REALIZING THE CBM+ VISION TO IMPROVE OPERATIONAL READINESS

ROGER CROMBIE,
SENIOR ACCOUNT EXECUTIVE, MICROSTRATEGY

NIKHIL SHENOY,
CEO, COLVIN RUN NETWORKS

Colvin Run

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Realizing the CBM+ Vision to Improve Operational Readiness

Roger Crombie, Senior Account Executive, MicroStrategy
Nikhil Shenoy, CEO, Colvin Run Networks

Military services face a variety of challenges in sustaining their aging fleets of vehicles, aircraft, and ships. They must accurately determine the optimal times to schedule maintenance and repairs. Time-based maintenance is the current best practice, but that can result in parts being replaced when they still have useful life remaining. Diminished Manufacturing Sources and Material Shortages (DMSMS) can also make replacing legacy parts time consuming and expensive as organizations try to adhere to a pre-determined schedule. Defense maintainers are also faced with challenges related to legacy systems, data quality, training, and methods that may be difficult to access or complicated to use.

The DoD has been studying Condition Based Maintenance Plus (CBM+) as a strategy to determine optimal times to schedule maintenance and repairs based on system conditions. The military is seeking to implement CBM+ where tailored maintenance programs are created for each individual aircraft, vehicle, or weapon.

New system status data is becoming readily available through sensors on modernized components such as engines, drivetrains, and electronic systems. The CBM+ vision can be brought together by integrating new internet of things (IoT) sensor data, financial data, mission priorities, manpower capacity, and supply chain information by leveraging advances in mobile analytics and best practices curated over time.

Building a successful CBM+ solution involves three key components:

1. Connecting a variety of disparate data sets
2. Building meaningful machine learning models
3. Sharing outputs of those models in a user friendly, harmonized system across maintainers, planners, and decision makers

Connecting to Data

Before data scientists can develop machine learning models, they need access to data that is both secure and governed. They then need connections to that data for the tools they use, such as RStudio and Jupyter Notebook. There are no shortcuts around the difficult work of building a schema that integrates diverse datasets ranging from existing DoD data environments to new IoT and other big data sources.

Ideally, this data is accessed through connectors in the source database itself, rather than being ingested by a tool that creates a completely separate and repetitive integrated database. The semantic graph is an approach that allows for central management and control of access to data while providing true data governance for a "single version of the truth." Beyond this, an analytics platform that enables CBM+ must be able to meet unique DOD security and compliance requirements without loss of performance—no small task.

Building Relevant Models

Once data connections are securely and reliably established, creating useful tools leveraging that data is the next essential step in any analytics-driven pursuit, including CBM+. Collecting sensor data and metadata is a first step, but verifying that the sensor and telemetry information is predictive of maintenance requirements is not necessarily a given.

Data discovery is required to determine the extent of predictability across multiple vectors. For example, temperature variations alone may not predict part failure, and neither does time in the air by itself. However, if an aircraft flies in a certain temperature range for a given amount of time, the likelihood of certain parts failing may be higher. Uncovering these potentially complex relationships out of multidimensional datasets, and tailoring them to specific program needs and logistical constraints is non-trivial and requires the proper level of rigor, analysis, and investment.

Culturally, the process model is equally as important as the data model. For example, shifting from deterministic plans (i.e. on this date and this time, change this part on this airplane) to probabilistic plans (i.e. change this part before changing that part, for these reasons) requires equal rigor and organizational buy-in for any data model to have operational relevance to CBM+.

Sharing Output

The third critical challenge for implementing a CBM+ solution is getting information into the right hands in an easy-to-understand format. There are multiple stakeholders involved in a maintenance enterprise, including: frontline operators, small unit leaders, maintenance technicians, planners, staff officers, and commanders. Each stakeholder may have a different familiarity with analytics tools and prefer to receive information in specific ways and on diverse devices, to meet shifting program goals and requirements. This is where most rigidly specified analytic tools and solutions fall short.

Even in the most successful organizations, analytics adoption is estimated to only reach 30%—with most users being analysts. This is why existing point analytics solutions are not readily adopted, as they are wholly inadequate to realize the vision of CBM+. Instead, the relationships that data scientists uncover need to be delivered to decision-makers and operators in their daily workflow on the tools they use, such as email, SharePoint, and spreadsheets. In the end, the greatest challenge facing CBM+ is not wrangling data or developing complex algorithms, it is implementing a single, predictive source of truth to improve confidence and operational efficiencies through data-driven decision making.

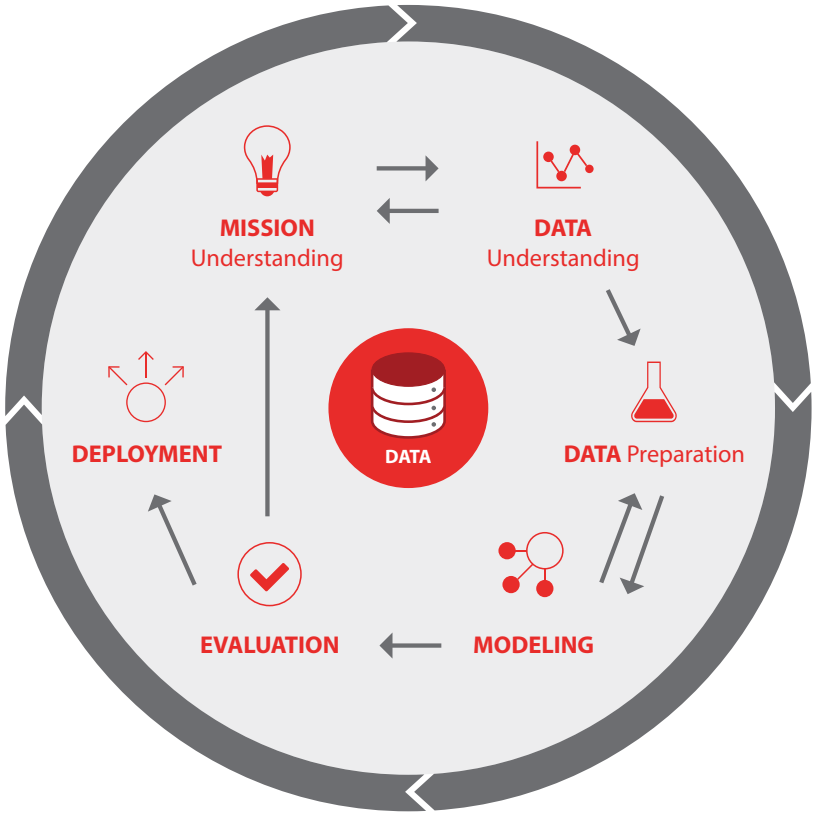
A Comprehensive Approach is Required

The Cross-Industry Standard Process for Data Mining (CRISP-DM) holistically addresses the data connections, modeling, and deployment aspects of data-driven initiatives tied to deep mission and data understanding. The CRISP-DM approach was developed over 30 years as data became more available (and essential) in a variety of industrial applications. The process continues to evolve today, as the data that fuels insights must be refined and delivered in a meaningful way to have value.

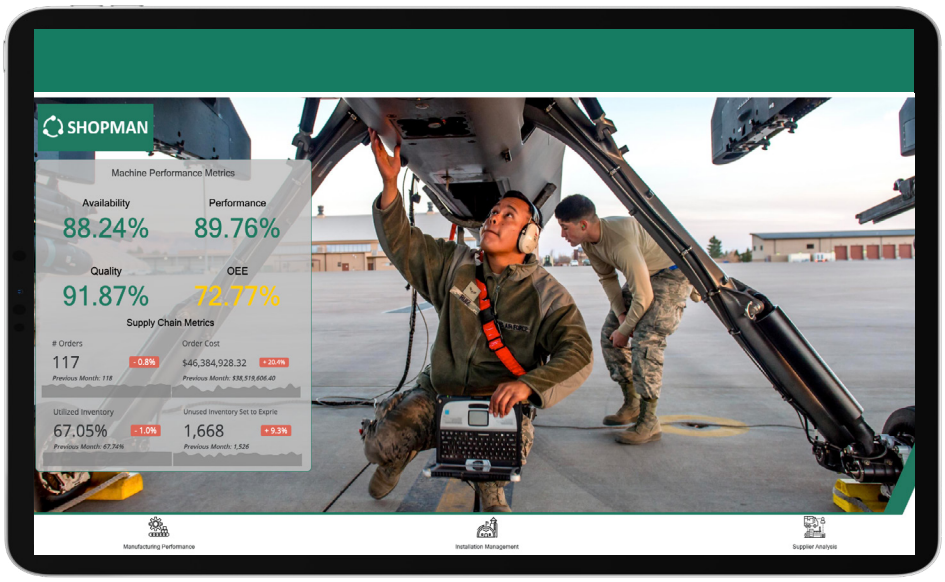
Cybersecurity is an increasingly important but orthogonal vector that requires its own special attention equal to the operational importance and rigor of the CRISP-DM approach. CRISP-DM involves six tool-agnostic phases with discrete, iterative tasks that ensure the data mining product is flexible and evolves with organizational needs.

These six phases include:

a. **Mission Understanding –** Practices developed over time have critical value to incorporate in modernization initiatives, as enterprise data environments must adapt to shifting mission contexts and priorities.
b. **Data Understanding –** Models are only as good as the underlying data. The data model and connection/correlation among data and outcomes is equally if not more important than the predictive model itself.
c. **Data Preparation –** How data is collected, curated, stored, distributed, secured, and managed is a crucial component of any data-driven environment.
d. **Modeling –** The analytical methods to harness data into relevant, actionable insights with operational integrity is a key component.
e. **Evaluation –** How to course correct with shifting mission priorities is vital to this process.
f. **Deployment –** A comprehensive understanding of the end-to-end user experience is required—from the maintainer and the planner, to supply chain analysts and decision makers—matrixed with system administrators, IT support, and data scientists.



Realizing the CBM+ Vision



The Supply Hub for Operational Predictive Maintenance and Analytics (SHOPMAN) developed by Colvin Run Networks, powered by MicroStrategy and with support from AFWERX and the Office of Naval Research, provides out-of-the box advanced analytics to enable the CBM+ vision. It delivers on the three key components discussed earlier for building a successful CBM+ solution:

1. It allows connection to a variety of disparate datasets in a secure and governed manner.

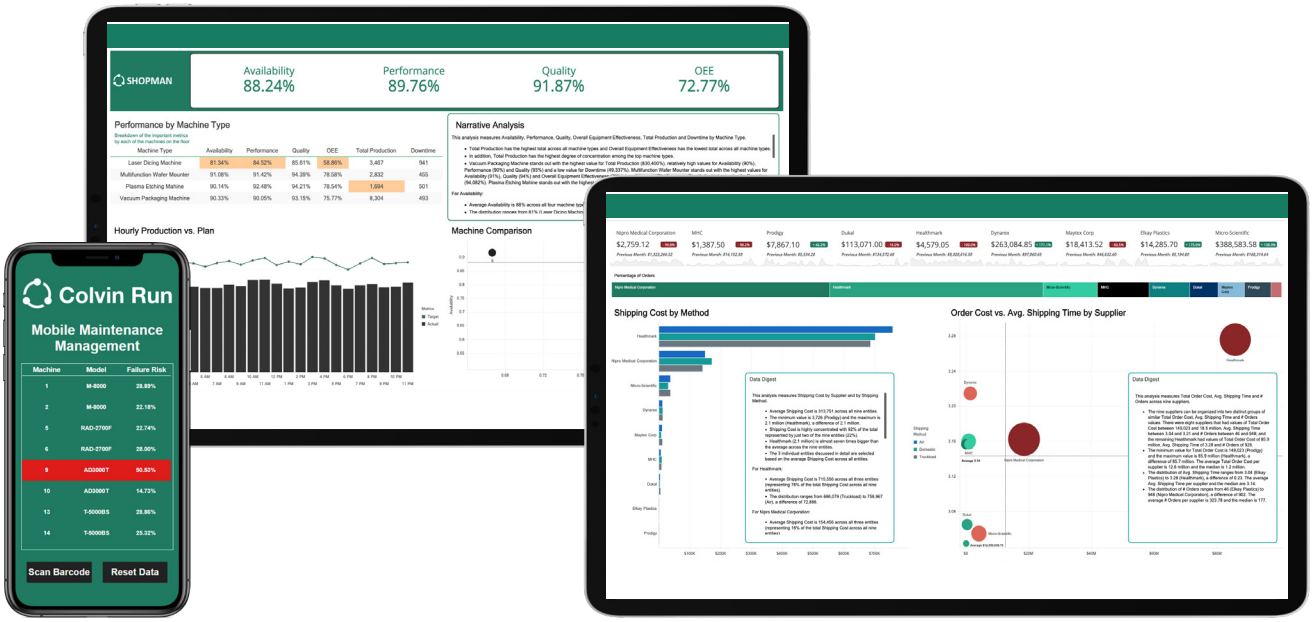
SHOPMAN is powered by MicroStrategy's leading enterprise analytics platform which is built on a powerful Semantic Graph to ensure trusted data governance, security, and consistency. The Semantic Graph elevates the potential of enterprise data assets, makes federated analytics possible, and delivers personalized recommendations and insights based on who you are, where you are, and what you are doing. Its Google-like index sits on top of an organization's enterprise data assets, providing the ability to consolidate disparate sources of data, deliver a single version of the truth, and surface insights quickly. It categorizes and federates each data investment in real time, constantly enriches the index with location intelligence and usage telemetry data and enables AI-powered experiences through contextual recommendations and personalized insights that users can trust. The Enterprise Semantic Graph makes data and analytics truly pervasive.

2. It builds meaningful machine learning models.

Colvin Run utilizes the CRISP-DM approach. This open, proven, and integrated methodology ensures holistic and comprehensive implementations.

3. It enables outputs of ML models to be shared in a user friendly, harmonized system across the enterprise.

To realize the full potential of CBM+, SHOPMAN delivers analytics in a user's normal workflow, driving faster data informed decisions. SHOPMAN provides intuitive, visually rich user interfaces to optimize the user experience and drive adoption for both desktop users and field personnel using mobile devices.



With its industry leading algorithms paired with intuitive user interfaces, SHOPMAN increases system availability while optimizing the user experience and driving analytics adoption. It reduces lifecycle costs by decreasing the likelihood of unnecessary orders and maintenance. And it improves warfighter readiness by implementing CBM+ the way it was envisioned.

ABOUT THE AUTHORS

Roger Crombie is the Senior Account Executive for the Defense and Intelligence Community at MicroStrategy. He is a retired U.S. Army Colonel with 24 years of service in Infantry and Special Operations units and culminated his career as the Senior Military Assistant for the Assistant Secretary of Defense for Strategy, Plans and Capabilities. Roger holds an MBA from the University of Virginia, Darden School of Business, an MS in National Security Studies from the National War College and a degree in History from The Citadel.
linkedin.com/in/roger-crombie/

Nikhil Shenoy is the Co-Founder and CEO of Colvin Run Networks, a Department of Defense-backed Data Science and Engineering company that was awarded multiple grants by the Virginia Center of Innovative Technology (CIT), and recognized by MassChallenge & AFWERX as a Top 10 Startup serving the US Air Force. Nikhil is leading Blockchain initiatives for the Armed Forces Communication and Electronics Association (AFCEA), as well as serving as leader within the National Defense Industry Association (NDIA). Nikhil has over a decade of experience in technical product development, delivering initiatives for leading companies in a variety of industries including finance, consumer goods, and security technology at Goldman Sachs, Procter & Gamble, and Kastle Systems respectively. Nikhil holds a Chemical Engineering degree from the Massachusetts Institute of Technology, and an MBA from the University of Chicago's Booth School of Business.
linkedin.com/in/nikhilshenoy/

For an overview of SHOPMAN, watch this video.

To learn more, contact the authors:
Roger Crombie at rcrombie@microstrategy.com
or Nikhil Shenoy at nikhil@colvinrun.net.