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Strategic Planning to Enhance Coordinated Total Resourcing of the Enterprise (SPECTRE)

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Abstract: The United States Joint Special Operations Command (JSOC) struggles to make well-informed and data-based decisions on resource allocation due to a lack of sufficient and efficient data, knowledge management, and processes to produce quantifiable insights for leadership. Stochastic modeling is one tool that could aid JSOC's decision-making by providing a quantifiable process for assessing and comparing project lines while also incorporating uncertainty. The proposed model shell and dashboard were created by the authors on Team Strategic Planning to Enhance Coordinate Total Resourcing of the Enterprise, or SPECTRE, using Microsoft® Excel®'s SIPmath® macro. The model shell and dashboard analyze project lines' performances across several value measures to best visualize tradeoffs leaders must make. Most importantly, the model provides insights and recommendations to JSOC on how to optimize resource allocation decisions through data collection and analysis.

Keywords: Resource Allocation, Stochastic Modeling, Value Modeling

1. Introduction

The Joint Special Operations Command (JSOC) conducts global, special operations in defense of the United States under the command of the US Special Operations Command (SOCOM). This unique mission set requires JSOC's capabilities and funding from the Department of Defense (DoD) to operate with optimal efficiency. JSOC has been facing challenges with justifying its acquisition process in a quantifiable way. Considering this, the organization is seeking to optimize its decision-making and data management process by creating a quantifiable and repeatable system that provides feedback on its acquisition process. To address this challenge, the authors aimed to construct a stochastic value model that will enhance JSOC's decision-making capabilities in terms of resource allocations among several projects. This proposed model seeks to provide JSOC with a reliable and objective means of assessing the value and cost of its acquisition decisions. The model would improve JSOC's ability to optimally allocate funds to project lines that best fit its and the DoD's guidelines and mission. Collecting qualitative and quantitative data on the resourcing risk and operational risk of project lines from various levels within JSOC is necessary to develop the stochastic value model. Using the data, the model visualizes risk and tradeoffs between project lines, providing an implementation for future use for JSOC and its leaders to make better-informed decisions on resource allocation using quantitative data and results. This paper addresses the data required for JSOC to make well-informed decision-making as well as visualizes project lines against each other to analyze opportunity costs and value. Through the implementation of the proposed model, JSOC will be able to make data-driven decisions that align with its objective requirements. optimizing its decision-making capabilities and creating a quantifiable and repeatable process, JSOC will be able to achieve its objectives more effectively and improve its overall performance.

1.2 Literature Review

For JSOC's resource allocation and knowledge management problem, three important topics can help better understand and solve the problem: the Planning, Programming, Budgeting, and Execution (PPBE) Process, the Special

Operations Force Capabilities Integration and Development System (SOFCIDS), and stochastic modeling. The PPBE is an acquisition process used by the DoD to assess the necessary capabilities for accomplishing the military's missions and to obtain funds from Congress to implement these capabilities into the force. SOFCIDS, a subset of the Joint Capabilities Integration and Development System (JCIDS) determines and prioritizes what capabilities Special Operations Forces (SOF) need based on their budget and requirements. In addition, stochastic modeling is a possible method of approaching the JSOC's resourcing problem as it considers the risks, rewards, and uncertainties associated with allocating resources to competing items. Exploring these three topics helps develop a deeper understanding of potential ways to help to create a solution for JSOC's resource allocation problem.

The PPBE process and JCIDS are two acquisition processes that the DoD uses to assess capabilities. JCIDS provides the "baseline requirements for documentation, review, and validation of capability requirements" across the DoD (DAU, n.d.). The processes together are used to "determine, validate, and prioritize capability requirements and associated capability gaps and risks, and then fund, develop, field, and sustain capability solutions for the Warfighter in a timely manner" (Joint Chiefs of Staff, 2021, p. D-5). This project is focused on improving JSOC's system of resource acquisition; accordingly, a detailed understanding of JCIDS improves the ability of JSOC to make adequate decisions for the betterment of their organization.

JCIDS mainly serves to justify the budgeting and resource allocations made within the PPBE. As a part of this process, JCIDS identifies gaps in capabilities that are hindering the military's ability to achieve its mission set and operational goals. JCIDS assesses the military's capabilities to ensure that they are meeting the specific requirements given by the DoD (Ierardi, 2018). These requirements support national, defense, joint, and Army strategies, particularly for the predicted future operational environment (Kem, 2020). Based on these requirements and available resources, JCIDS reviews and validates the military's capabilities to determine what needs more or less funding. The capability validating process uses doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy to find solutions (Kem, 2020). As a result, JCIDS ensures that capabilities are identified and effective in achieving the nation's future mission set.

As a subset of JCIDS, SOFCIDS was created to allow for a more rapid and streamlined acquisition process for SOCOM forces. Like JCIDS, SOFCIDS uses policies, processes, procedures, and products to identify and assess capability requirements and gaps (United States Special Operations Command, 2020). However, SOCOM is a small organization that operates at a faster pace with different needs and mission sets compared to the rest of the military, resulting in fewer requirements needed compared to JCIDS (Schaefer, 2011). Overall, JCIDS and SOFCIDS allow organizations to meet requirements for the operational future by closing capability gaps. Understanding the process of capability assessment and validation gives more insight into how resources are allocated and help frame JSOC's resource allocation problem.

Lastly, stochastic modeling in resource allocation involves uncertainty and probability of resourcing that results in different outcomes under different conditions. Several aspects of stochastic modeling influence how resources are allocated. Stochastic elements of resource allocation that must be considered are expected cash flow, optimal time-sharing, and allocation under uncertain conditions (Gittins, 1972). Often, stochastic demands occur randomly. With this, the expected time until failure must be maximized to prolong to time until the demand of one activity exceeds its allotted resources (Mendelson & Yechiali, 1980). Additionally, incomplete and noisy information often impacts stochastic resource allocation. Overall, because stochastic modeling accounts for the inevitable randomness, uncertainty, and probability involved in real-world resource allocation problems, it is useful to understand methods and equations for solving these types of problems. All the various elements of stochastic models give different perspectives on how to approach and solve resource allocation problems. This can prove useful to JSOC as uncertainty and risks are bound to occur throughout its resource allocation process.

In conclusion, research conducted on the PPBE, SOFCIDS, and stochastic modeling provided insights into ways to frame and solve the resource allocation and decision-making problems occurring within JSOC. Understanding the PPBE and SOFCIDS processes helps to frame JSOC's problem by giving more insight into how resources are allotted to capabilities. Overall, exploring these two topics provides a baseline and framework for JSOC's resource allocation and decision-making problem.

2. Methodology

After gauging the interests of JSOC, Team SPECTRE gathered feedback from stakeholders that enabled them to value different projects within capability areas. From this feedback, Team SPECTRE was advised to model operational risk against resourcing risk instead of cost versus value using stochastic modeling. The decision to assess operational and resourcing risk stemmed from congruency with JSOC's primary concerns. Operational risk describes the threat that a project does not best align with the needs of stakeholders and requirements of the assigned or desired mission set. Resourcing risk is constructed in two capacities. First, it encompasses the threat of a project's deviation from budgeting and scheduling plans. Second, it covers the inability of current technology and available materials to fulfill the desired end state of a project. The stochastic value model is a derivative of a value hierarchy that was vetted with JSOC to identify key factors of comparison between projects that could be built upon later.

2.1 Value Hierarchy

The first step in building the stochastic value model required the creation of a value hierarchy that incorporated both resourcing and operational risk. A value hierarchy consists of a fundamental objective, functions, objectives, and value measures (Parnell, 2011). The fundamental objective states the central problem or objective that the stakeholder wants to be solved or achieved. This model's fundamental objective was the optimization of the balance between operational and resourcing risk. Functions describe what is necessary for the model to function. Operational and resourcing risks were implemented into the model as functions because they are the two components that constitute the fundamental objective. Objectives describe subsets of the function necessary for achievement; objectives are also described in terms of maximize, minimize, or optimize. Finally, value measures are how objective completion is measured. The model's value hierarchy is illustrated in Figure 1.

Resourcing risk constitutes two objectives of maximizing the probability of resourcing success and optimizing resources. Resourcing success describes the ability of all required materials for a project to be acquired at the time of project conception or by a specified deadline. In layman's terms, it answers the questions of "is everything ready for implementation" or "is there any reason for a delay." The optimization of resources describes how efficiently existing materials are being utilized.

Operational risk also constitutes two objectives: maximize alignment to stakeholder needs and maximize alignment to mission. Alignment to stakeholder needs captures how well a project meets the desires of stakeholders at varying levels. Alignment to mission describes how well a project demonstrates performance in meeting/exceeding specific mission set requirements across different capability areas.

Value measures within the value hierarchy are the workhorse independent variables of the stochastic value model. They are the inputs of the model. Each objective has two core value measures. The following objectives are shown in Figure 1. The Technology Readiness Level (TRL) Value is a 1 to 9 scale that measures the current state of technology and its maturation of development for immediate use. Execution Rate describes the ability to act on the entirety of an acquisition at once. These two measures inform objective 1.1. Both Time Deviation and Cost Deviation describe the percentage by which a project is ahead/over or behind/under schedule and budget respectively. These two measures inform objective 1.2. Feedback Score corresponds to the ratings of end-user feedback on a project or system. Stakeholder Rankings capture direct feedback from stakeholders as a project evolves within development. It is important to gather feedback from both executors and decision-makers; these two measures inform objective 2.1. Fit Ranking is a 0 to 10 scale that determines how well a project completes its mission set or operational purpose. Readiness Measure assesses existing or needed training and planning for successful project implementation or execution. These two measures inform objective 2.2.

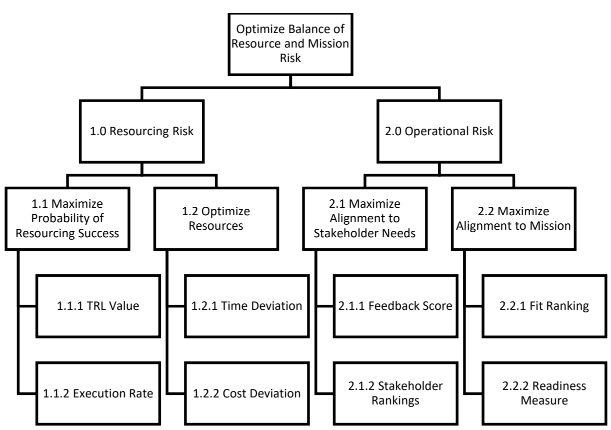

Figure 1. Team SPRECTRE Value Hierarchy displaying model Value Measures

2.2 Stochastic Value Model

After developing the value hierarchy and determining the value measures for resourcing and operational risk, the stochastic value model was created to show how its outputs can benefit JSOC. The model was developed to look at resourcing risk versus operational risk through a Monte Carlo simulation using the SIPmath® software developed by Probability Management. The model performed 1,000 iterations that created a value score-based distribution displaying resourcing risk versus operational risk. The output was plotted on a graph to compare a group of five project lines.

For the initial model, a decision was made to compare five placeholder project lines with the value measures from the functional hierarchy. Under these measures, raw data values were determined for each of the project lines to create distributions, either normal distributions or triangular distributions, that would be used in the next part of the model. The value measure data inputs were separated by their respective resourcing or operational risk groups. Value measures fit to a normal distribution included an average and standard deviation data value while a triangular distribution needed a low, most likely, and high data value.

Then, value score charts were created for stakeholders to assign scores to the raw data from the distributions. Stakeholders would provide scores from 0-100 for selected raw data points. For example, TRL scores were 1 through 9 so stakeholders would assign a score from 0 to 100 for each TRL level, 0 being the worst and 100 being the best. This step is typically performed through stakeholder analysis but due to this model being a placeholder for future models, it was created randomly. This allowed the 1,000-iteration model to assign each raw score an associated value out of 100 making it easy to compare raw scores with different scales.

Next, stakeholders would assign a value from 0 to 100 for each of the value measures depending on how much weight that value measure would hold in the model, with 100 being the most important piece of the model. These weights were normalized so each weighted score combined would be equal to one. The model then produces the sum product of value scores and respective weights to produce a final value score for each alternative. This way, 1,000 iterations along the distributions could get a weighted project total score based on all values looked at in the project.

With both a resourcing and operational risk score over a distribution for 1,000 iterations, a graph was produced with project lines to visualize differences between distributions. The highest-valued project lines had distributions with high values for both resourcing and operational risk scores were shown at the top right corner of the output which will be explained in more detail below. This output highlighted which project lines were providing good value at their associated cost, allowing stakeholders to have better insights on how to prioritize project line funding. While this model used placeholder measures and values generated through simulation, the main purpose of this model was to provide JSOC with a model that could be adapted to better examine its process with classified data. In addition, it generated ideas for stakeholders on what measures and values could be potentially modeled for them to help with issues they are experiencing that they did not originally think of.

3. Results

3.1 Dashboard

After setting up the stochastic model, Team SPECTRE created a dashboard where users at JSOC could easily input data that would update numbers in the model. The dashboard consisted of three parts all on the same worksheet that users could follow with instructions on the worksheet. Figure 1 a-c shows an example input for each step. Figure 1 a. shows step one, which is to input data for the distributions. Depending on the value being inputted, users were asked to give a low, most likely, and high or an average and standard deviation for each project that would autofill the model. Figure 1 b. shows the next step in the diagram which is to input stakeholder scores for the raw data highlighted in blue. Finally, Figure 1 c. shows where to input weights for each value measure used in the model.

Projects	Low	Most Likely	High
rifle	1	2	3
tank	9	9	9
plane	5	6	7
mortar	4	5	5
pistol	7	7	8

a.

TRL Value	
Raw Score	Value
9	100
8	95
7	90
6	80
5	70
4	55
3	35
2	30
1	0

b.

Weights	
Value	SW
TRL Value	60
Feedback Score	50
Stakeholder Rankings	70
Fit Rankings	30
Readiness Measure	20

c.

Figure 1 a-c. Dashboard steps show how to input data for distributions, stakeholder scores, and weights for value measures.

This simplified dashboard allows users with little knowledge of how the model works to input the data as explained previously and an output of a cloud plot is produced, an example of which is in Figure 2. This output on the model has an explanation for how to read it so JSOC can easily interpret results from the stochastic model.

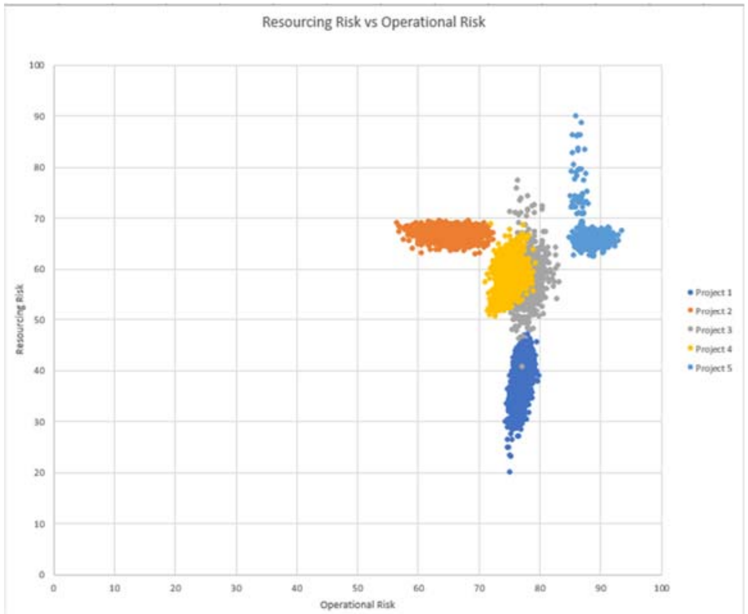

Figure 2. Output Cloud Plot

The model's second output is Pareto optimality and Level 1 analysis, allowing specific project lines to be compared against each other even further (Caddell, 2020). It compares one project's 1,000 random iterations against another project to see the percentage of when the first project's operational risk and resourcing risk scores are better than the second, called domination. It also analyzes when operational risk is higher but the resourcing risk is lower (PO(+)), when resourcing risk is higher but the operational risk is lower (PO(-)), and when both risk scores are lower (dominated). Table 1 displays an example of Level 1 analysis by comparing Project 3 with Project 4. Overall, Project 3 is more dominant and PO(+) over Project 4 based on its majority of points being in those two areas. This information paired with the cloud plot's visualization indicates that Project 3 most likely holds more value to JSOC compared to Project 4.

Table 1. Level 1 Analysis Comparing Projects 3 and 4

		Count	**Percent**
3 Dominates	**A**	430530	43.1%
3 PO(+)	**B**	479857	48.0%
3 PO(-)	**C**	60119	6.0%
3 is Dominated	**D**	29494	2.9%
Alts. Are Equal	**E**	0	0.0%

By using the combination of the cloud plot and Pareto analysis, JSOC can better understand tradeoffs in a more quantitatively. These tradeoffs could consist of how much to fund a project line or how much time should be spent on improving a project line's value to the mission. It visualizes and compares project lines' performance and value against each other, allowing leaders and decision-makers to make well-informed decisions on resource allocation. These data-driven outputs of the stochastic model offer a different perspective on JSOC's process of reviewing, funding, and supporting its project lines and capabilities.

4. Conclusion

4.1 Recommendations

To optimize resource allocation decision-making at JSOC, it is recommended that the method of collecting and analyzing data is changed. A more quantitative approach to decision-making would allow JSOC to make more informed decisions about how and where to place money, effort, and time. The value measures in the functional hierarchy and stochastic value model serve as a start for what type of data to collect on project lines. Additionally, the stochastic value model and its dashboard are also a good baseline for quantitatively approaching decision-making. Because the model is a dynamic shell, it can adapt to JSOC's needs and available data. As result, it is a recommended tool to begin the movement toward a more structured and data-driven method for resource allocation decision-making.

4.2 Future Work

Moving forward, Team SPECTRE intends to receive an increased volume of data and information from the clients at JSOC. The primary issue plaguing the current model is the paucity of available data. This issue can be traced to the challenges in JSOC's data management protocols, compounded by the classification of most of the available data.

In addition to refining the model, it is suggested that JSOC implements a robust data management system that ensures timely and accurate data collection, analysis, and dissemination. This will facilitate the optimization of the proposed model by making sure that data inputs within the model accurately reflect the current situation within a given project. This has the impact of mitigating the possibility of inaccurate or dated data inputs creating conflated or erroneous project scores within the value model. In addition, using this data will validate the model with previous project line data that can show if the model accurately predicts the risk associated with investing in it.

Overall, Team SPECTRE remains committed to collaborating with JSOC to refine the proposed model and improve its data management practices. By working together, the necessary support can be provided to enable JSOC to achieve its objectives and improve its overall efficiency.

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