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The Influence of Lead Time Variance, Quotation process and Local purchasing order generationon Inventory Management Performance in Humanitarian Organizations; A Case Study Of Afghan Red Crescent Society Medical Supply Chain

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ABSTRACT

Purpose: The main purpose of this study was to establish the influence of lead time variance, quotation process and local purchasing order generation optimization on inventory management performance in Afghan Red Crescent Society Medical Supply Chain.

Methodology: This study adopted descriptive survey design. The target population of the study was 45 end user clinics and 916 experts and procurement professionals existing in the email database of the researcher at the time of study. The sample size of the study was 96 respondents who were divided into strata's of 41 end user clinics and 55 procurement experts. This study used both primary and secondary data collected using questionnaires and secondary data collection guide**.** Secondary data wascollected for all variables from 10 end user clinics. Data analysis was done using SPSS generating both descriptive and inferential statistics like Pearson's bivariate correlation and regression analysis. Descriptive statistics included; frequencies, mean and standard deviation. Data analysis output was presented using tables and cartographies like pie charts and line graphs.

Results: Result findings indicated that over 80% of the leadtime for end user clinics was contributed by ACRCS process and this was supported by both the customer satisfaction survey as well the reported R squared in regression analysis.Quotation lead time was found to be statistically significant in explaining overall lead time in Afghan Red Crescent Society Medical Supply Chain. Further, Results revealed that it took a maximum of 20 days and a minimum of 11 days for the entire local purchase order process. The average mean was 14.55 days to prepare and deliver to supplier the confirmed request documents for the supply of goods. The skewness statistics was 0.983 which indicates that thevariable was skewed slightly to the right which implies that the local purchase order lead time had minimal outliers. Regression results indicate that LPO lead time was not statistically significant in explaining overall lead time

Unique contribution to theory, practice and policy: It is recommended to the management of ARCS to embrace strategies that can lead to reduction of lead time such as vendor managed inventory which enables the customer's partnership channel to be more efficient due to better planning coordination, reduced needs for inventories with increased sales by focusing on selling what end-customer wants.

Keywords*: Lead Time Variance, Quotation process, Local purchasing order generation, inventory management*

1.0 INTRODUCTION

In today‘s intensively competitive global market, effective supply chain management (SCM) plays a critical role in improving organizational performance and competitive advantage (Schneller and Smeltzer, 2006). The competitive environment requires organizations to provide high quality products and services, deliver rapid service response, and develop dynamic capabilities that are congruent with the rapidly changing business environment (Teece, 2007). As organizations are seeking to achieve competitiveness, new challenges in supply chains are emerging. These include increasing demands to reduce costs, increase quality, improve customer service and ensure continuity of supply (Pearson et al., 1996). Therefore supply chain environment is characterized by, increased customer responsiveness, information integration etc.

To cope, companies‘have been compelled to restructure and re-engineer relentlessly, innovate, rebrand and realign. This realization requires firms to evaluate how the resources and capabilities of suppliers and customers can be utilized to create exceptional value (Schneller and Smeltzer, 2006).

Nordas*et al.* (2006) indicate that Lead time is the amount of time between the placement of an order and the receipts of the goods ordered. It depends on the nature of the product e.g. whether it is made to order or if it is a from the shelf product. Lead time also depends on planning and supply chain management, logistics services and of course distance to customers and suppliers. Long lead time does not need to be a problem if delivery is predictable and demand is stable. However, if there is uncertainty about future demand, long lead time is costly even when the customer knows exactly when the merchandise will arrive. If future demand has been underestimated, running out of stock has costs in terms of foregone sales and the possibility of losing customers. If future demand has been overestimated, excess supply must be sold at a discount. Furthermore, the longer the lead time and the more varieties of the product in question are on the market, the larger stocks are needed. It is also important to notice that competitiveness on lead time is not a static concept. When some firms are able to shorten lead time, others must follow in order to avoid punishment in terms of discounted prices or at worst exclusion from the bidding process. The latter can happen when a critical mass of suppliers is able to deliver just-intime and the customer finds it safe to reduce inbound inventories to a couple of days or in some cases even a couple of hours.

Humanitarian organization receives products and services from suppliers, and then stores and distributes to each care unit based on the hospital‘s operation processes. Therefore, SCM includes business activities e.g. purchasing, distribution, management of suppliers) and operations that integrate a continuous, seamless flow of materials and services for aid delivery (Rivard and Royer et al., 2002; Shih et al., 2009). According to Singh et al. (2006), humanitarian supply chains processes have three types of flows: physical product flow, information flow, and financial flow. The physical product flow manages customized products and services. Information and financial flows are related to SC design decisions for effective product flow and improved organizational performance (Singh et al., 2006; Kowalski, 2009).

Inventory management includes two basic functions: one is how to classify inventory items and maintain accurate inventory records (Heizer and Render, 2004); the other is how to decide the amount and time to order items (Stevenson and Hojati, 2004). The main goal of inventory management is balance –too much adds unnecessary costs, while too little causes delays or disrupts schedules (Stevenson and Hojati, 2004).Thus, inventory management research has long been central to academic literatures. Scholars in different areas try to advance the theory and practice in inventory management.

1.2 Problem Statement

The replenishment decision and the delivery of emergency supplies are very important in postdisaster relief operations. With the increasing of frequency and impact of disasters in recent 20 years, the humanitarian organizations are under an increased pressure of improving their logistics performance, and such trends triggered an interest in humanitarian logistics research (Kovacs and Spen, 2011). After the magnitude 7.0 earthquake stuck Haiti at January 2010, Whybark et al. (2010) made a literature review about the relatively issues and suggested that the Disaster Relief Supply Chains (DRSC) should be treated as a subset of humanitarian supply chains. And there are important differences between the DRSC and the Commercial Supply Chain (CSC), such as the extremely uncertain and dynamic in their operating environment.

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To the researches about the impact of variable lead times and delayed information transfer, Song and Zipkin (2009) studied the performances of inventory management systems having deterministic lead times that been assumed constant, stochastic and exogenous.

The study therefore seeks to address the influence of Lead Time Variance, Quotation process and Local purchasing order generation on Inventory Management Performance in Humanitarian Organizations; A Case Study Of Afghan Red Crescent Society Medical Supply Chain.

1.3 Specific Objectives

i. To what extent can Lead time variance can be reduced using DMAIC process of Lean Six Sigma ii. To what extent can Quotation process practice time affect invetory management performancemeasured through leadtime

iii. To what extent can Local purchasing order generation practices influences inventory management performancemeasured through leadtime

2.0 LITERATURE REVIEW

2.1 Theory of Six Sigma DMAIC Procedure

Six Sigma DMAIC procedure is considered to bring very important and measurable improvements to the current processes that are below expectations in a business. This methodology is mostly used

in processes or products in a firm that do not meet the customer expectations or even products that currently have defects.
The objective of Six Sigma is to increase the profit margin, improve financial condition through minimizing the defects rate of product. It increases the customer satisfaction, retention and produces the best class product from the best process performance (Pyzdek, 2003). In order to use the Six Sigma in an organization, there are many things that are needed to achieve the financial goals in the organization such as understand the needs and who your customers are, and what is product that you want to provide the customers, review of the data, consumer survey report, and feedback of customers and determine the product standard that we provide and quality service, find out what are the defects are occurring and why these are produce during the manufacturing of process and how to reduce these problems by the different method and after implementation of different improvement actions, set up good matrices and follow up these actions and become the new standard of operating process (Pyzdek, 2003). The DMAIC is a basic component of Six Sigma methodology- a better way to improve work process by eliminating the defects rate in the final product. The DMAIC methodology has five phases Define, Measure, Analysis, Improvement and Control.

The first phrase is define in which the Six Sigma Team comes up with a certain project to improve on the business goals and also improve on the requirements and needs of clients. The main objective of Six Sigma is coming up with an unknown solution in order to solve an existing problem. Defining the problem is the first important measure in resolving an existing problem**.** In this phase, define the purpose of project, scope and process background for both internal and external customers. There are a different tools which is used in define phase like SIPOC, Voice of Customer and Quality Function deployment (Pyzdek, 2003). The Measure phrase involves defining metrics and carrying out the lengthy process of statistical data collection. This includes identifying and determining important and necessary measures needed in the evaluation of the success of the project. A measurable baseline is established by determining the initial stability and capability of the project. Other measures established include valid metrics and clear measurable indicators such process, input, and output. This is followed by analysis to come up with a series of process steps and also defining the operational plan in order to measure the available indicators.

The analysis phase is when the Six Sigma Team discovers what might be causing the problem and how it might be corrected. This involves researching on the reasons for defects by coming up a variation process enhanced by set of variables (all based and deeply rooted in statistical theory). During the process, the highly qualified and experienced Six Sigma team comes up with ways of upgrading the project and determining processes that will have beneficial results to the firm in the long term. There are different methods used for this phase are Regression Analysis, Design of Experiment and Process analysis. Optimization and verification of important inputs is done in order to eradicate the problem. Causes of the problem are determined. This is done through test evaluation and then creating improvements. In case the required improvements are not done, the staff uses a Six Sigma Tool known as the cost/benefit Analysis. An implementation plan is developed and a new management approach is taken in order to adapt and implement the solution.

The next phase is the control phase which mainly depends on previous steps. This includes the appropriate management methods and main monitoring plan that reveals important steps the shareholders will have to continue to follow. The fore mentioned plan is exercised and this is done to make sure that the main variables remain in the acceptable range. The highly qualified Six Sigma team develops reaction plans, a hands-off process, and training. This is to ensure that the project has a long term positive effect on the company. It is also important to document the project, and the solution that was discovered. Below is a figure showing the DMAIC model.

2.2 Empirical Literature Review

Petersen et al. (2009) present lead-times for waterfall development, showing that the majority of the time (41 %) is spent on requirements engineering activities. The remaining time was distributed as follows: 17 % in design and implementation, 19 % on verification, and 23 % on the release project. As in agile software development the main activitis should be coding and testing (Beck, 2004) the literature would suggest that those are the most time consuming activities. Petersen and Wohlin (2009) investigated issues hindering the performance of incremental and agile development. When scaling agile the main issues are (1) complex decision making in the requirements phase; (2) dependencies of complex systems are not discovered early on; and (3) agile does not scale well as complex architecture requires up-front planning. Given this qualitative result the literature indicates that with increase of requirements impact the leadtime should increase. For example, if a requirement can only be deliverable when parts of it are implemented across several systems a delay in one system would lead to prolonged lead-times for this requirement.

Harter et al. (2000) identified that lines of code (size) is a predictor for cycle time. This was confirmed by (Agrawal & Chari, 2007) who found that size was the only predictor for lead-time. Hence, from the related work point of view an increase of size should lead to an increase of leadtime. Collier (2005) summarizes a number of issues in cycle time reduction and states: (1) size prolongs lead-time, and (2) dependencies influence lead-time. Carmel (2004) investigated key success factors for achieving short lead-times. The finding shows that team factors (small team size, cross-functional teams, motivation) are critical. Furthermore, an awareness of lead-times is important to choose actions specifically targeted towards lead-time reduction. However, it is important to take quality into consideration when taking actions towards lead-time reduction.

Bourland et al. (1996) modeleda two-level supply chain to study the impact on supplierinventories that would result from access totimely demand information, demonstrating that fasteraccess to demand improved the supplier's fill rate ata given service level. The value of faster access todemand increased with demand variability and decreasedwith lead time.

Thonemann(2002) used an analytical model to demonstrate thatthe transfer of advance partial demand informationfrom customers to potential suppliers (customer intentto place an order, without specifying the supplier toreceive the order or the exact product to be ordered)reduced manufacturing costs and improved service levels when lead times were zero, but that market mediation efforts based on the advance demand information could substantially increase the bullwhip effect.

Dejonckheere et al. (2003) used a control engineering approach to demonstrate that demand sharing was able to reduce but not eliminate the bullwhip effect in a supply chain in which manufacturing was able to respond to the new demand information. If manufacturing lacked the flexibility to respond, Dejonckheere et al. proposed a smoothing rule to reduce the weight of the demand information in determining the order quantity; that is, they suggested that market mediation attempts should be limited in situations of inflexible manufacturing (e.g., long lead times), with the chain focusing, instead, on efficient supply irrespective of the demand information available. Wijngaard (in press) demonstrated that high capacity utilization (implying long manufacturing, and hence supply, lead times) substantially reduced the value of advance (partial) demand information in a single-stage, single-product supply chain.

2.3 Conceptual Framework

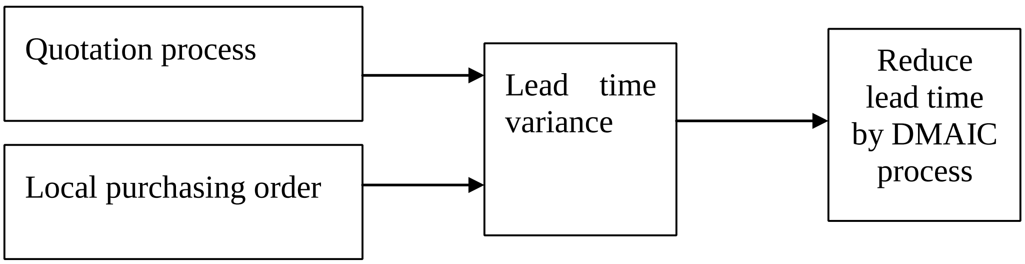

Figure 1: Conceptual framework

3.0 RESEARCH METHODOLOGY

This study used descriptive survey design.The population of this study wasall the 45 end user clinics being serviced by Afghan Red Crescent Society. Another population set was the 916 procurement professionals and experts in logistics management. The sampling frame for end users clinic was the list of end user clinics in the database of ARCS. The sampling frame for procurement professionals and experts was the list of contacts in the researcher email database. This study used simple random sampling for selecting 96 respondents (41 end user clinics and 55 experts). This study utilised both primary and secondary sources of information which was gathered by use of questionnaires and secondary collection data sheet. The study analysis was done by establishing the lead time of the Requisition stage, Quotation stage, goods receipt and transport stage up to customer (end user clinic). The above leadtimes were linked through a multivariate regression model to see which of the leadtime emanating from various procurement stages contribute more significantly to the leadtime data generated from system.

4.0 RESULTS AND DISCUSSIONS

4.1 Response Rate

The number of questionnaires that were administered was 41 to the employees in end users clinics. A total of 33 questionnaires were properly filled and returned which represented an overall successful response rate of 80% as shown on Table 1.

Table 1: Response Rate for End Users

Response Rate	Frequency	Percent

Returned	33	80%
Unreturned	8	20%
Total	41	100%

4.2 Demographic Characteristics

4.2.1 Level of satisfaction of end users

The study sought to find out the level of satisfaction of end users with the actual lead time for some consumable items such as cotton wool. Figure 1 illustrates that 70% of end users were lowly satisfied while 30% were highly satisfied with the actual lead time for consumable goods. The findings imply that the end users felt that the actual lead time could be improved so as to improved service delivery.

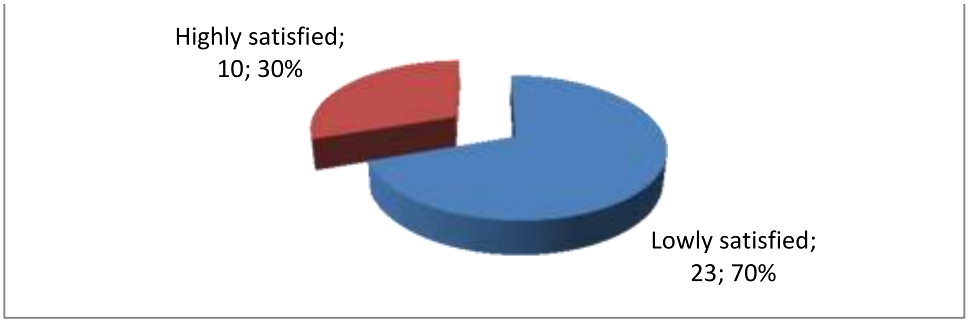

Figure 1: Level of Satisfaction

4.2.2 ACRCS internal process

In regard to question what portion of contribution to the overall lead-time would you attribute to ACRCS internal processes, 76% of the end users indicated between 76% to 100%, while 18% indicated 51 to 75% and 6% indicated between 26 to 50%. The study findings imply that internal processes such as quotation process, LPO generation, goods receipt and loading processes took much time and days hence contributing to deteriorating lead time in procurement process.
Results are presented in Figure 3.

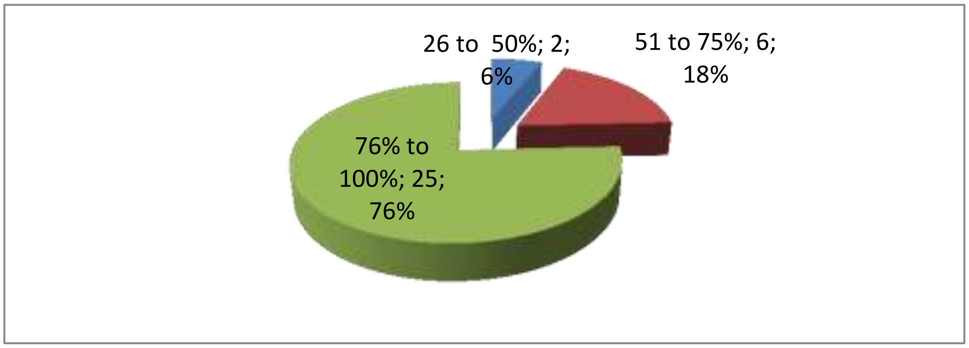

Figure 3: Internal Processes Contribution to Overall Lead Time

4.2.3Effect of Current Lead Time on End User Clinic Service Delivery

Figure 4 shows that 87.9% of the end users indicated that current lead time affected end user clinic service delivery negatively. This could be attributed to due to many days taken to get goods once the requisition is raised.

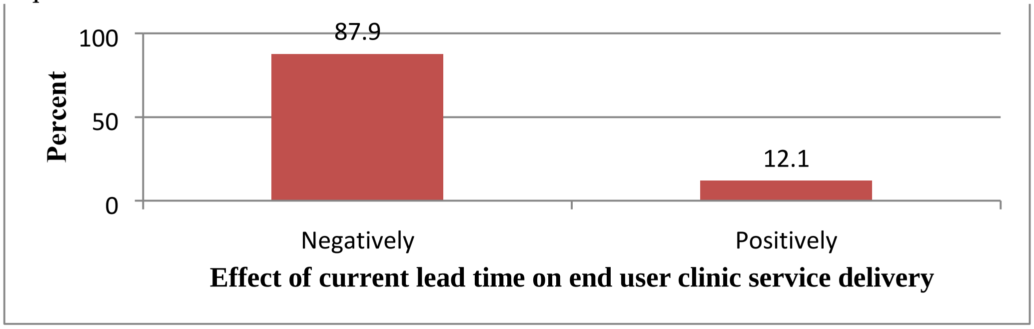

Figure 4: Effect of Current Lead Time on End User Clinic Service Delivery

4.2.4Effect of Current Lead Time on End User Clinic Processes

Figure 5 shows that 75.8% of the end users indicated that current lead time affected end user clinic processes negatively. This could be attributed to due to many days taken to get goods once the requisition is raised.

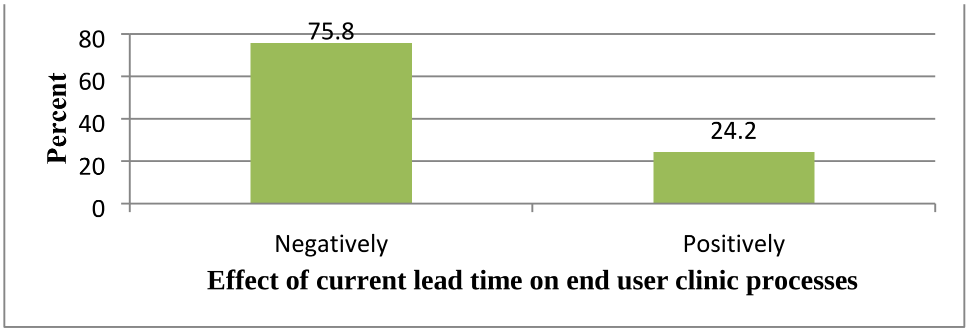

Figure 5: Effect of Current Lead Time on End User Clinic Processes

4.3 Descriptive Statistics

4.3.1 Overall Lead Time

The study sought to find out the overall lead time of goods that ishow much time in days was taken from requisition of goods by enduser clinic to ARCS Kabul to receipt of goods by end user clinic. Table 2 indicates that it took a maximum of 232.7 days and a minimum of 129.8 days for the entire process. The average mean was 166.63 days for goods to be received since requisition date. The skewness statistics was 0.891 which indicates that thevariable was skewed to the right which implies that the lead time had outliers. The standard deviation was above 3 and the variance was above 9.The study findings agree with those in the customer satisfaction survey presented in

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another part of this study, which demonstrated that majority of enduser clinics were not satisfied with the overall leadtime.

Table 2: Overall Lead Time Descriptive Analysis

Description	Coefficient
Mean	166.633
Std. Deviation	27.2922
Variance	744.864
Skewness	0.819
Kurtosis	-0.064
Minimum	129.8
Maximum	232.7

4.3.2 Quotation Lead Time

The study sought to find out the distribution of quotation process lead time (the time the process of preparing tender/supplier requests documents, sending them out and receiving the quotations back). Table 3 indicates that took a maximum of 65 days and a minimum of 36 days for the entire quotation process. The average mean was 45 days for the quotation process. The skewness statistics was 1.334 which indicates that thevariable was skewed to the right which implies that the quotation process lead time had outliers. The standard deviation was above 3 and the variance was above 9.

Table 3: Quotation Lead Time Descriptive Analysis

Description	Coefficient
Mean	45.45
Std. Deviation	7.299
Variance	53.279
Skewness	1.334
Kurtosis	0.679
Minimum	36
Maximum	65

4.3.3 Local Purchase Order Lead Time

The study sought to find out the local purchase order lead time that is the actual time taken to prepare and deliver to supplier the confirmed request documents for the supply of goods. Table 4 indicates that took a maximum of 20 days and a minimum of 11 days for the entire local purchase order process.

Table 4: Local Purchase Order Descriptive Analysis

Description	Coefficient
Mean	14.55
Std. Deviation	1.413
Variance	1.997
Skewness	0.983
Kurtosis	5.081
Minimum	11
Maximum	20

The average mean was 14.55 days to prepare and deliver to supplier the confirmed request documents for the supply of goods. The skewness statistics was 0.983 which indicates that thevariable was skewed slightly to the right which implies that the local purchase order lead time had minimal outliers. The LPO leadtime had a standard deviation of 1.413 and a variance of 1.997 which revealed that there was low variation in LPO lead time. Consquently,this implied that LPO leadtime may have an insignificant contribution to overall lead time.

4.4Inferential Statistics

4.4.1 Bivariate Correlations

Table 5 displays the results of correlation test analysis between the dependent variable (overall lead time) and independent variables and also correlation among the independent variables themselves. Results on Table 5 show that overall lead time was positively correlated with all the independent variables. This reveals that any positive change in quotation lead time, LPO lead time, goods receipt and sorting lead time and loading and delivery lead time was associated with an increased overall lead time in the procurement process.

Table 5: Bivariate Correlations

Variable		OverallLeadTime	Quotation Lead Time	LPO Lead Time
OverallLeadTime	Pearson Correlation	1		
	Sig. (2-tailed)			
Quotation Lead Time	Pearson Correlation	0.698**	1	
	Sig. (2-tailed)	0.000		
LPOLeadTime	Pearson Correlation	0.285	0.229	1
	Sig. (2-tailed)	0.075	0.155	

4.4.2 Regression Analysis

Table 6 shows that the coefficient of determination also called the R square is 82.8%. This means that the combined effect of the predictor variables quotation lead time and LPO lead time explains 82.8% of the variations in overall lead time of end user clinics. The correlation coefficient of 91% indicates that the combined effect of the predictor variables have a strong and positive correlation with overall lead time of end user clinics.

Table 6: Regression Model Fitness

Indicator	Coefficient
R	0.910
R Square	0.828
Std. Error of the Estimate	11.9327

Analysis of variance (ANOVA) on Table 7 shows that the combine effect of quotation lead time, LPO lead time and delivery lead time was statistically significant in explaining changes in overall lead time of end user clinic in ARCS. This is demonstrated by a p value of 0.000 which is less than the acceptance critical value of 0.05. The results indicated that the overall model was significant, that is, the independent variables were good joint explanatory variables/determinants for overall lead time (F=42.254, P value =0.000).

Table 7: Analysis of Variance (ANOVA)

Indicator	Sum of Squares	df	Mean Square	F	Sig.
Regression	24066.1	4	6016.52	42.254	0.000
Residual	4983.62	35	142.389		
Total	29049.7	39			

Table 8 displays the regression coefficients of the independent variables. The results reveal quotation lead time was statistically significant in explaining changes in overall lead time of end user clinics. LPO lead time was not significant.

Table 8: Regression Coefficients

Variable	Beta	Std. Error	t	Sig.
Constant	9.54	21.379	0.446	0.658
Quotation LeadTime	1.345	0.305	4.409	0.000
LPO Lead Time	0.576	1.41	0.409	0.685

5. CONCLUSIONS AND CONTRIBUTION TO POLICY PRACTICE AND THEORY

5.1 Discussion

The first objective of the study was to establish the effect of quotation process practice time on invetory management performance measured through leadtime. The study findings indicated that it took a maximum of 65 days and a minimum of 36 days for the entire quotation process. The average mean was 45 days for the quotation process and receiving the quotations back. The skewness statistics was 1.334 which indicates that thevariable was skewed to the right which implies that the quotation process lead time had outliers. Regression results show that the relationship between quotation lead time and overall lead time was positive and significant (b1= 1.345, p value, 0.000). This implies that an increase in quotation lead time by 1 unit leads to an increased overall lead time by 1.345 units.

The second objective of the study was to find out the influence of local purchasing order generation practices on inventory management performance measured through leadtimeResults revealed that it took a maximum of 20 days and a minimum of 11 days for the entire local purchase order process. The average mean was 14.55 days to prepare and deliver to supplier the confirmed request documents for the supply of goods. The skewness statistics was 0.983 which indicates that thevariable was skewed slightly to the right which implies that the local purchase order lead time had minimal outliers. Regression results indicate that LPO lead time was not statistically significant in explaining overall lead time. This was supported by (b1= 0.576, p value, 0.685). This implies that local purchasing order generation process does not influence overall lead time this could be because the process had minimum number of days in the process hence no much effect.

5.2 Conclusions

From the study, it was possible to conclude that there was high lead time in Afghan Red Crescent Society Medical Supply Chain. This may could be have been attributed to by the delays in the procurement processes since the requisition stage to the day of delivery and receipt to the end users.

Quotation lead time was found to be statistically significant in explaining overall lead time in Afghan Red Crescent Society Medical Supply Chain. It was possible to conclude that the longer the length of period the quotation process takes the longer the overall lead time in the procurement process which leads to higher inventory costs.

Local purchase order was not statistically significant in explaining the overall lead time in Afghan Red Crescent Society Medical Supply Chain. However it was possible to conclude that the number of days taken to raise an LPO can influence the overall lead time positively if not managed effectively.

5.3 Recommendations

The lead time reduction on inventory system has attracted more and more attention and many researchers have conducted extensive studies in this area. Lead time can be reduced at an added crashing cost which means that it is controllable. By shortening the lead time, it was found that safety stock can be lowered, reduce the loss caused by stock out, improve the service level to the customer, and increase the competitive ability in business. It is therefore recommended to the management of ARCS to embrace strategies that can lead to reduction of lead time such as vendor managed inventory which enables the customer's partnership channel to be more efficient due to better planning coordination, reduced needs for inventories with increased sales by focusing on selling what end-customer wants.

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