ASSESSING THE IMPACT OF AIRCRAFT SPARE PARTS IMPERFECTIONS SUPPLIED THROUGH FOREIGN SALES SECURITY ASSISTANCE PROGRAM

By

Hesham Al-Momani

A Graduate Capstone Project
Submitted to the Extended Campus
in Partial Fulfillment of the Requirements of the
Degree of Master of Aeronautical Science

Embry-Riddle Aeronautical University
Extended Campus
Dayton Area Center
February 2007

ASSESSING THE IMPACT OF AIRCRAFT SPARE PARTS IMPERFECTIONS SUPPLIED THROUGH FOREIGN SALES SECURITY ASSISTANCE PROGRAM

By

Hesham Al-Momani

This Graduate Capstone Project
was prepared under the direction of the candidate's Research Committee Member,
Mr. Brian Maddocks, Professor, Extended Campus,
and the candidate's Project Review Committee Chair,
Dr. Don Zimmerman, Associate Professor, Extended Campus, and has been
approved by the Project Review Committee. It was submitted
to the Extended Campus in partial fulfillment of
The requirements for the degree of
Master of Aeronautical Science

PROJECT REVIEW COMMITTEE:

_____
Brian Maddocks, MS
Committee Member

_____
Don Zimmerman, PhD
Committee Chair

ABSTRACT

Researcher: Hesham Ahmad Al-Momani

Title: Assessing the Impact of Aircraft Spare Parts Imperfections Supplied Through Foreign Sales Security Assistance Program

Institution: Embry-Riddle Aeronautical University

Degree: Master of Aeronautical Science

Year: 2006

This research will propose a framework for assessing the effectiveness and impact of imperfections of aircraft spare parts supplied to the Royal Jordanian Air Force. There is little literature on this research, especially academic magazines. Literature review will be restricted to U.S Air Force and other countries organizations data (publications, studies, briefings, system operations). The six sigma methodology will be used to study the Supply Discrepancy Reports data as a key indicator for program success. Research will be exploratory. Evaluation will consider performance, potential and latent problems, and proposed solutions. It will give concerned commanders clear workable metrics and proposed solutions to improve the program's performance and acquisition schemes.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

Background of the Problem

During the previous 36 years, the Royal Jordanian Air Force (RJAF) has purchased all security needs for its main weapons systems from the United States of America. It acquired an incessant flow of spare components and parts under the Security Assistance Program, which consists of the Foreign Military Sales (FMS) and Direct Commercial Sales (DCS) programs. These programs reinforce joint security relations, sustain alliance building, and improve interoperability between Jordanian forces and U.S Forces. Having spare parts available when needed to perform required maintenance and operations is critical to the Jordan Defense Department's accomplishment of its missions. Imperfections and discrepancies of aircraft spare parts are a key indicator of effectiveness and performance for both supply process and the assistance program in general. It shows whether the millions of dollars annually spent on these parts are being used in an effective, efficient, and economical manner.

Accepted and denied SDR's cost both the US and Jordan millions of dollars. Jordan submits an average of 63 Supply Discrepancy Reports (SDR's) per year, a value of 5.5 million dollars annually (average SDR Value $90,014). This also causes shortages of aircraft spare parts and adversely affects the performance of assigned missions as well as the economy and efficiency of maintenance activities.

Foreign Military Sales Program (FMS) & Direct Commercial Sales Program (DCS)

The FMS program organizes purchases of defense needs, security requirements necessities, and military training for allied countries. The foreign country's program is managed by the Security Assistance Organization (SAO), Air Force Security Assistance Centre (AFSAC) and U.S. Embassy. The country liaison officer is stationed at AFSAC, Wright Patterson AFB in Dayton, Ohio. All involved administer FMS cases and assess country potential and requirements. The US Department of Defense (DOD) works as a mediator between US companies and the country and supervises and executes procurement processes and transportation. The DCS program administers and controls sales between non-military/privately owned US corporations and allied countries' armed forces. The DCS benefits by allowing the country to bargain and deal directly with weapons manufacturers without a mediator. This allows the country to avoid administrative fees on weapons sales. Further, items manufactured by more than one company are frequently cheaper.

Purchasing Process

The country begins the purchasing process by requesting price and availability (P&A) data on the item(s) that country wants. If SAO approves the request, the country decides whether to buy the items through FMS or DCS. Both parties sign a Letter of Offer and Acceptance (LOA) and the Defense Security Cooperation Agency (DSCA), obtains the items from US companies, adding a 3.8 % administrative charge to the sale price to recover the expenses incurred while running the sales. For complex and multipart military weapons systems, the time between signing an LOA and delivery may be more than two years.

Security Assistance Management Information System (SAMIS) and Air Force Security Assistance Center (AFSAC) Online

All FMS acquisition information is kept in the Security Assistance Management Information System (SAMIS). SAMIS is the main operation and processing tool and system for all FMS requisitions. It contains many screens to support different business procedures. These screens include demands tracking, shipment data, and historical development data allowing the foreign countries an access point into the AFSAC supply system as well as the means of receiving current and old data. There are also applications in the fields of case administration, financial tracking, acquisitions, supply discrepancy processing, and delivery reporting follow up. Approximately 2500 requisitions per day are carried out through SAMIS. SAMIS also interacts with 18 different USAF systems such as the Defense Logistics Agency (DLA), the United States Army (USA), the United States Navy (USN), various contractors, and over 115 individual country data systems worldwide (SAMIS manual [2005]). The AFSAC Online website is ideal for worldwide FMS countries because it provides them an immediate and secure means to access their program FMS data. AFSAC Online reduces status update requests to AFSAC by providing country users access to the information they require. AFSAC Online contains the following windows: business applications, organizational descriptions and point of contact lists, Foreign Liaison Officer link, Reference guides, handbooks, base information, SAMIS Products & Online Queries Guides, etc. SAMIS accesses via Secure Web Access (SWA) link, Worldwide Warehouse Redistribution Services (WWRS), Parts and Repair Ordering System (PROS II) and DSAMS web sites. The most important window for this research is AFSAC Online SDRs. Applications (Application Suite) window contains a host of commonly used SAMIS queries and detail & summary SDR history data. SAMIS and AFSAC Online operate a number of different computer systems that connect more than 1500 foreign and US users. AFSAC Online provides an ideal interface for FMS country's acquisition data on an up to date podium. Together SAMIS

and AFSAC Online represent the backbone of the Air Force Materiel Command (AFMC) data systems with respect to foreign military sales.

Supply Tracking and Reparable Return

The country interactive coordination automated logistics system is called the Supply Tracking and Reparable Return (STARR/PC). It consists of the following six major modules. The Acquisition Management module is used to route, process and manage the requisitions, amendments, deletions and dispatch of requisitions to SAMIS. In the STARPC system, one can retrieve edit, view, delete, print and confirm information about any specific Standard Document Number (SDN) (STARPC manual [2005]). The Case/Financial Management module is used to obtain the monetary status of country cases. There are many choices in this screen such as the line selection that shows country case details. One can access the individual lines within those cases in the 'Selection Results' window. Ordering Query/Report option is used to interrogate FMS cases locally established in STARR/PC. The Supply Discrepancy Report Management module is used to set up, send, follow-up and re-send Deficiency Reports (DR) especially after they are accepted by the SDR agency at AFSAC. The contents of this module make second copies that are found on the monthly SDR reports provided by the SDR/AFSAC Department services, but is more current because SDR status changes are sent as updates occur rather than as monthly updates. The Publications/Technical Orders Management module is used to request, process, submit and follow-up on all US Army, Navy and Air Force publications, and Technical Orders (TO). The Reparable Management module is used to process Component Exchange Request, manual MRRL *spell out MRRL before using the acronym* request, Material Return (Repair/Return & Component/Exchange), and Receipts transactions to the USG services.

Supply Discrepancy Reports (SDR's)

A Supply Discrepancy Report (SDR) is a report submitted by a customer when an incorrect defense article or service is provided that is not in the quantity or quality shown in the Letter of Offer and Acceptance (LOA). AFSAC receives an estimated 6,500 SDRs per year. There was a 15% increase in the number of SDRs in CY 2004 over the number received in CY 2003. The manual SDR process, which was partially replaced on 28 November 2005 by an automated system, was complex, time consuming and duplicative. SDRs are a direct indicator of how well the USAF is providing its FMS customers the right material to the right place at the right time and at the right price. FMS customers requested faster turn-around time on SDR processing. This Six Sigma project focuses on improving the SDR process and reducing the total number of SDRs, and supports the Air Force Smart Operations 21 initiative.

AFSAC is the main contact point between foreign countries and the US. Their process of work is shown in the chart below. The Critical to Quality (CTQ) here is the (Delivery Time, Number and Cost) impact to RJAF. CTQ features are those that customers expect and consider when evaluating product or service quality. CTQ criteria here are that the customer does not expect an SDR within 6 sigma. The chart below shows the strategy map for the AFSAC vision: “world-class professionals fostering global partnerships.”

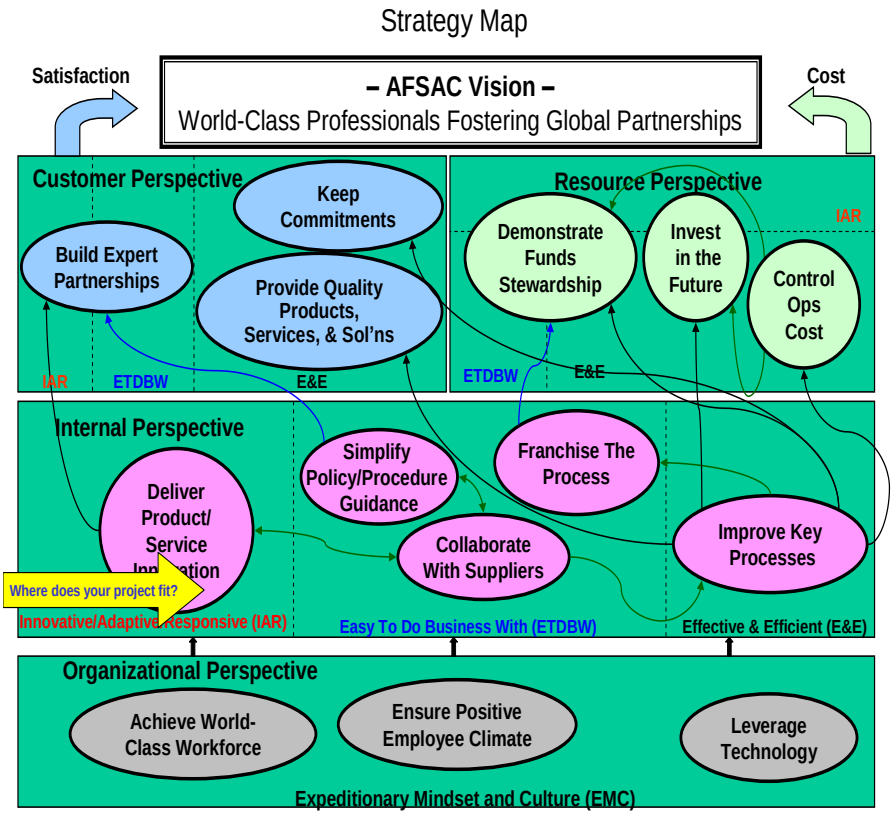


Figure 1 AFSAC Strategy and Process Map

Six Sigma

The roots of Six Sigma as an advanced quality control measurement standard can be traced back to Bill Smith, the Motorola engineer who spent years convincing higher-ups that he had created a new effective way of quality improvement strategy. Sigma is a statistical symbol (Greek letter) for standard deviation. Recall that 99.73% of the area under the standard normal distribution lies within +/- 3 sigma from the mean, i.e. 2700 Parts per Million (PPM), or 0.27%, lies outside +/- 3 sigma. Six sigma specification limits are six standard deviations from the mean. When the mean is centered at the target, the PPM defects can be measured to be .002 PPM. Note that the 6ó approach means that the average review process generates 3.4 defects per million. When 6ó was first developed, an assumption was made that when the process reaches the six sigma quality level the process mean is still subject to certain kinds of perturbations that may cause the

mean to shift by as much 1.5 sigma off target despite best efforts. The tables below show the process centered at the target and the process with the mean shifted 1.5sigma from the target

Table 1 Process centered at the target

SIGMA RATING	PPM DEFECTIVE	AT-QUALITY RATE
1	317300	68.27
2	45500	95.45
3	2700	99.73
4	63	99.9937
5	0.57	99.999943
6	0.002	99.9999998

Table 2 Process with the mean shifted 1.5sigma from the target

SIGMA RATING	PPM DEFECTIVE	AT-QUALITY RATE
1	697700	30.23
2	308700	69.13
3	66810	93.32
4	6210	99.3790
5	233	99.97670
6	3.4	99.999660

Six Sigma simply means a measure of quality that strives for near perfection. A Six Sigma process is a “zero defects” process. As the process sigma value increases from zero to six, the variation of the process around the mean value decreases. With a high value of process sigma, the process approaches zero variation. Six sigma is a “get rich slow” methodology. You cannot expect to significantly reduce costs and increase sales without investing in training, organizational infrastructure and cultural

evolution. Six sigma has two sub-methodologies. Design, Measure, Analyze, Improve, Control (DMAIC) is an improvement system for an existing process falling below specifications and looking for incremental improvements. The Define, Measure, Analyze, Design, Verify (DMADV) improvement system is used to develop new processes or products at six sigma quality levels.

.

Fig (2a) Shows the 5 steps in Six Sigma

Figure (2b) below shows how Six Sigma works from a statistical point of view.

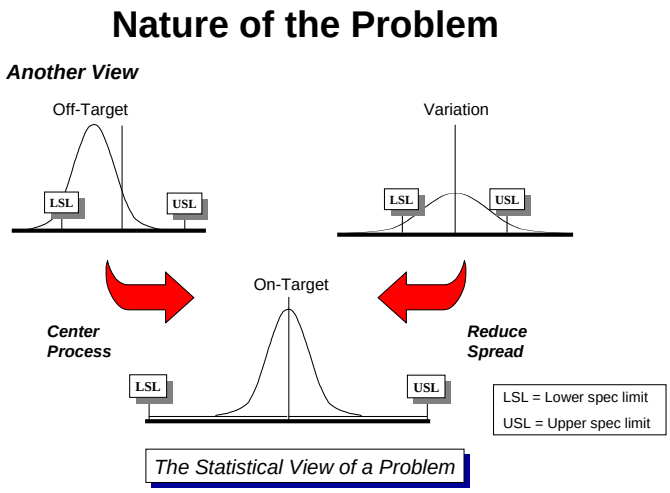


Fig (2b) Statistical point view of problem

Figure 2. Six Sigma Methodologies

Researcher's Work Setting and Role

The researcher/principal investigator (PI) is a Lieutenant Colonel Lngineer and liaison officer between the US Air Force and the Royal Jordanian Air Force (RJAF) currently stationed at Wright Patterson Air Force Base, OH. His current responsibilities involve the management of US Military Assistance to RJAF, which will end on Nov 21, 2006. He has been working with RJAF for the past 19 years in a variety of technical, maintenance, quality control and assurance, logistic and management positions. He holds a Bachelor of Science. in Mechanical Engineering with dual specialization in aeronautical and thermal power, a Master of Science in Administration, and is in the final stages of a Master of Aeronautical Science program at Embry-Riddle Aeronautical University. He also holds a Black Belt in Six Sigma and a Federal Aviation Administration (FAA) Mechanic and Power Plant Certificate. He has worked for the Royal Jordanian Air Force for the last 19 years in various maintenance and logistic positions.

Statement of the Problem

"Evaluation is possibly the most important activity that has allowed us to evolve, develop, improve things and survive in an ever changing environment" -- Jane Davidson

The increased number of SDRs is a key indicator of effectiveness and success of supply operations during country military sale assistance program and is very important regarding both readiness of the air force in a challenging world and saving of money and effort from both the United States of America and Jordan.

Significance of the Problem

The average money lost from both countries is 5.5 million dollars each year. The urgency in need for the same spare parts will increase and result in an extra cost incurred because of the high urgency and fastest shipping required . At the same time this study also gives leaders insight into whether this program and others like it are an appropriate

and effective way to drive the transformation they are endeavoring to bring about. The intent of this research is to present Jordan with a complete evaluation of the effectiveness of this program and suggest workable solutions to program shortcomings. These solutions should ultimately improve Jordan's military readiness and save money.

Approach

The approach section is where you briefly describe what you did to solve the problem. The style guides may not specify an Approach section, by it seems appropriate in this case.

This research proposes a framework to assess the impact of imperfections in aircraft spare parts supplied through the foreign sales security assistance program. [detected if the general problems, findings and difficulties are the same for all countries programs and Air Force Security assistance goals. *I don't get this*] Discrepancies related to supply process data are pulled from two years *of what data? SDR?* to determine the effectiveness of this program over a long period of time, in order to study and examine the root cause of the problems. The six sigma methodology is used to study the Supply Discrepancy Report data as a key indicator for program success. SDRs indicate a cost on average of 5.5 million dollars a year.

This research is an exploratory study using six sigma techniques to determine the degree that the FMS program systems are used as proposed. [by making a goal of reducing the number of Supply Discrepancy Reports to zero and processing time for SDRs to be like AFSAC average 82.5 days, identified processes that are off target and / or have a high degree of variation, and corrected the process. There were many data reports to study, using multiple sources of information and analysis and the most important limitation factors and parameters that influence our FMS program which are

included in Supply Discrepancy Reports (SDR's) were selected . Substantial numbers of requisitions has been analyzed. The evaluations and effectiveness of country program is important for all users, especially (commanders, logisticians, and human management personnel at all levels). *Break these sentences up…there are too many* ands…*]*

Limitations

There was some limitations to this research since there is little literature on assessing the impact and effectiveness on military sales security assistance program. Nothing has been written specially about Supply Discrepancy Reports in the academic journals and magazines; therefore, the literature review was restricted to those few publications and studies that have been conducted through the organizations themselves by Air Force Materiel Command (AFMC), Air Force Security Assistance Centre (AFSAC), and Royal Jordanian Air Force (RJAF). Also the sources for this paper were taken from different systems operating and capabilities manuals, briefings, training courses, conferences, and regulations. Data was variable during different intervals because of the complexity and big variance in aircraft spare parts regarding source of supply, cost, and life time issues, handling and shipping methods. Finally, data regarding international freight forwarders was changing because their contract is terminated and renewed every two years, other pitfalls appeared during further research and were mentioned with their effects in the research paper.

Assumptions

It is assumed that Jordan's program performance data approximates AFSAC goals and the other 25 countries average data. Systematic methods and data reports used to explore, examine and produce information useful for making a decision about performance effectiveness, spotted weak areas, found areas for improvements and generated an assessment of the overall quality of country program. The data was compared with other countries' average data and to the United States Air Force's (USAF) Security Assistance Center's (AFSAC) published metric goals. Judgments on this program are made in regard to the time period in which the objectives were to have been accomplished and the cost.

In capturing low performance spots and delayed process periods, a search made

for potential solutions for providing a cure for these cases and explore possible changes to prevent the occurrence of these problems. Furthermore, the same verdict and decision rules are applied to these data reports. Reliability did not offer any serious problems. Accuracy, reliability, precision and validity were very high because of the extent to which the data reports measured what it was supposed to measure. It containes all requisitions (demands) from the three different systems with multi-controls and limitations was only the mismatch problem among these systems. Taking in account that all of the mentioned data has been pulled from the database records in the same two years period, insuring that no additional records have been posted from earlier dates. Thus there was no troubles with validity and soundness in STARPC or in SAMIS.

Definition of Terms

All definitions used in this research are listed at Appendix X.

Acronyms

All acronyms used in this research are listed at Appendix X.

.

CHAPTER II

REVIEW OF RELEVANT LITERATURE AND RESEARCH

Introduction

There is little literature assessing the impact of imperfections of aircraft spare parts supplied through the foreign sales security assistance program. Nothing has been written about the subject in the academic journals and magazines; therefore, the literature review was restricted to those few publications and studies that have been conducted by Air Force Materiel Command (AFMC), Air Force Security Assistance Centre (AFSAC), and Royal Jordanian Air Force (RJAF). Other sources for this paper were taken from different systems operating and capabilities manuals, briefings, training courses, conferences, regulations and expert's recommendations. Also, a search was made for sources of relevant aviation and aerospace research literature at the ERAU Hunt Memorial Library. (http://amelia.db.erau.edu/).

Air Force Materiel Command (AFMC) Resources

Air Force materiel command has many useful resources regarding foreign military sales starting with AFMCR 57-7, 29 April 1983, Sustainment Materiel Acquisition Policy, which defines AFMC policy for processing purchase requests (PR) to acquire materiel. These materiel consist of replenishment spares (both consumable and reparable spares), item repair, and other related services. Another source is AFMCPD 23-2, 21 March 1997, Logistics Materiel Control Activity Operating Policies. This reference establishes the Logistics Materiel Control Activity (LMCA) especially for testing, developing, and evaluating all supply activities. The Federal Acquisition Regulations web site provides a huge information source on acquisition regulations in United States Air Force. The Defense Logistics Agency Web site and Foreign Military Sales Web site were perfect sources of information for this paper as well as the DLA Logistic operation customer handbook (2004), and the Acquisition Technology logistics web site.

Air Force Security Assistance Centre (AFSAC) Resources

Air Force Security Assistance Centre (AFSAC) has many resources which helped in completing this paper. First and most important is the AFSAC Online web site, "AFSAC Online provides world-wide users 'secure access' to the country's FMS data (access anywhere internet is available, instant customer access to data), reduces status requests to AFSAC/Supply Sources, customers can submit their own requisitions and narratives, this complements (not replaces) our valued personal interaction with our customers". AFSAC Online includes different windows that provide an overview of AFSAC automation capabilities in support of their various customers; it gives an explanation of their interfaces, and a technical description of the operating systems. An example is the business applications window which contains "Logistics Applications, Open Document Number Query, Online Requisitioning (A01s, A02s & A04s w/mass upload), FMS Repair/Replace Cross Reference, Daily NMCS Report, Open Requisitions Status Report, Financial Applications, FMS Case Financial Information Report, Worldwide Warehouse (WWRS) Support Applications, Technical Order Index, includes Country Standard & M-Symbol Technical Orders (TO's), PROS II Monthly Metrics Report, AFSAC Online Metrics (Open Requisitions, On-Time Shipments and SDR Processing), Automated LOR Processing", "AFSAC mission, vision, goals & values, organizational descriptions, all AFSAC briefings such as, Cooperative Logistics Supply Support Arrangement (CLSSA), Parts and Repair Ordering System (PROS), Worldwide Warehouse Redistribution Services (WWRS), Repair/Replace briefings, the foreign liaison officer link, reference guides, handbooks, SAMIS products & online queries guides, etc. Also it has special windows for Worldwide Warehouse Redistribution Services (WWRS), Parts and Repair Ordering System (PROS II)". One of the primary screens used by customers is AFSAC Metrics, which is the Comprehensive Requisition Report. The customer is provided with all available data for appropriate requisition and

freight tracking. The detail screen also displays every supply, transportation, or billing transaction that has occurred against that particular document number. All above systems indicate the document number and present a written description of a particular item or items of interest concerning that specific document number and allow the customer a method of addressing difficulties to their technical group.

The second important resource was the Air Force Materiel Command (AFMC) operating manual. "The purpose of this operating manual is to communicate to the newcomer the overall operation of the Air Force Security Assistance Center (AFSAC). This manual defines the organization's vision, mission and goals, policies and procedures, and general business practices in order to create a more efficient working environment for all AFSAC personnel". The systems of interest for this research are SAMIS, AFSAC Online and STARR/PC, although AFSAC maintains numerous other systems and capabilities. Since the briefing provides the non-technical reader with a broad overview of the purpose and capabilities of these systems it is particularly useful. The Security Assistance Management Information System (SAMIS) Reference Manual and system screens, which contain all data needed to evaluate this program such as open requisition states, shipping details, financial details, repair requisitions states, letter of request and letter of acceptance details and information related to this program. Another resource for this research is the SAMIS Training File, established by Air Force Security Assistance Centre, Wright-Patterson AFB, OH (1997). AFSAC Foreign Liaison Officer Orientation Course Manual, Air Force Security Assistance Centre, Wright-Patterson AFB, OH (2005) and the Management of Security Assistance handbook, 19th edition, prepared by the Defense Institute of Security Assistance Management, Wright Patterson Air Force Base.

Country Air Force Resources

The Supply Tracking and Reparable Return (STARR/PC) Manual was adequate to provide all system details on how it works and included thorough details about the modules, interface and data reports which can be compared to the SAMIS system output at AFSAC. The Royal Jordanian Air Force resources included the intermediate supply course text, advanced supply course text, Government Works Regulation No. 71 of 1986, the Supplies Regulation No. 32 of 1993 and Military Requisites System of 1995 for military supplies and needs, Procurement Regulation No. 32 of 1993, Tenders Regulation No. 1 of 1994, Directorate of Supply purchasing regulations.

Summary

Each country has its own defense and systems so there was little information regarding evaluation of the effectiveness of their programs to be found in literature for these countries because of the military nature of these projects. The literature dealing with all countries performance and AFSAC goals is primarily generic. Country data were available through different systems and all other countries average is available too, without details. The philosophy and methodology of six sigma tools was used to assess this research with less dependence on literature because of the reasons mentioned above. Finally, the Student Guide to the ASCI 605 manual was of great use in this research.

Statement of the Hypothesis & Research Questions

The research topic: Imperfections in Aircraft Parts Supplied to Country through Foreign Military Sales Program has a great impact on both readiness and economics of country air force. Country data averages were much greater than air force security assistance goals and other FMS countries average. Supply Discrepancy Report as a main indicator of performance of this program data has been analyzed for a long period of 2 years. Data were downloaded from three different systems (Security Assistance

Management Information System (SAMIS), Air Force Security Assistance Centre Web Site (AFSAC Online) and Supply Tracking and Reparable Return (STARR/PC). These data sets were analyzed to determine subsets of requisitions/orders for comparison. These subsets: Supply Deficiency Report (SDR) submission rate, the SDR on Time Decision (and their values), and SDR Open Aged metric. Six Sigma tools were used through Minitab Statistical Software which is the ideal package for Six Sigma and quality improvement projects. From statistical process control to the design of experiments, it offered the methods needed to implement every phase of the project. The Minitab computer program is designed to perform basic and advanced statistical functions. It combines the user-friendliness of Microsoft Excel with the ability to perform complex statistical analysis.

During the planning and operational phases of this research, the major questions to be considered were: For the Supply Discrepancy Report (SDR's), what are the Supply Deficiency Report (SDR) Submission Rate and the SDR on-time decision criteria (approved, denied, and advisory)? For the Supply Deficiency Report (SDR), how many SDR's were open, SDR's value and the percent of the total open that were more than a year old? How can the problems be remedied? What steps do we take to eliminate or diminish, the systems mismatch problem? All data was taken for the last eight quarters and country data was compared to all 25 countries' average of the same data**.**

CHAPTER III

RESEARCH METHODOLOGY

Research Model

This research consisted of a systematic process of inquiry aimed at discovering, interpreting, and revising facts. This intellectual investigation produced a greater knowledge of events and procedures and made practical applications possible. This researcher collected data and information about SDR's usually associated with the supply process. The research was of a constructive research type where the most common advanced statistical Minitab software research method was used. Here the conclusions have to be objectively argued and defined. Research involved evaluating the "construct" being developed analytically against some predefined criteria or performing some tests as a continuous improvement process. In addition, patterns in the data were modeled mathematically in a way that accounts for randomness and uncertainty in the observations. The mathematical model presented the essential aspects of an existing system (or a system to be constructed) which presents knowledge of that system in usable form.

Sources of Data

The data were collected from a combination of data mining/collection sources, using the same time period, from Security Assistance Management Information System (SAMIS) at Air Force Security Assistance Centre (AFSAC), Air Force Security Assistance Centre Web Site (AFSAC Online), Supply Tracking and Reparable Return (STARR/PC) at Country Air Force Directorate of Supply, and Through Freight Forwarders Web Sites.

The Data Collection Device

The data collection device in this research is a "Computer Related" storage device: Pentium IV computer with Hard Disk Drive/Flash Drive, Memory Chips. The research “Data Collector" met the mandatory requirements for successful and accurate collection of data at a fast but steady rate. It included: Time, Storage Space and an "advanced" understanding of Secure-Stable-Successful Data Collection.

Pilot Study

This research was a complete and permanent study for my country’s program. Data were real for the 2 year period. There were no major changes in defense needs for the near future so it will be valid and recommendations will be acted upon.

Instrument Pretest

All data collection devices were pre-tested to ensure their accuracy and comprehensiveness. An interface problem was expected among the three systems: Security Assistance Management Information System (SAMIS) at Air Force Security Assistance Centre (AFSAC), Air Force Security Assistance Centre Web Site (AFSAC Online), Supply Tracking and Reparable Return (STARR/PC) at Country Air Force Directorate of Supply, and Through Freight Forwarders Web Sites, but previous studies shows limited effect of this interface specially on long period study.

Distribution Method

All data collection devices were administered at a single meeting and placed on the Internet as an electronic data instrument, so there were problems expected during collecting, distribution or saving the data.

Instrument Reliability

The reliability of the data collection devices (SAMIS, STARR/PC, AFSAC Online) was very high as they are the backbone supply systems for U.S Air force, FMS management and other 25 countries using these systems. Reliability tests were performed and they are full reliable systems.

Instrument Validity

As mentioned in the reliability paragraph the data collection systems have a high validity in measuring what they are supposed to measure. The validity was determined during data collection and spot checks were made with other systems

Procedures

The research followed a structural process (the sequence of operations and involved events) taking up time and space, which led to the production of the outcome. The following steps were part of the formal research, both basic and applied: the topic statement was formatted, the problem statement as mentioned in this proposal. The hypothesis was established (suggested explanation of a phenomenon or reasoned proposal suggesting a possible correlation between multiple phenomena). The Operational Definition was defined, i.e. a description of the variable data in terms of the specific supply process and sets of validation tests to determine its presence and quantity. The data is commanders accessible and may be independently measured or tested at will. The

data was gathered from the three main systems, validated, and Six Sigma tools and methodology with Minitab was used to find different relations, distributions, etc. between variables. These outputs are discussed and conclusions and recommendations are made.

Treatment of Data

The five part methodology of Six Sigma was followed: Define, Measure, Analyze, Improve, and Control. In the Define phase, the objective was to reduce the number and processing time for supply discrepancy reports (SDR), i.e. reach zero SDR rate and a minimum processing time of 82.5 days (AFSAC goal). In the Measure phase, determination of the Critical X's and Y's (see next page) was made and performance standards were established using available data. A data collection method was developed and measurements were validated determining the process capability and baseline. In the Analyze phase, the goal was determined and the vital X's (root causes) were identified, giving the current process results. The process capability in the root cause analysis was statistically determined. A search was made for the fundamental reason for an event, which if corrected, would prevent recurrence and the last cause in the chain. Cause chain diagrams were used as a very powerful tool that is capable of handling large and complex problems. The *Why-Why* Analysis was used, e.g. Why did it happen? Didn't get to country on time, why? Country percentages, data averages are different than other countries, why? Country data averages different than AFSAC goals, why? Country actions were slow, why? …etc. In the Improve phase, solution alternatives were developed and ways recommended for removing the cause of defects and variations. And finally, in the Control phase, statistical process control was used and strategies were suggested.

The objectives in this research (Y's)

1-Y1 (Big) = Successful Supply operations (Support)

Y1(Small) = SDR Process time

X1=Source of Supply
X2=No of days take RJAF to submit SDR
X3=No of days took AFSAC to process and take Decision to SDR
X4=SDR Decision Criteria
X5=Cost Of SDR
X6=SDR to Domestic Cargo relation
X7=SDR to International cargo (AIR) relation
X8=SDR to International cargo (SEA) relation
X9=SDR to Reception Centre at Customer Facility relation
X10=SDR to Customer (RJAF) final Destination
X11=SDR Season Effect
X12=AGE
X13=NMCS SDR to SDR rate

2- Y2 (Big) = Successful Supply operations (Support)

Y2 (Small) = Number of Supply Discrepancy Reports

X1=SDR Root Causes
X2=Source of Supply
X2=Reason for SDR (Quality, Concealed Shortage, etc)
X3=SDR Decision (A, D, V)
X4=Cost Of SDR
X5=Defect
X6=SDR to Domestic Cargo relation
X7= SDR to International cargo (AIR) relation
X8= SDR to International cargo (SEA) relation
X9=SDR to Reception Centre at Customer Facility relation
X10=SDR to Customer (RJAF) final Destination
X11=SDR Season Effect
X12=AGE
X13=NMCS SDR to SDR rate

Quality Functional Deployment (QFD) and house of quality techniques were used to identify CTQ as a structured methodology to identify, prioritize, and translate expectations into technical requirements and measurable features and characteristics. Minitab tools and statistical tests were used to complete this research.

CHAPTER IV

RESULTS

Six Sigma was used in this research because it eliminates defects and reduces variations in processes. The reasons RJAF and AFSAC are candidates for Six Sigma methodology are customer/ supplier/ employee complaints, blaming people, failures in the field, too much rework (not right the first time) and variations in process. Consideration was given that Six Sigma is not a quick fix, cost reduction/ training/ short term/ statistics measurement/ quality program or publicity stunt. It is a methodology of finding and fixing the defect(s).

Research results of defects affecting the aircraft spare parts process are shown in the following figure.

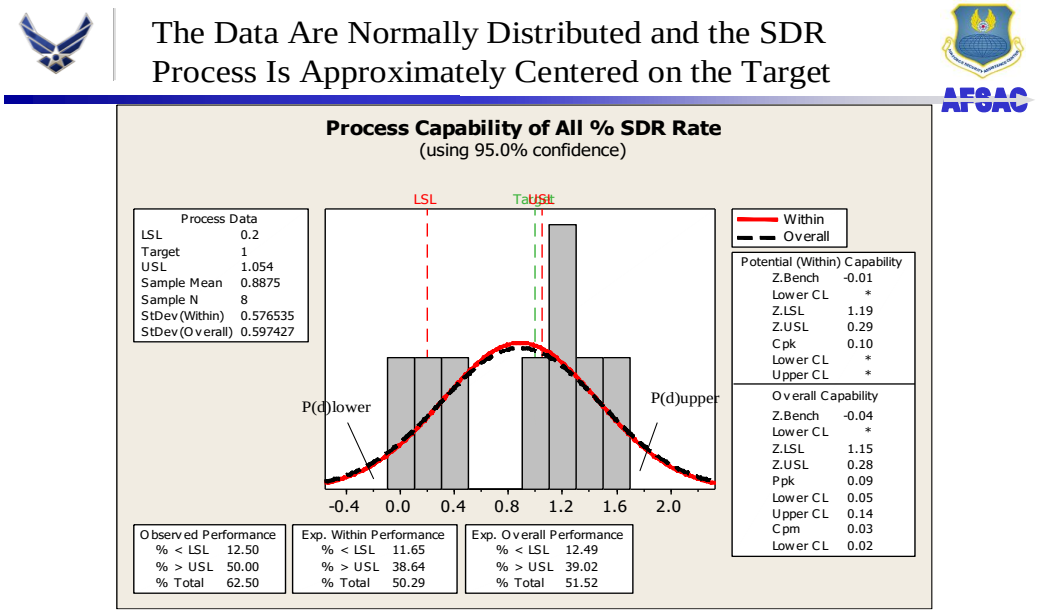


Figure 3. SDR Distribution

Where Normal Distribution Data:

- Customer Approved USL = 1.054%
- Customer Approved LSL = .20%
- Mean of All % SDR Rate = 0.8875
- Standard Deviation of All % SDR Rate = .576535
- Defects per Unit (dpu) = .01
- Z(LSL) = 1.19
- Z(USL) = 0.29
- P(d) = # Bad/# Total = 6372/678734 = .01
- First Time Yield (FTY) = # Good/# Total = .99

Note: FTY is percentage of units that pass through an operation or process without any defectives.

- Z(LT) = 2.30
- Z(ST) = -1.52
- Z(SHIFT) = Z(ST) – Z(LT) = -1.52 – (2.30)
- Z(SHIFT) = .78 (Technology Problem)
- Process should be reengineered vs simply reducing between group variation

Z-Bench Baseline:

Z-Bench was used to communicate total probability of defectives the SDR process has. Z-Bench is the metric describing the total "Sigma Level"

P(d)total = P(d)lower + P(d)upper

P(d)total = .115 + .382

P(d)total = .497 (The team is running a -0.04 Level Sigma SDR Process!)

The team predicts the process will have 49.7% of SDRs outside the specification limits. Establish how good the SDR process is today with Z-Bench(-.04). The Cpm value is 0.3, which indicates that the process does not meet the target value.

Z-Bench

- Z(LSL) = 1.19
- P(d)lower = .115
- Z(USL) = .29
- P(d)upper = .382

Also the Control and Technology Diagram revealed that the process far away from World class and we need a lot of work in the Control and Technology directions.

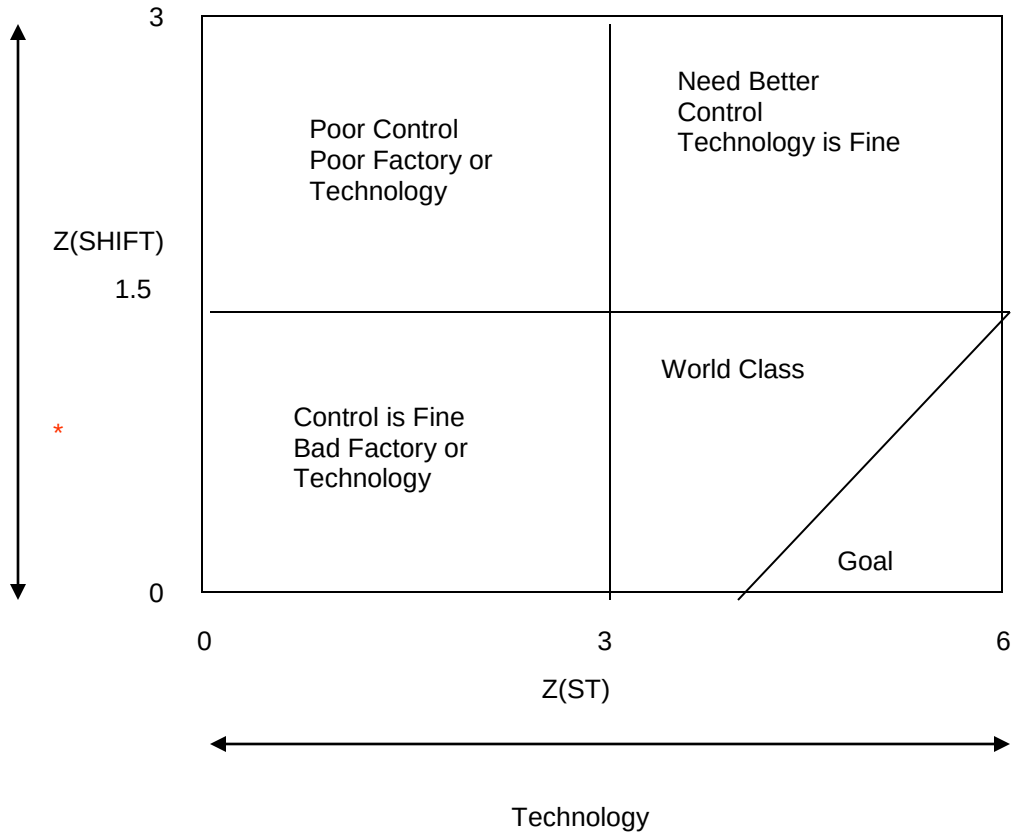


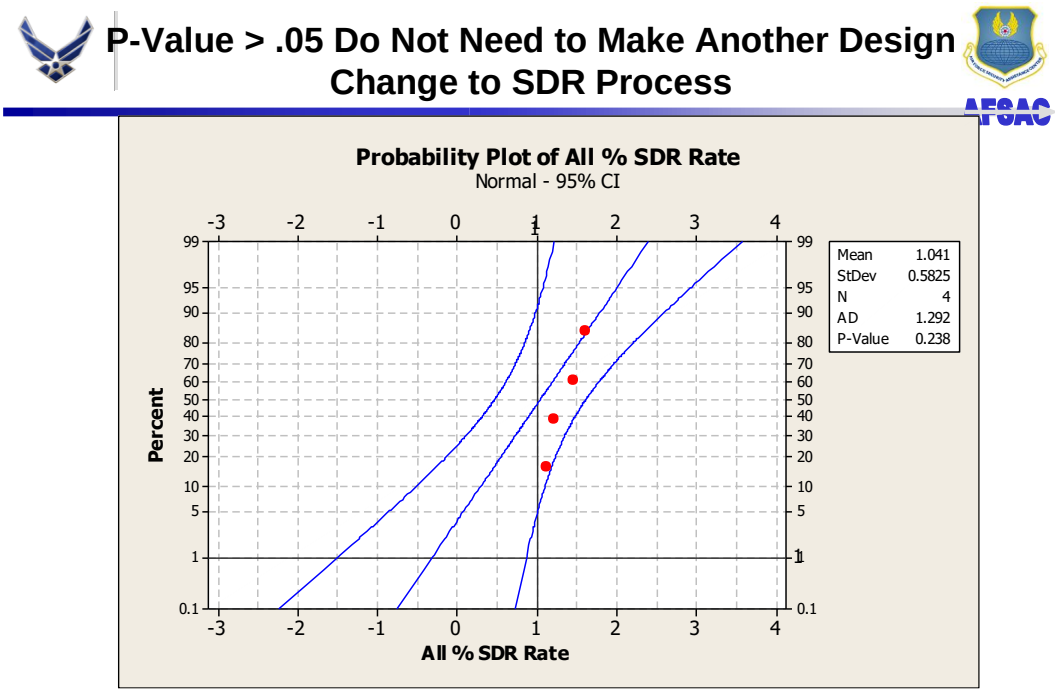
Figure 4. Control – Technology Diagram

CURRENT FUNCTIONAL IMPROVEMENTS PROCESS/ACTIVITY		
	Current Process # Days	Streamlined Process # Days
Customer to ILCO	29	1
ILCO Processing	25	2
Transmit to Action Agency	9	2
Action Agency Processing	50	50
Action Agency Reply to ILCO	7	2

ILCO Processes A/A Reply	13	3
Transmit Reply to Customer	30	1
Monitor Materiel Returns/ Financial Adjustments	46	46
(Web)SDR Process	209	107
Improved Processing Time (Web) *49%*		

Table 3. Functional Improvements

P-Value > .05 Do Not Need to Make Another Design Change to SDR Process



25

Figure 5. SDR Rate Probability

CHAPTER V

DISCUSSION

The goal is to provide quality products, i.e. deliver the right materiel, to the right place, at the right time, at the right price. The SDR process begins when the customer notifies AFSAC of a discrepancy. Our goal was to work proactively to streamline the supply process by reducing the percentage of SDRs by determining: the root cause of SDR submittals, the customer submittal rate, and the supplier type and rate of discrepancies.

Supply Discrepancy Report (SDR) is a report submitted by a customer when an incorrect defense article or service is provided that is not in the quantity or quality shown in the Letter of Offer and Acceptance (LOA). Six Sigma defines the best measures of a process, implements those measures, tracks them, and makes adjustments so that more of the outcomes fall in the acceptable range – reducing the number of defects

In our case, Y = a good SDR process. My country as FMS customers requested faster turn-around time on SDR processing, viz. have an average SDR processing time of 82.4 days for web customers and 91 days for non-web customers (when there is no materiel to be returned for credit or analysis) and a discrepancy rate of 1%.

The SDR process begins when RJAF submits to AFSAC an SDR notifying them of a discrepancy in the received item, then the SDR will be processed to the Defense Logistic Agency (DLA) who will investigate the causes by contacting the Domestic and International Carrier and Source of Supply to stand on root causes and solve it.

The Complete process diagram is as follows:

Source of Supply → Domestic Cargo → International Cargo (RJAF) (Sea / Air) → International Cargo Stores → Reception Centre At Customer Facility → Customer (RJAF) Final Destination.

Six Sigma steps: Define Phase – define the process map which graphically displays the events and operations in a time sequence that makes up the process. Work to understand each process and optimize it, find process defects (if possible), define the responsibilities of the process owners and determine the Critical to Customer Quality (CTQ) business process measurements. A simplified process model is illustrated in the following figure.

Simple Model

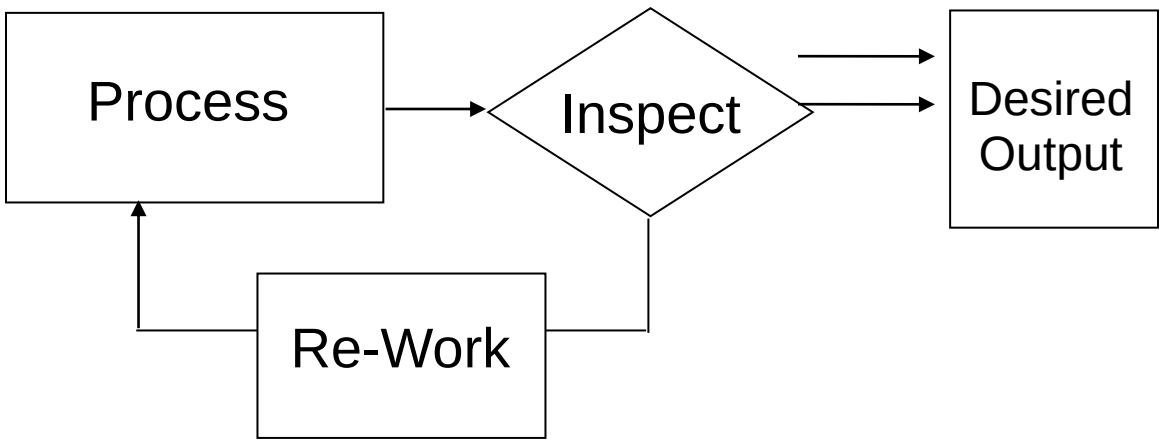


Figure 6. CTQ Process Model

Old and Current SDR Processes Flow Charts at AFSAC are shown in the following figures. Where Automation process starts, SDR Automation Scope by Automation of 8 major modules (SDR Submission Wizard, Submission Processing, Manual Review/Actions, EDI Communications, Reply Processing, Customer Notifications & Queries, Financial Follow-Up Processing, General Maintenance Activities)

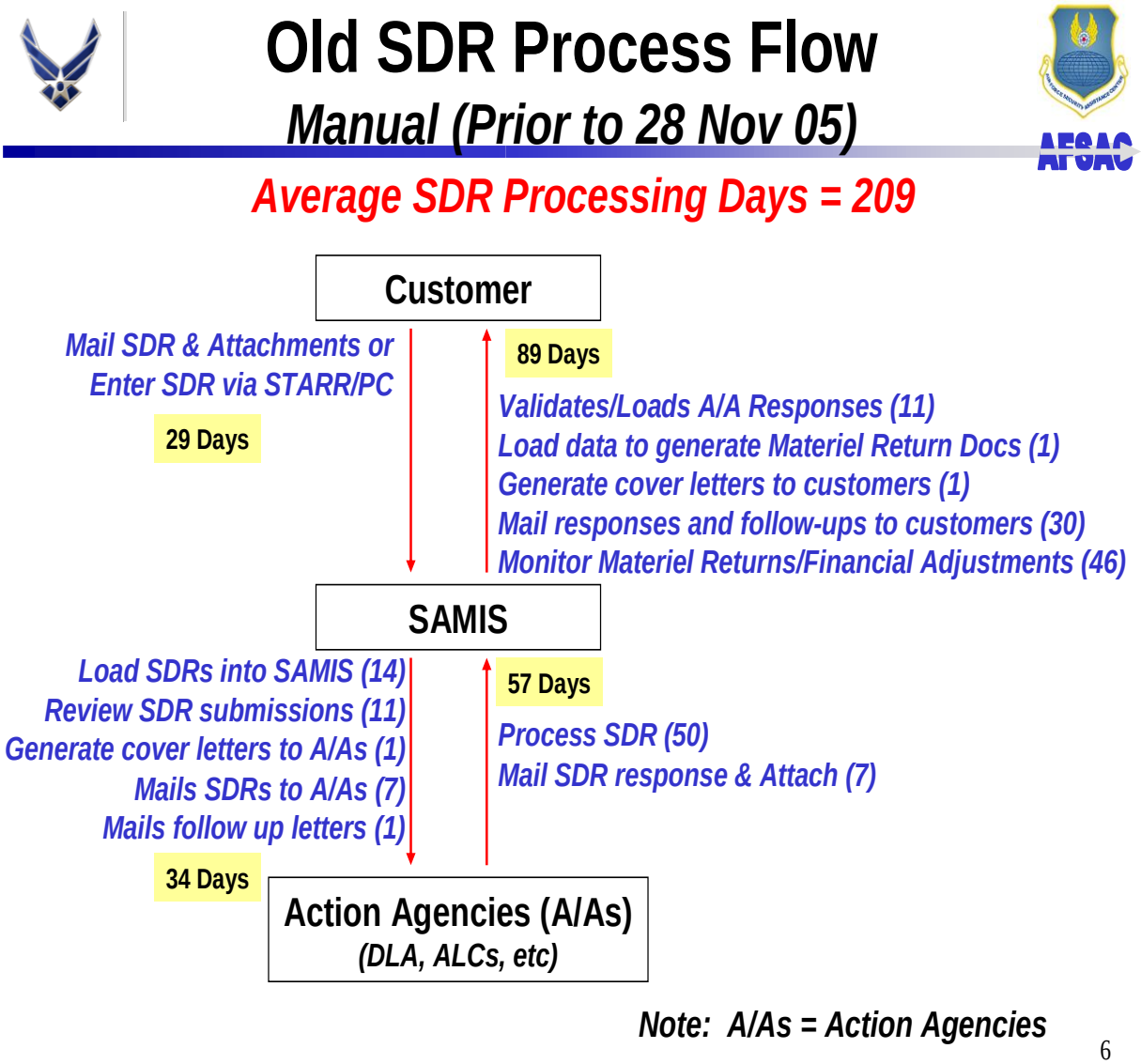


Figure 7. Old SDR Process Flow

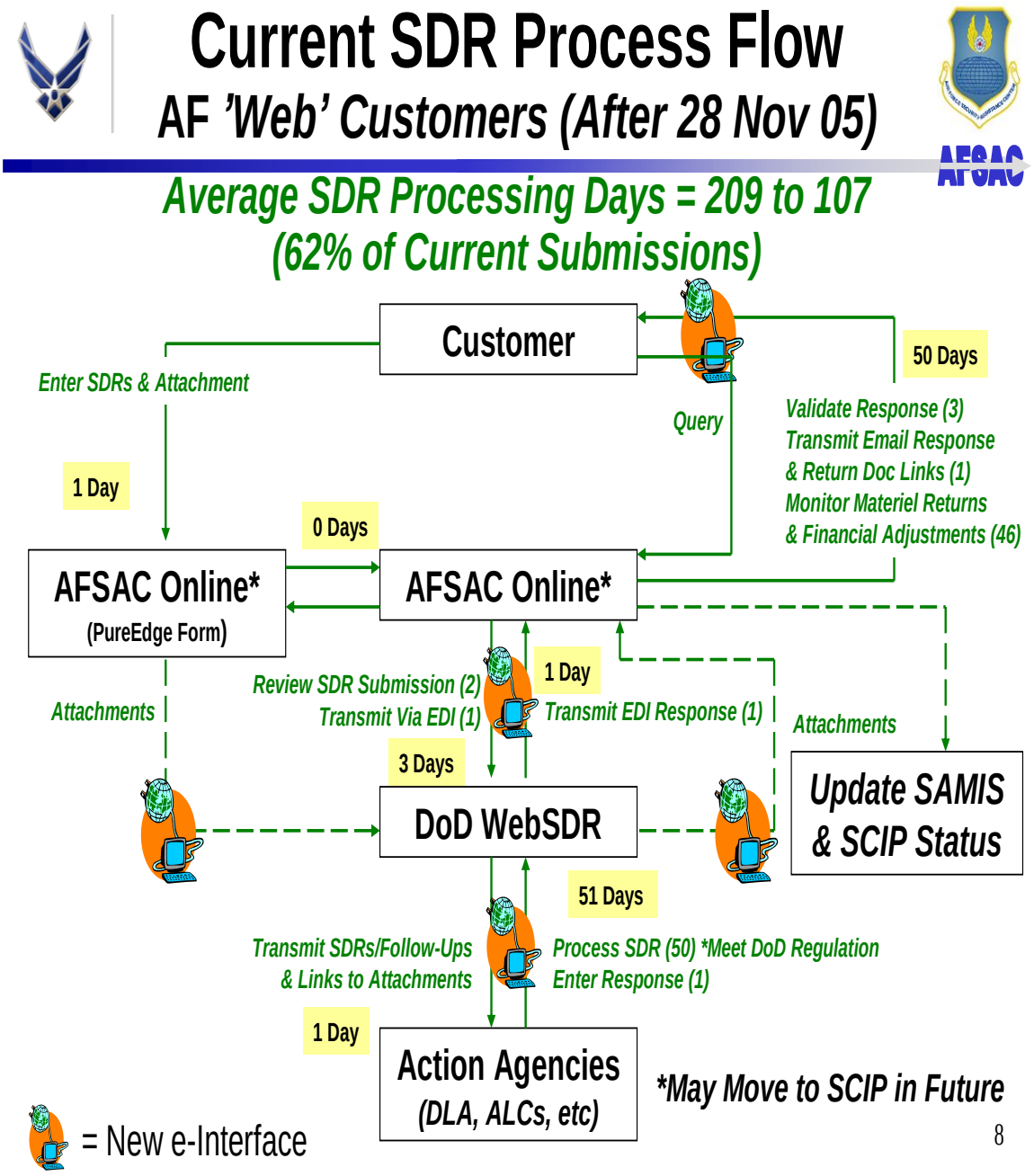


Figure 8. Current SDR Process Flow

An illustration of the cause and effect of this process from both the AFSAC and RJAF points of view is diagrammed below.

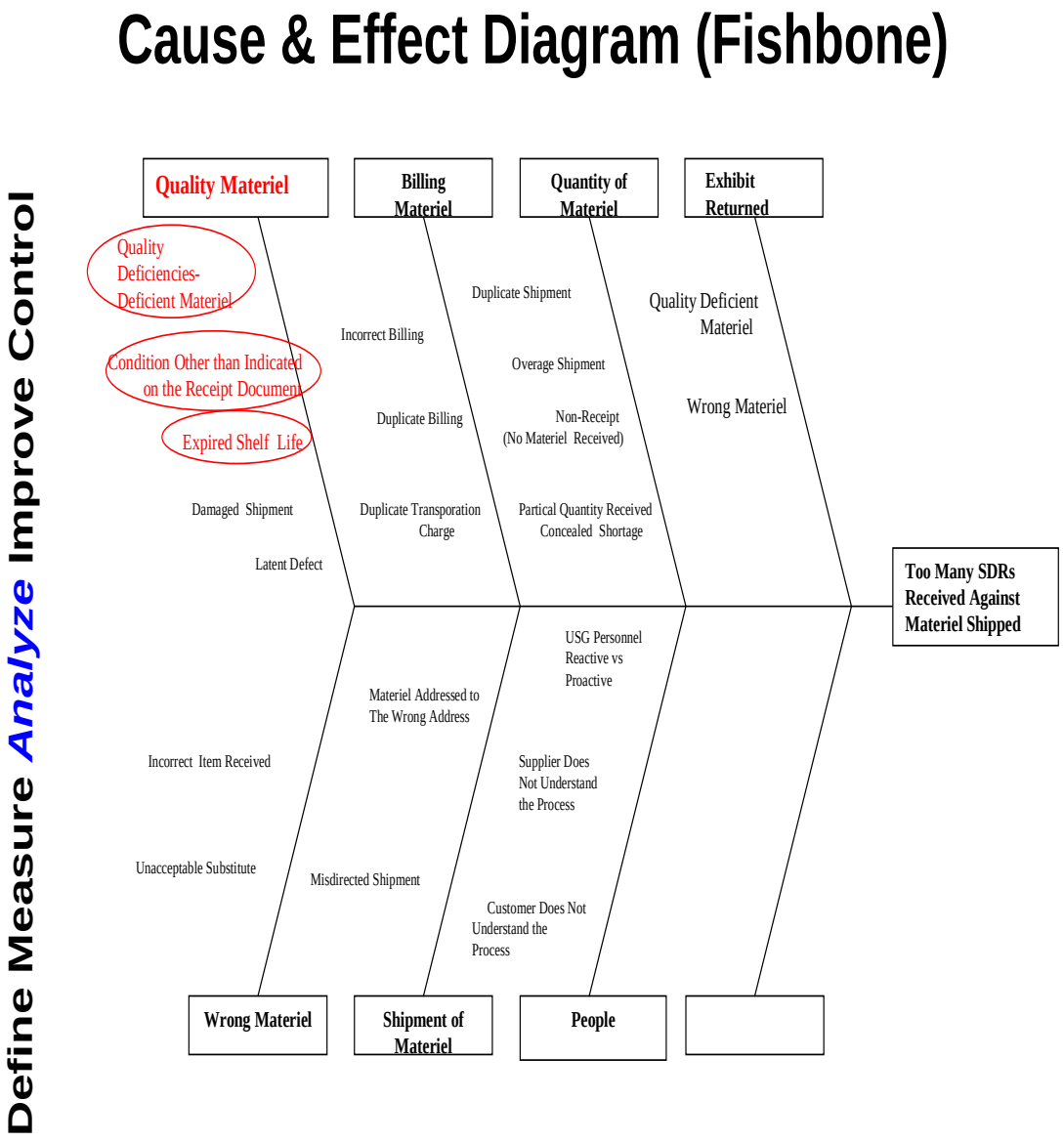


Figure 9. Cause and Effect Diagram

In the SDR process there are many pitfalls:

- Lack of understanding on data input by all parties.
- No standard narratives to identify serious processing problems.
- Limited desire by the case managers to work with their Command Country Managers.
- Case managers who hold a case rather than reject it back for correction.
- Release delays for document processing – AFSAC Online does not reflect accurate data for the time interval between submission and release.

There are many Xs (problems) which are unresolved (no data) due to time limitations. There is limited available data on the Defense Transportation System (DTS) and the Procurement and Repair System (PROS), and none on the Freight Forwarder System

RJAF lost large sums of money and has a decreased readiness due to the SDR issue. RJAF personnel at the supply branch operation control points do not have access to the main system at AFAC – SAMIS. If they had access, they could track each requisition that has an AS2 code, i.e. has been shipped from a source of supply. Additional problems are:

- Lack of staff to follow up on RJAF requisitions.
- Lack of training and understanding of the STARR/PC system which is complementary to the SAMIS system.
- Lack of capability or allowed capabilities through the STARR/PC system (RJAF can check for AS2 materiel).
- Lack of regulation for periodic checkups on RJAF requisitions.

- International freight forwarders are frequently changed which increases the number of SDRs due to long storage times / short shelf life items, lost items, failure to release items until payment is in hand, etc.
- Air shipping is more expensive with fewer defects. Sea shipping is cheaper but only one carrier is allowed every six months and there is a long wait until a shipment is made which leads to more SDRs.
- In the cargo section in country there is a lack of follow up tools with AFSAC (SAMIS) or STARR/PC and a lack of experience in how to deal with shipments.
- A long time is required to transport items from Aqaba, the only Jordanian port, to the RJAF (300 miles distant).
- At RJAF there are also problems with delayed acceptance checks and a lack of technical information and mishandling by AFSAC.
- Additional problems at AFSAC are the lack of an alert system, follow up or SAMIS knowledge. They should have quarterly or semi-annual meetings for evaluation and follow up of SDRs.

Solutions could entail training of managers and their teams to write standard narratives and input standard data for history and metrics into the system, especially looking for accountability for processing times.

CHAPTER VI

CONCLUSIONS

The data presented in this research have been successfully assessed regarding the effectiveness of the RJAF aircraft spare parts supply program. The conclusion was derived from numerous data reports. The problems in executing this program were indicated by increased numbers and long process times for SDRs; also there appeared to be a few signs that may be challenging in future years if not resolved by the country decision makers, both AFSAC and RJAF. In general, the country's average shipment SDR submission rate was much less than the average of AFSAC's goal and all other countries' rates. Percentages of the denied section are less than other countries' percentages and more than other countries' average SDRs (approved and advisory). For Aged Open SDRs country's data performance is better than all other countries. RJAF's process block looks better than AFSAC's, i.e. less skewed and a better distribution for box plots and intervals … but actually they are a total disaster. RJAF averages 362.5 days to submit SDRs. Ordinary SDRs comprise 60.1%, recurrent SDRs 39.9%, with denied SDRs 30%. Source of supply FLB + SDB took most of the RJAF time to submit an SDR. SDR value had no significant relation to the process. For the AFSAC process block, AFSAC data look healthy (RJAF mean 62.5 days, AFSAC goal 82.5 days) but SD=87.5 because the data is distorted by a maximum value of 646 days! Ordinary SDRs constitute 66.8% and recurrent SDRs 33.2% with advisory SDRs 58%. Approved SDRs make up 15%. AFSAC's problem is source of supply FLB + SDB took most of the AFSAC work days. Normality test is not good, $P < 0.005$.

RJAF process block and AFSAC process block. To assess the process capability, the Z value for both the upper and lower control limits was calculated as another way to describe the probability of defects. Also calculated were:

FTY = # good units / # total units

P(d) = # bad units / # total units

DPU = # defects / # total units

FTY=e-DPU

Z us l=15.9/0.74 .so P (d)=Zero/ 22.6%!!! Z LSL=1.44/1.44 P(d)=.73% Wrong!!

Z bench=1.44/0.51 or P(d)= 7.3%/30.8% why!!!

Z shift = Zst- Zlt

1- RJAF FTY=E-DPU=E (-362.5)=0 P(d)=1- FTY=1 so Zlt=-6.25

Zst=UCL - mean/SD= 1050-362.5/237=2.9 so Z shift=2.9+6.25 =9.15

2- AFSAC FTY=E-dpu=E(-63.61)=around 0 P(d)=1- FTY=0.99999 so Zlt=-4.85

Zst=UCL - mean/SD= 646-62.5/87.5=6.66 so Zshift=6.66+4.85.1586=11.5

Use SE Mean

1- RJAF FTY=E-DPU=E(-21.1)=beside zero P(d)=1- FTY=.99999 so Zlt= -4.8

Zst=UCL -mean/SD= 1050-362.5/21.1=32.6 so Zshift=37.4!!! .

2- AFSAC FTY=E-dpu=E(-63.61)=around 0 P(d)=1- FTY=0.99999 so Zlt=-4.85

Zst=ucl-mean/sd= 646-62.5/87.5=6.66 so Zshift=6.66+4.85.1586=11.5

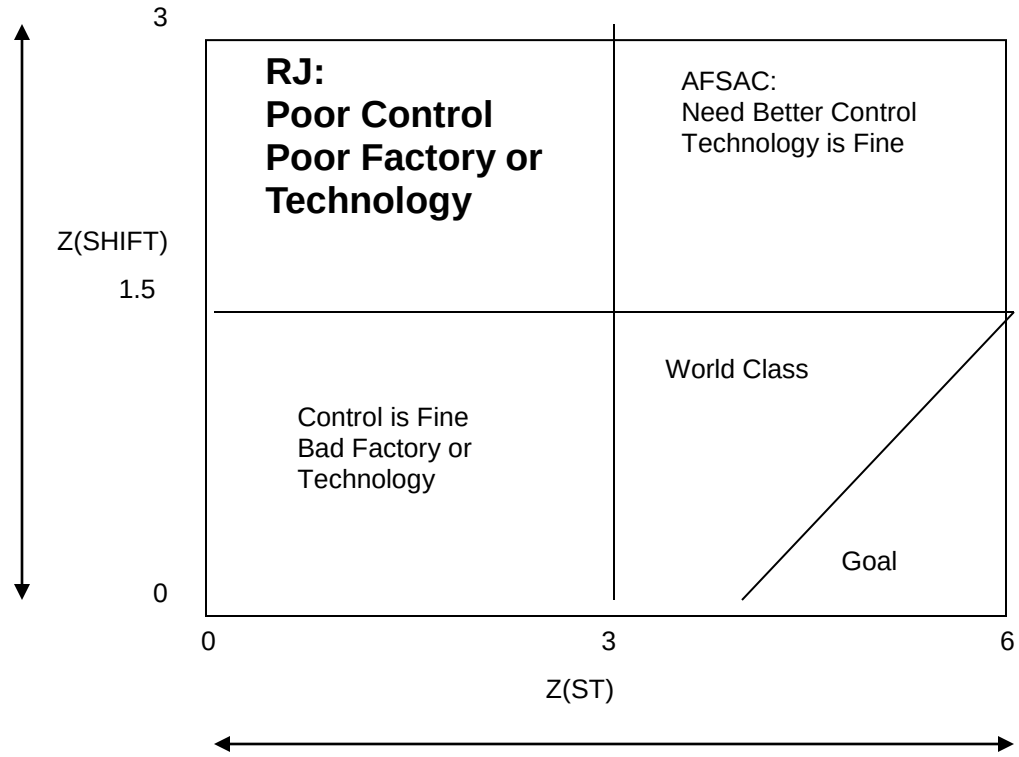


Figure 10. Control – Technology Diagram

So the country problem is poor control and poor technology, the causes are as follows

For current SDR process key areas of concern include, multiple manual steps from start to finish, average 362.5 days/SDR, continual backlog of 250 SDRs. Process steps identified for improvement, Action Agency processing (50 –> 40 days), monitor material returns/financial adjustments (46 –> 40 days), improve processing time for 4 or 5 non-web customers (362.5 –> 82.5 days) (77% reduction). RJAF block, have access to SAMIS, understand and improve STARR/PC capabilities (pull out AS2 items list), regulate follow up for requisitions every two weeks, arrange with AFSAC for weekly list for all shipped items, assign SDR staff, start SDR automation or improve communication methods with presence of FLO, decrease the frequency of changing Freight Forwarder

(now two years), choose experienced forwarder or improve its capabilities, set shipping priorities, make acceptance and release (specially for shelf life items) check at FF stores …etc. Avoid Sea shipments if possible. The impact: decrease the mean from 362.5 days to 60 days and standard deviation from 237 days to 30 days. For AFSAC block, understand SAMIS capabilities better, HAQ reports, shipping details, start contacting Source of Supply like FXA and FGB, make quarterly review for requisition states. Provide RJAF with weekly or daily AS2 states requisitions. The impact: decrease the mean from 362.5 days to 50 days and standard deviation from 237 days to10 days (after listening to Ron Brief).

CHAPTER VII

RECOMMENDATIONS

Basically, this is a very concrete program, however, there are some areas where improvement is needed. It is important for the country and AFSAC supervisors to objectively assess the A/C spare parts supply program to determine if the targets, purposes and desires of this program are being met in a high-quality and well-timed manner. This review and process evaluation should be done periodically to reduce costs and improve readiness of the air force in the country and look for blocks that need to be strengthened or adjusted. Supervisors and commanders managers can choose from both qualitative and quantitative measures like program reviewing times, frequency of meetings, and evaluation by targeted Source of Supply (SOS) categories. Extra considerations should be given to development of this program including the AFSAC Online web site accesses, which would increase the power and efficiency of the overall follow ups in the A/C spare parts supply programs. Country should consider the preventive maintenance actions like enlightening the country logistics regarding using AFSAC Online and SAMIS in order to reduce the number of SDR's. Moreover all parties need to ensure that the FLO RJAF personnel and AFSAC Team understand their job description and course of actions by receiving country feedback to augment team learning and improve team communication. Here maintaining close follow up from all parties personnel is the key to avoiding pitfalls by improving and reviewing the follow up procedures (by e-mail, FLO inter communications, semiannual/annual reviews, and meetings). The review sessions should be done at least on a quarterly basis. Special

attention by country and AFSAC should be taken for training to improve skills, system application, FMS program knowledge, which is conducted at USA training institutions. Enhance job improvements. Process assessments should be encouraged to check all pitfalls and review of the shipping actions /measures should be made on a quarterly basis. For example, AFSAC should review with SOS the quality procedure before shipping any requisitions to countries and make close follow up for SDR materials, especially high value SDR.

Data analysis revealed that country can reduce business to top 3 SDR producing Sources of Supply, improve Action Agency Processing, Monitor Material Returns/Financial Adjustments, FAX documents to 4 or 5 non-web customers vs mailing documents. Recommended solution(s):

- Reduce # of SDR's by reducing business to top 3 vendors (FXA, S9G, S9I) responsible for 55% of SDR's in 2005. Then monitor impact on # of SDR's.
- AFSAC, as Action Agency Processing, should clean up entries in the system to reduce false information.
- Create a milestone to stop the clock at the appropriate time.
- Hold managers accountable to make sure the process stays in tolerance.
- Create a measure to track status of work in process on a quarterly basis.
- Obtain working agreements with action agencies (e.g., DLA and ALCs) that they will reduce SDR processing time from 50 to 40 days.
- Obtain working agreements with customers that they will accompany material returns with proper customs paperwork and further streamline material returns/financial adjustments process to achieve a reduction from 46 to 40 days.

- If customer has no set organization or organic personnel to handle materiel returns, encourage them to utilize outside company (e.g., United Parcel Service) to package and ship materiel returns. If the outside company specializes in materiel returns, there is a high probability of achieving a reduction from the currently required 46 days for this process step.
- Obtain agreement with non-web customers that AFSAC will accept FAX documents, followed by mailed formally signed documents, to start and continue working SDR's, thus reducing SDR processing time by 59 days.
- A code or a follow-up phone call may be used to verify authenticity of document. This will result in a 28% reduction in processing time required

Verify recommended solution(s) is needed. Items to include*:*

- Follow-up SDR-A analysis
- Follow-up Process Capability Analysis
- Produce Control Charts to Demonstrate Process Stability

Develop Control Phase by developing a tracking system that will function as a control plan to insure that the SDR-A system will continue to perform. This tracking system will insure that all SDR's are moving through the system in the most efficient manner. Specific solution(s) is needed to achieve performance goals. The primary criteria for selecting a solution is that the solution must impact the root causes of SDR submittals and effect value-added SDR process improvements.

To summarize, we conclude we should reduce number of SDR's by reducing business to top 3 Sources of SDRs. Action agency processing, monitor materiel

returns/financial adjustments, attain agreement with non-web customers that AFSAC should accept FAX documents, AFSAC Online tracking system will function as a control plan to insure that SDR's continue to be efficiently processed through the SDR-A system, utilize new management tool using rational unified process model, utilize management plan to include program reviews to ensure the proper artifacts and processes are followed. Based on initial projects, we expect to reduce average processing time for gathering requirements from 35 working days to 30 working days or less. We will calculate re-engineered process capability in eight months to allow for collection of data under the new process.

To carry out this recommendation, country should request an immediate meeting with the AFSAC Team, FLO and country personnel to discuss all data SDR reports and take follow up action on the most important criteria specially SDR's related to Non–Mission Capability Supply (NMCS) items. As well, I will request that a briefing regarding this subject be presented to the country at a suitable time, outlining the study, the findings, and the impact of these results on the various directorates. Doing nothing to improve parameters and quality of country program, or modifying the program are an option, as long as the RJAF commanders are aware of the natures of difficulties that are happening and decreasing the efficiency of this program. Up to now, there have been no inclusive studies done on the efficiency of this program to determine when, where, why, and how, work stoppages and delays occur. Now that the information is in hand, country commanders can take the information into consideration when they make their plans.

REFERENCES

Acquisition Technology Logistics, web site http://www.acq.osd.mil/its/functions.htm

AFSAC Foreign Liaison Officer Orientation Course Manual (2005) Air Force Security Assistance Centre, Wright –Patterson AFB, OH

AFSAC Online web site https://afsac.wpafb.af.mil/

Davidson E. J. (2005) Evaluation Methodology Basics (Nuts and Bolts of Sound Evaluation) (7th ed.) Sage Publications

Green Belt Training Course Text (2004) General Electric

Leenders, Fearon, Flynn, Johnson (2002), Purchasing &Supply Management (12th ed.) McGraw Hill Irwin

Logistics Materiel Control Activity Operating Policies (21 March 1997) AFMCPD 23-2

Logistics Operations Defense Logistics Agency, Customer Assistance Handbook (15th ed.) (2004)

SAMIS Manual and Training File (1997) Air Force Security Assistance Centre, Wright – Patterson AFB, OH.

Security Assistance Management Information System (SAMIS) Reference Manual (2004)

Supply Tracking and Reparable Return (STARR/PC) Manual (1997) Royal Jordanian Air Force

Sustainment Materiel Acquisition Policy (29 April 1983) AFMCR 57-7

BIBLIOGRAPHY

American Psychological Association (1994) Publication Manual of the American Psychological Association (4th ed.)

Cary, P.E (2004) Development of Measures of Success for Corporate Level Air Force Acquisition Institute AFIT GAQ/ENV/04M

Chase, R B, Jacobs, F.R., Nicholas J.A, & Aguliano, N.J. (2005) Operations Strategy and Competitiveness (10th ed.)

Federal Acquisition Regulations web site at http://205.130.237.11/far/

Government Works Regulation No. 71 (1986) The Hashemite Kingdom of Jordan, Ministry of Trading

Greaver, M. (1998) Strategic Outsourcing: Risk Management .Methods and Benefits AMA Publications

Kotler (2003) Marketing Management (11th ed.) Prentice Hall

Management of Security Assistance Handbook (19th ed.) prepared by Defense Institute of Security Assistance Management, Wright Patterson Air Force Base

Management of Security Assistance (24th ed.) Defense Institute of Security Assistant Management

PMI PMBOK Standard Committee (1987) Project Management Body of Knowledge of the Project, Management Institute.

Royal Jordanian Air Force Foreign Liaison Officer Orientation Course Manual (2005) Air Force Security Assistance Centre, Wright –Patterson AFB, OH,

Sanders (2005) Human Factors in Engineering and Design (7th ed.) Irwin-McGraw-Hill.

Supplies Regulation No. 32 (1997) The Hashemite Kingdom of Jordan, Ministry of Trading

Stapenhurst, T. (2005) Mastering Statistical Process Control (7 th ed.) Elsevier Butterworth.