Chapter 61
Optimization of Aerospace Big Data Including Integrated Health Monitoring With the Help of Data Analytics

Ranganayakulu Chennu
Aeronautical Development Agency, India

Vasudeva Rao Veeredhi
University of South Africa, South Africa

ABSTRACT

The objective of this chapter is to present the role and advantages of big data governance in the optimal use of integrated health monitoring systems with a specific reference to the aerospace industry. Aerospace manufacturers and many passenger airlines have realized the benefits of sharing and analyzing the huge amounts of data being collected by their latest generation airliners and engines. While aero engines are already equipped with integrated engine health monitoring concepts, aircraft systems are now being introduced with integrated vehicle health monitoring concepts which require large number of sensors. The data generated by these sensors is enormously high and grows over a period of time to constitute a big data to be monitored and analyzed. This chapter aims to give an overview of various systems and their data logging processes, simulations, and data analysis. Various sensors that are required to be used in important systems of a typical fighter aircraft and their functionalities emphasizing the huge volume of data generated for the analysis are presented in this chapter.

INTRODUCTION

Aerospace manufacturers and MRO (Maintenance, Repair and Overall) providers have seen the future and are investing heavily in digital transformation. Many passenger airlines have no option except taking the benefits of sharing and analyzing the huge amounts of data being collected by their airliners

DOI: 10.4018/978-1-7998-5357-2.ch061

and aero-engines. Aero engines have been already equipped with integrated engine health monitoring systems and concepts. Whereas aircraft systems are being introduced with Integrated Vehicle Health Monitoring (IVHM) concepts which require large number of sensors data are to be monitored. In this direction, airlines should invest in Big Data analytics, OEMs should generate useful insights from the vast volumes of data available and independent MROs should carve out a role in this new world. Data Analytics help the Aerospace and Defense industry optimize their resources and business processes while promoting new business opportunities. By developing insightful analytical techniques, organizations have started using this data to improve their business processes by eliminating redundancies for optimal use of resources.

As more and more people are connected to the internet and sensors become integral parts of daily hardware an unprecedented amount of information is being produced. Fundamentally, big data is nothing new for the aerospace industry. Sensors have been collecting data on aircraft for years ranging from binary data such as speed, altitude and stability of the aircraft during flight, to damage and crack growth progression at service intervals. The authorities and parties involved have done an incredible job at using routine data and data gathered from failures to raise safety standards.

Bombardier plans to bring its C-Series jetliner that carries Pratt & Whitney's Geared Turbo Fan (GTF) engine – an engine that comes with 5000 sensors that generate up to 10 GB of data per second with Health Monitoring System. A single twin engine aircraft with an average of 12 hours flight-time can produce 844 TB of data. Therefore, the data generated by the aerospace industry alone could surpass the magnitude of the consumer internet. Most of the engines today have less than 250 sensors. For someone who has built engine health monitoring solutions on big data platforms and demonstrated the reduction in the processing time from days to minutes, the new engines are a different ball game. These scales are beyond imagination and the kind of data storage and computing infrastructure required to handle such data is truly mind blowing. GE expects to gain up to 40 per cent improvement in factory efficiencies by the application of Internet of Things (IoT) and Big Data Analytics. Avionics systems and other mechanical systems are also catching up to this trend quickly. The traditional avionics systems transfer data up to a maximum of 12.5 kB/s whereas Boeing 787 Dreamliner and A350s are using Ethernet-based, next-generation aircraft data networks, called AFDX that allows up to 12.5 MB/s. With rapid advancements being made in the Internet of Things in aircrafts combined with data analytics, it's a truly exciting time to be working in the aerospace industry. Soon, thousands of sensors will be embedded in each aircraft, allowing data to be streamed down to the ground in real-time.

This chapter explains the abundance of data that opened multiple opportunities for organizations to enhance their operations. Further, it provides a sense of direction in the following new business opportunities with advanced analytics solutions, such as:

- Health monitoring systems in real-rime.
- Predictive analytics solutions (Tools to identify system / component failures in advance and suggesting necessary preventive maintenance actions before the failure).
- Models to simulate the system behavior.
- Failure analysis of systems through root cause investigation of complex and inter-dependent systems.
- Intelligent models for scheduling and forecasting.

Further, some useful solutions for the following aero systems are indicated in this chapter.

Environmental Life Cycle Criteria for Propellant Selection Decision-Making
Christyl C. Johnsonand Michael R. Duffey (2012). *International Journal of Space Technology Management and Innovation (pp. 16-29).*
www.irma-international.org/article/environmental-life-cycle-criteria-propellant/69382