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**CENTRALIZED VERSUS DECENTRALIZED
PURCHASING OF MEDICAL MATERIEL**



**A Graduate Research Project
Submitted to the Faculty of
Baylor University
In Partial Fulfillment of the
Requirements for the Degree
of
Master of Health Administration**

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by
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CHAPTER I

INTRODUCTION

General

The cost of health care in the United States has been rising at an alarming rate. While the price inflation of the general economy rose 6.1 percent between 1981 and 1982, the medical component of the Consumer Price Index rose 11.6 percent.¹ As a result of this climb in health care costs the question of cost containment has become a significant issue in the health care field. Recent actions by the Federal government such as the Tax Equity and Fiscal Responsibility Act of 1982, and the subsequent move to prospective reimbursement for MEDICARE are strong indicators of the importance attached to controlling the rise in health care costs.

In response to this question of cost containment, there are three primary areas in which health care administrators can control costs. These areas are facilities, labor and materiel. In his 1978 book on materiel management, C. E. Housley cites materiel or supply costs as accounting for 18 to 25 percent of the hospital expense budget, and growing at a rate one and

one-half times that of personnel expenses.² Therefore, it is reasonable to expect that any reductions in materiel costs will have significant impact on total hospital expenses.

Federal Sector

Federal hospitals are not immune from criticism over high costs, as evidenced by the President's Private Survey on Cost Control - Task Force Report on Federal Hospital Management submitted in May 1983.³ One of the areas specifically addressed in the report is the materiel management in Federal hospitals. Following is a comment on materiel management from that report:

The MHCS (Military Health Care System) and VA (Veterans Administration) health care systems operate an anachronistic and costly depot system for distributing medical supplies. Despite this depot system, an excessive amount of expensive local-market purchasing takes place that largely defeats the economies inherent in purchasing on national contracts.⁴

The Task Force report strongly recommends the use of centrally negotiated contracts. The report recommends that through the use of these national contracts the percentage of locally procured medical materiel could be reduced from its current 40 percent level down to 15 to 25 percent of medical materiel purchased.⁵

Civilian Trends

The Task Force recommendations mirror trends in

the civilian sector. The development of shared or group purchasing activities and the subsequent establishment of large scale contracts has been a technique for cost containment embraced by the civilian sector. According to an article by Paul E. Widman published in the February 1982 edition of Hospital Materiel Management Quarterly the number of group purchasing organizations has grown from approximately 25 in 1972 to over 200 at the time of his article.⁶ Group purchasing programs generally involve a central entity which negotiates contracts on behalf of the participating hospitals. The contracts with vendors normally fix unit prices and other important provisions such as returns and delivery. The participating hospitals then place orders against these standing contracts. The major advantages of these arrangements include reduced unit prices, made possible by the combined market influence of the participating hospitals, and reduced administrative costs associated with not having to negotiate separate contracts.

The savings attributed to the use of group purchasing are significant. Estimated savings of \$320 per bed were attributed to the Alabama Hospital Association Group Purchasing Program for the period of December 1979 through November 1980.⁷ Average savings of \$400 per bed at Saint Vincents of Richmond in Staten Island, New

York, were attributed to participation in the Group Purchasing Program of Greater New York Hospital Association Services.⁸ A Columbus, Ohio, Program is credited with a 12 percent annual savings in purchases.⁹

Existing Environment

In the Federal sector common use items and mobilization significant medical materiel are centrally procured, centrally stored, and distributed through the Defense Logistics Agency (DLA) and Veterans Administration (VA). Some national centralized contracts are negotiated and administered by the General Services Administration (GSA) and VA which allow for decentralized ordering. These contracts are referred to as Federal Supply Schedules (FSSs). However, Department of Defense (DOD) procurement policy limits the ordering through FSSs only to authorized contracting officers. In the Army, the authorized ordering officials are normally located in consolidated installation procurement offices, and are not members of the hospital administrative staff. This situation appears to reduce many of the potential administrative savings associated with these contracts.

The Defense Personnel Support Center (DPSC) of DLA provides another acquisition tool in the form of their Decentralized Blanket Purchase Agreements (DBPAs).

There are currently one hundred of these DBPAs.¹⁰ These agreements allow hospital logistics personnel to place orders directly with the vendors. These agreements have a limitation in the form of a \$10,000 ceiling per order.¹¹

The DPSC also provides a centralized contracting function for non-standard (items not stocked in the DLA depot system) medical items in support of Army and Air Force hospitals located outside the continental United States (CONUS). DLA responsibility for this support to overseas Army and Air Force activities is recorded in DLA Manual 4140.2, Volume I. This publication carries the Army designation of Army Regulation 735-110.¹² In this situation the requirement is electronically transmitted by the overseas activity to DPSC and the order placed by their contracting personnel for delivery to the requesting hospital.¹³

The cited institutions, policies and procedures result in a pattern in which Army hospitals within CONUS acquire non-standard medical materiel through the local installation contracting offices. Army hospitals outside CONUS acquire non-standard medical materiel through DPSC's centralized contracting office. The DBPAs represent another avenue for acquisition of a limited range of requirements, but is generally available to both CONUS and overseas Army hospitals.

Tripler Army Medical Center (TAMC) represents a unique opportunity to compare the approaches to ordering non-standard medical materiel. TAMC has a Purchasing and Contracting Branch within its Logistics Division, and can therefore participate in local purchase operations to support medical materiel needs. Since TAMC is outside CONUS, DPSC will provide central contracting support for non-standard medical materiel requirements. This situation provide the opportunity to compare the performance of centralized versus decentralized or local contracting support.

Statement of the Research Question

That DOD level centralized contracting is more cost-effective than local contracting in the acquisition of non-standard medical materiel for Tripler Army Medical Center.

Objectives

The following list of objectives sets forth the tasks to be accomplished in order to provide an answer to the research question:

1. Conduct a review of the literature.
2. Determine and compare unit price estimates for non-standard medical materiel acquired through centralized contracting and through local contracting.
3. Determine estimate of savings or costs

associated with estimated changes in total medical materiel inventory (materiel on-hand and on-order), as a result of estimated differences in order and shipment times (OSTs) for non-standard medical materiel acquired through centralized contracting and through local contracting.

4. Determine and compare estimates of quality for centralized contracting and local contracting in terms of requisition rejection or cancellation; shipment damage; incorrect items; and incorrect quantities.

5. Answer the research question (test the hypothesis) based on the objectives set forth and the criteria established .

6. Construct recommendations on the acquisition of non-standard medical materiel at TAMC based on the outcome of the research.

Criteria

The following criteria were used to determine if DOD level centralized contracting is a more cost-effective method for acquiring non-standard medical materiel than local contracting at TAMC:

1. The percentage difference in unit price estimates must be significantly lower for centrally contracted materiel using a five percent level of significance.

2. The OST estimates must be significantly lower for centrally contracted materiel using a five percent level of significance.

3. The proportion of quality related incidents must not be significantly greater for centralized contracting at the five percent level of significance.

Limitations

The following factors proved to be limiting factors in the course of this research project.

1. Operational necessities in the Materiel Branch at TAMC limited the sample size of paired requisitions to 57.

2. Operational necessities in the Materiel Branch at TAMC precluded the use a systematic method to insure the randomness of the sample.

3. The sample size was further reduced because of the erroneous inclusion of eight paired requisitions for items which were depot stocked at the time of submission.

4. The data used to construct the segments on order and shipment time was obtained from automated files and dependent on the accuracy of the input to those files.

5. The study was accomplished using data compiled at TAMC. The transferability of results to CONUS

Army Medical Treatment Facilities may not be straightforward because of facility unique differences in local contracting support arrangements and/or proximity to medical materiel suppliers.

Definitions

The following are a number of terms which carry specific definitions when used in this project.

1. Non-standard medical materiel: Items of medical materiel which are not stocked in the DLA depot system. These items may or may-not be stocked by the hospital materiel branch.

2. Non-standard, non-stocked medical materiel: Medical materiel not stocked in the DLA depot system and not stocked by the TAMC Materiel Branch.

3. Order and shipment time (OST): The time from the submission of the requisition until receipt of the requisitioned item. The receipt date indicated on the materiel receipt transaction loaded into SAILS-ABX was used to close out the OST measurement. This figure was used instead of the cycle date on which the transaction was posted.

4. Procurement administrative lead time (PALT): The time from the submission of the requisition until a contract is awarded with a vendor.

5. Vendor and shipment time: The time from

contract award until receipt of the requisitioned item.

Research Methodology

The basic research tool used to meet the research objectives and answer the research question was a prospective study of a sample of paired non-standard medical materiel requirements. Requirements from the customer level were split at the time of submission, and equal quantities were submitted for acquisition through the local purchasing branch and to DPSC for central contracting. The paired requisitions were then tracked and data gathered on the unit prices, OSTs, and number of quality discrepancies for each of the sample requisitions.

Using the unit price data, a paired data test on the percentage difference in unit price was used to determine a mean difference in unit price. A paired data hypothesis test was then used to determine if the sample difference was significant at the five percent level of significance. A paired data test was used to determine the mean sample difference in OSTs. Again, a hypothesis test was used to determine if the sample difference was significant at the five percent level of significance. The quality discrepancy data was used to determine a sample proportion of quality discrepancies for each method of acquisition. A chi-square test was performed

to determine if quality discrepancy occurrence was independent of the method of procurement at the five percent level of significance.

An indicator of the dollar value savings associated with OST changes was obtained by using the dollar value of a day of inventory at TAMC and multiplying it by the proportion of non-standard materiel stocked at TAMC. This provided an indicator of the dollar value of a day of non-standard materiel inventory. The estimated value of changes in OST were then reflected as one time savings in inventory investment plus the recurring savings in inventory carrying costs. The inventory carrying costs were based on an accepted national figure and the estimated value of the difference in total inventory.

Footnotes

¹Hospital Week. 20(3), 20 January 1984, p. 1.

²C. E. Housley. Hospital Materiel Management (Germantown, MD: Aspen, 1978), p. 4.

³President's Private Sector Survey on Cost Control - Task Force Report on Federal Hospital Management. (May 17, 1983), p. 5.

⁴Ibid.

⁵Ibid., p. 6.

⁶P. E. Widman, "Group Purchasing - The Results of a Long and Arduous Endeavor," Hospital Materiel Management Quarterly 3 (February 1982): 46-7.

⁷ M. J. Brzezicki and P. Reed, "What Makes a Successful Group Purchasing Program?" Hospital Materiel Management Quarterly 3 (February 1982): 2.

⁸ "Group Purchasing Program Helps Participating Hospitals Save Thousands," Cost Containment 5 (12 July 1983): 6.

⁹ R. L. Sims, "Group Purchasing Makes Sense: An Administrator's Prospective," Hospital Materiel Management Quarterly 2 (November 1981): 3.

¹⁰ U. S. Department Of The Army Supply Bulletin S B 8-75-1, (Headquarters Department Of The Army, Washington, D. C. 20310, 6 January 1984), pp.56-8.

¹¹ Ibid., p.10.

¹² U. S. Defense Logistics Agency. Supply Operations Manual, Defense Logistics Agency Manual (DLAM) 4140.2, Vol. I, Chp. 4, "Processing Requisitions/Issue Transactions." Section VIII, pp. 4-44.

¹³ U. S. Department Of The Army Supply Bulletin S B 8-75-1, p.10.

CHAPTER II

DISCUSSION

Sample Determination

The operational considerations of maintaining uninterrupted medical materiel support to the hospital was the major factor influencing the nature of the sample used. The initial sample size calculations resulted in sample sizes which were far in excess of what was operationally feasible. See Appendix A for these initial computations. The sample size calculation was based on data from the U. S. Army Medical Materiel Agency's October 1983 "Supply Effectiveness Report."¹ Frequency distribution data on OSTs for TAMC non-standard requisitions sent to DPSC was extracted. This data was used to determine an estimate of 37.34 days for the standard deviation for OSTs on TAMC non-standard requisitions. The use of this figure and an allowable maximum error of two days at a five percent level of significance resulted in a sample size in excess of 1300 requisitions.

The time required to identify potential candidate requirements, split them into two requisitions,

submit the requisitions and track the resulting data on OST, unit price, and quality factors limited the sample size to 57 paired requisitions submitted over the period of November 1983 through February 1984.

The sample was composed of nine requirements identified by the Pharmacy Supply Section, which is one of the primary users of non-standard, non-stocked items. The remaining 48 requirements were identified by the Inventory Management Section of the Materiel Branch.

There was no formal system used to insure the randomness of the sample. However, the method for developing the sample leads to the logical assumption that the sample was random in nature. The inventory managers and the pharmacy supply clerks selected the sample. The primary criteria was that the requirement was for a non-standard item. Based on this criteria, the managers and clerks selected the sample as eligible requirements presented themselves, and as time permitted them to undertake the process of developing dual requisitions. Since all of the inventory managers and pharmacy supply participated in the sample selection, the entire spectrum of medical material used at TAMC became candidates for selection.

Gross Sample Data

Appendix B displays the original 57 requirements

and the paired requisitions developed for each of the requirements. The appendix also shows the submission dates, contract dates, receipt dates, OSTs, unit prices, and quality information on each of the requisitions in the sample.

A number of the original requirements were removed from the sample. Eight of the original requirements were discovered to be depot stocked by DLA and were eliminated from any of the subsequent computations. The paired data analysis required a valid contract price on each set of paired data. The effective sample available for these computations was 37 paired requisitions. The OST paired data analysis required the receipt of the requisitioned item. This requirement reduced the sample for this analysis to 33 paired requisitions. The chi-square analysis of quality defects also required receipt of the requisitioned items or valid information concerning the cancellation of the requisition. This analysis was not a paired data test and each requisition was considered a separate trial. The sample for this analysis was 91 total requisitions, 45 DPSC requisitions and 46 Local Purchase requisitions.

Data Sources

Data was derived primarily from two automated requisition data files. TAMC's Standard Army

Intermediate Level Supply Subsystem (SAILS-ABX) was the source for submission and receipt dates for all the requisitions. SAILS-ABX was also the primary source for unit price data on the locally purchased requisitions. The Requisition Management System (RMS) operated by the U. S. Army Medical Materiel Agency was the source for contract dates and unit price data for the requisitions submitted to DPSC. The contract files maintained by TAMC's Materiel Branch were the source for the contract dates, and were used to verify unit price data on the locally purchased requisitions. Quality data in the form of cancellation status was taken from both the RMS and SAILS-ABX. Quality data concerning the item quantity and item correctness was gathered from the inventory managers in the Materiel Branch and Pharmacy Supply Section. Quality data on requisition cancellations or rejections was taken from SAILS-ABX.

Unit Price Data

Table 1 shows how the paired data sample of 37 paired requisitions resulted from the original 57 requirements. Appendix C contains the results of the paired data comparison of the unit price data. The difference in unit prices was expressed as a percentage of the unit price for the DPSC contracted item. This was done so that the relative difference in unit prices

could be used, as opposed to an absolute difference in unit price. An absolute difference in unit price would not have indicated any trends since the unit prices between different requirements is not ratio scale data.

Table 1
Unit Price Sample

<u>Category</u>	<u>Number</u>
Original Sample	57
Removed From Sample because Pair Included:	
Depot stocked item	< 8>
Cancellation status	<10>
Lack of Contract data	< 2>
Sample Used for the Unit Price Comparison	37

The paired data revealed that for this sample the DPSC unit price was slightly lower than the unit price on the Local Purchase requisitions. The total difference expressed in terms of the DPSC unit price was only minus 2 percent. The mean difference was minus 0.059 percent of the DPSC price. The Standard Deviation for the differences was .39965 or 39.965 percent.

In the sample of 36 paired requisitions there

were five pairs with the same unit prices; there were 11 pairs in which the DPSC price was the lower; and 21 pairs in which the Local Purchase price was lower.

The hypothesis test used to determine if this difference was significant is displayed in Appendix C. The results of the hypothesis test indicate that at the five percent level of significance there is no significant difference in the unit price data, and it cannot be concluded that the DPSC unit price is significantly lower than the Local Purchase unit price.

Order and Ship Time (OST) Data

The OST data was also analyzed using a paired data analysis. From the original sample of 57 requirements, 33 paired requisitions were suitable for use in the paired data analysis. To be used in this paired data analysis, each of the paired requisitions must have a valid receipt date for the item requisitioned. Table 2 shows how the 33 paired requisitions resulted from the original 57 requirements.

Appendix D contains the paired data test. The difference in OST was reflected as the DPSC requisition OST minus the corresponding Local Purchase requisition OST. Therefore, a negative difference would result from lower DPSC OSTs, and a positive difference would result from lower Local Purchase OSTs. The total difference

for the entire sample was 659 days. The mean difference was 19.97 days, and the standard deviation of the differences was 28.63 days.

Table 2
OST Sample

<u>Category</u>	<u>Number</u>
Original Sample	57
Removed from sample:	
Depot Stocked item	< 8>
Cancellation status	<10>
Lack of receipt date	< 6>
Sample used for the OST comparison	33

The mean OSTs for both the DPSC and Local Purchase requisitions are included in Appendix D. However, because some of the paired requisitions were not included because either the DPSC or the Local Purchase requisition had not been recorded as received as of the cutoff date of 19 April 1984 (Julian Date 4110) the OSTs will be an understatement of the actual mean OSTs for either of the categories. Non-receipt of DPSC requisitions removed four requirements from the paired data analysis, while two requirements were removed because Local Purchase requisitions had not been received.

The Local Purchase requisitions had a shorter OST, as shown by the average difference of 19.97 days. These results made it obvious that the OSTs for the DPSC requisitions would not be significantly lower than the Local Purchase OSTs. However, when the hypothesis that Local Purchase OST is lower than DPSC OST is tested, the difference in OSTs is significant at the five percent level of significance. See Appendix D for the hypothesis test.

There are two primary segments which make up order and shipment time. The first is termed procurement administrative lead time or PALT. For the purpose of this project, this segment covers the time from requisition submission until the date a contract is awarded for the requisition. The second segment is the vendor and shipment time. This segment covers the time from the contract award date until the requisitioned item is received. Comparisons of performance in both these segments was conducted, again using a paired data test.

In order to include a requirement in the analysis of PALT, contract award data must have been available for each of the paired requisitions. Table 3 shows how the sample for the PALT test was developed from the original sample.

Table 3

PALT Sample

<u>Category</u>	<u>Number</u>
Original Sample	57
Removed from sample:	
Depot Stocked items	< 8>
Cancellation status	<10>
Lack of contract data	< 1>
Sample used for PALT comparison	38

The PALT paired data analysis is shown in Appendix E. The total difference in days was 254, and the mean difference was 6.68 days. Since the difference was computed as the DPSC PALT minus the Local Purchase PALT, the results indicate that the PALT for the Local Purchase requisitions in the sample averaged about six and a half days less than the PALT for the DPSC requisitions. The standard deviation in the differences was 16.94 days.

The hypothesis test contained in Appendix E indicates that at the five percent level of significance there is a significant difference in the PALT for DPSC requisitions and the PALT for Local Purchase requisitions. This indicates that procurement and administrative lead times are a significant reason that the OSTs

for the Local Purchase requisitions were significantly lower than the DPSC requisitions.

The vendor and shipment time segment of the OST is the time required by the vendor to process the contract, and ship the item, and the shipping time. The paired data analysis for vendor and shipment times is contained in Appendix F. In order to be included in this analysis the requirements must have contract data and receipt data on each of the paired requisitions. Table 4 shows the make-up of the sample used in the vendor and shipment time analysis.

Table 4
Vendor and Shipment Time Sample

<u>Category</u>	<u>Number</u>
Original Sample	57
Removed from sample:	
Depot Stocked items	< 8>
Cancellation status	<10>
Lack of contract data	< 1>
Lack of receipt data	< <u>5</u> >
Sample used for the vendor and shipment time comparison	33

The total difference in vendor and shipment time

was 428 days. The mean difference was 12.97 days, and the standard deviation was 26.85 days. The difference reflects the DPSC requisition vendor and shipment times minus the Local Purchase requisition vendor and shipment times. Therefore, the data from the sample indicates that the Local Purchase requisitions have a shorter vendor and shipment time segment.

The hypothesis test on the results of the vendor and shipment time paired data test is also contained in Appendix F. The hypothesis test indicates that at the five percent level of significance the vendor and shipment times of the Local Purchase requisitions are significantly less than the corresponding times for the DPSC requisitions.

In order to place some value on the influence of differences of order and shipment times, it is necessary to estimate the dollar value of a day of supply at TAMC. Each one day reduction in OST equates to a one day reduction in total supply inventory equal to the value of a day of supply. This reduction in inventory represents a one time investment savings which can be estimated by the multiplication of the difference in days by the value of a day of inventory, plus a recurring savings in the inventory carrying costs needed to support that day of inventory.

Because of its usefulness in estimating the total dollar value in inventory, each of the HSC medical supply accounts computes and reports a dollar value for a day of inventory. This figure is computed by taking the dollar value of demands for stocked items (supplies ordered) for the previous twelve months and dividing this figure by 365 days.² Based on the 31 December 1983 Quarterly Stratification Report the dollar value of a day of inventory at TAMC was \$20,958.90.³ This was computed from twelve month demands of \$7,650,000 divided by 365 days.

The difference in OST computed in the sample is an estimate of the population of non-standard requirements and not the population of all demands. In order to make use of the dollar value of a day of inventory figure, an estimate of the proportion of the inventory which is non-standard was needed. An estimate of this figure was developed based on a sample of 370 lines of items stocked out of a population of 4441 total lines stocked at TAMC.

The random sample of 370 lines was developed by taking every twelfth line of a SAILS-ABX special report which listed all the lines stocked at TAMC in National Stock Number sequence. The sample lines were then screened against the SAILS-ABX Combined Master Data File

and classified as standard or non-standard lines. Sixty five of the 370 lines or a proportion of 0.1757 of the sample lines were non-standard and eligible for local procurement. The 95 percent confidence interval for this sample was 0.1757 plus or minus 0.0388. This means that there is a probability of .95 that the true proportion of non-standard lines in the population of lines stocked at TAMC is between 0.2145 (21.45%) and 0.1369 (13.69%). See Appendix G for the proportional analysis, and the confidence interval calculation.

Multiplying the dollar value of a day of inventory, \$20,958.90, times the estimated proportion of non-standard lines stocked, 0.1757, gives an indicator of the dollar value of a day of non-standard inventory at TAMC. The resulting indicator of the dollar value of a day of non-standard inventory is \$3,682. This figure multiplied by the estimated difference in OST yields an indicator for the investment difference between the two methods of procurement.

The difference in OSTs, 19.47 days, times the indicator for the dollar value of a day of non-standard inventory, \$3,682, equals approximately \$71,688. This figure represents an indication of the possible one time investment difference between Local Purchase and DPSC procurement. In addition to the one time investment

savings, a reduction in inventory also yields savings in inventory holding or carrying costs. These carrying costs include costs due to expiration, spoilage, pilferage, storage space, and handling.

Published figures vary considerably on what the inventory carrying costs average. Figures as high as 32 percent of inventory annually are cited.⁴ Ammer cites a more conservative figure of 20 percent annually.⁵ Taking the inventory investment savings figure, \$71,688, and multiplying it by the conservative carrying cost figure of 20 percent annually yields \$14,338.

These figures are an indicator of the annual difference between Local Purchase and DPSC procurement indicated by the sample OST data. It should be remembered that these dollar value figures for the value of a day of non-standard inventory, one time investment differences and annual carrying cost differences are indicators and are not precise enough to be considered population estimates. However, they are useful indicators of the relationships between order and shipment times and costs, and of the general magnitude of these costs.

The order and shipment time data does not support the criteria that OST estimates must be significantly lower for centrally contracted materiel at the

five percent level of significance. The difference in OSTs was significant at the five percent level of significance; however it was the Local Purchase requisitions which had the shorter OSTs. The breakdown of the OST segments showed that Local Purchase was significantly lower for both the procurement and administrative lead time segment and the vendor and shipment time segment.

Quality Data

The quality of procurement action was viewed in terms of either satisfactory quality or unsatisfactory quality. Unsatisfactory quality consisted of four areas of discrepancies. These were: 1) Cancellation of an order; 2) Receipt of the wrong item; 3) Receipt of the wrong quantity; and 4) Receipt of damaged items.

The original intent was to use the 57 paired requirements and determine a proportion of unsatisfactory requisitions for both the sample of DPSC requisitions and the sample of Local Purchase requisitions. The requisitions for stocked items were removed from each sample, as were any requisitions that had not been received. This left 45 DPSC requisitions and 46 Local Purchase requisitions for the respective samples. The intent was to compute the proportions of unsatisfactory requisitions based on quality, and then determine if

there was a significant difference in the proportions using a hypothesis test for the difference between two population proportions. Table 5 shows the unsatisfactory requisitions by category and the computed proportions of unsatisfactory requisitions for both the DPSC sample and the Local Purchase sample.

Table 5

Quality Proportions

<u>Category</u>	<u>DPSC</u> <u>Requisitions</u>	<u>Local Purchase</u> <u>Requisitions</u>
Total Sample	45	46
Cancellations	9	2
Wrong Item	1	0
Wrong Quantity	0	0
Damaged Items	0	0
Total Unsatisfactory	10	2
Total Satisfactory	<u>35</u>	<u>44</u>
Proportion Unsatisfactory	0.222	0.043

In order to conduct a valid hypothesis test between two sample proportions, the sample proportions must be approximated by a normal distribution. This approximation is satisfactory, if the sample size multiplied by the proportion and multiplied by one minus the proportion are both greater than five ($np > 5$ and $n(1-p) > 5$) for both samples.⁶ The quality sample data failed

to meet this criteria ($46 \times 0.043 = 1.978$). In place of the hypothesis test a chi-square test was used to indicate, if the variable of satisfactory or unsatisfactory quality was independent of the variable of procurement source.

In order to conduct the chi-square test the sample requisitions were considered one sample and then classified by their quality and procurement source into four categories, or a two by two chi-square table. See Appendix H for the table, and the chi-square computations. At the five percent level of significance it was possible to reject the hypothesis that quality and procurement source were independent variables. This indicates that these variables are not independent. This information coupled with the proportions displayed in Table 5, indicate that unsatisfactory requisition quality is less frequent in Local Purchase requisitions, and is not independent of the source of procurement. At the five percent level of significance, it could not be concluded that the percentage of quality related discrepancies was not significantly greater for centralized contracting.

It is worthy to note that all but one of the quality discrepancies fell into the cancellation category. Nine of the eleven cancellations were on the DPSC

requisitions. Three were rejected because DPSC was unable to identify the requisitioned item (CG status). Two each were cancelled because no record of the original requisition (BF status); stock number changed (BG status); and due to minimum order requirements (BQ status). Both of the Local Purchase requisitions were cancelled because of no record of the original requisition (BF status). It appears that the automated edits associated with the larger wholesale level requisition processing are less forgiving than the manual edits used in the local contracting office.

General Results

The unit price sample data showed only a slight average difference in unit price in favor of the DPSC or centrally contracted requisitions. However, at the five percent level of significance the difference between the unit prices was not significant. This data indicates that for the population of non-standard requirements at TAMC, there is no difference in the unit prices between centrally contracted and locally contracted requirements.

The analysis of order and shipment time data indicated that at TAMC centrally contracted non-standard requirements were not lower than decentrally contracted non-standard requirements. In fact at the five percent

level of significance the sample data indicates that the OST for the decentrally contracted requisitions is significantly lower than the centrally contracted requisitions. This trend carries through on both the procurement and administrative lead time, and vendor and shipment time segments of the OST. In both segments the Local Purchase performance was significantly better than the DPSC performance.

In the area of quality, the chi-square analysis of the data indicates that at the five percent level of significance satisfactory or unsatisfactory quality is not independent of the source of contracting. In the sample data, the proportion of quality discrepancies was higher for the centrally contracted requisitions. These factors indicate that centrally contracted non-standard requirements from TAMC experience a higher proportion of quality discrepancies.

Footnotes

¹U. S. Army Medical Materiel Agency, "Supply Effectiveness Report," (October 1983).

²Interview with Dee Hanson, Inventory Management Specialist at Tripler Army Medical Center, 13 February 1984.

³Ibid.

⁴R. C. Mitchell, "Hospital Wide Inventory Turnover Gives Hospitals Positive Results," Hospitals 52 (July 1, 1978): 108.

⁵ D. S. Ammer, Hospital Materials Management:
Neglect and Inefficiency Promote High Costs of Care
(Boston: Bureau of Business and Economic Research,
Northeastern University, 1974), p.52.

⁶ Lecture by Lieutenant Colonel A. Badgett
titled "Hypothesis Testing for the Difference Between
Two Population Proportions," U. S. Army/Baylor Program
in Health Care Administration, Fort Sam Houston, Tx, 16
November 1982.

CHAPTER III

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The research question was to determine if DOD level centralized contracting is more cost-effective than local contracting in the acquisition of non-standard medical materiel for Tripler Army Medical Center. In order to answer the research question, data was gathered and analyzed in three areas. These areas were unit price of the materiel, order and ship times for the materiel, and quality discrepancies on the materiel requirements.

The criterion in the area of unit price performance required that the unit price estimates for centrally contracted materiel must be significantly lower than the locally purchase materiel at the five percent level of significance. The unit price data failed to support this criterion. The centrally contracted materiel in the sample averaged 0.05 percent less than the corresponding locally contracted materiel, but this difference was not significant at the five percent level of significance.

The second criterion required that the OST estimates for the centrally contracted materiel must be significantly lower than the locally purchased materiel at the five percent level of significance. The paired data test on OST times not only failed to show that the OST for centrally contracted materiel was lower, but it showed locally purchased materiel with OSTs which averaged 19.97 days lower than their corresponding DPSC materiel. This difference was significant at the five percent level of significance.

The final criterion was that quality related discrepancies must not be significantly greater for centralized contracting at the five percent level of significance. The quality sample data resulted in the centrally contracting materiel experiencing a higher proportion of quality discrepancies. The chi-square test of independence indicated that the quality discrepancies were not independent of the contracting source. These results make it impossible to conclude that the proportion of quality related discrepancies for centrally procured materiel is not greater than for locally purchased materiel.

Centralized contracting failed to meet any of the cost-effectiveness criteria established. Based on the data gathered and analyzed and the criteria

established beforehand, it can be concluded that DOD centralized contracting is not more cost effective than local contracting in the acquisition of non-standard medical materiel for Tripler Army Medical Center.

Recommendations

The primary recommendation resulting from the conclusions is not to actively increase the level of non-standard medical materiel requirements submitted to DPSC for central procurement. The data clearly indicates that there are longer OSTs associated with DPSC procurement, a relationship between DPSC as a source and quality discrepancies, and no significant reductions in the unit prices. An increase in the number of non-standard requirements processed for Local Purchase is not recommended until further analysis is accomplished concerning the relationship between workloads, staffing, and OSTs for locally purchased requirements.

There are a number of areas for potential follow-on or related research studies. In the June or July of 1984 time frame TAMC is scheduled to begin receiving the bulk of its medical materiel shipments via military airlift.¹ This program is titled Air Line of Communications - Hawaii (ALOC-H). ALOC-H is geared primarily to the shipment of DLA depot stocked materiel, but a considerable amount of non-standard materiel may

be shipped via this program. An interesting and valuable study would be the evaluation of ALOC-H on non-standard requisition OSTs. A second potential area for study is the cost-effectiveness of the DLA Decentralized Blanket Purchase Agreements as a source of non-standard procurement.

Additional areas for study include the relationship between staffing levels, workload levels, and cost-effectiveness of non-standard procurement at both the local (decentralized) and DPSC (centralized) levels. Finally, a comparison of TAMC unit prices with unit prices for the same item in the local civilian hospitals would make an interesting topic of study.

Footnote

¹ Interview with Major S. Mervis, Staff Officer, Office of the Surgeon General, at Tripler Army Medical Center, April 1984.

APPENDIX A
SAMPLE SIZE CALCULATIONS

SAMPLE SIZE CALCULATIONS

F=FREQUENCY

M=MID-POINT

X=MEAN

S=STANDARD DEVIATION

	F	M	M*F	(M-X)SQR*F
	21	19	399	34837.5909
	41	38	1558	19359.9089
	29	63	1827	310.0941
	15	88	1320	11987.8935
	6	113	678	17026.1574
	6	138	828	36757.1574
	3	163	489	31994.0787
	1	188	188	16453.1929
SUM	122	810	7287	168726.0738

$$X = \text{SUM}(M*F) / \text{SUM}(F) = 7287 / 122$$

$$X = 59.73 \text{ DAYS}$$

$$S = \text{SQR ROOT} (\text{SUM}((M-X) \text{SQR} * F / \text{SUM}(F) - 1))$$

$$S = \text{SQR ROOT} (168726.0738 / 121)$$

$$S = \text{SQR ROOT} (1394.42)$$

$$S = 37.34 \text{ DAYS}$$

n=SAMPLE SIZE

Z=Z-SCORE AT .05 LOS

d=MAXIMUM ALLOWABLE ERROR

$$d = 2 \text{ DAYS}$$

$$Z = 1.96$$

$$n = (Z) \text{SQR} * (S) \text{SQR} / (d) \text{SQR}$$

$$n = (1.96) \text{SQR} * (37.34) \text{SQR} / (2) \text{SQR}$$

$$n = 1339 \text{ REQUISITIONS}$$

APPENDIX B

SAMPLE

NATIONAL STOCK NUMBER		START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
NOMENCLATURE	REQUISITION (S9M)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
REQUISITION (LPC)						
1.)6505 NS						
ENSURE PLUS						
WX3JN833577701	3357	4004	4013	23.20		
WX3JN833567784	3357	4005	4017	16.71		
2.)6505 NS						
NASALCROM (4% CROMOLYN SOD. NASAL SOLN.)						
WX3JN833567705	3357	3364	4010	7.10		
WX3JN833547727	3357	3363	4019	6.28		
3.)6505 NS						
PLATINOL INJ. NDC: 0015-3072-97						
WX3JN833567706	3357	3365	4034	128.80		
WX3JN833567739	3357	4003	4010	118.17		
4.)6505 NS						
PRONESTYL INJ. 500 MG/ML NDC: 0063-1443-04						
WX3JN833567707	3357	4010	4010	10.64		
WX3JN833547731	3357	4002	4012	7.95		
5.)6505 NS						
KONYNE IV SOL. NDC: 00161-0620-20						
WX3JN840097758	4031	4042	4067	80.00		
WX3JN840097757	4009	4016	4019	49.00		
6.)6505 NS						
ORTHO NOVUM 10/11 21'S (288 CYCLES/BX) NDC: 62-1770-20						
WX3JN840117736	4031	4087		288.00		
WX3JN840117729	4011	4019	4027	288.00		
7.)6505 NS						
CALAN TABLETS NDC: 0025-1851-31						
WX3JN840117738	4031	4039	4047	21.53		
WX3JN840117735	4011	4023	4027	10.78		

NATIONAL STOCK NUMBER
NOMENCLATURE

REQUISITION (S9M)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
REQUISITION (LPC)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES

8.)6505 NS

CARDIZEM TABLETS NDC: 0088-1771-47

WX3JN840117737	4031	4038	4045	20.01	
WX3JN840117730	4011	4018	4024	16.00	

9.)6505 NS

ZANTAC TABLETS NDC: 0173-0344-42

WX3JN840117739	4031	4042	4067	41.66	
WX3JN840117732	4011	4018	4030	37.34	

10.)650500C996178

CEPHAPIRIN SOD. STER. EQUIV. TO 1 GM CEPHAPIRIN 100ML

WX3JN733637024	3363	4019	4058	2.33	
WX3JN733577002	3363	4003	4012	1.89	

11.)6505011562050

HYDROCORTISONE TOPICAL SPRAY AEROSOL 58 GM

WX3JN733567015	3356				CG STATUS 4061
WX3JN733567014	3356				BF STATUS 4038

12.)650500C996394

ASPIRIN TAB. USP 5GR IS 100S

WX3JN733637026	3363				
WX3JN733637025	3363	4004	4024	2.90	BG STATUS 3365

13.)650500C994371

LEVORPHANOL TARTRATE TABLETS 2MG 100S

WX3JN733537026	3353	4006	4019	24.92	
WX3JN733537027	3353	3364	4017	21.52	

14.)650500C996098

MAGNESIUM SULF INJ USP 50% 5GM 10ML 100S

WX3JN740067078	4006				
WX3JN740067079	4006	4015	4032	69.06	BF STATUS 4054

NATIONAL STOCK NUMBER		START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
NOMENCLATURE		START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
REQUISITION (S9M)	REQUISITION (LPC)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
15.)650500C993148						
SHAMPOO COAL TAR SALICYLIC ACID BENZALKONIUM CHL ALCOHOL						
WX3JN740067074		4006				CG STATUS 4055
WX3JN740067075		4006	4015	4024	2.39	
16.)650500C995575						
FLURAZEPAM HYDROCHLORIDE CAPSULES NF 15MG IS 100S						
WX3JN740097009		4009				CG STATUS 4054
WX3JN740067077		4006	4011	4019	16.58	
17.)650500C996015						
BARIUM SULF FOR SUSP USP 225GM IS 36S						
WX3JN740097027		4009				BF STATUS 4053
WX3JN74007AAAF		4012	4024		63.09	
18.)650500C993044						
RINGER'S INJ LACTATED USP 500ML 12S						
WX3JN740177021		4017	4042			
WX3JN740167018		4016	4037	4037	12.60	
19.)6505010510923						
PENICILLIN V POTASSIUM FOR ORAL SOL USP 50MG						
WX3JN733577017		3357		4011	26.59	DEPOT STOCKED **
WX3JN733577016		3361	4068	4010	43.90	
20.)6505010396397						
BARIUM SULFATE FOR SUSP USP DISPOSABLE ENEMA UNIT 24S						
WX3JN733637007		3363	4034	4033	76.88	
WX3JN733637008		3363	4010	4020	114.25	
21.)6505009615508						
WX3JN73309AACF						
WX3JN733137006		3312		3320	1.99	DEPOT STOCKED **
		3318		3329	1.97	

NATIONAL STOCK NUMBER	NOMENCLATURE	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
REQUISITION (S9M)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES	
REQUISITION (LPC)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES	
22.) 6505010153995						
WX3JN73309AACG	3312		3327	5.76		DEPOT STOCKED **
WX3JN733137007	3313	3335	3329	5.76		
23.) 6505011455214						
WX3JN73309AACL	3312		3327	61.51		DEPOT STOCKED **
WX3JN733137005	3318		3357	50.04		
24.) 6505008573585						
CODEINE PHOSPHATE INJ. USP 30MG PER ML 1 ML CART-NDL UNIT 10S						
WX3JN74007AAAP	4009	4014	4031	10.00		
WX3JN740097002	4009	4032	4054	4.89		
25.) 6505010351963						
WX3JN740067063	4006		4024	6.28		DEPOT STOCKED **
WX3JN740067093	4009		4024	15.00		
26.) 6505010449395						
WX3JN74007AAB7	4009		4020	14.92		DEPOT STOCKED **
WX3JN740097003	4009		4033	14.92		
27.) 6505010920391						
PNEUMOCOCCAL VACCINE POLYVALENT 2.5ML 5 DOSES						
WX3JN740067065	4006	4011	4020	21.31		
WX3JN740067094	4009	4013	4025	27.50		
28.) 6505011169245						
ALBUTEROL INHALATION 17GM						
WX3JN740067067	4006	4012	4032	2.37		
WX3JN740067095	4009	4016	4033	2.70		

NATIONAL STOCK NUMBER	NOMENCLATURE	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
REQUISITION (S9M)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES	
REQUISITION (LPC)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES	
29.) 6505011378448	GRISOFULSIN ORAL SUSP. USP					
WX3JN740067069	4006	4011	4033	10.00		
WX3JN740067096	4009	4023	4037	5.74		
30.) 6505011533335	PROPOXYPHENE NAPSYLATE TAB NF 100MG IS 100S					
WX3JN740067071	4006	4034	4038	9.42		
WX3JN740067097	4009	4018	4020	21.08		
31.) 6505011533992	SODIUM CHLORIDE INJ. 0.45% 100ML 12S					
WX3JN740067057	4006	4034	4059	16.69		
WX3JN740067092	4006	4013	4024	14.84		
32.) 6505011561604	FLURAZEPAM HCL CAPSULES 15MG 100S					
WX3JN74007AAAY	4009	4028	4032			
WX3JN740097004	4009	4013	4020	19.83		
33.) 6505011562014	OXYTOCIN INJ. USP SYNTHETIC 1ML 10S					
WX3JN74007AAAZ	4009	4033	4068	13.62		
WX3JN740097005	4009	4012	4067	9.55		WRONG ITEM RECEIVED
34.) 6505011562018	BATH SOLUTION BABY ANTIBACTERIAL 2 OZ 12S					
WX3JN74007AAA0	4009	4034	4046	2.64		
WX3JN740097006	4009	4016	4045	5.04		
35.) 6505011562195	DIETARY SUPPLEMENT EGGNOG 4.40Z IS 24S					
WX3JN74007AAA1	4009	4033	4032	308.40		
WX3JN740097007	4009	4013	4024	277.56		

NATIONAL STOCK NUMBER		NOMENCLATURE		START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
REQUISITION (S9M)	REQUISITION (LPC)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES	UNIT PRICE	NOTES
36.) 6505011533106								
FORMALDEHYDE SOLUTION USP 37% 1 GALLON								
WX3JN740237004		4023					21.44	
WX3JN740237003		4025	4026	4037			13.50	
37.) 6515011496661								
WX3JN733067010		3308					19.70	DEPOT STOCKED **
WX3JN733067011		3311		3319			24.97	
38.) 651500C973565								
TUBE TRACHEOSTOMY DISP. LOW PRESSURE CUFF 36 FR								
WX3JN733117015		3312	3333	3354			22.27	
WX3JN733117014		3312	3334	3343			22.27	
39.) 651500C976216								
CATH-NDC UN IV W/SYR 20 GA 1 1/4 IN CATH DISP RADIOPAQ. 200S								
WX3JN733077086		3307	3327	3348			207.21	
WX3JN733077087		3307	3331				207.21	
40.) 6515011405352								
STETHOSCOPE ESOPHAGEAL DISP. 19 IN LONG 24 FR 20S								
WX3JN733197016		3320	4028	4080			36.86	
WX3JN733197017		3320	3335	4003			76.40	
41.) 651500C973930								
CATH AND CON SUCT ENDO PLAS DISP 22 INCHES LONG 18 FR 50S								
WX3JN733337002		3335	3341	4072			18.63	
WX3JN733337001		3335	3335	3350			18.63	
42.) 651500C973176								
SUT. NONABS. SURG. SILK BR. SZ40 18 IN 3/8 CIRC. REV. CUT NDL SAP3 12								
WX3JN733557004		3355						BG STATUS 3357
WX3JN733557005		3355	3364	4019			24.49	

NATIONAL STOCK NUMBER		START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
NOMENCLATURE		START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
REQUISITION (S9M)	REQUISITION (LPC)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
43.) 651500C973217						
BLADE KNIFE SURG. SLOTTED 5S						
WX3JN733557006		3355				
WX3JN733557007		3355	4006	4065	1.75	BQ STATUS 4055
44.) 651500C973223						
BREAST PUMP W/RUBBER BULB						
WX3JN733557008		3355	4019	4090	3.84	
WX3JN733557009		3355	4018	4023	2.58	
45.) 651500C974313						
PEN SKIN MARKING SURG. GENTIAN VIOLET DISP. 36S						
WX3JN733557010		3355	4010	4095	42.00	
WX3JN733557011		3355	3364	4012	47.00	
46.) 651500C974530						
CANJULA UTERINE DISP. CVD PLAS 10MM						
WX3JN733557012		3355	4031	4096	7.50	
WX3JN733557013		3355	4016	4037	5.75	
47.) 651500C975772						
TUBE ENDO ORAL/NASAL DISP. PLAS MURPHY UNCUFF 5.8MM ID 20 FR OD 10						
WX3JN733557014		3355	4011	4052	24.55	
WX3JN733557015		3355	4016	4044	19.50	
48.) 651500C975773						
TUBE ENDO ORAL/NASAL DISP. PLAS. MURPHY UNCUFF 4.5MM ID 18 FR OD 10						
WX3JN733557016		3355	4011	4052	24.55	
WX3JN733557017		3355	4016	4016	23.80	
49.) 651500C975774						
TUBE ENDO ORAL/NASAL DISP. PLAS MURPHY UNCUFF 3.5MM ID 14 FR OD 10						
WX3JN733557018		3355	4011	4052	24.55	
WX3JN733557019		3355	4016	4016	23.80	

NATIONAL STOCK NUMBER	NOMENCLATURE	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
REQUISITION (S9M)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES	
REQUISITION (LPC)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES	
50.) 651500C976275						
SYRINGR HYPO PLAS DISP.	NDL LOCK TIP	W/O NDL	10 ML	5S		
WX3JN733557020	3355	4012	4023	9.80		
WX3JN733557021	3355	4017	4047	10.50		
51.) 652000C961210						
PLUGGER DENTAL ENDODONTIC	FINGER STAINLESS ASSORTED	SIZE	15-40	6S		
WX3JN740097016	4009	4018		10.50		
WX3JN740097017	4009	4032	4101	13.62		
52.) 6530011464262						
WX3JN74004AAB4	4005		4040	49.68		DEPOT STOCKED **
WX3JN740047005	4004					BF STATUS
53.) 653000C951819						
CHART RECORDING 6 3/16	IN DIA 0-280 DEGREES F	24 HR	100S			
WX3JN733637010	3363	4013	4073	11.05		
WX3JN733637011	3363					
54.) 6550011532987						
TEST KIT URINALYSIS	12ML 12S					
WX3JN740137007	4016	4020	4067	17.64		
WX3JN740137008	4016	4019	4037	22.24		
55.) 6640011536861						
TUBE CULTURE DISP PLAS	W/SCREW CAP 13X100MM	1000S				
WX3JN733647003	4004	4035	4076	158.08		
WX3JN733647002	4005	4067		162.75		
56.) 769000C910577						
LABEL STER. INDICATOR	3/4X3/4 IN BLACK	600S				
WX3JN733567009						
WX3JN733567010	3356	3363	4019	4.24		BQ STATUS

NATIONAL STOCK NUMBER

NOMENCLATURE

REQUISITION (S9M)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES
REQUISITION (LPC)	START	CONTRACT	RECEIPT	UNIT PRICE	NOTES

57.) 6550011021241

TEST STRIP AND COLOR CHART GLUCOSE PLAS 3 IN 25S

WX3JN740257040	4026	4069	4081	11.80	
WX3JN740257041	4026	4032	4060	11.80	

LEGEND:

S9M = REQUISITION SUBMITTED TO DPSC FOR CENTRAL PROCUREMENT
 LPC = REQUISITION SUBMITTED TO PURCHASING AND CONTRACTING BRANCH OF TAMC FOR

DECENTRALIZED PROCUREMENT

START = JULIAN DATE THE REQUISITION WAS SUBMITTED

CONTRACT = JULIAN DATE OF THE CONTRACT

RECEIPT = JULIAN DATE REQUISITIONED ITEM RECEIVED

BF STATUS = NO RECORD OF DOCUMENT FOR WHICH FOLLOW-UP WAS SUBMITTED

BG STATUS = STOCK NUMBER CHANGED OR NSN NOW ASSIGNED

BQ STATUS = CANCELLED PER REQUEST DUE TO MINIMUM ORDER REQUIREMENTS

CG STATUS = REJECTED. UNABLE TO IDENTIFY REQUESTED ITEM

APPENDIX C
UNIT PRICE DATA

UNIT PRICE DATA

S9M		LPC		
RQNS	U/P	RQNS	U/P	D
WX3JN8		WX3JN8		
33567701	23.20	33567784	16.71	0.28
33567705	7.10	33547727	6.28	0.12
33567706	128.80	33567739	118.17	0.08
33567707	10.64	33547731	7.95	0.25
40097758	80.00	40097757	49.00	0.39
40117736	288.00	40117729	288.00	0.00
40117738	21.53	40117735	10.78	0.50
40117737	20.01	40117730	16.00	0.20
40117739	41.66	40117732	37.34	0.10
WX3JN7		WX3JN7		
33637024	2.33	33577002	1.89	0.19
33537026	24.92	33537027	21.52	0.14
33637007	76.88	33637008	114.25	-0.49
4007AAAP	10.00	40097002	4.89	0.51
40067065	21.31	40067094	27.50	-0.29
40067067	2.37	40067095	2.70	-0.14
40067069	10.00	40067096	5.74	0.43
40067071	9.42	40067097	21.08	-1.24
40067057	16.69	40067092	14.84	0.11
4007AAAZ	13.62	40097005	9.55	0.30
4007AAA0	2.64	40097006	5.04	-0.91
4007AAA1	308.40	40097007	277.56	0.10
40237004	21.44	40237003	13.50	0.37
33117015	22.27	33117014	22.27	0.00
33077086	207.21	33077087	207.21	0.00
33197016	36.86	33197017	76.40	-1.07
33337002	18.63	33337001	18.63	0.00
33557008	3.84	33557009	2.58	0.33
33557010	42.00	33557011	47.00	-0.12
33557012	7.50	33557013	5.75	0.23
33557014	24.55	33557015	19.50	0.21
33557016	24.55	33557017	23.80	0.03
33557018	24.55	33557019	23.80	0.03
33557020	9.80	33557021	10.50	-0.07
40097016	10.50	40097017	13.62	-0.30
40137007	17.64	40137008	22.24	-0.26
33647003	158.08	33647002	162.75	-0.03
40257040	11.80	40257041	11.80	0.00

TOTAL D= -0.02

MEAN D= -0.000555

PAIRED SAMPLE SIZE= 37

S9M= REQUISITION SENT TO DPSC

LPC= REQUISITION SENT FOR LOCAL PURCHASE

U/P= UNIT PRICE IN DOLLARS

D= DIFFERENCE AS A PROPORTION OF DPSC U/P

STATISTICS PROGRAM

PAIRED DATA <D>

.28
.12
.08
.25
.39
0
.5
.2
.1
.19
.14
-.49
.51
-.29
-.14
.43
-1.24
.11
.3
-.91
.1
.37
0
0
-1.07
0
.33
-.12
.23
.21
.03
.03
-.07
-.3
-.26
-.03
0

NUMBER OF TRIALS= 37
MEAN=-5.40540515E-04
STD DEV= .39452465
VARIANCE= .1556497
COEFFICIENT OF VARIATION=-72987.0638 %

HYPOTHESIS TEST RESULTS

POPULATION MEAN= 0
SAMPLE MEAN=-5.40540515E-04
STD DEV= .39452465
NUMBER OF TRIALS= 37
LEVEL OF SIGNIFICANCE= .05
CALCULATED Z VALUE=-8.33402827E-03
ACCEPTANCE RANGE= 0 TO-.1066938

UNIT PRICE DATA

HYPOTHESIS TEST

(1) H_0 : Population mean of $d \geq 0$

H_a : Population mean of $d < 0$

d = difference in unit price between TAMC non-standard requisitions sent for central procurement (DPSC) and those sent for decentral procurement (Local Purchase) expressed as a proportion of the DPSC unit price.

(2) Level of significance (LOS) = .05%
Sample size (n) = 37
Sample mean of d = -0.0005
Sample standard deviation (S_d) = 0.3945

(3) One tailed test.
Critical Z value = -1.645
Calculated Z value = -0.0083

(4) Calculated Z value (-0.0083) > Critical Z value (-1.645).
Therefore, accept the null hypothesis (H_0).

(5) The sample data indicates that at the .05 LOS the unit prices for centrally procured (DPSC) requisitions is not significantly lower than the unit price for decentrally procured (Local Purchase) requisitions.

APPENDIX D

OST DATA

OST PAIRED DATA

RQNS	S9M	OST	RQNS	LPC	OST	D
WX3JN8			WX3JN8			
33577701		21	33567784		25	-4
33567705		18	33547727		27	-9
33567706		42	33567739		18	24
33567707		18	33547731		20	-2
40097758		36	40097757		10	26
40117737		14	40117730		13	1
40117738		16	40117735		16	0
40117739		36	40117732		19	17
WX3JN7			WX3JN7			
33637024		60	33577002		14	46
33537026		31	33637025		29	2
33637007		35	33637008		22	13
4007AAAP		22	40097002		45	-23
40067065		14	40067094		16	-2
40067067		26	40067095		24	2
40067069		27	40067096		28	-1
40067071		32	40067097		11	21
40067057		53	40067092		18	35
4007AAAY		23	40097004		11	12
4007AAAZ		59	40097005		58	1
4007AAA0		37	40097006		36	1
4007AAA1		23	40097007		15	8
33117015		42	33117014		31	11
33197016		125	33197017		48	77
33337002		102	33337001		15	87
33557008		100	33557009		33	67
33557010		105	33557011		22	83
33557012		106	33557013		47	59
33557014		62	33557015		54	8
33557016		62	33557017		26	36
33557018		62	33557019		26	36
33557020		33	33557021		57	-24
40137007		51	40137008		21	30
40257040		55	40257041		34	21
SUM OST=		1548	SUM OST=		889	TOTAL D= 659
MEAN OST=		46.91	MEAN OST=		26.94	MEAN D= 19.97

PAIRED SAMPLE SIZE= 33

S9M= REQUISITIONS SENT TO DPSC

LPC= REQUISITIONS SENT TO LOCAL PURCHASE

OST= ORDER AND SHIP TIME IN DAYS

D= DIFFERENCE IN OST IN DAYS

STATISTICS PROGRAM

PAIRED DATA <D>

-4

-9

24

-2

26

1

0

17

46

2

13

-23

-2

2

-1

21

35

12

1

1

8

11

77

87

67

83

59

8

36

36

-24

30

21

NUMBER OF TRIALS= 33

MEAN= 19.969697

STD DEV= 28.6339886

VARIANCE= 819.905303

COEFFICIENT OF VARIATION= 143.387196 %

HYPOTHESIS TEST RESULTS

POPULATION MEAN= 0

SAMPLE MEAN= 19.969697

STD DEV= 28.6339886

NUMBER OF TRIALS= 33

LEVEL OF SIGNIFICANCE= .05

CALCULATED Z VALUE= 4.00632888

ACCEPTANCE RANGE= 8.19956439 TO 0

OST DATA
HYPOTHESIS TEST

(1) H_0 : Population mean of $d \leq 0$

H_a : Population mean of $d > 0$

d = difference in OST between TAMC non-standard requisitions sent for central procurement (DPSC) and those sent for decentral procurement (Local Purchase).

(2) Level of significance (LOS) = .05%
Sample size (n) = 33
Sample mean of d = 19.97 days
Sample standard deviation (S_d) = 28.63 days

(3) One tailed test.
Critical Z value = 1.645
Calculated Z value = 4.006

(4) Calculated Z value (4.006) > Critical Z value (1.645).

Therefore, reject the null hypothesis (H_0).

(5) The sample data indicates that at the .05 LOS the OST for decentrally procured (Local Purchase) requisitions is significantly less than the OST for centrally procured (DPSC) requisitions.

APPENDIX E

PALT DATA

PALT DATA

RQNS	S9M	PALT	RQNS	LPC	PALT	D
WX3JN8			WX3JN8			
33577701		12	33567784		13	-1
33567705		7	33547727		6	1
33567706		8	33567739		11	-3
33567707		18	33547731		10	8
40097758		11	40097757		7	4
40117736		56	40117729		8	48
40117737		7	40117730		7	0
40117738		8	40117735		12	-4
40117739		11	40117732		7	4
WX3JN7			WX3JN7			
33637024		21	33577002		5	16
33537026		18	33537027		11	7
40177021		25	40167018		21	4
33637007		36	33637008		12	24
4007AAAP		5	40097002		23	-18
40067065		5	40067094		4	1
40067067		6	40067095		7	-1
40067069		5	40067096		14	-9
40067071		28	40067097		9	19
40067057		28	40067092		7	21
4007AAAY		19	40097004		4	15
4007AAAZ		24	40097005		3	21
4007AAA0		25	40097006		7	18
4007AAA1		24	40097007		4	20
33117015		21	33117014		22	-1
33077086		20	33077087		24	-4
33197016		73	33197017		15	58
33337002		6	33337001		0	6
33557008		29	33557009		28	1
33557010		20	33557011		9	11
33557012		41	33557013		26	15
33557014		21	33557015		26	-5
33557016		21	33557017		26	-5
33557018		21	33557019		26	-5
33557020		22	33557021		27	-5
40097016		9	40097017		23	-14
40137007		4	40137008		3	1
33647003		31	33647002		62	-31
40257040		43	40257041		6	37

TOTAL D= 254

MEAN D= 6.684210

PAIRED SAMPLE SIZE= 38

S9M= REQUISITIONS SENT TO DPSC

LPC= REQUISITIONS SENT FOR LOCAL PURCHASE

PALT= PROCUREMENT ADMIN. LEAD TIME IN DAYS

D= DIFFERENCE IN DAYS

STATISTICS PROGRAM

PAIRED DATA <D>

-1
1
-3
8
4
48
0
-4
4
16
7
4
24
-18
1
-1
-9
19
21
15
21
18
20
-1
-4
58
6
1
11
15
-5
-5
-5
-5
-14
1
-31
37

NUMBER OF TRIALS= 38

MEAN= 6.68421053

STD DEV= 16.9388491

VARIANCE= 286.924608

COEFFICIENT OF VARIATION= 253.415852 %

HYPOTHESIS TEST RESULTS

POPULATION MEAN= 0

SAMPLE MEAN= 6.68421053

STD DEV= 16.9388491

NUMBER OF TRIALS= 38

LEVEL OF SIGNIFICANCE= .05

CALCULATED Z VALUE= 2.43252896

ACCEPTANCE RANGE= 4.52020366 TO 0

PALT DATA
HYPOTHESIS TEST

(1) H_0 : Population mean of $d \leq 0$

H_a : Population mean of $d > 0$

d = difference in PALT between TAMC non-standard requisitions sent for central procurement (DPSC) and those sent for decentral procurement (Local Purchase).

(2) Level of significance (LOS) = .05%

Sample size (n) = 38

Sample mean of d = 6.68 days

Sample standard deviation (S_d) = 16.94 days

(3) One tailed test.

Critical Z value = 1.645

Calculated Z value = 2.433

(4) Calculated Z value (2.433) > Critical Z value (1.645).

Therefore, reject the null hypothesis (H_0).

(5) The sample data indicates that at the .05 LOS the PALT for decentrally procured (Local Purchase) requisitions is significantly less than the PALT for centrally procured (DPSC) requisitions.

APPENDIX F
VENDOR AND SHIPMENT TIME DATA

VENDOR AND SHIPMENT TIME

RQNS	S9M	V&S	RQNS	LPC	V&S	D
WX3JN8			WX3JN8			
33577701		9	33567784		12	-3
33567705		11	33547727		21	-10
33567706		34	33567739		7	27
33567707		0	33547731		10	-10
40097758		45	40097757		3	42
40117737		7	40117730		6	1
40117738		8	40117735		4	4
40117739		25	40117732		12	13
WX3JN7			WX3JN7			
33637024		39	33577002		9	30
33537026		13	33537027		18	-5
33637007		-1	33637008		10	-11
4007AAAP		17	40097002		22	-5
40067065		9	40067094		12	-3
40067067		20	40067095		17	3
40067069		22	40067096		14	8
40067071		4	40067097		2	2
40067057		25	40067092		11	14
4007AAAY		4	40097004		7	-3
4007AAAZ		35	40097005		55	-20
4007AAA0		12	40097006		29	-17
4007AAA1		-1	40097007		11	-12
33117015		21	33117014		9	12
33197016		52	33197017		33	19
33337002		96	33337001		15	81
33557008		71	33557009		5	66
33557010		85	33557011		13	72
33557012		65	33557013		21	44
33557014		41	33557015		28	13
33557016		41	33557017		0	41
33557018		41	33557019		0	41
33557020		11	33557021		30	-19
40137007		47	40137008		18	29
40257040		12	40257041		28	-16

TOTAL D= 428

MEAN D= 12.969696

PAIRED SAMPLE SIZE= 33

S9M= REQUISITIONS SENT TO DPSC

LPC= REQUISITIONS SENT TO LOCAL PURCHASE

V&S= VENDOR AND SHIPMENT TIME IN DAYS

D= DIFERENCE IN V&S IN DAYS

STATISTICS PROGRAM

PAIRED DATA <D>

-3
-10
27
-10
42
1
4
13
30
-5
-11
-5
-3
3
8
2
14
-3
-20
-17
-12
12
19
81
66
72
44
13
41
41
-19
29
-16

NUMBER OF TRIALS= 33

MEAN= 12.969697

STD DEV= 26.8461879

VARIANCE= 720.717806

COEFFICIENT OF VARIATION= 206.991636 %

HYPOTHESIS TEST RESULTS

POPULATION MEAN= 0

SAMPLE MEAN= 12.969697

STD DEV= 26.8461879

NUMBER OF TRIALS= 33

LEVEL OF SIGNIFICANCE= .05

CALCULATED Z VALUE= 2.77526318

ACCEPTANCE RANGE= 7.6876138 TO 0

VENDOR AND SHIPMENT TIME DATA

HYPOTHESIS TEST

(1) H_0 : Population mean of $d \leq 0$

H_a : Population mean of $d > 0$

d = difference in Vendor and Shipment time between TAMC non-standard requisitions sent for central procurement (DPSC) and those sent for decentral procurement (Local Purchase).

(2) Level of significance (LOS) = .05%
 Sample size (n) = 33
 Sample mean of d = 12.97 days
 Sample standard deviation (S_d) = 26.85 days

(3) One tailed test.
 Critical Z value = 1.645
 Calculated Z value = 2.775

(4) Calculated Z value (2.433) > Critical Z value (1.645).

Therefore, reject the null hypothesis (H_0).

(5) The sample data indicates that at the .05 LOS the Vendor and Shipment time for decentrally procured (Local Purchase) requisitions is significantly less than the PALT for centrally procured (DPSC) requisitions.

APPENDIX G
NON-STANDARD STOCKAGE PROPORTION

NON-STANDARD STOCKAGE

	Number	Proportion
Total Sample (n)	370	1.0000
Standard Lines	305	0.8243
Non-standard Lines	65	0.1757

p = proportion of non-standard lines stocked at TAMC

p' = an estimate of p = sample proportion of non-standard lines stocked at TAMC = 0.1757

Confidence Interval (CI):

$$\begin{aligned}
 95\% \text{ CI} &= p' (+ \text{ or } -) z * \text{SQR ROOT}((p' * (1 - p')) / n) \\
 &= 0.1757 (+ \text{ or } -) 1.96 * \text{SQR Root}((0.1757 * 0.8243) / 370) \\
 &= 0.1757 (+ \text{ or } -) 0.0388
 \end{aligned}$$

There is a probability of .95 that the interval 0.2145 to 0.1369 contains the true proportion of non-standard lines stocked at TAMC.

APPENDIX H
QUALITY CHI-SQUARE TEST

CHI-SQUARE TEST

OBSERVED FREQUENCIES

QUALITY	SOURCE		TOTAL
	DPSC	LOC PUR	
SATISFACTORY	35	44	79
UNSATISFACTORY	10	2	12
TOTAL	45	46	91

EXPECTED FREQUENCIES
(ROW X COLUMN)/TOTAL

QUALITY	SOURCE		TOTAL
	DPSC	LOC PUR	
SATISFACTORY	39.07	39.93	79
UNSATISFACTORY	5.93	6.07	12
TOTAL	45.00	46.00	91

CALCULATED CHI-SQUARE

OF	EF	$\frac{(OF-EF)^2}{EF}$
35	39.07	0.42
44	39.93	0.41
10	5.93	2.79
2	6.07	2.73

CHI-SQUARE= 6.35

CHI-SQUARE (DF=1, .05)= 3.84

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