

Quantitative Risk Assessment and Management of National Defense Acquisition with a Game-Theoretic Security Risk Meter Tool

Mehmet Sahinoglu* and Julian Christopher Petty

Abstract—Driven by the ever-increasing cost and complexity of Department of Defense (DoD) defensive weapons acquisitions and requirements as well as contracting and financial management challenges, risk assessment and management are an undeniably essential component of the defense acquisition process. Identifying and managing the vulnerabilities and threats that affect defense acquisition scientifically is critical to an efficient and cost-effective acquisition process. Failure to identify and manage these sources of risk has very real consequences ranging from schedule delays and cost overruns to project cancellation not only for U.S. but all modern nations. The Defense Acquisition Risk Meter (DARM) innovatively provides an indispensable tool for program managers, politicians and high-level decision makers, and tax payers who shoulder the burden. Using game theory and statistically-driven methodologies, DARM provides an objective, quantitative risk assessment, and unlike any other tool, a guidance for allocating and managing resources for risk mitigation. Defense Acquisition Risk from vulnerabilities, threats and countermeasures is quantified using a game-theoretic Security Risk Meter tool leading to optimally and cost-effectively manage the risk.

Index Terms—Software tool, vulnerabilities, threats, countermeasures

I. INTRODUCTION AND MOTIVATION

The sources of defense acquisition process risk can range from requirements imprecision to politico-economic factors. The consequences to those agencies and contractors that fail to identify and manage the associated vulnerabilities and threats follow up to cause often schedule delays and cost overruns, if not a project cancellation. Indeed, a 2011 Center for Strategic and International Studies report noted that 98 Major Defense Acquisition Programs (MDAPs) from FY (Finance Year) 2010 collectively ran \$402 billion over budget and were an average of 22 months behind schedule since their first full estimate, while 12 MDAPs were cancelled in the prior 10-year period [1]. The previous works have either described categorically this massive risk management issue reaching billions of dollars without any data [2], or examined a case study [3] to substantiate the argument that insufficient risk management has contributed to project delays and cost overruns significantly only by plots or cost diagrams without any math-statistical, probabilistic, objective game-theoretic automated software-based rigid

analysis as such in this article.

To minimize and avoid such schedule delays and cost overruns as well as program cancellations, it is imperative that a rational as well as a scientific approach that identifies, assesses, and manages defense acquisition risk be required.

In FY 2015, the U.S. Federal government obligated \$452 billion of contracts for the acquisition of goods, service, and research and development for spending in FY 2017 [4]. Of that \$452 billion in the same source, the Department of Defense share was roughly 62% or \$280 billion dollars. The Department of Defense (DoD) represents the largest portion of the federal government's budget and spending. Justifiably, the defense of a nation is a priority to the freedom of the land's people proper. At the same time, the nation has trusted the elected U.S. government officials to spend money in the right place, at the right cost, reducing any opportunity to lose money and never go over budget. Cost, schedule and performance are critical to the entire acquisition process.

II. TERMINOLOGY: RISKS, ISSUES, OPPORTUNITIES

The identification and management of risk is fundamental to an efficient and cost effective, and ultimately successful defense acquisition process. The DARM proposed here provides a unique, objective and auditable methodology that is critically needed. This pioneering work represents a true paradigm shift in risk assessment. The Defense Acquisition Risk Meter (DARM) provides a quantitative risk assessment, unlike a subjective range of high-medium-low or descriptive scales such as red-yellow-green commonly seen in other risk assessment methodologies. While there are other approaches to identifying and managing risk such as DoD's risk matrices as detailed in their Risk Management Guide for DoD Acquisition, none provide a means of allocating risk mitigation expenditures as well as Risk Reporting Matrix [5]. In contrast, the Defense Acquisition Risk Meter (DARM) provides objective and scientific guidance in allocating monetary resources for managing defense acquisition risk in accordance with budgetary constraints. Additionally, the DARM provides a means to shift from often subjective and unsophisticated risk evaluation mechanisms to a verifiable, quantitative approach to risk management, resulting in an optimized expenditure of risk remediation dollars.

The assessment and management of Defense Acquisition Risk is a critical part of completing large and complex DoD acquisitions to make progress. While there are many approaches to assessing and managing Defense Acquisition Risk, acquisition managers typically focus on high-level acquisition program attributes such as schedule, cost, and functionality to manage acquisition program risk and

Manuscript received February 16, 2023; revised March 24, 2023; accepted May 25, 2023.

Mehmet Sahinoglu is with Computer Science Department, Troy University, USA.

Julian Christopher Petty received his M.S. degree at Auburn University Montgomery, USA. E-mail: jpetty@aum.edu (J.C.P.)

*Correspondence: mesa@troy.edu (M.S.)

frequently neglect the lower-level acquisition program quality characteristics such as favorable pricing/concessions, supplier inventory, and validity/timeliness. They also generally neglect the broader acquisition program quality characteristics such as leadership support, roles and responsibilities, workforce retention, and communications.

These acquisition program characteristics dramatically affect the ability to execute the acquisition program but rarely show up in simple schedule, cost, and functionality metrics. This conventional approach has resulted, and is currently resulting in schedule and cost overruns that hinder the functionality and capability of the critical acquisition itself. Therefore, identification and management of risk metrics associated with these acquisition characteristics is essential for achieving the lofty goals of any acquisition reform.

Additionally, once risk metrics are identified, formulating a cost-optimized solution to minimize undesirable operational bottlenecks will be provided with priority, not as ad-hoc superficial patching anymore. However, based on the experts' experiential and learned responses, DoD Acquisition Risk index will be algorithmically managed step by step.

In this article, a model of defense acquisition risk that quantifies respondents' experience with crucial aspects of that very risk is adopted. Those responses are subsequently used to calculate the defense acquisition risk index through a designed algorithm by the principal author. To accomplish this task in this article, numerical and/or cognitive data was collected from 27-learned (with expertise) respondents to supply the input parameters to calculate the quantitative defense acquisition risk index. This article will not only present a quantitative model but also provide a remedial cost-optimized game-theoretic analysis about how to bring an undesirable risk down to a user-determined "tolerable level" on a gradual basis. Lastly, it is an easily adaptable framework that can be customized and configured by the analyst with XML inputs-coding and re-coding at will. This innovative article seeks to understand, through hands-off objective calculations, the risk associated with the DoD acquisition process by identifying and assessing vulnerabilities, threats and countermeasures. Likewise, presented to the acquisition community is a tool to assess organizations', programs' or projects' risk percentages.

In return, the analysis performed and tools used can provide a means to score the initial risk while providing the additional capability to reduce unfavorable risk score by implementing tailored countermeasures to be applied to organizations operating under the DoD acquisitions umbrella.

Table I depicts the duality between the proposed DARM and DoD's RIO Management Guide for Defense Acquisition.

TABLE I: TERMINOLOGY RELATION TABLE

Quantitative Metrics Based Assessment and Management-Defense Acquisitions Risk Meter (DARM)	DoD RIO Management Guide for Defense Acquisition Programs
Vulnerability	Issue
Threat	Risks
Countermeasure	Opportunities

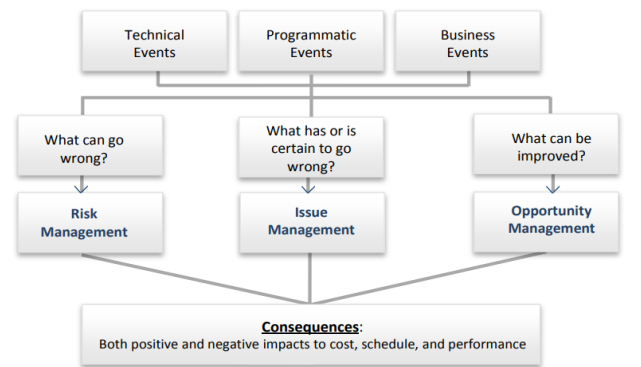


Fig. 1. Overview of potential sources of program risks, issues and opportunities [Figure 1-1 on page 11/96 Ref. 5].

III. USEFUL TERMS AND DEFINITIONS

For the purpose of this work, the terms vulnerabilities, threats, countermeasures and risk are defined as follow:

- 1) Vulnerability is when assets become weak under malicious threat conditions [6, 7].
- 2) Threat is defined as the probability of the exploitation (exposure) of a vulnerability item within a specific time frame under the accepted conditions [6, 7]
- 3) Countermeasures are the methods, techniques or tools applied to combat or mitigate risk [6, 7].
- 4) Risk is the calculation of the Vulnerability times the Threat. "Residual Risk" is the Risk times the "Lack of Countermeasures" likelihood due to the criticality factor assumed to be unity (=1.0) for convenience such as in the event of acquisition of nuclear warheads [6, 7].

Note, DoD Planning, Programming, Budgeting, and Execution (PPBE) is a strategic planning process for allocating resources among the military departments, defense agencies, and other components. Joint Capabilities Integration and Development System (JCIDS) is the process by which the military develops and validates capability requirements for joint (more than one service) use and interoperability.

Acquisitions personnel involved in risk management will most likely reference the Department of Defense Risk, Issue and Opportunity (RIO) Management Guide for Defense Acquisition Programs [8]. The RIO guide defines risk, issue and opportunity as follow:

- 1) Risks are potential future events or conditions that may have a negative effect on achieving program objectives for cost, schedule, and performance. Risks are defined by (i) $0 \leq \text{risk} \leq 1$ of undesired events or conditions, and (ii) the consequences, impacts, or severity of the undesired events, were they to occur.

- 2) Issues are events or conditions with negative effect that have occurred (such as realized risks) or are certain to occur (with probability of 1) that should be addressed.

- 3) Opportunities have potential future benefits to the program's cost, schedule, and timeliness and/or performance baseline.

In order for acquisition personnel to take full advantage of this article, Table I shows the relation between terminology researches conducted in this report and its relevance: Risk, Issues or Opportunities (RIO) Guides definitions [9]. Any event, condition or action may lead to issues (vulnerability), risk (threat) or opportunities (countermeasures) each with its cost, schedule and performance consequences. The DoD's

RIO guide portrays this best with the depiction in Fig. 1 of technical, programmatic, and business events that require risk, issue, and opportunity management throughout programs and projects' life cycle.

The DoD acquisition process is conducted in one of three procurement processes: Acquisition Management, Acquisition Funding, and Acquisition Requirements, as depicted by the authors (see Fig. 2). These three procurement processes make up the Defense Acquisition system and is implemented by DoD Instruction 5000.02 [10]. Similarly, this research will investigate and analyze three main vulnerability domains (or areas): Requirements, Management and Funding. Each vulnerability domain is independent of one another and has distinct threats and countermeasures. Fig. 3's tree diagram starts (left to right) with the risk theme: DoD Acquisition Risk, and spans to the three vulnerability domains, Requirements, Management and Funding. Those vulnerability domains branch out to identified threats, regarding, e.g., Acquisition Requirements such as Political, Funding, Program Requirements, etc. Threats can either lack

the relative countermeasure or employ countermeasures. This model is critical to the research and assessment process for calculating risk. The next two sections will go into detail on how pertinent data was collected and analyzed.

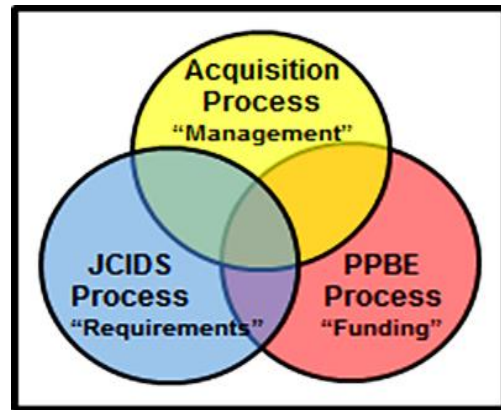


Fig. 2. DoD acquisition system process (JCIDS: Joint capabilities integration and development system; PPBE: Planning, programming, budgeting and execution system).

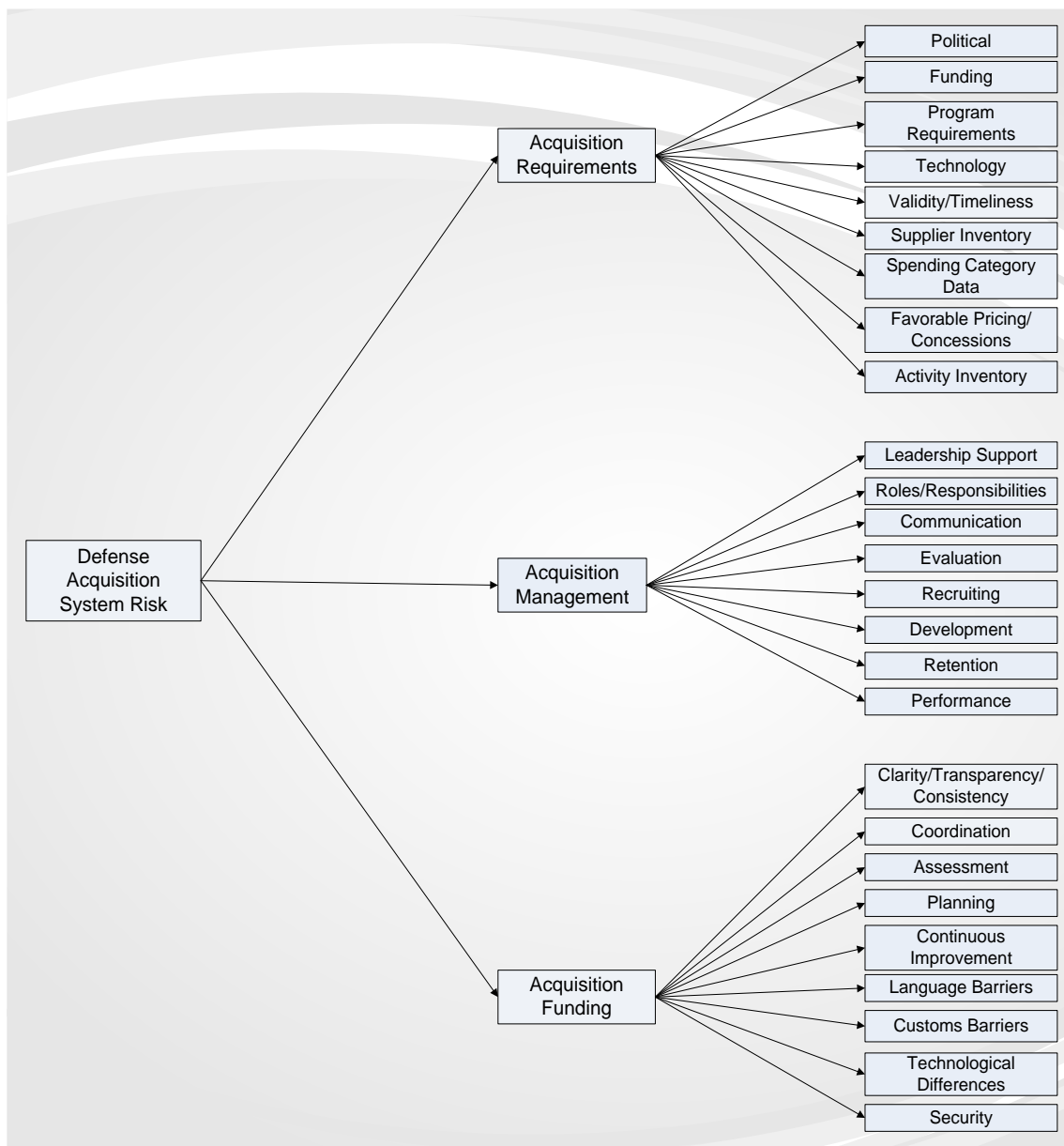


Fig. 3. Defense Acquisition Risk Meter (DARM) tree diagram.

IV. METHODOLOGY

The intent for the research project and purpose of this article was to assess DoD acquisitions organizations. Because of the second author’s affiliation to the Armed Forces and the proximity of Auburn University Montgomery to Maxwell Air Force in Montgomery, Alabama; the targeted audience were primarily the five armed service branches: Army, Air Force, Navy, Marines and Coast Guard working locally as well as across the world. Likewise, contracting organizations working for or with the service branches were also encouraged to take part in the survey.

In order to achieve a balanced and practical respondent base, our targeted audience was modeled after the RIO guide’s tiered risk management hierarchy. The executive, management and working tiers included: General officers, senior and mid-level executives, field-grade and company grade officers, program directors, project managers and specialized cyber security technicians. These were individuals involved in risk management at every tier, and in a variation of roles and responsibilities. From top-to-bottom of the chain of command and across multiple war fighting domains, this array of experts serve daily in the vital role of identifying, assessing, analyzing, reporting and mitigating risk. Research engagement was limited to personal coordination with professionals operating in or with the acquisitions community. The coordination was made via email and provided each recipient with an “Invitation Letter” from the Auburn University Montgomery where the project was conducted. This letter covered this research task, purpose, scope, survey process and the tools used to calculate various risks. This article provided the purpose and scope of this research as well as giving insight on how respondents were surveyed and the observations and analysis of collective and individual results.

A. Survey Process—Survey Monkey

Given that the targeted audience was invariably DoD personnel geographically dispersed across the globe, a worldwide data collection mechanism was needed to survey respondents. To facilitate these survey requirements, Survey Monkey, an online survey development Cloud-based software as a service, was chosen. Traditionally, an invitation

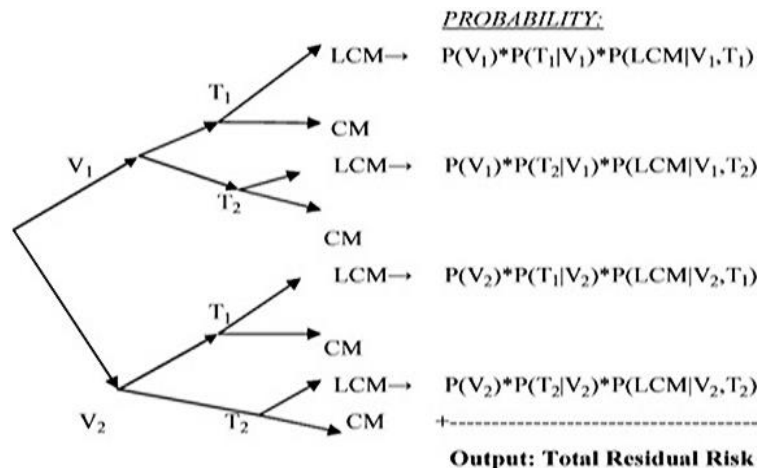
letter would be hand delivered, mailed, emailed along with a paper copy of the survey. Respondents would then have to print the survey, respond, and then deliver, scan or snail mail their finalized the survey back to the university. Surveyed respondents simply can visit <https://surveymonkey.com/r/aumcybersurvey> to complete the research survey [11].

Most DoD organizations train users to be aware of emails with multiple attachments, as attackers like to lure cleared government personnel in with crafty spoofed emails. To also reduce this risk and burden of printing, scanning, email or physically mailing printed surveys, the online survey is accessible from any government workstation, personal computer or mobile device. Survey Monkey [12] also collects and analyzes the data providing a “summary view of your data; browse individual responses; create custom charts; use filters to focus on specific data views and segments.” Another advantage to using Survey Monkey is the ability to customize filtering and export options. For the purpose of this article, respondents’ data was filtered on questions answering “Applies to my organization/section” and output to a Comma Separated Value (CSV) file in order to digitally transfer the data to DoD Acquisition Security Meter.

B. Security Risk Meter Overview

Once the respondents answered the DoD Acquisition risk survey, the data was automatically submitted to the DARM software. The primary author developed the (Security) Risk Meter (RM) tool suite that was used in this research project. The Java based software takes the survey responses (input), uses the probability and employs game-theory to calculate the residual risk (output) with related cost to mitigate the risk.

This proposed method stands apart from the DoD’s existing approaches that typically provide general guidance and use the traditional red-yellow-green risk matrix. Instead, the Security Meter (Figs. 3 and 4 provide a quantitative metric, based on statistical probability and game theory for risk management and risk mitigation. The DoD acquisition risk meter presented in this article will provide objective, automated, dollar-based risk mitigation advice with the option to optimize metrics to reduce the risk for acquisitions personnel working in various roles and responsibilities throughout the acquisition process.



(a)

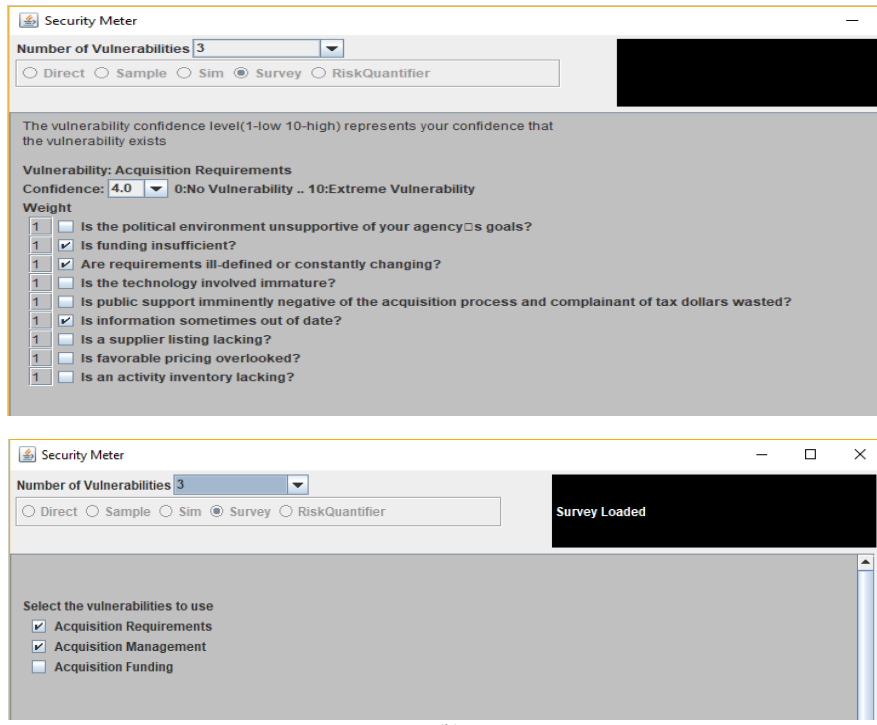


Fig. 4. (a) Generalized tree diagram showing calculations for TRR (V -branches, T -twigs, LCM -limbs). (b) Security meter application—An example by the user—Respondent #19 out of total 27 subjects.

A random sample of responses from 27 survey participants was analyzed; their residual risk was calculated, indexed, ranked and are provided in Tables II and III, and Figs. 3–16. A surveyed example, Respondent #19, is in Fig. 5. The 14th ranked median score, Respondent #1 of risk 53.12% among 27 respondents was identified and used to represent the acquisitions base table in Figs. 6–8 from the Table II.

TABLE II: RESULTS TABULATION OF 27 SECURITY METER (SM) RESPONDENTS ($MEDIAN \approx MEAN \leftrightarrow RANDOMNESS \approx NORMAL PDF$)

Respondent	Residual Risk	Ranked Overall in Ascending Order	Designation
1	53.12%	14	Respondent # 1 → MEDIAN (Exact)
2	61.31%	20	
3	52.52%	12	Respondent # 3 → ~ MEAN (52.3)
4	42.50%	6	
5	59.14%	16	
6	59.31%	17	
7	26.34%	2	
8	18.43%	1	
9	37.50%	3	
10	37.50%	4	
11	61.63%	21	
12	49.49%	10	
13	41.36%	5	
14	47.62%	9	
15	64.07%	24	
16	62.50%	22	
17	63.71%	23	
18	64.88%	25	
19	44.32%	7	
20	69.17%	27	
21	59.62%	18	
22	51.62%	11	
23	66.37%	26	
24	46.78%	8	
25	60.84%	19	
26	57.39%	15	
27	53.03%	13	

C. Factor of 20% Less Risk Optimization

The median's risk score will be reduced from 53.12% to 42.5% by 20% of initial 53.12%. Taking the initial risk index of 0.5312 multiplied by 0.20, and subtracting 0.10624 from 0.5312 equals 0.42496. For a lump-sum capital cost of \$1,000, one has to invest \$106.24 to upgrade Roles/Responsibilities' Countermeasure (CM) from 42.5% to 59.16% by 16.66% (Fig. 8 and Table II). The break-even cost is $\$106.24/16.66\% = \6.38 per 1% invested improvement. Advice column dictates to raise the CM capacity vs the multiple threats of Roles/Responsibilities from 42.5% to 59.16% for the Acquisition Management. Risk is defined as the likelihood of an undesirable event's occurrence. One utilizes the definition of risk as the product of the vulnerability likelihood and its pertinent threat impact:

$$Risk = Likelihood \times Impact \quad (1)$$

For example, the measure of security-related information residual risk is the product of its vulnerability, and its threat exposure to vulnerability, and risk of lack of countermeasure of the threat:

$$Residual Risk (Unitless) = Risk of Vulnerability \times Risk of Threat \times Risk of Lack of Countermeasure \quad (2)$$

$$Final Residual Risk (\$) = Residual Risk \times Criticality Constant (CC) \times Asset (\$) \quad (3)$$

Note, $0 < CC < 1$ indicates the severity of risk in case of a lethal risk, such as a Nuclear Power plant explosion with a $CC = 1$ due to the hazardous radioactivity spread to humans for a worst-case scenario. The Residual Risks (RR), i.e., the risk remaining after the risk mitigation decisions have been taken, should be estimated to ensure that sufficient protection

is achieved. If the residual risk is unacceptable, the risk treatment process should be re-iterated. If for instance, CM probability is perfect (100%), then the risk of Lack of Countermeasure (LCM) is $1 - CM = 0$ reducing the Residual Risk to a mere zero. The game-theoretic equations of constraints for risk management follows:

$$MIN COLLOSS (0 < Column Loss < 1) \tag{4}$$

subject to: (See all rows in Fig. 8).

$$1 CM_{11} > 0.5 \tag{5}$$

$$1 CM_{12} > 0.475 \tag{6}$$

$$1 CM_{13} > 0.525 \tag{7}$$

$$1 CM_{14} > 0.7 \tag{8}$$

$$1 CM_{21} > 0.425 \tag{9}$$

$$(0.36218 \times 0.25536) \rightarrow 0.0924509 CM_{11} - 1 \times Colloss < 0 \tag{10}$$

$$(0.36218 \times 0.264912) \rightarrow 0.0959455 CM_{12} - 1 \times Colloss < 0 \tag{11}$$

$$(0.36218 \times 0.248246) \rightarrow 0.0899095 CM_{13} - 1 \times Colloss < 0 \tag{12}$$




























$$(0.36218 \times 0.231579) \rightarrow 0.0838731 CM_{14} - 1 \times Colloss < 0 \tag{13}$$

$$(0.637821 \times 1.00) \rightarrow 0.0637821 CM_{21} - 1 \times Colloss < 0 \tag{14}$$

$$0.0924509 CM_{11} + 0.0959455 CM_{12} + 0.0899095 CM_{13} + 0.0838731 CM_{14} + 0.0637821 CM_{21} > (1 - 0.424497) \tag{15}$$

Optimally Feasible Objective Solution Vector (CM_{ij}) using an Automated Software Tool (Risk Meter) that can be observed in Appendix's SM or RM software is as follows when the objective function and constraints are satisfied. See column 5 for CM & LCM in Fig. 8 to mitigate by 20%: $CM_{11}=0.5$ (no change), $CM_{12}=0.475$ (no change), $CM_{13}=0.525$ (no change), $CM_{14}=0.7$ (no change), $CM_{21}=0.5916$ (to improve from an initial 0.425).

TABLE III: A SCREENSHOT OF LIST OF 27 RESPONDENTS' SURVEY MONKEY RESPONSES IN PDF

 _Response_1_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_2_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_3_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_4_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_5_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_6_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_7_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_8_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_9_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_10_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_11_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_12_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_13_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_14_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_15_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_16_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_17_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_18_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_19_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_20_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_21_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_22_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_23_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_24_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_25_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_26_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB
 _Response_27_171009.pdf	11/17/2017 6:49 AM	Microsoft Edge P...	4 KB

Vuln.	Vuln. Risk	Threat	Threat Risk	LCM	Res. Risk	Post Risk	Post Vuln. Risk	>
Acquisition Requirements	0.391304	Funding	0.104680	0.450000	0.018433	0.04		
		Program Requirements	0.365764	0.725000	0.103766	0.23		
		Technology	0.193350	0.475000	0.035938	0.08		
Acquisition Management	0.211180	Validity/Timeliness	0.336207	0.150000	0.019734	0.04	0.401298	!
		Roles/Responsibilities	0.193750	0.350000	0.014321	0.03		
		Communication	0.256250	0.500000	0.027057	0.06		
		Evaluation	0.256250	0.375000	0.020293	0.05		
Acquisition Funding	0.397516	Performance	0.293750	0.400000	0.024814	0.06	0.195121	
		Continuous Improvement	1.000000	0.450000	0.178882	0.40	0.403581	!

Criticality	1.00
Capital Cost	\$1,000.00
Total Threat Costs	N/A
Res-Risk * Criticality	0.443237
Total Res-Risk	0.443237
Expected Cost of Loss	\$443.24
Cust. Guess Res-Risk	0.50

Fig. 5. An Example of Defense Acquisition Risk Meter (DARM) input and result (~%44) for Respondent #19.

Vuln.	Threat	CM & LCM	Res. Risk	CM & LCM	Res Risk	Change	Opt Cost	Unit Cost	Final Cost	Advice
0.362179	0.255263	0.500000		0.500000						
		0.500000	0.046226	0.500000	0.046226					
	0.264912	0.475000		0.475017						
		0.525000	0.050372	0.524983	0.050370					
	0.248246	0.525000		0.525000						
		0.475000	0.042707	0.475000	0.042707					
	0.231579	0.700000		0.700000						
		0.300000	0.025162	0.300000	0.025162					
0.637821	1.000000	0.425000		0.508283		0.083283	\$53.11			Increase the CM capacity for threat "Roles/Responsibilities" from 42.50% to 50.83% for "Acquisition Management"
		0.575000	0.366747	0.491717	0.313627					
						Total Change	Total Cost	Break Even Cost	Total Final Cost	
						8.33%	\$53.12	\$6.38		

Criticality	1.00	Total Risk	0.531213	Total Risk	0.478092
Capital Cost	\$1,000.00	Percentage	53.121282	Percentage	47.809171
Total Threat Costs	N/A	Final Risk	0.531213	Final Risk	0.478092
		ECL	\$531.21	ECL	\$478.09
				ECL Delta	\$53.12

2 Vulnerabilities

Fig. 6. Results table of Median (#1 respondent, 14th ranked) risk mitigated by the original score's 10%. In the first iteration of optimization the initial median's risk score we will optimize by reducing the risk from 53.12% to 47.80%. With a capital cost of \$1,000 it would take \$53.12 to reduce the risk by 10%. That is, increase the Countermeasure Capacity for the threat of Roles/Responsibilities of the Acquisition Management vulnerability by investing \$53.12.

Vuln.	Threat	CM & LCM	Res. Risk	CM & LCM	Res Risk	Change	Opt Cost	Unit Cost	Final Cost	Advice
0.362179	0.255263	0.500000	0.046226	0.500000	0.046226					
	0.264912	0.475000	0.050372	0.475085	0.050363					
	0.248246	0.525000	0.042707	0.524915	0.042707					
	0.231579	0.475000	0.042707	0.475000	0.042707					
	0.231579	0.700000	0.025162	0.700000	0.025162					
	0.231579	0.300000	0.025162	0.300000	0.025162					
0.637821	1.000000	0.425000	0.366747	0.549915	0.287073	0.124915	\$79.63			Increase the CM capacity for threat "Roles/Responsibilities of the Acquisition Management" from 42.50% to 54.99% for
		0.575000	0.366747	0.450085	0.287073					
						Total Change	Total Cost	Break Even Cost	Total Final Cost	
						12.50%	\$79.68	\$6.37		

Criticality	1.00	Total Risk	0.531213	Total Risk	0.451531
Capital Cost	\$1,000.00	Percentage	53.121282	Percentage	45.153108
Total Threat Costs	N/A	Final Risk	0.531213	Final Risk	0.451531
		ECL	\$531.21	ECL	\$451.53
				ECL Delta	\$79.68

Show where you are in Security Meter	
Optimize	Change Cost

Change Unit Cost
Calculate Final Cost
Print Summary
Print Results Table
View Threat Advice
Print Single Threat/CM Selection
Print Advice Threat/CM Selections
Print All Threat/CM Selections
Update Survey Questions

Fig. 7. Results table of Median (#1 respondent, 14th ranked) risk mitigated by the original score by 15%. The second iteration of optimization will take the initial median's risk score by reducing the risk from 53.12% to 45.15%. With a capital cost of \$1,000 asset, it would cost \$79.68 to reduce the risk by 15%. That is, increase the Countermeasure Capacity for the threat of Roles/Responsibilities of the Acquisition Management vulnerability by investing \$79.68.

Vuln.	Threat	CM & LCM	Res. Risk	CM & LCM	Res Risk	Change	Opt Cost	Unit Cost	Final Cost	Advice
0.362179	0.255263	0.500000	0.046226	0.500000	0.046226					
	0.264912	0.475000	0.050372	0.475034	0.050368					
	0.248246	0.525000	0.042707	0.524966	0.042707					
	0.231579	0.475000	0.042707	0.475000	0.042707					
	0.231579	0.700000	0.025162	0.700000	0.025162					
	0.231579	0.300000	0.025162	0.300000	0.025162					
0.637821	1.000000	0.425000	0.366747	0.591566	0.260508	0.166566	\$106.22			Increase the CM capacity for threat "Roles/Responsibilities of the Acquisition Management" from 42.50% to 59.16% fo
		0.575000	0.366747	0.408434	0.260508					
						Total Change	Total Cost	Break Even Cost	Total Final Cost	
						16.66%	\$106.24	\$6.38		

Criticality	1.00	Total Risk	0.531213	Total Risk	0.424970
Capital Cost	\$1,000.00	Percentage	53.121282	Percentage	42.497039
Total Threat Costs	N/A	Final Risk	0.531213	Final Risk	0.424970
		ECL	\$531.21	ECL	\$424.97
				ECL Delta	\$106.24

Show where you are in Security Meter	
Optimize	Change Cost

Change Unit Cost
Calculate Final Cost
Print Summary
Print Results Table
View Threat Advice
Print Single Threat/CM Selection
Print Advice Threat/CM Selections
Print All Threat/CM Selections
Update Survey Questions

Fig. 8. Results table of Median (#1 respondent, 14th ranked) risk mitigated by the original score's 20%. In the third and final iteration, the initial median's risk score will be reduced from 53.12% to 42.5%. With a capital cost of \$1,000 it would cost \$106.24 to reduce the risk by 20%. That is, increase the Countermeasure Capacity for the threat of Roles/ Responsibilities of the Acquisition Management vulnerability by investing \$106.24.

V. OVERVIEW

This applied research article implements a methodology on how to reduce DoD Acquisition Risk from an undesirable to a desirable or tolerable level. A software-centered holistic approach is proposed to aid program managers and high level decision makers in identifying, assessing, and managing defense acquisition risk. Three vulnerabilities are assessed: Acquisition Requirements, Acquisition Management, and Acquisition Funding of Fig. 2. Within each vulnerability category, questions pertain to specific threats and countermeasures. For example, within the Acquisition Requirements vulnerability, respondents are asked questions regarding Political, Funding, Program Requirements, Technology, Validity/Timeliness, Supplier Inventory, Spending Category Data, Favorable Pricing/Concessions, and Activity Inventory threats and countermeasures. See Fig. 3 for the Defense Acquisition Risk Tree Diagram detailing vulnerabilities and threats. The respondents' answers are used to generate a quantitative Defense Acquisition Risk Index.

To elaborate, DoD Acquisition Risk is to be quantified using an algorithm for calculating risk indices associated with acquisition program characteristics, i.e., Defense Acquisition Risk Meter that drive the success of the program. Assessment by quantifying DoD Acquisition Risk to further minimize potential issues leading to acquisition program policy and procedural improvements based on application of risk reduction methods for a given acquisition program is the ultimate goal of this proposal. The Defense Acquisition Risk Meter software will evaluate a series of learned-questions/expert-responses using experienced personnel's perceptions toward the assessment of an Acquisition Risk index. The Acquisition Risk Meter implemented to U.S. and global sourcing in this proposal will provide objective, automated and dollar-based (budgetary) risk mitigation advice for interested parties such as investigators, administrators, and DoD primes and subcontractors to minimize DoD's Acquisition Risk and cost factors on any acquisition-affiliated program activity. For the purpose of continued research on this topic, it is imperative that academic, defense and industry relationships be established in order to strengthen two main domains: i) increase the sample size of data collected; and ii) refine the survey questions to reflect any updates or changes to acquisitions' practices used across all acquisition communities. These two recommendations alone would provide the DoD an increased data set from a practiced and applied experience realm. The DoD's largest research agencies like Defense Advanced Research Projects Agency (DARPA) and the Defense Acquisition University (DAU) or even independent organizations like MIT Research Establishment (MITRE) would be great starting points to establish the necessary relationships in order to increase the scale and relevance of assessing and managing Department of Defense Acquisition Risk. The primary author's innovation, i.e., Defense Acquisition Risk Meter (an automated software tool), will provide program managers and high level decision makers a measurable assessment of their current Defense Acquisition Risk while planning associated cost and risk mitigation path.

The Defense Acquisition Risk Meter will be demonstrated to provide such assessment and guidance for the allocation of resources to mitigate that risk. The Defense Acquisition Risk Metric out of a 100% will be assessed and a remedial cost-optimized game-theoretic analysis provided to bring an undesirable risk down to a user-determined "tolerable level".

The approach, the authors proposed here, is a probabilistic and game theoretical-based approach that emphasizes the quantitative analysis of vulnerabilities, threats and countermeasures shown in Fig. 3. See p. 220 in [6] for other thematic RMs from Digital Forensics to National Cybersecurity, to name a few. The theoretical framework behind the Defense Acquisition Risk diagram shown is a tree diagram with vulnerability branches, threat twigs, and countermeasure limbs that calculates total residual risk as elaborated. This framework allows for the quantitative analysis of vulnerabilities and threats and the cost-optimal allocation of resources to countermeasures that mitigate the risk from those vulnerabilities and threats. The framework used by the DARM software tool is described. Note that Total Residual Risk (TRR) is the sum of Residual Risks (RRs) as in Fig. 4 by [6]. The true capacity of this methodology lies in its algorithmic power through an automated software, namely an expert system, to assess risk in such a manner to subsequently offer objective risk mitigation advice delivered in hard currency such as U.S. dollars or else. While the Defense Acquisition Risk Meter can be utilized on virtually any acquisition process, this particular implementation focuses on three domains critical for optimal defense acquisition:

- 1) Acquisition Requirements: Fundamental to the defense acquisition process as well as long term program success, the need to precisely specify requirements is critical. This key area focuses on Political, Funding, Program Requirements, Technology, Validity/Timeliness, Supplier Inventory, Spending Category Data, Favorable Pricing/Concessions, and Activity Inventory threats.

- 2) Acquisition Management: This area focuses on the costs, schedules, and human capital integral to the defense acquisition process, such as Leadership Support, Roles and Responsibilities, and Evaluation, Recruiting, Development, Communication, Retention and Performance threats.

- 3) Acquisition Funding: Critical in preventing delays and Questions are designed to elicit responses regarding costs' overruns, this key area must be addressed to optimize the defense acquisition process. This key area focuses on Clarity and Transparency and Consistency, Coordination, Planning, Assessment, Continuous Improvement, Language Barriers, Customs Barriers, Technological Differences and Security threats. While these domains are not exhaustive, they are relatively comprehensive of and critical to defense Acquisition Risk. This research focuses on the domains vital to defense acquisition processes to provide program managers and high level decision makers with an analytical framework they can use to more efficiently structure these processes. A live person with exact Median (50th percentile) exists but no real person with the averaged risk, i.e. not useful to compare.

A. Sample of Assessment Questions

The perceived defense Acquisition Risk from particular

threats, and the countermeasures the users may employ to counteract those threats. For example, in the Acquisition Requirements vulnerability, questions regarding Technology threat include both threat and countermeasure questions. Several threat questions among many would include:

- Does program development depend on future technology?
- Has the technology not been tested?
- Is development and testing concurrent?
- Is the industrial base shrinking?

While several countermeasure questions would include:

- Does the program utilize well established technologies?
- Has the technology been realistically tested?
- Does further development occur only after successful tests?
- Is the industrial base supported through steady research and production funding?

B. Risk Calculation and Risk Mitigation

Essentially, the users are responding yes (positively) or no (negatively) to such questions. These responses are then used to calculate a total Residual Risk (TRR) index. Using a probabilistic and game-theoretical approach, the calculated risk index is then used to generate an optimization or lowering of risk to desired levels by [6, 7]. Further, mitigation guidance will be generated to aid program managers and high level decision makers in resource allocation decisions for lowering risk. In what domains can the risk be reduced to optimized or desired levels such as from 53.12% to 42.50% representing the median response from the study participants? See Fig. 8 for a screenshot of the Median Defense Acquisition Risk Meter results displaying threat, countermeasure, and residual risk indices, optimization options and risk mitigation advice. A screenshot of a sample of 27 respondents was taken and their residual risk assessment results are tabulated in Table II. Respondents' familiarity with defense Acquisition Risk was comprised of corporate and governmental records. Similarly, Figs. 6 and 7 refer to 10% and 15% risk mitigation results, respectively. In Fig. 6, the initial median's risk score we will optimize by reducing the risk from 53.12% to 47.80%. With a capital cost of \$1,000 it would take \$53.12 to reduce the overall risk by 10%. In Fig. 7, the initial median's risk score we will optimize by reducing the risk from 53.12% to 45.15%. With a capital cost of \$1,000 it would cost \$79.68 to reduce the respondent cross-section data of Fig. 17 overall risk by 15%. These are examples depending on the 1st respondent given in Fig. 16.

VI. CONCLUSIONS AND DISCUSSIONS

The Defense Acquisition Risk Meter breaks a new ground in providing both a quantitative assessment of risk to users and recommendations for managing and mitigating that risk as well as opting for Better Buying Power [13]. As such, it will be a highly useful tool for program managers and high level decision makers seeking to optimize the defense acquisition process through minimizing and mitigating the associated risk in an objective, quantitatively-based manner. Minimization of defense Acquisition Risk will greatly benefit not only the agencies and companies deploying the tool, but the taxpayer as well through greater efficiency and cost-effectiveness. Note that the Defense Acquisition Risk

Meter and its associated advice and refinement steps provide the means to do that differently.

As nations continuously take steps to advance their national, strategic and domestic capabilities as well as the warfighter and his/her mission critical equipment it is imperative that the proper identification and assessment of acquisition processes are continuously evaluated [14]. The lives and missions of a nation's Soldiers, Sailors, Airmen and Marines depend on timely, accurate and dependable systems in order to protect and defend any nation. The process and fashion in which the DoD procures and develops these critical systems must be heavily monitored and consistently measured. To do so, the article provides a method and means for those vital acquisitions professionals to assess projects, programs, organizations and agencies. From the analysis conducted during this assessment the overall 27 respondents of Tables II and III produced a symmetric normal distribution confirming randomly collected sample data. After evaluating the magnitude associated with this subject, a total risk rating (1 to 10 with 1 being the least severe risk and 10 being the most catastrophic risk) for DoD Acquisitions would be rated.

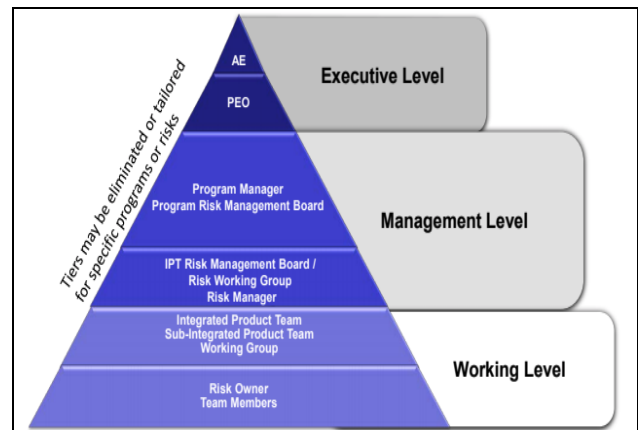


Fig. 9. Roles and responsibilities-tiering [Figure A-2 on page 66/96 Ref. 5]

The DoD's largest research agencies like DARPA and the Defense Acquisition University (DAU) or even independent organizations such as MITRE or others which favor defenseinnovationmarketplace [15] would be great starting points to establish the necessary relationships in order to increase the scale and relevance of assessing and managing DoD Acquisition Risk. It is worth noting that Figs. 9 and 10 demonstrate a comparison of DoD RIO for roles and responsibilities layers. Additionally, Figs. 11–17 illustrate a recorded sample of Survey Monkey Analysis which the respondents respectively engaged including cross-section of only the first respondent's Survey Monkey questionnaire. The DARM project also can benefit from mutually collaborative Digital Forensics-themed research, and retrospectively study what really went wrong post-facto [16]. Note, MIT of MITRE is the Massachusetts Institute of Technology. For more details on Security Meter, the reader may refer to the author's 2005 pivotal paper in IEEE [17]. Major limitations: 1) Absence and willingness of expert respondents, 2) Reluctance of organizations to place this digital survey in their portals, 3) The lack of awareness to prefer quantitative risk assessment and management methods to the up-to-date conventional.

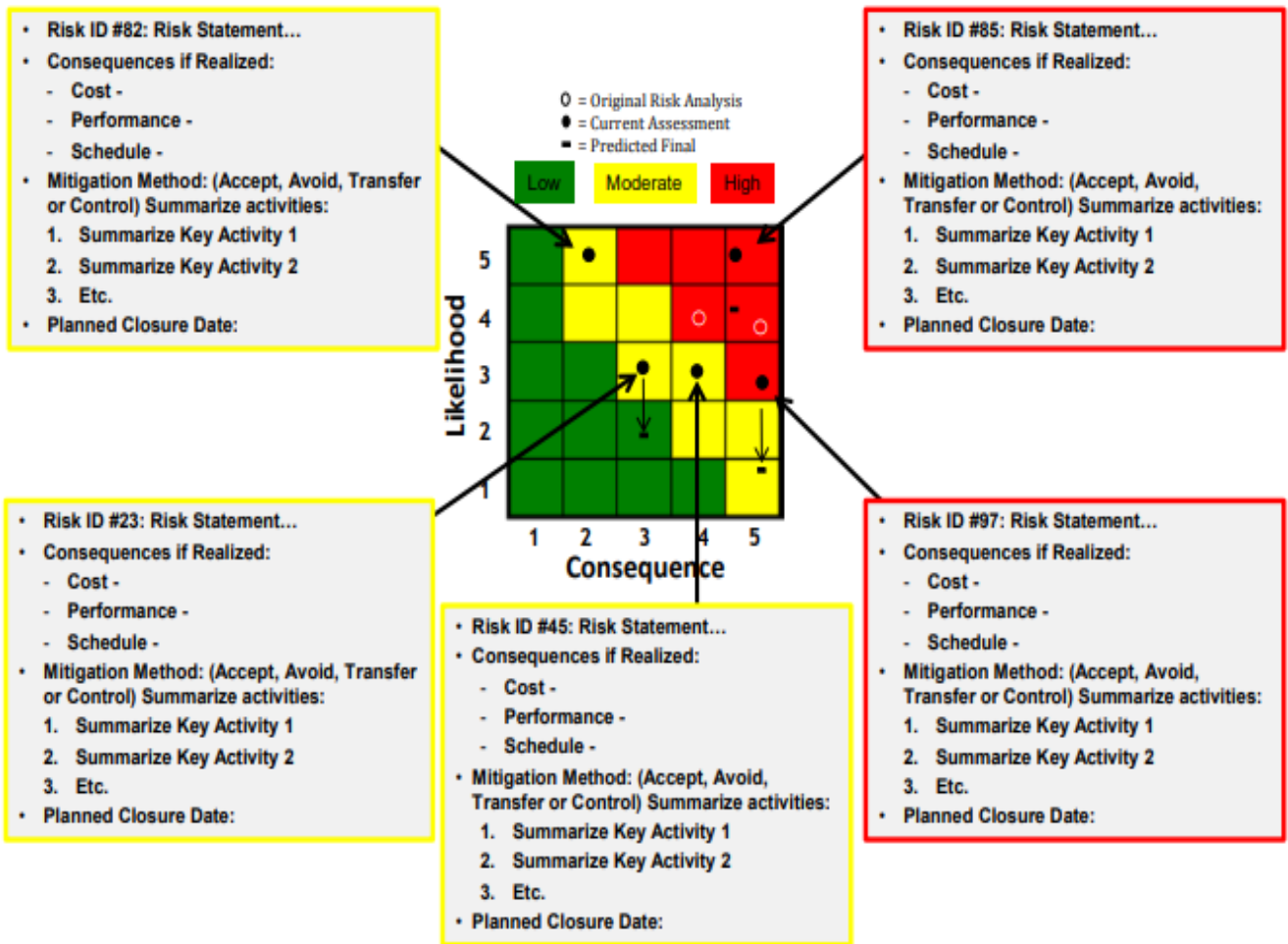


Fig. 10. Suggested risk reporting format [Figure 3-11 on page 47/96 Ref. 5].

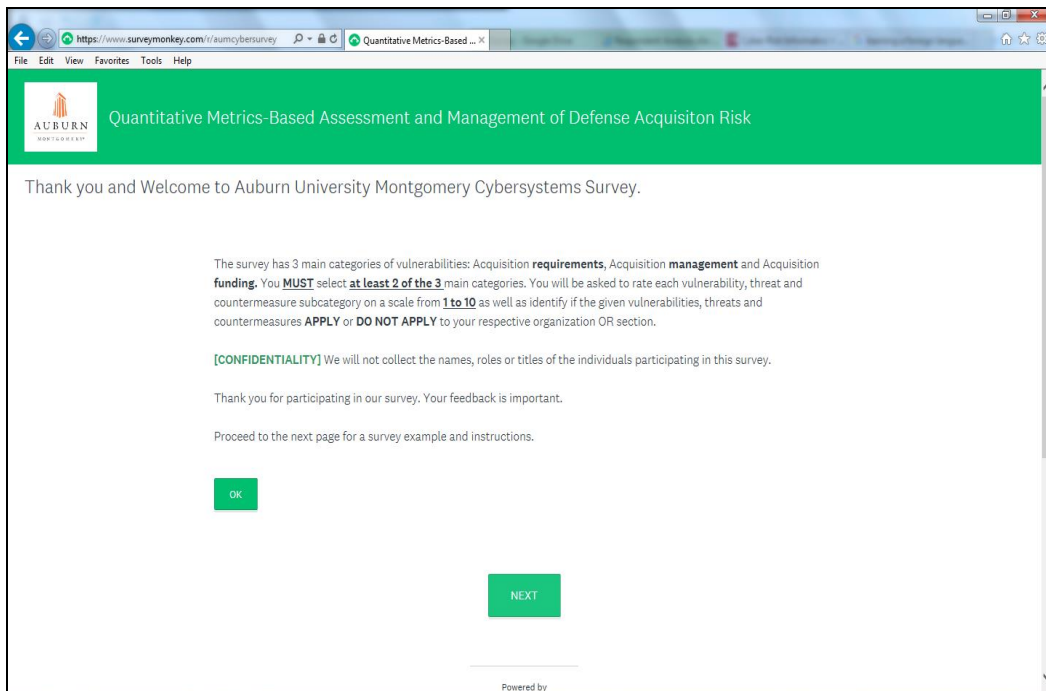


Fig. 11. Survey Monkey—Online survey.

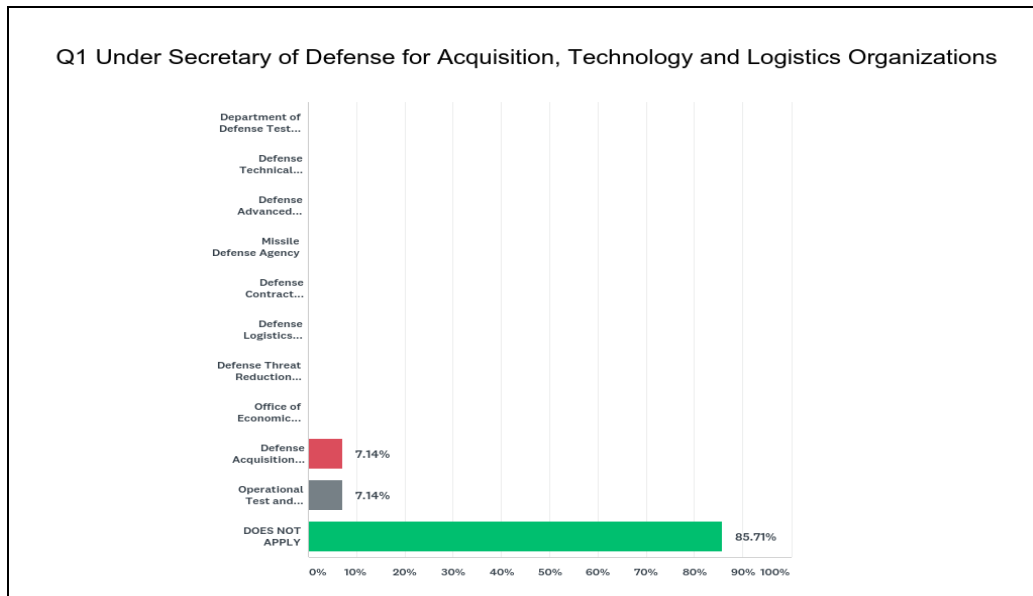


Fig. 12. DoD Organization Affiliation Analysis from the Survey Monkey online survey.

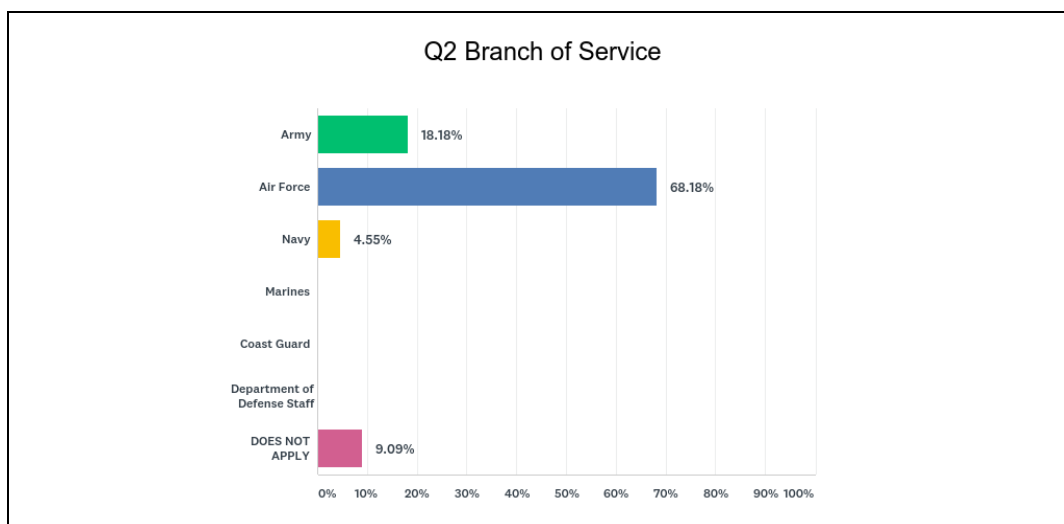


Fig. 13. Branch of Service Analysis from the Survey Monkey online survey.

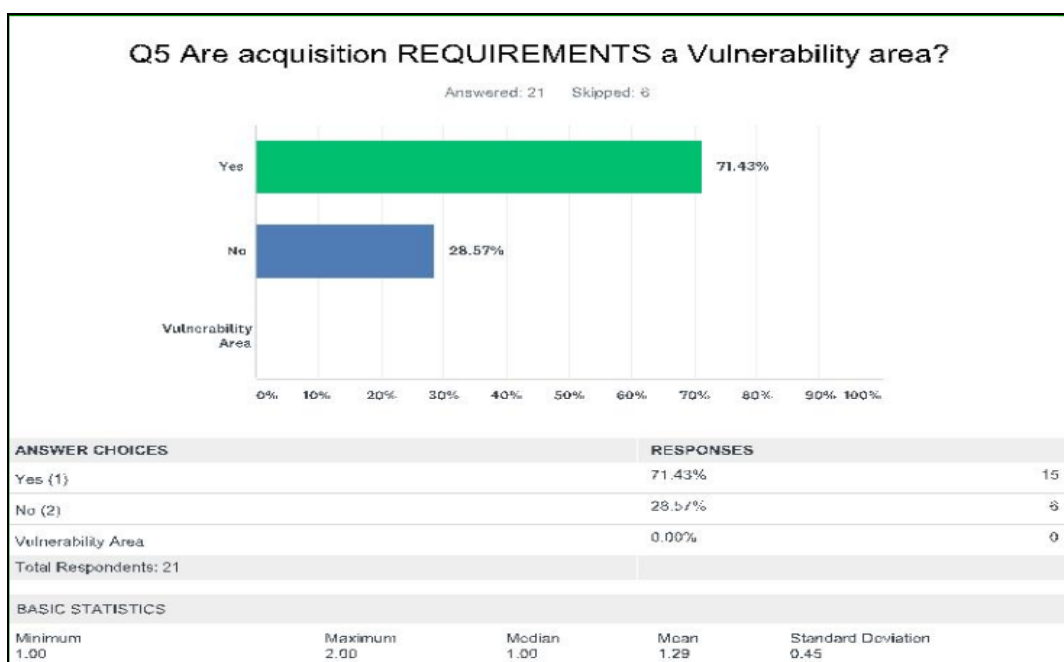


Fig. 14. Example of requirements vulnerability area analysis from the survey monkey online survey.

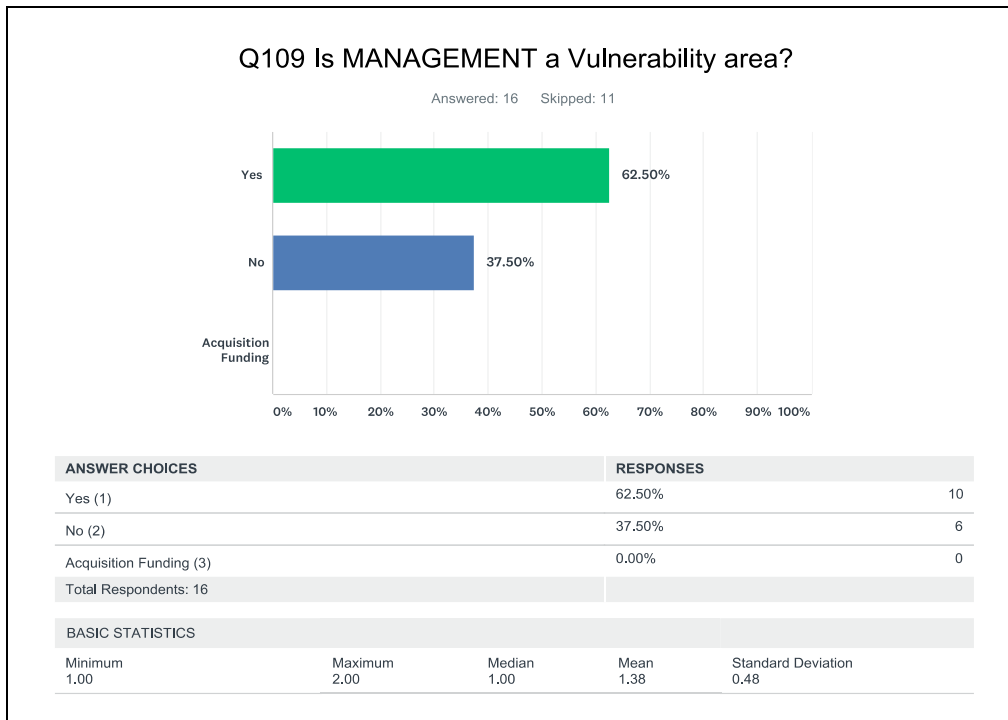


Fig. 15. Example of management vulnerability area analysis from the survey monkey online survey.

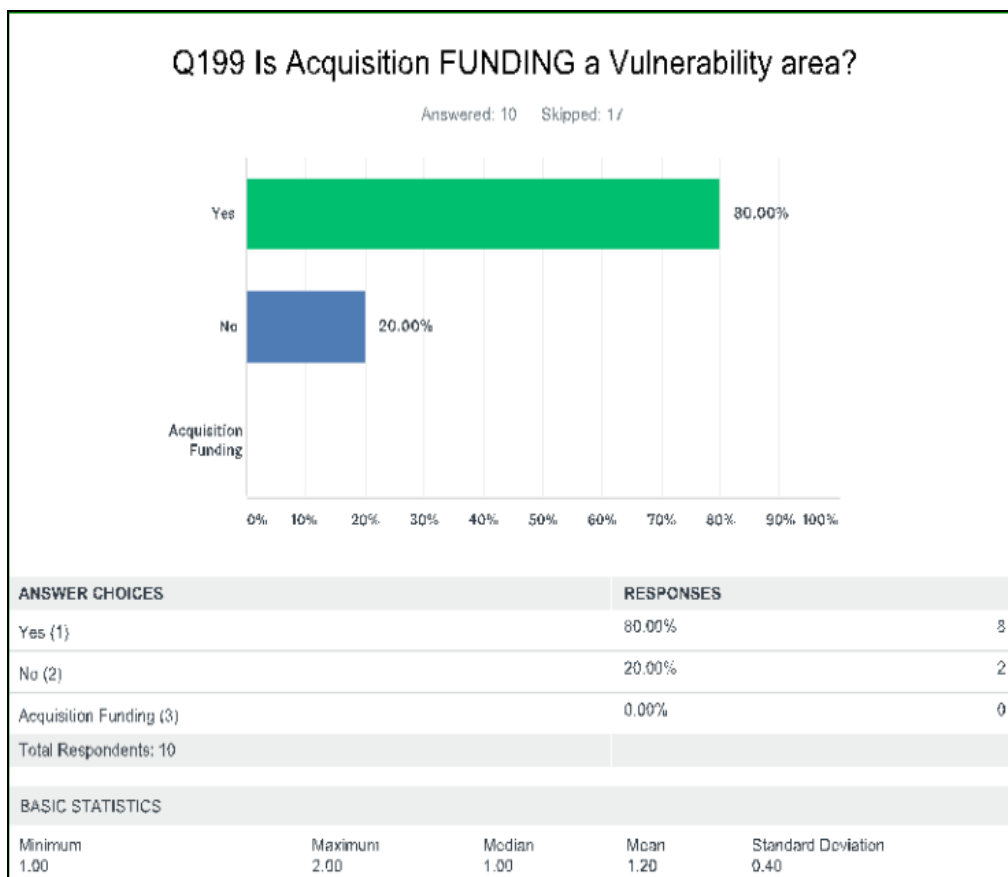


Fig. 16. Funding vulnerability area analysis from the survey monkey online survey.

Quantitative Metrics-Based Assessment and Management of Defense Acquisition Risk

#1

INCOMPLETE

Collector: Web Link 1 (Web Link)
 Started: Wednesday, August 30, 2017 11:32:58 AM
 Last Modified: Wednesday, August 30, 2017 11:43:12 AM
 Time Spent: 00:10:13

Page 2: Let us help optimize your organization?

Q1 Under Secretary of Defense for Acquisition, Technology and Logistics Organizations Respondent skipped this question

Q2 Branch of Service Respondent skipped this question

Q3 Contracting Organization Respondent skipped this question

Q4 Unit/Organization? Respondent skipped this question

Page 4: Department of Defense Acquisition Risk Survey: Acquisition Requirements (1 of 3)

Q5 Are acquisition REQUIREMENTS a Vulnerability area? Respondent skipped this question

Page 5: Vulnerability 1 :Acquisition Requirements

Q6 Rate the Vulnerability above (1-10) with 10 being most vulnerable and 1 being least vulnerable. 5

Q7 Is the political environment unsupportive of your agency's goals? Respondent skipped this question

Q8 Is funding insufficient? Respondent skipped this question

Q9 Are requirements ill-defined or constantly changing? Respondent skipped this question

Q10 Is the technology involved immature? Respondent skipped this question

Q11 Is the technology involved immature? Respondent skipped this question

1 / 25

Quantitative Metrics-Based Assessment and Management of Defense Acquisition Risk

Q12 Is public support imminently negative of the acquisition process and complainant of tax dollars wasted? Respondent skipped this question

Q13 Is information sometimes out of date? Respondent skipped this question

Q14 Is a supplier listing lacking? Respondent skipped this question

Q15 Is favorable pricing overlooked? Respondent skipped this question

Q16 Is an activity inventory lacking? Respondent skipped this question

Page 6: Threat:Political

Q17 Rate Threat (1-10) with 10 being greatest threat and 1 being the least threat. 7

Q18 Is the political environment unstable? Respondent skipped this question

Q19 Are newly elected leaders inexperienced? Respondent skipped this question

Q20 Does the party in power support funding cuts? Respondent skipped this question

Q21 Have international tensions diminished? v Respondent skipped this question

Q22 Is the national debt a factor for curbing DoDs acquisition activities? Applies to my organization/section.

Page 7: Countermeasures: Political

Q23 Rate the Countermeasures above (1-10) with 1 being least effective and 10 being the most effective countermeasure. 8

Q24 Will elections be held soon? Respondent skipped this question

Q25 Have the programs stakeholders lobbied the new leadership? Respondent skipped this question

2 / 25

Quantitative Metrics-Based Assessment and Management of Defense Acquisition Risk

Q110 Rate the Vulnerability above (1-10) with 10 being most vulnerable and 1 being least vulnerable.	7
Q111 Is leadership not committed to your agency's programs?	Respondent skipped this question
Q112 Are roles and responsibilities unclear in your agency?	Respondent skipped this question
Q113 Is there no clearly articulated strategic vision?	Respondent skipped this question
Q114 Is there little or no program evaluation?	Does not apply to my organization/section.
Q115 Does your agency lack a personnel recruiting program?	Does not apply to my organization/section.
Q116 Is a professional development program lacking?	Applies to my organization/section.
Q117 Is staff turnover high?	Does not apply to my organization/section.
Q118 Does staff performance go unassessed?	Applies to my organization/section.

Page 26: Threat: Leadership Support

Q119 Rate Threat (1-10) with 10 being greatest threat and 1 being the least threat.	7
Q120 Is leadership largely unaware of programs within your agency?	Respondent skipped this question
Q121 Does your agency not have a Chief Acquisition Officer?	Respondent skipped this question
Q122 Is leadership frequently rotated?	Does not apply to my organization/section.

10 / 25

Quantitative Metrics-Based Assessment and Management of Defense Acquisition Risk

Q148 Are goals and metrics for achieving mission results communicated to all levels of your agency?	Respondent skipped this question
--	----------------------------------

Page 32: Threat: Evaluation

Q149 Rate Threat (1-10) with 10 being greatest threat and 1 being the least threat.	5
Q150 Does the acquisition function of your agency largely go unevaluated?	Does not apply to my organization/section.
Q151 Does your acquisition system produce unrealistically low cost estimates?	Does not apply to my organization/section.
Q152 Is the contractor oversight function evaluated for effectiveness?	Does not apply to my organization/section.
Q153 Does the impact of technological change go unevaluated?	Does not apply to my organization/section.

Page 33: Countermeasure: Evaluation

Q154 Rate the Countermeasures above (1-10) with 1 being least effective and 10 being the most effective countermeasure.	6
Q155 Is the acquisition function of your agency programmatically evaluated on an annual basis?	Respondent skipped this question
Q156 Does your acquisition process only proceed when there is sufficient knowledge of what resources are needed to achieve mission success?	Respondent skipped this question
Q157 Are contractors regularly evaluated for efficiency and success?	Respondent skipped this question
Q158 Is the acquisition function adjusted in response to technological change?	Applies to my organization/section.

Page 34: Threat: Recruiting

13 / 25

Quantitative Metrics-Based Assessment and Management of Defense Acquisition Risk

Q283 Does the global sourcing partner use an office suite other than Microsoft Office?	Respondent skipped this question
Q284 Is internet connectivity haphazard or slow?	Respondent skipped this question
Page 59: Countermeasure: Technological Differences	
Q285 Rate the Countermeasures above (1-10) with 1 being least effective and 10 being the most effective countermeasure.	Respondent skipped this question
Q286 Did the contractor have the ability to compensate for different electrical systems?	Respondent skipped this question
Q287 Has the contractor incorporated metric units or can easily convert?	Respondent skipped this question
Q288 Does your agency have the ability to read and write documents in different formats?	Respondent skipped this question
Q289 Do you have an alternate means to connect to the internet such as using your smartphone or satellite?	Respondent skipped this question
Page 60: Threat: Security	
Q290 Rate Threat (1-10) with 10 being greatest threat and 1 being the least threat.	Respondent skipped this question
Q291 Does your global sourcing acquisition include digital hardware?	Respondent skipped this question
Q292 Does your global sourcing acquisition include software?	Respondent skipped this question
Q293 Is the background of your global sourcing partner unknown?	Respondent skipped this question
Q294 Is the country of your global sourcing partner not a treaty ally like NATO?	Respondent skipped this question
Page 61: Countermeasure: Security	

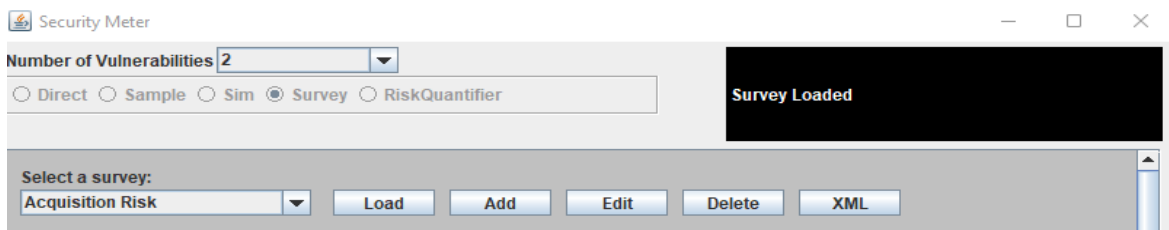
24 / 25

Quantitative Metrics-Based Assessment and Management of Defense Acquisition Risk

Q295 Rate the Countermeasures above (1-10) with 1 being least effective and 10 being the most effective countermeasure.	Respondent skipped this question
Q296 Has the device been thoroughly checked and tested for embedded malware?	Respondent skipped this question
Q297 Has the code been thoroughly examined and tested for embedded malware?	Respondent skipped this question
Q298 Has the background of your global sourcing partner been thoroughly vetted by an investigatory body?	Respondent skipped this question

Fig. 17. Median defense acquisition risk meter survey monkey results of #1 respondent—a cross section of results.

Remark: After Fig. 17, the reader will be able to pursue on how a respondent takes a survey (with Survey Monkey or directly using the Software Tool) from the very first block to the last block in Fig. 18 leading to Figs. 19 and 20 in terms of tabulated Risk Assessment and Mitigation results, respectively. These sample outcomes are all clarifications regarding the 12th ranked or Mean (Average)-valued respondent #3 (with 52.52% risk) in Table II. The sequential steps can be traced in XML code in Table IV as highlighted to observe how the responses find their paths in the XML file that performs the calculations, and how the XML file generates outputs as a result of Risk Assessment and Risk Optimization Management cycles. XML documentation can be revised, changed, deleted, or modified, or added with the help of DARM project tool’s auxiliary software features.



Security Meter

Number of Vulnerabilities **2**

Direct
 Sample
 Sim
 Survey
 RiskQuantifier

Survey Loaded

Select the vulnerabilities to use

Acquisition Requirements
 Acquisition Management
 Acquisition Funding

Security Meter

Number of Vulnerabilities **2**

Direct
 Sample
 Sim
 Survey
 RiskQuantifier

The vulnerability confidence level(1-low 10-high) represents your confidence that the vulnerability exists

Vulnerability: Acquisition Requirements
 Confidence: **5.0** 0:No Vulnerability .. 10:Extreme Vulnerability

Weight

1 Is the political environment unsupportive of your agency's goals?
 1 Is funding insufficient?
 1 Are requirements ill-defined or constantly changing?
 1 Is the technology involved immature?
 1 Is public support imminently negative of the acquisition process and complainant of tax dollars wasted?
 1 Is information sometimes out of date?
 1 Is a supplier listing lacking?
 1 Is favorable pricing overlooked?
 1 Is an activity inventory lacking?

Security Meter

Number of Vulnerabilities **2**

Direct
 Sample
 Sim
 Survey
 RiskQuantifier

The confidence level (1-low 10-high) represents your confidence that the threat exists for your system and the counter measure has been implemented.

Funding (threat) for Acquisition Requirements (vulnerability)
 Confidence: **5.0** 0:No Threat .. 10:Full Threat

Weight

1 Is program funding sporadic or unpredictable?
 1 Does your agency start more programs than it can afford?
 1 Does your agency not prioritize particular programs for funding purposes?
 1 Does your agency not follow auditing procedures?
 1 Are various agencies competing for the same funds?

Select the counter measures you currently use.
 Confidence: **5.0** 0:No Counter Measure .. 10:Full Counter Measure

Weight

1 Has long term funding been secured?
 1 Does program initiation follow from an overall plan?
 1 Do specific programs have a clearly set priority?
 1 Is there a clear division of program areas among agencies?
 1 Is there a clear division of program areas among the U.S. and global sourcing?

Security Meter

Number of Vulnerabilities **2**

Direct
 Sample
 Sim
 Survey
 RiskQuantifier

The confidence level (1-low 10-high) represents your confidence that the threat exists for your system and the counter measure has been implemented.

Program Requirements (threat) for Acquisition Requirements (vulnerability)
 Confidence: **5.0** 0:No Threat .. 10:Full Threat

Weight

1 Are programs initiated without clearly set requirements?
 1 Are new requirements or functionalities added while the program is well under way?
 1 Are program requirements unrealistic?
 1 Are program schedules stretched out to accommodate additional requirements?

Select the counter measures you currently use.
 Confidence: **5.0** 0:No Counter Measure .. 10:Full Counter Measure

Weight

1 Are program requirements clearly specified before initiation?
 1 Is there a policy that prevents mid-course requirements changes?
 1 Are requirements examined prior to initiation for feasibility?
 1 Are program schedules strictly adhered to?

Security Meter

Number of Vulnerabilities **2**

Direct Sample Sim Survey RiskQuantifier

The confidence level (1-low 10-high) represents your confidence that the threat exists for your system and the counter measure has been implemented.

Technology (threat) for Acquisition Requirements (vulnerability)
 Confidence: **5.0** 0:No Threat .. 10:Full Threat

Weight

Does program development depend on future technologies?
 Has the technology not been tested?
 Is development and testing concurrent?
 Is the industrial base shrinking?

Select the counter measures you currently use.
 Confidence: **5.0** 0:No Counter Measure .. 10:Full Counter Measure

Weight

Does the program utilize well established technologies?
 Has the technology been realistically tested?
 Does further development only occur after successful testing?
 Is the industrial base supported through steady research and production funding?

Security Meter

Number of Vulnerabilities **2**

Direct Sample Sim Survey RiskQuantifier

The confidence level (1-low 10-high) represents your confidence that the threat exists for your system and the counter measure has been implemented.

Activity Inventory (threat) for Acquisition Requirements (vulnerability)
 Confidence: **5.0** 0:No Threat .. 10:Full Threat

Weight

Is it unclear whether an activity is commercial or inherently governmental?
 Have seemingly inherently-governmental activities been challenged by interested parties?
 Does your agency have many commercial activities in its inventory?
 Does your agency have many personnel devoted to commercial activities?

Select the counter measures you currently use.
 Confidence: **5.0** 0:No Counter Measure .. 10:Full Counter Measure

Weight

Has the nature of the activity been ruled on by OMB?
 Has a justification of the inherently governmental function been provided?
 Can your agency's commercial activities be performed at lower cost by private contractors?
 Can the personnel involved in commercial activities be converted into contractors or transferred to private contractors?

Security Meter

Number of Vulnerabilities **2**

Direct Sample Sim Survey RiskQuantifier

The vulnerability confidence level(1-low 10-high) represents your confidence that the vulnerability exists

Vulnerability: Acquisition Management
 Confidence: **5.0** 0:No Vulnerability .. 10:Extreme Vulnerability

Weight

Is leadership not committed to your agency's programs?
 Are roles and responsibilities unclear in your agency?
 Is there no clearly articulated strategic vision?
 Is there little or no program evaluation?
 Does your agency lack a personnel recruiting program?
 Is a professional development program lacking?
 Is staff turnover high?
 Does staff performance go unassessed?

Security Meter

Number of Vulnerabilities **2**

Direct Sample Sim Survey RiskQuantifier

Select the threats to use for Acquisition Management Vulnerability

Leadership Support
 Roles/Responsibilities
 Communication
 Evaluation
 Recruiting
 Development
 Retention
 Performance

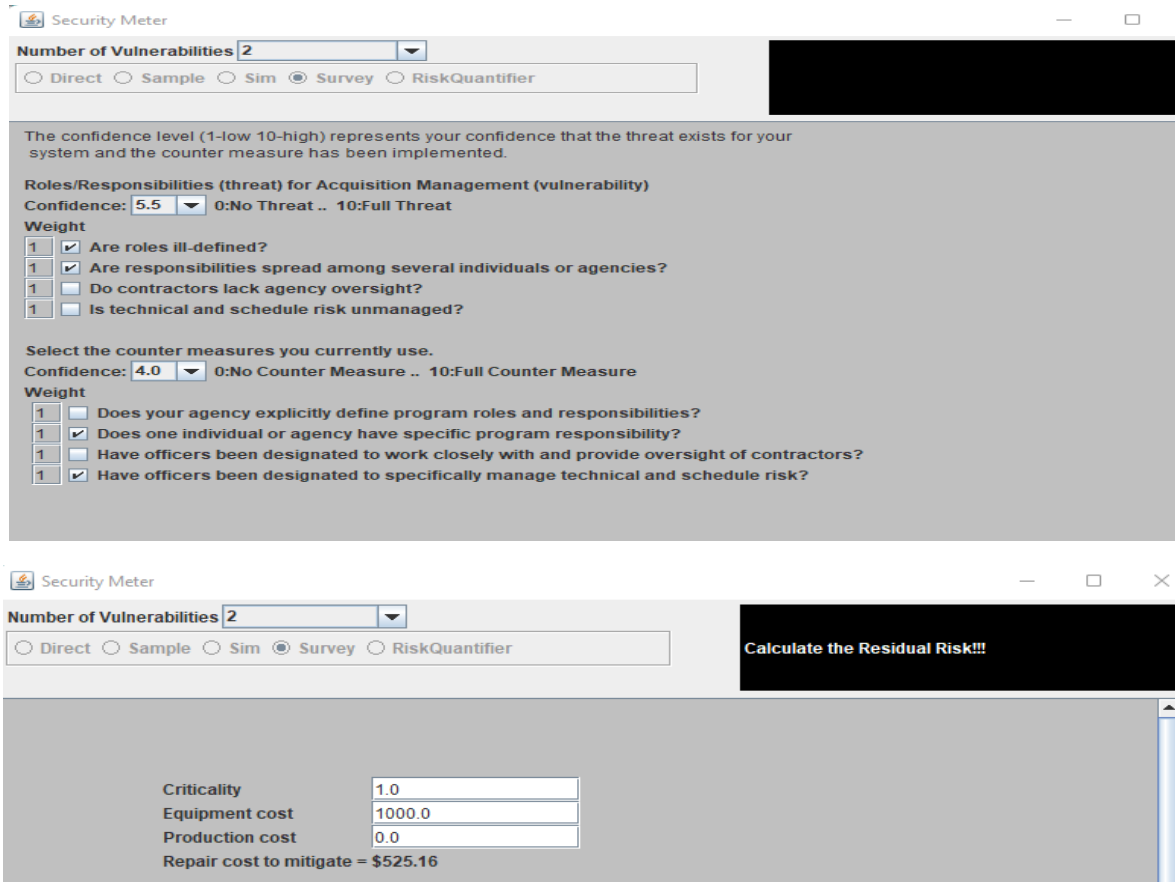


Fig. 18. All Sequential Steps to take the Defense Acquisitions Survey by the Respondent #3 (12th ranked) in Table II.

Vuln.	Vuln. Risk	Threat	Threat Risk	LCM	Res. Risk	Post Risk	Post Vuln. Risk	>
Acquisition Requirements	0.403846	Funding	0.230263	0.450000	0.041846	0.08		
		Program Requirements	0.322368	0.500000	0.065094	0.12		
		Technology	0.190789	0.500000	0.038525	0.07		
		Activity Inventory	0.256579	0.500000	0.051809	0.10	0.375646	
Acquisition Management	0.596154	Roles/Responsibilities	1.000000	0.550000	0.327885	0.62	0.624354	!

Criticality	1.00
Capital Cost	\$1,000.00
Total Threat Costs	N/A
Res-Risk * Criticality	0.525158
Total Res-Risk	0.525158
Expected Cost of Loss	\$525.16
Cust. Guess Res-Risk	0.50

Fig. 19. Security Meter Risk Results Table for the Mean Respondent #3 (12th ranked) yielding 52.52% (closest to the Mean≈52.03%) with vulnerability Acquisition Requirements' four threats (Funding, Program Requirements, Technology and Activity Inventory) and Acquisition Management's single threat (Roles/Responsibilities) selected by Respondent #3.

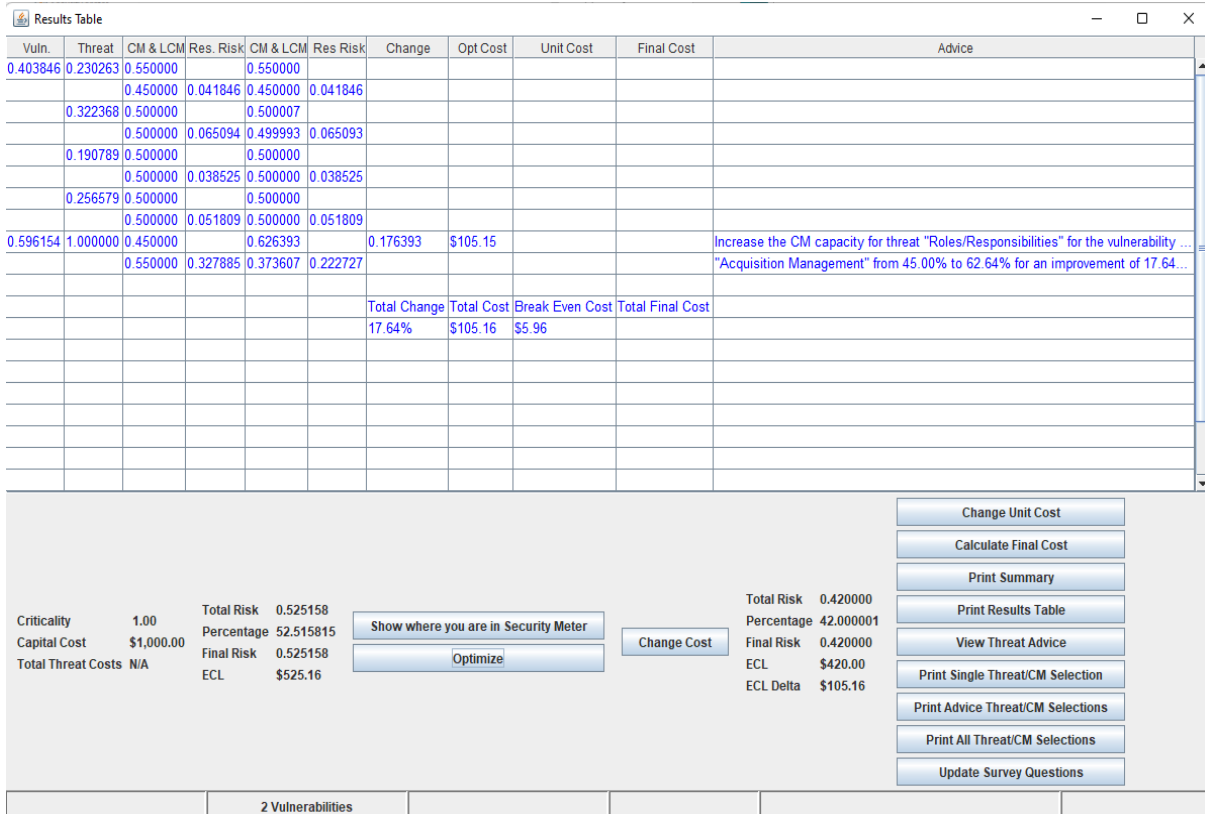


Fig. 20. Security Meter Optimization Results based on Figure 18 for the 12th ranked Mean Respondent #3's results, risk score was mitigated by 20% of the original score down to 42% from 52.52%. With a capital cost of \$1,000 asset, it would cost DoD, \$105.16, to reduce the risk by 20%. That is, increase the countermeasure capacity for the threat of Roles/Responsibilities of the Acquisition Management vulnerability by investing \$105.16 to reach the intended goal.

TABLE IV. XML CODING OF THE ACQUISITION SECURITY METER (SM) RE: MEAN RESPONDENT #3 ACTUAL SURVEY RESULTS (SEE FIG. 18)

```
<? xml version="1.0" encoding="ISO-8859-1"?>
<survey>
<security use Threat Cost="false">
<vulnerability title="Acquisition Requirements" confidence="5.0" selected="Y">
<vQuestion selected="N" weight="1"> Is the political environment unresponsive of your agency's goals? </vQuestion>
<vQuestion selected="Y" weight="1"> Is funding insufficient? </vQuestion>
<vQuestion selected="N" weight="1"> Are requirements ill-defined or constantly changing? </vQuestion>
<vQuestion selected="Y" weight="1"> Is the technology involved immature? </vQuestion>
<vQuestion selected="N" weight="1"> Is public support imminently negative of the acquisition process and complainant of tax dollars wasted? </vQuestion>
<vQuestion selected="N" weight="1"> Is information sometimes out of date? </vQuestion>
<vQuestion selected="N" weight="1"> Is a supplier listing lacking? </vQuestion>
<vQuestion selected="N" weight="1"> Is favorable pricing overlooked? </vQuestion>
<vQuestion selected="N" weight="1"> Is an activity inventory lacking? </vQuestion>

<threat title="Political" tConfidence="5.0" cConfidence="5.0" selected="N">
<tQuestion selected="N" weight="1" cost="0.0"> Is the political environment unstable? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Are newly elected leaders inexperienced? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Does the party in power support funding cuts? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Have international tensions diminished? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Is the national debt a factor for curbing DoDs acquisition activities? </tQuestion>
<cQuestion selected="N" weight="1"> Will elections be held soon? </cQuestion>
<cQuestion selected="N" weight="1"> Have the programs stakeholders lobbied the new leadership? </cQuestion>
<cQuestion selected="N" weight="1"> Does the program have a constituency to protect its funding? </cQuestion>
<cQuestion selected="N" weight="1"> Is the program of great importance to the nation's progress or security? </cQuestion>
<cQuestion selected="N" weight="1"> Is there outside support for the DoD acquisition process for better national defense? </cQuestion>
</threat>

<threat title="Funding" tConfidence="5.0" cConfidence="5.0" selected="Y">
<tQuestion selected="N" weight="1" cost="0.0"> Is program funding sporadic or unpredictable? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Does your agency start more programs than it can afford? </tQuestion>
<tQuestion selected="Y" weight="1" cost="0.0"> Does your agency not prioritize particular programs for funding purposes? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Does your agency not follow auditing procedures? </tQuestion>
<tQuestion selected="Y" weight="1" cost="0.0"> Are various agencies competing for the same funds? </tQuestion>
<cQuestion selected="Y" weight="1"> Has long term funding been secured? </cQuestion>
<cQuestion selected="N" weight="1"> Does program initiation follow from an overall plan? </cQuestion>
<cQuestion selected="N" weight="1"> Do specific programs have a clearly set priority? </cQuestion>
<cQuestion selected="Y" weight="1"> Is there a clear division of program areas among agencies? </cQuestion>
<cQuestion selected="Y" weight="1"> Is there a clear division of program areas among the U.S. and global sourcing? </cQuestion>
</threat>

<threat title="Program Requirements" tConfidence="5.0" cConfidence="5.0" selected="Y">
<tQuestion selected="Y" weight="1" cost="0.0"> Are programs initiated without clearly set requirements? </tQuestion>
<tQuestion selected="Y" weight="1" cost="0.0"> Are new requirements or functionalities added while the program is well under way? </tQuestion>
```

<tQuestion selected="Y" weight="1" cost="0.0"> Are program requirements unrealistic? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Are program schedules stretched out to accommodate additional requirements? </tQuestion>
 <cQuestion selected="Y" weight="1"> Are program requirements clearly specified before initiation? </cQuestion>
 <cQuestion selected="Y" weight="1"> Is there a policy that prevents mid-course requirements changes? </cQuestion>
 <cQuestion selected="N" weight="1"> Are requirements examined prior to initiation for feasibility? </cQuestion>
 <cQuestion selected="N" weight="1"> Are program schedules strictly adhered to? </cQuestion>
 </threat>

<threat title="Technology" tConfidence="5.0" cConfidence="5.0" selected="Y">
 <tQuestion selected="N" weight="1" cost="0.0"> Does program development depend on future technologies? </tQuestion>
 <tQuestion selected="Y" weight="1" cost="0.0"> Has the technology not been tested? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is development and testing concurrent? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is the industrial base shrinking? </tQuestion>
 <cQuestion selected="N" weight="1"> Does the program utilize well established technologies? </cQuestion>
 <cQuestion selected="Y" weight="1"> Has the technology been realistically tested? </cQuestion>
 <cQuestion selected="Y" weight="1"> Does further development only occur after successful testing? </cQuestion>
 <cQuestion selected="N" weight="1"> Is the industrial base supported through steady research and production funding? </cQuestion>
 </threat>

<threat title="Validity/Timeliness" tConfidence="5.0" cConfidence="5.0" selected="N">
 <tQuestion selected="N" weight="1" cost="0.0"> Are cost estimates off target? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is technological functionality sometimes less than promised? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is information out of date? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Are decisions made on the basis of where a program is supposed to be? </tQuestion>
 <cQuestion selected="N" weight="1"> Are only well established methodologies used for cost estimates? </cQuestion>
 <cQuestion selected="N" weight="1"> Are methodologies in place to assure realistic and accurate technological assessments? </cQuestion>
 <cQuestion selected="N" weight="1"> Are processes in place to assure that only the most up to date information is used for decision making? </cQuestion>
 <cQuestion selected="N" weight="1"> Is program phase progress continuously monitored? </cQuestion>
 </threat>

<threat title="Supplier Inventory" tConfidence="5.0" cConfidence="5.0" selected="N">
 <tQuestion selected="N" weight="1" cost="0.0"> Are potential acquisition suppliers not known? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Does the agency not know who it has purchased from beyond the near term? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> If there is no domestic acquisition partner, does the agency know where to turn? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Are acquisition partner sub-contractors unknown? </tQuestion>
 <cQuestion selected="N" weight="1"> Are listings of industry sector manufacturers kept and updated? </cQuestion>
 <cQuestion selected="N" weight="1"> Does the agency keep a listing of present and past acquisition suppliers? </cQuestion>
 <cQuestion selected="N" weight="1"> Does the agency keep a listing of global sourcing acquisition suppliers? </cQuestion>
 <cQuestion selected="N" weight="1"> Does the agency keep a listing of key agency acquisition suppliers? sub-contractors? </cQuestion>
 </threat>

<threat title="Spending Category Data" tConfidence="5.0" cConfidence="5.0" selected="N">
 <tQuestion selected="N" weight="1" cost="0.0"> Do cost overruns occur through lack of tracking? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is agency decision making hampered by lack of spending data? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is agency spending data not broken down by category? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Has your agency faced Congressional scrutiny for its spending? </tQuestion>
 <cQuestion selected="N" weight="1"> Is spending meticulously tracked and categorized? </cQuestion>
 <cQuestion selected="N" weight="1"> Is data on major categories of spending readily available to agency decision makers? </cQuestion>
 <cQuestion selected="N" weight="1"> Are all agency bureaus required to report categorized spending data? </cQuestion>
 <cQuestion selected="N" weight="1"> Do cost control managers have full access to spending data? </cQuestion>
 </threat>

<threat title="Favorable Pricing/Concessions" tConfidence="5.0" cConfidence="5.0" selected="N">
 <tQuestion selected="N" weight="1" cost="0.0"> Does your agency pay more than wholesale for items? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Does your agency merely pay up when an acquisition partner say they require more funds? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is the price the same whether the contract is short or long term? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Does the agency only rely on one acquisition partner for an item? </tQuestion>
 <cQuestion selected="N" weight="1"> Does your agency have volume discounts? </cQuestion>
 <cQuestion selected="N" weight="1"> Do acquisition partner contracts include penalties for cost overruns? </cQuestion>
 <cQuestion selected="N" weight="1"> Has the agency leveraged its long term spending patterns to obtain favorable pricing? </cQuestion>
 <cQuestion selected="N" weight="1"> Does the agency obtain favorable pricing or concessions by sourcing the same item from more than one acquisition partner? </cQuestion>
 </threat>

<threat title="Activity Inventory" tConfidence="5.0" cConfidence="5.0" selected="Y">
 <tQuestion selected="N" weight="1" cost="0.0"> Is it unclear whether an activity is commercial or inherently governmental? </tQuestion>
 <tQuestion selected="Y" weight="1" cost="0.0"> Have seemingly inherently-governmental activities been challenged by interested parties? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Does your agency have many commercial activities in its inventory? </tQuestion>
 <tQuestion selected="Y" weight="1" cost="0.0"> Does your agency have many personnel devoted to commercial activities? </tQuestion>
 <cQuestion selected="Y" weight="1"> Has the nature of the activity been ruled on by OMB? </cQuestion>
 <cQuestion selected="Y" weight="1"> Has a justification of the inherently governmental function been provided? </cQuestion>
 <cQuestion selected="N" weight="1"> Can your agency's commercial activities be performed at lower cost by private contractors? </cQuestion>
 <cQuestion selected="N" weight="1"> Can the personnel involved in commercial activities be converted into contractors or transferred to private contractors? </cQuestion>
 </threat>

</vulnerability>
 <vulnerability title="Acquisition Management" confidence="5.0" selected="Y">
 <vQuestion selected="N" weight="1"> Is leadership not committed to your agency's programs? </vQuestion>
 <vQuestion selected="N" weight="1"> Are roles and responsibilities unclear in your agency? </vQuestion>
 <vQuestion selected="Y" weight="1"> Is there no clearly articulated strategic vision? </vQuestion>

<vQuestion selected="Y" weight="1"> Is there little or no program evaluation? </vQuestion>
 <vQuestion selected="N" weight="1"> Does your agency lack a personnel recruiting program? </vQuestion>
 <vQuestion selected="Y" weight="1"> Is a professional development program lacking? </vQuestion>
 <vQuestion selected="Y" weight="1"> Is staff turnover high? </vQuestion>
 <vQuestion selected="N" weight="1"> Does staff performance go unassessed? </vQuestion>

<threat title="Leadership Support" tConfidence="5.0" cConfidence="5.0" selected="N">
 <tQuestion selected="N" weight="1" cost="0.0"> Is leadership largely unaware of programs within your agency? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Does your agency not have a Chief Acquisition Officer? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is leadership frequently rotated? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is leadership composed of political appointees? </tQuestion>
 <cQuestion selected="N" weight="1"> Do officials have the committed support of senior leadership? </cQuestion>
 <cQuestion selected="N" weight="1"> Has an officer been designated with primary responsibility for managing agency acquisitions? </cQuestion>
 <cQuestion selected="N" weight="1"> Does leadership have long term appointments? </cQuestion>
 <cQuestion selected="N" weight="1"> Is senior leadership composed of civil servants? </cQuestion>
 </threat>

<threat title="Roles/Responsibilities" tConfidence="5.5" cConfidence="4.0" selected="Y">
 <tQuestion selected="Y" weight="1" cost="0.0"> Are roles ill-defined? </tQuestion>
 <tQuestion selected="Y" weight="1" cost="0.0"> Are responsibilities spread among several individuals or agencies? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Do contractors lack agency oversight? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is technical and schedule risk unmanaged? </tQuestion>
 <cQuestion selected="N" weight="1"> Does your agency explicitly define program roles and responsibilities? </cQuestion>
 <cQuestion selected="Y" weight="1"> Does one individual or agency have specific program responsibility? </cQuestion>
 <cQuestion selected="N" weight="1"> Have officers been designated to work closely with and provide oversight of contractors? </cQuestion>
 <cQuestion selected="Y" weight="1"> Have officers been designated to specifically manage technical and schedule risk? </cQuestion>
 </threat>

<threat title="Communication" tConfidence="5.0" cConfidence="5.0" selected="N">
 <tQuestion selected="N" weight="1" cost="0.0"> Does your agency lack a strategy for its acquisition function? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Are agency goals unclear or unknown? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Are metrics for acquisition efficiency and effectiveness lacking? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Are mission results not well known? </tQuestion>
 <cQuestion selected="N" weight="1"> Has your agency clearly articulated and communicated a strategic vision? </cQuestion>
 <cQuestion selected="N" weight="1"> Are agency goals well known and publicized? </cQuestion>
 <cQuestion selected="N" weight="1"> Does your agency have well established measures for determining acquisition efficiency and effectiveness? </cQuestion>
 <cQuestion selected="N" weight="1"> Are goals and metrics for achieving mission results communicated to all levels of your agency? </cQuestion>
 </threat>

<threat title="Evaluation" tConfidence="5.0" cConfidence="5.0" selected="N">
 <tQuestion selected="N" weight="1" cost="0.0"> Does the acquisition function of your agency largely go unevaluated? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Does your acquisition system produce unrealistically low cost estimates? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is the contractor oversight function evaluated for effectiveness? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Does the impact of technological change go unevaluated? </tQuestion>
 <cQuestion selected="N" weight="1"> Is the acquisition function of your agency programmatically evaluated on an annual basis? </cQuestion>
 <cQuestion selected="N" weight="1"> Does your acquisition process only proceed when there is sufficient knowledge of what resources are needed to achieve mission success? </cQuestion>
 <cQuestion selected="N" weight="1"> Are contractors regularly evaluated for efficiency and success? </cQuestion>
 <cQuestion selected="N" weight="1"> Is the acquisition function adjusted in response to technological change? </cQuestion>
 </threat>

<threat title="Recruiting" tConfidence="5.0" cConfidence="5.0" selected="N">
 <tQuestion selected="N" weight="1" cost="0.0"> Are most personnel promoted from within? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Do most entry level hires hear about jobs in your agency through word of mouth? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Are most professional hires graduates of local universities? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Are executive level hires appointed because of connections? </tQuestion>
 <cQuestion selected="N" weight="1"> Does your agency have an external recruiting policy? </cQuestion>
 <cQuestion selected="N" weight="1"> Is your agency present at job fairs? </cQuestion>
 <cQuestion selected="N" weight="1"> Does your agency recruit at universities nationwide? </cQuestion>
 <cQuestion selected="N" weight="1"> Are executive level hires the product of a nationwide search? </cQuestion>
 </threat>

<threat title="Development" tConfidence="5.0" cConfidence="5.0" selected="N">
 <tQuestion selected="N" weight="1" cost="0.0"> Does the agency seem uninterested in its acquisition workforce? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Do most staff not participate in continuing education? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Is continuing education of a general nature? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Do acquisition staff have to pay on their own for outside courses or training? </tQuestion>
 <cQuestion selected="N" weight="1"> Does your agency value and invest in its acquisition workforce? </cQuestion>
 <cQuestion selected="Y" weight="1"> Does your agency regularly offer required training related to enhancing staff effectiveness? </cQuestion>
 <cQuestion selected="Y" weight="1"> Is continuing education designed to further the acquisition process? </cQuestion>
 <cQuestion selected="Y" weight="1"> Does your agency offer reimbursement for continuing education? </cQuestion>
 </threat>

<threat title="Retention" tConfidence="5.0" cConfidence="5.0" selected="N">
 <tQuestion selected="N" weight="1" cost="0.0"> Does your agency lack sufficient staff to carry out its mandate? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Does your agency have high turnover? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Are acquisition staff underpaid relative to private industry? </tQuestion>
 <tQuestion selected="N" weight="1" cost="0.0"> Does your agency lack ties to universities? </tQuestion>
 <cQuestion selected="N" weight="1"> Does your agency have an ongoing recruitment program? </cQuestion>
 <cQuestion selected="N" weight="1"> Does your agency have an ongoing retention program? </cQuestion>

<cQuestion selected="N" weight="1">Does your agency offer bonuses or cost of living adjustments, ? </cQuestion>
<cQuestion selected="N" weight="1">Has your agency established ties to universities that can provide trained personnel? </cQuestion>
</threat>

<threat title="Performance" tConfidence="5.0" cConfidence="5.0" selected="N">
<tQuestion selected="N" weight="1" cost="0.0">Has your agency not conducted an overall acquisition workforce assessment? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Do performance expectations vary from manager to manager? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Are performance metrics unclear? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Do some acquisition officials have greater workloads than others? </tQuestion>
<cQuestion selected="N" weight="1">Does your agency periodically conduct an overall acquisition workforce assessment? </cQuestion>
<cQuestion selected="N" weight="1">Does your agency have well publicized and uniform performance expectations? </cQuestion>
<cQuestion selected="N" weight="1"> Does your agency have well publicized and uniform performance metrics for acquisition officials and managers at all levels? </cQuestion>
<cQuestion selected="N" weight="1">Has the acquisition workforce been assessed for appropriate workloads to perform their jobs effectively? </cQuestion>
</threat>

</vulnerability>
<vulnerability title="Acquisition Funding" confidence="5.0" selected="N">
<vQuestion selected="N" weight="1"> Are agency policies lacking in clarity? </vQuestion>
<vQuestion selected="N" weight="1"> Is there a lack of coordination within your agency? </vQuestion>
<vQuestion selected="N" weight="1"> Is there a lack of assessment measures? </vQuestion>
<vQuestion selected="N" weight="1"> Are business processes carried out on ad hoc basis? </vQuestion>
<vQuestion selected="N" weight="1"> Do agency workers have a don't fix it if it's not broken mindset? </vQuestion>
<vQuestion selected="N" weight="1"> Do foreign languages create barriers for your agency's global sourcing? </vQuestion>
<vQuestion selected="N" weight="1"> Do local customs impede your global sourcing? </vQuestion>
<vQuestion selected="N" weight="1"> Have differences in the legal systems abroad created obstacles? </vQuestion>
<vQuestion selected="N" weight="1"> Have technological differences prevented global sourcing? </vQuestion>
<vQuestion selected="N" weight="1"> Have security concerns prevented global sourcing? </vQuestion>

<threat title="Clarity/Transparency/Consistency" tConfidence="5.0" cConfidence="5.0" selected="N">
<tQuestion selected="N" weight="1" cost="0.0"> Do agency decisions confuse stakeholders? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Do some programs seem to operate on their own? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Do contractor awards cause controversy? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Has your agency's acquisition process been investigated? </tQuestion>
<cQuestion selected="N" weight="1"> Are reasons for specific agency decisions well known and documented? </cQuestion>
<cQuestion selected="N" weight="1"> Are policies applied consistently across the acquisition process? </cQuestion>
<cQuestion selected="N" weight="1">Is the contractor award process transparent? </cQuestion>
<cQuestion selected="N" weight="1">Are all proceedings subject to public scrutiny? </cQuestion>
</threat>

<threat title="Coordination" tConfidence="5.0" cConfidence="5.0" selected="N">
<tQuestion selected="N" weight="1" cost="0.0">Are stakeholder actions uncoordinated? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Is there a strong threat-based or operationally driven need to field a capability solution quickly? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Do acquisition, requirements, and budgeting processes take place separately? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Are capability requirements invalidated? </tQuestion>
<cQuestion selected="N" weight="1">Have stakeholder cross-functional teams been established? </cQuestion>
<cQuestion selected="N" weight="1"> Have Milestone Decision Authorities (MDAs) been authorized to tailor regulatory requirements and acquisition procedures? </cQuestion>
<cQuestion selected="N" weight="1"> Do acquisition, requirements, and budgeting operate simultaneously with full cooperation and in close coordination? </cQuestion>
<cQuestion selected="N" weight="1"> Is leadership of the acquisition and budget processes involved during consideration of capability requirements validation to ensure coordination across the three processes? </cQuestion>
</threat>

<threat title="Assessment" tConfidence="5.0" cConfidence="5.0" selected="N">
<tQuestion selected="N" weight="1" cost="0.0">Do programs proceed to the next acquisition phase without assessment? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Are reviews pro forma? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Is the final decision authority unclear? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Are decisions resulting from reviews sometimes unclear? </tQuestion>
<cQuestion selected="N" weight="1">Has the MDA examined whether the program is ready to proceed? </cQuestion>
<cQuestion selected="N" weight="1">Are reviews issue and data focused to facilitate an examination of relevant questions affecting the decisions under consideration? </cQuestion>
<cQuestion selected="N" weight="1">Is the MDA the sole and final decision authority? </cQuestion>
<cQuestion selected="N" weight="1">Does an Acquisition Decision Memorandum (ADM) document decisions resulting from reviews? </cQuestion>
</threat>

<threat title="Planning" tConfidence="5.0" cConfidence="5.0" selected="N">

<tQuestion selected="N" weight="1" cost="0.0">Are agency needs only generally known? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Are agency acquisitions usually identified in the short term? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Are agency budget requests ad hoc? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Is there no document describing the overall approach for the program schedule, risks, funding, and business strategy? </tQuestion>
<cQuestion selected="N" weight="1">Have agency needs been determined in the context of how acquisition can meet those needs? </cQuestion>
<cQuestion selected="N" weight="1">Are agency acquisitions planned for the next 12-24 months? </cQuestion>
<cQuestion selected="N" weight="1">Are agency budget requests consistent with planned acquisition strategies? </cQuestion>
<cQuestion selected="N" weight="1">Has a periodically updated Acquisition Strategy document for MDA approval been submitted? </cQuestion>
</threat>

```

<threat title="Continuous Improvement" tConfidence="5.0" cConfidence="5.0" selected="N">
<tQuestion selected="N" weight="1" cost="0.0">Are processes carried out on a business as usual basis? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Do acquisition policies and processes go unchanged for long periods? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Do many stakeholders' needs and concerns go unheard? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0">Are new methodologies and business practices sometimes ignored? </tQuestion>
<cQuestion selected="N" weight="1">Are continuous improvement mechanisms in place? </cQuestion>
<cQuestion selected="N" weight="1">Are revisions to acquisition policies and processes made in response to changes in the environment? </cQuestion>
<cQuestion selected="N" weight="1">Do continuous improvement mechanisms incorporate stakeholders' needs and concerns? </cQuestion>
<cQuestion selected="N" weight="1">Are policies and procedures periodically reviewed for continuous improvement? </cQuestion>
</threat>

<threat title="Language Barriers" tConfidence="5.0" cConfidence="5.0" selected="N">
<tQuestion selected="N" weight="1" cost="0.0"> Is a significant portion of your sourcing overseas? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Are few staff members familiar with foreign languages? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Does your agency receive foreign language documents? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Do you frequently have to tell locals you don't speak their language? </tQuestion>
<cQuestion selected="N" weight="1"> Do you have translators available? </cQuestion>
<cQuestion selected="N" weight="1"> Does your agency have multilingual staff? </cQuestion>
<cQuestion selected="N" weight="1"> Was a means of translation available to your agency? </cQuestion>
<cQuestion selected="N" weight="1"> Do you have a translation app on your smart phone, tablet, or laptop? </cQuestion>
</threat>

<threat title="Customs Barriers" tConfidence="5.0" cConfidence="5.0" selected="N">
<tQuestion selected="N" weight="1" cost="0.0"> Is a substantial portion of your production exported? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Do misunderstandings occur? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Does your staff dislike overseas travel? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Did the deal seem done and then was later canceled? </tQuestion>
<cQuestion selected="N" weight="1"> Is your staff familiar with the local way of doing business? </cQuestion>
<cQuestion selected="N" weight="1"> Do you have agency representatives in place abroad? </cQuestion>
<cQuestion selected="N" weight="1"> Does your staff receive training or orientation prior to overseas travel? </cQuestion>
<cQuestion selected="N" weight="1"> Is acquisition undertaken in conformance to local laws and customs? </cQuestion>
</threat>

<threat title="Technological Differences" tConfidence="5.0" cConfidence="5.0" selected="N">
<tQuestion selected="N" weight="1" cost="0.0"> Does the country use a different electrical system? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Does the country use a different system of measurement? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Does the global sourcing partner use an office suite other than Microsoft Office? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Is internet connectivity haphazard or slow? </tQuestion>
<cQuestion selected="N" weight="1"> Did the contractor have the ability to compensate for different electrical systems? </cQuestion>
<cQuestion selected="N" weight="1"> Has the contractor incorporated metric units or can easily convert? </cQuestion>
<cQuestion selected="N" weight="1"> Does your agency have the ability to read and write documents in different formats? </cQuestion>
<cQuestion selected="N" weight="1"> Do you have an alternate means to connect to the internet such as using your smartphone or satellite? </cQuestion>
</threat>

<threat title="Security" tConfidence="5.0" cConfidence="5.0" selected="N">
<tQuestion selected="N" weight="1" cost="0.0"> Does your global sourcing acquisition include digital hardware? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Does your global sourcing acquisition include software? </tQuestion>
<tQuestion selected="N" weight="1" cost="0.0"> Is the background of your global sourcing partner unknown? </tQuestion>
selected="N" weight="1" cost="0.0"> Is the country of your global sourcing partner not a treaty ally like NATO? </tQuestion>
<cQuestion selected="N" weight="1"> Has the device been thoroughly checked and tested for embedded malware? </cQuestion>
<cQuestion selected="N" weight="1"> Has the code been thoroughly examined and tested for embedded malware? </cQuestion>
<cQuestion selected="N" weight="1"> Has the background of your global sourcing partner been thoroughly vetted by an investigatory body? </cQuestion>
<cQuestion selected="N" weight="1"> Can the same item be acquired from a global sourcing partner in an allied country? </cQuestion>
</threat>
</vulnerability>
</security>

```

APPENDIX: HOW TO INSTALL CYBERRISKSOLVER TO RUN SECURITYMETER

1. Click www.areslimited.com. Type in the user name: *mehmetsuna*, password: *Mehpareanne*, click OK. 2. Go to DOWNLOAD on www.areslimited.com for left hand side menu's 4th from the top. 3. Click on the Cyber Risk Solver in **red** and download the application which a ZIP file. Unzip or

extract the downloaded application into C:\myapp folder. See C:\myapp\dist. Open a Command Prompt and go to C:\myapp\dist folder and run the command: //For Cyber Risk Solver, java -jar twcSolver.jar. Use license code: **EFE28SEP1986** for starting twcSolver.jar. 4. Click SecurityMeter app (checked). Click Open. Use license code: **HAKAN07MAR1995**.

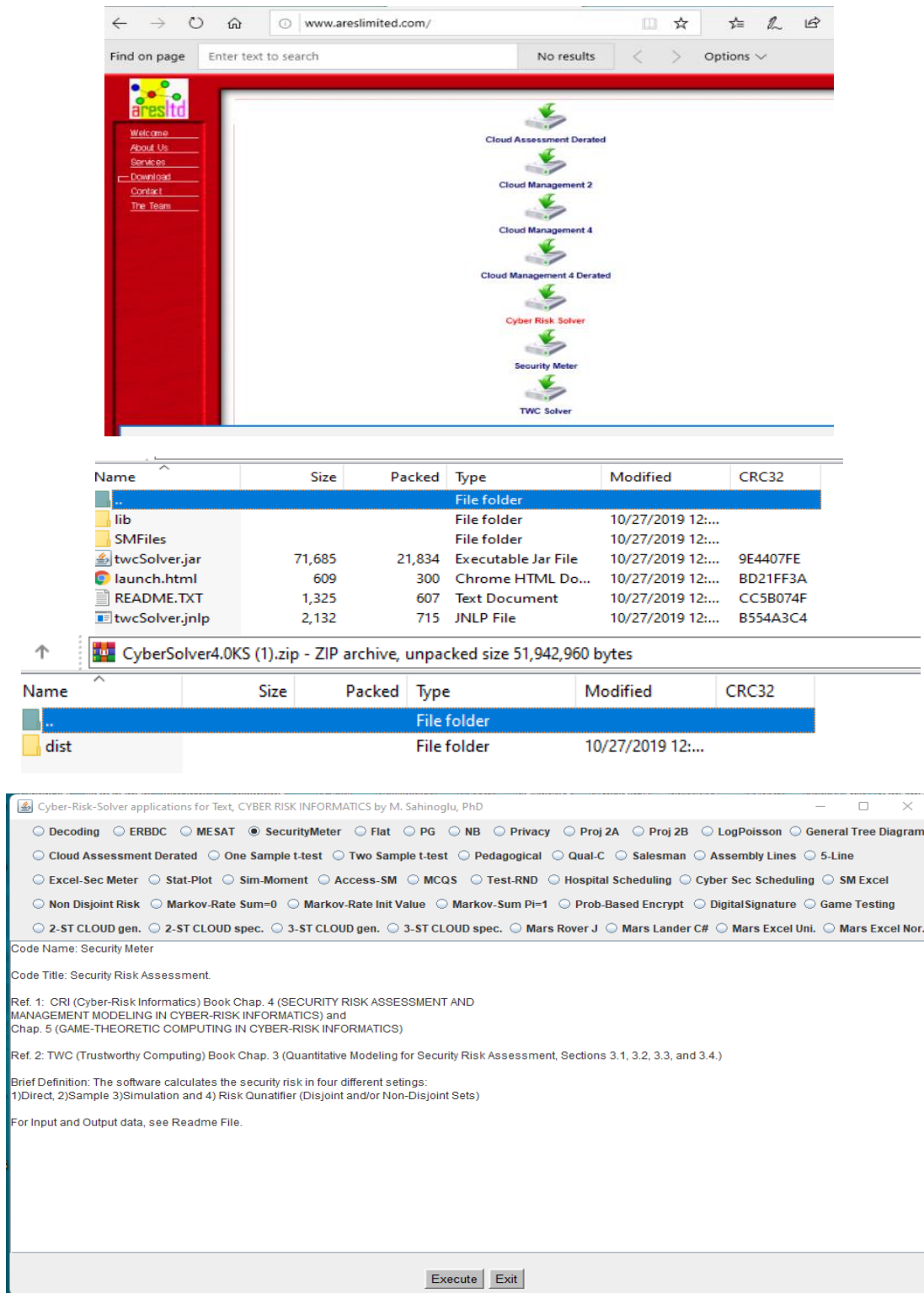


Fig. 21. How to Install Author's CyberRiskSolver to Run Security-Meter by clicking www.areslimited.com.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Both co-authors contributed fully to this article since 2017 in their focus areas. Dr. MS created the original SM's theory and application having jumpstarted this innovative Defense Acquisition project from 2015 onward whereas JP diligently collected the pertinent data utilizing the progressive Survey

Monkey to output optimal results. Both carried out the automated analyses and professional interpretations. Dr. MS's forte was scientific imagination of a pragmatic albeit an objective, not subjective or convenient or haphazard, as an innovative idea, not encountered up to date in the world of Cybersecurity-centric Computer/Software Engineering. Capt. JP's strength lies in leveraging of Defense Acquisition Project within DoD realm and traditions. This research can further be modified by DoD customizing the XML code as necessary.

ACKNOWLEDGEMENT

This paper presents the views of the authors only, and not those of the U.S. Department of Defense (DoD). Authors highly appreciate and value the anonymous reviewers' efforts.

REFERENCES

- [1] Defense-Industrial Initiatives Group, Center for Strategic & International Studies. (May 17, 2011). Cost and Time Overruns for Major Defense Acquisition Programs.
- [2] Risk Management Guide for DoD Acquisition. (1998). Defense Systems Management College Press. [Online]. Available: <https://apps.dtic.mil/sti/pdfs/ADA344089.pdf>
- [3] Y. H. Kwak and B. M. Smith, "Managing risk in mega defense acquisition projects: Performance, policy, and opportunities," *International Journal of Project Management*, vol. 27, pp. 812–820, 2009.
- [4] M. Schwartz, G. M. Nelson, and C. Coral, "Defense acquisitions: How and where DoD spends and reports its contracting dollars," *CRS Report*, Washington: Congressional Research Service, 2016.
- [5] U. S. Department of Defense. (2006). *Risk Management Guide for DoD Acquisition*, 6th ed. [Online]. Available: <https://www.dau.edu/tools/Lists/DAUTools/Attachments/140/RIO-Guide-January2017.pdf>
- [6] M. Sahinoglu, *Cyber-Risk Informatics: Engineering Evaluation with Data Science*, Hoboken, NJ: John Wiley, ISBN 9781119087526, 2016.
- [7] M. Sahinoglu, "An input-output measurable design for the security meter model to quantify and manage software security risk," *IEEE Transactions on Instrumentation and Measurement*, vol. 57, no. 6, pp. 1251–1260, 2008.
- [8] Department of Defense Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs. (June 2017). [Online]. Available: <https://acqnotes.com/wp-content/uploads/2017/07/DoD-Risk-Issue-and-Opportunity-Management-Guide-Jan-2017.pdf>
- [9] AcqNotes—Defense acquisitions made easy. (July 31, 2017).
- [10] Department of Defense. (2017). DoD Instruction 5000.02. USD (AT&L). [Online]. Available: <https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/50002p.pdf>
- [11] Deputy Assistance Secretary of Defense. Department of Defense Risk, Issue, and Management Guide for Defense Acquisition Programs. (2017). Guide, Office of the Deputy Assistant Secretary of Defense for Systems Engineering.
- [12] Survey Monkey. (January 1, 2017). Survey Monkey Help Center. [Online]. Available: <https://help.surveymonkey.com/en/surveymonkey/analyze/>
- [13] F. Kendall, "Better Buying Power (BBP) 3.0," White Paper, Office of the Under Secretary of Defense Acquisition, Technology, and Logistics, September 19, 2014.
- [14] M. Schwartz, "How DoD acquires weapon systems and recent efforts to reform the process," CRS Report, Congressional Research Service, Library of Congress, January 2, 2013.
- [15] Defense Innovation Market Place. [Online]. Available: <http://www.defenseinnovationmarketplace.mil/resources/RL340261.pdf>
- [16] M. Sahinoglu, S. Stockton, R. Barclay, and S. Morton, "Metrics-based risk assessment and management of digital forensics," *Defense Acquisition Research (DAU) Journal*, vol. 23, no. 2, pp. 152–177, DAU Hirsch Competition 2nd Place Silver Medalist Winner, 2016.
- [17] M. Sahinoglu, "Security meter—A practical decision tree model to quantify risk," *IEEE Security and Privacy Magazine*, vol. 3, no. 3, 18–24 April/May 2005.

Copyright © 2023 by the authors. This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited ([CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)).