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Determining Field Requirements of the Air Force Supply System: a Delphi Study

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DETERMINING FIELD REQUIREMENTS OF THE AIR FORCE SUPPLY SYSTEM: A DELPHI STUDY

THESIS

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Abstract

The Air Force Supply System can be a convoluted network of organizations with different classes of supply being managed by different organizations. Individuals deployed to austere environments must interact with multiple organizations to get logistics support. Recent supply organizational changes have improved the Air Force's ability to present combat support capability to the combatant commands and deployed logisticians. This research focused on simplifying the process by identifying the need for and determining the ideal capabilities provided by a Logistics Command and Control support cell that would provide a touch point for logistics support to those in a deployed or austere environment.

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I. INTRODUCTION

1.1 Problem Statement

The Air Force Supply System stretches across multiple organizations, with each class of supply being managed by a different organization using different logistics systems and different practices. This has created a complex supply environment where those in a deployed environment and planners for contingency operations must interact with multiple agencies to determine supply capabilities and obtain required supplies. Often contingency operation planners operate under the assumption that sufficient combat support resources will be available when needed. However, this assumption is not always valid and incurs a large amount of potential risk. Additionally, this puts the Air Force supply side into a reactive stance, responding to needs as they develop, instead of a proactive stance, planning for and mitigating potential problems and shortfalls before they happen.

Recent organizational changes have allowed the Air Force Supply System to better present Air Force supply as a single entity that can accurately reflect combat support resources, can better relate supply capabilities and constraints to operational effects, and better react to shortfall and requirement information to optimally respond to operational requirements. This presentation of supply capability can be done at both higher level strategic planning capability, but also to field level operatives if needed. The Air Force Sustainment Center, the sponsor of this research, has been tasked to develop the framework for developing this supply presentation capability.

This research looks at the need for a logistics command and control (C2) support

cell that provides a single face of Air Force supply to specifically those field level logisticians in a deployed or contingency response environment. The researchers developed investigative questions that probed the need for this support cell as well as the ideal benefits and capabilities that it could provide. These investigative questions were used to develop specific Delphi panel questions posed to senior logisticians. Results from this Delphi study and overall conclusions will be provided to the sponsor who can use the results in developing their future logistics command and control framework.

1.2 Research Objectives

The goal of this research was to qualitatively evaluate the needs of deployed logisticians via expert opinions and explore whether these needs would be solved by a direct logistics command and control support cell. Additionally, the researchers wanted to evaluate how various aspects of personal experience affect these views. The overall goal was to use the results to obtain a consensus view from field logisticians that will better inform the future shape of the Air Force Supply System.

1.3 Investigative Questions

1. Does the Air Force have a need for a supply-side logistics command and control support cell for those in a deployed environment?
2. What are the largest difficulties in obtaining logistics requirements and accurate information in a deployed environment?
3. What capabilities and information should a support cell be able to provide?
4. How do these requirements change as the deployed mission type changes?

1.4 Research Focus

This research only focuses on the needs of a supply-side logistics support function that would provide primary support to field level logisticians in austere deployed and contingency response environments. The decisions and requirements needed in these types of environments differ greatly from established bases where the full suite of logistics capability and expertise is present. Thus, this paper will focus specifically on logistics support requirements in austere locations composed of deployed, humanitarian response, or contingency response environments.

Additionally, this research focuses specifically on the support function provided to field level logisticians on the ground, not higher level strategic planning and combatant commander requirements. The consolidation of supply functions and development of dynamic logistics command and control can provide great benefits to the planning, responsiveness, and effectiveness of the entire logistic enterprise. This research focuses on one small piece of that which is direct support to those logisticians in the field.

1.5 Methodology

This research utilized a Delphi study to collect and analyze the expert opinion of senior Air Force logistics subject matter experts. A diverse group of logistics readiness and maintenance officers with recent command experience were selectively chosen to provide a strategic mix of respondents. Experts were chosen to provide an equal mix of logistics and maintenance officers, of primary mobility and primary combat aircraft experience, and a mix of weapon systems. Due to time constraints and acceptable levels of convergence based on prior Delphi studies, two rounds of analysis were used. The

first-round questionnaire consisted of open ended questions designed to obtain the expert opinions' relating to each of the investigative questions. The researchers then analyzed and consolidated the responses to generate the second round of questions that asked the respondents to evaluate the various answers using a Likert scale. The researchers then drew conclusions from the responses provided in both questionnaires.

1.6 Assumptions and Limitations

The study was based on the assumption that senior logisticians with command experience will provide the best mix of practical experience and knowledge of field requirements balanced with the enterprise perspective gained through command. Additional knowledge and expert opinion could be provided from enlisted supply subject matter experts or those with staff experience.

Another assumption inherent to Delphi studies is that the participants are equivalent in knowledge and experience in the subject matter, but this may not be completely justified (Altschuld & Thomas, 1991). This study was limited by the fact that the researchers were not able to select only respondents with experience deploying to austere environments. Instead the respondents were asked if they had deployed to austere environments and the analysis looked at whether that factor caused drastically different responses to be given.

1.7 Implications

This research will seek to provide the AFSC and senior logistics leaders information and insights on what the field needs from a logistic C2 support cell.

Additionally, insights from experienced professionals on the challenges of obtaining logistics support in austere environments will help decision makers better understand and provide for their needs. Analyzing the opinions of logistics experts will serve as evidence that will better inform organizational decision making and assist in building the future state of Air Force logistics

II. LITERATURE REVIEW

2.1 Chapter Overview

This chapter provides a literature review of topics relevant to this research and provides background on several key topics. It provides a brief history of consolidation of logistics functions in the Air Force over the past fifteen years; and examines current inefficiencies in the way Air Force combat support capabilities are postured and planned for use by combatant commanders. Lastly it examines a proposed framework for improving combat support planning for contingency response operations.

2.2 Logistics Consolidation

Over the past seventeen years the Air Force Logistics Enterprise has been centralizing management of logistics resources and functions into the Air Force Material Command (AFMC). This process started seventeen years ago, with the consolidation of spares management functions and other base level supply functions into Regional Supply Squadrons, which were Command focused. In 2006 these consolidated into the Logistics Support Centers with a weapon system focus. HQ AF combined the centers and placed them under the responsibility of the 635th Supply Chain Operations Wing (SCOW), which maintains an enterprise focus. This consolidation provided one organization who helped manage Class IX, repair parts, for the Air Force and individual bases.

In 2012, as a result of tightening budgets, AFMC reorganized from 12 individual centers, Figure 1, into five centers, Figure 2, consolidating like functions (Tripp et al., 2012). The AFSC was stood up with its focus on operations support of the Air Force

supply chain. This brought the three depot repair complexes, the 448th Supply Chain Management Wing, and the 635 SCOW all under a single entity with auspices to standardize supply chain processes, procedures, and metrics for the Air Force (AFSC, 2015). Since the creation of the AFSC further consolidation has brought multiple classes of supply into the AFSC including Class 3, with the Air Force Petroleum Agency, vehicles with Vehicle and Equipment Management Support Office, and War Reserve Material (WRM) with the WRM Global Management Office. This consolidation has begun to not only allow for improving processes, but also getting closer to putting a single face to Air Force supply.

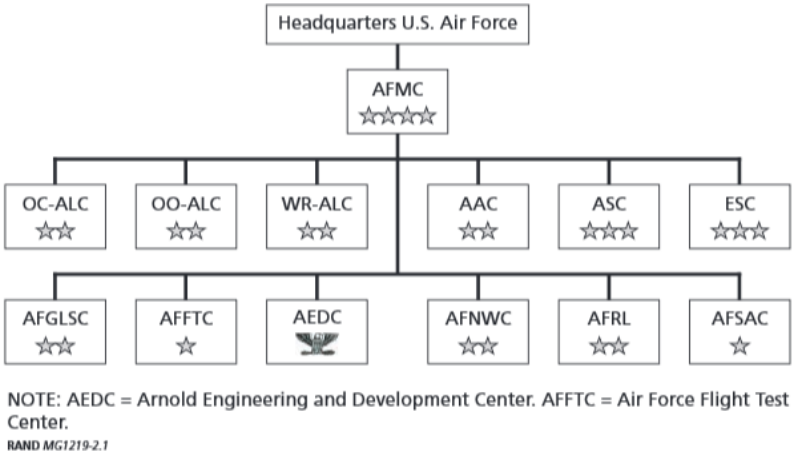

Figure 1: AFMC before reorganization (Tripp et al., 2012)

Figure 2: AFMC after reorganization (Tripp et al., 2012)

Additionally, in 2015, the Air Force Installation and Mission Support Center (AFIMSC) was added to AFMC as the headquarters for providing installation and mission support capabilities. This organization is now the enterprise manager for all installation support functions, but most importantly security forces, civil engineering, communications, medical, and logistics readiness (AFIMSC, 2017). This now brings most of the classes of supply into either the AFSC or the AFIMSC. This allows for a known manager for logistics processes in the Air Force and improves the Air Force Enterprise's ability to present combat support capabilities to the combatant commanders and those deployed logisticians in the field.

2.3 Current Disconnects

At the October 2014 Logistics Board (LB) senior logistics leaders began discussing and assessing the Logistics Enterprise's ability to posture support for global operations. A team of Air Staff, MAJCOM, AFSC, and RAND logistics personnel looked at this issue during fiscal year (FY) 2015 and identified key issues and poor processes that resulted in poor posturing of Air Force combat support capabilities. This poor posturing and inadequate planning means that geographic combatant commanders incur

greater risk and suboptimal utilization of limited combat support capabilities. The team identified four performance gaps as identified in the FY15 Enterprise Logistics Strategy (ELS) Annual Report (ELS, 2016):

1. Demand side not fully articulating requirements to include concepts of operations, capability, capacity, and access
2. Supply side not developing balanced resourcing options. These resourcing options include Joint Services, Operational Contract Support, Host & Partner Nations, and Military Industrial Base
3. Integration function not developed
4. Analysis capability to assess resourcing options/decisions in achieving desired operational effects is not developed

This issue termed "Set the Theaters" has spurred further identification of process gaps, policy reviews, and further study that will all be used in the development of a solution for the future. Additionally, findings identified will help inform the Long Duration Logistics Wargame (LDLW), which will examine, validate, and quantify the needed support, potential shortfalls, and gaps that these issues might have in completing hypothetical missions (ELS, 2016).

An additional study by the RAND Corporation explored a conceptual framework that would better integrate and posture Air Force combat support capabilities into global contingency planning and execution (Trip, Drew, & Lynch, 2015). The authors propose a framework that would allow for better integration of demand side requirements planning with supply side providers like the AFSC and AFIMSC. The demand-side organizations call for required resources and capabilities needed to meet operational objectives and the supply-side organizations seek to meet those requirements in the best way possible using

allocated resources. An integrator would exist to resolve any imbalances between the two sides. This ensures that supply-side and demand-side decisions are made independently from each other with each side sticking to what they do best. The other key aspect is the independence of the integrator, which must be separate from the two to impartially resolve differences that may arise. This relationship can be seen in Figure X.

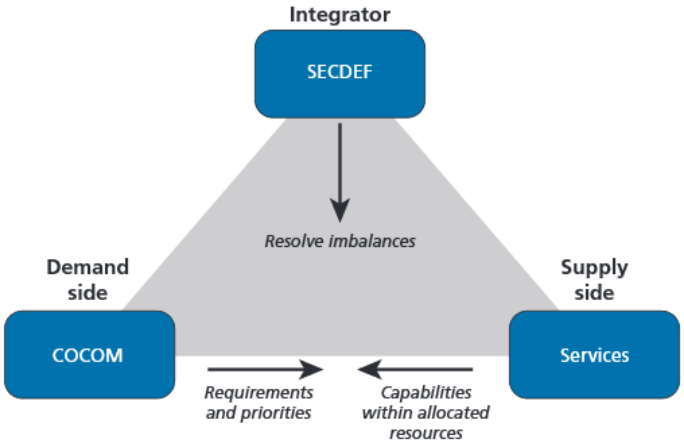

Figure 3: Framework for Combat Support Integration (Trip, Drew, & Lynch, 2015)

III. METHODOLOGY

3.1 Chapter Overview

This chapter provides an overview of the research techniques and methods used in this Delphi study. The Delphi process consists of a sequential series of questionnaires that build off prior responses in order to form a consensus opinion of an expert panel. Additional data analysis methods utilized included a Likert Scale, Kendall's W, and a targeted panel selection process. This section will also include a review of each of the survey questionnaires.

3.2 Delphi Method

The Delphi Method is a research technique developed by the RAND Corporation in the 1950s that elicits the opinions of a group of subject matter experts with the ultimate objective of gathering data from a group of experts (Helmer, 1967). It was developed as a group communication process that conducts discussions and examinations to explore problems where there is a lack of agreement or incomplete knowledge of the nature of the problem. It is best utilized for broad and complex problems where the aggregation of ideas and viewpoints allows the pool to arrive at decisions that are more holistic compared to individual opinions. The technique can be applied to multiple fields of study and various problem areas. Delbecq, Van de Ven, and Gustafson determined that the Delphi technique can best be used to achieve the following objectives:

1. To determine or develop a range of possible program alternatives
2. To explore or expose underlying assumptions or information leading to different judgements

3. To seek out information which may generate a consensus on the part of the respondent group
4. To correlate informed judgements on a topic spanning a wide range of disciplines
5. To educate the respondent group as to the diverse and interrelated aspects of the topic. (1975, p. 11)

The Delphi Method possesses a few unique criteria that minimize potential bias and other issues often found in group problem solving and data gathering techniques. The first is a controlled feedback process that allows participants to reassess their initial judgements based on comments and feedbacks provided by the other panelists. Additionally, since it is controlled feedback it reduces the noise that is inherent in group communication and focuses the individuals on direct problem solving and the topic at hand. An additional characteristic is the anonymity provided by the respondents only interacting directly with the administrator (Rowe & Wright, 1999). This reduces the effects of dominant individuals who might overpower the debate, minimizes group pressure for conformity or groupthink, and allows free expression of opinions without fear of reprisal, which is important in military studies. The last characteristic is the unique mixture of qualitative data gathering while maintaining the ability to utilize statistical analysis techniques to allow for objective and impartial analysis of the collected data (Skulmoski & Hartman, 2007).

These characteristics provide many benefits to the Delphi method, but also provide a few inherent weaknesses that must be accounted for. Due to the multiple questionnaires being developed and distributed to several participants the entire Delphi method can be time-consuming and labor intensive on the part of both the participants and the researcher. This increased time can lead to issues with subject motivation and full

participation. Not only does the potential exist for low initial response rates, but due to the subsequent surveys a portion of subjects may discontinue their participation throughout the process affecting the quality and validity of overall conclusions. Another potential issue with the Delphi technique is ensuring inherent bias on the part of the researcher is not present in the questionnaires (Hsu & Sandford, 2007). Any potential bias may appear in the wording of the questionnaires or in the analysis and consolidation of the responses. These issues must be considered when designing a Delphi study.

3.3 Likert Scale

The Likert Scale is a scaling method that measures an individual's attitude towards questions, statements, and responses. The scale measures the response along a range of positive to negative feelings towards the item with each measurement corresponding to a rank (Norman, 2010). This study uses a Likert Scale to ask individuals to rank a number of factors on their amount of importance on a scale of 1 to 5 going from low to high.

3.4 Kendall's W Factor

This research utilizes a nonparametric statistical analysis technique called Kendall's W or Kendall's coefficient of concordance that provides a numerical measure assessing the agreement among raters. This analysis seeks to obtain a consensus view among the expert panel members. Kendall's W allows the researcher to obtain a rigorous assessment of the various responses to the research questions. Due to the inherently small sample size in a Delphi study the assumption of normality associated with a lot of the

more common statistical analysis techniques is not necessarily valid. Nonparametric statistic techniques like Kendal's W do not require an assumption of any probability distribution to be accurate.

To calculate Kendall's W apply the following formulas. The term $r_{i,j}$ is the rank given by judge j to object i, where there are n total objects and m judges. Thus the overall rank given to object i is

$$R_i = \sum_{j=1}^{m} r_{i,j} \quad (1)$$

And the mean value of the rank of all objects is

$$\bar{R} = \frac{1}{n}\sum_{i=1}^{n} R_i \quad (2)$$

The sum of squared deviations, S is defined as

$$S = \sum_{i=1}^{n}(R_i - \bar{R})^2 \quad (3)$$

And the Kendall's W value is defined by

$$W = \frac{12S}{m^2(n^3-n)} \quad (4)$$

The calculated value of W corresponds to the level of concordance on a scale of 0 to 1, where 1 is perfect agreement with all judges voting the same for each object. The equivalent interpretation of the range of Kendall's W values as defined by Schmidt (1997) is shown in Table 1.

Table 1: Kendall's W values

W	Interpretation	Confidence in ranks
.1	Very weak agreement	None
.3	Weak agreement	Low
.5	Moderate agreement	Fair
.7	Strong agreement	High
.9	Unusually strong agreement	Very high

3.5 Delphi Process for This Study

3.5.1 Panel Selection.

The selection of the panel for a Delphi study is one of, if not the most important, part of a Delphi study since it directly impacts the quality of the responses and results. The subjects should be highly experienced and knowledgeable in the field of study. Additionally, they should consist of individuals who have a direct interest in the target issue, since it will help motivate the individuals to reach the best decision. Adler and Ziglio (1996) recommend four criteria requirements including: knowledge and experience with the issues under investigation, capacity and willingness to participate sufficient time to participate in the Delphi, and effective communication skills.

Delbecq, Van de Ven, and Gustafson (1975) recommend that researchers should select the smallest number of subjects sufficient to accomplish the purpose of the research and should utilize follow-up explorations to increase validity. The number depends greatly on the processing capability of the researcher, since increased numbers means increased work, and a sufficient number to create a representative pooling of judgements. Ten to fifteen subjects are typically considered sufficient if the background of the subjects is fairly homogenous (Delbecq, Van de Ven, and Gustafson, 1975).

This study selected members based on those who completed a squadron command in 2016 and selected an equal mix of logistics readiness and maintenance officers. This level of experience balances the tactical, operational, and strategic mindset that comes from command with the length of service to have served during time periods of heavy deployment operations. Since the researchers were not able to select candidates with austere location deployments this was deemed the best way to obtain a sample of that

population. Additional factors included a balancing of squadron command experience at primarily mobility aircraft bases and primarily combat aircraft bases. This was designed to obtain an appropriate representative sample of Air Force logistics experience. Of a pool of 25 individuals 12 were selected as participants and 6 were chosen as reserves in case individuals declined to participate.

3.5.2 Initial Questionnaire.

Using input from the sponsors at AFSC/LGX and based on prior Air Force supply chain operations experience, the researchers built demographic and background questions and five open ended questions related to the needs and benefits of a logistics C2 support cell for logisticians in a deployed environment. The initial questions were open ended to capture any ideas, thoughts, and issues that the experts felt were pertinent. This was done to minimize potential research bias and provide for free discussion of opinions. After thorough review by the researchers and AFSC/LGX staff the questionnaire was sent to the 12 selected panel members. The complete version of the Initial Questionnaire is shown in Appendix A. The survey questions section provided a brief overview of the potential topic and a description of the proposed support cell structure. The five survey questions were as follows:

1. Does the Air Force have a need for such a resource? Why or why not?
2. What are the largest difficulties in obtaining logistic requirements and accurate information in a deployed environment?
3. What are the most important capabilities and assistance that a support cell should be able to provide?

4. What are the top 10-15 types of information needed to support your logistics and sustainment decisions in this environment? Consider all A4/7 functional responsibilities to include POL, Munitions, Aircraft Status, Supply Chain, Aerial Port, Security, Infrastructure and Transportation requirements.
5. Do you feel these requirements would change if your mission shifts from maintaining operations to preparing for redeployment? Yes or no.

   If yes, how do you think they would change?

The panel members were given one and a half weeks initially to complete the survey, with extensions provided two more times bringing the total allotted time to four weeks. The final participation results are represented in Table 2.

Table 2: Initial Questionnaire Participation

	LROs	MOs	Total	Percent
Survey Recipients	6	6	12	
Participants	2	3	5	41.67%

The respondents to the initial questionnaire provided a large variety of responses. The valuable input provided was used by the researchers for further analysis and the full anonymous responses were provided to the research sponsors. The researchers reviewed each of the responses to the questions to determine key concepts that captured the respondents' thoughts. Many of these key concepts were shared by multiple respondents. After complete review, the key concepts were used in building the second questionnaire for further group discussion.

3.5.3 Round Two Questionnaire.

The common concepts received for each of the questions from the initial survey were used to build the second questionnaire. Each of the concepts were presented back to the expert panel and they were asked to rank how important they were on a scale from 1 to 5. The full questionnaire is seen in Appendix B. Question 1 and Question 5 were not included in the second questionnaire because the answers were so diverse and the main purpose of the questions was to get the initial responses. The panel was again given the opportunity to add additional comments as desired. After review the questionnaire was sent to the five respondents from the first round of research. The panel members were given approximately two weeks in total to complete the survey. All five respondents from the initial survey completed the second questionnaire as well. Due to time constraints and a good level of concordance the researcher felt that another round of questions was not necessary.

3.6 Summary

This chapter described the techniques and methods used to complete this analysis. The various data analysis methods used in the analysis were discussed including the Delphi Process, the Likert Scale, and Kendall's W. Additionally, the method followed in this analysis was discussed including the panel selection process, the initial questionnaire, and the second questionnaire. The analysis and results of this method are looked at in Chapter IV.

IV. ANALYSIS AND RESULTS

4.1 Chapter Overview

This chapter discusses the analysis of the questionnaires described in Chapter III. The various responses to the survey questions are reviewed individually as to the level of the panel's agreement. The panel's responses were analyzed using the group mean, standard deviation, range, median, and Kendall's W values. Additionally, some of the questions were analyzed based on the different subgroups described earlier including deployed experience, career field, and weapon system experience. The analysis and results obtained are potentially limited by the small sample size and the low response rate to the initial questionnaire.

4.2 Question 1

Question 1 served as a guide question meant to obtain qualitative data on the respondent's feelings towards the need for a centralized logistics C2 support cell for those in austere locations. The question itself was very open ended and meant to obtain the respondent's thoughts and opinions based on their past experiences. As expected this question received very diverse responses from the panel and the researcher decided enough information had been received from the responses without subsequent questions.

4.2 Question 2

The second question asked the panel to rate the relative difficulty and impact of each of the main responses received from the panel in the initial questionnaire. Table 3 depicts an ordered listing of the responses with the item with the highest degree of

agreement at the top. The question identified the most difficult aspects of obtaining logistics requirements and information in a deployed environment.

Table 3: Question 2 Results

Rank	Rank the largest difficulties in obtaining logistic requirements (ordered from highest to lowest agreement)	High	Neutral	Low	Average	STD DEV	Range Low	Range High	Median
1	Reliable telephone communication	5	0	0	4.2	.45	4	5	4
2	Reliable internet access	4	1	0	3.8	.45	3	4	4
3	Competing priorities for airlift	2	3	0	3.8	1.1	3	5	3
4	Getting necessary supplies expediently through customs	2	2	1	3.6	1.3	2	5	3
5	Local in-theater transportation for delivery	1	4	0	3.4	.89	3	5	3
6	Obtaining supply information	1	1	3	2.8	1.3	2	5	2

Table 3 shows that not having reliable phone and internet connections were the largest challenges to obtaining logistics support in austere environments with all five respondents placing high importance on the former and four respondents for the latter. The panel showed less agreement on the other items, although three of the respondents felt obtaining supply information was of lower difficulty. Converting the Likert scale ratings to a ranking and calculating the Kendall's W value showed weak agreement with a value of 0.2. This value indicates that there is low agreement in the panel's overall ranking order.

Further analysis of the responses in Question 2 showed that those with mobility aircraft experience felt that obtaining supply information was of higher difficulty with it being second on the list behind reliable phone connections. Additionally, logistics readiness officers felt obtaining supply information was of higher difficulty than maintenance officers. However, the further analysis broke a very small sample pool into

even smaller components, which greatly decreases the validity and reliability of any conclusions.

4.3 Question 3

The third question asked the panel to rate the relative importance of each of the main responses received from the panel in the initial questionnaire. Table 4 depicts an ordered listing of the responses with the item with the highest degree of agreement at the top. The question identified the most important capabilities a logistics C2 support cell should be able to provide to those in an austere environment.

Table 4: Question 3 Results

Rank	Rank the important capabilities a support cell should provide (ordered from highest to lowest agreement)	High	Neutral	Low	Average	STD DEV	Range Low	Range High	Median
1	Accurate In-Transit Visibility	4	0	1	4.4	1.3	2	5	5
2	Ordering of requirements	3	2	0	4.0	1.0	3	5	4
3	Supply requirements supportability	2	2	1	3.4	1.1	2	5	3
4	Transportation support	2	2	1	3.4	1.1	2	5	3
5	Reliable switchboard operator to connect caller to desired organization	2	1	3	3.2	1.3	2	5	3
6	Customs knowledge or customs handling contact information	1	2	2	3.0	1.2	2	5	3

Table 4 shows that providing accurate in-transit visibility (ITV) of items and ordering of requirements were the most important capabilities with four respondents placing high importance on the former and three respondents for the latter. Overall, the panel did not agree on any of the items being of significantly lower importance. The panel felt that each of these items was important in that each of the items received a value of 5 at least once. Converting the Likert scale ratings to a ranking and calculating the Kendall's W value showed slightly weaker agreement than the previous question with a

value of 0.18. This value indicates that there is low agreement in the panel's overall ranking order.

Further analysis of the responses in Question 3 showed very little significant difference when divided into primary aircraft experience or based on deployment experience to austere environments. Logistics readiness officers did place the lowest amount of importance on providing customs information with each of that group giving it a 2 or lower.

4.4 Question 4

The fourth question asked the panel to rate the relative importance of each of the main responses received from the panel in the initial questionnaire. Table 5 depicts an ordered listing of the responses with the item with the highest degree of agreement at the top. The question identified the most critical types of information needed to support logistics and sustainment decisions in an austere environment.

Table 5 shows that accurate information regarding Classes 1 and 3, were the most critical types of information with all respondents placing the highest importance on both of them. Additionally, power, communications and the resupply schedule were each deemed very important as well with four panel members placing high importance on each of these items. Overall, the panel did not agree on any of the items being of significantly lower importance. Converting the Likert scale ratings to a ranking and calculating the Kendall's W value showed moderate agreement with a value of 0.54. This value indicates that there is fair agreement in the panel's overall ranking order.

Table 5: Question 4 Results

Rank	Rank the important types of information needed to support logistics and sustainment decisions (ordered from highest to lowest agreement)	High	Neutral	Low	Average	STD DEV	Range Low	Range High	Median
1	Class I (food, water)	5	0	0	5	0	5	5	5
2	Class III (POL)	5	0	0	5	0	5	5	5
3	Power	4	1	0	3.8	0.45	3	4	4
4	Communications	4	1	0	3.8	0.45	3	4	4
5	Security status of location	3	2	0	3.8	0.84	3	5	4
6	Resupply schedule and all supply contacts	4	0	1	3.6	0.89	2	4	4
7	Intra-theater transportation	3	2	0	3.6	0.55	3	4	4
8	Parts availability and delivery status	2	3	0	3.4	0.55	3	4	3
9	Medical evacuation	1	4	0	3.2	0.45	3	4	3
10	Living quarters	1	4	0	3.2	0.45	3	4	3
11	Fleet health	1	3	1	3	0.71	2	4	3
12	MHE equipment	1	3	1	3	0.71	2	4	3
13	Munition storage	1	2	2	3	1.2	2	5	3

Further analysis of the responses in Question 4 showed that those with deployment experience to austere environments felt that intra-theater transportation was of higher importance with it being third on the list behind Class 1 and Class 3. Additionally, maintenance officers felt security status was of higher importance than logistics readiness officers placing it third on the list.

4.5 Question 5

Question 5 was similar to Question 1 in that it was mainly used to obtain qualitative data on the respondent's feelings on how these requirements would change as the mission shifts to redeployment. The question itself was very open ended and meant to obtain the respondent's thoughts and opinions based on their past experiences. As expected this

question received very diverse responses from the panel and the researcher decided enough information had been received from the responses without subsequent questions.

4.6 Summary

This chapter detailed the statistical analysis that was performed on the panel responses to the questionnaires. The panels responses in the second questionnaire were looked at to determine levels of agreement amongst the raters. The fourth question was the only question to show moderate agreement based on Kendall's W. However, all of the questions yielded valuable information and further analysis did show some differences amongst the subgroups within the panel members. Chapter 5 uses the data and information derived from this analysis to draw conclusions and recommendations.

V. DISCUSSION

5.1 Chapter Overview

This chapter will provide a summary of the research conducted and the significant findings obtained from the analysis. It also will discuss some of the assumptions and limitations of the research followed by a look at recommendations for future research related to this topic.

5.2 Summary of Research

This research examined the need for a logistics C2 support cell for deployed logisticians in austere environments. In this Delphi study a group of experienced logisticians completed two rounds of questionnaires that explored the need for such a capability, the challenges of obtaining logistics in these environments, the ideal capabilities of such a cell, and the most important types of information needed. Overall the answers to the various questions showed limited convergence with only one of the questions showing moderate convergence. The range of answers and limited convergence is not surprising given the vastly different experiences and backgrounds. Additionally, the poor response rate limited the pool of respondents leading to a very small sample size, which also had a negative impact on the amount of convergence. However, the varied opinions still provided great insight into the research questions and yielded valuable conclusions.

The panel, as a whole, does not feel there is a need for a separate logistics C2 support cell as looked at in this paper, although it was a slim majority of three of five

individuals viewing it this way. The reasons given for not needing such a capability were diverse, but two stood out. The first is that any location will fall under the control of the combatant command and Joint Task Force (JTF) and any logistics requirements will flow through joint channels with most of it being "common user" logistics sourced from non-Air Force sources of supply. Any Air Force source of supply requirements will then flow out from the JTF. The other main reason was shared by two different respondents and boiled down to the fact that the challenges and problems they have faced do not stem from obtaining or tracking supplies, but rather from other factors that would not easily be solved by a logistics C2 support cell.

The panel did show fairly strong agreement that reliable telephone and internet access were the largest challenges to obtaining logistics requirements in a deployed environment. These two difficulties were followed closely by transportation issues stemming from lack of sufficient airlift, difficulties dealing with customs, and lastly obtaining local in-theater transportation. Obtaining supply information was identified to be the item of lowest difficulty in comparison to the other factors provided and is also the factor that would be most easily solved by a logistics C2 support cell. When looking at what capabilities a logistics C2 support cell should be able to provide the panel did agree that obtaining accurate ITV was the most important item followed closely by the ability to order requirements.

The one question that did show a fairly strong level of agreement was the types of information needed to support logistics and sustainment decisions in a deployed environment. The panel unanimously agreed that accurate accounting of Class 1 (food and water) and Class 3 (fuel) are the most important items to have accurate knowledge of.

The rest of the items were not as clearly agreed upon, but power, communications and security were the next three topics of highest importance.

Overall, although the panel did not agree that a logistics C2 support cell is necessary to directly assist the logisticians on the ground, there are avenues that can be improved higher up that would improve the situation on the ground. One respondent did mention that if the levels planned for do not accurately match the requirements than it takes too long to make the adjustments. This showcases two potential issues. The first being a need for improved planning capability to more accurately forecast requirements and secondly a more agile and responsive system. The sources of supply should be able to see the misallocation of requirements and more quickly flex to meet those needs. Additionally, another respondent mentioned the theater not having enough assets to sustain the campaign as a whole. This result also stems from the two previously mentioned issues. The information flow between sources of supply and demand from the field needs to be improved upon, so that the system can react and adjust quicker. Also, improved coordination and integration between the supply side and demand side during the planning process would more accurately highlight any potential shortfalls or lack of supply capability and thus pre-identify potential mitigation strategies and alternative sources. These are both key points identified in the plans to improve enterprise logistics command and control.

5.3 Significance of Research

HAF/A4 and the Logistics Board have placed large importance on improving the Air Force Supply System's integration with contingency planning and execution and the

ability to posture combat support capabilities for the combatant commanders. The AFSC is leading a lot of the development of the processes in this area with the goal of shifting to more effective dynamic logistics command and control. These efforts will ensure the supply side capabilities will be more capable of identifying and reacting to requirements proactively to develop solutions earlier in the process. The firsthand feedback given from the expert panel used in this study will be beneficial to the planners designing the framework that will shift the enterprise into this new direction. Obtaining feedback from the end user is critical to effectively designing any product and the feedback given will help inform necessary features and capabilities. This research will help to provide some insight into a small section of how best to serve the needs of the ultimate customers, the warfighters on the ground.

5.4 Assumptions and Limitations

There are a few assumptions and limitations that may impact the results and conclusions obtained from this research. Several statistical analysis techniques were used in analyzing the qualitative data obtained from the expert panel. These technique help obtain additional meaning from the qualitative data by attempting to distill common opinions into a consensus response. The techniques used including mean, median, range, and Kendall's W are not the only ways to determine level of consensus and other means may yield different results. The small sample size places limits on the validity and reliability of the methods used. However, since Delphi studies utilize expert opinion they still provide relevant information even at smaller sample sizes.

5.5 Future Research

This research provided an initial look at this topic and the broader topic of enterprise logistics command and control in the Air Force, but both still could benefit from additional study. Further analysis into the need for a logistics C2 support cell or more importantly the needs of the logisticians in the field would greatly aid in the development of the future framework that will be developed in this area. Larger sample sizes and detailed interviews with experienced logisticians who have extensive experience in austere environments would help identify specific areas of need and recommended improvements to the current logistics operating environment. This should not just include senior officers like this study focused on but senior enlisted supply personnel as well. The area of enterprise logistics command and control is an important topic that could benefit from further study to inform policy makers.

5.6 Summary

This study used a panel of expert logisticians to identify the specific questions of whether there is a need for a logistics C2 support cell for those in austere environments. It also identified challenges faced in obtaining logistics in an austere environment, the benefits and capabilities a support cell should be able to provide, and the most important types of information needed to make logistics and sustainment decisions in deployed environment. The results and insights obtained are valuable and timely as the Air Force works on developing a framework for enterprise logistics command and control and better integrating supply side logistics capabilities with demand side requirements.

Appendix A: Initial Survey

Questionnaire #1: Initial Survey
Field Requirements for a Logistics Command and Control (C2) Capability

You are receiving this questionnaire because your experience as a Logistics or Maintenance Squadron Commander has identified you as a knowledgeable expert with valuable input on future logistics decisions. The purpose of this research is to conduct a qualitative study that explores the most beneficial capabilities of a Logistics Command and Control touchpoint for those in a deployed or contingency response environment.

The fragmented nature of Air Force logistics can make it difficult to obtain the correct class of supply requirements and accurate information from the various responsible organizations. This research will look at the benefits and required capabilities of a centralized cell that would provide a single touchpoint for logistics support and information. This support would primarily be to assist those in a deployed or contingency response location with minimal in-place support.

This series of responses ask you to put yourself in a deployed environment where you have been placed in charge of Logistics and Sustainment support and operations for a Main Operating Base that is still growing. We are looking for your feedback as to what information you would need at your fingertips in a deployed environment, to make logistics and sustainment decisions that will affect the units you are responsible for while insuring the chances of success of the pieces of the Air Campaign your units are tasked to accomplish. We realize that decisions are rarely, if ever, made with 100% accurate information; less than 40% is closer to reality, and that many leaders are forced into new and different situations with little to no experience in some areas.

Part 1: Demographic and Background Data

1. How many years of service do you have in the USAF?
2. How many times have you deployed?
3. Have you deployed to an austere location with minimal in-place support? Yes or no.

Part 2: Field Requirements for a Log C2 capability

The following questions refer to the creation of a centralized Logistics Command and Control touchpoint that would provide a single source for logistics support and information for those in a deployed or contingency response location. They would be able to provide points of contact, accurate information when available, sourcing requirements, and other supply support across all classes of supply not just aircraft parts.

1. Does the Air Force have a need for such a resource? Why or why not?

2. What are the largest difficulties in obtaining logistic requirements and accurate information in a deployed environment?

3. What are the most important capabilities and assistance that a support cell should be able to provide?

4. What are the top 10-15 types of information needed to support your logistics and sustainment decisions in this environment? Consider all A4/7 functional responsibilities to include POL, Munitions, Aircraft Status, Supply Chain, Aerial Port, Security, Infrastructure and Transportation requirements.

5. Do you feel these requirements would change if your mission shifts from maintaining operations to preparing for redeployment? Yes or no.
   If yes, how do you think they would change?

Appendix B: Round Two Questionnaire

Questionnaire #2: Follow Up Survey
Field Requirements for a Logistics Command and Control (C2) Capability

You are receiving this questionnaire because your experience as a Logistics or Maintenance Squadron Commander has identified you as a knowledgeable expert with valuable input on future logistics decisions. The purpose of this research is to conduct a qualitative study that explores the most beneficial capabilities of a Logistics Command and Control touchpoint for those in a deployed or contingency response environment.

The fragmented nature of Air Force logistics can make it difficult to obtain the correct class of supply requirements and accurate information from the various responsible organizations. This research will look at the benefits and required capabilities of a centralized cell that would provide a single touchpoint for logistics support and information. This support would primarily be to assist those in a deployed or contingency response location with minimal in-place support.

This series of responses ask you to put yourself in a deployed environment where you have been placed in charge of Logistics and Sustainment support and operations for a Main Operating Base that is still growing. We are looking for your feedback as to what information you would need at your fingertips in a deployed environment, to make logistics and sustainment decisions that will affect the units you are responsible for while insuring the chances of success of the pieces of the Air Campaign your units are tasked to accomplish. We realize that decisions are rarely, if ever, made with 100% accurate information; less than 40% is closer to reality, and that many leaders are forced into new and different situations with little to no experience in some areas.

Round 2: Field Requirements for a Log C2 capability

Thank you for your responses to the questions in the previous round. The purpose of this round is to rank the importance of the various responses from the first round in an effort to reach a consensus. A variety of answers and opinions were received in the first round. The responses that occurred most frequently are included in the questions below. Please feel free to provide feedback in the space below each of the questions as you see fit.

The following questions refer to the creation of a centralized Logistics Command and Control touchpoint that would provide a single source for logistics support and information for those in a deployed or contingency response location. They would be able to provide points of contact, accurate information when available, sourcing requirements, and other supply support across all classes of supply not just aircraft parts.

1. In Round 1 of this survey I asked the panel "What are the largest difficulties in obtaining logistic requirements and accurate information in a deployed environment?" Please rate each of the following items on a scale of 1 to 5 with 5 being the most difficult. Add any additional comments in space below items.

   ____ Obtaining supply information
   ____ Getting necessary supplies expediently through customs
   ____ Local in-theater transportation for delivery
   ____ Competing priorities for airlift
   ____ Reliable telephone communication
   ____ Reliable internet access

2. In Round 1 of this survey I asked the panel "What are the most important capabilities and assistance that a support cell should be able to provide?" Please rate each of the following items on a scale of 1 to 5 with 5 being the most important. Add any additional comments in space below items.

   ____ Accurate In-Transit Visibility
   ____ Supply requirement supportability
   ____ Ordering of requirements
   ____ Transportation support
   ____ Customs knowledge or customs handling contact information
   ____ Reliable switchboard operator to connect caller to desired organization

3. In Round 1 of this survey I asked the panel "What are the top 10-15 types of information needed to support your logistics and sustainment decisions in this

environment?" Please rate each of the following items on a scale of 1 to 5 with 5 being the most critical to mission success. Add any additional comments in space below items.

____ Class 1 (food, water)
____ Class 3 (POL)
____ Power
____ Communications
____ Intra-theater transportation
____ Security status of location
____ Parts availability and delivery status
____ Resupply schedule and all supply contacts
____ Fleet health
____ MHE equipment
____ Medical evacuation
____ Living quarters
____ Munition storage

Appendix C: IRB Exemption Approval

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT-PATTERSON AIR FORCE BASE OHIO

8 December 2016

MEMORANDUM FOR Dr. William Cunningham (AFIT/ENS)

FROM: Brett J. Borghetti, Ph.D.
AFIT IRB Exempt Determination Official
2950 Hobson Way
Wright-Patterson AFB, OH 45433-7765

SUBJECT: Approval for exemption request from human experimentation requirements (32 CFR 219, DoDD 3216.2 and AFI 40-402) for "a survey to research field requirements of the Air Force supply system", dated 30 Nov 2016.

1. Your request was for exemption based on the Code of Federal Regulations, title 32, part 219, section 101, paragraph (b) (2) Research activities that involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior unless: (i) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) Any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

2. Your study **qualifies for this exemption.** Although you are collecting personally identifiable information (name), the questions in your attached survey cannot reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation. I urge you to be careful in developing follow-up questions for the participants during the Delphi process – since you are collecting identifiable information, it is important that the subject's answers to questions do not place the subjects at risk in any of the ways described above. If you know that questions increasing these risks will be required during the follow-on phases of the process, my recommendation would be to eliminate the collection of names from the research process.

3. This determination pertains only to the Federal, Department of Defense, and Air Force regulations that govern the use of human subjects in research. Further, if a subject's future response reasonably places them at risk of criminal or civil liability or is damaging to their financial standing, employability, or reputation, you are required to file an adverse event report with this office immediately.

12/8/2016

X 

Signed by: BORGHETTI.BRETT.J.1009082820
BRETT J. BORGHETTI, Ph.D.
AFIT Exempt Determination Official

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14. ABSTRACT
The Air Force Supply System can be a convoluted network of organizations with different classes of supply being managed by different organizations. Individuals deployed to austere environments must interact with multiple organizations to get logistics support. Recent supply organizational changes have improved the Air Force's ability to present combat support capability to the combatant commands and deployed logisticians. This research focused on simplifying the process by identifying the need for and determining the ideal capabilities provided by a Logistics Command and Control support cell that would provide a touch point for logistics support to those in a deployed or austere environment.

15. KEYWORDS
Logistics Command and Control, logistics enterprise, Air Force Sustainment Center, Delphi Method

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