CORROSION MANAGEMENT MATURITY MODEL

CMMM Model Definition

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OVERVIEW

The Corrosion Management Maturity Model (CMMM) is an organizational assessment tool created by NACE, the National Association of Corrosion Engineers. The model provides a framework for understanding the current extent of corrosion management (CM) operations and practices within an organization, a context for establishing strategic objectives and implementation plans in support of improving corrosion policies and practices, and a means to evaluate progress over time toward those objectives.

The CMMM is composed of 10 domains and five maturity levels as detailed in this document, which contains the full definition and description of the model. Introductory material to aid in the understanding of the purpose and use of the CMMM is also provided.

The primary audiences for the CMMM, and for this document, are organizations seeking guidance related to improving their corrosion operations and practices. The audience also includes any stakeholders for such organizations that will be part of improving corrosion management and corrosion control with that organization.
I. INTRODUCTION

1.1 THE NEED
The global cost of corrosion is estimated to be US$2.5 trillion and it is estimated that savings of between 15 and 35% of the cost of corrosion could be realized by using available corrosion control practices.

During the 2015 International Measures of Prevention, Application, and Economics of Corrosion Technologies (IMPACT) study sponsored by NACE, the advisory panel and project team identified a need to more explicitly assess corrosion management within organizations. The study concluded that, “to achieve the full extent of potential savings... implementing a Corrosion Management System (CMS) and its integration into an organization’s overall management system is mandatory.”

The IMPACT study defined a CMS as “a set of policies, processes, and procedures for planning, executing, and continually improving the ability of an organization to manage the threat of corrosion for existing and future assets.” During the study, corrosion control practices across management system domains and the life cycle of assets were evaluated. While powerful, the structure used lacked the detail to clearly assess how well an organization was doing and what the next steps might be. The CMMM was developed by NACE to address these concerns.

1.2 THE CORROSION MANAGEMENT MATURITY MODEL
The CMMM is a structured model of corrosion management capabilities organized by:

- Maturity level – levels of progressively higher capability
- Management system domains – groupings of related characteristics and associated capabilities (e.g., resource management or organizational structure)

The CMMM represents the elements of a CMS deemed essential to achieve improved corrosion management and corrosion control, supporting the goals toward corrosion cost and risk reduction over time.

The CMMM is intended for use primarily by asset owners and operators, but may also be beneficial for a broader set of stakeholders for degradable assets (e.g., suppliers, service providers, etc.).

1.3 THE CORROSION MANAGEMENT PRODUCT SUITE
The CMMM is part of the NACE IMPACT Plus product suite as depicted in Figure 1.

Within this IMPACT Plus product suite, the CMMM has several components provided to realize its benefits:

1. CMMM Assessment – a structured assessment tool that allows organizations to evaluate their current state against the CMMM capabilities
2. **CMMM Assessment Report** – a detailed report of an organization’s current state, with comparisons to blinded, aggregate results
3. **CMMM Aggregate Results** – blinded, aggregate results, from the community of organizations that have also completed a CMMM assessment, that depict the maturity level by domain and capability-specific distribution of organizations current state, used for comparison purposes

### NACE’s Impact Plus Product Suite

#### Corrosion Management Maturity Model (CMMM)
Structured model of corrosion management maturity characteristics, with an assessment tool that enables evaluation of organizations. Results are then stored for aggregate reporting and comparison.

#### Corrosion Management Process Classification Framework (CMPCF)
Comprehensive listing of enterprise business processes augmented with corrosion-specific details. Enables alignment of content related to each process, comparison of practices, and benchmarking performance.

#### IMPACT Plus Portal
Cloud-based collaborative environment for organizations to create custom process frameworks based upon the CMPCF and store or link content in an easy to access and use web-based form. CMMM results are visible for comparison.

**Figure 1**

Additional information about the components of the IMPACT Plus product suite can be found at [nace.org/impactplus](http://nace.org/impactplus).

### 1.4 ABOUT THIS DOCUMENT

This document fully defines the structure and components of the CMMM:

- Section II – maturity levels
- Section III – management system domains
- Sections IV – XIII – key characteristics and capability statements for each management system domain, organized by maturity level
II. CMMM MATURITY LEVELS

Five levels of maturity are defined in the CMMM as shown in Figure 2. The levels of maturity represent defined stages, described in terms of capabilities, of an organization’s progress toward achieving its corrosion vision in terms of policy, stakeholder integration, accountability, resources, communication, continuous improvement, and performance measures.

The Five Levels of the CMMM

- **5 Innovative & Leading**
  - Highly engaged and driving the state-of-the-art of corrosion management
  - Anticipatory, agile, and embedded in the flow of the work
- **4 Optimized & Proactive**
  - Corrosion management program implemented:
  - Lessons learned activities built into CM processes to capture and apply learnings to improve CM processes
  - May have some anticipatory capabilities
- **3 Managed & Integrated**
  - Corrosion management is well-structured management approach
  - Aligned end-to-end across the enterprise
- **2 Defined & Compliant**
  - Corrosion management defined but only compliant with the standard or bare minimum
  - Some CM processes defined, but may still be isolated and not part of integrated management approach
- **1 Reactive**
  - Need for corrosion management identified, but no strategic focus
  - Corrosion management activities occur on as-needed basis but no systematic plan in place to address more consistently

The lowest maturity level in the model represents an organization that has not implemented a consistent and comprehensive corrosion management practice end-to-end. As the organization begins to implement and integrate end-to-end corrosion management, the organization’s maturity rating would be increased across one or more of the domains to higher maturity levels.

An organization can establish its current maturity level by completing a CMMM assessment and having it scored. With this baseline, or starting point, in mind, the utility can establish objectives for the timing and extent of its improvement efforts by setting maturity level targets for each of the domains in the model for a particular time window. Additional assessments can be completed to track progress toward the established objectives.

While higher levels of maturity in the model are consistent with an organization that is successfully adopting and benefiting from corrosion management improvement efforts, it is important for each organization to establish its own target maturity levels based on its own
unique operating profile, strategy, and timeline. Achieving Level 5 in any domain is not necessarily the goal for an organization and is unlikely to be an appropriate goal for many organizations. Each organization must assess the cost/benefit of higher maturity levels to set appropriate targets.

A CMMM assessment provides an organization with a maturity rating for each of the model’s 10 management system domains (hereafter referred to as domains). Domains are logical groupings of corrosion-related capabilities and characteristics. The model’s 10 domains are shown below and are described in Section III.

1. Policy
2. Stakeholder Integration
3. Organization
4. Accountability
5. Resources
6. Culture and Knowledge Management
7. Communication
8. Corrosion Management Practices Integration
9. Continuous Improvement
10. Performance Measures

The levels of maturity organize the expected characteristics for each domain into hierarchical groupings. Each level builds upon the next, so an organization must achieve Level 1 in a domain in order to achieve Level 2 in that domain, and so forth. In order to achieve a level within a domain, the organization must demonstrate that it has sufficiently implemented the expected characteristics defined for that level in that domain area. While an organization will receive a specific level rating for each domain, that organization may possess some characteristics associated with higher maturity levels.

The following sections provide additional detail on each of the five maturity levels.

2.1 LEVEL 1 – REACTIVE

At this level, the need for corrosion management may have been identified, but there is no strategic focus within the organization.

- Corrosion management activities occur on an as-needed basis; however, there is no systematic plan in place to address corrosion needs more consistently
- Corrosion activities, while often governed by standards and regulations, are defined and managed by individuals and within teams
- Cross-team and organizational alignment for corrosion control practices is limited and typically informal
2.2 LEVEL 2 – DEFINED AND COMPLIANT

At level 2, corrosion management practices are locally consistent.
- Corrosion management has been defined by the organization, but corrosion engineers only are compliant with the standard or bare minimum of requirements
- Some corrosion management processes may have been defined, but typically these are still isolated and not part of any integrated management approach
- Consistency in corrosion control activities within teams, projects and local organizational units is expected
- Organization-wide coordination and alignment may still be informal

2.3 LEVEL 3 – MANAGED AND INTEGRATED

At level 3, an organization has a comprehensive, enterprise-wide corrosion management approach.
- End-to-end standards, policies, processes and procedures exist
- Common roles and accountability structures in place for corrosion specific needs
- CM is integrated with a well-structured organizational management approach
- Organization-wide coordination and alignment is defined and communicated

2.4 LEVEL 4 – OPTIMIZED AND PROACTIVE

At level 4 the CM program is visible across the organization.
- The CM program should be fully implemented and include lessons learned activities built into CM processes to capture and apply learnings to improve those processes
- The program may exhibit some anticipatory capabilities as well, such as succession planning for key corrosion roles
- Visibility to corrosion performance metrics enables leadership to leverage into strategies and future plans

2.5 LEVEL 5 – INNOVATIVE AND LEADING

Level 5 represents a progressive and inclusive CM program with highly engaged stakeholders at all levels of the organization.
- The stakeholders proactively seek out state-of-the-art CM practices and the program itself is anticipatory, agile (semi real-time), and embedded in the flow of work in the organization
- The organization seeks to not only improve itself, but actively improve their industry and corrosion management across industries
III. CMMM MANAGEMENT SYSTEM DOMAINS

Management system domains are logical groupings of related capabilities and characteristics for which the CMMM defines a maturity progression. Each level of maturity within a domain builds upon the previous, so an organization must achieve Level 1 to achieve Level 2, and so forth. Each level of maturity within a domain is fully described by a set of key characteristics and a set related capability statements.

The CMMM Version 1.0 includes the following 10 domains:
1. Policy (POL)
2. Stakeholder Integration (STA)
3. Organization (ORG)
4. Accountability (ACT)
5. Resources (RES)
6. Culture and Knowledge Management (CKM)
7. Communication (COM)
8. Corrosion Management Practices Integration (CMP)
9. Continuous Improvement (IMP)
10. Performance Measures (PER)

3.1 KEY CHARACTERISTICS AND CAPABILITY STATEMENTS

Key characteristics are the standard capabilities that an organization must implement or exhibit within a domain. They provide a framework of characteristics that translate into specific capabilities statements at increasing levels of maturity within a domain. Each capability is a declarative statement to support the consistent evaluation of its implementation and its independence from other capability statements within the model. While it is possible that an organization may exhibit capabilities associated with several maturity levels within a domain, the model requires that for a given level of maturity to be achieved, the capability for that level and all lower levels in that domain must be sufficiently implemented. For an organization to achieve Level 2 in a given domain, for example, it must sufficiently implement the capabilities aligned to the same key characteristic for both Level 1 and Level 2 in that domain.

Every capability statement in the CMMM corresponds to a single question in the CMMM Assessment, the instrument used for measuring an organization’s current maturity profile. The CMMM uses a simple labeling system to uniquely identify each expected characteristic in the model. The label for a given characteristic is defined by its domain abbreviation, the maturity level where it resides, and its characteristic number. The label POL-2.3, for example, refers to the third expected characteristic, at maturity Level 2, for the Policy domain.

3.2 DOMAIN STRUCTURE

The next 10 sections (Section 4 through Section 13) of this document contain descriptions of each domain. Each section follows the same structure, consisting of a brief domain overview,
identification of the domain’s key characteristics, followed by capability statements for each of the five levels.

The domain overview establishes the domain’s boundaries and provides an overview of the maturity progression. The maturity elaboration for each level begins with a list of expected characteristics followed by the capability statements that describe what would be expected at each level of maturity within this domain.
IV. POLICY (POL)

The Policy (POL) domain encompasses CM objectives, policy, and strategy. Namely, this domain is associated with key principles and requirements utilized to manage corrosion threats over the asset or asset system life cycle. Policies are foundational to CM planning and strategy and must assess and address external and internal factors (e.g., environmental, legal, regulatory, or societal.)

KEY CHARACTERISTICS

P-1 Organization has defined and communicated CM policy that address purpose, objectives, and goals across asset lifecycle
P-2 CM policies aligned to measurable organizational outcomes
P-3 CM strategy linked to measurable financial goals and outcomes across asset lifecycle
P-4 CM policy includes impact of environmental, legal, regulatory, or societal factors
P-5 CM integrated into organizational strategy
P-6 Corporate social responsibility groups evaluate CM practices on external environment and have targeted programs to address concerns
P-7 Organization has identified, assessed, and defined CM risks across asset lifecycle and has either accepted or mitigated those risks
P-8 CM plan guides the design, construction/manufacturing, maintenance/operations, and abandonment of degradable assets
P-9 Plans for design, construction/manufacturing, maintenance/operations, and abandonment of degradable assets integrated across organization
P-10 CM projects evaluated according to value based costing instead of lowest price costing

CAPABILITY STATEMENTS (BY MATURITY LEVEL)

Level 1
POL-1.1 CE standards identified on a project basis
POL-1.2 CE objectives defined on a project basis
POL-1.3 CE standards identified for operating assets
POL-1.4 Corrosion risks addressed as they are identified
POL-1.5 Corrosion risks are identified on a project basis

Level 2
POL-2.1 Recommendations for corrosion engineering incorporated into asset management plans
POL-2.2 Strategies and metrics for corrosion control practices identified
POL-2.3 Interactions with CE stakeholders are defined and conducted at the local (project, department, or functional) level
POL-2.4 Policies and standards aligned with external stakeholder’s interests

Level 3
POL-3.1 Enterprise CM policy defined and documented that includes purpose, objectives, goals, training, certification, and authority
POL-3.2  Enterprise CM policies and strategies define process safety requirements
POL-3.3  CM policies and standards integrated with operational activities
POL-3.4  Corrosion R&D activities conducted for identified improvement opportunities
POL-3.5  CM policies aligned to measurable enterprise outcomes
POL-3.6  CM policies and standards across enterprise aligned to external stakeholder's interests
POL-3.7  Enterprise CM plans developed across the asset lifecycle
POL-3.8  Enterprise has identified CM risks across asset lifecycle and has either accepted or mitigated those risks
POL-3.9  Enterprise's CM lessons learned drive local CM strategies
POL-3.10 Corrosion optimization activities conducted to identify practice improvement opportunities

**Level 4**

POL-4.1  Enterprise's CM strategy aligns with enterprise's process safety/HSE strategy
POL-4.2  CM policy requires regular assessments to identify potential risks
POL-4.3  Enterprise evaluates CM policy compliance and tracks resolution of non-compliance
POL-4.4  Identified CM risks are evaluated for mitigation and where not feasible, contingency plans in place
POL-4.5  CM policy, strategy, and plans includes impact of external as well as internal factors (e.g., environmental, legal, regulatory, and/or societal)
POL-4.6  Impact of CM policy to outcomes measured and visible to senior leadership.
POL-4.7  CM policies and plans integrated with other disciplines across enterprise (e.g., quality assurance, continuous improvement and management of change practices)
POL-4.8  Policies and standards for external CM stakeholders integrated with the enterprise's policies and standards
POL-4.9  Strategic objectives and goals drive focus on corrosion management optimization and R&D activities

**Level 5**

POL-5.1  Corporate social responsibility groups evaluate impact of CM policy, strategy and plans on external environment and implement targeted programs to address concerns
POL-5.1  Policies and strategies establish asset integrity and asset systems safety as a priority
POL-5.1  Enterprise periodically evaluates CM policy to address changes to environmental and societal sustainability
POL-5.1  CM-related risks are communicated and understood at all levels of the enterprise
V. STAKEHOLDER INTEGRATION (STA)

The Stakeholder Integration (STA) domain indicates how organizations should work with external and internal stakeholders. The key purpose of this domain is to ensure the organization is aligned with key stakeholder desires. This domain also includes how CM key performance indicators (KPIs) are managed and used to monitor CM compliance across the organization.

KEY CHARACTERISTICS

SI-1 External and internal stakeholders identified and integrated into CM lifecycle
SI-2 Policies and standards of external stakeholders evaluated for alignment with organizational policies and standards
SI-3 Appropriate service level agreements or contractual requirements established with external and internal stakeholders
SI-4 CM performance measures and KPIs established
SI-5 CM performance monitored and reported
SI-6 CM performance management integrated into organizational performance management
SI-7 External and internal CM compliance monitored
SI-8 CM non-compliance tracked through resolution
SI-9 Organization has a defined and communicated CM outsourcing strategy
SI-10 External and internal stakeholders audited and reviewed on periodic basis for alignment with organizational requirements

CAPABILITY STATEMENTS (BY MATURITY LEVEL)

**Level 1**

STA-1.1 Stakeholder engagement is defined by CE personnel
STA-1.2 Expectations and needs of internal stakeholders are known

**Level 2**

STA-2.1 Interactions with CE stakeholders conducted at the local level
STA-2.2 Corrosion engineering philosophy for outsourcing defined locally

**Level 3**

STA-3.1 Internal CM stakeholders are integrated into the enterprise CM program
STA-3.2 Expectations and needs of external stakeholders are established enterprise-wide
STA-3.3 CM performance measures and KPIs are established for the enterprise
STA-3.4 Collaboration with CM personnel occurs with identified external stakeholders across the enterprise
STA-3.5 Enterprise has a defined CM outsourcing strategy
STA-3.6 Internal and external interactions with CE stakeholders are managed according to policy

**Level 4**

STA-4.1 External CM stakeholders leveraged for improvements to the enterprise CM program
STA-4.2  Expectations and needs of both internal and external stakeholders are embedded into service level agreements and contractual requirements

STA-4.3  Corrosion related activities monitored and reported

STA-4.4  CM non-compliance resolution communicated to stakeholders

STA-4.5  CM effectiveness measures are utilized to balance the level of CM activities across lifecycle phases (TAP members - We need examples of measures that evaluate the effectiveness of CM)

STA-4.6  Enterprise has a defined and communicated CM outsourcing strategy

STA-4.7  Enterprise CM service providers audited and reviewed on a periodic basis

STA-4.8  CM performance measures and KPIs are reviewed to ensure alignment with enterprise expectations

STA-4.9  CM performance is integrated into management dashboards

**Level 5**

STA-5.1  Corrosion measures benchmarked across companies and geographies to identify improvement opportunities

STA-5.1  CM measures are aligned to industry wide measures
VI. ORGANIZATION (ORG)

The Organization (ORG) domain evaluates whether CM is centralized or distributed throughout the organization. The domain evaluates the interaction and reporting structures for corrosion and design engineers, vendors, and suppliers within the organization.

KEY CHARACTERISTICS

- **O-1** CM roles and responsibilities linked to defined organizational structure
- **O-2** Interactions with CM practitioners defined across organizational structure (i.e., managed organizational matrix, including external suppliers, vendors, and stakeholders)
- **O-3** Formalized CM group exists to support full lifecycle of all degradable assets within the organization
- **O-4** Effective management of the matrix in place (i.e., embedded versus centralized)
- **O-5** Corrosion activities aligned and embedded in other functional processes and work activities

CAPABILITY STATEMENTS (BY MATURITY LEVEL)

**Level 1**

- **ORG-1.1** CE roles and responsibilities are defined and assigned on a project basis
- **ORG-1.2** Interactions with external and internal CE stakeholders managed on a project basis
- **ORG-1.3** CE resources available to support the asset lifecycle

**Level 2**

- **ORG-2.1** CE roles and responsibilities are defined in accordance with enterprise policies and standards, but are managed locally
- **ORG-2.2** Interactions with CE stakeholders are defined locally
- **ORG-2.3** An enterprise structure established to facilitate CM collaboration
- **ORG-2.4** A formal enterprise CM group exists

**Level 3**

- **ORG-3.1** CM roles and responsibilities are integrated and standardized as a part of the enterprise's policies and standards
- **ORG-3.2** Internal and external interactions with CM stakeholders are managed and integrated
- **ORG-3.3** CM personnel integrated in all enterprise initiatives

**Level 4**

- **ORG-4.1** CM roles and responsibilities are evaluated periodically for relevancy and updated as needed
- **ORG-4.2** CM collaboration is embedded in CM stakeholder performance expectations
- **ORG-4.3** Accountability for improvements to CM policies, procedures, and standards assigned
Level 5
ORG-5.1   Formalized CM group represents the organization in external industry and cross-industry forums to improve CM practices
VII. ACCOUNTABILITY (ACT)

The Accountability (ACT) domain focuses on the responsibilities and authority of CM roles in the organization. The domain evaluates the integration of CM personnel, including contractors and external resources, in other disciplines and functions of the organization.

KEY CHARACTERISTICS

A-1 CM roles and responsibilities defined, documented, and communicated
A-2 CM roles and responsibilities integrated into work processes
A-3 CM roles and responsibilities formally embedded in job descriptions and professional performance management
A-4 CM decision authority defined and communicated
A-5 Organizational understanding of CM roles and responsibilities
A-6 Organization has dedicated resources for external stakeholder engagement
A-7 CM personnel consulted and engaged in supplier and vendor selection processes
A-8 CM personnel consulted and involved in supplier and vendor management and oversight
A-9 Organization has established accountability for CM asset design approval, acceptance and commissioning, maintenance scheduling, monitoring, performance, and abandonment
A-10 CM performance measures identified and aligned with organizational accountability structures (i.e., individual performance reviews, bonus structure)
A-11 CM resource allocation linked, embedded, and sustained into organizational accountability structures
A-12 Organization articulates and understands value of CM roles and responsibilities
A-13 CM accountability structures reviewed on a just-in-time and periodic basis

CAPABILITY STATEMENTS (BY MATURITY LEVEL)

Level 1
ACT-1.1 CE decision authority defined on a project basis
ACT-1.2 CE accountability structures are reviewed on a project-by-project basis

Level 2
ACT-2.1 CE roles and responsibilities integrated into local work processes
ACT-2.2 CE roles and responsibilities are recognized by other disciplines (e.g., procurement, engineering, construction, maintenance, etc.)
ACT-2.3 CE requirements should be provided by CE personnel to support supplier and vendor management and oversight
ACT-2.4 CE accountability across the asset lifecycle is established locally
ACT-2.5 CE authority sufficient to influence enterprise accountability

Level 3
ACT-3.1 CM roles and responsibilities defined, documented, and communicated to enterprise
ACT-3.2 Decision authority embedded in the CM role definitions consistently across the enterprise
ACT-3.3 Supplier and vendor selection processes engage CM personnel
ACT-3.4 CM personnel engage in supplier and vendor management and oversight
ACT-3.5 CM accountability established across the enterprise, including authority levels for CM specialists based on identified corrosion risk levels
ACT-3.6 Enterprise CM accountability structures incorporate CM performance measures
ACT-3.7 CM resources allocated to fulfill accountability structures
ACT-3.8 CM roles and accountability structures reviewed periodically

Level 4
ACT-4.1 Enterprise has dedicated CM resources for external CM stakeholder engagement
ACT-4.2 CM personnel have a defined set of responsibilities for supplier and vendor management and oversight
ACT-4.3 CM performance measures are aligned with enterprise CM objectives
ACT-4.4 Compliance to CM accountability monitored

Level 5
ACT-5.1 CM roles and responsibilities are aligned to industry organizations and peers
ACT-5.2 CM personnel are engaged in evolving and maturing CM accountability structures across the industry
VIII. RESOURCES (RES)

The Resources (RES) domain evaluates organizational commitment to identifying and managing CM personnel and other resources responsible for development, implementation, or continuous improvement of CM practices. The domain also assesses and ensures allocation of appropriate resources to deliver CM programs across the organization.

KEY CHARACTERISTICS

R-1 Corrosion engineering (CE) and CM staffing levels identified and supported for design, construction and manufacturing, maintenance and operation, and abandonment of degradable assets
R-2 Appropriate budgets established and allocated to support CE and CM staffing levels
R-3 CE and CM competencies defined and communicated with respect to experience, education, and knowledge
R-4 CE and CM competencies aligned to role descriptions
R-5 CE and CM resources assigned based on position requirements and resource competencies
R-6 CE and CM competencies integrated into work processes
R-7 Succession planning conducted for key CE and CM positions
R-8 External and internal certification programs used to qualify resources
R-9 Defined CE and CM career path

CAPABILITY STATEMENTS (BY MATURITY LEVEL)

Level 1
RES-1.1 Corrosion resources assigned for projects and operations
RES-1.2 Corrosion laboratory facilities outsourced

Level 2
RES-2.1 Corrosion staffing levels identified locally across the asset lifecycle
RES-2.2 Corrosion competencies defined and documented locally
RES-2.3 Corrosion resources qualified to meet position requirements
RES-2.4 CE laboratory facilities apply consistent outsourcing requirements across projects and assets
RES-2.5 Budgets to support corrosion activities are adequate

Level 3
RES-3.1 CM competency definitions include experience, education, knowledge, and industry-recognized technical certifications
RES-3.2 Budgets to support corrosion staffing levels established across the enterprise
RES-3.3 Corrosion competencies aligned to formalized role descriptions at the enterprise level
RES-3.4 Corrosion laboratory facilities include blend of internal and locally-outsourced capabilities
RES-3.5 Corrosion resources are assigned based on resource competencies
RES-3.6 Corrosion competencies are embedded into enterprise work process requirements
| RES-3.7 | External certification programs are used to qualify corrosion resources |
| Level 4 | RES-4.1 Budgets to support corrosion staffing levels are established within strategic budgeting and planning cycle |
| RES-4.2 | Corrosion competencies are visible to the enterprise |
| RES-4.3 | Succession planning conducted for key corrosion positions |
| RES-4.4 | Enterprise-wide integration of corrosion laboratory facilities |
| RES-4.5 | An internal certification program is defined and established to qualify corrosion resources to enterprise corrosion processes and standards |
| RES-4.6 | Availability of corrosion resources drives workforce planning |
| RES-4.7 | An enterprise corrosion career path is defined, documented, and communicated |
| RES-4.8 | A prequalified candidate pool is maintained for recruiting and developing talent to fill resource needs |
| Level 5 | RES-5.1 Succession planning for all corrosion roles across the enterprise |
| RES-5.2 | Enterprise-wide corrosion laboratory facilities perform R&D and innovation |
| RES-5.3 | Corrosion staff lead and influence industry practices and regularly contribute to industry training, development and certification programs |
| RES-5.4 | Corrosion personnel are engaged in industry competency development |
| RES-5.5 | A blend of external and internal training and certification programs are used to develop and qualify corrosion resources |
IX. CULTURE AND KNOWLEDGE MANAGEMENT (CKM)

The Culture and Knowledge Management (CKM) domain focuses on the management of critical information of the organization, namely, content and documentation management, and the integration of CM practices into the culture of the organization. This domain also explores how all learning opportunities (informal, proactive, and reactive) can be embedded into the flow of work for CM-related personnel.

KEY CHARACTERISTICS

CKM-1 CM knowledge capture and transfer processes embedded into organization knowledge transfer processes
CKM-2 Collaborative approaches (e.g., online discussion forums, MS SharePoint sites, etc.) for CE and CM established
CKM-3 Process for CM lessons captured and learned
CKM-4 CM and CE best practice transfer approach across organization
CKM-5 Leadership culture of openness to prevent negative ramifications of sharing critical information
CKM-6 Established CE and CM content management practices enable identification and access to critical documentation
CKM-7 Organization identifies and provides access to CE and CM Subject Matter Experts
CKM-8 Leadership aware of and actively engaged in CM practices
CKM-9 Cross-discipline and cross-functional awareness and engagement of CM practices

CAPABILITY STATEMENTS (BY MATURITY LEVEL)

Level 1
CKM-1.1 Documentation is managed on a project basis
CKM-1.2 Collaboration occurs within projects, teams and personal networks
CKM-1.3 Corrosion personnel capture lessons learned on a project-by-project basis

Level 2
CKM-2.1 Corrosion lessons learned are shared locally
CKM-2.2 Corrosion best practices are captured locally
CKM-2.3 Awareness of corrosion practices locally
CKM-2.4 Corrosion subject matter experts are known locally
CKM-2.5 Corrosion artifacts are identified and organized locally
CKM-2.6 Corrosion personnel leverage the enterprise’s collaboration capabilities (e.g., discussion forums, instant messaging)

Level 3
CKM-3.1 Enterprise approach for identification, capture, and use of corrosion lessons learned
CKM-3.2 Enterprise approach for identification, capture, and use of corrosion best practices
CKM-3.3 Open culture of sharing and learning across enterprise corrosion program
CKM-3.4 Enterprise-wide corrosion training plan exists
CKM-3.5 Corrosion subject matter experts identified and accessible across the enterprise
CKM-3.6 Corrosion content management workflows standardized across the enterprise
CKM-3.7 Enterprise recognizes value of corrosion roles and responsibilities

Level 4
CKM-4.1 Corrosion lessons learned integrated as a part of enterprise’s standard workflows
CKM-4.2 Corrosion best-practice transfer integrates systemically with other disciplines across enterprise
CKM-4.3 Collaboration for corrosion is the expectation and norm beyond corrosion personnel
CKM-4.4 Cross-functional and cross-discipline engagement in corrosion practices
CKM-4.5 Corrosion communication and training plans integrated into enterprise communication and training plans

Level 5
CKM-5.1 Corrosion best practice sharing across industry
CKM-5.2 Corrosion subject matter experts lead or drive external industry and cross-industry forums to improve CM
X. **COMMUNICATION (COM)**

The Communication (COM) domain focuses on interactions with key stakeholders to the CM process. The domain evaluates the communication between the design and operation sides of CM, between external and internal stakeholders, as well as how the organization engages in industry-wide CM efforts.

**KEY CHARACTERISTICS**

- **C-1** CM processes and standards communicated across the organization
- **C-2** Organization promotes importance of CM practices
- **C-3** Process to capture and visibly communicate employee CM concerns to key decision makers (i.e., vertical communications)
- **C-4** Communication between responsible CM groups actively employed
- **C-5** KPIs established and communicated to demonstrate effectiveness and improvement of CM
- **C-6** Process to communicate to external CM stakeholders established and applied
- **C-7** Communication plan addresses external CM information transfer
- **C-8** Process for capturing corrosion lessons learned in place and utilized by all stakeholders

**CAPABILITY STATEMENTS (BY MATURITY LEVEL)**

**Level 1**

- **COM-1.1** Corrosion personnel promote awareness of CE processes and standards locally
- **COM-1.2** Corrosion personnel communicate within projects and teams

**Level 2**

- **COM-2.1** Corrosion personnel promote awareness of CM processes and standards across the enterprise
- **COM-2.2** Corrosion communications are part of local communication plans

**Level 3**

- **COM-3.1** A corrosion communication plan is in place and executed to raise awareness of CM policies, processes, and practices internally
- **COM-3.2** Corrosion personnel promote the value of CM to the enterprise with senior leaders and key internal stakeholders
- **COM-3.3** A process for capturing and communicating corrosion concerns is in place across the enterprise

**Level 4**

- **COM-4.1** Internal and external CM communication vehicles have a ‘brand’ to assist in raising awareness of the value of CM policy, processes, and practices
- **COM-4.2** Enterprise articulates value of CM roles and responsibilities to their external and internal audiences
- **COM-4.3** CM concerns are communicated to business leaders and tracked to resolution
- **COM-4.4** Corrosion personnel promote awareness of CM processes and standards to external stakeholders
- **COM-4.5** Corrosion communication plans extend messaging to external stakeholders
COM-4.6  CM communication plans integrated into enterprise communication plans

Level 5
COM-5.1  Senior leadership promote the importance of CM processes and standards across the enterprise
COM-5.2  Corrosion communication plans extend messaging to external stakeholders across multiple channels (e.g., print media, email, marketing, etc.)
COM-5.3  CM concerns are integrated into business strategy and planning
XI. CORROSION MANAGEMENT PRACTICES INTEGRATION (CMP)

The Corrosion Management Practice Integration (CMP) domain considers the integration of all CM activities into established work processes. The domain evaluates the alignment of CM to Quality and other relevant disciplines and/or functions to remove communication and performance barriers. Incident tracking and resolution is also incorporated into this domain.

KEY CHARACTERISTICS

CMP-1 CM processes and tools aligned to and embedded into other disciplines (e.g., health, safety, environment, quality, risk, maintenance, integrity, engineering, etc.)
CMP-1 CM practices incorporate threat and incident management (e.g., identification, assessment, and mitigation)
CMP-1 Supplier and vendor corrosion control practices reviewed and approved
CMP-1 Awareness and implementation of corrosion control practices across the lifecycle of degradable assets
CMP-1 Corrosion control practices designed into systems and solutions
CMP-1 Effective application of corrosion control practices across organization
CMP-1 Organization influences industry-wide and discipline-specific processes and standards
CMP-1 Corrosion control practices to audit and manage the oversight of suppliers and vendors established and implemented
CMP-1 Asset life extension assessments developed and applied

CAPABILITY STATEMENTS (BY MATURITY LEVEL)

Level 1
CMP-1.1 CE requirements incorporated into basis of design
CMP-1.2 Applicable regulatory compliance understood
CMP-1.3 Reliance on outside parties for guidance

Level 2
CMP-2.1 CE processes and standards are defined locally
CMP-2.2 Localized incident management accounts for corrosion threats
CMP-2.3 Implementation of corrosion control practices site-specific
CMP-2.4 Policies and standards for external CE stakeholders are developed locally
CMP-2.5 Asset life extension assessments are developed locally
CMP-2.6 Corrosion resources consulted on costing and sourcing strategies

Level 3
CMP-3.1 CM processes and standards are defined enterprise wide
CMP-3.2 CM processes and tools are aligned to those of other key disciplines, e.g., health, safety, environment, quality, risk, etc.
CMP-3.3 CM threat and incident management practices are embedded into operations emergency management processes and standards
CMP-3.4 The enterprise defines corrosion control requirements for suppliers and vendors
CMP-3.5 Corrosion control practices for critical assets consistently implemented across the enterprise
CMP-3.6 Corrosion control practices consistent across systems enterprise wide
CMP-3.7  Enterprise-wide requirements and/or guidelines for asset life extension assessments developed and leveraged
CMP-3.8  Enterprise guidelines for costing and sourcing strategies
CMP-3.9  CM practices are factored into project business cases, but not explicitly delineated

**Level 4**
CMP-4.1  Corrosion processes and standards updated regularly
CMP-4.2  CM processes aligned with other disciplines
CMP-4.3  CM processes are monitored and controlled for non-compliance
CMP-4.4  Effectiveness of corrosion control practices evaluated on an ongoing basis
CMP-4.5  CM process non-compliance has defined corrective action plans
CMP-4.6  Supplier and vendor corrosion control practices reviewed for compliance with enterprise requirements
CMP-4.7  Asset life extension assessments are integrated into CM systems and solutions to enable extension determination
CMP-4.8  CM threat and incident management analysis and resolution are tracked

**Level 5**
CMP-5.1  Influencing industry-wide processes and standards
CMP-5.2  Enterprise visibility of threat and incident management includes both "push" and "pull" indicators, messaging, etc.
CMP-5.3  Influence industry-wide supplier and vendor corrosion control practices
CMP-5.4  Real-time notification of corrosion threats from data management systems
CMP-5.5  CM systems and solutions automation provides asset life extension recommendations
CMP-5.6  Continuous improvement considers alignment between CM and other disciplines
XII. CONTINUOUS IMPROVEMENT (IMP)

The Continuous Improvement (IMP) domain evaluates improvement identification, prioritization, authorization, selection, and change management practices and processes. CM innovations, such as evaluation of evolving resources, are addressed and incorporated into this domain. Change management processes should be effectively documented and communicated across the organization.

KEY CHARACTERISTICS

CI-1 CM improvements identified, assessed, and prioritized across organization
CI-2 Selected CM improvements funded, staffed, and measured for intended results
CI-3 CM improvements adhered to the defined organizational management of change processes
CI-4 Both internal and external improvement opportunities identified (in all related aspects of CM, e.g., technology, resourcing, processes, etc.)

CAPABILITY STATEMENTS (BY MATURITY LEVEL)

**Level 1**

IMP-1.1 Corrosion improvements are identified, assessed, and implemented on project-by-project basis

**Level 2**

IMP-2.1 Corrosion improvements are identified, assessed, and prioritized locally
IMP-2.2 Corrosion improvement plans include change management activities

**Level 3**

IMP-3.1 Corrosion improvements are identified, assessed, and prioritized at the enterprise level
IMP-3.2 Selected corrosion improvements are funded and staffed
IMP-3.3 Change management strategies for corrosion improvements are aligned to the defined enterprise management of change process

**Level 4**

IMP-4.1 Selected internal corrosion improvements are measured for intended results
IMP-4.2 Corrosion improvements are evaluated for compliance to enterprise management of change process
IMP-4.3 CM improvements are prioritized as a part of enterprise-wide improvement assessments
IMP-4.4 CM improvement opportunities are evaluated in the context of the extended value chain (including vendors and suppliers)

**Level 5**

IMP-5.1 Substantial internal improvements are communicated externally to advance the industry
IMP-5.2 CM identifies, assesses, and implements other disciplines’ best practices to improve CM performance
XIII. PERFORMANCE MEASURES (PER)

The Performance Measures (PER) domain focuses solely on quantifiable indicators capable of assessing and measuring how well an individual or organization is achieving its desired CM goals.

KEY CHARACTERISTICS

PM-1 CM cost measures have been identified and defined
PM-2 Failure history
PM-3 Cost versus lifetime
PM-4 CM process non-conformance
PM-5 Incident resolution
PM-6 Impact of improvements or resolution

CAPABILITY STATEMENTS (BY MATURITY LEVEL)

Level 1
PER-1.1 External CE standards compliance
PER-1.2 External CE regulatory compliance

Level 2
PER-2.1 Internal CE standards compliance
PER-2.2 CM cost locally
PER-2.3 Trend analysis is conducted locally (e.g., corrosion rate, anodic polarization, ER monitoring, etc.)
PER-2.4 Failure history locally
PER-2.5 Incident rate locally

Level 3
PER-3.1 CM process compliance across organization
PER-3.2 CM cost across enterprise
PER-3.3 Impact of CM improvement (to include time to impact)
PER-3.4 CM metrics and KPIs benchmarked across enterprise
PER-3.5 Enterprise trend analysis for key corrosion metrics and KPIs conducted (e.g., corrosion rate, anodic polarization, ER monitoring, etc.)
PER-3.6 Enterprise failure rate
PER-3.7 Incident rate across enterprise
PER-3.8 CM data is captured in structured and consistent manner

Level 4
PER-4.1 CM process standards, regulatory and process compliance across extended value chain
PER-4.2 CM cost across extended value chain
PER-4.3 Aggregate impact of CM improvement activities
PER-4.4 CM metrics and KPIs are reviewed and updated periodically (e.g., annually)
PER-4.5 CM cost integrated into total lifecycle cost of assets
PER-4.6 CM performance concerns are linked to annual business performance metrics
PER-4.7 CM metrics and KPI benchmarked externally
**Level 5**

PER-5.1  Application of benchmarks to drive industry-wide improvement
PER-5.2  Predictive analytics for key corrosion metrics and KPIs
PER-5.3  Predictive analytics linked in to autonomic systems
PER-5.4  CM system provides real-time visibility into CM performance
PER-5.5  CM metrics are integrated into organizational reporting (e.g., dashboards)
XIV. USING THE CMMM

The previous sections of this document covered the details of the model. This final section provides a brief overview on how an organization can successfully use the model.

The CMMM was created to serve as a management support tool for any organization with a CM strategy, processes, and procedures. The model provides a framework for understanding the current state of CM within the organization and provides a context for establishing future aspirations and strategies. As such, it has a number of valid uses:

- To establish a shared picture of CM objectives.
- To communicate the CM vision both internally and externally.
- To use as a strategic framework for identifying business and investment objectives.
- To benchmark and learn from others.
- To use as a guide to identify a specific roadmap or waypoints.
- To assess and prioritize current opportunities and projects.
- To use as a decision-making framework for investment purposes.
- To assess resource needs to move from one level to another in a domain.
- To measure progress.

12.1 CMMM SCORING

Sample Maturity Profile

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<th>Management System Domains</th>
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<td>12%</td>
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<tr>
<td>1</td>
<td>18%</td>
</tr>
</tbody>
</table>

Previous Results - <date of previous assessment>

<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Management System Domains</th>
</tr>
</thead>
<tbody>
<tr>
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<td>2</td>
<td>12%</td>
</tr>
<tr>
<td>1</td>
<td>18%</td>
</tr>
</tbody>
</table>

Legend:
- Green: High level of CM maturity
- Red: High level of CM deficiency
- Yellow: High level of CM maturity
- Purple: High level of CM deficiency

Each maturity level within a CM domain has an associated score based upon the answers provided which quantifies your current state.

Figure 3

An organization is rated in each domain of the model based on its answers to the questions in the CMMM assessment tool. The CMMM assessment is composed of both domain-specific and
organizational attribute questions. The maturity rating for a specific domain is entirely based on
the domain-specific questions for that domain. The CMMM Assessment contains one domain-
specific question for each expected capability in the model. An organization does not have to
completely exhibit all expected capabilities of a given level of a domain to be rated at that level.
Scoring criteria establish a level rating based on a composite of the responses to all domain-
specific questions in that domain level. Higher ratings in a domain reflect a growing extent of
CM implementation in an organization with respect to the subject of that domain. The result of
a CMMM assessment is a maturity profile that includes maturity ratings for each of the 10
CMMM domains (see Figure 3).

12.2 THE CMMM NAVIGATION PROCESS

The Navigation Process

A CMMM Navigation is facilitated by a NACE-certified CMMM Navigator. The Navigator assists
an organization in understanding the CMMM and leads the organization through a process of
assessing where the organization is against the CMMM and setting its aspirations relative to the
CMMM. This process helps to build consensus within the organization about the CMMM and its
CM strategy and goals. After completing all of the steps in the Preparation phase with the
organization, the Navigator facilitates the completion of the CMMM assessment tool with
corrosion stakeholders from throughout the organization. Because the answers collected in the
CMMM assessment reflect the collective view from people across the organization, the Survey
Workshop produces a more accurate description of the organization’s current CM maturity. The
CMMM assessment is then validated and scored to produce a maturity profile, such as the one
in Figure 3. The Navigator analyzes the organization’s scored CMMM data during the Analysis
phase to provide findings that provide valuable insights based on the Navigator’s domain
expertise, knowledge of the CMMM, and familiarity with the organization. During the
Aspirations Workshop, the Navigator presents the findings to the organization, and based on
those findings, the business objectives, and an agreed upon timeframe, the organization’s
corrosion stakeholders begin to lay the foundation for their CM aspirations.

12.3 USING CMMM DATA

An organization’s ratings are best and most appropriately used to compare the organization
against itself over time (e.g., to understand the effectiveness and impact of ongoing efforts or
planning exercises in the context of the CMMM). However, as with any model that provides a
“score,” there is often significant interest in comparing the scores of different organizations.
While this might be an interesting exercise, it is important to be cautious when drawing
conclusions from the results. There is a temptation to say that higher maturity scores within a
domain are always better than lower scores. This, however, is not a valid use of the model because it does not take into consideration the organization’s business goals and operating environment.

There is significant diversity in the operating environments of the corrosion community. The maturity profile that is ideal for one organization at a particular point in time is going to be determined by an organization’s size, its economic and regulatory profile, its ownership profile, and many other factors. It may be the case that some CMMM domains do not apply to a particular organization or that an organization’s current environment (e.g., regulatory) prevents it from moving beyond a specific level of maturity within a domain. Making evaluations based strictly on an organization’s CMMM ratings without a reasonably good understanding of the context will likely lead to invalid conclusions.

That being said, the results of a CMMM assessment can be used for some benchmarking. For example, it might be useful for an organization to compare its domain ratings against other organizations that have a similar demographic profile. If their ratings are significantly different, then it might be useful for the organization to explore why that difference exists. It may highlight some area of strategic importance that may have been overlooked or prompt the organization to explore how gains in an overlooked domain might increase its success. Differences in business goals and objectives can sometimes explain significant differences in objectives and ratings.

All organization-specific data collected will be kept completely confidential by NACE. Data summary reports and trends analyses may be published, but they will never reveal the identity of any specific organizations without express permission.

**12.4 PERFORMING A CMMM ASSESSMENT**

To perform an assessment against the model, an organization needs to complete the CMMM Assessment and then have it scored. More information on CMMM scoring can be found at [nace.org/impactplus](http://nace.org/impactplus).
ABOUT APQC

APQC helps organizations work smarter, faster, and with greater confidence. It is the world’s foremost authority in benchmarking, best practices, process and performance improvement, and knowledge management. APQC’s unique structure as a member-based nonprofit makes it a differentiator in the marketplace. APQC partners with more than 500 member organizations worldwide in all industries. With more than 40 years of experience, APQC remains the world’s leader in transforming organizations. Visit us at www.apqc.org, and learn how you can make best practices your practices.
Succession planning for all CM roles across the enterprise

Collaboration occurs within projects, teams and personal networks

Localized CE practices incorporate threat and incident management

CE best practices are captured locally

Expectations and needs of internal stakeholders are established

CM improvements are evaluated for compliance to enterprise management

CE staffing levels identified locally across the asset lifecycle

Policies and standards for external CE stakeholders are developed locally

CM communication and training plans integrated into enterprise

CM roles and responsibilities are integrated and standardized as a part of

CM resources consulted on costing and sourcing strategies

Applicable regulatory compliance is determined on a project-by-project

Real-time notification of corrosion control practices in systems and

Asset life extension assessments are developed locally

Internal CE standards compliance

Corrosion control practices integrated into systems and solutions

Enterprise trend analysis for key corrosion metrics and KPIs conducted

CM best practice sharing across industry