THE EFFECTS OF EMPLOYING HVM ON C-130 AIRCRAFT AT WR-ALC TO AIRCRAFT AVAILABILITY

GRADUATE RESEARCH PROJECT

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Abstract

The objective of this research is to evaluate the impact of increasing the labor burn rate, one of the High Velocity Maintenance (HVM) core tenets, and the transition of isochronal aircraft inspections from the field to the depots under the Single Maintenance Concept. This study focuses on depot maintenance data from WR-ALC for AFSOC C-130 aircraft to evaluate HVM effectiveness to improve the on-time delivery rate and increase aircraft availability rates for commanders in the field. Additionally, this project will discuss commercial industry best practices that best achieve higher labor burn rates and the challenges of implementing these practices into the traditional depot maintenance process.

In order to quantitatively assess the potential effects of HVM on depot production, this project examines WR-ALC C-130 depot maintenance data from July 2007 to May 2011, and interviews WR-ALC depot personnel in the HVM office and 560 AMXS. During the interviews the full catalog of HVM briefings were also reviewed extending to the inception of the HVM's program at WR-ALC. Moreover, this study utilized a field questionnaire to gather the average aircraft down-days in relation to depot-prep, post-depot, isochronal inspections, and home station checks.

With the depot maintenance data and assistance from the WR-ALC and field Subject Matter Experts (SMEs) the labor burn rate tenet and Single Maintenance Concept of HVM are evaluated to assess the effect on reducing C-130 aircraft production flow days, improving on–time aircraft delivery rates, and increasing aircraft availability.

Dedication

To my lovely wife and my wonderful children who have fully endured and supported me throughout my AFIT tour and career

Acknowledgments

I would like to express my sincere appreciation to my research advisor, Dr. William Cunningham, for his guidance and support throughout this research effort and total AFIT experience. I would also like to share my personal thanks with the entire WR-ALC HVM team and field SMEs, specifically Doug Keene, Jerry Mobley, Marty Cain, John Huff, and SMSgt John Bettridge for their professionalism, contagious drive for continuous improvement, educated risk-taking prowess with implementing new initiatives, and hospitality demonstrated during my multiple visits at WR-ALC and during my many personal phone conversations and e-mail transmissions.

I am indebted to numerous AFIT staff, WR-ALC, and field professionals who assisted me in my research, and will use this entire research experience as the foundation for attacking future opportunities that deliver “big” results for our customer…because our main customer, the warfighters, deserve nothing less.

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THE EFFECTS OF EMPLOYING HVM ON C-130 AIRCRAFT AT WR-ALC TO AIRCRAFT AVAILABILITY

1. Introduction

1.1. Background

The Develop and Sustain Warfighting Systems (D&SWS) established goals to increasing aircraft availability by 20 percent with a 10 percent cost decrease by 2011 (Department of the Air Force, 2010). With recent DoD force shaping initiatives, the enduring GWOT commitment, and the termination of several poorly performing programs, the need to modernize and balance USAF capabilities with future requirements has never been greater. Air Force Material Command (AFMC) has committed to extensive depot maintenance changes to meet the DoD objectives. The HVM program is designed to improve aircraft capability rates while meeting the cost reductions goals established under D&SWS. AFMC has initiated the HVM program for the C-130 aircraft at Warner Robins Air Logistics Center (WR-ALC), B-1 aircraft at Oklahoma City Air Logistics Center (OC-ALC), and F-22 aircraft at Ogden Air Logistics Center (OO-ALC).

HVM is an Air Force Smart Operations for the 21st Century (AFSO 21) initiative initiated by WR-ALC during a 2007 strategic planning event with Air Force Special Operations Command (AFSOC). During that event, a diverse team of subject matter experts researched commercial best practices and conducted an enterprise-wide, Value-Stream Map (VSM) of Programmed Depot Maintenance (PDM). This event and VSM not only covered the maintenance process flows but also included maintenance requirements, funding, manpower, supply, tooling, support equipment, engineering, facilities, and information and technology data support. As a result of that event, WR-ALC established a High Performance Team (HPT) with AFSOC as the prime customer to further develop the HVM concept. (Department of the Air Force, 2010).

Since 2007, WR-ALC's HPT reengineered their typical overhaul PDM strategy from extensive overhaul requirements conducted at longer intervals at a low velocity to smaller maintenance requirements or cycles that are conducted more frequently with an increased labor-burn rate (total labor/day) or more velocity. This emulation of commercial best practices of more frequent scheduled maintenance that are conducted at higher velocities could enable the reduction of aircraft maintenance downtime, while simultaneously increase the visibility of aircraft condition for better planning and most importantly, improve aircraft availability.   In other words, rather than schedule a C-130 aircraft down for a 160-day PDM overhaul inspection every 5-6 years, the HVM concept only requires the C-130 aircraft in PDM status for 60 days total during the same period (4 intervals of 15 days each), resulting in less aircraft on the ground; thus increase aircraft availability.

1.2. Problem Statement

Although the validation phase of HVM on the C-130s at WR-ALC has not been fully completed through all four cycles of fuselage, wing empennage, and flight controls; and the HVM concept and tenets are currently being transitioned throughout WR-ALC's 560 AMXS (C-130) and soon 559 AMXS (C-5) squadrons, the effects of employing and measuring the HVM concepts towards achieving on-time scheduled delivery from depot to the field and improving aircraft availability have yet to be thoroughly analyzed.

1.3. Problem Approach

The goal of this research is to study the concept and tenets of HVM and their application to C-130 aircraft depot maintenance operations. This study will cover the HVM validation metrics used by WR-ALC's HVM team to track their adherence to their HVM tenets. Additionally, this study will focus on the effects of labor-burn rate towards on-time aircraft delivery to field, and the effects of employing the "Single Maintenance Concept" of absorbing field-level isochronal (ISO) inspections towards decreasing aircraft maintenance downtime and improving aircraft availability. With the limited availability of data pertaining to fleet scheduling, direct labor, resource constraints, cost systems and access to appropriate data bases such as GO97-Program Depot Maintenance Scheduling System (GO97-PDMSS), Depot Maintenance Accounting and Production System (DMAPS), Role-Oriented Consolidated Information Tool (ROCIT), Logistics Installation Mission Support – Enterprise View (LIMS-EV), Subject Matter Experts (SMEs) at WR-ALC and field will be used.

1.4. Research Scope and Methodology

Since the application of the HVM concept and respective tenets are currently being validated and employed at WR-ALC through the completion of four HVM fuselage cycles on four C-130 aircraft (two C-130H, one MC-130P, and one MC-130W), one PDM-Transition (PDM-T) package on one MC-130P aircraft, and an ongoing HVM PDM on another MC-130P aircraft, the scope of this research will be limited to the PDM aircraft designated to HVM and AFSOC PDM aircraft. Historical data from GO97-PDMSS, covering the period of 23 July 2007 to 1 May 2011, will be used to compute actual labor-burn rate, on-time aircraft delivery rate, and the effects of increasing labor-burn rates from actual burn rates to 300-, 400-, 500-hours burn rate per day respectively.

In order to further assess the HVM burn rate and also “Single Maintenance Concept” effects of depot absorbing field-level ISO inspection requirements to decrease total aircraft maintenance down time and increase aircraft availability, this research will be limited to the various Mission-Design Series (MDS) aircraft assigned to active duty C-130 bases that possess the same MDSs that were inducted into depot as HVM or PDM aircraft. The field data required to evaluate the HVM effects will be gathered from e-mailed questionnaires. The specific questions will include the average number of days the respective bases’ assigned aircraft were held down for PDM preparation, the number of days the aircraft were held down to recover and ready for flight after PDM, days the aircraft were scheduled down to complete an ISO inspection, and days the aircraft were scheduled for HSCs.

The applicable response averages of aircraft down days will be added to the planned average HVM cycle and traditional PDM down days. The total planned aircraft HVM cycle down days per MDS will be compared with the total planned aircraft down days of the traditional PDM schedule per MDS. The main assumptions of this measure are that maintenance would be conducted in an ideal condition with all the required parts, supportability, and labor fully provided, and the schedule occurs as planned. The potential aircraft down days saved per aircraft and aircraft availability per MDS will be a result of this comparison. Therefore, in this comparison, planned and not actual down days will be used.

In summary, with the analysis of the data mentioned above, this research will assess the effects of employing the HVM concept and tenets at PDM towards improving WR-ALC’s C-130 aircraft on-time delivery rate and aircraft availability.

2. Literature Review

2.1. General Maintenance Concepts

Currently, USAF aircraft maintenance is conducted in three various levels: organizational-level (on-equipment maintenance), intermediate-level (off-equipment maintenance), and depot-level. Each distinct level is categorized by the level of maintenance complexity from simple to difficult. Organizational repair is the simplest level which primarily consists of on-equipment minor repair actions, troubleshooting, and simple remove and replace actions. Intermediate repair consists of "backshop" off-equipment repair actions that consist of testing and replacement of component parts. Depot-level repair consists of repair actions that cannot be completed at the Intermediate-level and primarily consists of major overhaul maintenance actions. (Secretary of the Air Force, 1998)

To further categorize the levels of maintenance, organizational and intermediate repair actions focus on aircraft systems maintenance, whereas depot repair actions focus more on the structural and corrosion aspect of maintenance (Booz Allen Hamilton Inc., 2009). In order to successfully employ the concepts of HVM, the traditional practice of separate field and depot maintenance needs to evolve to become more integrated or "enterprised", centered one of the key principles of HVM, "Single Maintenance Concept."

Maintenance could further be categorized in terms of scheduled and unscheduled maintenance. Scheduled maintenance refers primarily to maintenance that occurs in set time-distribution intervals such as in hours or calendar days (i.e. ISO, phased, or HSC inspections, etc.), or can be referred to as "planned" events such as modifications, preventive maintenance actions (i.e. Time Compliance Technical

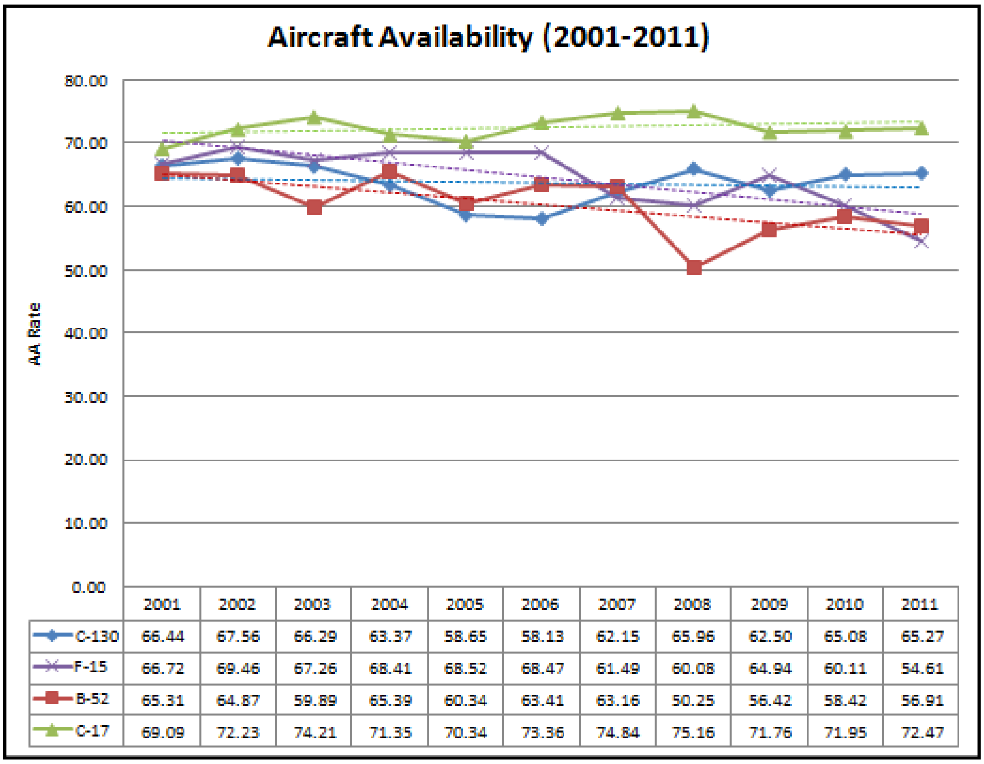
Orders, paint, washes, etc.), or routine servicing and inspections after flights. Unscheduled maintenance, on the other hand, is a result of "unplanned" events that occur, such as aircraft malfunctions, improper flying or maintenance practices, or even weather events such as lightning strikes or severe hail storms. In short, the main difference between scheduled and unscheduled maintenance is that scheduled maintenance can be planned for, whereas unscheduled maintenance cannot. (Mattioda, 2002)

For the purpose of this research, scheduled maintenance in the field and at depot will be analyzed and compared as separate entities as per the traditional maintenance concept and integrated as per the HVM concept to determine if the employment of the HVM concept and tenets will positively affect aircraft availability.

2.2. Burning Platform

One of the major players to drive this new approach of accomplishing depot maintenance is AFSOC. According to Ellen Griffith, AFMC Chief of Operations Division, "since AFSOC assets are a low-density, high-demand fleet, they need every bit of flying time we can give them…we definitely want to reduce the amount of time that we have aircraft like gunships down at depot" (Adams, 2008). In fact, according to Doug Keene, the former HVM Team Lead and current 402nd MXW Deputy Director, "as many as 70 C-130s are on the ground at one time, either in depot or in calendar-based ISO maintenance...HVM promises to reduce the number of aircraft on the ground, giving as many as 55 C-130s back to the operators…that's $1.6 billion in assets" (Adams, 2008).

Furthermore, by looking at the decreasing trend of aircraft availability of the C-130, F-15, and B-52 fleet from 2001 through 2011 (see Figure 1), one can attribute the decrease to numerous factors such as the effects of an “aging fleet”, the increased time aircraft is held down for unscheduled maintenance, or the increased amount of time the aircraft is held down for scheduled maintenance at both the field and at depot.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
C-130	66.44	67.56	66.29	63.37	58.65	58.13	62.15	65.96	62.50	65.08	65.27
F-15	66.72	69.46	67.26	68.41	68.52	68.47	61.49	60.08	64.94	60.11	54.61
B-52	65.31	64.87	59.89	65.39	60.34	63.41	63.16	50.25	56.42	58.42	56.91
C-17	69.09	72.23	74.21	71.35	70.34	73.36	74.84	75.16	71.76	71.95	72.47

Figure 1. Aircraft Availability Rates
(Bettridge, J., personal communication, April 23, 2011)

Currently, the average age of the C-130 fleet is 30 years. According to a RAND Graduate School Study by Matthew Dixon in 2005, the average age of the C-130 fleet was 25 years. Moreover, according to Dixon’s study, approximately 20 percent of the C-130s in 2005 were grounded or restricted to age-related conditions, such as wing cracks. In fact, during Dixon’s research, the C-130 aircraft with more than 45,000 operating hours were grounded, while those with more than 38,000 hours were restricted. Figure 2 illustrates the average age of multiple USAF aircraft in relation to the aircraft’s respective inventory number in 2005. The C-130 fleet’s average age during 2005 was 25 years. Out of 565 C-130s in the total inventory, around 450 aircraft were at the 25 year mark. (Dixon, 2005) In other words, the C-130 aircraft is an "aged" aircraft; and due to its low-density, high-demand profile; and its frequent exposure to various corrosive environments throughout the Areas of Responsibility (AOR), the potential for stress-related cracks or excessive corrosive conditions could cause an increase of unscheduled or scheduled maintenance requirements.

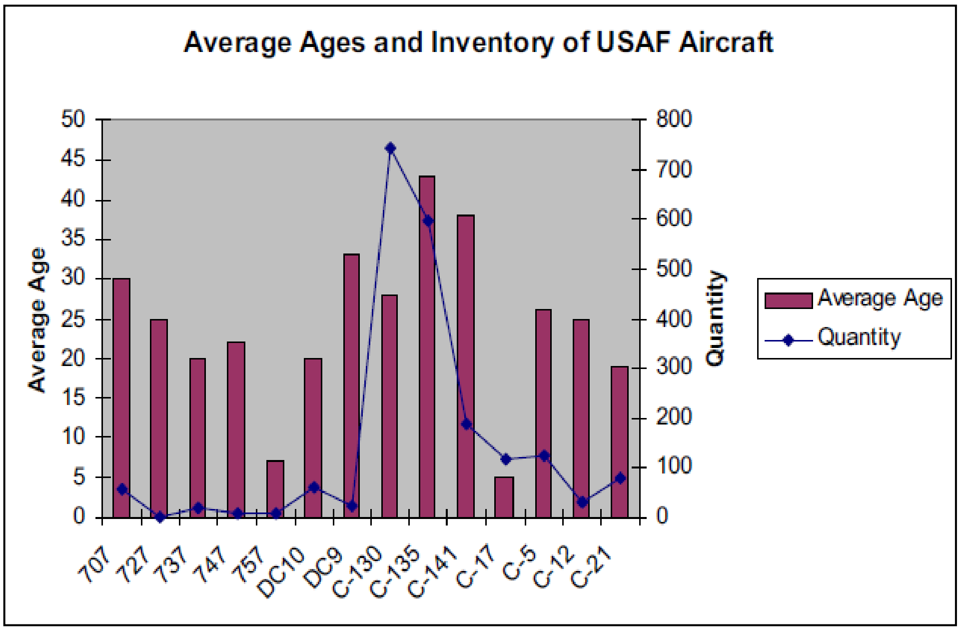
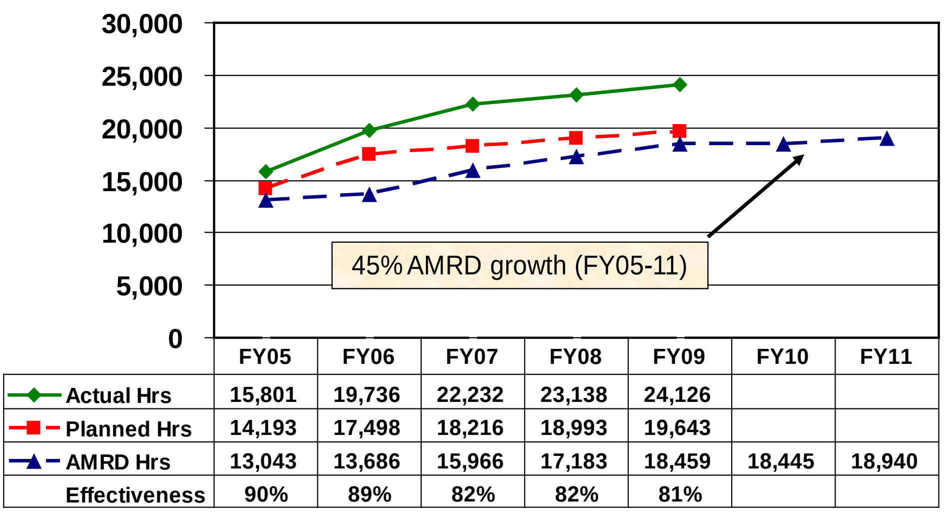


Figure 2. Average Ages and Inventory
of USAF Aircraft (Dixon, 2005)

Based on a C-130 baseline analysis study conducted by Booze Allen Hamilton Incorporated in 2009, one can further look at the effects of the "aging fleet" to increased scheduled or programmed maintenance requirements. In Figure 3, FY05-FY09 Direct Labor Hours Compared to Aircraft and Missiles Requirement Document (AMRD) Growth Rates, the significant point to highlight is the drastic increase in AMRD hours from FY05 to FY11. During that six year time span, the AMRD or programmed hours increased 45 percent from 13,043 to 18,940 hours. The increase in programmed hours was primarily due to foam replacement and fuel system maintenance, and center- and outer-wing inspections and maintenance. In short, these added programmed maintenance requirements were due to the aging factor effects of the C-130 aircraft. Another important factor to recognize in Figure 3 is the increasing gap between the planned and actual maintenance hours during FY05 through FY09. The gap represents the average unplanned maintenance hours or unpredictable requirements that occurred during that specific timeframe. (Booz Allen Hamilton Inc., 2009)



	FY05	FY06	FY07	FY08	FY09	FY10	FY11
Actual Hrs	**15,801**	**19,736**	**22,232**	**23,138**	**24,126**		
Planned Hrs	**14,193**	**17,498**	**18,216**	**18,993**	**19,643**		
AMRD Hrs	**13,043**	**13,686**	**15,966**	**17,183**	**18,459**	**18,445**	**18,940**
Effectiveness	**90%**	**89%**	**82%**	**82%**	**81%**		

Data Set	FY05	FY06	FY07	FY08	FY09
78-82	1	0	2	2	1
83+	14	9	15	6	6
Total	15	9	17	8	7

Figure 3. Direct Labor Hours Compared to AMRD Growth Rates (Booz Allen Hamilton Inc., 2009)

According to AFMCI 21-133, Depot Maintenance Management for Aircraft Repair (2005), the unplanned or unpredictable hours are a result of discrepancies that were identified during aircraft records review conducted during Pre-Induction conference, during Pre-Dock or In-Dock Inspections, or during Post-Dock activities such as at functional test or during functional check flight. Moreover, unpredictable requirements can further be broken down into two categories: work specification-related (project) unpredictables or Over & Above (O&A) (non-work specification/non-project-related) unpredictables. (Air Force Material Command, 2005)

Work specification or project unpredictables are maintenance requirements that are defined and are within depot work specifications; thus, money and hours are pre-allocated and available to assign if the requirement is identified as either a discrepancy or as a “safety of flight” issue during depot maintenance. If identified as a “safety of flight” condition, the Project Administration Officer (PAO) will load the pre-allocated funds into the depot work package. If the pre-allocated funds are exceeded or if the discrepancy is not a “safety of flight” condition, the PAO will contact the customer to discuss the discrepancy details and the additional required cost and time added to the scheduled production date. (Air Force Material Command, 2005)

O&A unpredictables are requirements that are not related to any current work specifications, but should be completed at the depot due to safety or for economic reasons. Unlike the work-specification unpredictable requirement, O&A unpredictables are not funded and require both PAO and customer approval. (Air Force Material Command, 2005)

Furthermore, unpredictables can further be categorized as planned or unplanned. Planned unpredictables can be categorized as high-frequency (more than 20 percent occurrence) that are fully planned or low-frequency (less than 20 percent) that are only planned when work is critical or complex, whereas a low-frequency unplanned unpredictable fall within work specification scope but occurs less than 20 percent of time. (Air Force Material Command, 2005) According to the Fiscal Year 2010 Maintenance Requirements Review Board Brochure (2008), some unpredictable hours are already planned in PDM maintenance requirements. For example, for an

AC-130U in 2010, of the total depot-level maintenance planned hours of 25,111.67 hours, O&A planned hours account for 1,605.20 hours (Warner Robins-ALC, 2008).

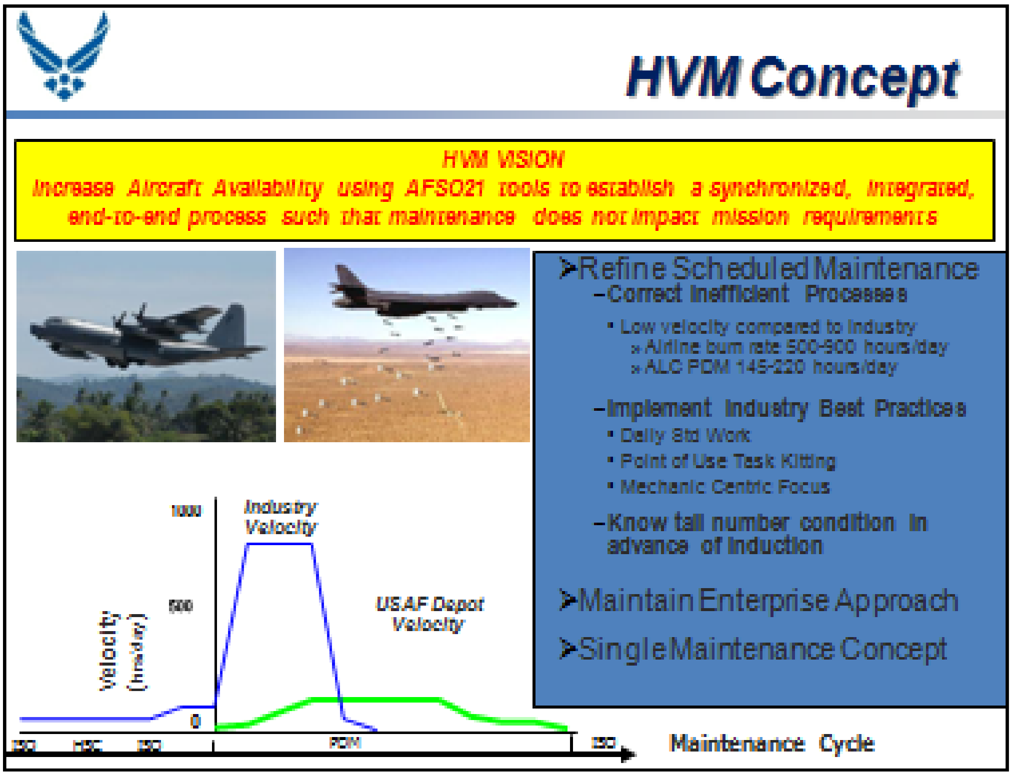
In Figure 3, the gap between FY05's actual and planned hours when compared to FY09's gap increased from 11 percent to 23 percent. This disparity of hours between actual and planned hours represents the number of unplanned maintenance requirements that were identified after induction; in turn, further highlights the need for depot to improve aircraft condition knowledge. This improved knowledge could lead to the earlier establishment of a work plan and grant the necessary lead time to acquire all parts and resources prior to aircraft induction. In short, improved aircraft condition knowledge enables the total supportability required to keep the mechanic on the aircraft and increase labor-burn rate. Increased labor-burn rate in essence is the primary measure of HVM (Canaday, 2011).

One important note here is that HVM is not all about maintenance. It is about the total lifecycle management of a platform that could eventually impact the acquisition strategy of purchasing less aircraft due to having fewer aircraft down for maintenance (Adams, 2008). In a Question & Answer article with Lt Gen Wolfenbarger, AFMC Vice Commander, she commented that HVM is not just about product flow but also includes funding, requirements, infrastructure, and materiel support and information technology. She further said "Our objectives include increasing system availability to the field; reducing the number of needed assets; increasing depot capacity for dealing with unscheduled repairs and modifications; and ultimately reducing costs to the Air Force…while still early in implementation, the initiative has and will continue to provide the warfighters increased aircraft availability." (McKaughan, 2010) In other words, HVM is not just about maintenance, but is a philosophy and process geared towards achieving high labor-burn rates.

Therefore, in order to “blueprint” the lessons learned in WR-ALC’s validation or trial phase of employing the HVM concept and tenets Air Logistics Center-wide and perhaps the entire DoD, the following section will elaborate on the commercial best practices that were identified and used towards formulating WR-ALC’s HVM concept. The following section will also elaborate on the traditional PDM challenges associated to emulating the commercial best practices of achieving high labor-burn rates, will define the HVM tenets, and further describe the validation metrics used to establish the much-needed traction of reengineering the whole PDM process.

2.3. Commercial Benchmarking and Traditional PDM Challenges

According to Jerry Mobley, the HVM team in 2007 initiated the study and industrial analysis of the Maintenance, Repair, and Overhaul (MRO) processes of numerous commercial companies such as American Airlines, TIMCO, the Royal Canadian Air Force, and Hon Furniture to determine how and why the touch-labor burn rates of the commercial industry were four to ten time higher than the normal labor burn rates of WR-ALC’s aircraft depot lines, specifically the C-130 PDM line. (WR-ALC HVM Office (b), 2010) In fact, according to Doug Keene, HVM architect, the high-level of commercial MRO burn rate enabled the airlines to achieve aircraft availability rates well above 90 percent, whereas the USAF maintains an average aircraft availability rate of only 60 percent (Badiru, A. & Thomas,M., 2009). As a result of the HVM Team’s study of commercial industry’s burn rates, several commercial industry best practices that could be benchmarked by depot were identified. (Warner Robins-ALC/ HVM Team, 2011) Figure 4 identifies the commercial industry's best practices used to achieve high labor burn rates.



HVM Concept

HVM VISION

Increase Aircraft Availability using AFSO21 tools to establish a synchronized, integrated, end-to-end process such that maintenance does not impact mission requirements

- Refine Scheduled Maintenance
  - Correct Inefficient Processes
    - Low velocity compared to industry
      - Airline burn rate 500-900 hours/day
      - ALC PDM 145-220 hours/day
  - Implement Industry Best Practices
    - Daily Std Work
    - Point of Use Task Kitting
    - Mechanic Centric Focus
  - Know tail number condition in advance of induction
- Maintain Enterprise Approach
- Single Maintenance Concept

Figure 4. Commercial Industry's Best Practices
(Warner Robins-ALC/ HVM Team, 2011)

The first critical factor identified by the HVM team to benchmark was commercial industry's methodology of establishing accurate work requirements or daily standard work. According to HVM team's research, with the commercial industry's work requirements accurately defined daily, coupled with a strict adherence to a production schedule, their average burn rates of 500 to 900 hours per day was achievable and were also paramount to their production success. In terms of depot emulating commercial industry's methodology of developing more standard work requirements to control variability of repair processes and increase burn rate, the HVM team identified WR-ALC's current inability to quickly and accurately determine the aircraft's condition prior to PDM input. This inability significantly impedes the immediate and accurate development of work requirements and procurement of required material; thus, the average C-130 aircraft burn rate for depot is 145 to 220 hours per day. According to Jerry Mobley, although the burn rate is incrementally improving, the depot is aiming for 500 hours of labor-burn rate per day. (Canaday, Faster Maintenance Through HVM, 2011)

Currently, as per traditional depot procedures, only after the aircraft arrives at depot and the Evaluation and Inspection (E&I) phase is complete can depot establish the tailored work requirement plan and source required materials for that specific aircraft. According to Brian Keeling, “master sensei” for the HVM Team, even after 60 days that a C-130 arrives at depot, the E&I phase on some aircraft is still being accomplished. This inability to complete the E&I phase immediately after aircraft arrival directly impacts depot’s on-schedule production capability, ultimately affecting the on-time delivery of aircraft to the customer. In fact, per traditional depot procedures, only after the aircraft’s E&I phase is complete, can depot identify the aircraft’s repair requirements and order the materials needed to repair aircraft. Therefore, this delay in gaining knowledge of the aircraft’s condition can lead the mechanics to be underemployed waiting for materials to arrive prior to performing work. (Adams, 2008) In terms of the HVM concept, mechanics waiting equates to zero labor-burn hours.

Furthermore, because of the current alignment of Program Office engineers in the 330th Aircraft Sustainment Wing and the depot planners and maintainers in the 402nd Maintenance Wing, there is little feedback pertaining to the content and validity of the Work Control Documents (WCDs) or 173 cards maintained in the 402nd Maintenance Wing. Due to this separation of functional expertise between the Program Office engineers and the maintenance planners and maintainers, any modification to the maintenance requirements are often made with insufficient data, made with the non-participation of the appropriate SMEs, or made to solve an immediate problem without any knowledge if the long-term scheduled modifications included repair for those problems. (Warner Robins-ALC/ HVM Team, 2011) In other words, without the full knowledge of the overall maintenance requirements and schedule, immediate repair could be unnecessarily implemented and even duplicate scheduled maintenance tasks.

The second commercial best practice identified during study that PDM could benchmark was the “mechanic-centric” focus of commercial industry. This mechanic-centric methodology enables the mechanics to stay on standardized tasks while the required parts, tools, and equipment are either pre-positioned or brought to the mechanic. Moreover, to further enable this mechanic-centric focus, the commercial industry utilizes highly-ordered process steps that were reproducible as standard work, such that variations in work processes were minimized. This industry drive for standard work became further enabled by the development and usage of task kits and/or Point of Use (POU) kits. When compared with traditional depot processes, depot operates in a “job shop” environment wherein the mechanic is responsible for acquiring the parts and equipment to accomplish their scheduled tasks. In other words, while the mechanic is pulled away from the aircraft to scrounge for required parts, support equipment, tools, and other maintenance support, the opportunity to remain on scheduled task and improve touch-labor burn rate is lost. (Creel, 2010) Again, this leads to a low burn rate when compared to commercial industry.

The third factor identified from study was commercial industry’s “enterprise approach” to operations. This enterprise approach is accomplished through the usage of an integrated information system. This integrated information system capability enables the synchronized planning, scheduling, data collection, and analysis required to implement a highly choreographed execution of maintenance tasks. The current Air Force information systems used at depot and field does not enable the real-time, integrated visibility to proactively plan and schedule maintenance requirements. Although Expeditionary Combat Support System (ECSS) is designed to eventually integrate the current legacy systems into an overall full Enterprise Resource Planning (ERP) system similar to that of the commercial industry, the current legacy PDM- and field-level systems do not enable this “enterprised” real-time visibility of knowing the aircraft condition or other fleet scheduling requirements prior to PDM input. (Warner Robins-ALC/ HVM Team, 2011) This delay in receiving required information to immediately create a more integrated, planned approach to synchronize depot and field-level maintenance requirements minimizes the opportunity to fully optimize scheduled aircraft downtime. According to Marty Cain, HVM Office Information Technology Lead, there are at least 17 different information systems or databases that the HVM Office uses to track the cost, scheduling, and performance of PDM operations (Cain, 2011). See Appendix A for list and description of depot information systems used for PDM operations.

As a result of the aforementioned commercial best practices identified by industrial study and analysis to increase burn rate and affect aircraft availability, the HVM team further identified the need to transition the traditional maintenance concept of “segregated” field and depot-level maintenance to a “Single Maintenance Concept” approach. Thus, the new month 18-month HVM cycle was developed to prevent duplication of work requirements, decrease the amount of aircraft in field held down for scheduled maintenance, optimize aircraft downtime while at depot, and increase aircraft availability. (Warner Robins-ALC/ HVM Team, 2011)

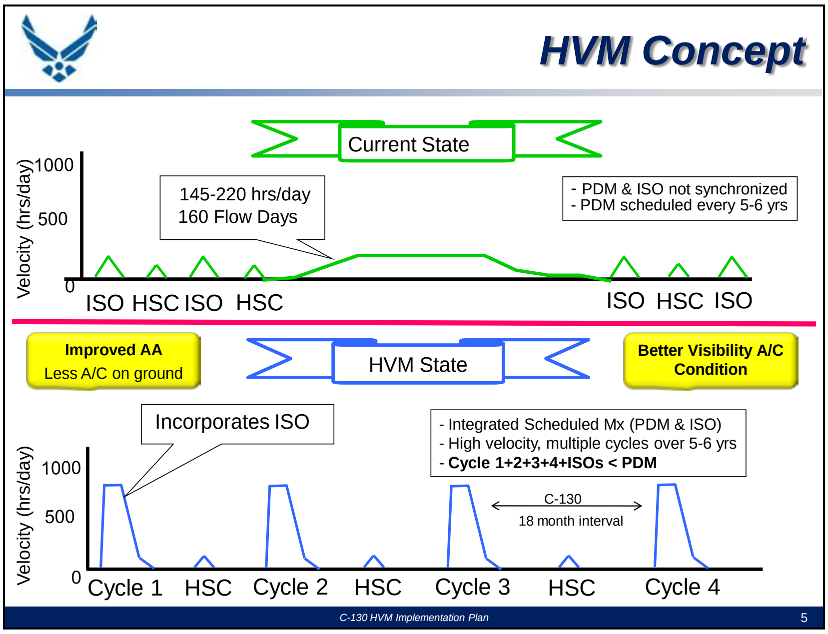
In this "Single Maintenance Concept" approach, the HVM team included the field ISO requirement work packages into their current HVM cycle work requirements. According to Jerry Mobley, this field ISO requirement added to the current HVM cycle requirements does not add any additional hours to the PDM workload, prevents the duplication of unnecessary maintenance requirements, and ultimately could increase aircraft availability; that is if, depot produces the HVM cycle aircraft as scheduled. (Mobley, personal communication, March 25, 2011)

2.4. HVM Concept

The HVM concept is a philosophy or process that evolved from the private-industry practice of accomplishing high touch-labor burn rate. Through a study conducted by the HVM team with the assistance of Georgia Institute of Technology and University of Tennessee, the previously mentioned commercial best practices were analyzed and compared with the traditional C-130 aircraft PDM process. After a gap analysis of PDM current state to future state was conducted, the need to reduce the variability in the overall PDM process was highlighted. From the variability analysis, the traditional PDM practice of conducting an average 26,000-hour PDM overhaul of C-130 aircraft every 5 to 6 years impacted the on-time delivery rate of the aircraft due to the long intervals between depot visits where depot fully analyzes aircraft condition. As a result, the four HVM cycles conducted in shorter intervals of 18 months were established. According to the variability analysis conducted, the four smaller cycle packages were believed to increase the probability of improved on-time production of the C-130 aircraft. (Department of the Air Force, 2010) According to the GO97-PDMSS data pull, covering the production of 151 C-130 aircraft during the period of July 2007 to May 2011, the on-time delivery rate of C-130 aircraft is 18 percent (Cain M. , personal communication, May 6, 2011).

Another factor to consider that counters the traditional PDM process of lengthy PDM aircraft down day average of 205 days is the “must fix now mentality”. This mentality of “must fix now” versus the flexibility of deferring maintenance requirements until next PDM is a function of the longer traditional PDM intervals of 5 to 6 years versus the HVM shorter intervals of 18 months. As a result of this “must fix now mentality,” the tendency to add unpredictable work requirements to the traditional PDM package exists and could negatively affect the on-time delivery rate of aircraft to customer. (Adams, 2008) If the requirements were known due to improved aircraft condition knowledge, these unplanned requirements could be planned and inputted into the Aircraft Missiles Requirements Document (AMRD) schedule prior to aircraft induction.

Figure 5 contrasts the traditional C-130 aircraft PDM process to the future state C-130 aircraft process when the HVM concept of cycle maintenance and the HVM tenets are employed. Under the HVM concept, C-130 aircraft is inducted into PDM more frequently for shorter durations. If the C-130 aircraft were to be produced on-schedule as per the HVM cycle approach, the C-130 aircraft would accumulate less aircraft down time, when compared to the traditional PDM process.



HVM Concept

Current State

145-220 hrs/day
160 Flow Days

- PDM & ISO not synchronized
- PDM scheduled every 5-6 yrs

Improved AA
Less A/C on ground

HVM State

Better Visibility A/C Condition

Incorporates ISO

- Integrated Scheduled Mx (PDM & ISO)
- High velocity, multiple cycles over 5-6 yrs
- **Cycle 1+2+3+4+ISOs < PDM**

C-130
18 month interval

C-130 HVM Implementation Plan 5

Figure 5. HVM Concept (Warner Robins-ALC/ HVM Team, 2011)

In terms of burn rate, WR-ALC currently maintains an average burn rate on C-130 aircraft of 145-220 hours per day, whereas the private industry burn-rate average is between 500-900 hours. If WR-ALC's C-130 aircraft burn rates were to increase comparable to industry per HVM implementation, the resulting increase in C-130 aircraft availability could further equate to 14 percent. (WR-ALC HVM Office (a), 2010) According to Jerry Mobley, the HVM Team Lead, the depot is aiming for a labor-burn rate of 500 hours per day (Canaday, 2011).

Another significant initiative WR-ALC HVM Team initiated towards increasing aircraft availability is the commercial best practice of synchronizing field and depot maintenance. By synchronizing field and depot maintenance into a "Single Maintenance Concept," such as by absorbing field ISO requirements and conducting Pre-Induction Inspections (PII) during field-scheduled C-130 HSCs, optimizes aircraft downtime and enables a better knowledge of aircraft condition. This increased understanding of aircraft condition prior to PDM induction will allow the appropriate lead time to thoroughly plan and acquire necessary parts, engineering repair dispositions, personnel, and equipment to better synchronize maintenance and enable the mechanic-centric focus of keeping the mechanic on the aircraft for increased labor burn rate. Additionally, this HVM concept will enable the improved analysis of aircraft condition to meet established goals of on-time delivery and increased aircraft availability. (Adams, 2008)

Although this WR-ALC HVM initiative primarily focuses on the C-130 aircraft, this commercially-derived concept, and the processes and capabilities developed and validated therein could further be scalable and transportable to other weapon platforms. According to WR-ALC HVM office, future improvements will encompass the methodology of condition-based maintenance, reliability-centered maintenance and other AFSO21 tools to eventually achieve the capability to further ascertain and predict aircraft condition prior to aircraft disassembly and/or input into PDM. In turn, this overall strategy of employing the HVM concept along with the other AFSO21 tools could eventually result in the overall reduction in total maintenance workload and aircraft downtime, decrease maintenance costs, and also increase aircraft availability. According to Jerry Mobley, in order for the field to fully trust depot, embrace this concept, and allow their aircraft to be held down for maintenance at WR-ALC four times more than is currently required as per traditional PDM schedule, on-time delivery of all C-130 aircraft from PDM to the field is necessary; whether aircraft was scheduled for a PDM, HVM, Unscheduled Depot Level Maintenance (UDLM), or modification. (Mobley, personal communication, March 25, 2011)

2.5. Primary Tenets of HVM

The following paragraphs will elaborate on the HVM tenets and the validation metrics used by the HVM Office to track their progress towards employing the HVM concept and tenets throughout WR-ALC. Figure 6 illustrates the primary tenets of HVM.

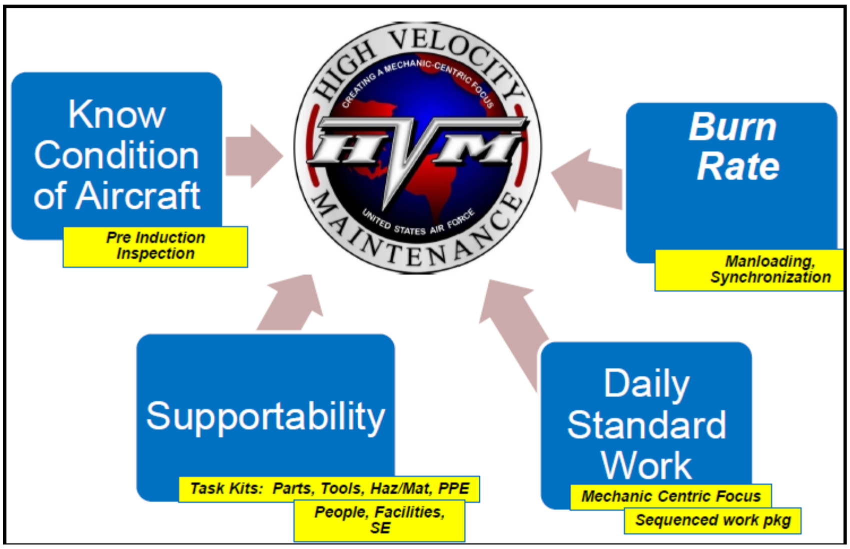


Figure 6. Primary Tenets of HVM (Fraley, 2010)

2.5.1. Knowing Condition of Aircraft

The first HVM tenet involves “knowing condition of aircraft.” This tenet is accomplished by using an enterprise-wide, integrated approach to gather and analyze aircraft maintenance data/information to better ascertain the condition of the aircraft prior to depot induction. By knowing the aircraft condition prior to induction, planning maintenance requirements and ensuring total supportability by acquiring the necessary parts, equipment, engineering repair dispositions, deferring non-safety of flight repairs will further enable the mechanic-centric focus of HVM; in turn, eliminate non-productive time at depot. (WR-ALC HVM Office (b), 2010)

Furthermore, by implementing more aircraft inspections at depot every 18 months through smaller cycle maintenance packages of average 6,000 to 12,000 programmed hours (WR-ALC HVM Office, 2011) versus the traditional PDM requirement of 5 to 6 years of average 26,000 programmed hours, increased knowledge of aircraft condition will be achieved and prevent unnecessary downtime due to major grounding conditions that could have been preventable and mitigated through proper and early engineering assessments. (Warner Robins-ALC/ HVM Team, 2011) A good example of this need to move to more frequent depot inspections was during the 2009 visit of Ms Debra Tune, Principal Deputy Assistant Secretary of the Air Force for Installations, Environment and Logistics, to WR-ALC. During her visit, she commented on the reason a C-5B aircraft that was initially programmed to 50,000 hours of work resulted into 70,000 hours as “because the depot hadn’t seen that airplane in six years.” She further said “you want to continuously look at that airplane…you want that engineering assessment…you want feedback from the field as to what’s happening in it, and look at it and catch it before it becomes a big difficult problem…before it becomes a grounding situation.” (Scully, 2009) To proactively improve the knowledge of aircraft condition prior to induction, the HVM team proactively established a Predictability Analysis Process in 2010 (Mobley, 2010).

2.5.1.1. Predictability Analysis Process

In accordance with the HVM tenet of increasing knowledge of aircraft condition prior to aircraft induction, WR-ALC HVM Team initiated an Expected Management Agreement with 402th MXW, 330th ASW, AMC/A4M, and AFSOC/A4M. This agreement enables the thorough predictive analysis for aircraft condition to occur. This Predictive Analysis Process (PAP), as stated in the agreement is a critical component of HVM philosophy since the current depot processes of assessing an aircraft's condition and preplanning prior to aircraft induction is inadequate; thus, this overall PAP process involves two steps: 1) Conduct thorough aircraft historical maintenance records review, and 2) Conduct Pre-Induction Inspection (PII) four to seven months prior to aircraft's depot induction date during aircraft's scheduled HSC. (Mobley, 2010)

The thorough maintenance review step involves reviewing both scheduled and unscheduled maintenance actions captured in various maintenance data collection systems such as Core Automated Maintenance System (CAMS), G081 (CAMS for Mobility), and Reliability and Maintainability Information System (REMIS); in applicable aircraft Air Force Technical Order (AFTO) forms such as AFTO Form 781A (Maintenance Discrepancy or Work Document), AFTO Form 781K (Aerospace Vehicle Inspection, Engine Data, Calendar Inspection and Delayed Discrepancy Document), AFTO Form 103 (Aerospace Vehicle/Missile Condition Code) (TO 00-20-1); or in depot/technical assistance requests such as AF Forms 107s or 202s (TO 00-25-107); etc. (Mobley, 2010)

The PII step involves conducting a thorough aircraft inspection led by a government-service HVM team member. The HVM PII team will consist of five government-service or contract personnel who are experienced and trained in maintenance and supply systems management, statistical process control, job data documentation, and aircraft repair. This team will also include an Operational Safety, Suitability, and Effectiveness (OSS&E) engineering representative who will be capable to immediately evaluate and resolve any safety or non-safety of flight discrepancies identified during PII. Rather than the typical wait four calendar days for an engineer response to a routine engineering repair request due to established response guidelines per TO 00-25-107 (2008), the engineer on-site will be capable to make or coordinate immediate repair dispositions; in turn, avoid unnecessary aircraft downtime (Secretary of the Air Force, 2008). Moreover, this engineer will be capable of deferring non-safety of flight maintenance actions until scheduled aircraft's depot input date. According to this agreement, field representatives such as squadron Plans and Scheduling (P&S), Non-Destructive Inspection (NDI), and QA personnel will be provided to assist in the PII. (Mobley, 2010)

Additionally, the inspection checklist currently developed by the HVM team incorporates usage of borescopes to conduct non-intrusive inspections behind panels, floor boards, or in other corrosive-prone areas. According to Doug Keene, borescopes previously were used primarily to inspect deep inside engines. With the validation of the HVM concept at WR-ALC, the engineers developed and implemented new procedures with old equipment to conduct look-ahead inspections in areas that will be inspected during aircraft's next inspection cycle at depot. (Rector, 2009) For example, when an aircraft undergoes its HVM fuselage inspection, a borescope can be used to non-intrusively inspect the wings of the aircraft to prepare for its next HVM wing inspection.

The borescope procedure is currently used during the PIIs to catch discrepancies early and further gain better knowledge of the aircraft condition. This inspection is currently being finalized and will eventually be published as an official Air Force Technical Order. Again, to optimize aircraft downtime, this PII will be conducted during scheduled HSCs. A HSC is conducted 270 calendar days or 9 months prior to a 540 day or 18-month ISOs (Secretary of the Air Force (b), 2010), and is typically scheduled for five days. The PII to be conducted concurrently with the HSC normally lasts 3 to 5 days. (Mobley, 2010)

The intent of this PAP is to determine the aircraft's condition, such that the required parts, unscheduled maintenance repair requirements, and engineering repair dispositions can be identified and pre-ordered, pre-planned, or both safety or non-safety of flight discrepancies temporarily repaired and deferred until the aircraft's depot input date. After the aircraft undergoes its first HVM cycle, this PII requirement will be included in the aircraft's subsequent E&I phase to again conduct a look-ahead, pre-plan, pre-order, or defer maintenance action until its next HVM cycle. This PII is part of the PAP of HVM that enables increased predictability of aircraft condition, and is a critical component of the HVM tenet of "knowing aircraft condition" (Mobley, 2010).

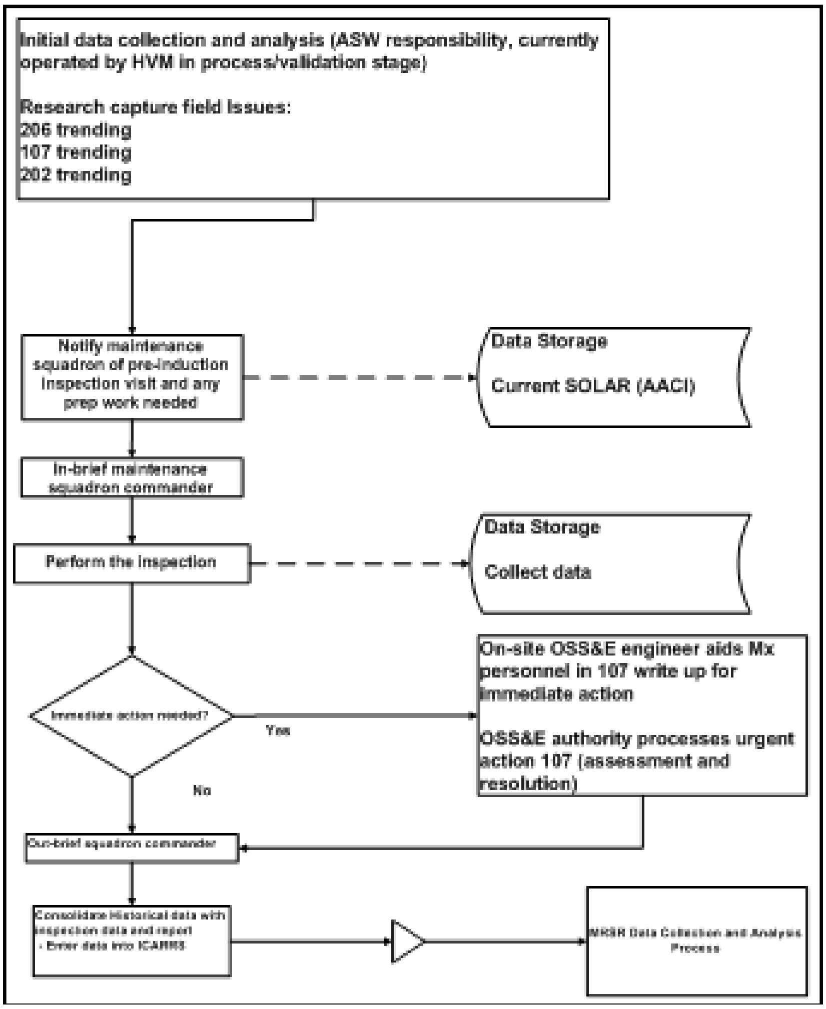


Figure 7. Predictability Analysis Process (Mobley, 2010)

2.5.1.2. Pre-Induction Inspection Metrics

Figure 7 illustrates the number of discrepancies identified during PII that are planned into the aircraft's next HVM cycle. Although the PII metrics identifies the number of discrepancies found during PII, it does not directly show its relation to the overarching objective of on-time scheduled delivery per aircraft. However, with the increased knowledge of aircraft condition, the discrepancies planned, and the required materials sourced prior to aircraft induction, the planned discrepancies could affect the supportability of the mechanic and enable an increased labor-burn rate, thus impact the on-time production or delivery of aircraft.

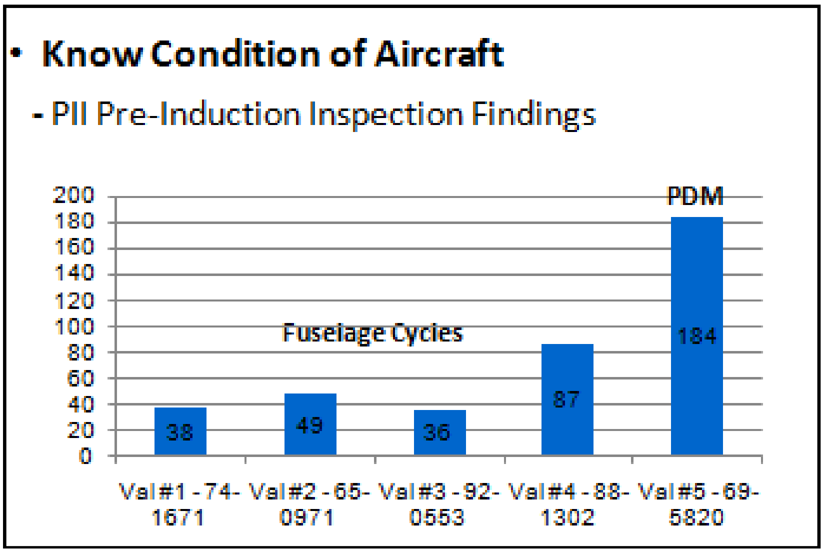


Figure 8. Condition of Aircraft Metric
(WR-ALC HVM Office (c), 2010)

2.5.2 Daily Standard Work

The second HVM tenet involves enabling the mechanic to perform "daily standard work." This tenet is achieved by developing and providing the mechanic step-by-step visual workcards rather than traditional depot 173 workcards that lists only tasks, requiring the mechanic to pull and reference applicable task workcards or applicable technical orders to accomplish task assigned. Through use of these newly developed step-by-step visual workcards, the mechanics can remain on task to perform all maintenance actions and reduce variations in task accomplishment by using standardized visual instructions, such that the task is accomplished the same time, every time.

Figure 9 illustrates the new visual workcards that were developed from the previous 173 work control documents. These new visual workcards are currently being used in the C-130 HVM Dock and are being developed for use throughout the 560th AMXS. In terms of the validation metrics used to ensure the traction of this tenet, this “Daily Standard Work” metric is rolled into the validation metrics for Maintenance Requirements Supportability Process (MRSP).

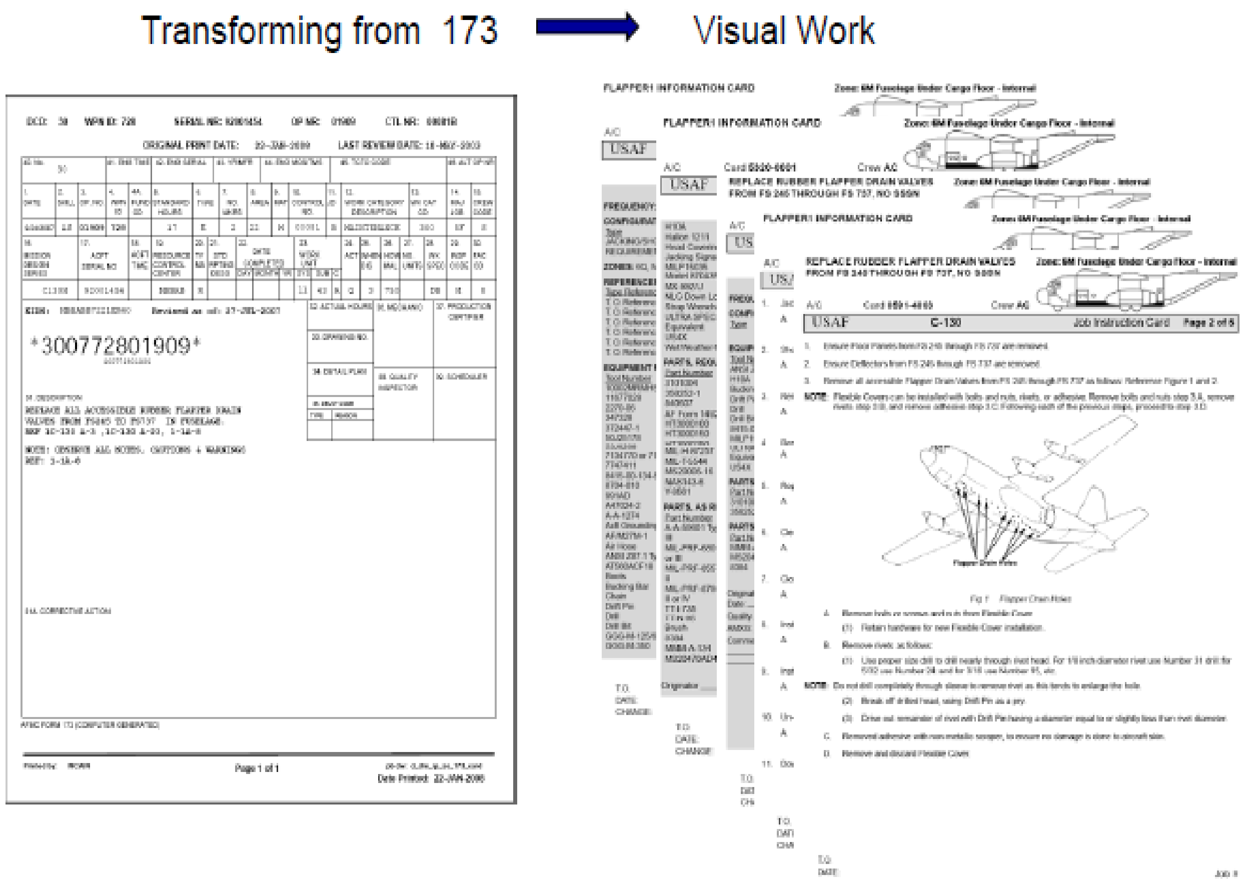


Figure 9. Visual Workcards (Fraley, 2010)

2.5.3. Maintenance Requirements Supportability Process

The third HVM tenet, MRSP, is a collaborative team approach between the 330th ASW C-130 System Program Office (SPO), 402 MXW, Defense Logistics Agency (DLA), and Global Logistics Support Center (GLSC) that enables the mechanic to achieve high touch-labor burn rates. MRSP is the total process that encompasses receiving and analyzing aircraft maintenance data, evaluating supply drivers, and formulating engineering repair procedures to generate tail-number specific work requirements, and further synchronizes maintenance tasks or Bill of Work (BOW) with the material required or Bill of Material (BOM) to accomplish each task. (WR-ALC HVM Office (c), 2010) Figure 7 illustrates how the four HVM tenets are interrelated with MRSP as the center tenet.

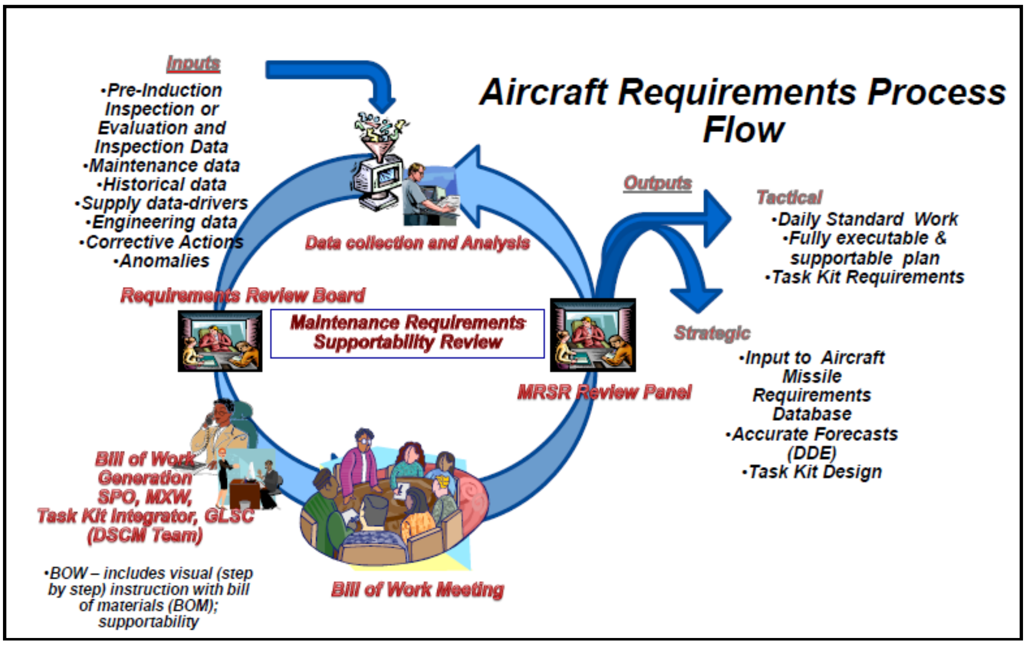


Figure 10. HVM Tenets Centered on MRSP (Fraley, 2010)

The BOM consists of everything required for the mechanic to accomplish tasks such as parts, tools, applicable technical data, applicable Personal Protective Equipment, required hazardous material, etc. Additionally, this process pushes the development and usage of task kitting with point-of-use (POU) delivery prior to every mechanics' shift. (Derco Aerospace Incorporated, 2010)

The building of task kits start with the MRSR (Maintenance Requirements Supportability Review (MRSR) Panel. This Panel is comprised of Maintenance, Logistics, and Supply representatives who forecasts the material required for maintenance. After the MRSR Panel and Aircraft Maintenance Team (AMT) approves the BOM and BOW, the BOM and BOW along with the daily work sequence that is established by the AMT are sent to the Derco Aerospace Task Kit Integrator to further design and build the task kits required for each shift. The Task Kit Integrator interfaces with the 330th ASW engineers, 402nd MXW maintainers, DLA, and GLSC representatives. The Integrator is the single point of supply for the HVM dock that is responsible for all serviceable and unserviceable material that enters and/or leaves the dock. If the parts required for task is not procurable due to excessive lead time requirements or are not available, the MRSR Team will re-plan the operation and/or research temporary repair requirements. (Derco Aerospace Incorporated, 2010)

According to J.J. Arnold, Logistics Sales Manager of Derco Aerospace who is subcontracted under M1 Support Services and provides integration support for WR-ALC's HVM Team mentioned that in addition to the designing and the building of the task kits and ensuring full supply chain support in the HVM dock, the Derco Integration team provides an Andon audio-visual system to notify management of quality or process issues. (Canaday, 2010) The M1 team members include the Project Director, kitting Project Supervisor, Technical Writer, Quality Assurance Analyst, and numerous Material Coordinators. The Derco Team Members include the

C-130 HVM Project Manager, C-130 HVM Subject Matter Expert, and numerous Supply Chain Analysts. (Hughes, P., personal communication, April 29, 2011)

This Andon system or status display system is positioned in numerous locations throughout the hangar and is used by the mechanics when tools or materials are not provided by the task kit or if a problem occurs in the process (see Figure 11). When the Andon light system is triggered, a signal is sent to the receiver mounted in the AMT section. At that time, an interrogator sends a runner to evaluate the needs of the mechanic who triggered the light, then coordinates the required material or support to ensure the mechanic remains on task and the issues are fully resolved. (Canaday, 2010) Additionally, the Andon system tracks the mechanics' material/support requests and the response time that the mechanics' requests were met. The Andon information tracked is further analyzed to provide improved mechanic support and POU task kits (Derco Aerospace Incorporated, 2010).

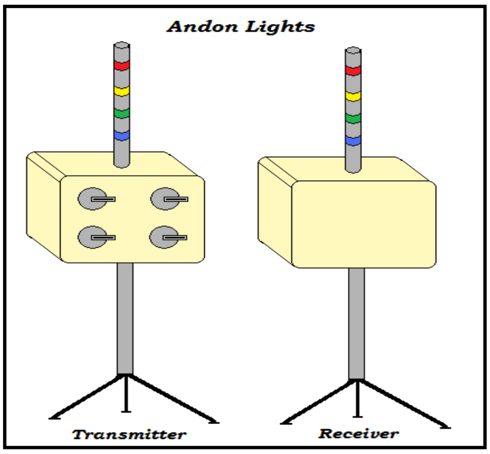
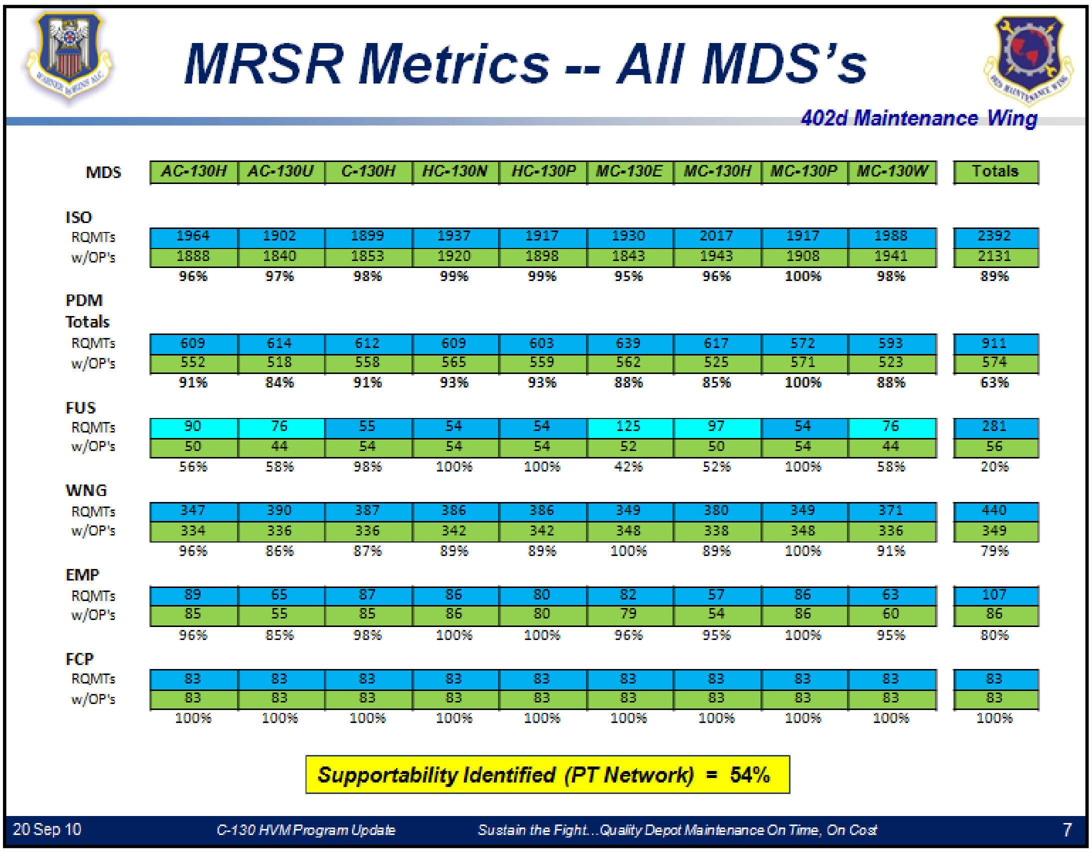


Figure 11. Andon Light System
(Derco Aerosapce Incorporated, 2009)

2.5.3.1. MRSP Validation Metrics

Figure 12 illustrates the number of planned MDS requirements per the approved cycle requirements and identifies the status of the planned maintenance operations and visual workcards (BOW) and material (BOM) that are established and ready to be sent to the Derco Aerospace Task Kit Integrator for POU kit build. The building of the POU kit occurs after the MRSR Team and AMT approves the BOW, BOM and daily work sequence. (Derco Aerospace Incorporated, 2010)

The MRSP validation metric shows the supportability aspect of providing the mechanic all the support requirements such as standard work through visual workcards, choreographed tasks, and required material through POU kits to ensure the mechanic stays on aircraft and executes a high labor-burn rate. In relation to the overarching objective of on-time production and delivery of aircraft, the MRSP metric is moderately related to the on-time production and delivery of aircraft since higher burn rates directly correlate to on-time production.



MRSR Metrics -- All MDS's

402d Maintenance Wing

MDS	AC-130H	AC-130U	C-130H	HC-130N	HC-130P	MC-130E	MC-130H	MC-130P	MC-130W	Totals
ISO										
RQMTs	1964	1902	1899	1937	1917	1930	2017	1917	1988	2392
w/OP's	1888	1840	1853	1920	1898	1843	1943	1908	1941	2131
	96%	97%	98%	99%	99%	95%	96%	100%	98%	89%
PDM Totals										
RQMTs	609	614	612	609	603	639	617	572	593	911
w/OP's	552	518	558	565	559	562	525	571	523	574
	91%	84%	91%	93%	93%	88%	85%	100%	88%	63%
FUS										
RQMTs	90	76	55	54	54	125	97	54	76	281
w/OP's	50	44	54	54	54	52	50	54	44	56
	56%	58%	98%	100%	100%	42%	52%	100%	58%	20%
WNG										
RQMTs	347	390	387	386	386	349	380	349	371	440
w/OP's	334	336	336	342	342	348	338	348	336	349
	96%	86%	87%	89%	89%	100%	89%	100%	91%	79%
EMP										
RQMTs	89	65	87	86	80	82	57	86	63	107
w/OP's	85	55	85	86	80	79	54	86	60	86
	96%	85%	98%	100%	100%	96%	95%	100%	95%	80%
FCP										
RQMTs	83	83	83	83	83	83	83	83	83	83
w/OP's	83	83	83	83	83	83	83	83	83	83
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Supportability Identified (PT Network) = 54%

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Figure 12. MRSP Metrics (402d Maintenance Wing, 2010)

Figure 13 illustrates the number of POU task kits built per the C-130 aircraft that underwent the HVM cycle maintenance. Since the following chart is dated 20 September, the chart does not reflect the POU task kits built for aircraft 69-5820. According to the 5 May 2011 data pull from Allen Quattlebaum, HVM Workforce and Financial Issues Lead, 184 operations were kitted for aircraft 69-5820 (see Table 1). (Quattlebaum, A., personal communication, May 11, 2011)

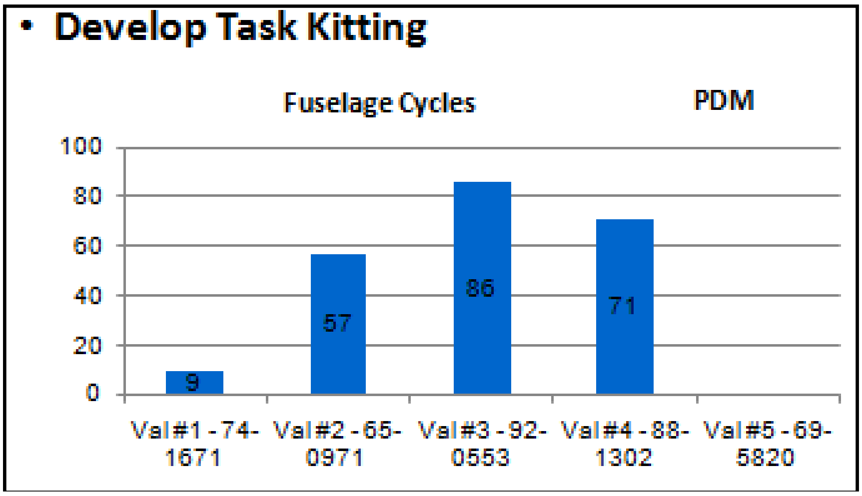
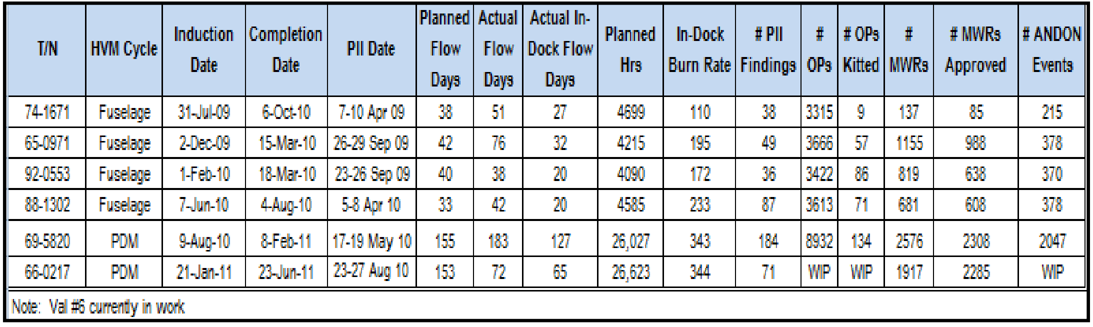


Figure 13. Task Kitting (WR-ALC HVM Office (c), 2010)

Table 1 shows a data pull from Allen Quattlebaum on 5 May 2011. This data table is used to build the HVM tenet validation metrics previously discussed.

Table 1. Data Used to Build Validation Metrics
(Quattlebaum, personal communicarion, May 6, 2011)



T/N	HVM Cycle	Induction Date	Completion Date	PII Date	Planned Flow Days	Actual Flow Days	Actual In-Dock Flow Days	Planned Hrs	In-Dock Burn Rate	# PII Findings	# OPs	# OPs Kitted	# MWRs	# MWRs Approved	# ANDON Events
74-1671	Fuselage	31-Jul-09	6-Oct-10	7-10 Apr 09	38	51	27	4699	110	38	3315	9	137	85	215
65-0971	Fuselage	2-Dec-09	15-Mar-10	26-29 Sep 09	42	76	32	4215	195	49	3666	57	1155	988	378
92-0553	Fuselage	1-Feb-10	18-Mar-10	23-26 Sep 09	40	38	20	4090	172	36	3422	86	819	638	370
88-1302	Fuselage	7-Jun-10	4-Aug-10	5-8 Apr 10	33	42	20	4585	233	87	3613	71	681	608	378
69-5820	PDM	9-Aug-10	8-Feb-11	17-19 May 10	155	183	127	26,027	343	184	8932	134	2576	2308	2047
66-0217	PDM	21-Jan-11	23-Jun-11	23-27 Aug 10	153	72	65	26,623	344	71	WIP	WIP	1917	2285	WIP

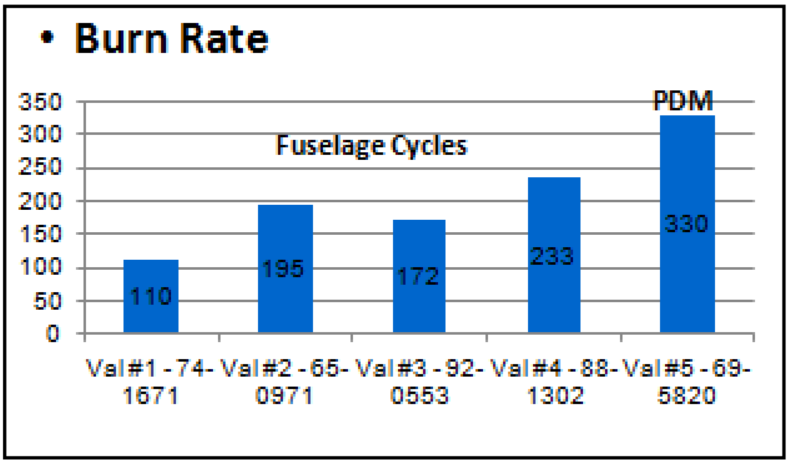
Note: Val #6 currently in work

2.5.4. Burn Rate

Burn rate, the fourth tenet of HVM, is a function of the first three tenets. Burn rate is primarily the rate at which direct work in relation to programmed work is accomplished on the aircraft. If daily work is standardized in terms of work performed and choreographed in sequence; the condition of the aircraft is known; and the supportability of the mechanic in terms of BOM, BOW, POUs and kitting is provided, the direct labor performed by the mechanic is optimized and the results of increasing burn rates can be realized. In fact, the higher application of direct labor-hours or burn rate per day is the primary measure of true HVM (Canaday, 2011).

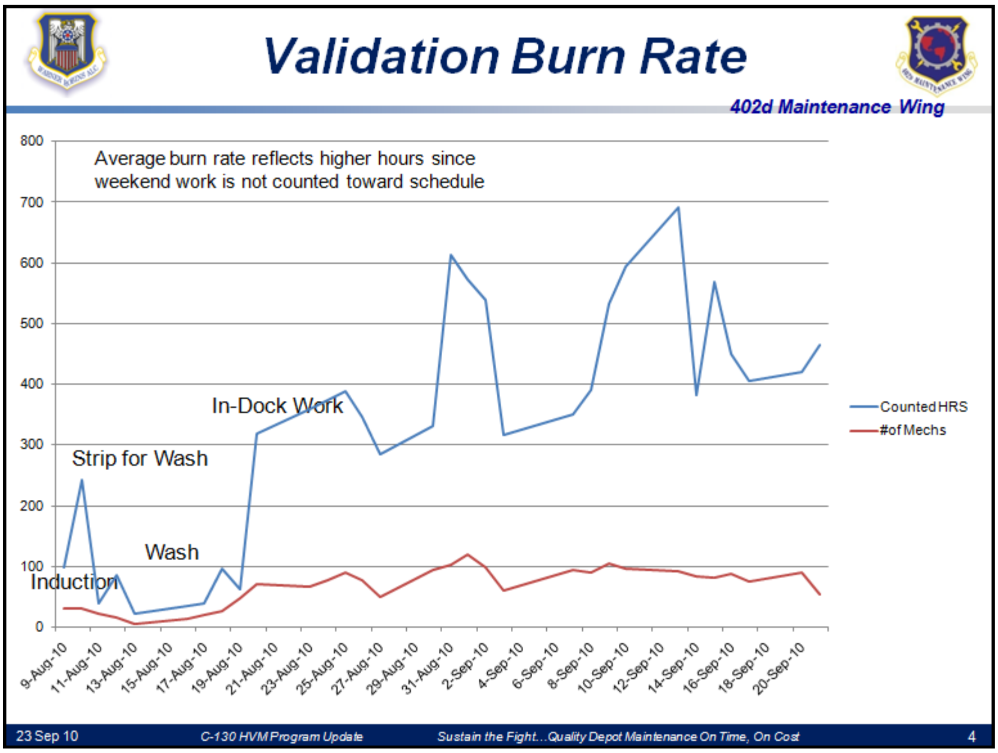
2.5.4.1. Burn Rate Validation Metrics

Figure 14 illustrates the burn rates per aircraft that underwent the HVM cycle maintenance, and shows a steady increase in the burn rate for in-dock maintenance (Quattlebaum, personal communication, May 6, 2011). One item to note pertaining to this HVM burn rate validation chart is that the burn rates listed below do not reflect the total burn-rate per aircraft; just the in-dock burn rate. From the 6 May 2011 data pull from Marty Cain through GO97-PDMSS, the total burn rate, including aircraft induction, strip for wash, wash, in-dock, to functional test for each aircraft below is as follows: aircraft 74-1671 – 137 hours; aircraft 65-0971 – 75 hours; aircraft 93-0553 – 157 hours; aircraft 88-1302 – 178 hours; and aircraft 69-5820 – 255 hours. (Cain M., personal communication, May 6, 2011) Lastly, according to the 402nd MXW Burn rate Validation Chart for aircraft 69-5820, dated 23 September 2010, the snapshot of the burn rates for aircraft are higher (485 hours per day) in chart since the weekend work is not accounted for in schedule (see Figure 15). (402d Maintenance Wing, 2010).



- **Burn Rate**

Figure 14. Burn Rate (WR-ALC HVM Office (c), 2010)



Validation Burn Rate

402d Maintenance Wing

Average burn rate reflects higher hours since weekend work is not counted toward schedule

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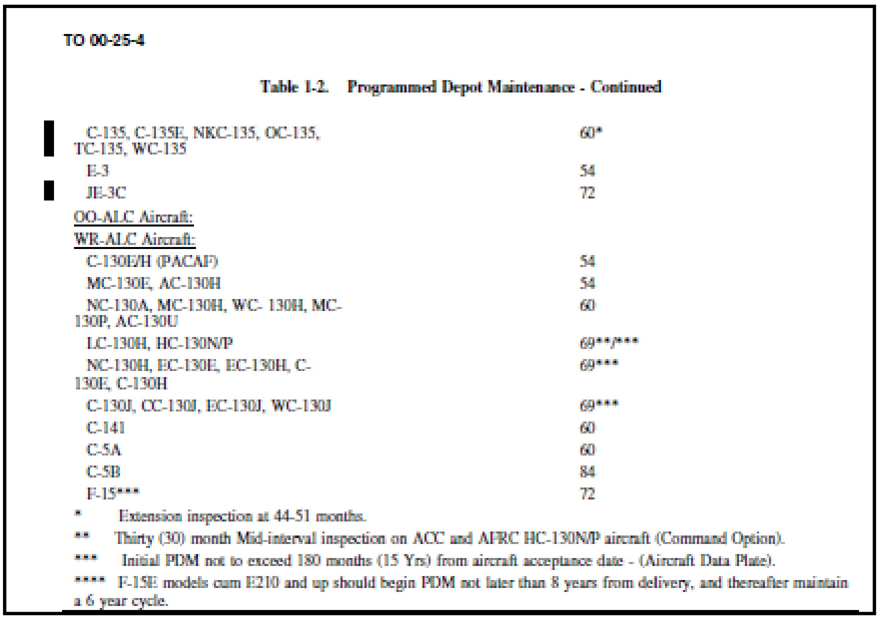
Figure 15. 402nd MXW Burn Rate for Aircraft 69-5820 (402d Maintenance Wing, 2010)

This disparity in the accounting of burn rate as referenced in the previous paragraph highlights a potential problem for PDM operations; that is if the burn rates are used as planning factors to man-load aircraft, determine Work in Process (WIP), or even determine aircraft production schedules. The methodology for the formulation, accounting, and even application of burn rates to production can be a topic for future research since burn rates are the true measure of HVM.

2.6. Progression of C-130 HVM Cycle Approach from 2009 to Current

Initially the HVM cycle approach or plan started with four cycles: Cycle 1 - Fuselage, Cycle 2 - Wing, Cycle 3 - Empennage, and Cycle 4 - Flight Controls/Paint. Each cycle was expected to hold the aircraft down for maintenance at depot for 15 days each (WR-ALC HVM Office (a), 2010). Following this initial plan, the total aircraft downtime would have equated to 60 totals days during the 5 to 6 year depot interval as established by T.O. 00-25-4, Depot Maintenance of Aerospace Vehicles and Training Equipment (2002). According to T.O. 00-25-4 (2002), depending on the configuration or MDS of the C-130 aircraft, the calendar time interval of PDM ranges between 54 to 69 months. (Secretary of the Air Force, 2002) Figure 16, illustrates the PDM intervals of the different configurations of C-130 aircraft.



TO 00-25-4

Table 1-2.   Programmed Depot Maintenance - Continued

C-135, C-135E, NKC-135, OC-135, TC-135, WC-135	60*
E-3	54
JE-3C	72
OO-ALC Aircraft:	
WR-ALC Aircraft:	
C-130E/H (PACAF)	54
MC-130E, AC-130H	54
NC-130A, MC-130H, WC- 130H, MC-130P, AC-130U	60
LC-130H, HC-130N/P	69**/***
NC-130H, EC-130E, EC-130H, C-130E, C-130H	69***
C-130J, CC-130J, EC-130J, WC-130J	69***
C-141	60
C-5A	60
C-5B	84
F-15***	72

*   Extension inspection at 44-51 months.

**   Thirty (30) month Mid-interval inspection on ACC and AFRC HC-130N/P aircraft (Command Option).

***   Initial PDM not to exceed 180 months (15 Yrs) from aircraft acceptance date - (Aircraft Data Plate).

****   F-15E models cum E210 and up should begin PDM not later than 8 years from delivery, and thereafter maintain a 6 year cycle.

Figure 16. C-130 Aircraft PDM Interval (Secretary of the Air Force, 2002)

Secondly, this initial inception of HVM included a PDM-Transition (PDM-T) plan. Due to funding constraints, the PDM-T was established to incrementally transition aircraft scheduled for PDM to HVM in a cost-neutral fashion. The plan incorporated reducing the aircraft's current scope of the programmed PDM requirements by 50 percent and involved deferring non-safety of flight or non-critical repairs to the aircraft's next HVM cycle. The money saved during this de-scoped PDM or PDM-T would be used to induct that aircraft into its next HVM cycle, 18 months later. (WR-ALC HVM Office (a), 2010)

After five HVM validations; four fuselage cycles (C-130H, aircraft 74-1671; MC-130P, aircraft 65-0917; C-130H, aircraft 92-0553; MC-130W, aircraft 88-1302) and one PDM-T that eventually turned out to be a full PDM that the HVM concept and tenets were employed (MC-130P, aircraft 69-5820); and another aircraft undergoing a full PDM (MC-130P, aircraft 66-0217), the HVM flow days per cycle, particularly the HVM wing cycle increased significantly from 15 days to 49 days. (Quattlebaum, personal communication, May 6, 2011)

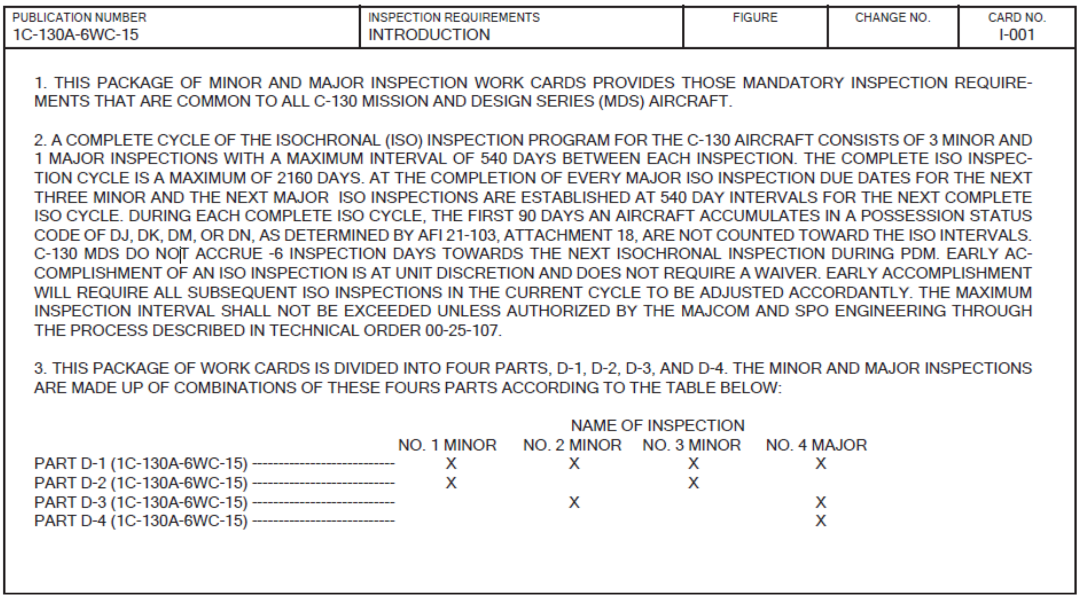
The increase in flow days per the HVM cycles in relation to the initial HVM plan discussed above were due to three main factors, incorporating ISOs in the cycles to integrate field-level and depot-level maintenance, the learning curve effects associated with being the first-ever in the DoD to validate and implement HVM, and the unanticipated corrosive condition of the aircraft that was identified during the look-ahead inspections conducted during the validation phase of the HVM's fuselage cycle inspection. As a result, the current programmed depot flow days per HVM cycles are as follows: Cycle 1 - Fuselage – 28 days; Cycle 2 – Wing – 49 days; Cycle 3 – Empennage – 28 days; and Cycle 4 - Flight Controls/Paint – 28 days. (Quattlebaum, personal communication, May 6, 2011) Altogether, during the PDM cycle of 5 to 6 years, the current HVM Cycle concept would equate to 133 days that the aircraft is scheduled down for maintenance; much higher than the initial full HVM cycle plan of only 60 days.

When compared to the planned C-130 PDM average flow days of 164 days, the total aircraft down days resulting from the current HVM cycle concept is only 31 days less than the average traditional PDM flow days. A further analysis of the total aircraft maintenance down days potentially decreased or increased in relation to the HVM cycle approach or traditional PDM process will be discussed and evaluated in the methodology and analysis sections of this paper.

2.7. C-130 Aircraft Isochronal Inspections

According to T.O. 1C-130A-6WC-14, Workcards Minor and Major Isochronal Inspection USAF Series All C-130 Aircraft (2010), the C-130 aircraft ISO inspection consists of three minor and one major inspection that will be completed every 540 days (18 months) (see Figure 17). The total ISO inspection cycle or interval between ISOs is 2,160 days (72 months). With the intervals of each ISO at 18 months, the alignment of ISOs (three minors and one major inspection) with the HVM cycle approach is optimal since the HVM cycle intervals are also 18 months. By integrating the field ISOs with the depot HVM cycles per the “Single Maintenance Concept”, aircraft down time could decrease and aircraft availability increase. According to an interview with Jerry Mobley, the ISOs have been incorporated into the HVM Cycle maintenance packages with no additional program hours or costs (Mobley, personal communication, March 25, 2011).

However, according to T.O. 00-25-4 (Secretary of the Air Force, 2002), the ISO engine inspection requirement as per TO 1C-130A-6WC-14 (2010) will not be accomplished at depot; thus, still must be accomplished in the field. (Secretary of the Air Force (b), 2010)



PUBLICATION NUMBER	INSPECTION REQUIREMENTS	FIGURE	CHANGE NO.	CARD NO.
1C-130A-6WC-15	INTRODUCTION			I-001

1. THIS PACKAGE OF MINOR AND MAJOR INSPECTION WORK CARDS PROVIDES THOSE MANDATORY INSPECTION REQUIREMENTS THAT ARE COMMON TO ALL C-130 MISSION AND DESIGN SERIES (MDS) AIRCRAFT.

2. A COMPLETE CYCLE OF THE ISOCHRONAL (ISO) INSPECTION PROGRAM FOR THE C-130 AIRCRAFT CONSISTS OF 3 MINOR AND 1 MAJOR INSPECTIONS WITH A MAXIMUM INTERVAL OF 540 DAYS BETWEEN EACH INSPECTION. THE COMPLETE ISO INSPECTION CYCLE IS A MAXIMUM OF 2160 DAYS. AT THE COMPLETION OF EVERY MAJOR ISO INSPECTION DUE DATES FOR THE NEXT THREE MINOR AND THE NEXT MAJOR ISO INSPECTIONS ARE ESTABLISHED AT 540 DAY INTERVALS FOR THE NEXT COMPLETE ISO CYCLE. DURING EACH COMPLETE ISO CYCLE, THE FIRST 90 DAYS AN AIRCRAFT ACCUMULATES IN A POSSESSION STATUS CODE OF DJ, DK, DM, OR DN, AS DETERMINED BY AFI 21-103, ATTACHMENT 18, ARE NOT COUNTED TOWARD THE ISO INTERVALS. C-130 MDS DO NOT ACCRUE -6 INSPECTION DAYS TOWARDS THE NEXT ISOCHRONAL INSPECTION DURING PDM. EARLY ACCOMPLISHMENT OF AN ISO INSPECTION IS AT UNIT DISCRETION AND DOES NOT REQUIRE A WAIVER. EARLY ACCOMPLISHMENT WILL REQUIRE ALL SUBSEQUENT ISO INSPECTIONS IN THE CURRENT CYCLE TO BE ADJUSTED ACCORDANTLY. THE MAXIMUM INSPECTION INTERVAL SHALL NOT BE EXCEEDED UNLESS AUTHORIZED BY THE MAJCOM AND SPO ENGINEERING THROUGH THE PROCESS DESCRIBED IN TECHNICAL ORDER 00-25-107.

3. THIS PACKAGE OF WORK CARDS IS DIVIDED INTO FOUR PARTS, D-1, D-2, D-3, AND D-4. THE MINOR AND MAJOR INSPECTIONS ARE MADE UP OF COMBINATIONS OF THESE FOURS PARTS ACCORDING TO THE TABLE BELOW:

	NAME OF INSPECTION			
	NO. 1 MINOR	NO. 2 MINOR	NO. 3 MINOR	NO. 4 MAJOR
PART D-1 (1C-130A-6WC-15) --------------------------	X	X	X	X
PART D-2 (1C-130A-6WC-15) --------------------------	X		X	
PART D-3 (1C-130A-6WC-15) --------------------------		X		X
PART D-4 (1C-130A-6WC-15) --------------------------				X

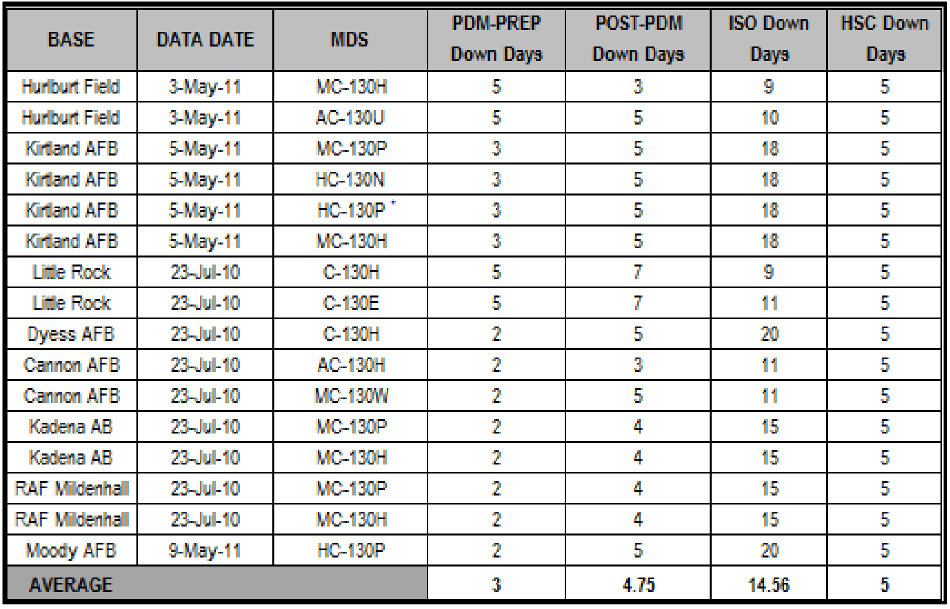
Figure 17. ISO Workcards (Secretary of the Air Force (b), 2010)

2.8. Additional Field-level Aircraft Down Days to Support HVM Concept

According to the data gathered from the field through e-mail questionnaires and a study conducted by John Huff, C-130 HVM Production Flight Chief, the average C-130 aircraft down days scheduled for ISOs ranged between 9 to 20 days; average from sample data, resulted into 15 days of aircraft downtime. (Huff, 2011)

The other aircraft-scheduled down days in field attributable to PDM or HVM input or output are the PDM-prep days whereat the field unit holds the aircraft down to prep for PDM input, the Post-PDM days where the field unit accepts aircraft and readies aircraft for first flight after PDM, the ISO days where the field or depot accomplishes the ISO, and the HSC days where the field conducts a mid-point inspection between the ISOs. The sample data average for PDM-prep down days is 3 days, for Post-PDM down days is 5 days, for ISOs is 15 days, and for HSCs is 5 days. Depending on whether the traditional PDM process or HVM cycle approach is used will dictate the use of the different columns in survey towards computing aircraft total down days. The methodology of computing total aircraft down days in relation to traditional PDM and HVM cycles will be discussed in next section. Table 2 shows the results of the questionnaire used to equate the aircraft down days cited in the previous paragraphs. See Appendix B for e-mailed questionnaire with response from 1st SOW.

Table 2. Responses to Field Questionnaire, (2011)



BASE	DATA DATE	MDS	PDM-PREP Down Days	POST-PDM Down Days	ISO Down Days	HSC Down Days
Hurlburt Field	3-May-11	MC-130H	5	3	9	5
Hurlburt Field	3-May-11	AC-130U	5	5	10	5
Kirtland AFB	5-May-11	MC-130P	3	5	18	5
Kirtland AFB	5-May-11	HC-130N	3	5	18	5
Kirtland AFB	5-May-11	HC-130P	3	5	18	5
Kirtland AFB	5-May-11	MC-130H	3	5	18	5
Little Rock	23-Jul-10	C-130H	5	7	9	5
Little Rock	23-Jul-10	C-130E	5	7	11	5
Dyess AFB	23-Jul-10	C-130H	2	5	20	5
Cannon AFB	23-Jul-10	AC-130H	2	3	11	5
Cannon AFB	23-Jul-10	MC-130W	2	5	11	5
Kadena AB	23-Jul-10	MC-130P	2	4	15	5
Kadena AB	23-Jul-10	MC-130H	2	4	15	5
RAF Mildenhall	23-Jul-10	MC-130P	2	4	15	5
RAF Mildenhall	23-Jul-10	MC-130H	2	4	15	5
Moody AFB	9-May-11	HC-130P	2	5	20	5
AVERAGE			**3**	**4.75**	**14.56**	**5**

3. Methodology

This chapter will cover the research methodology of assessing multiple sources of data to determine the HVM concept and tenets effects to C-130 aircraft production flow days, on-time aircraft delivery rates, and aircraft availability rates. Additionally, this chapter will elaborate of the methodology of assessing and comparing the effects of HVM's "Single Maintenance Concept" to the total aircraft scheduled down days associated with the current full HVM cycle approach versus the traditional PDM model.

3.1. Data Sources

Data used for the research was derived from multiple sources. The data sources include the following: direct interviews and e-mail correspondence with key personnel from WR-ALC HVM Office, 560th Aircraft Maintenance Squadron, and several C-130 aircraft active duty units; historical data covering all C-130 aircraft inducted into PDM during the period of 23 July 2007 to 1 May 2011--see Appendix C for complete data pull of GO97-PDMSS inputted into Excel spreadsheets (Cain M. , personal communication, May 6, 2011) multiple HVM briefing and other research documents identified throughout literature review and research paper; and an e-mailed field questionnaire associated with the field C-130 aircraft scheduled-related down days associated with PDM input and output, and other maintenance scheduling requirements as dictated by various USAF technical orders and other aircraft-specific directives—see Appendix B for 1st Special Operations Wing's response to field questionnaire.

3.2. Research Scope

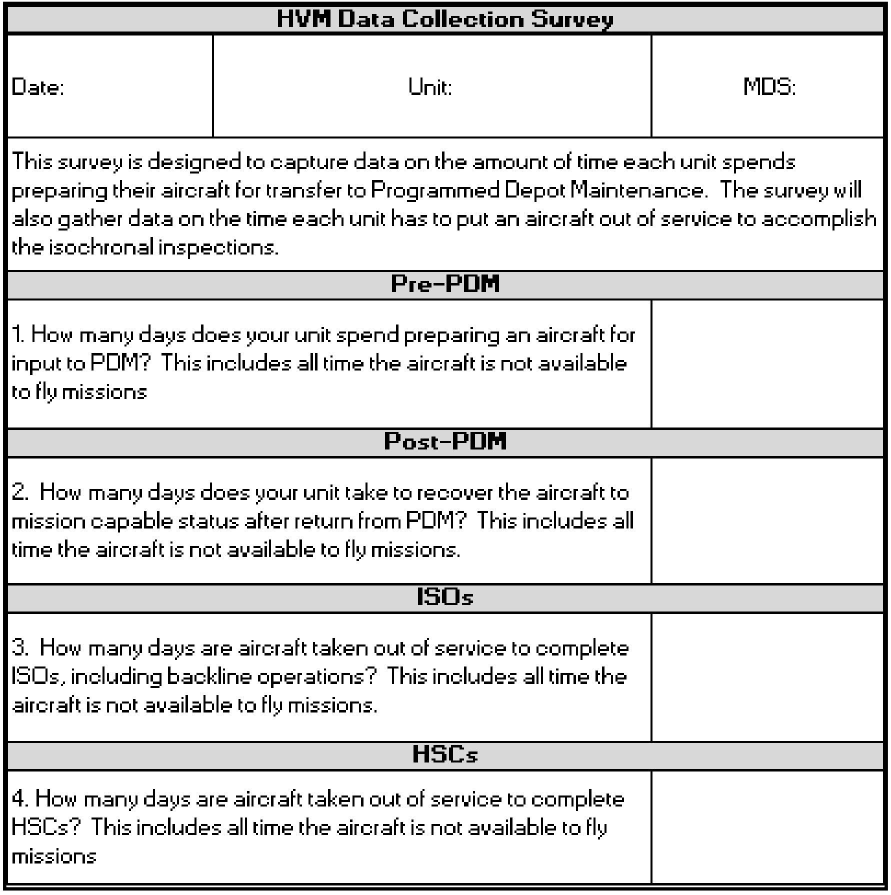
Since the application of the HVM concept and respective tenets are currently being validated and employed at WR-ALC on AFSOC-specific MDSs, this research will target the HVM-, PDM-, and AFSOC-inducted aircraft. Historical data from GO97-PDMSS, covering the period of 23 July 2007 to 1 May 2011, will be used to compute actual labor-burn rates, on-time aircraft delivery rates, and the effects of increasing labor-burn rates from actual burn rates to 300-, 400-, 500- hours burn rate to production flow days and on-time aircraft delivery respectively. Furthermore, since the accounting of burn rates at WR-ALC is not standardized as highlighted in previous chapter, the simple computation of dividing total programmed hours by total workflow days will be used to calculate per aircraft, MDS, MAJCOM, or whether HVM or PDM aircraft.

In order to further assess the HVM burn rate and also “Single Maintenance Concept” effects of depot absorbing field-level ISO inspection requirements to decrease total aircraft maintenance down time and increase aircraft availability, this research will be limited to the various MDS aircraft assigned to active duty C-130 bases that possess the same MDSs that were inducted into PDM as HVM or PDM aircraft. The field data required to evaluate the HVM effects of integrating applicable field-level inspections into the HVM cycle approach was gathered from e-mailed questionnaires and previous field study conducted by John Huff, C-130 HVM Production Flight Chief. This field questionnaire was distributed to multiple C-130 active duty bases through the 3rd Maintenance Operation Squadron, Maintenance Operations Flight Chief, SMSgt John Bettridge.

Lastly, with the limited accessibility of pertinent data pertaining to fleet scheduling, direct labor, resource constraints, cost systems, and appropriate data bases such as GO97-PDMSS, DMAPS, ROCIT, LIMS-EV, etcetera, and SMEs at WR-ALC and field units will be used.

The specific questions included the average amount of days the respective bases' assigned aircraft were held down for PDM preparation, the amount of days the aircraft were held down to recover and ready for flight after PDM, the amount of days the aircraft are scheduled down to complete an ISO inspection, and the number of days the aircraft are scheduled for HSCs. See Table 3 for e-mailed field survey used.

Table 3. Sample Field Survey



HVM Data Collection Survey		
Date:	Unit:	MDS:
This survey is designed to capture data on the amount of time each unit spends preparing their aircraft for transfer to Programmed Depot Maintenance. The survey will also gather data on the time each unit has to put an aircraft out of service to accomplish the isochronal inspections.		
Pre-PDM		
1. How many days does your unit spend preparing an aircraft for input to PDM? This includes all time the aircraft is not available to fly missions		
Post-PDM		
2. How many days does your unit take to recover the aircraft to mission capable status after return from PDM? This includes all time the aircraft is not available to fly missions.		
ISOs		
3. How many days are aircraft taken out of service to complete ISOs, including backline operations? This includes all time the aircraft is not available to fly missions.		
HSCs		
4. How many days are aircraft taken out of service to complete HSCs? This includes all time the aircraft is not available to fly missions		

In Chapter 4, Results and Analysis section, the applicable response averages of aircraft down days will be added to the total aircraft scheduled down days of the current HVM cycle approach and the traditional PDM schedule. With the applicable field-level aircraft down days added to both models, the total planned aircraft HVM cycle down days per MDS will be compared with the total planned aircraft down days of the traditional PDM schedule per MDS. The main assumption of this measure is that maintenance will be conducted in an ideal condition where all the required parts, supportability, and labor are fully provided, and the scheduled maintenance occurs as planned. The potential aircraft down days saved per aircraft and aircraft availability per MDS will be a result of this comparison. Therefore, in this comparison, planned and not actual down days will be used.

3.3. Research Objectives

In summary, through the analysis of the data mentioned above, this research will assess two main issues:

1. Effects of incrementally increasing burn rates from actual average (current), 300-, 400-, 500-labor hours respectively towards C-130 production flow days and C-130 on-time delivery rates.

2. Effects of employing the current HVM Cycle approach versus the traditional PDM process towards improving C-130 aircraft availability.

4. Results and Analysis

This chapter will analyze the data and discuss the results of the two main objectives mentioned in Chapter 3:

1. Effects of incrementally increasing burn rates from actual average (current), 300-, 400-, 500-labor hours respectively towards C-130 production flow days and C-130 on-time delivery rates.

2. Effects of employing the current HVM Cycle approach versus the traditional PDM process towards improving C-130 aircraft availability.

4.1. Effects of Burn Rate to Production Flow Days and Delivery Rates

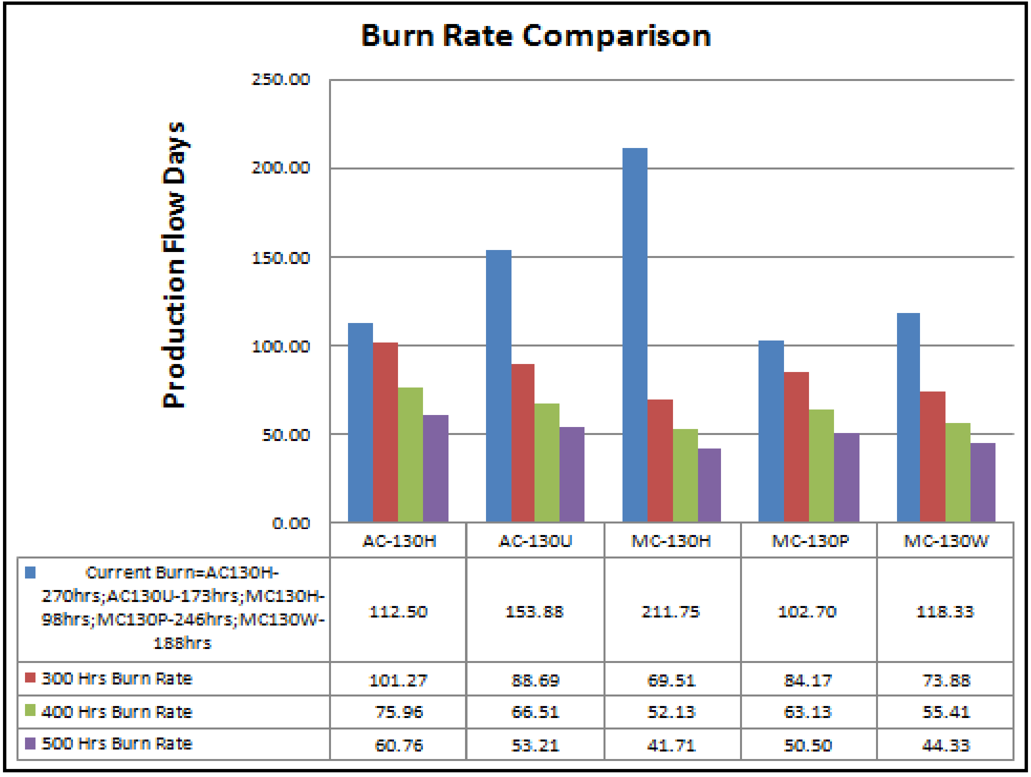
In order to compute the C-130 aircraft burn rate at WR-ALC, historical data was pulled from GO97-PDMSS. The historical data covered all C-130 aircraft inducted at depot during the period of 23 July 2007 to 1 May 2011 (Cain M. , personal communication, May 6, 2011). See Appendix C for complete data sheet. The data included individual tail numbers; MDS; MAJCOM assigned; scheduled and actual aircraft induction date; scheduled and actual aircraft output or production date; total workflow days; total calendar days; total programmed maintenance hours per requirement; the variances between scheduled workflow day and actual workflow day; and a text section that included description of maintenance required, work required, and comments section. To generate the actual burn rate per aircraft, MDS, MAJCOM, or whether HVM or PDM, the total programmed hours were divided by the total workflow days.

Due to the research scope of focusing primarily on AFSOC and HVM aircraft, the aircraft were segmented by MAJCOM, MDS, and whether aircraft was programmed for HVM or PDM. To minimize the variances between each aircraft programmed total workflow hours due to the additional maintenance packages or requirements added to PDM or HVM package such as Center Wing Replacements (CWRs), Analytical Condition Inspections (ACIs), or unpredictable requirements such as excessive corrosion discovered during the E&I phase or other repair phases after aircraft arrival, average programmed workflow hours were computed per MDS.

Due to the limited access of data pertaining to the scheduling and assignment of direct laborers to each aircraft per maintenance task and production day, an average total workflow day was computed per MDS. From the MDS averages of total programmed hours and total workflow days, the average burn rate per MDS was computed. Furthermore, due to the limited access of data pertaining to the computation of HVM in-dock and out-dock burn rates, an overall average MDS burn rate was computed.

Table 4 illustrates the burn rate effects of current (actual) burn rates, 300-, 400-, 500-hour burn rates to flow days. As the burn rate increases, the number of flow days to complete PDM decreases. For example, AC130H current burn rate of 270 hours per day equates to 112.50 flow days; at 300-hours burn rate, computed flow day equates to 101.27 days, and so forth.

Table 4. Average Flow Days Effects of Actual, 300, 400, and 500 Hour Burn Rates



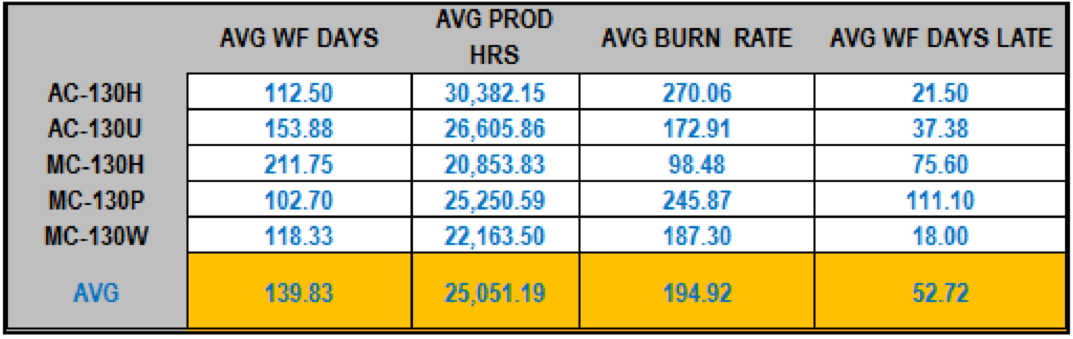
	AC-130H	AC-130U	MC-130H	MC-130P	MC-130W
🟦 Current Burn=AC130H-270hrs;AC130U-173hrs;MC130H-98hrs;MC130P-246hrs;MC130W-188hrs	112.50	153.88	211.75	102.70	118.33
🟥 300 Hrs Burn Rate	101.27	88.69	69.51	84.17	73.88
🟩 400 Hrs Burn Rate	75.96	66.51	52.13	63.13	55.41
🟪 500 Hrs Burn Rate	60.76	53.21	41.71	50.50	44.33

In order to generate the data for Table 4, the sample data included AFSOC aircraft that were produced at WR-ALC since 2007 to current. Of the total 39 AFSOC aircraft produced within timeframe, 27 aircraft were inducted for either PDM or HVM cycles (see Appendix C.4). To identify these aircraft as either PDM or HVM, the work requirement text column was used. Any PDM or HVM narrative in the text columns identified the aircraft to be included in sample set. Moreover, there are 12 additional AFSOC aircraft currently in work status at depot; thus, not part of this sample set, since historical data based on produced aircraft was used.

From the sample set, the average burn rate was computed per MDS by dividing the Average Programmed Hours by the Actual Work Flow Days. For example, for AC-130H MDS, the total Average Programmed Hours of 30,382.15 hours divided by the AC-130H Average Work Flow Days of 112.5 days equal 270.06 hours per day or burn rate.

To compute the effects of target burn rates of 300-, 400-, 500-hours per day, the Average Programmed hours per MDS were divided by the Target Burn Rates previously mentioned. The end-result of computation would be the MDS-Average Work Flow Days required to complete the MDS' Programmed Hour Requirements. Table 5 shows the actual Average Work Flow Days calculated by dividing the Average Production Hours by the Average Burn rate. Table 5 further shows the Average Work Flow Days Late.

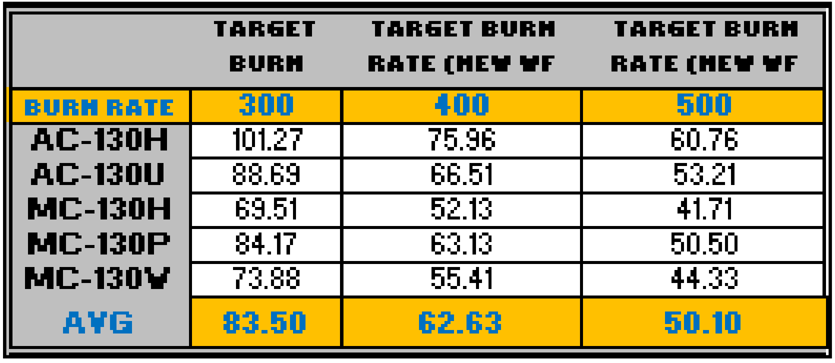
Table 5. Average Workflow Days and Average Days Late by Actual Burn Rates



	AVG WF DAYS	AVG PROD HRS	AVG BURN RATE	AVG WF DAYS LATE
AC-130H	112.50	30,382.15	270.06	21.50
AC-130U	153.88	26,605.86	172.91	37.38
MC-130H	211.75	20,853.83	98.48	75.60
MC-130P	102.70	25,250.59	245.87	111.10
MC-130W	118.33	22,163.50	187.30	18.00
AVG	139.83	25,051.19	194.92	52.72

Table 6 shows the MDS-Average New Work Flow days generated by dividing the MDS-Average Production Hours (Table 5) by the Target Burn Rates of 300-, 400-, 500-hours per day.

Table 6. New Average Workflow Days by Target Burn Rates



	TARGET BURN	TARGET BURN RATE (NEW WF	TARGET BURN RATE (NEW WF
BURN RATE	300	400	500
AC-130H	101.27	75.96	60.76
AC-130U	88.69	66.51	53.21
MC-130H	69.51	52.13	41.71
MC-130P	84.17	63.13	50.50
MC-130W	73.88	55.41	44.33
AVG	83.50	62.63	50.10

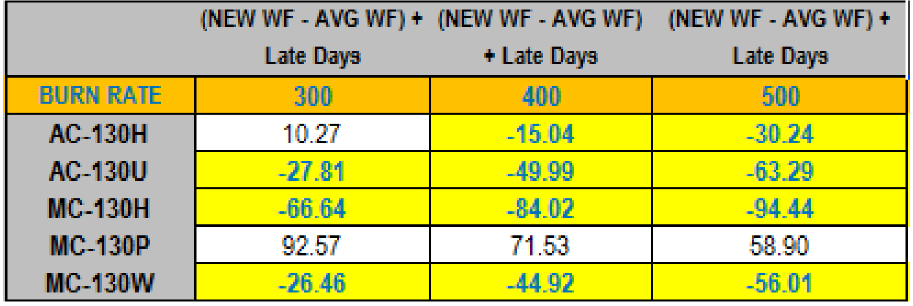
From the sample data, the on-time delivery rate of the 27 produced aircraft is 22.22 percent (6 on-time/27 aircraft) (see Appendix C.4). The total on-time delivery rate of PDM-produced aircraft for AFSOC is 20.5% (8 on-time/39 aircraft) (see

Appendix C.4.). From Table 5 above, the Average Work Flow Days late is illustrated per MDS. The overall Average Workflow Day Late is 52.72 days.

In order to compute the effects of increased burn rates to the production schedule or on-time delivery rate of C-130 aircraft from WR-ALC, the MDS-computed Average Workflow Days were compared to the computed Average Workflow Days of the incrementally increasing burn rates of 300-, 400-, and 500-hours per day respectively. From that comparison of flow days, the average variances per MDS-scheduled and actual output flow days were assessed to determine if the incrementally increasing burn rates affected their respective production output schedule; in turn, affect the MDS-specific and overall WR-ALC to AFSOC on-time delivery rate.

This was accomplished by taking the New Average Work Flow Days (Table 6), computed by the incrementally increasing burn rate of 300-, 400-, 500-hours per day, minus the MDS-Average Actual Work Flow Days (Table 5), plus the Average Work Flow Days Late (Table 5). The desired end-result of a negative number represents the average number of flow days required to produce each MDS prior to average scheduled due date. If the resulting number is negative, then the burn-rate effects of incrementally increasing burn-rate target from actual to burn rates of 300-, 400-, or 500-hours per day caused the production of the aircraft per MDS to be under-schedule or on-time. For example, to compute the effects of a 400-hour burn rate to an AC-130H schedule, take the New Work Flow Days that was generated by a 400-hour burn rate (75.96 days), minus the Average Actual Workflow days (112.5 days), and then add the Average Work Flow Days Late (21.50 days). The result of the computation is -15.04 days (75.96 days - 112.5 days + 21.5 days = -15.04 days). This means, if the burn rate of 400 hours per day were applied to the two AC-130H aircraft that were produced on average 21.50 days late; both aircraft would have been produced 15.04 days earlier than scheduled. Table 7 shows the effects of employing the target burn rates of 300-, 400-, and 500-hours per day to produce aircraft on time or under-schedule.

Table 7. Effects of Employing Target Burn Rates to On-time Aircraft Production



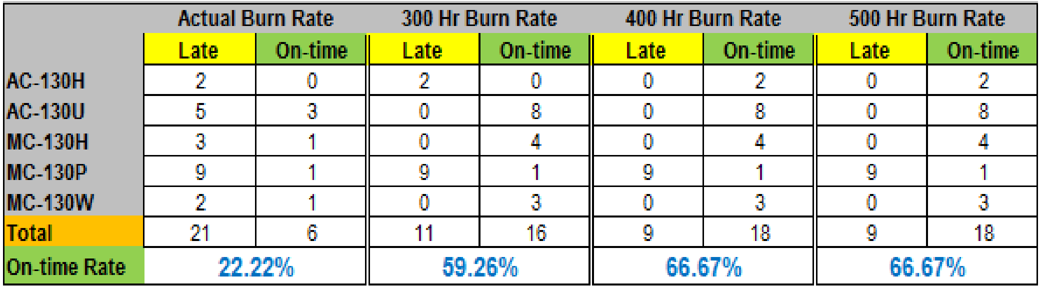
	(NEW WF - AVG WF) + Late Days	(NEW WF - AVG WF) + Late Days	(NEW WF - AVG WF) + Late Days
BURN RATE	300	400	500
AC-130H	10.27	-15.04	-30.24
AC-130U	-27.81	-49.99	-63.29
MC-130H	-66.64	-84.02	-94.44
MC-130P	92.57	71.53	58.90
MC-130W	-26.46	-44.92	-56.01

Furthermore, based on the results of employing the target burn rates to on-time aircraft production in Table 7, the on-time aircraft delivery rate from data set can be computed. At the overall actual average burn rate of 194.92 hours (see Table 5), the on-time delivery rate of 27 aircraft (see Appendix C.4) is 22.22 percent (see Table 8). At a 300-hour burn rate, the on-time delivery rate of the same 27 aircraft would increase to 59.26 percent; almost triple the on-time delivery rate when compared to the results of the actual burn rates. One item to highlight in Table 8 is the ineffectiveness of applying additional hours to produce the MC-130P aircraft. Regardless if the burn rate was set at 300-, 400-, or 500-labor hours, there would be no gain to the on-time delivery rate for that MDS; thus, by computing labor-burn hours, optimal burn rates can also be computed to determine the optimal burn hours for the maximum output at least cost. This topic will be recommended for future research in Chapter 5 of this paper.

The actual average burn rates of the C-130 MDSs used in sample set are as follows: AC-130H – 270.06 hours; AC-130U – 172.91 hours; MC-130H – 98.48 hours; MC-130P – 245.87 hours; and MC-130W – 187.30 hours (see Appendix C.4).

Table 8 shows the on-time delivery rates of aircraft as a result of increasing burn rates.

Table 8. Effects of Increased Burn Rates to On-time Delivery Rates



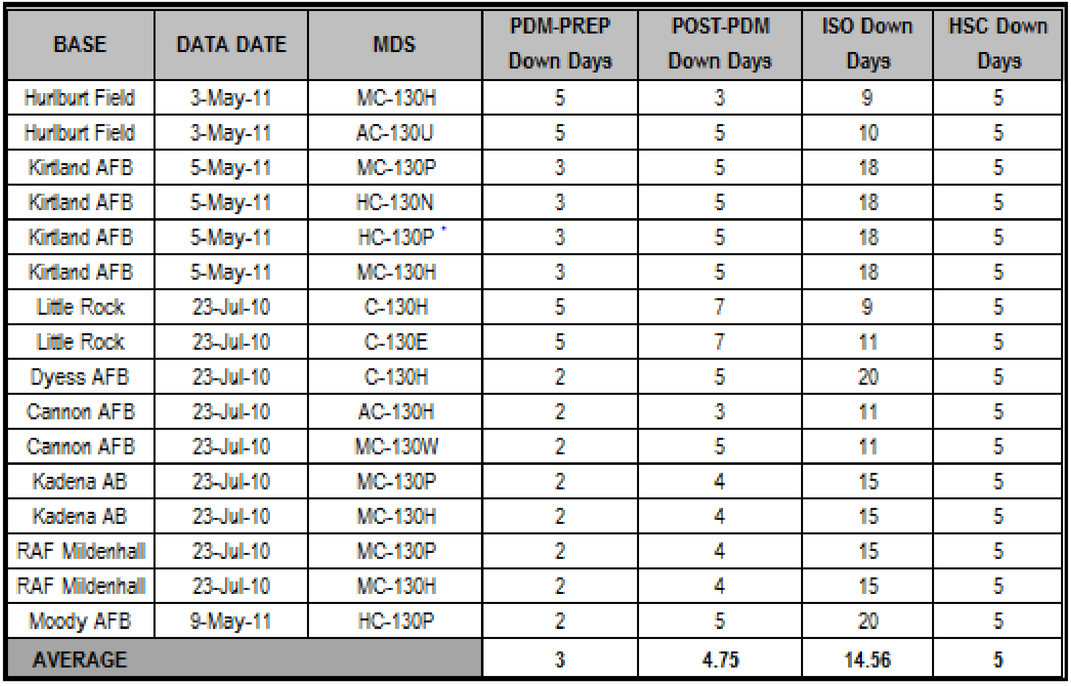
	Actual Burn Rate		300 Hr Burn Rate		400 Hr Burn Rate		500 Hr Burn Rate	
	Late	On-time	Late	On-time	Late	On-time	Late	On-time
AC-130H	2	0	2	0	0	2	0	2
AC-130U	5	3	0	8	0	8	0	8
MC-130H	3	1	0	4	0	4	0	4
MC-130P	9	1	9	1	9	1	9	1
MC-130W	2	1	0	3	0	3	0	3
Total	21	6	11	16	9	18	9	18
On-time Rate	22.22%		59.26%		66.67%		66.67%	

4.2. Effects of HVM "Single Maintenance Concept" to Aircraft Availability

In order to compute the effects of HVM's "Single Maintenance Concept" towards C-130 aircraft availability, the planned average flow days between the HVM full cycle and traditional PDM schedule will be compared. The total scheduled down days that will be factored into both models include the field days required to prep aircraft for PDM, to ready aircraft after PDM, days required for ISO, and days required for HSC. This model comparison will be limited to the various MDS aircraft assigned to active duty C-130 bases (primarily AFSOC bases) that possess the same MDSs that were inducted into depot as HVM aircraft.

The field data that reflects the aircraft down days due to PDM input, post-PDM, ISO, and HSC was collected from an e-mailed questionnaire. This field questionnaire was distributed to multiple C-130 active duty bases through the 3rd Maintenance Operations Squadron, Maintenance Operations Flight Chief, SMSgt John Bettridge. Additional field data was gathered from a previous study conducted by John Huff, HVM Production Flight Chief. Table 9 shows the responses to the questionnaire, along with the data from John Huff's previous study (Huff, 2011). The responses with a data date of 23 July 2010 reflect the data gathered from a previous study, and the responses with different data dates reflect the data gathered directly from active-duty units.

Table 9. Responses to Field Questionnaire (2011)

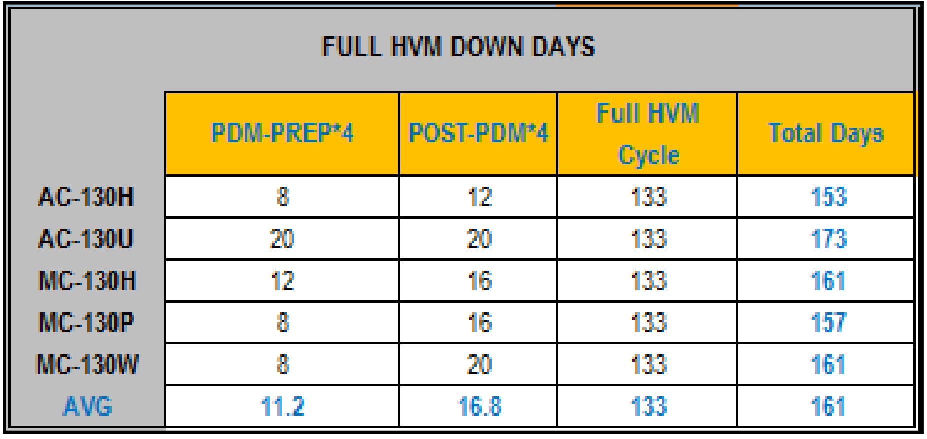


BASE	DATA DATE	MDS	PDM-PREP Down Days	POST-PDM Down Days	ISO Down Days	HSC Down Days
Hurlburt Field	3-May-11	MC-130H	5	3	9	5
Hurlburt Field	3-May-11	AC-130U	5	5	10	5
Kirtland AFB	5-May-11	MC-130P	3	5	18	5
Kirtland AFB	5-May-11	HC-130N	3	5	18	5
Kirtland AFB	5-May-11	HC-130P	3	5	18	5
Kirtland AFB	5-May-11	MC-130H	3	5	18	5
Little Rock	23-Jul-10	C-130H	5	7	9	5
Little Rock	23-Jul-10	C-130E	5	7	11	5
Dyess AFB	23-Jul-10	C-130H	2	5	20	5
Cannon AFB	23-Jul-10	AC-130H	2	3	11	5
Cannon AFB	23-Jul-10	MC-130W	2	5	11	5
Kadena AB	23-Jul-10	MC-130P	2	4	15	5
Kadena AB	23-Jul-10	MC-130H	2	4	15	5
RAF Mildenhall	23-Jul-10	MC-130P	2	4	15	5
RAF Mildenhall	23-Jul-10	MC-130H	2	4	15	5
Moody AFB	9-May-11	HC-130P	2	5	20	5
AVERAGE			**3**	**4.75**	**14.56**	**5**

The current programmed days per HVM cycles are as follows: Cycle 1 - Fuselage – 28 days; Cycle 2 – Wing – 49 days; Cycle 3 – Empennage – 28 days; and Cycle 4 - Flight Controls/Paint – 28 days (Quattlebaum, personal communication, May 6, 2011). Altogether, during the PDM cycle of 5 to 6 years, the HVM Cycle concept would equate to 133 days that the C-130 aircraft is held down for maintenance.

In addition to the 133 aircraft down days previously mentioned, other field-related down days need to be added to the equation, such as PDM-prep and post-PDM days. According to the field-survey responses and direct correspondence with John Huff, the PDM-prep and post-PDM down days will be conducted before and after every 18- month HVM cycle within the 5 to 6 year period; thus, the Average PDM-Prep and Post-PDM down days per MDS Average (see Table 11) will be multiplied by four (Huff, 2011). For example, for the AC-130H MDS, using the Average PDM-Prep days of 2 days (see Table 11), multiply by 4 to compute the full PDM-Prep down days of 8 total days associated with aircraft under the full HVM cycle approach (see Table 10). Furthermore, since the ISO is included in the HVM cycle at no additional hours to the current programmed hours, the ISO down days will not be added to the total down days for HVM cycles (Mobley, personal communication, March 25, 2011). Table 10 shows the total aircraft down days per MDS under the full HVM cycle concept, wherein the "Single Maintenance Concept" of absorbing the field-level ISOs is employed.

Table 10. Aircraft Down Days under HVM Cycle Concept



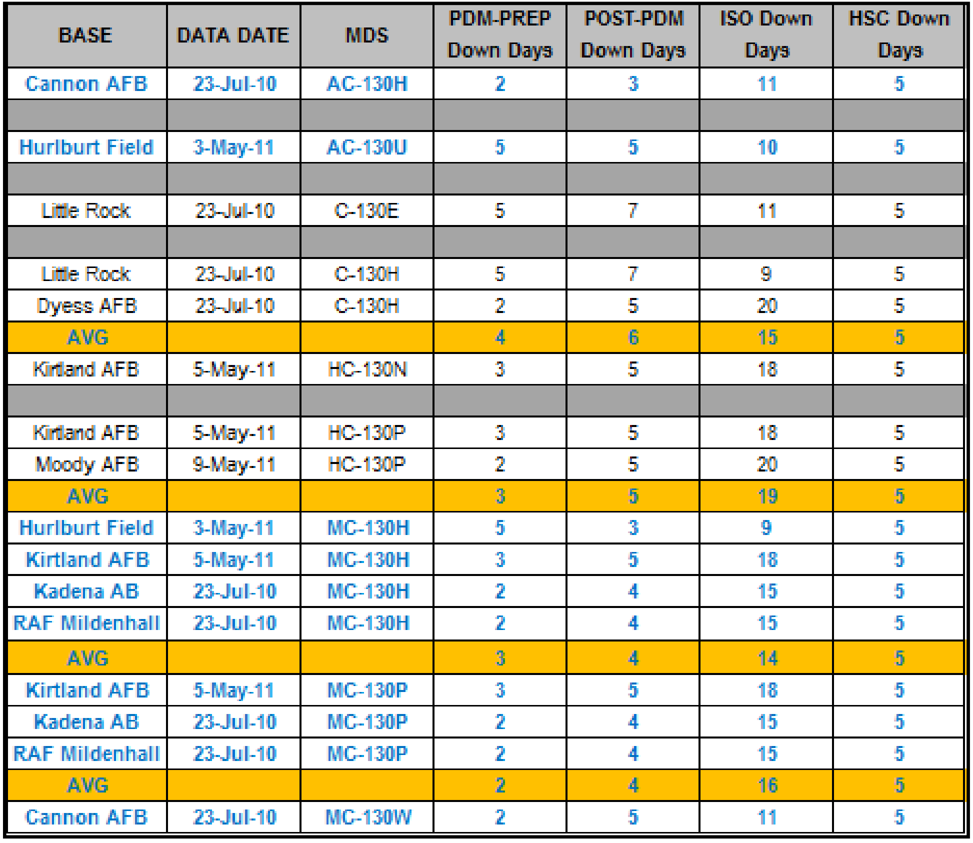
FULL HVM DOWN DAYS				
	PDM-PREP*4	POST-PDM*4	Full HVM Cycle	Total Days
AC-130H	8	12	133	153
AC-130U	20	20	133	173
MC-130H	12	16	133	161
MC-130P	8	16	133	157
MC-130W	8	20	133	161
AVG	11.2	16.8	133	161

In terms of the HSCs accomplished in the field during the mid-point between each HVM cycle and ISO, since the HSCs are accomplished in the field regardless of whether the aircraft is undergoing the HVM cycle or traditional PDM, HSC aircraft down days will not be a factor in either model.

The current planning factor for C-130 aircraft PDM flow days, regardless of MDS, is 164 days (Department of the Air Force, 2010). In order to fully compute the total aircraft down days during the 5 to 6 year period of a traditional PDM, several field-related aircraft down days need to be evaluated. In terms of PDM-prep and post-PDM down days, these factors only occur once since a traditional PDM only occurs once during the 5 to 6 year timeframe. Furthermore, since the ISOs will remain in the field under the traditional PDM concept, the total aircraft down day average for ISOs per MDS will be multiplied by four, and then added to the total aircraft down days; since ISOs are required every 540 days or 18 months in the 5 to 6 year period. As stated previously, the HSC down days are still not a factor since whether the HVM cycle concept or traditional PDM is implemented, the HSCs will still be accomplished in the field at the mid-point between each ISO or HVM cycle.

Since the scope of this research is specific to MDS-specific C-130 aircraft, the survey data was separated per MDS to get averages. Table 11 shows the average field down days per MDS.

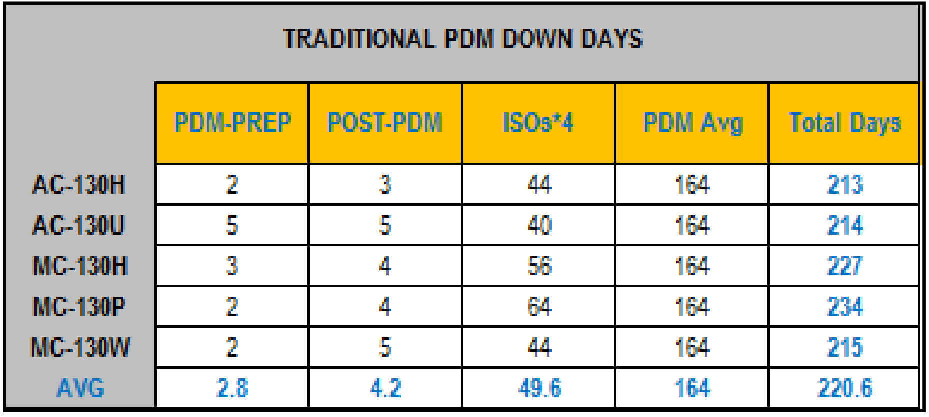
Table 11. Average Field Down Days per C-130 MDS



BASE	DATA DATE	MDS	PDM-PREP Down Days	POST-PDM Down Days	ISO Down Days	HSC Down Days
Cannon AFB	23-Jul-10	AC-130H	2	3	11	5
Hurlburt Field	3-May-11	AC-130U	5	5	10	5
Little Rock	23-Jul-10	C-130E	5	7	11	5
Little Rock	23-Jul-10	C-130H	5	7	9	5
Dyess AFB	23-Jul-10	C-130H	2	5	20	5
AVG			4	6	15	5
Kirtland AFB	5-May-11	HC-130N	3	5	18	5
Kirtland AFB	5-May-11	HC-130P	3	5	18	5
Moody AFB	9-May-11	HC-130P	2	5	20	5
AVG			3	5	19	5
Hurlburt Field	3-May-11	MC-130H	5	3	9	5
Kirtland AFB	5-May-11	MC-130H	3	5	18	5
Kadena AB	23-Jul-10	MC-130H	2	4	15	5
RAF Mildenhall	23-Jul-10	MC-130H	2	4	15	5
AVG			3	4	14	5
Kirtland AFB	5-May-11	MC-130P	3	5	18	5
Kadena AB	23-Jul-10	MC-130P	2	4	15	5
RAF Mildenhall	23-Jul-10	MC-130P	2	4	15	5
AVG			2	4	16	5
Cannon AFB	23-Jul-10	MC-130W	2	5	11	5

Table 12 below shows the total average aircraft down days per C-130 MDS under the traditional PDM concept. The average total aircraft down days using the traditional PDM concept equates to 220.6 days, whereas the average aircraft down days using the HVM cycle concept equates to 161 days (see Table 10). Based on the comparison of total average aircraft down days between traditional PDM and full HVM cycle concept, a total of 60 aircraft down days are saved under the "Single Maintenance Concept" of HVM. In other words, the 60 aircraft down days saved also means an increase in average aircraft availability of 60 days per aircraft over a 5 to 6 year period or 10 days per aircraft per year.

Table 12. Aircraft Down Days under Traditional PDM Concept



TRADITIONAL PDM DOWN DAYS					
	PDM-PREP	POST-PDM	ISOs*4	PDM Avg	Total Days
AC-130H	2	3	44	164	213
AC-130U	5	5	40	164	214
MC-130H	3	4	56	164	227
MC-130P	2	4	64	164	234
MC-130W	2	5	44	164	215
AVG	2.8	4.2	49.6	164	220.6

4.3. Conclusion

In summary, the results to the two main research objectives indentified earlier in the chapter are as follows:

1. Effects of incrementally increasing burn rates from actual average (current), 300-, 400-, 500-labor hours respectively towards C-130 production flow days and C-130 on-time delivery rates.

From the analysis of the data presented in this chapter, at the actual (current) average burn rate of 195 labor-hours per day (see Table 5), the average production work flow days is 140 days (see Table 5). When compared to the burn rate of 300 labor-hours per day, the production work flow days decrease to 84 days (see Table 6);

thus, the effect of increasing the average burn rate by only 105 hours per day would decrease the average production work flow day by 56 days or a 40 percent decrease in total production flow days.

In terms of the effects of increased burn rates to on-time aircraft delivery rates, at the overall actual average burn rate of 195 hours (see Table 5), the on-time delivery rate of 27 aircraft (see Appendix C.4) is 22.22 percent (see Table 8). When compared to the effects of a 300-hour burn rate, the on-time delivery rate of the same 27 aircraft would increase to 59.26 percent; almost triple the on-time delivery rate when compared to the results of the actual burn rate average; thus, the effects of only increasing the average burn rate by 105 hours to 300 hours, results to almost tripling the AFSOC C-130 aircraft on-time delivery rates.

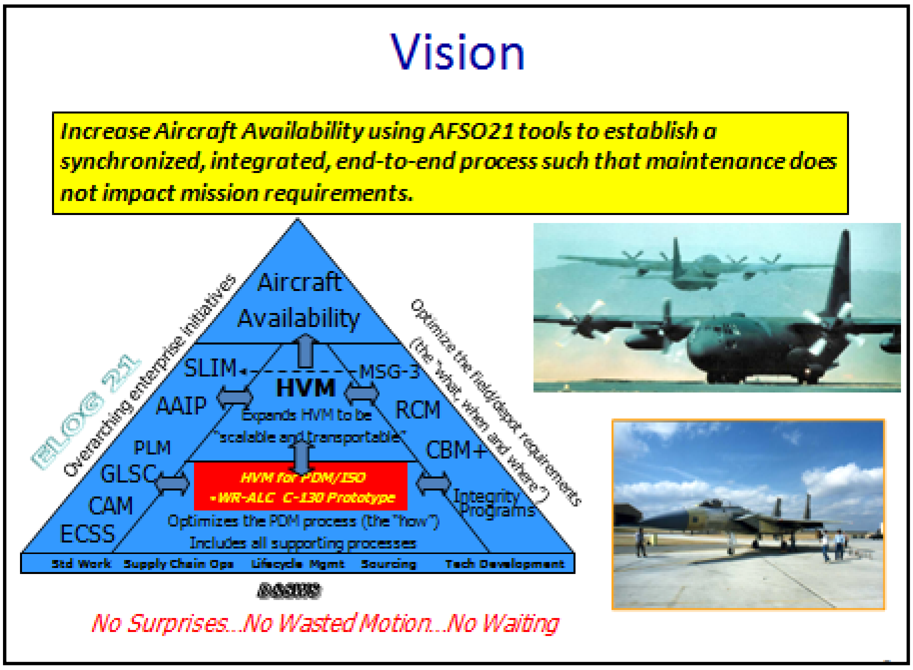
2. Effects of employing the current HVM Cycle approach versus the Traditional PDM process towards improving C-130 aircraft availability.

Likewise, from the results gathered in this section, the total aircraft availability per aircraft increased 60 days over the 5-6 year HVM or PDM period when the HVM cycle versus the traditional PDM schedule is implemented. To simplify by year, that is 10 additional days of aircraft availability per aircraft that is given back to the customer.

In closing, the results of both research objectives prove positive for the application of increased burn rates to achieve on-time delivery rates, and the employment of integrating depot and field maintenance through HVM's "Single Maintenance Concept" to improve C-130 aircraft availability.

5. Recommendations

This study indicates that employing HVM tenets and concept of knowing aircraft condition, providing improved supportability through MRSP, choreographing and executing daily standard work through an integrated BOM and BOW approach, achieving high labor-burn rates, and integrating field and depot maintenance positively affect both on-time aircraft delivery and aircraft availability rates. However, since HVM application at WR-ALC is still maturing and the field-customer trust of receiving aircraft on schedule, under cost, with zero customer defects as expected still building, further efforts of improving HVM supportability and production under AFSO21 needs to continue (see Figure 18).



Vision

Increase Aircraft Availability using AFSO21 tools to establish a synchronized, integrated, end-to-end process such that maintenance does not impact mission requirements.

No Surprises...No Wasted Motion...No Waiting

Figure 18. HVM Vision with AFSO 21 Tools (WR-ALC HVM Office (c), 2010)

Future recommended research opportunities that could be further analyzed to better support WR-ALC's HVM initiative are as follows:

1. Standardized accounting of overall labor-burn rates at depot to improve data accuracy and validity; in turn, enable labor-burn rate to be used as valid planning factor to man-load aircraft, determine WIP, and optimize production schedules.

2. Optimum labor-burn rate tool to determine and execute optimal labor-burn rate target to produce the most number of aircraft on-time at least labor-burn hours and cost.

3. Optimum C-130 aircraft WIP target based on customer and fleet requirements, equipment, support, and personnel capacity design limits to improve aircraft throughput and on-time depot production.

4. Improved analytical (non-destructive inspection) tools and techniques versus engine borescopes to accurately assess excessive corrosion and stressed areas during pre-induction or look-ahead inspections to better plan, execute, or defer maintenance requirements.

5. ERP capability to fill gap prior to full ECSS implementation to enable the single-input, accuracy, transparency, and accessibility of aircraft condition data, supply, and fleet scheduling requirements both at depot and at field.

5\. Synchronize HVM validation metrics to overarching objectives of delivering aircraft as scheduled, under cost, and at customer specification; in turn, affecting aircraft availability.

6. Robotics usage in aircraft disassembly and reassembly under the HVM short-cycle concept to minimize variability and improve production time.

Appendix A: WR-ALC PDM-used Information Systems (Cain M. , WR-ALC PDM-used Information Systems, 2011)

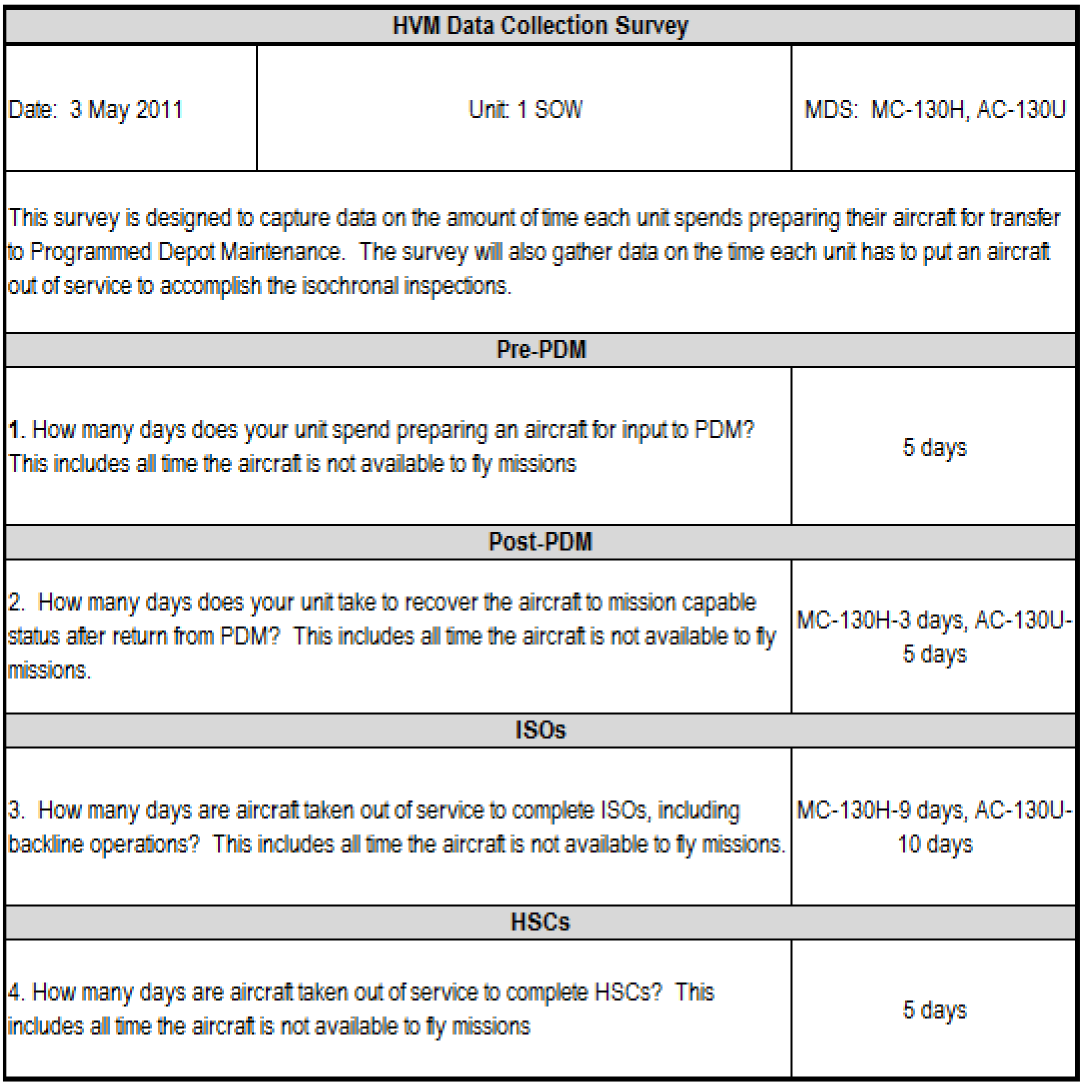
1. System Name	DMAPS Time and Attendance (TAA)
System Acronym	TAA
Data System Designator (DSD)	
System Description	Time And Attendance (TAA) is one of the DMAPS suites of systems. The purpose of TAA is to collect labor cost at the task level. Through implementation of DMAPS, the detailed information in TAA includes labor hours as well as production data. On a real-time basis, DMAPS provides production data from TAA to the three production control systems (PDMSS, FEM, and ITS) enabling continued tracking of schedules and work flow. TAA feeds these labor hours to DIFMS nightly for our DMAG cost. TAA also automatically feeds labor exceptions to the payroll system DCPS.
2. System Name	DMAPS Data Store (DDS)
System Acronym	DDS
Data System Designator (DSD)	DDS
System Description	The purpose of the DMAPS Data Store (DDS) SCS is to provide a relational database repository allowing a variety of functional users to inquire and retrieve production information. The primary users of the CSC are Production Supervisors, Production Planners, Work Loaders, Cost Analysts, Cost Accountants, Budget Analysts and Support Supervisors. The Purpose of the DDS is: - Provide a graphical user interface to change JON financial status to closed and/or set restriction codes for JONs. - Store induction, JON, base hours, actual hours, and job order cost at task level, and other task data from legacy, TAA, and DIFMS systems. - Roll-up and summarize production and financial data in the DDS database for warehousing and reporting. - Provide production and financial reporting capability to user base. - Support calculation of occurrence factors, cost analysis, variance analysis and transactional analysis. The DDS CSC is comprised of two database CSUs, DDS_DB and DDS_RI_DB, and many procedural CSUs that implement the necessary business rules to populate the DDS.
3. System Name	DMAPS Defense Industrial Financial Management System (DIFMS)
System Acronym	DIFMS
Data System Designator (DSD)	
System Description	DIFMS is the official system of record for DMAPS - includes several subsystems.
4. System Name	Labor Standard Mechanization System (LSMS)
System Acronym	LSMS
Data System Designator	E046B

(DSD)	
System Description	E046B is used to establish and maintain labor standards that are used for planning, forecasting, production count, data validation, and tracking direct product standard hours.
5. System Name	Enterprise Management Information System (EMIS)
System Acronym	EMIS
Data System Designator (DSD)	EMIS
System Description	EMIS is a web-based information system and enterprise-level integrator for Aircraft Repair Enhancement Program (AREP) applications supporting the 402 MXW. EMIS applications include: ROCIT (Role Oriented Consolidated Information Tool), D012 - Material Production Components System (MPCS), FOM (Facilitate Other Maintenance), RIPL (Routed Items Parts Locator), MWR (Maintenance Work Requests), CANN (Parts Cannibalization Tracking), XX-RCC (Work Control Document RCC Assignment), CCM (Change Control Manager), Ask IT(BLOG/Frequently Asked Questions) Detailed information about these applications is available at the EMIS website.
6. System Name	Depot Maintenance Workload Planning and Control System (MWPCS)
System Acronym	MWPCS
Data System Designator (DSD)	G004C
System Description	The G004C system provides maintenance management and material management funding personnel at the ALCs the capacity to plan workload and manpower actions for a five-year period, and track the results of that plan. It also provides the capability to price all ALC workload by applying established RCC rates.
7. System Name	Job Order Production Master System (JOPMS)
System Acronym	JOPMS
Data System Designator (DSD)	G004L
System Description	Provide for organic depot level maintenance, internal workload control and planning and scheduling functions within the Air Logistic Centers.
8. System Name	Wholesale and Retail Receiving/Shipping (WARRS)
System Acronym	WARRS
Data System Designator (DSD)	D035K
System Description	D035K is an on-line driven system where 10 of the 22 Stock Control System (SCS) functions are supported. They include: computing retail requirements, property accounting, producing management products, maintaining cataloging and management control data, receiving, storing and inventory of material, producing external system interfaces

	all the while maintaining complete data visibility for single transaction items. D035K maintains historical data for all accountable retail transactions and others.
9. System Name	Depot Maintenance Materiel Support System (DMMSS)
System Acronym	DMMSS
Data System Designator (DSD)	G005M
System Description	The G005M system is used to identify material that must be positioned to support maintenance workloads. This system also is a source for identifying cost associated with depot repair. The systems intent is to increase the effectiveness of material standards.
10. System Name	Materiel Processing System (MPS)
System Acronym	MPS
Data System Designator (DSD)	D230
System Description	The Material Processing System (MPS) was designed to: (1) allow the mechanic to order parts directly from the maintenance floor, (2) allow production controllers to support the orders by computer and (3) automate the parts pulling process.
11. System Name	DMAPS Automated Bill of Material (ABOM)
System Acronym	ABOM
Data System Designator (DSD)	None
System Description	Automated Bill of Material (ABOM) system is the front-end validation system to the NAVAIR Industrial Material Management System (NIMMS). ABOM provides on-line BOM updates, batch and single order processing, query capabilities, administrative background programs for database and system maintenance. It also provides user with front-end validation of data, generates order/requisition records, history records, and maintains an audit trail to monitor any BOM file updates.
12. System Acronym	NIMMS
Data System Designator (DSD)	None
System Description	NIMMS is the Back-End-System and the principle vehicle for transaction (requisitions, turn-ins, etc) input, update, and retrieval of data from the database. NIMMS in the inventory management system where material inventory is managed and stored, issued, updated, and where costs are applied and submitted to the Defense Industrial Financial Management System (DIFMS).
13. System Name	MISTR Requirements Scheduling and Analysis System (MISTR)
System Acronym	MISTR
Data System Designator (DSD)	G019C
System Description	G019C provides maintenance with scheduling and analysis data on

	Management Items Subject to Repair (MISTR) items. Schedules and track MISTR items and provides management information necessary to respond to the turnaround required by the repair cycle.
14. System Name	Programmed Depot Maintenance Scheduling System (PDMSS)
System Acronym	PDMSS
Data System Designator (DSD)	G097
System Description	G097-PDMSS is the USAF standard project management information system, which facilitates planning, tracking, scheduling and execution, and performance measurement activities for programmed/unprogrammed depot maintenance workload at Air Logistics Centers (ALCs). The Defense Depot Maintenance Council Joint Policy Coordinating Group-Depot Maintenance (JPCG-DM) requirements supported by PDMSS include: Facilitate workflow scheduling by operation and major job; Optimize resource allocation; Manage capacity and labor utilization more effectively; Facilitate competitive positioning; and Strengthen performance measurement visibility.
15. System Name	Inventory Tracking System (ITS)
System Acronym	ITS
Data System Designator (DSD)	G337
System Description	G337 is an online real-time data system. It tracks parts through the maintenance overhaul line. It assigns Item Tracking Numbers (ITNs) to all parts as they come into the shop and subsequently tracks them and their subassemblies/components through the disassembly, repair, and assembly processes. G337 is divided into three sub-systems: Production Planning, Scheduling Support, and Production/Shop Floor Support. A logon ID and password are assigned for system integrity.
16. System Name	Exchangeable Production System (EPS)
System Acronym	EPS
Data System Designator (DSD)	G402A
System Description	G402A enables Depot Maintenance to communicate directly with Supply. G402A enables the user to view workload requirement, end item assets availability in Supply, and Job Order Number (JON) data for all workloads. Users can also update Maintenance and Supply records by processing production issues and turn-in transactions.
17. System Name	Cost Performance and Budget Module
System Acronym	CPBM
Data System Designator (DSD)	H033
System Description	The Cost and Production Performance Module (CPPM) is a management information system that provides clear, concise and tailored financial and production information as well as essential performance indicators to each ALC manager. CPPM supports ALC managers

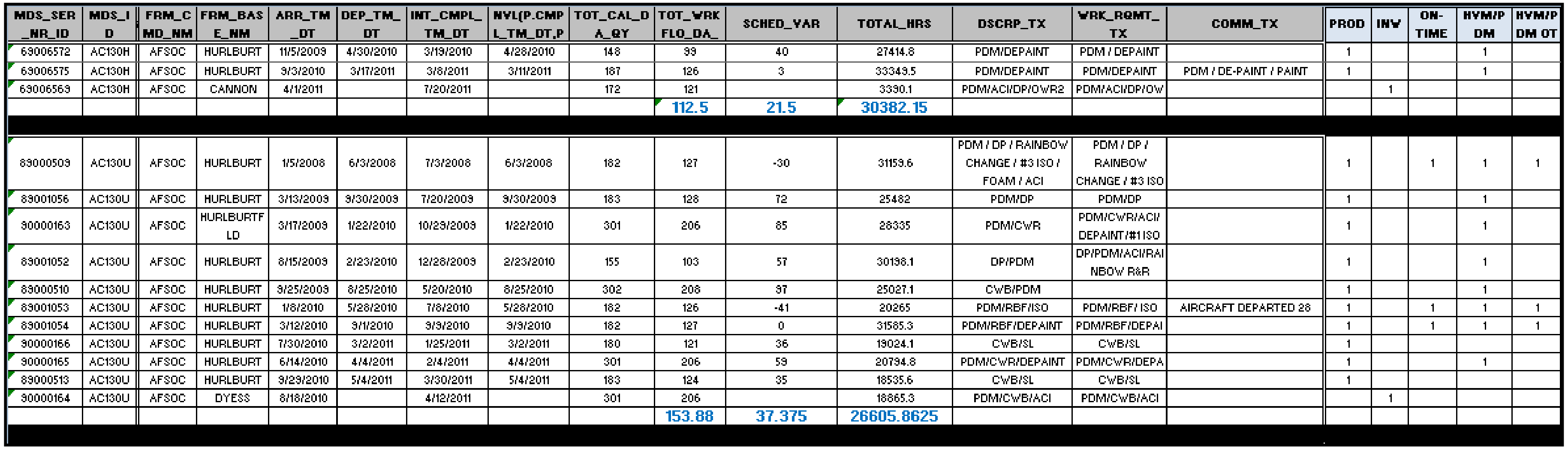
Appendix B. Field Questionnaire



HVM Data Collection Survey		
Date: 3 May 2011	Unit: 1 SOW	MDS: MC-130H, AC-130U
This survey is designed to capture data on the amount of time each unit spends preparing their aircraft for transfer to Programmed Depot Maintenance. The survey will also gather data on the time each unit has to put an aircraft out of service to accomplish the isochronal inspections.		
Pre-PDM		
1. How many days does your unit spend preparing an aircraft for input to PDM? This includes all time the aircraft is not available to fly missions		5 days
Post-PDM		
2. How many days does your unit take to recover the aircraft to mission capable status after return from PDM? This includes all time the aircraft is not available to fly missions.		MC-130H-3 days, AC-130U-5 days
ISOs		
3. How many days are aircraft taken out of service to complete ISOs, including backline operations? This includes all time the aircraft is not available to fly missions.		MC-130H-9 days, AC-130U-10 days
HSCs		
4. How many days are aircraft taken out of service to complete HSCs? This includes all time the aircraft is not available to fly missions		5 days

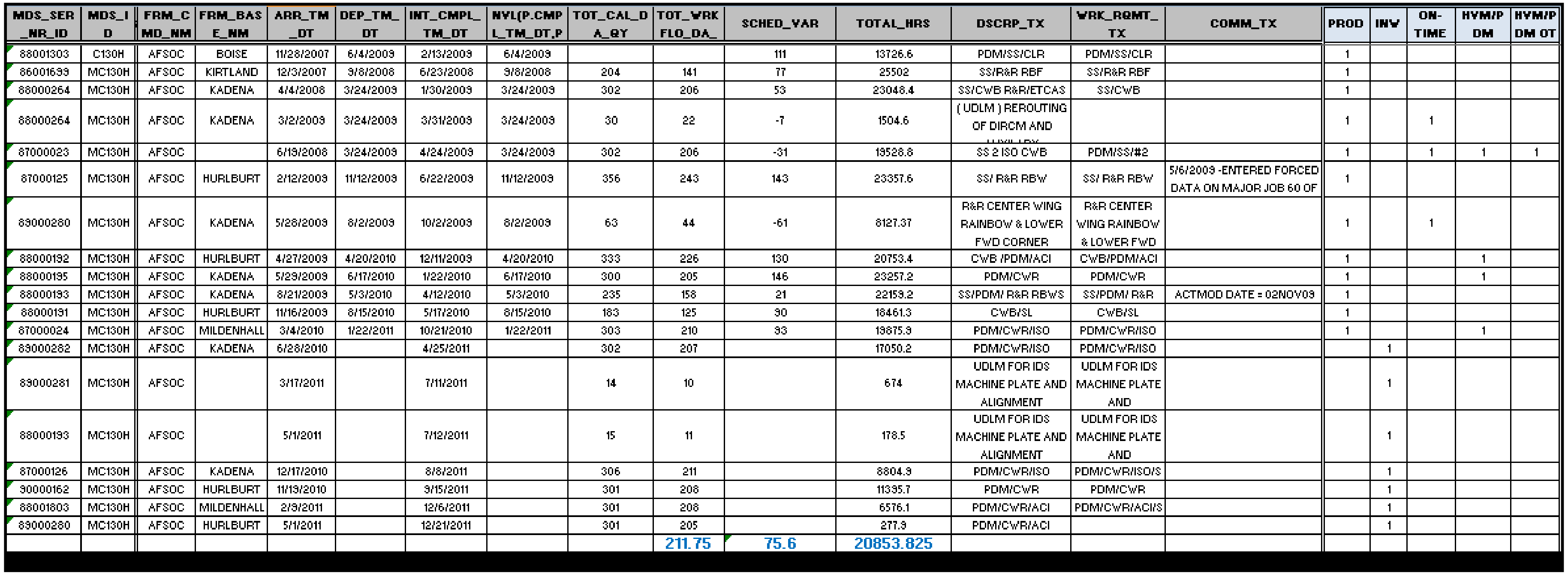
Appendix C: GO97-PDMSS C-130 Data

C.1. AC-130H and AC-130U Data (Cain M. , personal communication, May 6, 2011)



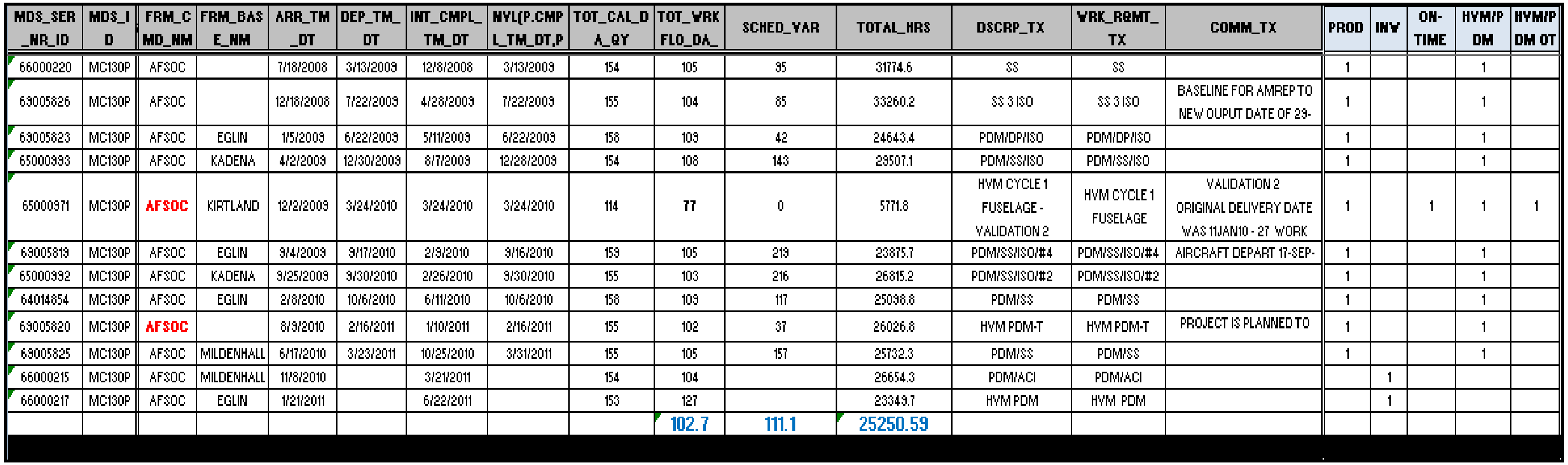
MDS_SER_NR_ID	MDS_ID	FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NVL(P.CMPL_TM_DT,P	TOT_CAL_DA_QY	TOT_WRKFLO_DA_	SCHED_VAR	TOTAL_HRS	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INV	ON-TIME	HVM/PDM	HVM/PDM OT
69006572	AC130H	AFSOC	HURLBURT	11/5/2009	4/30/2010	3/19/2010	4/28/2010	148	99	40	27414.8	PDM/DEPAINT	PDM / DEPAINT		1			1	
69006575	AC130H	AFSOC	HURLBURT	9/3/2010	3/17/2011	3/8/2011	3/11/2011	187	126	3	33349.5	PDM/DEPAINT	PDM/DEPAINT	PDM / DE-PAINT / PAINT	1			1	
69006569	AC130H	AFSOC	CANNON	4/1/2011		7/20/2011		172	121		3390.1	PDM/ACI/DP/OWR2	PDM/ACI/DP/OW			1			
									112.5	21.5	30382.15								
89000509	AC130U	AFSOC	HURLBURT	1/5/2008	6/3/2008	7/3/2008	6/3/2008	182	127	-30	31159.6	PDM / DP / RAINBOW CHANGE / #3 ISO / FOAM / ACI	PDM / DP / RAINBOW CHANGE / #3 ISO		1		1	1	1
89001056	AC130U	AFSOC	HURLBURT	3/13/2009	9/30/2009	7/20/2009	9/30/2009	183	128	72	25482	PDM/DP	PDM/DP		1			1	
90000163	AC130U	AFSOC	HURLBURTFLD	3/17/2009	1/22/2010	10/29/2009	1/22/2010	301	206	85	28335	PDM/CWR	PDM/CWR/ACI/DEPAINT/#1 ISO		1			1	
89001052	AC130U	AFSOC	HURLBURT	8/15/2009	2/23/2010	12/28/2009	2/23/2010	155	103	57	30198.1	DP/PDM	DP/PDM/ACI/RAINBOW R&R		1			1	
89000510	AC130U	AFSOC	HURLBURT	9/25/2009	8/25/2010	5/20/2010	8/25/2010	302	208	97	25027.1	CWB/PDM			1			1	
89001053	AC130U	AFSOC	HURLBURT	1/8/2010	5/28/2010	7/8/2010	5/28/2010	182	126	-41	20265	PDM/RBF/ISO	PDM/RBF/ ISO	AIRCRAFT DEPARTED 28	1		1	1	1
89001054	AC130U	AFSOC	HURLBURT	3/12/2010	9/1/2010	9/9/2010	9/9/2010	182	127	0	31585.3	PDM/RBF/DEPAINT	PDM/RBF/DEPAI		1		1	1	1
90000166	AC130U	AFSOC	HURLBURT	7/30/2010	3/2/2011	1/25/2011	3/2/2011	180	121	36	19024.1	CWB/SL	CWB/SL		1				
90000165	AC130U	AFSOC	HURLBURT	6/14/2010	4/4/2011	2/4/2011	4/4/2011	301	206	59	20794.8	PDM/CWR/DEPAINT	PDM/CWR/DEPA		1			1	
89000513	AC130U	AFSOC	HURLBURT	9/29/2010	5/4/2011	3/30/2011	5/4/2011	183	124	35	18535.6	CWB/SL	CWB/SL		1				
90000164	AC130U	AFSOC	DYESS	8/18/2010		4/12/2011		301	206		18865.3	PDM/CWB/ACI	PDM/CWB/ACI			1			
									153.88	37.375	26605.8625								

C.2. MC-130H Data (Cain M. , personal communication, May 6, 2011)



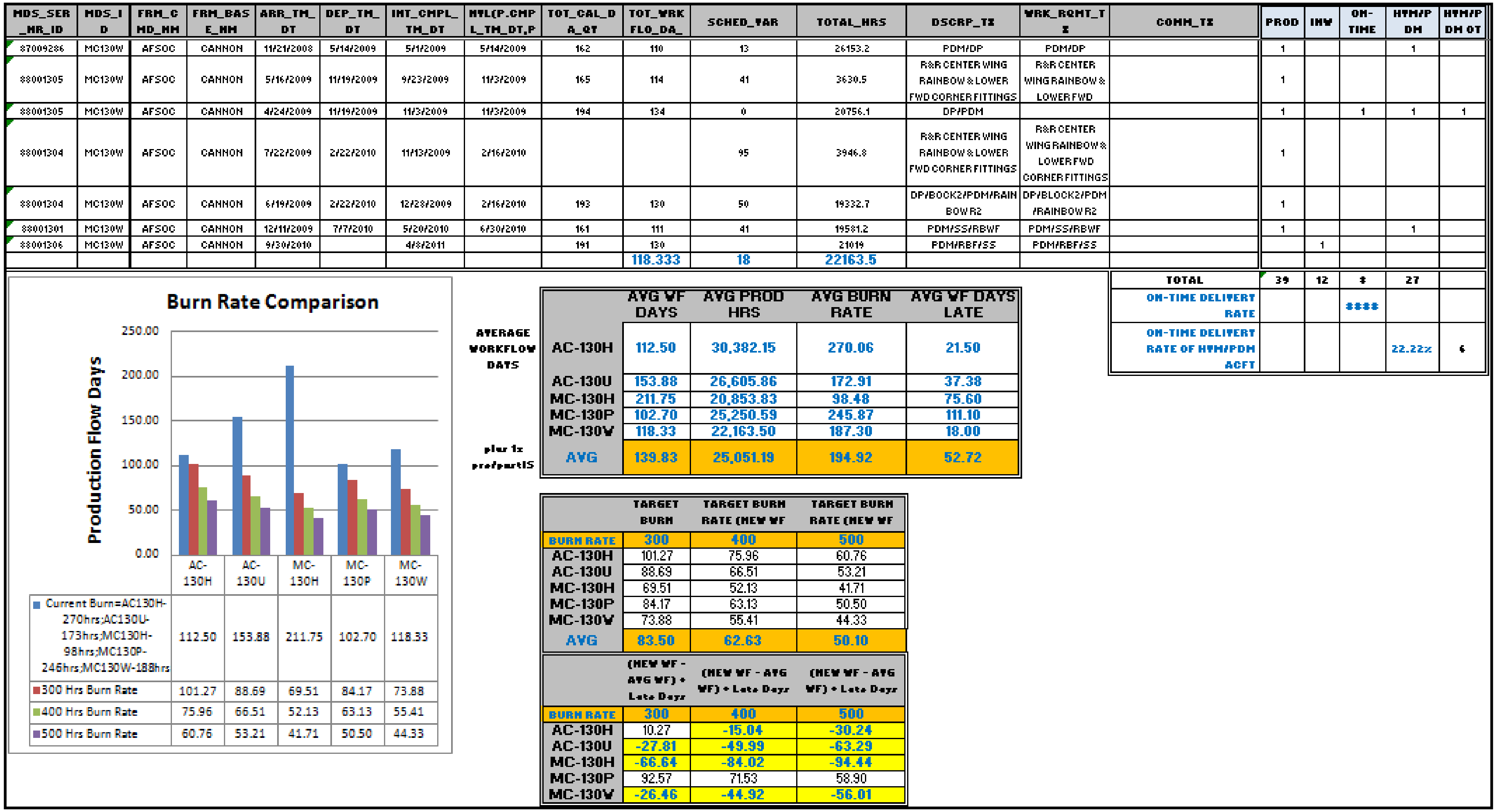
MDS_SER_NR_ID	MDS_ID	FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NVL(P.CMPL_TM_DT,P	TOT_CAL_DA_QY	TOT_WRK FLO_DA_	SCHED_VAR	TOTAL_HRS	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INV	ON-TIME	HVM/PDM	HVM/PDM OT
88001303	C130H	AFSOC	BOISE	11/28/2007	6/4/2009	2/13/2009	6/4/2009			111	13726.6	PDM/SS/CLR	PDM/SS/CLR		1				
86001699	MC130H	AFSOC	KIRTLAND	12/3/2007	9/8/2008	6/23/2008	9/8/2008	204	141	77	25502	SS/R&R RBF	SS/R&R RBF		1				
88000264	MC130H	AFSOC	KADENA	4/4/2008	3/24/2009	1/30/2009	3/24/2009	302	206	53	23048.4	SS/CWB R&R/ETCAS	SS/CWB		1				
88000264	MC130H	AFSOC	KADENA	3/2/2009	3/24/2009	3/31/2009	3/24/2009	30	22	-7	1504.6	(UDLM) REROUTING OF DIRCM AND			1		1		
87000023	MC130H	AFSOC		6/19/2008	3/24/2009	4/24/2009	3/24/2009	302	206	-31	19528.8	SS 2 ISO CWB	PDM/SS/#2		1		1	1	1
87000125	MC130H	AFSOC	HURLBURT	2/12/2009	11/12/2009	6/22/2009	11/12/2009	356	243	143	23357.6	SS/ R&R RBW	SS/ R&R RBW	5/6/2009 -ENTERED FORCED DATA ON MAJOR JOB 60 OF	1				
89000280	MC130H	AFSOC	KADENA	5/28/2009	8/2/2009	10/2/2009	8/2/2009	63	44	-61	8127.37	R&R CENTER WING RAINBOW & LOWER FWD CORNER	R&R CENTER WING RAINBOW & LOWER FWD		1		1		
88000192	MC130H	AFSOC	HURLBURT	4/27/2009	4/20/2010	12/11/2009	4/20/2010	333	226	130	20753.4	CWB /PDM/ACI	CWB/PDM/ACI		1			1	
88000195	MC130H	AFSOC	KADENA	5/29/2009	6/17/2010	1/22/2010	6/17/2010	300	205	146	23257.2	PDM/CWR	PDM/CWR		1			1	
88000193	MC130H	AFSOC	KADENA	8/21/2009	5/3/2010	4/12/2010	5/3/2010	235	158	21	22159.2	SS/PDM/ R&R RBWS	SS/PDM/ R&R	ACTMOD DATE = 02NOV09	1				
88000191	MC130H	AFSOC	HURLBURT	11/16/2009	8/15/2010	5/17/2010	8/15/2010	183	125	90	18461.3	CWB/SL	CWB/SL		1				
87000024	MC130H	AFSOC	MILDENHALL	3/4/2010	1/22/2011	10/21/2010	1/22/2011	303	210	93	19875.9	PDM/CWR/ISO	PDM/CWR/ISO		1			1	
89000282	MC130H	AFSOC	KADENA	6/28/2010		4/25/2011		302	207		17050.2	PDM/CWR/ISO	PDM/CWR/ISO			1			
89000281	MC130H	AFSOC		3/17/2011		7/11/2011		14	10		674	UDLM FOR IDS MACHINE PLATE AND ALIGNMENT	UDLM FOR IDS MACHINE PLATE AND			1			
88000193	MC130H	AFSOC		5/1/2011		7/12/2011		15	11		178.5	UDLM FOR IDS MACHINE PLATE AND ALIGNMENT	UDLM FOR IDS MACHINE PLATE AND			1			
87000126	MC130H	AFSOC	KADENA	12/17/2010		8/8/2011		306	211		8804.9	PDM/CWR/ISO	PDM/CWR/ISO/S			1			
90000162	MC130H	AFSOC	HURLBURT	11/19/2010		9/15/2011		301	208		11395.7	PDM/CWR	PDM/CWR			1			
88001803	MC130H	AFSOC	MILDENHALL	2/9/2011		12/6/2011		301	208		6576.1	PDM/CWR/ACI	PDM/CWR/ACI/S			1			
89000280	MC130H	AFSOC	HURLBURT	5/1/2011		12/21/2011		301	205		277.9	PDM/CWR/ACI				1			
									211.75	75.6	20853.825								

C.3. MC-130P Data (Cain M. , personal communication, May 6, 2011)



MDS_SER_NR_ID	MDS_ID	FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NYL(P.CMPL_TM_DT,P	TOT_CAL_DA_QY	TOT_WRK FLO_DA_	SCHED_VAR	TOTAL_HRS	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INV	ON-TIME	HVM/PDM	HVM/PDM OT
66000220	MC130P	AFSOC		7/18/2008	3/13/2009	12/8/2008	3/13/2009	154	105	35	31774.6	SS	SS		1			1	
69005826	MC130P	AFSOC		12/18/2008	7/22/2009	4/28/2009	7/22/2009	155	104	85	33260.2	SS 3 ISO	SS 3 ISO	BASELINE FOR AMREP TO NEW OUPUT DATE OF 29-	1			1	
69005823	MC130P	AFSOC	EGLIN	1/5/2009	6/22/2009	5/11/2009	6/22/2009	158	109	42	24643.4	PDM/DP/ISO	PDM/DP/ISO		1			1	
65000993	MC130P	AFSOC	KADENA	4/2/2009	12/30/2009	8/7/2009	12/28/2009	154	108	143	23507.1	PDM/SS/ISO	PDM/SS/ISO		1			1	
65000971	MC130P	**AFSOC**	KIRTLAND	12/2/2009	3/24/2010	3/24/2010	3/24/2010	114	**77**	0	5771.8	HVM CYCLE 1 FUSELAGE - VALIDATION 2	HVM CYCLE 1 FUSELAGE	VALIDATION 2 ORIGINAL DELIVERY DATE WAS 11JAN10 - 27 WORK	1		1	1	1
69005819	MC130P	AFSOC	EGLIN	9/4/2009	9/17/2010	2/9/2010	9/16/2010	159	105	219	23875.7	PDM/SS/ISO/#4	PDM/SS/ISO/#4	AIRCRAFT DEPART 17-SEP-	1			1	
65000992	MC130P	AFSOC	KADENA	9/25/2009	9/30/2010	2/26/2010	9/30/2010	155	103	216	26815.2	PDM/SS/ISO/#2	PDM/SS/ISO/#2		1			1	
64014854	MC130P	AFSOC	EGLIN	2/8/2010	10/6/2010	6/11/2010	10/6/2010	158	109	117	25098.8	PDM/SS	PDM/SS		1			1	
69005820	MC130P	**AFSOC**		8/9/2010	2/16/2011	1/10/2011	2/16/2011	155	102	37	26026.8	HVM PDM-T	HVM PDM-T	PROJECT IS PLANNED TO	1			1	
69005825	MC130P	AFSOC	MILDENHALL	6/17/2010	3/23/2011	10/25/2010	3/31/2011	155	105	157	25732.3	PDM/SS	PDM/SS		1			1	
66000215	MC130P	AFSOC	MILDENHALL	11/8/2010		3/21/2011		154	104		26654.3	PDM/ACI	PDM/ACI			1			
66000217	MC130P	AFSOC	EGLIN	1/21/2011		6/22/2011		153	127		23349.7	HVM PDM	HVM PDM			1			
									102.7	111.1	25250.59								

C.4. MC-130W, Burn Rate, and On-time Delivery Data (Cain M. , personal communication, May 6, 2011)



MDS_SER_NR_ID	MDS_ID	FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NTL(P.CMPL_TM_DT,P	TOT_CAL_DA_QT	TOT_WRK_FLO_DA_	SCHED_VAR	TOTAL_HRS	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INV	ON-TIME	HVM/PDM	HVM/PDM OT
87009286	MC130W	AFSOC	CANNON	11/21/2008	5/14/2009	5/1/2009	5/14/2009	162	110	13	26153.2	PDM/DP	PDM/DP		1			1	
88001305	MC130W	AFSOC	CANNON	5/16/2009	11/19/2009	9/23/2009	11/3/2009	165	114	41	3630.5	R&R CENTER WING RAINBOW & LOWER FWD CORNER FITTINGS	R&R CENTER WING RAINBOW & LOWER FWD		1				
88001305	MC130W	AFSOC	CANNON	4/24/2009	11/19/2009	11/3/2009	11/3/2009	194	134	0	20756.1	DP/PDM			1		1	1	1
88001304	MC130W	AFSOC	CANNON	7/22/2009	2/22/2010	11/13/2009	2/16/2010			95	3946.8	R&R CENTER WING RAINBOW & LOWER FWD CORNER FITTINGS	R&R CENTER WING RAINBOW & LOWER FWD CORNER FITTINGS		1				
88001304	MC130W	AFSOC	CANNON	6/19/2009	2/22/2010	12/28/2009	2/16/2010	193	130	50	19332.7	DP/BOCK2/PDM/RAINBOW R2	DP/BLOCK2/PDM/RAINBOW R2		1				
88001301	MC130W	AFSOC	CANNON	12/11/2009	7/7/2010	5/20/2010	6/30/2010	161	111	41	19581.2	PDM/SS/RBWF	PDM/SS/RBWF		1			1	
88001306	MC130W	AFSOC	CANNON	9/30/2010		4/8/2011		191	130		21019	PDM/RBF/SS	PDM/RBF/SS			1			
									118.333	18	22163.5								

	PROD	INV	ON-TIME	HVM/PDM	HVM/PDM OT
TOTAL	39	12	8	27	
ON-TIME DELIVERY RATE			####		
ON-TIME DELIVERY RATE OF HVM/PDM ACFT				22.22%	6

Burn Rate Comparison

	AC-130H	AC-130U	MC-130H	MC-130P	MC-130W
🟦 Current Burn=AC130H-270hrs;AC130U-173hrs;MC130H-98hrs;MC130P-246hrs;MC130W-188hrs	112.50	153.88	211.75	102.70	118.33
🟥 300 Hrs Burn Rate	101.27	88.69	69.51	84.17	73.88
🟩 400 Hrs Burn Rate	75.96	66.51	52.13	63.13	55.41
🟪 500 Hrs Burn Rate	60.76	53.21	41.71	50.50	44.33

AVERAGE WORKFLOW DAYS

	AVG WF DAYS	AVG PROD HRS	AVG BURN RATE	AVG WF DAYS LATE
AC-130H	112.50	30,382.15	270.06	21.50
AC-130U	153.88	26,605.86	172.91	37.38
MC-130H	211.75	20,853.83	98.48	75.60
MC-130P	102.70	25,250.59	245.87	111.10
MC-130W	118.33	22,163.50	187.30	18.00
AVG	139.83	25,051.19	194.92	52.72

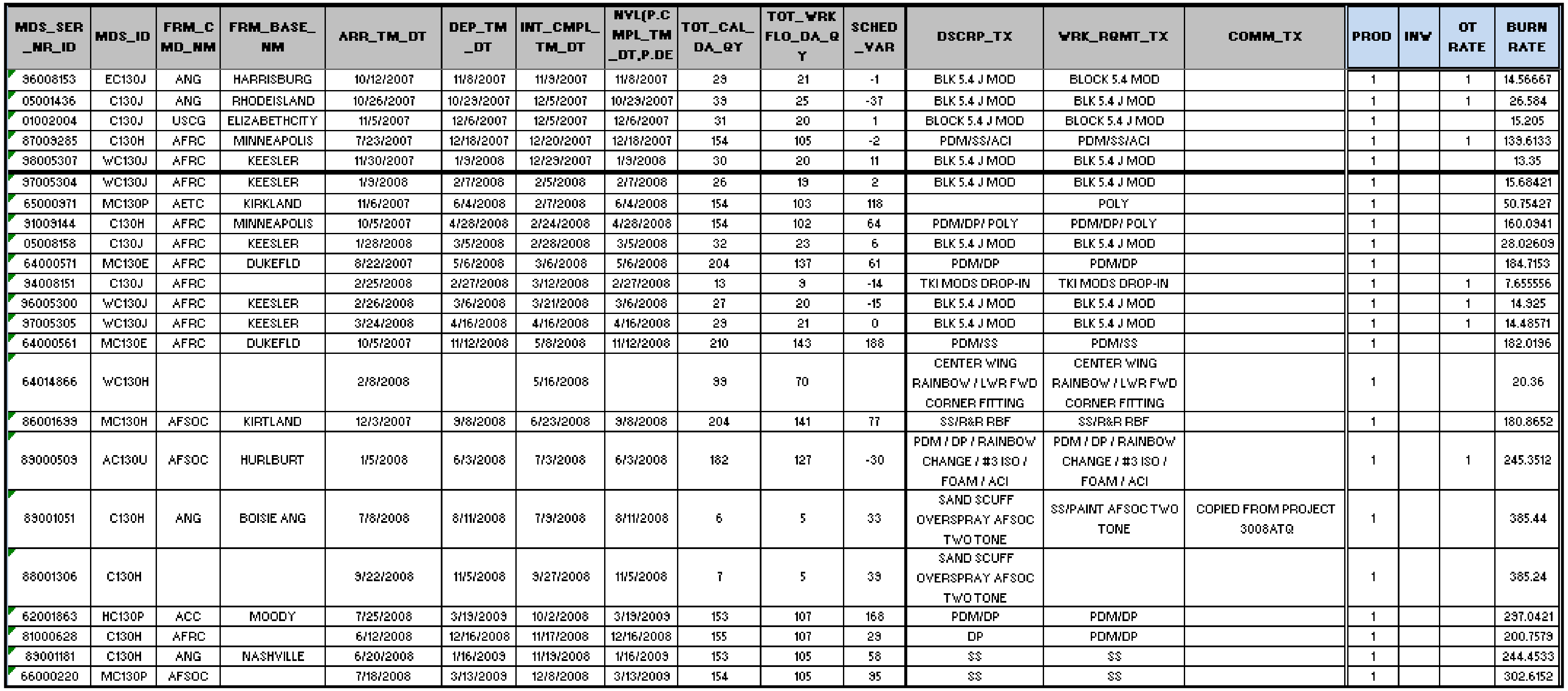
plus 1x pre/post15

	TARGET BURN	TARGET BURN RATE (NEW WF	TARGET BURN RATE (NEW WF
BURN RATE	300	400	500
AC-130H	101.27	75.96	60.76
AC-130U	88.69	66.51	53.21
MC-130H	69.51	52.13	41.71
MC-130P	84.17	63.13	50.50
MC-130W	73.88	55.41	44.33
AVG	83.50	62.63	50.10

	(NEW WF - AVG WF) + Late Days	(NEW WF - AVG WF) + Late Days	(NEW WF - AVG WF) + Late Days
BURN RATE	300	400	500
AC-130H	10.27	-15.04	-30.24
AC-130U	-27.81	-49.99	-63.29
MC-130H	-66.64	-84.02	-94.44
MC-130P	92.57	71.53	58.90
MC-130W	-26.46	-44.92	-56.01

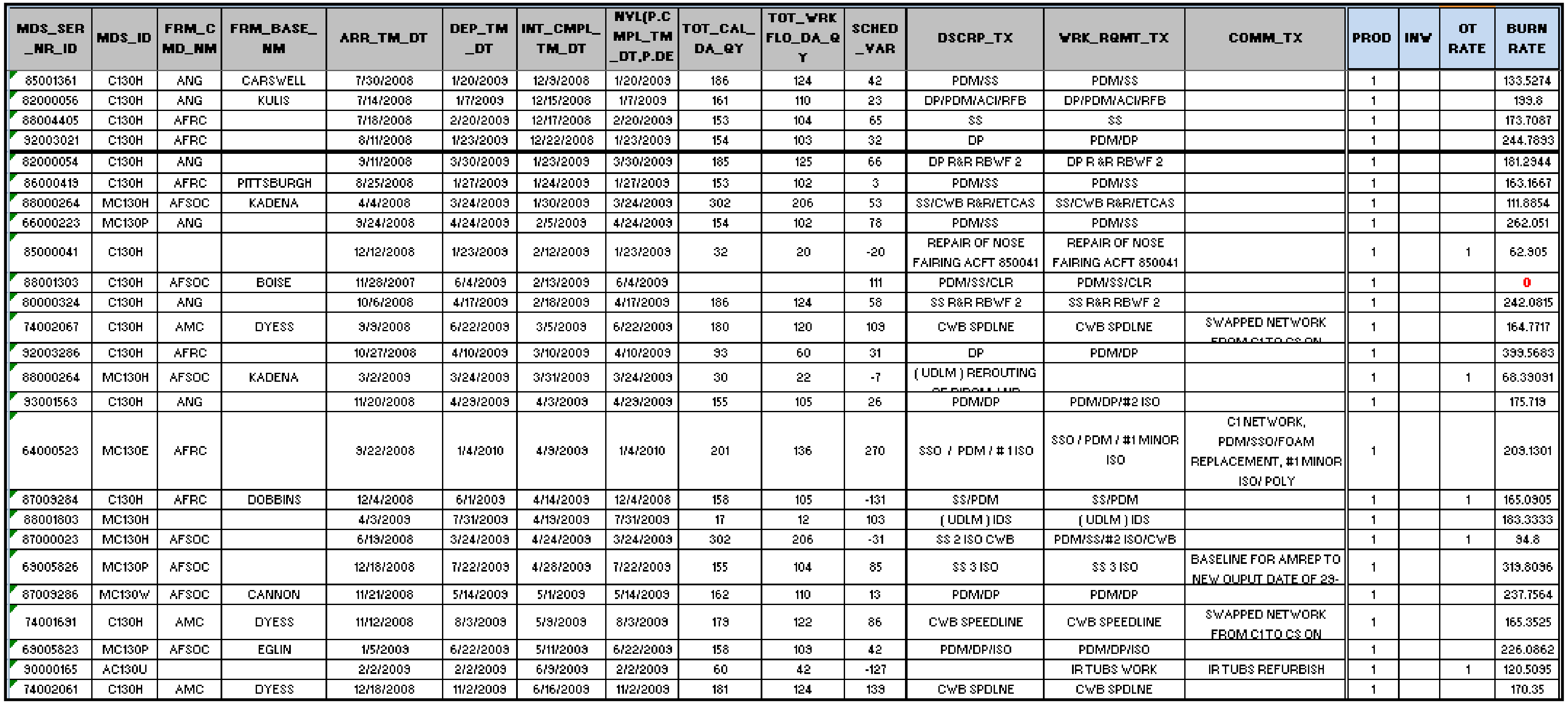
C.5. All C-130 PDM Data from July 2007 – May 2011

C.5.1. Lines 2 through 24 (Cain M. , personal communication, May 6, 2011)



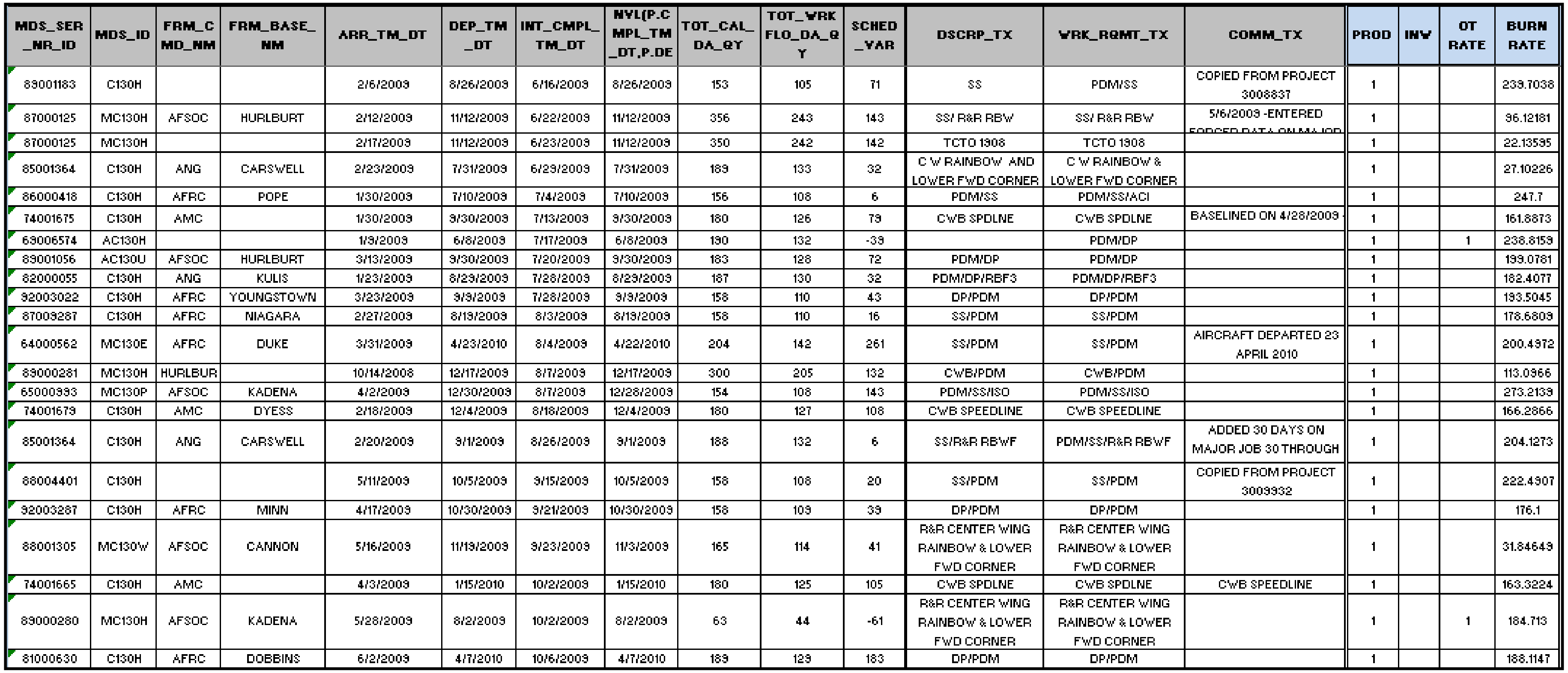
MDS_SER_NR_ID	MDS_ID	FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NYL(P.CMPL_TM_DT,P.DE	TOT_CAL_DA_QY	TOT_WRK FLO_DA_QY	SCHED_VAR	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INV	OT RATE	BURN RATE
96008153	EC130J	ANG	HARRISBURG	10/12/2007	11/8/2007	11/9/2007	11/8/2007	29	21	-1	BLK 5.4 J MOD	BLOCK 5.4 MOD		1		1	14.56667
05001436	C130J	ANG	RHODEISLAND	10/26/2007	10/29/2007	12/5/2007	10/29/2007	39	25	-37	BLK 5.4 J MOD	BLK 5.4 J MOD		1		1	26.584
01002004	C130J	USCG	ELIZABETHCITY	11/5/2007	12/6/2007	12/5/2007	12/6/2007	31	20	1	BLOCK 5.4 J MOD	BLOCK 5.4 J MOD		1			15.205
87009285	C130H	AFRC	MINNEAPOLIS	7/23/2007	12/18/2007	12/20/2007	12/18/2007	154	105	-2	PDM/SS/ACI	PDM/SS/ACI		1		1	139.6133
98005307	WC130J	AFRC	KEESLER	11/30/2007	1/9/2008	12/29/2007	1/9/2008	30	20	11	BLK 5.4 J MOD	BLK 5.4 J MOD		1			13.35
97005304	WC130J	AFRC	KEESLER	1/9/2008	2/7/2008	2/5/2008	2/7/2008	26	19	2	BLK 5.4 J MOD	BLK 5.4 J MOD		1			15.68421
65000971	MC130P	AETC	KIRKLAND	11/6/2007	6/4/2008	2/7/2008	6/4/2008	154	103	118		POLY		1			50.75427
91009144	C130H	AFRC	MINNEAPOLIS	10/5/2007	4/28/2008	2/24/2008	4/28/2008	154	102	64	PDM/DP/ POLY	PDM/DP/ POLY		1			160.0941
05008158	C130J	AFRC	KEESLER	1/28/2008	3/5/2008	2/28/2008	3/5/2008	32	23	6	BLK 5.4 J MOD	BLK 5.4 J MOD		1			28.02609
64000571	MC130E	AFRC	DUKEFLD	8/22/2007	5/6/2008	3/6/2008	5/6/2008	204	137	61	PDM/DP	PDM/DP		1			184.7153
94008151	C130J	AFRC		2/25/2008	2/27/2008	3/12/2008	2/27/2008	13	9	-14	TKI MODS DROP-IN	TKI MODS DROP-IN		1		1	7.655556
96005300	WC130J	AFRC	KEESLER	2/26/2008	3/6/2008	3/21/2008	3/6/2008	27	20	-15	BLK 5.4 J MOD	BLK 5.4 J MOD		1		1	14.925
97005305	WC130J	AFRC	KEESLER	3/24/2008	4/16/2008	4/16/2008	4/16/2008	29	21	0	BLK 5.4 J MOD	BLK 5.4 J MOD		1		1	14.48571
64000561	MC130E	AFRC	DUKEFLD	10/5/2007	11/12/2008	5/8/2008	11/12/2008	210	143	188	PDM/SS	PDM/SS		1			182.0196
64014866	WC130H			2/8/2008		5/16/2008		99	70		CENTER WING RAINBOW / LWR FWD CORNER FITTING	CENTER WING RAINBOW / LWR FWD CORNER FITTING		1			20.36
86001699	MC130H	AFSOC	KIRTLAND	12/3/2007	9/8/2008	6/23/2008	9/8/2008	204	141	77	SS/R&R RBF	SS/R&R RBF		1			180.8652
89000509	AC130U	AFSOC	HURLBURT	1/5/2008	6/3/2008	7/3/2008	6/3/2008	182	127	-30	PDM / DP / RAINBOW CHANGE / #3 ISO / FOAM / ACI	PDM / DP / RAINBOW CHANGE / #3 ISO / FOAM / ACI		1		1	245.3512
89001051	C130H	ANG	BOISIE ANG	7/8/2008	8/11/2008	7/9/2008	8/11/2008	6	5	33	SAND SCUFF OVERSPRAY AFSOC TWO TONE	SS/PAINT AFSOC TWO TONE	COPIED FROM PROJECT 3008ATQ	1			385.44
88001306	C130H			9/22/2008	11/5/2008	9/27/2008	11/5/2008	7	5	39	SAND SCUFF OVERSPRAY AFSOC TWO TONE			1			385.24
62001863	HC130P	ACC	MOODY	7/25/2008	3/19/2009	10/2/2008	3/19/2009	153	107	168	PDM/DP	PDM/DP		1			297.0421
81000628	C130H	AFRC		6/12/2008	12/16/2008	11/17/2008	12/16/2008	155	107	29	DP	PDM/DP		1			200.7579
89001181	C130H	ANG	NASHVILLE	6/20/2008	1/16/2009	11/19/2008	1/16/2009	153	105	58	SS	SS		1			244.4533
66000220	MC130P	AFSOC		7/18/2008	3/13/2009	12/8/2008	3/13/2009	154	105	95	SS	SS		1			302.6152

C.5.2. Lines 25 through 49 (Cain M. , personal communication, May 6, 2011)



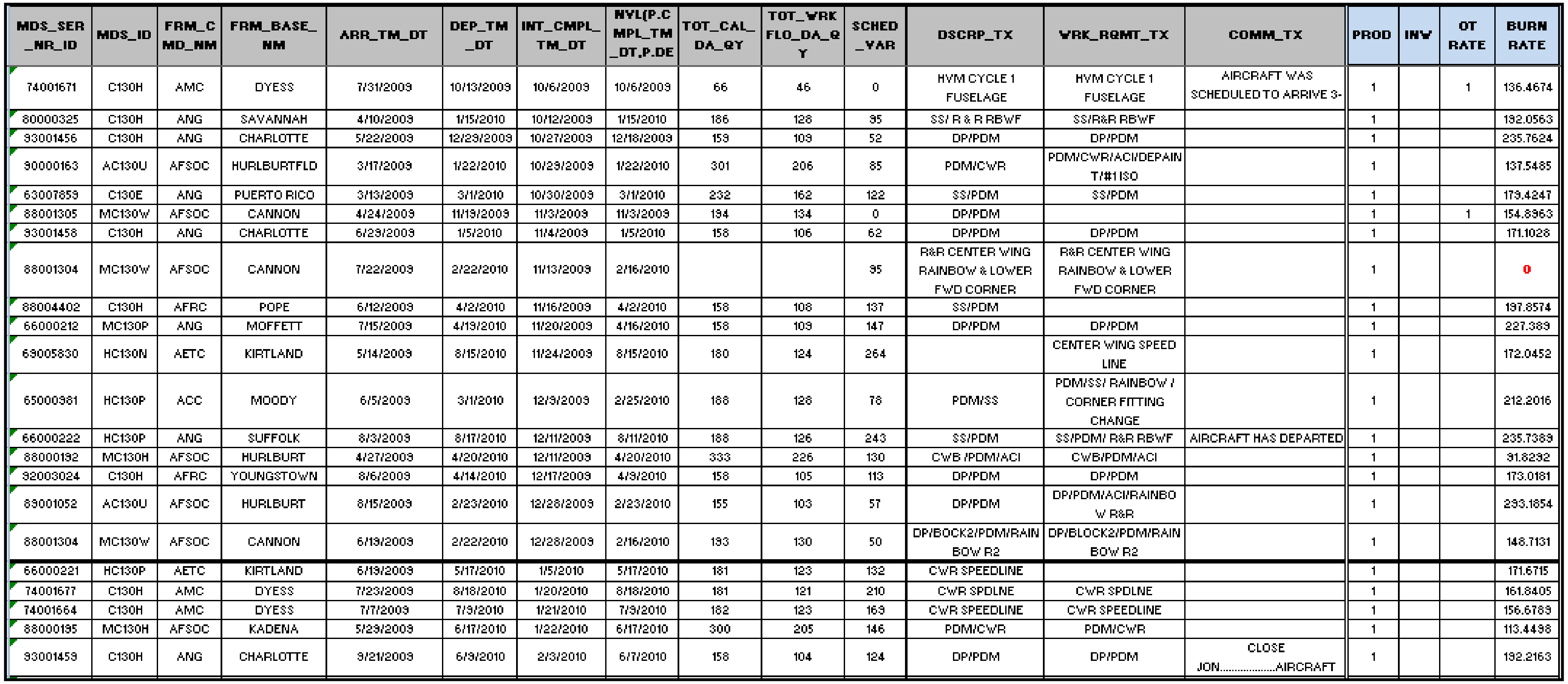
MDS_SER_NR_ID	MDS_ID	FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NVL(P.CMPL_TM_DT,P.DE	TOT_CAL_DA_QY	TOT_WRK FLO_DA_QY	SCHED_VAR	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INW	OT RATE	BURN RATE
85001361	C130H	ANG	CARSWELL	7/30/2008	1/20/2009	12/9/2008	1/20/2009	186	124	42	PDM/SS	PDM/SS		1			133.5274
82000056	C130H	ANG	KULIS	7/14/2008	1/7/2009	12/15/2008	1/7/2009	161	110	23	DP/PDM/ACI/RFB	DP/PDM/ACI/RFB		1			199.8
88004405	C130H	AFRC		7/18/2008	2/20/2009	12/17/2008	2/20/2009	153	104	65	SS	SS		1			173.7087
92003021	C130H	AFRC		8/11/2008	1/23/2009	12/22/2008	1/23/2009	154	103	32	DP	PDM/DP		1			244.7893
82000054	C130H	ANG		9/11/2008	3/30/2009	1/23/2009	3/30/2009	185	125	66	DP R&R RBWF 2	DP R &R RBWF 2		1			181.2944
86000419	C130H	AFRC	PITTSBURGH	8/25/2008	1/27/2009	1/24/2009	1/27/2009	153	102	3	PDM/SS	PDM/SS		1			163.1667
88000264	MC130H	AFSOC	KADENA	4/4/2008	3/24/2009	1/30/2009	3/24/2009	302	206	53	SS/CWB R&R/ETCAS	SS/CWB R&R/ETCAS		1			111.8854
66000223	MC130P	ANG		9/24/2008	4/24/2009	2/5/2009	4/24/2009	154	102	78	PDM/SS	PDM/SS		1			262.051
85000041	C130H			12/12/2008	1/23/2009	2/12/2009	1/23/2009	32	20	-20	REPAIR OF NOSE FAIRING ACFT 850041	REPAIR OF NOSE FAIRING ACFT 850041		1		1	62.905
88001303	C130H	AFSOC	BOISE	11/28/2007	6/4/2009	2/13/2009	6/4/2009			111	PDM/SS/CLR	PDM/SS/CLR		1			0
80000324	C130H	ANG		10/6/2008	4/17/2009	2/18/2009	4/17/2009	186	124	58	SS R&R RBWF 2	SS R&R RBWF 2		1			242.0815
74002067	C130H	AMC	DYESS	9/9/2008	6/22/2009	3/5/2009	6/22/2009	180	120	109	CWB SPDLNE	CWB SPDLNE	SWAPPED NETWORK	1			164.7717
92003286	C130H	AFRC		10/27/2008	4/10/2009	3/10/2009	4/10/2009	93	60	31	DP	PDM/DP		1			399.5683
88000264	MC130H	AFSOC	KADENA	3/2/2009	3/24/2009	3/31/2009	3/24/2009	30	22	-7	(UDLM) REROUTING			1		1	68.39091
93001563	C130H	ANG		11/20/2008	4/29/2009	4/3/2009	4/29/2009	155	105	26	PDM/DP	PDM/DP/#2 ISO		1			175.719
64000523	MC130E	AFRC		9/22/2008	1/4/2010	4/9/2009	1/4/2010	201	136	270	SSO / PDM / # 1 ISO	SSO / PDM / #1 MINOR ISO	C1 NETWORK, PDM/SSO/FOAM REPLACEMENT, #1 MINOR ISO/ POLY	1			209.1301
87009284	C130H	AFRC	DOBBINS	12/4/2008	6/1/2009	4/14/2009	12/4/2008	158	105	-131	SS/PDM	SS/PDM		1		1	165.0905
88001803	MC130H			4/3/2009	7/31/2009	4/19/2009	7/31/2009	17	12	103	(UDLM) IDS	(UDLM) IDS		1			183.3333
87000023	MC130H	AFSOC		6/19/2008	3/24/2009	4/24/2009	3/24/2009	302	206	-31	SS 2 ISO CWB	PDM/SS/#2 ISO/CWB		1		1	94.8
69005826	MC130P	AFSOC		12/18/2008	7/22/2009	4/28/2009	7/22/2009	155	104	85	SS 3 ISO	SS 3 ISO	BASELINE FOR AMREP TO NEW OUPUT DATE OF 23-	1			319.8096
87009286	MC130W	AFSOC	CANNON	11/21/2008	5/14/2009	5/1/2009	5/14/2009	162	110	13	PDM/DP	PDM/DP		1			237.7564
74001691	C130H	AMC	DYESS	11/12/2008	8/3/2009	5/9/2009	8/3/2009	179	122	86	CWB SPEEDLINE	CWB SPEEDLINE	SWAPPED NETWORK FROM C1TO CS ON	1			165.3525
69005823	MC130P	AFSOC	EGLIN	1/5/2009	6/22/2009	5/11/2009	6/22/2009	158	109	42	PDM/DP/ISO	PDM/DP/ISO		1			226.0862
90000165	AC130U			2/2/2009	2/2/2009	6/9/2009	2/2/2009	60	42	-127		IR TUBS WORK	IR TUBS REFURBISH	1		1	120.5095
74002061	C130H	AMC	DYESS	12/18/2008	11/2/2009	6/16/2009	11/2/2009	181	124	139	CWB SPDLNE	CWB SPDLNE		1			170.35

C.5.3. Lines 50 through 71 (Cain M. , personal communication, May 6, 2011)



MDS_SER_NR_ID	MDS_ID	FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NVL(P.CMPL_TM_DT,P.DE	TOT_CAL_DA_QY	TOT_WRK FLO_DA_QY	SCHED_VAR	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INV	OT RATE	BURN RATE
89001183	C130H			2/6/2009	8/26/2009	6/16/2009	8/26/2009	153	105	71	SS	PDM/SS	COPIED FROM PROJECT 3008837	1			239.7038
87000125	MC130H	AFSOC	HURLBURT	2/12/2009	11/12/2009	6/22/2009	11/12/2009	356	243	143	SS/ R&R RBW	SS/ R&R RBW	5/6/2009 -ENTERED	1			96.12181
87000125	MC130H			2/17/2009	11/12/2009	6/23/2009	11/12/2009	350	242	142	TCTO 1908	TCTO 1908		1			22.13595
85001364	C130H	ANG	CARSWELL	2/23/2009	7/31/2009	6/29/2009	7/31/2009	189	133	32	C W RAINBOW AND LOWER FWD CORNER	C W RAINBOW & LOWER FWD CORNER		1			27.10226
86000418	C130H	AFRC	POPE	1/30/2009	7/10/2009	7/4/2009	7/10/2009	156	108	6	PDM/SS	PDM/SS/ACI		1			247.7
74001675	C130H	AMC		1/30/2009	9/30/2009	7/13/2009	9/30/2009	180	126	79	CWB SPDLNE	CWB SPDLNE	BASELINED ON 4/28/2009 -	1			161.8873
69006574	AC130H			1/9/2009	6/8/2009	7/17/2009	6/8/2009	190	132	-39		PDM/DP		1		1	238.8159
89001056	AC130U	AFSOC	HURLBURT	3/13/2009	9/30/2009	7/20/2009	9/30/2009	183	128	72	PDM/DP	PDM/DP		1			199.0781
82000055	C130H	ANG	KULIS	1/23/2009	8/29/2009	7/28/2009	8/29/2009	187	130	32	PDM/DP/RBF3	PDM/DP/RBF3		1			182.4077
92003022	C130H	AFRC	YOUNGSTOWN	3/23/2009	9/9/2009	7/28/2009	9/9/2009	158	110	43	DP/PDM	DP/PDM		1			193.5045
87009287	C130H	AFRC	NIAGARA	2/27/2009	8/19/2009	8/3/2009	8/19/2009	158	110	16	SS/PDM	SS/PDM		1			178.6809
64000562	MC130E	AFRC	DUKE	3/31/2009	4/23/2010	8/4/2009	4/22/2010	204	142	261	SS/PDM	SS/PDM	AIRCRAFT DEPARTED 23 APRIL 2010	1			200.4972
89000281	MC130H	HURLBUR		10/14/2008	12/17/2009	8/7/2009	12/17/2009	300	205	132	CWB/PDM	CWB/PDM		1			113.0966
65000993	MC130P	AFSOC	KADENA	4/2/2009	12/30/2009	8/7/2009	12/28/2009	154	108	143	PDM/SS/ISO	PDM/SS/ISO		1			273.2139
74001679	C130H	AMC	DYESS	2/18/2009	12/4/2009	8/18/2009	12/4/2009	180	127	108	CWB SPEEDLINE	CWB SPEEDLINE		1			166.2866
85001364	C130H	ANG	CARSWELL	2/20/2009	9/1/2009	8/26/2009	9/1/2009	188	132	6	SS/R&R RBWF	PDM/SS/R&R RBWF	ADDED 30 DAYS ON MAJOR JOB 30 THROUGH	1			204.1273
88004401	C130H			5/11/2009	10/5/2009	9/15/2009	10/5/2009	158	108	20	SS/PDM	SS/PDM	COPIED FROM PROJECT 3009932	1			222.4907
92003287	C130H	AFRC	MINN	4/17/2009	10/30/2009	9/21/2009	10/30/2009	158	109	39	DP/PDM	DP/PDM		1			176.1
88001305	MC130W	AFSOC	CANNON	5/16/2009	11/19/2009	9/23/2009	11/3/2009	165	114	41	R&R CENTER WING RAINBOW & LOWER FWD CORNER	R&R CENTER WING RAINBOW & LOWER FWD CORNER		1			31.84649
74001665	C130H	AMC		4/3/2009	1/15/2010	10/2/2009	1/15/2010	180	125	105	CWB SPDLNE	CWB SPDLNE	CWB SPEEDLINE	1			163.3224
89000280	MC130H	AFSOC	KADENA	5/28/2009	8/2/2009	10/2/2009	8/2/2009	63	44	-61	R&R CENTER WING RAINBOW & LOWER FWD CORNER	R&R CENTER WING RAINBOW & LOWER FWD CORNER		1		1	184.713
81000630	C130H	AFRC	DOBBINS	6/2/2009	4/7/2010	10/6/2009	4/7/2010	189	129	183	DP/PDM	DP/PDM		1			188.1147

C.5.4. Lines 72 through 93 (Cain M. , personal communication, May 6, 2011)

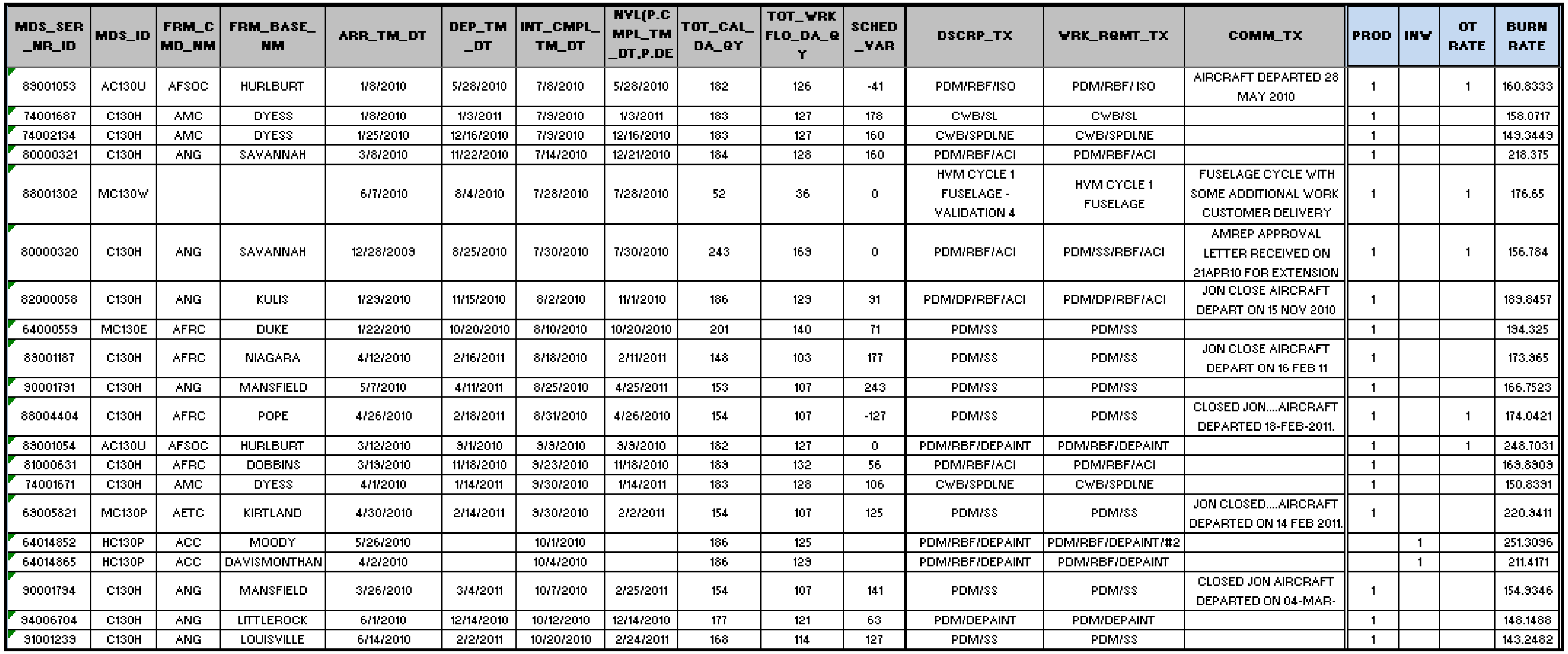


MDS_SER_NR_ID	MDS_ID	FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NVL(P.CMPL_TM_DT,P.DE	TOT_CAL_DA_QY	TOT_WRK_FLO_DA_QY	SCHED_VAR	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INW	OT RATE	BURN RATE
74001671	C130H	AMC	DYESS	7/31/2009	10/13/2009	10/6/2009	10/6/2009	66	46	0	HVM CYCLE 1 FUSELAGE	HVM CYCLE 1 FUSELAGE	AIRCRAFT WAS SCHEDULED TO ARRIVE 3-	1		1	136.4674
80000325	C130H	ANG	SAVANNAH	4/10/2009	1/15/2010	10/12/2009	1/15/2010	186	128	95	SS/ R & R RBWF	SS/R&R RBWF		1			192.0563
93001456	C130H	ANG	CHARLOTTE	5/22/2009	12/29/2009	10/27/2009	12/18/2009	159	109	52	DP/PDM	DP/PDM		1			235.7624
90000163	AC130U	AFSOC	HURLBURTFLD	3/17/2009	1/22/2010	10/29/2009	1/22/2010	301	206	85	PDM/CWR	PDM/CWR/ACI/DEPAINT/#1 ISO		1			137.5485
63007859	C130E	ANG	PUERTO RICO	3/13/2009	3/1/2010	10/30/2009	3/1/2010	232	162	122	SS/PDM	SS/PDM		1			179.4247
88001305	MC130W	AFSOC	CANNON	4/24/2009	11/19/2009	11/3/2009	11/3/2009	194	134	0	DP/PDM			1		1	154.8963
93001458	C130H	ANG	CHARLOTTE	6/29/2009	1/5/2010	11/4/2009	1/5/2010	158	106	62	DP/PDM	DP/PDM		1			171.1028
88001304	MC130W	AFSOC	CANNON	7/22/2009	2/22/2010	11/13/2009	2/16/2010			95	R&R CENTER WING RAINBOW & LOWER FWD CORNER	R&R CENTER WING RAINBOW & LOWER FWD CORNER		1			0
88004402	C130H	AFRC	POPE	6/12/2009	4/2/2010	11/16/2009	4/2/2010	158	108	137	SS/PDM			1			197.8574
66000212	MC130P	ANG	MOFFETT	7/15/2009	4/19/2010	11/20/2009	4/16/2010	158	109	147	DP/PDM	DP/PDM		1			227.389
69005830	HC130N	AETC	KIRTLAND	5/14/2009	8/15/2010	11/24/2009	8/15/2010	180	124	264		CENTER WING SPEED LINE		1			172.0452
65000981	HC130P	ACC	MOODY	6/5/2009	3/1/2010	12/9/2009	2/25/2010	188	128	78	PDM/SS	PDM/SS/ RAINBOW / CORNER FITTING CHANGE		1			212.2016
66000222	HC130P	ANG	SUFFOLK	8/3/2009	8/17/2010	12/11/2009	8/11/2010	188	126	243	SS/PDM	SS/PDM/ R&R RBWF	AIRCRAFT HAS DEPARTED	1			235.7389
88000192	MC130H	AFSOC	HURLBURT	4/27/2009	4/20/2010	12/11/2009	4/20/2010	333	226	130	CWB /PDM/ACI	CWB/PDM/ACI		1			91.8292
92003024	C130H	AFRC	YOUNGSTOWN	8/6/2009	4/14/2010	12/17/2009	4/9/2010	158	105	113	DP/PDM	DP/PDM		1			173.0181
89001052	AC130U	AFSOC	HURLBURT	8/15/2009	2/23/2010	12/28/2009	2/23/2010	155	103	57	DP/PDM	DP/PDM/ACI/RAINBOW R&R		1			293.1854
88001304	MC130W	AFSOC	CANNON	6/19/2009	2/22/2010	12/28/2009	2/16/2010	193	130	50	DP/BOCK2/PDM/RAINBOW R2	DP/BLOCK2/PDM/RAINBOW R2		1			148.7131
66000221	HC130P	AETC	KIRTLAND	6/19/2009	5/17/2010	1/5/2010	5/17/2010	181	123	132	CWR SPEEDLINE			1			171.6715
74001677	C130H	AMC	DYESS	7/23/2009	8/18/2010	1/20/2010	8/18/2010	181	121	210	CWR SPDLNE	CWR SPDLNE		1			161.8405
74001664	C130H	AMC	DYESS	7/7/2009	7/9/2010	1/21/2010	7/9/2010	182	123	169	CWR SPEEDLINE	CWR SPEEDLINE		1			156.6789
88000195	MC130H	AFSOC	KADENA	5/29/2009	6/17/2010	1/22/2010	6/17/2010	300	205	146	PDM/CWR	PDM/CWR		1			113.4498
93001459	C130H	ANG	CHARLOTTE	9/21/2009	6/9/2010	2/3/2010	6/7/2010	158	104	124	DP/PDM	DP/PDM	CLOSE JON..................AIRCRAFT	1			192.2163

C.5.5. Lines 94 through 118 (Cain M. , personal communication, May 6, 2011)

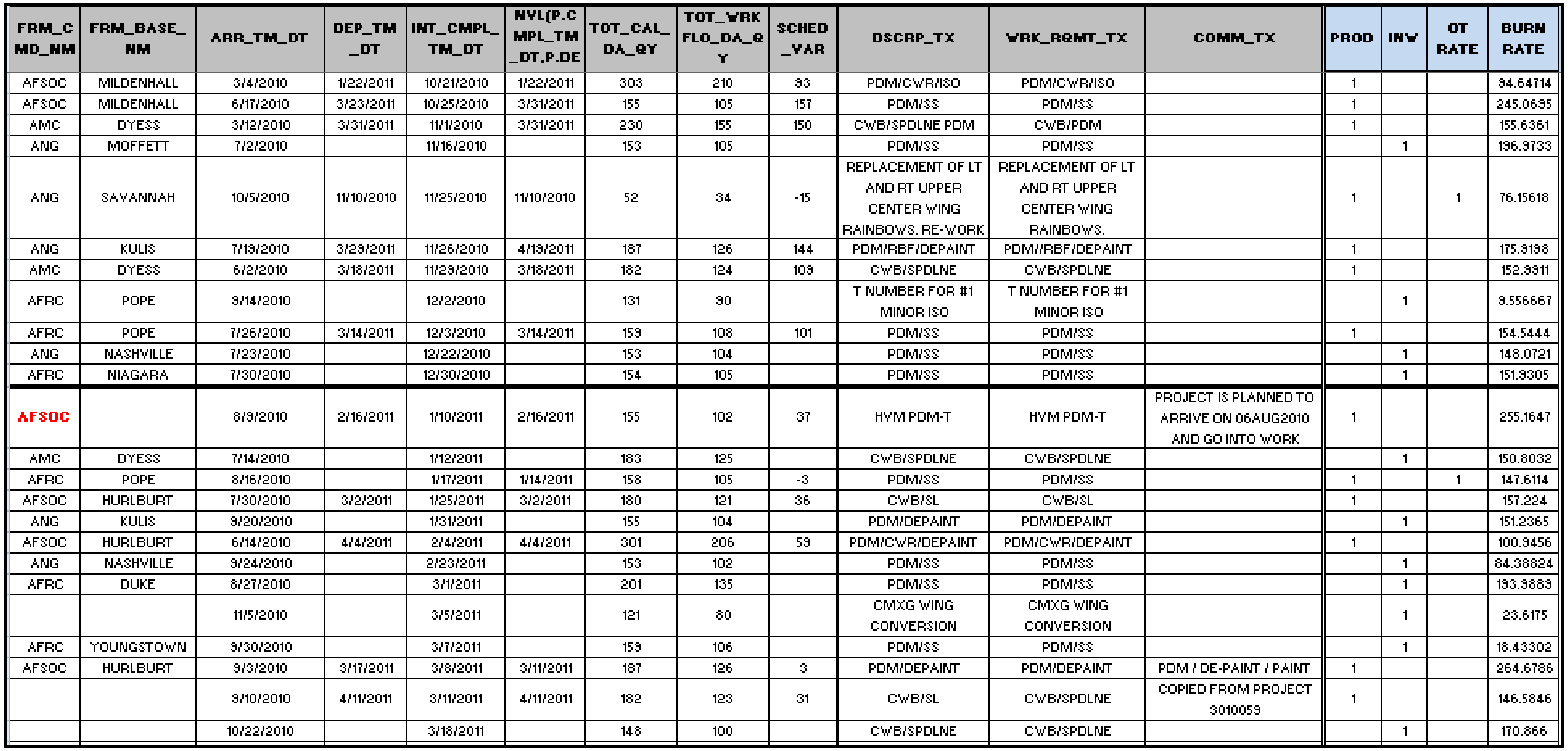
MDS_SER_NR_ID	MDS_ID	FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NVL(P.CMPL_TM_DT,P.DE	TOT_CAL_DA_QY	TOT_WRK_FLO_DA_QY	SCHED_VAR	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INV	OT RATE	BURN RATE
74001680	C130H	AMC	DYESS	8/11/2009	7/29/2010	2/8/2010	7/29/2010	182	122	171		CWR SPEEDLINE		1			156.759
69005813	MC130P	AFSOC	EGLIN	9/4/2009	9/17/2010	2/9/2010	9/16/2010	159	105	219	PDM/SS/ISO/#4	PDM/SS/ISO/#4	AIRCRAFT DEPART 17-SEP-2010	1			227.3876
65000986	HC130P	ACC	MOODY	9/30/2009	11/3/2010	2/11/2010	11/1/2010	189	126	263	DP/PDM/#3 ISO	DP/PDM/#3 ISO	JON CLOSED AIRCRAFT DEPARTED 03 NOV. 2010.	1			265.8175
63007814	C130E	ACC	MOODY	7/22/2009	6/17/2010	2/12/2010	6/17/2010	204	138	125	SS/PDM	SS/PDM		1			82.48768
65000992	MC130P	AFSOC	KADENA	9/25/2009	9/30/2010	2/26/2010	9/30/2010	155	103	216	PDM/SS/ISO/#2	PDM/SS/ISO/#2		1			260.3417
87009288	C130H	ANG	BOISE	1/13/2009	4/1/2010	3/11/2010	4/1/2010	423	290	21	PDM/SS/ISO/#2 MINOR/CLR12	PDM/SS/ISO/#2 MINOR	SWAPPED FROM C1 TO HH PRIOR TO INDUCTION.	1			47.82897
69006572	AC130H	AFSOC	HURLBURT	11/5/2009	4/30/2010	3/19/2010	4/28/2010	148	99	40	PDM/DEPAINT	PDM / DEPAINT		1			276.9172
92000553	C130H			2/1/2010	3/25/2010	3/22/2010	3/22/2010	50	34	0	HVM CYCLE 1 FUSELAGE -	HVM CYCLE 1 FUSELAGE	ORIGINAL DELIVER DATE WAS 10MAR10 - WORK	1		1	156.8265
65000971	MC130P	AETC	KIRTLAND	12/2/2009	3/24/2010	3/24/2010	3/24/2010	114	77	0	HVM CYCLE 1 FUSELAGE	HVM CYCLE 1 FUSELAGE	VALIDATION 2 ORIGINAL DELIVERY DATE	1		1	74.95844
88000193	MC130H	AFSOC	KADENA	8/21/2009	5/3/2010	4/12/2010	5/3/2010	235	158	21	SS/PDM/ R&R RBWS	SS/PDM/ R&R RBWS	ACTMOD DATE =	1			140.2481
74001666	C130H	AMC	DYESS	10/15/2009	9/9/2010	4/14/2010	9/9/2010	183	124	148	CWB/SPDLNE	CWB/SPDLNE		1			158.3661
74001663	C130H	AMC	DYESS	11/2/2009	8/26/2010	4/30/2010	8/26/2010	183	124	118	CWB/SPDLNE	CWB/SPDLNE		1			155.1016
88000194	MC130H	AETC	KIRTLAND	12/28/2009	7/13/2010	5/4/2010	7/2/2010	202	138	59	PDM/SS	PDM/SS	AIRCRAFT DEPARTED 13 JULY 2010.	1			146.108
89001186	C130H	AFRC	NIAGARA	12/4/2009	10/5/2010	5/6/2010	10/5/2010	154	106	152	PDM/SS	PDM/SS		1			176.4
83000488	C130H	ANG	SCHENECTADY	11/6/2009	7/6/2010	5/12/2010	7/1/2010	188	127	50	PDM/SS/ACI/RBWF	PDM/SS/ACI/RWBF		1			195.2299
88000191	MC130H	AFSOC	HURLBURT	11/16/2009	8/15/2010	5/17/2010	8/15/2010	183	125	90	CWB/SL	CWB/SL		1			147.6904
89000510	AC130U	AFSOC	HURLBURT	9/25/2009	8/25/2010	5/20/2010	8/25/2010	302	208	97	CWB/PDM			1			120.3226
88001301	MC130W	AFSOC	CANNON	12/11/2009	7/7/2010	5/20/2010	6/30/2010	161	111	41	PDM/SS/RBWF	PDM/SS/RBWF		1			176.4072
74001689	C130H	AMC	DYESS	12/7/2009	11/9/2010	6/8/2010	11/9/2010	183	126	154	CWB/SPDLNE	CWB/SPDLNE		1			156.3532
64014854	MC130P	AFSOC	EGLIN	2/8/2010	10/6/2010	6/11/2010	10/6/2010	158	109	117	PDM/SS	PDM/SS		1			230.2642
93001455	C130H	ANG	CHARLOTTE	1/5/2010	8/16/2010	6/12/2010	8/6/2010	159	111	55	PDM/DEPAINT	PDM/DEPAINT	AIRCRAFT DEPARTED 16	1			172.4838
93001457	C130H	ANG	CHARLOTTE	2/16/2010	11/4/2010	6/23/2010	12/3/2010	184	128	163	PDM/DEPAINT	PDM/DEPAINT		1			160.8164
88004403	C130H	AFRC	POPE	2/22/2010	11/10/2010	6/24/2010	11/10/2010	153	106	139	PDM/SS	PDM/SS	JON CLOSE AIRCRAFT	1			178.0434
64000551	MC130E	AFRC	DUKE	11/13/2009	2/1/2011	7/2/2010	1/28/2011	232	159	210	PDM/SS	PDM/SS	AMREP TO 02-JUL-2010	1			142.4208
83000486	C130H	ANG	SCHENECTADY	3/2/2010	10/6/2010	7/7/2010	3/19/2010	185	131	-110	PDM/RBF/DEPAINT	PDM/RBF/DEPAINT	AIRCRAFT DEPARTED ON 06 OCT. 2010	1		1	155.9954

C.5.6. Lines 119 through 138 (Cain M. , personal communication, May 6, 2011)



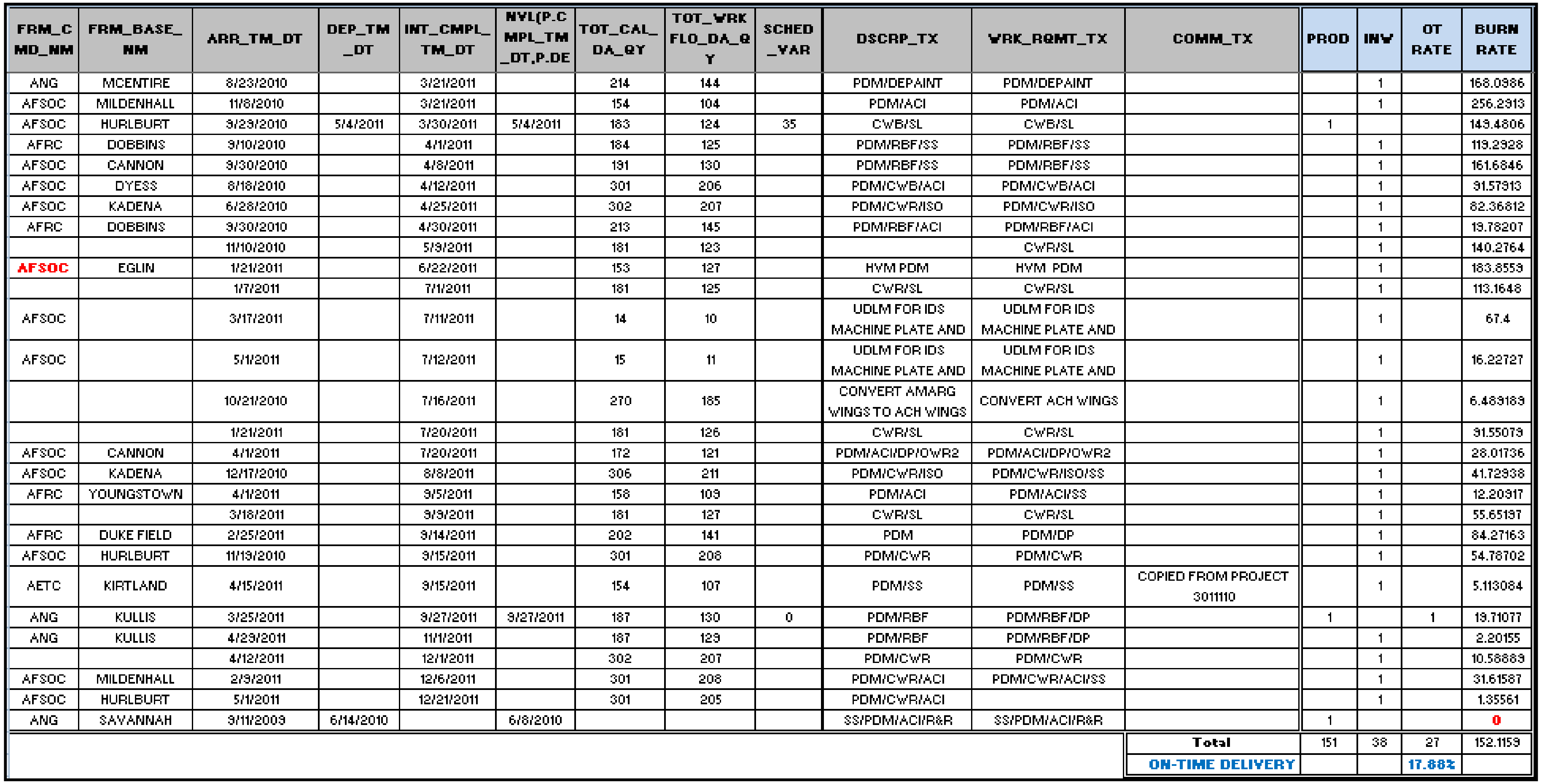
MDS_SER_NR_ID	MDS_ID	FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NVL(P.CMPL_TM_DT,P.DE	TOT_CAL_DA_QY	TOT_WRK FLO_DA_QY	SCHED_VAR	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INW	OT RATE	BURN RATE
89001053	AC130U	AFSOC	HURLBURT	1/8/2010	5/28/2010	7/8/2010	5/28/2010	182	126	-41	PDM/RBF/ISO	PDM/RBF/ ISO	AIRCRAFT DEPARTED 28 MAY 2010	1		1	160.8333
74001687	C130H	AMC	DYESS	1/8/2010	1/3/2011	7/9/2010	1/3/2011	183	127	178	CWB/SL	CWB/SL		1			158.0717
74002134	C130H	AMC	DYESS	1/25/2010	12/16/2010	7/9/2010	12/16/2010	183	127	160	CWB/SPDLNE	CWB/SPDLNE		1			149.3449
80000321	C130H	ANG	SAVANNAH	3/8/2010	11/22/2010	7/14/2010	12/21/2010	184	128	160	PDM/RBF/ACI	PDM/RBF/ACI		1			218.375
88001302	MC130W			6/7/2010	8/4/2010	7/28/2010	7/28/2010	52	36	0	HVM CYCLE 1 FUSELAGE - VALIDATION 4	HVM CYCLE 1 FUSELAGE	FUSELAGE CYCLE WITH SOME ADDITIONAL WORK CUSTOMER DELIVERY	1		1	176.65
80000320	C130H	ANG	SAVANNAH	12/28/2009	8/25/2010	7/30/2010	7/30/2010	243	169	0	PDM/RBF/ACI	PDM/SS/RBF/ACI	AMREP APPROVAL LETTER RECEIVED ON 21APR10 FOR EXTENSION	1		1	156.784
82000058	C130H	ANG	KULIS	1/29/2010	11/15/2010	8/2/2010	11/1/2010	186	129	91	PDM/DP/RBF/ACI	PDM/DP/RBF/ACI	JON CLOSE AIRCRAFT DEPART ON 15 NOV 2010	1			189.8457
64000559	MC130E	AFRC	DUKE	1/22/2010	10/20/2010	8/10/2010	10/20/2010	201	140	71	PDM/SS	PDM/SS		1			194.325
89001187	C130H	AFRC	NIAGARA	4/12/2010	2/16/2011	8/18/2010	2/11/2011	148	103	177	PDM/SS	PDM/SS	JON CLOSE AIRCRAFT DEPART ON 16 FEB 11	1			173.965
90001791	C130H	ANG	MANSFIELD	5/7/2010	4/11/2011	8/25/2010	4/25/2011	153	107	243	PDM/SS	PDM/SS		1			166.7523
88004404	C130H	AFRC	POPE	4/26/2010	2/18/2011	8/31/2010	4/26/2010	154	107	-127	PDM/SS	PDM/SS	CLOSED JON....AIRCRAFT DEPARTED 18-FEB-2011.	1		1	174.0421
89001054	AC130U	AFSOC	HURLBURT	3/12/2010	9/1/2010	9/3/2010	9/3/2010	182	127	0	PDM/RBF/DEPAINT	PDM/RBF/DEPAINT		1		1	248.7031
81000631	C130H	AFRC	DOBBINS	3/19/2010	11/18/2010	9/23/2010	11/18/2010	189	132	56	PDM/RBF/ACI	PDM/RBF/ACI		1			169.8909
74001671	C130H	AMC	DYESS	4/1/2010	1/14/2011	9/30/2010	1/14/2011	183	128	106	CWB/SPDLNE	CWB/SPDLNE		1			150.8391
69005821	MC130P	AETC	KIRTLAND	4/30/2010	2/14/2011	9/30/2010	2/2/2011	154	107	125	PDM/SS	PDM/SS	JON CLOSED....AIRCRAFT DEPARTED ON 14 FEB 2011.	1			220.9411
64014852	HC130P	ACC	MOODY	5/26/2010		10/1/2010		186	125		PDM/RBF/DEPAINT	PDM/RBF/DEPAINT/#2			1		251.3096
64014865	HC130P	ACC	DAVISMONTHAN	4/2/2010		10/4/2010		186	129		PDM/RBF/DEPAINT	PDM/RBF/DEPAINT			1		211.4171
90001794	C130H	ANG	MANSFIELD	3/26/2010	3/4/2011	10/7/2010	2/25/2011	154	107	141	PDM/SS	PDM/SS	CLOSED JON AIRCRAFT DEPARTED ON 04-MAR-	1			154.9346
94006704	C130H	ANG	LITTLEROCK	6/1/2010	12/14/2010	10/12/2010	12/14/2010	177	121	63	PDM/DEPAINT	PDM/DEPAINT		1			148.1488
91001239	C130H	ANG	LOUISVILLE	6/14/2010	2/2/2011	10/20/2010	2/24/2011	168	114	127	PDM/SS	PDM/SS		1			143.2482

C.5.7. Lines 139 through 162 (Cain M. , personal communication, May 6, 2011)



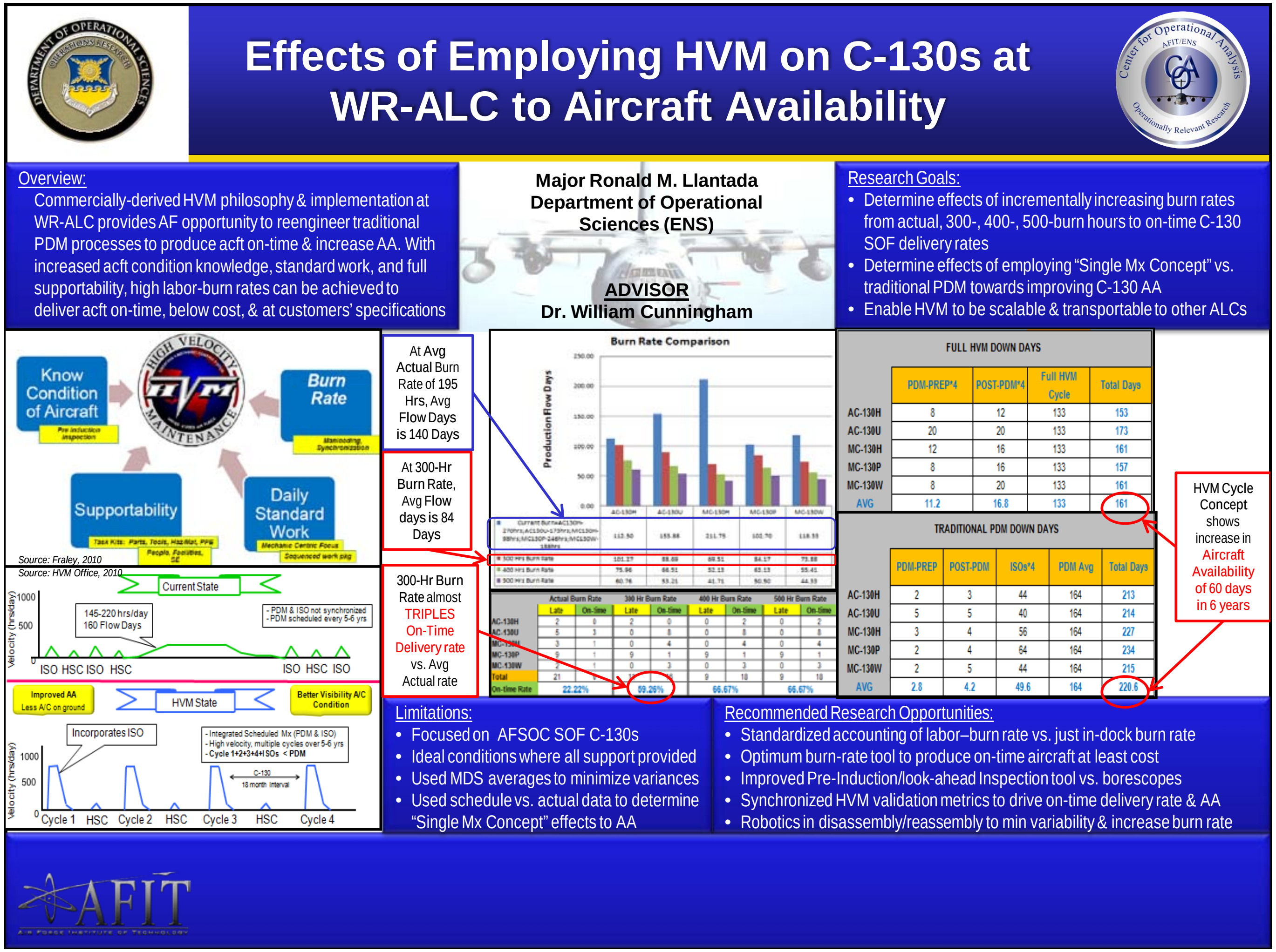
FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NVL(P.CMPL_TM_DT,P.DE	TOT_CAL_DA_QY	TOT_WRK FLO_DA_QY	SCHED_VAR	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INV	OT RATE	BURN RATE
AFSOC	MILDENHALL	3/4/2010	1/22/2011	10/21/2010	1/22/2011	303	210	93	PDM/CWR/ISO	PDM/CWR/ISO		1			94.64714
AFSOC	MILDENHALL	6/17/2010	3/23/2011	10/25/2010	3/31/2011	155	105	157	PDM/SS	PDM/SS		1			245.0695
AMC	DYESS	3/12/2010	3/31/2011	11/1/2010	3/31/2011	230	155	150	CWB/SPDLNE PDM	CWB/PDM		1			155.6361
ANG	MOFFETT	7/2/2010		11/16/2010		153	105		PDM/SS	PDM/SS			1		196.9733
ANG	SAVANNAH	10/5/2010	11/10/2010	11/25/2010	11/10/2010	52	34	-15	REPLACEMENT OF LT AND RT UPPER CENTER WING RAINBOWS. RE-WORK	REPLACEMENT OF LT AND RT UPPER CENTER WING RAINBOWS.		1		1	76.15618
ANG	KULIS	7/19/2010	3/29/2011	11/26/2010	4/19/2011	187	126	144	PDM/RBF/DEPAINT	PDM//RBF/DEPAINT		1			175.9198
AMC	DYESS	6/2/2010	3/18/2011	11/29/2010	3/18/2011	182	124	109	CWB/SPDLNE	CWB/SPDLNE		1			152.9911
AFRC	POPE	9/14/2010		12/2/2010		131	90		T NUMBER FOR #1 MINOR ISO	T NUMBER FOR #1 MINOR ISO			1		9.556667
AFRC	POPE	7/26/2010	3/14/2011	12/3/2010	3/14/2011	159	108	101	PDM/SS	PDM/SS		1			154.5444
ANG	NASHVILLE	7/23/2010		12/22/2010		153	104		PDM/SS	PDM/SS			1		148.0721
AFRC	NIAGARA	7/30/2010		12/30/2010		154	105		PDM/SS	PDM/SS			1		151.9305
AFSOC		8/9/2010	2/16/2011	1/10/2011	2/16/2011	155	102	37	HVM PDM-T	HVM PDM-T	PROJECT IS PLANNED TO ARRIVE ON 06AUG2010 AND GO INTO WORK	1			255.1647
AMC	DYESS	7/14/2010		1/12/2011		183	125		CWB/SPDLNE	CWB/SPDLNE			1		150.8032
AFRC	POPE	8/16/2010		1/17/2011	1/14/2011	158	105	-3	PDM/SS	PDM/SS		1		1	147.6114
AFSOC	HURLBURT	7/30/2010	3/2/2011	1/25/2011	3/2/2011	180	121	36	CWB/SL	CWB/SL		1			157.224
ANG	KULIS	9/20/2010		1/31/2011		155	104		PDM/DEPAINT	PDM/DEPAINT			1		151.2365
AFSOC	HURLBURT	6/14/2010	4/4/2011	2/4/2011	4/4/2011	301	206	59	PDM/CWR/DEPAINT	PDM/CWR/DEPAINT		1			100.9456
ANG	NASHVILLE	9/24/2010		2/23/2011		153	102		PDM/SS	PDM/SS			1		84.38824
AFRC	DUKE	8/27/2010		3/1/2011		201	135		PDM/SS	PDM/SS			1		193.9889
		11/5/2010		3/5/2011		121	80		CMXG WING CONVERSION	CMXG WING CONVERSION			1		23.6175
AFRC	YOUNGSTOWN	9/30/2010		3/7/2011		159	106		PDM/SS	PDM/SS			1		18.43302
AFSOC	HURLBURT	9/3/2010	3/17/2011	3/8/2011	3/11/2011	187	126	3	PDM/DEPAINT	PDM/DEPAINT	PDM / DE-PAINT / PAINT	1			264.6786
		9/10/2010	4/11/2011	3/11/2011	4/11/2011	182	123	31	CWB/SL	CWB/SPDLNE	COPIED FROM PROJECT 3010059	1			146.5846
		10/22/2010		3/18/2011		148	100		CWB/SPDLNE	CWB/SPDLNE			1		170.866

C.5.8. Lines 163 through 190 (Cain M. , personal communication, May 6, 2011)



FRM_CMD_NM	FRM_BASE_NM	ARR_TM_DT	DEP_TM_DT	INT_CMPL_TM_DT	NVL(P.CMPL_TM_DT,P.DE	TOT_CAL_DA_QY	TOT_WRKFLO_DA_QY	SCHED_VAR	DSCRP_TX	WRK_RQMT_TX	COMM_TX	PROD	INV	OT RATE	BURN RATE
ANG	MCENTIRE	8/23/2010		3/21/2011		214	144		PDM/DEPAINT	PDM/DEPAINT			1		168.0986
AFSOC	MILDENHALL	11/8/2010		3/21/2011		154	104		PDM/ACI	PDM/ACI			1		256.2913
AFSOC	HURLBURT	9/29/2010	5/4/2011	3/30/2011	5/4/2011	183	124	35	CWB/SL	CWB/SL		1			149.4806
AFRC	DOBBINS	9/10/2010		4/1/2011		184	125		PDM/RBF/SS	PDM/RBF/SS			1		119.2928
AFSOC	CANNON	9/30/2010		4/8/2011		191	130		PDM/RBF/SS	PDM/RBF/SS			1		161.6846
AFSOC	DYESS	8/18/2010		4/12/2011		301	206		PDM/CWB/ACI	PDM/CWB/ACI			1		91.57913
AFSOC	KADENA	6/28/2010		4/25/2011		302	207		PDM/CWR/ISO	PDM/CWR/ISO			1		82.36812
AFRC	DOBBINS	9/30/2010		4/30/2011		213	145		PDM/RBF/ACI	PDM/RBF/ACI			1		19.78207
		11/10/2010		5/9/2011		181	123			CWR/SL			1		140.2764
AFSOC	EGLIN	1/21/2011		6/22/2011		153	127		HVM PDM	HVM PDM			1		183.8559
		1/7/2011		7/1/2011		181	125		CWR/SL	CWR/SL			1		113.1648
AFSOC		3/17/2011		7/11/2011		14	10		UDLM FOR IDS MACHINE PLATE AND	UDLM FOR IDS MACHINE PLATE AND			1		67.4
AFSOC		5/1/2011		7/12/2011		15	11		UDLM FOR IDS MACHINE PLATE AND	UDLM FOR IDS MACHINE PLATE AND			1		16.22727
		10/21/2010		7/16/2011		270	185		CONVERT AMARG WINGS TO ACH WINGS	CONVERT ACH WINGS			1		6.489189
		1/21/2011		7/20/2011		181	126		CWR/SL	CWR/SL			1		91.55079
AFSOC	CANNON	4/1/2011		7/20/2011		172	121		PDM/ACI/DP/OWR2	PDM/ACI/DP/OWR2			1		28.01736
AFSOC	KADENA	12/17/2010		8/8/2011		306	211		PDM/CWR/ISO	PDM/CWR/ISO/SS			1		41.72938
AFRC	YOUNGSTOWN	4/1/2011		9/5/2011		158	109		PDM/ACI	PDM/ACI/SS			1		12.20917
		3/18/2011		9/9/2011		181	127		CWR/SL	CWR/SL			1		55.65197
AFRC	DUKE FIELD	2/25/2011		9/14/2011		202	141		PDM	PDM/DP			1		84.27163
AFSOC	HURLBURT	11/19/2010		9/15/2011		301	208		PDM/CWR	PDM/CWR			1		54.78702
AETC	KIRTLAND	4/15/2011		9/15/2011		154	107		PDM/SS	PDM/SS	COPIED FROM PROJECT 3011110		1		5.113084
ANG	KULLIS	3/25/2011		9/27/2011	9/27/2011	187	130	0	PDM/RBF	PDM/RBF/DP		1		1	19.71077
ANG	KULLIS	4/29/2011		11/1/2011		187	129		PDM/RBF	PDM/RBF/DP			1		2.20155
		4/12/2011		12/1/2011		302	207		PDM/CWR	PDM/CWR			1		10.58889
AFSOC	MILDENHALL	2/9/2011		12/6/2011		301	208		PDM/CWR/ACI	PDM/CWR/ACI/SS			1		31.61587
AFSOC	HURLBURT	5/1/2011		12/21/2011		301	205		PDM/CWR/ACI				1		1.35561
ANG	SAVANNAH	9/11/2009	6/14/2010		6/8/2010				SS/PDM/ACI/R&R	SS/PDM/ACI/R&R		1			0
											Total	151	38	27	152.1159
											ON-TIME DELIVERY			17.88%	

Appendix D. Quad Chart



Effects of Employing HVM on C-130s at WR-ALC to Aircraft Availability

Overview:

Commercially-derived HVM philosophy & implementation at WR-ALC provides AF opportunity to reengineer traditional PDM processes to produce acft on-time & increase AA. With increased acft condition knowledge, standard work, and full supportability, high labor-burn rates can be achieved to deliver acft on-time, below cost, & at customers' specifications

Major Ronald M. Llantada
Department of Operational Sciences (ENS)

ADVISOR
Dr. William Cunningham

Research Goals:

- Determine effects of incrementally increasing burn rates from actual, 300-, 400-, 500-burn hours to on-time C-130 SOF delivery rates
- Determine effects of employing "Single Mx Concept" vs. traditional PDM towards improving C-130 AA
- Enable HVM to be scalable & transportable to other ALCs

Know Condition of Aircraft
Pre-induction inspection

Burn Rate
Manloading Synchronization

Supportability
Task Kits: Parts, Tools, HazMat, PPE
People, Facilities, SE

Daily Standard Work
Mechanic Centric Focus
Sequenced work pkg

Source: Fraley, 2010

Source: HVM Office, 2010

Current State

145-220 hrs/day
160 Flow Days

- PDM & ISO not synchronized
- PDM scheduled every 5-6 yrs

Improved AA
Less A/C on ground

HVM State

Better Visibility A/C Condition

Incorporates ISO

- Integrated Scheduled Mx (PDM & ISO)
- High velocity, multiple cycles over 5-6 yrs
- **Cycle 1+2+3+4+ISOs < PDM**

C-130
18 month Interval

At Avg Actual Burn Rate of 195 Hrs, Avg Flow Days is 140 Days

At 300-Hr Burn Rate, Avg Flow days is 84 Days

300-Hr Burn Rate almost TRIPLES On-Time Delivery rate vs. Avg Actual rate

Burn Rate Comparison

	AC-130H	AC-130U	MC-130H	MC-130P	MC-130W
Current Burn=AC130H-270hrs;AC130U-175hrs;MC130H-98hrs;MC130P-246hrs;MC130W-188hrs	112.50	155.88	211.75	102.70	118.55
300 Hrs Burn Rate	101.27	88.69	69.51	84.17	73.88
400 Hrs Burn Rate	75.96	66.51	52.13	63.13	55.41
500 Hrs Burn Rate	60.76	53.21	41.71	50.50	44.33

	Actual Burn Rate		300 Hr Burn Rate		400 Hr Burn Rate		500 Hr Burn Rate	
	Late	On-time	Late	On-time	Late	On-time	Late	On-time
AC-130H	2	0	2	0	0	2	0	2
AC-130U	5	3	0	8	0	8	0	8
MC-130H	3	1	0	4	0	4	0	4
MC-130P	9	1	9	1	9	1	9	1
MC-130W	2	1	0	3	0	3	0	3
Total	21	6	11	16	9	18	9	18
On-time Rate	22.22%		59.26%		66.67%		66.67%	

FULL HVM DOWN DAYS

	PDM-PREP*4	POST-PDM*4	Full HVM Cycle	Total Days
AC-130H	8	12	133	153
AC-130U	20	20	133	173
MC-130H	12	16	133	161
MC-130P	8	16	133	157
MC-130W	8	20	133	161
AVG	11.2	16.8	133	161

TRADITIONAL PDM DOWN DAYS

	PDM-PREP	POST-PDM	ISOs*4	PDM Avg	Total Days
AC-130H	2	3	44	164	213
AC-130U	5	5	40	164	214
MC-130H	3	4	56	164	227
MC-130P	2	4	64	164	234
MC-130W	2	5	44	164	215
AVG	2.8	4.2	49.6	164	220.6

HVM Cycle Concept shows increase in Aircraft Availability of 60 days in 6 years

Limitations:

- Focused on AFSOC SOF C-130s
- Ideal conditions where all support provided
- Used MDS averages to minimize variances
- Used schedule vs. actual data to determine "Single Mx Concept" effects to AA

Recommended Research Opportunities:

- Standardized accounting of labor–burn rate vs. just in-dock burn rate
- Optimum burn-rate tool to produce on-time aircraft at least cost
- Improved Pre-Induction/look-ahead Inspection tool vs. borescopes
- Synchronized HVM validation metrics to drive on-time delivery rate & AA
- Robotics in disassembly/reassembly to min variability & increase burn rate

Appendix E. Blue Dart

First Name: Ronald Last Name: Llantada

Rank (Military, AD, etc.): Major Designator # AFIT/ILS/ENS/11-06

Student Involved in Research for Blue Dart: Major Ronald Llantada

Position/Title: Student

Phone Number: 478-714-3481 E-mail: Ronald.llantada@us.af.mil

School/Organization: Air Force Institute of Technology / ENS

Status: [X] Student [ ] Faculty [ ] Staff [ ] Other

Optimal Media Outlet (optional): ____

Optimal Time of Publication (optional): ____

General Category / Classification: [ ] core values [ ] command [ ] strategy

[ ] war on terror [ ] culture & language [ ] leadership & ethics

[ ] Warfighting [ ] international security [ ] doctrine

[X] other (specify): WR-ALC C-130 High Velocity Maintenance

Suggested Headline: The Effects of Employing HVM on C-130 Aircraft at WR-ALC to Aircraft Availability

Keywords: High Velocity Maintenance, HVM, Depot, PDM, WR-ALC, C-130 Aircraft, Burn Rate, Single Maintenance Concept, Pre-Induction Inspection, MRSP

The objective of this research is to evaluate the impact of increasing the labor burn rate, one of the High Velocity Maintenance (HVM) core tenets, and the transition of isochronal aircraft inspections from the field to the depots under the Single Maintenance Concept. This study focuses on depot maintenance data from WR-ALC for AFSOC C-

130 aircraft to evaluate HVM effectiveness to improve the on-time delivery rate and increase aircraft availability rates for commanders in the field. Additionally, this project will discuss commercial industry best practices that best achieve higher labor burn rates and the challenges of implementing these practices into the traditional depot maintenance process.

In order to quantitatively assess the potential effects of HVM on depot production, this project examines WR-ALC C-130 depot maintenance data from July 2007 to May 2011, and interviews WR-ALC depot personnel in the HVM office and 560 AMXS. During the interviews the full catalog of HVM briefings were also reviewed extending to the inception of the HVM's program at WR-ALC. Moreover, this study utilized a field questionnaire to gather the average aircraft down-days in relation to depot-prep, post-depot, isochronal inspections, and home station checks.

With the depot maintenance data and assistance from the WR-ALC and field Subject Matter Experts (SMEs) the labor burn rate tenet and Single Maintenance Concept of HVM are evaluated to assess the effect on reducing C-130 aircraft production flow days, improving on–time aircraft delivery rates, and increasing aircraft availability.

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Vita

Major Ronald M Llantada was born in 1969, in Charleston, S.C. He graduated in 1986 from Saint Louis Pacdal High School in Baguio City, Philippines. He enlisted in the Air Force in 1991 at Clark AB, Philippines, and attended Aerospace Ground Equipment (AGE) technical training at Chanute AFB, Illinois. After technical school, he served as an AGE mechanic at three different bases, supporting B-52s, KC-135s, F-15s, and RC-135s. In 1996, he earned his promotion to Staff Sergeant.

Upon graduation from University of Nebraska at Omaha in 1998, Major Llantada received his commission through ROTC. He has since served in various positions as a maintenance officer and as a Logistics Career Broadening Officer, supporting the warfighter with numerous airframes, to include F-22As, F-15C/Ds, KC-135R/Ts, C-17As, C-5 A/B/Cs, E-3Bs, MC-130Es, C-130H1s, and F-16C aircraft. His duties have taken him on numerous worldwide deployments, to include OPERATIONS SOUTHERN WATCH, IRAQI FREEDOM, and ENDURING FREEDOM. In 2009, he further served as an Afghan National Army Combat Advisor, supporting the NATO Training Mission-Afghanistan as the Afghan National Army Depot 1 Senior Advisor.

In May 2010, Major Llantada entered the Graduate School of Engineering and Management, Air Force Institute of Technology, as an in-resident Intermediate-Development Education student. Upon graduation, he will be assigned as the Commander of the 48th Component Maintenance Squadron, RAF Lakenheath, UK.

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14. ABSTRACT

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