

Unlocking the Power of Data

How Industries Can Drive Efficiency and Innovation Through Analytics and Visualization

Introduction

Almost every industry uses data analytics to generate business intelligence (BI) about performance, improve products and services, streamline operations, and forecast needs for resource allocation, acquisitions, hiring, and more. In eCommerce, data analytics helps to provide personalized product recommendations. In health care, it assists with identifying and predicting diseases. In manufacturing, it informs product design and development, predictive analysis, preventive maintenance, supply chain management, and more.

Industries tasked with sustaining large, expensive assets face a unique set of data challenges related to manufacturing, spare parts sourcing, and forecasting. An example of this is one of the US Department of Defense's most expensive assets, F-35 fighter jets, which require massive amounts of multifaceted, global data to support rapid analytics and decision-making. For this reason, F-35s are an ideal case study of how to apply the technologies of data storage, mining, analytics, and visualization.

A recent NCMS project applied and advanced these technologies with the goals of reducing F-35 production and sustainment costs, improving warfighter readiness, accelerating innovation, and facilitating technology transition. The collaboration—Automated Data Support, Analytics, and Integration (ADSAI) in Support of Enterprise Transformation, a partnership between

industry partner Guidehouse and the DOD's F-35 Joint Program Office (JPO)—conducted a three-step process: mapping the F-35 JPO's data ecosystem, creating an automated data pipeline, and producing automated data visualizations. Industries in all sectors can leverage this process to upgrade reporting for decision-makers, enhance workforce productivity, improve products and services, and reduce costs.

Mapping the Data Ecosystem

Organizations that seek to eliminate manual data collection, aggregation, assembly, and presentation should begin by mapping their data ecosystem—the programming languages, packages, algorithms, cloud-computing services, and general infrastructure used to collect, store, analyze, and leverage data. A data ecosystem map is a visual diagram that illustrates how data moves within an organization, focusing on all the online tools and platforms used, and whether the data is automated or digital. In the manufacturing industry, researchers have identified nine essential components of the data ecosystem: data ingestion, storage, computing, analytics, visualization, management, workflow, infrastructure, and security.

The DOD's F-35 JPO conducted a hierarchical mapping of its data ecosystem by producing a high-level operational concept graphic (OV-1) of the F-35 ecosystem. The team identified program metrics that support procure-

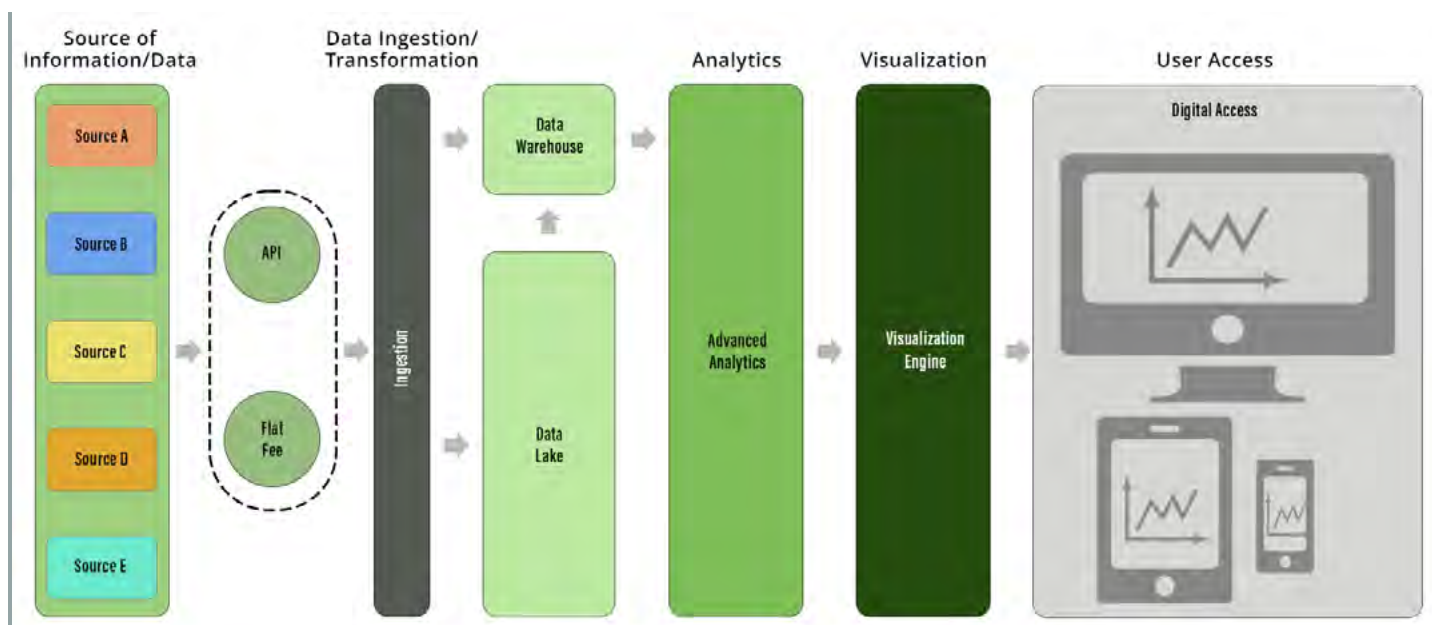


Figure 1: Data Journey—From Data Collection to User Dashboards

to-pay (P2P) goals—the business functions necessary to obtain goods and services using procurement processes and procedures. These steps enabled the team to understand the JPO’s data environment, including gaps, limitations, and needs.

Creating an Automated Data Pipeline

After completing a data ecosystem mapping, organizations will be able to create an automated data pipeline, which gathers data from various data sources (APIs, database tables, Excel sheets, XML files, webpages, and more) and transforms the data into the format required by the destination data repository. This is done via extract, transform, and load (ETL), a data integration process that combines data from multiple sources into a single, consistent data store. ETL is the foundation for data analytics because this process uses a set of business rules to clean and organize data so that it can address specific business intelligence needs such as generating dashboards and reports, predicting the outcome of business decisions, reducing inefficiencies, and more. The data is then loaded into a data warehouse or data lake—a

centralized repository that ingests and stores large volumes of data.

For the F-35 JPO project, Guidehouse delivered a consolidated data lake for leveraging powerful, data-driven solutions by deploying Impact Level 5 (IL5) Azure cloud infrastructure within the government’s operating environment. The F-35 JPO’s ETL pipeline to the data lake provides real-time data on-demand, eliminating manual efforts to create weekly, monthly, and quarterly reports. Moreover, the automated data pipeline merges and enriches data to allow maintenance, supply, and sustainment data, along with cost-procurement and earned value data, to be informed by each other. Creating an automated data pipeline is needed to produce automated data visualizations.

Automated Data Visualizations

The automated data pipeline serves as the source material to create data visualizations, which represent data via graphics such as charts, plots, and infographics. These visual displays of information communicate complex data relationships and data-driven insights in an easy-to-understand way. The F-35 JPO

collaboration produced business intelligence dashboards with Microsoft's Power BI platform, a software that allows users to pull data from multiple sources to produces real-time data visualizations that help drive quicker and better business decisions.

The Power BI solution streamlines the report-creating process, reducing the amount of labor needed and creating a faster turnaround time for decision-making. The result is a stable, integrated, available, and scalable data environment that uses both automation and introductory robotic process automatic techniques to meet the needs of a rapidly growing data ecosystem.

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The dashboards enable F-35 JPO decision-makers to look at historical data, view current problems, and forecast future issues. These will improve the F-35 JPO's ability to make sound decisions in the areas of manufacturing, security, supply resourcing, cost reductions, and workforce productivity.

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With artificial intelligence (AI) and machine learning (ML) tools embedded into business intelligence platforms such as Power BI, organizations will be able to handle even the most complex of data.

For the F-35 JPO, the collaboration facilitated the creation of several digital decision-support dashboards including:

- The Air Vehicle (AV) dashboard, which presents data on asset development, production, sustainment, and availability
- The Earned Value Management Analysis (EVM) dashboard, which displays data

on performance, cybersecurity, system engineering, program management, system test and evaluation, autonomic logistic information system (ALIS), training, and more.

- The Fleet Health Trends dashboard, which features data on aircraft status, partially mission capable status, non-mission capable status, and flight hour utilization.

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Conclusion: From Data Automation to Data Democratization

Industries across all sectors can use the three-step process employed in this initiative—creating an automated data pipeline, mapping the data ecosystem, and facilitating automated data visualizations—to establish a common, functional data baseline for the entire organization. Automated data visualizations enable leaders to make key programmatic decisions based on metrics informed by accurate, timely, and available data. Moreover, automated data visualization will continue to be a living artifact that will continuously be updated as processes change, or new technologies emerge.

As more organizations begin to leverage business intelligence tools, data democratization will become increasingly important. By broadening access to data and enabling all employees to access, analyze, and share data—with reasonable limitations on legal confidentiality and security—organizations will be able to mobilize the insights of their entire workforce to make better-informed decisions.



About NCMS

The National Center for Manufacturing Sciences (NCMS) is a cross-industry technology development consortium, dedicated to improving the competitiveness and strength of the U.S. industrial base. As a member-based organization, it leverages its network of industry, government, and academia partners to develop, demonstrate, and transition innovative technologies efficiently, with less risk and lower cost.

NCMS enables world-class member companies to work effectively with other members on new opportunities – bringing together highly capable companies with providers and end users who need their innovations and technology solutions. NCMS members benefit from an accelerated progression of idea creation through execution.

