



1. Executive Summary

In the aviation industry, tool-management (T-M) is an often overlooked yet crucial factor in the Maintenance, Repairs & Operations (MRO) sector. This study aims to help Bombardier Canada find and implement an efficient and cost-effective tool-management system across their Global Express GX5000/GX6000/GX7500* programs. The main issues Bombardier is currently facing along with their subsequent risks can be summarized as follows:

- Poor storage, management, and organization of maintenance workshop tools – resulting in a gap in production efficiency and workplace performance.
- High frequency of lost, stolen, or misplaced tools, all of which come in different sizes, types, and costs. Sometimes, tools are misplaced and forgotten inside critical aircraft components (such as engines). At best, a loss of tools results in unnecessary recurring costs and a wasteful management of resources. At worst, it could lead to life-threatening accidents due to Foreign Object Damage (FOD), thereby resulting in:
 - Damage to the company's reputation,
 - Multiple lawsuits and large financial penalties,
 - Significant financial loss (e.g. resulting from termination of careless employees, damaged aircrafts, settlements relating to any legal issues like fatalities, etc.).

Therefore, minimizing human error through a sophisticated tool-management system is crucial and diminishes the odds of losing or misplacing tools. The main findings of the study come in the form of five (5) T-M systems which have been identified by the team. The study follows the approach below when presenting the analysis of each T-M system:

- a) Extensive research on background,
- b) Cost & feasibility study,
- c) Implementation,
- d) Risk analysis.

The systems presented *Section 4* are:

1. The Kardex Remstar KR-LR35 Automated Storage & Retrieval System (AS/RS),
2. Near Field Communication (NFC) technology,
3. AutoCrib Industrial Vending Machines (IVMs)

* Previously called GX7000.



4. Barcode & QR Systems,
5. Radio-Frequency Identification (RFID) Systems.

These operate in a multitude of industries ranging from automotive, retail, space & defence, to production and more. They are all well-suited to Aerospace MRO applications.

The paper concludes with a strategy-map outlining the steps required for the successful implementation of any of the proposed solutions to Bombardier's GX5000/GX6000/GX7500 programs (i.e. general implementation strategies are provided so as to remain applicable to all proposed systems).

Finally, the report adheres to the objectives outlined in the proposal stage of the project [1] (shown below).

- Outline the significance of using an effective tool-management system, especially one with a higher degree of autonomy & automation.
- Highlight the safety, reputational, legal, and financial implications of misplacing aerospace tools -- particularly in operational aircraft.
- Identify which kinds of tools are most likely to be lost, stolen, or misplaced -- and their common root causes.
- Identify constraints & client requirements associated with the research phase -- i.e. consider top level requirements provided by Bombardier Canada.
- Research and compare existing tool-management systems within manufacturing industries, identifying the benefits and drawbacks of each.
- Perform cost analysis and feasibility studies for each system, focusing on their compatibility for integration into Bombardier's GX5/6 & 7 programs.
- Combine all data collected to propose a tailored solution based on:
 - Cost and time constraints throughout its lifecycle.
 - Accessibility i.e. ease of use.
 - Effectiveness i.e. in a practical environment, will it live up to its theorized value?
 - Hassle-free integration.
- Summarize benefits and drawbacks of the recommended tool management system.
- Explore the changes needed in workplace management for the proposed solution to remain effective -- i.e. suggest management regulations which could be introduced to support and reinforce the initiative of tool-preservation.
- Provide a project roadmap illustrating the proposed implementation timeline of the solution.
- Comment on any improvements which can be made in the future.

Figure 1.1 Project Objectives [1]

¹ AER1601 TEAM 4 Project charter; objectives.