MARINE CORPS SYSTEMS COMMAND | MARINE INNOVATION UNIT

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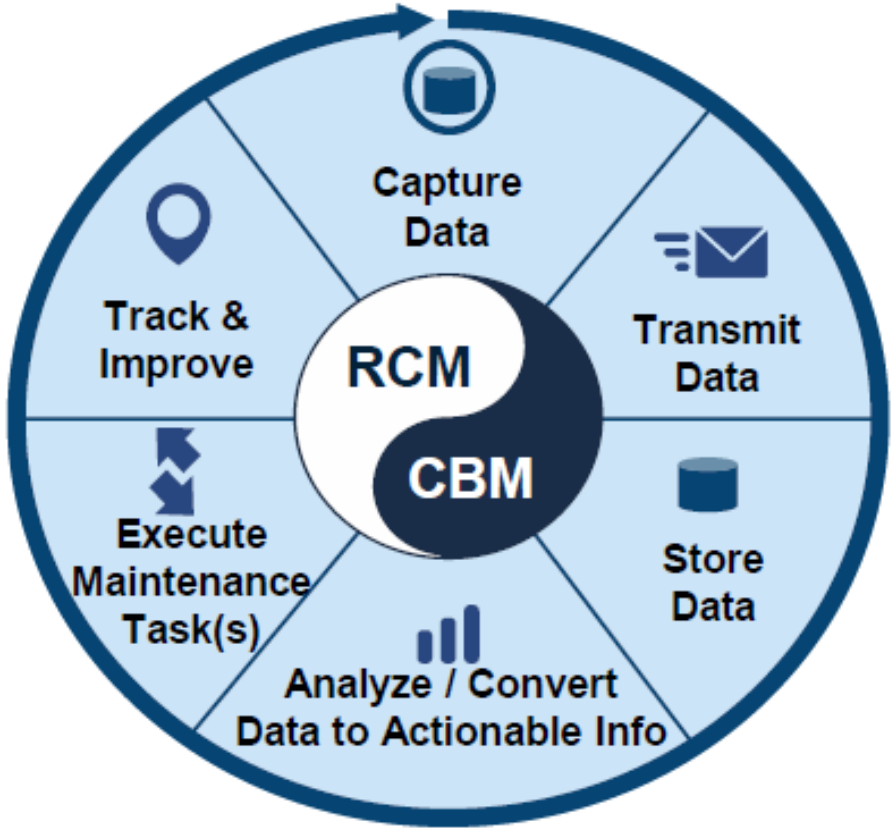
USMC CONDITION BASED MAINTENANCE PLUS (CBM+) AND RELIABILITY CENTERED MAINTENANCE (RCM)

USMC CBM+ FUNCTIONAL CAPABILITY AREAS

CBM+ is enabled through Reliability Centered Maintenance (RCM), technology, and engineering best practices that identify failures before they occur, leading to the reduction of uncertainty and improved life-cycle sustainment. We partner with operational and strategic maintenance community stakeholders, industry, and other DoD organizations to optimize maintenance practices to enhance readiness, improve Marine safety, and drive cost-effective maintenance practices for the Marine Corps.

RCM is the **defining process** for determining the **most effective maintenance strategies.**



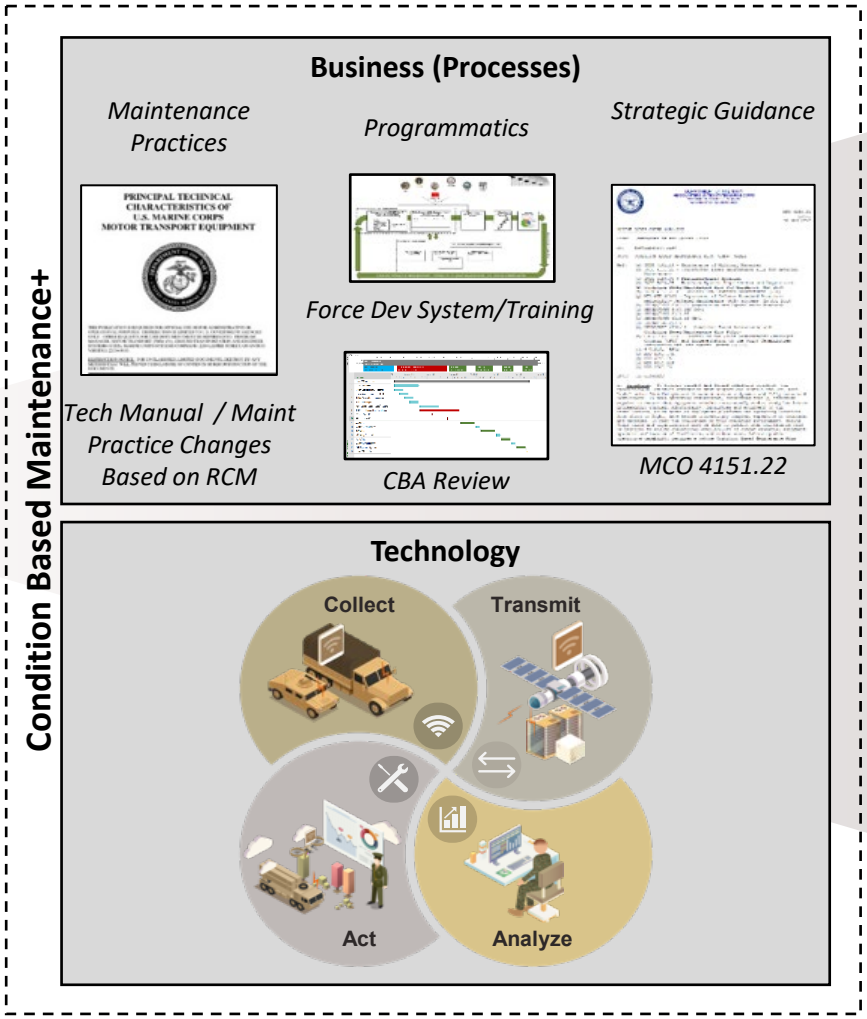
CBM+ is a strategy. It's the **source** of methods and technologies to execute the selected maintenance approaches.

USMC CBM+ VISION

*CBM+ is a **shift in maintenance behavior** and practices enabled by technology*

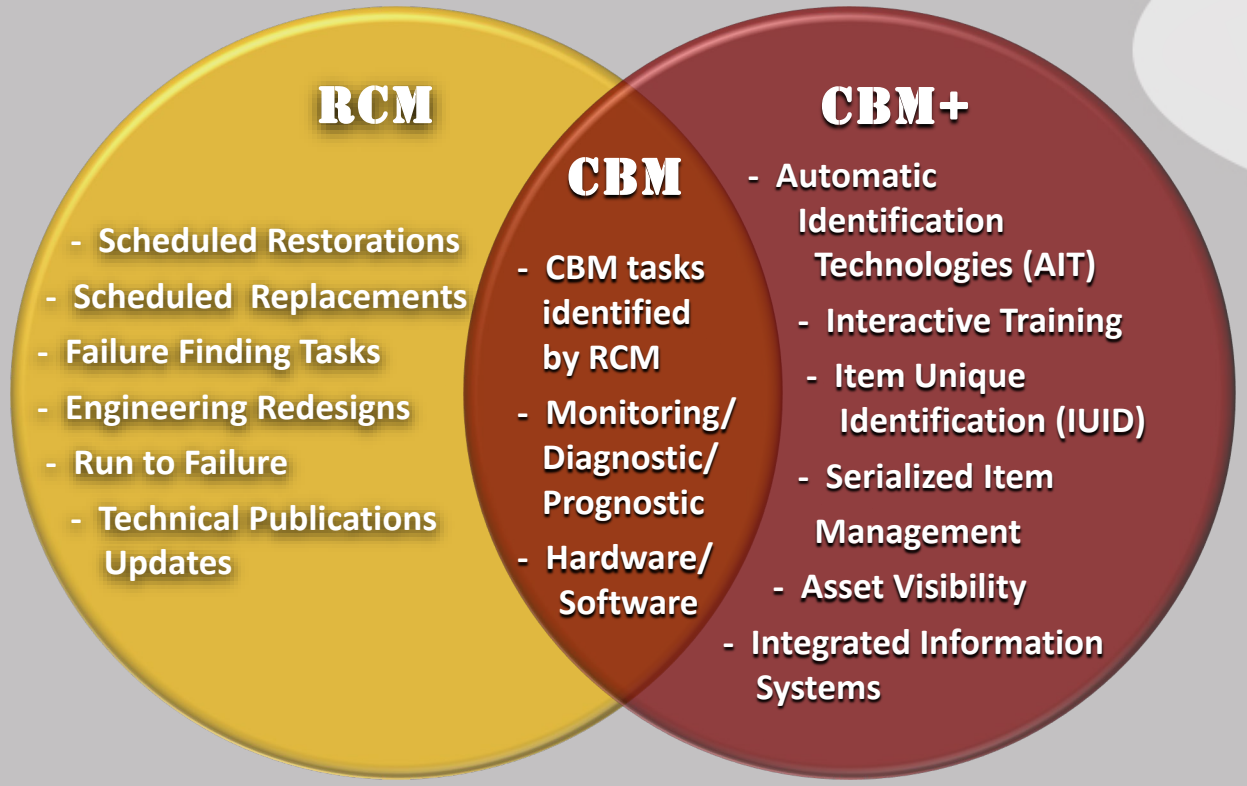
Current Maintenance Posture

- **Limited ability to conduct just two condition monitoring elements** (inspections and repair history data)
- Performed **reactively** when there are **failures**
- Maintenance based on **time/utilization**
- Diagnostics data stuck at weapon system, **cannot be offboarded**
- **Limited & manual** failure analysis capabilities
- **Unpredictable** future operational availability

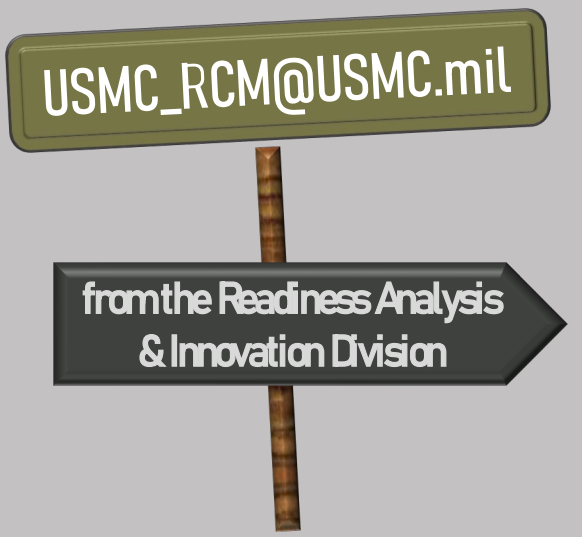


Future Maintenance Posture

- **Full use of all five elements of condition monitoring** (fluid analysis, repair history, inspections, electronic data, and site conditions)
- **Reliability Centered Maintenance** analysis feeds weapon systems' CBM+ Strategies
- Performed **proactively,** based on **predicting remaining useful life**
- Maintenance based on **anticipated events**, performed only as needed
- Diagnostics successfully **offboarded, centralized, and analyzed**
- Failure analysis performed in an **automated manner**
- **Data-driven insight** on future operational availability



RCM PROVIDES THE ANALYTICAL FOUNDATION TO AN EFFECTIVE CBM+ ENVIRONMENT. CONTACT THE MCSC RCM TEAM FOR SUPPORT.



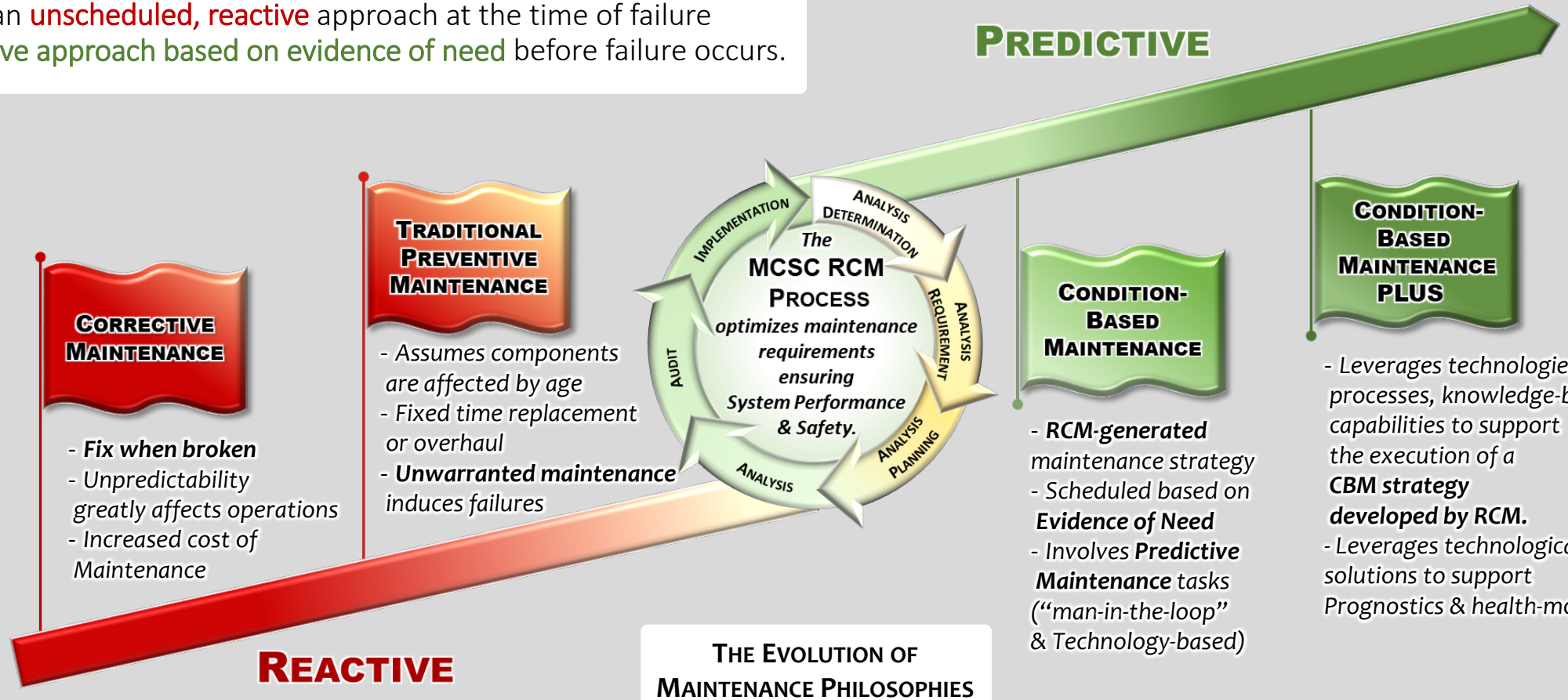
"From a weapon system or equipment perspective, health management without RCM analysis becomes technology insertion without a justified functionality". MCO 4151.22

CONDITION-BASED MAINTENANCE PLUS (CBM+)

The Interactive Relationship between CBM+ and Reliability Centered Maintenance (RCM)

Condition-Based Maintenance PLUS (CBM+)

represents a conscious effort to shift equipment maintenance from an unscheduled, reactive approach at the time of failure to a predictive approach based on evidence of need before failure occurs.



THE EVOLUTION OF MAINTENANCE PHILOSOPHIES & THE ROLE OF RCM

RELIABILITY-CENTERED MAINTENANCE (RCM)

A scientific process used to determine what must be done to ensure that any system continues to do what its users want it to do in its present operating context.

THE ***RELIABILITY CENTERED MAINTENANCE*** PROCESS IDENTIFIES THE **EVIDENCE OF NEED** JUSTIFYING AN ***ON-CONDITION MAINTENANCE*** TASK AND ENABLES ***CONDITION-BASED MAINTENANCE PLUS (CBM+)*** WITH THE DEVELOPMENT OF ***CONDITION-BASED MAINTENANCE (CBM)*** STRATEGIES CONSISTING OF:

- On-condition tasks
- Failure finding tasks
- Scheduled restoration tasks
- Scheduled discard tasks

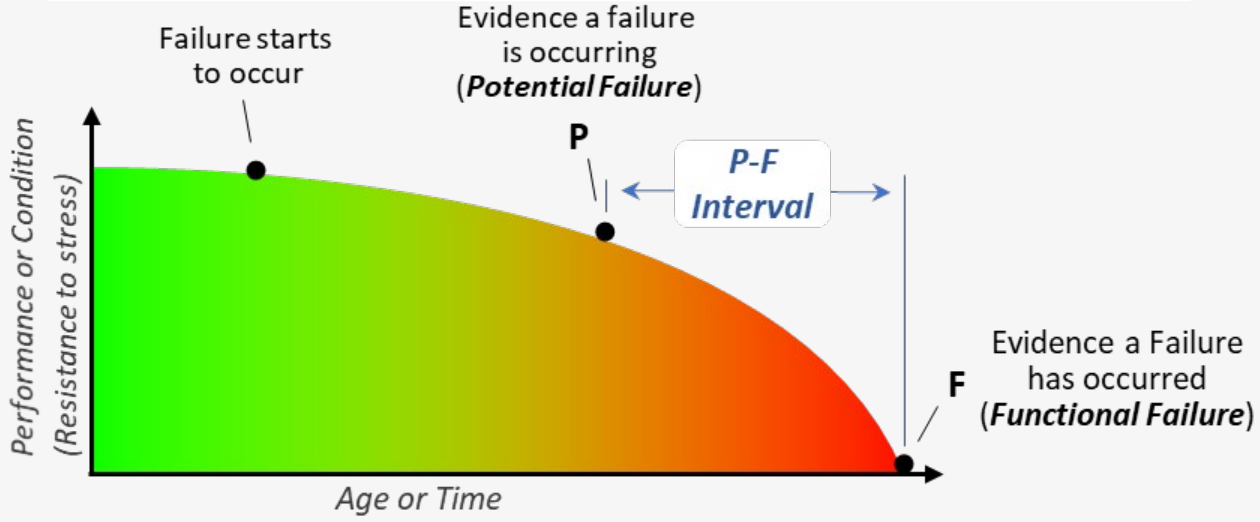
THE ***USMC (MCSC) RCM PROCESS*** ALSO CONTRIBUTES TO THE SAFE, RELIABLE, & COST-EFFECTIVE OPERATION OF WEAPON SYSTEMS WITH:

- Design modifications
- Training recommendations
- Identification of new operating and emergency procedures
- Modifications to technical manuals …

COMMAND RESOURCES:

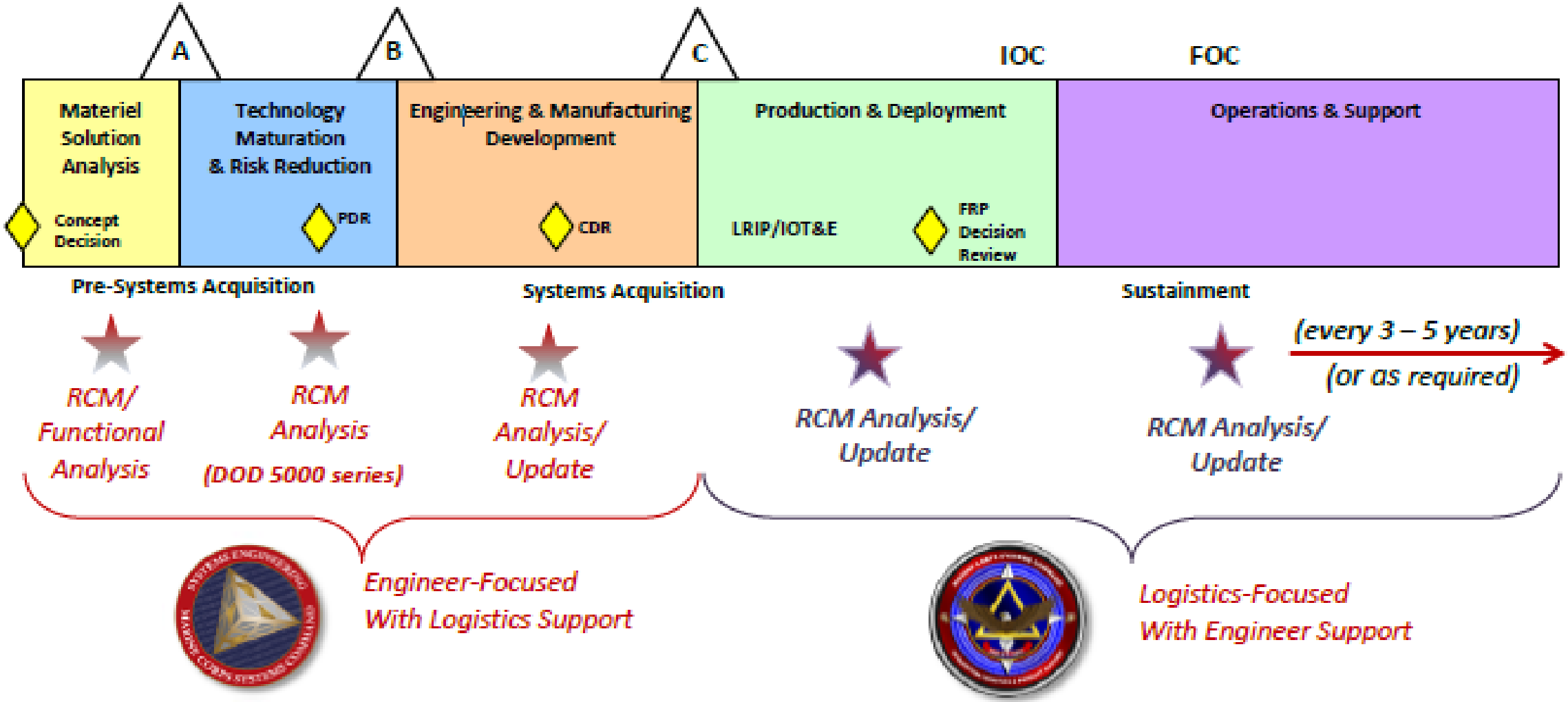
- MCSC Order 4151.22C: CBM+ & RCM Program
- MCSC RCM Handbook
Support @ *USMC_RCM@USMC.mil*

RCM recognizes there is little to no relationship between length of service & the probability a component may fail. Roughly 89% of components fail on a purely random basis, However most ***FAILURES*** provide a ***WARNING*** or ***EVIDENCE*** *of deterioration.*



Stages of Failure. The P-F curve

RCM Across the Lifecycle



USMC CBM+ IMPLEMENTATION

"We will make strategic investment in **Data Science**, **Machine Learning** and **Artificial Intelligence**. Initial investments will be focused on challenges we are confronting in talent management, **Predictive Maintenance**, Logistics, intelligence, and training." – 38TH Commandant's Planning Guidance

Up to FY19

Individual Pilots

Conduct pilots on individual weapon systems and gather initial learnings

Individualized Pilots

LAV *M777* *M88*

- Gauged impact from use of sensors and changes to scheduled maintenance
- Conducted 7 total CBM+ related pilots
- Focus on individual functional capabilities of CBM+ (collect, transmit, store, analyze, act)

FY20

CBM+ MVP Started

Build a full-spectrum, tightly scoped CBM+ minimum viable product (MVP)

Minimum Viable Product

JLTV *MTVR*

- Enable a total of 10 JLTVs and 10 MTVRs
- Partner with 1 CONUS unit
- Leverage initial learnings from existing pilot efforts
- Synchronize efforts across spectrum of stakeholders

FY21-24

CBM+ Expansion

Evaluate and expand MVP to additional units

MVP Expansion

JLTV *MTVR*

- Grow JLTV/MTVR MVP to multiple units
- Establish a CBM+ cloud solution within Jupiter/Advana
- Measure impacts on *material readiness,* and decision support

FY25-29

CBM+ Scaling

Scale aggressively to Marine Logistics Groups, additional weapon systems, and new acquisitions with POM-25 FYDP

Scaling CBM+ Fleetwide

MHE *ROGUE Fires* *ACV*

- Enroll remaining applicable weapon systems at MLGs in CBM+ program
- Deploy mature AI and cloud infrastructure at scale
- Reshape training, education, supply, and policy to revolve around CBM+

FY30

Realized CBM+ Value Force Design 2030

Global Logistics Awareness will support the **lethality** of Marine Corps forces by **enabling decision** and execution **superiority**, allowing commanders to **outpace** the enemies' **decision** cycle. It will do so by allowing the **logistics enterprise** to deliver the *right* resources, to the *right* place, at the *right* time, for the *right* reasons.

Sustaining the Force for the 21st Century
- Commandant of Marine Corps

EQUIPPING OUR MARINES

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