Trip Report

Development of an Industry Standardized Auditing and Surveillance Tool Prototype

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Creation Date: February 23rd, 2004

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I. <u>Introduction</u>

This document presents the details of the meeting held in Mobile on the 9th and in Memphis on the 16th of February, 2004. It summarizes the information gathered in sessions conducted by Kunal Kapoor, Nikhil Iyengar, and Pallavi Dharwada from Clemson University's WebSAT team on these two days.

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II. <u>Attendees of the Mobile observation session</u>

Attendees from FedEx: Ron H. Haven Jr. (Quality Services Project Representative, Aircraft Quality Assurance, Air Operations Division), Christopher J. Hill (Quality Services Project Representative, Aircraft Quality Assurance, Air Operations Division), Larry D. McKinnerney Jr. (Manager Aircraft Quality Assurance, Air Operations Quality Assurance)

Attendees from Clemson's WebSAT Team: Kunal Kapoor (Doctoral Student), Nikhil Iyengar (Doctoral Student), Pallavi Dharwada (Doctoral Student)

III. <u>Notes from the Mobile observation session</u>

The Clemson WebSAT team met Ron, Larry and Chris. They conducted observation sessions with Ron. Larry was also present during these sessions. The team got the opportunity to observe Ron while he conducted his routine surveillance activity. Ron considered conducting C checks for 3 to 4 aircraft at any given time as a "slow time" – less busy schedule. He used the term "line" which refers to an aircraft that has been brought over for heavy maintenance or a C check. The typical aircraft at this facility are Boeing 727, MD 10, and DC 10. This could vary depending on the business need of FedEx, or on the flight hours of the aircraft.

Ron and Larry described the Mobile Aerospace Engineering (MAE) facility as a 'Drop-In' maintenance facility. A drop-in facility accommodates unplanned scheduled maintenance of aircraft. Such an unplanned maintenance event occurs when an aircraft's maintenance period exceeds the time allocated for maintenance. Under such circumstances the aircraft is moved to a drop-in facility. There could be various factors, both procedural and cost related, that are taken into account when considering a drop-in.
However, Ron was quick to point out that the MAE is not only a drop-in facility. Scheduled substantial heavy maintenance such as C checks are also done in this facility. It must also be noted here that Larry and his team refer to MAE facility as BFM (Berkeley Field Mobile) in their reports. Ron uses a planning chart to identify which aircraft will be coming into the facility. This

is a chart which is created by the Engineering Planning department a couple of months in advance. This chart is available over the FedEx intranet in the Production Control System (PCS) which is used by the Quality Assurance (QA) representatives for their routine activities. The scheduling chart is made 60 days in advance. The chart is hard coded and cannot be modified. It does not reflect drop-ins. However, the facility is flexible. While discussing about the ability for the schedule to accommodate unplanned maintenance, Larry pointed out that the planning chart is not dynamic but the system is and it can adjust itself to accommodate a drop-in.

Every Thursday Ron and Christopher have a status meeting with Ken Hutcherson (Manager Aircraft Quality Assurance, Air Operations Quality Assurance) and Larry. Ron and Christopher provide a weekly 'Status Report' to Ken and Larry. The reporting of planned maintenance agendas are the focus of these weekly reports. The contents of the report are discussed in the meeting. During our session, Ron provided us with a copy of the Status report. The report presents various aircraft undergoing maintenance at MAE. The status meeting uses Estimated Time In Commission (ETIC) to conclude if the facility is on schedule for the maintenance of a particular aircraft. The report has been divided into two sections:
(a) Aircraft status: It shows the maintenance status of the aircraft at MAE including their ETIC date and the QA Representative responsible for the surveillance of the aircraft. The ETIC date may eventually trigger off a Drop-in event. This need not happen always. Ron pointed out here that there may be two representatives in charge of surveillance of the same aircraft. Similarly, there may be one representative who may be incharge of the surveillance of two aircraft. This depends on the amount of work available for a particular time period and the number of QA representatives available for that time frame. Ron also added that the representative who arrives for the second shift may be incharge of more than one aircraft as he is the only representative present during that shift. Other fields in the report are Work Order Number, Aircraft Tail Number, and Induction date.

(b) Facility Quality Issues: It presents the distribution of the surveillance activity for that week, in terms of Rejections, Accepted and Other. This section is used by Ken and Larry to review the performance of the QA representative and the maintenance facility.

Ron pointed out that currently he has to go to disparate sources to manually feed information into the report. This involves using the PCS and the mainframe system. Such a procedure has the inherent ability for errors during data entry. It comes across to him and the research team as unscientific.

Larry is incharge of the domestic facilities which are at Seattle in Washington, Greensboro in North Carolina, Lake Charles in Louisiana, and Mobile in Alabama. Ken is in charge of the international maintenance facilities. Larry pointed out that there are specific facilities where heavy modifications are done to an aircraft. All the international sites are modification and maintenance site with exception to Singapore, which has a maintenance facility. New acquisitions undergo heavy modifications at the international facilities. These heavy modifications are different from the routine C checks in that they take about 3 to 6 months per aircraft. However, a typical C check would last for about 30 to 45 days per aircraft.

As a site specific quality services representative, Ron is interested in capturing location based trends from the surveillance data, and as a manager, Larry is interested in making standard procedures mandatory for representatives across all facilities. The common concern of Ron and Larry was that no analysis is done with the surveillance data, which both of them saw as an opportunity lost. Larry cited the example of Fleet Specific Analyses which refers to analyzing trends across an aircraft fleet and concluding on their airworthiness. Larry conducts analysis of some data, which forms the basis of the monthly progress report that he sends out to the QA representatives working under him.

Larry further described the problem existing due to lack of data analysis. In addition to the inability of the current surveillance tool to analyze data, the other problem is the classification of the data to a certain type of impact variable. QA representatives located both in domestic and international sites use the same standards However, the interpretation varies. The research team asked Larry about the usefulness of the existing number of impact variables. His response was that these impact variables were developed by Ken and originally they were more in number with sub categories included. Yet again, he came up with the existing number of variables, which he strongly feels is an optimal number. Larry supported this by saying that an overwhelming data is difficult to analyze whereas too few variables result in subcategories. The research team inquired about the significance of the Case I A standard which is the fifth impact variable in their existing list and which is also the guideline for most of the impact variables. Larry and Ron explained that this Case standard is a universal operator. Larry explained that the impact variables like inprocess and verification surveillance assess the risk on the airplane whereas other variables like shelf control and housekeeping assess the risk involved with other factors related to maintenance activity which can be of potential risk. The QA representative is familiar with the impact variables, and about 80 to 85 % of the data is accurate. To improve the accuracy of data collected from the impact variables, Larry suggested categorizing various activities performed during surveillance into the 17 different impact variables. This would assist the representative in classifying his surveillance activities consistently. A number of these impact variables have been derived from various manuals such as CASE, GMM and IPM. This adds to the ambiguity in the definition of these variables.

Categorization of activities to generate useful data for specific impact variables is a problem. Ron said that some activities are open ended, resulting in lack of standardization. Larry specifically mentioned that impact variables such as inspection, quality control, IPM compliance, GMM compliance, and work processing were ambiguous in their definitions. Larry and his team are in the process of defining and standardizing these variables. The definitions of these impact variables are presented in detail in the Desktop Procedures Manual.

During our subsequent trip to Memphis, for additional data collection, Ken said that he has no confusion in his mind about which particular task belongs to an activity. He said that ambiguity was created because of addition of some more items such as the GMM and IPM. Nevertheless Ken strongly attributed this to training. He claimed that the new QA representatives, do not have any ambiguity as they were trained by him. The experienced QA representatives are unwilling to adopt the 17 activity bins.

Larry's concern was the varied interpretation of the 17 activities by the QA representatives. This results in inaccurate data. The team was asked to help out with the standardization of the impact variables. The 17 impact variables used for surveillance currently is a base line. Ron indicated that more impact variables would lead to more data and confusion. Larry and Ron indicated that 17 is a manageable number right now, and if this was further cut down to lesser variables, the resulting data analysis would be inadequate. The problem of interpretation was further explained by Larry. The QA representatives at different facilities see the impact variables differently, interpret them differently, resulting in variance in the data. In addition to this, each aircraft has its own maintenance manual, which creates different work cards during surveillance. The intricacies of the aircraft in itself, creates problems for QA representatives. Larry felt that a standardized procedure should exist at all facilities, and then the compliance can be done differently. For example, 2 to 4 verification and in-process surveillance can be conducted depending on the condition of the aircraft. Larry added that the various airlines comply with the standards, such as GMM, differently, based on their business functions and goals.

Larry explained the difference in how Brian D. Bittner (QA Manager, Air Operations Quality Assurance), and he perceived the activities to meet the CASE I A standards. Brian's department deals with audits. The auditors' audit is based on CASE I A standards. This activity performed by the auditor is more detailed than a QA representative. The QA representative's job is at the task level. The QA representative answers the question, how well the surveillance is being done. The auditor works at the process level. The auditor understands the adequacy of the surveillance activity and answers the question, if the surveillance meets its specific standard.

Larry and Ron unanimously expressed their need for the surveillance and auditing tool to help out in the planning of surveillance. They expressed the need to generate a sample size for the surveillance activity regardless of the problem being systemic or not. There were four high level categories out of the 17 impact variables defined for the purpose of surveillance. They explained their mental model of how the selection of categories has to work out. The process of surveillance can start with a number indicating the surveillance activities which need to be done. The next step would be to identify some surveillance activities as Technical, and the remaining could be under other surveillance activity categories. Larry said that he perceives the tool as a goal recognizer. Larry said that about 200 surveillance activities every month is an achievable goal. Larry describes his expectation in terms of a percentile distribution. For example, he assigns 50% for technical category and the remaining percentile to be evenly divided among the other surveillance categories. This puts an expectation on the representative to conduct at least 50% technical impact variable related tasks. For effective surveillance, variable and sub-variable categorization is required.

Ron explained the various work domains he is involved at his work place. Ron provided a copy of the Work Processing audit checklist in order to give the team an insight on typical activities that would come under the Work Processing impact variable.

Depending on the number of QA representatives at the maintenance site, and the tail number of the aircraft, one or more representative takes responsibility of conducting surveillance for an aircraft. However, there is only one representative who is primarily concerned with an aircraft. It also depends on the kind of maintenance to be performed and the work load at the maintenance

site. Ron also mentioned that a representative may perform surveillance on another aircraft not assigned to him.

Ron looks at the schedule from the PCS to know which aircraft is coming for maintenance to the MAE facility. Once the aircraft arrives at the maintenance site, the representative uses the PCS and makes a note of the tail number on a post it and enters it into the surveillance system in PCS. The PCS provides the pending work order number of the newly arrived aircraft along with the previous work order numbers. This page provides historical information about the maintenance activities carried out on the plane. The representative has to scroll down through the list to the last entry to identify the new work order for the current maintenance event. This work order contains a list of work cards that the maintenance will work on. The surveillance schedule with the work card numbers is available as an electronic version on the PCS. Every QA representative has a user login and a password to view the surveillance schedule. A manual Master Job Control Sheet (MJCS) is a similar hardcopy that is available. The FedEx intranet is not accessible to all the vendors. The sites which do not have access to the FedEx intranet have to rely on the MJCS.

After reviewing the surveillance schedule, the representative prioritizes his work. The FAA requires the QA representative to complete all the Airworthiness Directives (ADs) for a work order. The schedule includes ADs with the various work cards. At present, it does not differentiate ADs from work cards. The representative also needs to schedule an appointment with the maintenance personnel or the inspector for operational maintenance work cards. Hence, he pays particular attention to such work cards in the schedule.

Ron said that ordinarily there are about 750 routine work cards, and about 900 to 1500 non-routine cards in a typical C-check surveillance. All the routine work cards are pre-loaded 2 or 3 days before the aircraft comes in. If surveillance is typically technical, then a routine card might generate a non-routine card, which is in addition to the defined routine cards for surveillance. A work card is meant for the purpose of fault finding, and that is what it does when a non-routine is generated.

Ron then walked the research team through his surveillance activities at the maintenance facility. Ron said that there are times when a need is reflected for a particular facility, which is the unknown variable. Larry, on the other hand, said that this unknown variable is site specific and hampers the entire agenda of standardization of surveillance activities. Ron is interested in having numerical answers for his surveillance findings based on what happens at the site. Ron also realizes that it is impossible to have all numerical answers as valid answers. His typical expectation for quantitative and qualitative data is to have a database that includes the non-routines for a work-order number, work card numbers for a particular surveillance, and analysis of the quantitative and qualitative findings to indicate high risk areas. Ron said that each facility has its own limitation. One may have a technical problem while the other may have a training problem. A QA representative cannot look at the previous maintenance event to look for a trend as it may reflect a facility specific limitation. Ron and Larry explained that the human factor aspect of surveillance, related to the overall quality of the vendor maintenance is a routine surveillance activity. The non-routine activity is generated due to the aircraft status, and has no direct bearing on the vendor's status. Non-routines are important for the aircraft. Ron said that the work order numbers added by non-routines, hampers the routine vendor surveillance, and is thus addressed as a situation of opportunity lost by him.

Ron and Larry explained that the data of the non-routine and routine activities should generate trends which could result in new findings, and may also lead to new audit checklists. The Reliability and Maintenance Planning department are always in the look out of historical data to add value to the surveillance activities at various sites. Ron indicated that he was the end user of the raw data which is provided to him by the Reliability and Maintenance Planning department.

Larry and Ron talked about the auditors again. They explained how the auditors work on the information gathered by the QA representatives. They work with the representatives, and gather the information they need for a particular audit. The auditors then look at the surveillance data. They look at the projected start date of the surveillance activity. Their concern would be to see the number of rejected surveillance activities at the facility. The audits are representative specific, vendor specific, and some other aspects are also touched upon by the auditors. Larry expressed the desire to tie up the auditor and QA representative departments with the surveillance and auditing tool. That way when a flag is raised by the QA representative during a particular surveillance activity, the auditor is aware of this development and can focus his audit on that area. He had no problem in sharing his data with the people in the auditing department.

Larry explained the purpose of the AD department. The AD keeps a vigil on the requirements of the Federal Aviation Administration (FAA), and then passes on the information to the auditing and surveillance departments. Once new ADs come in, a 100 % inspection of these directives is required, over and above the routine and non-routine surveillance activities performed by the QA representatives. Airworthiness directives can be printed out of the PCS system as a Tally. Engineering Orders (EO) generated by routine surveillance and EO generated by ADs are not differentiated. Larry perceives this as the next programming change in the existing surveillance tool. All ADs are categorized as work processing. Larry felt that some of them could belong to other technical categories such as verification. The maintenance planning and engineering department is at the site to validate the new work cards for the new ADs. Based on the reliability monitors, findings are generated. The FAA defines that a minimum of 10 % routine surveillance activities be performed on the work cards by the QA representative. In reality, the representatives perform more than 10 %, and there are some mental notes which they make. These are typically housekeeping, safety precautions, manual update, shelf life of parts, which the QA representatives do not take credit for. Larry mentioned that at the moment only rejects are being controlled and taken care of, but conscious and unconscious surveillance activity resulting in accepts should be accounted for. Larry expressed his desire to document data and information coming out of these unaccounted surveillance activities, to help the overall surveillance and credit the representative for the surveillance performed.

Larry expressed his expectation of the tool as follows, "Ron identifies impact categories, based on his findings; a risk analysis is done based on all the data provided by Ron and other QA representatives like him; finally, how do Larry, Ken, Brian, and other concerned managers view, utilize, and use this information?"

IV. Attendees of the Memphis trip interviews

Attendees from FedEx: Kenneth R. Hutcherson (Manager, Aircraft Quality Assurance), Larry D. McKinnerney Jr. (Manager Aircraft Quality Assurance, Air Operations Quality Assurance),

William Williams (Manager, Regulatory Compliance & FAA), John Blaszkowski (Manager, Internal Evaluation and Audits).

Attendees from Clemson's WebSAT Team: Kunal Kapoor (Doctoral Student) and Nikhil Iyengar (Doctoral Student)

V. <u>Notes from the Memphis trip interviews</u>

<u>Discussion with John Blaszkowski</u>

John makes a checklist which depends on FedEx documentation, GMM, DPM, FAR 121 and Advisory Circulars (AC) for each work function. Brian Bittner (Manager, Technical Audits) uses FAR 145 operations which are applicable to vendor locations while John uses FAR 121 which is applicable for local FedEx initiatives and operations. Some of the requirements for John's checklists may also stem from FAR 145. The FAA sets up a committee and the AC tells the airlines what the FAR means. Brian and John have overlap in their work since both use the Case I A standards at times.

John takes care of the heavy maintenance at the Los Angeles, Memphis and Indianapolis facilities through his Engineering, Material and Maintenance (EMM) Internal Evaluations and Audits. John uses the "Hangar checklist" and "Environmental checklist" for EMM audits. Rocky Ruggieri and Mike Gudiarous report to Frank Basile. Mike is based in Los Angeles and he controls six managers (inspectors). Three of these are based in Los Angeles, one in Indianapolis and two in Memphis. Terry Kleiser is based in Indianapolis. Gary Deprader and Joe Scheifield are the Memphis based managers. These managers are the equivalent to QA representatives at vendor maintenance bases. John is not involved with vendor audits at vendor locations.

John has five auditors under him- one performing EMM, two for Flight Operations and two for ATOS. EMM audit is initiated by identifying the areas to be audited. There are approximately 24 areas or work functions - not necessarily departments- that are audited by John and his auditors. Some of John's audits take place at managerial level while some take place at directorial level. John has already determined these work areas but occasionally there are some new ones that come from other managers. For the non-Memphis sites of Los Angeles and Indianapolis, John includes the information for back shop audits in hangar and environmental audits. In Memphis there are separate audits for hangar and back shops. Back shops are machine or component shops like sheet metal forming shops which provide necessary machining or components for the aircraft.

John may have as many as three auditors go to Los Angeles for conducting EMM audits. John said that the auditors use the checklist as a template. Even after categorizing an item in the checklist as a No, the auditors ask a series of questions based on the checklist. There are three answer options to an auditor's question- Yes, No, and N/A (Not Applicable). If the answer is a 'No,' then the auditors generate a report which is reviewed by John. The person or items due to which this report was generated will have to create a corrective action report. John has a form that he or the auditor forwards to the persons concerned which is used in formulating the report. John provided us with a copy of this corrective action form. John expected the WebSAT tool to

help the auditors to complete the corrective actions form. For every 'No' there is a corrective action form/plan which is generic in nature. As mentioned earlier, based on FAR 121, GMM, industrial standards, the desktop procedural manual, John and his personnel in the internal audit department come up with a series of associated checklists. These checklists are dynamic and can change over a period of time. Since the organization itself is changing dynamically, departments can be added to be audited in the future. These checklists are guidelines for John's auditors. If there are more questions asked, it might not be documented.

The information John is looking for from his auditors is to find out if the audit was done. He expected his auditors to accept only comprehensive corrective actions. John also wanted to inform specific departments about their progress based on the analysis of his auditors' findings using WebSAT. John expressed his desire to do quality evaluation of auditors through internal evaluation and customer feedback survey form. Even though the categories of audits vary, John expected the tool to categorize audit findings. The reason for this according to John is that even though the finding is an immediate remedy to problem solving, for organizational problems standardized categories is required.

John's hangar checklist consists of the following categories: A-admin, P-Procedures, M-manual, S-safety, T-training and R-Record. John uses these categories to group all the audit information. John came up with these six categories based on his judgment and experience. John provided us with a copy of this checklist. John showed us the audit scores for the EMM audits which are prepared on a monthly basis. These audit scores consist of the following three sections:
a) Score Percentiles: Number of audits that have been completed and their results in terms of percentile, where outstanding is 100%, unsatisfactory is 80% or less and so on.
b) Pie diagram: Score percentiles shown on a pie diagram
c) Audit Findings by Category: Audit findings grouped in terms of the above mentioned six categories.

For EMM audits, John uses these three categories of information for his annual and monthly reports presented to his seniors including the Vice Presidents.

During the interview session, the team identified that the following table would be helpful to understand the pie diagram for the base maintenance audit scores.

Outstanding	Excellent	Satisfactory	Marginal	Unsatisfactory
10	2	2	2	8

John mentioned that all his auditors receive the same level of training. This allows him to measure the performance of the auditors on the same scale. The departments or persons who were previously audited evaluate the auditors using the performance measures which are qualitative and quantitative checklists. The more important measure is the quantitative measure where John is interested in seeing if all the auditors complete their audits on time and if the corrective actions were reviewed.

John showed us an Excel table which summarizes all the EMM audits that he had done. In this table, he had 'Hangar 10' mentioned which was the Memphis line maintenance. Thus, John does

both line and base maintenance for Memphis. John gave the following example: If an auditor finds out that there is a lack of training, he enters it as one 'No' even if there are five training items/questions in that checklist. He said this is fine, as the auditors then follow it up with more questions.

John also looks into Flight Operations. He said that the flight operations do not deal with the mechanics and other organizations. It deals with pilots and operations like crew scheduling, dispatch, weather forecasting and flight safety. Flight operations have 22 to 24 different areas. These departments or areas are based in Memphis. Flight Operations audits are a mirror image of the EMM audits although the auditors are different.

John also manages the FAA governed ATOS audits. These auditors look at an entire system from the beginning to the end. John gave an example of "Deicing process" where various departments are touched upon. This could be considered as the main difference between ATOS audit and the two other audits. The auditors will look at a large amount of information during these audits. The duration of these audits depends on what is being audited. John mentioned that the ATOS requirement may be generated by the upper management. In a year, about 3 to 4 ATOS audits are done. ATOS tools are SAI and EPI. Though EPI looks at the system overall and tests the system, it takes lesser time compared to SAI. SAI is meant to identify if the system is adequate or not. Not all airlines do SAI and EPI. Only 10 passenger air carriers are in this list. The other group of carriers including FedEx is in the waiting list. ATOS is FAA governed.

A typical audit takes about 6 months. The auditors have the ability to report risk findings to managers. A management action follows risk finding. This might be to mitigate the problem, accept it, transfer it, or track it. The auditors spend months with a specific system, they look at the procedures based on the 6 SAI attributes, and if something is not documented or measured adequately, it is a risk. If the upper management feels that there is a genuine risk involved with a finding, an ATOS requirement is triggered off. The eventual requirement for auditors, managers and upper management is to identify risks which have been accepted.

John wants to use the MEL- the deferred maintenance list- to feed into the "safety index." He gave his reason by citing the following example. A 1000 maintenance items have not been looked at means "unsafe" while if 50 items have to be looked at, it is relatively safer.

Los Angeles, Memphis and Indianapolis are heavy maintenance facilities. However, all the data that is looked at is no different from the vendor site. It is still the same work cards, ADs etc. Thus, the data remains the same and is shared whenever and wherever the aircraft goes.

Discussion with Ken and Larry

Ken and Larry reiterated that at Memphis, Los Angeles and Indianapolis, the Quality Control department does not do surveillance. Terry from Indianapolis has used the tool as he was earlier working in Memphis. The other two locations Los Angeles and Memphis do not use the existing surveillance tool. This is due to the lack of pressure from the higher-up management on these facilities to use the tool. There are no QA representatives at these facilities. The managers in

these facilities keep an eye on the inspectors and maintenance personnel in their facilities. Further there are no performance measures being used to evaluate how the site is doing.

Larry said that almost all the places have Fuel Vendor Surveillance except for Mobile as it does not have FedEx ramp.

John's group does internal audits and is involved with the internal evaluation for surveillance. The Case I A audit checklists used by Brian do an in depth analysis, and is not the day to day surveillance done by the QA representatives at the vendor site. Ken and Larry also said that there might be a situation where John's and their data might not have any relation at all, but individual data sets and findings will be responsible in creating a total safety picture.

Ken and Larry emphasized on the definition of the impact variables. Their emphasis was more on the semantics of the items the WebSAT team is calling as 'impact variables.' They refer to the 17 items listed in the DPM as 'activities' and the consequence of not adhering to one of the activities would result in an 'impact' on economy, safety, human factor etc., which they would refer to as impact variables. Ken attributed this to the fact that the individuals in the aviation industry are more concerned about impact on what happens next if something went wrong, and often are not concerned about what is right. He suggested that we keep their lingo in mind when we qualify variables. Ken also asked us to keep in mind that the impact variables should apply consistently across all the airlines and not restrict itself to the FedEx jargon. The specific example he gave was GMM where US airways may not be using the same name for their manuals.

Ken mentioned that he is absolutely sure about which surveillance activity is associated with which specific category. He mentioned that there was a need to categorize data and use it properly. Ken cautioned the research team not to drill to finite details, because then the tool will cater to specific needs of FedEx, but this tool over time has to cater to industry developed standards. Ken mentioned that activities identified by CASE are well defined, and activities such as GMM and IPM were added by Ken on the request of QA representatives, which he said are not very valid and critical. Ken said that the 17 activities maybe appropriate. He expected that the research team will figure out the appropriateness of these 17 activities.

Auditor sits with the QA representatives to decide how to the checklist should be created. This procedure is very manual and is not automated.

IPM is the vendor's documentation of their processes. The FAA requires that the vendor maintain a manual of their own.

CASE has one big advantage i.e. if other airlines auditors, for instance United, go to the same vendor site and performs an audit then FedEx can take credit for the same audit.

Discussion with Bill Williams

ATA is responsible to enhance procedural change with respect to FAA regulations, and the Federal Register. The ATA number is different to the NPRM number. The ATA is a lobbying and industrial group looking out for the concerns of airlines. According to Bill, 90 % of the times

a NPRM gets converted to an ATA, and based on comments on NPRM, the FAA may develop some ADs. All the information about duration, and specific requirements, is documented by the ATA to give to the FAA, to think and rectify certain Ads. The ATOS makes the airworthiness directives department at FedEx, to come up with a good process measurement tool. The introduction of ADs happens in 3 ways: emergency AD, immediate adopt rule, and NPRM.

Before proceeding further, Bill mentioned the basic difference between the EO and the WIC: the EO is an instruction, and the WIC tells the mechanic what to do.

Bill showed us two documents:

1) The first document is an audit checklist was referred to as 'Canned statements' by Bill. There are three checklists that Bill uses viz Engine, Aircrafts and Auxiliary Power Units. The items in these checklists are qualified as Accept, Reject and Other. The results of these statements are sent to the senior VP level.

2) A Process measurement document is used to provide qualitative information on the various documents that the ADCG uses such as EO/WIC, GMM, DPM etc.

Bill mentioned that the AD master list shows all the ADs irrespective of it being dropped of or having been converted into a work card.

Bill said that the airlines are given 60 days to respond to an AD when it is still in the NPRM phase. There is an ATA lobbying group which considers the airlines comments on an AD and communicates it to the FAA. This may result in the AD either being dropped or another AD or EO being modified. Bill also spoke about Emergency AD which takes immediate effect and does not go through the 60 day phase or review.

VI. <u>Notes from the conference call with Brian Bittner</u>

Attendees from FedEx: Brian D. Bittner (Quality Assurance Manager)

Attendees from Clemson University: Kunal Kapoor (Doctoral Student), Nikhil Iyengar (Doctoral Student), and Pallavi Dharwada (Doctoral Student).

Brian is involved with different audits: Supplier audits, FMR audits, and Joint audits. The Joint audit belongs to the FMR audits. Brian described how he decides if a particular audit has been done effectively. Brian and his auditors ensure that the checklists were completed. The auditors determine if the vendor meets the checklists standards and if any findings have been registered or not. Brian mentioned that the auditors weigh everything on the checklists, and determine a weighted score for vendors. A standardized score card is created for each vendor. Each vendor is then attributed with an annual score. Eventually, each vendor would be expected to have a 100 % annual score. Brian and his auditors use categories such as administration, training, functionality, etc. to evaluate the audits. There are different sections on each checklist, and there are 5 to 10

evaluation categories. Each category on the checklist has 5 to 50 questions which have to be addressed to during an audit.

Questions on a checklist are answered by using options such as Yes/No/Not Applicable (NA), Yes/No/Not Observed (NO), fill in the blanks for certain questions, and indicating the sample size, to check the number of defectives in a sample during an audit. Brian mentioned that attributes such as audit completion date is not used to evaluate the effectiveness of an audit, however, the purpose of the audit completion date is to evaluate how well the auditors are doing on a particular audit. Brian mentioned that John's department is responsible to audit the auditors working under Brian, to see how effective they are at their job.

Brian told the research team about a checklist generation system, known as Audit Management System, which is being created at FedEx and Brian would expect this to tie up with WebSAT, to help him and his auditors with the analysis based on findings of audits done by auditors in his department. Brian mentioned that he is unsure about which specific audit evaluation outcomes would be considered for analysis, using WebSAT. He said that he is trying to come to a final decision, but he still needs some time. Currently all his effort is directed towards the creation of the Audit Management System, and his daily job agendas.

A supplier audit is done on operations external to FedEx. FMR audits deal with operations internal to FedEx. Fuel audits are done on fuel contractors. Brian is responsible for the fuel audits at Memphis and for audits at the line maintenance facilities, internal to FedEx. There are times when Brian and his auditors may audit a contractor responsible for line maintenance. Ramp operations are always internal to FedEx. Brian mentioned that the standards for the supplier audits and the FMR audits are different. Ramp operations and line maintenance audits are done differently, the findings are weighed differently, and a severity index is calculated. FMR audits are more in number, but supplier audits take more time.

Currently no line maintenance data is being collected, because audits involving line maintenance look in to the management aspect at facilities. There are certain suppliers which do not require the approval of the auditors. Brian mentioned this is a possibility because auditors might have their own criteria to qualify some suppliers, which might be attributed to the fact that these suppliers have had a good performance record, and have been legally authorized to distribute parts. There are at least 5 supplier types which do not require a QA review. Brian said that ideally the requirement would be to get a review for every supplier type. Currently his department deals with audits on a case to case basis. Two of these supplier types are OEM, and audits for non-aircraft parts.

The CASE register records information pertaining to when an audit is done. Information pertaining to audit findings cannot be added to the CASE register. As of now no analysis is being done by Brian's department. SCORE is not used for any audit analysis; however, some reports can be generated using SCORE. The utility of SCORE is to request a new vendor audit when a department in the FedEx supply chain sends out this request. The SCORE is tied to the Maxi Merlin database, where vendor information (vendor list) is stored. SCORE does not provide the status of an ongoing audit. The Maxi Merlin database does not store any information on line

maintenance vendors. There is no information pertaining to line maintenance stored anywhere, because this information is transparent to Brian and his auditors.

Brian mentioned that the surplus vendor audits are the most risky for his department, because there is no basis or records by which his department can reach a conclusion for these suppliers.

The next audit on a supplier is decided based on supplier type, reliability data, audit findings, supplier usage, and business needs. Brian said that there is no quantitative or qualitative basis for his auditors to decide this; it is based on a judgment call.

Brian mentioned that the fuel vendor surveillance is done by Ken's department. The Base maintenance audits are done by John and his auditors. The team inquired about the overlap of Ken and Brian's work domain. Brian explained that an audit is responsible for an entire system. Ken and his QA representatives are responsible for the day to day working at the vendor facility. Ken and his workforce look at samples of the day to day job, and are concerned with the base line system. Brain's auditors look into the working of a system, and hence their job is in-depth. The auditors and the QA representatives have their own standards, with the QA representatives looking at the audit results. Brain mentioned that his auditors do a lot of work up front before an audit. The substantial vendor audits ay international sites are done by Brian's supplier auditors.

The research team inquired about work overlap between the AD department and Brian's department. Brian said that there is no common interface between the ADCG and his group, but a possibility of information sharing between these two groups is a step in the positive direction.

VII. <u>Next Steps</u>

The next steps are

1) Conduct an observation session at Mobile, Alabama.
2) Develop a set of impact variables.
3) Develop a survey tool to collect feedback from other airlines on the impact variables.

VIII. Glossary

This document will be used as an appendix in all the WebSAT reports. It will expand on the various abbreviations used by the aviation.

F=Form; S= System; A=Audit type; D=Department; P= Aviation Program; M=Manuals; R=Regulatory body; I=Industry Standard.

Abbreviation	Full Form	Item Type
ATOS 2.0	Air Transport Oversight System	D
ADCG	Airworthiness Directive Control Group	D
ADNT	Airworthiness Directive Notification Transmittal form	F
ADMT	Airworthiness Directive Management Tracking	F
ACAP	??	
CAMP	Continuous Airworthiness Maintenance Program	P
CASE	Coordinating Agency for Supplier Evaluation	I
CAS	Continuous Airworthiness and Surveillance	P
CRS	Certified Repair Stations	
CFR	Code of Federal Regulation	
DPM	Desktop Procedure Manual	M
EO	Engineering Order	F
EA	Engineering Audit	F
EAS	Engineering Authoring System	S
EOCN	Engineering Order Change Notice	F
EMRA	??	
EMM	Engineering, Material and Maintenance	A
ECM	Engine Condition Monitoring	A
EPI	Element Performance Inspection	A
FAA	Federal Aviation Administration	R
FR	Federal Register	M
FAR	Federal Aviation Regulation	M
FCD	Fleet Campaign Directive	F
FMR	Fuel, Maintenance and Ramp Operations Audits	A
GMM	General Maintenance Manual	M
IATP	International Airline Technical Pool	P
MX	A Maintenance event	
MCS	Modification Control System	S
MMF	Manufacturer's Maintenance Facilities	A
MEL	Minimum Equipment List	F
MARS	Maintenance ?? System	S
NPRM	Notice of Proposed Rule Making	F
OEM	Original Equipment Manufacturer	F
PCS	Production Control system	S
PFCR	Publication Form Change Request	F
QA	Quality Assurance	D
SNRM	Non Routine Maintenance	F
SCORE	Supplier Capability and Operational Reporting	S
Specman	Specification Maintenance	S
SAI	Safety Attribute Inspection	A
SCS	Supply Chain Services	
STS	Supply Technical Services	
WCCR	Work Card Change Request	F
WIC	Work Instruction Card	F