research topics identified by our sponsors to NPS graduate students. This three-pronged approach provides for a rich and broad diversity of scholarly rigor mixed with a good blend of practitioner experience in the field of acquisition. We are grateful to those of you who have contributed to our research program in the past and encourage your future participation.

Unfortunately, what will be missing this year is the active participation and networking that has been the hallmark of previous symposia. By purposely limiting attendance to 350 people, we encourage just that. This forum remains unique in its effort to bring scholars and practitioners together around acquisition research that is both relevant in application and rigorous in method. It provides the opportunity to interact with many top DoD acquisition officials and acquisition researchers. We encourage dialogue both in the formal panel sessions and in the many opportunities we make available at meals, breaks, and the day-ending socials. Many of our researchers use these occasions to establish new teaming arrangements for future research work. Despite the fact that we will not be gathered together to reap the above-listed benefits, the ARP will endeavor to stimulate this dialogue through various means throughout the year as we interact with our researchers and DoD officials.

Affordability remains a major focus in the DoD acquisition world and will no doubt get even more attention as the sequestration outcomes unfold. It is a central tenet of the DoD's Better Buying Power initiatives, which continue to evolve as the DoD finds which of them work and which do not. This suggests that research with a focus on affordability will be of great interest to the DoD leadership in the year to come. Whether you're a practitioner or scholar, we invite you to participate in that research.

We gratefully acknowledge the ongoing support and leadership of our sponsors, whose foresight and vision have assured the continuing success of the ARP:

- Office of the Under Secretary of Defense (Acquisition, Technology, & Logistics)
- Director, Acquisition Career Management, ASN (RD&A)
- Program Executive Officer, SHIPS
- Commander, Naval Sea Systems Command
- Program Executive Officer, Integrated Warfare Systems
- Army Contracting Command, U.S. Army Materiel Command
- Office of the Assistant Secretary of the Air Force (Acquisition)
- Office of the Assistant Secretary of the Army (Acquisition, Logistics, & Technology)
- Deputy Director, Acquisition Career Management, U.S. Army
- Office of Procurement and Assistance Management Headquarters, Department of Energy
- Director, Defense Security Cooperation Agency
- Deputy Assistant Secretary of the Navy, Research, Development, Test, & Evaluation
- Program Executive Officer, Tactical Aircraft
- Director, Office of Small Business Programs, Department of the Navy
- Director, Office of Acquisition Resources and Analysis (ARA)
- Deputy Assistant Secretary of the Navy, Acquisition & Procurement
- Director of Open Architecture, DASN (RDT&E)
- Program Executive Officer, Littoral Combat Ships

James B. Greene Jr.
Rear Admiral, U.S. Navy (Ret.)

Keith F. Snider, PhD
Associate Professor

Logistics Management

Fully-Burdened Cost of Supply in Self-Sustaining Logistics Networks

Eva Regnier, Jay Simon, Daniel Nussbaum, Aruna Apte, and John Khawam
Naval Postgraduate School

Platform Design for Fleet-Level Efficiency: Application for Air Mobility Command (AMC)

Jung Hoon Choi, Parithi Govindaraju, Navindran Davendralingam, and William A. Crossley
Purdue University

Improving DoD Energy Efficiency: Combining MMOWGLI Social-Media Brainstorming With Lexical Link Analysis (LLA) to Strengthen the Defense Acquisition Process

Ying Zhao, Don Brutzman, and Douglas J. MacKinnon
Naval Postgraduate School

Addressing Counterfeit Parts in the DoD Supply Chain

Jacques S. Gansler, William Lucyshyn, and John Rigilano
University of Maryland

Wave Release Strategies to Improve Service in Order Fulfillment Systems

Erdem Çeven and Kevin Gue
Auburn University

Issues and Challenges in Self-Sustaining Response Supply Chains

Aruna Apte, John Khawam, Eva Regnier, Jay Simon, and Daniel Nussbaum
Naval Postgraduate School

Lead Time Demand Modeling in Continuous Review Supply Chain Models

Barry R. Cobb, *Virginia Military Institute*
Alan W. Johnson, *Air Force Institute of Technology*

Improving Multi-Component Maintenance Acquisition With a Greedy Heuristic Local Algorithm

Sifat Kalam and Kash Barker, *University of Oklahoma*
Jose Emmanuel Ramirez-Marquez, *Stevens Institute of Technology*

An Internal, Demand-Side Approach Toward Implementing Strategic Sourcing:

Political, Legal, and Economic Considerations

John Fallon, *University of Maryland, University College*
Timothy Reed, *Beyond Optimal Strategic Solutions*

Optimizing Causes of Procurement Cost Through Strategic Sourcing: The Impact of Rate, Process, and Demand

Timothy Reed, *Beyond Optimal Strategic Solutions*
Michael E. Knipper, *United States Air Force*
John Fallon, *University of Maryland, University College*

Improving DoD Energy Efficiency: Combining MMOWGLI Social-Media Brainstorming With Lexical Link Analysis (LLA) to Stengthen the Defense Acquisiton Process

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Abstract

DoD energy inefficiency is a significant liability and a constraint on operations and a force-protection challenge. It is therefore imperative to reduce energy demand and provide operational forces greater flexibility among alternative energy sources. However, the current acquisition processes undervalue technologies with the potential to improve energy efficiency. We report the results of leveraging an innovative platform, the Massive Multiplayer Online Wargame Leveraging the Internet (MMOWGLI) to link and elicit collective intelligence from the acquisition community for the challenge of DoD energy inefficiency. We first linked the existing MMOWGLI energy data with samples of acquisition data using lexical link analysis (LLA). We generated *match matrices* based on themes discovered in both data sets. The themes and match matrices helped identify the gaps and opportunities to apply collective intelligence from the MMOWGLI game to the current acquisition process. This effort demonstrates superb potential of an innovative methodology that can be deployed quickly to mobilize the intellectual capacities of the acquisition community. It may also increase the overall awareness of ongoing acquisition research to warfighters and create a positive impact for the future acquisition decisions to help achieve improved DoD energy efficiency.

Background, Needs, and Research Questions

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 consistent requirements for DoD energy efficiency: (1) By reducing energy demand, we may provide operational forces greater flexibility and reduce their dependency on logistics infrastructure; and (2) We can improve the DoD's current requirements and acquisition processes to value the technologies with the potential to improve energy efficiency (DoD Acquisition and Technology, 2012).

The 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. The Naval Postgraduate School (NPS) is one of the primary developers of the game software. Recently, the Navy's Energy and Environmental Readiness Division (OPNAV N45), hosted by NPS Modeling Virtual Environments and Simulation (MOVES) Institute, conducted a civic and military collaboration specifically for examining Navy energy efficiency May 22–25. In the past, the NPS hosted a series of successful games, *piracyMMOWGLI* (2011–present, ongoing) and *energyMMOWGLI* (May 2012), which built the critical mass of players needed to find creative solutions to the real-life difficult problems, such as piracy and energy.

In the energyMMOWGLI game, ideas were collected through "play an idea card" and "take action," as shown in Figure 1. The motivating "call to action" for players is to improve the U.S. Navy's combat capability and energy security, particularly by promoting energy efficiency, reducing energy consumption, and diversifying its energy supply (use of alternative energy) for the sake of future strategic readiness. The overall goal is to reduce reliance on fossil fuels from overseas.

Figure 1. The energyMMOWGLI Game

In this energyMMOWGLI game, 560 players contributed over 5000 ideas and 68 action plans. Lexical link analysis (LLA; Zhao, Gallup, & MacKinnon, 2010, 2011a, 2011b, 2011c, 2012) was used in analyzing the collected data. All results are published online (see MMOWGLI Energy Game, 2012; MMOWGLI Energy Game Portal, 2012; MMOWGLI Business Initiative [BII] Game, 2013; MMOWGLI BII Game Portal, 2013).

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

We leveraged the energyMMOWGLI game in the acquisition community through the following four-step process. Further details appear later in this paper and in the online game portal.

1. Prepare acquisition data. Collate key terms and goal statements of current acquisition programs within the congressional budget processes for use by the LLA methodology.
2. Perform link analysis and correlation. Compare the already-collected energyMMOWGLI results to determine action plan relevance on a program-by-program basis.
3. Design new capabilities for information collection. Define questions for a continuation round of the energyMMOWGLI game, to support programmatic life-cycle needs of the acquisition community.
4. Plan/conduct follow-on games. Conduct a follow-on game focused on shared needs of many energy programs, demonstrating the value of this approach in a formal, repeatable way.

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 identification (ID) and e-mail. First and last name and other personal identification information (PII) are not required.

The game starts with the explanation of the situation and allows a player to "play an idea" or "take action." Users 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 the following categories: expand—build on this idea to amply the impact; counter—challenge this idea; adapt—take this idea in a different direction; explore—something missing?; or ask a question, as shown in Figure 2.

In the end, the system will gather collective intelligence that resides in color-coded, tree-structured sets of ideas and discussions in text format as shown in Figure 3. 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 will be taken into a separate "take action" board for further planning and deliberation.

Figure 2. Categories of Ideas Based on the Styles of Responses

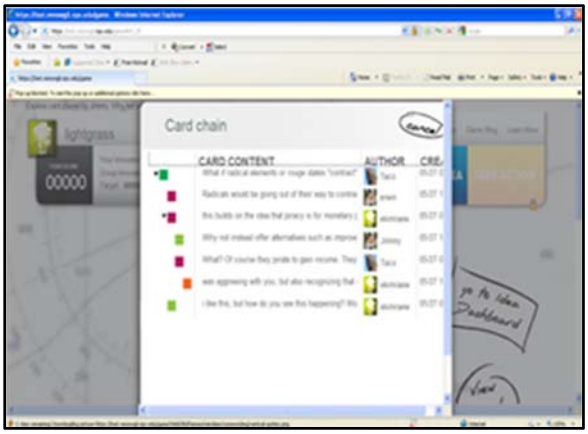

Figure 3. Ideas Collected in the Color-Coded Tree-Structured Categories

The MMOWGLI platform is suitable for tackling a broad range of challenges for national security, multiple stakeholders, and challenges for small or big communities (e.g., corporations and research communities like the acquisition system community). It is a configurable innovation platform that can be adapted to any scenario. For example, an aerospace and defense company, Raytheon, is considering the game engine for use within a company as a corporate innovation platform.

Lexical Link Analysis

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 (Zhao et al., 2010, 2011a, 2011b, 2011c, 2012). 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 lexical, semantic, and social 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 with potential automation. For example, for the recent MMOWGLI games used to develop and identify new ideas about stated subject matters, LLA was leveraged to identify potentially interesting information from "idea cards," link them, then recommend them to the matched action plans for Game Masters.

Figure 4 shows the game's content and attributes, which were processed into the inputs (i.e., meta_data.txt and a directory of text files with idea card contents to LLA).

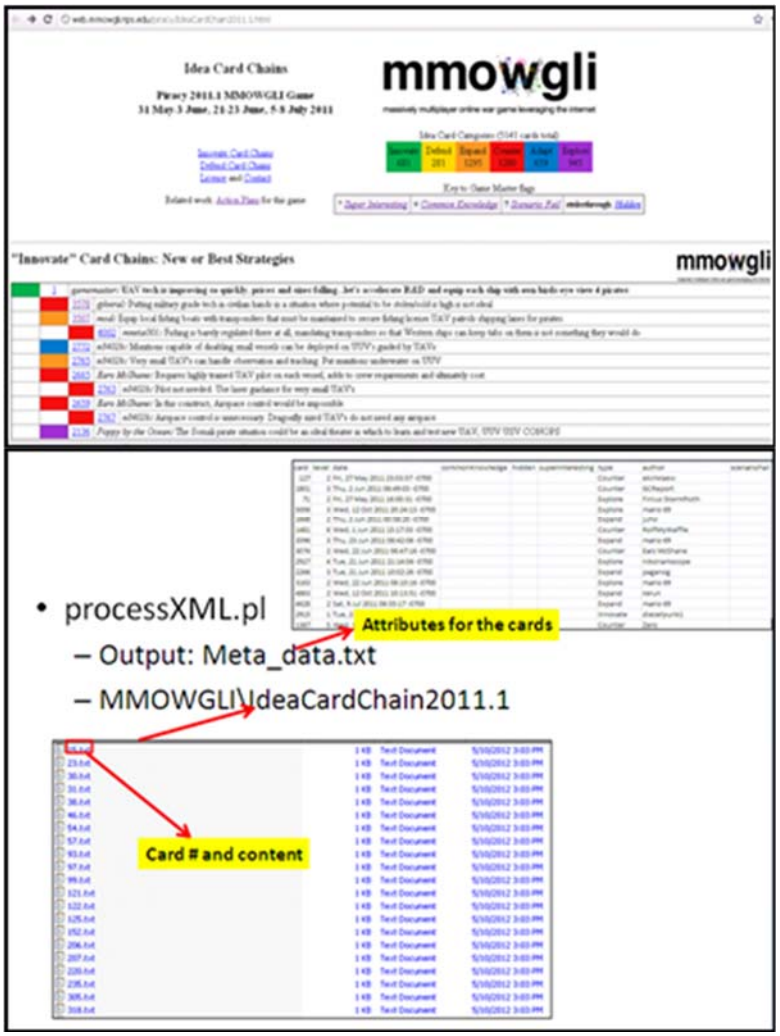

Figure 4. Idea Cards Transformed to LLA Inputs (e.g., a Directory With Files of Content of the Cards and Attributes, meta_data.txt)

There are two steps used in LLA to discover themes. A theme is a cluster of related word pairs:

- 1st Iteration (Figure 5 (a)): Compute word pair clusters using Newman community finding algorithm—words as in a community (Girvan & Newman, 2002).
- 2nd Iteration (Figure 5 (b)): Select lexical terms linked to the most central nodes, for example, "fuel, shipboard, liquid."

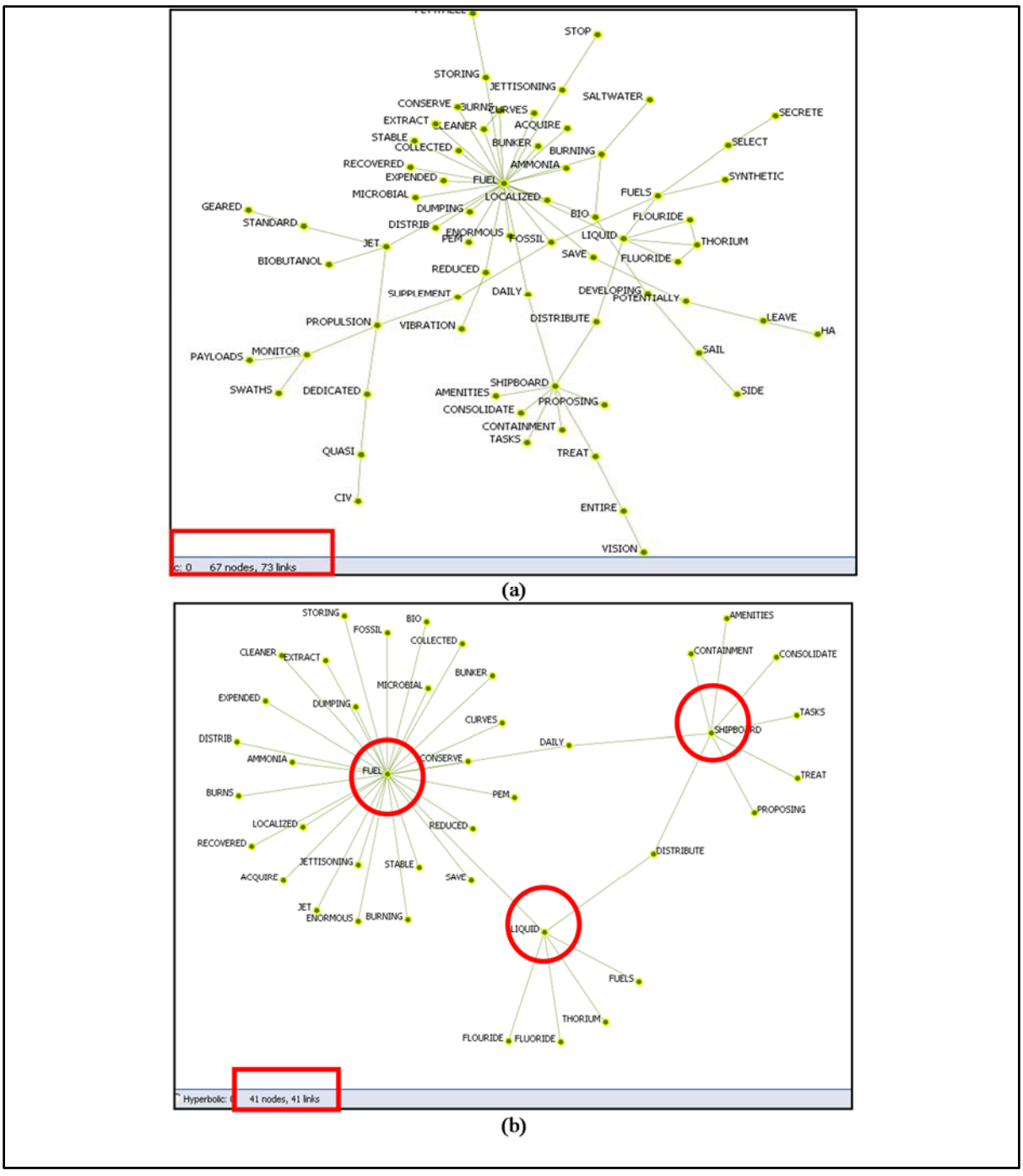

Figure 5. Two Steps LLA Iterations to Group Word Pairs Into Themes

Research Results

As shown in Figure 6, in Phase I, we planned to demonstrate the feasibility of the social media energyMMOWGLI game as an innovation platform that could generate valuable and unexpected contributions and solutions towards the DoD energy efficiency through the acquisition process by linking the current acquisition programs with the energyMMOWGLI game using LLA. We achieved this objective through performing the tasks.

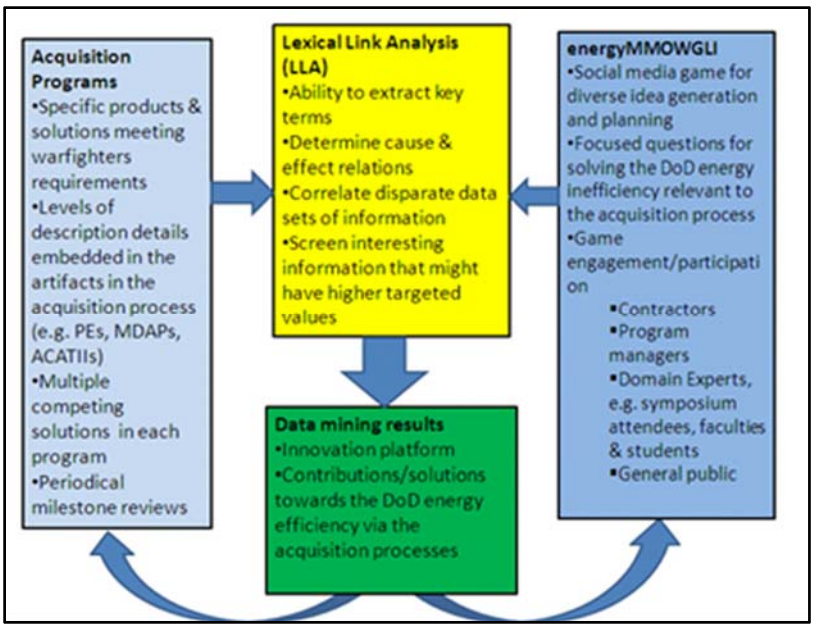

Figure 6. A Glance of the Proposal Objective

Task 1: 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) will be used in this task. This source is the accurate and authoritative high-level artifacts under the DoD Research, Development, Test, and Evaluation (RDT&E). We had analyzed part of these documents in the past (Zhao et al., 2010, 2011a, 2011c, 2012) in detail using the LLA method jointly with other measures such as cost, schedule, and performance.

Specifically, we collected the following most recent (2013) tri-service PE documents 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

Task 2: Perform Analysis and Correlation

Compare the already collected energyMMOWGLI results to determine action plan relevance on a program-by-program basis.

We linked the energyMMOWGLI data, specifically, 38 action plans with the PEs prepared in Task 1, and 224 Navy PEs to evaluate the current Navy programs relevant to the game data. Figure 7 shows that the process resulted in a relevance and correlation matrix as illustrated.

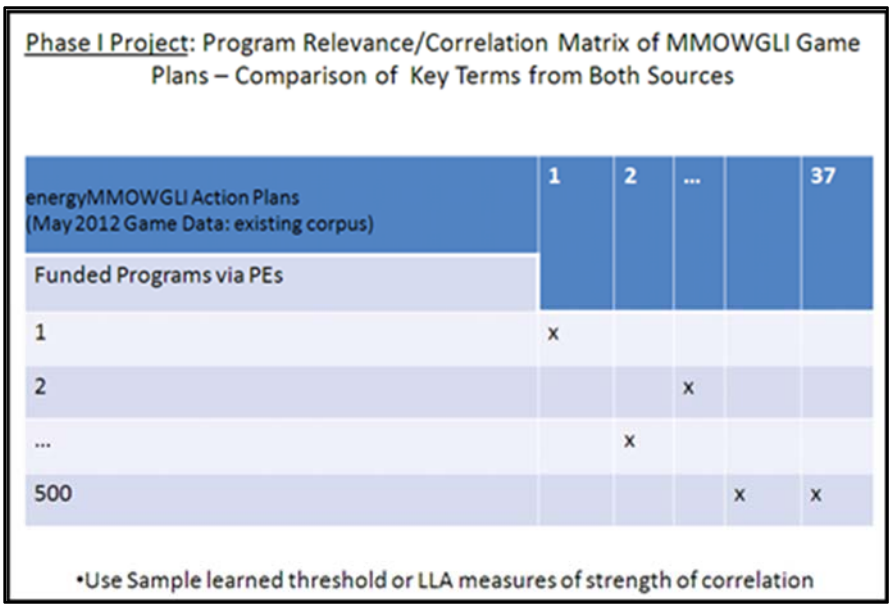

Figure 7. Phase I Relevance Matrix

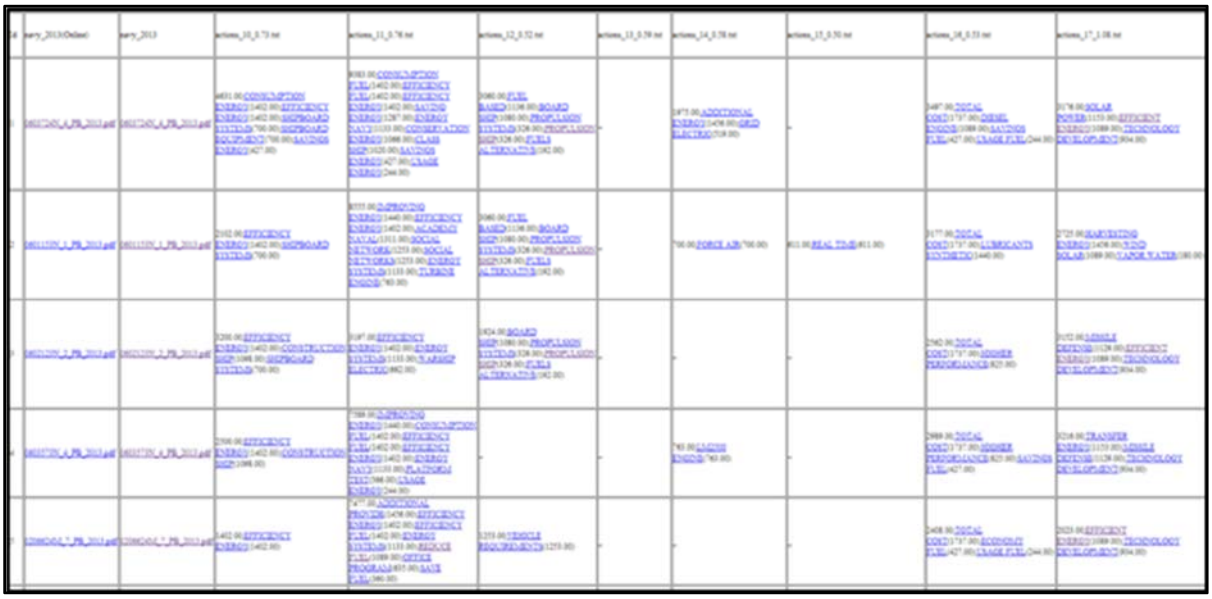

Figure 8. The Overall Match Matrix for the MMOWGLI Energy Game Action Plans and Navy 2013 Program Elements

Figure 8 shows sorted Navy PEs that match the MMOWGLI game data based on a sorted LLA score. The top five most relevant PEs are listed as follows:

- 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 Combat Services Support

Clicking on the online link for the top one 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 9. This validates that the LLA extracted the relevant keywords from the game data.

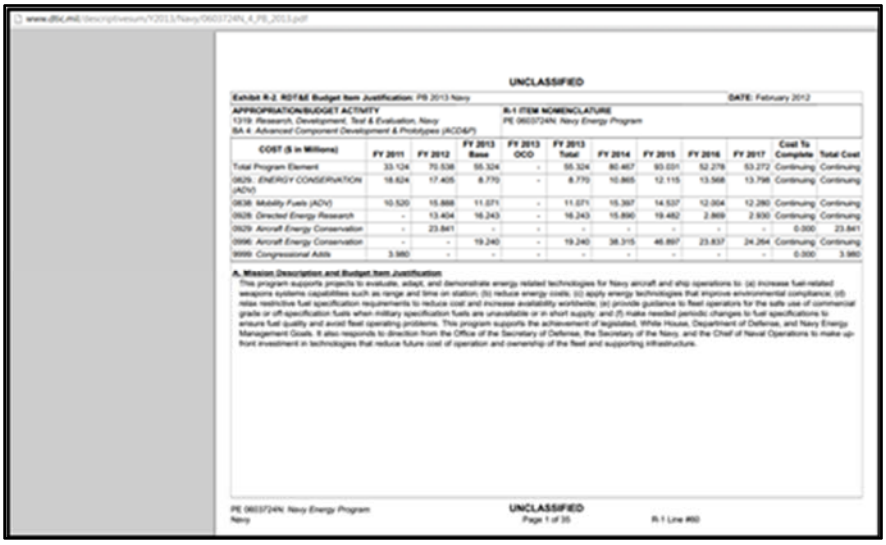

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Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Navy — DATE: February 2012

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	52.279	53.272	Continuing	Continuing
0929: 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
0926: 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

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R-1 Line #60

Figure 9. Navy Energy Program Element

The matrix in Figure 8 shows a holistic picture of the current acquisition programs in connection with the DoD energy inefficiency situations, efficiency requirements, and possible innovative solutions. Directly looking into the match matrix, as illustrated in Figure 8, can be overwhelming. For that, we applied LLA to discover the themes and divide a single match matrix into many match matrices in different themes. 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 Newman community finding algorithm—words as in a community (Girvan & Newman, 2002). There we select lexical terms linked to the most *central* nodes. For example, shown in Figure 11, the red nodes are the most central nodes "environmental, ship, and effective." The red links are the word pairs shared by both sources PEs and MMOWGLI game action plans; the yellow links are the word pairs unique to the game data; and the green ones are those unique to the PEs.

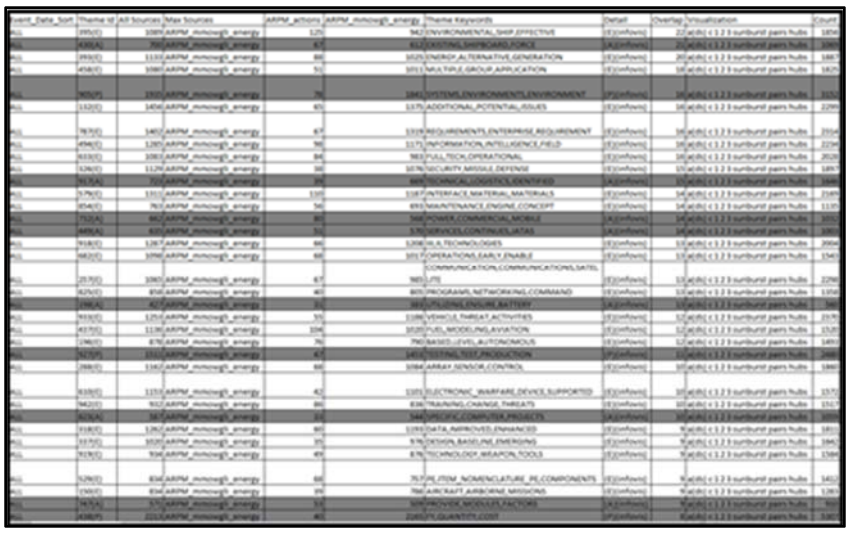

Figure 10. Themes Discovered for Navy 2013 Program Elements Documents and energyMMOWGLI Data, Thresholded and Then Sorted According to the Overlapped Word Pairs From the Two Sources

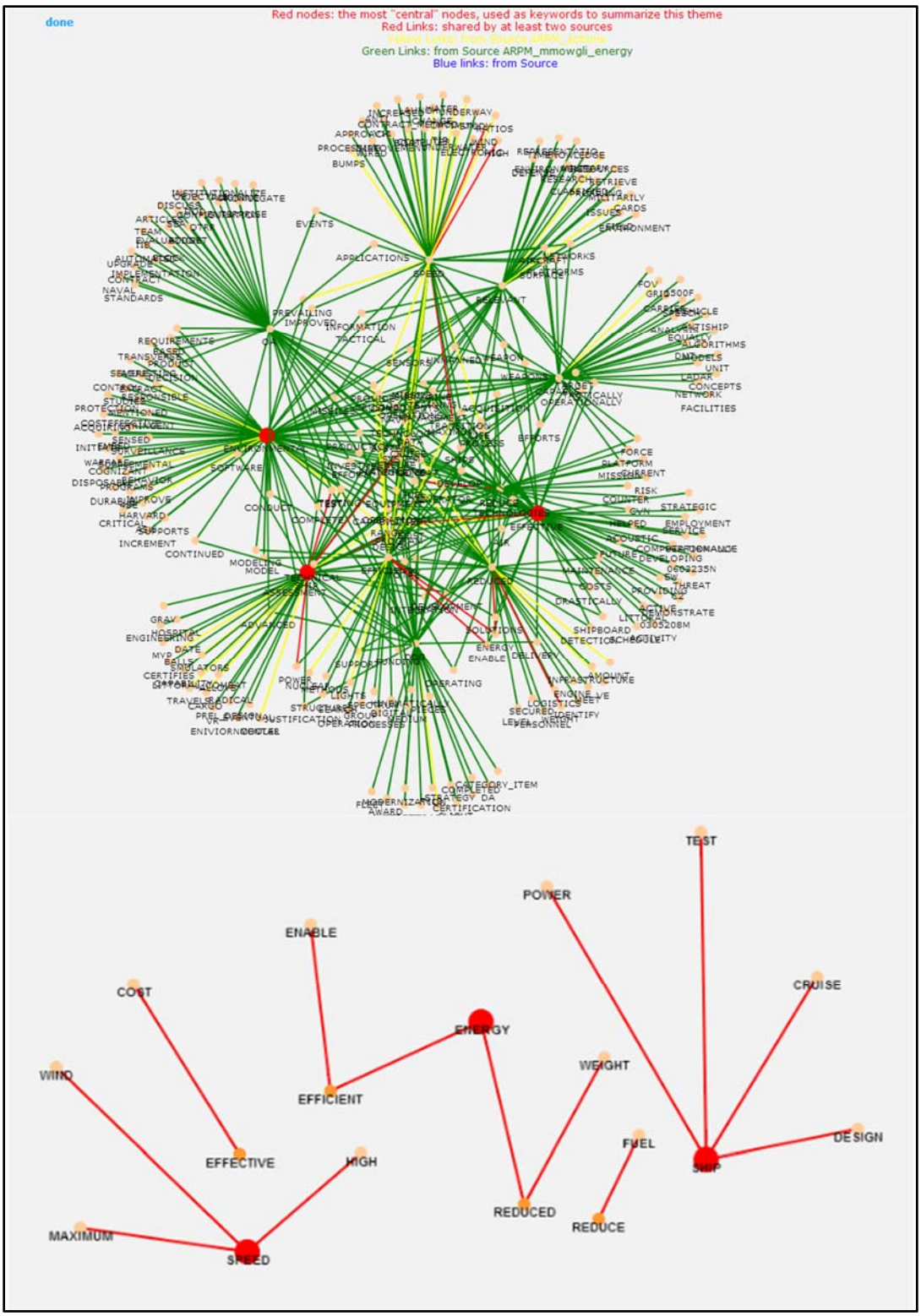

Figure 11. Theme 395(E) Link-Strength Visualizations: "Environmental, Ship, & Effective"

A separate matrix can be constructed for each theme for the word pairs that belongs to only a theme. Figure 12, the correlation matrix for Theme 395(E) labeled as

"environmental, ship, & effective," which has the highest matched word pairs in Figure 12. The matched PEs are sorted according to the number of matched action plans. For example, the top matched PE is "0603724N_PB_2013," titled "Navy Energy Program," indicating that there 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. Also shown in Figure 12, two concepts, "energy efficient" and "ship design," are dominant in this theme. They are dominant because there are four (4) and two (2) out of 38 action plans contain word pairs "energy efficient" and "ship design," respectively. This seems to suggest that "efficient energy" may have to work with the concept "ship design." However, among the 12 PEs that mentions "ship design," only one entry mentions "energy efficient." This indicates that 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_3_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

Figure 12. Match Matrix for Theme 395(E)

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

In the near future, we will engage the students, faculties, and a wide acquisition research community to continue the discussion of the DoD energy efficiency and possible solutions through series of planned MMOWGLI games (MMOWGLI Energy Game Portal, 2012). As possible acquisition professionals being Game Masters, the brainstorming and discussions can be steered towards more specific requirements, for example, the ones below:

1. How to provide operational forces greater flexibility and reduce their dependency on logistics infrastructure.
2. How to change the DoD's current requirements and acquisition processes so they do not undervalue technologies with the potential to improve energy efficiency.

The results from the match matrices can be recommended areas for the seed questions for a MMOWGLI energy game.

Conclusions

Multiple useful conclusions of broad applicability arise from this work.

- We demonstrated the use of the MMOWGLI social media brainstorming platform and LLA as a combined collective intelligence platform to gather consensus via the MMOWGLI energy game and match data using LLA, with the current existing DoD programs, derived from Navy 2013 PEs documents.
- We identified critical variables, elements, concepts, or word pairs that can be linked to Navy energy efficiency within and among numerous programs.
- We used match matrices for each individual theme found through LLA to identify energy-related parameters or elements as word pairs, and then we used these word pairs to further identify opportunities in the current process, (i.e., what PEs might be good candidates to engage the energy-related action plans discussed in the MMOWGLI energy game?).
- We found that the great majority of Navy programs are affected by (or even critically dependent on) energy issues, but goals and even terms are handled inconsistently.

Therefore, 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.

The resulting capability, the automation of LLA computations and an analyst interface for report generation, demonstrate MMOWGLI together with LLA as an important tool throughout the longer life cycle of the acquisition process for incorporating the "fully burdened cost of fuel" into acquisition analyses.

Recommendations for Future Work

Much work can continue; specifically, we see excellent potential in the following:

- Crowd sourcing to provide meaningful feedback on either cross-cutting themes (such as energy reduction/efficiency) or specific acquisition programs.
    - For example, acquisition experts might participate in the Business Innovation Initiative (bii) MMOWGLI Game Round 2 in summer 2013 to gain further experience in relevant crowd-sourcing capabilities.
- Building 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 producing 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 that 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 that should continue, both for proposed and current programs of record. Games + link analysis, 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 needs to be handled consistently across programs. Terms of reference, metrics, and 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 DoD-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?
- Open question: How can these tools statistically identify discussions that are focused on concepts in novel combinations? In other words, are they "on topic" but not explicitly addressed by the reference documents? These are the discussions where significant innovation may be occurring.
- Improving the defense acquisition process is a major challenge that holds potentially massive payoffs. Decision-milestone preparations can benefit from broader review and judicious cross-program comparisons that discover possibilities that aren't already recognized. Future rounds of the BII MMOWGLI game will continue investigating how crowd-sourcing techniques might best be applied to make a good acquisition process even better.

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Acknowledgements

This work has also been informed by related work described in these proceedings (Guertin, Womble, & Bruhns, 2013). Essential support to perform this applied research work was provided by the NPS Defense Acquisition Research Program, Deputy Assistant Secretary of the Navy (DASN) Research, Development, Test, and Evaluation (RDT&E), and the Office of Naval Research (ONR) Office of Innovation. The authors gratefully acknowledge the contributions of Garth Jensen, Becca Law, Paul Bruhns, and Nickolas Guertin. We especially thank all of the many players who contributed their time and ideas by participating in the Energy and BII MMOWGLI Games.

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

"Fuel," as an independent variable, can be crucial for improving DoD energy efficiency. For example, according to the DoD energy inefficiency report (DoD Acquisition Technology, 2012),

> The current process either does not consider fuel, or considers only the commodity price. However, moving fuel into and around the theater of combat imposes significant operational burdens and vulnerabilities, drives force structure toward support at the expense of combat operations, and increases costs for delivery and logistics. Neither current requirements nor

acquisition processes accurately explore tradeoff opportunities using fuel as an independent variable. This prevents an end-to-end view of fuel utilization and distorts platform design choices, consequently preventing DoD from achieving maximum combat benefit for its logistics effort.

We argue that by matching the data and consensus gathered from the collective intelligence platform (e.g., MMOWGLI energy game data with the current existing DOD programs, exemplified in the Navy 2013 PEs documents), we can identify critical variables, elements, concepts or word pairs that are linked to energy. Therefore, without imposing significant operational burdens and vulnerabilities, innovative "energy efficiency" ideas from the game might be naturally implemented into the current processes that drives force structures, combat operations, delivery, and logistics.

We use match matrices for each individual theme found through LLA to identify energy-related parameters or elements as word pairs, and then we use these word pairs to identify the opportunities in the current process (i.e., what PEs might be good candidates to engage the energy-related parameters/elements/concepts/word pairs discussed in the MMOWGLI energy game). These findings are listed below.

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 Plans 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.

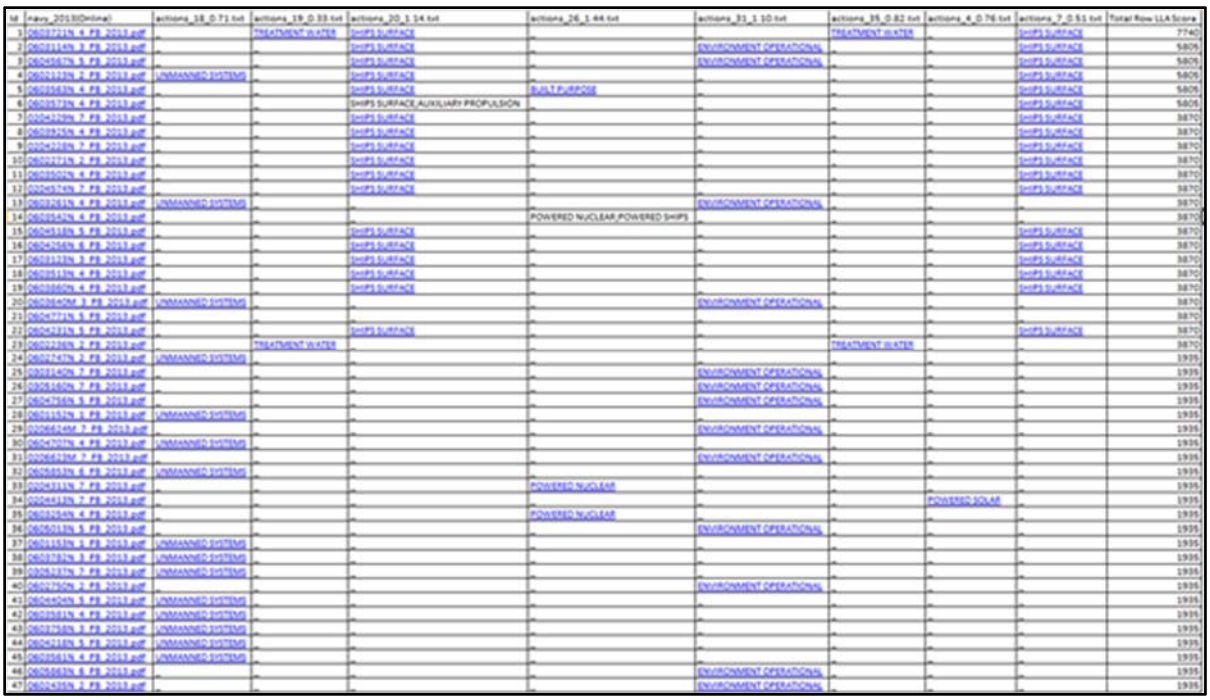
The match matrix for Theme 393 suggests that the PEs with the concepts “Navy energy,” “energy systems,” “power generation,” “alternative fuel,” “alternative energy,” “renewable sources,” and “costs—energy/infrastructure” could be used good candidates to implement the innovative ideas related to Action 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.”

The match matrix for Theme 458 shows that the PEs mentioned (“naval expeditionary,” “ship board,” and “strike carrier”) can good candidates to engage Action Plans 15 and 26.

- Action 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 26: Expand use of nuclear power in the fleet.

Related concepts include “multiple hardware,” “operating time,” and “dashboard energy.”



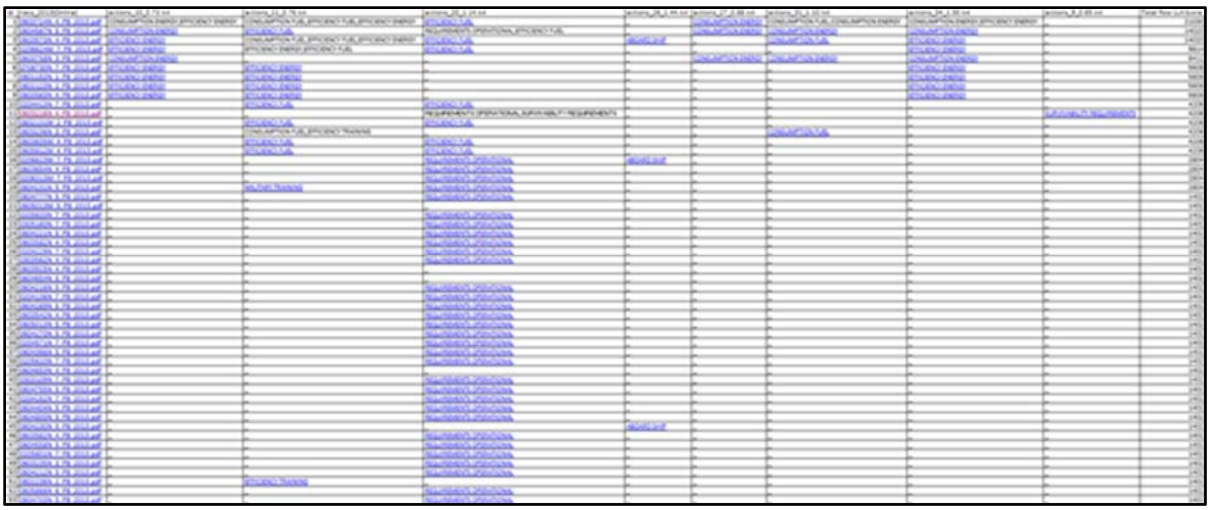
The matrix for Theme 905 that the PEs involved ("unmanned systems," "surface ships," "nuclear powered," "operational environment," and "water treatment") can be good candidates for engaging Action Plans 18, 19, 20, 26, 31, 35, 4, and 7.

- Action Plan 18: Offshore basing.
- Action Plan 19: Implement 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/vertical 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 capacity.
- 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.

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	0206658N_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	0206620N_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

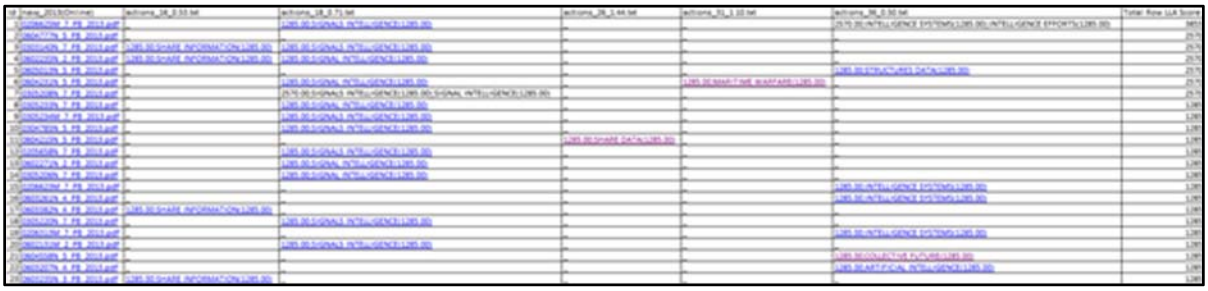
The match matrix for Theme 132 shows that the PEs mentioned ("additional energy," "ground forces" [e.g., PE 0602131M, PE 0603640M; PE 0206313M; PE 0602750N; PE 0605013M; PE 0604404N], "harvesting energy" [e.g., PE 0602236N: Warfighter Sustainment Applied Res; PE 0603673N: (U)Future Naval Capabilities Advanced Tech Dev; PE 0601153N: Defense Research Sciences; PE 0602123N: Force Protection Applied Res], "potential energy," and "hydrodynamic forces") are the good candidates to engage Action Plans 14, 15, 17, 18, 34, and 7.

- Action Plan 14: Recycle everything biological into fuel: waste, etc.
- 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 it 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 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, reduce need for tugs.



The match matrix for Theme 787 suggests that the PEs ("energy efficiency" and "fuel efficiency") 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).



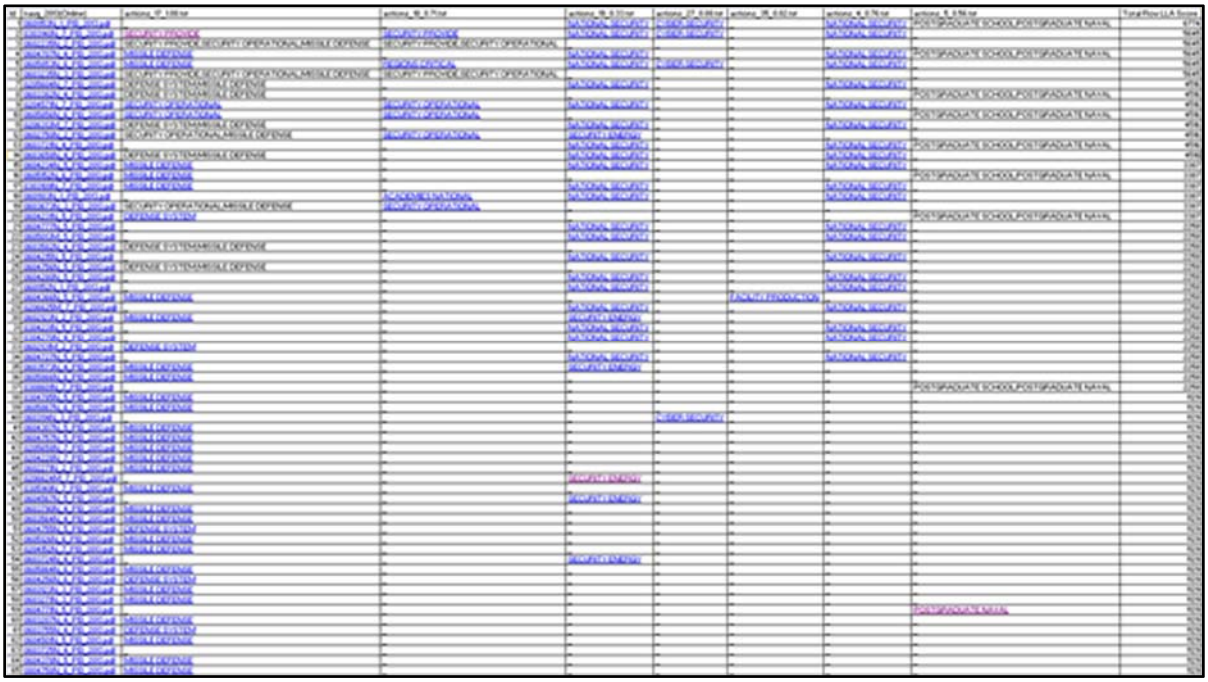
The match matrix for Theme 494 suggests that the PEs mentioned ("shared information," "signal intelligence," "share data," "data structures," "intelligence systems," "artificial intelligence," and "maritime warfare") might be good candidates to engage Action Plans 16, 18, 26, 31, and 36.

- Action Plan 16: Using synthetic lubricants to save 5% to 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 being sought.

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") can be good candidates to engage Action Plans 11, 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 (liquid fluoride thorium reactor [LFTR]) for power generation off the grid.
- Action Plan 4: Change small land vehicle transportation to hybrid vehicles in non-combat capacity.



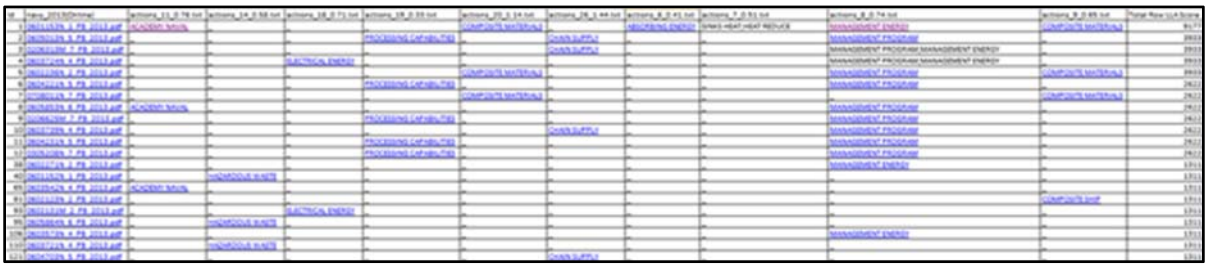
The match matrix for Theme 326 suggests that the PEs mentioned ("energy security," "missile defense," "operational security," "cyber security," "national security," and "Naval Postgraduate School") might be good candidates to engage Action Plans 17, 19, 4, 27, 4, 35, and 5.

- 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

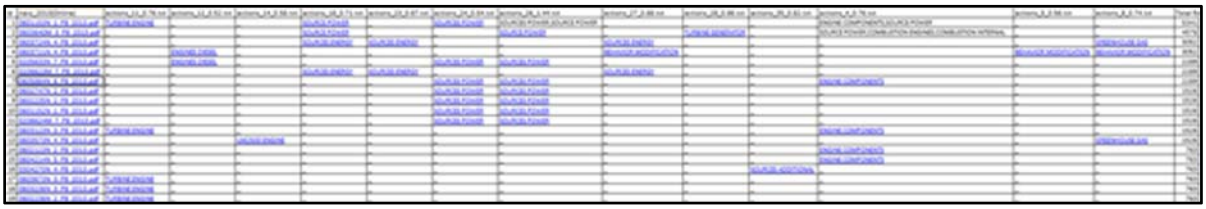
The match matrix for Theme 917 suggests that the PEs mentioned ("nuclear power," "nuclear technology," "safety standards," "logistics systems," "logistics management," "standards development/data," and "common standards") might be good candidates to engage Action Plans 16, 18, 25, 26, 31, 34, and 9.

- Action Plan 34: Create 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") 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") might be good candidates to engage "behavior modification" related Action Plans 27, 8, and 5.

- Action 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 5: Incentivize behavior to reduce electricity usage in Navy housing.
- Action 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	_	_	1906
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	0603114N_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	0204785N_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	0601153N_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	0603542N_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	0602271N_3_PB_2013.pdf	_	_	_	_	POWER MANAGEMENT	_	_	_	662
36	0605804M_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

The match matrix for Theme 732 suggests that the PEs mentioned ("ship surface," "fleet surface," "power management," "ship power," "supplying power," and "generating power") might be good candidates to engage action plans mentioned ("mobile power," "electric warship," "training centers" and "ocean wave"). These PEs include, for example, the following:

- 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

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	5861
2	0602235N_2_PB_2013.pdf	_	MEDIA SOCIAL	MEDIA SOCIAL	_	_	_	_	_	2574
3	0603640M_3_PB_2013.pdf	_	_	_	PROJECTION POWER;PLATFORMS MARINE	_	_	_	_	2574
4	0604213N_5_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	SEQUORES 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	0603132N_1_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
9	0604567N_5_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
10	0603132N_6_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
11	0602651M_2_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
12	0602131N_2_PB_2013.pdf	_	_	_	PROJECTION POWER	_	_	_	_	1287
13	0208131M_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	0601153N_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

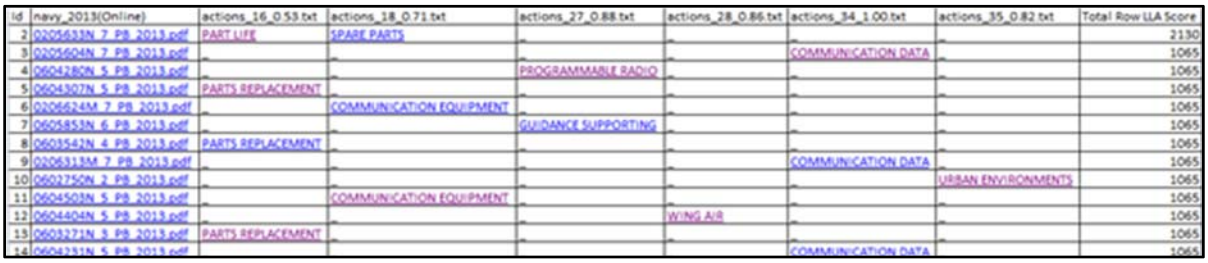
The match matrix for Theme 449 suggests that the PE mentioned ("power projection") can be used to engage "social media" for "fuel/energy saving."

- Action 11: Enhanced education to develop an energy efficient fleet, 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	0603774N_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	0604307N_5_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	IRON BATH;IRON WORKS	_	_	CONSTRUCTION SHIP	4392
4	0603573N_4_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	OPERATIONS FLEET	_	CONSTRUCTION MILITARY	CONSTRUCTION SHIP	4392
5	0603561N_4_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	KEEPING SEA	_	_	CONSTRUCTION SHIP	3294
6	0604777N_5_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	_	_	_	CONSTRUCTION SHIP	2196
7	0603553N_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	0603723N_2_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	_	_	_	CONSTRUCTION SHIP	2196
12	0603961N_4_PB_2013.pdf	CONSTRUCTION SHIP	_	_	_	_	_	_	_	CONSTRUCTION SHIP	2196
13	0603725N_4_PB_2013.pdf	_	_	WORKS PUBLIC	_	_	_	_	CONSTRUCTION MILITARY	_	2196
14	0603739N_2_PB_2013.pdf	_	_	_	_	_	_	OPERATIONS RESEARCH	_	_	1098
15	0604267N_5_PB_2013.pdf	_	_	_	_	_	OPERATIONS FLEET	_	_	_	1098
16	0605152N_6_PB_2013.pdf	_	_	_	_	OPERATIONS SHIP	_	_	_	_	1098
17	0304373N_7_PB_2013.pdf	_	_	_	_	_	OPERATIONS FLEET	_	_	_	1098
18	0605877N_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	0305601N_7_PB_2013.pdf	_	_	_	_	_	_	_	CONSTRUCTION MILITARY	_	1098
23	0602435N_2_PB_2013.pdf	_	_	_	_	_	OPERATIONS FLEET	_	_	_	1098
24	0603236N_2_PB_2013.pdf	_	_	_	_	_	_	OPERATIONS RESEARCH	_	_	1098
25	0305601N_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,” and “operations research”) 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 ship cooler; 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	0206331M_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”) might be good candidates for Action Plans 16, 18, 27, 28, 34, and 35.

- Action 16: Using synthetic lubricants to save 5% to 25% of energy costs.
- Action 18: Offshore basing.
- Action 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 28: Power on-board minor electronics with stationary bikes used for personnel fitness training.
- Action 34: Online feedback and social networking.
- Action 35: 3D farming: Less land use and local agriculture reducing fuel use and potential location of bio-fuel crops.

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") might be good candidates to engage Action Plans related to these concepts.

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

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