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# Automating Job Card Generation for Maintenance, Repair and Overhaul

enigma

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## Introduction

For airlines and MRO shops, the maintenance organization is one of the largest workforces in the company and among its biggest operating expenses. To work efficiently, and to comply with FAA/CAA regulations and safety standards, these highly trained technicians and engineers must be fully informed about the jobs they are to perform.

The creation and generation of complete, accurate, and properly organized job or task cards are among the most critical processes supporting maintenance activities. Yet, in many organizations this remains a largely manual function that can involve searching for data in multiple systems, sorting the information, and then entering it into the proper job card format.

This time-consuming and error-prone process contributes to maintenance errors and slows down the maintenance and repair of aircraft and engines. Not only are these efficiency constraints painfully obvious on heavy maintenance checks that may require job cards exceeding 1,000 pages, but also they waste precious time on A&B checks, unscheduled maintenance and non-routine jobs, directly contributing to flight delays.

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## Solution Requirements

Most methods for generating job cards fail to offer the efficiency, flexibility, and control that maintenance organizations need:

**Manual labor.** In many organizations, job card generation remains a largely manual, painfully slow, and labor-intensive process that, for C and D checks, can take weeks or months. Typically the planning system holds reference data used to generate job cards (the aircraft, model, ATA tasks, skills, hours, etc.). A planning engineer must work from these references, merging Airbus, Boeing, Embraer, or other OEM data, adding service bulletins, checking for updates, and so forth. Job cards for heavy maintenance (C and D checks) must often be revised before they are used, because the job card generation process takes so long. This usually involves manually comparing and synchronizing recent updates to vendor data, service bulletins, and so forth—another error-prone and inefficient process.

**Outsourcing.** Some airlines outsource the generation of job cards. This appears to simplify the process but actually it only shifts some responsibility, adds expense and presents control and coordination challenges around maintenance activities. In the end, each airline is still responsible for the maintenance of its fleet and ensuring that aircraft comply with maintenance regulations and aviation directives.

**Purchasing from vendor.** Aircraft manufacturers, such as Boeing and Airbus, offer generic job cards for the equipment they build. Any airline-specific processes, customer originated changes (COC), best practices, etc. must be appended to the end of a generic job card or work package, rather than being inserted as a part of the relevant tasks or subtasks, as there is no way to integrate or reference other data with the pre-packaged, vendor-supplied job cards. Furthermore, in a mixed fleet environment an airline needs multiple systems to properly maintain all of their aircraft.

## A High-Value Solution To A Critical Problem

Maintenance organizations will benefit from a highly automated system that can generate job cards (even for heavy maintenance checks) in print and/or online formats at the push of a button, in a matter of minutes or hours rather than months. Ideally the planning or maintenance and engineering software would drive such a system; not only for optimal efficiency and control, but also to avoid the cost and aggravation associated with changing business processes.

A fully automated job card generator must automatically access all the latest service data to ensure accuracy, eliminate manual intervention and minimize maintenance rework. Further, it must automatically include all the relevant source data from manufacturers such as Boeing, Airbus, etc. At the same time, a complete system for automated job card generation would be flexible enough to integrate in-house standards and processes at the task and sub-task level, rather than appending them to the end of the job card where they are awkward to reference and easy to overlook.

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## About InService JCG

The Enigma® InService Job Card Generator (InService JCG) enables airlines and MROs to reduce maintenance errors and save thousands of hours of labor-intensive activity by fully automating job card generation. This ATA-compliant solution, based on Java 2 Enterprise Edition (J2EE) open standards, can generate any number and any type of job card using a uniform process. It can generate job cards using Boeing, Airbus or any other OEM source data and insert customer-ordered changes (COCs) and best practices at the task and subtask level in the proper location on the job card—not just tacked on at the end.

### Among its key features, InService JCG:

- Improves the quality of job cards by assembling all relevant technical service information and merging it with planning data in the appropriate order and context
- Ensures that only relevant information, based on maintenance task and equipment serial number, is included in the job card and delivered to the technician
- Generates job cards (in PDF format) that can be used electronically and/or printed on paper, along with all required information and standardized, company-specific formatting
- Supports all different kinds of data: OEM data such as wiring diagrams and service bulletins; COCs; and airline-specific documentation, procedures and best practices
- Can integrate with, and be driven directly by, a planning system without any manual intervention or effort.

## How it Works

InService JCG pulls together core planning information such as resource, material and tooling data from maintenance planning systems and merges it with procedural, parts, and service bulletin data from the central InService JCG repository. The information is analyzed and filtered to ensure it matches the specific serial number (tail number) of the aircraft or engine being serviced. The maintenance tasks are then printed or sent electronically to the appropriate technician in the form of one or more job cards. This process is illustrated in Figure 1.

InService JCG generates a separate PDF document for each job card within a work package. Each PDF can contain multiple tasks and subtasks. These documents can be printed and used for maintenance and sign-off purposes in the traditional manner. Organizations also have the option (see below) to leverage digital signature capabilities and automated, document-level workflow while working with job cards using laptops or handheld devices. These features expedite sign-off and reduce errors and omissions.

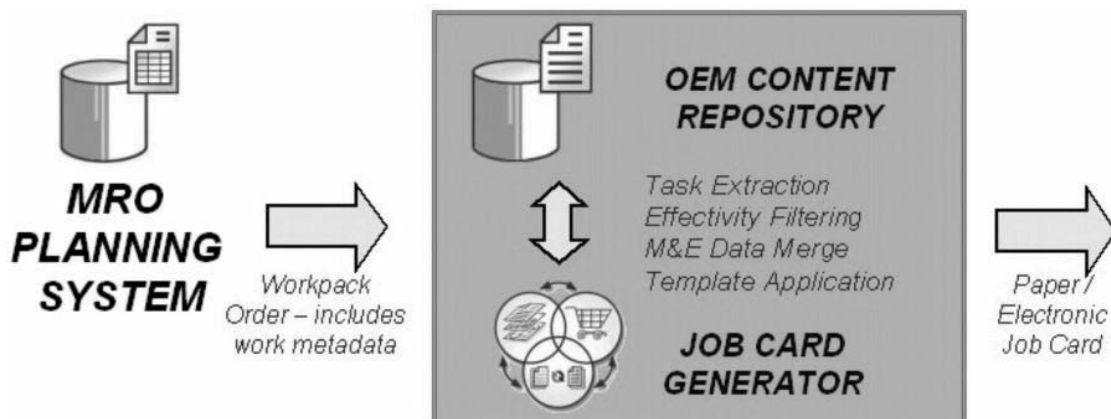
## The InService JCG Architecture

InService JCG consists of two separate, but closely linked, environments (see Figure 2):

- The data load environment, in which disparate data from relevant applications is automatically combined into a single content repository that is up-to-date with all the latest service bulletins, technical revisions, and company-specific procedures and best practices. This data, once imported, is indexed for faster access and online viewing, and can be enriched with active links to service bulletins, COCs and other aircraft or fleet information.
- The job card generation environment, in which the actual job cards are produced. Driven by job card output from the planning system, InService JCG identifies which data is relevant to what jobs, tasks, and subtasks; filters extraneous data; and generates one or more documents in PDF format.

When the planning system generates a work package request (including the tail number, job description, ATA references and any relevant planning information), InService JCG automatically pulls the relevant technical information (text, graphics, diagrams, schematics, OEM data, best

Figure 1: How InService JCG works



practices, etc.) from its unified repository. It then renders the combined and organized information in PDF format according to company layout/formatting requirements, and sends it to a specified location, such as a central server or archival system, as a complete work package. Job cards can include task-specific planning data contained in the M&E system, such as fleet, skill, zone, access panel, hours, and material. Different types of jobs can automatically be given a specific appearance or layout.

## Digital signatures

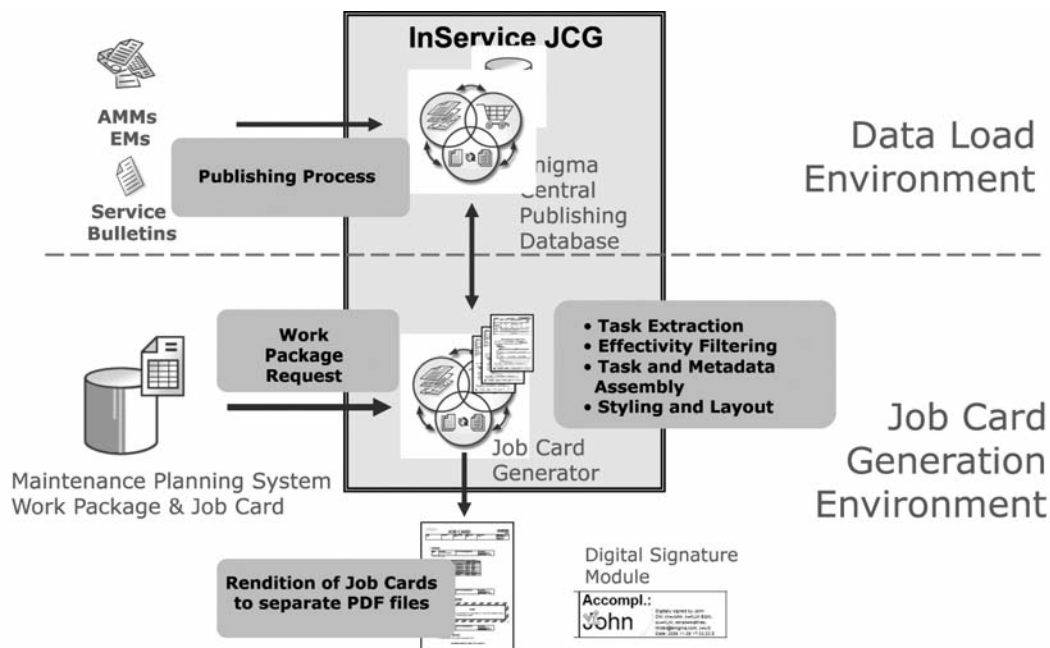
Digital signature capability helps streamline maintenance activity, eliminates paperwork, and simplifies regulatory compliance. Maintenance engineers and supervisors can apply their e-signatures from the line or the hangar using a laptop, PDA or other handheld device, or e-mail PDF documents for signoff.

This optional module, separately available from Enigma, supports all basic sign-off procedures per regulatory requirements. That is, a technician can sign off on each subtask, and technicians and supervisors can sign off on each completed task and job card. Multiple technicians and/or

supervisors can sign off on a job, task, or subtask: e-signature authorization is not limited to the person who started a task unless the organization desires this.

InService JCG generates interactive job cards that support electronic completion of checkboxes, comment fields, and signoffs; all adhering to regulatory requirements in line with your business processes. E-signatures and task data (how long the job took, notes on problems, etc.) can easily be exported for synchronization with the planning system—eliminating the need to manually scan and import paper documents. These capabilities help prevent data loss associated with misplaced paper documents and scanning errors, and protect job cards and edited data from unauthorized access. Advanced job cards with e-signature capability can also include built-in workflow to ensure that subtasks and tasks are all carried out, and completed and signed off in the right order. Organizations can easily add and configure these simple but powerful workflows to suit their own processes, or use a document management or other system to manage job card workflow.

Figure 2: The InService JCG architecture



## Deploying InService JCG

Enigma InService JCG is specifically designed for fast implementation and deployment—often in 10-12 weeks. For example, it comes pre-packaged with standard ATA job card style sheets that are easy to customize to meet your specific requirements.

Alignment with your current business processes facilitates quick and smooth user adoption.

Its modern, standards-based architecture makes InService JCG straightforward to integrate with M&E or MRO planning systems, as well as content management, document management or other systems, using an API such as XML, Web Services or HTTP. No new software or changes to current business processes are required to fully leverage the power and flexibility of InService JCG.

Data interchange between systems takes place in Enigma's predefined XML format. Integration can be:

- Unidirectional, where the planning system "pushes" the data required to generate a job to InService JCG using XML
- Bidirectional, which further enables InService JCG to push data on completed jobs back to the planning system.

Bidirectional integration helps to support ongoing maintenance planning, streamlines audits and compliance processes, and provides management with the latest status information. It also supports improved configuration management through faster, more accurate tracking of data on new/changed parts. This optional level of automation can be implemented at any point.

## Extending InService JCG

Based on well-proven Enigma 3C® technology, InService JCG is an enterprise class, fully scalable and upgradeable solution, making it straightforward to add new fleets or additional types of manuals—even adding documentation for a new aircraft model or, to support organizational growth, an entire airline.

A further compelling advantage of this open and highly flexible architecture is that it is vendor- and system-neutral. In the future you can upgrade or replace your planning system, add new content management capabilities, or otherwise enhance your business processes in any way you choose, while still retaining all the capabilities of InService JCG.

Customers can also easily extend the core capabilities of InService JCG in a variety of ways, including:

- Adding Enigma Revision Manager to InService JCG. Revision Manager allows you to compare two versions of job card data to see what task-level content has changed. This tells you immediately whether a job card needs to be revised, and initiates the process at the click of a button. You can then feed this information back to your planning system to flag all in-process job cards that need to be regenerated. You can then update your Enigma repository so that all future job cards automatically incorporate the latest data.
- Upgrading to the Enigma InService MRO solution, to optimize your entire maintenance information delivery process, with online manuals, parts catalogs and collaboration, as well as automatic job card generation.

Enigma partners with other leading vendors to provide pre-defined, integrated solutions that incorporate InService JCG and other Enigma technology. These currently include:

- Oracle's Complex MRO (CMRO) maintenance management and delivery solution, to automate the full maintenance planning function
- IBM's Technical Document Management and Delivery (TDMD) content management and delivery solution, to automate your whole technical publications function.

## Benefits of InService JCG

InService JCG's automated and advanced capabilities offer a range of benefits by making job card generation faster and more accurate, leading to increased productivity across maintenance planning and execution functions and simplifying maintenance auditing and compliance.

Faster, smoother job card generation reduces manual labor and maintenance delays (such as "dead time" spent waiting for job cards)—all leading to faster turnaround time and fewer delays at the gate. Automation also saves significant time on unscheduled maintenance and non-routine job cards, where the savings often matter most. Moreover, because job card generation is no longer a highly labor-intensive, "variable" factor in maintenance activities, you can streamline resource allocation to realize further efficiencies. In particular, planning engineers who would otherwise be spending large amounts of time preparing and validating work packages are free to focus on higher value activities.

Greater job card accuracy confers an equally wide range of advantages. Most importantly, it reduces rework resulting from the inadvertent inclusion of incorrect or out-of-date information. Enigma's highly efficient filtering mechanism ensures that all relevant data is automatically included. This

improves first-time fix rates while decreasing the number of errors caused by incorrect documentation. Greater job card accuracy further improves maintenance execution by ensuring that maintenance instructions are consistent over time.

## Customer Scenario

A large European airline leverages InService JCG technology to help reduce aircraft maintenance costs at more than 100 airports in 40 countries. The new system generates custom job cards with up-to-the-minute maintenance and repair information, and is currently used by thousands of technicians, maintenance planners and engineers worldwide.

Leveraging its core competence in aircraft MRO, this airline not only maintains its own fleet but those of nearly 50 other airlines. Efficient maintenance is thus all the more critical to the organization's success. The customer uses the InService JCG system to dynamically generate custom job cards that not only indicate maintenance tasks but also include all relevant maintenance data for the specific aircraft being serviced.

InService JCG technology extracts maintenance and execution information from the customer's maintenance planning and content management systems and generates a comprehensive job card that includes all the references, equipment, tools, codes and other critical instructions necessary to perform a specific maintenance procedure.

On completion of allocated tasks, engineers sign off on physical job cards and check the completed paperwork back into the planning system. The company is now in the process of extending their Enigma solution to include digital signatures. The maintenance planning department credits the new system with eliminating 80% of the manual intervention activity associated with generating job cards. Reducing manual activity has also reduced human error and improved the quality of job cards.

For aircraft maintenance technicians (AMTs), Enigma has improved efficiency by eliminating the need to look for missing data (e.g., the latest service bulletins) needed to carry out the maintenance assignment.

Overall, InService JCG technology has significantly improved the airline's service workflow, while enhancing maintenance accuracy and increasing AMTs' efficiency.

## Conclusion

Manual job card generation processes significantly hamper maintenance efficiency and accuracy for A, B, C, and D checks alike, directly resulting in lost time, errors, and flight delays. While traditional options offer partial solutions, airlines and MRO shops will benefit greatly from a highly automated solution that can generate job cards in print and/or online formats on demand. The automated system must be integrated with current planning, content management and/or document management systems and related business processes. Further, it must offer the flexibility to incorporate in-house standards and processes at the task and sub-task level within job cards—even vendor-supplied job cards.

Enigma InService JCG addresses the needs of technicians, planners, and engineers with a comprehensive, automated job card generation solution that empowers a more efficient and consistent service organization, leading to:

- Reduced operating costs
- Increased equipment uptime
- Enhanced customer support and satisfaction
- Improved on-the-job safety
- Improved support for regulatory compliance

By making these direct and significant contributions to the bottom line, Enigma InService JCG drives significant competitive advantage in the MRO marketplace.

## About Enigma

Enigma is the only software company with a full suite of products aimed at improving the installation, operation and maintenance of complex equipment. Enigma takes data from enterprise applications to create an interactive maintenance solution that delivers the latest service, parts, and diagnostic information, helping every technician perform like an expert. By capturing best practices and providing an optimized workflow, Enigma simplifies maintenance. Enigma focuses on aftermarket service and support, maximizing customers' profits through improved workforce productivity, parts logistics, and equipment uptime.

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[www.enigma.com](http://www.enigma.com).**