ANALYTICAL TECHNIQUES AND THE AIR FORCE LOGISTICS READINESS OFFICER

THESIS

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Abstract

As the Air Force begins to implement the Expeditionary Combat Support System (ECSS), it is imperative that Air Force logisticians competently analyze logistics data. This exploratory study sought to determine which analytical skills are useful for Logistics Readiness Officers (LROs), as reported by active-duty LROs in grades O1-O5 and their supervisors. The research question was answered through a comprehensive literature review and the use of survey methodology. Over five hundred LROs and supervisors provided inputs. Analysis of survey responses found that Forecasting, Graphical Statistics and Descriptive Statistics are the analytical techniques valued most by both LROs and their supervisors. LROs and their supervisors valued the same techniques, though supervisors considered them to be more important. Company grade officers reported a higher degree of usefulness for each technique than field grade officers did. Responses were compared across groups of LROs and found to be consistently similar. This research noted the reported importance of Forecasting techniques among LROs and identified a potential gap between perceived usefulness and competence levels.

To 1st LT Thomas Michael Martin
United States Army
(KIA)

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This research effort would not have been possible without the help of a host of family, friends and Department of Defense professionals. I would like to express thanks to my faculty advisors, Dr. William Cunningham and Major Daniel Mattioda, PhD. Their insight and guidance were critical to the successful completion of this study. In the classroom and for this research project, both men have made the AFIT experience worthwhile by bridging the gaps between Air Force logistics and academia. Mr. Wendall Drennan and Major Shane N. Hall, PhD deserve credit for their persistence in teaching me the power of quantification. My classmates have provided outstanding camaraderie and memories. I can't imagine a more enjoyable group of people with whom to have traversed this past 18 months.

My family has patiently endured many moves and schedule disruptions to provide me with a supportive home. A special thanks is reserved for my amazing wife, a good and perfect gift from God. Her love and respect inspire me to do grow wings, do great things, then hurry home at the end of the day.

Bryan D. Main

Table of Contents

List of Figures

List of Tables

ANALYTICAL TECHNIQUES AND THE AIR FORCE LOGISTICS READINESS OFFICER

I. Introduction

Background

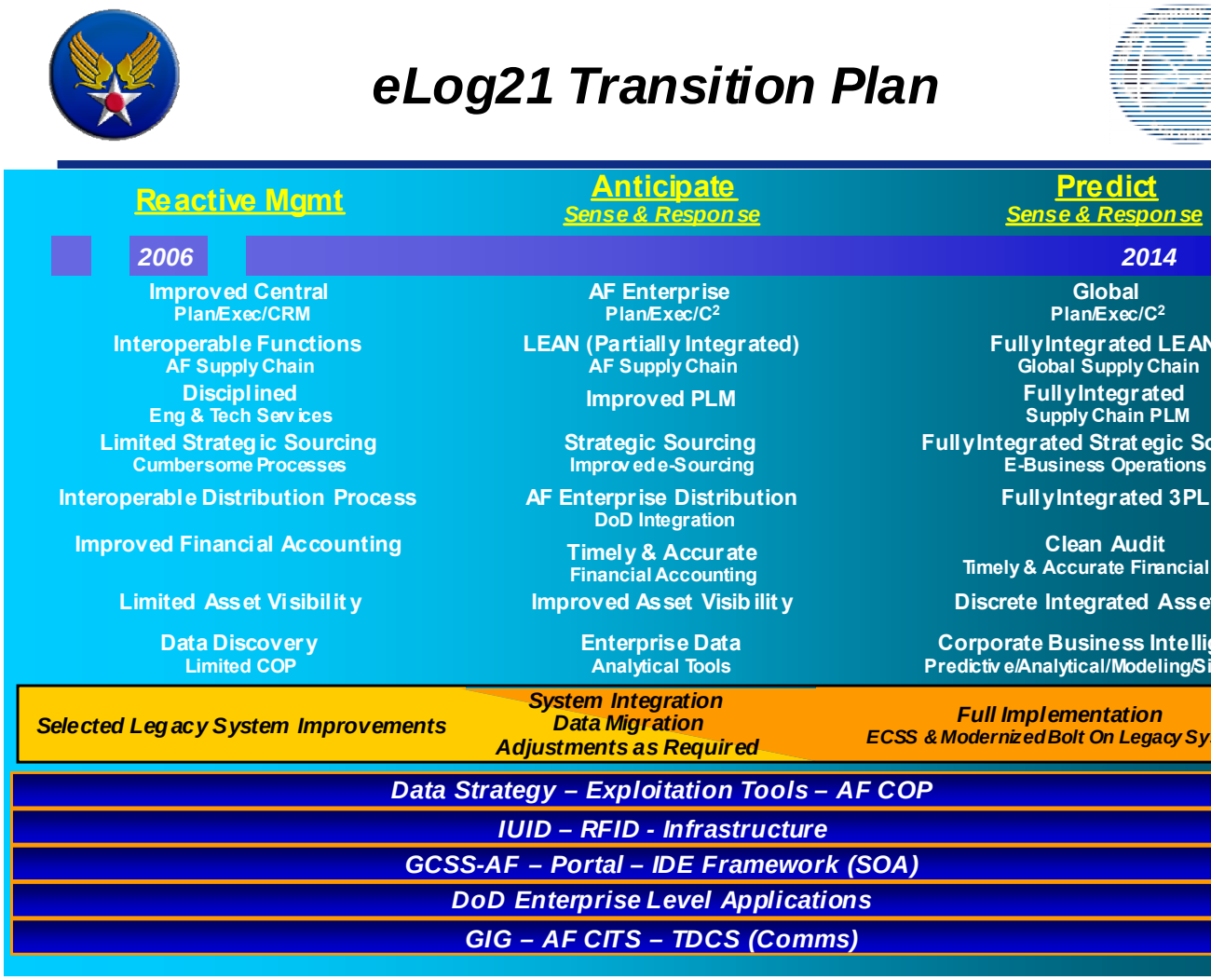
In 2002, three separate Air Force logistics-related officer career fields (Supply, Transportation, and Logistics Plans) merged to form the new Logistics Readiness Officer (LRO) career field. The LRO is expected to perform a variety of different logistics management functions. In the past, logistics officers were "stove-piped" by design. That is, assignments during their career would primarily focus on applying their specialized knowledge to one of the aforementioned logistics categories. A transportation officer, for example, would manage a range of activities in his or her career to include movement of household goods, vehicle maintenance, cargo deployments, air transportation and possibly a 2-3 year assignment in aircraft maintenance or supply chain management. Today, the logistics readiness officer may perform duties in any of the previously mentioned positions (except aircraft maintenance) in addition to managing acquisition and wholesale logistics, support agreements, war reserve materiel management, or base-level fuels operations.

Along with the career field merger, LROs have also adapted to an increasingly expeditionary force. The ongoing global war on terror has ensured that today's LRO is far more likely to deploy than their pre-9/11 predecessors. As such, new training for

LROs has focused more on training the logistician technically than on educating the logistician academically.

In 2010, the Air Force plans to establish initial operating capability for the Expeditionary Combat Support System, an enterprise resource planning system that will be used extensively by Air Force logisticians. As logistics information becomes more readily available to logistics managers and practitioners, it will be imperative that Air Force logisticians are equipped with a set of analytical tools to make the best possible use of the information available to them. Figure 1 illustrates the role of analytical tools in this transformation (Dunn, 2007).

Figure 1:


eLog21 Transition Plan
Reactive Mgmt
Anticipate
Sense & Response
Predict
Sense & Response
2006
2014
Improved Central
Plan/Exec/CRM
AF Enterprise
Plan/Exec/C²
Global
Plan/Exec/C²
Interoperable Functions
AF Supply Chain
LEAN (Partially Integrated)
AF Supply Chain
Fully Integrated LEAN
Global Supply Chain
Disciplined
Eng & Tech Services
Improved PLM
Fully Integrated
Supply Chain PLM
Limited Strategic Sourcing
Cumbersome Processes
Strategic Sourcing
Improved e-Sourcing
Fully Integrated Strategic So
E-Business Operations
Interoperable Distribution Process
AF Enterprise Distribution
DoD Integration
Fully Integrated 3PL
Improved Financial Accounting
Timely & Accurate
Financial Accounting
Clean Audit
Timely & Accurate Financial
Limited Asset Visibility
Improved Asset Visibility
Discrete Integrated Asse
Data Discovery
Limited COP
Enterprise Data
Analytical Tools
Corporate Business Intelli
Predictive/Analytical/Modeling/Si
Selected Legacy System Improvements
System Integration
Data Migration
Adjustments as Required
Full Implementation
ECSS & Modernized Bolt On Legacy Sy
Data Strategy – Exploitation Tools – AF COP
IUID – RFID - Infrastructure
GCSS-AF – Portal – IDE Framework (SOA)
DoD Enterprise Level Applications
GIG – AF CITS – TDCS (Comms)

Determining the best way to conduct training and education for these new broad-based LROs is still a question that looms large; particularly, what analytical skills should LROs be taught? How should they be taught these skills and at what point in their career should they learn them? Are each of these analytical skills necessary for all LRO duties or are there certain skills that can be taught on an as-needed basis for the particular position in which the LRO has duties? Answering these questions will aid the AF/A4I office as it seeks to map out the skill sets that LROs should possess in order to best assist the combatant commanders and support the Air Force.

Research Focus

The focus of this research is to specifically determine which analytical tools are the most useful for the active-duty Air Force LRO in grades O1-O5. While previous research has examined the value of statistics training in the commercial logistics industry (Parker, Kent and Brown, 2001) and perceived training transfer of LRO technical school (Hobbs, 2005), no specific academic research has been published regarding analytical skills needed by the LRO.

Research Objectives/Research Questions & Hypotheses

Determining which analytical skills are needed by the active duty Air Force LRO is the goal of this research. Research conducted for this thesis focused on two investigative questions:

1. *Which analytical skills do LROs deem to be most important for conducting their duties?*

2. *Which analytical skills do the supervisors of LROs deem most important for conducting their duties?*

Methodology

The research used established survey methods and statistics techniques in framing, conducting and analyzing the research. The researcher began by identifying specific analytical skills which may be useful for the LRO. Next, the researcher developed and distributed a web-based survey of LROs and their supervisors. The survey consisted of a questionnaire to determine which of a set of 20 pre-identified potential techniques were believed useful in conducting LRO duties. Respondents self-identified demographic information such as rank, current duty position and education background. They then answered items related to their familiarity with each of the techniques and the value they ascribe each one to carrying out the duties of an LRO. A similar survey was developed for supervisors of LROs to collect their views of which analytical techniques would be useful for the LROs under their command or supervision.

The researcher compiled the completed survey data and used statistical techniques available in statistics software packages to determine which techniques are indeed important. Non-parametric independent sample tests were used to determine if there are statistically significantly different responses from LROs and their supervisors, field grade officers and company grade officers, LROs assigned to acquisitions-related jobs and those who are not, LROs on a staff and LROs in operations-related jobs.

Assumptions/Limitations

There are many different types of analysis and analytical techniques. This research focuses on techniques that might be considered building blocks for performing more complex analysis.

This research makes several key assumptions. By using a survey, the researcher assumes that the sample is not biased. Furthermore, respondents are assumed to be able to sufficiently determine whether or not the analytical techniques they know are, in fact, helpful. The research will likely have implications relevant primarily to the Air Force LRO career field. Findings which indicate that knowledge of analytical techniques are helpful in some or all LRO duties may lead to the incorporation of some type of analytical skills training within the Career Field Education and Training Plan (CFETP) or by other means.

Implications

The immediate goal of the research is to establish which analytical skills are needed by Air Force LROs, herein uncharted academic territory. The resulting knowledge of which skills are needed by LROs can be used by AF/A4I to determine how and when AF LROs will gain these skills. Findings which indicate that knowledge of analytical techniques are helpful in some or all LRO duties may lead to the incorporation of quantitatively oriented training within the CFETP. Analytic techniques could be taught either in conjunction with existing mandatory in-residence training for LROs, such as the LRO Basic Course or the Logistics Readiness Expeditionary Course, be taught using existing continuous learning training modules through the Defense Acquisition

University (DAU) or be taught in a newly developed AFIT Online course. The research could also be beneficial in understanding which analytical techniques might be most useful for other logistics managers, adding to the limited volume of existing literature on the subject.

II. Literature Review

This chapter provides background related to the Air Force Logistics Readiness Officer (LRO) career field training, industry statistics training literature, and basic quantitative terms.

AF LRO Training

In 2002, the release of the first-ever LRO Career Field Education and Training Plan (CFETP) accompanied the creation of the LRO career field. The CFETP was intended to guide the way in which LROs received training. Both the 2002 CFETP and its 2005 update state that it is the document is to be used to "plan, manage and control training" within the career field (Department of the Air Force, 2002:7, 2005:3).

The CFETP categorizes LRO functions into three core competencies and outlines LRO training opportunities. LRO duties are divided into three core competencies: materiel management, distribution and contingency operations (Table 1), mandating on-the-job training in each competency before the LRO is considered fully qualified. The CFETP also identifies training available for the LRO—both mandatory and optional training opportunities. There are two mandatory courses taught by the 37th Training Group at Lackland AFB, TX: the LRO Basic Course which is required for new LROs (usually Second Lieutenants) and the Logistics Readiness Expeditionary Course (LREC), a two-week course taught to Majors and Major-selects. Optional training opportunities delineated in the CFETP include DAU and AFIT Online e-courses, and the Contingency Wartime Planning Course.

Table 1:

Core Competency Matrix (Adapted from DAF, 2005:11).

Competencies	Materiel Management	Distribution	Contingency Operations
Proficiencies	Materiel Management & Vehicle Maintenance & Fuels Management & Acquisition Logistics	Distribution Management & Aerial Port Operations & Vehicle Operations	Contingency Operations

As the Air Force continued to adapt to the ever-changing expeditionary and fiscal environment, the eLog21 initiative caused the Air Force transformation office (HQ AF/A4I) to commission a study comparing the different curriculum offered to the Logistics Readiness career field. The recommendations of the team study included the continued development of a sustainment curriculum portfolio for the LRO career field (Department of the Air Force, 2006:51). The portfolio is being compiled by AFIT and consists of several online courses through AFIT online, including Enterprise Resource Planning and Activity-Based Costing. Course content does not presently contain an overview or survey of analytical techniques or other quantitative skills. A formal study

has not taken place in which the value of such content has been investigated.

Industry Training Literature

The academic literature has shown that knowledge of statistics is perceived to be valuable within business schools (Parker, Pettitjohn and Keillor, 1999) and among leaders of the transportation and logistics industry (Parker, Kent and Brown, 2001). Parker, Pettitjohn and Keillor (1999) found that at least 90% of undergraduate business schools required either one or two statistics classes, some of which were taught at the graduate level (Parker, Pettitjohn and Keillor, 1999).

Parker, Kent and Brown (2001) found that 86% of logistics and transportation executives considered statistics to be either supportive or critical to their operations. Furthermore, they found that there were five statistics techniques in particular that were considered most important: Probability, Sampling, Averages, Graphics, and Quality. These techniques considered important by industry leaders were different from those that were most commonly taught at the university level – descriptive statistics, probability distribution, hypothesis testing, and tables and charts (Parker, Pettitjohn and Keillor, 1999:51).

What should be done with this disconnect between what universities teach and what industry leaders consider important? One recommendation proposed by Parker, Kent and Brown in their 2001 study was for education and industry leaders to communicate with one another to ensure that education providers are teaching the statistics techniques that are needed by industry.

The Importance of Analysis within the Organization

Davenport (2006) studied 32 organizations that had made a commitment to quantitative, fact-based analysis including Amazon, Netflix and the Boston Red Sox. Three common traits of these successful organizations include widespread use of modeling and optimization, an enterprise approach, and senior executive advocates. Davenport points out that an organization wishing to compete on analytics must be willing to invest significantly in technology, accumulate massive stores of data and formulate company-wide strategies for managing data. As the Air Force invests significantly in technology and data storage through the Expeditionary Combat Support System (ECSS), it is especially important that it also formulates these strategies for managing data. Davenport notes that as an organization that competes on analytics, employees will require extensive training.

> They need to know what data are available and all the ways the information can be analyzed; and they must learn to recognize such peculiarities and shortcomings as missing data, duplication, and quality problems (Davenport 2006).

The following methodology works toward the purpose of examining the analytical knowledge needs of Air Force LROs and communicating those needs to those Air Force leaders who can guide the career path toward gaining that knowledge at the appropriate time and method.

III. Methodology

Procedures

Though no previous study has explored analytical skills and the LRO, many elements of the research are similar to those used by Parker, Kent and Brown (2001). Research began by identifying specific analytical skills which may be useful for the LRO. Items used by Parker *et al* (2001) in their survey were included in a bank of potentially useful analytical skills for the LRO. A list of other statistics tools and a short description of each technique was compiled by consulting several statistics textbooks including Discovering Statistics using SPSS by Andy Field (2005), Statistics for Business and Economics by James T. McClave, P. George Benson and Terry Sincich (2005), Statistics: The Exploration and Analysis of Data by Jay Devore and Roxy Peck (2001), and Introduction to Statistical Analysis by Wilfrid J. Dixon and Frank J. Massey, Jr. (1983).

Additionally, several quantitative and management textbooks were referenced to include other quantitative analytical techniques not categorized as statistics. These textbooks included Spreadsheet Modeling & Decision Analysis: A Practical Introduction to Management Science by Cliff T. Ragsdale (2007), Discrete-Event System Simulation by Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol (2005), and Forecasting: Methods and Applications by Spyros Makridakis, Steven C. Wheelwright and Rob J. Hyndman (2003). A list of 20 analytical tools was compiled from these sources along with a 4- to 16- word description of each technique (Table 2).

Table 2:

Analytical Techniques with Descriptions

Title	Description
Descriptive Statistics	utilizing numerical and graphical methods to observe patterns, gather information and present information in a convenient form
Probability	logically determining likelihood of events
Statistical Sampling	proper data handling techniques
Estimating	parameters based on empirical data
Variation	measuring how data is dispersed
Averages	determining an expected value
Graphical Statistics	understanding pie charts, bar charts and histograms
Hypothesis Testing	a method for using sample data to decide between two competing claims about a population characteristic
Regression	explaining an output variable based on one or more independent variables
Time-Series	observing trends and seasonality in viewing data in a time series
Forecasting	predicting future output values based on past trends or future independent variables
Quality	quantitatively assessing the quality of a good or service (e.g. Six Sigma)
Student's T-tests	comparing means between two groups
Analysis of Variance (ANOVA)	comparing means between three or more groups
Other Multivariate Techniques	comparing means multiple differences between groups
Decision Analysis	methods of evaluating alternatives based on selected criteria
Linear Programming	creating and solving optimization problems with linear objective functions and linear constraints
Simulation Techniques	imitating a real-world process or system over time
Queuing Theory	the study of waiting lines
Critical Path Method (CPM) / Program Evaluation and Review Technique (PERT)	developing and managing project schedules

Two surveys were then developed. The first survey was designed to be answered by active-duty LROs in grades O1-O5. The second survey was designed to be answered by their supervisors. Both surveys were made up of four sections. The first collected basic demographic information, such as rank, MAJCOM, and deployment history. The

second section asked respondents to gauge their own degree of familiarity with each of the 20 analytical techniques. For LROs, the third section asked respondents to mark each of the analytical techniques they believe to be useful in their current position. For supervisors of LROs, the third section asked respondents to mark each of the analytical techniques they believe to be useful for the LROs they currently supervise. The fourth section asked respondents to assign a score on a scale of 1-10 for each analytical technique based on how useful they believed the technique is in the LRO position they fill or supervise (0=Not Familiar with the Technique; 1=Not At All Useful; 10=Absolutely Necessary to Perform Duties). For all sections of the survey which asked about analytical techniques, the 4- to 16- word description of each technique was written next to the technique name. (Appendices A and B)

Each 65-item survey was developed with the guidance of an experienced academic professional familiar with survey-building procedures. The surveys were approved by the sponsoring office, converted into a web-based format and pilot tested among a small group of logistics officers for the purpose of gathering feedback. The first survey was developed for LROs to report which techniques they believed would be useful in the positions in which they are currently assigned. The second survey was developed for supervisors of LROs to report which analytical techniques they believed were important for the LROs who work for them.

A list of active-duty LROs in grades O1-O5, excluding those in student and special duty status, was obtained from the Air Force Personnel Center (AFPC). A similar list of LRO supervisors was not available due to computer system limitations. A survey invitation along with a link to the web-based survey was emailed to the 1,485 LROs. To

gather data for the second survey, LROs were asked in their survey invitation to forward a copy of the invitation to their supervisors. After approximately 2 weeks, a follow-up email was sent to LROs requesting that they complete the survey.

Participants

From the list of 1,485 LROs provided by AFPC, email addresses were provided for 1,476. The Air Force's Global Address List provided email addresses for 8 of the remaining 9 LROs. Invitations were sent to 1,484 LROs, and, excluding Out-of-Office messages which specified that the respondent would return prior to the survey close date, 220 undeliverable, full mailbox, or invalid email address messages were received. Of the 1,264 LROs who had the opportunity to respond to the survey, 494 participated (excluding duplicate entries) for a response rate of 39.1%. This high response rate does not seem surprising for a population of military members. The population size of LRO supervisors is unknown, but responses were received for a total of 85 participants. The response rate may have been diminished by the lack of ability to contact supervisors directly with the survey invitation.

Using methods described by Armstrong and Overton (1977), the researcher analyzed responses to both surveys for non-response bias. Armstrong and Overton (1977) propose that non-respondents are likely to respond most similarly to those who are last to return their completed surveys. The final wave of responses (N=124, 25%) from the first survey was compared with the first 370 responses. Likewise, responses from the last group of LRO supervisors to respond (N=28, 33%) were compared with the first

group. For both surveys, no significant differences exist between mean responses of several selected items, and no non-response bias is believed to exist.

Methods

Percentages and mean score values for each technique were calculated, then differences were examined using the Wilcoxon rank-sum test for non-parametric independent samples. Because the data collected for these surveys is neither continuous nor normally distributed and because comparisons made for this research are between different groups of respondents, non-parametric independent sample tests are the appropriate method of analysis for measuring differences in these surveys. Fields (2005) describes the Wilcoxon rank-sum test as one of the accepted methods of conducting these tests. The software package calculated these rank sums and returned a significance value ($0<\alpha<1$). Differences between means were considered significant at the 95% level ($\alpha<.05$).

IV. Results

Investigative Question #1:
Which analytical skills do LROs deem to be most important for conducting their duties?

All survey participants were asked to identify which of the 20 analytical skills they believed to be useful for their current position. Responses varied from 70.4% who identified Forecasting as a useful technique to only 10.5% who identified Student's T-tests as being useful. 5.7% of LROs believe that none of the listed techniques are useful. Most respondents identified Forecasting, Descriptive Statistics, Graphical Statistics, Averages, Quality, Probability, Time-Series and Decision Analysis as useful tools in their present position. (Table 3).

Table 3: All LROs – Percent Believe Useful

Technique	% Believe Useful
Forecasting	70.4%
Descriptive	70.0%
Graphics	68.8%
Averages	56.9%
Quality	53.6%
Probability	53.0%
TimeSeries	51.4%
DecisionA	50.4%
Estimating	45.5%
Sampling	42.7%
Variation	34.4%
CPM	34.4%
Simulation	32.0%
HypothesisTest	22.7%
Regression	20.2%
Queuing	17.0%
LP	15.4%
OtherMultiV	12.8%
ANOVA	12.6%
StudentT	10.5%
None_Apply	5.7%

After identifying which techniques were useful in their present position, LROs assigned each technique a score from 1-10, (1 = Not at all Useful; 10 = absolutely necessary to perform duties). On the whole, LROs gave the highest ratings to Graphical Statistics (7.44), Descriptive Statistics (6.77) and Forecasting (6.48) followed by Decision Analysis (6.05), Averages (6.02) and Quality (6.01). Further results are listed in Table 4.

Table 4: All LROs – Mean Scores

Technique	Mean Score
Graphics	7.44
Descriptive	6.77
Forecasting	6.48
DecisionA	6.05
Averages	6.02
Quality	6.01
TimeSeries	5.61
Probability	5.60
CPM	5.29
Estimating	5.24
Sampling	5.15
Simulation	4.67
Variation	4.53
HypothesisT	4.17
Regression	3.85
LP	3.76
Queuing	3.49
OtherMultiV	3.27
ANOVA	3.20

Exploratory Analysis

Company Grade Officers (CGOs) and Field Grade Officers (FGOs)

An analysis was conducted based on company and field grade ranks. Second lieutenants, first lieutenants and captains are company grade officers (CGOs); majors and

lieutenant colonels are field grade officers (FGOs). Of the LROs who responded to the survey, 272 (55.1%) are CGOs and 222 (44.9%) are FGOs.

Table 5: Comparison of Percentages (CGO/FGO)

	All LROs - % Believe Useful	CGO - % Believe Useful	FGO - % Believe Useful
Forecasting	70.4%	70.96%	69.82%
Descriptive	70.0%	67.28%	73.42%
Graphics	68.8%	65.81%	72.52%
Averages	56.9%	57.35%	56.31%
Quality	53.6%	58.46%	47.75%
Probability	53.0%	58.46%	46.40%
TimeSeries	51.4%	52.57%	50.00%
DecisionA	50.4%	49.26%	51.80%
Estimating	45.5%	43.75%	47.75%
Sampling	42.7%	44.85%	40.09%
Variation	34.4%	34.19%	34.68%
CPM	34.4%	34.19%	34.68%
Simulation	32.0%	34.93%	28.38%
HypothesisTest	22.7%	24.26%	20.72%
Regression	20.2%	20.22%	20.27%
Queuing	17.0%	16.91%	17.12%
LP	15.4%	13.97%	17.12%
OtherMultiV	12.8%	13.24%	12.16%
ANOVA	12.6%	12.87%	12.16%
StudentT	10.5%	11.40%	9.46%
None_Apply	5.7%	4.78%	6.76%

When asked to score each of the techniques, both CGOs and FGOs rated Graphical Statistics, Descriptive Statistics and Forecasting as the most useful of the given analytical techniques to performing their duties. CGOs tended to score each individual technique higher than FGOs. Differences exist between perceived importances of Probability, Simulation, Regression, ANOVA and Student's T-Test techniques. In each case, CGOs valued the technique more so than FGOs. Table 6 shows mean values for each category.

Table 6: Comparison of Mean Scores (CGO/FGO)

Technique	All LROs Mean Score	CGO Mean Score	FGO Mean Score	α
Graphics	7.44	7.10	7.86	.000
Descriptive	6.77	6.63	6.93	.078
Forecasting	6.48	6.62	6.31	.310
DecisionA	6.05	6.03	6.06	.631
Averages	6.02	5.92	6.15	.081
Quality	6.01	6.22	5.74	.092
TimeSeries	5.61	5.82	5.36	.126
Probability	5.60	5.91	5.21	.006
CPM	5.29	5.46	5.10	.283
Estimating	5.24	5.34	5.11	.395
Sampling	5.15	5.27	5.00	.325
Simulation	4.67	5.09	4.19	.001
Variation	4.53	4.55	4.50	.605
HypothesisT	4.17	4.55	3.73	.001
Regression	3.85	4.11	3.57	.026
LP_Score	3.76	3.85	3.65	.371
Queuing	3.49	3.64	3.31	.263
OtherMultiV	3.27	3.49	3.01	.027
ANOVA	3.20	3.45	2.90	.016
StudentT	3.19	3.47	2.87	.013

LROs assigned to a Logistics Readiness Squadron (LRS) or Aerial Port Squadron (APS) and All Others

Further analysis was conducted to determine if LROs used analytical techniques differently based on the classification of jobs that they hold. Data provided by AFPC showed that 55.8% (829 of 1,485) of active-duty LROs are assigned to a Logistics Readiness Squadron, Aerial Port Squadron, Air Mobility Squadron or Contingency Response Wing. 56.7% (280 of 494) of respondents were classified as filling these operational positions.

Responses of Operational LROs compared to all others are shown in Tables 7 and 8. Most respondents in both groups considered Forecasting, Descriptive Statistics, Graphics and Averages useful in their present position.

Table 7: Comparisons of Percentages (LRS/APS vs All Others)

Technique	All LROs - % Believe Useful	LRS/APS - % Believe Useful	All Others - % Believe Useful
Forecasting	70.4%	69.6%	71.5%
Descriptive	70.0%	71.4%	68.2%
Graphics	68.8%	71.1%	65.9%
Averages	56.9%	58.9%	54.2%
Quality	53.6%	57.9%	48.1%
Probability	53.0%	55.7%	49.5%
TimeSeries	51.4%	55.7%	45.8%
DecisionA	50.4%	50.0%	50.9%
Estimating	45.5%	42.9%	49.1%
Sampling	42.7%	43.2%	42.1%
Variation	34.4%	32.5%	36.9%
CPM	34.4%	36.1%	32.2%
Simulation	32.0%	34.6%	28.5%
HypothesisTest	22.7%	23.9%	21.0%
Regression	20.2%	19.3%	21.5%
Queuing	17.0%	16.8%	17.3%
LP	15.4%	14.3%	16.8%
OtherMultiV	12.8%	13.9%	11.2%
ANOVA	12.6%	12.1%	13.1%
StudentT	10.5%	8.9%	12.6%
None_Apply	5.7%	3.6%	8.4%

. Some minor differences appear to exist between the two groups. In general, personnel assigned to an LRS or APS tend to score each technique higher. No significant differences exist between the highest scored items for both groups—Descriptive Statistics, Graphical Statistics and Forecasting. Higher scores from LROs assigned to an LRS or APS are statistically significant for Quality, Time Series, Critical Path Method, Simulation, Regression and Linear Programming (Table 8).

Table 8: Comparisons of Mean Scores (LRS/APS vs All Others)

Technique	Total Mean Score	LRS/APS Mean Score	All Others Mean Score	α
Graphics	7.44	7.50	7.39	.347
Descriptive	6.77	6.92	6.63	.849
Forecasting	6.48	6.84	6.16	.138
DecisionA	6.05	6.29	5.82	.150
Averages	6.02	6.14	5.91	.966
Quality	6.01	6.50	5.55	.001
TimeSeries	5.61	6.11	5.16	.029
Probability	5.60	5.92	5.29	.066
CPM	5.29	5.87	4.78	.001
Estimating	5.24	5.16	5.31	.324
Sampling	5.15	5.28	5.02	.369
Simulation	4.67	5.15	4.22	.001
Variation	4.53	4.67	4.40	.180
HypothesisT	4.17	4.59	3.77	.002
Regression	3.85	4.18	3.55	.006
LP	3.76	4.19	3.37	.002
Queuing	3.49	4.06	3.00	.000
OtherMultiV	3.27	3.78	2.81	.000
ANOVA	3.20	3.67	2.77	.000
StudentT	3.19	3.66	2.75	.000

Next, we consider that company grade LROs are more likely to be assigned to these operational units than are field grade officers. Similarly, FGOs are more likely to be assigned to a staff position than are CGOs. To compare the effect of the types of units to which LROs are assigned, we compare FGOs assigned to operational units (N = 76) with all other FGOs (N=146). The analytical technique valued by most FGOs assigned to operational positions is Graphics. The technique valued by most other FGOs is Forecasting.

Table 9: Comparison of Percentages (Operational FGOs vs All Other FGOs)

Technique	All FGOs - % Believe Useful	Operational FGOs - % Believe Useful	All Other FGOs - % Believe Useful
Graphics	73%	80%	68%
Descriptive	73%	78%	71%
Forecasting	70%	62%	74%
Averages	56%	58%	55%
TimeSeries	50%	51%	49%
Quality	48%	47%	48%
DecisionA	52%	46%	55%
Estimating	48%	43%	50%
Probability	46%	42%	49%
Sampling	40%	42%	39%
CPM	35%	34%	35%
Variation	35%	30%	37%
Simulation	28%	24%	31%
HypothesisTest	21%	18%	22%
Regression	20%	13%	24%
Queuing	17%	13%	19%
LP	17%	12%	20%
ANOVA	12%	11%	13%
OtherMultiV	12%	11%	13%
StudentT	9%	4%	12%
None_Apply	7%	3%	9%

An analysis of the mean scores marked by FGOs revealed no major differences between operational and non-operational FGOs' perceptions of usefulness for the techniques. Field grade LROs assigned to an operational unit gave higher scores to both Quality and Queuing Theory. The differences were slightly significant at the 90% level (α=.10).

Table 10: Comparison of Mean Scores (Operational FGOs vs All Other FGOs)

Technique	Mean Score - All FGOs	Mean Score - Operational FGOs	Mean Score - All Other FGOs	α
Graphics	7.86	8.20	7.67	.773
Descriptive	6.93	7.31	6.72	.306
Forecasting	6.31	6.31	6.31	.648
Averages	6.15	6.09	6.18	.495
DecisionA	6.06	6.26	5.95	.645
Quality	5.74	6.28	5.45	.082
TimeSeries	5.36	5.50	5.29	.664
Probability	5.21	5.32	5.15	.690
Estimating	5.11	4.85	5.26	.294
CPM	5.10	4.83	5.25	.334
Sampling	5.00	4.97	5.02	.965
Variation	4.50	4.45	4.53	.832
Simulation	4.19	3.86	4.37	.339
HypothesisT	3.73	3.70	3.75	.701
LP	3.65	3.74	3.59	.428
Regression	3.57	3.49	3.61	.839
Queuing	3.31	3.67	3.11	.089
OtherMultiV	3.01	3.21	2.90	.217
ANOVA	2.90	3.11	2.78	.229
StudentT	2.87	2.98	2.79	.397

Additional Exploratory Analysis

Further exploratory analysis was conducted comparing responses of LROs assigned to the Air Staff and all others. Air staff duties of budgeting and establishing policy may be thought of as more analytically intensive; however, responses from LROs assigned to the Air Staff did not differ significantly from all other LROs.

Additionally, analysis was conducted to compare responses of wholesale logistics LROs (those assigned to Air Force Materiel Command or the Defense Logistics Agency) with all other LROs. It was hypothesized that LRO duties within these two organizations may require greater usage of quality-related statistics for comparing reliability rates or

greater usage of the critical path method for program management. No significant differences, however, were found.

A final exploratory analysis was conducted to compare responses of Installation Deployment Officers (IDOs) with all other LROs. One responsibility of an IDO is to manage the structure of the deployment processing line, a duty which might be assisted by Simulation, Queuing Theory or the Critical Path Method. Exploratory analysis revealed no statistically significant differences between IDOs and non-IDOs in their scoring of any of the 20 techniques.

Investigative Question #2:
Which analytical skills do the supervisors of LROs deem most important for conducting their duties?

Supervisors' Views of Analytical Skills Believed Useful for LROs

As a group, LROs believed that Graphical Statistics, Descriptive Statistics and Forecasting were the most useful analytical techniques in performing their duties. A sample of LRO Supervisors (N=88) responded with which analytical skills they believed to be useful for the LROs under their supervision or command. On the whole, a greater percentage of supervisors tended to consider the techniques useful compared with the LROs. 81.8% of supervisors consider Descriptive Statistics to be useful compared with 70.0% of LROs. 78.4% of supervisors consider Graphical Statistics to be useful compared with 68.8% of LROs. (Table 11).

Table 11: Comparison of Percentages (LROs vs Supervisors)

Technique	LROs - % Believe Useful	Supervisors - % Believe Useful
Descriptive	70.0%	81.8%
Graphics	68.8%	78.4%
Forecasting	70.4%	68.2%
Averages	56.9%	63.6%
Quality	53.6%	60.2%
Probability	53.0%	54.5%
Estimating	45.5%	53.4%
DecisionA	50.4%	52.3%
TimeSeries	51.4%	50.0%
Sampling	42.7%	48.9%
Variation	34.4%	47.7%
CPM	34.4%	45.5%
HypothesisTest	22.7%	30.7%
Simulation	32.0%	27.3%
Queuing	17.0%	26.1%
Regression	20.2%	23.9%
LP	15.4%	21.6%
ANOVA	12.6%	20.5%
OtherMultiV	12.8%	19.3%
StudentT	10.5%	14.8%
None_Apply	5.7%	9.1%

An analysis of the mean scores assigned to each technique revealed a continued trend of supervisors valuing these analytical techniques more than the LROs they supervise. Descriptive and Graphical Statistics were scored higher by supervisors at a statistically significant level (α=.02 and α =.04 respectively). These two techniques, however, receive the highest scores from both LROs and their supervisors. Variation (α=.085) and Queuing Theory (α =.081) are two other techniques in which supervisors' higher scores are statistically significant (Table 12).

Table 12: Comparison of Mean Scores (LROs vs Supervisors)

Technique	Mean Score LROs	Mean Score Supervisors	α
Graphics	7.44	8.19	.021
Descriptive	6.77	7.41	.047
Forecasting	6.48	6.30	.418
Averages	6.02	6.29	.319
DecisionA	6.05	6.28	.600
Quality	6.01	6.17	.672
CPM	5.29	5.87	.126
TimeSeries	5.61	5.75	.628
Probability	5.60	5.73	.643
Estimating	5.24	5.63	.195
Sampling	5.15	5.40	.425
Variation	4.53	5.10	.085
HypothesisT	4.17	4.41	.613
Simulation	4.67	4.30	.314
Queuing	3.49	4.08	.081
LP	3.76	3.90	.793
Regression	3.85	3.68	.540
OtherMultiV	3.27	3.47	.746
ANOVA	3.20	3.46	.637
StudentT	3.19	3.28	.831

Summary of Analysis

This chapter provided summarized results of the perceived value of various analytical techniques by LROs and their supervisors. Though some differences exist as to the relative importance of several techniques, results from this study indicate that groups agree that Descriptive Statistics, Graphical Statistics and Forecasting are the most important techniques. On the whole, supervisors of LROs believe the techniques to be more important for LROs than LROs believe they are. CGOs value these analytical techniques more than FGOs for conducting their own duties.

Responses were surprisingly similar across ranks and organizations. No major differences existed between which techniques LROs and their supervisors believed to be important, though a greater percentage of supervisors tend to believe the techniques are useful. Descriptive and Graphical Statistics are very useful and relatively non-complex analytical tools. Viewing outputs from logistics information systems or explaining monthly metrics are two common ways for an LRO to use Descriptive and Graphical Statistics.

One surprising result from the survey was the high importance placed on Forecasting. In the Parker *et al* study (2001), Forecasting was perceived to be less important than either Sampling or Quality. CGOs in our research consistently rated Forecasting in the top three most important techniques along with Descriptive and Graphical Statistics. Forecasting techniques can be more quantitatively rigorous than the other two, incorporating elements of both Descriptive and Graphical Statistics as well as Regression, Linear Programming, Tim-Series, Estimating, and Student's T-tests. Respondents low assessment of these sub-components of Forecasting may indicate a gap between user competence and perceived usefulness.

V. Discussion

Implications of Research

Presently, there is no adequate quantitatively based training available to teach Forecasting techniques to all LROs. A three-month graduate-level Forecasting course is taught in residence at AFIT. The in-resident requirement precludes participation for most LROs. An online Forecasting familiarity course is also taught through AFIT On-line. The short (1 Continuous Learning Point credit) course is directed at informing students of the Enterprise Architecture (EA) more than teaching them how to use forecasting techniques. A more rigorous and quantitatively oriented Forecasting course could be developed and made available to all interested Air Force logisticians through either AFIT On-line or Defense Acquisition University.

Future Research

An exploratory study assessing demand for more quantitatively oriented online courses through either AFIT Online or the Defense Acquisition University. Potential course offerings could include instruction in Linear Programming, Simulation, Basic Statistics, Forecasting, and Regression.

The type of analytical techniques considered for this study are of the "building block" variety. Future research could inquire about other techniques such as benefit-cost analysis) or technical skills related to analysis (e.g. ability to query the Global Transportation Network; ability to use Microsoft Excel®'s built-in Solver software).

Limitations

Research for this study was limited by not having direct access to a comprehensive list of LRO supervisors. Furthermore, survey questions related to technique familiarity were poorly worded and did not prove to be useful during analysis. Specifically, the questions incorrectly assumed that all of those who were very familiar or highly competent with one of the analytical techniques also used the technique frequently.

Interpreting the results of the survey may have been enhanced by allowing users to leave comments within the survey. While many respondents did email comments to the researcher, the perception of confidentiality may have been lost by emailing comments rather than embedding them within the survey.

Comments received from respondents indicated that this research also would have benefited from directly asking respondents their view of the importance of analytical techniques compared with other skills. For example, how important do LROs believe analytical techniques are compared with leadership skills or technical skills.

Conclusion

The overall purpose of this research was to determine which analytical techniques LROs and their supervisors believe are important in conducting LRO duties. Forecasting, Graphical Statistics and Descriptive Statistics are considered by both LROs and their supervisors to be the most important techniques. Given the reported importance of Forecasting, LROs may benefit from having the opportunity to learn quantitatively based Forecasting techniques.

With the upcoming implementation of ECSS, analytical skills are an increasingly necessary tool for Air Force logisticians. Coupled with leadership ability, LROs will be able to use these skills to lead the equipping and sustainment of the nation's warfighters.

Appendix A. Analytical Techniques Survey for LROs

Survey #1 - LROs

Reassurance of Confidentiality

ALL ANSWERS ARE CONFIDENTIAL. No one other than the research team will see your completed questionnaire. Findings will be reported at the group level only. We asked for some demographic information in order to interpret results more accurately. Reports summarizing trends in large groups may be published.

Our records indicate that you are an Air Force Logistics Readiness Officer (LRO).

<Button that says "I am not an LRO"> - Exit System
<" I am an LRO"> - Proceed

This survey will ask questions related to your views of the position you now hold as a logistics readiness officer and will take approximately 10-15 minutes to complete

Demographics

1. What is your Rank? (Check box)
   - □ 2nd Lieutenant
   - □ 1st Lieutenant
   - □ Captain
   - □ Major
   - □ Lieutenant Colonel
   - □ Colonel

2. How many years of commissioned service have you completed?

   _____

3. What is the highest level of education you have completed?
   - □ Bachelor's Degree

□ Master's Degree
□ Doctorate Degree

4. Which of the following best classifies your present organization?

A. MAJCOM
- □ HQ/USAF – Headquarters, United States Air Force
- □ DRU/FOA - Direct Reporting Unit/Field Operating Agency
- □ ACC - Air Combat Command
- □ AETC – Air Education and Training Command
- □ AFMC – Air Force Materiel Command
- □ AFSPC – Air Force Space Command
- □ AFSOC - Air Force Special Operations Command
- □ AMC - Air Mobility Command
- □ PACAF – Pacific Air Forces
- □ USAFE – U.S. Air Forces in Europe
- □ DLA – Defense Logistics Agency
- □ CENTCOM – United States Central Command
- □ Other – Please Explain

_____

B. Level
- □ Joint Staff
- □ Air Staff
- □ MAJCOM Staff
- □ NAF Staff
- □ Logistics Readiness Squadron
- □ Aerial Port Squadron
- □ Contingency Response Group
- □ Other (Please Explain)

_____

C. Deployed Status
- □ Currently Deployed
- □ Not Currently Deployed

5. Which of the following best classifies your present position?

□ Flight Commander
□ Installation Deployment Officer
□ Operations Officer
□ Squadron Commander
□ Group Commander
□ Staff Officer
□ Other (Please Explain)

_____

Analytical Tools

6. Using the scale below please indicate your degree of familiarity with the following analytical tools:

Descriptive Statistics – utilizing numerical and graphical methods to observe patterns, gather information and present information in a convenient form

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Probability – logically determining likelihood of events

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Statistical Sampling - proper data handling techniques

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Estimating parameters based on empirical data

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Variation – measuring how data is dispersed

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Averages – determining an expected value

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Graphical Statistics – understanding pie charts, bar charts and histograms

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Hypothesis Testing – understanding Type I/II errors

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Regression – explaining a Y-response (dependent variable) based on 2 or more independent X variables

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Time-Series – Observing trends and seasonality in viewing data in a time series

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Forecasting – predicting future Y-values based on past trends or future independent variables

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Quality – Quantitatively assessing the quality of a good or service (e.g. Six Sigma)

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Student's T-tests – comparing means between two groups

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Analysis of Variance (ANOVA) – comparing means between three or more groups

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Other Multivariate Techniques – comparing multiple differences between groups

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Decision Analysis – methods of evaluating alternatives based on selected criteria

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Linear Programming – creating and solving optimization problems with linear objective functions and linear constraints

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Simulation Techniques – imitating a real-world process or system over time

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Queuing Theory – the study of waiting in lines

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Critical Path Method (CPM) /Program Evaluation and Review Technique (PERT) – developing and managing project schedules

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

7. Regardless of your own skills, which of the following do you believe are useful analytical tools for your current position? (check all that apply)

   - □ **Descriptive Statistics** – utilizing numerical and graphical methods to observe patterns, gather information and present information in a convenient form
   - □ **Probability** – logically determining likelihood of events
   - □ **Statistical Sampling** - proper data handling techniques
   - □ **Estimating** parameters based on empirical data
   - □ **Variation** – measuring how data is dispersed
   - □ **Averages** – determining an expected value
   - □ **Graphical Statistics** – understanding pie charts, bar charts and histograms
   - □ **Hypothesis Testing** – understanding Type I/II errors
   - □ **Regression** – explaining a Y-response (dependent variable) based on 2 or more independent X variables
   - □ **Time-Series** – Observing trends and seasonality in viewing data in a time series
   - □ **Forecasting** – predicting future Y-values based on past trends or future independent variables
   - □ **Quality** – Quantitatively assessing the quality of a good or service (e.g. Six Sigma)
   - □ **Student's T-tests** – comparing means between two groups
   - □ **Analysis of Variance (ANOVA)** – comparing means between three or more groups
   - □ **Other Multivariate Techniques** – comparing multiple differences between groups
   - □ **Decision Analysis** – methods of evaluating alternatives based on selected criteria
   - □ **Linear Programming** – creating and solving optimization problems with linear objective functions and linear constraints
   - □ **Simulation Techniques** – imitating a real-world process or system over time
   - □ **Queuing Theory** – the study of waiting in lines
   - □ **Critical Path Method (CPM) /Program Evaluation and Review Technique (PERT)** – developing and managing project schedules

8. Using a scale of 1-10, please rate the usefulness of the following analytical tools in your current position

(1 = Not at all useful; 10 = absolutely necessary to perform my duties; Enter "0" If you are not familiar with the analytical tool)

___ **Descriptive Statistics** – utilizing numerical and graphical methods to observe patterns, gather information and present information in a convenient form
___ **Probability** – logically determining likelihood of events
___ **Statistical Sampling** - proper data handling techniques
___ **Estimating** parameters based on empirical data
___ **Variation** – measuring how data is dispersed
___ **Averages** – determining an expected value
___ **Graphical Statistics** – understanding pie charts, bar charts and histograms
___ **Hypothesis Testing** – understanding Type I/II errors
___ **Regression** – explaining a Y-response (dependent variable) based on 2 or more independent X variables
___ **Time-Series** – Observing trends and seasonality in viewing data in a time series
___ **Forecasting** – predicting future Y-values based on past trends or future independent variables
___ **Quality** – Quantitatively assessing the quality of a good or service (e.g. Six Sigma)
___ **Student's T-tests** – comparing means between two groups
___ **Analysis of Variance (ANOVA)** – comparing means between three or more groups
___ **Other Multivariate Techniques** – comparing multiple differences between groups
___ **Decision Analysis** – methods of evaluating alternatives based on selected criteria
___ **Linear Programming** – creating and solving optimization problems with linear objective functions and linear constraints
___ **Simulation Techniques** – imitating a real-world process or system over time
___ **Queuing Theory** – the study of waiting in lines
___ **Critical Path Method (CPM) /Program Evaluation and Review Technique (PERT)** – developing and managing project schedules

Appendix B. Analytical Techniques Survey for Supervisors of LROs

Reassurance of Confidentiality

ALL ANSWERS ARE CONFIDENTIAL. No one other than the research team will see your completed questionnaire. Findings will be reported at the group level only. We asked for some demographic information in order to interpret results more accurately. Reports summarizing trends in large groups may be published.

Our records indicate that you supervise or command one or more Air Force Logistics Readiness Officers (LROs).

<Button that says "I am not a supervisor or commander of an LRO"> - Exit System
<" I am a supervisor or commander of an LRO"> - Proceed

Note: If you are a Logistics Readiness Officer, you may have received a similar survey recently inquiring about your own duties. This is a separate survey related to LROs that you supervise; both surveys need to be completed.

This survey will ask questions related to your views of the LRO career field and will take approximately 10-15 minutes to complete. The questions asked of you are related to the LRO **positions** you supervise, not necessarily the **officers** who hold or have held those positions.

Demographics

1. What is your Rank? (Check box)
    - □ 1st Lieutenant
    - □ Captain
    - □ Major
    - □ Lieutenant Colonel
    - □ Colonel
    - □ General Officer
    - □ GS-09/10
    - □ GS-11
    - □ GS-12
    - □ GS-13
    - □ GS-14
    - □ GS-15
    - □ SES
    - □ Other: Please explain

    _____

2. How many years have you served within the Department of Defense?

    _____

3. What is the highest level of education you have completed?
    - □ Some College
    - □ Bachelor's Degree
    - □ Master's Degree
    - □ Doctorate Degree

4. Which of the following best classifies your present organization?

A. MAJCOM
- □ HQ/USAF – Headquarters, United States Air Force
- □ DRU/FOA - Direct Reporting Unit/Field Operating Agency
- □ ACC - Air Combat Command
- □ AETC – Air Education and Training Command
- □ AFMC – Air Force Materiel Command
- □ AFSPC – Air Force Space Command
- □ AFSOC - Air Force Special Operations Command
- □ AMC - Air Mobility Command
- □ PACAF – Pacific Air Forces
- □ USAFE – U.S. Air Forces in Europe
- □ DLA – Defense Logistics Agency
- □ CENTCOM – United States Central Command
- □ Other – Please Explain

_____

B. Level
- □ Joint Staff
- □ Air Staff
- □ MAJCOM Staff
- □ NAF Staff
- □ Logistics Readiness Squadron
- □ Aerial Port Squadron
- □ Contingency Response Group
- □ Other (Please Explain)

_____

C. Deployed Status
- □ Currently Deployed
- □ Not Currently Deployed

Analytical Tools

5. Using the scale below please indicate your degree of familiarity with of the following analytical tools:

Descriptive Statistics – utilizing numerical and graphical methods to observe patterns, gather information and present information in a convenient form

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Probability – logically determining likelihood of events

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Statistical Sampling - proper data handling techniques

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Estimating parameters based on empirical data

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Variation – measuring how data is dispersed

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Averages – determining an expected value

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Graphical Statistics – understanding pie charts, bar charts and histograms

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Hypothesis Testing – understanding Type I/II errors

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Regression – explaining a Y-response (dependent variable) based on 2 or more independent X variables

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Time-Series – Observing trends and seasonality in viewing data in a time series

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Forecasting – predicting future Y-values based on past trends or future independent variables

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Quality – Quantitatively assessing the quality of a good or service (e.g. Six Sigma)

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Student's T-tests – comparing means between two groups

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Analysis of Variance (ANOVA) – comparing means between three or more groups

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

Other Multivariate Techniques – comparing multiple differences between groups

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

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Decision Analysis – methods of evaluating alternatives based on selected criteria

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

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Linear Programming – creating and solving optimization problems with linear objective functions and linear constraints

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

---

Simulation Techniques – imitating a real-world process or system over time

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

---

Queuing Theory – the study of waiting in lines

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

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Critical Path Method (CPM) /Program Evaluation and Review Technique (PERT) – developing and managing project schedules

☐	☐	☐	☐
Not at all Familiar	Somewhat Familiar, but Have Not Used	Somewhat Familiar & Have Used	Highly Competent & Use Often

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8. Regardless of your own skills, which of the following do you believe are useful analytical tools for the LRO position(s) that you supervise/command? (check all that apply)

- □ **Descriptive Statistics** – utilizing numerical and graphical methods to observe patterns, gather information and present information in a convenient form
- □ **Probability** – logically determining likelihood of events
- □ **Statistical Sampling** - proper data handling techniques
- □ **Estimating** parameters based on empirical data
- □ **Variation** – measuring how data is dispersed
- □ **Averages** – determining an expected value
- □ **Graphical Statistics** – understanding pie charts, bar charts and histograms
- □ **Hypothesis Testing** – understanding Type I/II errors
- □ **Regression** – explaining a Y-response (dependent variable) based on 2 or more independent X variables
- □ **Time-Series** – Observing trends and seasonality in viewing data in a time series
- □ **Forecasting** – predicting future Y-values based on past trends or future independent variables
- □ **Quality** – Quantitatively assessing the quality of a good or service (e.g. Six Sigma)
- □ **Student's T-tests** – comparing means between two groups
- □ **Analysis of Variance (ANOVA)** – comparing means between three or more groups
- □ **Other Multivariate Techniques** – comparing multiple differences between groups
- □ **Decision Analysis** – methods of evaluating alternatives based on selected criteria
- □ **Linear Programming** – creating and solving optimization problems with linear objective functions and linear constraints
- □ **Simulation Techniques** – imitating a real-world process or system over time
- □ **Queuing Theory** – the study of waiting in lines
- □ **Critical Path Method (CPM) /Program Evaluation and Review Technique (PERT)** – developing and managing project schedules

7. Using a scale of 1-10, please rate in your opinion how useful each of the following analytical tools are for the LRO positions that you supervise/command.

(1 = Not at all useful; 10 = absolutely necessary to perform LRO duties;
Enter "0" If you are not familiar with the analytical tool)

___ **Descriptive Statistics** – utilizing numerical and graphical methods to observe patterns, gather information and present information in a convenient form
___ **Probability** – logically determining likelihood of events
___ **Statistical Sampling** - proper data handling techniques
___ **Estimating** parameters based on empirical data
___ **Variation** – measuring how data is dispersed
___ **Averages** – determining an expected value
___ **Graphical Statistics** – understanding pie charts, bar charts and histograms
___ **Hypothesis Testing** – understanding Type I/II errors
___ **Regression** – explaining a Y-response (dependent variable) based on 2 or more independent X variables
___ **Time-Series** – Observing trends and seasonality in viewing data in a time series
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___ **Linear Programming** – creating and solving optimization problems with linear objective functions and linear constraints
___ **Simulation Techniques** – imitating a real-world process or system over time
___ **Queuing Theory** – the study of waiting in lines
___ **Critical Path Method (CPM) /Program Evaluation and Review Technique (PERT)** – developing and managing project schedules

Appendix C. Human Subject Exemption Form

18 Jan 2008

MEMORANDUM FOR AFIT/IRB

FROM: AFIT/ENS

SUBJECT: Request for exemption from human experimentation requirements (32 CFR 219, DoDD 3216.2 and AFI 40-402) for the Air Force Logistics Readiness Officer's (LRO's) Analytical Skills Survey

1. The purpose of this study is to determine which analytical skills are needed by Air Force LROs. Survey responses will be analyzed by Capt Bryan D. Main and reported in a Master's thesis as part of his academic requirements for the Master of Science in Logistics Management degree at the Air Force Institute of Technology. The results of this research will also be reported to the Air Force transformation office (AF/A4I) which is sponsoring the research project.

2. This request is 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.

3. The following information is provided to show cause for such an exemption:

    3.1. Equipment and facilities: Subjects will respond to the survey using a government-issued personal computer.

    3.2. Subjects: This survey will be sent to all active-duty LROs in grades O1-O6 as well as their supervisors--approximately 1,000 personnel. The survey group will not include LROs presently assigned as students; nor will it include LROs serving in special non-LRO duty positions such as ROTC instructors, protocol officers and legislative liaisons.

    3.3. Timeframe: The duration of the study will be approximately 60 days total. Survey respondents will complete the survey within 20 minutes.

3.4. Data collected: Data collected from the subjects will include rank, career field, duty position, organization, and education level. The survey includes both demographic data and questions related to the subjects own understanding of the value of certain analytical skills. A complete list of questions is attached. (See Attachments 1 & 2)

3.5. Risks to Subjects: By participating in this survey, participants could potentially risk having their individual responses disclosed. For this survey, the researchers will not be able to associate names with responses, mitigating the risk of unwanted disclosure. Furthermore, findings based on the data will be reported at the group level only. I understand that the names and associated data I collect must be protected at all times, only be known to the researchers, and managed according to AFIT protocol. 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, I understand I am required to immediately file an adverse event report with the AFIT IRB office.

3.6. Informed consent: All subjects are self-selected to volunteer to participate in the interview. No adverse action is taken against those who choose not to participate. Subjects are made aware of the nature and purpose of the research, sponsors of the research, and disposition of the survey results. A copy of the Privacy Act Statement of 1974 is presented for their review.

4. If you have any questions about this request, please contact Capt Bryan D. Main – Phone (937) 654-5798; E-mail – bryan.main@us.af.mil or Dr. William A. Cunningham (primary investigator) – Phone (937) 656-3636 (x4283); Email – william.cunningham@afit.edu.

WILLIAM A. CUNNINGHAM, PhD
Professor of Logistics Management
Faculty Advisor, AFIT/ENS

BRYAN D. MAIN, Capt
Graduate Student, AFIT/ENS

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Vita

Captain Bryan D. Main graduated from Cabot High School, Cabot, Arkansas. He entered undergraduate studies at John Brown University in Siloam Springs, Arkansas, where he graduated with a Bachelor of Arts degree in History in May 2000. He received his commission through the Reserve Officer Training Corps at the University of Arkansas.

His first assignment was at Dyess AFB where he performed various duties within the 7th Supply Squadron and was the executive officer for the 7th Maintenance Group. In November 2003, he was re-assigned to the 314th Logistics Readiness Squadron in Little Rock, Arkansas where he served as the Installation Deployment Officer and Aerial Operations Flight Commander. While stationed at Little Rock, he deployed to Southwest Asia as the operations officer of the 386th Expeditionary Logistics Readiness Squadron. In August 2006, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology at Wright Patterson AFB, Ohio. Upon graduation, he will be assigned to Air Mobility Command headquarters at Scott AFB, Illinois.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From – To)*
03-24-2008	**Master's Thesis**	Aug 2007 - Mar 2008

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ANALYTICAL TECHNIQUES AND THE AIR FORCE LOGISTICS READINESS OFFICER

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5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Main, Bryan D., Captain, USAF

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)

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8. PERFORMING ORGANIZATION REPORT NUMBER

AFIT/GLM/ENS/08-9

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

HAF/A4I
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13. SUPPLEMENTARY NOTES

14. ABSTRACT

As the Air Force begins to implement the Expeditionary Combat Support System (ECSS), it is imperative that Air Force logisticians competently analyze logistics data. This exploratory study sought to determine which analytical skills are useful for Logistics Readiness Officers (LROs), as reported by active-duty LROs in grades O1-O5 and their supervisors. The research question was answered through a comprehensive literature review and the use of survey methodology. Over five hundred LROs and supervisors provided inputs. Analysis of survey responses found that Forecasting, Graphical Statistics and Descriptive Statistics are the analytical techniques valued most by both LROs and their supervisors. LROs and their supervisors valued the same techniques, though supervisors considered them to be more important. Company grade officers reported a higher degree of usefulness for each technique than field grade officers did. Responses were compared across groups of LROs and found to be consistently similar. This research noted the reported importance of Forecasting techniques among LROs and identified a potential gap between perceived usefulness and competence levels.

15. SUBJECT TERMS
Logistics, Logistics Readiness Officer, 21R3, 21RX, Analytical Skills, Analysis, Air Force Logistics, elog21, Enterprise Resource Planning, Logistics Plans, Logistics Training, Logistics Education, military logistics, logistics officer, logistics manager, transportation officer, supply officer, analytical skills, analytics

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			William A. Cunningham, PhD, USAF (ENS)
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