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INFORMATION MANAGEMENT STRATEGY FOR AIRCRAFT MAINTENANCE IN THE CANADIAN FORCES

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ABSTRACT

The information revolution continues to affect most areas of our lives. The focus has however changed from the 'storing and retrieving' of information to the 'manipulation and interpretation' of information. Many organizations are realizing the potential benefits from this new level of automation.

In this new 'connected' world the new trend in information technology is the implementation of enterprise systems. These all-encompassing information systems promise to deliver complete integration of all information management needs within an organization but this has proven difficult.

The Department of National Defence is attempting to automate Materiel Acquisition and Support (MA&S) through the implementation of an enterprise system called MASIS. This paper will focus on the aircraft maintenance problem within MA&S and it will demonstrate, through a review of current practices and with the analysis of a previous trial of an aircraft maintenance information system, that the Canadian Forces requires a specialized information system to meet the specific needs of aircraft maintenance management.

INFORMATION MANAGEMENT STRATEGY FOR AIRCRAFT MAINTENANCE IN THE CANADIAN FORCES

As a national institution, the Canadian Forces (CF) is accountable to the Canadian government for the efficient management of its budget and as such the Canadian people have the right to expect the most efficient use of any resources dedicated to their defence. It is also one of our main responsibilities to continuously look at the ways and means to improve the efficiency with which we deliver our national defence capability given the finite resources we are given.

Although not always appropriate to compare the CF to private industry, there are some valuable lessons that can be learned from their operations. One such example is in the area of aircraft maintenance, repair and overhaul. Civilian industries in general, and in particular airlines, have realized long ago that the more expensive the equipment one operates, the more efficiently it must be used. Consequently, the emphasis of most airline operators has been to reduce the downtime of their aircraft fleet by reducing the time it takes for maintenance. Similarly for the CF, reduced maintenance time will translate into improved aircraft availability which can be turned into savings and/or operational effectiveness.

The coming of age of computer networking and the use of large databases have brought a new tool to bear on this particular problem. Many industries, including the aircraft maintenance industry, are successfully using information

technology (IT) tools to improve their effectiveness. This paper is intended to convince the reader that in order to make the most efficient use of its limited aerospace equipment, the CF would be wise to invest in a proven aircraft maintenance management information system. Such a system would permit the introduction of new management practices such as total asset visibility[1] and advanced diagnostic tools that would improve the net availability of its weapon systems. First, the current environment in terms of logistics and information management systems will be described. Then, the specific problem of aircraft maintenance management will be developed. This will be followed by a brief description of information systems that are currently used in the CF as well as some comments on the difficulties in implementing such systems. Finally, the paper will conclude with some recommendations on the way ahead for the successful introduction of an aircraft maintenance management information system for the CF.

Logistics has long been a key enabler of war fighting. The industrial revolution and the associated increased complexity of military equipment, as well as the introduction of large scale manoeuvre warfare in the nineteenth century, all contributed to the continued importance of robust logistic support. History shows that many of the most elegant plans have collapsed due to the failure of logistic services. Such failures were usually the result of inferior peacetime logistic

[1] Total asset visibility is the ability of an asset management system to provide the user with readily available and complete information on all the assets the user is interested in. It provides the ability to perform detailed and

preparations due to the common political pressures to economize by 'cutting the logistics tail'.[2]

The end of the Cold War, in the latter part of the twentieth century, has been followed by a number of smaller scale conflicts around the world. These have brought the requirement to have highly deployable forces, since most of these emergencies are short notice and they involve the movement of forces over long distances. Therefore, the logistic support of these forces becomes an even more challenging proposition. In the Gulf War for example, the feat of moving large number of air assets, as well as three corps of ground troops into that theatre of operations within five months is considered one of the greatest achievements of this campaign.[3]

Another complicating factor is the increasing complexity of weapon systems. This also affects the logistical support requirements, as military forces become more dependent on their sophisticated equipment and that
equipment requires a higher degree of technical expertise to support. While this trend is being felt by all elements of combat forces, this paper will focus specifically on aerospace systems. As aircraft are some of the most complex of weapon systems, they require one of the most comprehensive logistical support networks to make sure they are used most effectively.

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comprehensive inventory control of all assets.

[2] Kenneth Macksey, *For Want of a Nail*, Brassey's, 1989, xiii.

[3] Dr Paul T. Mitchell, *The Persian Gulf War*, Canadian Forces College Applied Military Studies, Warfare and History Series, 1999, 13.

This is where new IT, which empowers distributed intelligence and decision making to users[4], can be very useful.

Management Considerations

Effective information management is an indispensable decision making tool. Dramatic enhancements on many fronts such as mobility, supportability and affordability are available by exploiting the information revolution. Compared to the commercial sector, the military is getting a late start in applying IT.[5] The strategic value of information and the importance of information systems as critical logistic enablers has, however, been recognized by both the United States Armed Forces[6] and the Canadian Department of National Defence (DND).[7]

For successful implementation of IT systems, researchers have long prescribed the importance of having project champions, good relations between developers and user departments, user involvement, adequate resources and a supportive organizational climate.[8] These conditions continue to be important today. There must be broad participation by all those who will be affected by the new technology. If they are not involved, they

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[4] Don Tapscott, Art Caston, *Paradigm Shift – The New Promise of Information Technology*, McGraw-Hill, 1993, xiii.
[5] David C. Gompert, *Right Makes Might: Freedom and Power in the Information Age*, Headline Series No. 316, June 1998, 56.
[6] *Doctrine for Logistic Support of Joint Operations*, 6 April 2000, I-17.
[7] 1150-110/D129 (DM/CDS), *NDHQ Policy Directive P3/94 DND/CF Policy for Information Management*, 29 September 1994, 3.
[8] Richard E. Walton, *Up and Running – Integrating Information Technology and the Organization*, Harvard Business School Press, 1989, 1.

are not likely to buy in to the potential benefits of the new system and it will therefore be doomed to failure.

In the next section, we will look more specifically at the aircraft maintenance management problem. Although there are many similarities between managing the maintenance of aircraft and managing the maintenance of other complex weapon systems, the aircraft maintenance management problem brings specific challenges that we will look at in greater detail.

The Aircraft Maintenance Management Problem

There are many problems related to aircraft maintenance management. Specifically, MxI, an aviation maintenance management software developer, has broken down the aircraft maintenance management problem in seven categories.[9] Those categories are: 1. *Configuration Management* – the tracking of serialized configuration, status and location of aircraft fleet and spare parts; 2. *Maintenance Planning & Scheduling* - identifying, prioritising and grouping maintenance tasks and allocating the resources to meet the requirements; 3. *Maintenance tracking* - collecting and storing maintenance records to allow the performance of maintenance analysis and to satisfy audits; 4. *Line maintenance* - tracking of flight usage and fault reports to support line maintenance activities;

[9] Maintenix White Paper, MxI Technologies, 1997-2001, 1.

5. *Maintenance Programme Management and Control* - establishing and modifying a maintenance programme and issuing it to field units; 6. *Fleet management* - analysing of fleet data to project spare requirements and future maintenance costs; and 7. *Regulatory compliance* - complying with the requirement of the regulations as set by regulatory bodies.

The above categories have long existed in the realm of aircraft maintenance but the increasing complexity of weapon systems has made them gradually more difficult to manage. This complexity has driven the development of many maintenance management systems. However, since the responsibilities for these issues are not consolidated, the result has been a number of stand-alone systems that are not generally integrated and within which there is also significant redundancy of information.[10] The regulatory framework will now be examined in greater detail to emphasize its importance in the realm of aircraft maintenance.

[10] LCdr Lynch, *Materiel Acquisition and Support Information System (MASIS) Concept of Operations*, 25 May 1998, 1.

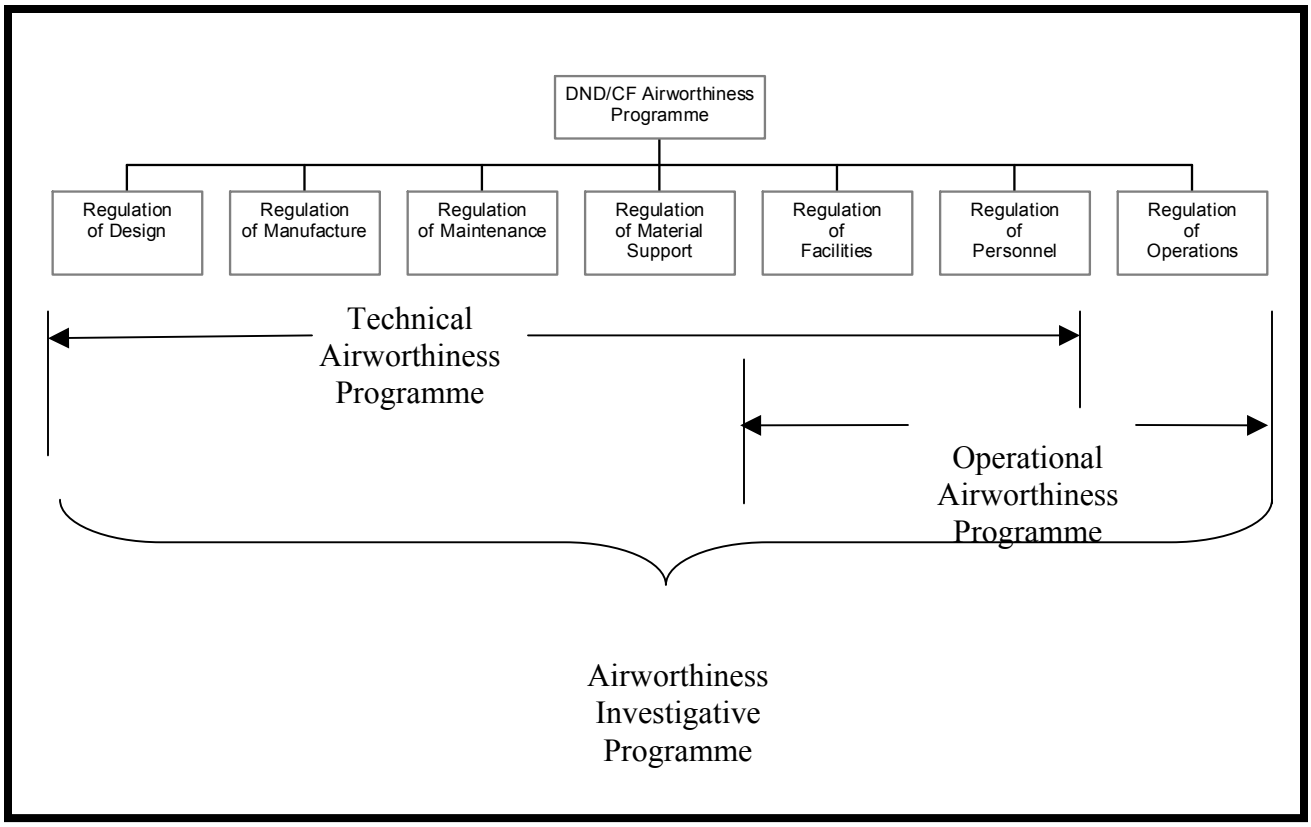
Regulatory framework

The high complexity of aircraft in general, as well as the dramatic consequences of system failure, has made the aerospace industry worldwide very regulatory. In Canada, for example, the Aeronautics Act is an authoritative legislation that sets the legal basis for aviation safety. The Act assigns aviation safety duties and responsibilities to the Minister of Transport for civil aviation and to the Minister of National Defence for military aviation.[11] Specifically, it sets rules and regulations in seven broad areas; design, manufacture, maintenance, material support, facilities, personnel, and operations.[12] This document sets the foundation for more detailed rules and regulations as set out by the respective ministers.

The Minister of National Defence, under the provision of the Aeronautics Act, has delegated powers and authority to the Airworthiness Authority (AA); Technical Airworthiness Authority (TAA); Operational Airworthiness Authority (OAA); and Airworthiness Investigative Authority(AIA).[13] The figure below is a graphical representation of the elements of the DND airworthiness programme.

[11] http://lois.justice.gc.ca/en/A-2/, 26 Feb 2002, Aeronautics Act.
[12] Technical Airworthiness Manual, C-05-005-001/AG-001, 30 Nov 2001, 1-1-1-2.
[13] Ibid, 1-1-1-2.

DND/CF Airworthiness Programme[14]



The new CF Technical Airworthiness Manual (TAM), published in November 2001, sets out in great detail the technical airworthiness rules and standards for military aviation in Canada. While much of the TAM deals with rules and standards, it also describes the airworthiness documentation requirements for aeronautical systems and components. As described in the TAM "the management of airworthiness-related information is a vital part of assuring the airworthiness of an aeronautical product."[15]

[14] Ibid, 1-1-1-3.
[15] Ibid, 5-5-1-2.

There is a vast amount of information generated during the life cycle of an aeronautical product and its effective management is critical to the maintenance of the product's airworthiness status. Information management is, therefore, a very important consideration throughout the life cycle of an aeronautical product.[16]

The importance of information management to meet the regulatory requirements has long been recognized. The volume of airworthiness related information makes it very difficult to manage it without the help of an automated system. The TAM has also recognized this reality and it has set the guidelines for the use of electronic record keeping systems. Next, we will look at the information systems that are being used and that are planned to be used in the CF aircraft maintenance community.

Current and planned information systems

The Aircraft Maintenance Management Information System (AMMIS) has been in use for many years.[17] The purpose of AMMIS was to have a central repository of historical maintenance actions that had taken place on aeronautical products. For many years, this database was populated manually by a number of clerks in National Defence Headquarters. Even with its limitations, AMMIS proved to be a valuable tool for Life Cycle Maintenance Managers (LCMM) in headquarters, who looked for long term trends

[16] Ibid, 5-5-1-2.
[17] http://admmat.dwan.dnd.ca/dgaepm/adam/ammis_e.asp, 15 Jan 2002.

in the equipment they were responsible for. That said, for first and second line maintenance organizations, AMMIS was of very limited value.

The introduction of the Automated Data for Aerospace Maintenance (ADAM) system in the early 1990s brought electronic record keeping in the hands of the first and second line technicians.[18] ADAM introduced some advantages to the aircraft maintenance community. Manual data entry into AMMIS was no longer required and the data used by LCMM was much more timely and accurate. However, even now, the advantages of ADAM and AMMIS to first and second line organizations remain insignificant.

Today, the main drawback of ADAM is that it simply automated the old 'paper' process. In fact, the computer screen was made to look the same as the old paper form. This was done to facilitate the transition from paper to electronic entry by technicians but it also prevented taking advantage of so much more capability potential offered by the new electronic medium. In short, in order to tap into the considerable efficiency potential of the new IT systems, we must change our procedures to take advantage of its power.

In a follow on from above, ADAM has also proven to be slow to adapt to new technology and to new requirements from the users. This is mostly due to ADAM being developed within the CF and because it has not been managed with the priority and status

[18] Ibid.

it deserves. This highlights the fact that the CF should, as much as possible, strongly consider the use of Commercial Off The Shelf (COTS) products to meet our information management needs. In addition, given today's criticality of information, these systems should be given the same status and priority as we give to weapon systems to ensure they are supported adequately.

Even though ADAM has met some of the information needs of the aircraft maintenance community, it only addressed a small portion of the larger Materiel Acquisition and Support (MA&S) problem. The Materiel Acquisition and Support Information System (MASIS) project was initiated to resolve this dilemma. During the deliberation of the Management Command and Control Reengineering Team (MCCRT), in the early 1990s, the need for a solution to address the MA&S end-to-end information requirements was realized. The conclusion of MCCRT was that there was a requirement for a system that would capture data once at the source and provide global visibility at all required levels.[19] The project name became MASIS and its objectives are to optimise equipment availability and support costs by providing integrated information to link engineering and maintenance. MASIS intends to reach these objectives by using off-the-shelf software developed by private industry.[20]

The MA&S problem is not unique to DND. It is worthwhile considering how some of the civilian industry view and deal with

[19] Material Acquisition and Support Information System, http://www.dnd.ca/admmat/masis/Backgrnd_e.html, 8 Nov 2001.
[20] Ibid.

this issue. The next section will look at how some industries, focusing on the aerospace industry, deal with this management problem.

Systems used in civilian industry

Many civilian industries understand and are pursuing the use of IT to optimise maintenance operations. In particular, static plant manufacturing facilities lend themselves well to the integration of IT to improve plant productivity. The main advantage of improved IT is the vehicle that it provides workers to access, share and manipulate information.[21] Teams often make better decisions than the same people working independently[22] and IT provides the mechanism to make working in teams, even over long distances, more accessible. IT represents a significant investment and to realize the maximum benefits the technology needs to enable the workers to become more efficient by streamlining the current processes.[23]

Due to the high cost of large manufacturing equipment, the concept of asset management is also well recognized by industry. Computerized maintenance management systems (CMMS), which are combined with condition monitoring equipment, are becoming more common in manufacturing industries.[24] The industry is also convinced that new cost-effective technologies

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[21] Robert L. Matusheski, *Using Information Technology to Optimize Maintenance Operations*, Plant Engineering, Barrington, May 2001, 2.
[22] Ibid, 2.
[23] Ibid, 3.
[24] Glenn Schulz, *Information drives asset management*, Manufacturing Engineering, Dearborn, Sep 2001,1.

now make it possible to connect CMMS to production, scheduling and procurement to allow the operation to transition from reactive to more predictive maintenance.[25]

The aerospace industry on the other hand has been facing many challenges to the introduction of IT for their maintenance and repair organizations. The main challenges include the regulatory issues, error-proofing and the lack of software systems expressly designed for aircraft maintenance organizations.[26] Nonetheless, there have been many islands of automation implemented since the 1970's. Since those systems use non-standard hardware and software however, it is difficult to interface and network them. The strict regulatory framework within which the aircraft maintenance, repair and overhaul (MRO) industry is working has made the acceptance and implementation of IT systems a very slow process. For example, in 1999 at Lufthansa, electronic data was only approved if it was accompanied by paper printouts.[27]

Many aircraft maintenance organizations have evaluated enterprise-wide resource planning solutions to solve their automation needs. It was quickly discovered however, that these systems were intended primarily for manufacturers. "Aircraft maintenance has lots of unique features, including regulatory requirements, tracking needs and configuration details that make it difficult to put such systems into place."[28] Too many of the

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[25] Ibid, 2.
[26] Paul Proctor, Michael A. Taverna, *International Centers Lead IT Revolution*, Aviation Week & Space Technology, New York, 30 August 1999, 1.
[27] Ibid, 3.
[28] Ibid, 3.

proposed software solutions for MRO have been adopted from manufacturing applications and are not user-friendly for maintenance work.[29] The bottom line is that aircraft maintenance organizations are very reluctant, because of the consequences of errors, to introduce IT systems until 100% accuracy and ease of use in an aircraft maintenance environment is ensured.

With the increased sophistication of IT systems and their associated improved security and reliability, it is now more feasible to implement IT solutions for aviation MRO. The new generations of IT will not only maintain the strict regulatory requirements but they will also help organizations to more easily meet those requirements. At Delta Airlines, for example, the company is implementing a new IT system which they believe will help them to meet the government airworthiness compliance requirements.[30] In addition, Delta sees two other major benefits to the implementation of the new IT system. These are the collection of detailed cost data and the building of a reliability database to allow them to better plan the next year's activities.[31]

Another airline, Cathay Pacific, has taken the lead in the use of IT for inventory management.[32] It has been aggressively implementing a number of IT initiatives including Aeroxchange, an airline run, business to business electronic exchange system for

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[29] Michael Mecham, *Software Solutions Making MRO 'Smarter'*, Aviation Week & Space Technology, New York, 30 August 1999, 2.
[30] Donna K Henderson, *Is the Holy Grail in Sight?,* Air Transport World, Cleveland, Feb 2000, 2.
[31] Ibid, 2.
[32] Barry Rosenberg, *Cathay Pacific Engineers Its Future*, Overhaul & Maintenance, Washington, 20 December 2001, 1.

which Cathay Pacific was a founding member. Derek Cridland, Cathay Pacific's engineering director, also believes in the implementation of IT programs to reduce its maintenance costs. He believes that "airline engineering departments must know how to take advantage of advanced diagnostic systems so problems are not misread and misdiagnosed, which can be expensive."[33] And computer systems are much better at identifying problems and trends to help improve the accuracy of diagnosis.

These same principles and deductions apply equally to military aircraft maintenance organizations. A 1992 RAND report highlighted the need for putting in place data systems that support repair prioritisation at the US Naval Aviation Depot.[34] Another example comes from the new Georgia Institute of Technology research centre which currently has a project to use IT to reduce the cost of maintaining the US Navy's fleet of P-3 Orion antisubmarine aircraft. This project is expected to cut more than $1 million a year from the cost of maintaining that fleet.[35] Finally, the largest benefit of information systems is the provision of better information and better tutoring for technicians to more accurately troubleshoot problems. The members of the research centre expect to reduce unnecessary repairs by 25%.[36] The key is then to make better use of the technician's time.

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[33] Ibid, 2.
[34] Marygail K. Brauner, Daniel A. Relles, Lionel A. Galway, *Improving Naval Aviation Depot Responsiveness*, RAND, 1992, viii.
[35] Anonymous, *Reducing Aircraft Maintenance Costs for the U.S. Navy*, IIE Solutions, Norcross, April 2001, 1.
[36] Ibid, 2.

IS Implementation

An information system can be defined as a set of components working together to collect and disseminate information to support decision making within an organization.[37] As IT is evolving, other names have been given to such systems. Most recently the names of Enterprise Resource Planning (ERP), Manufacturing Resource Planning (MRP) or simply Enterprise Systems (ES) have been used to describe all-encompassing information systems that allow organizations to work across the traditional boundaries within them. What differentiates the ES from previous information systems is that it may be the only information system an organization requires.[38]

We now realize that for an organization to fully leverage the advantages of IT, it must also alter its concept of operation, doctrine and force structure.[39] In their rush to introduce information technologies, many organizations failed to recognize that changes in process and structures, not only technologies, were required to increase effectiveness.[40] In the early 1990's, many Chief Executive Officers did not embrace the concept of information as a strategic resource while their Chief Information Officers were too focused on technology and could not relate it to the company's mission.[41] DND did not do much better.

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[37] Kenneth C. Laudon, Jane P. Laudon, *Management Information Systems: New Approaches to Organization and Technology*, Prentice Hall, 1998, 7.
[38] Thomas H. Davenport, *Mission Critical*, Harvard Business School Press, 2000, 2.
[39] David S. Alberts, *The Unintended Consequences of Information Age Technologies*, The Center for Advanced Concepts and Technology, April 1996, 11.
[40] Jim Manzi, *Productivity: Faith Isn't Enough*, Computerworld Vol 26, Iss 18, 4 May 1992, 29.
[41] Julia King, *Closers*, Computerworld, Vol 29, Iss 21, 22 May 1995, 86.

Its failure to recognize information as mission-critical led the department to introduce IT solutions mostly for administrative resource management.[42]

With the maturing and wide spread use of information systems, the information specialists are now moving out of the back rooms and many systems being designed today are much more than data management mechanisms.[43] Decision support systems and management information systems that use historical information and details about past decisions are now useful tools for middle managers.[44]

But buying expensive new IT tools will not make an organization more productive unless it knows how to effectively employ this technology.[45] While the application of technology has evolved significantly, the mind-set of senior leaders, in many instances, has failed to keep pace.[46] The result is often the random and ineffective application of new technology to existing processes. Then frustration sets in when the expected benefits of the investment in IT does not materialize. So the track record of IT investment is uneven, particularly because it is difficult to figure what makes a successful IT investment.[47]

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[42] Major L. Cook, Information Technology – The False Saviour, Ex New Horizons, 2 May 1997, 11.
[43] James M. Kerr, *The IRM Imperative – Strategies for Managing Information Resources*, John Wiley & Sons, 1991, xv.
[44] Ibid, 4.
[45] John Thorp, *The Information Paradox – Realizing the Business Benefits of Information Technology*, McGraw-Hill, 1998, xxiii.
[46] Ibid, xx.
[47] Ibid, xviii.

Recommendations

What does all this mean for the CF aircraft maintenance community? Is the solution an enterprise system like that proposed by MASIS to ensure the connectivity of all the phases of equipment life cycle management? Or should the solution be focussed on the technicians and middle managers to more effectively help them in becoming more effective? I believe the solution should address both these areas.

The need for linking all facets of materiel acquisition and support as defined by the MASIS project is important. However, as discussed earlier, it is also critical to ensure any new information system meets the needs of the technicians and middle managers since this is where the largest potential savings in manpower reside. In order to make any significant improvement in the efficiency of aircraft maintenance operations we must focus our attention on the technician to give him/her better diagnostic tools and capabilities.

This is certainly not a new concept. A 1965 RAND report prepared for the US Air Force (USAF) highlights that resource allocation at base level can be made much more effective when the functions of data generation, data retrieval and resource control are unified.[48] The report concludes that the USAF could improve weapon system effectiveness by strengthening maintenance control with the use of information systems, information aids, and better

[48] I.K. Cohen, O.M. Hixon, R.L. Horn, *Unifying Resource Allocation, Control, and Data Generation: An Approach to Improved Base-Level Maintenance Management*, RAND, November 1965, 1.

communication nets at the base level.[49] Today's IT is a key enabler in this regard.

I believe the objectives of MASIS are on the right track to meet the needs of senior management within DND. The MASIS concept of operations includes many functions from engineering, logistics and management.[50] If they come to fruition, these functionalities will allow headquarters staffs to be able to make better decisions in terms of resource allocations. It will also be very useful for LCMMs to make forecasts of equipment support requirements. I do not believe, however, that MASIS will meet the needs of the front line organizations. As many civilian aircraft maintenance organizations have already realized, the enterprise systems that exist today are not designed to meet the specific needs of the aircraft maintenance community. In addition, there has been no, or very little, involvement of first line technicians and managers in the development of the requirements for MASIS. Thus, it is difficult to expect results that will be very useful for that community. And since we have already discussed the fact that the largest potential benefit in efficiency improvement is at that level, there is a good argument for additional information systems that will focus in this area.

There are maintenance management information systems on the market today that are designed specifically to meet the stringent needs of the aircraft maintenance community. Many of the

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[49] Ibid, v.
[50] LCdr Lynch, *Materiel Acquisition and Support Information System (MASIS) Concept of Operations*, 25 May 1998, 1.

airlines discussed earlier have successfully integrated specialized aircraft maintenance management systems into their operation. The proposed solution for the CF is to introduce such a system to replace the outdated ADAM system. ADAM has provided good service for the aircraft maintenance community, but it has now outlived its usefulness. Of course, it may be possible to upgrade ADAM to meet today's needs but it is not cost effective given that extremely powerful systems are already available on the market.

One of the aircraft maintenance management information systems currently available on the market is called Maintenix. This system underwent an extensive year long trial at 434 (Combat Support) Squadron, 14 Wing Greenwood, Nova Scotia in 1998. 434 Squadron was then one of the largest aircraft squadrons in the CF and it operated a fleet of seven Challengers and seventeen CT-133s. The trial was very successful and the results showed that there could be significant labour savings while, simultaneously providing much improved visibility of all assets at the unit and beyond. The trial also demonstrated that the system was easy to implement and the training requirements were minimal.[51]

This trial was carried out in three phases. Phase 1 was the installation of one stand-alone station in 434 Squadron and one in NDHQ for familiarization purposes. Phase 2 included the installation of a local area network (LAN) at the squadron with twelve stations in key areas. Finally, in phase 3, the Maintenix

[51] Maintenix Report, *Trial Evaluation Report of a Maintenance Management Information System "Maintenix"*, 1 May 1999, E-1.

software was populated with the aircraft blueprints[52] as well as their inspection requirements.[53] Following phase 3 implementation, all key areas of the squadron maintenance organization, as well as the headquarters could access and manipulate data, within their given authority, on all the squadron's aircraft. Maintenix provided capabilities that were well beyond those of ADAM. For example, the Squadron Aircraft Maintenance and Engineering Officer (SAMEO) could easily track fleet status as well as organization and fleet metrics using customisable reports.[54] Even the aircrew on squadron could see a real benefit as they could now easily access, either from the servicing desk or from their own office space, all the maintenance activities that had taken place since the last flight.

As part of the trial, a survey to determine the production time savings was carried out. It was found that considerable time could be saved because the users were provided quick access to the required information and because the need to register part and serial number information when recording maintenance action was eliminated.[55] The survey concluded that an overall saving of 8% of the maintenance time could be accomplished by using Maintenix.[56] This is a significant saving that would by itself

[52] In this context, the aircraft blueprints mean the breakdown of the components that make up the aircraft as well as their relationship with each other. This data is inputted in a relational database management system and used by the Maintenix software.
[53] Maintenix Report, *Trial Evaluation Report of a Maintenance Management Information System "Maintenix"*, 1 May 1999, 3.
[54] Ibid, 7.
[55] Ibid, 9.
[56] Ibid, 10.

pay for the investment of purchasing this program within the first two years of operation.

Maintenix demonstrated some very powerful capabilities in many areas. One of those is human resource management. This functionality of the software "demonstrated that controls could be exercised to ensure only qualified personnel could sign for aircraft work."[57] Other impressive capabilities were in the area of maintenance scheduling management, maintenance task management, parts tracking and serialized item usage, trouble report management and modification and special inspection tracking. The trial proved that Maintenix is "capable of handling all the squadron's day-to-day maintenance activities from aircrew operational requirements through to minor maintenance tasks such as tool control."[58]

Overall, the Maintenix trial at 434 Squadron highlighted some key benefits that can result from the implementation of such a powerful maintenance management information system. The first of these is the increased availability of the weapon systems. Maintenix was especially designed for managing the maintenance of highly mobile and geographically distributed aircraft assets.[59] Unlike other enterprise systems, this design allows for centralized control of the fleet maintenance programme while allowing first line managers to independently execute and track their maintenance tasks. Maintenix provides managers with total

[57] Ibid, 11.
[58] Ibid, 15.
[59] Maintenix White Paper, MxI Technologies, 1997-2001, 29.

asset visibility in a user-friendly graphical interface that makes it easy to manage multiple layers of information. This allows managers to more quickly assess and analyse the status of their fleet as well as to more effectively plan future support requirements resulting in better asset availability.

A second benefit is an improved supply chain management. The data replicating technique used by Maintenix allows for the quick and efficient sharing of all asset information between users at all levels and all support organizations such as third line contractors. Up-to-date information is therefore always available to all the organizations involved in the life cycle support of the assets which enables new levels of efficiency to be attained.[60]

The final key benefit derived from the use of a modern information system is the reduced maintenance costs due to improved parts utilization, more effective human resources management and more complete maintenance rationalization. Using today's current systems, the maintenance programmes are normally grouped in consolidated inspections for administrative and record keeping simplicity. Using a sophisticated system like Maintenix, however, allows for the implementation of 'equalized maintenance programmes'[61] which can result in significant maintenance reduction.

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[60] Ibid, 29.

[61] An equalized maintenance programme involves more frequent and less time-consuming inspections that optimize the individual component requirements to minimize over maintenance. Such programmes are more challenging to manage as they are more dynamic, frequent and shorter. Traditional maintenance management systems cannot effectively manage such complexity.

The proposed solution for the CF, therefore, is to continue with the implementation of MASIS to address the corporate issues dealing with materiel acquisition and support while pursuing the acquisition of a specialized aircraft maintenance management system to deal with the specific management issues of that community. MASIS is an enterprise system and as such, it will link all the agencies providing equipment life cycle support. The complexity of the aircraft maintenance management problem, however, will not be addressed with MASIS. On the other hand, a specialized maintenance management system, such as Maintenix, can be a very powerful tool to improve the effectiveness and efficiency of a maintenance organization as it was demonstrated in the trial at 434 Squadron.

In order to take advantage of the strength of two separate systems, we must also ensure that they can also exchange information. The issue that remains then is to ensure the compatibility of the two systems. Right from its initial conception, Maintenix was designed to run on modern, industry standard computer hardware and software architecture.[62] For example, Maintenix operates on the Oracle Relational Database Management System (RDBMS) which allows the system to be hosted on any network protocol supported by Oracle. Since Oracle is the world leader with over 60% of the total RDBMS market, the more common network protocols are all supported. In addition, Maintenix was designed to be integrated with Enterprise Resource

[62] Maintenix White Paper, MxI Technologies, 1997-2001, 27.

Planning (ERP) systems through the use of standard interfaces and technology.[63]

A modern specialized aircraft maintenance management system such as Maintenix would therefore not only provide an extremely useful tool for the front line maintenance community but it would also provide a powerful tool for exchanging data with an enterprise system to meet the strategic needs of the Department of National Defence. And as discussed earlier, an investment in such a system is certain to pay for itself in a very short time.

Conclusion

The maturing of IT has opened many opportunities to improve efficiencies across a wide spectrum of activities. Implementing the technology by itself however, is not enough to make these activities more efficient. The technology must work hand in hand with the business processes to realize its full potential.

This paper described how IT can best be applied to the problem of aircraft maintenance management in the CF. The aircraft maintenance community brings special management challenges that must be met head on by the implementation of an information system. Trying to implement a system that was designed to address a different environment can lead to major disappointments and setbacks. Much can be learned in that respect from the experiences of large airlines who are

[63] Ibid, 28.

continuously struggling to improve the efficiency of their operations.

Implementing a new information management system is not a trivial task and the track record for the implementation of these in DND is not very good. The goal of the MASIS project is to deliver an integrated system for the cost-effective optimisation of weapon system availability throughout its life cycle. It will likely take a few more years before we see the results of MASIS but if successful, it has the potential to provide a valuable management tool for the most senior managers in DND. It will, however, be of little value for the front line technicians and the middle managers charged with the management of front line activities.

The proposed solution is, therefore, to acquire a currently available commercial off the shelf aircraft maintenance management system. These systems have the potential for the most improvement in efficiency since they provide valuable tools for every single front line technician and their middle managers. As MASIS will provide valuable tools for the senior managers, the two systems can later be integrated to form a seamless network of information through the use of standard communication protocols.

It is a lot to expect that one single system can meet all the requirements of the material acquisition and support environment. It is more reasonable to implement specialized systems that can handle specific problems much better while ensuring that these individual systems will be able to share information where and when required.

Better information management for the CF aircraft maintenance community has the potential to make considerable improvement in the efficiency of maintenance. This will result in higher availability of these critical aerospace resources. In today's tight fiscal environment and scrupulous accountability, the CF cannot afford to wait for the possibility of a large enterprise system such as MASIS to tackle these issues. We must be more proactive and allocate appropriate resources to deal with this critical information management issue.

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