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NAMRL Technical Memorandum 09-13

CRITICAL SKILLS FOR U.S. MARINE CORPS CALL FOR FIRE POSITIONS

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
06 MAR 2009		

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Critical Skills for U.S. Marine Corps Call for Fire Positions	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)	5d. PROJECT NUMBER
Richard Arnold; Jeffrey Phillips; Phillip Mangos; Joshua Isaacson	**PA405**
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER **ONR 70705**

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Naval Aerospace Medical Research Laboratory,280 Fred Bauer Street,Pensacola,FL,32508	

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Emerging Marine Corps infantry warfighting concepts as enhanced company operations (ECO) and distributed operations (DO) place increasing trust in small unit team members to perform responsibilities previously executed at higher echelons. As such concepts are put into practice it will be important to identify individuals with the required skill sets to perform these jobs. In this study a comprehensive job-task analysis was performed to identify the most important skills, abilities, and other characteristics (SAOs) required for successful job performance in small unit, combined arms, call for fire positions, specifically for Marine Fire Support Team (FiST) Forward Air Controller (FAC) and Forward Observer (FO) positions. Ratings were obtained from Marine Corps FiST instructors and expert job analysts. Agreement within and between ratings sources was high. Among the SAOs that emerged as most important for call for fire positions were several related to attention, planning, and problem solving skills. Other important SAOs related to communications, teamwork and stress tolerance.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**		**13**	

ABSTRACT

Emerging Marine Corps infantry warfighting concepts as enhanced company operations (ECO) and distributed operations (DO) place increasing trust in small unit team members to perform responsibilities previously executed at higher echelons. As such concepts are put into practice it will be important to identify individuals with the required skill sets to perform these jobs. In this study a comprehensive job-task analysis was performed to identify the most important skills, abilities, and other characteristics (SAOs) required for successful job performance in small unit, combined arms, call for fire positions, specifically for Marine Fire Support Team (FiST) Forward Air Controller (FAC), Joint Terminal Attack Controller (JTAC), and Forward Observer (FO) positions. Ratings were obtained from Marine Corps FiST instructors and expert job analysts. Agreement within and between ratings sources was high. Among the SAOs that emerged as most important for call for fire positions were several related to attention, planning, and problem solving skills. Other important SAOs related to communications, teamwork and stress tolerance.

INTRODUCTION

In the US Marine Corps, emerging concepts such as enhanced company operations (ECO) and distributed operations (DO) prescribe decentralization of decision making responsibility to empower small teams (e.g. fire teams, squads, platoons) to take more timely and effective actions. However, such changes to established practice and scope of responsibility can be expected to present significant new job performance challenges. For example, ECO/DO units will be capable of directly coordinating fire support from joint fire agencies to effectively respond to a broad range of threats, and sophisticated electronic communications will extend below the company level to small DO units to enable separation and coordination of interdependent tactical actions (Mattis, 2006). Due to these expanded responsibilities, ECO/DO team members will be required to possess an increasingly broad range of skills and abilities to effectively execute missions.

As a first step in identifying the requisite skills, abilities and other characteristics (SAOs) critical to successful job performance in infantry small unit call for fire positions, a job analysis was performed on a key Marine Corps small unit, the fire support team (FiST). The FiST is a company-level asset that functions to coordinate indirect fire agencies to support a maneuver element. The FiST generally consists of three or four principal members including: a FiST Lead (team leader), a forward air controller (FAC) or joint terminal attack controller (JTAC), and at least one forward observer (FO). The latter two positions are responsible for calling for fire from supporting agencies, the FAC/JTAC from aviation assets and the FO or FOs from mortar and artillery assets.

METHOD

A facet-level SAO taxonomy consisting of 78 cognitive, non-cognitive, physiological, sensory and physical SAOs was culled to 57 based on preliminary ratings from job analysts familiar with FiST operations (Arnold, Phillips, & Strompolis, 2008). The original 78 SAOs, with definitions, are presented in appendix A. The decision to use such a large number of preliminary SAOs was made to ensure essential traits were not overlooked during the job analytic process, and to facilitate unambiguous measurement by focusing to the greatest extent possible on unidimensional psychological constructs. Preliminary culling of marginally relevant SAOs was performed to reduce SME rating time requirements. Five-point Likert rating scales were developed to elicit SME ratings of the 57 retained SAOs.

After obtaining informed consent from SMEs to participate in the study, interviews were conducted over the course of one day with three USMC FiST Coyotes (instructors) at USMC Tactical Training Exercise Control Group (TTECG), 29 Palms, CA. The interview session was conducted in a group format, with a single researcher (RDA) meeting with the three SMEs. The SAO job importance ratings described in this report were provided by SMEs during this interview session.

Due to the small number of available SMEs, SAO ratings from three expert analysts, previously described by Arnold et al. (2008), were aggregated with SME ratings, resulting in a total of 6 raters. Spearman's rho rank-order correlations of r = .52, p <.001 for FAC and r = .33, p <.05 for FO were observed between expert rater and SME ratings, indicating moderate to good agreement between rater sources.

Analyses

To ensure data quality, quantitative indices of interrater agreement for SME ratings were calculated to support interpretation of the basic descriptive statistics (i.e., mean, standard deviation, and 95% confidence intervals). Two indexes of interrater agreement were used: r_{wg} and the average deviation (AD) index. The r_{wg} statistic is a conservative test that considers the ratio of variance observed in a set of ratings to variance that would be expected by chance (James, Demaree, & Wolf, 1984; 1993). The r_{wg} was supplemented with the use of the average deviation (AD) index, a measure of the average absolute deviation of a set of ratings from the mean or median of the ratings (Burke & Dunlap, 2002; Burke, Finkelstein, & Dusig, 1999). Research has indicated differential results associated with these indexes (Burke et al., 1999; Burke & Dunlap, 2002; Dunlap, Burke, & Smith-Crowe, 2003). Interpretation of observed interrater agreement was based on guidelines developed by Harvey and Hollander (2004) and statistical significance tests developed by Dunlap et al. (2003).

Following the work of Burke and Dunlap (2002) the statistical significance level of both r_{wg} and the AD index, which further takes into account the number of raters, was considered. The critical values of these statistics depend both on the number of raters and number of response categories. For example, according to Dunlap et al. (2003), when *N* equals 10 and the number of categories equals 5, the critical value is .53. In a case when *N* equals 6, the critical value is .72 according to Dunlap et al. (2003). For the AD index *statistically* significant ($p \leq .05$) AD values are *practically* significant as well (that is, less than $c/6$) for Likert scales with five or more categories.

RESULTS

Table 1 presents the combined results of the descriptive statistical and interrater agreement analyses for the FAC/JTAC position. Table 2 presents the results for the FO position. All SAOs, for both the FO/JTAC and FO positions, were rated at the mid point (i.e., 2.5) of the job importance scale or higher, which perhaps is to be expected since a preliminary cull by expert raters had eliminated 21 SAOs deemed least important to job performance in fire support team positions (see Arnold et al., 2008). SAOs related to attention, problem solving, planning, communication, map reading, teamwork and stress tolerance were rated highly for both call for fire positions. Visual acuity was deemed highly important for the FAC/JTAC position.

Table 1. FAC/JTAC SAO job importance ratings

FAC KSAOs	Mean	Stdv	0.95	lower bound	Rwg	*p*	AD	*p*
time management skills	5.00	0.00	-	-	1.00	p<.05	0.00	p<.05 and Prac. Sig.
oral expression	4.83	0.41	0.33	4.51	0.80	ns	0.28	p<.05 and Prac. Sig.
spatial orientation	4.83	0.41	0.33	4.51	0.80	ns	0.28	p<.05 and Prac. Sig.
concentration/selective attention	4.83	0.41	0.33	4.51	0.80	ns	0.28	p<.05 and Prac. Sig.
teamwork skills	4.83	0.41	0.33	4.51	0.80	ns	0.28	p<.05 and Prac. Sig.
attention to detail	4.83	0.41	0.33	4.51	0.80	ns	0.28	p<.05 and Prac. Sig.
problem solving skills	4.67	0.52	0.41	4.25	0.74	ns	0.44	p<.05 and Prac. Sig.
oral comprehension	4.67	0.82	0.65	4.01	0.59	ns	0.56	Prac. Sig. only
map reading	4.67	0.52	0.41	4.25	0.74	ns	0.44	p<.05 and Prac. Sig.
attention allocation and control	4.67	0.52	0.41	4.25	0.74	ns	0.44	p<.05 and Prac. Sig.
stress tolerance	4.67	0.52	0.41	4.25	0.74	ns	0.44	p<.05 and Prac. Sig.
visual acuity	4.67	0.52	0.41	4.25	0.74	ns	0.44	p<.05 and Prac. Sig.
mental math	4.50	0.55	0.44	4.06	0.73	ns	0.50	p<.05 and Prac. Sig.
decision making skills	4.50	0.84	0.67	3.83	0.58	ns	0.67	Prac. Sig. only
mental rotation	4.50	0.84	0.67	3.83	0.58	ns	0.67	Prac. Sig. only
task prioritization	4.50	0.55	0.44	4.06	0.73	ns	0.50	p<.05 and Prac. Sig.
working memory	4.50	0.84	0.67	3.83	0.58	ns	0.67	Prac. Sig. only
adaptability	4.50	0.84	0.67	3.83	0.58	ns	0.67	Prac. Sig. only
handling crisis/emergency situations	4.50	0.55	0.44	4.06	0.73	ns	0.50	p<.05 and Prac. Sig.
mathematical ability	4.33	0.52	0.41	3.92	0.74	ns	0.44	p<.05 and Prac. Sig.
information mgmt skills	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
systems comprehension	4.33	1.03	0.83	3.51	0.48	ns	0.89	Prac. Sig. only
reasoning skills	4.33	0.52	0.41	3.92	0.74	ns	0.44	p<.05 and Prac. Sig.
spatial visualization	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
confidence	4.33	0.52	0.41	3.92	0.74	ns	0.44	p<.05 and Prac. Sig.
dependability	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
emotional control/stability	4.33	0.52	0.41	3.92	0.74	ns	0.44	p<.05 and Prac. Sig.
disengagement	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
planning skills	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
critical thinking skills	4.17	0.41	0.33	3.84	0.80	ns	0.28	p<.05 and Prac. Sig.
accountability	4.17	0.75	0.60	3.56	0.62	ns	0.56	Prac. Sig. only
listening skills	4.17	0.41	0.33	3.84	0.80	ns	0.28	p<.05 and Prac. Sig.
safety consciousness	4.17	0.75	0.60	3.56	0.62	ns	0.56	Prac. Sig. only
depth perception	4.17	0.98	0.79	3.38	0.51	ns	0.83	Prac. Sig. only
initiative	4.00	0.89	0.72	3.28	0.55	ns	0.67	Prac. Sig. only
deliberation	4.00	0.89	0.72	3.28	0.55	ns	0.67	Prac. Sig. only
organization skills	4.00	0.63	0.51	3.49	0.68	ns	0.33	p<.05 and Prac. Sig.
technical troubleshooting	3.83	0.98	0.79	3.05	0.51	ns	0.83	Prac. Sig. only
navigation skills	3.83	0.98	0.79	3.05	0.51	ns	0.83	Prac. Sig. only
learning ability	3.83	0.75	0.60	3.23	0.62	ns	0.56	Prac. Sig. only
work motivation	3.83	0.98	0.79	3.05	0.51	ns	0.83	Prac. Sig. only
self-discipline	3.83	0.98	0.79	3.05	0.51	ns	0.83	Prac. Sig. only
assertiveness	3.83	0.75	0.60	3.23	0.62	ns	0.56	Prac. Sig. only
long-term memory	3.67	0.82	0.65	3.01	0.59	ns	0.67	Prac. Sig. only
rule abiding	3.67	1.03	0.83	2.84	0.48	ns	0.78	Prac. Sig. only
reaction time	3.67	1.75	1.40	2.27	0.12	ns	1.44	ns

mastery orientation	3.50	0.84	0.67	2.83	0.58	ns	0.67	Prac. Sig. only
leadership skills	3.50	0.84	0.67	2.83	0.58	ns	0.67	Prac. Sig. only
leadership motivation	3.50	0.84	0.67	2.83	0.58	ns	0.67	Prac. Sig. only
perceptual speed and accuracy	3.50	1.05	0.84	2.66	0.48	ns	0.83	Prac. Sig. only
response selection	3.50	1.38	1.10	2.40	0.31	ns	1.00	Prac. Sig. only
hearing	3.50	0.84	0.67	2.83	0.58	ns	0.67	Prac. Sig. only
numerical reasoning	3.33	1.37	1.09	2.24	0.32	ns	1.00	Prac. Sig. only
achievement motivation	3.33	0.82	0.65	2.68	0.59	ns	0.56	Prac. Sig. only
pattern recognition	3.17	0.75	0.60	2.56	0.62	ns	0.56	Prac. Sig. only
goal setting	2.83	1.17	0.94	1.90	0.42	ns	0.89	Prac. Sig. only
adventure seeking	2.50	0.55	0.44	2.06	0.73	ns	0.50	p<.05 and Prac. Sig.

Table 2. Forward Observer SAO job importance ratings

FO KSAOs	Mean	Stdv	0.95	lower bound	Rwg	p	AD	p
attention to detail	4.83	0.41	0.33	4.51	0.80	ns	0.28	p<.05 and Prac. Sig.
map reading	4.67	0.52	0.41	4.25	0.74	ns	0.44	p<.05 and Prac. Sig.
teamwork skills	4.67	0.52	0.41	4.25	0.74	ns	0.44	p<.05 and Prac. Sig.
adaptability	4.67	0.52	0.41	4.25	0.74	ns	0.44	p<.05 and Prac. Sig.
time management skills	4.67	0.52	0.41	4.25	0.74	ns	0.44	p<.05 and Prac. Sig.
oral expression	4.50	0.55	0.44	4.06	0.73	ns	0.50	p<.05 and Prac. Sig.
spatial orientation	4.50	0.84	0.67	3.83	0.58	ns	0.67	Prac. Sig. only
concentration/selective attention	4.50	0.84	0.67	3.83	0.58	ns	0.67	Prac. Sig. only
attention allocation and control	4.50	0.84	0.67	3.83	0.58	ns	0.67	Prac. Sig. only
task prioritization	4.50	0.55	0.44	4.06	0.73	ns	0.50	p<.05 and Prac. Sig.
working memory	4.50	0.84	0.67	3.83	0.58	ns	0.67	Prac. Sig. only
stress tolerance	4.50	0.84	0.67	3.83	0.58	ns	0.67	Prac. Sig. only
disengagement	4.50	0.84	0.67	3.83	0.58	ns	0.67	Prac. Sig. only
dependability	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
deliberation	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
listening skills	4.33	0.52	0.41	3.92	0.74	ns	0.44	p<.05 and Prac. Sig.
emotional control/stability	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
handling crisis/emergency situations	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
planning skills	4.33	0.52	0.41	3.92	0.74	ns	0.44	p<.05 and Prac. Sig.
visual acuity	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
depth perception	4.33	0.82	0.65	3.68	0.59	ns	0.67	Prac. Sig. only
mental math	4.17	0.75	0.60	3.56	0.62	ns	0.56	Prac. Sig. only
problem solving skills	4.17	0.75	0.60	3.56	0.62	ns	0.56	Prac. Sig. only
oral comprehension	4.17	0.98	0.79	3.38	0.51	ns	0.83	Prac. Sig. only
initiative	4.17	0.98	0.79	3.38	0.51	ns	0.83	Prac. Sig. only
confidence	4.17	0.75	0.60	3.56	0.62	ns	0.56	Prac. Sig. only
self-discipline	4.17	0.98	0.79	3.38	0.51	ns	0.83	Prac. Sig. only
accountability	4.17	0.75	0.60	3.56	0.62	ns	0.56	Prac. Sig. only
organization skills	4.17	0.75	0.60	3.56	0.62	ns	0.56	Prac. Sig. only
safety consciousness	4.17	0.98	0.79	3.38	0.51	ns	0.83	Prac. Sig. only
critical thinking skills	4.00	0.63	0.51	3.49	0.68	ns	0.33	p<.05 and Prac. Sig.
decision making skills	4.00	0.89	0.72	3.28	0.55	ns	0.67	Prac. Sig. only
mental rotation	4.00	0.89	0.72	3.28	0.55	ns	0.67	Prac. Sig. only

work motivation	4.00	0.89	0.72	3.28	0.55	ns	0.67	Prac. Sig. only
mathematical ability	3.83	0.41	0.33	3.51	0.80	ns	0.28	p<.05 and Prac. Sig.
reasoning skills	3.83	0.41	0.33	3.51	0.80	ns	0.28	p<.05 and Prac. Sig.
learning ability	3.83	0.75	0.60	3.23	0.62	ns	0.56	Prac. Sig. only
long-term memory	3.83	0.98	0.79	3.05	0.51	ns	0.83	Prac. Sig. only
assertiveness	3.83	1.17	0.94	2.90	0.42	ns	0.89	Prac. Sig. only
information mgmt skills	3.67	0.82	0.65	3.01	0.59	ns	0.67	Prac. Sig. only
systems comprehension	3.67	0.82	0.65	3.01	0.59	ns	0.67	Prac. Sig. only
technical troubleshooting	3.67	0.82	0.65	3.01	0.59	ns	0.67	Prac. Sig. only
rule abiding	3.67	0.82	0.65	3.01	0.59	ns	0.67	Prac. Sig. only
numerical reasoning	3.50	1.38	1.10	2.40	0.31	ns	1.00	Prac. Sig. only
navigation skills	3.50	0.84	0.67	2.83	0.58	ns	0.67	Prac. Sig. only
spatial visualization	3.50	0.84	0.67	2.83	0.58	ns	0.67	Prac. Sig. only
achievement motivation	3.50	0.84	0.67	2.83	0.58	ns	0.67	Prac. Sig. only
mastery orientation	3.50	0.55	0.44	3.06	0.73	ns	0.50	p<.05 and Prac. Sig.
leadership skills	3.50	0.55	0.44	3.06	0.73	ns	0.50	p<.05 and Prac. Sig.
perceptual speed and accuracy	3.50	1.05	0.84	2.66	0.48	ns	0.83	Prac. Sig. only
reaction time	3.50	1.64	1.31	2.19	0.18	ns	1.33	Prac. Sig. only
leadership motivation	3.33	1.03	0.83	2.51	0.48	ns	0.78	Prac. Sig. only
response selection	3.33	1.37	1.09	2.24	0.32	ns	1.00	Prac. Sig. only
hearing	3.17	0.41	0.33	2.84	0.80	ns	0.28	p<.05 and Prac. Sig.
pattern recognition	3.00	0.89	0.72	2.28	0.55	ns	0.67	Prac. Sig. only
adventure seeking	2.83	0.41	0.33	2.51	0.80	ns	0.28	p<.05 and Prac. Sig.
goal setting	2.67	0.82	0.65	2.01	0.59	ns	0.67	Prac. Sig. only

DISCUSSION

There was substantial overlap between SAOs rated highly for FAC/JTAC and FO positions. This suggests there is a core set of skills relevant to dynamic planning and coordination of indirect fires, whether from supporting agencies providing aviation, mortar or artillery assets. In such a dynamic and fast-paced environment, it is not surprising that skills and abilities related to attention, planning, problem solving, teamwork and stress tolerance were rated as critically important to job performance.

In a separate report SAO importance ratings for small unit infantry leaders (FiST Leaders) were reported (Arnold, Phillips, Mangos and Isaacson, under review). Many of the same attention, planning, teamwork, and stress tolerance related skills that were highly rated in the present study were identified as important for small unit infantry leaders. In addition to these shared SAO requirements, there were SAOs that emerged as uniquely important for each position. Not surprisingly, in the previous report, several of these related to leadership skills. In the present study visual acuity emerged as specifically important to FAC/JTAC job performance. This may be a very important distinguishing requirement for FAC/JTAC. Under many conditions aircraft may not be permitted to release ordnance until “cleared hot” by the FAC/JTAC, which requires

visual identification of the aircraft to ensure correct targeting. During our observations of live-fire training, and in discussions with FAC/JTAC operators and instructors, it became apparent that lack of visual identification is a very common occurrence, due to the inherent difficulty of detecting a small, fast-moving object, often with poor visibility, low contrast and other factors. Performance improvements in this singly important FAC/JTAC skill may be realized through better screening for visual acuity, specifically for acuity related to target size and contrast detection thresholds.

The high level of interrater agreement, both within and between rater sources provides confidence in the validity of our findings. Ideally, however, research will be conducted to confirm these findings, employing psychological tests to assess such critical SAOs as we have identified, and assessing their predictive validity in relation to established job performance criteria. In the interim, it is anticipated that these findings can provide useful information for personnel decisions related to Forward Observer, Forward Air Controller and Joint Terminal Attack Controller positions.

REFERENCES

Arnold, R. D., Phillips, J. B., Mangos, P. M., & Isaacson, J. A. (under review). Critical skills of Marine Corps infantry small unit leaders. Naval Aerospace Medical Research Laboratory, technical memorandum NAMRL-09-07, Pensacola, FL.

Arnold, R. D., Phillips, J. D., & Strompolis, M. E. (2008). The Marine fire support team as a model for distributed operations analysis: Review of prior analyses, ongoing research, and recommendations for future work. Naval Aerospace Medical Research Laboratory, special report NAMRL-08-11, Pensacola, FL.

Burke, M. J., & Dunlap, W. P. (2002). Estimating interrater agreement with the average deviation (AD) index: A user's guide. *Organizational Research Methods, 5*, 159 – 172.

Burke, M. J., Finkelstein, L. M., & Dusig, M. S. (1999). On average deviation indices for estimating interrater agreement. *Organizational Research Methods, 2*, 49 – 68.

Dunlap, W. P., Burke, M. J., & Smith-Crowe, K. (2003). Accurate tests of statistical significance for r_{WG} and Average Deviation interrater agreement indexes. *Journal of Applied Psychology, 88*, 356 – 362.

Harvey, R. J., & Hollander, E. (2004, April). *Benchmarking r_{WG} interrater agreement indices: Let's drop the .70 rule-of thumb*. Paper presented at the Annual Conference of the Society for Industrial and Organizational Psychology, Chicago.

James, L. R., Demaree, R. G., & Wolf, G. (1993). rwg: An assessment of within-group interrater agreement. *Journal of Applied Psychology*, 78, 306-309.

James, L. R., Demaree, R. G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology*, 69, 85-98.

Mattis, J. N. (2006). Distributed Operations. Briefing to Assistant Secretary of the Navy (RD&A), 23 June 2006, SPAWAR Systems Command, San Diego, CA.

Appendix A. Skills, Abilities and Other Characteristics (SAO) definitions.

Accountability - To consider oneself responsible for one's actions; to take corrective actions after making a mistake.

Achievement Motivation - To seek out difficult and demanding tasks; to show extra effort and persistence when striving to meet work goals; to strive to do the best job possible.

Adaptability - To adjust easily to changing situations or unexpected events; to flexibly change one's actions in response to changing task priorities.

Adventure Seeking - To prefer tasks that may involve danger or risks (for example, high speeds); to avoid boring or routine activities.

Assertiveness - To take charge and make decisions; to be persuasive, influential, and direct when dealing with others.

Attention Allocation and Control - To flexibly switch attention across different tasks; to attend to multiple, potentially conflicting sources of information.

Attention to Detail - To pay close attention to the details of one's work; to ensure work is accurate and complete; to carefully review and scrutinize one's work.

Concentration/Selective Attention - To maintain high levels of performance on a task in distracting or repetitive conditions; to maintain focus despite interruptions.

Confidence - To believe that one is capable of performing tasks in a wide variety of situations; to have confidence in one's skills and abilities.

Critical Thinking Skills - To analyze the strengths and weaknesses of specific actions or decisions.

Decision Making Skills - To make effective, confident decisions in a timely manner; to use sound, informed reasoning and avoid bias when making decisions.

Deliberation - To be careful, thoughtful, and calculating when planning actions; to avoid impulsive actions; to imagine the possible outcomes of one's actions before acting.

Dependability - To be responsible, reliable, and punctual; to follow through on commitments.

Depth Perception - To judge the distance of an object from an observer; to judge the relative distance of multiple objects from an observer.

Disengagement - To avoid disruptive thoughts after making an error; to quickly refocus attention on a task after a disturbing situation.

Emotional Control/Stability - To control one's emotions in stressful situations; to avoid feelings of anxiety, insecurity, depression, or worry.

Goal Setting - To set and strive towards challenging, realistic work goals; to adjust goals based on performance feedback.

Handling Crisis/Emergency Situations - To remain calm, analyze the situation, act appropriately, and make quick, accurate decisions in emergency situations.

Hearing - To detect and discriminate among sounds that vary in pitch or loudness.

Information Management Skills - To perform research and gather information necessary to solve specific problems; to identify and locate important sources of information (for example, technical manuals).

Initiative - To initiate difficult tasks without excessive procrastination; to work independently and accomplish tasks without constant supervision; to take personal responsibility for completing work tasks.

Leadership Motivation – To be motivated to assume leadership roles and responsibilities, and to maintain such motivation in persistence and intensity over time.

Leadership Skills – To effectively persuade and influence others to perform specific actions; to act as a role model for others; to offer instruction and feedback to others as part of a team.

Learning Ability - To be willing and able to acquire new skills quickly and easily; to quickly understand new concepts, ideas, or facts.

Listening Skills - To actively listen to and understand others; to attend to verbal and nonverbal cues (for example, body language, eye contact).

Long-term Memory - To retain and recall information (for example, words, numbers, pictures, and procedures) after long time periods.

Map Reading - To understand a visual representation of an area; to use information from a map to aid in navigation.

Mastery Orientation - To seek out opportunities to acquire new skills and knowledge; to seek and use feedback to improve performance; to view performance errors as opportunities for self-improvement.

Mathematical Ability - To add, subtract, multiply, and divide accurately.

Mental Math - To perform mathematical operations in one's head quickly and accurately.

Mental Rotation - To accurately rotate an object (for example, a map) in one's imagination while maintaining an accurate sense of direction.

Navigation Skills - To effectively navigate through an unfamiliar area to a desired location.

Numerical Reasoning - To reason through math problems to determine the operations that can be performed and possible solutions; to apply mathematical formulas to problems.

Oral Comprehension - To understand spoken English words and sentences (for example, information, ideas, or instructions).

Oral Expression - To speak English words or sentences so others will understand; to express information or ideas clearly.

Organization Skills - To schedule and organize one's work activities, materials, tools, and equipment in order to complete tasks efficiently; to keep one's work space neat and tidy.

Pattern Recognition - To identify or detect a known pattern (for example, a numerical code); to combine and organize different pieces of information into a meaningful pattern quickly.

Perceptual Speed and Accuracy - To perceive or compare information (for example, letters, numbers, symbols, or patterns) quickly and accurately; to notice or compare details about things quickly and accurately.

Planning Skills - To carefully plan out the sequence of actions needed to meet short- and long-term work goals.

Problem Solving Skills - To recognize problems, their potential causes and solutions, and when they are likely to occur; to create effective and innovative solutions to problems.

Reaction Time - To respond quickly and accurately to one signal with a manual (hand or foot) or verbal response.

Reasoning Skills - To apply rules to come up with logical answers to problems; to combine separate pieces of information to form general rules or conclusions; to recognize patterns or trends and anticipate outcomes.

Response Selection - To choose between two or more possible responses quickly and accurately when two or more different signals are given.

Rule Abiding - To respect authority; to follow instructions and orders; to adhere to military rules, standards, and procedures.

Safety Consciousness - To be aware of safety hazards; to take steps to protect oneself and others from harm; to avoid risky behavior that could lead to accidents.

Self-Discipline - To perform difficult, repetitive, or boring tasks while avoiding distractions or alternate activities.

Spatial Orientation - To know one's location in relation to the environment; to maintain directional orientation when navigating an unfamiliar area; to accurately estimate direction or location after traveling for a certain amount of time.

Spatial Visualization - To form a mental image of a pattern or figure; to visualize how an object would look after certain changes are made (for example, when it is moved around or when its parts are rearranged).

Stress Tolerance - To perform effectively under high workload, time pressure, or other stressful situations; to effectively handle stress under demanding situations.

Systems Comprehension - To understand a system as a whole and the relationships among its components; to anticipate how changes in one component will affect the system as a whole.

Task Prioritization - To perform multiple tasks in order of their importance; to direct attention to tasks when they change priorities (e.g., emergencies).

Teamwork Skills - To coordinate with others in a team setting to accomplish group goals; to assist team members who are overwhelmed; to offer and receive feedback.

Technical Troubleshooting - To use technical information to identify the source of a problem and potential solutions.

Time Management Skills - To manage one's own time and the time of others to accomplish work goals.

Visual Acuity - To accurately discriminate details of near or distant objects or objects near the edge of the visual field; to see under low light conditions.

Work Motivation - To take a genuine interest in work tasks; to be willing to go above and beyond normal role duties; to be hard-working and ambitious.

Working Memory - To hold information in memory while processing other information.

Disclaimer: The study protocol was approved by the Naval Aerospace Medical Research Laboratory Review Board in compliance with all applicable federal regulations governing the protection of human subjects.

Sources of Support: This project was funded by the Office of Naval Research (ONR) Work Unit Number 70705.