2018-04

MV-22 Supply Chain Agility: A Static Supply Chain Serving a Dynamic Deployment

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MONTEREY, CALIFORNIA

MV-22 Supply Chain Agility: A Static Supply Chain Supporting a Dynamic deployment

Report Type: Final Report
Period of Performance: 01/01/2018-12/31/2018

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Prepared for:
Topic Sponsor: OPNAV N41
Research Sponsor Organization: Distributed Agile Logistics Development
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EXECUTIVE SUMMARY

Project Summary
The U.S. Marine Corps prides itself on the ability to successfully operate within a dynamic environment in an expedient and expeditious manner. To achieve power projection requirements, high states of aircraft, vessel, equipment, and personnel readiness are to be preserved. No small accomplishment, this burden lies heavily on supply professionals and the agility of the supply network in support of operating forces. Supply Chain Management (SCM) must cultivate dynamic supply chains, fluid as the maneuver units they support. Though military action is reactive at times, proactive preparations foster an ability to increase momentum and gain the initiative. SCM should also adopt a proactive mindset, forecasting readiness requirements through critical and balanced consideration.

The purpose of this quantitative research is to assess the supply chain network of a deployed Multi-Mission Vertical and/or Short Takeoff and Landing (MV-22) Osprey squadron, discover inefficiencies that exist, and make recommendations to increase supply chain productivity. Specifically, this study takes advantage of Microsoft Excel and Big Data (BD) techniques to sort through structured and unstructured data. Collaboration with the Department of the Navy (DoN) for requirements and attaining data sets will permit the application of Excel and Lexical Link Analysis (LLA), a text-mining software, to derive relationships between given data sets. Extraction of variables such as response times and aircraft part availability will measure SCM strengths and draw attention to deficiencies. Interpreted relationships helps determine opportunities, shortfalls, and favorable and unfavorable conditions within the organizational and intermediate maintenance levels of the Osprey supply chain. The results observed will be the basis for supply chain improvement recommendations and assist with enhancing DoN SCM productivity.

Keywords: *supply chain management, Department of Defense Supply Chain Management, Big Data, Data Mining, Text Mining, Big Data and Supply Chain Management, MV-22 Osprey, MV-22 Osprey Supply Chain, Lexical Link Analysis*

Background
The philosophy of SCM is one approach many organizations embrace as a force multiplier. When suppliers, manufacturers, distributors, and vendors form a cohesive partnership, benefits throughout the supply chain can be recognized while minimizing unwanted consequences. Just as SCM provides positive outcomes for the private sector, so too can the government and Department of Defense (DoD) realize many of the same advantages.

The concept of SCM has grown over the past few decades, with organizations developing supply chain systems to increase competitive advantage. Ellram and Cooper, (2014) stated in a journal article that the definition of SCM is "a supply chain is defined as a set of three or more entities (organizations or individuals) directly involved with the upstream and downstream flows of products, services, finances, and/or information from a source to a customer, (and return)" (p. 9). Citing previous work 13 years

earlier by Mentzer, Dewitt, Keebler, Min, Nix, Smith, and Zacharia, (2001) demonstrates the consistency that SCM has remained. Essentially organizations must collaborate with its supply chain partners and develop aligned strategic policy to recognize the benefits of SCM. As Mentzer et al., (2001) stated, the same holds true today: managers must visualize the supply chain not as independent organizations but as a network of nodes facilitating a system of interaction, each impacting the function of the whole. With this perception, the integration of each supply chain member is vital to the success of the supply chain.

To take advantage of the benefits SCM can produce, members must align processes and policies to foster a collaborative environment throughout the supply chain. Every member must integrate processes, aligning strategic activities to gain a competitive advantage. Each must believe in a philosophy where unity of effort is more productive than the efforts of individual members. The challenges organizations experience when developing a SCM model are those where collaboration is critical to the success of the supply chain and the enhancement of all participants within the supply system.

To optimize SCM, discover opportunities, and identify shortfalls, Big Data and Business Analytics (BDBA) can be applied to enhance supply chain processes (Wang, Gunasekaran, Ngai, and Papadopoulos, 2016). For this research Big Data (BD) will be defined as "a vast amount of data generated very quickly and containing a large amount of content. The characteristics of BD is based on the rule of 4 V: volume (a large amount of data), variety (any type of data), velocity (high changeability, dynamic of data), and value (assessment expressed by verification)." (Kościelniak and Puto, 2015).

Due to the challenges BD imposes, BDBA must employ complex methods to process and analyze the data to discover valuable information relevant to the organization. Wang et al., (2016) continued to discuss the importance of business analytics and the application of BD. The end-state of BDBA is to assist managers concerning decisions on all levels of an organization; strategic, operational, and tactical. By implementing BDBA, organizations can "improve visibility, flexibility, and integration of global supply chains and logistical processes, effectively manage demand volatility, and handle cost fluctuations." (Wang et al., 2016, p. 99). Hazen, Boone, Ezell, and Jones-Farmer, (2014) also argue that organizations that utilize data science, predictive analytics, and big data (DPB) do improve supply chain effectiveness. The key component of DPB Hazen et al., (2014) mentioned is the quality of data during the assessment. If the data is of low quality, the results of analysis will include high levels of inaccuracy or noise. This can be detrimental to organizations who would make decisions based on DPB. The quality of information flow throughout a supply chain is vital to enhance supply chain performance.

The mission of the MV-22, defined in the MV-22B Training and Readiness (T&R) Manual is to "Support the MAGTF Commander by providing assault support transport of combat troops, supplies and equipment, day or night, under all weather conditions during expeditionary, joint, or combined operations" (DON, 2010, p. 1-3). The focus of this research will be to assess the supply vulnerabilities or opportunities that present themselves between a MV-22 operational level (O-level) and intermediate level (I-Level) maintenance activities deployed on a Marine Expeditionary Unit (MEU). The squadron

examined will be Marine Medium Tiltrotor Squadron (VMM) 264 when assigned to the 22nd MEU in 2016. VMM-264 was embarked on the U.S.S. Wasp from 26 June 2016 to 21 December 2016 and assigned to support U.S. Africa Command, U.S. Central Command, Sixth Fleet, and Fifth Fleet operations (P. Arensdorf, email to author. April 18, 2018). During the deployment VMM-264 participated in Operation ODYSSEY LIGHTNING and conducted operations in the Mediterranean and Red Sea areas of responsibility.

Findings and Conclusions

This project focused on two objectives: to assess how dynamic the supply chain was during an MV-22 MEU deployment, and discover potential opportunities to preposition MV-22 parts to maintain high aircraft readiness rates. To meet these goals the study leveraged Aviation Maintenance/Supply Readiness Report (AMSRR) documentation to assess organizational and intermediate level maintenance and supply activities. After receiving the MV-22 data from the Heavy Lift Helicopter Program Management Office, the data was preprocessed. This modified the supply documents for ease of information extraction and compatibility with LLA. Data analysis occurred applying Microsoft Excel and LLA to structured and unstructured data components.

Supply documents annotated on the AMSRR with initial status codes of "BA" (parts in inventory and being ready to ship), and "AS" (parts that were shipping) were isolated for investigation. Concentrating the research solely on these components allowed for detailed scrutiny of supply chain efficiency and removed those parts that experienced specific component shortfalls and were not readily available, such as contractual agreements or life expectancy inconsistences.

Shortfalls within this project lie with the accuracy of the data received. Results that will be uncovered and potential recommendations to enhance SCM will stem from the data provided. Errors in the AMSRR documentation, such as erroneous estimated arrival times and invalid routing identification codes, should be evaluated prior to making SCM recommendations and conclusions.

The first answer to the sponsor's requirements was that SCM, overwhelmingly, did not behave as an agile network, adjusting and adapting to the needs of VMM-264. After analyzing a 92-day period, the supply documents reported on the AMSRR conveyed a supply network that was reliant on supply nodes located within the continental United States. Highlighting "BA" Not Mission Capable Supply (NMCS) parts, the research showed that 71.3% of the requisitions were sourced from the continental United States while DLA Europe, located in Germany, sourced only 0.19% of the requests. "BA" Partial Mission Capable Supply (PMCS) displayed similar sourcing rates from the United States, accounting for 73.6% of the components while none of the PMCS parts were sourced from DLA Europe or other European distribution centers. "AS" coded parts shared comparable results. "AS" NMCS and PMCS sourcing activities accounted for 83.4% and 72% of the components forwarded from the United States. None of the parts initially given a status code of "AS" were sourced within the European theater of operation.

The second sponsor requirement was to identify and recommend parts with possibilities to preposition. This project discovered nine outlier parts that were ordered at a higher frequency than the preponderance of the components demanded. Emphasizing parts that were originally categorized as "BA" and "AS", and critical to aircraft readiness, the research recognized those nine parts as maintained in the supply system, having the opportunity to be pushed to optimal supply chain locations based on mission requirements. The study uncovered an opportunity for supply professionals to proactively engage supply chains supporting deployed units, confirming the rigidity of SCM. Not tethered to the MV-22 Osprey, this research and methodology could be used to assess supply chain agility across numerous platforms within the DoD. In this situation, applying BA analytics to supply documentation provided a descriptive evaluation of the supply chain. Employing predictive analytics to supply records would be an alternative study that could advantageous, assisting in SCM decisions.

Recommendations for Further Research

Follow on research to assess and increase SCM efficiency can be broken down into three subject areas: parts, locations, and inventory management. Focusing efforts to understand shortfalls and limitations with demanded components, supply warehouse locations, and methods of managing inventories will position supply chain professionals in a manner that will cultivate supply chain agility. Fostering agile supply chain management strategies will create a proactive rather than reactive supply chain response, resulting in improved readiness and increased combat capability.

Due to the robust nature of naval aircraft and equipment, an intimate knowledge of component lifespans and proper diagnosis of faulty parts and subsystems is a critical element to any supply system. Studies concerning failure rates of parts and engineering expectations may uncover additional supply chain vulnerabilities. Parts that are not identified or perceived as challenges will put un-do burden on the supply chain and decrease SCM effectiveness. This research could also consider maintenance actions repairing and diagnosing inoperative components. Assessing personnel habits and techniques to repair aircraft may unearth training deficiencies that negatively impact supply systems. Parts can also be grouped into subcomponents and subsystems to assess categories of parts and find inconsistencies or obstacles that may be occurring due to a specific subsystem rather than discrete components.

Another aspect to conduct research on would be to measure the efficiencies of each supply node. Analyzing each supply warehouse location and routing identification codes could provide additional insight to evaluate efficient locations. Through comparisons, research could uncover valuable information about location productivity, available space for stock, and shipping/transportation responsiveness. This could unearth reasons for the use of supply distribution originating from the continental U.S. Furthermore, information regarding host nation requirements, such as customs obligations, must be considered to ensure impediments are mitigated and do not add to supply chain delays. Making informed decisions regarding supply nodes and locations, supply chain professionals could real-time optimize the supply network depending on mission requirements.

Lastly, researching inventory management techniques and tools for supply warehouses and stockpiles could be beneficial to enhancing SCM effectiveness. Whether information technology systems are implemented to track and manage inventories, or locations manually account for inventories, various approaches to accountability could be assessed to determine the most resourceful. Again, supply professionals could modify inventory management methods to best fit each supply location benefiting the entire supply network.

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Acronyms

AMSRR	Aircraft Maintenance/Supply Readiness Report
BD	big data
BDBA	big data and business analytics
DoN	Department of the Navy
DPB	data science, predictive analytics, and big data
LLA	Lexical Link Analysis
MEU	Marine Expeditionary Unit
MV-22	Multi-Mission Vertical and/or Short Takeoff and Landing
NMCS	not mission capable supply
PMCS	partial mission capable supply
SCM	supply chain management
T&R	training and readiness
VMM	Marine medium tiltrotor