



ENTERPRISE SUSTAINMENT METRICS

GRADUATE RESEARCH PAPER

Faith K. Posey, Major, USAF

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Abstract

The Air Force sustainment enterprise does not have “metrics that . . . adequately measure key sustainment parameters,” according to the 2011 National Research Council of the National Academies study, "Examination of the U.S. Air Force’s Aircraft Sustainment Needs in the Future and Its Strategy to Meet Those Needs." That report further stated that although the Air Force has good metrics employed at the lower echelons, these metrics are not command-standardized and do not contribute to the overall assessment of the sustainment enterprise.

This paper explores the development of a single metric, similar to the Naval Aviation Enterprise’s (NAE) Single Fleet Driven Metric (SFDM): “Naval Aviation Forces, efficiently provided for tasking,” to accurately assess sustainment efforts. Through qualitative comparative analysis of current Air Force Aircraft Availability and Performance-Based Logistics metrics and the support environment of the NAE’s SFDM, it was determined that developing a single metric to accurately assess Air Force sustainment efforts is not feasible. To answer the question “does the sustainment enterprise provide cost-effective readiness for a weapon system,” a suite of metrics is required to make resource allocation decisions. Through this enhanced the visibility, the Air Force can optimize resources to increase aircraft availability while reducing operating support costs.

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Maj Faith K. Posey

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ENTERPRISE SUSTAINMENT METRICS

I. Introduction

Background

The U.S. Air Force's mission is to “*fly, fight and win ... in air, space, and cyberspace.*” To accomplish this mission in support of combatant commanders and national security objectives, the Air Force maintains a fleet of 5,762 aircraft consisting of 56 aircraft types (Deputy Assistant Secretary; Assistant Secretary of the Air Force, 2012). This diverse fleet is supported and maintained by a myriad of supply chains. Additionally, under the strain of being in war for two decades, these aircraft have become increasingly more expensive to operate and maintain (NRC, 2011). The increased expense of war, coupled with budgetary constraints, led to the Air Force to ask the National Research Council (NRC) of the National Academies to conduct a study of sustainment. This study focused on the Air Force's concern that “the resources needed to sustain its legacy aircraft may increase to the point where they could consume the resources needed to modernize the Air Force” (NRC, 2011: vii).

As a result of the 2011 NRC study, *Examination of the U.S. Air Force's Aircraft Sustainment Needs in the Future and Its Strategy to Meet Those Needs*, the committee identified one of the “Big 7” themes regarding Air Force sustainment as “metrics that do not adequately measure key sustainment parameters.” The committee further determined that the Air Force is committed to improvement and has good metrics employed at the lower echelons across the sustainment enterprise. However, these metrics are not command-standardized and do not contribute to the overall assessment of the sustainment enterprise. Current metrics include the following:

- Joint Sustainment Metrics (revalidated in the CJCSI 3170.0);
- Defense Logistics Agency (nine key metrics covered in the current Performance-Based Agreement);

- Air Logistics Centers (ALC) including:
 - System Metric and Reporting Tool Database,
 - Logistics Health Assessment,
 - Probability of Program Success sustainment metrics.

These metrics only assess certain aspects of developing or sustaining a weapon system. There is not one metrics that accounts for all the components within the sustainment enterprise. The Air Forces sustainment enterprise includes:

“...the package of support functions required to maintain the readiness and operational capability of weapon systems, subsystems, software, and support systems. It encompasses materiel management, distribution, technical data management, maintenance, training, cataloging, configuration management, engineering support, repair parts management, failure reporting and analysis, and reliability growth” (DOD, 2009: 3).

To resolve this issue the committee made several recommendations regarding metrics development, such as:

“Recommendation 2-5. The Air Force should develop and implement weapon system-level metrics that set aircraft availability levels and cost of providing their availability, as well as identify who is responsible for attaining both. Furthermore, these measures should be at a level that reflects sustained implementation of process improvement initiatives as cost-reduction incentives and not just increasing sustainment costs by aircraft aging” (NRC, 2011: 8).

“Recommendation 4-9. The Air Force should develop key metrics for sustainment that flow to ALC commanders and that highlight the success or shortcomings of ALC activities, drive appropriate behavior for the workforce, and allow Air Force leadership to assess the health of the enterprise and the adequacy of resourcing for the sustainment process regardless of organizational affiliation” (NRC, 2011: 11).

The Air Force sustainment community needs holistic metrics that are tied to end results, such as materiel or operational availability that directly impact operations. To develop holistic metrics, the Air Force needs to clearly define Critical Success Factors (CSF) and relate them to Balanced Scorecard (BSC) perspectives. Additionally, they must identify the correct Key Performance Indicators (KPI) the measure and report essential data.

Finally, link the data back to CSF performance measures. Through this process, the Air Force can develop sustainment metrics that can answer the question “does the sustainment enterprise provide cost-effective readiness for a weapon system?”

Effective sustainment metrics are critical to managing a cost effective sustainment enterprise. They can drive behavior that eliminates waste and find much-needed cost savings. Not only does this mitigate some of the challenges brought on by budgetary constraints but is a core component of our duty to be good stewards of our nation’s resources.

Problem Statement

The objective of this research is to evaluate the effectiveness of current Aircraft Availability (AA) and Performance-Based Logistics (PBL) metrics and explore the possibility of developing a single metric to accurately assess sustainment efforts and optimize aircraft availability while reducing operating support costs.

Research Question

- Can the Air Force implement a single sustainment metric, by applying the methodology of the Naval Aviation Enterprise’s (NAE’s) Single Fleet Driven Metric (SFDM), “Naval Aviation forces, efficiently provided for tasking,” to the Air Force business model?

Investigative Questions:

- What are the advantages and disadvantages of the Air Force’s AA metric?
- What are the advantages and disadvantages of PBL metrics?
- What are the advantages and disadvantages of NAE’s SFDM model?

Hypothesis

- A single sustainment metric, similar to the NAE's SFDM, will more accurately measure Air Force sustainment efforts and to optimize aircraft availability at reduced operating support costs.

Research Objective and Focus

The primary goal of this paper is to explore the possibility of developing a single metric, similar to the NAE's SFDM: "Naval Aviation Forces, efficiently provided for tasking," to accurately assess sustainment efforts and optimize aircraft availability while reducing operating support costs. There are a myriad of metrics that address sustainment; this research will focus on the strengths and weaknesses of AA, PBL metrics, and SFDM. The AA metric is the most commonly referred to sustainment metric in the Air Force's sustainment enterprise, and PBL has been the DOD's preferred sustainment strategy since the 2001 Quadrennial Defense Review (QDR). NAE's SFDM was selected based on the 2011 NRC report Finding 2-10:

"Although the Air Force structure and program management mechanisms are designed differently, the NAE approach provides an interesting governance model and foci for the Air Force to consider as it executes its eLog21 strategy and deliberates how to sustain its overall force" (63).

Methodology

For the qualitative comparative analysis I will evaluate the strengths and weaknesses of AA, PBL, and compare them to the support environment of NAE SFDM and standards identified in the literature review on supply chain management and metric development.

Assumptions and Limitations

To have viable sustainment metrics, they must tie to top-level goals. For the purpose of this paper, I will use the Air Force Logistics Balanced Scorecard for these goals. The Scorecard has four main perspectives: Warfighter, Resource Planning and Execution, Logistics Processes, and Innovation and the Workforce.

Limitations include the lack of ownership and accountability of the AA identified by the NRC. As they note, “because there are so many ‘cooks in the AA kitchen’ no one can be truly held accountable” (NRC, 2011: 25). Other needs include “strong centralized policy, procedures, and practices determined by the SAF/AQ, AF/A4 and the sustainment commander;” lack of a formally designated senior commander of the entire sustainment process; and lack of an integrated system that ties all the sustainment requirements together (NRC, 2011). These limitations must be resolved to implement enterprise-wide sustainment metrics but are beyond the scope of this research.

The final limitations of this research are limited access to the NAE and the calculations and analysis of the SFDM. The primary source available is the NAVSUP Weapon System Support that uses Ready for Tasking (RFT) and Ready Basic Aircraft (RBA) metric to determine aviation asset availability performance (R.L. Hoak, personal communications, April 20, 2015). These metrics do not include cost data, but the Cost Performance Index for each type/model/series throughout the NAE briefing cycle includes cost data (R.L. Hoak, personal communications, April 20, 2015). For this analysis, and from the information available, I made the assumption that in its current state the NAE SFDM is a suite of metrics focusing on the top cost and readiness drivers.

When analyzed together, these metrics provide an assessment of “Naval Aviation forces, efficiently provided for tasking.”

Implications

A single metric to measure enterprise sustainment could assist Air Force leaders in their assessment of the enterprise’s ability to meet eLog21 sustainment goals. These goals are to increase equipment availability to match AA targets and reduce Operations & Support costs by 10%. Additionally, a viable metric can enable leaders to optimize resources and find cost savings within the sustainment enterprise.

The first chapter addressed the background of the problem and established research goals and focus. Chapter II will provide a review of the literature supporting supply chain management and metric development, AA, PBL and NAE’s SFDM. Chapter III will explore processes that will then be used to conduct a comparative analysis of the metrics mentioned above. Chapter IV will concentrate on the comparative analysis and results. Lastly, Chapter V will conclude the research and provide recommendations for further research.

II Literature Review

Chapter Overview

An extensive amount of literature is available on the subject of metrics. The primary documents used for this research are: TO 00-20-2, Maintenance Data Documentation (1 Nov 12), AFI 21-101, AMC Sup 1, Aircraft and Equipment Maintenance Management (HQ USAF/A4L, 26 Jul 10; HQ AMC/A4M, 14 Feb 11), Department of Defense's 2014 *PBL Guidebook* and the 2011 National Research Council of the National Academies study, *Examination of the U.S. Air Force's Aircraft Sustainment Needs in the Future and Its Strategy to Meet Those Needs*.

Supply Chain Management Components

The Air Force's sustainment enterprise includes both materiel management and distribution. These entities also fall under the supply chain management umbrella. The definition of supply chain management (SCM) is "the management of relationships, using key cross-functional business processes to create value for customers and other shareholders" (Lambert, 2014: 2). Although the definition of value for customers and shareholders is different than civilian corporations, private-public partnerships are critical to managing the Air Force sustainment enterprise.

Lambert, Leuschner, and Rogers (2014) identify eleven management components in supply chain management. These management components are broken down into two major sub-categories: structural and behavioral. Structural management components are planning, control methods, workflow structure, organization structure, knowledge management, and communications structure (Lambert, Leuschner, & Rogers, 2014). Behavioral management components are management methods, power and leadership,

risk and reward, culture and attitude, and trust and commitment (Lambert, Leuschner, & Rogers, 2014).

This research focused on control methods and organization structure SCM structural components. At the foundation, “structure management components are important because structure drives behavior” (Lambert, Leuschner, & Rogers, 2014: 240). I also reviewed power and leadership and culture behavioral components.

Control Method: Metrics Development and Characteristics

“Control is achieved by developing and implementing the best metrics”
(Lambert, Leuschner, & Rogers, 2014: 241).

It is critical to understand how to construct good metrics. David Parmenter’s book, *Key Performance Indicators: Developing, Implementing, and Using Winning KPIs* provides a good standard. First, Critical Success Factors (CSFs) are defined as “the list of issues or aspects of organizational performance that determine ongoing health, vitality, and wellbeing. Normally there are between five to eight CSFs in any organization” (Parmenter, 2010: 25). The next building blocks are Key Results Indicators (KRI) and Key Performance Indicators (KPI):

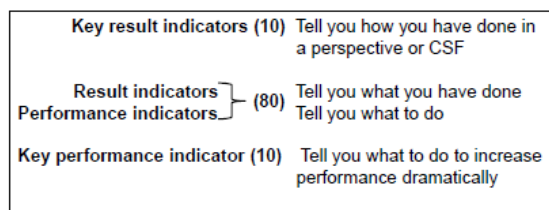


Figure 1: 10/80/20 Rule (Parmenter, 2010)

Culture and relationships also play an integral part in successful development and utilization of KPIs. Parmenter highlights these as determined by the presence or absence of four foundational stones:

1. Partnership with the staff, unions, key suppliers, and key customers: “The success pursuit of performance improvement requires the establishment of an effective partnership among management, local employee representatives, unions representing organization’s employees, employees, major customers, and major suppliers” (Parmenter, 2010: 30).
2. Transfer of power to the front line: “Successful performance improvement requires empowerment of the organization’s employees, particularly those in the operational front line”(Parmenter, 2010: 31). For successful empowerment of employees, it is important that all levels understand CSF (Parmenter, 2010). Additionally, employees must have the authority to “take immediate action to rectify situations that are negatively impacting KPIs” (Parmenter, 2010: 31).
3. Measuring and reporting only what matters: “It is critical that management develop an integrated framework so that performance is measured and reported in a way that results in action” (Parmenter, 2010: 33).
4. Linkage of performance measures to strategy through the CSFs: “For a performance measure to be a KPI it has to be linked to one or more of the organization’s CSFs, more than one balanced scorecard perspective, and the organization’s strategic objectives” (Parmenter, 2010: 34).

For KPIs to be effective, they must have buy-in from all levels of employees and measure what matters to the overall company strategy.

Additionally, KPIs should have most or all of the following characteristics:

“non-financial measures; measured frequently; acted on by CEO and senior management team; clearly indicate what action is required by the staff; measures that ties responsibility down to a team; significant impact (e.g. it impacts most of the core CSFs and more than one BSC perspective); and encourage appropriate action (e.g. have been tested to ensure they have a positive impact on performance)” (Parmenter, 2010: 88).

These characteristics expand on the four foundational stones described above and provide guidelines to refine further metrics. A simple metric make for more effective metric because employees understand why and how their performance impacts the organization. “Measurement is more critical than communication, training, or perhaps anything else when it comes to managing human behavior.” (Fawcett, Ellram, & Ogden, 2007: slide 6)

Last, Parmenter (2010) states, “winning KPIs will incorporate all triple bottom-line issues (environment, social, and financial)” (60). Although the public sector definition of a triple-bottom-line differs, it is just as important to develop KPIs that incorporate the Air Force’s and DOD’s bottom-line issues, such as readiness and cost.

Unfortunately in the government sector, organizational and bottom-line objectives are much more difficult to define. Doerr, Lewis, & Eaton (2005) determined that, “readiness itself...is only a surrogate for the organizational objectives of the DOD (i.e. ready for what?)” (174-175). They further explain that “maximizing national security” could be an objective, but this quickly becomes, “a measurement and translation problem – measuring the services in terms of the contribution to the objectives and incentives of the DOD, and translating that measure to the dollar measurement used by the private sector” (Doerr, Lewis, & Eaton, 2005: 169). For the commercial sector, the primary language concerns profitability, but for the government it is difficult to define mission objectives by financial measures. This top-level conundrum makes the task of developing meaningful metrics that much more difficult to define.

Once an organization determines what they should measure, they need to develop metrics that have the characteristics of effective measures. The focus of this research is a “macro-comparison” and leaves the micro-refinement of metrics for further research. However, any refinement of metrics must be identified as either leading or lagging indicators. Leading indicators are predictive. They can directly impact an organization’s capability to provide resources to execute the mission (AFLMA, 2001). Lagging indicators are historical and show established trends (AFLMA, 2001). By understanding

if a metric is a leading or lagging indicator, leaders can better manage resources to support the mission.

The elements above provide a foundation for developing effective metrics. However, there are additional challenges to address. Lambert, Leuschner, & Rogers state that “the problem is often metrics are in conflict across functions within the firm and across companies in the supply chain” (2014: 241). Additionally, “the complexity associated with overlapping supply chains makes the development of supply chain metrics difficult” (Lambert & Pohlen, 2014: 257). The last concern is:

“There is no evidence that meaningful performance measures that span the entire supply chain actually exist. Many factors contribute to this situation including: the lack of a supply chain orientation, the complexity of capturing metrics across multiple organizations, the unwillingness to share information among organizations, and the inability to capture performance by customer, product, or supply chain. A major contributor to the lack of meaningful supply chain management performance measures is the absence of an approach for developing and designing such measures” (Lambert & Pohlen, 2014: 257).

If the public sector struggles with the development of both cross-functional and cross-organization supply chain metrics, it makes our sustainment metric development that much harder. However, it is not an impossible task. It is a task that requires value stream mapping to facilitate metrics alignment. The subsection on organization structure addresses this concept.

Organization Structure

The second structural SCM component used for this research is organization structure. Gibson, Ivancevich, Donnelly, and Konopaske (2012) describe its importance as “the structure of the organization contributes to the organizational effectiveness, and that relationship justifies our interest” (398). An organization shapes their design by four

key decisions: division of labor, departmentalization, span of control, and authority (Gibson, Ivancevich, Donnelly, & Konopaske, 2012). The definitions of the four key decisions provided by Gibson, Ivancevich, Donnelly and Konopaske (2012):

- Division of Labor: “Process of dividing work into relatively specialized jobs to achieve the advantage of specializations” (400).
- Departmentalization: “Process in which an organization is structurally divided by combining jobs in departments according to some shared characteristic or basis” (401).
- Span of Control: “Number of individuals who report to a specific manager” (405).
- Authority (Delegation of): “Process of distributing authority downward in an organization” (408).

Additionally, organization structure and design components are used as secondary articulation and reinforcement mechanism in an organization’s culture (Schein, 1990). Therefore, organization structure and culture SCM components are considered heavily intertwined.

Many organizations and communities play a role in the Air Force’s sustainment enterprise. The Air Force’s organizational hierarchy starts at Headquarters Air Force and proceeds down to Major Commands, Direct Reporting Units, Field Operating Offices, Number Air Forces, Wings, Groups, Squadrons, and Flights. Serving as the backbone of the sustainment enterprise is the Air Force Sustainment Command and Air Logistics Centers. Within the Air Force, the acquisition, contracting, engineering, and sustainment communities are all critical components of the overall sustainment enterprise. Last, some of the outside organizations include the Defense Logistics Agency (DLA), other service components that the Air Force has partnered with in joint acquisitions and varied contractors like Boeing and Lockheed Martin.

The organization structure SCM component integrates with the workflow structure. Lambert and Pohlen state that “by analyzing the processes at each link and understanding the value the link creates, managers can align the supply chain management processes in order to provide the best value for the consumers or end-users and the highest profitability and shareholder value for each company” (2014: 273). By systematically diagraming a process, either through a swim lane flowchart or other value stream mapping, handoffs between cross-functional activities are highlighted (Fitzsimmons & Fitzsimmons, 2011). After identifying cause and effect relationships, then we can identify the right metrics and align them, link-by-link throughout the sustainment enterprise. If the metric alignment is not across firms in the supply chain, suboptimal behavior is rewarded (Lambert, Leuschner, & Rogers).

Power and Leadership

The first behavioral SCM component used in this research is power and leadership. For this SCM component, power is defined as authority. The definition of delegation of authority is “process of distributing authority downward in an organization” (Gibson, Ivancevich, Donnelly, & Konopaske, 2012: 408). Depending on the degree of delegation; authority can be decentralized or centralized. Decentralized authority empowers managers to make significant decisions and encourages professional development (Gibson, Ivancevich, Donnelly, & Konopaske, 2012). Centralized authority maintains control of decision making and mitigates duplication of functions (Gibson, Ivancevich, Donnelly, & Konopaske, 2012). I addressed authority in the organization structure subsection, but it is not a one SCM component attribute. Authority is both a structural and behavioral attribute.

There are varying levels of power within a firm and between the firms that comprise the supply chain (Lambert, Leuschner, & Rogers, 2014: 247). “Management can use its power in ways that only benefit the firm or in ways the benefit the entire supply chain (Lambert, Leuschner, & Rodger, 2014: 247). This dynamic can be affected by the wrong metrics that “reward managers for short-run success,” which makes “it is difficult for them to make short term sacrifices for long term gains (Lambert, Leuschner, & Rodger, 2014: 247).

Leadership and resource management occurs at all levels of an organization. Senior leaders in the Air Force are developed along three tracks: joint, service, and political. The Joint Officer is designed to strive in cross-service environments. The Service Officer is the subject matter expert of their service. The Political Officer is the champion for DOD priorities on Capitol Hill. The Navy has identified the need for a fourth development track. Senior leaders who think like “business executives in addition to warfighters” and have a sense of their “command’s business metrics or language: resource levels, costs, lines of business (Perkins, 2007: 12). This new track can lead to optimized resource allocation for mission requirements under current fiscal constraints (Perkins, 2007).

Culture

The second behavioral SCM component used for this research is culture. The core of a positive culture consists of a historical foundation; an understanding of what is expected; being part of a group; and encouraging interpersonal and personal relationships (Gibson, Ivancevich, Donnelly, & Konopaske, 2012). The combination of these elements leads to a cohesive organizational culture (Gibson, Ivancevich, Donnelly, & Konopaske,

2012). Additionally, culture of an organization is determined by “the values and norms held by top management” (Lambert, Leuschner, & Rogers, 2014: 248). Beyond top management’s perspective, organization culture is affected by how employee perceptions create beliefs, values, and expectations; or the combination of artifacts, values, and basic assumptions layered throughout an organization (Gibson, Ivancevich, Donnelly, & Konopaske, 2012).

Developing culture is a process. It evolves from “a pattern of basic assumptions that an organization has invented, discovered, or developed, and that have worked well enough to be considered (Lambert, Leuschner, & Rogers, 2014: 248). Culture “is what a group learns over a period of time as the group solves its problems of survival in an external environment and its problems of internal integration” (Schein, 2009: 111). Finally, the “norms and beliefs arise around the way the members respond to critical incidents” is a mechanism to culture creation (Schein, 1990: 115).

The Air Force, by design, has the attributes of bureaucratic culture that “emphasizes rules, policies, procedures, chain of command, and centralized decision making” (Gibson, Ivancevich, Donnelly, & Konopaske, 2012). Managing these attributes and coupled with cultural development processes above, significantly impacts the effectiveness of the organization.

Aircraft Availability

During the NRC’s research on the Air Force’s sustainment enterprise, “it was often stated during the course of the study that aircraft availability is the measure of merit” (NRC, 2011: 20). The current metric is defined by Technical Order 00-20-2,

Maintenance Data Documentation (1 Nov 12), stating AA as mission capable (MC) hours divided by total aircraft inventory (TAI) hours, then multiplied by 100:

Equation 1: AA Formula

$$Availability\ Rate = \frac{MC\ HOURS}{TAI\ HOURS} \times 100$$

The definition for MC is fully mission capable (FMC) hours plus partially mission capable (PMC) hours, divided by Possessed Hours, and then multiplied by 100:

Equation 2: MC Rate Formula

$$MC\ Rate = \frac{(FMC\ HOURS + PMC\ HOURS)}{POSSESSED\ HOURS} \times 100$$

One benefit of the AA metric is that it is the most commonly referred metric in the Air Force sustainment enterprise. Additionally, the committee did determine that AA does have high utility for operational commanders and may apply to the overall sustainment community if the community at large focused on providing the number of aircraft to as determined by the war plan (NRC, 2011). Last, AA's performance is linked to the strategy through CSFs as reported on the Logistics, Installations and Mission Support – Enterprise View (LIMS-EV) Logistics Balanced Scorecard under the Warfighter Perspective.

There are several challenges with the AA metric. First, both AA and MC are lagging metrics that can be hard to improve on or influence change. These metrics are similar to Navy's previous metrics that were, "historically used to track readiness – FMC and MC (fully mission critical and mission critical) – were inadequate because they focused on near-term solutions (i.e. fixing existing casualties) and provided no leading indicator through which to improve readiness" (NRC, 2011: 222).

AA may also lead to the failure of resource allocation optimization. For example, Doerr, Lewis, and Eaton (2005) identified this potential pitfall with this proposed productivity ratio for weapons system logistics:

Equation 3: Proposed Productivity Ratio

$$A_o = \frac{\text{Fully mission capable hours available}}{\text{Total deployed hours}}$$

They explain that “ A_o is only a surrogate for readiness because it is a ‘single factor’ measure,” and “not fine-grained enough for many resource allocation decisions” (Doerr, Lewis, & Eaton, 2005: 174). In some cases, a single metric is not sufficient for an accurate cost-benefit analysis needed to make informed decisions.

Another issue identified in the NRC’s report was AA’s disconnect from the eLog21 goals. These goals are to increase equipment availability to match AA targets and reduce Operations & Support costs by 10%. The committee stated AA was “far more widely reported than cost parameters as goals” (NRC, 2011: 25). AA also falls into a common pitfall for metrics identified as supply chain metrics. Lambert and Pohlen (2014) identify this pitfall as:

“Many measures identified as supply chain metrics are actually measures of internal logistics operations such as fill rate, lead time, on-time performance, damage and responsiveness and are not the multi-firm measures that are necessary to measure the performance of the supply chain” (258).

In the end, “the Committee universally came to believe that AA is fragmented, and its accountability is such that it’s not a measurable performance criterion for a single sustainment manager” (NRC, 2011: 128).

There is no perfect metric. AA does give an assessment of the health of the fleet, but what it does not tell is the cost associated with obtaining the level of readiness. AA

may be a viable metric if further linked to an overarching sustainment goal and CSFs that address sustainment costs.

Performance-Based Logistics

Since the 2001 QDR's mandate to use PBL to compress the supply chain and improve readiness, there has been much discussion over public-private partnerships.

Randy Fowler provided a concise depiction of the shift in logistics' business model in his 2009 article,

“PBL has not significantly changed DOD's reliance on contractors; it has only changed the nature of how we use their services. Simply put, we have transitioned from buying iterative discrete quantities of goods and services (transactional logistics) to acquiring sustainment via top-level outcomes (PBL)” (10).

PBL arrangements should not be confused with Contractor Logistics Support (CLS). CLS is the “who” where PBL is the “how” of the business model (DOD, 2014). Unlike CLS, PBL arrangements “are tied to Warfighter outcomes and integrate the various product support activities (e.g. supply support, sustaining engineering, maintenance, etc.) of the supply chain with appropriate incentives and metrics” (DOD, 2014: 6). The NRC lauded PBL in their 2011 report, stating:

“PBL offers the best strategic approach for delivering required life-cycle readiness, reliability, and ownership costs. Because this process is performance-based and focuses on weapon system availability and lowering costs, it can be accomplished organically, through suppliers or a combination thereof. PBL tackles the problem of aging by instituting incentives between the government and the weapon system manufacturer to ensure support providers continuously modernize and improve their systems and methods of support” (86).

The shift from transactional logistics to sustainment aligned with top-level outcomes has reshaped the management of the sustainment enterprise. However, within the PBL business model the right metrics must be identified to optimize resources and

cultivate continuous improvement. The following PBL tenant provides guidance for achieving that goal: “use measurable and manageable metrics that accurately assess the product support provider’s performance against delivery of targeted Warfighter outcomes” (DOD, 2014: 9). Furthermore, metrics should be linked to top-level sustainment requirements (i.e. Materiel Availability or Reliability) and deliver the required performance (reliability or availability) at a reduced total cost than previous transactional arrangements (DOD, 2014).

The *PBL Guidebook: A Guide to Developing Performance-Based Arrangements* provides the DOD foundation and guidance for metrics development. It establishes definitions and relationships for the Joint Requirements Oversight Council required Key Performance Parameters: Material Availability (A_M) and Operational Availability (A_O); Key System Attributes – Reliability (R_M); Operating & Support (O&S) Cost. Full definitions and relationships are below (DOD, 2014: 24-25):

- Materiel Availability (A_M): A_M is the measure of the percentage of the total inventory of a system operationally capable, based on materiel condition, to perform an assigned mission. This can be expressed as the number of operationally available end items (i.e. total population).
- Operational Availability (A_O): A_O is the measure of the percentage of time that a system or group of systems within a unit are operationally capable to perform an assigned mission and can be expressed as uptime/(uptime+downtime).
- Reliability (R_M): R_M is a measure of the probability that the system will perform without failure over a specific interval, under specified conditions. More than one reliability metric may be specified for a system as appropriate.
- Operating & Support (O&S) Cost: Total O&S costs associated with achieving A_M .



Figure 2: Relationship between A_O and A_M (DOD, 2014)

Additionally, the *PBL Guidebook* establishes the importance that metrics satisfies the “SMART” test (Specific, Measurable, Attainable, Relevant, Timely). Metrics link or contribute to top level performance outcomes and each other (Level 1, 2, and 3 metrics) (DOD, 2014). The *PBL Guidebook* provides the following definitions for Level 1, 2, and 3 metrics:

- **Level 1 metrics** are the overarching top-level performance goals or attributes for the PBL arrangement.
- **Level 2 metrics** serve as diagnostics and support for Level 1 metrics. The diagnostic relationship helps identify the root cause or causes of a performance gap for a Level 1 metric.
- **Level 3 metrics** serve as diagnostics and support for level 2 (DOD, 2014: 43).

Within the various levels of metrics, there are 92 PBL sustainment metrics defined in Appendix F: PBL Metrics. This paper focuses on Level 1 PBL metrics. These metrics, Materiel Availability, Operation Availability, Reliability, and O&S Cost provide both a

readiness level and associated cost. As PBL arrangements are developed, organizations are assigned the right level of authority to affect system availability or reliability.

There are many benefits to PBL metrics. There are well defined and satisfy the “SMART” test. Most importantly they align performance objectives within the supply chain. Lambert and Pohlen (2014) identified that “implementing a supply chain strategy requires metrics that align performance with the objectives of other members in the supply chain.” PBL arrangement use incentives to drive behavior, actions, and investment decisions of the Product Support Provider (PSP) (DOD, 2014). For example, customer wait time (CWT) and mean time between failure (MTBF) metrics for a generic subsystem (GSS).

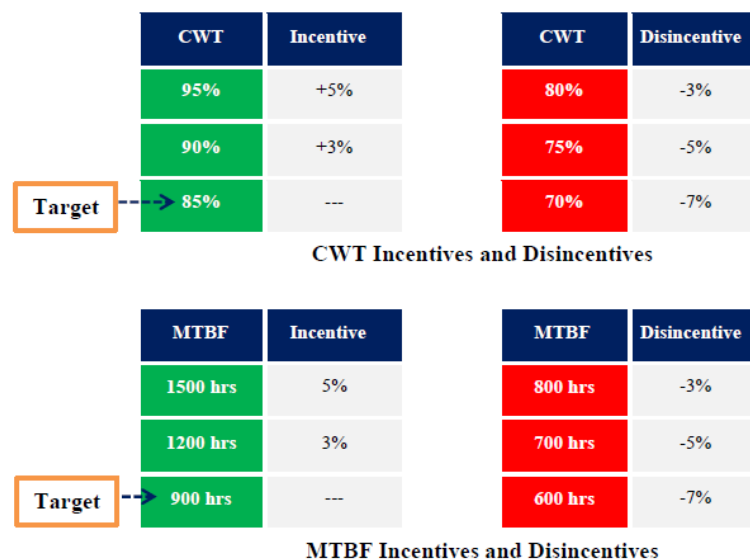


Figure 3: PBL Incentives and Disincentives Example (DOD, 2014)

By providing incentives or disincentives for PSP performance targets, the PSP has a greater investment in the relationship, thus creating a true partnership.

One of the challenges of PBL is linking metrics to top-level sustainment requirements can be a laborious endeavor. Aligning PBL goals is difficult as described by Doerr, Lewis, & Eaton (2005: 171):

“The DOD factors...do not all translate so readily into dollars, and fall into three categories or dimensions that demonstrate how logistics support is intended to improve warfighting capability; improved readiness (facilitated both directly by a focus on readiness and indirectly by a focus on reliability), increased agility (reducing logistical footprint, eliminating non-value added steps, supply chain compression, and improved reliability) and reducing cost (by freeing capital for other warfighting priorities).”

Other PBL challenges include difficulty in comparing organic and contracting support cost drivers.

The *PBL Guidebook* defines SMART metric development for the PBL business model. It takes into account the various relationships (private-public partnerships) and components (Materiel Availability, Operation Availability, Reliability, and O&S cost) within the sustainment enterprise. Although PBL metrics have been well defined, are senior leaders or operational forces tracking these metrics as they relate to their readiness? Unlike AA that focuses primarily on availability, do PBL metrics focus too much on total lifecycle costs?

Naval Aviation Enterprise – Single Fleet Driven Metric

“Enterprise behavior is about understanding your processes and aligning your organization to execute those processes in a way you can monitor using metrics.”
RADM Terry Etnyre, Commander, Naval Surface Force, U.S. Atlantic Fleet, 2005

In the late 1990s and early 2000s, the Navy shifted focus to enterprise activities in order to change a “culture of consumption and lack of alignment between requirements and processes” (Perkins, 2007: 2). The Navy had to address four main barriers to

cultivate an enterprise-wide perspective on metrics. Those barriers consisted of Structure and Tribal Culture, Budget Systems, Performance Measurement Systems, and Lack of Strategic and Business Alignments (Perkins, 2007). The fiscal constraints of DOD budget cuts and inflation quickly highlighted the effects of these barriers. Commands, with their stovepipe perspectives, “were reluctant to voluntarily cut programs,” that resulted in comptrollers making “across-the-board percentage cuts based on dollars, not on a strategic understanding of how the money was being spent to generate the required output” (Perkins, 2007: 3). This broad brush stroke to budget cuts deeply impacted the Navy’s readiness which was revealed when the Navy was tasked to deploy eight carriers in support of Operation Enduring Freedom in October of 2001 and only had supplies for four and a half (Perkins, 2007).

Navy senior leaders needed to start thinking like “business executives in addition to warfighters” and to develop a sense of their “command’s business metrics or language: resource levels, costs, lines of business – working with such concepts had never been considered command responsibility” (Perkins, 2007: 12). Additionally, by embracing enterprise behavior, they could now assess objectives and processes in their entirety to make informed resource decisions to maximize output under current fiscal constraints (Perkins, 2007).

Changing a culture for an institution as large as the Navy was not a simple task. The Navy hired the Thomas Group to facilitate this task with the Naval Aviation Readiness Integrated Improvement Program (NAVRIIP). The backbone of the NAVRIIP efforts consisted of three cross-function teams (CFTs) focused on aligning the aviation community around a single metric (Perkins, 2007). The first CFT was responsible for

developing “entitlements based on fleet driven requirements, creating a “demand pull” signal to which maintenance organizations and the supply chain could respond” (Perkins, 2007: 7). The second CFT was responsible “for providing parts, aircraft and support equipment to squadrons through NAVSUP, DLA, BUPERS and NAVAIR to enable aviators to meet training milestones” (Perkins, 2007: 7). Lastly, the third CFT, “focused on planning and programming to ensure funding requirements were met” (Perkins, 2007: 7). In the end, NAVRRIIP “had connected the three levels of maintenance to fleet-driven entitlements” and determined the root causes of high cost, for example, issues of component reliability which exasperated consumption (Perkins, 2007). Establishing CFTs played a critical role in the Navy’s cultural evolution by establishing organizational structures that promote interpersonal and intergroup and provide cross-functional processes that inform risk-balanced decisions (About Us: Naval Aviation Enterprise).

In addition to the process improvements of NAVRIIP, multiple Air Board gatherings and the Aviation Maintenance and Supply Readiness (AMSR) group set the foundation for the Naval Aviation Enterprise (NAE) in 2004 (www.navy.public.mil). The NAE defined relationships as a behavioral model triad. At the top, housed with Requirements, a Single Process Owner (SPO) was identified that was deemed “responsible and accountable and fireable” (Perkins, 2007: 8). The SPO was supported by Providing Organizations and Resources at the two base corner points of the triangle (Perkins, 2007).

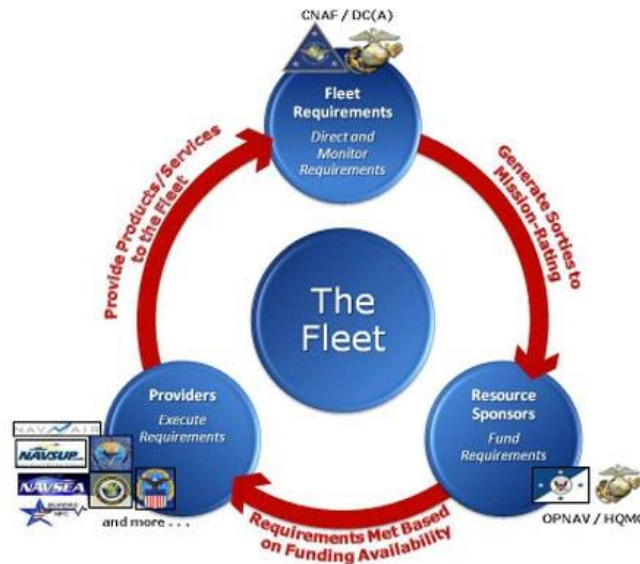


Figure 4: Navy Enterprise Framework (About Us: Enterprise Framework)

With relationships and responsibilities defined, NAE's approach is based on the following principles:

1. Concentrate efforts on improving readiness, while sustaining fleet wholeness and increasing efficiencies.
2. Exercise a bias for action.
3. Drive systemically cross-functional, cross-command practices.
4. Apply disciplined, process-driven, analytic methodologies.
5. Understand the Single Fleet Driven Metric: Naval Aviation forces efficiently delivered for tasking.
6. Use consistent, integrated and hierarchical metrics.
7. Ensure full and consistent transparency of data, information and activities.
8. Establish and maintain accountability for actions and results.
9. Commit to active participation (About Us: Enterprise Framework).

As with the NAVRIIP, the NAE still relies heavily on CFTs to meet their enterprise objectives. The three current CFTs are Current Readiness, Future Readiness

CFT, and Total Force. The Integrated Resource Management team facilitates these CFTs. The CFTs cover the following responsibilities:

- Current Readiness CFT: “on achieving Units Ready for Tasking in the Navy and Core Competent Units in the Marine Corps as defined by “measured readiness” at the right time and at an optimal O&S cost” (Cross Functional Teams: Current Readiness CFT) Please note, “measured readiness” is defined by the under the Defense Readiness Reporting System the readiness as it pertains to the standard of a Major Combat Operation (MCO) (Cross Functional Teams: Current Readiness CFT).
- Future Readiness: “is responsible for engaging NAE stakeholders to more effectively and efficiently produce required levels of future readiness while optimizing costs by identifying readiness-related issues to the NAE (Future Readiness).
- Total Force CFT: “is responsible for aligning and managing the key processes related to Naval Aviation manpower, to include active and reserve military, government civilians, and contractor support personnel (Total Force).

These CFTs are critical factors in executing the NAE’s goal for achieving “cost-wise readiness” by enabling an understanding of their “total force cost structure, managing cost reductions, and making sound investments as a cohesive enterprise” (About Us: How We Operate).

To support the NAE, they created the SFDM. When the NAE first established the SFDM in mid-2003, the metric was identified as “Aircraft Available for Tasking at Reduced Cost” which “added cost to the readiness equation” (Perkins, 2007). The metric has further evolved to “Naval Aviation forces, efficiently provided for tasking.” This research had limited access to the NAE and the calculations and analysis of the SFDM. The primary source available is the NAVSUP Weapon System Support that uses Ready for Tasking (RFT) and Ready Basic Aircraft (RBA) metric to determine aviation asset availability performance (R.L. Hoak, personal communications, April 20, 2015).

These metrics do not include cost data, but the Cost Performance Index for each type/model/series throughout the NAE briefing cycle includes cost data (R.L. Hoak, personal communications, April 20, 2015). Metrics briefed are T-Rating, Maintainer Core Competency, Core Competency, RFT Availability, Aircraft Life Management, and Cost Per Hour (R.L. Hoak, personal communications, April 20, 2015).

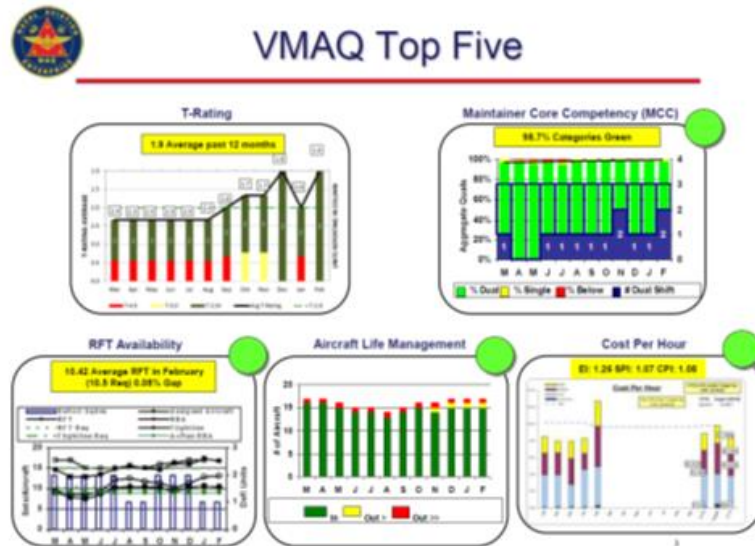


Figure 5: NAE Metrics Example (R.L. Hoak, personal communications, April 20, 2015)

Additional Cost Performance Indexes include Schedule Performance and Execution Indexes.

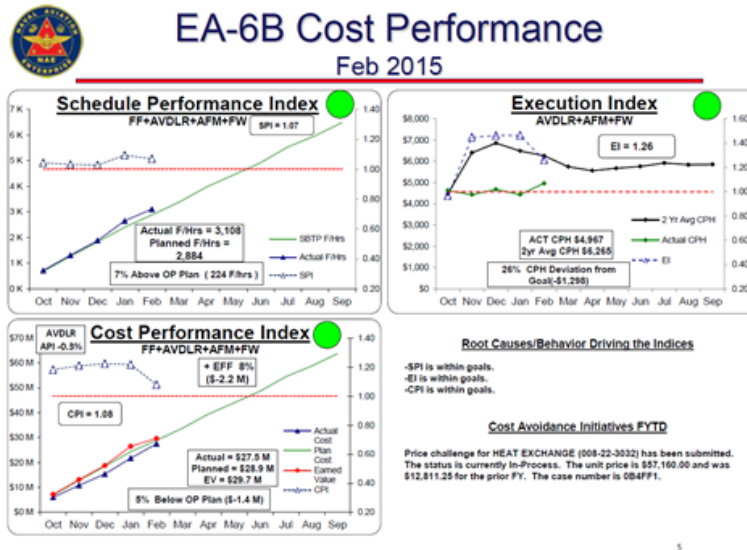


Figure 6: NAE Cost Performance Example (R.L. Hoak, personal communications, April 20, 2015)

The benefit of the NAE metrics is that within the briefing cycle both readiness and cost are tracked and analyzed. The SPO, providers, and resource sponsors receive information on the health of the fleet. Additionally, fleets are supported by CFTs that manage resources through an enterprise view.

The disadvantage of the NAE metrics, specifically the NAE SFDM, is well advertised but not used or readily understood at the lower echelons of the Naval Enterprise. The NAE SFDM is promoted as the metric that “everyone from the CNO down to the shop floor; from pilots, maintainers, the supply system and industry partners – were able to measure their contribution by this new metric” (Clemente, 2009: 7). However, beyond the messaging on the NAE website, the NAE SFDM was not a familiar metric at lower echelons in the Navy Supply System.

The NAE SFDM is the standard against which the Navy measures their ability to deliver their main objectives: warfighting first; cost-wise readiness; improved time on wing; greater speed and reduced cycle time; reliability; reducing total cost; and

implementing process efficiencies (About Us: Naval Aviation Enterprise). Be that as it may if the lower echelons do not have an understanding of the metric it is difficult to affect behavior.

Summary

To create a viable control method for an organization, metrics must align with organizational goals. SCM components, such as organization structure, power and leadership, and culture, must also be aligned with organizational goals. Without this supporting structure, an ineffective metric may just be a symptom of deeper organizational issues. An effective metric is meaningful, promotes the desired behavior, and easy to collect, calculate, and understand. These are just a few attributes of an effective metric. AA, PBL metrics, and NAE metrics are quantifiable and defined. However, they may not be appropriately linked or supported by other SCM components.

III. Methodology

Chapter Overview

The Qualitative Comparative Analysis (QCA) technique was chosen as the primary methodology for the research because of its “small-N” and “macro-comparative” approach (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008). In this research, the QCA will be a “very small-N” consisting of two cases that will enable a binary comparison (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008). In this chapter, I will cover the objectives, benefits, and potential results of a QCA, as well as the QCA design and application it pertains to this research.

QCA Objectives

The development of QCA was in the late 20th century for “applications in political science (comparative politics) and historical sociology (e.g. welfare state studies).” (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008: 2). This “macro-comparative” approach bridges both “quantitative (defining variables) and qualitative (keeping in touch with the holistic perspective) approaches” (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008). Ragin (2008) further explains “QCA is capable of pinpointing decisive cross-case patterns, the usual domain of quantitative analysis” (Slide 3).

To balance the quantitative and qualitative approaches within QCA, one must embrace the parsimony principle. The basic premise of the parsimony principle is “why make it complicated when one can make it simple?” Berg-Schlosser, De Meur, Rihoux, and Ragin (2008) highlighted that “simple QCA techniques strive to achieve some form of “short” (parsimonious) explanation of certain phenomenon of interests, while still providing appropriate allowance for causal complexity” (10). The balance of

parsimonious explanation and causal complexity is one reason QCA a good fit for evaluating metrics used by two different services but still working within the confines of the DOD. There is a certain commonality among the services, such as bureaucracy and fiscal constraints. However, does organization structure, power and leadership, or culture feed the causal complexity that may affect the effectiveness of enterprise sustainment metrics?

To answer the questions above, QCA allows us “not to specify a single causal model that best fits the data,” which is usually required with statistical techniques, but “determine the number and character of different causal models that exist among comparable cases” (Ragin, 1987: 167). This construct provides the flexibility to determine the number of conditions that you can evaluate for the determined outcome.

QCA Benefits and Results

One benefit of QCA is its scope of application. It can be applied to “very small-N” research to “small-N” around 10-15 cases, “intermediate-N” around 50-100 cases, and “large-N” research designs (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008). QCA can as also be applied to “fields of organizational sociology, management studies, and education studies and applied to “meso” level (the level of organizations, social networks, collective actors, etc.) and “micro” level (small groups or individuals)” (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008: 4).

Another benefit to QCA is that it requires the researcher to be “more active, get a better grip on the “mechanics” of the formal operations, make more decisions in the course of the analysis, and follow an iterative logic, with frequent “returns to the cases” (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008: 14). QCA differs from statistical

work that tends to be more mechanical. QCA also gives explanations that incorporate “exceptions” or “outliers” rather than dismissing them (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008). These conditions allow for both diversity and a more holistic understanding of the cases being analyzed.

There are many benefits to the QCA methodology. It can apply to a wide range of data sets, across a myriad of fields spanning from “meso” to “micro” levels. It provides a systematic means to dissect complex causal relationships. From those relationships and explicit connections, modest generalization may be applied to similar cases.

QCA Design and Application

At its most basic, “QCA techniques can be located in a two-dimensional matrix listing numbers of variables and numbers of cases in relation to other supplementary or neighboring approaches” (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008: 4). Additionally, “QCA techniques require that each case be broken down into a series of features: certain number of condition variables and outcome variable” (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008: 12). There are five different QCA techniques: summarizing data, checking coherence of data, checking hypotheses or existing theories, quick test of conjectures, and developing new theoretical arguments (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2008). For this research, I will use QCA to summarize data pertaining the AA, PBL metrics, and SFDM.

Although this approach is purely descriptive, I will leverage the QCA to gain insight about the Air Force and Navy sustainment metrics. Through this process, I will be able to determine similarities, gaps, and disconnects between the Air Force and Navy

sustainment enterprises. Ultimately, I will be able to determine if the Air Force can implement a single sustainment metric, similar to the NAE's SFDM, within the Air Force's current business model.

The design of my QCA will follow Ragin's (2008) basic approach to conducting a QCA, which "is grounded in the analysis of set relations, not correlations" (Slide 4). In Phase 1, I have identified the relevant cases: AF AA and PBL (negative case) and NAE SFDM (positive case). I have also assigned the following causal conditions: control methods – metrics characteristics, organization structure, power and leadership, culture. In Phase 2, I constructed a truth table. For this research, I created a crisp-set truth table using 0 for "the condition does not exist" and 1 for "yes the condition does exist." Phase 3 is the analysis of the truth table. Phase 4 is the evaluation of the results. Chapters IV and V will document the discoveries and recommendations for these actions.

Summary

QCA is a hybrid of qualitative and quantitative research methodology; however it is still more "case-oriented." I will analyze metrics related data in a "very small-N" and "macro-comparative" approach through this methodology. Through using Ragin's basic QCA outline, I have constructed, analyzed, and evaluated a truth table to determine if the Air Force can implement a single sustainment metric within its current business model.

IV. Analysis and Results

Chapter Overview

This QCA consisted of a two cases. I selected the AF AA and PBL metrics as the negative case and the NAE SFDM as the positive case. The four causal conditions selected for analysis are control method – metrics characteristics, organization structure, power and leadership, and culture. Although the comparison is binary in nature, QCA provided the framework for a systematic macro-comparison of the Air Force and Navy sustainment enterprises.

Results of QCA

I constructed a truth table that assigned 0 for “the condition does not exist” and 1 for “the condition does exist” to four causal conditions. The following values were assigned:

Table 1: AF AA and PBL v. NAE SFDM Truth Table

METRIC	CONDITION			
	Control Method - Metrics	Organizational Structure	Power & Leadership	Culture
AF AA & PBL	0	0	0	0
NAE SFDM	0	1	1	1

The results depicted in the diagram below provide a visual reference of the differences.

Partnership with the Staff, Unions, Key Suppliers, and Key Customers

Parmenter (2010) states the importance of the partnership foundation stone is “the success pursuit of performance improvement requires the establishment of an effective partnership among management, local employee representatives, unions representing organization’s employees, employees, major customers, and major suppliers” (30). These partnerships are critical to establishing shared performance goals and objectives. They are also important for cost-benefit trade-off discussions and decisions throughout the supply chain.

In the current state, the Air Force’s metrics partially meet the partnership foundation stone requirements. The AA metric only measures internal logistics and is not multi-firm measure that can measure the performance of the supply chain (Lambert & Pohlen, 2014). However, the *PBL Guidebook* directs that PBL arrangements and supporting metrics integrate various product support strategies that create partnerships with the staff, unions, key suppliers, and key customers (DOD, 2014). PBL arrangements also link partners with appropriate incentives and metrics, such as CWT and MTBF examples (DOD, 2014).

In the Navy’s current state, partnerships with the staff, unions, key suppliers, and key customers are facilitated and supported by the Integration Resource Management Team, Current Readiness, Future Readiness, and Total Force CFTs. These partnerships work towards cost-wise readiness through collaborative resource management decisions (About Us: How We Operate).

Transfer of Power to the Front Line

“Successful performance improvement requires empowerment of the organization’s employees, particularly those in the operational front line” (Parmenter, 2010: 31). For successful empowerment of employees, it is important that employees at all levels understand CSF (Parmenter, 2010). Additionally, employees need the authority to “take immediate action to rectify situations that are negatively impacting KPIs” (Parmenter, 2010: 31).

In the current state, the Air Force’s AA and PBL metrics are once again split. AA does not transfer power to the front line in several ways. First, it is a lagging metric that is difficult to influence or change. Second, although many Level 2 and 3 metrics, such as those associated with supply and maintenance, it can be difficult to link influence and cost drivers. However, with PBL metrics power is transferred to the front line. The *PBL Guidebook* defines this relationship as processes are performance-based, and metrics linked to top performance outcomes and each other (Level 1, 2, and 3 metrics) (DOD, 2014).

In the Navy’s current state, the NAE SFDM lacks in its transfer of power to the frontline. Even though it is well advertised on the NAE website and throughout various documents is a familiar metric at lower echelons of the Navy Supply System.

Measures and Reports What Matters

“It is critical that management develop an integrated framework so that performance is measured and reported in a way that results in action” (Parmenter, 2010: 33). The framework is instrumental to aligning organizational efforts with

CSFs. Additionally, what is measured and reported must be actionable to affect performance. The actionable metric attribute is not analyzed in this research because the suite of metrics that support AA, PBL, and SFDM are a vast mix of leading and lagging indicators.

In the current state, both Air Force metrics measure and report what matters. It is important to have the right level of aircraft available for both peace and wartime requirements. AA and PBL provide operational availability. PBL metrics also promote behavior to low cost through incentives (DOD, 2014). Cost matters too and costs associated with required levels of readiness assists in resource allocation decisions.

For this analysis, and from the information available, I made the assumption that in its current state the NAE SFDM is a suite of metrics focusing on the top cost and readiness drivers. When analyzed together, these metrics provide an assessment of “Naval Aviation forces, efficiently provided for tasking.” The NAE SFDM suite of metrics measure and report what matters by assessing both readiness and cost within the briefing cycle. Items briefed include T-Rating, Maintainer Core Competency, RFT Availability, Aircraft Life Management, Cost Per Hour, and Cost Performance Index (R.L. Hoak, personal communications, April 20, 2015).

Linkage of Performance to Strategy through CSFs

Parmenter (2010) states “for a performance measure to be a KPI it has to be linked to one or more of the organization’s CSFs, more than one balanced scorecard perspectives and the organization’s strategic objectives” (34). Since

the government sector is difficult to assess as its objectives are not defined by financial measure, this research looked only for top-level linkage.

In the current state, the Air Force's AA and PBL metrics both link to CSFs. AA's performance is linked to the strategy through CSFs as reported on the LIMS-EV Logistics Balanced Scorecard under the Warfighter Perspective. Per the *PBL Guidebook*, at their inception, PBL arrangements are tied to warfighter outcomes (DOD, 2014).

In the Navy's current state, the NAE SFDM links to performance measures to the strategy through CSFs. Specifically, the Current Readiness CFT primary focus is on achieving Units Ready for Tasking by linking measured readiness at the right time with O&S costs (Cross Functional Teams: Current Readiness CFT).

As a result from the comparison above, the following ratings were assigned. The Air Force and associated metrics was assigned a 0 for Condition 1: Control Method - Metrics Characteristics because PBL satisfies all of the four KPI foundational stones, but AA only satisfies two of the four. The NAE SFDM metric was assigned a 0 for Condition 1: Control Method - Metrics Characteristics because it satisfies three of the four KPI foundational stones.

Table 2: Evaluation of Metric Characteristics

Metric			KPI Foundations
AA	PBL	SFDM	
N	Y	Y	Partnership with the staff, unions, key suppliers, and key customers
N	Y	N	Transfer power to the front line
Y	Y	Y	Measures and reports what matters
Y	Y	Y	Linkage of performance to strategy through CSFs

Condition 2: Organization Structure

Organization structure is important because it contributes to organizational effectiveness (Gibson, Ivancevich, Donnelly, & Konopaske, 2012). An Organization Structure rating of 1 consists of the effective use of the organization's four key design decisions: division of labor, departmentalization, span of control, and authority (Gibson, Ivancevich, Donnelly, & Konopaske, 2012). At the foundation, both Air Force and Navy are structured and bureaucratic by nature. Also, both are affected by the causal combination of organization structure, power and leadership, and culture. There is no "right" formula for organization design, but gaps and disconnects can hinder organizational effectiveness.

Division of labor

Gibson, Ivancevich, Donnelly, and Konopaske, (2012) define the division of labor as the "process of dividing work into relatively specialized jobs to achieve the advantage of specializations" (400). Division of labor did not appear as an issue for the Air Force or Navy during this research. However, the Air Force and Navy are significantly different in departmentalization, span of control, and authority.

Departmentalization

Gibson, Ivancevich, Donnelly, and Konopaske, (2012) define departmentalization as the "process in which an organization is structurally divided by combining jobs in departments according to some shared characteristic or basis" (401). Departmentalization and functional expertise create efficiencies. Nonetheless, these silos or stovepipes can hinder the optimization of an

organization's capability. CFTs are excellent means to combat limited organizational views.

Currently, the Air Force construct leans towards strict departmentalization that does not cultivate enterprise resource decision making. Metrics are sometimes defined differently from Headquarters Air Force, Air Force Sustainment Command and Air Logistics Centers, as well as other Major Commands, Direct Reporting Units, Field Operating Offices, Number Air Forces, Wings, Groups, Squadrons, and Flights. With differently defined metrics throughout the sustainment enterprise, it is more difficult to conduct trade-off analysis for resource allocations.

In the early 2000s, the Navy identified the need to reduce ineffective stovepipe thinking. The Navy now relies heavily on CFTs to mitigate the issues associated strict departmentalization. CFTs are organization structure reinforcement mechanism used ventilate silos and create an enterprise focused culture (Schein, 1990). Condition 4: Culture provides an in-depth explanation of CFTs.

Span of Control and Authority

For this research, span of control and authority are discussed simultaneously as an interwoven causal combination. Gibson, Ivancevich, Donnelly, and Konopaske (2012) define:

- Span of Control: "Number of individuals who report to a specific manager" (405).

and

- Authority (Delegation of): “Process of distributing authority downward in an organization” (408).

Span of control is more than the number of individual who report to a manager.

Span of control also reaches the capabilities and functions that those individuals provide for the organizations. How these individuals contribute to the organization is affected by the authority that is delegated to them. When an individual is a delegated authority, the individual is empowered to make certain decisions at their level. Decisions are made at higher levels if authority remains centralized.

The Air Force and associated metrics experience ineffectiveness in span of control and authority from the lack of an assigned SPO. By assigning a SPO, who is “accountable, responsible and fireable,” such as the Air Force Materiel Command Commander, resources could be optimized under one vision (Perkins, 2007). The lack of a SPO is a critical overarching deficiency. Nonetheless, PBL and arrangements are designed to assign the right level of authority and control to affect system availability and reliability. Neither AA nor PBL metrics have accountability to single sustainment manager.

The Navy’s sustainment enterprise’s span of control and authority are supported by an assigned SPO and NAE triad construct. Under this structure, all entities know their role in supporting readiness and the sustainment enterprise. The primary objective of both the Resource Sponsors and Providers is to support the fleet requirements under the SPO.

Although the NAE is organization structure supports enterprise thinking, the SFDM does not appear to be readily understood at the lower echelon in Navy

Supply System. The disconnects between advertisement and implementation make it difficult to assess whether or not it is driving the appropriate behavior throughout the enterprise.

As a result from the comparison above, the following ratings were assigned. The Air Force and associated metrics was assigned a 0 for Condition 2: Organization Structure because organizational disconnects with departmentalization, the span of control, and authority. The NAE SDFM was assigned a 1 for Condition 2: Organization Structure because the organization by design supports the metrics through appropriate departmentalization, span of control, and authority.

Condition 3: Power and Leadership

Power and Leadership are important because they define relationships and affect behavior. A Power and Leadership rating of 1 consists of an organization with the appropriate level of authority and established relationships within the supply chain. Also, organization structure, power and leadership, and culture are part of a causal combination.

Level of Authority within the Supply Chain

I addressed authority in the Condition 2: Organization Structure, but it is not a one SCM component attribute. Authority is both a structural and behavioral attribute. The definition of delegation of authority remains “process of distributing authority downward in an organization” (Gibson, Ivancevich, Donnelly, & Konopaske, 2012: 408).

The Air Force and associated metrics once again are affected by lack of a SPO. As a foundation, the SPO must be assigned legitimate authority to affect the

sustainment enterprise. The SPO needs centralized authority to maintain control of decision-making for the sustainment enterprise. The Air Force's primary weakness for Condition 3 is the lack of a SPO with legitimate and centralized authority.

The Navy's sustainment enterprise and associated metrics are supported by an assigned SPO and defined supporting relationships within NAE triad. The "CEO Warfighter" embraces enterprise behavior. Enterprise behavior provides leadership ability to make informed resource decisions to maximize output under current fiscal constraints. However, it could not be determined the management at every tier of the NAE had the appropriate level of authority to affect the sustainment enterprise. Navy's primary strength for Condition 3 is the legitimate and centralized authority of an assigned SPO.

Relationships within the Supply Chain

The definition of SCM is "the management of relationships, using key cross-functional business processes to create value for customers and other shareholders" (Lambert, 2014: 2). Management of relationship takes leadership and investment in partnerships at every level. Functional areas need to reach out of their silos and cultivate relationships across the supply chain.

The Air Force has improved their sustainment enterprise through the *PBL Guidebook* to define relationships in PBL arrangements and appropriately assigning authority required to affect behavior and resource management. Even though PBL arrangements made great strides, metrics from ALCs, DLA, and various other entities need to link together to create the same effects.

The Navy's sustainment enterprise's defined supporting roles of Providers and Resource Sponsors provide the focus require for making optimal fleet-wide readiness and resourcing decisions. Additionally, the Navy strengthens relationships through CFTs. CFTs support cross-functional communication and enterprise-

wide resource decisions.

As a result from the comparison above, the following ratings were assigned. The Air Force and associated metrics was assigned a 0 for Condition 3: Power and Leadership because lack of authority and defined relationships within the sustainment enterprise. The NAE SFDM was assigned a 1 for Condition 3: Power and Leadership because the NAE established top-level authority and relationships in their sustainment enterprise.

Condition 4: Culture

The culture of an organization significantly impacts organizational effectiveness. A Culture rating of 1 consists of an organization's use of bureaucratic attributes and historical problem solving. Also, organization structure, power and leadership, and culture are part of a causal combination.

Bureaucratic Attributes

The Air Force and Navy, by design, carry the attributes of bureaucratic cultures that "emphasizes rules, policies, procedures, chain of command, and centralized decision making" (Gibson, Ivancevich, Donnelly, & Konopaske, 2012). However, the degree of attributes employment in the Air Force and Navy sustainment enterprises vary.

Per the 2011 NRC report, the Air Force is deficient in well-articulated sustainment policies and procedures. Additionally, the lack of the Air Force's ability to identify a SPO hinders centralized decision-making. These attributes are the Air Force's primary weakness for Condition 4. By correcting the deficiencies in the Air Force's bureaucratic culture, we can create an environment that supports the sustainment enterprise and associated metrics.

The Navy's bureaucracy works to support their sustainment enterprise. The NAE has well established overarching sustainment enterprise goals and supporting structure is their strength in Condition 4. The SPO and supporting triad components provide a solid sustainment enterprise framework. The nine guiding NAE principle focus the enterprise on command priorities and processes.

Historical Problem Solving

The core of a positive culture consists of a historical foundation and encouraging interpersonal and personal relationships (Gibson, Ivancevich, Donnelly, & Konopaske, 2012). Culture also "is what a group learns over a period of time as the group solves its problems of survival in an external environment and its problems of internal integration" (Schein, 2009: 111). All these elements are fused together over time, ultimately defining an organization's culture.

The Air Force is a culture of innovation which has kept us from a readiness crisis. However, as the Air Force becomes a leaner and more fiscally constrained force, we cannot count on "get it done" innovation alone. The Air Force needs to encourage interpersonal and personal relationships between

functional silos to cultivate enterprise thinking. To support these relationships, the Air Force needs to use structural mechanisms like CFTs.

In comparison, the Navy has also excelled in positive problem-solving. The Navy used their 2001 OEF carrier shortage crisis served as a mechanism to create an enterprise culture through problem-solving (Schein, 1990). Although a readiness crisis served as a critical incident for the Navy, they took positive, methodological steps to cultivate lasting change in their sustainment processes and community that embraced enterprise behavior. However, the Navy's sustainment enterprise cultural shift that started at the top may not be fully infused from the "CNO to the shop floor." Further investigation is required to understand fully if a cultural shift has occurred at all levels.

Another facet the Navy has excelled in is the encouraging of personnel and intergroup relationships. CFTs were instrumental in the problem-solving process of NAVRIIP, and the NAE still relies heavily on CFTs to meet their enterprise objectives. These CFTs are critical components needed for the NAE to achieve cost-wise readiness by enabling holistic decision making for the sustainment enterprise (About Us: How We Operate).

As a result from the comparison above, the following ratings were assigned. The Air Force and associated metrics was assigned a 0 for Condition 4: Culture because the Air Force is deficient in well-articulated sustainment policies and procedures and lack of an assigned SPO for centralized decision-making. The NAE SDFM was assigned a 1 for Condition 4: Culture because the Navy's bureaucracy works to support their sustainment enterprise.

Investigative Questions Answered

- What are the advantages and disadvantages of the Air Force's AA metric?

Although AA received a 0 rating for all four causal conditions it is not without merit. The primary advantage of the AA metric is that it is the most commonly referred to sustainment metric in the Air Force sustainment enterprise. It is quantitative and easy to calculate but varies in definition throughout the sustainment community.

There are two primary disadvantages to AA. First there is the lack of accountability where you cannot tie success to a single sustainment manager. Second, AA does not report on the cost parameters required to obtain the target level of availability. It is lagging metric based on historical information, which makes it difficult to influence or change. To mitigate these disadvantages, the Air Force should assign a SPO and appropriate accountability throughout the sustainment enterprise. Also, incorporate AA into a suite of metrics that gives the right information for informed sustainment decisions.

- What are the advantages and disadvantages of PBL metrics?

As DOD's preferred sustainment strategy, PBL and associated metrics have several advantages. The first advantage is that PBL metrics tie to Warfighter outcomes. Additionally, it focuses on both weapon system availability and lowering costs. For the metrics themselves, they are clearly defined and relationships are mapped. This creates a common language and establishes cause and effect links within the sustainment enterprise.

There are areas of concern with PBL metrics. First, the metrics have the potential focus on total lifecycle cost that does not lend to tactical level decision-making. Second,

is it may make it difficult to compare organic and contracting support cost drivers. For example, comparing the contract support heavy C-17 against the organic supported C-5.

- What are the advantages and disadvantages of NAE's SFDM model?

The primary advantage of the suite of metrics under the NAE SFDM is that they provide a holistic assessment of a weapon system. These metrics include T-Rating, Maintainer Core Competency, RFT Availability, Aircraft Life Management, Cost Per Hour, and Cost Performance Indexes (R.L. Hoak, personal communications, April 20, 2015). It provides leaders the ability to assess objectives and processes in their entirety to make informed resource decisions to maximize output under current fiscal constraints (Perkins, 2007). Additionally, the NAE sustainment enterprise is supported by an assigned SPO, supporting Providers, Resource Sponsors and CFTs.

The disadvantages to the NAE SFDM are that it requires expensive consultants to create and maintain. Also, beyond the messaging of the NAE website, the NAE SFDM is not a familiar metric at lower echelons in Navy Supply System.

Summary

The QCA provided the framework for a systematic macro-comparison of the Air Force and Navy sustainment enterprises. Through analyzing the conditions of control method – metrics characteristics, organization structure, power and leadership, and culture, it was determined that it is not feasible for adopt a single sustainment metric within the Air Force's current business model. It is not feasible because of the lack of critical nodes in organization structure, power and leadership, and culture. Feasibility aside, the Air Force should not try to adopt a single sustainment metric. To answer the

question “does the sustainment enterprise provide cost-effective readiness for a weapon system,” a suite of metrics is required to make resource allocation decisions.

V. Conclusions and Recommendations

Chapter Overview

Through a qualitative comparative analysis, it was determined that under the Air Force's current business model, developing a single metric to assess sustainment efforts is not feasible. Feasibility aside, the Air Force should not try to adopt a single sustainment metric. To answer the question "does the sustainment enterprise provide cost-effective readiness for a weapon system," a suite of metrics is required to make resource allocation decisions. Through this enhanced the visibility, the Air Force can optimize resources to increase aircraft availability while reducing operating support costs.

Conclusions of Research

There are many deficiencies within the current Air Force sustainment enterprise and supporting metrics. The lack of overarching sustainment goals and objectives; disjointed policies and procedures; and accountability contribute significantly to a fragmented enterprise. The resolution of these items will serve as the foundation of the Air Force sustainment enterprise, supporting metrics, and community.

The culture of the NAE provides an example of how an institution can evolve from hardship and create a metric that affects behavior within their enterprise. Ultimately creating a culture surrounding the NAE SFDM, that aligns with their organizational strategy and values, is continuously reviewed and adapted, and serves as catalysts for change. The macro-comparison the NAE SFDM highlighted the strength of Navy's organization structure, power and leadership, and culture.

The Air Force lacks an identified single sustainment manager. This deficiency affects accountability, span of control, and structural and behavioral authority in the Air

Force sustainment enterprise. The assignment of a SPO with legitimate and centralized authority to control decision making for the sustainment enterprise would resolve these issues. The SPO, who is “accountable, responsible, and fireable,” such the Air Force Materiel Command Commander, could then optimize resources under one vision (Perkins, 2007). Finally, the SPO would be supported by resource sponsors and providers similar to the relationships in the NAE triad.

Strict departmentalization also fragments the sustainment enterprise. Although functional areas provide much needed expertise, these silos may have limited views and vary in their metrics. Therefore, silos can hinder the optimization of an organization’s capability. Also, differently defined metrics throughout the sustainment enterprise makes it difficult to conduct trade-off analysis for resource allocation.

Mapping processes and relationships and creating CFTs are excellent means to combat these ailments. By mapping processes and relationships, we can identify the cause and effect of those relationships. The next step is to identify the right metrics and align them, link-by-link throughout the sustainment enterprise. Likewise from the understanding of these relationships, we can cultivate enterprise thinking through the establishment of CFTs. CFTs are a structural mechanism that supports relationships between functional silos. They support cross-functional communication and enterprise-wide resource decisions. As a baseline, the Air Force can use the NAE CFT construct of Current Readiness, Future Readiness, and Total Force.

The Air Force can begin to bolster their sustainment enterprise by assigning a SPO, mapping processes and relationships, and ventilating silos with CFTs. Ineffectiveness of AA and PBL metrics are just symptoms of a disconnected sustainment

enterprise. A suite of metrics that address key readiness and cost drivers should incorporate AA and PBL metrics.

Significance of Research

At the onset of this research, the objective was to evaluate current AA and PBL metrics and explore the possibility of developing a single metric to assess sustainment efforts. At the conclusion of this research, I determined single metric should not be developed because a single factor cannot accurately assess key readiness and cost drivers. AA and PBL are adequate but fragmented. Additionally, they are only one component of many that affect the sustainment enterprise. The relationships of all SCM components, structural and behavioral, need consideration when assessing the sustainment enterprise. Through this assessment and development of key SCM components, leaders than can optimize resources and find cost savings within the sustainment enterprise.

Recommendations for Action

The Air Force should assign a SPO, map sustainment processes and relationships, and ventilate silos with CFTs. The assignment of a SPO affects the causal combination of Condition 2, 3, and 4. It will address challenges with the span of control, lack of authority, and centralized decision making within the sustainment enterprise. Additionally, the Air Force could create the same clarity between the acquisition, contracting, engineering and support communities as those garnered in the NAE triad. These entities are there to support the warfighter, but without a link-by-link analysis of current processes and relationships it is impossible to articulate the gaps between the communities that are limiting enterprise behavior. CFTs assigned the appropriate scope and responsibility can break down internal barriers and provide leadership with the

capability to make informed risk-balanced decisions. To create cultural change, the Air Force should refine policies, procedures, and accountability of the sustainment enterprise to hone the bureaucratic culture. These are but a few of many tactics the Air Force could use to resolve gaps in the sustainment enterprise and build a culture that can consolidate current metrics into a suite that informs leaders and affects behavior.

Recommendations for Future Research

To resolve the lack of an overarching, outcome-based assessment of the sustainment process, the Air Force would benefit from an in-depth process and relationship analysis. This analysis can determine and align metrics to reflect the overall health of the sustainment enterprise. Although an organization must first establish top-level goals and an overall strategy to meet those goals, another key ingredient in developing viable metrics is to understand the organization's processes and relationships. Process and relationship analysis of the sustainment enterprise must include the various communities internal to the Air Force and all the contributing organizations outside of the Air Force. This analysis would shape the environment needed to develop metrics that would reflect the overall health of the sustainment enterprise.

Summary

The Air Force needs holistic metrics that are tied to end results, such as materiel or operational availability that directly impact operations. Measurement manages human behavior. To be good stewards of our nation's resources, we must measure and manage our capabilities. There has to be a shift in organizational structure, power and leadership, and culture. Without that foundation, we cannot obtain cost-wise readiness.



Enterprise Sustainment Metrics



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Introduction

The Air Force sustainment enterprise does not have "metrics that...adequately measure key sustainment parameters," according to the 2011 National Research Council of the National Academies study, "Examination of the U.S. Air Force's Aircraft Sustainment Needs in the Future and Its Strategy to Meet Those Needs." That report further stated that although the Air Force has good metrics employed at the lower levels, the metrics are not consistent and do not contribute to the overall assessment of the sustainment enterprise.

This paper explores the development of a single metric, similar to the Naval Aviation Enterprise's (NAE) Single Pilot Driven Metric (SPDM): "Naval Aviation Forces, efficiently provided for tailoring," to accurately assess sustainment efforts. Through qualitative comparative analysis of current Air Force Aircraft Availability (AA) and Performance-Based Logistics (PBL) metrics and the support environment of the NAE's SPDM, it was determined that developing a single metric to accurately assess Air Force aircraft sustainment efforts is not feasible. To counter this, the paper proposes a single metric, a value of metrics, to be used for a weapon system's value of metrics. Through this, the Air Force can optimize resources to increase aircraft availability while reducing operating support costs.

Research Goals

Research Question:

- Can the Air Force implement a single sustainment metric, by applying the methodology of the NAE's SPDM, "Naval Aviation Forces, efficiently provided for tailoring," to the Air Force business model?

Investigative Questions:

- What are the advantages and disadvantages of the Air Force's AA metric?
- What are the advantages and disadvantages of PBL metrics?
- What are the advantages and disadvantages of NAE's SPDM model?

Methodology

For the qualitative comparative analysis (QCA) the researcher evaluated the strengths and weaknesses of AA, PBL metrics, and compared them to the support environment of Navy SPDM and standards identified in the literature review on supply chain management and metric development.

The researcher selected the AF AA and PBL metrics as the representative of the NAE's SPDM for the qualitative comparative analysis. The researcher selected for analysis a coded method – metrics characteristics, organization structure, power and leadership, and culture. Although the comparison is binary in nature, QCA provided the framework for a systematic macro-comparison of the Air Force and Navy sustainment enterprises.

Results

The research found the following results for each question:

Research Question:

- Adoption of a single sustainment metric is not feasible within the Air Force's current business model due to current organizational structure, power and leadership, and culture.

Investigative Questions:

- A primary advantage of AA is it is the most commonly referenced sustainment metric. A primary disadvantage of AA is that it does not report cost performance.
- A primary advantage of PBL metrics is that it focuses on both support system and support system cost. A primary disadvantage of PBL metrics is that it is not sufficient to compare organic and contracting support cost drivers.
- A primary advantage of NAE SPDM is that the associated value of metrics provides a holistic assessment of a weapon system. A primary disadvantage of NAE SPDM is that it is not a further metric at lower echelons in the Navy Supply System.

Recommendations

- The Air Force should assign a single process owner to provide the span of control, authority, and centralized decision making within the sustainment enterprise.
- The Air Force should conduct a link-by-link analysis of the current processes and relationships throughout the sustainment enterprise to identify gaps between the functional areas that are limiting enterprise behavior.
- The Air Force should develop cross-functional teams to break down internal barriers and provide leadership with the capability to make informed risk-balanced decisions.

Collaboration

NAF/A4L.F, NAVSUP N85 Philadelphia

Table 1: AF AA and PBL v. NAE SPDM Truth Table

METRIC	CONTROL METHOD	ORGANIZATION STRUCTURE	POWER & LEADERSHIP	CULTURE
AF AA & PBL	0	0	0	0
NAE SPDM	0	1	1	1

The results depicted in the diagram below provide a visual reference of the differences.

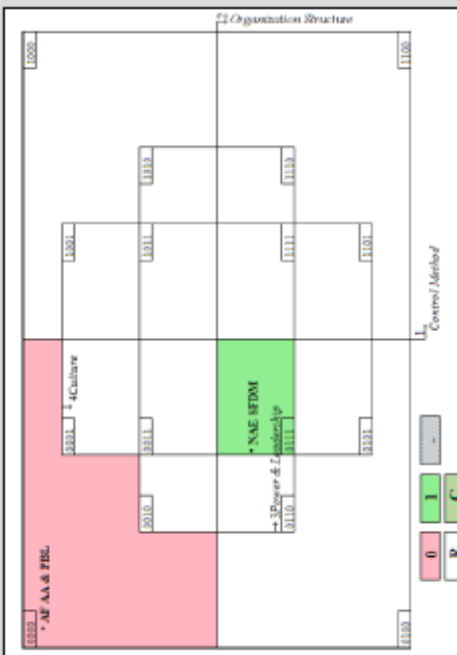


Figure 7: AF AA and PBL v. NAE SPDM Venn Diagram

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