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



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

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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 <a href="https://www.acquisitionresearch.net">www.acquisitionresearch.net</a>, 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
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# Improving DoD Energy Efficiency: Combining MMOWGLI Social-Media Brainstorming With Lexical Link Analysis (LLA) to Strengthen the Defense Acquisition Process

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

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# 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/ldeaCardChainEnergy2012.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

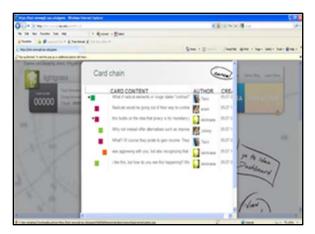


Figure 3. Ideas Collected in the Color-Coded Tree-Structured Categories

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).

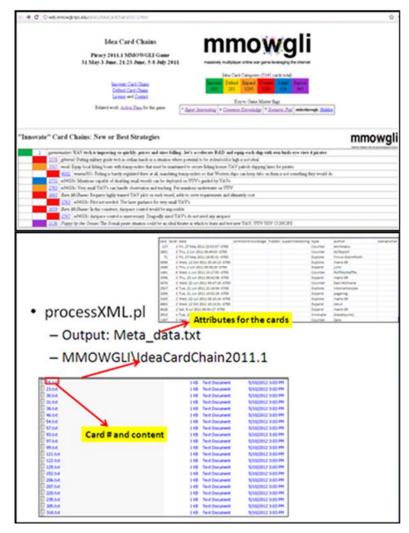


Figure 4. Idea Cards Transformed to LLA Inputs (e.g., a Directory With Files of Content of the Cards and Attributes, meta\_data.txt)

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."

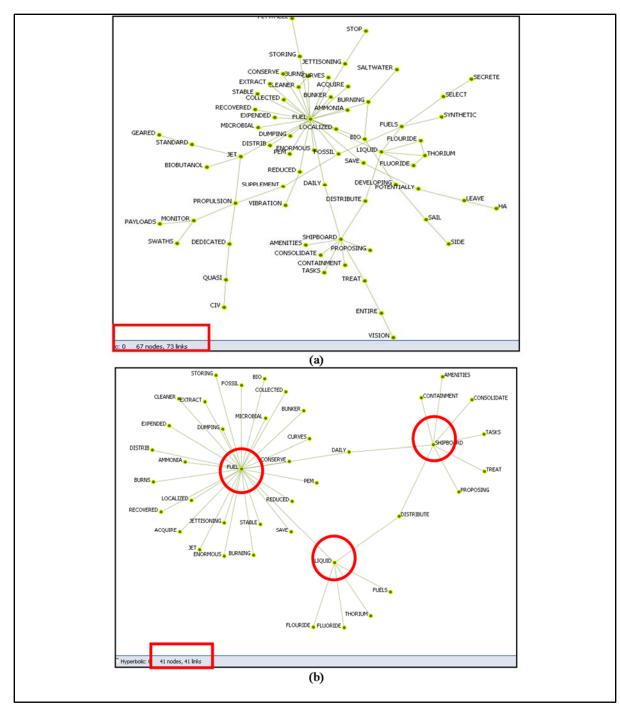


Figure 5. Two Steps LLA Iterations to Group Word Pairs Into Themes

#### **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.



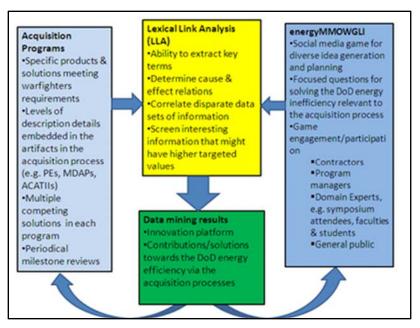


Figure 6. A Glance of the Proposal Objective

#### 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.

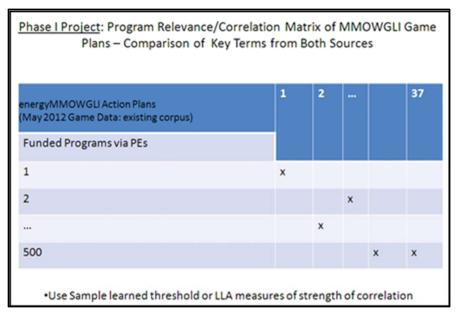


Figure 7. Phase I Relevance Matrix

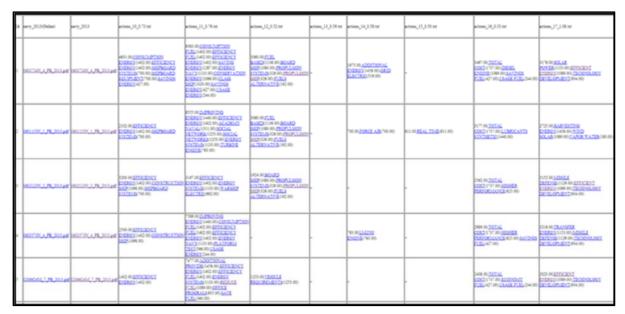


Figure 8. The Overall Match Matrix for the MMOWGLI Energy Game Action Plans and Navy 2013 Program Elements

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.

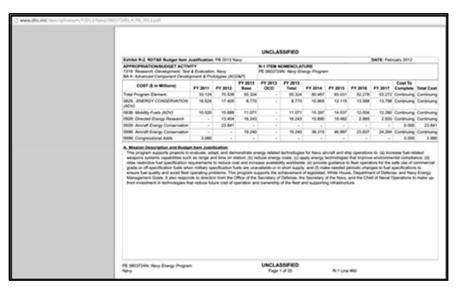


Figure 9. Navy Energy Program Element

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.

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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

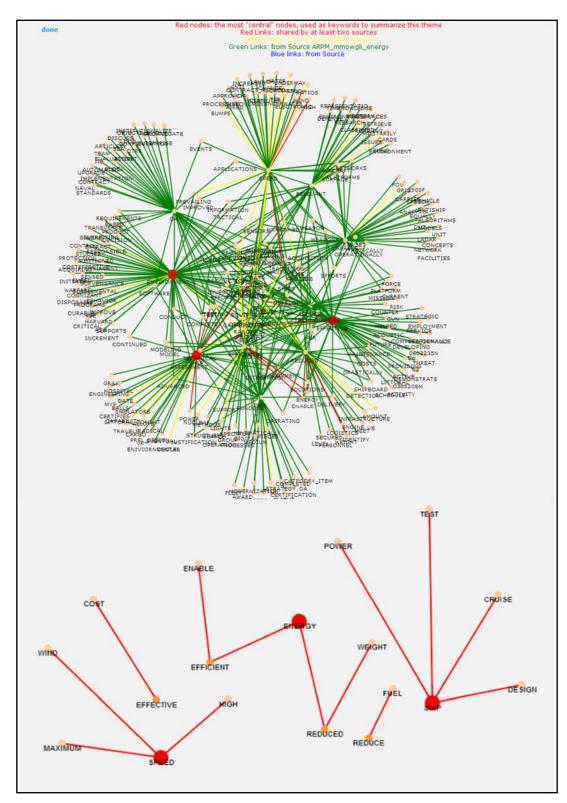


Figure 11. Theme 395(E) Link-Strength Visualizations: "Environmental, Ship, & Effective"

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."

																#of matched
PEID	PETitle	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	action plans
0603724N_4_P8_2013	Navy Energy Program					<b>ENERGY EFFICIENT</b>		GENERATOR SETS	<b>ENERGY EFFICIENT</b>	SHIP DESIGN	<b>ENERGY EFFICIENT</b>	DIESEL ENGINE			SHIP DESIGN	7
0206624M_7_PB_2013	Marine Corps Cmbt Services Supt			ENERGY EFFICIENT		ENERGY EFFICIENT		REDUCE FUEL	<b>ENERGY EFFICIENT</b>		ENERGY EFFICIENT					5
0601153N_1_P8_2013	Defense Research Sciences	TURBINES GAS	SPEED HIGH							SHIP DESIGN					SHIP DESIGN	4
0206623M_7_P8_2013	MC Ground Cmbt Spt Arms Sys			ENERGY EFFICIENT		ENERGY EFFICIENT			ENERGY EFFICIENT		ENERGY EFFICIENT					4
0602123N_2_P8_2013	Force Protection Applied Res			WIND SOLAR, ENERGY EFFICIENT		ENERGY EFFICIENT			ENERGY EFFICIENT		ENERGY EFFICIENT					4
0603563N_4_P8_2013	Ship Concept Advanced Design		SPEED HIGH							SHIP DESIGN				MAXIMUM SPEED	SHIP DESIGN	4
0602271N_2_P8_2013	Electromagnetic Systems Applied Research			ENERGY EFFICIENT		ENERGY EFFICIENT			ENERGY EFFICIENT		ENERGY EFFICIENT					4
0604567N_5_P8_2013	Ship Contract Design/Live Fire T&E	TURBINES GAS								SHIP DESIGN					SHIP DESIGN	3
0603721N_4_P8_2013	Environmental Protection									SHIP DESIGN			DIESEL ENGINES		SHIP DESIGN	3
0603561N_4_P8_2013	Advanced Submarine System Development									SHIP DESIGN					SHIP DESIGN	2
0603512N_4_P8_2013	Carrier Systems Development									SHIP DESIGN					SHIP DESIGN	2
0604777N_5_P8_2013	Navigation/ld System									SHIP DESIGN					SHIP DESIGN	2
0605152N_6_P8_2013	Studies & Analysis Supt - Navy									SHIP DESIGN					SHIP DESIGN	2
0204413N_7_P8_2013	Amphibious Tactical Supt Units									SHIP DESIGN					SHIP DESIGN	2
0708730N_7_P8_2013	Maritime Tech (MARITECH									SHIP DESIGN					SHIP DESIGN	2
0605866N_6_P8_2013	Navy Space & Electr Warfare Supt									SHIP DESIGN					SHIP DESIGN	2
0603236N_3_P8_2013	Warfighter Sustainment Advd Tech		1													1
0603673N_3_P8_2013	Future Naval Capabilities Advanced Tech Dev		SPEED HIGH													1
0603640M_3_P8_2013	MC Advanced Technology Demo				GENERATOR TURBINE											1
0602114N_2_P8_2013	Power Proj Applied Research	TURBINES GAS														1
0205633N_7_P8_2013	Aviation Improvements												DIESEL ENGINES			1
0604258N_6_P8_2013	Target Systems Development													MAXIMUM SPEED		1
0603658N_4_P8_2013	Cooperative Engagement						REDUCED WEIGHT									1
0603758N_3_P8_2013	Navy Warfighting Exp & Demo										REDUCED ENERGY					1
	Warfighter Sustainment Applied Res		SPEED HIGH				REDUCED WEIGHT									1
		SHIP POWER														1
0603564N_4_PB_2013	Ship Prel Design & Feasibility Studies		SPEED HIGH													1
0208058N_7_P8_2013	Joint High Speed Vessel (JHSV)		SPEED HIGH												$\overline{}$	1
	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 costeffectiveness 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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## 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 P8 2013.pdf	SHIPBOARD SYSTEMS; SHIPBOARD EQUIPMENT	_	EXISTING FLEET	2100
5	0604777N 5 P8 2013.pdf	SHIPBOARD SYSTEMS	_	EXISTING FLEET	1400
6	0603512N 4 P8 2013.pdf	SHIPBOARD EQUIPMENT; SHIPBOARD SYSTEMS	_	_	1400
7	0205633N 7 PB 2013.pdf	_	SECONDARY POWER	_	1400
9	0604567N 5 P8 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 P8 2013.pdf	SHIPBOARD SYSTEMS	2	_	700
41	0205620N 7 P8 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.

	actions_32_0.75.64	actions_12_676.ne	actions_17_1.08.ne		WITISMS_22_0.65.5K	ections 28,036 tel	actions_34_1.00 tel		Total Row U.A.Score
\$10606724N; 4, PB 2013.pdf		ENERGY NAVY		ALTERNATIVE PURIL GENERATION POWER ALTERNATIVE ENERGY RENEWABLE SOURCES	RENEWABLE ENERGY		COSTS ENERGY	ALTERNATIVE FUEL	29799
2 (MC1153N 1 PR 2015 per		ENERGY SYSTEMS		ALTERNATIVE PUBLICIENSHATION POWER	REMEMBABLE ENERGY			ACTESTATIVE FUEL	33390
\$10602128N 2 FB 2013.pdf		ENERGY SYSTEMS		GENERATION POWER, ALTERNATIVE ENERGY					10197
400601131M 2 PS 2013 per				ALTERNATIVE FUEL GENERATION FOWER				ALTERNATIVE FUEL	9064
NORCHSTON 4, PR. 2013 ANT		ENERGY NAVY		GENERAL TOWN POWER					9064
#EDDOMENIA 7 FB 2015 per		ENERGY SYSTEMS		CONSTRUCTOR FOREST	RENEWABLE ENERGY				7901
750601640M 3 FS 2013.pdf			_	GENERATION FOWER RENEWARDS SOURCES					6798
#IDM01152N 1 PR 3015 AMF				SENERATION POINTS					4532
9 06045679 5 FB 2013 Adr				SENERATION FOWER					4532
10 0604274N 5 PR 2015 per				SENERATION FOWER					4552
15 OKC1758N, 3, FB, 2013 AMF				SENERATION FOREST					4532
12(0601206N 3 FB 2013 per				SENERATION FOWER					4552
18/0804512N 5 FB 2013.pdf									2264
14 020423M 7 FB 2013 pdf					RENEWABLE ENERGY				2364
15 0206313M 7 FE 2013 per		ENERGY SYSTEMS							2294
14/06527N7N 2 PB 2013.pdf					KINETIC EMERCY				31.99
IP DESCRIPT A PE 2013 AND	_								1133
16 0303140N 7 PS 2013 pdf	MACHINE YORTUNG								3139
1910504795N 5 FB 2013 Adf 1									11.99
20 0804080% 1 PR 2015 per									1199
2150602271N 2 PB 3013.pdf								_	3139
17 (MESSEEN & PR. 2013 per									1139
29/0604276M S FE 2013 ANT					100				3133
24 0604292N S FB 2015 per									3339
25/0603237N, 4, FS, 2013 per	MACHINE YIETURE								1139
IN CHESTAN & PR 2012 AND									1199
27 DECISION 4 PS 2013 per									1159
76 0604230W 5 FB 2013 pur									1339
29/0605873M 6 FB 2013 par									1139
1051206625M 7 FB 2013.pdf		3.5	STATHON BASE						1139
50/0000231N 5 PB 2013 per 52/0602750N 2 PB 2013 per						COSTS IMPRASTRUCTURE			1139
52 DECEMBER 2 PR 2013 ANT		ENERGY SYSTEMS							1139
\$810605154N 6 PB 2013 per									1139
\$4.0004800W 5 PB 2015 put									11.00
15 0604717M 7 PE 2013 per									1133
MIDSONSOM 4 PE 2003 per									1199
17/08/25812M 4 FB 2013 pdf									1155

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."

ld new_2013(Online)	ections_32_0.73.64	ections 12 0 52 net	actions 15 0 50 se	actions_22_0.63.txt	actions 25 0.88 to	actions 26,144 tel	actions_\$2_050 tel	actions 4 0.76 tet	ections 5 0.56 for	Total flow U.A.Score
2 0604231N 5 FB 2003.0	of .		EXPEDITIONARY NAVAL	ACTION ITEMS		STRIKE CARRIER		_		4320
3 0603724N 4 PB 2013 p	et l	BOARD SHIP				STRIKE CARRIER		_	DASHBOARD ENERGY	3240
4 0206624M 7 PB 2013 p	25			OPERATING TIME				OPERATING TIME		2160
\$ 0603542N 4 PB 2013.0	et l.	BOARD SHIP						APPLICATION MILITARY		2160
# 0604311N 5 PB 2013.p	of I.		DIFFORTIONALLY NAVAL							1080
9 06035127V 4 PB 2053 p	er l		-			STRIKE CARRIER				1080
10 0205453N 7 PB 2015 p	et l						BOARD SQUIPMENT	_		1080
11 0602582N 4 PS 2013.p	of I.					STRIKE CARRIER				1080
\$3 0602782N 2 PB 2013.0	ef L				OPERATING NETWORK			_		1080
14 0604280N 5 PB 2013 p	of MULTIPLE HARDWARE									1080
15 0604234N 5 PB 2013.p	et l					STRIKE CARRIER				1080
16/0205658N 7 PB 2003.p	<u>#</u> ].			_		STRIKE CARRIER		_		1060
17/0804216N 5 PB 2013.0	et l.					STRIKE CARRIER				1080
18/0605152FV 6 PB 2013.p	ef l.					STRIKE CARRIER		_		1080
19 0603261N 4 PB 2003.0	et .					STRIKE CARRIER				1080
2010601135N 1 PB 2013 c	et l	SOARD SHIP								1080
21 0602125N 2 PS 2005.p	et l	SOARD SHIP								1080
22 0204152N 7 FB 2013.p	of I					STRIKE CARRIER				1080
29 0602750N 2 PB 2013.p	of L		DIPEDITIONARY NAVAL	_						1080
24 0602131M 2 PB 2013 d	at .		EXPEDITIONARY NAVAL							1080
25 0603581N 4 PB 2013.p	of .		-			STRIKE CARRIER				1060
26 0604230N 5 PS 2003.p			DIFFORTIONARY NAVAL							1080
2710603640M 3 PB 2013 c	27		DIPEDITIONARY NAVAL							1080
28 0603235N 3 FB 2013.0			DIFFORTIONARY NAVAL							1080
29 0603755N A PS 2003 p						STRIKE CARRIER				1080
\$0006042128y % #8 2013 o						STRIKE CARRIES				1060

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."

3	nevy_2013(Online)	actions 58 0.71 tel	actions 19 0.33 tel	actions_20_1 14 tot	actions 26_1.44 tot	actions 31 1 10 cut	actions 35, 0.82 tot	actions 4 0 76 tel	actions, 7, 0.51 tot	Total Row LLAScore
	0602721N 4 PB 2013 pdf		TREATMENT WATER			_	TREATMENT HINZER	-	SHIPS SURFACE	7740
	0602114N 3 PR 2013.pdf			SHIPS SURFACE		ENVIRONMENT OPERATIONAL			SHIPS SURFACE	5805
	0604567N 5 PE 2013.pdf			SHIPS SURFACE		ENVIRONMENT OPERATIONAL			SHIPS SURFACE	5805
		UNMANNED EISTEMS		SHIPS SURFACE					SHIPS SURFACE	5405
	0600563N 4 FE 2013.pdf			SHIPS SURFACE	BUILT PURPOSE				SHIPS SURFACE	5405
	0600573N 4 PR 2013.pdf	*		SHIPS SURFACE AUXILIARY PROPULSION			-	-	SHIPS SURFACE	5805
	0204229N 7 PS 2013.pdf			SHIPS SURFACE			*	*	SHIPS SURFACE	3470
	0600905N 4 PR 2013.pdf			SHIPS SURFACE					SHIPS SURFACE	3870
	0204228N 7 FB 2013.6df			SHIPS SURFACE					SHIPS SURFACE	3870
10	0602271N 2 FB 2013 pdf			SHIPS SUBFACE				*	SHIPS SURFACE	3470
	0603502N 4 PR 2013 adf			SHIPS SURFACE			*		SHIPS SURFACE	3870
	0204574N 7 FB 2013.pdf			SHIPS SURFACE			*		SHIPSSURFACE	3870
	0602261N 4 FB 2013.pdf	UNMANAGED SYSTEMS	_			ENVIRONMENT OPERATIONAL		*		3870
	0600542N 4 FB 2013 pdf	And Company of the Party of the			POWERED NUCLEAR FOWERED SHIPS	And a second sec	*	-	-	3870
	0604518N 5 P8 2013.pdf			SHIPS SURFACE			•	_	SHIPS SURFACE	3870
	0604256N 6 FS 2013.pdf			SHIPS SURFACE			*		SHIPS SURFACE	3870
	0602123N 3 PR 2013 pdf			SHIPS SURFACE			-	*	SHIPS SURFACE	3870
	0600513N 4 FB 2013.pdf			SHIPS SURFACE			*	*	SHIPS SURFACE	3470
	0600060N 4 PR 2013 pdf		-	SHIPS SURFACE			*	*	SHIPS SURFACE	3870
	0600640M 3 FB 2013.6dF	UNMANAGE SYSTEMS				ENVIRONMENT OPERATIONAL	*	*	Secretary Secret	3870
	0604771N 5 FR 2013 art					Annual Control of the	*	*	*	3870
	0604231N S PR 2013 pdf	^		SHIPS SURFACE	-		*	-	SHIPS SURFACE	3870
	0602236N 2 FB 2013.pdf	-	TREATMENT WATER			-	TREATMENT HIRTER	*	-	3870
	0602747N 2 FE 2013.pdf	UNMANNED SYSTEMS	CONTRACTOR OF THE PARTY OF THE				Control of the Contro			1919
	0902140N 7 PS 2013.pdf	And in case of the last of the				ENVIRONMENT OPERATIONAL	*	*	*	1939
	0905160N 7 PR 2013.pdf	-		*	1	ENVIRONMENT OPERATIONAL	*	*	-	1935
	0604756N 5 FB 2013.pdf	-	•		*	ENVIRONMENT OPERATIONAL	*	*	-	1935
	0601152N 1 FR 2013 pdf	CHANGED SYSTEMS	-	*	-	And and a second second	*	*	-	1935
	0206624M 7 PR 2013 adf	A STATE OF THE PARTY OF THE PAR	_	*	1	ENVACAMENT OFFIATIONAL	*	-	-	1935
	0604707N 4 PE 2013 pdf	CHARAGNET SYSTEMS		-		The second secon	•	-	-	1936
	0206623M 7 PR 2013 per	And in case of the last of the	•	1		ENVACAMENT CREATIONS	*	*	-	1916
	0605853N 6 FR 2013 pdf	UNMANAGED SYSTEMS	-		*	ALL DESCRIPTION OF THE PARTY OF	•	-	*	1936
	0204311N 7 PB 2013.pdf	And in case of the last of the	-	*	POWERED NUCLEAR	-	-	-	*	1935
	0204413N 7 PB 2013.pdf	-		-	CALLACTOR CO.	-	-	POWERED SOLAR	-	1935
	0603254N 4 PS 2013.pdf				POWERED NUCLEAR		*	-	-	1935
	0605013N 5 PR 2012 adf			*	MANAGEMENT CO.	ENVIRONMENT OPERATIONAL	*	-	-	1935
	0601153N 1 F9 2013.pdf	COMMANDED EXCERNAL	_	-		ATTOCKED AND ADDRESS.		-	*	1935
	0602782% 3 PS 2013 pdf		-	-			-	-	-	1935
	0905237N 7 PR 2013 pdf		*	*	-	-	*	*	-	1935
	0602750N 2 FB 2013 per	A STATE OF THE PARTY OF THE PAR	*	-		ENVACAMENT OF STATIONAL	*	*	*	1936
	0604404N S FR 2013 pdf	LINASHANIES EVERTINAL	-	-		The state of the s	•	*	-	1936
	0602581N 4 FB 2013 per		-	-		*	*	-	-	1935
		COMMANGE STREET	-	-		*	*	-	-	1935
	0602758N J FR 2013.pdf		-	-		-	-	-	-	1935
	0604218N 5 FB 2013.pdf 0602561N 5 FB 2013.pdf		-	-		-	*	-	-	
	0605563N 5 PR 2013.pdf	ALL DESIGNATION OF THE PARTY OF	-	-		CHARLEST CHEST CONTRACTOR OF	-	-	-	1935
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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	1	*	2912
6 0603724N 4 PB 2013.pdf	ADDITIONAL ENERGY	_		LINE CONTRACTOR OF THE PARTY OF	POTENTIAL ENERGY	*	2912
7 0603673N 3 PB 2013.pdf			HARVESTING ENERGY	HARVESTING ENERGY		*	2912
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9 0603640M 3 PB 2013.pdf		FORCES GROUND	-	-	-	*	2912
10 0605812M 4 PB 2013.pdf	*	CONSTRUCTION OF THE PERSON OF	*	*	-	*	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	HARACOTTING ENERGY	PARATESTING ENGINGS	-	-	1456
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17 0603582N 4 PB 2013.pdf		-	-	-	-		1456
18 0604761N 5 P8 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		1	*	*	1	*	1456
41 0603721N 4 PB 2013.pdf			*			-	1456
42 0604231N 5 PB 2013.pdf			-	*	1	*	1456
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44 0603235N 3 PB 2013.pdf	•	-	-	-	-	-	1456
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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.



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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).

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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.

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- 2	2 0603747N 3 PB 2013 pd	TECH ADVANCED		GREATER EFFICIENCY	_	GREATER EFFICIENCY	_		3249
- 3	3 0206624M 7 PB 2013 pd			GREATER EFFICIENCY		GREATER EFFICIENCY			2166
4	4 0604230N 5 PB 2013.pd			GREATER EFFICIENCY	_	GREATER EFFICIENCY		_	2166
- 9	9 0605873M 6 PB 2013 pc			_		_		_	1083
11	1 0206313M 7 P8 2013 pd			_	_	_		_	1083
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14	4 0204202N 5 PB 2013.pd			_	_		_		1083
35	5 0604231N 5 PB 2013.pd			_	_	_		_	1083
26	6 0603207N 4 PB 2013.pd	_	_	_	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.

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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.



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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
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6	0702239N 7 PB 2013.pdf			_			LOGISTICS MANAGEMENT	STANDARDS DEVELOPMENT		1446
7	0604231N 5 PB 2013.pdf			_			LOGISTICS MANAGEMENT	STANDARDS DATA	_	1446
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9	0604215N 5 PB 2013.pdf			_				STANDARDS DEVELOPMENT		723
10	0604404N 5 PB 2013.pdf			2		_	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		29	3		NUCLEAR TECHNOLOGY	9			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.

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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.

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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.

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		WARSHIP ELECTRIC			MOBILE POWER	<b>POWER MANAGEMENT</b>			SURFACE SHIP	3310
	0603573N 4 PB 2013.pdf	_	_	SUPPLYING FOWER		POWER MANAGEMENT		_	GENERATING POWER SURFACE SHIP	331
	0206624M 7 PB 2013.pdf				MOBILE POWER	POWER MANAGEMENT	MOBILE POWER			190
4	0603114N 3 PB 2013.pdf		STORE ENERGY						SURFACE SHIP	132
	0601153N 1 PB 2013.pdf					POWER MANAGEMENT	_	_	SURFACE SHIP	132
- 6	0602131M 2 PB 2013.pdf					POWER MANAGEMENT		PEAK FOWER		132
	0602114N 2 PB 2013.pdf							_	SURFACE SHIP	132
8	0602236N 2 PB 2013.pdf					POWER MANAGEMENT			SURFACE SHIP	132
9	0602747N 2 PB 2015.pdf								SURFACE SHIP	66
10	0604777N 5 PB 2013.pdf								SURFACE SHIP	44
11	0604258N 6 PB 2013.pdf		_				SURFACE FLEET			66
12	0602235N 2 PB 2013 pdf		_				_	PEAK POWER	_	66
13	0204229N 7 PB 2013.pdf								SURFACE SHIP	46
14	0602782N 2 PB 2013.pdf						_		SURFACE SHIP	66
15	0304785N 5 PB 2013.pdf						SURFACE FLEET			66
16	0603925N 4 PB 2013.pdf		_				_	_	SURFACE SHIP	46
17	0604756N 5 PB 2013.pdf						SURFACE FLEET			66
18	0604757N 5 PB 2013.pdf								SURFACE SHIP	46
19	0602271N 2 PB 2015.pdf	_				POWER MANAGEMENT			_	66
20	0601152N 1 PB 2013.pdf								SURFACE SHIP	66
21	0604707N 4 PB 2013.pdf						_		SURFACE SHIP	46
	0605152N 6 PB 2013.pdf								SURFACE SHIP	44
23	0603506N 4 PB 2013.pdf								SURFACE SHIP	66
24	0603564N 4 PB 2013.pdf								SURFACE SHIP	- 66
25	0205620N 7 FB 2013.pdf						_	_	SURFACE SHIP	66
24	0605873M 6 PB 2013.pdf	CENTERS TRAINING								46
27	0603563N 4 PB 2013.pdf								SURFACE SHIP	44
28	0602750N 2 PB 2013 pdf								SURFACE SHIP	66
29	0603673N 3 PB 2013.pdf		_				_		SURFACE SHIP	66
30	0603581N 4 PB 2013.pdf						SURFACE FLEET			66
31	0603123N 3 PB 2013.pdf		_	_					SURFACE SHIP	66
	0603562N 4 PB 2015.pdf							2	SURFACE SHIP	66
3.3	0604558N 5 PB 2013.pdf								SURFACE SHIP	66
	0603236N 3 PB 2013.pdf					-	_	2	SURFACE SHIP	66
35	0603271N 3 PB 2013.pdf					POWER MANAGEMENT		_		66
36	0603640M 3 PS 2013.pdf					POWER MANAGEMENT				66
3.7	0605863N 6 PB 2013.pdf							2	SURFACE SHIP	44
38	0602435N 2 PB 2013.pdf		_	_	WAVE OCEAN		_			66
39	0603747N 3 PB 2013.pdf						_		SURFACE SHIP	66

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

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_3	0603724N; 4, PB, 2013,pdf		SAYING ENERGY				SAYONS FUEL		SAVING ENERGY	3861
-3	0602235N 2 PB 2013.pdf		MEDIA SOCIAL	MEDIA SOCIAL					_	2574
	0603640M 3 PB 2013 pdf				PROJECTION POWER PLATFORMS MARINE					2574
-	0604251N 5 PB 2015.pdf				PROJECTION POWER			RESOURCES INFORMATION		2574
1	0205604N 7 PB 2013.pdf					PLATFORMS EXISTING				1287
	0204229N 7 PB 2013.pdf					PLATFORMS EXISTING				1297
3	0603114N 3 FB 2013.pdf				PROJECTION POWER					1287
	0601132N 1 PS 2013 pdf				PROJECTION POWER					1287
- 9	0604067N 5 PB 2013.pdf				PROJECTION POWER				_	1287
20	0605132N 6 PB 2013-pdf				PROJECTION POWER					1287
13	0602651M 2 FB 2013 pdf				PROJECTION POWER					1287
1.7	0602123N 2 PB 2013.pdf				PROJECTION POWER					1287
3.1	0206313M 7 PB 2013 pdf	PLATFORMS HARDWARE								1297
34	0602750N 2 PB 2013.pdf				PROJECTION POWER				_	1297
1:	0603673N 3 PB 2013.pdf	_			PROJECTION POWER				_	1297
24	0602131M 2 FB 2013.pdf				PROJECTION POWER					1287
13	0603123N 3 PB 2013 pdf				PROJECTION POWER					1287
3.6	0603575N 4 PB 2013.pdf					PLATFORMS EXISTING				1267
11	0602134N 2 PB 2013.04f				PROJECTION POWER	_				1287
25	0602256N 2 FB 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.

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- 2	0603573N, A. PB, 2003.pdf	CONSTRUCTION SHIP					IRON BATHLIRON WORKS			CONSTRUCTION SHIP	4992
_3	0204202N 5 PB 2003.pdf	CONSTRUCTION SHIP					IRON BATH, IRON WORKS			CONSTRUCTION SHIP	4392
- 4	0605720N A PS 2005 port	CONSTRUCTION SHIP					OPERATIONS FLEET		CONSTRUCTION MILITARY	CONSTRUCTION SHIP	4392
- 5	0603580N 4 FB 2003 par	CONSTRUCTION SHIP					KEEPING SEA			CONSTRUCTION SHIP	1294
- 6	0604777N 5 FB 2003.6df	CONSTRUCTION SHIP								CONSTRUCTION SHIP	2194
_7	0603512N 4 PB 2005.pdf	CONSTRUCTION SHIP						2		CONSTRUCTION SHIP	2194
	0604567h; 5.78,2013.pdf	CONSTRUCTION SHIP						4		CONSTRUCTION SHIP	2296
9	0605853N 6 PS 2003.pdf					OPERATIONS SHIP		OPERATIONS RESEARCH			2196
22	0603564N 4 PB 2003.pdf	CONSTRUCTION SHIP								CONSTRUCTION SHIP	2196
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	0601779N 4 PB 2015 pdf						_		CONSTRUCTION MILITARY		1096
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	0602236N 2 PB 2003.pdf						-	OPERATIONS RESEARCH			3098
25	0308600W 7 PB 2003 port						_	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.

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2 0205633N 7 P8 2013.pdf	PART LIFE	SPARE PARTS	_		_	-	2130
3 0205604N 7 P8 2013.pdf		_			COMMUNICATION DATA	_	1065
4 0604280N 5 P8 2013.pdf	_	_	PROGRAMMABLE RADIO	_		_	1065
5 0604307N 5 P8 2013.pdf	PARTS REPLACEMENT	_				_	1065
6 0205624M 7 PB 2013.pdf		COMMUNICATION EQUIPMENT			_	-	1065
7 0605853N 6 P8 2013.pdf		_	<b>GUIDANCE SUPPORTING</b>			_	1065
8 0603542N 4 P8 2013.pdf	PARTS REPLACEMENT	_	_	_	_	_	1065
9 0206313M 7 PB 2013.pdf		_			COMMUNICATION DATA		1065
10 0602750N 2 P8 2013.pdf		_				URBAN ENVIRONMENTS	1065
11 0604503N 5 P8 2013.pdf	_	COMMUNICATION EQUIPMENT	_			_	1065
12 0604404N 5 PB 2013.pdf		_	_	WING AIR		-	1065
15 0603271N 3 P8 2013.pdf	PARTS REPLACEMENT	_					1065
14 0604231N 5 PB 2013 6df					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.



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	DUCKTON PROGRAMS									427
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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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