75ᵗʰ MORSS 712CD Cover Page

12-14 June 2007, at US Naval Academy, Annapolis, MD

75TH MORSS
US Naval Academy
Annapolis, Maryland
June 12-13-14 2007
Through Multiple Disciplines, Analytical Power

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_____

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Using Unique Questionnaire and Interview Techniques to Inform Acquisition Decision-Making

MAJ Eric Tollefson, MAJ Jon Alt, and LTC Jeffrey Schamburg (TRAC-MTRY)

Ms. Petra Alfred (ARL-HRED)

Dr. Nita Miller and Dr. Lawrence Shattuck, COL(Ret) (NPS)

MORSS WG26 Presentation

12 June 2007

Agenda

Purpose of this briefing
To describe TRAC-MTRY survey development and analysis support to the LW/MW DOTMLPF Assessment study.

- **Objectives.**

- **Project team and background research.**

- **Methodology.**

- **Survey plan development.**

- **Survey instrument development and administration.**

- **Data consolidation and analysis.**

- **Conclusions.**

LW: Land Warrior   MW: Mounted Warrior   DOTMLPF: Doctrine, Organization, Training, Materiel, Leader Development, Personnel, Facilities

Consolidated Survey Effort Objectives

- **To design and administer questionnaires and focus group interviews for large Soldier populations based upon requiring agency input.**

- **To provide initial analyses of the questionnaire responses and focus group interviews, with additional, more-thorough, analyses as needed.**

- **Advance the state-of-the-art in survey development and administration within TRAC.**
  - **Develop an overarching methodology.**
  - **Develop supporting tools.**
  - **Demonstrate effective application of advanced analysis techniques.**

Project Team

- **Survey effort project team.**
  - **MAJ Eric Tollefson, lead analyst and project lead.**
  - **MAJ Jon Alt, supporting analyst.**
  - **LTC Jeffrey Schamburg, senior analyst.**
  - **Mr. Kevin Wainer, TRAC-WSMR.**
  - **Mr. Eric Johnson, TRAC-MRO.**
  - **Dr. Nita Miller, Naval Postgraduate School (NPS), Operations Research (Human Systems Integration).**
  - **Dr. Lawrence Shattuck, COL (Ret), NPS, Operations Research (Human Systems Integration).**
  - **Dr. Lyn Whitaker, NPS, Operations Research (Statistics).**
  - **Ms. Petra Alfred, NPS thesis student, Army Research Lab – Human Research and Engineering Directorate (ARL-HRED).**

- **Other contributing agencies.**
  - **TRAC-WSMR, analysis lead.**
    - MAJ Pedro Habic.
    - Mr. Eddie Edwards.
    - CPT Clark Adams.
  - **TRADOC Capabilities Manager (TCM)-Soldier, study lead.**
  - **Army Research Institute (ARI).**
  - **Army Evaluation Center (AEC).**
  - **US Army Armor Center.**
  - **US Army Infantry Center Directorate of Training (DOT).**
  - **ARL-HRED.**
  - **US Army Materiel Systems Analysis Activity (AMSAA).**
  - **TRAC-LEE.**
  - **Army Capabilities Integration Center (ARCIC).**
  - **Office of Infantry Proponency (OIP).**
 - **Project Manager – Soldier Warrior (PM-SWAR).**

Overall Assessment Process
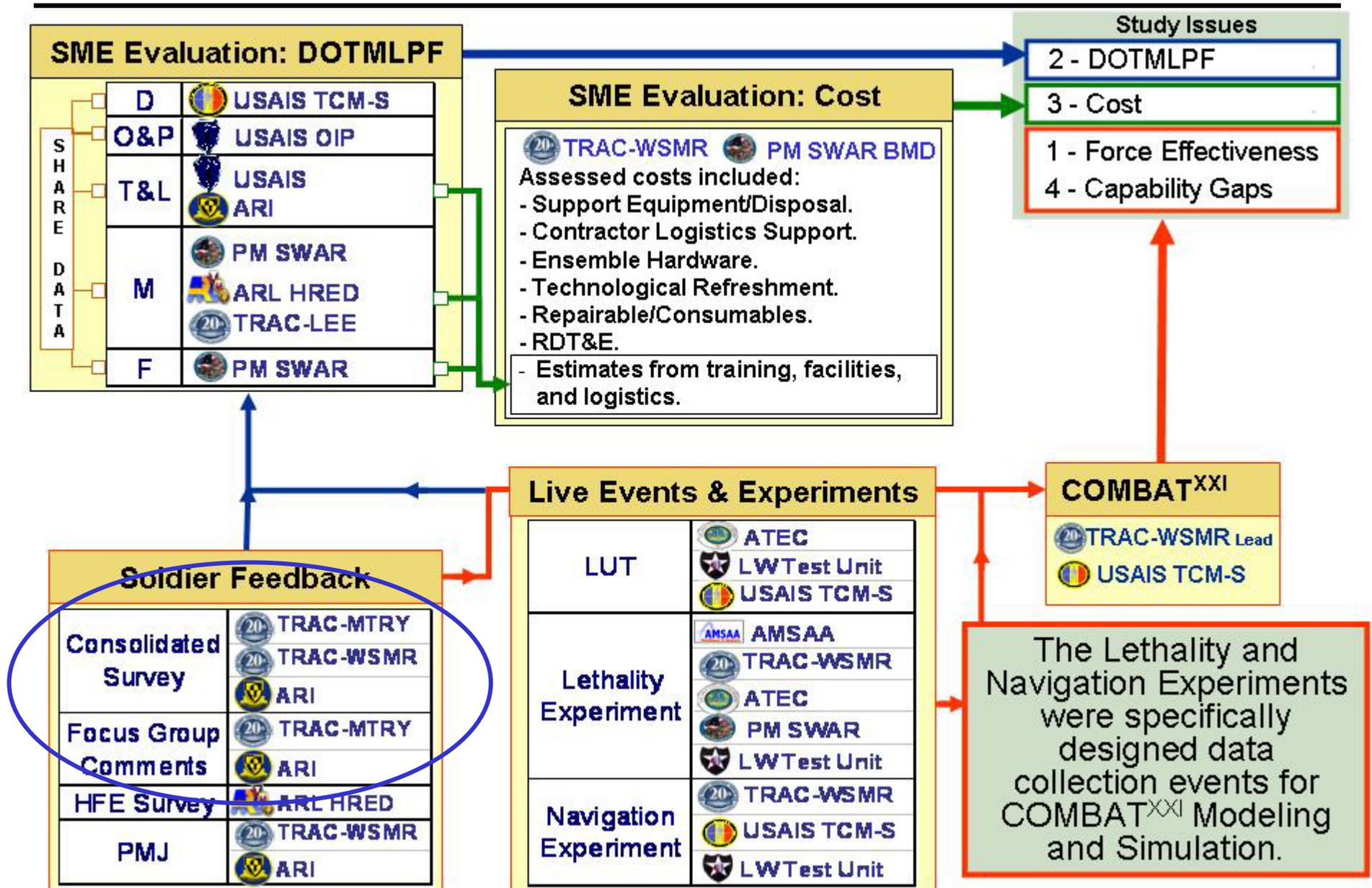
Background Research

- **Previous TRAC documentation concerning survey development.**
  - Cioppa, Thomas and Chris Morey, TRAC, "A Primer for Conducting Surveys, Questionnaires, and Assessments," dated 12 May 05.
  - Daniel, John, "Survey Design and Analysis: A Course Presented for the U.S. Army, Ft. Leavenworth."
  - Anderson, Mike, TRAC, "Survey Definitions."

- **Project team expertise.**
  - Drs. Miller and Shattuck have extensive experience in survey administration and analysis, and teach it in their graduate-level courses.
  - Many of the other team participants also have extensive survey expertise, particularly ARI and AEC.

Developed Survey Methodology

Plan Development
- Define Problem / Analyze System
- Develop Survey Plan
- Identify Issues to be Addressed

Survey Instrument Development and Administration
- Solicit and Analyze SME / Stakeholder Input
- Develop and Refine Questions
- Pilot Questionnaire
- Administer Questionnaires and Interviews

Data Consolidation and Analysis
- Code and Enter Data
- Analyze Basis of Issue (BOI) Responses
- Analyze Questionnaire Responses
- Analyze Interview Responses
- Integrate Analyses

Results Publication
- Deliver Analysis Products
- Write Report

Solicit and Analyze SME / Stakeholder Input

- **Required to integrate question input from numerous contributing agencies.**

- **Developed a question input spreadsheet that requested the following elements of information for each question.**
  - **Study issue, essential element of analysis (EEA), measure of effectiveness (MOE) being addressed.**
  - **Recommended question.**
  - **Priority compared to other submitted questions.**
  - **Recommended format of the question (Likert, interview, etc.).**
  - **Recommended respondent (all, leader only, etc.).**
  - **Rationale for question inclusion.**
  - **Analysis requirements.**

Unique question input spreadsheet provided traceability from questions to study issues, which was essential for survey development.

Develop, Refine, and Pilot Questions

- **Integrated input from contributing agencies.**
  - **Selected questions for inclusion.**
    - **Based upon question priority.**
    - **Combined similar questions to remove redundancy.**
  - **Adjusted question format.**
  - **Developed questions to fill perceived gaps.**

- **Developed draft questionnaires and interview questions.**

- **Sent drafts to contributing agencies for revision.**

- **Piloted draft questionnaires with groups of Soldiers at the Defense Language Institute (DLI).**

- **Printed 4 questionnaire versions: LW Leader, LW Non-leader, MW Vehicle Commander (VC), and MW Driver.**

Question development was an iterative process that integrated stakeholder input and pilot group feedback within a continuous development cycle.

Administer Questionnaires and Interviews

- **Questionnaires.**
  - **Longest version of the questionnaires (LW Leader) took approximately 1.5 hrs to complete.**

- **Focus group interviews.**
  - **Four per company.**
    - **LW junior leader (squad leader and below).**
    - **LW senior leader (platoon sergeant and above).**
    - **LW non-leader.**
    - **MW vehicle crewman.**
  - **Total of 16 focus groups, each consisting of 5-7 Soldiers.**
  - **Interview team included an experienced facilitator and a recorder.**
  - **Each interview lasted approximately 1 hour.**

Questionnaires Completed

Date	16 Oct	17 Oct	18 Oct	20 Oct	
Unit	**B Co**	**A Co**	**C Co**	**HHC/ EN Plt**	**All**
LW Leader	37	43	26	12	118
LW Non-Leader	38	35	37	10	120
MW Vehicle Cdr	18	9	8	5	40
MW Driver	17	11	12	4	44

Questionnaires and focus group interviews effectively captured the opinions of a large portion of the 4-9 IN population.

Questionnaire Demographics Summary

Demographic	Overall	Land Warrior			Mounted Warrior		
		Overall	Leader	Non-Ldr	Overall	VC	Driver
Number of respondents	322	238	103	135	84	38	46
Average age	24.2	24.2	26.9	22.1	24.1	26.0	22.6
Average time in duty position (months)	9.8	9.6	9.6	9.6	10.2	9.9	10.5
Average years of service	3.7	3.8	6.1	2.0	3.3	5.7	2.0
Average years of active service	3.3	3.4	5.2	1.9	3.1	4.4	1.9
% of Soldiers with deployment experience	28%	33%	61%	23%	14%	29%	2%
Average deployment time (of Soldiers that deployed, in months)	15.9	15.9	16.7	10.9	16.1	16.5	13

Consolidate Data

- **Questionnaires.**
  - **Manually entered the data into the database.**
  - **Analyzed data for detectable errors (invalid values, blanks, unusual patterns).**
  - **Estimated error rate.**
    - **Randomly chose 10 questionnaires.**
    - **Checked every entry for errors.**
    - **Found 14 errors in 5,045 data points for an error rate of about 0.3%.**

- **Focus group interviews.**
  - **Recorded interviews digitally.**
  - **Recorders compiled final interview summaries from notes taken during the interviews and the digital recordings.**

Unique techniques were used to mitigate and characterize data entry error.

Note-taking, in conjunction with digital recordings, was an ideal combination of data collection methods for the focus group interviews.

Analyze LW Basis of Issue (BOI) Responses

- Received a short notice requirement to provide initial BOI results by 25 Oct 06.

- Data entry.
  - Focused on selected BOI questions and limited demographic sections of the 238 completed LW questionnaires.
  - Entered 112,220 data points in 2.5 days.

- Initial data summary.
  - Focus: desired LW functions by duty position.
  - Conducted item-level summaries for key questions.
  - Results reported by total population and by leader versus non-leader.

- Subsequent data summaries.
  - Provided results by enlisted versus officer/NCO and by company on 01 Nov 06.
  - Color-coded the spreadsheets to reveal patterns.

Consolidated survey team was able to enter BOI data and provide useful first-cut analyses in a very short period of time.

Example BOI Results

15. Which of the following *leader* positions should have each of the following Land Warrior *functions* ?

	Rifle Team Leader	Rifle Squad Leader	Rifle Platoon Sergeant	Rifle Platoon Leader	Reconnaissance (Scout) Team Leader	Reconnaissance (Scout) Squad Leader	Reconnaissance (Scout) Platoon Sergeant	Reconnaissance (Scout) Platoon Leader	Engineer Team Leader	Engineer Squad Leader
a. View situation awareness display:										
(1) Self-locate (own icon or GBI) only.	79%	80%	82%	82%	77%	82%				
(2) Select other individuals to display.	78%	84%	92%	89%	80%	82%				
b. Manipulate map display.	74%	74%	84%	87%	80%	82%				
c. Use measure distance tool.	61%	67%	70%	69%	67%	71%	70%	68%	54%	57%
d. *Send* digital *messages* :										
(1) Call for fire.	53%	64%	78%	78%	60%	61%	74%	68%	50%	65%
(2) Call for medic.	77%	78%	86%	80%	77%	79%	78%	77%	75%	78%
(3) SALUTE.	64%	74%	80%	78%	73%	71%	74%	73%	67%	70%
(4) Free text.	61%	67%	76%	76%	63%	68%	74%	73%	67%	70%
e. *Receive* digital *messages*.	55%	58%	70%	69%	67%	68%	74%	73%	67%	70%
f. Use DVS to detect and engage targets.	18%	16%	14%	13%	27%	29%	22%	18%	21%	17%
g. Use HMD to view TVS images.	22%	24%	22%	22%	30%	29%	26%	23%	21%	17%
h. Use HMD to view/send target information from the MFL/STORM.	30%	43%	36%	42%	50%	50%	52%	55%	38%	48%
i. *Receive/View* digital *overlays*.	72%	76%	84%	82%	70%	71%	74%	73%	75%	74%
j. *Receive/View* digital *orders* .	60%	66%	78%	78%	63%	64%	70%	68%	63%	65%
k. *View* preloaded digital *images*.	66%	74%	78%	80%	70%	75%	74%	73%	63%	70%
l. *Save* digital *images*.	55%	64%	70%	71%	67%	79%	74%	73%	67%	65%
m. *Send* digital *images*.	55%	62%	66%	67%	67%	75%	74%	73%	63%	70%
n. Use voice communications.	86%	83%	84%	82%	77%	82%	78%	82%	75%	74%
o. *Create* digital *overlays*.	34%	54%	68%	80%	73%	75%	74%	73%	50%	65%
p. *Modify* digital *overlays*.	31%	51%	70%	82%	63%	75%	70%	73%	50%	65%
q. *Create* digital *orders*.	20%	36%	58%	71%	37%	46%	61%	59%	29%	43%
r. *Modify* digital *orders*.	21%	34%	56%	76%	37%	46%	57%	59%	29%	43%
Total Respondents Who Chose to Evaluate the Duty Position	94	76	50	45	30	28	23	22	24	23

Percentage (79%) of all respondents who felt that the Rifle Team Leader should have the ability to self-locate.

Adjustable color-coding of BOI responses provides the analyst a means to detect patterns in responses across duty positions and across capabilities.

Analyze Questionnaire Responses

- **Provided data summaries to the Assessment team.**
  - **Total number of respondents and number who chose each possible response level.**
  - **Percentage of respondents who chose each potential response.**
  - **Percentage of respondents who chose each potential response, except "N/A" or non-entries ("Percent of Those with Opinion" below).**
  - **Broken down by: leader/non-leader, officer&NCO/enlisted, company.**

- **No means, standard deviations, etc.**
  - **Responses were ordinal in nature.**
  - **Response level intervals cannot be considered equal or constant.**

Number	Question		Sample Size	Much Worse	Worse	About the Same	Better	Much Better	N/A; No Basis to Judge	No Entry
						OVERALL				
1A1	Situational Awareness. Compared to your standard equipment, Land Warrior makes your ability to monitor the location of your unit members...	Number Responded	238	7	24	68	85	40	12	2
		Percent of Total Responded	238	2.9%	10.1%	28.6%	35.7%	16.8%	5.0%	0.8%
		Percent of Those with Opinion	224	3.1%	10.7%	30.4%	37.9%	17.9%		

Provided summary analyses in an easy-to-read format for all questions while avoiding the common pitfalls in categorical data analysis.

Analyze Association between Sub-populations

- **By question.**
  - Explored association between the responses of certain sub-populations (leader vs. non-leader, A/C vs. B Company*).
  - Considered both original response levels and combined response levels (e.g., combining "Strongly Disagree" and "Disagree" and combining "Agree" and "Strongly Agree").
  - Tested for statistical significance for each question.

- **Question groupings.**
  - Explored associations between the sub-populations of interest across groupings of questions.
  - Used a combination of statistical techniques to detect evidence of association across the question groupings.

> * B Company had a different BOI and participated in unique training events as part of the US Army Test and Evaluation Command (ATEC) Limited User Test (LUT).

> **These results allow the analyst to determine the value of examining the results by sub-population versus the overall population and to see trends across question groupings.**

Association Analysis Results
by Question

- **Provided results for:**
  - **All questions.**
  - **Original and adjusted response levels.**
  - **Three statistical tests.***

- **Color-coded the levels of significance.**

- **Identified questions for which required statistical assumptions are violated.**

- **Provided a methodology for determining significance based upon the results of the three statistical tests.**

Example of the Association Results Spreadsheet

Question #	Chi-Squared Tests		Fisher's Exact (2-Tail)	CMH General Assoc
	Likelihood Ratio	Suspect?		
CG 1A1	0.4167	N	N/A	0.3504
CG 1A2	0.1742	N	N/A	0.1631
CG 1A3	0.9028	N	N/A	0.9215
CG 1B1	0.4194	N	N/A	0.3745
CG 1B2	0.3782	N	N/A	0.3757
CG 1B3	0.6149	N	N/A	0.6371
CG 1C	0.3011	N	N/A	0.2571
CG 1D	0.0028	N	N/A	0.0038
CG 1E	0.3577	N	N/A	0.3333
CG 1F	0.9159	N	N/A	0.9112
CG 1G	0.6426	N	N/A	0.6432
CG 1H	0.2084	N	N/A	0.219
CG 1I	0.4684	N	N/A	0.4707
CG 1J	0.3889	N	N/A	0.4
CG 1K	0.3927	N	N/A	0.4035
CG 2A	0.1835	N	N/A	0.2208
CG 2B	0.1278	N	N/A	0.1783
CG 2C	0.1549	N	N/A	0.2561
CG 2D	0.094	N	N/A	0.1035
CG 2E	0.2346	N	N/A	0.2888
CG 3A	0.8286	N	N/A	0.8579
CG 3B	0.4351	N	N/A	0.4882
CG 3C	0.0062	N	N/A	0.0075
CG 3D	0.0414	N	N/A	0.0645
CG 3E	0.5025	N	N/A	0.5347
CG 3F	0.0112	N	N/A	0.0138
CG 4A	0.0271	N	N/A	0.0743
CG 4B	0.9618	N	N/A	0.9531
CG 4C	0.7787	N	N/A	0.841
CG 4D	0.0	N	N/A	0.1874
CG 4E	0.5856	Y	N/A	0.8649

A&C vs B Co All Levels

Results for 3 statistical tests.

Color-coded significance levels.

Assumptions violated for statistical test.

***Likelihood ratio (LR) chi-square test, Fisher's exact test (only for 2 by 2 tables), Cochran-Mantel-Haenszel test (for A/C vs B after blocking for leader vs non-leader).**

Association Analysis Results
by Question Groupings

Overall Sub-population Association for Land Warrior Questionnaires

Section	Leader versus Non-Leader	A/C Co versus B Co
Capability Gaps	Significant	Significant
BOI 1-12	Significant	Significant
BOI 13-14	Not Significant	Significant
BOI 15	N/A*	Not Significant
Training	Significant	Not Significant
Other Implications	Significant	Significant

*BOI Question 15 was not asked of non-leaders.

Overall Sub-population Association for Mounted Warrior Questionnaires

Section	VC versus Driver	A/C Co versus B Co
Capability Gaps	Significant	Significant
Training	Significant**	Significant
Other Implications	Not Significant	Not Significant

**Not significant if Fisher's exact test p-values are not included when available.

For each question grouping, the overall sub-population association either tends toward "Significant" or "Not Significant".

Conclusions

- **Refined and improved survey methodologies and capabilities through the:**
  - **Development of a generalized survey development and analysis methodology.**
  - **Development of supporting tools.**
  - **Effective application of advanced analysis techniques.**

- **Keys to success.**
  - **Wide range of stakeholder input for the creation of a holistic survey.**
  - **Use of multiple analysis techniques to mitigate risk and clearly identify most important aspects of the system.**

- **Significant effort.**
  - **Input from 12 different Army and DoD agencies.**
  - **322 completed questionnaires consisting of over 189,000 data points.**
  - **16 hours of focus group interviews.**

- **Application of these techniques provided a significant contribution to the overarching study results, particularly with respect to capability gaps, training, and leader development issues.**

Using Unique Questionnaire and Interview Techniques to Inform Acquisition Decision-Making

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MORSS WG26 Presentation

12 June 2007

Milestones

| Activity	Completed
Data requirements sent to TRAC in Monterey (TRAC-MTRY) by requiring agencies.	17 JUL 06
Initial drafts developed and sent out for agency input (DRAFT #1).	28 JUL 06
Feedback on initial drafts provided to TRAC.	10 AUG 06
Revised drafts developed and sent out for agency input, to include draft focus group interview questions (DRAFT #2).	11 AUG 06
Feedback on revised drafts provided to TRAC.	22 AUG 06
Pilot questionnaires and focus group interviews executed.	30-31 AUG 06
Initial Institutional Review Board (IRB) / Human Use Committee (HUC) approval received.	05 SEP 06
Revised drafts developed (DRAFT #3); meeting with analysis lead (TRAC-WSMR) conducted.	06-07 SEP 06
Revised drafts developed; sent out for final agency input (DRAFT #4).	21 SEP 06
Questionnaires complete; sent to printer.	29 SEP 06
Final NPS IRB/HUC approval received.	13 OCT 06
Questionnaires and focus group interviews conducted.	16-20 OCT 06
Initial LW BOI analysis sent to TRAC-WSMR.	25 OCT 06
Refined LW BOI analysis complete.	01 NOV 06
Sent LW and MW questionnaire response databases to requiring agencies.	20 NOV 06
Initial analysis of all questionnaire responses complete.	18 DEC 06
Final analysis of all questionnaire responses complete.	08 FEB 07

Agency Contributions

- **ARI: demographics, BOI, training, leader development.**

- **AEC: force effectiveness/capability gaps, miscellaneous.**

- **ARL-HRED: human factors.**

- **TRAC-LEE: logistics.**

- **TCM-Soldier (Ft. Knox): Mounted Warrior.**

- **TRAC-WSMR: capability gaps, BOI, organization, personnel, facilities.**

- **AMSAA: communications.**

Questionnaire Demographics Summary
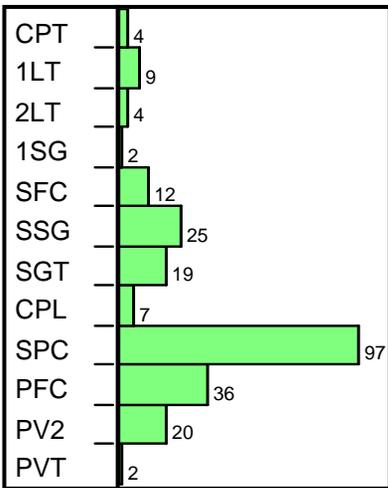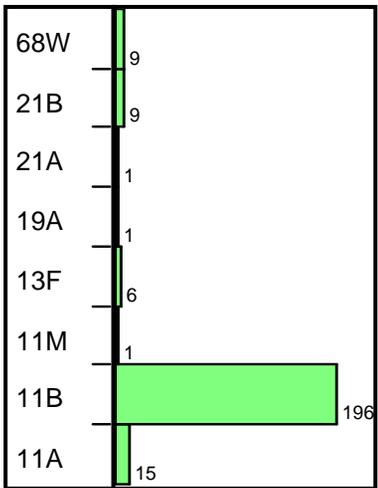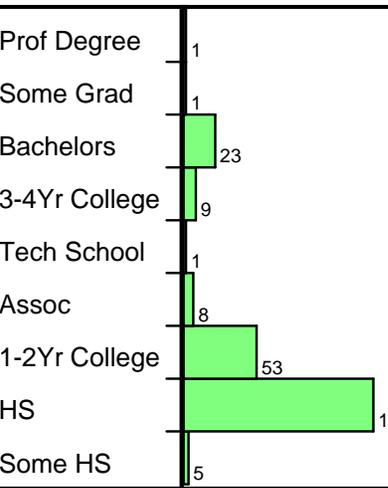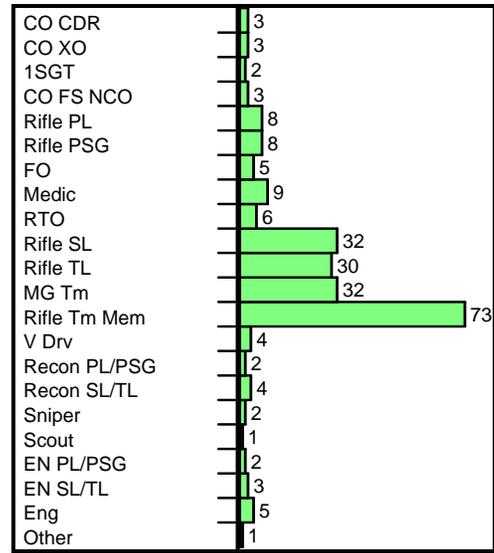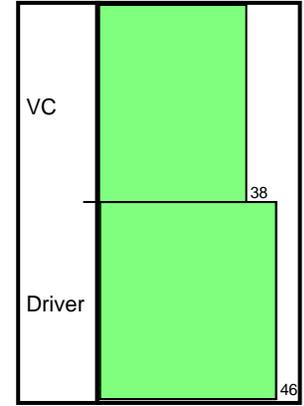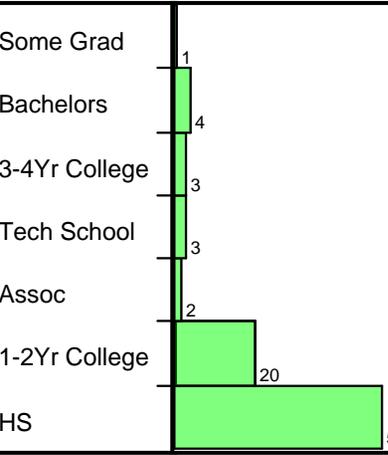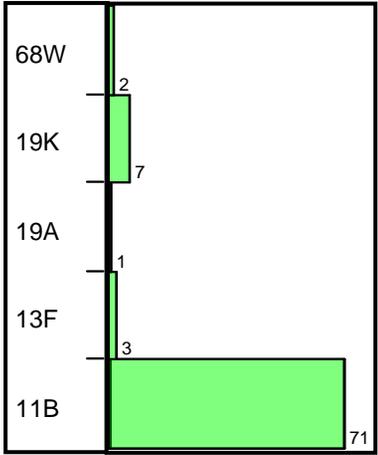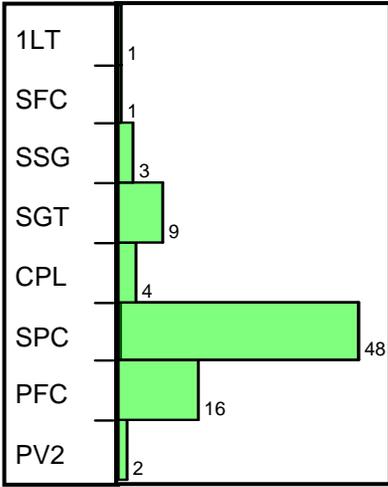
Analytical Model for Association between Variables
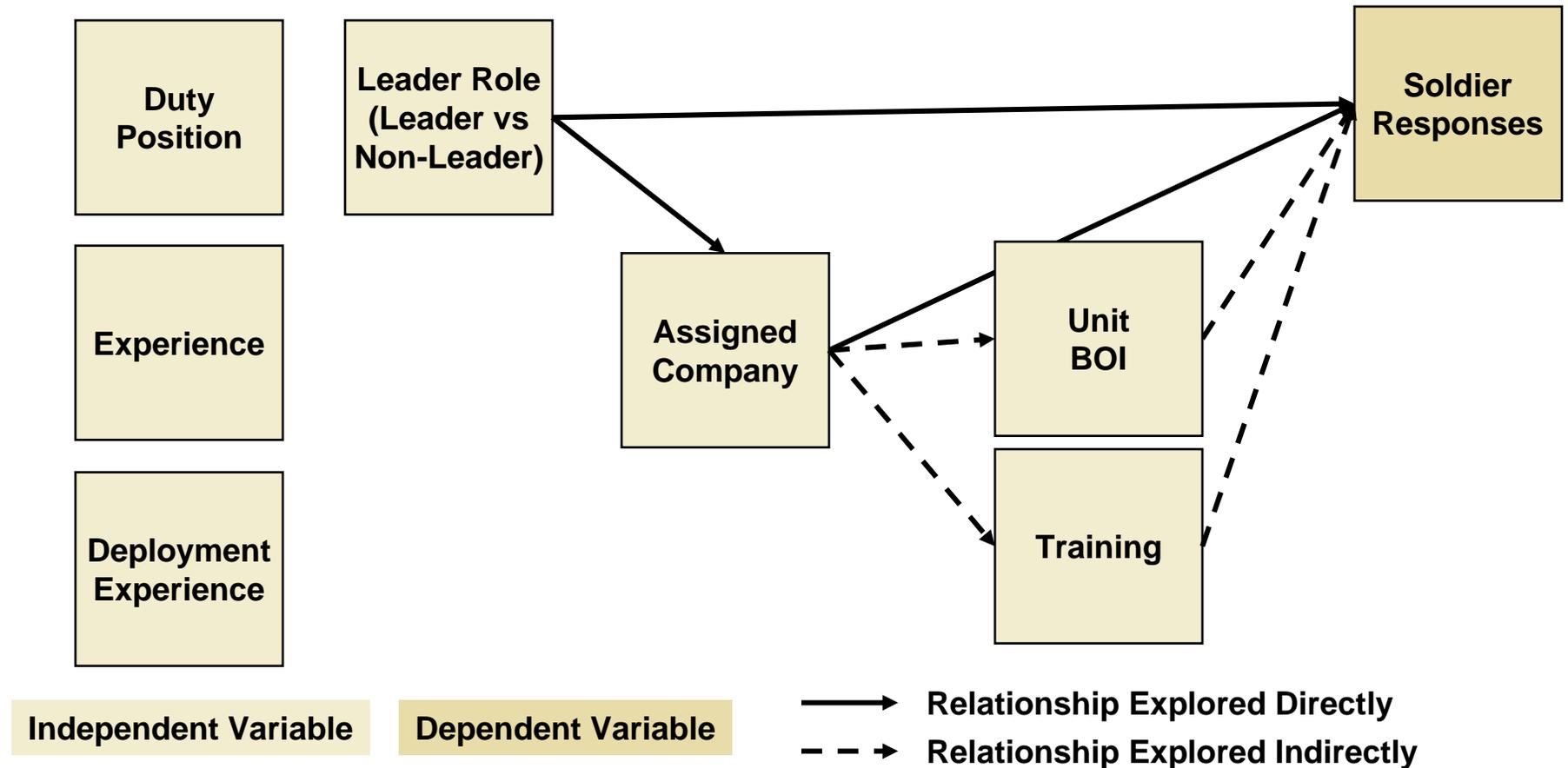
Focused on those variables (or sub-populations) for which the variable was expected to have the greatest effect – leadership role and company.

Association by Question Groupings

- **Interested in seeing if the associations between the sub-populations (independent variables) of interest could be extended to groupings of questions.**

- **Used the observation that if there is only a random association within a group of questions, their p-values should be randomly distributed as a uniform (0,1) random variable.**

- **Tests: for each group of questions we compared the observed p-values against a uniform (0,1) distribution using a combination of:**
  - **The Kolmogorov-Smirnov (K-S) test.**
  - **Mean CI test: A comparison of the calculated confidence interval (CI) for the mean of the observed values against the expected value of a uniform (0,1) random variable (0.5).**
    - **If the CI is entirely below 0.5: tends toward significance.**
    - **If the CI overlaps 0.5: inconclusive.**
    - **If the CI is entirely above 0.5: tends toward non-significance.**

Association Analysis Results by Question Groupings

OVERALL SUB-POPULATION ASSOCIATION FOR LAND WARRIOR QUESTIONNAIRES				
Section	**Leader versus Non-Leader**		**A/C Co versus B Co**	
	Combined Levels	**Original Levels**	**Combined Levels**	**Original Levels**
Capability Gaps	Significant	Significant	Significant	Significant
BOI 1-12	Significant	Significant	Significant	Significant
BOI 13-14	Not Significant	Not Significant	Significant	Significant
BOI 15	N/A	N/A	Not Significant	Not Significant
Training	Significant	Significant	Not Significant	Not Significant
Other Implications	Significant	Significant	Significant	Significant

OVERALL SUB-POPULATION ASSOCIATION FOR MOUNTED WARRIOR QUESTIONNAIRES				
Section	**VC versus Driver**		**A/C Co versus B Co**	
	Combined Levels	**Original Levels**	**Combined Levels**	**Original Levels**
Capability Gaps	Significant	Significant	Significant	Significant
Training	Significant	Not Significant	Significant	Significant
Other Implications	Not Significant	Not Significant	Not Significant	Not Significant

For each question grouping, the overall sub-population association either tends toward "Significant" or "Not Significant".

K-S Test Results by Question Groups

KOLMOGOROV-SMIRNOV TEST RESULTS FOR LAND WARRIOR QUESTIONNAIRES				
Section	**Leader versus Non-Leader**		**A/C Co versus B Co**	
	Combined Levels	**Original Levels**	**Combined Levels**	**Original Levels**
Capability Gaps	Significant	Significant	Significant	Significant
BOI 1-12	Significant	Significant	Significant	Significant
BOI 13-14	Significant*	Significant*	Significant	Significant
BOI 15	N/A	N/A	Not Significant	Not Significant
Training	Significant	Significant	Not Significant	Not Significant
Other Implications	Significant	Significant	Significant	Significant

KOLMOGOROV-SMIRNOV TEST RESULTS FOR MOUNTED WARRIOR QUESTIONNAIRES				
Section	**VC versus Driver**		**A/C Co versus B Co**	
	Combined Levels	**Original Levels**	**Combined Levels**	**Original Levels**
Capability Gaps	Significant	Significant	Significant	Significant
Training	Significant	Not Significant	Significant	Significant
Other Implications	Not Significant	Not Significant	Not Significant	Not Significant

*Not significant if Fisher's exact test p-values are not included.

For each question grouping, the K-S test either indicates that the p-values appear to be randomly-distributed ("Not Significant") or not ("Significant").

Mean CI Test Results by Question Groups

MEAN CI TEST RESULTS FOR LAND WARRIOR QUESTIONNAIRES				
Section	Leader versus Non-Leader		A/C Co versus B Co	
	Combined Levels	Original Levels	Combined Levels	Original Levels
Capability Gaps	Significant	Significant	Significant	Significant
BOI 1-12	Significant	Significant	Significant	Significant
BOI 13-14	Not Significant*	Not Significant*	Significant	Significant
BOI 15	N/A	N/A	Inconclusive	Inconclusive
Training	Significant	Significant	Not Significant	Inconclusive
Other Implications	Significant	Significant	Significant	Significant

MEAN CI TEST RESULTS FOR MOUNTED WARRIOR QUESTIONNAIRES				
Section	VC versus Driver		A/C Co versus B Co	
	Combined Levels	Original Levels	Combined Levels	Original Levels
Capability Gaps	Significant	Significant	Significant	Significant
Training	Significant	Significant	Significant	Significant
Other Implications	Inconclusive	Inconclusive	Inconclusive	Inconclusive

*"Inconclusive" if Fisher's exact test p-values are not included.

For each question grouping, the mean CI test either indicates that the p-values tend toward significance ("Significant"), toward non-significance ("Not Significant"), or inconclusive ("Inconclusive").