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QUALITY, MEASUREMENT, AND AIR FORCE MAINTENANCE DATA COLLECTION: WHAT IS WRONG WITH THE PROCESS?

by

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A RESEARCH REPORT SUBMITTED TO THE FACULTY

IN

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Quality, Measurement, and Air Force Maintenance Data Collection: What is Wrong With Process?

I. Introduction

Everywhere you turn, you see the word--QUALITY. The United States is engulfed in a commitment to quality, and the movement has spilled over into the government sector, including the Air Force. Everyone it seems, wants to "get a little quality."

But quality is not new to the Air Force. In the 1970's, General Wilbur L. Creech, then commander of Tactical Air Command (TAC), espoused many of the "new" tenets being bantered about today through "the five P's: People, Purpose, Pride, Professionalism, and Product" (2:-). One key element of General Creech's philosophy was a greatly enhanced emphasis on measurement.

TAC's aircraft maintenance community was a prime benefactor of General Creech's revolutionary way of leading. Because of his efforts, TAC maintainers received new tools, new facilities, and most importantly, a new level of respect. Armed with this expanded arsenal of assets, they were empowered by TAC's senior leadership with significantly greater levels of authority and responsibility. The results of this empowerment contributed significantly to the command achieving record aircraft mission capable rates, resulting in unmatched levels of combat capability, the command's primary product.

A key element of the maintainers' success was the ability to more accurately measure production and performance. For the first time, technicians were receiving meaningful feedback on a variety of measures encompassing the entire aircraft repair process. As a result, they developed a more comprehensive picture of what they were doing wrong, and just as important, what they were doing right. This measurement process was accomplish through a series of data collection systems commonly referred to as the Maintenance Data Collection (MDC) system. Today, the Air Force continues to rely on the MDC process as its primary source for maintenance measurement. Unfortunately, confidence in MDC at all levels within the Air Force is extremely low. So, what is wrong with the process?

This paper will explore that question by first analyzing the generic structure of a process, then exploring the role of measurement in process improvement. With this foundation, the paper will then more broadly describe the MDC system, analyzing the process, with the goal of identifying the problems affecting its utility. Finally, from this analysis, conclusions will be drawn on how to improve the process.

II. What is a Process?

A precursor to improving a system is understanding the concept of a process. According to Juran, a process is "a systematic series of actions directed to the achievement of a goal" (9:123). Coopers and Lybrand take a different tangent, describing a process as "the basic building block" (1:46) of any system. These two definitions, when combined, suggest a process to be a series of interrelated events that when accomplished sequentially, achieve a predetermined goal.

Why is understanding the concept of a process so important? Scholtes in The Team Handbook, suggests, "whole new insights open up when you begin to see tasks as related series of events" (11:2-2). By taking the complex and breaking it down into individual parts, it is easier to understand. Just as important, it is easier to solve multi-faceted problems by analyzing one process at a time.

What then are the elements of a process? According to Coopers and Lybrand, there are three elements: inputs, a transformation, and outputs (1:46). Scholtes, on the other hand, does not talk of inputs and outputs. Instead, he refers to customers and suppliers (11:2-4). Pictorially, these two definitions when combined would be represented as presented in Figure 1 (9:87).

Figure 1

This model serves as the basis of analysis for the remainder of the paper. A further review of each component helps clarify the interrelationship of the individual elements.

Input. An input is the raw material for the process (1:46). It can take the form of something tangible, such as iron ore to be converted into sheet metal, or sheet metal to be converted into an automobile fender. Or it can be something intangible such as an idea or information. In either case, the input is sourced from outside the process (1:46).

Supplier. The supplier provides the raw material, or input, for the process (9:86). The supplier has the responsibility to clearly understand the specifications of the input, and to provide an input that meets those specifications. However, it is the responsibility of both the supplier and the process owner to insure the specifications are clearly articulated to the supplier.

Transformation. The transformation converts the input provided by the supplier to a value-added product or service (1:47). The transformation includes all the tasks necessary to produce the product or service.

Output. The output is the product or service generated by the transformation. Key to the concept of output is the notion of "value-added." As was mentioned above, if the transformation as designed adds no value to the input, the actions taken do not comprise a successful process (1:47).

Customer. The customer is the benefactor of the output generated by the transformation (1:47). The whole purpose of the process is to produce a product for the customer. If there were no customer, there would be no need for the process.

The key point is that any system can be broken down into a process or series of interconnected processes. Understanding processes alone, however, will not insure that systems are running smoothly. Knowing how well the system is running is just as important. This is the role of measuring the process.

III. Process Measurement

A critical element of process improvement is process measurement. Without measurement, it is impossible to determine how well a process is working, or how effectively an output meets the customer's expectations.

Further, it is impossible to improve a process without first measuring its present performance. According to Walton in the *Deming Management Method*, "Critical is the need to base decisions as much as possible on accurate and timely data, not on wishes or hunches or 'experience'"(14:96).

Measurement can be done on the input, but is most often accomplished on the output or the process itself. Output data is primarily *results* oriented (1:61). It gives the process owner feedback on how closely actual products match the specifications of desired products. Process management, on the other hand, is *control* oriented (1:62). Is the system in or out of control? If there is a discrepancy between the desired and actual output, process data can help identify the cause of the discrepancy. Or, process data can be used to identify ways to make the process more efficient, even when output specifications are being met.

The decision of what to measure depends primarily on deciding for what purpose the data will be used (11:5-38). If feedback is required on product quality, or the ability of a product to meet specifications, results data are required. If, however, additional efficiencies in the process are being sought, process data are needed. Regardless of what type ~~are~~ is needed, process owners should determine data collection requirements.

Within the Air Force maintenance community, there is a reliance on both results and process data. One example of process data is maintenance managers monitor four hour and eight hour fix rates to determine how efficiently maintenance technicians are repairing aircraft. A majority of the data collected however, is results data. This includes but is not limited to, mission capable rates, break rates, configuration data, cannibalization rates, and down time for both parts and maintenance. Once collected, these data are analyzed at all levels, from individual aircraft at base level, to entire fleets of aircraft by Air Force Material Command (AFMC) and weapon system contractors.

Having determined the data collection goal and what data are to be collected, the next decision is, "How to collect the data?" Within the Air Force the answer to this question is the Maintenance Data Collection system.

IV. The Maintenance Data Collection System

To increase combat capability and operational suitability, the Air Force is concentrating its efforts on making weapon systems more reliable and more maintainable (4:1). This concept is collectively managed under acquisition guidance known as Reliability and Maintainability (R&M) Policy (4:1). The purpose of the Maintenance Data Collection (MDC) process is to collect, store, and retrieve base level, depot level, and contractor type maintenance data in support of implementing R&M policy (6:1-1).

The MDC system serves as the source of both process and results data in support of R&M efforts. These data are used by AFMC and by civilian contractors to improve Air Force weapon systems. In addition, MDC data are used at base level to provide "information feedback to base managers and supervisors for controlling the maintenance operation" (6:1-2). This includes providing data while base level personnel are deployed. Further, major operational commands use MDC data to aid in weapon system management decisions. Finally, Headquarters Air Force uses MDC data to determine the cost of base level maintenance operations.

The MDC process relies on automation to collect the data. Separate systems have been developed for collection at base level and to consolidate the data at AFMC. Eventually, depot maintenance data may be consolidated with the base level data at AFMC, but interfaces to make this a reality do not presently exist. Therefore, this paper will consider only data collected at base level as the source for maintenance data.

Although a number of base level collection systems exist, the most widely used is the Core Automated Maintenance System (CAMS). Aircraft maintainers throughout the Air Force use CAMS to collect data on aircraft assigned to their respective bases. Once collected, this information is electronically transmitted to AFMC and consolidated with data from all other bases in the Reliability and Maintainability Information System (REMIS).

Like all processes, the MDC system is made up of suppliers, inputs, input transformation, outputs, and customers. Using the process model previously developed, the MDC process can be pictorially represented as presented in Figure 2.

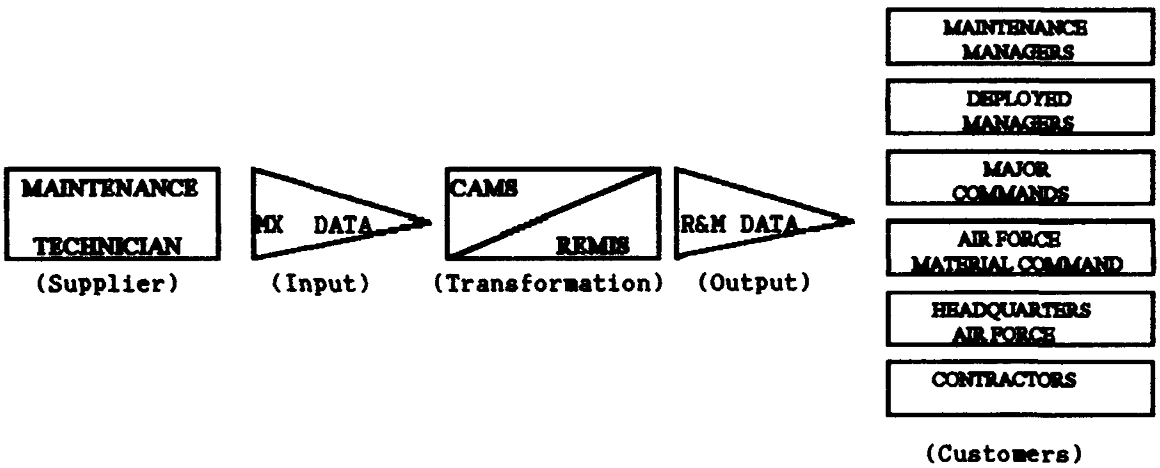

Figure 2

As has been previously mentioned, there is a very low level of confidence in the MDC system within the Air Force. Using this representation as a basis, the process can be broken down and analyzed to identify what problems exist within the MDC system.

V. Analysis of the MDC Process

According to a 1990 Air Force audit, the MDC system is "inadequate to ensure the accuracy, timeliness, and integrity of the data" (5:3). A recent study found that many contractors, a prime MDC process customer, use MDC only as a second source of data if at all, because of concerns over its accuracy (13:9). What is wrong with the process? An analysis of problems in each process element will help provide some clues.

Suppliers. The primary suppliers of MDC data are base level maintenance technicians. As expected, a maintenance technician's primary responsibility is to launch, recover, and repair aircraft. As part of these responsibilities, technicians are required to record key information, and input it into the MDC system. This information encompasses flight data, aircraft system discrepancies, and maintenance repair actions. Most maintenance however, takes place on the flightline or in hangars, neither of which is readily accessible to CAMS terminals. As a result, inputting data into the system becomes "an additional chore," and accomplished when convenient. Further, since the data are normally not input immediately upon completion of a task, the technician usually manually documents the information, and then transcribes the data into CAMS at a later time. Periodically, the manual documentation is lost and the information is not recorded. In other instances (estimated to represent 25 percent of the intentionally generated errors in CAMS), the technician simply elects not to record the data (7:61). In both cases, the results are holes in the data base and measures generated with incomplete information.

What would cause technicians not to record data? The answer is that technicians perceive little personal benefit from the MDC system. A recent study shows only 25 percent of flightline maintenance technicians felt the MDC system aided in the performance of their duties (8:C-4). A review of the MDC process model explains why. Maintenance technicians, by design, are not a customer of the process. Further, they receive no compensation for supplying data as would a supplier in the business community. Finally, because the primary use of the data is for R&M improvements which take many years to complete, technicians can make no correlation between inputting the data and seeing improved maintainability in their aircraft. As a result, the data suppliers have little motivation to insure the process is effective.

Input. The input for the MDC process is raw maintenance data collected by maintenance technicians. Air Force regulations and technical orders clearly spell out what data should be collected. Many of the data elements however, are general in nature, and require interpretation or a ''best guess'' by the technician. For example, one element collected defines the nature of how an aircraft failed. For the F-16, there are 305 choices, among them ''worn,'' ''failed,'' and ''broken'' (13:12). This level of choice relies on a technician to make a subjective decision about imprecise terms, making analysis of the results almost meaningless.

In addition, MDC collection requirements have not been updated since they were established in 1958 (10:24). As a result, data elements that could provide more accurate failure information have not been incorporated. For example, the Maintenance Integrated Data Access System (MIDAS) provides a more coherent tie between system failure modes and repair actions then does the present MDC data elements (10:21-22). As a result, if MIDAS were incorporated into MDC, much more coherent conclusions could be drawn from MDC, making the process output data more meaningful to system customers. However, due to the estimated cost of its inclusion, the Air Force has taken no action to incorporate the MIDAS data elements into MDC.

Transformation Process. Understanding how to properly input data into the MDC system is essential for an effective transformation process. Unfortunately, nearly every study done identifies a lack of training on the MDC system as the primary problem with the process. In one survey, 41 percent of those technicians interviewed identified insufficient training as the primary problem with MDC, nearly twice as many as those selecting the second choice (7:61). Without adequate training, technicians are frustrated in trying to use the system, and ultimately end up inaccurately entering information or not entering it at all.

The second most often identified problem with the MDC system is a lack of ''user friendliness'' (7:61). This is due in part to a lack of training on how to use the system. In addition, technicians are often required to use multiple screens to enter information and have no ''help'' screens available to guide them. Further, those aids that are available (Air Force regulations) are often written with a highly trained computer user in mind, and provide no additional help for the average aircraft maintenance technician.

Finally, the base level computer that houses the MDC system also houses a variety of other base level computer systems. High volume use by these other systems can have a significant impact on the speed with which the base level computer accepts MDC inputs. As a result, technicians often become frustrated with the length of time required to input the data, and elect to not make the inputs at all. Further, the base level computer is periodically brought ''off-line'' (made unavailable to computer system users from all specialties) during peak periods of use, making the loss of data collected during those periods more likely.

Output. The primary problem with the output process is that the narrative portion of aircraft failure data is "lost" during the transformation phase. Presently, CAMS collects the narrative information and makes the information available at base level. At present however, REMIS is unable to collect this data and therefore unable to provide it to the customers. How significant is this system shortfall? An Air Force Logistics Management study suggested that narrative data was the primary information R&M engineers relied on to make assessments (13:15).

Lack of narrative information is further exacerbated by the general nature of the data collected as previously described. Returning to the F-16 example, R&M engineers are limited in the depth of their analysis when the data they are assessing is couched in terms such as "worn" and "broken." The utility of the data is reduced even further when considering these subjective terms were selected by maintenance technicians who may have become disenchanted with the process.

Finally, the output is not time sensitive. On average, customers must wait 45 to 60 days after the data is collected before it is available for assessment due to the time required by AFMC to process the data (10:20). Although this may be acceptable to R&M engineers making trend assessments, it has negative implications for managers at major commands trying to identify incremental changes in operational readiness.

Customers. As previously discussed, there are significant concerns about the validity of MDC data. Cumulatively, these shortfalls lead many MDC customers to question the accuracy, and therefore the utility, of the output. In other words, the process output is failing to meet the requirements of the customers.

In addition, as presently designed, the MDC system fails to provide any data to deployed senior leaders or their staffs. Rather, data collected whiled deployed is funneled back to home station and consolidated with data from aircraft that are not deployed. For example, during Desert Shield/Storm, the CENTAF logistics staff had to rely on phone calls to each of the operating locations for status information on each deployed organization's respective aircraft. Meanwhile, home station logistics staffs had a complete picture of status information for their respective deployed aircraft. This failure to make MDC data available to deployed leaders is a major flaw with the process, as it ignores the requirements of one of the system's key customers.

Although this analysis has identified numerous problems with the MDC system, the combination of CAMS and REMIS is a dramatic improvement over the manual process that existed prior to 1985. Further, there are many actions ongoing to make additional improvements to the two systems. There still remains however, numerous system shortfalls requiring attention. The remainder of the paper will be dedicated to developing a road map for accomplishing those improvements.

VI. Road Map For Improving MDC

The paper has thus far introduced the role of the MDC system, built a model for analyzing MDC, and using that model, identified problems that presently exist within the MDC process. The remainder of the paper will concentrate on suggesting how to improve the MDC system. Before building the road map however, it is first necessary to define the future environment that the MDC process will operate in.

The Air Force, as with all of the military services, is presently undergoing a dramatic downsizing. This is due in part to the demise of the Soviet Union and the Warsaw Pact, as well as budget realities associated with the United States looking inward to solve its domestic problems. To illustrate the point, in 1990 the Department of Defense budget was $299.3 billion (3:349). In fiscal year 1994 it stands at $241 billion (15:8), a 19 percent reduction over 1990. Further, in 1985, the Air Force operated with 38.5 fighter wing equivalents. By 1996, that number will be cut nearly in half, down to 20 fighter wing equivalents.

Within the Air Force maintenance community, the method by which maintenance is accomplished is also changing. Flightline technicians are now working as an integral part of an operations squadron and not a maintenance squadron. In addition, the Air Force is moving towards a two-level maintenance concept. Under this concept, a majority of the intermediate level repair of assets (rebuilding black boxes and engines) will no longer be accomplished at base level, but will instead be done at a depot.

Finally, the realities of today's environment have caused the Air Force to reconsider its basing concept. No longer is maintaining a forward presence economically or strategically sound. Rather, today's focus is on bringing forces back to the United States, and projecting power from there when needed. This new strategy is encapsulated within the foundation of "Global Reach, Global Power." It is within this environment that changes must be made to the MDC process.

In the era of today's military budget reductions, the first question that must be asked about MDC is, "Is this process still necessary, and if so, are there alternative methods to satisfy the requirements of the process customers?" Answering this question requires the customers to first validate their process output requirements. This is especially important in an environment such as the Air Force where the customer may not clearly see the cost of the process. An environment where additional demands on the process may not directly lead to additional costs to the customer in terms of time or money, but may carry significant additional costs for the system suppliers. Once accomplishing this validation, managers of the MDC process should analyze whether alternative methods for meeting customers' needs are available. For example, will supply usage data combined with failure rates generated from modeling provide the same information as MDC? If so, can it be accomplished more efficiently and more effectively than MDC? If the answer to all of these questions is yes, then this may be an alternative to the present process.

If however, managers of the MDC process find no alternative way to meet the needs of the customer, the new question becomes, ''How do we improve MDC?'' A review of the problems associated with the MDC process suggest that by concentrating on improving the input, many of the remaining problems would be eliminated. Key among these is improving the quality of training maintenance technicians receive on using the MDC system.

When CAMS was originally fielded, maintenance technicians were given a short introductory class on CAMS taught by a mobile training team from Air Training Command. This training was generic in that it simply taught basic skills needed to use CAMS, and did not address applying skills to specific functional specialties (i.e., crew chiefs, back shop avionics, phase docks).

This training was then supplemented with over-the-shoulder training by maintenance technicians from other bases who were already using CAMS. Unfortunately, the over-the-shoulder training was sporadic, and taught by individuals with only a marginally better understanding of CAMS then the student. Finally, there was no additional training provided as new enhancements to CAMS were fielded.

Today, CAMS training is provided to all new airmen going through initial aircraft maintenance technical training. This training provides each airman with the basic skills necessary to input data into the system. Further, CAMS refresher courses are available at bases that have a Field Training Detachment (FTD). Unfortunately, due to the attitudes developed during initial training on CAMS, maintenance managers are not inclined to take advantage of this available training. In addition, because of their limited skills with the system, they are unable to answer questions of newly assigned airmen or provide them with additional over-the-shoulder training.

What then is the solution to the MDC training issue? Initial training during technical training is a good first start. However, this needs to be supplemented with a more comprehensive training regime once the individual arrives at their first assignment. This could be accomplished by incorporating CAMS usage into the maintenance career field Career Development

Course (CDC) lessons and tests. Further, CAMS proficiency could become a formal task to be demonstrated during on-the-job (OJT) training. This would help insure a trainer provided the trainee with at least a minimum level of CAMS training. Finally, under the new Air Education and Training Command concept of mid-career formal training, maintenance technicians could receive CAMS refresher training, and information on MDC system upgrades, while back in the classroom.

The next issue to address is, "How do we insure the trainer is knowledgeable enough to provide training to the trainee?" On possible solution is to put an MDC expert in each maintenance organization to provide refresher training. The logical person to fill this position would be a member of the Air Force Engineering and Technical Service, or AFETS. An AFETS is an Air Force civil servant who has been hired to provide technical expertise in a specific field to a base's maintenance community. Typical AFETS at a base are system experts in aircraft fire control systems, flight controls, or engines. This program could be expanded to include a MDC expert for each unit.

The AFETS could also provide the solution for training personnel on upgrades to CAMS and other MDC systems. For example, when an improvement to CAMS is fielded today, there is no formal method for introducing or training field personnel on the upgrade. In the future, the AFETS could serve as the formal training source for insuring personnel were trained on the system improvements. By serving as the MDC expert, the AFETS could also provide valuable feedback to those developing the CAMS software on problems being experienced in the field, and what additional system improvements were needed. Training alone however, will not improve the quality of input into the MDC system. Just as important, is improving the "user-friendliness" of the system.

One of the simplest ways to improve the quality of information coming out of a data collection system, is to make inputting data into the system easier. This can be accomplished two ways; by providing clearer guidance on how to input data, and by simplifying actual data input. Efforts are already underway to improve the guidance on inputting data into CAMS. First, user manuals are being rewritten, this time with the maintenance technician in mind. This means that system use is described in clear terms that everyone can understand, not just those who are highly proficient with automated data collection systems. Second, "help" screens are being added to the system for describing the most common of data input requirements. Although helpful in reducing user frustration for the technician, these two steps represent only a fraction of what can be done to improve the ease of inputting data.

Real improvements in simplifying data input can be gained by utilizing existing computer technologies. For example, touch screens combined with icons would provide a much "friendlier" appearance to the technician than the present maze of data screens. As a result, technicians may feel less threatened by the system, and more likely to input data.

Another technology that could simplify data collection would be the introduction of bar code technology into the data collection process. Hand-held bar code readers such as those employed by overnight delivery services could make inputting data significantly easier than the present method of writing the information down and carrying it to the nearest input terminal. The added benefit of the mobile bar-code reader is that it puts the input terminal at the job site, eliminating the primary cause of inaccurate output data--incomplete input data due to voluntary non-collection by the technician.

This technology could be combined with another presently available technology, mobile radio-frequency (RF) computer terminals, to further increase the likelihood of data input. Although RF terminals have been successfully tested with CAMS, the Air Force has not centrally funded then, and, as a result, they have not been widely fielded. By utilizing the RF terminals, not only would the likelihood of data collection improve, but information availability would improve as well. For example, senior flightline managers would now have direct access to query the supply system for the availability of parts from their trucks, rather than having to drive off the flightline to an available telephone. Each of these technologies would increase the likelihood that not only would more data make it into the system, but the data would be more accurate than that presently being entered. This, combined with improvements with training and guidance, should dramatically improve the process of inputting data.

With improvements to the input process identified, the next step is to identify improvements that can be made to the input data itself. As was previously mentioned, data elements being collected in the MDC process have not been updated since 1958. This is not to imply however, that there have not been improvements made in the quality of information generated concerning aircraft maintenance discrepancies. For example, in the early 1980s, the Air Force transitioned to a more effective system of tying aircraft system failures to corrective actions--the MIDAS numbering system--for its technical orders. MIDAS was implemented on the F-15 and the F-16, and has been incorporated into the troubleshooting guides of every new Air Force aircraft since then. Despite that fact, MDC continues to use the data elements originally established in 1958. Converting to the MIDAS numbering system however, will benefit both the data supplier--the maintenance technician--and the customers of the MDC process.

~~however, will benefit both the data supplier, the maintenance technician, and the customers of the MDC process.~~

Today for example, the maintenance technician receives a pilot reported discrepancy described in both narrative form and in a MIDAS Fault Reporting Code that comes from a technical order Fault Reporting Manual. Utilizing the fault reporting code, the maintenance technician consults a technical order Fault Isolation Manual that provides the logic to accurately isolate the aircraft system failure to a specific problem. This failure is represented in the manual by a unique MIDAS Reference Designator. The reference designator also identifies a specific technical order job guide that describes the repair process in detail. A key benefit of MIDAS is that the data collected during this process was generated as part of the repair process, not in addition to it, as is the case with the data elements presently being collected in MDC. Further, the MIDAS data elements, if used in MDC, would tie a very specific description of a system failure to the exact cause of the problem, and the specifics of what it took to fix the problem. This is in direct contrast to the present system which describes problems in terms such as "broke", and repair actions in terms such as "repaired."

The most significant benefit of transitioning to a MIDAS numbering system however, is that data collection and aircraft troubleshooting would become a single process. As previously described, each step of the troubleshooting process, from identifying a pilot reported discrepancy to generating a specific description of the repair action, can be represented by a MIDAS code that reflects both a specific portion of an aircraft maintenance technical order and a data element in the MDC process. This provides the potential for using MDC to not only collected R&M data, but to improve aircraft troubleshooting technical orders as well. By being able to collect large volumes of data tying system failures to successful repair actions, those writing technical orders could validate the accuracy of the troubleshooting guides. An added benefit from this process, besides the obvious improvements to troubleshooting guides, is that technicians would see a tangible benefit from the MDC process, perhaps motivating them to provide more complete and accurate inputs.

The final step in this improvement process is to incorporate MDC, troubleshooting guides, and troubleshooting *equipment* into a single process. This concept is now being tested under a program known as the Integrated Maintenance Information System (IMIS). Under IMIS, a single automated system would analyze the aircraft for problems through a connection with the aircraft's on-board computers, walk the technician through any repair processes needed, and collect all of the associated information for input into

MDC. This process takes the concept of minimizing the effort required to collect quality MDC data to its ultimate conclusion.

The final element in laying out a road map for improving the MDC process is to insure that all customers' needs are being met, in particular the needs of leaders and managers working in the deployed environment. As designed, the MDC system is centered around a base's main computer system. When a unit of aircraft deploy to a location away from home station, maintenance personnel still have access to their home station through the Defense Data Network (DDN). Just as important, home station senior maintenance managers have access to information concerning the deployed aircraft. This applies even when units are deployed to an environment such as Saudi Arabia during Desert Shield/Storm. Unfortunately, during a campaign such as Desert Shield/Storm, the decision makers who needed access to information about the deployed aircraft were not those at home station, but those running the campaign such as members of the CENTAF staff in this example. As was previously described, the MDC system as it presently exists, is not designed to meet their needs. Nor have ~~their~~ there been any requirements established to develop this capability for the system.

One alternative to solve this problem may be to specifically identify what maintenance data are required by deployed senior managers, and incorporate those needs into some future deployable command and control system, fulfilling the information requirements for all specialties, not just maintenance. Regardless of what the solution is, however, with the environment transitioning from overseas basing to that of CONUS basing and reliance on "Global Reach, Global Power," the likelihood of future large deployments, and the requisite information systems to support those deployments, is only going to increase.

VII. Conclusions

Since General Creech's tenure as the Commander of TAC, the aircraft maintenance community has relied on process measurement as one of the tools to improve the quality of its product--combat capability. Automated MDC systems have helped to improve the process. However, there is still much work to do.

This paper provided a road map for accomplishing those improvements. First, the Air Force must decide if a maintenance data collection system is still necessary, or whether there are alternatives that could provide the same data. If the conclusion is that the MDC system is still necessary, then improvements must be made to each of the five elements of the process, beginning with the way technicians are trained on MDC. At the same time, there must be improvements in the system's "user friendliness," focusing on clearer system aids, as well as incorporating existing computer technologies to simplify system use. Improvements to the specific data being collected are also essential to making MDC a viable tool. Systems such as MIDAS provide the possibility of collecting much more accurate data, and for making MDC collection a by-product of repairing aircraft, not a process in itself. Finally, the MDC process must evolve with the realities of today's Air Force, a CONUS based force, and do a much better job of meeting the needs of one of its primary customers, the deployed commander and his staff.

The recommendations in this paper will not come free. More useful and timely maintenance data will cost the Air Force money at a time when budgets are being reduced. But the cost for not improving the system could be even higher. As the Air Force continues its move towards maintenance generalists, two-level maintenance, and unit funding for spare parts, the need for accurate maintenance data has never been greater. The need for change is apparent. All that remains is the resolve to do so.

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