ABSTRACT

Nowadays, the survival of companies mainly depends on their ability to swiftly evolve and develop new ideas, so that they can compete in ever changing and competitive markets. There is enormous need for searching new methods and processes to improve the quality and productivity at reduced production and maintenance cost. In this dynamic environment, the airlines try to stay competitive by responding to these changes quickly while keeping their daily operations running as smoothly as possible. The Airline Industries are vulnerable to global economy. There are many potential factors that hinder the growth of the airline industry. The predominant one is Direct Operating Cost (DOC). It escalates everyday due to increase in fuel cost, labor cost, taxes and depreciating money value etc. The cost of maintenance is 12% of DOC. Roughly it varies from $515 to $1700 per flight hour for twin engine or four engine wide body aircraft. The cost of maintenance includes all cost from airframe maintenance to component maintenance and also from labour cost to material cost. The airliners spend around 100 billion dollars every year for servicing and maintaining aircraft and its systems in airworthy state. As it is a huge expenditure, it reflects how much efforts are needed for controlling the cost of maintenance and servicing. The unscheduled grounding of aircraft or its components due to unexpected breakdown of aircraft systems or components is one such major reason for increase in maintenance cost. Because of such events, there are so many wastages in manpower, machine and materials. Lean principles will help us to identify and reduce these
wastages. Systematic approach in maintenance and inspections assure airworthiness of aircraft and prevent failure of any aircraft component during its operation.

The Marketing department would always like to maximize the aircraft availability for operations. But the Quality Assurance department would like to have sufficient time for locating and rectifying any impending failure or to carry out any scheduled maintenance task. It is noteworthy that any unexpected malfunctions of systems or any shortfall in availability of vital component or manpower and shortage of adequate qualification for accomplishing and certifying the task would escalate the grounding time. It adds more problems to maintenance planning. As the Maintenance Cost increases along with increase in aircraft life, it is mandatory to reduce it; otherwise the airliners will not be able to survive in a country like India. Lean and Six Sigma tools in combination with other initiative, such as Total Preventive Maintenance, have provided all industries to contemplate on the efficiency of their production, operation and maintenance processes. These are very effective tools for reducing the wastages in manpower, machine and material. As the time interval for execution of scheduled maintenance activities is known well in advance, the Lean and Six Sigma Tools can be easily implemented while planning and scheduling the Scheduled Maintenance Tasks, which is not possible in the case of Unscheduled Maintenance Tasks.
This thesis proposes two new methods for the prediction of any impending failure of Aero-Engine components. It suggests the operator to make use of Life Usage Monitoring System (LUMS) for critical components, like, compressor rotor blades and turbine blades. LUMS is a useful aid for structural health monitoring. It is a system that can be used for onboard and off-board condition monitoring of engines. It would evaluate the extent to which the blade has been damaged; thereby it would help the operator to assess the number of Fatigue Life Cycles available before any failure. Thereby, it helps to determine the airworthiness condition of the critical components. This thesis also proposes a new mathematical model for evaluating the Mean Time Between Failure (MTBF) of an engine. These two approaches are proposed to find out the approximate lead time available between successive failures. In other words, they contemplate the possibilities to predict unscheduled breakdowns partially or totally so that the Unscheduled Maintenance tasks are converted into Scheduled Maintenance tasks. This thesis also recommends the airliners to make use of Reliability Centered Maintenance (RCM). RCM will be a valuable aid for implementing Lean and Six Sigma principles in Aircraft Maintenance Industries without jeopardizing the safety or airworthiness requirements. Hence the optimization of maintenance cost and increase in availability of aircraft and its components can be realized.

Key Words: LCF, MTBF, Lean Tools, Waste Minimization, Cost Optimization, RCM, LUMS.