CLOCKWORK SOLUTIONS

PRODUCT APPLICATION

Advanced Total Life-Cycle Assessment Software Tool(ATLAST™) and the T700 Engine Family Data Model (ATLAST™/ T700)

Introduction

The T700 family of turbine engines is used to power the US Army's fleet of AH-64 Apache and UH-60 Blackhawk helicopters. The US Army Logistics Integration Agency (LIA) contracted with Clockwork to create and utilize predictive models for analyses of life-cycle costs related to T700 engine reliability and logistics. The work was conducted in coordination with the Aviation and Missiles Command (AMCOM), Utility Helicopter Program Management Office (UHPMO), and the Integrated Material Management Center (IMMC).

The goal of the project was to develop a tool, the Aircraft Total Life-Cycle Assessment Software Tool, ATLAST™, to provide the capability to reduce life-cycle sustainment costs without adversely impacting fleet readiness.

Project objectives were to:

- Develop an easy-to-use forecasting software application based on SPAR™ simulation technology.
- Construct a T700 Engine Data Model capturing the state of the T700 fleet.
- Integrate the application software and data model.
- Perform what-if fleet sustainment experiments and analyze life-cycle cost impacts.
- Provide AMCOM with the **ATLAST / T700™** engine data model, final fleet assessment report, and training.

Major benefits to the US Army include:

- Quantify life-cycle costs due to management decisions with regard to equipment configuration changes, life-limit and repair screen modifications, alternate sparing strategies, adjusted flying hour programs, and modified repair concepts.
- Forecast operations and maintenance performance by aircraft by base.
- Extend current capabilities of the US Army Maintenance Management System (TAMMS-A) to manage aging aircraft.
- Create reusable application software allowing flexible insertion of additional aircraft sub-system data models

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SPAR™ / ATLAST™

SPAR™ is Clockwork's modeling and simulation technology for predicting system behavior in order to reduce asset ownership cost and increase performance. SPAR™ models are based on statistics and rules that define, at a detailed level, how elements of a system and its support infrastructure behave dynamically in time. By modeling the details of element behavior and the relationships between elements, performance of large, complicated systems can be predicted accurately. ATLAST™ is a custom application built on top of the SPAR™ simulation engine and tailored to aircraft overhaul and repair. Much of the work involved in creating an aviation maintenance simulation model has been designed into ATLAST™. Users must concern themselves only with changing inputs to the existing model, running life-cycle simulations, and evaluating life-cycle impacts. **ATLAST™ is quick to access, easy to use, and powerful!**

ATLAST / T700 - THE T700 ENGINE FAMILY DATA MODEL

Clockwork incorporated data from several sources into a single comprehensive model of the T700 engine. The data represents 5,585 engines comprising T700, T701, and T701C configurations. The engines support a fleet of 720 Apache and 1480 Blackhawk aircraft. Approximately 320,000 components are tracked by serial number throughout the life-cycle simulation. All engines are included and complete hardware breakdowns are identified. The state of the engine fleet was assembled through a combination of Component Removal and Repair/Overhaul Records (DA Form 2410), monthly flight hour status reports (DA Form 2408-19-3), and PM configuration tracking databases. The state representation of the fleet tells ATLAST™ where everything is in the world, what it is attached to, how much life it has on it, and whether it is installed, in repair, or is a spare. This integrated, aggregated, cleansed data set may ultimately stand as the most accurate depiction of the state of the T700 fleet existing anywhere today.

ATLAST™ employs SPAR™ technology to simulate the behavior of engines for a defined duration automatically generating failure, repair, maintenance, and supply events. Aircraft in the model fly according to a flying program determined by the user. Statistical distributions have been developed to represent the programs flown historically at every operating base, and are used as the foundation for generating future flying hour programs. Army personnel "operate" the aircraft (run the model) to achieve an equivalent number of flying hours per month per aircraft. For each engine, the model generates failures representing unplanned removals that cause the engine to enter a three-level maintenance system. Upon engine failure, the aircraft is grounded until a replacement engine is available from the spares pool. Failed engines are tagged as unserviceable and are queued subject to depot induction. The model supplies a set of outputs that are used to compute both costs and benefits by adopting various strategies over a given time interval. A sample of default outputs include:

- Number of unplanned engine removals
- Number of engine inductions for overhaul at the depot
- Counts of depot actions for each type of assembly
- Number of life limit events for each assembly type
- Number of spare engines used
- Awaiting Parts Status (AWP) and Awaiting Maintenance (AWM) averages
- Readiness levels
- Failure counts per assembly type

Conclusion

ATLAST™ will greatly enhance the US Army's ability to quantify time-dependent, life-cycle costs and impacts resulting from proposed aircraft and engine sustainment decisions. ATLAST™ / T700 offers the first opportunity to measure the impacts of recapitalization decisions for the T700 fleet prior to their implementation enabling the US Army to avoid millions of dollars of previously unanticipated sustainment costs. ATLAST™ provides a framework for the rapid insertion of additional aircraft sub-systems in order to support more comprehensive US Army aircraft readiness evaluations.

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