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## Automated Source Code Quality Measures

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# Preface

## About the Object Management Group

### OMG

Founded in 1989, the Object Management Group, Inc. (OMG) is an open membership, not-for-profit computer industry standards consortium that produces and maintains computer industry specifications for interoperable, portable and reusable enterprise applications in distributed, heterogeneous environments. Membership includes Information Technology vendors, end users, government agencies and academia.

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## 0. Submission-Specific Material

### 0.1 Submission Preface

This submission is of a measure represented in compliance with OMG's Knowledge Discovery Metamodel (KDM), Structured Patterns Metamodel for Software (SPMS), and Structured Metrics Meta-Model (SMM). However, its submission is independent of KDM, SPMS, and SMM to establish it as a supported specification in its own right. This specification for four Structural Quality Measures builds on elements already developed in OMG's Automated Source Code Measures for Reliability, Security, Performance Efficiency, and Maintainability Measure standards. The measures described in this specification are an important component for achieving the mission of the Architecture Driven Modernization Task Force by qualifying the structural quality of modernized software and its architecture.

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## 0.5 Proof of Concept

Coverity and CAST among other static analysis vendors have implemented versions of these measures based on the set of weaknesses their technologies detect. Currently there are no industry-wide standards for which weaknesses to include in structural quality measures or how such measures should be calculated. Consequently, each vendor produces a unique version of these structural quality measures.

# 1. Scope

## 1.1 Purpose

This specification updates, expands, and combines four previous adopted specifications of the OMG:

- Automated Source Code Maintainability Measure (ASCMM) <https://www.omg.org/spec/ASCMM/1.0/>
- Automated Source Code Performance Efficiency Measure (ASCPEM) <https://www.omg.org/spec/ASCPEM/1.0/>
- Automated Source Code Reliability Measure (ASCRM) <https://www.omg.org/spec/ASCRM/1.0/>
- Automated Source Code Security Measure (ASCSM) <https://www.omg.org/spec/ASCSM/1.0/>

The measures in these standards were calculated from detecting and counting violations of good architectural and coding practices in the source code that could result in unacceptable operational risks or excessive costs. Establishing standards for these measures at the source code level is important because they have been used in outsourcing and system development contracts without having international standards to reference. For instance, the ISO/IEC 25000 series of standards that govern software product quality do not provide measures at the source code level.

A primary objective of updating these measures was to extend their applicability to embedded software, which is especially important for the growing implementation of embedded devices and the Internet of Things. Functionality that has traditionally been implemented in IT applications is now being moved to embedded chips. Since the weaknesses included in the measures specified in this document have been found to be applicable to all forms of software, embedded software is not treated separately in this specification.

## 1.2 Overview of Structural Quality Measurement in Software

Measurement of the structural quality characteristics of software has a long history in software engineering (Curtis, 1980). These characteristics are also referred to as the structural, internal, technical, or engineering characteristics of software source code. Software quality characteristics are increasingly incorporated into development and outsourcing contracts as the equivalent of service level agreements. That is, target thresholds based on structural quality measures are being written into contracts as acceptance criteria for delivered software. Currently there are no standards for most of the software structural quality measures used in contracts. ISO/IEC 25023 purports to address these measures, but only provides measures of external behavior and does not define measures that can be developed from source code during development. Consequently, providers are subject to different interpretations and calculations of common structural quality characteristics in each contract. This specification addresses one aspect of this problem by providing a specification for measuring four

structural quality characteristics from the source code—Reliability, Security, Performance Efficiency, and Maintainability.

Recent advances in measuring the structural quality of software involve detecting violations of good architectural and coding practice from statically analyzing source code. Violations of good architectural and design practice can also be detected from statically analyzing design specifications written in a design language with a formal syntax and semantics. Good architectural and coding practices can be stated as rules for engineering software products. Violations of these rules will be called weaknesses in this specification to be consistent with terms used in the Common Weakness Enumeration (Martin & Barnum, 2006) which lists many of the weaknesses used in several of these measures.

The Automated Source Code Quality Measures are correlated measures rather than absolute measures. That is, since they do not measure all possible weaknesses in each of the four areas, they do not provide absolute measures. However, since they include counts of what industry experts have determined to be most severe weaknesses, they provide strong indicators of the quality of a software system in each area. In most instances they will be highly correlated with the probability of operational or cost problems related to each measure's area.

Recent research in analyzing structural quality weaknesses has identified common patterns of code structures that can be used to detect weaknesses. Many of these 'Detection Patterns' are shared across different weaknesses. Detection Patterns will be used in this specification to organize and simplify the presentation of weaknesses underlying the four structural quality measures. Each weakness will be described as a quality measure element to remain consistent with ISO/IEC 25020. Each quality measure element will be represented as one or more Detection Patterns. Many quality measure elements (weaknesses) will share one or more Detection Patterns in common.

The normative portion of this specification represents each quality attribute (weakness) and quality measure element (detection pattern) using the Structured Patterns Metamodel Standard (SPMS). The code-based elements in these patterns are represented using the Knowledge Discovery Metamodel (KDM). The calculation of each of the four Automated Source Code Quality Measures from their quality measure elements is then represented in the Structured Metrics Metamodel (SMM). This calculation is developed by counting the number of detection patterns for each weakness, and then summing these numbers for all the weaknesses included in the specific quality characteristic measure.

## 2. Conformance

Implementations of this specification should be able to demonstrate the following attributes in order to claim conformance—automated, objective, transparent, and verifiable.

- **Automated**—The analysis of the source code and counting of weaknesses must be fully automated. The initial inputs required to prepare the source code for analysis include the source code of the application, the artifacts and information needed to configure the application for operation, and any available description of the architectural layers in the application.
- **Objective**—After the source code has been prepared for analysis using the information provided as inputs, the analysis, calculation, and presentation of results must not require further human intervention. The analysis and calculation must be able to repeatedly produce the same results and outputs on the same body of software.
- **Transparent**—Implementations that conform to this specification must clearly list all source code (including versions), non-source code artifacts, and other information used to prepare the source code for submission to the analysis.
- **Verifiable**—Compliance with this specification requires that an implementation state the assumptions/heuristics it uses with sufficient detail so that the calculations may be independently verified by third parties. In addition, all inputs used are required to be clearly described and itemized so that they can be audited by a third party.

### 3. Normative References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this specification. For dated references, subsequent amendments to, or revisions of any of these publications do not apply.

- Structured Patterns Metamodel Standard, <https://www.omg.org/spec/SPMS/1.2/>
- Knowledge Discovery Metamodel, version 1.4~~3~~ (KDM), <https://www.omg.org/spec/KDM/1.4/>
- Structured Metrics Metamodel, version 1.2~~0~~ (SMM), formal/2012-01-05
- MOF/XMI Mapping, version 2.5~~4~~.1 (XMI), <https://www.omg.org/spec/XMI/2.5.1/>
- ~~Automated Function Points (AFP), <https://www.omg.org/spec/AFP/1.0/>~~
- ~~Automated Source Code Reliability Measure, version 1.0 (ASCRM), <https://www.omg.org/spec/ASCRM/1.0/>~~
- ~~Automated Source Code Security Measure, version 1.0 (ASCSM), <https://www.omg.org/spec/ASCSM/1.0/>~~
- ~~Automated Source Code Performance Efficiency Measure, version 1.0 (ASCPEM), <https://www.omg.org/spec/ASCPEM/1.0/>~~
- ~~Automated Source Code Maintainability Measure, version 1.0 (ASCMM), <https://www.omg.org/spec/ASCMM/1.0/>~~
- ISO/IEC 25010 Systems and software engineering – System and software product Quality Requirements and Evaluation (SQuaRE) – System and software quality models
- ISO/IEC 25020:2007 Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Measurement reference model and guide
- ~~International Organization for Standards (2019). *ISO/IEC 19515:2019, Automated Function Points*. Information technology -- Object Management Group Automated Function Points (AFP), 1.0. Geneva, Switzerland. Also, Object Management Group (2014). *Automated Function Points*. formal 2014-01-03 <http://www.omg.org/spec/AFP/>. Needham, MA: Object Management Group.~~
- ~~International Telecommunications Union (2012). *ITU-T X.1524 – Series X: Data Networks, Open System Communications and Security – Cybersecurity information exchange – Vulnerability/state exchange – Common weakness enumeration*. Geneva:, Switzerland.~~

## 4. Terms and Definitions

For the purposes of this specification, the following terms and definitions apply.

**Automated Function Points**—a specification for automating the counting of Function Points that mirrors as closely as possible the counting guidelines of the International Function Point User Group. (OMG, formal 2014-01-03)

**Common Weakness Enumeration**—a repository maintained by MITRE Corporation of known weaknesses in software that can be exploited to gain unauthorized entry into a software system. (cwe.mitre.org)

**Contributing Weakness**—a weakness that is represented as a child of a parent weakness in the Common Weakness Enumeration, that is, a variant instantiation of the parent weakness (cwe.mitre.org)

**Cyclomatic Complexity**—A measure of control flow complexity developed by Thomas McCabe based on a graph-theoretic analysis that reduces the control flow of a computer program to a set of edges, vertices, and their attributes that can be quantified. (McCabe, 1976)

**Detection Pattern**—a collection of parsed program elements and their relations that constitute a weakness in the software.

**Internal Software Quality**—the degree to which a set of static attributes of a software product satisfy stated and implied needs for the software product to be used under specified conditions. This will be referred to as software structural quality, or simply structural quality in this specification. (ISO/IEC 25010)

**Maintainability**—capability of a product to be modified by the intended maintainers with effectiveness and efficiency (ISO/IEC 25010)

**Parent Weakness**—a weakness in the Common Weakness Enumeration that has numerous possible instantiations in software that are represented by its relation to child CWEs (cwe.mitre.org)

**Performance Efficiency**—capability of a product to use an appropriate amount of resources under stated conditions (ISO/IEC 25010)

**Quality Measure Element**—a measure defined in terms of a software quality attribute and the measurement method for quantifying it, including optionally the transformation by a mathematical function (ISO/IEC 25010)

**Reliability**—capability a product, to perform specified functions under specified conditions for a specified period of time (ISO/IEC 25010)



**Security**— capability of a product to protect information and data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorization, and to defend against attack patterns by malicious actors (ISO/IEC 25010)

**Software Product**—a set of computer programs, procedures, and possibly associated documentation and data. (ISO/IEC 25010)

**Software Product Quality Model**—a model that categorizes product quality properties into eight characteristics (functional suitability, reliability, performance efficiency, usability, security, compatibility, maintainability and portability). Each characteristic is composed of a set of related sub-characteristics. (ISO/IEC 25010)

**Software Quality**—degree to which a software product satisfies stated and implied needs when used under specified conditions. (ISO/IEC 25010)

**Software Quality Attribute**—an inherent property or characteristic of software that can be distinguished quantitatively or qualitatively by human or automated means. (derived from ISO/IEC 25010)

**Software Quality Characteristic**—a set of software quality attributes that affect a specific category of software quality outcomes. (similar to but more specific than ISO/IEC 25010)

**Software Quality Characteristic Measure**—a software quality measure derived from measuring the attributes related to a specific software quality characteristic. ([ISO/IEC 25020](#))

**Software Quality Measure**—a measure that is defined as a measurement function of two or more values of software quality measure elements. (ISO/IEC 25010)

**Software Quality Measure Element**—a measure defined in terms of a software quality attribute and the measurement method for quantifying it, including optionally the transformation by a mathematical function. (ISO/IEC 25010)

**Software Quality Measurement**—(verb) a set of operations having the object of determining a value of a software quality measure. (ISO/IEC 25010)

**Software Quality Model**—a defined set of software characteristics, and of relationships between them, which provides a framework for specifying software quality requirements and evaluating the quality of a software product. (derived from ISO/IEC 25010)

**Software Quality Rule**—an architectural or coding practice or convention that represents good software engineering practice and avoids problems in software development, maintenance, or operations. Violations of these quality rules produces software anti-patterns.

**Software Quality Sub-characteristic**—a sub-category of a software quality characteristic to which software quality attributes and their software quality measure elements are conceptually related. (derived from ISO/IEC 25010)

**Structural Element**—a component of software code that can be uniquely identified and counted such as a token, decision, variable, etc.

**Structural Quality**—the degree to which a set of static attributes of a software product satisfy stated and implied needs for the software product to be used under specified conditions—a component of software quality. This concept is referred to as internal software quality in ISO/IEC 25010.

**Weakness**—sometimes referred to as a software anti-pattern, is a pattern or structure in the code (Detection Pattern) that is inconsistent with good architectural or coding practice, violates a software quality rule, and can lead to operational or cost problems. [\(derived from cwe.mitre.com\)](#)

## 5. Symbols (and Abbreviated Terms)

- AFP** — Automated Function Points
- ASCMM** — Automated Source Code Maintainability Measure
- ASCPEM** — Automated Source Code Performance Efficiency Measure
- ASCQM** — Automated Source Code Quality Measure
- ASCRM** — Automated Source Code Reliability Measure
- ASCSM** — Automated Source Code Security Measure
- CWE** — Common Weakness Enumeration
- CISQ** — Consortium for IT Software Quality
- KDM** — Knowledge Discovery Metamodel
- SPMS** — Structured Pattern Metamodel Standard
- SMM** — Structured Metrics Metamodel

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## 6. Additional Information (Informative)

### 6.1 Software Product Inputs

The following inputs are needed by static code analyzers in order to interpret violations of the software quality rules that would be included in individual software quality measure elements.

- The entire source code for the application being analyzed
- All materials and information required to prepare the application for production
- A list of vetted libraries that are being used to sanitize data against potential attacks
- What routines/API calls are being used for remote authentication, to any custom initialization and cleanup routines, to synchronize resources, or to neutralize accepted file types or the names of resources

Static code analyzers will also need a list of the violations that constitute each quality element in the Automated Source Code Security Measure.

### 6.2 Automated Source Code Quality Measure Elements

The weaknesses violating software quality rules that compose the CISQ Automated Source Code Quality Measures are grouped by measure in the clauses 6 and 7. Some of the weaknesses are included in more than one quality measure because they can cause several types of problems. The Common Weakness Enumeration repository (CWE, Appendix B) has recently been expanded to include weaknesses from quality characteristics beyond security. All weaknesses included in these measures are identified by their CWE number from the repository. In most cases the description of CWEs is taken from information in the online repository ([cwe.mitre.org](http://cwe.mitre.org)). The mappings of the weaknesses from the previous CISQ measures to the current measures are presented in Appendix C.

Some weaknesses drawn from the CWE repository (parent weaknesses) have related weaknesses listed as ‘contributing weaknesses’ (‘children’ in the CWE). Contributing weaknesses represent variants of how the parent weakness can be instantiated in software. In the following tables the cells containing CWE IDs for parents are presented in a darker blue than the cells containing contributing weaknesses. Based on their severity, not all children were included. Compliance to the CISQ measures is assessed at the level of the parent weakness. A technology must be able to detect at least one of the contributing weaknesses to be assessed compliant on the parent weakness.

### 6.3 Automated Source Code Maintainability Measure Element Descriptions

The quality measure elements (weaknesses violating software quality rules) that compose the CISQ Automated Source Code Maintainability Measure are presented in Table 1. This measure contains ~~2928~~ parent weaknesses and ~~no3~~ contributing weaknesses.

Table 1. Quality Measure Elements for Automated Source Code Maintainability Measure

CWE #	Descriptor	Weakness Description
CWE-407	Algorithmic Complexity	<del>An algorithm in a product has an inefficient worst-case computational complexity that may be detrimental to system performance and can be triggered by an attacker, typically using crafted manipulations that ensure that the worst case is being reached. Remove instances where a module has references that cycle back to itself, e.g., the existence of cycles between packages in JAVA.</del>
CWE-478	Missing Default Case in Switch Statemen	The code does not have a default case in a switch statement, which <del>might</del> lead to complex logical errors <u>and resultant weaknesses.</u>
CWE-480	Use of Incorrect Operator	The programmer accidentally uses the wrong operator, which changes the application logic in security-relevant ways.
CWE-484	Omitted Break Statement in Switch	The program omits a break statement within a switch or similar construct, causing code associated with multiple conditions to execute. <del>This can cause problems</del> when <u>the programmer</u> only <del>associated with one condition was</del> intended to execute code <u>associated with one condition.</u>
CWE-561	Dead code	The software contains dead code that can never be executed. (Thresholds are set at 5% logically dead code or <u>0% for</u> code that is <del>0%</del> structurally dead. Code that exists in the source but not in the object does not count.)
<del>CWE-1061</del>	<del>Unreachable Named Callable or Method Control Element</del>	<del>The software contains a function or method that is unreferenced and unused by any other software element in the application. The measure is the number of unreferenced or unused software elements. The defined application boundary determines the scope of the search for software elements that could call a function or method element; exceptions are getters and setters, as well as libraries outside the scope of the application.</del>
CWE-570	Expression is Always False	The software contains an expression that will always evaluate to false. <span style="float: right;">Formatted: Font color: Background 1</span>
CWE-571	Expression is Always True	The software contains an expression that will always evaluate to true. <span style="float: right;">Formatted: Font color: Background 1</span>
<del>CWE-1081</del>	<del>Public member element</del>	<del>The software should not declare an uncontrolled data element as public.</del>

CWE-783	<b>Operator Precedence Logic Error</b>	The program uses an expression in which operator precedence causes incorrect logic to be used. While often just a bug, operator precedence logic errors can have serious consequences if they are used in security-critical code, such as making an authentication decision.
CWE-1041	<b>Use of Redundant Code (Copy-Paste) Named Callable and Method Control Element Excessive Similarity</b>	The software has multiple functions, methods, procedures, macros, etc. that contain the same code. The number of logical instructions that have been copied and pasted to other parts of the software exceeds a threshold value. (The default threshold for each instance of copy-pasted code sets the maximum number of allowable copy-pasted instructions at 10% of the total instructions in the instance, <i>alternate thresholds can be set prior to analysis</i> ).
CWE-1045	<b>Parent Class with a Virtual Destructor and a Child Class without a Virtual Destructor Child Class Element without Virtual Destructor unlike its Parent Class Element</b>	A parent class has a virtual destructor method, but the parent has a child class that does not have a virtual destructor. For languages in which custom destructors can be written, the child class does not have its own virtual destructor, while its parent class has a virtual destructor.
CWE-1047	<b>Modules with Circular Dependencies Inter-Module-Dependency Cycles</b>	The software contains modules in which one module has references that cycle back to itself, i.e., there are circular dependencies. A software component within the application contains references that cycle back to itself (for example, in JAVA this pattern means cycles between packages).
CWE-1048	<b>Invokable Control Element with Large Number of Outward Calls (Excessive Coupling or Fan-out) Callable and Method Control Element Number of Outward Calls</b>	The code contains callable control elements that contain an excessively large number of references to other application objects external to the context of the callable, i.e. a Fan-Out value that is excessively large. A function, method, procedure, stored procedure, or sub-routine references too many other objects within the application (default threshold for the maximum number of references is 5, <i>alternate threshold can be set prior to analysis</i> )
CWE-1051	<b>Storable and Member Data Element Initialization with Hard-Coded Network Resource Configuration Data</b>	The software initializes data using hard-coded values that act as network resource identifiers. A variable, field, member, etc. is initialized with a hard-coded network resource identification information.
CWE-1052	<b>Excessive Use of Hard-Coded Literals in Initialization Storable and Member Data Element Initialization with Hard-Coded Literals</b>	The software initializes a data element using a hard-coded literal that is not a simple integer or static constant element. The software uses a literal value to initialize a variable, field, member, etc. (exceptions are simple integers and a static constant variable, field, member, etc.)

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CWE-1054	<u>Invocation of a Control Element at an Unnecessarily Deep Horizontal Layer Named Callable and Method Control Element with [Layer-skipping Call]</u>	The code at one architectural layer invokes code that resides at a deeper layer than the adjacent layer, i.e., the invocation skips at least one layer, and the invoked code is not part of a vertical utility layer that can be referenced from any horizontal layer. A function, method, procedure, stored procedure, or sub-routine calls a function, method, procedure, stored procedure, or sub-routine in a different architectural layer that violates the allowable connections as defined in a model of the application's architectural layers.
CWE-1055	<u>Multiple Inheritance from Concrete Classes Class Element Excessive Inheritance of Class Elements with Concrete Implementation</u>	The software contains a class with inheritance from more than one concrete class. A class inherits from too many concrete classes (default threshold for the maximum number of concrete class inheritances is 1, alternate threshold can be set prior to analysis).
CWE-1062	<u>Parent Class Element with References to Child Class Element</u>	The code has a parent class that contains references to a child class, its methods, or its members. A parent class references one of its child classes, directly or indirectly via its methods and fields.
CWE-1064	<u>Invokable Control Element with Signature Containing an Excessive Number of Parameters Callable and Method Control Element Excessive Number of Parameters</u>	The software contains a function, subroutine, or method whose signature has an unnecessarily large number of parameters/arguments. A function, method, procedure, stored procedure, or sub-routine has too many parameters in its signature (default threshold for the maximum number of parameters is 7, alternate threshold can be set prior to analysis).
CWE-1074	<u>Class with Excessively Deep Inheritance Class Element Excessive inheritance Level</u>	A class has an inheritance level that is too high, i.e., it has a large number of parent classes. A class inheritance level is too large (default threshold for maximum inheritance levels is 7, alternate threshold can be set prior to analysis).
CWE-1075	<u>Unconditional Control Flow Transfer outside of Switch Block Control transferred outside switch statement</u>	The software performs unconditional control transfer (such as a "goto") in code outside of a branching structure such as a switch block. The software transfers control flow outside a switch statement (e.g., depending on the technology, by using a 'go to' statement).
CWE-1079	<u>Parent Class Element without Virtual Destructor Method Element</u>	A parent class contains one or more child classes, but the parent class does not have a virtual destructor method. For languages in which custom destructors can be written, the parent has no virtual destructor.

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CWE-1080	<u>Source Code File with Excessive Number of Lines of Code</u> <u>Source Element Excessive Size</u>	<u>A source code file has too many lines of code. A file within the application has too many logical source lines of code (default threshold for the maximum lines of code is 1000, alternate threshold can be set prior to analysis).</u>
CWE-1084	<u>Invokable Control Element with Excessive File or Data Access Operations</u> <u>Callable and Method Control Element Excessive Number of Control Elements involving Data Element from Data Manager or File Resource</u>	<u>A function or method contains too many operations that utilize a data manager or file resource. A function, method, procedure, stored procedure, or sub-routine has too many SQL or file operations (default threshold for the maximum number of SQL or file operations is 7, alternate threshold can be set prior to analysis).</u>
CWE-1085	<u>Invokable Control Element with Excessive Volume of Commented-out Code</u> <u>Commented-out Code Element Excessive Volume</u>	<u>A function, method, procedure, etc. contains an excessive amount of code that has been commented out within its body. A software component within the application contains too many commented-out instructions (default threshold for the maximum percent of commented-out instructions is 2%, alternate threshold can be set prior to analysis).</u>
CWE-1086	<u>Class with Excessive Number of Child Classes</u> <u>Class Element Excessive Number of Children</u>	<u>A class contains an unnecessarily large number of children. The number of children of a class is too large (default threshold for the maximum number of children of a class is 10, alternate threshold can be set prior to analysis).</u>
CWE-1087	<u>Class Element with Virtual Method Element without a Virtual Destructor</u>	<u>A class contains a virtual method, but the method does not have an associated virtual destructor. A class contains a virtual method, yet the class does not declare any virtual destructor.</u>
CWE-1090	<u>Method Containing Access of a Member Element from Another Class</u> <u>Method Control Element Usage of Member Element from other Class Element</u>	<u>A method for a class performs an operation that directly accesses a member element from another class. A method from a class accesses a field or member from another class.</u>
CWE-1095	<u>Loop Condition Value Update within the Loop</u>	<u>The software uses a loop with a control flow condition based on a value that is updated within the body of the loop. Within the body of a loop, the software updates the value of a local variable, field, member, etc. used in the loop condition.</u>



<b>CWE-1121093</b>	<b>Excessive McCabe Cyclomatic Complexity Callable and Method Control Element Excessive Cyclomatic Complexity Value</b>	<i>A module, function, method, procedure, etc. contains McCabe cyclomatic complexity that exceeds a desirable maximum. A function, method, procedure, stored procedure, sub-routine, etc. has a Cyclomatic Complexity that is too large compared to a threshold value (default threshold for Cyclomatic Complexity is 20, alternate threshold can be set prior to analysis).</i>
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#### 6.4 Automated Source Code Performance Efficiency Measure Element Descriptions

The quality measure elements (weaknesses violating software quality rules) that compose the CISQ Automated Source Code Performance Efficiency Measure are presented in Table 2. This measure contains 16 parent weaknesses and 3 contributing weaknesses (children in the CWE) that represent variants of these weaknesses. The CWE numbers for contributing weaknesses is presented in light blue cells immediately below the parent weakness whose CWE number is in a dark blue cell.

Table 2. Quality Measure Elements for Automated Source Code Performance Efficiency Measure

CWE #	Descriptor	Weakness Description
CWE-404	<b>Improper Resource Shutdown or Release</b>	The program does not release or incorrectly releases a resource before it is made available for re-use.
CWE-401	<b>Improper Release of Memory Before Removing Last Reference ('Memory Leak')</b>	The software does not sufficiently track and release allocated memory after it has been used, which slowly consumes remaining memory.
CWE-772	<b>Missing Release of Resource after Effective Lifetime</b>	The software does not release a resource after its effective lifetime has ended, i.e., after the resource is no longer needed.

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CWE-775	<b>Missing Release of File Descriptor or Handle after Effective Lifetime</b>	<u>The software does not release a file descriptor or handle after its effective lifetime has ended, i.e., after the file descriptor/handle is no longer needed. When a file descriptor or handle is not released after use (typically by explicitly closing it), attackers can cause a denial of service by consuming all available file descriptors/handles, or otherwise preventing other system processes from obtaining their own file descriptors/handles.</u> <del>The software does not release a file descriptor or handle after its effective lifetime has ended, i.e., after the file descriptor/handle is no longer needed.</del>
CWE-424	<b>Improper Protection of Alternate Path</b>	The product does not sufficiently protect all possible paths that a user can take to access restricted functionality or resources. <u>When data storage relies on a DBMS, special care shall be given to secure all data accesses and ensure data integrity.</u>
CWE-1071	<b>Storable and Member Data Element Memory Allocation Missing De-allocation Control Element</b>	<del>A method locks and unlocks an object without ever de-referencing it.</del>
CWE-1042	<b>Static Member Data Element outside of a Singleton Class Element</b>	<u>The code contains a member element that is declared as static (but not final), in which its parent class element is not a singleton class - that is, a class element that can be used only once in the 'to' association of a Create action.</u> <del>The software declares static field as static, but its parent class is not a singleton class; it does not account for final static fields or members.</del>
CWE-1043	<b>Data Element Aggregating an Excessively Large Number of Non-Primitive Elements</b> <b>Storable and Member Data Element Excessive Number of Aggregated Storable and Member Data Elements</b>	<u>The software uses a data element that has an excessively large number of sub-elements with non-primitive data types such as structures or aggregated objects.</u> <del>The software contains a data element aggregated from too many non-primitive data types (default threshold for the maximum number of aggregated non-primitive data types is 5, alternate threshold can be set prior to analysis).</del>

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CWE-1046	<p><b><u>Creation of Immutable Text Using String Concatenation</u></b>  <b><u>Immutable Storable and Member Data Element Creation</u></b></p>	<p><u>This programming pattern can be inefficient in comparison with use of text buffer data elements. This issue can make the software perform more slowly. If the relevant code is reachable by an attacker, then this performance problem might introduce a vulnerability.</u>  <i>A software operation inside a loop creates immutable text data via a string concatenation (which could be avoided by using text buffer instead).</i></p>
CWE-1049	<p><b><u>Excessive Data Query Operations in a Large Data Table</u></b>  <b><u>Data Resource Read and Write Access Excessive Complexity</u></b></p>	<p><u>The software performs a data query with a large number of joins and sub-queries on a large data table. A SQL statement with too many joins (default threshold <u>is</u> 5 joins, <i>alternate threshold can be set prior to analysis</i>) and too many sub-queries (default threshold <u>is</u> 3 sub-queries, <i>alternate threshold can be set prior to analysis</i>) accesses a very large table exceeding a threshold number of rows (default threshold <u>is</u> and 1,000,000 rows for a large table, <i>alternate threshold for all three parameters can be set prior to analysis</i>).</u></p>
CWE-1050	<p><b><u>Excessive Platform Resource Consumption within a Loop</u></b>  <b><u>Control Elements Requiring Significant Resource Element within Control Flow Loop Block</u></b></p>	<p><u>The software has a loop body or loop condition that contains a control element that directly or indirectly consumes platform resources, e.g. messaging, sessions, locks, or file descriptors. A software operation that is directly or indirectly called within a loop body or loop condition consumes platform resources (messaging, lock, file, stream, directory, etc.) beyond an acceptable threshold (default threshold for resource consumption should be set based on the system architecture <del>is</del> <del>XX</del> platform resources, <i>alternate threshold can be set prior to analysis</i>).</u></p>

CWE-1057	<p><u>Data Access Operations Outside of Expected Data Manager Component</u>  <u>Data Access Control Element from Outside Designated Data Manager Component</u></p>	<p>The software uses a dedicated, central data manager component as required by design, but it contains code that performs data-access operations that do not use this data manager. The software executes a data access outside of a dedicated data access component, thus circumventing the intended design to deny direct data access, thus allowing access only through dedicated data access components. —Notes:</p> <ul style="list-style-type: none"> <li>· The dedicated data access component can be either client-side or server-side, which means that data access components can be developed using non-SQL language.</li> <li>· If there is no dedicated data access component, every data access is a <u>weakness violation</u>.</li> <li>· For some embedded software that requires access to data from anywhere, the whole software is defined as a data access component. This condition must be identified as input to the analysis.</li> </ul>
CWE-1060	<p><u>Excessive Number of Inefficient Server-Side Data Accesses</u>  <u>Non-stored SQL Callable Control Element with Excessive Number of Data Resource Access</u></p>	<p>The software performs too many data queries without using efficient data processing functionality such as <u>stored procedures</u>. A server-side non-stored procedure contains too many data queries (default threshold for maximum number of data queries is 5, alternate threshold can be set prior to analysis).</p>
CWE-1067	<p><u>Excessive Execution of Sequential Searches of Data Resource</u>  <u>Data Resource Read Access Unsupported by Index Element</u></p>	<p>The software contains a data query against a SQL table or view that is configured in a way that does not utilize an index and may cause sequential searches to be performed. The syntax of a SQL SELECT statement and the index configuration of a SQL table or SQL view causes the DBMS to run sequential searches on a very large table exceeding a threshold number of rows (default threshold for a weakness to be counted is a query on a table of at least 1,000,0500 rows, or an alternate threshold recommended by the database vendor. No weakness should be counted under conditions where the vendor recommends an index should not be used. An alternate threshold can be set prior to analysis).</p>

CWE-1072	<u>Data Resource Access without Use of Connection Pooling</u> Data-access-not-using connection-pool	The software accesses a data resource through a database without using a connection pooling capability. The software executes a data resource management action without using a connection pool (the use of a connection pool is technology dependent; for example, connection pooling is disabled with the addition of 'Pooling=false' to the connection string with ADO.NET or the value of a 'com.sun.jndi.ldap.connect.pool' environment parameter in Java).
CWE-1073	<u>Non-SQL Invokable Control Element with Excessive Number of Data Resource Accesses</u> Excessive data queries in client-side code	The software contains a client with a function or method that contains a large number of data accesses/queries that are sent through a data manager, i.e., does not use efficient database capabilities. A client-side software operation contains too many data queries (default threshold for the maximum number of data queries is 2, alternate threshold can be set prior to analysis).
CWE-1089	<u>Large Data Table with Excessive Number of Indices</u> Large Data Resource ColumnSet Excessive Number of Index Elements	The software uses a large data table. A very large table exceeding a threshold number of rows (default is 1,000,000 rows, alternate threshold can be set prior to analysis) that contains an excessively large number of indices. has too many indices (default threshold for the maximum number of indices is 3, alternate threshold can be set prior to analysis).
CWE-1091	<u>Use of Object without Invoking Destructor Method</u> Storable and Member Data Element Reference Missing De-referencing Control Element	The software contains a method that accesses an object but does not later invoke the element's associated finalize/destructor method. The software is missing a dereferencing element that operates on a pointer variable and returns an l-value equivalent to the value at the pointer address.
CWE-1094	<u>Excessive Index Range Scan for a Data Resource</u> Large Data Resource ColumnSet with Index Element of Excessive Size	The software contains an index range scan for a large data table. The software writes to a very large table exceeding a threshold number of rows (default threshold is 1,000,000 rows, alternate threshold can be set prior to analysis) but the scan can cover a large number of rows, and has an index whose size is too large (default threshold for the index range is 10, alternate threshold can be set prior to analysis).

## 6.5 Automated Source Code Reliability Measure Element Descriptions

The quality measure elements (weaknesses violating software quality rules) that compose the CISQ Automated Source Code Reliability Measure are presented in Table 3. This measure contains 356 parent weaknesses and 398 contributing weaknesses (children in the CWE) that represent variants of these weaknesses. The CWE numbers for contributing weaknesses is presented in light blue cells immediately below the parent weakness whose CWE number is in a dark blue cell.

Table 3. Quality Measure Elements for Automated Source Code Reliability Measure

CWE #	Descriptor	Weakness description
CWE-119	<b>Improper Restriction of Operations within the Bounds of a Memory Buffer</b> <i>Improper reading or writing to a memory buffer</i>	The software performs operations on a memory buffer, but it can read from or write to a memory location that is outside of the intended boundary of the buffer.
CWE-120	<b>Buffer Copy without Checking Size of Input</b> <i>(Classic buffer overflow)</i>	The program copies an input buffer to an output buffer without verifying that the size of the input buffer is less than the size of the output buffer, leading to a buffer overflow.
CWE-123	<b>Write-what-where condition</b>	<i>Any condition where the attacker has the ability to write</i> The program allows an arbitrary value to be written to an arbitrary location, often as the result of a buffer overflow.
CWE-125	<b>Out-of-bounds read</b>	The software reads data past the end, or before the beginning, of the intended buffer.
CWE-130	<b>Improper Handling of Length Parameter Inconsistency</b>	The software parses a formatted message or structure, but it does not handle or incorrectly handles a length field that is inconsistent with the actual length of the associated data.
CWE-786	<b>Access of Memory Location Before Start of Buffer</b>	The software reads or writes to a buffer using an index or pointer that references a memory location prior to the beginning of the buffer. This typically occurs when a pointer or its index is decremented to a position before the buffer, when pointer arithmetic results in a position before the beginning of the valid memory location, or when a negative index is used.
CWE-787	<b>Out-of-bounds Write</b>	The software writes data past the end, or before the beginning, of the intended buffer. The software may modify an index or perform pointer arithmetic that references a memory location that is outside of the boundaries of the buffer.

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<b>CWE-788</b>	<b>Access of Memory Location After End of Buffer</b>	<p>The software reads or writes to a buffer using an index or pointer that references a memory location after the end of the buffer. This typically occurs when a pointer or its index is decremented to a position before the buffer; when pointer arithmetic results in a position before the buffer; or when a negative index is used, which generates a position before the buffer.</p>
<b>CWE-805</b>	<b>Buffer Access with Incorrect Length Value</b>	<p>The software uses a sequential operation to read or write a buffer, but it uses an incorrect length value that causes it to access memory that is outside of the bounds of the buffer.</p>
<b>CWE-822</b>	<b>Untrusted Pointer Dereference</b>	<p>The program obtains a value from an untrusted source, converts this value to a pointer, and dereferences the resulting pointer. There are several variants of this weakness, including but not necessarily limited to:</p> <ul style="list-style-type: none"> <li>• The untrusted value is directly invoked as a function call.</li> <li>• In OS kernels or drivers where there is a boundary between "userland" and privileged memory spaces, an untrusted pointer might enter through an API or system call (see CWE-781 for one such example).</li> <li>• Inadvertently accepting the value from an untrusted control sphere when it did not have to be accepted as input at all. This might occur when the code was originally developed to be run by a single user in a non-networked environment, and the code is then ported to or otherwise exposed to a networked environment.</li> </ul>
<b>CWE-823</b>	<b>Use of Out-of-range Pointer Offset</b>	<p>The program performs pointer arithmetic on a valid pointer, but it uses an offset that can point outside of the intended range of valid memory locations for the resulting pointer.</p> <ul style="list-style-type: none"> <li>• While a pointer can contain a reference to any arbitrary memory location, a program typically only intends to use the pointer to access limited portions of memory, such as contiguous memory used to access an individual array.</li> <li>• Programs may use offsets to access fields or sub-elements stored within structured data. The offset might be out-of-range if it comes from an untrusted source, is the result of an incorrect calculation, or occurs because of another error.</li> </ul>
<b>CWE-824</b>	<b>Access of Uninitialized Pointer</b>	<p>The program accesses or uses a pointer that has not been initialized. If the pointer contains an uninitialized value, then the value might not point to a valid memory location.</p>

<b>CWE-825</b>	<b>Expired Pointer Dereference</b>	The program dereferences a pointer that contains a location for memory that was previously valid, but is no longer valid.
<b>CWE-170</b>	<b>Improper Null Termination</b>	The software does not terminate or incorrectly terminates a string or array with a null character or equivalent terminator.
<b>CWE-252</b>	<b>Unchecked Return Value</b>	The software does not check the return value from a method or function, which can prevent it from detecting unexpected states and conditions.
<b>CWE-390</b>	<b>Detection of Error Condition Without Action</b>	The software detects a specific error, but takes no actions to handle the error. For instance, where an exception handling block (such as Catch and Finally blocks) do not contain any instruction, making it impossible to accurately identify and adequately respond to unusual and unexpected conditions.
<b>CWE-394</b>	<b>Unexpected Status Code or Return Value</b>	The software does not properly check when a function or operation returns a value that is legitimate for the function, but is not expected by the software.
<b>CWE-404</b>	<b>Improper Resource Shutdown or Release</b>	The program does not release or incorrectly releases a resource before it is made available for re-use.
<b>CWE-401</b>	<b>Improper Release of Memory Before Removing Last Reference ('Memory Leak')</b>	The software does not sufficiently track and release allocated memory after it has been used, which slowly consumes remaining memory.
<b>CWE-772</b>	<b>Missing Release of Resource after Effective Lifetime</b>	The software does not release a resource after its effective lifetime has ended, i.e., after the resource is no longer needed.
<b>CWE-775</b>	<b>Missing Release of File Descriptor or Handle after Effective Lifetime</b>	The software does not release a file descriptor or handle after its effective lifetime has ended, i.e., after the file descriptor/handle is no longer needed. When a file descriptor or handle is not released after use (typically by explicitly closing it), attackers can cause a denial of service by consuming all available file descriptors/handles, or otherwise preventing other system processes from obtaining their own file descriptors/handles.
<b>CWE-424</b>	<b>Improper Protection of Alternate Path</b>	The product does not sufficiently protect all possible paths that a user can take to access restricted functionality or resources. <a href="#"><u>When data storage relies on a DBMS, special care shall be given to secure all data accesses and ensure data integrity.</u></a>
<b>CWE-459</b>	<b>Incomplete Cleanup</b>	The software does not properly "clean up" and remove temporary or supporting resources after they have been used.



CWE-476	<b>NULL Pointer Dereference</b>	A NULL pointer dereference occurs when the application dereferences a pointer that it expects to be valid, but is NULL, typically causing a crash or exit.
CWE-480	<b>Use of Incorrect Operator</b>	The programmer accidentally uses the wrong operator, which changes the application logic in security-relevant ways.
CWE-484	<b>Omitted Break Statement in Switch</b>	The program omits a break statement within a switch or similar construct, causing code associated with multiple conditions to execute. <u>This can cause problems when the programmer only intended to execute code associated with one condition, when only code associated with one condition was intended to execute.</u>
CWE-562	<b>Return of Stack Variable Address</b>	<u>A function returns the address of a stack variable, which will cause unintended program behavior, typically in the form of a crash.</u> Because local variables are allocated on the stack, when a program returns a pointer to a local variable, it is returning a stack address. A subsequent function call is likely to re-use this same stack address, thereby overwriting the value of the pointer, which no longer corresponds to the same variable since a function's stack frame is invalidated when it returns. At best this will cause the value of the pointer to change unexpectedly. In many cases it causes the program to crash the next time the pointer is dereferenced.
CWE-595	<b>Comparison of Object References Instead of Object Contents</b>	The program compares object references instead of the contents of the objects themselves, preventing it from detecting equivalent objects.
CWE-597	<b>Use of Wrong Operator in String Comparison</b>	The software uses the wrong operator when comparing a string, such as using "==" when the equals() method should be used instead. In Java, using == or != to compare two strings for equality actually compares two objects for equality, not their values.
CWE-1097	<b>Persistent Storable Data Element without Associated Proper Comparison Control Element</b>	<u>The software uses a storable data element that does not have all of the associated functions or methods that are necessary to support comparison.</u> Remove instances where the persistent data has missing or improper dedicated comparison operations. Note: * In case of technologies with classes, this means situations where a persistent field is from a class that is made persistent while it does not implement methods from the list of required comparison operations (a JAVA example is the list composed of {'hashCode()','equals()'} methods)

<b>CWE-662</b>	<b>Improper Synchronization</b>	The software attempts to use a shared resource in an exclusive manner, but does not prevent or incorrectly prevents use of the resource by another thread or process.
<b>CWE-366</b>	<b>Race Condition within a Thread</b>	If two threads of execution use a resource simultaneously, there exists the possibility that resources may be used while invalid, in turn making the state of execution undefined.
<b>CWE-543</b>	<b>Use of Singleton Pattern Without Synchronization in a Multithreaded Context</b>	The software uses the singleton pattern when creating a resource within a multithreaded environment.
<b>CWE-567</b>	<b>Unsynchronized Access to Shared Data in a Multithreaded Context</b>	The product does not properly synchronize shared data, such as static variables across threads, which can lead to undefined behavior and unpredictable data changes.
<b>CWE-667</b>	<b>Improper Locking</b>	The software does not properly acquire a lock on a resource, or it does not properly release a lock on a resource, leading to unexpected resource state changes and behaviors.
<b>CWE-764</b>	<b>Multiple Locks of a Critical Resource</b>	The software locks a critical resource more times than intended, leading to an unexpected state in the system.
<b>CWE-820</b>	<b>Missing Synchronization</b>	The software utilizes a shared resource in a concurrent manner but does not attempt to synchronize access to the resource.
<b>CWE-821</b>	<b>Incorrect Synchronization</b>	The software utilizes a shared resource in a concurrent manner but it does not correctly synchronize access to the resource.
<b>CWE-1058</b>	<b><del>Invokable Named-Callable and Method-Control Element in Multi-Thread Context with non-Final Static Storable or Member Element</del></b>	<del>The code contains a function or method that operates in a multi-threaded environment but owns an unsafe non-final static storable or member data element. A control element owns an unsafe non-final static data element while it operates in a multi-threaded environment.</del>
<b>CWE-1096</b>	<b><del>Singleton Class Instance Creation without Proper Locking or Synchronization Lock Element Management</del></b>	<del>The software implements a Singleton design pattern but does not use appropriate locking or other synchronization mechanism to ensure that the singleton class is only instantiated once. The software instantiates a singleton class without activating any prior locking mechanism.</del>
<b>CWE-665</b>	<b>Improper Initialization</b>	The software does not initialize or incorrectly initializes a resource, which might leave the resource in an unexpected state when it is accessed or used.
<b>CWE-456</b>	<b>Missing Initialization of a Variable</b>	The software does not initialize critical variables, which causes the execution environment to use unexpected values.

CWE-457	Use of uninitialized variable	<u>The code uses a variable that has not been initialized, leading to unpredictable or unintended results.</u> <del>The software uses a variable that has not been initialized.</del>
CWE-672	Operation on a Resource after Expiration or Release	The software uses, accesses, or otherwise operates on a resource after that resource has been expired, released, or revoked.
CWE-415	Double Free	The product calls free() twice on the same memory address, potentially leading to modification of unexpected memory locations.
CWE-416	Use After Free	Referencing memory after it has been freed can cause a program to crash, use unexpected values, or execute code.
CWE-681	Incorrect Conversion between Numeric Types	<u>When converting from one data type to another, such as long to integer, data can be omitted or translated in a way that produces unexpected values. If the resulting values are used in a sensitive context, then dangerous behaviors may occur. For instance, if</u> The software declares a variable, field, member, etc. with a numeric type, and then updates it with a value from a second numeric type that is incompatible with the first numeric type.
CWE-194	Unexpected Sign Extension	The software performs an operation on a number that causes it to be sign-extended when it is transformed into a larger data type. When the original number is negative, this can produce unexpected values that lead to resultant weaknesses.
CWE-195	Signed to Unsigned Conversion Error	The software uses a signed primitive and performs a cast to an unsigned primitive, which can produce an unexpected value if the value of the signed primitive cannot be represented using an unsigned primitive.
CWE-196	Unsigned to Signed Conversion Error	The software uses an unsigned primitive and performs a cast to a signed primitive, which can produce an unexpected value if the value of the unsigned primitive cannot be represented using a signed primitive.
CWE-197	Numeric Truncation Error	<u>Truncation errors occur when a primitive is cast to a primitive of a smaller size and data is lost in the conversion.</u> When a primitive is cast to a smaller primitive, the high order bits of the large value are lost in the conversion, potentially resulting in an unexpected value that is not equal to the original value. This value may be required as an index into a buffer, a loop iterator, or simply necessary state data. In any case, the value cannot be trusted and the system will be in an undefined state. While this method may be employed viably to isolate the low bits of a value, this usage is rare, and truncation usually implies that an implementation error has occurred.

CWE-682	<b>Incorrect Calculation</b>	The software performs a calculation that generates incorrect or unintended results that are later used in security-critical decisions or resource management.
CWE-131	<b>Incorrect Calculation of Buffer Size</b>	The software does not correctly calculate the size to be used when allocating a buffer, which could lead to a buffer overflow.
CWE-369	<b>Divide By Zero</b>	The product divides a value by zero.
CWE-703	<b>Improper Check or Handling of Exceptional Conditions</b>	<del>Address instances where</del> The software does not properly anticipate or handle exceptional conditions that rarely occur during normal operation of the software.
CWE-248	<b>Uncaught Exception</b>	An exception is thrown from a function, but it is not caught.
CWE-391	<b>Unchecked Error Condition</b>	Ignoring exceptions and other error conditions may allow an attacker to induce unexpected behavior unnoticed.
CWE-392	<b>Missing Report of Error Condition</b>	The software encounters an error but does not provide a status code or return value to indicate that an error has occurred.
CWE-704	<b>Incorrect Type Conversion or Cast</b>	The software does not correctly convert an object, resource, or structure from one type to a different type.
CWE-758	<b>Reliance on Undefined, Unspecified, or Implementation-Defined Behavior</b>	The software uses an API function, data structure, or other entity in a way that relies on properties that are not always guaranteed to hold for that entity.
CWE-833	<b>Deadlock</b>	The software contains multiple threads or executable segments that are waiting for each other to release a necessary lock, resulting in deadlock.
CWE-835	<b>Loop with Unreachable Exit Condition ('Infinite Loop')</b>	The program contains an iteration or loop with an exit condition that cannot be reached, i.e., an infinite loop.
CWE-908	<b>Use of Uninitialized Resource</b>	<del>Address instances where</del> The software uses a resource that has not been properly initialized.
CWE-1045	<b><u>Parent Class with a Virtual Destructor and a Child Class without a Virtual Destructor</u> <u>Child Class Element without Virtual Destructor unlike its Parent Class Element</u></b>	<del>A parent class has a virtual destructor method, but the parent has a child class that does not have a virtual destructor. The software fails to include a virtual destructor in a child class despite the existence of a virtual destructor in the parent class.</del>

CWE-1051	<del>Storable and Member Data Element</del> Initialization with Hard-Coded Network Resource Configuration Data	The software initializes data using hard-coded values that act as network resource identifiers. The software contains hard-coded values corresponding to network resource identifications.
CWE-1066	<del>Serializable Storable Data Element without</del> Missing Serialization Control Element	The software contains a serializable data element that does not have an associated serialization method. The software fails to fully implement serialization capabilities.
CWE-1070	Serializable <del>Storable Data Element</del> <del>Containing</del> with non-Serializable Item Elements	The software contains a serializable, storable data element such as a field or member, but the data element contains member elements that are not serializable. The software contains an incomplete implementation of serialization capabilities.
CWE-1077	<del>Floating Point Comparison with Incorrect Operator</del> <del>Float-Type Storable and Member Data Element</del> <del>Comparison with Equality Operator</del>	The code performs a comparison such as an equality test between two float (floating point) values, but it uses comparison operators that do not account for the possibility of loss of precision. Address instances where the float values of a variable, field, member, etc. are compared for equality using regular comparison operators. Numeric calculation using floating point values can generate imprecise results because of rounding errors. As a result, two different calculations might generate numbers that are mathematically equal, but have slightly different bit representations that do not translate to the same mathematically-equal values. As a result, an equality test or other comparison might produce unexpected results. (an example in JAVA, is the use of '=' or '!=' ) instead of being checked for precision.
CWE-1079	Parent Class <del>Element</del> without Virtual Destructor Method <del>Element</del>	A parent class contains one or more child classes, but the parent class does not have a virtual destructor method. The software fails to include a virtual destructor in a parent class.
CWE-1082	Class Instance Self Destruction Control Element	The code contains a class instance that calls the method or function to delete or destroy itself. Address instances where a class can self destruct (an example of a self-destruction in C++ is 'delete this')

CWE-1083	Data Access Control Element from Outside Designated Data Manager Component	<p>The software is intended to manage data access through a particular data manager component such as a relational or non-SQL database, but it contains code that performs data access operations without using that component. The software executes a data access outside of a dedicated data access component, thus circumventing the intended design to deny direct data access, thus allowing access only through dedicated data access components.—Notes:</p> <ul style="list-style-type: none"> <li>• The dedicated data access component can be either client-side or server-side, which means that data access components can be developed using non-SQL language.</li> <li>• If there is no dedicated data access component, every data access is a violation.</li> <li>• For some embedded software that requires access to data from anywhere, the whole software is defined as a data access component. This condition must be identified as input to the analysis.</li> </ul>
CWE-1087	Class Element with Virtual Method Element without a Virtual Destructor	A class contains a virtual method, but the method does not have an associated virtual destructor. The software fails to include a virtual destructor in a class that includes a virtual method(s).
CWE-1088	Synchronous Access of Remote Resource without Timeout Synchronous Call Timeout Absence	The code has a synchronous call to a remote resource, but there is no timeout for the call, or the timeout is set to infinite. Software allows synchronous remote resource access without handling time-out capabilities.
CWE-1098	Storable or Member Data Element containing Pointer Item Element without Proper Copy Control Element	The code contains a data element with a pointer that does not have an associated copy or constructor method. The software contains a pointer but no dedicated copy operation or copy constructor.

## 6.6 Automated Source Code Security Measure Element Descriptions

The quality measure elements (weaknesses violating software quality rules) that compose the CISQ Automated Source Code Security Measure are presented in Table 4. This measure contains 367 parent weaknesses and 376 contributing weaknesses (children in the CWE) that represent variants of these weaknesses. The CWE numbers for contributing weaknesses are presented in light blue cells immediately below the parent weakness whose CWE number is in a dark blue cell.

Table 4. Quality Measure Elements for Automated Source Code Security Measure

CWE #	Descriptor	Weakness description
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<b>CWE-22</b>	<b>Improper Limitation of a Pathname to a Restricted Directory ('Path Traversal')</b>	The software uses external input to construct a pathname that is intended to identify a file or directory that is located underneath a restricted parent directory, but the software does not properly neutralize special elements within the pathname that can cause the pathname to resolve to a location that is outside of the restricted directory.
<b>CWE-23</b>	<b>Relative Path Traversal</b>	The software uses external input to construct a pathname that should be within a restricted directory, but it does not properly neutralize sequences such as ".." that can resolve to a location that is outside of that directory.
<b>CWE-36</b>	<b>Absolute Path Traversal</b>	The software uses external input to construct a pathname that should be within a restricted directory, but it does not properly neutralize absolute path sequences such as "/abs/path" that can resolve to a location that is outside of that directory.
<b>CWE-77</b>	<b>Improper Neutralization of Special Elements used in a Command ('Command Injection')</b>	The software constructs all or part of a command using externally-influenced input from an upstream component, but it does not neutralize or incorrectly neutralizes special elements that could modify the intended command when it is sent to a downstream component.
<b>CWE-78</b>	<b>Improper Neutralization of Special Elements used in an OS Command ('OS Command Injection')</b>	The software constructs all or part of an OS command using externally-influenced input from an upstream component, but it does not neutralize or incorrectly neutralizes special elements that could modify the intended OS command when it is sent to a downstream component.
<b>CWE-88</b>	<b>Argument Injection or Modification</b>	The software does not sufficiently delimit the arguments being passed to a component in another control sphere, allowing alternate arguments to be provided, leading to potentially security-relevant changes.

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CWE-79	Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')	<p>The software does not neutralize or incorrectly neutralizes user-controllable input before it is placed in output that is used as a web page that is served to other users.</p> <p><u>Cross-site scripting (XSS) vulnerabilities occur when:</u></p> <ol style="list-style-type: none"> <li><u>1. Untrusted data enters a web application, typically from a web request.</u></li> <li><u>2. The web application dynamically generates a web page that contains this untrusted data.</u></li> <li><u>3. During page generation, the application does not prevent the data from containing content that is executable by a web browser, such as JavaScript, HTML tags, HTML attributes, mouse events, Flash, ActiveX, etc.</u></li> <li><u>4. A victim visits the generated web page through a web browser, which contains malicious script that was injected using the untrusted data.</u></li> <li><u>5. Since the script comes from a web page that was sent by the web server, the victim's web browser executes the malicious script in the context of the web server's domain.</u></li> <li><u>6. This effectively violates the intention of the web browser's same-origin policy, which states that scripts in one domain should not be able to access resources or run code in a different domain.</u></li> </ol>
CWE-89	Improper Neutralization of Special Elements used in an SQL Command ('SQL Injection')	The software constructs all or part of an SQL command using externally-influenced input from an upstream component, but it does not neutralize or incorrectly neutralizes special elements that could modify the intended SQL command when it is sent to a downstream component.
CWE-564	SQL Injection: Hibernate	Using Hibernate to execute a dynamic SQL statement built with user-controlled input can allow an attacker to modify the statement's meaning or to execute arbitrary SQL commands.
CWE-90	Improper Neutralization of Special Elements used in an LDAP Query ('LDAP Injection')	The software constructs all or part of an LDAP query using externally-influenced input from an upstream component, but it does not neutralize or incorrectly neutralizes special elements that could modify the intended LDAP query when it is sent to a downstream component.

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<b>CWE-917</b>	<b>XML Injection (aka Blind XPath Injection)</b>	The software does not properly neutralize special elements that are used in XML, allowing attackers to modify the syntax, content, or commands of the XML before it is processed by an end system.
<b>CWE-99</b>	<b><u>Improper Control of Resource Identifiers</u> ('Resource injection')</b>	The software receives input from an upstream component, but it does not restrict or incorrectly restricts the input before it is used as an identifier for a resource that may be outside the intended sphere of control.
<b>CWE-119</b>	<b>Improper Restriction of Operations within the Bounds of a Memory Buffer</b>	The software performs operations on a memory buffer, but it can read from or write to a memory location that is outside of the intended boundary of the buffer.
<b>CWE-120</b>	<b>Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')</b>	The program copies an input buffer to an output buffer without verifying that the size of the input buffer is less than the size of the output buffer, leading to a buffer overflow.
<b>CWE-123</b>	<b>Write-what-where condition</b>	<u>Any condition where the attacker has the ability to write</u> <del>The program allows</del> an arbitrary value to <del>be written to</del> an arbitrary location, often as the result of a buffer overflow.
<b>CWE-125</b>	<b>Out-of-bounds Read</b>	The software reads data past the end, or before the beginning, of the intended buffer.
<b>CWE-130</b>	<b>Improper Handling of Length Parameter Inconsistency</b>	The software parses a formatted message or structure, but it does not handle or incorrectly handles a length field that is inconsistent with the actual length of the associated data.
<b>CWE-786</b>	<b>Access of Memory Location Before Start of Buffer</b>	The software reads or writes to a buffer using an index or pointer that references a memory location prior to the beginning of the buffer. This typically occurs when a pointer or its index is decremented to a position before the buffer, when pointer arithmetic results in a position before the beginning of the valid memory location, or when a negative index is used.
<b>CWE-787</b>	<b>Out-of-bounds Write</b>	The software writes data past the end, or before the beginning, of the intended buffer. The software may modify an index or perform pointer arithmetic that references a memory location that is outside of the boundaries of the buffer.

CWE-788	<b>Access of Memory Location After End of Buffer</b>	The software reads or writes to a buffer using an index or pointer that references a memory location after the end of the buffer. This typically occurs when a pointer or its index is decremented to a position before the buffer; when pointer arithmetic results in a position before the buffer; or when a negative index is used, which generates a position before the buffer.
CWE-805	<b>Buffer Access with Incorrect Length Value</b>	The software uses a sequential operation to read or write a buffer, but it uses an incorrect length value that causes it to access memory that is outside of the bounds of the buffer.
CWE-822	<b>Untrusted Pointer Dereference</b>	<p>The program obtains a value from an untrusted source, converts this value to a pointer, and dereferences the resulting pointer. There are several variants of this weakness, including but not necessarily limited to:</p> <ul style="list-style-type: none"> <li>• The untrusted value is directly invoked as a function call.</li> <li>• In OS kernels or drivers where there is a boundary between "userland" and privileged memory spaces, an untrusted pointer might enter through an API or system call (see CWE-781 for one such example).</li> <li>• Inadvertently accepting the value from an untrusted control sphere when it did not have to be accepted as input at all. This might occur when the code was originally developed to be run by a single user in a non-networked environment, and the code is then ported to or otherwise exposed to a networked environment.</li> </ul>
CWE-823	<b>Use of Out-of-range Pointer Offset</b>	<p>The program performs pointer arithmetic on a valid pointer, but it uses an offset that can point outside of the intended range of valid memory locations for the resulting pointer.</p> <ul style="list-style-type: none"> <li>• While a pointer can contain a reference to any arbitrary memory location, a program typically only intends to use the pointer to access limited portions of memory, such as contiguous memory used to access an individual array.</li> <li>• Programs may use offsets to access fields or sub-elements stored within structured data. The offset might be out-of-range if it comes from an untrusted source, is the result of an incorrect calculation, or occurs because of another error.</li> </ul>

CWE-824	Access of Uninitialized Pointer	The program accesses or uses a pointer that has not been initialized. If the pointer contains an uninitialized value, then the value might not point to a valid memory location.
CWE-825	Expired Pointer Dereference	The program dereferences a pointer that contains a location for memory that was previously valid, but is no longer valid.
CWE-129	Improper Validation of Array Index	The product uses untrusted input when calculating or using an array index, but the product does not validate or incorrectly validates the index to ensure the index references a valid position within the array.
CWE-134	Use of Externally-Controlled Format String	The software uses a function that accepts a format string <u>originating from an external source</u> as an argument, but the format string <u>originates from an external source, is not sanitized prior to use based on a list of vetted sanitization functions.</u>
CWE-252	Unchecked Return Value	The software does not check the return value from a method or function, which can prevent it from detecting unexpected states and conditions.
CWE-404	Improper Resource Shutdown or Release	The program does not release or incorrectly releases a resource before it is made available for re-use.
CWE-401	Improper Release of Memory Before Removing Last Reference ('Memory Leak')	The software does not sufficiently track and release allocated memory after it has been used, which slowly consumes remaining memory.
CWE-772	Missing Release of Resource after Effective Lifetime	The software does not release a resource after its effective lifetime has ended, i.e., after the resource is no longer needed.
CWE-775	Missing Release of File Descriptor or Handle after Effective Lifetime	<u>The software does not release a file descriptor or handle after its effective lifetime has ended, i.e., after the file descriptor/handle is no longer needed. When a file descriptor or handle is not released after use (typically by explicitly closing it), attackers can cause a denial of service by consuming all available file descriptors/handles, or otherwise preventing other system processes from obtaining their own file descriptors/handles.</u>
CWE-424	Improper Protection of Alternate Path	The product does not sufficiently protect all possible paths that a user can take to access restricted functionality or resources. <u>When data storage relies on a DBMS, special care shall be given to secure all data accesses and ensure data integrity.</u>

CWE-434	<b>Unrestricted Upload of File with Dangerous Type</b>	The software allows the upload or transfer files of dangerous types that can be automatically processed within the product's environment.
CWE-477	<b>Use of Obsolete Function</b>	The code uses deprecated or obsolete functions, which suggests that the code has not been actively reviewed or maintained.
CWE-480	<b>Use of Incorrect Operator</b>	The programmer accidentally uses the wrong operator, which changes the application logic in security-relevant ways.
CWE-502	<b>Deserialization of Untrusted Data</b>	The application deserializes untrusted data without sufficiently verifying that the resulting data will be valid.
CWE-570	<b>Expression is Always False</b>	The software contains an expression that will always evaluate to false.
CWE-571	<b>Expression Is Always True</b>	The software contains an expression that will always evaluate to true.
CWE-606	<b>Unchecked Input for Loop Condition</b>	<u>The product does not properly check inputs that are used for loop conditions, potentially leading to a denial of service because of excessive looping. The software accepts a user input without any range check prior to being used in a loop condition statement.</u>
CWE-611	<b>Improper Restriction of XML External Entity Reference ('XXE')</b>	The software processes an XML document that can contain XML entities with URIs that resolve to documents outside of the intended sphere of control, causing the product to embed incorrect documents into its output.
CWE-643	<b>Improper Neutralization of Data within XPath Expressions ('XPath Injection')</b>	The software uses external input to dynamically construct an XPath expression used to retrieve data from an XML database, but it does not neutralize or incorrectly neutralizes that input. This allows an attacker to control the structure of the query.
CWE-652	<b>CWE-652 Improper Neutralization of Data within XQuery Expressions ('XQuery Injection')</b>	The software uses external input to dynamically construct an XQuery expression used to retrieve data from an XML database, but it does not neutralize or incorrectly neutralizes that input. This allows an attacker to control the structure of the query.
CWE-665	<b>Improper Initialization</b>	The software does not initialize or incorrectly initializes a resource, which might leave the resource in an unexpected state when it is accessed or used.
CWE-456	<b>Missing Initialization of a Variable</b>	The software does not initialize critical variables, which causes the execution environment to use unexpected values.

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<b>CWE-457</b>	<b>Use of uninitialized variable</b>	The software uses a variable that has not been initialized <a href="#">leading to unpredictable or unintended results.</a>
<b>CWE-662</b>	<b>Improper Synchronization</b>	The software attempts to use a shared resource in an exclusive manner, but does not prevent or incorrectly prevents use of the resource by another thread or process.
<b>CWE-366</b>	<b>Race Condition within a Thread</b>	If two threads of execution use a resource simultaneously, there exists the possibility that resources may be used while invalid, in turn making the state of execution undefined.
<b>CWE-543</b>	<b>Use of Singleton Pattern Without Synchronization in a Multithreaded Context</b>	The software uses the singleton pattern when creating a resource within a multithreaded environment.
<b>CWE-567</b>	<b>Unsynchronized Access to Shared Data in a Multithreaded Context</b>	The product does not properly synchronize shared data, such as static variables across threads, which can lead to undefined behavior and unpredictable data changes.
<b>CWE-667</b>	<b>Improper Locking</b>	The software does not properly acquire a lock on a resource, or it does not properly release a lock on a resource, leading to unexpected resource state changes and behaviors.
<b>CWE-820</b>	<b>Missing Synchronization</b>	The software utilizes a shared resource in a concurrent manner but does not attempt to synchronize access to the resource.
<b>CWE-821</b>	<b>Incorrect Synchronization</b>	The software utilizes a shared resource in a concurrent manner but it does not correctly synchronize access to the resource.
<b>CWE-672</b>	<b>Operation on a Resource after Expiration or Release</b>	The software uses, accesses, or otherwise operates on a resource after that resource has been expired, released, or revoked.
<b>CWE-415</b>	<b>Double Free</b>	The product calls free() twice on the same memory address, potentially leading to modification of unexpected memory locations.
<b>CWE-416</b>	<b>Use After Free</b>	Referencing memory after it has been freed can cause a program to crash, use unexpected values, or execute code.

<b>CWE-681</b>	<b>Incorrect Conversion between Numeric Types</b>	<p><u>When converting from one data type to another, such as long to integer, data can be omitted or translated in a way that produces unexpected values. If the resulting values are used in a sensitive context, then dangerous behaviors may occur. For instance, if t</u></p> <p>The software declares a variable, field, member, etc. with a numeric type, and then updates it with a value from a second numeric type that is incompatible with the first numeric type.</p>
<b>CWE-194</b>	<b>Unexpected Sign Extension</b>	The software performs an operation on a number that causes it to be sign-extended when it is transformed into a larger data type. When the original number is negative, this can produce unexpected values that lead to resultant weaknesses.
<b>CWE-195</b>	<b>Signed to Unsigned Conversion Error</b>	The software uses a signed primitive and performs a cast to an unsigned primitive, which can produce an unexpected value if the value of the signed primitive cannot be represented using an unsigned primitive.
<b>CWE-196</b>	<b>Unsigned to Signed Conversion Error</b>	The software uses an unsigned primitive and performs a cast to a signed primitive, which can produce an unexpected value if the value of the unsigned primitive cannot be represented using a signed primitive.
<b>CWE-197</b>	<b>Numeric Truncation Error</b>	<p><u>Truncation errors occur when a primitive is cast to a primitive of a smaller size and data is lost in the conversion.</u> When a primitive is cast to a smaller primitive, the high order bits of the large value are lost in the conversion, potentially resulting in an unexpected value that is not equal to the original value. This value may be required as an index into a buffer, a loop iterator, or simply necessary state data. In any case, the value cannot be trusted and the system will be in an undefined state. While this method may be employed viably to isolate the low bits of a value, this usage is rare, and truncation usually implies that an implementation error has occurred.</p>
<b>CWE-682</b>	<b>Incorrect Calculation</b>	The software performs a calculation that generates incorrect or unintended results that are later used in security-critical decisions or resource management.
<b>CWE-131</b>	<b>Incorrect Calculation of Buffer Size</b>	The software does not correctly calculate the size to be used when allocating a buffer, which could lead to a buffer overflow.

CWE-369	Divide By Zero	The product divides a value by zero.
CWE-732	Incorrect Permission Assignment for Critical Resource	The software specifies permissions for a security-critical resource in a way that allows that resource to be read or modified by unintended actors.
CWE-775	Missing Release of File Descriptor or Handle after Effective Lifetime	<del>The software does not release a file descriptor or handle after its effective lifetime has ended, i.e., after the file descriptor/handle is no longer needed. When a file descriptor or handle is not released after use (typically by explicitly closing it), attackers can cause a denial of service by consuming all available file descriptors/handles, or otherwise preventing other system processes from obtaining their own file descriptors/handles.</del>
CWE-778	Insufficient Logging of security events	When a security-critical event occurs, <del>the software either does not record the event it is either not recorded or omits</del> important details about the event <del>are omitted</del> when logging it
CWE-783	Operator Precedence Logic Error	The program uses an expression in which operator precedence causes incorrect logic to be used. While often just a bug, operator precedence logic errors can have serious consequences if they are used in security-critical code, such as making an authentication decision.
CWE-789	Uncontrolled Memory Allocation	The product allocates memory based on an untrusted size value, but it does not validate or incorrectly validates the size, allowing arbitrary amounts of memory to be allocated.
CWE-798	Use of Hard-coded Credentials	The software contains hard-coded credentials, such as a password or cryptographic key, which it uses for its own inbound authentication, outbound communication to external components, or encryption of internal data.
CWE-259	Use of Hard-coded Password	The software contains a hard-coded password, which it uses for its own inbound authentication or for outbound communication to external components.
CWE-321	Use of Hard-coded Cryptographic Key	<del>The use of a hard-coded cryptographic key significantly increases the possibility that encrypted data may be recovered. The software uses a hard-coded cryptographic key.</del>

CWE-835	<b>Loop with Unreachable Exit Condition ('Infinite Loop')</b>	The program contains an iteration or loop with an exit condition that cannot be reached, i.e., an infinite loop.
CWE-917	<b>Improper Neutralization of Special Elements used in an Expression Language Statement ('Expression Language Injection')</b>	The software constructs all or part of an expression language (EL) statement in a Java Server Page (JSP) using externally-influenced input from an upstream component, but it does not neutralize or incorrectly neutralizes special elements that could modify the intended EL statement before it is executed.
CWE-1057	<b>Data Access Operations Outside of Expected Data Manager Component Circumventing data access routines</b>	<u>The software uses a dedicated, central data manager component as required by design, but it contains code that performs data-access operations that do not use this data manager. The software executes a data access outside of a dedicated data access component, thus circumventing the intended design to deny direct data access, thus allowing access only through dedicated data access components.</u> Notes: <ul style="list-style-type: none"> <li>• The dedicated data access component can be either client-side or server-side, which means that data access components can be developed using non-SQL language.</li> <li>• If there is no dedicated data access component, every data access is a <u>weakness violation</u>.</li> <li>• For some embedded software that requires access to data from anywhere, the whole software is defined as a data access component. This condition must be identified as input to the analysis.</li> </ul>

## 6.4 Introduction to the Specification of Quality Measure Elements

Clauses 7, 8, and 9 display in human readable format the content of the machine readable XMI format file attached to this specification. The content of the machine readable XMI format file represents the Quality Measure Elements with the following conventions

- structural elements included in a weakness pattern are represented in the Knowledge Discovery Metamodel (KDM)
- relations among the structural elements constituting a weakness pattern are represented in the Software Patterns Metamodel Standard (SPMS) to compute measures at the weakness level.
- Calculation of the 4 measures are represented in the Structured Metrics Metamodel (SMM).



## 6.5 Knowledge Discovery Metamodel (KDM)

This specification uses the Knowledge Discovery Metamodel (KDM) to represent the parsed entities whose relationships create a weakness pattern. The machine readable XML format file attached to the current specification uses KDM entities in the 'KDM outline' section of the pattern definitions to represent the code elements whose presence or absence indicates an occurrence of the weakness. Descriptions try to remain as generic, yet as accurate as possible, so that the pattern can be applied to as many situations as possible: different technologies, different programming languages, etc. This means:

1. The descriptions include information such as (MethodUnit), (Reads), (ManagesResource), ... to identify the KDM entities included in the pattern definition.
2. The descriptions only describe the salient aspects of the pattern since the specifics can be technology or language-dependent

Detection Patterns presented in Clause 8 use micro-KDM to provide greater granularity to their specification of weakness patterns. Additional semantic constraints are required to coordinate producers and consumers of KDM models to use the KDM Program Element layer for control- and data-flow analysis applications, as well as for providing more precision for the Resource Layer and the Abstraction Layer. Micro-KDM achieves this by constraining the granularity of the leaf action elements and their meaning by providing the set of micro-actions with predefined semantics. Micro-KDM treats the original macro-action as a container that owns certain micro-actions with predefined semantics. Thus, precise semantics of the macro-action is defined. Thus, micro-KDM constrains the patterns of how to map the statements of the existing system as determined by the programming language into KDM.

KDM is helpful for reading this chapter. However, for readers not familiar with KDM, Table 5 presents a primer which translates standard source code element terms into the KDM outline in this specification.

Table 5. Software elements translated into KDM wording

Software element	KDM outline
function, method, procedure, stored procedure, sub-routine etc.	CallableUnit MethodUnit id="cel" ...
variable, field, member, etc.	StorableUnit MemberUnit id="del" ...

class, interface definition and use as a type, use as base class	ClassUnit InterfaceUnit id="cul" ... StorableUnit id="sul" type="cul" ... ClassUnit id="cu2" ... Extends "cul" ...
method	ClassUnit id="cu2" ... MethodUnit "mul" ...
field, member	ClassUnit id="cu2" ... MemberUnit "mul" ...
SQL stored procedures	DataModel RelationalSchema ... CallableUnit id="cul" kind="stored" ...
return code value definition and use	CallableUnit MethodUnit id="cel" type="cel_signature" ... Signature "cel_signature" ParameterUnit id="pul" kind="return" ... Value StorableUnit MemberUnit id="del" ... ActionElement id="ael" kind="Call PtrCall MethodCall VirtualCall" ... Calls "cel" Reads "del"
exception	CallableUnit MethodUnit id="cel" type="cel_signature" ... Signature "cel_signature" ParameterUnit id="pul" kind="exception" ...

user input data flow	<pre> UIModel     UIField id="uf1"     UIAction id="ua1" implementation="ae1" kind="input"         ReadsUI "uf1"     ... CodeModel     ...     StorableUnit id="su1"     StorableUnit id="su2"     ActionElement id="ae1" kind="UI"         Writes "su1"         Flow "ae2"     ActionElement id="ae2"         Flow "ae3"         Reads "su1"         Writes "su2"     ActionElement id="ae3"         Flow "ae4"     ... </pre>
execution path	<pre> ActionElement id="ae1" kind="UI"     Flow Calls "ae2" ActionElement id="ae2"     Flow Calls "ae3" ActionElement id="ae3"     Flow Calls "ae4" </pre>
RDBMS	<pre> DataModel     RelationalSchema ... </pre>

for loop	<pre> ActionElement id="ae5" kind="Compound"   StorableUnit id="su3"   ActionElement id="ae6" kind="Assign"     Reads ...     Writes "su3"     Flows "ae7"   ActionElement id="ae7" kind="LessThan LessThanOrEqual GreaterThan GreaterThanOrEqual"   Reads "su3"   Reads "su2"   TrueFlow "ae8"   FalseFlow "ff1"   ActionElement id="ae8" kind=...   ...   ActionElement id="ae9" kind="Incr Decr"   Addresses "loopVariable"   Flows "ae6"   ActionElement id="ff1" kind="Nop" </pre>
while loop	<pre> ActionElement id="ae5" kind="Compound"    BooleanType id="booleanType"    DataElement id="del" type="booleanType"    EntryFlow "tf1"    ActionElement id="tf1" ...    ...    ActionElement id ="ae6" kind="GreaterThan GreaterThanOrEqual LessThan LessThanOrEqual"    Reads "su2"    ...    Writes "del"    ActionElement id="ae7" kind="Condition"    Reads "del"    TrueFlow "tf1"    FalseFlow "ff1"    ActionElement id="ff1" </pre>
checked	<pre> Value StorableUnit MemberUnit id="del" ... ActionElement id="ae1" kind="Equals NotEqualTo GreaterThan GreaterThanOrEqual LessThan LessThanOrEqual" ...   Reads "del" </pre>

## 6.6 Software Patterns Metamodel Standard (SPMS)

This specification uses the Software Patterns Metamodel Standard (SPMS) to represent weaknesses as software patterns involving code elements and their relationships in source code. In the machine readable XMI format file attached to the current specification each weakness pattern is represented in SPMS Definitions Classes as follows:

- **PatternDefinition (SPMS:PatternDefinition):** the pattern specification describing a specific weakness and a specific detection pattern. In the context of this document, each Quality Measure Element is the count of occurrences of the SPMS detection patterns detected in the source code for a specific weakness related to the Quality Characteristic being measured.
- **Role (SPMS:Role):** “A pattern is informally defined as a set of relationships between a set of entities. Roles describe the set of entities within a pattern, between which relationships will be described. As such the Role is a required association in a PatternDefinition...Semantically, a Role is a 'slot' that is required to be fulfilled for an instance of its parent PatternDefinition to exist. Roles for weaknesses are abstractions, while the roles for detection patterns can be linked back to the code elements.
- **PatternSection (SPMS:PatternSection):** “A PatternSection is a free-form prose textual description of a portion of a PatternDefinition.” In the context of this document, there are 7 different PatternSections in use:
  - “Descriptor” (“descriptor” in the XMI document) to provide pattern signature, a visible interface of the pattern,
  - “Description” (“description” in XMI document) to provide a human readable explanation of the measure,
  - “KDM Outline” (“kdm outline” in XMI document) to provide an illustration of the essential elements related to KDM, in a human readable outline,
  - “What to report” (“reporting” in XMI document) to provide the list of elements to report to claim the finding of an occurrence of a detection pattern
  - “Reference” (“reference” in XMI document) to provide pointers to the weakness description in the CWE repository
  - “Usage name” (“usage\_name” in XMI document) to provide a more user-friendly name to the weakness, generally the case when the weakness original name was too strongly KDM-flavored for the general audience

SPMS Relationships Classes:

- **MemberOf (SPMS:MemberOf):** “An InterpatternRelationship specialized to indicate inclusion in a Category”

- RelatedPattern (SPMS:RelatedPattern) with 4 different Natures (SPMS:Nature) (“DetectedBy”, “Detecting”, “AggregatedBy”, and “Aggregating”): InterpatternRelationships used to model the relations between weaknesses and detection patterns, and between parent and child weaknesses
- Category (SPMS:Category): “A Category is a simple grouping element for gathering related PatternDefinitions into clusters.” In the context of this document, the SPMS Categories are used to represent the 4 Quality Characteristics:
  - “Reliability”,
  - “Security”,
  - “Performance Efficiency”,
  - And “Maintainability”.

## 6.7 Reading guide

For each numbered sub-clause in clause 7:

- Sub-clause 7.x represents the Software Quality characteristic addressed by the associated weakness patterns .
- Sub-clause 7.x.y represents the SPMS and SMM modeling associated with a weakness pattern for a specific weakness associated with the Software Quality characteristic.
- The last sub-clause 7.x.y represents the SMM modeling associated with the quality characteristic computation.

Weakness pattern sub-clauses are summarizing the various aspects related to a weakness:

- (SPMS) usage name pattern section, if any
- (SPMS) reference pattern section
- (SPMS) roles
- (SPMS) contributing weaknesses and parent weakness, if any,
  - useful for reporting of weakness pattern-level information, aggregated or detailed
- (SPMS and SMM) detection patterns,
  - useful for reporting of detection pattern-level findings at the weakness level
  - useful for counting the violations to the weakness, by summing the count of violations to its detection patterns

Last sub-clauses are summarizing the computation of the quality measure scores:

- (SMM) detection patterns,
  - useful for reporting of detection pattern-level findings at the quality characteristic level
  - useful for computing the score of the quality measure, by summing the count of violations to its detection patterns
-

For each numbered sub-clause in clause 8:

- Sub-clause 8.x represents the SPMS modeling associated with a detection pattern

Detection pattern sub-clause are summarizing the various aspects related to a detection pattern:

- (SPMS) descriptor, description, KDM outline, reporting pattern sections,
  - In description and reporting pattern sections, data between angle brackets (e.g.: <ControlElement>) identify SPMS roles

## 7 List of ASCQM Weaknesses (Normative)

### 7.1 Weakness Category Maintainability

#### 7.1.1 CWE-407 Algorithmic Complexity

**Reference**

<https://cwe.mitre.org/data/definitions/407-Algorithmic-Complexity>

**Roles**

- the <ControlFlow>

**Contributing weaknesses**

[MINT-11 Callable and Method Control Element Excessive Cyclomatic Complexity Value](#)

**Detection Patterns**

ASCQM Ban Switch in Switch Statement

ASCQM Limit Algorithmic Complexity via Cyclomatic Complexity Value

ASCQM Limit Algorithmic Complexity via Essential Complexity Value

ASCQM Limit Algorithmic Complexity via Module Design Complexity Value

#### 7.1.2 CWE-478 Missing Default Case in Switch Statement

**Reference**

<https://cwe.mitre.org/data/definitions/478-Missing-Default-Case-in-Switch-Statement>

**Roles**

- the <SwitchStatement>

**Detection Patterns**

ASCQM Use Default Case in Switch Statement

#### 7.1.3 Weakness CWE-480 Use of Incorrect Operator

**Reference**

<https://cwe.mitre.org/data/definitions/480-Use-of-Incorrect-Operator>

**Roles**

- the <Operator>

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### **Detection Patterns**

ASCQM Ban Assignment Operation Inside Logic Blocks  
ASCQM Ban Comparison Expression Outside Logic Blocks  
ASCQM Ban Incorrect Object Comparison  
ASCQM Ban Incorrect String Comparison  
ASCQM Ban Logical Operation with a Constant Operand

#### **7.1.4 CWE-484 Omitted Break Statement in Switch**

##### **Reference**

<https://cwe.mitre.org/data/definitions/484> Omitted Break Statement in Switch

##### **Roles**

- the <SwitchStatement>

### **Detection Patterns**

ASCQM Use Break in Switch Statement

#### **7.1.5 CWE-561 Dead Code**

##### **Reference**

<https://cwe.mitre.org/data/definitions/561> Dead Code

##### **Roles**

- the <DeadCode>

### **Detection Patterns**

ASCQM Ban Exception Definition without Ever Throwing It  
ASCQM Ban Logical Dead Code  
ASCQM Ban Unreferenced Dead Code

#### **7.1.6 CWE-570 Expression is Always False**

##### **Reference**

<https://cwe.mitre.org/data/definitions/570> Expression is Always False

##### **Roles**

- the <BooleanExpression>

### **Detection Patterns**

ASCQM Check Boolean Variables are Updated in Different Conditional Branches before Use

#### **7.1.7 CWE-571 Expression is Always True**

### **Reference**

<https://cwe.mitre.org/data/definitions/571> ~~Expression is Always True~~

### **Roles**

- the <BooleanExpression>

### **Detection Patterns**

ASCQM Check Boolean Variables are Updated in Different Conditional Branches before Use

## **7.1.8 CWE-783 Operator Precedence Logic Error**

### **Reference**

<https://cwe.mitre.org/data/definitions/783> ~~Operator Precedence Logic Error~~

### **Roles**

- the <Formula>

### **Detection Patterns**

ASCQM Ban Incorrect Joint Comparison

ASCQM Ban Not Operator On Non-Boolean Operand Of Comparison Operation

ASCQM Ban Not Operator On Operand Of Bitwise Operation

## **7.1.9 CWE-1075 Unconditional Control Flow Transfer Control Element outside of Switch Block**

### **Usage name**

Control transferred outside switch statement

### **Reference**

[https://cwe.mitre.org/data/definitions/\\_1075](https://cwe.mitre.org/data/definitions/_1075) ~~Control Flow Transfer Control Element outside Switch Block~~

### **Roles**

- the <SwitchBlock>

- the <ControlFlowTransfer>

### **Detection Patterns**

ASCQM Limit Volume of Similar Code

## **7.1.10 ~~CWE-1121093 Callable and Method Control Element Excessive~~ McCabe Cyclomatic Complexity Value**

**Usage name**

Excessive Cyclomatic Complexity

**Reference**

<https://cwe.mitre.org/data/definitions/1121093> ~~Callable and Method Control Element Excessive Cyclomatic Complexity Value~~

**Roles**

- the <Operation>
- the <ControlFlow>

**Parent weaknesses**

~~MNT-11 Callable and Method Control Element Excessive Cyclomatic Complexity Value~~

**Detection Patterns**

ASCQM Limit Algorithmic Complexity via Cyclomatic Complexity Value

**7.1.11 CWE-1054 ~~Invocation of a Control Element at an Unnecessarily Deep Horizontal Layer~~ ~~Named Callable and Method Control Element with (Layer-skipping Call)~~****Usage name**

Layer-skipping calls

**Reference**

<https://cwe.mitre.org/data/definitions/1054> ~~https://cwe.mitre.org/data/definitions/1054 Named Callable and Method Control Element with Layer-skipping Call~~

**Roles**

- the <Layer1>
- the <Layer2>
- the <Call>

**Detection Patterns**

ASCQM Ban Unintended Paths

**7.1.12 CWE-1064 ~~Invokable Control Element with Signature Containing an Callable and Method Control Element~~ Excessive Number of Parameters****Usage name**

Excessive parameterization

**Reference**

<https://cwe.mitre.org/data/definitions/1064> ~~https://cwe.mitre.org/data/definitions/1064 Callable and Method Control Element Excessive Number of Parameters~~

**Roles**

- the <OperationSignature>

**Detection Patterns**

ASCQM Limit Number of Parameters

**7.1.13 CWE-1084 Invokable Control Element with Excessive File or Data Access Operations**  
~~Callable and Method Control Element Excessive Number of Control Elements involving Data Element from Data Manager or File Resource~~

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**Usage name**

Control element with excessive data operations

**Reference**

<https://cwe.mitre.org/data/definitions/1084> ~~https://cwe.mitre.org/data/definitions/1084 Callable and Method Control Element Excessive Number of Control Elements involving Data Element from Data Manager or File Resource~~

**Roles**

- the <Operation>  
- the <DataAccesses>

**Detection Patterns**

ASCQM Limit Number of Data Access

**7.1.14 CWE-1051 Initialization with Hard-Coded Network Resource Configuration Data**

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**Usage name**

Hard-coded network resource information

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**Reference**

<https://cwe.mitre.org/data/definitions/1051>

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**Roles**

- the <NetworkResourceAccess>
- the <HardCodedValue>

**Detection Patterns**

ASCQM Ban Hard-Coded Literals used to Connect to Resource

**7.1.14 — CWE-1081 Public Member Element**

**Usage name**

-Public data element

**Reference**

<https://cwe.mitre.org/data/definitions/1081> Public Member Element

**Roles**

- the <PublicDataDeclaration>

**Detection Patterns**

ASCQM Ban Public Data Elements

**7.1.15 CWE-1090 Method Containing Access of a Member Element from Another Class**  
~~Method Control Element Usage of Member Element from other Class Element~~

**Usage name**

Cross element data access

**Reference**

<https://cwe.mitre.org/data/definitions/1090>~~<https://cwe.mitre.org/data/definitions/1090> Method Control Element Usage of Member Element from other Class Element~~

**Roles**

- the <Class1>
- the <Class2>
- the <Reference>

**Detection Patterns**

ASCQM Ban Usage of Data Elements from Other Classes

**7.1.16 CWE-1074 Class ~~Element with Excessively Deep Inheritance Level~~**

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**Usage name**

Excessive inheritance levels

**Reference**

<https://cwe.mitre.org/data/definitions/1074> ~~https://cwe.mitre.org/data/definitions/1074 Class Element Excessive Inheritance Level~~

**Roles**

**Roles:**

- the <ClassInheritanceTree>

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**Detection Patterns**

ASCQM Ban Excessive Number of Inheritance Levels

**7.1.17 CWE-1086 Class ~~Element~~ with Excessive Number of Children ~~Classes~~**

**Usage name**

Excessive child classes

**Reference**

<https://cwe.mitre.org/data/definitions/1086> ~~https://cwe.mitre.org/data/definitions/1086 Class Element Excessive Number of Children~~

**Roles**

- the <Class>
- the <Children>

**Detection Patterns**

ASCQM Ban Excessive Number of Children

**7.1.18 CWE-1041 ~~Use of Redundant Code (Copy-Paste)~~ Named Callable and Method ~~Control Element Excessive Similarity~~**

**Usage name**

Element redundancy

**Reference**

<https://cwe.mitre.org/data/definitions/1041> ~~https://cwe.mitre.org/data/definitions/1041 Named Callable and Method Control Element Excessive Similarity~~

**Roles**

- the <Operation1>
- the <Operation2>
- the <SimilarCodeElements>

**Detection Patterns**

ASCQM Limit Volume of Similar Code

**7.1.19 CWE-1055 Class Element Excessive Multiple Inheritance of Class Elements with from Concrete Implementation Classes**

**Usage name**

Excessive inheritance from concrete classes

**Reference**

<https://cwe.mitre.org/data/definitions/1055><https://cwe.mitre.org/data/definitions/1055> **Class Element Excessive Inheritance of Class Elements with Concrete Implementation**

**Roles**

- the <ClassInheritanceDeclaration>
- the <ConcreteClasses>

**Detection Patterns**

ASCQM Ban Excessive Number of Concrete Implementations to Inherit From

**7.1.20 CWE-1045 Parent Class with a Virtual Destructor and a Child Class without a Virtual Destructor**

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**Usage name**

Child class missing virtual destructor

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**Reference**

<https://cwe.mitre.org/data/definitions/1045><https://cwe.mitre.org/data/definitions/>

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**Roles**

- the <ParentClass>
- the <ParentClassVirtualDestructor>
- the <ChildClass>

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**Detection Patterns**

ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor

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**7.1.20 CWE 1061 Unreachable Named Callable or Method Control Element**

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**Usage name**

-Unused code

**Reference**

<https://cwe.mitre.org/data/definitions/1061> Unreachable Named Callable or Method Control Element

**Roles**

—the <Operation>

**Detection Patterns**

ASCQM Ban Unreferenced Dead Code

**7.1.21 CWE-1052 Excessive Use of Storable and Member Data Element Initialization with Hard-Coded Literals in Initialization**

**Usage name**

Hard-coded literals

**Reference**

<https://cwe.mitre.org/data/definitions/1052> <https://cwe.mitre.org/data/definitions/1052> Storable and Member Data Element Initialization with Hard-Coded Literals

**Roles**

- the <Initialization>
- the <HardCodedValue>

**Detection Patterns**

ASCQM Ban Hard-Coded Literals used to Initialize Variables

**7.1.22 CWE-1048 Callable and Method/Invokable Control Element with Large Number of Outward Calls (Excessive Coupling or Fan-out)**

**Usage name**

Excessive references

**Reference**

<https://cwe.mitre.org/data/definitions/1048> <https://cwe.mitre.org/data/definitions/1048> Callable and Method Control Element Number of Outward Calls

**Roles**

- the <Operation>
- the <OutwardCalls>

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### **Detection Patterns**

ASCQM Limit Number of Outward Calls

#### **7.1.23 CWE-1095 Loop Condition Value Update within the Loop**

##### **Usage name**

Condition value update within loop

##### **Reference**

<https://cwe.mitre.org/data/definitions/1095>~~https://cwe.mitre.org/data/definitions/1095 Loop Value Update within the Loop~~

##### **Roles**

- the <LoopCondition>
- the <LoopValueUpdate>

### **Detection Patterns**

ASCQM Ban Loop Value Update within Incremental and Decremental Loop

#### **7.1.24 CWE-1085 Invokable Control Element with Excessive Volume of Commented-out Code ~~Element Excessive Volume~~**

##### **Usage name**

Excessive commented-out code

##### **Reference**

<https://cwe.mitre.org/data/definitions/1085>~~https://cwe.mitre.org/data/definitions/1085 Commented-out Code Element Excessive Volume~~

##### **Roles**

- the <CommentedOutCode>

### **Detection Patterns**

ASCQM Limit Volume of Commented-Out Code

#### **7.1.25 CWE-1047 Inter-Modules with Circular Dependency ~~icy-Cycles~~**

##### **Usage name**

Circular dependencies

##### **Reference**

<https://cwe.mitre.org/data/definitions/1047>~~https://cwe.mitre.org/data/definitions/1047 Inter-Module Dependency-Cycles~~

**Roles**

- the <ModuleDependencyCycles>

**Detection Patterns**

ASCQM Ban Circular Dependencies between Modules

**7.1.26 CWE-1080 Source Code File with Excessive Number of Lines of Code**  
**Source Element Excessive Size**

**Usage name**

Excessively large file

**Reference**

<https://cwe.mitre.org/data/definitions/1080>  
<https://cwe.mitre.org/data/definitions/1080> Source Element Excessive Size

**Roles**

- the <Operation>  
- the <SourceCode>

**Detection Patterns**

ASCQM Limit Size of Operations Code

**7.1.27 CWE-1062 Parent Class Element with References to Child Class**  
**Element**

**Usage name**

Parent class referencing child class

**Reference**

<https://cwe.mitre.org/data/definitions/1062>  
<https://cwe.mitre.org/data/definitions/1062> Parent Class Element with References to Child Class Element

**Roles**

- the <ParentClass>  
- the <ChildClass>  
- the <Reference>

**Detection Patterns**

ASCQM Ban Conversion References to Child Class

### 7.1.28 CWE-1087 Class ~~Element~~ with Virtual Method ~~Element~~ without a Virtual Destructor

#### **Usage name**

Class with virtual method missing destructor

#### **Reference**

<https://cwe.mitre.org/data/definitions/1087>~~https://cwe.mitre.org/data/definitions/1087 Class Element with Virtual Method Element without Virtual Destructor~~

#### **Roles**

- the <Class>
- the <VirtualMethod>

#### **Detection Patterns**

ASCQM Implement Virtual Destructor for Classes with Virtual Methods

### 7.1.29 CWE-1079 Parent Class ~~Element~~ without Virtual Destructor Method ~~Element~~

#### **Usage name**

Parent class missing virtual destructor

#### **Reference**

<https://cwe.mitre.org/data/definitions/1079>~~https://cwe.mitre.org/data/definitions/1079 Parent Class Element without Virtual Destructor Method Element~~

#### **Roles**

- the <ParentClass>

#### **Detection Patterns**

ASCQM Implement Virtual Destructor for Parent Classes

### ~~7.1.30 CWE 1045 Child Class Element without Virtual Destructor unlike its Parent Class Element~~

#### **Usage name**

~~Child class missing virtual destructor~~

#### **Reference**

~~<https://cwe.mitre.org/data/definitions/1045> Child Class Element without Virtual Destructor unlike its Parent Class Element~~

### **Roles**

- the <ParentClass>
- the <ParentClassVirtualDestructor>
- the <ChildClass>

### **Detection Patterns**

ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor

## **7.1.31 — CWE 1051 Storable and Member Data Element Initialization with Hard-Coded Network Resource Configuration Data**

### **Usage name**

Hard-coded network resource information

### **Reference**

<https://cwe.mitre.org/data/definitions/1051> Storable and Member Data Element Initialization with Hard-Coded Network Resource Configuration Data

### **Roles**

- the <NetworkResourceAccess>
- the <HardCodedValue>

### **Detection Patterns**

ASCQM Ban Hard-Coded Literals used to Connect to Resource

## **7.1.302 Maintainability detection patterns**

### **Detection Patterns**

- ASCQM Ban Assignment Operation Inside Logic Blocks
- ASCQM Ban Circular Dependencies between Modules
- ASCQM Ban Comparison Expression Outside Logic Blocks
- ASCQM Ban Control Flow Transfer
- ASCQM Ban Conversion References to Child Class
- ASCQM Ban Exception Definition without Ever Throwing It
- ASCQM Ban Excessive Number of Children
- ASCQM Ban Excessive Number of Concrete Implementations to Inherit From
- ASCQM Ban Excessive Number of Inheritance Levels
- ASCQM Ban Hard-Coded Literals used to Connect to Resource
- ASCQM Ban Hard-Coded Literals used to Initialize Variables
- ASCQM Ban Incorrect Joint Comparison
- ASCQM Ban Incorrect Object Comparison
- ASCQM Ban Incorrect String Comparison
- ASCQM Ban Logical Dead Code
- ASCQM Ban Logical Operation with a Constant Operand

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ASCQM Ban Loop Value Update within Incremental and Decremental Loop  
ASCQM Ban Not Operator On Non-Boolean Operand Of Comparison Operation  
ASCQM Ban Not Operator On Operand Of Bitwise Operation  
ASCQM Ban Public Data Elements  
ASCQM Ban Switch in Switch Statement  
ASCQM Ban Unintended Paths  
ASCQM Ban Unreferenced Dead Code  
ASCQM Ban Usage of Data Elements from Other Classes  
ASCQM Check Boolean Variables are Updated in Different Conditional Branches before Use  
ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor  
ASCQM Implement Virtual Destructor for Classes with Virtual Methods  
ASCQM Implement Virtual Destructor for Parent Classes  
ASCQM Limit Algorithmic Complexity via Cyclomatic Complexity Value  
ASCQM Limit Algorithmic Complexity via Essential Complexity Value  
ASCQM Limit Algorithmic Complexity via Module Design Complexity Value  
ASCQM Limit Number of Data Access  
ASCQM Limit Number of Outward Calls  
ASCQM Limit Number of Parameters  
ASCQM Limit Size of Operations Code  
ASCQM Limit Volume of Commented-Out Code  
ASCQM Limit Volume of Similar Code  
ASCQM Use Break in Switch Statement  
ASCQM Use Default Case in Switch Statement

## 7.2 Weakness Category Performance Efficiency

### 7.2.1 CWE-401 Improper Release of Memory Before Removing Last Reference ('Memory Leak')

#### **Reference**

<https://cwe.mitre.org/data/definitions/401> ~~Improper Release of Memory Before Removing Last Reference ('Memory Leak')~~

#### **Roles**

- the <MemoryAllocation>

#### **Parent weaknesses**

CWE-404 Improper Resource Shutdown or Release

#### **Detection Patterns**

ASCQM Ban Comma Operator from Delete Statement  
ASCQM Implement Required Operations for Manual Resource Management  
ASCQM Release Memory After Use  
ASCQM Release Memory after Use with Correct Operation  
ASCQM Release Platform Resource after Use  
ASCQM Release in Destructor Memory Allocated in Constructor

### 7.2.2 Weakness CWE-404 Improper Resource Shutdown or Release

#### **Reference**

<https://cwe.mitre.org/data/definitions/404> ~~Improper Resource Shutdown or Release~~

#### **Roles**

- the <ResourceAllocation>

#### **Contributing weaknesses**

CWE-401 Improper Release of Memory Before Removing Last Reference ('Memory Leak')  
CWE-772 Missing Release of Resource after Effective Lifetime  
CWE-775 Missing Release of File Descriptor or Handle after Effective Lifetime

#### **Detection Patterns**

ASCQM Ban Comma Operator from Delete Statement  
ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor  
ASCQM Implement Virtual Destructor for Classes with Virtual Methods  
ASCQM Implement Virtual Destructor for Parent Classes  
ASCQM Release File Resource after Use in Operation  
ASCQM Release Platform Resource after Use

ASCQM Release in Destructor Memory Allocated in Constructor

### 7.2.3 CWE-424 Improper Protection of Alternate Path

#### Reference

<https://cwe.mitre.org/data/definitions/424> ~~Improper Protection of Alternate Path~~

#### Roles

- the <AlternatePath>

#### Detection Patterns

ASCQM Ban Unintended Paths

### 7.2.4 CWE-772 Missing Release of Resource after Effective Lifetime

#### Reference

<https://cwe.mitre.org/data/definitions/772> ~~Missing Release of Resource after Effective Lifetime~~

#### Roles

- the <ResourceAllocation>

#### Parent weaknesses

CWE-404 Improper Resource Shutdown or Release

#### Detection Patterns

ASCQM Release File Resource after Use in Operation

ASCQM Release Platform Resource after Use

ASCQM Release in Destructor Memory Allocated in Constructor

### 7.2.5 CWE-775 Missing Release of File Descriptor or Handle after Effective Lifetime

#### Reference

<https://cwe.mitre.org/data/definitions/775> Missing Release of File Descriptor or Handle after Effective Lifetime

#### Roles

- the <FileDescriptorOrHandleAllocation>

#### Parent weaknesses

Weakness CWE-775 ~~Missing Release of File Descriptor or Handle after Effective Lifetime~~

#### Detection Patterns

ASCQM Release File Resource after Use in Class

ASCQM Release File Resource after Use in Operation

### 7.2.6 **CWE-1073 Non-SQL ~~Named-Callable and Method-Invokable~~ Control Element with Excessive Number of Data Resource Accesses**

#### **Usage name**

Excessive data queries in client-side code

#### **Reference**

<https://cwe.mitre.org/data/definitions/1073>~~<https://cwe.mitre.org/data/definitions/1073> Non-SQL Named-Callable and Method-Invokable Control Element with Excessive Number of Data Resource Access~~

#### **Roles**

- the <NonSQLOperation>
- the <DataAccesses>

#### **Detection Patterns**

ASCQM Ban Excessive Number of Data Resource Access from non-SQL Code

### 7.2.7 **CWE-1057 Data Access ~~Operations~~Control Element from Outside of DesignatExpected Data Manager Component**

#### **Usage name**

Circumventing data access routines

#### **Reference**

<https://cwe.mitre.org/data/definitions/1057>~~<https://cwe.mitre.org/data/definitions/1057> Data Access Control Element from Outside Designated Data Manager Component~~

#### **Roles**

- the <DataManager>
- the <DataAccess>

#### **Detection Patterns**

ASCQM Ban Unintended Paths

### 7.2.8 **CWE-1043 Storable and Member Data Element Excessive Number of Aggregated Storable and Member Data Elements**

#### **Usage name**

Excessively large data element



**Reference**

<https://cwe.mitre.org/data/definitions/1043><https://cwe.mitre.org/data/definitions/1043> Storable and Member Data Element Excessive Number of Aggregated Storable and Member Data Elements

**Roles**

- the <AggregationData>
- the <AggregatedData>

**Detection Patterns**

ASCQM Limit Number of Aggregated Non-Primitive Data Types

**7.2.9 CWE-1072 Data Resource Access without ~~not~~ using of Connection Pooling Capability**

**Usage name**

Data access not using connection pool

**Reference**

<https://cwe.mitre.org/data/definitions/1072><https://cwe.mitre.org/data/definitions/1072> Data Resource Access not using Connection Pooling Capability

**Roles**

- the <Connection>

**Detection Patterns**

ASCQM Ban Use of Prohibited Low-Level Resource Management Functionality

**7.2.10 CWE-1060 Excessive Number of Inefficient Server-Side Data Accesses**

**Usage name**

Excessive data queries in non-stored procedure

**Reference**

<https://cwe.mitre.org/data/definitions/1060><https://cwe.mitre.org/data/definitions/>

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**Roles**

- the <NonStoredSQLOperation>
- the <DataAccesses>

**Detection Patterns**

ASCQM Ban Excessive Number of Data Resource Access from non-stored SQL Procedure

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### **7.2.10 — ~~CWE-1071 Storable and Member Data Element Memory Allocation Missing De-allocation Control Element~~**

#### **Usage name**

Unreleased data

#### **Reference**

<https://cwe.mitre.org/data/definitions/1071> ~~Storable and Member Data Element Memory Allocation Missing De-allocation Control Element~~

#### **Roles**

—the <MemoryAllocation>

#### **Detection Patterns**

ASCQM Release Memory after Use with Correct Operation

### **7.2.11 ~~CWE-1091- Use of Object without Invoking Destructor Method~~ ~~Storable and Member Data Element Reference Missing De-referencing Control Element~~**

#### **Reference**

<https://cwe.mitre.org/data/definitions/1091> ~~https://cwe.mitre.org/data/definitions/1091 Storable and Member Data Element Reference Missing De-referencing Control Element~~

#### **Roles**

- the <Object>

#### **Detection Patterns**

ASCQM Release Memory after Use with Correct Operation

### **7.2.12 ~~CWE-1046 Creation of Immutable Text Using String Concatenation~~ ~~Immutable Storable and Member Data Element Creation~~**

#### **Usage name**

Immutable text data

#### **Reference**

<https://cwe.mitre.org/data/definitions/1046> ~~https://cwe.mitre.org/data/definitions/1046 Immutable Storable and Member Data Element Creation~~

#### **Roles**

- the <ImmutableDataCreation>

**Detection Patterns**

ASCQM Ban Incremental Creation of Immutable Data

**7.2.13 CWE-1042 Static Member Data Element outside of a Singleton Class Element**

**Usage name**

Static data outside of singleton class

**Reference**

<https://cwe.mitre.org/data/definitions/1042>  
~~https://cwe.mitre.org/data/definitions/1042-Static-Member-Data-Element-outside-of-a-Singleton-Class-Element~~

**Roles**

- the <StaticDataDeclaration>

**Detection Patterns**

ASCQM Ban Static Non-Final Data Element Outside Singleton

**7.2.14 CWE-1049 Excessive Data Query Operations in a Large Data Table**  
~~Data Resource Read and Write Access Excessive Complexity~~

**Usage name**

Complex read/write access

**Reference**

<https://cwe.mitre.org/data/definitions/1049>  
~~https://cwe.mitre.org/data/definitions/1049-Data-Resource-Read-and-Write-Access-Excessive-Complexity~~

**Roles**

- the <DataQuery>

**Detection Patterns**

ASCQM Ban Excessive Complexity of Data Resource Access

**7.2.15 CWE-1067 Excessive Execution of Sequential Searches of Data Resource**  
~~Data Resource Read Access Unsupported by Index Element~~

**Usage name Incorrect indices**

**Reference**

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<https://cwe.mitre.org/data/definitions/1067><https://cwe.mitre.org/data/definitions/1067> Data Resource  
Read Access Unsupported by Index Element

**Roles**

- the <DataQuery>
- the <TableOrView>

**Detection Patterns**

ASCQM Implement Index Required by Query on Large Tables

**7.2.16 CWE-1089 Large Data Resource ColumnSet Table with Excessive Number of Index Elements**

**Usage name**

Excessive number of indices on large tables

**Reference**

<https://cwe.mitre.org/data/definitions/1089><https://cwe.mitre.org/data/definitions/1089> Large Data  
Resource ColumnSet Excessive Number of Index Elements

**Roles**

- the <Table>
- the <Indexes>

**Detection Patterns**

ASCQM Ban Excessive Number of Index on Columns of Large Tables

**7.2.17 CWE-1094 Excessive Index Range Scan for a Data Resource Large Data Resource ColumnSet with Index Element of Excessive Size**

**Usage name**

Excessively large indices on large tables

**Reference**

<https://cwe.mitre.org/data/definitions/1094><https://cwe.mitre.org/data/definitions/1094> Large Data  
Resource ColumnSet with Index Element of Excessive Size

**Roles**

- the <Table>
- the <Indexes>

**Detection Patterns**

ASCQM Ban Excessive Size of Index on Columns of Large Tables

### 7.2.18 **CWE-1050 Excessive Platform Resource Consumption within a Loop** ~~Control Elements Requiring Significant Resource Element within Control Flow Loop Block~~

#### **Usage name**

Resource consuming operation in loop

#### **Reference**

<https://cwe.mitre.org/data/definitions/1050>  
~~<https://cwe.mitre.org/data/definitions/1050> Control Elements Requiring Significant Resource Element within Control Flow Loop Block~~

#### **Roles**

- the <Loop>
- the <ExpensiveOperation>

#### **Detection Patterns**

ASCQM Ban Expensive Operations in Loops

### 7.2.19 **CWE-1060 Excessive Number of Inefficient Server-Side Data Accesses** ~~Non-stored SQL-Callable Control Element with Excessive Number of Data Resource Access~~

#### **Usage name**

Excessive data queries in non-stored procedure

#### **Reference**

<https://cwe.mitre.org/data/definitions/1060>  
~~<https://cwe.mitre.org/data/definitions/1060> Non-stored SQL-Callable Control Element with Excessive Number of Data Resource Access~~

#### **Roles**

- the <NonStoredSQLOperation>
- the <DataAccesses>

#### **Detection Patterns**

ASCQM Ban Excessive Number of Data Resource Access from non-stored SQL Procedure

### 7.2.20 **Performance Efficiency detection patterns**

#### **Detection Patterns**

ASCQM Ban Comma Operator from Delete Statement

ASCQM Ban Excessive Complexity of Data Resource Access  
ASCQM Ban Excessive Number of Data Resource Access from non-SQL Code  
ASCQM Ban Excessive Number of Data Resource Access from non-stored SQL Procedure  
ASCQM Ban Excessive Number of Index on Columns of Large Tables  
ASCQM Ban Excessive Size of Index on Columns of Large Tables  
ASCQM Ban Expensive Operations in Loops  
ASCQM Ban Incremental Creation of Immutable Data  
ASCQM Ban Static Non-Final Data Element Outside Singleton  
ASCQM Ban Unintended Paths  
ASCQM Ban Use of Prohibited Low-Level Resource Management Functionality  
ASCQM Implement Index Required by Query on Large Tables  
ASCQM Implement Required Operations for Manual Resource Management  
ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor  
ASCQM Implement Virtual Destructor for Classes with Virtual Methods  
ASCQM Implement Virtual Destructor for Parent Classes  
ASCQM Limit Number of Aggregated Non-Primitive Data Types  
ASCQM Release File Resource after Use in Class  
ASCQM Release File Resource after Use in Operation  
ASCQM Release Memory After Use  
ASCQM Release Memory after Use with Correct Operation  
ASCQM Release Platform Resource after Use  
ASCQM Release in Destructor Memory Allocated in Constructor

## 7.3 Weakness Category Reliability

### 7.3.1 CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

#### Reference

<https://cwe.mitre.org/data/definitions/119> Improper Restriction of Operations within the Bounds of a Memory Buffer

#### Roles

- the <BufferOperation>

#### Contributing weaknesses

CWE-120 Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')  
CWE-123 Write-what-where Condition  
CWE-125 Out-of-bounds Read  
CWE-130 Improper Handling of Length Parameter Inconsistency  
CWE-786 Access of Memory Location Before Start of Buffer  
CWE-787 Out-of-bounds Write  
CWE-788 Access of Memory Location After End of Buffer  
CWE-805 Buffer Access with Incorrect Length Value  
CWE-822 Untrusted Pointer Dereference  
CWE-823 Use of Out-of-range Pointer Offset  
CWE-824 Access of Uninitialized Pointer  
CWE-825 Expired Pointer Dereference

#### Detection Patterns

ASCQM Ban Input Acquisition Primitives without Boundary Checking Capabilities  
ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities  
ASCQM Ban Use of Expired Pointer  
ASCQM Check Index of Array Access  
ASCQM Check Input of Memory Manipulation Primitives  
ASCQM Check Input of String Manipulation Primitives with Boundary Checking Capabilities  
ASCQM Check Offset used in Pointer Arithmetic  
ASCQM Initialize Pointers before Use  
ASCQM Sanitize User Input used as Pointer

### 7.3.2 CWE-120 Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')

#### Reference

<https://cwe.mitre.org/data/definitions/120> Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')

**Roles**

- the <BufferCopy>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Ban Input Acquisition Primitives without Boundary Checking Capabilities  
ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities

### 7.3.3 CWE-123 Write-what-where Condition

**Reference**

<https://cwe.mitre.org/data/definitions/123> ~~Write-what-where Condition~~

**Roles**

- the <BufferWrite>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities

### 7.3.4 CWE-125 Out-of-bounds Read

**Reference**

<https://cwe.mitre.org/data/definitions/125> ~~Out-of-bounds Read~~

**Roles**

- the <BufferRead>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Check Index of Array Access

### 7.3.5 CWE-130 Improper Handling of Length Parameter Inconsistency

**Reference**

<https://cwe.mitre.org/data/definitions/130> ~~Improper Handling of Length Parameter Inconsistency~~



**Roles**

- the <DataHandling>
- the <LengthParameter>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Check Index of Array Access

**7.3.6 CWE-131 Incorrect Calculation of Buffer Size****Reference**

<https://cwe.mitre.org/data/definitions/131> ~~Incorrect Calculation of Buffer Size~~

**Roles**

- the <BufferSizeCalculation>

**Parent weaknesses**

CWE-682 Incorrect Calculation

**Detection Patterns**

ASCQM Ban Buffer Size Computation Based on Array Element Pointer Size  
ASCQM Ban Buffer Size Computation Based on Bitwise Logical Operation  
ASCQM Ban Buffer Size Computation Based on Incorrect String Length Value

**7.3.7 CWE-170 Improper Null Termination****Reference**

<https://cwe.mitre.org/data/definitions/170> ~~Improper Null Termination~~

**Roles**

- the <BufferWithoutNULLTermination>

**Detection Patterns**

ASCQM NULL Terminate Output Of String Manipulation Primitives

**7.3.8 CWE-194 Unexpected Sign Extension****Reference**

<https://cwe.mitre.org/data/definitions/194> ~~Unexpected Sign Extension~~

**Roles**

- the <NumberSignExtension>

**Parent weaknesses**

CWE-681 Incorrect Conversion between Numeric Types

**Detection Patterns**

ASCQM Ban Incorrect Numeric Implicit Conversion

**7.3.9 CWE-195 Signed to Unsigned Conversion Error**

**Reference**

<https://cwe.mitre.org/data/definitions/195> ~~Signed to Unsigned Conversion Error~~

**Roles**

- the <NumberConversionToUnsigned>

**Parent weaknesses**

CWE-681 Incorrect Conversion between Numeric Types

**Detection Patterns**

ASCQM Ban Incorrect Numeric Implicit Conversion

**7.3.10 CWE-196 Unsigned to Signed Conversion Error**

**Reference**

<https://cwe.mitre.org/data/definitions/196> ~~Unsigned to Signed Conversion Error~~

**Roles**

- the <NumberConversionToSigned>

**Parent weaknesses**

CWE-681 Incorrect Conversion between Numeric Types

**Detection Patterns**

ASCQM Ban Incorrect Numeric Implicit Conversion

**7.3.11 CWE-197 Numeric Truncation Error**

**Reference**

<https://cwe.mitre.org/data/definitions/197> ~~Numeric Truncation Error~~

**Roles**

- the <NumberTruncation>

**Parent weaknesses**

CWE-681 Incorrect Conversion between Numeric Types

**Detection Patterns**

ASCQM Ban Incorrect Numeric Implicit Conversion

**7.3.12 CWE-248 Uncaught Exception****Reference**

<https://cwe.mitre.org/data/definitions/248> ~~Uncaught Exception~~

**Roles**

- the <ExceptionThrowDeclaration>  
- the <ExceptionCatchSequence>

**Parent weaknesses**

CWE-703 Improper Check or Handling of Exceptional Conditions

**Detection Patterns**

ASCQM Catch Exceptions

**7.3.13 CWE-252 Unchecked Return Value****Reference**

<https://cwe.mitre.org/data/definitions/252> ~~Unchecked Return Value~~

**Roles**

- the <OperationCall>

**Detection Patterns**

ASCQM Check Return Value of Resource Operations Immediately  
ASCQM Handle Return Value of Must Check Operations

**7.3.14 CWE-366 Race Condition within a Thread****Reference**

<https://cwe.mitre.org/data/definitions/366> ~~Race Condition within a Thread~~

**Roles**

- the <Thread1>
- the <Thread2>
- the <ConflictingResource>

**Parent weaknesses**

CWE-662 Improper Synchronization

**Detection Patterns**

ASCQM Ban Creation of Lock On Private Non-Static Object to Access Private Static Data  
ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context

**7.3.15 CWE-369 Divide By Zero**

**Reference**

<https://cwe.mitre.org/data/definitions/369-Divide-By-Zero>

**Roles**

- the <Division>

**Parent weaknesses**

CWE-682 Incorrect Calculation

**Detection Patterns**

ASCQM Check and Handle ZERO Value before Use as Divisor

**7.3.16 CWE-390 Detection of Error Condition Without Action**

**Reference**

<https://cwe.mitre.org/data/definitions/390-Detection-of-Error-Condition-Without-Action>

**Roles**

- the <ErrorCondition>

**Detection Patterns**

ASCQM Ban Empty Exception Block  
ASCQM Handle Return Value of Resource Operations

**7.3.17 CWE-391 Unchecked Error Condition**

**Reference**

<https://cwe.mitre.org/data/definitions/391-Unchecked-Error-Condition>

**Roles**

- the <ErrorConditionProcessing>

**Parent weaknesses**

CWE-703 Improper Check or Handling of Exceptional Conditions

**Detection Patterns**

ASCQM Ban Empty Exception Block

ASCQM Ban Useless Handling of Exceptions

**7.3.18 CWE-392 Missing Report of Error Condition**

**Reference**

<https://cwe.mitre.org/data/definitions/392> ~~Missing Report of Error Condition~~

**Roles**

- the <ErrorConditionProcessing>

**Parent weaknesses**

CWE-703 Improper Check or Handling of Exceptional Conditions

**Detection Patterns**

ASCQM Ban Useless Handling of Exceptions

**7.3.19 CWE-394 Unexpected Status Code or Return Value**

**Reference**

<https://cwe.mitre.org/data/definitions/394> ~~Unexpected Status Code or Return Value~~

**Roles**

- the <ReturnValue>

**Detection Patterns**

ASCQM Ban Incorrect Numeric Conversion of Return Value

ASCQM Handle Return Value of Must Check Operations

ASCQM Handle Return Value of Resource Operations

**7.3.20 CWE-401 Improper Release of Memory Before Removing Last Reference ('Memory Leak')**

**Reference**

<https://cwe.mitre.org/data/definitions/401> ~~Improper Release of Memory Before Removing Last Reference ('Memory Leak')~~

**Roles**

- the <MemoryAllocation>

**Parent weaknesses**

CWE-404 Improper Resource Shutdown or Release

**Detection Patterns**

ASCQM Ban Comma Operator from Delete Statement  
ASCQM Implement Required Operations for Manual Resource Management  
ASCQM Release Memory After Use  
ASCQM Release Memory after Use with Correct Operation  
ASCQM Release Platform Resource after Use  
ASCQM Release in Destructor Memory Allocated in Constructor

**7.3.21 CWE-404 Improper Resource Shutdown or Release****Reference**

<https://cwe.mitre.org/data/definitions/404> Improper Resource Shutdown or Release

**Roles**

- the <ResourceAllocation>

**Contributing weaknesses**

CWE-401 Improper Release of Memory Before Removing Last Reference ('Memory Leak')  
CWE-772 Missing Release of Resource after Effective Lifetime  
CWE-775 Missing Release of File Descriptor or Handle after Effective Lifetime

**Detection Patterns**

ASCQM Ban Comma Operator from Delete Statement  
ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor  
ASCQM Implement Virtual Destructor for Classes with Virtual Methods  
ASCQM Implement Virtual Destructor for Parent Classes  
ASCQM Release File Resource after Use in Operation  
ASCQM Release Platform Resource after Use  
ASCQM Release in Destructor Memory Allocated in Constructor

**7.3.22 CWE-415 Double Free****Reference**

<https://cwe.mitre.org/data/definitions/415> Double Free

**Roles**

- the <ResourceRelease >
- the <ResourceAccess>
- the <ResourceUse>

**Parent weaknesses**

CWE-672 Operation on a Resource after Expiration or Release

**Detection Patterns**

ASCQM Ban Double Free On Pointers

### 7.3.23 CWE-416 Use After Free

**Reference**

<https://cwe.mitre.org/data/definitions/416-Use-After-Free>

**Roles**

- the <ResourceRelease>
- the <ResourceUse>

**Parent weaknesses**

CWE-672 Operation on a Resource after Expiration or Release

**Detection Patterns**

ASCQM Ban Free Operation on Pointer Received as Parameter  
ASCQM Ban Use of Expired Pointer  
ASCQM Implement Copy Constructor for Class With Pointer Resource

### 7.3.24 CWE-424 Improper Protection of Alternate Path

**Reference**

<https://cwe.mitre.org/data/definitions/424-Improper-Protection-of-Alternate-Path>

**Roles**

- the <AlternatePath>

**Detection Patterns**

ASCQM Ban Unintended Paths

### 7.3.25 CWE-456 Missing Initialization of a Variable

**Reference**

<https://cwe.mitre.org/data/definitions/456-Missing-Initialization-of-a-Variable>

**Roles**

- the <VariableDeclaration>

**Parent weaknesses**

CWE-665 Improper Initialization

**Detection Patterns**

ASCQM Ban Allocation of Memory with Null Size

ASCQM Initialize Variables

### 7.3.26 CWE-459 Incomplete Cleanup

**Reference**

<https://cwe.mitre.org/data/definitions/459> ~~Incomplete Cleanup~~

**Roles**

- the <ResourceAllocation>

- the <ResourceRelease>

**Detection Patterns**

ASCQM Release Memory after Use with Correct Operation

### 7.3.27 CWE-476 NULL Pointer Dereference

**Reference**

<https://cwe.mitre.org/data/definitions/476> ~~NULL Pointer Dereference~~

**Roles**

- the <PointerDereferencing>

**Detection Patterns**

ASCQM Check NULL Pointer Value before Use

### 7.3.28 CWE-480 Use of Incorrect Operator

**Reference**

<https://cwe.mitre.org/data/definitions/480> ~~Use of Incorrect Operator~~

**Roles**

- the <Operator>

**Detection Patterns**

ASCQM Ban Assignment Operation Inside Logic Blocks



ASCQM Ban Comparison Expression Outside Logic Blocks  
ASCQM Ban Incorrect Object Comparison  
ASCQM Ban Incorrect String Comparison  
ASCQM Ban Logical Operation with a Constant Operand

### 7.3.29 CWE-484 Omitted Break Statement in Switch

#### **Reference**

<https://cwe.mitre.org/data/definitions/484> [Omitted Break Statement in Switch](#)

#### **Roles**

- the <SwitchStatement>

#### **Detection Patterns**

ASCQM Use Break in Switch Statement

### 7.3.30 CWE-543 Use of Singleton Pattern Without Synchronization in a Multithreaded Context

#### **Reference**

<https://cwe.mitre.org/data/definitions/543> [Use of Singleton Pattern Without Synchronization in a Multithreaded Context](#)

#### **Roles**

- the <SingletonUse>

#### **Parent weaknesses**

CWE-662 Improper Synchronization

#### **Detection Patterns**

ASCQM Ban Non-Final Static Data in Multi-Threaded Context  
ASCQM Singleton Creation without Proper Locking in Multi-Threaded Context

### 7.3.31 CWE-562 Return of Stack Variable Address

#### **Reference**

<https://cwe.mitre.org/data/definitions/562> [Return of Stack Variable Address](#)

#### **Roles**

- the <ReturnStatement>

#### **Detection Patterns**

ASCQM Ban Return of Local Variable Address

ASCQM Ban Storage of Local Variable Address in Global Variable

### 7.3.32 CWE-567 Unsynchronized Access to Shared Data in a Multithreaded Context

#### Reference

<https://cwe.mitre.org/data/definitions/567> ~~Unsynchronized Access to Shared Data in a Multithreaded Context~~

#### Roles

- the <SharedDataAccess>

#### Parent weaknesses

CWE-662 Improper Synchronization

#### Detection Patterns

ASCQM Ban Non-Final Static Data in Multi-Threaded Context

ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context

### 7.3.33 CWE-595 Comparison of Object References Instead of Object Contents

#### Reference

<https://cwe.mitre.org/data/definitions/595> ~~Comparison of Object References Instead of Object Contents~~

#### Roles

- the <ObjectReferencesComparison>

#### Contributing weaknesses

CWE-597 Use of Wrong Operator in String Comparison

~~CWE-1097RLB-4 Persistent Storable Data Element without Associated Proper Comparison Control Element~~ ~~Persistent Storable Data Element without Proper Comparison Control Element~~

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#### Detection Patterns

ASCQM Ban Incorrect Object Comparison

ASCQM Ban Incorrect String Comparison

ASCQM Implement Correct Object Comparison Operations

### 7.3.34 CWE-597 Use of Wrong Operator in String Comparison

#### Reference

<https://cwe.mitre.org/data/definitions/597> ~~Use of Wrong Operator in String Comparison~~

#### Roles

- the <StringComparison>

**Parent weaknesses**

CWE-595 Comparison of Object References Instead of Object Contents

**Detection Patterns**

ASCQM Ban Incorrect String Comparison

**7.3.35 CWE-662 Improper Synchronization**

**Reference**

<https://cwe.mitre.org/data/definitions/662> ~~Improper Synchronization~~

**Roles**

- the <Thread1>
- the <Thread2>
- the <SharedResourceAccess>

**Contributing weaknesses**

- CWE-366 Race Condition within a Thread
- CWE-543 Use of Singleton Pattern Without Synchronization in a Multithreaded Context
- CWE-567 Unsynchronized Access to Shared Data in a Multithreaded Context
- CWE-667 Improper Locking
- CWE-764 Multiple Locks of a Critical Resource
- CWE-820 Missing Synchronization
- CWE-821 Incorrect Synchronization
- CWE-833 Deadlock

~~CWE-1058 RLB-11 Named Callable and Method Invokable~~ Control Element in Multi-Thread Context with non-Final Static Storable or Member Element

~~CWE-1096 RLB-12 Singleton Class Instance Creation without Proper Locking or Synchronization~~ Leak Element Management

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**Detection Patterns**

- [ASCQM Ban Creation of Lock On Inappropriate Object Type](#)
- [ASCQM Ban Creation of Lock On Non-Final Object](#)
- [ASCQM Ban Creation of Lock On Private Non-Static Object to Access Private Static Data](#)
- [ASCQM Ban Incompatible Lock Acquisition Sequences](#)
- [ASCQM Ban Incorrect Synchronization Mechanisms](#)
- [ASCQM Ban Non-Final Static Data in Multi-Threaded Context](#)
- [ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context](#)
- [ASCQM Ban Sequential Acquisitions of Single Non-Reentrant Lock](#)
- [ASCQM Ban Sleep Between Lock Acquisition and Release](#)

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[ASCQM Ban Use of Thread Control Primitives with Known Deadlock Issues](#)  
[ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context](#)  
[ASCQM Release Lock After Use](#)  
[ASCQM Singleton Creation without Proper Locking in Multi-Threaded Context](#)

### 7.3.36 CWE-667 Improper Locking

#### **Reference**

Reference <https://cwe.mitre.org/data/definitions/667> ~~Improper Locking~~

#### **Roles**

Roles:

- the <Thread1>
- the <Thread2>
- the <SharedResourceAccess>
- the <Lock>

#### **Parent weaknesses**

CWE-662 Improper Synchronization

#### **Detection Patterns**

ASCQM Ban Incorrect Synchronization Mechanisms  
ASCQM Ban Non-Final Static Data in Multi-Threaded Context  
ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context  
ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context  
ASCQM Singleton Creation without Proper Locking in Multi-Threaded Context

### 7.3.37 CWE-672 Operation on a Resource after Expiration or Release

#### **Reference**

<https://cwe.mitre.org/data/definitions/672> ~~Operation on a Resource after Expiration or Release~~

#### **Roles**

- the <ResourceRelease>
- the <ResourceAccess>

#### **Contributing weaknesses**

CWE-415 Double Free  
CWE-416 Use After Free

#### **Detection Patterns**

ASCQM Ban Double Release of Resource

ASCQM Ban Use of Expired Resource

### 7.3.38 CWE-681 Incorrect Conversion between Numeric Types

#### Reference

<https://cwe.mitre.org/data/definitions/681>-Incorrect Conversion between Numeric Types

#### Roles

- the <NumericConversion>

#### Contributing weaknesses

CWE-194 Unexpected Sign Extension  
CWE-195 Signed to Unsigned Conversion Error  
CWE-196 Unsigned to Signed Conversion Error  
CWE-197 Numeric Truncation Error

#### Detection Patterns

ASCQM Ban Incorrect Numeric Implicit Conversion

### 7.3.39 CWE-682 Incorrect Calculation

#### Reference

<https://cwe.mitre.org/data/definitions/682>-Incorrect Calculation

#### Roles

- the <Calculation>

#### Contributing weaknesses

CWE-131 Incorrect Calculation of Buffer Size  
CWE-369 Divide By Zero

#### Detection Patterns

[ASCQM Ban Buffer Size Computation Based on Array Element Pointer Size](#)  
[ASCQM Ban Buffer Size Computation Based on Bitwise Logical Operation](#)  
[ASCQM Ban Buffer Size Computation Based on Incorrect String Length Value](#)  
[ASCQM Check and Handle ZERO Value before Use as Divisor](#)

### 7.3.40 CWE-703 Improper Check or Handling of Exceptional Conditions

#### Reference

<https://cwe.mitre.org/data/definitions/703>-Improper Check or Handling of Exceptional Conditions

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**Roles**

- the <ErrorHandling>

**Contributing weaknesses**

CWE-166 Improper Handling of Missing Special Element  
CWE-167 Improper Handling of Additional Special Element  
CWE-168 Improper Handling of Inconsistent Special Elements  
CWE-228 Improper Handling of Syntactically Invalid Structure  
CWE-248 Uncaught Exception  
CWE-280 Improper Handling of Insufficient Permissions or Privileges  
CWE-391 Unchecked Error Condition  
CWE-392 Missing Report of Error Condition  
CWE-393 Return of Wrong Status Code  
CWE-754 Improper Check for Unusual or Exceptional Conditions  
CWE-755 Improper Handling of Exceptional Conditions

**Detection Patterns**

ASCQM Ban Useless Handling of Exceptions

**7.3.41 CWE-704 Incorrect Type Conversion or Cast****Reference**

<https://cwe.mitre.org/data/definitions/704> ~~Incorrect Type Conversion or Cast~~

**Roles**

- the <TypeConversion>

**Contributing weaknesses**

CWE-843 Access of Resource Using Incompatible Type ('Type Confusion')

**Detection Patterns**

ASCQM Ban Incorrect Type Conversion

**7.3.42 CWE-758 Reliance on Undefined, Unspecified, or Implementation-Defined Behavior****Reference**

<https://cwe.mitre.org/data/definitions/758> ~~Reliance on Undefined, Unspecified, or Implementation-Defined Behavior~~

**Roles**

- the <Statement>

### **Detection Patterns**

ASCQM Ban Delete of VOID Pointer

ASCQM Ban Reading and Writing the Same Variable Used as Assignment Value

ASCQM Ban Variable Increment or Decrement Operation in Operations using the Same Variable

### **7.3.43 CWE-764 Multiple Locks of a Critical Resource**

#### **Reference**

<https://cwe.mitre.org/data/definitions/764> ~~Multiple Locks of a Critical Resource~~

#### **Roles**

- the <Lock1>

- the <Lock2>

- the <Resource>

#### **Parent weaknesses**

CWE-662 Improper Synchronization

### **Detection Patterns**

ASCQM Ban Sequential Acquisitions of Single Non-Reentrant Lock

### **7.3.44 CWE-772 Missing Release of Resource after Effective Lifetime**

#### **Reference**

<https://cwe.mitre.org/data/definitions/772> ~~Missing Release of Resource after Effective Lifetime~~

#### **Roles**

- the <ResourceAllocation>

#### **Parent weaknesses**

CWE-404 Improper Resource Shutdown or Release

### **Detection Patterns**

ASCQM Release File Resource after Use in Operation

ASCQM Release Platform Resource after Use

ASCQM Release in Destructor Memory Allocated in Constructor

### **7.3.45 CWE-775 Missing Release of File Descriptor or Handle after Effective Lifetime**

#### **Reference**

<https://cwe.mitre.org/data/definitions/775> ~~Missing Release of File Descriptor or Handle after Effective Lifetime~~

**Roles**

- the <FileDescriptorOrHandleAllocation>

**Parent weaknesses**

CWE-404 Improper Resource Shutdown or Release

**Detection Patterns**

ASCQM Release File Resource after Use in Class

ASCQM Release File Resource after Use in Operation

**7.3.46 CWE-786 Access of Memory Location Before Start of Buffer****Reference**

<https://cwe.mitre.org/data/definitions/786> ~~Access of Memory Location Before Start of Buffer~~

**Roles**

- the <MemoryAccess>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Check Index of Array Access

ASCQM Check Input of String Manipulation Primitives with Boundary Checking Capabilities

**7.3.47 CWE-787 Out-of-bounds Write****Reference**

<https://cwe.mitre.org/data/definitions/787> ~~Out-of bounds Write~~

**Roles**

- the <BufferWrite>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Check Index of Array Access

ASCQM Check Input of Memory Manipulation Primitives

**7.3.48 CWE-788 Access of Memory Location After End of Buffer****Reference**



<https://cwe.mitre.org/data/definitions/788> ~~Access of Memory Location After End of Buffer~~

**Roles**

- the <MemoryAccess>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities

ASCQM Check Index of Array Access

ASCQM Check Input of Memory Manipulation Primitives

### 7.3.49 CWE-805 Buffer Access with Incorrect Length Value

**Reference**

<https://cwe.mitre.org/data/definitions/805> ~~Buffer Access with Incorrect Length Value~~

**Roles**

- the <BufferAccess>

- the <LengthParameter>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities

ASCQM Check Input of Memory Manipulation Primitives

ASCQM Check Input of String Manipulation Primitives with Boundary Checking Capabilities

### 7.3.50 CWE-820 Missing Synchronization

**Reference**

<https://cwe.mitre.org/data/definitions/820> ~~Missing Synchronization~~

**Roles**

- the <SharedResourceUse>

**Parent weaknesses**

CWE-662 Improper Synchronization

**Detection Patterns**

ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context

### 7.3.51 CWE-821 Incorrect Synchronization

#### **Reference**

<https://cwe.mitre.org/data/definitions/821> ~~Incorrect Synchronization~~

#### **Roles**

- the <SharedResourceUse>
- the <IncorrectSynchronization>

#### **Parent weaknesses**

CWE-662 Improper Synchronization

#### **Detection Patterns**

ASCQM Ban Incorrect Synchronization Mechanisms

### 7.3.52 CWE-822 Untrusted Pointer Dereference

#### **Reference**

<https://cwe.mitre.org/data/definitions/822> ~~Untrusted Pointer Dereference~~

#### **Roles**

- the <PointerDereferencing>
- the <TaintedInput>

#### **Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

#### **Detection Patterns**

ASCQM Sanitize User Input used as Pointer

### 7.3.53 CWE-823 Use of Out-of-range Pointer Offset

#### **Reference**

<https://cwe.mitre.org/data/definitions/823> ~~Use of Out-of-range Pointer Offset~~

#### **Roles**

- the <PointerOffset>

#### **Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

#### **Detection Patterns**

ASCQM Check Offset used in Pointer Arithmetic

### 7.3.54 CWE-824 Access of Uninitialized Pointer

#### **Reference**

Reference <https://cwe.mitre.org/data/definitions/824>-Access of Uninitialized Pointer

#### **Roles**

Roles:

- the <PointerAccess>

#### **Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

#### **Detection Patterns**

ASCQM Initialize Pointers before Use

### 7.3.55 CWE-825 Expired Pointer Dereference

#### **Reference**

<https://cwe.mitre.org/data/definitions/825>-Expired Pointer Dereference

#### **Roles**

- the <PointerAccess>

- the <PointerRelease>

#### **Parent weaknesses**

CWE-672 Operation on a Resource after Expiration or Release

#### **Detection Patterns**

ASCQM Ban Use of Expired Pointer

### 7.3.56 CWE-833 Deadlock

#### **Reference**

<https://cwe.mitre.org/data/definitions/833>-Deadlock

#### **Roles**

- the <Thread1>

- the <Thread2>

- the <ConflictingLock>

#### **Parent weaknesses**

Weakness CWE-662 Improper Synchronization

**Detection Patterns**

ASCQM Ban Incompatible Lock Acquisition Sequences

ASCQM Ban Use of Thread Control Primitives with Known Deadlock Issues

**7.3.57 CWE-835 Loop with Unreachable Exit Condition ('Infinite Loop')**

**Reference**

[https://cwe.mitre.org/data/definitions/835-Loop-with-Unreachable-Exit-Condition\('Infinite-Loop'\)](https://cwe.mitre.org/data/definitions/835-Loop-with-Unreachable-Exit-Condition('Infinite-Loop'))

**Roles**

- the <InfiniteLoop>

**Detection Patterns**

ASCQM Ban Unmodified Loop Variable Within Loop

ASCQM Ban While TRUE Loop Without Path To Break

**7.3.58 CWE-908 Use of Uninitialized Resource**

**Reference**

<https://cwe.mitre.org/data/definitions/908-Use-of-Uninitialized-Resource>

**Roles**

- the <ResourceUse>

**Detection Patterns**

ASCQM Initialize Resource before Use

**7.3.59 CWE-1083 Data Access Control Element from Outside Designated Data Manager Component**

**Usage name**

Circumventing data access routines

**Reference**

<https://cwe.mitre.org/data/definitions/1083><https://cwe.mitre.org/data/definitions/1083-Data-Access-Control-Element-from-Outside-Designated-Data-Manager-Component>

**Roles**

- the <DataManager>

- the <DataAccess>

### **Detection Patterns**

ASCQM Ban Unintended Paths

## **7.3.60 CWE-1058 ~~Named Callable and Method~~Invokable Control Element in Multi-Thread Context with non-Final Static Storable or Member Element**

### **Usage name**

Non-final static data in a multi-threaded environment

### **Reference**

<https://cwe.mitre.org/data/definitions/1058>~~https://cwe.mitre.org/data/definitions/1058 Named Callable and Method Control Element in Multi-Thread Context with non-Final Static Storable or Member Element~~

### **Roles**

- the <Operation>
- the <NonFinalStaticData>

### **Parent weaknesses**

CWE-662 Improper Synchronization

### **Detection Patterns**

ASCQM Ban Non-Final Static Data in Multi-Threaded Context

## **7.3.61 CWE-1096 Singleton Class Instance Creation without Proper Locking or Synchronization-Element Management**

### **Usage name**

Improper locking of singleton classes

### **Reference**

<https://cwe.mitre.org/data/definitions/1096>~~https://cwe.mitre.org/data/definitions/1096 Singleton Class Instance Creation without Proper Lock Element Management~~

### **Roles**

- the <SingletonUse>

### **Parent weaknesses**

CWE-662 Improper Synchronization

### **Detection Patterns**

ASCQM Singleton Creation without Proper Locking in Multi-Threaded Context

### 7.3.62 CWE-1087 Class ~~Element~~ with Virtual Method ~~Element~~ without a Virtual Destructor

#### **Usage name**

Class with virtual method missing destructor

#### **Reference**

<https://cwe.mitre.org/data/definitions/1087>~~<https://cwe.mitre.org/data/definitions/1087> Class Element with Virtual Method Element without Virtual Destructor~~

#### **Roles**

- the <Class>
- the <VirtualMethod>

#### **Detection Patterns**

ASCQM Implement Virtual Destructor for Classes with Virtual Methods

### 7.3.63 CWE-1079 Parent Class ~~Element~~ without Virtual Destructor Method ~~Element~~

#### **Usage name**

Parent class missing virtual destructor

#### **Reference**

<https://cwe.mitre.org/data/definitions/1079>~~<https://cwe.mitre.org/data/definitions/1079> Parent Class Element without Virtual Destructor Method Element~~

#### **Roles**

- the <ParentClass>

#### **Detection Patterns**

ASCQM Implement Virtual Destructor for Parent Classes

### 7.3.64 CWE-1045 ~~Parent Class with a Child Class Element without Virtual Destructor and a Child Class without a Virtual Destructor~~ unlike its Parent Class ~~Element~~

#### **Usage name**

Child class missing virtual destructor

#### **Reference**

<https://cwe.mitre.org/data/definitions/1045>~~<https://cwe.mitre.org/data/definitions/1045> Child Class Element without Virtual Destructor unlike its Parent Class Element~~

**Roles**

- the <ParentClass>
- the <ParentClassVirtualDestructor>
- the <ChildClass>

**Detection Patterns**

ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor

**7.3.65 CWE-1051 ~~Storable and Member Data Element~~ Initialization with Hard-Coded Network Resource Configuration Data****Usage name**

Hard-coded network resource information

**Reference**

<https://cwe.mitre.org/data/definitions/1051>~~https://cwe.mitre.org/data/definitions/1051 Storable and Member Data Element Initialization with Hard-Coded Network Resource Configuration Data~~

**Roles**

- the <NetworkResourceAccess>
- the <HardCodedValue>

**Detection Patterns**

ASCQM Ban Hard-Coded Literals used to Connect to Resource

**7.3.66 CWE-1088 ~~Synchronous Access of Remote Resource without Timeout~~ Synchronous Call Time-Out Absence****Usage name**

Synchronous call with missing timeout

**Reference**

<https://cwe.mitre.org/data/definitions/1088>~~https://cwe.mitre.org/data/definitions/1088 Synchronous Call Time-Out Absence~~

**Roles**

- the <SynchronousCall>
- the <TimeOutOption>

**Detection Patterns**

ASCQM Manage Time-Out Mechanisms in Blocking Synchronous Calls

### 7.3.67 **CWE-1066** ~~Missing Serialization Control Element~~ **Serializable Storable Data Element without Serialization Control Element**

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#### **Reference**

<https://cwe.mitre.org/data/definitions/1066>~~https://cwe.mitre.org/data/definitions/1066~~ **Serializable Storable Data Element without Serialization Control Element**

#### **Roles**

- the <SerializableData>

#### **Detection Patterns**

ASCQM Ban Non-Serializable Elements in Serializable Objects

### 7.3.68 **CWE-1070** **Serializable Storable Data Element with non-Serializable Item Elements**

#### **Reference**

<https://cwe.mitre.org/data/definitions/1070>~~https://cwe.mitre.org/data/definitions/1070~~ **Serializable Storable Data Element with non-Serializable Item Elements**

#### **Roles**

- the <SerializableData>  
- the <NonSerialibleChildData>

#### **Detection Patterns**

ASCQM Ban Non-Serializable Elements in Serializable Objects

### 7.3.69 **CWE-1097** **Persistent Storable Data Element without ~~Proper-Associated~~ Comparison Control Element**

#### **Usage name**

Persistent data without proper comparison controls

#### **Reference**

<https://cwe.mitre.org/data/definitions/1097>~~https://cwe.mitre.org/data/definitions/1097~~ **Persistent Storable Data Element without Proper Comparison Control Element**

#### **Roles**

- the <PersistentData>

#### **Parent weaknesses**



CWE-595 Comparison of Object References Instead of Object Contents

**Detection Patterns**

ASCQM Implement Correct Object Comparison Operations

**7.3.70 CWE-1098 ~~Storable or Member Data Element~~ containing Pointer Item Element without Proper Copy Control Element**

**Usage name**

Improper copy capabilities for data pointers

**Reference**

<https://cwe.mitre.org/data/definitions/1098>~~https://cwe.mitre.org/data/definitions/1098 Storable or Member Data Element containing Pointer Item Element without Proper Copy Control Element~~

**Roles**

- the <ParentData>
- the <PointerChildData>

**Detection Patterns**

ASCQM Implement Copy Constructor for Class With Pointer Resource

**7.3.71 CWE-1082 Class Instance Self Destruction Control Element**

**Usage name**

Self-destruction

**Reference**

<https://cwe.mitre.org/data/definitions/1082>~~https://cwe.mitre.org/data/definitions/1082 Class Instance Self Destruction Control Element~~

**Roles**

- the <SelfDestruction>

**Detection Patterns**

ASCQM Ban Self Destruction

**7.3.72 CWE-1077 ~~Floating Point Comparison with Incorrect Operator~~Float Type Storable and Member Data Element Comparison with Equality Operator**

**Usage name**

Improper equality comparisons of float-type numerical data

### **Reference**

<https://cwe.mitre.org/data/definitions/1077>~~https://cwe.mitre.org/data/definitions/1077~~ Float Type Storable and Member Data Element Comparison with Equality Operator

### **Roles**

- the <FloatNumberEqualityComparison>

### **Detection Patterns**

ASCQM Ban Incorrect Float Number Comparison

## **7.3.73 CWE-665 Improper Initialization**

### **Reference**

<https://cwe.mitre.org/data/definitions/665>~~Improper Initialization~~

### **Roles**

- the <Initialization>

### **Contributing weaknesses**

CWE-456 Missing Initialization of a Variable

CWE-457 Use of Uninitialized Variable

### **Detection Patterns**

ASCQM Ban Self Assignment

ASCQM Initialize Pointers before Use

ASCQM Initialize Variables before Use

## **7.3.74 CWE-457 Use of Uninitialized Variable**

### **Reference**

<https://cwe.mitre.org/data/definitions/457>~~Use of Uninitialized Variable~~

### **Roles**

- the <VariableDeclaration>

- the <VariableUse>

### **Parent weaknesses**

CWE-665 Improper Initialization

### **Detection Patterns**

ASCQM Ban Allocation of Memory with Null Size

ASCQM Initialize Variables

### 7.3.75 Reliability detection patterns

#### **Detection Patterns**

ASCQM Ban Allocation of Memory with Null Size  
ASCQM Ban Assignment Operation Inside Logic Blocks  
ASCQM Ban Buffer Size Computation Based on Array Element Pointer Size  
ASCQM Ban Buffer Size Computation Based on Bitwise Logical Operation  
ASCQM Ban Buffer Size Computation Based on Incorrect String Length Value  
ASCQM Ban Comma Operator from Delete Statement  
ASCQM Ban Comparison Expression Outside Logic Blocks  
ASCQM Ban Creation of Lock On Inappropriate Object Type  
ASCQM Ban Creation of Lock On Non-Final Object  
ASCQM Ban Creation of Lock On Private Non-Static Object to Access Private Static Data  
ASCQM Ban Delete of VOID Pointer  
ASCQM Ban Double Free On Pointers  
ASCQM Ban Double Release of Resource  
ASCQM Ban Empty Exception Block  
ASCQM Ban Free Operation on Pointer Received as Parameter  
ASCQM Ban Hard-Coded Literals used to Connect to Resource  
ASCQM Ban Incompatible Lock Acquisition Sequences  
ASCQM Ban Incorrect Float Number Comparison  
ASCQM Ban Incorrect Numeric Conversion of Return Value  
ASCQM Ban Incorrect Numeric Implicit Conversion  
ASCQM Ban Incorrect Object Comparison  
ASCQM Ban Incorrect String Comparison  
ASCQM Ban Incorrect Synchronization Mechanisms  
ASCQM Ban Incorrect Type Conversion  
ASCQM Ban Input Acquisition Primitives without Boundary Checking Capabilities  
ASCQM Ban Logical Operation with a Constant Operand  
ASCQM Ban Non-Final Static Data in Multi-Threaded Context  
ASCQM Ban Non-Serializable Elements in Serializable Objects  
ASCQM Ban Reading and Writing the Same Variable Used as Assignment Value  
ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context  
ASCQM Ban Return of Local Variable Address  
ASCQM Ban Self Destruction  
ASCQM Ban Sequential Acquisitions of Single Non-Reentrant Lock  
ASCQM Ban Sleep Between Lock Acquisition and Release  
ASCQM Ban Storage of Local Variable Address in Global Variable  
ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities  
ASCQM Ban Unintended Paths  
ASCQM Ban Unmodified Loop Variable Within Loop  
ASCQM Ban Use of Expired Pointer  
ASCQM Ban Use of Expired Resource

ASCQM Ban Use of Thread Control Primitives with Known Deadlock Issues  
ASCQM Ban Useless Handling of Exceptions  
ASCQM Ban Variable Increment or Decrement Operation in Operations using the Same Variable  
ASCQM Ban While TRUE Loop Without Path To Break  
ASCQM Catch Exceptions  
ASCQM Check Index of Array Access  
ASCQM Check Input of Memory Manipulation Primitives  
ASCQM Check Input of String Manipulation Primitives with Boundary Checking Capabilities  
ASCQM Check NULL Pointer Value before Use  
ASCQM Check Offset used in Pointer Arithmetic  
ASCQM Check Return Value of Resource Operations Immediately  
ASCQM Check and Handle ZERO Value before Use as Divisor  
ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context  
ASCQM Handle Return Value of Must Check Operations  
ASCQM Handle Return Value of Resource Operations  
ASCQM Implement Copy Constructor for Class With Pointer Resource  
ASCQM Implement Correct Object Comparison Operations

## 7.4 Weakness Category Security

### 7.4.1 CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

#### Reference

<https://cwe.mitre.org/data/definitions/119> Improper Restriction of Operations within the Bounds of a Memory Buffer

#### Roles

- the <BufferOperation>

#### Contributing weaknesses

CWE-120 Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')  
CWE-123 Write-what-where Condition  
CWE-125 Out-of-bounds Read  
CWE-130 Improper Handling of Length Parameter Inconsistency  
CWE-786 Access of Memory Location Before Start of Buffer  
CWE-787 Out-of-bounds Write  
CWE-788 Access of Memory Location After End of Buffer  
CWE-805 Buffer Access with Incorrect Length Value  
CWE-822 Untrusted Pointer Dereference  
CWE-823 Use of Out-of-range Pointer Offset  
CWE-824 Access of Uninitialized Pointer  
CWE-825 Expired Pointer Dereference

#### Detection Patterns

ASCQM Ban Input Acquisition Primitives without Boundary Checking Capabilities  
ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities  
ASCQM Ban Use of Expired Pointer  
ASCQM Check Index of Array Access  
ASCQM Check Input of Memory Manipulation Primitives  
ASCQM Check Input of String Manipulation Primitives with Boundary Checking Capabilities  
ASCQM Check Offset used in Pointer Arithmetic  
ASCQM Initialize Pointers before Use  
ASCQM Sanitize User Input used as Pointer

### 7.4.2 CWE-120 Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')

#### Reference

<https://cwe.mitre.org/data/definitions/120> Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')

**Roles**

- the <BufferCopy>

**Parent weaknesses**

CWE-119 ~~Improper Restriction of Operations within the Bounds of a Memory Buffer~~

**Detection Patterns**

ASCQM Ban Input Acquisition Primitives without Boundary Checking Capabilities  
ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities

**7.4.3 CWE-123 Write-what-where Condition**

**Reference**

<https://cwe.mitre.org/data/definitions/123> ~~Write-what-where Condition~~

**Roles**

- the <BufferWrite>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities

**7.4.4 CWE-125 Out-of-bounds Read**

**Reference**

<https://cwe.mitre.org/data/definitions/125> ~~Out-of-bounds Read~~

**Roles**

- the <BufferRead>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Check Index of Array Access

**7.4.5 CWE-129 Improper Validation of Array Index**

**Reference**

<https://cwe.mitre.org/data/definitions/129> ~~Improper Validation of Array Index~~

**Roles**

- the <ArrayAccess>
- the <TaintedIndex>

**Detection Patterns**

ASCQM Sanitize User Input used as Array Index

**7.4.6 CWE-130 Improper Handling of Length Parameter Inconsistency****Reference**

<https://cwe.mitre.org/data/definitions/130> ~~Improper Handling of Length Parameter Inconsistency~~

**Roles**

- the <DataHandling>
- the <LengthParameter>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Check Index of Array Access

**7.4.7 CWE-131 Incorrect Calculation of Buffer Size****Reference**

Reference <https://cwe.mitre.org/data/definitions/131> ~~Incorrect Calculation of Buffer Size~~

**Roles**

- the <BufferSizeCalculation>

**Parent weaknesses**

CWE-682 Incorrect Calculation

**Detection Patterns**

ASCQM Ban Buffer Size Computation Based on Array Element Pointer Size  
ASCQM Ban Buffer Size Computation Based on Bitwise Logical Operation  
ASCQM Ban Buffer Size Computation Based on Incorrect String Length Value

**7.4.8 CWE-134 Use of Externally-Controlled Format String****Reference**

<https://cwe.mitre.org/data/definitions/134> ~~Use of Externally-Controlled Format String~~

**Roles**

- the <Formatting>
- the <TaintedFormatString>

**Detection Patterns**

ASCQM Sanitize User Input used as String Format

**7.4.9 CWE-194 Unexpected Sign Extension**

**Reference**

<https://cwe.mitre.org/data/definitions/194> ~~Unexpected Sign Extension~~

**Roles**

- the <NumberSignExtension>

**Parent weaknesses**

CWE-681 Incorrect Conversion between Numeric Types

**Detection Patterns**

ASCQM Ban Incorrect Numeric Implicit Conversion

**7.4.10 CWE-195 Signed to Unsigned Conversion Error**

**Reference**

<https://cwe.mitre.org/data/definitions/195> ~~Signed to Unsigned Conversion Error~~

**Roles**

- the <NumberConversionToUnsigned>

**Parent weaknesses**

CWE-681 Incorrect Conversion between Numeric Types

**Detection Patterns**

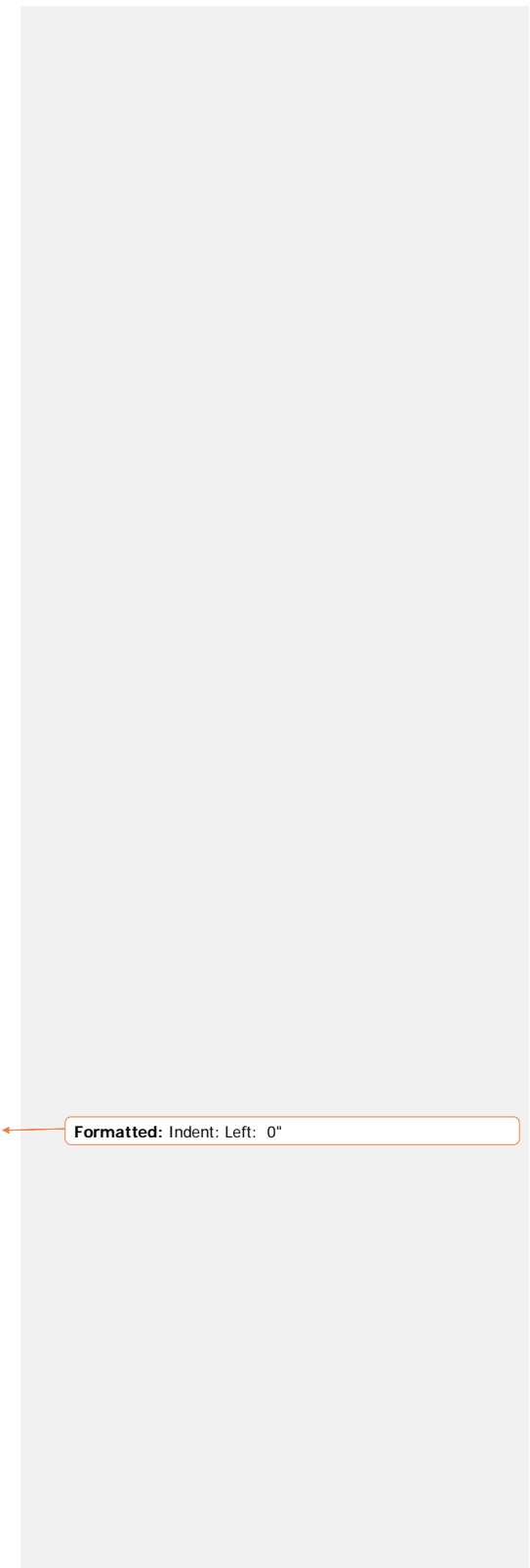
[ASCQM Ban Incorrect Numeric Implicit Conversion](#)

**7.4.11 CWE-196 Unsigned to Signed Conversion Error**

**Reference**

<https://cwe.mitre.org/data/definitions/196> ~~Unsigned to Signed Conversion Error~~

**Roles**



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- the <NumberConversionToSigned>

**Parent weaknesses**

CWE-681 Incorrect Conversion between Numeric Types

**Detection Patterns**

ASCQM Ban Incorrect Numeric Implicit Conversion

**7.4.12 CWE-197 Numeric Truncation Error**

**Reference**

<https://cwe.mitre.org/data/definitions/197-Numeric-Truncation-Error>

**Roles**

- the <NumberTruncation>

**Parent weaknesses**

CWE-681 Incorrect Conversion between Numeric Types

**Detection Patterns**

ASCQM Ban Incorrect Numeric Implicit Conversion

**7.4.13 CWE-22 Improper Limitation of a Pathname to a Restricted Directory ('Path Traversal')**

**Reference**

[https://cwe.mitre.org/data/definitions/22-Improper-Limitation-of-a-Pathname-to-a-Restricted-Directory-\(Path-Traversal!\)](https://cwe.mitre.org/data/definitions/22-Improper-Limitation-of-a-Pathname-to-a-Restricted-Directory-(Path-Traversal!))

**Roles**

- the <PathManipulationStatement>  
- the <TaintedInput>

**Contributing weaknesses**

CWE-23 Relative Path Traversal  
CWE-36 Absolute Path Traversal

**Detection Patterns**

ASCQM Sanitize User Input used in Path Manipulation

**7.4.14 CWE-23 Relative Path Traversal**

**Reference**

<https://cwe.mitre.org/data/definitions/23> ~~Relative Path Traversal~~

**Roles**

- the <PathManipulation>
- the <TaintedInput>

**Parent weaknesses**

CWE-22 Improper Limitation of a Pathname to a Restricted Directory ('Path Traversal')

**Detection Patterns**

ASCQM Sanitize User Input used in Path Manipulation

**7.4.15 CWE-252 Unchecked Return Value**

**Reference**

<https://cwe.mitre.org/data/definitions/252> ~~Unchecked Return Value~~

**Roles**

- the <OperationCall>

**Detection Patterns**

ASCQM Check Return Value of Resource Operations Immediately  
ASCQM Handle Return Value of Must Check Operations

**7.4.16 CWE-259 Use of Hard-coded Password**

**Reference**

<https://cwe.mitre.org/data/definitions/259> ~~Use of Hard-coded Password~~

**Roles**

- the <Authentication>
- the <HardCodedValue>

**Parent weaknesses**

CWE-798 Use of Hard-coded Credentials

**Detection Patterns**

ASCQM Ban Hard-Coded Literals used to Connect to Resource

**7.4.17 CWE-321 Use of Hard-coded Cryptographic Key**

**Reference**

<https://cwe.mitre.org/data/definitions/321> ~~Use of Hard-coded Cryptographic Key~~

**Roles**

- the <Authentication>
- the <HardCodedCryptographicKey>

**Parent weaknesses**

CWE-798 Use of Hard-coded Credentials

**Detection Patterns**

ASCQM Ban Hard-Coded Literals used to Connect to Resource

**7.4.18 CWE-36 Absolute Path Traversal****Reference**

<https://cwe.mitre.org/data/definitions/36> ~~Absolute Path Traversal~~

**Roles**

- the <PathManipulation>
- the <TaintedInput>

**Parent weaknesses**

CWE-22 Improper Limitation of a Pathname to a Restricted Directory ('Path Traversal')

**Detection Patterns**

ASCQM Sanitize User Input used in Path Manipulation

**7.4.19 CWE-366 Race Condition within a Thread****Reference**

<https://cwe.mitre.org/data/definitions/366> ~~Race Condition within a Thread~~

**Roles**

- the <Thread1>
- the <Thread2>
- the <ConflictingResource>

**Parent weaknesses**

CWE-662 Improper Synchronization

**Detection Patterns**

ASCQM Ban Creation of Lock On Private Non-Static Object to Access Private Static Data  
ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context

#### 7.4.20 CWE-369 Divide by Zero

##### **Reference**

<https://cwe.mitre.org/data/definitions/369> ~~Divide By Zero~~

##### **Roles**

- the <Division>

##### **Parent weaknesses**

CWE-682 Incorrect Calculation

##### **Detection Patterns**

ASCQM Check and Handle ZERO Value before Use as Divisor

#### 7.4.21 CWE-401 Improper Release of Memory Before Removing Last Reference ('Memory Leak')

##### **Reference**

<https://cwe.mitre.org/data/definitions/401> ~~Improper Release of Memory Before Removing Last Reference ('Memory Leak')~~

##### **Roles**

- the <MemoryAllocation>

##### **Parent weaknesses**

CWE-404 Improper Resource Shutdown or Release

##### **Detection Patterns**

ASCQM Ban Comma Operator from Delete Statement  
ASCQM Implement Required Operations for Manual Resource Management  
ASCQM Release Memory After Use  
ASCQM Release Memory after Use with Correct Operation  
ASCQM Release Platform Resource after Use  
ASCQM Release in Destructor Memory Allocated in Constructor

#### 7.4.22 CWE-404 Improper Resource Shutdown or Release

##### **Reference**

<https://cwe.mitre.org/data/definitions/404> ~~Improper Resource Shutdown or Release~~

##### **Roles**

- the <ResourceAllocation>

### **Contributing weaknesses**

~~Weakness~~ CWE-401 Improper Release of Memory Before Removing Last Reference ('Memory Leak')

~~Weakness~~ CWE-772 Missing Release of Resource after Effective Lifetime

~~Weakness~~ CWE-775 Missing Release of File Descriptor or Handle after Effective Lifetime

### **Detection Patterns**

ASCQM Ban Comma Operator from Delete Statement

ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor

ASCQM Implement Virtual Destructor for Classes with Virtual Methods

ASCQM Implement Virtual Destructor for Parent Classes

ASCQM Release File Resource after Use in Operation

ASCQM Release Platform Resource after Use

ASCQM Release in Destructor Memory Allocated in Constructor

## **7.4.23 CWE-424 Improper Protection of Alternate Path**

### **Reference**

<https://cwe.mitre.org/data/definitions/424> ~~Improper Protection of Alternate Path~~

### **Roles**

- the <AlternatePath>

### **Detection Patterns**

ASCQM Ban Unintended Paths

## **7.4.24 CWE-434 Unrestricted Upload of File with Dangerous Type**

### **Reference**

<https://cwe.mitre.org/data/definitions/434> ~~Unrestricted Upload of File with Dangerous Type~~

### **Roles**

- the <FileUpload>

### **Detection Patterns**

ASCQM Sanitize User Input used in Path Manipulation

## **7.4.25 CWE-456 Missing Initialization of a Variable**

### **Reference**

<https://cwe.mitre.org/data/definitions/456> ~~Missing Initialization of a Variable~~

### **Roles**

- the <VariableDeclaration>

**Parent weaknesses**

CWE-665 Improper Initialization

**Detection Patterns**

ASCQM Ban Allocation of Memory with Null Size

ASCQM Initialize Variables

**7.4.26 CWE-457 Use of Uninitialized Variable**

**Reference**

<https://cwe.mitre.org/data/definitions/457> [Use of Uninitialized Variable](#)

**Roles**

- the <VariableDeclaration>

- the <VariableUse>

**Parent weaknesses**

CWE-665 Improper Initialization

**Detection Patterns**

ASCQM Ban Allocation of Memory with Null Size

ASCQM Initialize Variables

**7.4.27 CWE-477 Use of Obsolete Function**

**Reference**

<https://cwe.mitre.org/data/definitions/477> [Use of Obsolete Function](#)

**Roles**

- the <ObsoleteFunctionCall>

**Detection Patterns**

ASCQM Ban Use of Deprecated Libraries

**7.4.28 CWE-480 Use of Incorrect Operator**

**Reference**

<https://cwe.mitre.org/data/definitions/480> [Use of Incorrect Operator](#)

**Roles**

- the <Operator>

### **Detection Patterns**

ASCQM Ban Assignment Operation Inside Logic Blocks  
ASCQM Ban Comparison Expression Outside Logic Blocks  
ASCQM Ban Incorrect Object Comparison  
ASCQM Ban Incorrect String Comparison  
ASCQM Ban Logical Operation with a Constant Operand

### **7.4.29 CWE-502 Deserialization of Untrusted Data**

#### **Reference**

<https://cwe.mitre.org/data/definitions/502-Deserialization-of-Untrusted-Data>

#### **Roles**

- the <Deserialization>
- the <TaintedData>

#### **Detection Patterns**

ASCQM Sanitize User Input used as Serialized Object

### **7.4.30 CWE-543 Use of Singleton Pattern Without Synchronization in a Multithreaded Context**

#### **Reference**

<https://cwe.mitre.org/data/definitions/543-Use-of-Singleton-Pattern-Without-Synchronization-in-a-Multithreaded-Context>

#### **Roles**

- the <SingletonUse>

#### **Parent weaknesses**

CWE-662 Improper Synchronization

#### **Detection Patterns**

ASCQM Ban Non-Final Static Data in Multi-Threaded Context  
ASCQM Singleton Creation without Proper Locking in Multi-Threaded Context

### **7.4.31 CWE-564 SQL Injection: Hibernate**

#### **Reference**

<https://cwe.mitre.org/data/definitions/564-SQL-Injection-Hibernate>

#### **Roles**

- the <HibernateSQLStatement>
- the <TaintedInput>

**Parent weaknesses**

CWE-89 Improper Neutralization of Special Elements used in an SQL Command ('SQL Injection')

**Detection Patterns**

ASCQM Sanitize User Input used in SQL Access

### 7.4.32 CWE-567 Unsynchronized Access to Shared Data in a Multithreaded Context

**Reference**

<https://cwe.mitre.org/data/definitions/567> ~~Unsynchronized Access to Shared Data in a Multithreaded Context~~

**Roles**

- the <SharedDataAccess>

**Parent weaknesses**

CWE-662 Improper Synchronization

**Detection Patterns**

ASCQM Ban Non-Final Static Data in Multi-Threaded Context  
ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context

### 7.4.33 CWE-570 Expression is Always False

**Reference**

<https://cwe.mitre.org/data/definitions/570> ~~Expression is Always False~~

**Roles**

- the <BooleanExpression>

**Detection Patterns**

ASCQM Check Boolean Variables are Updated in Different Conditional Branches before Use

### 7.4.34 CWE-571 Expression is Always True

**Reference**

<https://cwe.mitre.org/data/definitions/571> ~~Expression is Always True~~

**Roles**

- the <BooleanExpression>



**Detection Patterns**

ASCQM Check Boolean Variables are Updated in Different Conditional Branches before Use

**7.4.35 CWE-606 Unchecked Input for Loop Condition**

**Reference**

<https://cwe.mitre.org/data/definitions/606> [Unchecked Input for Loop Condition](#)

**Roles**

- the <LoopCondition>
- the <TaintedValue>

**Detection Patterns**

ASCQM Sanitize User Input used in Loop Condition

**7.4.36 CWE-643 Improper Neutralization of Data within XPath Expressions ('XPath Injection')**

**Reference**

<https://cwe.mitre.org/data/definitions/643> [Improper Neutralization of Data within XPath Expressions \('XPath Injection'\)](#)

**Roles**

- the <XPathExpression>
- the <TaintedValue>

**Detection Patterns**

ASCQM Sanitize User Input used in Document Navigation Expression

**7.4.37 CWE-652 Improper Neutralization of Data within XQuery Expressions ('XQuery Injection')**

**Reference**

<https://cwe.mitre.org/data/definitions/652> [Improper Neutralization of Data within XQuery Expressions \('XQuery Injection'\)](#)

**Roles**

- the <XQueryExpression>
- the <TaintedValue>

**Detection Patterns**

ASCQM Sanitize User Input used in Document Manipulation Expression

### 7.4.38 CWE-662 Improper Synchronization

#### Reference

<https://cwe.mitre.org/data/definitions/662> ~~Improper Synchronization~~

#### Roles

- the <Thread1>
- the <Thread2>
- the <SharedResourceAccess>

#### Contributing weaknesses

CWE-366 Race Condition within a Thread  
CWE-543 Use of Singleton Pattern Without Synchronization in a Multithreaded Context  
CWE-567 Unsynchronized Access to Shared Data in a Multithreaded Context  
CWE-667 Improper Locking  
CWE-764 Multiple Locks of a Critical Resource  
CWE-820 Missing Synchronization  
CWE-821 Incorrect Synchronization  
CWE-833 Deadlock  
[CWE-1058 Invokable Control Element in Multi-Thread Context with non-Final Static Storable or Member Element](#)  
[CWE-1096 Singleton Class Instance Creation without Proper Locking or Synchronization](#)  
[RLB-11 Named Callable and Method Control Element in Multi-Thread Context with non-Final Static Storable or Member Element](#)  
[RLB-12 Singleton Class Instance Creation without Proper Lock Element Management](#)

#### Detection Patterns

[ASCQM Ban Creation of Lock On Inappropriate Object Type](#)  
[ASCQM Ban Creation of Lock On Non-Final Object](#)  
[ASCQM Ban Creation of Lock On Private Non-Static Object to Access Private Static Data](#)  
[ASCQM Ban Incompatible Lock Acquisition Sequences](#)  
[ASCQM Ban Incorrect Synchronization Mechanisms](#)  
[ASCQM Ban Non-Final Static Data in Multi-Threaded Context](#)  
[ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context](#)  
[ASCQM Ban Sequential Acquisitions of Single Non-Reentrant Lock](#)  
[ASCQM Ban Sleep Between Lock Acquisition and Release](#)  
[ASCQM Ban Use of Thread Control Primitives with Known Deadlock Issues](#)  
[ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context](#)  
[ASCQM Release Lock After Use](#)  
[ASCQM Singleton Creation without Proper Locking in Multi-Threaded Context](#)  
[ASCQM Ban Incorrect Synchronization Mechanisms](#)  
[ASCQM Ban Non-Final Static Data in Multi-Threaded Context](#)

~~ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context~~  
~~ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context~~  
~~ASCQM Singleton Creation without Proper Locking in Multi-Threaded Context~~

#### 7.4.39 CWE-665 Improper Initialization

##### **Reference**

<https://cwe.mitre.org/data/definitions/665> ~~Improper Initialization~~

##### **Roles**

- the <Initialization>

##### **Contributing weaknesses**

CWE-456 Missing Initialization of a Variable  
CWE-457 Use of Uninitialized Variable

##### **Detection Patterns**

ASCQM Ban Self Assignment  
ASCQM Initialize Pointers before Use  
ASCQM Initialize Variables before Use

#### 7.4.40 CWE-667 Improper Locking

##### **Reference**

<https://cwe.mitre.org/data/definitions/667> ~~Improper Locking~~

##### **Roles**

- the <Thread1>  
- the <Thread2>  
- the <SharedResourceAccess>  
- the <Lock>

##### **Parent weaknesses**

CWE-662 Improper Synchronization

##### **Detection Patterns**

ASCQM Ban Creation of Lock On Inappropriate Object Type  
ASCQM Ban Creation of Lock On Non-Final Object  
ASCQM Ban Creation of Lock On Private Non-Static Object to Access Private Static Data  
ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context  
ASCQM Ban Sleep Between Lock Acquisition and Release  
ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context  
ASCQM Release Lock After Use

#### 7.4.41 CWE-672 Operation on a Resource after Expiration or Release

##### **Reference**

<https://cwe.mitre.org/data/definitions/672> ~~Operation on a Resource after Expiration or Release~~

##### **Roles**

- the <ResourceRelease>
- the <ResourceAccess>

##### **Contributing weaknesses**

CWE-415 Double Free  
CWE-416 Use After Free

##### **Detection Patterns**

ASCQM Ban Double Release of Resource  
ASCQM Ban Use of Expired Resource

#### 7.4.42 CWE-681 Incorrect Conversion between Numeric Types

##### **Reference**

<https://cwe.mitre.org/data/definitions/681> ~~Incorrect Conversion between Numeric Types~~

##### **Roles**

- the <NumericConversion>

##### **Contributing weaknesses**

CWE-194 Unexpected Sign Extension  
CWE-195 Signed to Unsigned Conversion Error  
CWE-196 Unsigned to Signed Conversion Error  
CWE-197 Numeric Truncation Error

##### **Detection Patterns**

ASCQM Ban Incorrect Numeric Implicit Conversion

#### 7.4.43 CWE-682 Incorrect Calculation

##### **Reference**

<https://cwe.mitre.org/data/definitions/682> ~~Incorrect Calculation~~

##### **Roles**

- the <Calculation>

**Contributing weaknesses**

CWE-131 Incorrect Calculation of Buffer Size  
CWE-369 Divide By Zero

**Detection Patterns**

- [ASCQM Ban Buffer Size Computation Based on Array Element Pointer Size](#)
- [ASCQM Ban Buffer Size Computation Based on Bitwise Logical Operation](#)
- [ASCQM Ban Buffer Size Computation Based on Incorrect String Length Value](#)
- [ASCQM Check and Handle ZERO Value before Use as Divisor](#)

**7.4.44 CWE-732 Incorrect Permission Assignment for Critical Resource**

**Reference**

<https://cwe.mitre.org/data/definitions/732> ~~Incorrect Permission Assignment for Critical Resource~~

**Roles**

- the <PermissionAssignment>

**Detection Patterns**

ASCQM Ban File Creation with Default Permissions

**7.4.45 CWE-77 Improper Neutralization of Special Elements used in a Command ('Command Injection')**

**Reference**

<https://cwe.mitre.org/data/definitions/77> ~~Improper Neutralization of Special Elements used in a Command ('Command Injection')~~

**Roles**

- the <Command>  
- the <TaintedValue>

**Contributing weaknesses**

CWE-78 Improper Neutralization of Special Elements used in an OS Command ('OS Command Injection')  
CWE-88 Argument Injection or Modification

**Detection Patterns**

- [ASCQM Sanitize User Input used in Expression Language Statement](#)
- [ASCQM Sanitize User Input used in System Command](#)

**7.4.46 CWE-772 Missing Release of Resource after Effective Lifetime**

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**Reference**

<https://cwe.mitre.org/data/definitions/772> ~~Missing Release of Resource after Effective Lifetime~~

**Roles**

- the <ResourceAllocation>

**Parent weaknesses**

CWE-404 Improper Resource Shutdown or Release

**Detection Patterns**

ASCQM Release File Resource after Use in Operation

ASCQM Release Platform Resource after Use

ASCQM Release in Destructor Memory Allocated in Constructor

**7.4.47 CWE-775 Missing Release of File Descriptor or Handle after Effective Lifetime****Reference**

<https://cwe.mitre.org/data/definitions/775> ~~Missing Release of File Descriptor or Handle after Effective Lifetime~~

**Roles**

- the <FileDescriptorOrHandleAllocation>

**Parent weaknesses**

CWE-775 Missing Release of File Descriptor or Handle after Effective Lifetime

**Detection Patterns**

ASCQM Release File Resource after Use in Class

ASCQM Release File Resource after Use in Operation

**7.4.48 CWE-778 Insufficient Logging****Reference**

<https://cwe.mitre.org/data/definitions/778> ~~Insufficient Logging~~

**Roles**

- the <SecurityExceptionOrError>

**Detection Patterns**

ASCQM Log Caught Security Exceptions

#### 7.4.49 CWE-78 Improper Neutralization of Special Elements used in an OS Command ('OS Command Injection')

##### **Reference**

<https://cwe.mitre.org/data/definitions/78> Improper Neutralization of Special Elements used in an OS Command ('OS Command Injection')

##### **Roles**

- the <OSCommand>
- the <TaintedValue>

##### **Parent weaknesses**

CWE-77 Improper Neutralization of Special Elements used in a Command ('Command Injection')

##### **Detection Patterns**

ASCQM Sanitize User Input used in System Command

#### 7.4.50 CWE-783 Operator Precedence Logic Error

##### **Reference**

<https://cwe.mitre.org/data/definitions/783> Operator Precedence Logic Error

##### **Roles**

- the <Formula>

##### **Detection Patterns**

ASCQM Ban Incorrect Joint Comparison

ASCQM Ban Not Operator On Non-Boolean Operand Of Comparison Operation

ASCQM Ban Not Operator On Operand Of Bitwise Operation

#### 7.4.51 CWE-786 Access of Memory Location Before Start of Buffer

##### **Reference**

<https://cwe.mitre.org/data/definitions/786> Access of Memory Location Before Start of Buffer

##### **Roles**

- the <MemoryAccess>

##### **Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

##### **Detection Patterns**

ASCQM Check Index of Array Access

ASCQM Check Input of String Manipulation Primitives with Boundary Checking Capabilities

#### 7.4.52 CWE-787 Out-of-bounds Write

##### **Reference**

<https://cwe.mitre.org/data/definitions/787-Out-of-bounds-Write>

##### **Roles**

- the <BufferWrite>

##### **Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

##### **Detection Patterns**

ASCQM Check Index of Array Access

ASCQM Check Input of Memory Manipulation Primitives

#### 7.4.53 CWE-788 Access of Memory Location After End of Buffer

##### **Reference**

<https://cwe.mitre.org/data/definitions/788-Access-of-Memory-Location-After-End-of-Buffer>

##### **Roles**

- the <MemoryAccess>

##### **Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

##### **Detection Patterns**

ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities

ASCQM Check Index of Array Access

ASCQM Check Input of Memory Manipulation Primitives

#### 7.4.54 CWE-789 Uncontrolled Memory Allocation

##### **Reference**

<https://cwe.mitre.org/data/definitions/789-Uncontrolled-Memory-Allocation>

##### **Roles**

- the <MemoryAllocation>

##### **Detection Patterns**

ASCQM Check Input of Memory Allocation Primitives



ASCQM Sanitize User Input used as Array Index

#### 7.4.55 CWE-79 Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')

##### **Reference**

<https://cwe.mitre.org/data/definitions/79> Improper Neutralization of Input During Web Page Generation ('Cross-site Scripting')

##### **Roles**

- the <WebPageGenerationStatement>
- the <TaintedInput>

##### **Detection Patterns**

- ASCQM Sanitize Stored Input used in User Output
- ASCQM Sanitize User Input used in User Output

#### 7.4.56 CWE-798 Use of Hard-coded Credentials

##### **Reference**

<https://cwe.mitre.org/data/definitions/798> Use of Hard-coded Credentials

##### **Roles**

- the <HardCodedValue>
- the <Authentication>

##### **Contributing weaknesses**

- CWE-259 Use of Hard-coded Password
- CWE-321 Use of Hard-coded Cryptographic Key

##### **Detection Patterns**

- ASCQM Ban Hard-Coded Literals used to Connect to Resource

#### 7.4.57 CWE-805 Buffer Access with Incorrect Length Value

##### **Reference**

<https://cwe.mitre.org/data/definitions/805> Buffer Access with Incorrect Length Value

##### **Roles**

- the <BufferAccess>
- the <LengthParameter>

##### **Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities

ASCQM Check Input of Memory Manipulation Primitives

ASCQM Check Input of String Manipulation Primitives with Boundary Checking Capabilities

**7.4.58 CWE-820 Missing Synchronization**

**Reference**

<https://cwe.mitre.org/data/definitions/820> ~~Missing Synchronization~~

**Roles**

- the <SharedResourceUse>

**Parent weaknesses**

CWE-662 Improper Synchronization

**Detection Patterns**

ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context

**7.4.59 CWE-821 Incorrect Synchronization**

**Reference**

<https://cwe.mitre.org/data/definitions/821> Incorrect Synchronization

**Roles**

- the <SharedResourceUse>

- the <IncorrectSynchronization>

**Parent weaknesses**

CWE-662 Improper Synchronization

**Detection Patterns**

ASCQM Ban Incorrect Synchronization Mechanisms

**7.4.60 CWE-822 Untrusted Pointer Dereference**

**Reference**

<https://cwe.mitre.org/data/definitions/822> ~~Untrusted Pointer Dereference~~

**Roles**

- the <PointerDereferencing>
- the <TaintedInput>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Sanitize User Input used as Pointer

#### 7.4.61 CWE-823 Use of Out-of-range Pointer Offset

**Reference**

<https://cwe.mitre.org/data/definitions/823> [Use of Out-of-range Pointer Offset](#)

**Roles**

- the <PointerOffset>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Check Offset used in Pointer Arithmetic

#### 7.4.62 CWE-824 Access of Uninitialized Pointer

**Reference**

<https://cwe.mitre.org/data/definitions/824> [Access of Uninitialized Pointer](#)

**Roles**

- the <PointerAccess>

**Parent weaknesses**

CWE-119 Improper Restriction of Operations within the Bounds of a Memory Buffer

**Detection Patterns**

ASCQM Initialize Pointers before Use

#### 7.4.63 CWE-825 Expired Pointer Dereference

**Reference**

<https://cwe.mitre.org/data/definitions/825> [Expired Pointer Dereference](#)

**Roles**

- the <PointerAccess>
- the <PointerRelease>

**Parent weaknesses**

CWE-672 Operation on a Resource after Expiration or Release

**Detection Patterns**

ASCQM Ban Use of Expired Pointer

### 7.4.64 CWE-835 Loop with Unreachable Exit Condition ('Infinite Loop')

**Reference**

[https://cwe.mitre.org/data/definitions/835-Loop-with-Unreachable-Exit-Condition-\(Infinite-Loop\)](https://cwe.mitre.org/data/definitions/835-Loop-with-Unreachable-Exit-Condition-(Infinite-Loop))

**Roles**

- the <InfiniteLoop>

**Detection Patterns**

ASCQM Ban Unmodified Loop Variable Within Loop  
ASCQM Ban While TRUE Loop Without Path To Break

### 7.4.65 CWE-88 Argument Injection or Modification

**Reference**

<https://cwe.mitre.org/data/definitions/88-Argument-Injection-or-Modification>

**Roles**

- the <Command>
- the <TaintedInput>

**Parent weaknesses**

CWE-77 Improper Neutralization of Special Elements used in a Command ('Command Injection')

**Detection Patterns**

ASCQM Sanitize User Input used in System Command

### 7.4.66 CWE-89 Improper Neutralization of Special Elements used in an SQL Command ('SQL Injection')

**Reference**

[https://cwe.mitre.org/data/definitions/89-Improper-Neutralization-of-Special-Elements-used-in-an-SQL-Command-\(SQL-Injection\)](https://cwe.mitre.org/data/definitions/89-Improper-Neutralization-of-Special-Elements-used-in-an-SQL-Command-(SQL-Injection))

**Roles**

- the <SQLStatement>
- the <TaintedInput>

**Contributing weaknesses**

Weakness CWE-564 SQL Injection: Hibernate

**Detection Patterns**

ASCQM Sanitize User Input used in Document Manipulation Expression  
ASCQM Sanitize User Input used in Document Navigation Expression

### 7.4.67 CWE-90 Improper Neutralization of Special Elements used in an LDAP Query ('LDAP Injection')

**Reference**

<https://cwe.mitre.org/data/definitions/90> Improper Neutralization of Special Elements used in an LDAP Query ('LDAP Injection')

**Roles**

- the <LDAPQuery>
- the <TaintedInput>

**Detection Patterns**

ASCQM Sanitize User Input used to access Directory Resources

### 7.4.68 CWE-91 XML Injection (aka Blind XPath Injection)

**Reference**

<https://cwe.mitre.org/data/definitions/91> XML Injection (aka Blind XPath Injection)

**Roles**

- the <XMLHandlingExpression>
- the <TaintedValue>

**Detection Patterns**

ASCQM Sanitize User Input used in Document Manipulation Expression  
ASCQM Sanitize User Input used in Document Navigation Expression

### 7.4.69 CWE-99 Improper Control of Resource Identifiers ('Resource Injection')

**Reference**

<https://cwe.mitre.org/data/definitions/99> Improper Control of Resource Identifiers ('Resource Injection')

**Roles**

- the <ResourceIdentifier>
- the <TaintedValue>

**Detection Patterns**

ASCQM Sanitize User Input used in Path Manipulation

**7.4.70 CWE-611 Improper Restriction of XML External Entity Reference ('XXE')****Reference**

<https://cwe.mitre.org/data/definitions/CWE-611> ~~Improper Restriction of XML External Entity Reference ('XXE')~~

**Roles**

- the <XMLHandlingOperation>

**Detection Patterns**

ASCQM Secure Use of Unsafe XML Processing with Secure Parser  
ASCQM Secure XML Parsing with Secure Options

**7.4.71 CWE-1057 Data Access ~~Operations~~Control Element from Outside of Designated Data Manager Component****Usage name**

Circumventing data access routines

**Reference**

<https://cwe.mitre.org/data/definitions/1057> ~~https://cwe.mitre.org/data/definitions/1057 Data Access Control Element from Outside Designated Data Manager Component~~

**Roles**

- the <DataManager>
- the <DataAccess>

**Detection Patterns**

ASCQM Ban Unintended Paths

**7.4.72 CWE-415 Double Free****Reference**

<https://cwe.mitre.org/data/definitions/415> ~~Double Free~~

**Roles**

- the <ResourceRelease >
- the <ResourceAccess>
- the <ResourceUse>

**Parent weaknesses**

CWE-672 Operation on a Resource after Expiration or Release

**Detection Patterns**

ASCQM Ban Double Free On Pointers

**7.4.73 CWE-416 Use After Free****Reference**

<https://cwe.mitre.org/data/definitions/416-Use-After-Free>

**Roles**

- the <ResourceRelease>
- the <ResourceUse>

**Parent weaknesses**

CWE-672 Operation on a Resource after Expiration or Release

**Detection Patterns**

ASCQM Ban Free Operation on Pointer Received as Parameter  
ASCQM Ban Use of Expired Pointer  
ASCQM Implement Copy Constructor for Class With Pointer Resource

**7.4.74 Security detection patterns****Detection Patterns**

ASCQM Ban Allocation of Memory with Null Size  
ASCQM Ban Assignment Operation Inside Logic Blocks  
ASCQM Ban Buffer Size Computation Based on Array Element Pointer Size  
ASCQM Ban Buffer Size Computation Based on Bitwise Logical Operation  
ASCQM Ban Buffer Size Computation Based on Incorrect String Length Value  
ASCQM Ban Comma Operator from Delete Statement  
ASCQM Ban Comparison Expression Outside Logic Blocks  
ASCQM Ban Creation of Lock On Inappropriate Object Type  
ASCQM Ban Creation of Lock On Non-Final Object  
ASCQM Ban Creation of Lock On Private Non-Static Object to Access Private Static Data  
ASCQM Ban Double Free On Pointers  
ASCQM Ban Double Release of Resource

ASCQM Ban File Creation with Default Permissions  
ASCQM Ban Free Operation on Pointer Received as Parameter  
ASCQM Ban Hard-Coded Literals used to Connect to Resource  
ASCQM Ban Incompatible Lock Acquisition Sequences  
ASCQM Ban Incorrect Joint Comparison  
ASCQM Ban Incorrect Numeric Implicit Conversion  
ASCQM Ban Incorrect Object Comparison  
ASCQM Ban Incorrect String Comparison  
ASCQM Ban Incorrect Synchronization Mechanisms  
ASCQM Ban Input Acquisition Primitives without Boundary Checking Capabilities  
ASCQM Ban Logical Operation with a Constant Operand  
ASCQM Ban Non-Final Static Data in Multi-Threaded Context  
ASCQM Ban Not Operator On Non-Boolean Operand Of Comparison Operation  
ASCQM Ban Not Operator On Operand Of Bitwise Operation  
ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context  
ASCQM Ban Self Assignment  
ASCQM Ban Sequential Acquisitions of Single Non-Reentrant Lock  
ASCQM Ban Sleep Between Lock Acquisition and Release  
ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities  
ASCQM Ban Unintended Paths  
ASCQM Ban Unmodified Loop Variable Within Loop  
ASCQM Ban Use of Deprecated Libraries  
ASCQM Ban Use of Expired Pointer  
ASCQM Ban Use of Expired Resource  
ASCQM Ban Use of Thread Control Primitives with Known Deadlock Issues  
ASCQM Ban While TRUE Loop Without Path To Break  
ASCQM Check Boolean Variables are Updated in Different Conditional Branches before Use  
ASCQM Check Index of Array Access  
ASCQM Check Input of Memory Allocation Primitives  
ASCQM Check Input of Memory Manipulation Primitives  
ASCQM Check Input of String Manipulation Primitives with Boundary Checking Capabilities  
ASCQM Check Offset used in Pointer Arithmetic  
ASCQM Check Return Value of Resource Operations Immediately  
ASCQM Check and Handle ZERO Value before Use as Divisor  
ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context  
ASCQM Handle Return Value of Must Check Operations  
ASCQM Implement Copy Constructor for Class With Pointer Resource  
ASCQM Implement Required Operations for Manual Resource Management  
ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor  
ASCQM Implement Virtual Destructor for Classes with Virtual Methods  
ASCQM Implement Virtual Destructor for Parent Classes  
ASCQM Initialize Pointers before Use  
ASCQM Initialize Variables  
ASCQM Initialize Variables before Use



ASCQM Log Caught Security Exceptions  
ASCQM Release File Resource after Use in Class  
ASCQM Release File Resource after Use in Operation  
ASCQM Release Lock After Use  
ASCQM Release Memory After Use  
ASCQM Release Memory after Use with Correct Operation  
ASCQM Release Platform Resource after Use  
ASCQM Release in Destructor Memory Allocated in Constructor  
ASCQM Sanitize Stored Input used in User Output  
ASCQM Sanitize User Input used as Array Index  
ASCQM Sanitize User Input used as Pointer  
ASCQM Sanitize User Input used as Serialized Object  
ASCQM Sanitize User Input used as String Format  
ASCQM Sanitize User Input used in Document Manipulation Expression  
ASCQM Sanitize User Input used in Document Navigation Expression  
ASCQM Sanitize User Input used in Expression Language Statement  
ASCQM Sanitize User Input used in Loop Condition  
ASCQM Sanitize User Input used in Path Manipulation  
ASCQM Sanitize User Input used in SQL Access  
ASCQM Sanitize User Input used in System Command  
ASCQM Sanitize User Input used in User Output  
ASCQM Sanitize User Input used to access Directory Resources  
ASCQM Secure Use of Unsafe XML Processing with Secure Parser  
ASCQM Secure XML Parsing with Secure Options  
ASCQM Singleton Creation without Proper Locking in Multi-Threaded Context

## 8. ASCQM Weakness Detection Patterns

### 8.1 Specification of Detection Patterns

Detection patterns provide guidance for automated detection of the weaknesses enumerated in Clause 7. Each weakness may have several different instantiations in the source code. Thus, a weakness may be associated with several different detection patterns. Each detection pattern may be associated with weaknesses in several different quality measures. There are 135 detection patterns associated with the weaknesses in Automated Source Code Quality Measures. This number will grow as more detection patterns are discovered and specified.

Detection Patterns use micro-KDM to provide greater granularity to their specification of weakness patterns. Additional semantic constraints are required to coordinate producers and consumers of KDM models to use the KDM Program Element layer for control- and data-flow analysis applications, as well as for providing more precision for the Resource Layer and the Abstraction Layer. Micro-KDM achieves this by constraining the granularity of the leaf action elements and their meaning by providing the set of micro-actions with predefined semantics. Micro-KDM treats the original macro-action as a container that owns certain micro-actions with predefined semantics. Thus, precise semantics of the macro-action is defined. Micro-KDM constrains the patterns of how to map the statements of the existing system as determined by the programming language into KDM.

### 8.2 Detection Patterns

#### 8.2.1 ASCQM Check Index of Array Access

##### Descriptor

ASCQM Check Index of Array  
Access(PathFromDeclarationStatementToUseAsAnIndexStatement,  
VariableDeclarationStatement, ArrayAccessStatement)

##### Description

Identify occurrences in application model where

- the <PathFromDeclarationStatementToUseAsAnIndexStatement> path
- from the <VariableDeclarationStatement> variable declaration statement
- to the <ArrayAccessStatement> array access statement using the variable as an index,
- lacks a range check operation.

##### KDM outline illustration

*KDM elements present in the application model*

KDM outline illustrating only the essential elements related to micro KDM:

```
...
StorableUnit id="su1"
StorableUnit id="su2"
ArrayType id="at1"
StorableUnit id="su3" type="at1"
...
ActionElement id="ae2"
  Flow "ae3"
  Reads "su1"
  Writes "su2"
ActionElement id="ae3"
  Flow "ae4"
ActionElement id="ae4"
  Flow "ae5"
ActionElement id="ae5" kind="ArraySelect|ArrayReplace"
  Addresses "su3"
  Reads "su2"
  Reads|Writes ...
...
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae2" kind="GreaterThan|GreaterThanOrEqual"
  Reads "su2"
  Reads ...
...
ActionElement id="ae3" kind="LessThan|LessThanOrEqual"
  Reads "su2"
  Reads ...
...
```

#### **What to report**

Roles to report are

- the <PathFromDeclarationStatementToUseAsAnIndexStatement> path
- the <VariableDeclarationStatement> variable declaration statement
- the <ArrayAccessStatement> array access statement

### **8.2.2 ASCQM Check Input of Memory Manipulation Primitives**

#### **Descriptor**

ASCQM Check Input of Memory Manipulation Primitives(MemoryManipulationCall)

### Description

Identify occurrences in application model where

- the <MemoryManipulationCall> call to a memory manipulation function, procedure, method, ... with boundary checking capabilities
- uses the length parameter without range checking its value

### KDM outline illustration

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
PointerType id="pt1"
IntegerType id="it1"
ControlElement id="cel" name="memcpy|..." type="cel_signature"
    Signature id="cel_signature"
    ...
    ParameterUnit id="pu1" type="dt1" kind="byValue"
    ParameterUnit id="pu2" type="pt1" kind="return"
    ...
StorableUnit id="sul" type="it1"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
    ...
    Reads "sul"
    Calls "cel"
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae2" kind="GreaterThan|GreaterThanOrEqual"
    Reads "sul"
    ...
ActionElement id="ae3" kind="LessThan|LessThanOrEqual"
    Reads "sul"
    ...
```

### What to report

Roles to report

- the <MemoryManipulationCall> call to a memory manipulation function, procedure, method, ... with boundary checking capabilities

## 8.2.3 ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities

### Descriptor

ASCQM Ban String Manipulation Primitives without Boundary Checking Capabilities(StringManipulationCall)

### Description

Identify occurrences in application model where

- the <StringManipulationCall> call to a string manipulation function, procedure, method, ... without boundary checking capabilities

### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce1" name="strcpy|strlen|..."
...
...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
...
  Calls "ce1"
```

### What to report

Roles to report:

- the <StringManipulationCall> call to a string manipulation function, procedure, method, ... without boundary checking capabilities

## 8.2.4 ASCQM Check Input of String Manipulation Primitives with Boundary Checking Capabilities

### Descriptor

ASCQM Check Input of String Manipulation Primitives with Boundary Checking Capabilities(StringManipulationCall)

### Description

Identify occurrences in application model where

- the <StringManipulationCall> call to a string manipulation function, procedure, method, ... with boundary checking capabilities
- uses the length parameter without range checking its value

### KDM outline illustration

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
StringType id="st1"
```

```

IntegerType id="it1"
ControlElement id="cel" name="strcpy|strncat|..." type="cel_signature"
  Signature id="cel_signature"
    ParameterUnit id="pu1" type="st1"
    ParameterUnit id="pu2" type="it1" kind="byValue"
    ParameterUnit id="pu3" type="st1" kind="return"
  ...
...
StorableUnit id="sul" type="it1"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  ...
  Reads "sul"
  Calls "cel"

```

### KDM elements absent from the application model

KDM outline illustrating only the essential elements related to micro KDM:

```

ActionElement id="ae2" kind="GreaterThan|GreaterThanOrEqual"
  Reads "sul"
  ...
ActionElement id="ae3" kind="LessThan|LessThanOrEqual"
  Reads "sul"
  ...

```

### What to report

Roles to report

- the <StringManipulationCall> call to a string manipulation function, procedure, method, ... with boundary checking capabilities

## 8.2.5 ASCQM Ban Use of Expired Pointer

### Descriptor

ASCQM Ban Use of Expired Pointer(PathToPointerAccessFromPointerRelease, PointerReleaseStatement, PointerAccessStatement)

### Description

Identify occurrences in application model where

- the <PathToPointerAccessFromPointerRelease> path
- from the <PointerReleaseStatement> resource release statement
- to the <PointerAccessStatement> resource access statement

### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```

ClassUnit | IntegerType | DecimalType | FloatType | StringType | VoidType | ... id="dt1"
PointerType id="pt1"
  ItemUnit id="pi1" type="dt1"
StorableUnit id="su1" type="pt1"
...
ActionElement id="ae1" name="free|delete|..."
  Addresses "pt1"
  Flows "ae2"
ActionElement id="ae2"
  Flows "ae3"
ActionElement id="ae3"
kind=PtrSelect|PtrReplace|Call|PtrCall|MethodCall|VirtualCall"
  Reads|Addresses "pt1"
...

```

or

```

ClassUnit | IntegerType | DecimalType | FloatType | StringType | VoidType | ... id="dt1"
name="dt1"
PointerType id="pt1" name="pt1"
  ItemUnit id="iu1" type="dt1" ext="dt1 & pt1"
StorableUnit id="su1" type="dt1"
StorableUnit id="su2" type="pt1"
  HasType "pt1"
  HasValue "su1"
...
ActionElement id="ae1" name="free|delete|...|push_back|..."
  Addresses "su1"
  Flows "ae2"
ActionElement id="ae2"
  Flows "ae3"
ActionElement id="ae3"
kind=PtrSelect|PtrReplace|Call|PtrCall|MethodCall|VirtualCall"
  Reads|Addresses "su2"

```

### What to report

#### Roles to report

- the <PathToPointerAccessFromPointerRelease> path
- the <PointerReleaseStatement> resource release statement
- the <PointerAccessStatement> resource access statement

## 8.2.6 ASCQM Ban Input Acquisition Primitives without Boundary Checking Capabilities

### Descriptor

ASCQM Ban Input Acquisition Primitives without Boundary Checking Capabilities(InputAcquisitionCall)

### Description

Identify occurrences in application model where

- the <InputAcquisitionCall> call to an input acquisition function, procedure, method, ... without boundary checking capabilities

### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce1" name="gets|scanf|..."
...
...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
...
  Calls "ce1"
```

### What to report

Roles to report:

- the <InputAcquisitionCall> call to an input acquisition function, procedure, method, ... without boundary checking capabilities

## 8.2.7 ASCQM Check Offset used in Pointer Arithmetic

### Descriptor

ASCQM Check Offset used in Pointer Arithmetic(ArithmeticExpression, EvaluationStatement)

### Description

Identify occurrences in application model where

- the result of the <ArithmeticExpression> arithmetic expression,
- with an offset value which is not range checked
- is used to dereference the pointer in the <EvaluationStatement> evaluation statement

### KDM outline illustration

**KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
...
PointerType id="pt1"
StorableUnit id="sul" type="pt1"
```



```

...
IntegerType id="it1"
StorableUnit id="su2" type="it1"
StorableUnit id="su3" type="it1"
...
ActionElement id="ae1" kind="Add|Subtract"
  Reads "su1"
  Reads "su2"
  Writes "su3"
...
ActionElement id="ae2" kind="PtrSelect|PtrReplace"
  Addresses "su3"
  ..

```

### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

ActionElement id="ae2" kind="GreaterThan|GreaterThanOrEqual"
  Reads "su2"
  Reads ...
...
ActionElement id="ae3" kind="LessThan|LessThanOrEqual"
  Reads "su2"
  Reads ...
...

```

### **What to report**

Roles to report are

- the <ArithmeticExpression> arithmetic expression
- the <EvaluationStatement> evaluation statement

## **8.2.8 ASCQM Sanitize User Input used as Pointer**

### **Descriptor**

ASCQM Sanitize User Input used as Pointer(PathFromUserInputToPointerDereferencing, UserInput, PointerDereferencingStatement, PointerDereferencingSanitizationControlElementList)

### **Description**

Identify occurrences in application model where

- the <PathFromUserInputToPointerDereferencing> path
- from the <UserInput> user interface input
- to the <PointerDereferencingStatement> pointer dereferencing statement,
- lacks a sanitization operation from the <PointerDereferencingSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process.

### KDM outline illustration

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
UIModel
  UIField id="uf1"
  UIAction id="ua1" implementation="ae1" kind="input"
    ReadsUI "uf1"
  ...
CodeModel
  ...
  StorableUnit id="su1"
  StorableUnit id="su2"
  ActionElement id="ae1" kind="UI"
    Writes "su1"
    Flow "ae2"
  ActionElement id="ae2"
    Flow "ae3"
    Reads "su1"
    Writes "su2"
  ActionElement id="ae3"
    Flow "ae4"
  ActionElement id="ae4"
    Flow "ae5"
  ActionElement id="ae5" kind="PtrSelect"
    Addresses "su2"
    Reads|Writes ...
  ...
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce1" kind="sanitization"
...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  Flow "ae4"
  Calls "ce1"
  Reads "su2"
  Writes "su2"
...
```

### What to report

Roles to report are

- the <PathFromUserInputToPointerDereferencing> path
- the <UserInput> user interface input

- the <PointerDereferencingStatement> pointer dereferencing statement,
- the <PointerDereferencingSanitizationControlElementList> list of vetted sanitization.

### 8.2.9 ASCQM Initialize Pointers before Use

#### Descriptor

ASCQM Initialize Pointers before Use(PathToPointerAccessFromPointerDeclaration, PointerDeclarationStatement, PointerAccessStatement)

#### Description

Identify occurrences in application model where

- the <PathToPointerAccessFromPointerDeclaration> path
- from the <PointerDeclarationStatement> pointer declaration statement
- to the <PointerAccessStatement> pointer access statement
- lacks a pointer initialization statement

excluding variable and platform resources

#### KDM outline illustration

##### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...
PointerType id="pt1"
StorableUnit id="su1" type="pt1"
...
ActionElement id="ae2" ...
    Flows "ae3"
ActionElement id="ae3" kind="PtrSelect"
    Reads "su1"
    ...
...
```

##### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...
ActionElement id="ae1" kind="Assign|Ptr"
    Writes "su1"
    Flows "ae2"
...
```

### What to report

Roles to report are

- the <PathToPointerAccessFromPointerDeclaration> path
- the <PointerDeclarationStatement> pointer declaration statement
- the <PointerAccessStatement> pointer access statement

### 8.2.10 ASCQM Check NULL Pointer Value before Use

#### Descriptor

ASCQM Check NULL Pointer Value before Use(EvaluationStatement)

#### Description

Identify occurrences in application model where

- a pointer is evaluated in the <EvaluationStatement> evaluation statement
- with no NULL comparison operation performed on the pointer immediately before

#### KDM outline illustration

##### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...
PointerType id="pt1"
  ItemUnit id="iu1"
StorableUnit id="su1" type="pt1"
ActionElement id="ae3" kind="PtrSelect|PtrReplace"
  Reads "iu1"
  Addresses "su1"
```

##### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...
Value id="v1" name="NULL|nullptr"
StorableUnit id="su2"
ActionElement id="ae1" kind="NotEqual"
  Reads "v1"
  Reads "su1"
  Writes "su2"
  Flows "ae2"
ActionElement id="ae2" kind="Condition"
  Reads "su2"
  TrueFlow "ae3"
  FalseFlow "ff1"
...
```

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### What to report

Roles to report are

- the <EvaluationStatement> evaluation statement

### 8.2.11 ASCQM Ban Use of Expired Resource

#### Descriptor

ASCQM Ban Use of Expired Resource(PathToResourceAccessFromResourceRelease, ResourceReleaseStatement, ResourceAccessStatement)

#### Description

Identify occurrences in application model where

- the <PathToResourceAccessFromResourceRelease> path
  - from the <ResourceReleaseStatement> resource release statement
  - to the <ResourceAccessStatement> resource access statement
- excluding pointers

#### KDM outline illustratio

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
...
DataManager|FileResource id="pr1"
...
PlatformResource id="pa1" kind="open" implementation="ae4"
  ManagesResource "pr1"
PlatformResource id="pa2" kind="close" implementation="ae1"
  ManagesResource "pr1"
...
CodeModel
...
ActionElement id="ae1" kind="PlatformAction"
  Flows "ae3"
ActionElement id="ae3"
  Flows "ae4"
ActionElement id="ae4" kind="PlatformAction"
...
...
```

### What to report

Roles to report

- the <PathToResourceAccessFromResourceRelease> path
- the <ResourceReleaseStatement> resource release statement
- the <ResourceAccessStatement> resource access statement

### 8.2.12 ASCQM Ban Double Release of Resource

#### Descriptor

ASCQM Ban Double Release of Resource(PathToResourceReleaseFromResourceRelease, FirstResourceReleaseStatement, SecondResourceReleaseStatement)

#### Description

Identify occurrences in application model where

- the <PathToResourceReleaseFromResourceRelease> path
- from the <FirstResourceReleaseStatement> resource release statement
- to the <SecondResourceReleaseStatement> resource release statement

#### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
...
DataManager|ExecutionResource id="pr1"
...
PlatformAction id="pa2" kind="close" implementation="ae1 ae4"
    ManagesResource "pr1"
...
CodeModel
...
ActionElement id="ae1" kind="PlatformAction"
    Flows "ae3"
ActionElement id="ae3"
    Flows "ae4"
ActionElement id="ae4" kind="PlatformAction"
...
...
```

#### What to report

Roles to report

- the <PathToResourceReleaseFromResourceRelease> path
- the <FirstResourceReleaseStatement> resource release statement
- the <SecondResourceReleaseStatement> resource release statement

### 8.2.13 ASCQM Implement Copy Constructor for Class With Pointer Resource

#### Descriptor

ASCQM Implement Copy Constructor for Class With Pointer Resource(Class, Pointer)

### Description

Identify occurrences in application model where

- the <Class> Class
- owns the <Pointer> pointer resource
- but lacks a copy constructor

### KDM outline illustration

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
PointerType id="pointerType"
...
ClassUnit id="cul"
  MemberUnit id="mul" type="pointerType"
  ...
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cul"
...
  MethodUnit is="m1"
name="class|this|__construct|new|New|__new__|alloc|constructor|initialize|...
" methodKind="constructor" type="ml_signature"
  Signature id = "ml_signature"
    ParameterUnit id="p1" name="p1" type="class" kind="byReference"
    ParameterUnit id="r" name="r" type="class" kind="return"
  ...
```

### What to report

Roles to report are

- the <Class> Class
- the <Pointer> pointer resource

## 8.2.14 ASCQM Ban Free Operation on Pointer Received as Parameter

### Descriptor

ASCQM Ban Free Operation on Pointer Received as Parameter(ReleaseStatement, Signature)

### Description

Identify occurrences in application model where

- the pointer is released by the <ReleaseStatement> release statement

- and was received as a parameter in the <Signature> signature

The list of release operations are technology, language dependent. E.g. with C-type languages: free, delete.

#### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
...
PointerType id="pt1"
...
ControlElement id="ce1" name="free|delete|..."
...
CallableUnit kind="regular|external|stored" | MethodUnit id="ce2"
type="ce2_signature"
  Signature id="ce2_signature"
    ParameterUnit id="pul" kind="byReference" type="pt1"
  ...
  ActionElement id="ae1" kind="Call|PtrCall[MethodCall|VirtualCall"
    Calls "ce1"
    Reads "pul"
  ...
...
```

#### What to report

Roles to report are

- the <ReleaseStatement> release statement
- the <Signature> signature

### 8.2.15 ASCQM Ban Delete of VOID Pointer

#### Descriptor

ASCQM Ban Delete of VOID Pointer(DeclarationStatement, ReleaseStatement)

#### Description

Identify occurrences in application model where

- the pointer declared as a VOID pointer in <DeclarationStatement> declaration statement
- is released by the <ReleaseStatement> release statement
- without ever been casted into a non-VOID pointer

The list of release operations are technology, language dependent. E.g. with C-type languages: delete.



### KDM outline illustration

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
VoidType id="vt1"
PointerType id="pt1"
  ItemUnit id="iu1" type="vt1"
StorableUnit id="sul" type="pt1"
ControlElement id="cel" name="delete|..."
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Reads "sul"
  Calls "cel"
```

#### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
...
IntegerType|DecimalType|FloatType|StringType|ClassUnit id="dt1"
PointerType id="pt2"
  ItemUnit id="iu2" type="dt1"
ActionElement id="ae2" kind="TypeCast|DynCast"
  Reads "sul"
  UsesType "pt2"
  Writes "sul"
...
```

### What to report

Roles to report are

- the <DeclarationStatement> declaration statement
- the <ReleaseStatement> release statement

### 8.2.16 ASCQM Ban Variable Increment or Decrement Operation in Operations using the Same Variable

#### Descriptor

ASCQM Ban Variable Increment or Decrement Operation in Operations using the Same Variable(VariableAssignment)

#### Description

Identify occurrences in application model where

- the <VariableAssignment> variable assignment
- uses the outcome of increment or decrement operation on a variable
- jointly with the variable itself

e.g.: x + x++;

#### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
StorableUnit id="sul"
ActionElement id="ae1" kind="Compound"
  ActionElement id="ae2" kind="Incr|Decr"
    Addresses "sul"
  ...
  ActionElement id="ae3"
    ...
    Reads "sul"
...
```

#### What to report

Roles to report

- the <VariableAssignment> variable assignment

### 8.2.17 ASCQM Ban Reading and Writing the Same Variable Used as Assignment Value

#### Descriptor

ASCQM Ban Reading and Writing the Same Variable Used as Assignment Value(VariableAssignment)

#### Description

Identify occurrences in application model where

- the <VariableAssignment> variable assignment
- uses the outcome of an operation on a variable
- jointly with the assignment of the variable itself

e.g.: x = a + (a=2);

#### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
StorableUnit id="sul"
ActionElement id="ae1" kind="Compound"
  StorableUnit id="su2"
  ActionElement id="ae2" kind="Assign"
    ...
    Writes "sul"
```

```

...
ActionElement id="ae3"
...
  Reads "su1"
  Writes "su2"
ActionElement id="ae4" kind="Assign"
  Reads "su2"
  Writes ...

```

### What to report

Roles to report

- the <VariableAssignment> variable assignment

## 8.2.18 ASCQM Handle Return Value of Resource Operations

### Descriptor

ASCQM Handle Return Value of Resource Operations(CallToTheOperation)

### Description

Identify occurrences in application model where

- the platform resource management function, method, procedure, ... is called in the <CallToTheOperation> call statement
- with no use in a conditional statement of the return value

### KDM outline illustration

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

PlatformModel
...
DataManager|ExecutionResource|... id="pr1"
...
PlatformResource id="pal" implementation="ae1"
  ManagesResource|ReadsResource|WritesResource "pr1"
...
CodeModel
...
CallableUnit|MethodUnit id="cel" type="cel_signature"
  Signature id="cel_signature"
  ParameterUnit id="pul" kind="return"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
...

```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
StorableUnit id="su1"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Writes "su1"
  Flows "ae2"
ActionElement id="ae2" kind="Switch"
  Reads "su1"
  GuardedFlow "gf1"
  GuardedFlow|FalseFlow "gf2"
...
```

or

```
StorableUnit id="su1"
StorableUnit id="su2"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Writes "su1"
  Flows "ae2"
ActionElement id="ae2"
kind="Equal|NotEqual|LessThan|LessThanOrEqual|GreaterThan|GreatedThanOrEqual"
  Reads "su1"
  Writes "su2"
  Flows "ae3"
ActionElement id="ae3" kind="Condition"
  TrueFlow "tfl"
  FalseFlow "ffl"
...
```

#### What to report

Roles to report are

- the <CallToTheOperation> call statement

### 8.2.19 ASCQM Ban Incorrect Numeric Conversion of Return Value

#### Descriptor

ASCQM Ban Incorrect Numeric Conversion of Return Value(FunctionMethodOrProcedure, VariableDataType, CallStatement, TargetDataType)

#### Description

Identify occurrences in application model where

- the <FunctionMethodOrProcedure> function, method, procedure, ...
- declared to return a value with the <VariableDataType> numerical data type
- is called in the <CallStatement> call statement

- with assignment of its return value to a variable of the <TargetDataType> second numerical data type
- which is incompatible with the first one
- without any explicit casting

### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
IntegerType|DecimalType|FloatType id="dt1"
IntegerType|DecimalType|FloatType id="dt2"
StorableUnit|ItemUnit|MemberUnit|Value id="de1" type="dt2"
...
CallableUnit|MethodUnit id="cel" type="cel_signature"
attribute="CheckReturnValue|..."
  Signature id="cel_signature"
    ParameterUnit id="pul" kind="return" type="dt1"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Calls "cel"
  Writes "de1"
...
```

and the numeric datatypes are not compatible.

### What to report

Roles to report are

- the <FunctionMethodOrProcedure> function, method, procedure, ...
- the <VariableDataType> numerical data type
- the <CallStatement> call statement with assignment
- the <TargetDataType> second numerical data type

## 8.2.20 ASCQM Handle Return Value of Must Check Operations

### Descriptor

ASCQM Handle Return Value of Must Check Operations(CallToTheOperation)

### Description

Identify occurrences in application model where

- the must-check function, method, procedure, ... is called in the <CallToTheOperation> call statement
- with no use in a conditional statement of the return value

The must-check nature of a function, method, procedure, ... is technology dependent. E.g. in Java: the @CheckReturnValue annotation

### KDM outline illustration

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
...
CallableUnit|MethodUnit id="ce1" type="ce1_signature"
attribute="CheckReturnValue|..."
  Signature id="ce1_signature"
  ParameterUnit id="pu1" kind="return"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
...
```

#### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
StorableUnit id="su1"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Writes "su1"
  Flows "ae2"
ActionElement id="ae2" kind="Switch"
  Reads "su1"
  GuardedFlow "gf1"
  GuardedFlow|FalseFlow "gf2"
...
|
```

or

```
StorableUnit id="su1"
StorableUnit id="su2"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Writes "su1"
  Flows "ae2"
ActionElement id="ae2"
kind="Equal|NotEqual|LessThan|LessThanOrEqual|GreaterThan|GreatedThanOrEqual"
  Reads "su1"
  Writes "su2"
  Flows "ae3"
ActionElement id="ae3" kind="Condition"
  TrueFlow "tf1"
  FalseFlow "ff1"
...
|
```

### What to report

Roles to report are

- the <CallToTheOperation> call statement

## 8.21 ASCQM Check Return Value of Resource Operations Immediately

### Descriptor

ASCQM Check Return Value of Resource Operations Immediately(CallToTheOperation)

### Description

Identify occurrences in application model where

- a platform resource management function, procedure, method, ... is called in the <CallToTheOperation> call statement
- with no operation performed immediately after on the return value

### KDM outline illustration

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
...
DataManager|ExecutionResource|... id="pr1"
...
PlatformResource id="pal" implementation="ae1"
  ManagesResource|ReadsResource|WritesResource "pr1"
...
CodeModel
  CallableUnit|MethodUnit id="cel" type="cel_signature"
    Signature id="cel_signature"
      ParameterUnit id="pu1" kind="return"
  ...
  ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  ...
```

#### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
StorableUnit id="sul"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Writes "sul"
  Flows "ae2"
ActionElement id="ae2"
  Reads "sul"
```

### What to report

Roles to report are

- the <CallToTheOperation> call statement

## 8.2.22 ASCQM Ban Useless Handling of Exceptions

### Descriptor

ASCQM Ban Useless Handling of Exceptions(CatchBlock)

### Description

Identify occurrences in application model where

- the <CatchBlock> catch block
- does not report on the error condition as a new throw or as a return value

### KDM outline illustration

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...
CatchUnit id="cu1"
  ...
  ...
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...
CatchUnit id="cu1"
  ...
  ActionElement id="ae1" kind="Throw"
    Throws ...
  ...
```

or

```
...
CatchUnit id="cu1"
  ...
  ActionElement id="ae1" kind="Return"
    Reads ...
  ...
```

### What to report

Roles to report are



- the <CatchBlock> catch block

### 8.2.23 ASCQM Ban Incorrect Object Comparison

#### Descriptor

ASCQM Ban Incorrect Object Comparison(ObjectEqualityComparisonExpression)

#### Description

Identify occurrences in application model where

- the <ObjectEqualityComparisonExpression> equality comparison expression between two objects

#### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cul"  
StorableUnit|ItemUnit|MemberUnit id="de1" type="cul"  
StorableUnit|ItemUnit|MemberUnit id="de2" type="cul"  
ActionElement id="ael" kind="Equals|NotEqual" ext="de1 == de2 | de1 != de2"  
  Reads "de1"  
  Reads "de2"
```

#### What to report

Roles to report are

- the <ObjectEqualityComparisonExpression> equality comparison expression

### 8.2.24 ASCQM Ban Assignment Operation Inside Logic Blocks

#### Descriptor

ASCQM Ban Assignment Operation Inside Logic Blocks(AssignmentExpression, LogicBlock)

#### Description

Identify occurrences in application model where

- the <AssignmentExpression> assignment expression  
- is used within the <LogicBlock> logic block

#### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
ActionElement id="ael" kind="Compound"
```

```

StorableUnit|MemberUnit id="del"
...
ActionElement id="ae2" kind="Condition|Switch"
  Reads "del"
  ActionElement id="ae3" kind="Assign"
    Writes "del"
...

```

### What to report

Roles to report are

- the <AssignmentExpression> assignment expression
- the <LogicBlock> logic block

## 8.2.25 ASCQM Ban Comparison Expression Outside Logic Blocks

### Descriptor

ASCQM Ban Comparison Expression Outside Logic Blocks(ComparisonExpression)

### Description

Identify occurrences in application model where

- the <ComparisonExpression> comparison expression
- is not used within a logic block

### KDM outline illustration

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

...
ActionElement id="ae1" kind="Compound"
  StorableUnit|MemberUnit id="del"
  ...
  ActionElement id="ae3" kind="Equal"
    Reads "del"
...

```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

...
ActionElement id="ae1" kind="Compound"
  StorableUnit|MemberUnit id="del"
  ...
  ActionElement id="ae2" kind="Condition|Switch"
    Reads "sul"
    StorableUnit id="sul" type="register"

```

```
ActionElement id="ae3" kind="Equal"
  Writes "sul"
  Reads "de1"
```

...

#### What to report

Roles to report are

- the <ComparisonExpression> comparison expression

### 8.2.26 ASCQM Ban Incorrect String Comparison

#### Descriptor

ASCQM Ban Incorrect String Comparison(StringEqualityComparisonExpression)

#### Description

Identify occurrences in application model where

- the <StringEqualityComparisonExpression> equality comparison expression between two strings

#### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
StringType id="st1"
StorableUnit|ItemUnit|MemberUnit id="de1" type="st1"
StorableUnit|ItemUnit|MemberUnit id="de2" type="st1"
ActionElement id="ae1" kind="Equals|NotEqual" ext="de1 == de2 | de1 != de2"
  Reads "de1"
  Reads "de2"
```

#### What to report

Roles to report are

- the <StringEqualityComparisonExpression> equality comparison expression

### 8.2.27 ASCQM Ban Logical Operation with a Constant Operand

#### Descriptor

ASCQM Ban Logical Operation with a Constant Operand(ComparisonExpression)

#### Description

Identify occurrences in application model where

- the <ComparisonExpression> comparison expression with a constant operand

### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
Value id="v1"  
...  
ActionElement id="ae1" kind="And|Or|Xor"  
  Reads "v1"  
  ...
```

### What to report

Roles to report are

- the <ComparisonExpression> comparison expression

## 8.2.28 ASCQM Implement Correct Object Comparison Operations

### Descriptor

ASCQM Implement Correct Object Comparison Operations(Class)

### Description

Identify occurrences in application model where

- the <Class> class
- lacking the required comparison operations

### KDM outline illustration

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cu1"
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
BooleanType id="bt1"  
IntegerType id="it1"  
...  
ClassUnit id="cu1"  
  ...  
  MethodUnit id="mul" name="equals|Equals|operator==|..."  
  type="mul_signature"  
  Signature id="mul_signature"  
    ParameterUnit id="pu1" kind="byReference" type="cu1"  
    ParameterUnit id="pu2" kind="Return" type="bt1"  
  ...
```

```

MethodUnit id="mu2" name="hashCode|GetHashCode|hash|..."
type="mu2_signature"
  Signature id="mu2_signature"
    ParameterUnit id="pu3" kind="byReference" type="cu1"
    ParameterUnit id="pu4" kind="Return" type="it1"
...

```

#### What to report

Roles to report are  
- the <Class> class

### 8.2.2930 ASCQM Ban Comma Operator from Delete Statement

#### Descriptor

ASCQM Ban Comma Operator from Delete Statement(DeleteStatement, CommaStatement)

#### Description

Identify occurrences in application model where  
- the <DeleteStatement> delete statement  
- compounded with the <CommaStatement> comma statement

#### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```

...
CallableUnit id="cu1" name="delete" callableKind="operator"
CallableUnit id="cu2" name="comma" callableKind="operator"
...
ActionElement id="ae1" kind="Compound" ext="delete x, y"
  ActionElement id="ae2" kind="Call"
    Calls "cu1"
  ...
  ActionElement id="ae3" kind="Call"
    Calls "cu2"
  ...
...

```

#### What to report

Roles to report are  
- the <DeleteStatement> delete this statement  
- the <CommaStatement> comma statement

### 8.2.301 ASCQM Release in Destructor Memory Allocated in Constructor

## Descriptor

ASCQM Release in Destructor Memory Allocated in Constructor(MemoryAllocationStatement)

## Description

Identify occurrences in application model where

- the <MemoryAllocationStatement> memory allocation statement in the class constructor
- lacking a corresponding memory release statement in the class destructor

## KDM outline illustration

### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit | IntegerType | DecimalType | FloatType | StringType | VoidType | ... id="dt1"
PointerType id="pt1"
  ItemUnit id="iul" type="dt1"
...
ClassUnit id="cul"
  ...
  StorableUnit id="sul" type="pt1"
  ...
  MethodUnit id="mul" MethodKind="constructor"
    ...
    ActionElement id="ael" kind="New|NewArray"
      Creates "dt1"
      Writes "sul"
...

```

or

```
ControlElement id="cel" name="malloc|calloc|..."
...
ClassUnit | IntegerType | DecimalType | FloatType | StringType | VoidType | ... id="dt1"
PointerType id="pt1"
  ItemUnit id="iul" type="dt1"
...
ClassUnit id="cul"
  ...
  StorableUnit id="sul" type="pt1"
  ...
  MethodUnit id="mul" MethodKind="constructor"
    ...
    ActionElement id="ael" kind="Call"
      Calls "cel"
      Writes "sul"
...

```

### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce2" name="delete|delete[]|free|..."
...
ClassUnit id="cu1"
...
    MethodUnit id="mu2" MethodKind="destructor"
    ...
        ActionElement id="ae2" kind="Call"
            Addresses "su1"
            Calls "ce2"
```

### What to report

Roles to report

- the <MemoryAllocationStatement> memory allocation statement

## 8.3.12 ASCQM Release Memory after Use with Correct Operation

### Descriptor

ASCQM Release Memory after Use with Correct Operation(MemoryAllocationStatement, MemoryReleaseStatement)

### Description

Identify occurrences in the application model where

- the memory is allocated via the <MemoryAllocationStatement> allocation statement
- then released via the mismatched <MemoryReleaseStatement> release statement

The pairs of matching allocation/deallocation primitives and operations are technology, framework, language dependant. E.g.: malloc/free, calloc/free, realloc/free in C/C+, new/delete, new[]/delete[] in C+, new/Release() with COM IUnknown interface.

### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit|IntegerType|DecimalType|FloatType|StringType|VoidType|... id="dt1"
PointerType id="pt1"
    ItemUnit id="iu1" type="dt1"
...
StorableUnit id="su1" type="pt1"
...
ActionElement id="ae1" kind="New"
    Creates "dt1"
    Writes "su1"
...
```

```
ControlElement id="ce2" name="delete[]|free|..."
...
ActionElement id="ae2" kind="Call"
  Addresses "sul"
  Calls "ce2"
```

or

```
ClassUnit|IntegerType|DecimalType|FloatType|StringType|VoidType|... id="dt1"
PointerType id="pt1"
  ItemUnit id="iu1" type="dt1"
...
StorableUnit id="sul" type="pt1"
...
ActionElement id="ae1" kind="NewArray"
  Creates "dt1"
  Writes "sul"
...
ControlElement id="ce2" name="delete|free|..."
...
ActionElement id="ae2" kind="Call"
  Addresses "sul"
  Calls "ce2"
```

or

```
ControlElement id="ce1" name="malloc|calloc|..."
...
ClassUnit|IntegerType|DecimalType|FloatType|StringType|VoidType|... id="dt1"
PointerType id="pt1"
  ItemUnit id="iu1" type="dt1"
...
StorableUnit id="sul" type="pt1"
...
ActionElement id="ae1" kind="Call"
  Calls "ce1"
  Writes "sul"
...
ControlElement id="ce2" name="delete|delete[]|..."
...
ActionElement id="ae2" kind="Call"
  Addresses "sul"
  Calls "ce2"
```

### What to report

Roles to report are

- the <MemoryAllocationStatement> allocation statement
- the <MemoryReleaseStatement> release statement



## 8.2.3.23 ASCQM Implement Required Operations for Manual Resource Management

### Descriptor

ASCQM Implement Required Operations for Manual Resource Management(ObjectDeclaration)

### Description

Identify occurrences in application model where

- the <ObjectDeclaration> object declaration
- declares an object with manual resource management capabilities
- which lacks the required operation.

The manual resource management capability is technology, framework, and language dependent. E.g.: class inheritance from IDisposable in C#, and AutoClosable in Java, class with `__enter__` in python.

### KDM outline illustration

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
InterfaceUnit id="iu1" name="IDisposable|AutoClosable|..."
...
ClassUnit id="cu1"
  Extends "iu1"
  ...
```

of

```
...
ClassUnit id="cu1"
  MethodUnit "mu1" name="__enter__"
  ...
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cu1"
  ...
  MethodUnit "mu1" name="dispose|close|__exit__|..."
```

### What to report

Roles to report

- the <ObjectDeclaration> object declaration

### 8.2.334 ASCQM Release Platform Resource after Use

#### Descriptor

ASCQM Release Platform Resource after Use(FunctionProcedureOrMethod, ResourceAllocationStatement, PathToExitWithoutResourceRelease)

#### Description

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- uses the <ResourceAllocationStatement> resource allocation statement
- excluding memory and file resources
- while there exist the <PathToExitWithoutResourceRelease> path to exit the <FunctionProcedureOrMethod> function, procedure, method, ... without releasing the resource

#### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
...
DataManager|ExecutionResource id="pr1"
...
PlatformAction id="pa1" kind="open" implementation="ae1"
    ManagesResource "pr1"
PlatformAction id="pa2" kind="close" implementation="ae2"
    ManagesResource "pr1"
...
CodeModel
...
CallableUnit|MethodUnit id="cel" name="..."
...
    ActionElement id="ae1" kind="PlatformAction"
        Flows "ae3"
    ActionElement id="ae3"
        Flows "ae4"
    ActionElement id="ae4" kind="Return"
    ...
    ActionElement id="ae2" kind="PlatformAction"
    ...
...
```

#### What to report

Roles to report

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <ResourceAllocationStatement> file resource open statement
- the <PathToExitWithoutResourceRelease> path to exit

### **8.2.34 ASCQM Release Memory After Use**

#### **Descriptor**

ASCQM Release Memory After Use(MemoryAllocationStatement)

#### **Description**

Identify occurrences in application model where  
- the <MemoryAllocationStatement> memory allocation statement  
- lacking a corresponding memory release statement

#### **KDM outline illustration**

##### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit | IntegerType | DecimalType | FloatType | StringType | VoidType | ... id="dt1"  
PointerType id="pt1"  
ItemUnit id="iul" type="dt1"  
...  
StorableUnit id="sul" type="pt1"  
...  
ActionElement id="ael" kind="New|NewArray"  
Creates "dt1"  
Writes "sul"  
...
```

#### **or**

```
ControlElement id="cel" name="malloc|calloc|..."  
...  
ClassUnit | IntegerType | DecimalType | FloatType | StringType | VoidType | ... id="dt1"  
PointerType id="pt1"  
ItemUnit id="iul" type="dt1"  
...  
StorableUnit id="sul" type="pt1"  
...  
ActionElement id="ael" kind="Call"  
Calls "cel"  
Writes "sul"  
...
```

##### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce2" name="delete|delete[]|free|..."
...
ActionElement id="ae2" kind="Call"
  Addresses "s1"
  Calls "ce2"
```

#### **What to report**

##### **Roles to report**

- the <MemoryAllocationStatement> memory allocation statement

### **8.2.35 ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor**

#### **Descriptor**

ASCQM Implement Virtual Destructor for Classes Derived from Class with Virtual Destructor(Class, ParentClass, ParentVirtualDestructor)

#### **Description**

Identify occurrences in application model where

- the <Class> class
- inherits from the <ParentClass> parent class
- with the <ParentVirtualDestructor> virtual destructor
- but lacks a virtual destructor

#### **KDM outline illustration**

##### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="c1"
...
  MethodUnit is="m1" methodKind="method" isVirtual="true"
...
ClassUnit id="c2" InheritsFrom="c1"
...
...
```

##### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="c2"
...
  MethodUnit is="m2" methodKind="destructor" isVirtual="true"
...
...
```

#### **What to report**

##### **Roles to report are**

- the <Class> class
- the <ParentClass> parent class
- the <ParentVirtualDestructor> virtual destructor

### **8.2.36 ASCQM Implement Virtual Destructor for Parent Classes**

#### **Descriptor**

ASCQM Implement Virtual Destructor for Parent Classes(Class, ParentClass)

#### **Description**

Identify occurrences in application model where

- the <Class> class
- inherits from the <ParentClass> parent class
- which lacks a virtual destructor

#### **KDM outline illustration**

***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="c1"
.....
ClassUnit id="c2" InheritsFrom="c1"
.....
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="c1"
.....
MethodUnit is="m1" methodKind="method" isVirtual="true"
.....
```

#### **What to report**

Roles to report are

- the <Class> class
- the <ParentClass> parent class

### **8.2.37 ASCQM Release File Resource after Use in Operation**

#### **Descriptor**

ASCQM Release File Resource after Use in Operation(FunctionProcedureOrMethod, FileResourceOpenStatement, PathToExitWithoutFileResourceClose)

### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- uses the <FileResourceOpenStatement> file resource open statement
- while there exist the <PathToExitWithoutFileResourceClose> path to exit the <FunctionProcedureOrMethod> function, procedure, method, ... without releasing the file resource

The path to exit the function, procedure, method, includes calls to other functions, procedures, methods, ...

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
...
  FileResource id="pr1"
...
  PlatformAction id="pa1" kind="open" implementation="ae1"
    ManagesResource "pr1"
  PlatformAction id="pa2" kind="close" implementation="ae2"
    ManagesResource "pr1"
...
CodeModel
...
  CallableUnit|MethodUnit id="ce1" name="..."
...
  ActionElement id="ae1" kind="PlatformAction"
    Flows "ae3"
  ActionElement id="ae3"
    Flows "ae4"
  ActionElement id="ae4" kind="Return"
...
  ActionElement id="ae2" kind="PlatformAction"
...
...
```

### **What to report**

Roles to report

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <FileResourceOpenStatement> file resource open statement
- the <PathToExitWithoutFileResourceClose> path to exit

### **8.2.38 ASCQM Implement Virtual Destructor for Classes with Virtual Methods**

#### **Descriptor**

ASCQM Implement Virtual Destructor for Classes with Virtual Methods(Class, VirtualMethod)

#### **Description**

Identify occurrences in application model where

- the <Class> class
- owns the <VirtualMethod> virtual method
- but lacks a virtual destructor

#### **KDM outline illustration**

##### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="c1"  
....  
MethodUnit is="m1" methodKind="method" isVirtual="true"  
....
```

##### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="c1"  
....  
MethodUnit is="m2" methodKind="destructor" isVirtual="true"  
....
```

#### **What to report**

Roles to report are

- the <Class> class
- the <VirtualMethod> virtual method

### **8.2.39 ASCQM Ban Self Destruction**

#### **Descriptor**

ASCQM Ban Self Destruction(DeleteThisStatement)

#### **Description**

Identify occurrences in application model where

- the <DeleteThisStatement> delete this statement

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
CallableUnit id="cul" name="delete" callableKind="operator"  
...  
ClassUnit id="cul"  
...  
StorableUnit id="sul"  
...  
ActionElement id="ae1" kind="This"  
Writes "sul"  
...  
ActionElement id="ae2" kind="Call"  
Addresses "sul"  
Calls "cul"
```

#### **What to report**

##### Roles to report

- the <DeleteThisStatement> delete this statement

### **8.2.40 ASCQM Manage Time-Out Mechanisms in Blocking Synchronous Calls**

#### **Descriptor**

ASCQM Manage Time-Out Mechanisms in Blocking Synchronous Calls(BlockingSynchronousCall, TimeOutOption)

#### **Description**

Identify occurrences in application model where

- the <BlockingSynchronousCall> synchronous call

- doesn't use its <TimeOutOption> time-out option

The list of blocking synchronous primitives is technology, framework, language dependent. E.g. in Java: connect(), receive().

#### **KDM outline illustration**

##### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="cel" name="connect|receive|..." type="cel_signature"  
Signature id="cel_signature"  
...
```



```

ParameterUnit id="pul" name="timeout|..."
...
Value id="v1" attribute="infinite_wait"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
...
Calls "ce1"
Reads "v1"

```

***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

...
Value id="v2" attribute="finite_wait"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
...
Calls "ce1"
Reads "v2"

```

**What to report**

Roles to report:

- the <BlockingSynchronousCall> synchronous call
- the <TimeOutOption> time-out option

**8.2.41 ASCQM Ban Non-Final Static Data in Multi-Threaded Context**

**Descriptor**

ASCQM Ban Non-Final Static Data in Multi-Threaded Context(Declaration)

**Description**

Identify occurrences in application model where

- the <Declaration> declaration of non-final static data
- in multi-threaded environment

**KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```

CodeModel
StorableUnit id="sul" isFinal="false" isStatic="true"
...
PlatformModel
DeployedResource id="dr1"
ExecutionResource id="er1"
Thread id="t1"
Thread id="t2"

```

.....

### **What to report**

Roles to report are

- the <Declaration> declaration of non-final static data

### **8.2.42 ASCQM Ban Non-Serializable Elements in Serializable Objects**

#### **Descriptor**

ASCQM Ban Non-Serializable Elements in Serializable Objects(SerializableClass, NonSerializableMember)

#### **Description**

Identify occurrences in application model where

- the <SerializableClass> serializable class
- owns the <NonSerializableMember> non-serializable member, excluding final and transient members and members of primitive types
- without owning custom serialization / deserialization methods

The serializable nature of the element is technology dependent. E.g.: serializable nature comes from a serializable SerializableAttribute attribute or the inheritance from System.Runtime.Serialization.ISerializable in .NET, and the inheritance from the java.io.Serializable interface in Java.

#### **KDM outline illustration**

##### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
Package id="java.io" name="java.io" | Namespace
id="System.Runtime.Serialization" name="System.Runtime.Serialization"
  InterfaceUnit id="iu1" name="Serializable|ISerializable"
  ClassUnit id="cu1"
  ClassUnit id="cu2" Implements="iu1" | attribute="Serializable"
  ClassUnit id="cu3" Implements="iu1" | Extends="cu2" |
  attribute="Serializable"
  MemberUnit id="mu1" type="cu1"
```

##### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cu1" Implements="iu1" | Extends="cu2" |
attribute="Serializable"
```

or

```
ClassUnit id="cu3" Implements="iu1" | Extends="cu2" |  
attribute="Serializable"  
MemberUnit id="mu1" type="cu1" storableKind="static"
```

or

```
ClassUnit id="cu3" Implements="iu1" | Extends="cu2" |  
attribute="Serializable"  
MemberUnit id="mu1" type="cu1" attribute="transient|NonSerialized"
```

or

```
ClassUnit id="cu3" Implements="iu1" | Extends="cu2"  
MethodUnit id="mu1" name="readObject" kind="method"  
MethodUnit id="mu2" name="readObjectNoData" kind="method"  
MethodUnit id="mu3" name="writeObject" kind="method"
```

or

```
ClassUnit id="cu3" Implements="iu1" | Extends="cu2"  
MethodUnit id="mu1" name="GetObjectData" kind="method"  
MethodUnit id="mu2" name="cu2" kind="constructor" type="mu2_signature"  
Signature id="mu2_Signature"  
ParameterUnit id="p1" name="info" type="SerializationInfo"  
ParameterUnit id="p2" name="context" type="StreamingContext"
```

### **What to report**

#### **Roles to report:**

- the <SerializableClass> serializable class
- the <NonSerializableMember> non-serializable member

## **8.2.43 ASCQM Ban Hard-Coded Literals used to Connect to Resource**

### **Descriptor**

ASCQM Ban Hard-Coded Literals used to Connect to Resource(InitializationStatement, ResourceAccessStatement)

### **Description**

Identify occurrences in application model where

- the <InitializationStatement> initialization statement
- initialize a variable used in the <ResourceAccessStatement> resource access statement as parameter to call a resource access primitive

It covers credentials, passwords, encryption keys, tokens, remember-me keys...

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
Value id="hcv" name="hcv"  
...  
StorableUnit|ItemUnit|MemberUnit id="sul"  
...  
ActionElement id="ae1" kind="Assign  
  Reads "hcv"  
  Writes "sul"  
...  
MarshaledResource|MessagingResource|DataManager|ExecutionResource id="nwr"  
...  
ControlElement id="ce1"  
...  
  ActionElement id="ae2" kind="Platform"  
    ManagesResource|ReadsResource|WritesResource "nwr"  
...  
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"  
  Reads "sul"  
...  
  Calls "ce1"
```

### **What to report**

Roles to report are

- the <InitializationStatement> initialization statement
- the <ResourceAccessStatement> resource access statement

## **8.2.44 ASCQM Ban Unintended Paths**

### **Descriptor**

ASCQM Ban Unintended Paths(ArchitectureModel, Relation, Caller, Callee, OriginModule, TargetModule)

### **Description**

Identify occurrences in the application model where

- the <Relation> call-type, data, use relations
- between the <Caller> caller
- grouped in the <OriginModule> origin layer, component, or subsystem
- and the <Callee> callee
- grouped into the <TargetModule> target layer, component, or subsystem

- as defined in the <ArchitectureModel> architectural blueprint defining layers, components, or subsystems

- where relations from the <OriginModule> layer, component, or subsystem to the <TargetModule> layer, component, or subsystem are not intended

The architectural blueprint defining layers, components, or subsystems is application dependent.

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
Layer | Component | Subsystem id="m1"  
...  
    CallableUnit callableKind="regular|external|stored" | MethodUnit id="ce1"  
name="..."  
...  
    ActionElement id="ae1"  
    UsesType | Reads | Writes | Creates | Addresses | Calls | Dispatches "ce2"  
...  
Layer | Component | Subsystem id="m2"  
...  
    CallableUnit callableKind="regular|external|stored" | MethodUnit id="ce2"  
name="..."  
...
```

With "m1" not intended to reference "m2"

### **What to report**

Roles to report are

- the <ArchitectureModel> architectural blueprint

- the <Relation> relation

- the <Caller> caller

- the <Callee> callee

- the <OriginModule> origin layer, component, or subsystem

- the <TargetModule> target layer, component, or subsystem

## **8.2.45 ASCQM Ban Incorrect Float Number Comparison**

### **Descriptor**

ASCQM Ban Incorrect Float Number Comparison(FloatEqualityComparisonExpression)

### **Description**

Identify occurrences in application model where

- the <FloatEqualityComparisonExpression> equality comparison expression
- between two float numbers

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
FloatType id="ft1"  
StorableUnit|ItemUnit|MemberUnit id="de1" type="ft1"  
StorableUnit|ItemUnit|MemberUnit id="de2" type="ft1"  
ActionElement id="ae1" kind="Equals|NotEqual" ext="de1 == de2 | de1 != de2"  
  Reads "de1"  
  Reads "de2"
```

#### **What to report**

Roles to report are

- the <FloatEqualityComparisonExpression> equality comparison expression

### **8.2.46 ASCQM Singleton Creation without Proper Locking in Multi-Threaded Context**

#### **Descriptor**

ASCQM Singleton Creation without Proper Locking in Multi-Threaded Context(SingletonClass, InitializationStatement)

#### **Description**

Identify occurrences in application model where

- the <SingletonClass> singleton class
- with the <InitializationStatement> self-reference initialization statement
- not properly locked
- while it operates in a multi-threaded environment

The proper locking is technology, framework, and language dependent.

The detection of multi-threading capability is technology, framework, and language dependent.

#### **KDM outline illustration**

***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel  
  DeployedResource id="dr1"  
  ExecutionResource id="er1"  
  Thread id="t1"  
  ...
```

```

PlatformAction id="pa1" implementation="ae1"
  ManagesResource "t1"
...
CodeModel
  ActionElement id="ae1"
...
  ClassUnit id="singleton" exportKind="public"
    MemberUnit id="reference" isStatic="true" exportKind="private"
type="singleton"
    MethodUnit id="c" kind="constructor" exportKind="private"
type="c_signature"
      Signature
        ParameterUnit id="r1" kind="return" type="singleton"
...
    MethodUnit id="refget" kind="method" storableKind="static"
exportKind="public" type="refget_signature"
      Signature id="refget_signature"
        ParameterUnit id="r2" kind="return" type="singleton"
      ActionElement id="a2" name="a2" kind="Return"
        Writes "r2"
        Reads "reference"
...

```

***KDM elements absent from the application model***

***KDM outline illustrating only the essential elements related to micro KDM:***

```

PlatformModel
  DeployedResource id="dr1"
...
  LockResource id="lr1"
...
  PlatformAction id="pa2" kind="lock" implementation="ae3"
    ManagesResource|ReadsResource|WritesResource "lr1"
  PlatformAction id="pa3" kind="unlock" implementation="ae5"
    ManagesResource|ReadsResource|WritesResource "lr1"
...
CodeModel
  ClassUnit id="singleton" exportKind="public"
...
    ActionElement id="ae2" kind="Compound"
      EntryFlow "ae3"
      ActionElement id="ae3" kind="PlatformAction"
        Flows "ae4"
      ActionElement id="ae4"
        Writes "reference"
        Flows "ae5"
      ActionElement id="ae5" kind="PlatformAction"
...

```

### **What to report**

#### **Roles to report are**

- the <SingletonClass> singleton class
- the <InitializationStatement> initialization statement

### **8.2.47 ASCQM Ban Incorrect Numeric Implicit Conversion**

#### **Descriptor**

ASCQM Ban Incorrect Numeric Implicit Conversion(Variable, VariableDataType, VariableAssignmentStatement, Data, TargetDataType)

#### **Description**

Identify occurrences in application model where

- the <Variable> variable is declared with the <VariableDataType> numerical data type
- then updated is the <VariableAssignmentStatement> assignment statement
- with the <Data> data of the <TargetDataType> second numerical data type
- which is incompatible with the first one
- and without any range check or explicit casting

#### **KDM outline illustration**

##### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
IntegerType|DecimalType|FloatType id="dt1"  
StorableUnit|ItemUnit|MemberUnit id="de1" type="dt1"  
IntegerType|DecimalType|FloatType id="dt2"  
StorableUnit|ItemUnit|MemberUnit|Value id="de2" type="dt2"  
ActionElement id="ae1" kind="Assign"  
    Writes "de1"  
    Reads "de2"
```

##### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae2" kind="LessThan|LessThanOrEqual"  
    Reads "de2"  
ActionElement id="ae3" kind="GreaterThan|GreaterThanOrEqual"  
    Reads "de2"
```

or

```
ActionElement id="ae1" kind="TypeCast"  
    Reads "de2"
```



```
UsesType "dt1"  
Writes "del"
```

and the numeric datatypes are not compatible.

Compatibility comes from storage size and primary types. E.g.: char and int8, wchar and int16, 64-bit pointers and 64-bits long integers, ...

### **What to report**

Roles to report are

- the <Variable> variable
- the <VariableDataType> numerical data type
- the <VariableAssignmentStatement> assignment statement
- the <Data> data
- the <TargetDataType> second numerical data type

## **8.2.48 ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context**

### **Descriptor**

ASCQM Data Read and Write without Proper Locking in Multi-Threaded Context(InitializationStatement)

### **Description**

Identify occurrences in application model where

- the <WriteOrReadStatement> write or read statement
- of variable with the <NonAtomicDataType> non-atomic data type
- is not properly locked,
- while it operates in a multi-threaded environment

The proper locking is technology, framework, and language dependent.

The detection of multi-threading capability is technology, framework, and language dependent.

The list of non-atomic data types is technology, framework, and language dependent.

### **KDM outline illustration**

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel  
  DeployedResource id="dr1"  
  ExecutionResource id="er1"  
    Thread id="t1"  
  ...
```

```

PlatformAction id="pa1" implementation="ae1"
  ManagesResource "t1"
...
CodeModel
  ActionElement id="ae1"
...
  DataType id="dt1" isAtomic="false"
  StorableUnit id="sul" type="dt1"
...
  ActionElement id="ae4" kind="Assign|Select|..."
  Reads|Writes "sul"
...

```

### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```

PlatformModel
  DeployedResource id="drl"
  ...
  LockResource id="lrl"
  ...
  PlatformAction id="pa2" kind="lock" implementation="ae3"
  ManagesResource|ReadsResource|WritesResource "lrl"
  PlatformAction id="pa3" kind="unlock" implementation="ae5"
  ManagesResource|ReadsResource|WritesResource "lrl"
...
CodeModel
  ...
  ActionElement id="ae2" kind="Compound"
  EntryFlow "ae3"
  ActionElement id="ae3" kind="PlatformAction"
  Flows "ae4"
  ActionElement id="ae4" kind="Assign|Select|..."
  Reads|Writes "sul"
  Flows "ae5"
  ActionElement id="ae5" kind="PlatformAction"
...

```

### **What to report**

Roles to report are

- the <InitializationStatement> initialization statement

## **8.2.49 ASCQM Ban Incorrect Synchronization Mechanisms**

### **Descriptor**

ASCQM Ban Incorrect Synchronization Mechanisms(IncorrectSynchronizationPrimitiveCall)

### **Description**

Identify occurrences in application model where

- the <IncorrectSynchronizationPrimitiveCall> call to incorrect synchronization primitive
- while it operates in a multi-threaded environment

The list of incorrect synchronization primitives is technology, framework, language dependent.  
E.g.: java.lang.Thread.run() in Java; getlogin() in C; synchronisation primitives with EJBs.  
The detection of multi-threading capability is technology, framework, and language dependent.

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
CodeModel
  ControlElement id="ce1" name="run|getlogin|..."
  ...
  ...
  ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  ...
  Calls "ce1"
  ...
PlatformModel
  DeployedResource id="dr1"
  ExecutionResource id="er1"
  Thread id="t1"
  Thread id="t2"
  ...
```

### **What to report**

Roles to report are

- the <IncorrectSynchronizationPrimitiveCall> call to incorrect synchronization primitive

## **8.2.50 ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context**

### **Descriptor**

ASCQM Ban Resource Access without Proper Locking in Multi-Threaded Context(ResourceAccessStatement)

### **Description**

Identify occurrences in application model where

- the <ResourceAccessStatement> access statement to a resource
- not properly locked
- while it operates in a multi-threaded environment

The proper locking is technology, framework, and language dependent.  
The detection of multi-threading capability is technology, framework, and language dependent.

### **KDM outline illustration**

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
  DeployedResource id="dr1"
  ExecutionResource id="er1"
  Thread id="t1"
  ...
  PlatformAction id="pa1" implementation="ae1"
  ManagesResource "t1"
  ...
  StreamResource|FileResource|... id="pr1"
  ...
  PlatformAction id="pa2" implementation="ae2"
  ManagesResource|ReadsResource|WritesResource "pr1"
  ...
  ...
CodeModel
  ActionElement id="ae1" kind="PlatformAction"
  ...
  ActionElement id="ae2" kind="PlatformAction"
  ...
  ...
```

#### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
  DeployedResource id="dr1"
  ...
  LockResource id="lr1"
  ...
  PlatformAction id="pa2" kind="lock" implementation="ae4"
  ManagesResource|ReadsResource|WritesResource "lr1"
  PlatformAction id="pa3" kind="unlock" implementation="ae5"
  ManagesResource|ReadsResource|WritesResource "lr1"
  ...
CodeModel
  ClassUnit id="singleton" exportKind="public"
  ...
  ActionElement id="ae3" kind="Compound"
  EntryFlow "ae4"
  ActionElement id="ae4" kind="PlatformAction"
```

```

Flows "ae2"
ActionElement id="ae2"
Flows "ae5"
ActionElement id="ae5" kind="PlatformAction"
...

```

**What to report**

Roles to report are

- the <ResourceAccessStatement> access statement to a resource

**8.2.51 ASCQM Ban Incorrect Type Conversion**

Descriptor

ASCQM Ban Incorrect Type Conversion(Variable, VariableDataType, VariableAssignmentStatement, Data, TargetDataType)

Description

Identify occurrences in application model where

- the <Variable> variable is declared with the <VariableDataType> non-numerical data type

- then updated is the <VariableAssignmentStatement> assignment statement

- with the <Data> data is of the <TargetDataType> second non-numerical data type

- which is incompatible with the first one

KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```

StringType|ClassUnit|... id="dt1"
StorableUnit|ItemUnit|MemberUnit id="de1" type="dt1"
StringType|ClassUnit|... id="dt2"
StorableUnit|ItemUnit|MemberUnit|Value id="de2" type="dt2"
ActionElement id="ae1" kind="Assign"
  Writes "de1"
  Reads "de2"

```

or

```

StringType|ClassUnit|... id="dt1"
PointerType id="pt1"
StorableUnit|ItemUnit|MemberUnit id="de1" type="pt1"
StringType|ClassUnit|... id="dt2"
PointerType id="pt2"
ActionElement id="ae1" kind="TypeCast"
  Reads "de1"
  UsesType "pt2"

```

Where the non-numeric datatypes are not compatible.

Compatibility comes from inheritance links between objects, and, when numeric types are concerned, from storage size and primary types. E.g.: char and int8, wchar and int16, 64-bit pointers and 64-bits long integers, ...

#### **What to report**

Roles to report are

- the <Variable> variable
- the <VariableDataType> data type
- the <VariableAssignmentStatement> assignment statement
- the <Data> data
- the <TargetDataType> second data type

### **8.2.52 ASCQM Ban Return of Local Variable Address**

#### **Descriptor**

ASCQM Ban Return of Local Variable Address(LocalVariable, Operation)

#### **Description**

Identify occurrences in application model where

- he address of the <LocalVariable> local variable
- is returned by the <Operation> operation

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
...
PointerType id="pt1"
CallableUnit callableKind="regular|external|stored" | MethodUnit id="cel"
name="..." type="cel_signature"
  Signature id="cel_signature"
  ...
  ParameterUnit id="pul" kind="return" type="pt1"
  ...
  StorableUnit id="sul" kind="register"
  StorableUnit id="su2" kind="local"
  ActionElement id="ae1" kind="Ptr"
    Writes "sul"
    Addresses "su2"
  ActionElement id="ae2" kind="Return"
    Reads "sul"
...
```

**What to report**

Roles to report are

- the <LocalVariable> local variable address
- the <Operation> operation

**8.2.53 ASCQM Ban Storage of Local Variable Address in Global Variable**

**Descriptor**

ASCQM Ban Storage of Local Variable Address in Global Variable(LocalVariable, StorageStatement, GlobalVariable)

**Description**

Identify occurrences in application model where

- the address of the <LocalVariable> local variable
- is stored by the <StorageStatement> statement
- into the <GlobalVariable> global variable

**KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
StorableUnit id="su1" kind="global"
...
CallableUnit callableKind="regular|external|stored" | MethodUnit id="ce1"
...
  StorableUnit id="su2" kind="register"
  StorableUnit id="su3" kind="local"
  ActionElement id="ae1" kind="Ptr"
    Writes "su2"
    Addresses "su3"
  ActionElement id="ae2" kind="Assign"
    Reads "su2"
    Writes "su3"
...
```

**What to report**

Roles to report are

- the <LocalVariable> local variable address
- the <StorageStatement> statement
- the <GlobalVariable> global variable

## 8.2.54 ASCQM Ban While TRUE Loop Without Path To Break

### Descriptor

ASCQM Ban While TRUE Loop Without Path To Break(WhileTrueLoop)

### Description

Identify occurrences in the application model where:

- the <WhileTrueLoop> "while true" loop
- lacks a control flow to a break statement out of the loop

### KDM outline illustration

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
BooleanType id="booleanType"  
Value id="true" name="true" type="booleanType"  
ActionElement id="ae1" kind="Compound"  
  ActionElement id="ae2" kind="Condition"  
    Reads "true"  
    TrueFlow "tf1"  
    FalseFlow "ff1"  
  ActionElement id="tf1" ...  
  ...  
  Flows "ae2"  
ActionElement id="ff1" ...
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae1" kind="Compound"  
  ActionElement id="ae2" kind="Condition"  
    ...  
    TrueFlow "tf1"  
    ...  
  ActionElement id="tf1" ...  
    Flows "ae3"  
  ActionElement id="ae3"  
    Flows "e1"  
  ActionElement id="e1" kind="Goto"  
    Flows "ff1"  
  ...  
ActionElement id="ff1" ...
```

### What to report

#### Roles to report

- the <WhileTrueLoop> "while true" loop



## **8.2.55 ASCQM Ban Unmodified Loop Variable Within Loop**

### **Descriptor**

ASCQM Ban Unmodified Loop Variable Within Loop(WhileLoop)

### **Description**

Identify occurrences in the application model where:

- the `<WhileLoop>` while loop
- lacks an update of the condition value within the loop

### **KDM outline illustration**

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
BooleanType id="booleanType"  
StorableUnit id="sul" type="booleanType"  
ActionElement id="ae1" kind="Compound"  
...  
ActionElement id="ae2" kind="Condition"  
  Reads "sul"  
...  
...  
...
```

#### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae1" kind="Compound"  
...  
ActionElement id="ae3" kind="Assign|Incr|Decr"  
  Writes "sul"  
...  
...
```

### **What to report**

#### **Roles to report**

- the `<WhileLoop>` while loop

## **8.2.56 ASCQM Check and Handle ZERO Value before Use as Divisor**

### **Descriptor**

ASCQM Check and Handle ZERO Value before Use as Divisor(DivisionStatement)

### **Description**

Identify occurrences in application model where

- the <DivisionStatement> division statement

- uses a variable which is not checked and handled before use as divisor immediately before

### **KDM outline illustration**

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
StorableUnit id="su1"  
StorableUnit id="su2"  
ActionElement id="ae3" kind="Divide"  
  Reads "su1"  
  Reads "su2"
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
Value id="v1" name="0"  
StorableUnit id="su3"  
ActionElement id="ae1" kind="NotEqual"  
  Reads "v1"  
  Reads "su2"  
  Writes "su3"  
  Flows "ae2"  
ActionElement id="ae2" kind="Condition"  
  Reads "su3"  
  TrueFlow "ae3"  
  FalseFlow "ff1"  
...
```

### **What to report**

Roles to report are

- the <DivisionStatement> division statement

## **8.2.57 ASCQM Ban Creation of Lock On Private Non-Static Object to Access Private Static Data**

### **Descriptor**

ASCQM Ban Creation of Lock On Private Non-Static Object to Access Private Static Data(PrivateNonStaticLock, DataAccess, PrivateStaticData)

### **Description**

- Identify occurrences in application model where
- the <PrivateNonStaticLock> private non-static lock object
- is used to lock a block including the <DataAccess> data access
- to the <PrivateStaticData> private static data

The locking mechanism is technology, framework, language dependent.

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
  DeployedResource id="dr1"
  ...
  LockResource id="lr1"
  ...
  PlatformAction id="pa2" kind="lock" implementation="ae1"
    ManagesResource|ReadsResource|WritesResource "lr1"
  ...
CodeModel
  ...
  StorableUnit id="su1" isStatic="false" exportKind="private"
  StorableUnit id="su2" isStatic="true" exportKind="private"
  ...
  ActionElement id="ae1" kind="PlatformAction"
    Reads "su1"
    Flows "ae2"
  ActionElement id="ae2"
    Flows "ae3"
  ActionElement id="ae3"
kind="Assign|PtrReplace|ArrayReplace|PtrSelect|ArraySelect|..."
  Reads|Writes "su2"
  ...
  ...
```

### **What to report**

#### **Roles to report**

- the <PrivateNonStaticLock> private non-static lock object
- the <DataAccess> data access
- the <PrivateStaticData> private static data

## **8.2.58 ASCQM Release Lock After Use**

### **Descriptor**

ASCQM Release Lock After Use(FunctionProcedureOrMethod, LockAcquisitionStatement, PathToExitWithoutLockRelease)

### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- uses the <LockAcquisitionStatement> lock acquisition statement
- while there exist the <PathToExitWithoutLockRelease> path to exit the <FunctionProcedureOrMethod> function, procedure, method, ... without releasing the lock resource

The path to exit the function, procedure, method, includes calls to other functions, procedures, methods, ...

The locking mechanism is technology, framework, and language dependent.

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
  DeployedResource id="dr1"
  ...
  LockResource id="lr1"
  ...
  PlatformAction id="pa2" kind="lock" implementation="ae1"
    ManagesResource|ReadsResource|WritesResource "lr1"
  PlatformAction id="pa3" kind="unlock" implementation="ae2"
    ManagesResource|ReadsResource|WritesResource "lr1"
  ...
CodeModel
  ...
  CallableUnit|MethodUnit id="ce1" name="..."
  ...
  ActionElement id="ae1" kind="PlatformAction"
    Flows "ae3"
  ActionElement id="ae3"
    Flows "ae4"
  ActionElement id="ae4" kind="Return"
  ...
  ActionElement id="ae2" kind="PlatformAction"
  ...
  ...
```

### **What to report**

Roles to report

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <LockAcquisitionStatement> lock acquisition statement
- the <PathToExitWithoutLockRelease> path to exit

## 8.2.59 ASCQM Ban Sleep Between Lock Acquisition and Release

### Descriptor

ASCQM Ban Sleep Between Lock Acquisition and Release(PathFromLockAcquisitionToLockRelease, LockAcquisitionStatement, LockReleaseStatement, SleepStatement)

### Description

Identify occurrences in application model where  
- the <PathFromLockAcquisitionToLockRelease> path  
- from the <LockAcquisitionStatement> lock acquisition statement  
- to the <LockReleaseStatement> lock release statement  
- contains the <SleepStatement> sleep statement

The path includes calls to other functions, procedures, methods, ...  
The locking mechanism is technology, framework, and language dependent.

### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
  DeployedResource id="dr1"
  ...
  LockResource id="lr1"
  ...
  PlatformAction id="pa2" kind="lock" implementation="ae1"
    ManagesResource|ReadsResource|WritesResource "lr1"
  PlatformAction id="pa3" kind="unlock" implementation="ae5"
    ManagesResource|ReadsResource|WritesResource "lr1"
  ...
  ExecutionResource id="er1"
  ...
  Thread id="t1"
  ...
  PlatformAction id="pa3" kind="sleep" implementation="ae3"
    ManagesResource "t1"
  ...
CodeModel
  ...
  CallableUnit|MethodUnit id="ce1" name="..."
  ...
  ActionElement id="ae1" kind="PlatformAction"
    Flows "ae2"
  ActionElement id="ae2"
    Flows "ae3"
```

```

          ActionElement id="ae3" kind="PlatformAction"
          Flows "ae4"
          ActionElement id="ae4"
          Flows "ae5"
          ActionElement id="ae5" kind="PlatformAction"
...
...

```

**What to report**

Roles to report

- the <PathFromLockAcquisitionToLockRelease> path
- the <LockAcquisitionStatement> lock acquisition statement
- the <LockReleaseStatement> lock release statement
- the <SleepStatement> sleep statement

**8.2.60 ASCQM Ban Creation of Lock On Non-Final Object**

Descriptor

ASCQM Ban Creation of Lock On Non-Final Object(NonFinalObjectDeclaration, LockingAcquisitionStatement)

Description

Identify occurrences in application model where

- the <NonFinalObjectDeclaration> non-final object declaration
- declares an object used as a lock in the <LockingAcquisitionStatement> locking acquisition statement

The locking mechanism is technology, framework, language dependent.

**KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```

PlatformModel
  DeployedResource id="dr1"
  ...
  LockResource id="lr1"
  ...
  PlatformAction id="pa2" kind="lock" implementation="ae1"
    ManagesResource | ReadsResource | WritesResource "lr1"
  ...
CodeModel
  ...
  StorableUnit id="sul" isFinal="false"
  ...

```

```
    ActionElement id="ae1" kind="PlatformAction"  
    Reads "sul"  
    ...
```

### **What to report**

#### **Roles to report**

- the <NonFinalObjectDeclaration> non-final object declaration
- the <LockingAcquisitionStatement> locking acquisition statement

## **8.2.61 ASCQM Ban Creation of Lock On Inappropriate Object Type**

### **Descriptor**

ASCQM Ban Creation of Lock On Inappropriate Object Type(ObjectDeclaration, LockingAcquisitionStatement)

### **Description**

Identify occurrences in application model where

- the <ObjectDeclaration> object declaration
- declares an object used as a lock in the <LockingAcquisitionStatement> locking acquisition statement
- while its type is not suitable for locking

The list of proper locking object types is technology, framework, language dependent. E.g. in C# and Java: Reference Types, excluding Boxed Types, Strings

### **KDM outline illustration**

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel  
    DeployedResource id="dr1"  
    ...  
    LockResource id="lr1"  
    ...  
    PlatformAction id="pa2" kind="lock" implementation="ae1"  
        ManagesResource | ReadsResource | WritesResource "lr1"  
    ...  
CodeModel  
    ...  
    StorableUnit id="sul"  
    ...  
    ActionElement id="ae1" kind="PlatformAction"  
        Reads "sul"  
    ...
```

**KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
CodeModel  
...  
ClassUnit|InterfaceUnit|... id="dt1"  
StorableUnit id="sul" type="dt1"  
...
```

**What to report**

Roles to report

- the <ObjectDeclaration> object declaration
- the <LockingAcquisitionStatement> locking acquisition statement

**8.2.62 ASCQM NULL Terminate Output Of String Manipulation Primitives**

**Descriptor**

ASCQM NULL Terminate Output Of String Manipulation Primitives(StringManipulationCallStatement)

**Description**

Identify occurrences in application model where

- the <StringManipulationCallStatement> string manipulation call statement
- is not immediately followed by adding a NULL termination to the resulting string

**KDM outline illustration**

**KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
StringType id="string"  
StorableUnit id="sul" type="string"  
...  
ControlElement id="cel" type="cel_signature"  
Signature id="cel_signature"  
ParameterUnit id="pu1" kind="Return|byReference" type="string"  
...  
ActionElement id="ael" kind="Call|PtrCall|MethodCall|VirtualCall"  
Calls "cel"  
Writes "sul"
```

**KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:



```
Value id="null"  
ActionElement id="ae2" kind="PtrReplace|ArrayReplace"  
  Reads "null"  
  Addresses "s1"
```

### **What to report**

#### **Roles to report**

- the <StringManipulationCallStatement> string manipulation call statement

### **8.2.63 ASCQM Release File Resource after Use in Class**

#### **Descriptor**

ASCQM Release File Resource after Use in Class(Class, FileResourceOpenStatement)

#### **Description**

Identify occurrences in application model where

- the <Class> class, ...

- uses the <FileResourceOpenStatement> file resource open statement

- without releasing the file resource in any of its methods

The path to exit the function, procedure, method, includes calls to other functions, procedures, methods, ...

#### **KDM outline illustration**

##### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel  
  ...  
  FileResource id="pr1"  
  ...  
  PlatformAction id="pa1" kind="open" implementation="ae1"  
    ManagesResource "pr1"  
  PlatformAction id="pa2" kind="close" implementation="ae2"  
    ManagesResource "pr1"  
  ...  
CodeModel  
  ...  
  ClassUnit id="cul"  
  ...  
  ActionElement id="ae1" kind="PlatformAction"  
  ...  
  ...
```

### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cu1"  
...  
ActionElement id="ae2" kind="PlatformAction"  
...
```

### **What to report**

#### Roles to report

- the <Class> class
- the <FileResourceOpenStatement> file resource open statement

## **8.2.64 ASCQM Use Break in Switch Statement**

### **Descriptor**

ASCQM Use Break in Switch Statement(Switch, ControlFlowBranch)

### **Description**

Identify occurrences in application model where

- the <ControlFlowBranch> control flow branch
- of the <Switch> switch
- does not contain a break statement

### **KDM outline illustration**

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
StorableUnit id="su1"  
StorableUnit id="su2"  
StorableUnit id="su3"  
ActionElement id="ael" kind="Switch"  
  Reads "su1"  
  GuardedFlow "gf1"  
  GuardedFlow "gf2"  
  ...  
  FalseFlow "ff1"  
ActionElement id="gf1" kind="Guard"  
  Reads "su2"  
  Flows "f1"  
ActionElement id="gf2" kind="Guard"  
  Reads "su3"  
  Flows "f2"  
...  
ActionElement id="ff1" kind="Compound"
```

```

...
  ActionElement id="g1" kind="Goto"
    Flows "e1"
ActionElement id="f1" kind="Compound"
...
ActionElement id="f2" kind="Compound"
...
  ActionElement id="g1" kind="Goto"
    Flows "e1"
...
ActionElement id="e1" ...

```

### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```

StorableUnit id="su1"
StorableUnit id="su2"
ActionElement id="ael" kind="Switch"
  Reads "su1"
  GuardedFlow "gf1"
...
ActionElement id="gf1" kind="Guard"
  Reads "su2"
  Flows "f1"
...
ActionElement id="f1" kind="Compound"
...
  ActionElement id="g1" kind="Goto"
    Flows "e1"
...
ActionElement id="e1" ...

```

### **What to report**

Roles to report are

- the <Switch> switch
- the <ControlFlowBranch> control flow branch

## **8.2.65 ASCQM Catch Exceptions**

### **Descriptor**

ASCQM Catch Exceptions(Method, Exception, MethodCall)

### **Description**

Identify occurrences in application model where

- the <Method> method
- declared as throwing the <Exception> exception

- is called in the <MethodCall> method call
- which doesn't catch exceptions of type <Exception>

### **KDM outline illustration**

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```

...
ClassUnit id="cu1"
...
MethodUnit id="mul" type="mul_signature"
  Signature id="mul_signature"
  ParameterUnit id="pu1" type="cu1" kind="throws"
  ...
...
ActionElement id="ae1" kind="MethodCall"
  Calls "mul"
...

```

#### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```

...
TryUnit id="t1"
  ...
  ActionElement id="ae1" kind="MethodCall"
    Calls "mul"
  ...
  ExceptionFlow "c1"
...
CatchUnit id="c1"
  ParameterUnit id="pu2" type="cu1"
  ...
...

```

### **What to report**

Roles to report are

- the <Method> method
- the <Exception> exception
- the <MethodCall> method call

## **8.2.66 ASCQM Ban Empty Exception Block**

### **Descriptor**

ASCQM Ban Empty Exception Block(CatchBlock)

### **Description**

Identify occurrences in application model where

- the <CatchBlock> catch block
- is empty

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
CatchUnit id="cul"  
  ActionElement id="ae1" kind="Nop"  
...
```

### **What to report**

Roles to report are

- the <CatchBlock> catch block

## **8.2.67 ASCQM Initialize Resource before Use**

### **Descriptor**

ASCQM Initialize Resource before Use(PathToResourceAccessFromResourceDeclaration, ResourceDeclarationStatement, ResourceAccessStatement)

### **Description**

Identify occurrences in application model where

- the <PathToResourceAccessFromResourceDeclaration> path
- from the <ResourceDeclarationStatement> resource declaration statement
- to the <ResourceAccessStatement> resource access statement
- lacks a resource initialization statement

excluding pointers and variables

### **KDM outline illustration**

***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel  
...  
PlatformResource id="pr1"  
...  
PlatformResource id="pal" kind="read|write" implementation="ae6"  
  ReadsResource|WritesResource "pr1"  
...
```

```

CodeModel
...
StorableUnit id="sul"
ActionElement id="ae1" kind="Assign"
  Writes "sul"
  Flows "ae3"
ActionElement id="ae3" ...
  Flows "ae4"
ActionElement id="ae4" ...
  Flows "ae5"
ActionElement id="ae5" ...
  Flows "ae6"
ActionElement id="ae6" kind="PlatformAction"
  Reads "sul"
...
...

```

***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

PlatformModel
...
PlatformResource id="pa2" kind="open" implementation="ae4"
  ReadsResource|WritesResource "pr1"
...
CodeModel
...
ActionElement id="ae4" kind="PlatformAction"
  Reads "sul"
  Flows "ae5"
...
...

```

**What to report**

**Roles to report**

- the <PathToResourceAccessFromResourceDeclaration> path
- the <ResourceDeclarationStatement> resource declaration statement
- the <ResourceAccessStatement> resource access statement

**8.2.68 ASCQM Ban Incompatible Lock Acquisition Sequences**

**Descriptor**

ASCQM Ban Incompatible Lock Acquisition Sequences(LockAcquisitionSequence, ReverseLockAcquisitionSequence)

**Description**

Identify occurrences in application model where

- the <LockAcquisitionSequence> sequence of lock acquisition
- is the reverse of the <ReverseLockAcquisitionSequence> sequence of lock acquisition

The locking mechanism is technology, framework, and language dependent.

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```

PlatformModel
  DeployedResource id="dr1"
  ...
  LockResource id="lr1"
  LockResource id="lr2"
  ...
  PlatformAction id="pa1" kind="lock" implementation="ae1 ae12"
    ManagesResource|ReadsResource|WritesResource "lr1"
  PlatformAction id="pa2" kind="lock" implementation="ae3 ae10"
    ManagesResource|ReadsResource|WritesResource "lr2"
  ...
CodeModel
  ...
  ActionElement id="ae1" kind="PlatformAction"
    Flows "ae2"
  ActionElement id="ae2" ...
    Flows "ae3"
  ActionElement id="ae3" kind="PlatformAction"
    Flows "ae4"
  ActionElement id="ae4" ...
  ...
  ActionElement id="ae10" kind="PlatformAction"
    Flows "ae11"
  ActionElement id="ae11" ...
    Flows "ae12"
  ActionElement id="ae12" kind="PlatformAction"
    Flows "ae13"
  ActionElement id="ae13" ...

```

### **What to report**

Roles to report are

- the <LockAcquisitionSequence> sequence of lock acquisition
- the <ReverseLockAcquisitionSequence> sequence of lock acquisition

## **8.2.69 ASCQM Ban Use of Thread Control Primitives with Known Deadlock Issues**

### **Descriptor**

ASCQM Ban Use of Thread Control Primitives with Known Deadlock Issues(ThreadControlPrimitiveCall)

### **Description**

Identify occurrences in application model where  
- the <ThreadControlPrimitiveCall> call to a thread control function, procedure, method, ... with known deadlock issues.

The list of primitives is technology, framework, language dependant. E.g. in Java:  
java.lang.Thread.suspend(), java.lang.Thread.resume(), java.lang.ThreadGroup.suspend(), java.lang.ThreadGroup.resume() and dependent methods java.lang.ThreadGroup.allowThreadSuspension().

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce1"  
name=" java.lang.Thread.suspend | java.lang.Thread.resume | ..."  
...  
...  
ActionElement id="ae3" kind="Call | PtrCall | MethodCall | VirtualCall"  
...  
Calls "ce1"
```

### **What to report**

Roles to report:  
- the <ThreadControlPrimitiveCall> call to a thread control function, procedure, method, ... with known deadlock issues.

## **8.2.70 ASCQM Ban Buffer Size Computation Based on Bitwise Logical Operation**

### **Descriptor**

ASCQM Ban Buffer Size Computation Based on Bitwise Logical Operation(MemoryAllocationCall, BitwiseOperation)

### **Description**

Identify occurrences in application model where  
- the <MemoryAllocationCall> call to a memory allocation primitive  
- uses the length parameter based on the <BitwiseOperation> bitwise operation



The list of memory allocation primitives is technology, framework, language dependent. E.g. with C-type languages: malloc, calloc, realloc.

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
IntegerType id="it1"
...
ControlElement id="ce1" name="malloc|calloc|realloc|..." type="ce1_signature"
  Signature id="ce1_signature"
  ParameterUnit id="pu1" type="it1" kind="byValue"
  ParameterUnit id="pu1" type="pt1" kind="return"
...
...
StorableUnit id="su1" type="it1"
StorableUnit id="su2" type="it1"
StorableUnit id="su3" type="it1"
...
ActionElement id="ae1" kind="BitAnd|BitOr|BitXor"
  Reads "su1"
  Reads "su2"
  Writes "su3"
ActionElement id="ae2" kind="Call|PtrCall|MethodCall|VirtualCall"
  Reads "su3"
  Calls "ce1"
```

### **What to report**

#### Roles to report

- the <MemoryAllocationCall> call to a memory allocation primitive
- the <BitwiseOperation> bitwise operation

## **8.2.71 ASCQM Ban Buffer Size Computation Based on Array Element Pointer Size**

### **Descriptor**

ASCQM Ban Buffer Size Computation Based on Array Element Pointer Size(MemoryAllocationCall)

### **Description**

Identify occurrences in application model where

- the <MemoryAllocationCall> call to a memory allocation primitive
- uses the length parameter based on datatype pointer size

The list of memory allocation primitives is technology, framework, language dependent. E.g. with C-type languages: malloc, calloc, realloc.

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
DataType id="dt1"
PointerType id="pt1"
  ItemUnit id="iu1" type="dt1"
IntegerType id="it1"
ControlElement id="ce1" name="malloc|calloc|realloc|..." type="cel_signature"
  Signature id="cel_signature"
    ParameterUnit id="pul" type="it1" kind="byValue"
    ParameterUnit id="pul" type="pt1" kind="return"
  ...
...
StorableUnit id="su1" type="it1"
StorableUnit id="su2" type="pt1"
StorableUnit id="su3" type="it1"
...
ActionElement id="ae1" kind="Sizeof"
  Writes "su1"
  Reads "su2" | UsesType "pt1"
ActionElement id="ae2" kind="Multiply"
  Reads "su1"
  Reads ...
  Writes "su3"
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Reads "su3"
  Calls "ce1"
```

### **What to report**

Roles to report

- the <MemoryAllocationCall> call to a memory allocation primitive

## **8.2.72 ASCQM Ban Buffer Size Computation Based on Incorrect String Length Value**

### **Descriptor**

ASCQM Ban Buffer Size Computation Based on Incorrect String Length Value(MemoryAllocationCall, LengthComputation)

### **Description**

Identify occurrences in application model where

- the <MemoryAllocationCall> call to a memory allocation primitive

- uses the length parameter based on the incorrect <LengthComputation> string length computation where 1 is added to the string address and not the result of the call

The list of memory allocation primitives is technology, framework, language dependent. E.g. with C-type languages: malloc, calloc, realloc.

The list of string length computation primitives is technology, framework, language dependent. E.g. with C-type languages: strlen.

e.g.: `new_name = (char*)malloc(strlen(name+1));`

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
StringType id="st1"
PointerType id="pt1"
IntegerType id="it1"
...
ControlElement id="ce1" name="strlen|..." type="ce2_signature"
  Signature id="ce2_signature"
    ParameterUnit id="pu3" type="pt1"
    ParameterUnit id="pu4" type="it1" kind="return"
...
ControlElement id="ce2" name="malloc|calloc|realloc|..." type="ce1_signature"
  Signature id="ce1_signature"
    ParameterUnit id="pu1" type="it1" kind="byValue"
    ParameterUnit id="pu1" type="pt1" kind="return"
...
Value id="v1" name="1" type="it1"
StorableUnit id="su1" type="st1"
StorableUnit id="su2" type="pt1"
StorableUnit id="su3" type="it1"
...
ActionElement id="ae1" kind="Add"
  Reads "su1"
  Reads "v1"
  Writes "su2"
ActionElement id="ae2" kind="PtrCall|Call|MethodCall|VirtualCall"
  Reads "su1"
  Writes "su3"
  Calls "ce1"
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  Reads "su3"
  Calls "ce2"
```

### **What to report**

#### Roles to report

- the <MemoryAllocationCall> call to a memory allocation primitive
- the <LengthComputation> string length computation

### **8.2.73 ASCQM Ban Sequential Acquisitions of Single Non-Reentrant Lock**

#### **Descriptor**

ASCQM Ban Sequential Acquisitions of Single Non-Reentrant Lock(FirstLockAcquisitionStatement, SecondLockAcquisitionStatement)

#### **Description**

Identify occurrences in application model where  
- the <FirstLockAcquisitionStatement> lock acquisition statement  
- is followed by the <SecondLockAcquisitionStatement> lock acquisition statement  
- on a single lock  
- without any lock release statement in between

The locking mechanism is technology, framework, and language dependent.  
Reentrant locks are excluded.

#### **KDM outline illustration**

##### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
  DeployedResource id="dr1"
  ...
  LockResource id="lr1"
  ...
  PlatformAction id="pa2" kind="lock" implementation="ae1 ae5"
  ManagesResource|ReadsResource|WritesResource "lr1"
  ...
CodeModel
  ...
  ActionElement id="ae1" kind="PlatformAction"
  Flows "ae2"
  ActionElement id="ae2" ...
  Flows "ae3"
  ActionElement id="ae3" ...
  Flows "ae4"
  ActionElement id="ae4" ...
  Flows "ae5"
  ActionElement id="ae5" kind="PlatformAction"
  ...
```

##### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
```

```

    DeployedResource id="dr1"
    ...
    LockResource id="lr1"
    ...
    PlatformAction id="pa2" kind="lock" implementation="ae1 ae5"
    ManagesResource|ReadsResource|WritesResource "lr1"
    PlatformAction id="pa3" kind="unlock" implementation="ae3"
    ManagesResource|ReadsResource|WritesResource "lr1"
    ...
CodeModel
    ...
    ActionElement id="ae1" kind="PlatformAction"
    Flows "ae2"
    ActionElement id="ae2" ...
    Flows "ae3"
    ActionElement id="ae3" kind="PlatformAction"
    Flows "ae4"
    ActionElement id="ae4" ...
    Flows "ae5"
    ActionElement id="ae5" kind="PlatformAction"
    ...

```

### **What to report**

#### **Roles to report are**

- the [<FirstLockAcquisitionStatement> lock acquisition statement](#)
- the [<SecondLockAcquisitionStatement> lock acquisition statement](#)

### **8.2.74 ASCQM Initialize Variables**

#### **Descriptor**

[ASCQM Initialize Variables\(PathFromVariableDeclaration, VariableDeclarationStatement\)](#)

#### **Description**

[Identify occurrences in application model where](#)

- the [<PathFromVariableDeclaration> path](#)
- from the [<VariableDeclarationStatement> variable declaration statement](#)
- lacks a variable initialization statement

#### **KDM outline illustration**

##### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

...
StorableUnit id="sul"
...

```

### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
ActionElement id="ae1" kind="Assign"  
  Writes "s1"  
  Flows "ae2"  
...
```

### **What to report**

Roles to report are

- the <PathFromVariableDeclaration> path
- the <VariableDeclarationStatement> variable declaration statement

## **8.2.75 ASCQM Ban Allocation of Memory with Null Size**

### **Descriptor**

ASCQM Ban Allocation of Memory with Null Size(MemoryAllocationCall)

### **Description**

Identify occurrences in application model where

- the <MemoryAllocationCall> call to a memory allocation primitive
- uses a zero length parameter

The list of memory allocation primitives is technology, framework, language dependent. E.g. with C-type languages: malloc, calloc, realloc.

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
PointerType id="pt1"  
IntegerType id="it1"  
Value id="v1" type="it1" name="0"  
ControlElement id="cel" name="malloc|calloc|realloc|..." type="cel_signature"  
  Signature id="cel_signature"  
    ParameterUnit id="pu1" type="it1" kind="byValue"  
    ParameterUnit id="pu1" type="pt1" kind="return"  
  ...  
...  
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"  
  Reads "v1"  
  Calls "cel"
```

### What to report

#### Roles to report

- the <MemoryAllocationCall> call to a memory allocation primitive

### 8.2.76 ASCQM Ban Double Free On Pointers

#### Descriptor

ASCQM Ban Double Free On Pointers(PathToPointerReleaseFromPointerRelease, FirstPointerReleaseStatement, SecondPointerReleaseStatement)

#### Description

Identify occurrences in application model where  
- the <PathToPointerReleaseFromPointerRelease> path  
- from the <FirstPointerReleaseStatement> pointer release statement  
- to the <SecondPointerReleaseStatement> pointer release statement

#### KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit | IntegerType | DecimalType | FloatType | StringType | VoidType | ... id="dt1"  
PointerType id="pt1"  
ItemUnit id="pi1" type="dt1"  
StorableUnit id="sul" type="pt1"  
...  
ActionElement id="ae1" name="free | delete | ..."  
Addresses "pt1"  
Flows "ae2"  
ActionElement id="ae2"  
Flows "ae3"  
ActionElement id="ae3" name="free | delete | ..."  
Addresses "pt1"  
...
```

#### or

```
ClassUnit | IntegerType | DecimalType | FloatType | StringType | VoidType | ... id="dt1"  
name="dt1"  
PointerType id="pt1" name="pt1"  
ItemUnit id="iu1" type="dt1" ext="dt1 & pt1"  
StorableUnit id="sul" type="dt1"  
StorableUnit id="su2" type="pt1"  
HasType "pt1"  
HasValue "sul"  
...  
ActionElement id="ae1" name="free | delete | ... | push_back | ..."  
Addresses "sul"
```

```
Flows "ae2"
ActionElement id="ae2"
Flows "ae3"
ActionElement id="ae3" name="free|delete|...|push_back|..."
Addresses "sul"
```

### **What to report**

#### **Roles to report**

- the <PathToPointerReleaseFromPointerRelease> path
- the <FirstPointerReleaseStatement> pointer release statement
- the <SecondPointerReleaseStatement> pointer release statement

## **8.2.77 ASCQM Initialize Variables before Use**

### **Descriptor**

ASCQM Initialize Variables before Use(PathToVariableAccessFromVariableDeclaration, VariableDeclarationStatement, VariableAccessStatement)

### **Description**

Identify occurrences in application model where

- the <PathToVariableAccessFromVariableDeclaration> path
- from the <VariableDeclarationStatement> variable declaration statement
- to the <VariableAccessStatement> variable access statement
- lacks a variable initialization statement

excluding pointers and platform resources

### **KDM outline illustration**

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...
StorableUnit id="sul"
...
ActionElement id="ae2" ...
Flows "ae3"
ActionElement id="ae3"
Reads "sul"
...
...
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:



```
...  
ActionElement id="ae1" kind="Assign"  
  Writes "su1"  
  Flows "ae2"  
...
```

#### **What to report**

Roles to report are

- the <PathToVariableAccessFromVariableDeclaration> path
- the <VariableDeclarationStatement> variable declaration statement
- the <VariableAccessStatement> variable access statement

### **8.2.78 ASCQM Ban Self Assignment**

#### **Descriptor**

ASCQM Ban Self Assignment(SelfAssignmentStatement)

#### **Description**

Identify occurrences in application model where

- the <SelfAssignmentStatement> assignment statement
- assign one's variable to itself

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
StorableUnit id="su1"  
...  
ActionElement id="ae1" kind="Assign"  
  Reads "su1"  
  Writes "su1"...
```

#### **What to report**

Roles to report

- the <SelfAssignmentStatement> assignment statement

### **8.2.79.1 ASCQM Check Boolean Variables are Updated in Different Conditional Branches before Use**

### **Descriptor**

ASCQM Check Boolean Variables are Updated in Different Conditional Branches before Use(Boolean, Condition)

### **Description**

Identify occurrences in application model where

- the <Boolean> variable

- is used in the <Condition> condition

- but its value is never assigned in different branches of conditional statements

### **KDM outline illustration**

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
BooleanType id="booleanType"  
...  
StorableUnit id="sul" type="booleanType"  
...  
ActionElement id="ae1" kind="Condition"  
  Reads "sul"
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae2" kind="Condition"  
  ...  
    TrueFlow "tf1"  
    FalseFlow "ff1"  
  ...  
ActionElement id="tf1" kind="Compound"  
  ...  
    ActionElement id="ae3" kind="Assign"  
      Writes "sul"  
  ...  
ActionElement id="ff1" kind="Compound"  
  ...  
    ActionElement id="ae4" kind="Assign"  
      Writes "sul"  
  ...
```

or

```
ActionElement id="ae2" kind="Switch"  
  ...  
    GuardedFlow "gf1"
```

```

GuardedFlow | FalseFlow "gf2"
...
ActionElement id="gf1" kind="Compound"
...
ActionElement id="ae3" kind="Assign"
Writes "su1"
...
ActionElement id="gf2" kind="Compound"
...
ActionElement id="ae4" kind="Assign"
Writes "su1"
...

```

**What to report**

Roles to report

- the <Boolean> variable
- the <Condition> condition

**8.2.80 ASCQM Ban Not Operator On Operand Of Bitwise Operation**

Descriptor

ASCQM Ban Not Operator On Operand Of Bitwise Operation(BitwiseExpression)

Description

Identify occurrences in application model where

- the <BitwiseExpression> bitwise expression with a not operator on one of the operand

KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```

IntegerType|BitstringType|OctetstringType id="dt1"
StorableUnit id="su1" type="dt1"
...
StorableUnit id="su2" kind="register"
ActionElement id="ae1" kind="Not"
Reads "su1"
Writes "su2"
Flows "ae2"
ActionElement id="ae2" kind="BitAnd|BitOr|BitXor"
Reads "su2"
Reads ...

```

**What to report**

Roles to report are

- the <BitwiseExpression> bitwise expression

### **8.2.81 ASCQM Ban Not Operator On Non-Boolean Operand Of Comparison Operation**

#### **Descriptor**

ASCQM Ban Not Operator On Non-Boolean Operand Of Comparison Operation(ComparisonExpression)

#### **Description**

Identify occurrences in application model where

- the <ComparisonExpression> comparison expression with a not operator on one of the non-boolean operand

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
IntegerType|DecimalType|FloatType|StringType|PointerType|ClassUnit|...  
id="dt1"  
StorableUnit id="su1" type="dt1"  
...  
StorableUnit id="su2" kind="register"  
ActionElement id="ae1" kind="Not "  
Reads "su1"  
Writes "su2"  
Flows "ae2"  
ActionElement id="ae2"  
kind="Equals|NotEqualTo|GreaterThan|GreaterThanOrEqual|LessThan|LessThanOrEqual"  
Reads "su2"  
Reads ...
```

#### **What to report**

Roles to report are

- the <ComparisonExpression> comparison expression

### **8.2.82 ASCQM Ban Incorrect Joint Comparison**

#### **Descriptor**

ASCQM Ban Incorrect Joint Comparison(JointComparisonExpression)

#### **Description**

Identify occurrences in application model where

- the <JointComparisonExpression> joint comparison expression is one of the following: != || != or == || != or == && == or == && !=

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
StorableUnit id="su1" kind="register"  
StorableUnit id="su2" kind="register"  
...  
ActionElement id="ae1" kind="NotEqual"  
...  
  Writes "su1"  
ActionElement id="ae2" kind="NotEqual"  
...  
  Writes "su2"  
ActionElement id="ae3" kind="Or"  
  Reads "su1"  
  Reads "su2"  
...
```

or

```
StorableUnit id="su1" kind="register"  
StorableUnit id="su2" kind="register"  
...  
ActionElement id="ae1" kind="Equals"  
...  
  Writes "su1"  
ActionElement id="ae2" kind="NotEqual"  
...  
  Writes "su2"  
ActionElement id="ae3" kind="Or"  
  Reads "su1"  
  Reads "su2"  
...
```

or

```
StorableUnit id="su1" kind="register"  
StorableUnit id="su2" kind="register"  
...  
ActionElement id="ae1" kind="Equals"  
...  
  Writes "su1"  
ActionElement id="ae2" kind="Equals"  
...  
  Writes "su2"  
ActionElement id="ae3" kind="And"  
  Reads "su1"  
  Reads "su2"  
...
```

or

```
StorableUnit id="su1" kind="register"  
StorableUnit id="su2" kind="register"  
...  
ActionElement id="ae1" kind="Equals"  
...  
Writes "su1"  
ActionElement id="ae2" kind="NotEqual"  
...  
Writes "su2"  
ActionElement id="ae3" kind="And"  
Reads "su1"  
Reads "su2"  
...
```

#### **What to report**

Roles to report are

- the [<JointComparisonExpression> joint comparison expression](#)

### **8.2.83 ASCQM Secure XML Parsing with Secure Options**

#### **Descriptor**

[ASCQM Secure XML Parsing with Secure Options\(XMLParsingCall, DTDProcessingDisablingOption\)](#)

#### **Description**

Identify occurrences in application model where

- the [<XMLParsingCall>](#) call to an XML parsing method, function, procedure, ...

- doesn't use its [<DTDProcessingDisablingOption>](#) DTD processing disabling capability

[The list of XML parsing primitives is technology, framework, language dependent. E.g. in Java: SchemaFactory, JAXP DocumentBuilderFactory, SAXParserFactory, XMLReader.](#)

[The list of option\(s\) to disable DTD processing is primitive dependent. E.g. with XMLReader: set disallow-doctype-decl feature to true and external-general-entities and external-parameter-entities features to false.](#)

[Cf. https://www.owasp.org/index.php/XML\\_External\\_Entity\\_\(XXE\)\\_Prevention\\_Cheat\\_Sheet](https://www.owasp.org/index.php/XML_External_Entity_(XXE)_Prevention_Cheat_Sheet)

#### **KDM outline illustration**

***[KDM elements present in the application model](#)***

[KDM outline illustrating only the essential elements related to micro KDM:](#)

```

ControlElement id="ce1"
name="xmlCtxtReadDoc|xmlCtxtReadFd|xmlCtxtReadFile|xmlCtxtReadIO|xmlCtxtReadMemory|xmlCtxtUseOptions|xmlParseInNodeContext|xmlReadDoc|xmlReadFd|xmlReadFile|xmlReadIO|xmlReadMemory|..." type="ce1_signature"
  Signature id="ce1_signature"
  ...
  ParameterUnit id="pu1" name="options|..."
  ...
  ...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  ...
  Calls "ce1"

```

**or**

```

ClassUnit id="cu1"
name="SchemaFactory|DocumentBuilderFactory|SAXParserFactory|XMLReader|..."
  MethodUnit id="mu1" name="newSchema|..."
  ...
  MethodUnit id="mu2" name="setProperty|setAttribute|setFeature|..."
  type="mu2_signature"
  Signature id="mu2_signature"
  ParameterUnit id="pu1" name="name|property|attribute|feature|..."
  ParameterUnit id="pu2" name="value|..."
  ...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  ...
  Calls "mu1"

```

***KDM elements absent from the application mode!***

KDM outline illustrating only the essential elements related to micro KDM:

```

...
StorableUnit id="su1" attribute="DTD_disable"
...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  ...
  Calls "ce1"
  ...
  Reads "su1"

```

**or**

```

...
StorableUnit id="su1" attribute="DTD_processing"
StorableUnit id="su2" attribute="disable"
...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  ...
  Calls "mu2"

```

```
____ Reads "su1"
____ Reads "su2"
...

```

### **What to report**

#### **Roles to report:**

- the `<XMLParsingCall>` call to an XML parsing function, procedure, method, ...
- the `<DTDProcessingDisablingOption>` DTD processing disabling option(s)

## **8.2.84 ASCQM Secure Use of Unsafe XML Processing with Secure Parser**

### **Descriptor**

ASCQM Secure Use of Unsafe XML Processing with Secure Parser(XMLProcessingCall)

### **Description**

Identify occurrences in application model where

- the `<XMLProcessingCall>` call to an XML processing method, function, procedure, ... without DTD processing disabling capabilities
- is not preceded by a call to a secure XML parser

The list of XML processing primitives without DTD processing disabling capabilities is technology, framework, language dependent. E.g. in Java: JAXB Unmarshaller, XPathExpression. The list of XML parsing primitives with DTD processing disabling capabilities is technology, framework, language dependent. E.g. in Java: DocumentBuilder.

The list of option(s) to disable DTD processing is primitive dependent. E.g. with SAXParserFactory: set external-general-entities, external-parameter-entities, and load-external-dtd features to false.

Cf. [https://www.owasp.org/index.php/XML External Entity \(XXE\) Prevention Cheat Sheet](https://www.owasp.org/index.php/XML_External_Entity_(XXE)_Prevention_Cheat_Sheet)

### **KDM outline illustration**

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cu1" name="Unmarshaller|XPathExpression|...
____ MethodUnit id="mu1" name="unmarshall|evaluate|..."
____ ...
...
StorableUnit id="su1"
...
ActionElement id="ae2" kind="MethodCall"
____ Reads "su1"
____ Calls "mu1"

```

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### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cu2" name="DocumentBuilder|...
  MethodUnit id="mu2" name="parse|..."
...
ActionElement id="ae1" kind="MethodCall"
...
  Calls "mu2"
  Writes "su1"
  Flows "ae2"
...
```

### **What to report**

Roles to report:

- the <XMLProcessingCall> call to an XML processing method, function, procedure, ... without DTD processing disabling capabilities

## **8.2.85 ASCQM Sanitize User Input used in Path Manipulation**

### **Descriptor**

ASCQM Sanitize User Input used in Path Manipulation(PathFromUserInputToPathManipulation, UserInput, PathManipulationStatement, PathManipulationStatementSanitizationControlElementList)

### **Description**

Identify occurrences in application model where

- the <PathFromUserInputToPathManipulation> path
- from the <UserInput> user interface input
- to the <PathManipulationStatement> file path manipulation statement,
- lacks a sanitization operation from the <PathManipulationStatementSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process.

The list of file manipulation primitives is technology, framework, language dependent. E.g. with C-type languages: File, FileInputStream, open.

### **KDM outline illustration**

**KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```

PlatformModel
  FileResource id="fr1"
...
UIModel
  UIField id="uf1"
  UIAction id="ua1" implementation="ae1" kind="input"
    ReadsUI "uf1"
...
CodeModel
  ...
  StorableUnit id="su1"
  StorableUnit id="su2"
  ActionElement id="ae1" kind="UI"
    Writes "su1"
  Flow "ae2"
  ActionElement id="ae2"
    Flow "ae3"
    Reads "su1"
    Writes "su2"
  ActionElement id="ae3"
    Flow "ae4"
  ActionElement id="ae4"
    Flow "ae5"
  ActionElement id="ae5" kind="Data"
    ManagesResource|ReadsResource|WritesResource "fr1"
...

```

***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

ControlElement id="ce1" kind="sanitization"
...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  Flow "ae4"
  Calls "ce1"
  Reads "su2"
  Writes "su2"
...

```

**What to report**

Roles to report are

- the <PathFromUserInputToPathManipulation> path
- the <UserInput> user interface input
- the <PathManipulationStatement> file path manipulation statement,
- the <PathManipulationStatementSanitizationControlElementList> list of vetted sanitization.

**8.2.86 ASCQM Sanitize User Input used in SQL Access**

### **Descriptor**

ASCQM Sanitize User Input used in SQL Access(PathFromUserInputToSQLStatement, UserInput, SQLStatement, SQLStatementSanitizationControlElementList)

### **Description**

Identify occurrences in application model where

- the <PathFromUserInputToSQLStatement> path

- from the <UserInput> user interface input

- to the <SQLStatement> SQL statement,

- lacks a sanitization operation from the <SQLStatementSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process. SQL is not limited to traditional RDBMS SQL, it covers all data management capabilities. E.g.: NoSQL databases.

### **KDM outline illustration**

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
  DataManager id="dml"
  HasContent "rs1"
...
DataModel
  RelationalSchema id="rs1"
  RelationTable|RelationalView id="rtv1"
  PlatformAction id="pal" implementation="ae5"
  ReadsColumnSet|WritesColumnSet "rtv1"
  ReadsResource|WritesResource "dml"
...
UIModel
  UIField id="uf1"
  UIAction id="ual" implementation="ae1" kind="input"
  ReadsUI "uf1"
...
CodeModel
  ...
  StorableUnit id="sul"
  StorableUnit id="su2"
  ActionElement id="ae1" kind="UI"
  Writes "sul"
  Flow "ae2"
  ActionElement id="ae2"
  Flow "ae3"
  Reads "sul"
```

```
Writes "su2"  
ActionElement id="ae3"  
Flow "ae4"  
ActionElement id="ae4"  
Flow "ae5"  
ActionElement id="ae5" kind="Data"  
...
```

### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce1" kind="sanitization"  
...  
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"  
Flow "ae4"  
Calls "ce1"  
Reads "su2"  
Writes "su2"  
...
```

### **What to report**

Roles to report are

- the <PathFromUserInputToSQLStatement> path
- the <UserInput> user interface input
- the <SQLStatement> SQL statement,
- the <SQLStatementSanitizationControlElementList> list of vetted sanitization.

## **8.2.87 ASCQM Sanitize User Input used in Document Manipulation Expression**

### **Descriptor**

ASCQM Sanitize User Input used in Document Manipulation Expression(PathFromUserInputToDocumentManipulation, UserInput, DocumentManipulationExpression, DocumentManipulationSanitizationControlElementList)

### **Description**

Identify occurrences in application model where

- the <PathFromUserInputToDocumentManipulation> path
- from the <UserInput> user interface input
- to the <DocumentManipulationExpression> document manipulation expression,
- lacks a sanitization operation from the <DocumentManipulationSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process.

The list of document manipulation primitives is technology, framework, and language dependent. E.g.: XQuery

### **KDM outline illustration**

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
UIModel
  UIField id="uf1"
  UIAction id="ua1" implementation="ae1" kind="input"
    ReadsUI "uf1"
  ...
CodeModel
  ...
  StorableUnit id="su1"
  StorableUnit id="su2"
  StringType id="st1"
  StorableUnit id="su3"
  ControlElement id="ce1" name="..."
  ...
  ActionElement id="ae1" kind="UI"
    Writes "su1"
    Flow "ae2"
  ActionElement id="ae2"
    Flow "ae3"
    Reads "su1"
    Writes "su2"
  ActionElement id="ae3"
    Flow "ae4"
  ActionElement id="ae4"
    Flow "ae5"
  ActionElement id="ae5" kind="Call|PtrCall|MethodCall|VirtualCall"
    Calls "ce1"
    Reads "su3"
    Reads "su2"
  ...
  ...
```

#### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce2" kind="sanitization"
  ...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  Flow "ae4"
  Calls "ce2"
  Reads "su2"
  Writes "su2"
  ...
```

### **What to report**

Roles to report are

- the <PathFromUserInputToDocumentManipulation> path
- the <UserInput> user interface input
- the <DocumentManipulationExpression> document manipulation expression,
- the <DocumentManipulationSanitizationControlElementList> list of vetted sanitization.

### **8.2.88 ASCQM Sanitize User Input used in Document Navigation Expression**

#### **Descriptor**

ASCQM Sanitize User Input used in Document Navigation Expression(PathFromUserInputToDocumentNavigationEvaluation, UserInput, DocumentNavigationEvaluationExpression, DocumentNavigationSanitizationControlElementList)

#### **Description**

Identify occurrences in application model where

- the <PathFromUserInputToDocumentNavigationEvaluation> path
- from the <UserInput> user interface input
- to the <DocumentNavigationEvaluationExpression> document navigation evaluation expression,
- lacks a sanitization operation from the <DocumentNavigationSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process. The list of document navigation expression evaluation primitives is technology, framework, language dependent. E.g. with Java language: javax.xml.xpath.evaluate, javax.xml.xpath.XPath.evaluateExpression.

#### **KDM outline illustration**

##### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
UIModel
  UIField id="uf1"
  UIAction id="ual" implementation="ael" kind="input"
    ReadsUI "uf1"
  ...
CodeModel
  ...
```

```

    StorableUnit id="su1"
    StorableUnit id="su2"
    StringType id="st1"
    StorableUnit id="su3"
    ControlElement id="ce1" name="evaluate|evaluateExpression|..."
    ...
    ActionElement id="ae1" kind="UI"
    Writes "su1"
    Flow "ae2"
    ActionElement id="ae2"
    Flow "ae3"
    Reads "su1"
    Writes "su2"
    ActionElement id="ae3"
    Flow "ae4"
    ActionElement id="ae4"
    Flow "ae5"
    ActionElement id="ae5" kind="Call|PtrCall|MethodCall|VirtualCall"
    Calls "ce1"
    Reads "su3"
    Reads "su2"
    ...
    ...

```

**KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```

ControlElement id="ce2" kind="sanitization"
...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
    Flow "ae4"
    Calls "ce2"
    Reads "su2"
    Writes "su2"
...

```

**What to report**

Roles to report are

- the <PathFromUserInputToDocumentNavigationEvaluation> path
- the <UserInput> user interface input
- the <DocumentNavigationEvaluationExpression> document navigation evaluation expression,
- the <DocumentNavigationSanitizationControlElementList> list of vetted sanitization.

**8.2.89 ASCQM Sanitize User Input used to access Directory Resources**

### **Descriptor**

ASCQM Sanitize User Input used to access Directory Resources(PathFromUserInputToExecuteRunTimeCommand, UserInput, DirectoryAccessStatement, DirectoryAccessStatementSanitizationControlElementList)

### **Description**

Identify occurrences in application model where  
- the <PathFromUserInputToExecuteRunTimeCommand> path  
- from the <UserInput> user interface input  
- to the <DirectoryAccessStatement> directory access statement,  
- lacks a sanitization operation from the  
<DirectoryAccessStatementSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process.

### **KDM outline illustration**

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel  
  NamingResource id="nr1"  
  ...  
UIModel  
  UIField id="uf1"  
  UIAction id="ual" implementation="ae1" kind="input"  
  ReadsUI "uf1"  
  ...  
CodeModel  
  ...  
  StorableUnit id="su1"  
  StorableUnit id="su2"  
  ActionElement id="ae1" kind="UI"  
    Writes "su1"  
    Flow "ae2"  
  ActionElement id="ae2"  
    Flow "ae3"  
    Reads "su1"  
    Writes "su2"  
  ActionElement id="ae3"  
    Flow "ae4"  
  ActionElement id="ae4"  
    Flow "ae5"  
  ActionElement id="ae5" kind="Data"  
    ManagesResource|ReadsResource|WritesResource "nr1"  
  ...
```



### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce1" kind="sanitization"
...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  Flow "ae4"
  Calls "ce1"
  Reads "su2"
  Writes "su2"
...
```

### **What to report**

Roles to report are

- the <PathFromUserInputToExecuteRunTimeCommand> path
- the <UserInput> user interface input
- the <DirectoryAccessStatement> directory access statement,
- the <DirectoryAccessStatementSanitizationControlElementList> list of vetted sanitization.

## **8.2.90 ASCQM Sanitize Stored Input used in User Output**

### **Descriptor**

ASCQM Sanitize Stored Input used in User Output(PathFromUserInputToStorageStatement, UserInput, StorageStatement, PathFromRetrievalStatementToUserDisplay, RetrievalStatement, UserDisplay, CrossSiteScriptingSanitizationControlElementList)

### **Description**

Identify occurrences in application model where

- the <PathFromUserInputToStorageStatement> path
- from the <UserInput> user interface input
- to the <StorageStatement> data storage statement,
- and the <PathFromRetrievalStatementToUserDisplay> path
- from the <RetrievalStatement> data retrieval statement
- to the <UserDisplay> user interface display,
- lacks a sanitization operation from the <CrossSiteScriptingSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process.

### **KDM outline illustration**

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
  FileResource|DataManager id="pr1"
  HasContent "rr1"
...
DataModel
  RecordFile|RelationalSchema id="rr1"
  DataAction id="da1" implementation="ae3"
  WritessColumnSet ...
  WritesResource "pr1"
  DataAction id="da2" implementation="ae4"
  ReadsColumnSet ...
  ReadsResource "pr1"
...
UIModel
  UIField id="uf1"
  UIAction id="ua1" implementation="ae1" kind="input"
  ReadsUI "uf1"
  UIAction id="ua1" implementation="ae5" kind="output"
  ReadsUI "uf1"
...
CodeModel
  ...
  StorableUnit id="su1"
  StorableUnit id="su2"
  StorableUnit id="su3"
  ActionElement id="ae1" kind="UI"
  Writes "su1"
  Flow "ae2"
  ActionElement id="ae2"
  Flow "ae3"
  Reads "su1"
  Writes "su2"
  ActionElement id="ae3" kind="Data"
  Reads "su2"
  Flow "ae4"
  ...
  ActionElement id="ae4" kind="Data"
  Writes "su3"
  Flow "ae5"
  ActionElement id="ae5"
  Flow "ae6"
  ActionElement id="ae6" kind="UI"
  Reads "su3"
  ...
```

#### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce1" kind="sanitization"  
...  
ActionElement id="ae5" kind="Call|PtrCall|MethodCall|VirtualCall"  
  Flow "ae6"  
  Calls "ce1"  
  Reads "su3"  
  Writes "su3"  
...
```

**What to report**

Roles to report are

- the <PathFromUserInputToStorageStatement> path
- the <UserInput> user interface input
- the <StorageStatement> data storage statement,
- the <PathFromRetrievalStatementToUserDisplay> path
- the <RetrievalStatement> data retrieval statement
- the <UserDisplay> user interface display,
- the <CrossSiteScriptingSanitizationControlElementList> list of vetted sanitization.

**8.2.91 ASCQM Sanitize User Input used in User Output**

**Descriptor**

ASCQM Sanitize User Input used in User Output(PathFromUserInputToUserDisplay, UserInput, UserDisplay, CrossSiteScriptingSanitizationControlElementList)

**Description**

Identify occurrences in application model where

- the <PathFromUserInputToUserDisplay> path
- from the <UserInput> user interface input
- to the <UserDisplay> user interface display,
- lacks a sanitization operation from the <CrossSiteScriptingSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process.

**KDM outline illustration**

**KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
UIModel  
  UIField id="uf1"
```

```
UIAction id="ual" implementation="ae1" kind="input"  
  ReadsUI "uf1"  
UIField id="uf2"  
UIAction id="ual" implementation="ae5" kind="output"  
  WritesUI "uf2"
```

...

CodeModel

...

```
StorableUnit id="su1"  
StorableUnit id="su2"  
ActionElement id="ae1" kind="UI"  
  Writes "su1"  
  Flow "ae2"  
ActionElement id="ae2"  
  Flow "ae3"  
  Reads "su1"  
  Writes "su2"  
ActionElement id="ae3"  
  Flow "ae4"  
ActionElement id="ae4"  
  Flow "ae5"  
ActionElement id="ae5" kind="UI"
```

...

### **KDM elements absent from the application mode!**

KDM outline illustrating only the essential elements related to micro KDM:

```
ControlElement id="ce1" kind="sanitization"
```

...

```
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"  
  Flow "ae4"  
  Calls "ce1"  
  Reads "su2"  
  Writes "su2"
```

...

### **What to report**

Roles to report are

- the <PathFromUserInputToUserDisplay> path
- the <UserInput> user interface input
- the <UserDisplay> user interface display,
- the <CrossSiteScriptingSanitizationControlElementList> list of vetted sanitization operations

## **8.2.92 ASCQM Sanitize User Input used in System Command**

### **Descriptor**

ASCQM Sanitize User Input used in System Command(PathFromUserInputToExecuteRunTimeCommand, UserInput,

ExecuteRunTimeCommandStatement,  
ExecuteRunTimeCommandStatementSanitizationControlElementList)

### **Description**

Identify occurrences in application model where

- the <PathFromUserInputToExecuteRunTimeCommand> path

- from the <UserInput> user interface input

- to the <ExecuteRunTimeCommandStatement> system command,

- lacks a sanitization operation from the

<ExecuteRunTimeCommandStatementSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process.

### **KDM outline illustration**

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
  RunTimeResource id="rtrl"
  ...
UIModel
  UIField id="uf1"
  UIAction id="ua1" implementation="ae1" kind="input"
  ReadsUI "uf1"
  ...
CodeModel
  ...
  StorableUnit id="su1"
  StorableUnit id="su2"
  ActionElement id="ae1" kind="UI"
  Writes "su1"
  Flow "ae2"
  ActionElement id="ae2"
  Flow "ae3"
  Reads "su1"
  Writes "su2"
  ActionElement id="ae3"
  Flow "ae4"
  ActionElement id="ae4"
  Flow "ae5"
  ActionElement id="ae5" kind="Data"
  ManagesResource|ReadsResource|WritesResource "rtrl"
  ...
```

### **KDM elements absent from the application model**

#### **KDM outline illustrating only the essential elements related to micro KDM:**

```
ControlElement id="ce1" kind="sanitization"  
...  
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"  
  Flow "ae4"  
  Calls "ce1"  
  Reads "su2"  
  Writes "su2"  
...
```

### **What to report**

#### **Roles to report are**

- the <PathFromUserInputToExecuteRunTimeCommand> path
- the <UserInput> user interface input
- the <ExecuteRunTimeCommandStatement> system command,
- the <ExecuteRunTimeCommandStatementSanitizationControlElementList> list of vetted sanitization.

## **8.2.93 ASCQM Ban Use of Deprecated Libraries**

### **Descriptor**

ASCQM Ban Use of Deprecated Libraries(CallStatement, DeprecatedLibrary)

### **Description**

Identify occurrences in application model where

- the <CallStatement> call statement targets an operation
- from the <DeprecatedLibrary> deprecated library

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
Module id="m1" attribute="deprecated"  
...  
  CallableUnit id="cu1" | MethodUnit id="mu1"  
...  
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"  
  Calls "cu1|mu1"
```

### **What to report**

#### **Roles to report**

- the <CallStatement> call statement

- the <DeprecatedLibrary> deprecated library

### 8.2.94 ASCQM Sanitize User Input used as Array Index

#### Descriptor

ASCQM Sanitize User Input used as Array Index(PathFromUserInputToArrayAccess, UserInput, ArrayAccessStatement)

#### Description

Identify occurrences in application model where

- the <PathFromUserInputToArrayAccess> path
- from the <UserInput> user interface input
- to the <ArrayAccessStatement> array access statement,
- lacks a range check operation

#### KDM outline illustration

##### *KDM elements present in the application model*

KDM outline illustrating only the essential elements related to micro KDM:

```
UIModel
  UIField id="uf1"
  UIAction id="ual" implementation="ae1" kind="input"
    ReadsUI "uf1"
  ...
CodeModel
  ...
  StorableUnit id="su1"
  StorableUnit id="su2"
  ArrayType id="at1"
  StorableUnit id="su3" type="at1"
  ActionElement id="ae1" kind="UI"
    Writes "su1"
    Flow "ae2"
  ActionElement id="ae2"
    Flow "ae3"
    Reads "su1"
    Writes "su2"
  ActionElement id="ae3"
    Flow "ae4"
  ActionElement id="ae4"
    Flow "ae5"
  ActionElement id="ae5" kind="ArraySelect|ArrayReplace"
    Addresses "su3"
    Reads "su2"
    Reads|Writes ...
  ...
```

### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae2" kind="GreaterThan|GreaterThanOrEqual"  
  Reads "su2"  
  Reads ...  
  ...  
ActionElement id="ae3" kind="LessThan|LessThanOrEqual"  
  Reads "su2"  
  Reads ...  
  ...
```

### **What to report**

Roles to report are

- the <PathFromUserInputToArrayAccess> path
- the <UserInput> user interface input
- the <ArrayAccessStatement> array access statement,

## **8.2.95 ASCQM Check Input of Memory Allocation Primitives**

### **Descriptor**

ASCQM Check Input of Memory Allocation Primitives(MemoryAllocationCall)

### **Description**

Identify occurrences in application model where

- the <MemoryAllocationCall> call to a memory allocation primitive
- uses the length parameter without range checking its value

The list of memory allocation primitives is technology, framework, language dependent. E.g. with C-type languages: malloc, calloc, realloc.

### **KDM outline illustration**

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
PointerType id="pt1"  
IntegerType id="it1"  
ControlElement id="cel" name="malloc|calloc|realloc|..." type="cel_signature"  
  Signature id="cel_signature"  
    ParameterUnit id="pu1" type="it1" kind="byValue"  
    ParameterUnit id="pu1" type="pt1" kind="return"  
  ...  
  ...
```



```
StorableUnit id="sul" type="it1"
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Reads "sul"
  Calls "cel"
```

### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae2" kind="GreaterThan|GreaterThanOrEqual"
  Reads "sul"
  Reads ...
...
ActionElement id="ae3" kind="LessThan|LessThanOrEqual"
  Reads "sul"
  Reads ...
...
```

### **What to report**

#### **Roles to report**

- the <MemoryAllocationCall> call to a memory allocation primitive

## **8.2.96 ASCQM Sanitize User Input used as String Format**

### **Descriptor**

ASCQM Sanitize User Input used as String Format(PathFromUserInputToFormatStatement, UserInput, FormatStatement, FormatStatementSanitizationControlElementList)

### **Description**

Identify occurrences in application model where

- the <PathFromUserInputToFormatStatement> path
- from the <UserInput> user interface input
- to the <FormatStatement> formatting statement,
- lacks a sanitization operation from the <FormatStatementSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process.

The list of string format primitives is technology, framework, language dependent. E.g. with C-type languages: printf, sprintf.

### **KDM outline illustration**

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

UIModel
  UIField id="uf1"
  UIAction id="ua1" implementation="ae1" kind="input"
    ReadsUI "uf1"
  ...
CodeModel
  ...
  StorableUnit id="su1"
  StorableUnit id="su2"
  StringType id="st1"
  StorableUnit id="su3"
  ControlElement id="ce1" name="printf|sprintf|..."
  ...
  ActionElement id="ae1" kind="UI"
    Writes "su1"
    Flow "ae2"
  ActionElement id="ae2"
    Flow "ae3"
    Reads "su1"
    Writes "su2"
  ActionElement id="ae3"
    Flow "ae4"
  ActionElement id="ae4"
    Flow "ae5"
  ActionElement id="ae5" kind="Call|PtrCall|MethodCall|VirtualCall"
    Calls "ce1"
    Reads "su3"
    Reads "su2"
  ...
  ...

```

***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

ControlElement id="ce2" kind="sanitization"
...
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"
  Flow "ae4"
  Calls "ce2"
  Reads "su2"
  Writes "su2"
...

```

**What to report**

Roles to report are

- the <PathFromUserInputToFormatStatement> path
- the <UserInput> user interface input
- the <FormatStatement> formatting statement,

- the <FormatStatementSanitizationControlElementList> list of vetted sanitization.

### 8.2.97 ASCQM Sanitize User Input used in Loop Condition

#### Descriptor

ASCQM Sanitize User Input used in Loop Condition(PathFromUserInputToLoopCondition, UserInput, LoopConditionStatement)

#### Description

Identify occurrences in application model where  
- the <PathFromUserInputToLoopCondition> path  
- from the <UserInput> user interface input  
- to the <LoopConditionStatement> loop condition,  
- lacks a range check operation

#### KDM outline illustration

##### *KDM elements present in the application model*

KDM outline illustrating only the essential elements related to micro KDM:

```
UIModel
  UIField id="uf1"
  UIAction id="ual" implementation="ae1" kind="input"
    ReadsUI "uf1"
  ...
CodeModel
  ...
  StorableUnit id="su1"
  StorableUnit id="su2"
  ActionElement id="ae1" kind="UI"
    Writes "su1"
    Flow "ae2"
  ActionElement id="ae2"
    Flow "ae3"
    Reads "su1"
    Writes "su2"
  ActionElement id="ae3"
    Flow "ae4"
  ActionElement id="ae4"
    Flow "ae5"
  ...
  ActionElement id="ae5" kind="Compound"
    StorableUnit id="su3"
    ActionElement id="ae6" kind="Assign"
      Reads ...
      Writes "su3"
      Flows "ae7"
```

```

    ActionElement id="ae7"
kind="LessThan|LessThanOrEqualTo|GreaterThan|GreaterThanOrEqualTo"
    Reads "su3"
    Reads "su2"
    TrueFlow "ae8"
    FalseFlow "ae10"
    ActionElement id="ae8" kind=...
    ...
    ActionElement id="ae9" kind="Incr|Decr"
    Addresses "loopVariable"
    Flows "ae6"
    ActionElement id="ae10" kind="Nop"

```

or

```

UIModel
    UIField id="uf1"
    UIAction id="ual" implementation="ae1" kind="input"
    ReadsUI "uf1"
    ...
CodeModel
    ...
    StorableUnit id="sul"
    StorableUnit id="su2"
    ActionElement id="ae1" kind="UI"
    Writes "sul"
    Flow "ae2"
    ActionElement id="ae2"
    Flow "ae3"
    Reads "sul"
    Writes "su2"
    ActionElement id="ae3"
    Flow "ae4"
    ActionElement id="ae4"
    Flow "ae5"
    ...
    ActionElement id="ae5" kind="Compound"
    BooleanType id="booleanType"
    DataElement id="del" type="booleanType"
    EntryFlow "tf1"
    ActionElement id="tf1" ...
    ...
    ActionElement id="ae6"
kind="GreaterThan|GreaterThanOrEqualTo|LessThan|LessThanOrEqualTo"
    Reads "su2"
    ...
    Writes "del"
    ActionElement id="ae7" kind="Condition"
    Reads "del"
    TrueFlow "tf1"
    FalseFlow "ff1"
    ActionElement id="ff1" ...

```

...

### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae2" kind="GreaterThan|GreaterThanOrEqual"  
  Reads "su2"  
  Reads ...  
  ...  
ActionElement id="ae3" kind="LessThan|LessThanOrEqual"  
  Reads "su2"  
  Reads ...  
  ...
```

### **What to report**

Roles to report are

- the <PathFromUserInputToLoopCondition> path
- the <UserInput> user interface input
- the <LoopConditionStatement> loop condition,

## **8.2.98 ASCQM Sanitize User Input used as Serialized Object**

### **Descriptor**

ASCQM Sanitize User Input used as Serialized Object(PathFromUserInputToDeserialization, UserInput, DeserializationStatement, DeserializationStatementSanitizationControlElementList)

### **Description**

Identify occurrences in application model where

- the <PathFromUserInputToDeserialization> path
- from the <UserInput> user interface input
- to the <DeserializationStatement> deserialization statement,
- lacks a sanitization operation from the  
<DeserializationStatementSanitizationControlElementList> list of vetted sanitization.

The list of vetted sanitization primitives is an input to provide to the measurement process.

The list of deserialization primitives is technology, framework, language dependent. E.g. in Java: XMLdecoder, readObject, readExternal.

### **KDM outline illustration**

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

UIModel
  UIField id="uf1"
  UIAction id="ual" implementation="ae1" kind="input"
    ReadsUI "uf1"
  ...
CodeModel
  ...
  StorableUnit id="su1"
  StorableUnit id="su2"
  ActionElement id="ae1" kind="UI"
    Writes "su1"
    Flow "ae2"
  ActionElement id="ae2"
    Flow "ae3"
    Reads "su1"
    Writes "su2"
  ActionElement id="ae3"
    Flow "ae4"
  ActionElement id="ae4"
    Flow "ae5"
  ActionElement id="ae5" kind="Data"
    ManagesResource | ReadsResource | WritesResource "fr1"
  ...

```

#### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```

ControlElement id="ce1" kind="sanitization"
...
ActionElement id="ae3" kind="Call | PtrCall | MethodCall | VirtualCall"
  Flow "ae4"
  Calls "ce1"
  Reads "su2"
  Writes "su2"
...

```

#### **What to report**

Roles to report are

- the <PathFromUserInputToDeserialization> path
- the <UserInput> user interface input
- the <DeserializationStatement> deserialization statement,
- the <DeserializationStatementSanitizationControlElementList> list of vetted sanitization.

### **8.2.99 ASCQM Log Caught Security Exceptions**

#### **Descriptor**

ASCQM Log Caught Security Exceptions(Method, SecurityException, MethodCall, CatchStatement)

### **Description**

Identify occurrences in application model where

- the <Method> method
- declared as throwing the <SecurityException> security exception
- is called in the <MethodCall> method call
- which catches exceptions of type <SecurityException> in the <CatchStatement> catch statement
- but doesn't log it

List of security exception is technology, framework, and language dependent. E.g. in Java: java.security.GeneralSecurityException and its dependent classes.

### **KDM outline illustration**

#### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...
ClassUnit id="cu1" name="GeneralSecurityException|..."
...
ClassUnit id="cu2"
  Extends "cu1"
...
MethodUnit id="mul" type="mul_signature"
  Signature id="mul_signature"
  ParameterUnit id="pul" type="cu1" kind="throws"
  ...
...
TryUnit id="t1"
  ...
  ActionElement id="ael" kind="MethodCall"
  Calls "mul"
  ...
  ExceptionFlow "c1"
...
CatchUnit id="c1"
  ParameterUnit id="pu2" type="cu1"
  ...
...
```

#### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
PlatformModel
  FileResource id="fr1"
  ...
```

```

PlatformAction id="pa1" kind="write" implementation="ae2"
  WritesResource "fr1"
...
CodeModel
  CatchUnit id="c1"
    ParameterUnit id="pu2" type="cul"
    ...
  ActionElement id="ae2" kind="PlatformAction"
    Reads "pu2"
...

```

### **What to report**

Roles to report are

- the <Method> method
- the <SecurityException> security exception
- the <MethodCall> method call
- the <CatchStatement> catch statement

### **8.2.100 ASCQM Ban File Creation with Default Permissions**

#### **Descriptor**

ASCQM Ban File Creation with Default Permissions(FileCreationStatement, Permission)

#### **Description**

Identify occurrences in application model where

- the <FileCreationStatement> file creation statement with permission setting capabilities
- doesn't use its <Permission> permission option

The list of file creation primitives with permission setting capabilities is technology, framework, language dependent. E.g.: open from fcntl.h in C, os.open in python.

#### **KDM outline illustration**

##### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

ControlElement id="ce1" name="open|..." type="ce1_signature"
  Signature id="ce1_signature"
    ParameterUnit id="pu1" name="file|..."
    ParameterUnit id="pu2" name="flags|..."
    ParameterUnit id="pu3" name="mode|..."
    ...
...
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Calls "ce1"
  Reads ...

```



Reads ...

### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"  
  Calls "ce1"  
  Reads ...  
  Reads ...  
  Reads ...
```

### **What to report**

Roles to report:

- the <FileCreationStatement> file creation statement with permission setting capabilities
- the <Permission> permission option

## **8.2.101 ASCQM Ban Use of Prohibited Low-Level Resource Management Functionality**

### **Descriptor**

ASCQM Ban Use of Prohibited Low-Level Resource Management Functionality(ResourceManagementPrimitiveCall, TechnologyStack)

### **Description**

Identify occurrences in application model where

- the <ResourceManagementPrimitiveCall> low-level resource management primitive call
- which is bypassing the resource management primitives provided by the <TechnologyStack> technology stack

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
CodeModel  
  Package id="p1"  
  name="javax.ejb|javax.servlet|javax.jms|javax.faces|javax.xml.bind|javax.acti  
  vation|javax.mail|..."  
  ...  
  Package id="p2" name="java.sql"  
    ClassUnit id="cu2" name="DriverManager"  
      MethodUnit id="mu2"  
    ...  
  CompilationUnit id="cu2"  
    Imports "p1"
```

```
Imports "p2"  
...  
ActionElement id="ae1" kind="MethodCall"  
Calls "mu2"
```

or

```
CodeModel  
Package id="p1" name="javax.servlet"  
...  
Package id="p2" name="java.net"  
ClassUnit id="cu2" name="Socket|ServerSocket"  
MethodUnit id="mu2"  
...  
CompilationUnit id="cu2"  
Imports "p1"  
Imports "p2"  
...  
ActionElement id="ae1" kind="MethodCall"  
Calls "mu2"
```

or

```
CodeModel  
Package id="p1" name="javax.ejb"  
...  
Package id="p2" name="java.net"  
ClassUnit id="cu2" name="Socket|ServerSocket"  
MethodUnit id="mu2"  
...  
Package id="p3" name="java.lang"  
ClassUnit id="cu3" name="ClassLoader"  
MethodUnit id="mu3"  
...  
Package id="p4" name="java.io"  
ClassUnit id="cu4" name="File"  
MethodUnit id="mu4"  
...  
Package id="p5" name="java.awt"  
ClassUnit id="cu5"  
MethodUnit id="mu5"  
...  
CompilationUnit id="cu2"  
Imports "p1"  
Imports "p2"  
...  
ActionElement id="ae1" kind="MethodCall"  
Calls "mu2|mu3|mu4|mu5"
```

or

```

CodeModel
  Package id="p1" name="javax.ejb"
  ...
  CompilationUnit id="cu2"
    Imports "p1"
    Imports "p2"
    ...
    ActionElement id="ae1" kind="MethodCall" attribute="synchronized"
    ...

```

### **What to report**

#### **Roles to report**

- the <ResourceManagementPrimitiveCall> low-level resource management primitive call
- the <TechnologyStack> technology stack

## **8.2.102 ASCQM Ban Excessive Size of Index on Columns of Large Tables**

### **Descriptor**

ASCQM Ban Excessive Size of Index on Columns of Large Tables(Table, TotalSizeOfIndexes, MaxTotalSizeOfIndexes, MinNumberOfRows)

### **Description**

Identify occurrences in application model where

- the <Table> table
- with <TotalSizeOfIndexes> number of indexes
- which is greater than <MaxTotalSizeOfIndexes>
- and with more than <MinNumberOfRows>

The <MaxTotalSizeOfIndexes> value is a measurement parameter. Its default value is: 30

The <MinNumberOfRows> value is a measurement parameter. Its default value is: 1000000

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```

DataModel
  RelationalSchema
    RelationalTable id="rtl"
      Index id="i1" implementation="iu1"
      Index id="i2" implementation="iu1 iu2"
      ...
      itemUnit id="iu1" type="dt1"
      itemUnit id="iu2" type="dt2"
    ...

```

```

CodeModel
  DataType id="dt1"
  DataType id="dt2"
  ...

```

The size of an Index is the size in bytes of the data types of the columns it relies on.

**What to report**

Roles to report

- the <Table> table
- the <TotalSizeOfIndexes> value
- the <MaxTotalSizeOfIndexes> value
- the <MinNumberOfRows> value

**8.2.103 ASCQM Implement Index Required by Query on Large Tables**

**Descriptor**

ASCQM Implement Index Required by Query on Large Tables(Query, Table, Column, MinNumberOfRows)

**Description**

Identify occurrences in application model where

- the <Query> query
- queries the <Table> table
- using the <Column> column(s)
- where the <Table> table has more than <MinNumberOfRows>
- but lacks a proper index

The <MinNumberOfRows> value is a measurement parameter. Its default value is: 1000000

**KDM outline illustration**

***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

DataModel
  RelationalSchema
    RelationalTable id="rtl"
      itemUnit id="iul"
      ...
    DataAction id="dal" kind="Select|Insert|Update|Delete"
      ...
    Reads "iul"
    ...

```

.....  
.....  
.....

**KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
DataModel
  RelationalSchema
    RelationalTable id="rtl"
      Index id="il" implementation="iul"
      itemUnit id="iul"
  .....
```

**What to report**

Roles to report

- the <Query> query
- the <Table> table
- the <Column> column (list)
- the <MinNumberOfRows> value

**8.2.104 ASCQM Ban Excessive Number of Index on Columns of Large Tables**

**Descriptor**

ASCQM Ban Excessive Number of Index on Columns of Large Tables(Table, NumberOfIndexes, MaxNumberOfIndexes, MinNumberOfRows)

**Description**

Identify occurrences in application model where

- the <Table> table
- with <NumberOfIndexes> number of indexes
- which is greater than <MaxNumberOfIndexes>
- and with more than <MinNumberOfRows>

The <MaxNumberOfIndexes> value is a measurement parameter. Its default value is: 3

The <MinNumberOfRows> value is a measurement parameter. Its default value is: 1000000

**KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
DataModel
  RelationalSchema
    RelationalTable id="rtl"
      Index id="il"
```

Index id="i2"
Index id="i3"
Index id="i4"
Index id="i5"
Index id="i6"
...

**What to report**

Roles to report

- the <Table> table
- the <NumberOfIndexes> value
- the <MaxNumberOfIndexes> value
- the <MinNumberOfRows> value

**8.2.105 ASCQM Ban Excessive Complexity of Data Resource Access**

**Descriptor**

ASCQM Ban Excessive Complexity of Data Resource Access(Query, NumberOfTables, MaxNumberOfTables, NumberOfSubqueries, MaxNumberOfSubqueries, MinNumberOfRows)

**Description**

Identify occurrences in application model where

- the <Query> query
- with <NumberOfTables> number of tables or views
- which is greater than <MaxNumberOfTables>
- and with <NumberOfSubqueries> number of subqueries
- which is greater than <MaxNumberOfSubqueries>
- with at least one table or view with more than <MinNumberOfRows>

The <MaxNumberOfTables> value is a measurement parameter. Its default value is: 5

The <MaxNumberOfSubqueries> value is a measurement parameter. Its default value is: 3

The <MinNumberOfRows> value is a measurement parameter. Its default value is: 1000000

**KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

<u>DataModel</u>	
<u>RelationalSchema</u>	
RelationalTable	RelationalView id="cs1"
RelationalTable	RelationalView id="cs2"
RelationalTable	RelationalView id="cs3"
RelationalTable	RelationalView id="cs4"
RelationalTable	RelationalView id="cs5"
RelationalTable	RelationalView id="cs6"

```

...
DataAction id="da1" kind="Select|Insert|Update|Delete"
...
ReadsColumnSet|WritesColumnSet "cs1"
ReadsColumnSet|WritesColumnSet "cs2"
ReadsColumnSet|WritesColumnSet "cs3"
ReadsColumnSet|WritesColumnSet "cs4"
ReadsColumnSet|WritesColumnSet "cs5"
ReadsColumnSet|WritesColumnSet "cs6"
...
DataAction id="da2" kind="Select"
...
DataAction id="da3" kind="Select"
...
DataAction id="da4" kind="Select"
...
DataAction id="da5" kind="Select"
...
...
...
...

```

**What to report**

Roles to report

- the <Query> query
- the <NumberOfTables> value
- the <MaxNumberOfTables> value
- the <NumberOfSubqueries> value
- the <MaxNumberOfSubqueries> value
- the <MinNumberOfRows> value

**8.2.106 ASCQM Ban Expensive Operations in Loops**

Descriptor

ASCQM Ban Expensive Operations in Loops(ResourceConsummingStatement, Loop)

Description

Identify occurrences in application model where

- the <ResourceConsummingStatement> resource consuming statement
- is used within the <Loop> loop.

KDM outline illustration

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae1" kind="New|NewArray"
```

or

```
ActionElement id="ae1" kind="SizeOf|InstanceOf|DynCast|TypeCast"
```

or

```
ActionElement id="ae1" kind="New|NewArray"
```

or

```
PlatformModel  
...  
MarshaledResource|NamingResource|DataManager id="pr1"  
...  
PlatformAction id="pal" implementation="ae1"  
ManagesResource|WritesResource|ReadsResource "pr1"
```

...

CodeModel

```
...  
ActionElement id="ae1" kind="PlatformAction"  
...
```

or

```
PlatformModel  
...  
FileResource|StreamResource|MessagingResource id="pr1"  
...  
PlatformAction id="pal" implementation="cel"  
ManagesResource "pr1"
```

...

CodeModel

```
...  
ActionElement id="ae1" kind="PlatformAction"  
.....
```

with (while loops)

```
BooleanType id="booleanType"  
Value id="true" name="true" type="booleanType"  
ActionElement id="ae2" kind="Compound"  
ActionElement id="ae3" kind="Condition"  
Reads "true"  
TrueFlow "tf1"  
FalseFlow "ff1"  
ActionElement id="tf1" ...  
...
```



```
Flows "ae1"  
...  
Flows "ae3"  
ActionElement id="ff1" ...
```

or (for loops)

```
ActionElement id="ae2" kind="compound"  
  ActionElement id="ae3" kind="Assign"  
    Reads ...  
    Writes "LoopVariable"  
    Flows "ae4"  
  ActionElement id="ae4"  
kind="LessThan|LessThanOrEqualTo|GreaterThan|GreaterThanOrEqualTo"  
  Reads "LoopVariable"  
  Reads ...  
  TrueFlow "ae5"  
  FalseFlow "ae7"  
  ActionElement id="ae5" kind=...  
...  
  Flows "ae1"  
...  
  ActionElement id="ae6" kind="Incr|Decr"  
    Addresses "LoopVariable"  
    Flows "ae4"  
  ActionElement id="ae7" kind="Nop"  
...  
...
```

### **What to report**

Roles to report are

- the <ResourceConsumingStatement> resource consuming statement
- the <Loop> loop.

## **8.2.107 ASCQM Limit Number of Aggregated Non-Primitive Data Types**

### **Descriptor**

ASCQM Limit Number of Aggregated Non-Primitive Data Types(Class,  
NumberOfNonPrimitiveMembers, MaxNumberOfNonPrimitiveMembers)

### **Description**

Identify occurrences in application model where

- the <Class> class
- with <NumberOfNonPrimitiveMembers> number of non-primitive members
- which is greater than <MaxNumberOfNonPrimitiveMembers>

The <MaxNumberOfNonPrimitiveMembers> value is a measurement parameter. Its default value is: 5

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cu1"  
ClassUnit id="cu2"  
ClassUnit id="cu3"  
ClassUnit id="cu4"  
ClassUnit id="cu5"  
ClassUnit id="cu6"  
...  
ClassUnit id="cu0"  
MemberUnit id="mu1" type="cu1"  
MemberUnit id="mu2" type="cu2"  
MemberUnit id="mu3" type="cu3"  
MemberUnit id="mu4" type="cu4"  
MemberUnit id="mu5" type="cu5"  
MemberUnit id="mu6" type="cu6"  
...
```

#### **What to report**

##### Roles to report

- the <Class> class
- the <NumberOfNonPrimitiveMembers> value
- the <MaxNumberOfNonPrimitiveMembers> value

### **8.2.108 ASCQM Ban Excessive Number of Data Resource Access from non-stored SQL Procedure**

#### **Descriptor**

ASCQM Ban Excessive Number of Data Resource Access from non-stored SQL Procedure(Function, NumberOfDataAccess, MaxNumberOfDataAccess)

#### **Description**

Identify occurrences in application model where

- the <Function> SQL function is not a stored procedure
- with <NumberOfDataAccess> accesses to data resources
- which is greater than <MaxNumberOfDataAccess>

The <MaxNumberOfDataAccess> value is a measurement parameter. Its default value is: 5

### **KDM outline illustration**

#### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
DataModel
  RelationSchema id="rs1"
  ...
  CallableUnit id="cu1"
  ...
  ActionElement id="da1" kind="Select|Insert|Update|Delete"
  ...
  ActionElement id="da2" kind="Select|Insert|Update|Delete"
  ...
  ActionElement id="da3" kind="Select|Insert|Update|Delete"
  ...
  ActionElement id="da4" kind="Select|Insert|Update|Delete"
  ...
  ActionElement id="da5" kind="Select|Insert|Update|Delete"
  ...
  ActionElement id="da6" kind="Select|Insert|Update|Delete"
  ...
```

#### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
DataModel
  RelationSchema id="rs1"
  ...
  CallableUnit id="cu1" kind="stored"
  ...
```

### **What to report**

#### **Roles to report**

- the <Function> function
- the <NumberOfDataAccess> value
- the <MaxNumberOfDataAccess> value

## **8.2.109 ASCQM Ban Excessive Number of Data Resource Access from non-SQL Code**

### **Descriptor**

ASCQM Ban Excessive Number of Data Resource Access from non-SQL  
Code(FunctionProcedureOrMethod, NumberOfDataAccess, MaxNumberOfDataAccess)

### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...

- with <NumberOfDataAccess> accesses to data resources
- which is greater than <MaxNumberOfDataAccess>

The <MaxNumberOfDataAccess> value is a measurement parameter. Its default value is: 2

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```

DataModel
  RelationSchema id="rs1"
  ...
  ActionElement id="da1" kind="Select|Insert|Update|Delete"
  implementation="i1"
  ActionElement id="da2" kind="Select|Insert|Update|Delete"
  implementation="i2"
  ActionElement id="da3" kind="Select|Insert|Update|Delete"
  implementation="i3"
  ...
CodeModel
  ...
  CallableUnit id="cul" | MethodUnit id="mul"
  ...
  ActionElement id="i1"
  ...
  ActionElement id="i2"
  ...
  ActionElement id="i3"
  ...
  ...

```

### **What to report**

Roles to report

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <NumberOfDataAccess> value
- the <MaxNumberOfDataAccess> value

### **8.2.110 ASCQM Ban Incremental Creation of Immutable Data**

#### **Descriptor**

ASCQM Ban Incremental Creation of Immutable Data(StringConcatenationStatement)

#### **Description**

Identify occurrences in the application model where

- a text variable is incrementally updated in the <StringConcatenationStatement> string concatenation statement

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
StringType id="st1"  
StorableUnit id="sul" type="st1"  
...  
ActionElement id="ael" kind="Append"  
  Reads "sul"  
  Writes "sul"  
...  
...
```

### **What to report**

Roles to report are

- the <StringConcatenationStatement> string concatenation statement

### **8.2.111 ASCQM Ban Static Non-Final Data Element Outside Singleton**

#### **Descriptor**

ASCQM Ban Static Non-Final Data Element Outside Singleton(StaticNonFinalVariableDeclaration)

#### **Description**

Identify occurrences in application model where

- the <StaticNonFinalVariableDeclaration> declaration of a static non-final variable
- is not part of a Singleton design pattern

### **KDM outline illustration**

***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
MemberUnit id="mul" isStatic="true"  
...
```

***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
ClassUnit id="singleton" exportKind="public"  
  MemberUnit id="mul" isStatic="true" exportKind="private"  
  type="singleton"
```

```

MethodUnit id="c" kind="constructor" exportKind="private"
type="c_signature"
Signature
ParameterUnit id="r1" kind="return" type="singleton"
...
MethodUnit id="refget" kind="method" storableKind="static"
exportKind="public" type="refget_signature"
Signature id="refget_signature"
ParameterUnit id="r2" kind="return" type="singleton"
ActionElement id="a2" name="a2" kind="Return"
Writes "r2"
Reads "sul"
...

```

or

```

...
MemberUnit id="mul" isStatic="true" isFinal="true"
...

```

#### **What to report**

Roles to report are

- the <StaticNonFinalVariableDeclaration> declaration of a static non-final variable

### **8.2.112 ASCQM Ban Conversion References to Child Class**

#### **Descriptor**

ASCQM Ban Conversion References to Child Class(Class, ParentClass, TypeConversion)

#### **Description**

Identify occurrences in application model where

- the <Class> class
- inherits from the <ParentClass> parent class
- which uses the <Class> class in the <TypeConversion> type conversion operation

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```

{code:title=KDM outline}
ClassUnit id="c1"
...
ActionElement id="ae1" kind="InstanceOf|DynCast|TypeCast"
UsesType "c2"
...

```

```

ClassUnit id="c2" InheritsFrom="c1"
...

and

{code:title=KDM outline}
ClassUnit id="c1"
...
    ActionElement id="ae1" kind="SizeOf"
    Reads "mu1" | UsesType "c2"
...
ClassUnit id="c2" InheritsFrom="c1"
    MemberUnit id="mu1"
...

```

### **What to report**

#### **Roles to report are**

- the <Class> class
- the <ParentClass> parent class
- the <TypeConversion> type conversion operation

## **8.2.113 ASCQM Ban Circular Dependencies between Modules**

### **Descriptor**

ASCQM Ban Circular Dependencies between Modules(Module, ModuleDependencyCycle)

### **Description**

Identify occurrences in application model where

- the <Module> module cycles back to itself
- via the <ModuleDependencyCycle> module dependency cycle

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```

Module id="m1"
...
    CallableUnit id="cu1" | MethodUnit id="mu1"
...
    CallableUnit id="cu2" | MethodUnit id="mu2"
...
    ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"
    Calls "cu3|mu3|cu4|mu4"
...
Module id="m2"
...

```

```
CallableUnit id="cu3" | MethodUnit id="mu3"  
...  
CallableUnit id="cu4" | MethodUnit id="mu4"  
...  
ActionElement id="ae2" kind="Call|PtrCall|MethodCall|VirtualCall"  
Calls "cu1|mu1|cu2|mu2"  
...
```

**or**

```
Module id="m1"  
...  
CallableUnit id="cu1" | MethodUnit id="mu1"  
...  
CallableUnit id="cu2" | MethodUnit id="mu2"  
...  
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"  
Calls "cu3|mu3|cu4|mu4"  
...  
Module id="m2"  
...  
CallableUnit id="cu3" | MethodUnit id="mu3"  
...  
CallableUnit id="cu4" | MethodUnit id="mu4"  
...  
ActionElement id="ae2" kind="Call|PtrCall|MethodCall|VirtualCall"  
Calls "cu5|mu5|cu6|mu6"  
...  
Module id="m3"  
...  
CallableUnit id="cu5" | MethodUnit id="mu5"  
...  
CallableUnit id="cu6" | MethodUnit id="mu6"  
...  
ActionElement id="ae2" kind="Call|PtrCall|MethodCall|VirtualCall"  
Calls "cu1|mu1|cu2|mu2"  
...
```

### **What to report**

#### **Roles to report**

- the <Module> module
- the <ModuleDependencyCycle> module dependency cycle

### **8.2.114 ASCQM Limit Volume of Commented-Out Code**

#### **Descriptor**

**ASCQM Limit Volume of Commented-Out Code(FunctionProcedureOrMethod, PercentageOfCommentedOutCode, MaxPercentageOfCommentedOutCode)**



### **Description**

- Identify occurrences in application model where
- the <FunctionProcedureOrMethod> function, procedure, method, ...
  - contains <PercentageOfCommentedOutCode> percentage of lines of code as comments
  - which is greater than <MaxPercentageOfCommentedOutCode> value

The <MaxPercentageOfCommentedOutCode> value is a measurement parameter. Its default value is: 5%

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
CallableUnit|MethodUnit id="ce1" name="..."
  SourceRef id="srl" language="..." snippet="s1"
  CommentUnit id="cul"
  ...
...
```

### **What to report**

Roles to report

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <PercentageOfCommentedOutCode> value
- the <MaxPercentageOfCommentedOutCode> value

### **8.1.115 ASCQM Limit Size of Operations Code**

#### **Descriptor**

ASCQM Limit Size of Operations Code(FunctionProcedureOrMethod, NumberOfNonEmptyLinesOfCode, MaxNumberOfNonEmptyLinesOfCode)

#### **Description**

- Identify occurrences in application model where
- the <FunctionProcedureOrMethod> function, procedure, method, ...
  - has <NumberOfNonEmptyLinesOfCode> number of non-empty lines of codes
  - which is greater than <MaxNumberOfNonEmptyLinesOfCode> value

The <MaxNumberOfNonEmptyLinesOfCode> value is a measurement parameter. Its default value is: 5%

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
CallableUnit|MethodUnit id="ce1" name="..."
  SourceRef id="sr1" language="..." snippet="s1"
  ...
...
...
```

### **What to report**

#### **Roles to report**

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <NumberOfNonEmptyLinesOfCode> value
- the <MaxNumberOfNonEmptyLinesOfCode> value

### **8.2.116 ASCQM Limit Volume of Similar Code**

#### **Descriptor**

ASCQM Limit Volume of Similar Code(FunctionProcedureOrMethod1, FunctionProcedureOrMethod2, PercentageOfSimilarElements, MaxPercentageOfSimilarElements)

#### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod1> function, procedure, method, ...
- the <FunctionProcedureOrMethod2> function, procedure, method, ...
- share <PercentageOfSimilarElements> percentage of similar discriminate elements
- which is greater than <MaxPercentageOfSimilarElements> value

The <MaxPercentageOfSimilarElements> value is a measurement parameter. Its default value is: 90%

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
CallableUnit|MethodUnit id="ce1" name="..."
  SourceRef id="sr1" language="..." snippet="s1"
  ...
CallableUnit|MethodUnit id="ce2" name="..."
  SourceRef id="sr2" language="..." snippet="s2"
  ...
...
...
```

Similarity is based on similarity of code snippets, that is, the number of identical discriminant tokens. The method to determine what is discriminant shall be reported. For example, NLP TF-IDF statistic can be used to identify discriminant tokens.

### **What to report**

#### **Roles to report**

- the <FunctionProcedureOrMethod1> function, procedure, method, ...
- the <FunctionProcedureOrMethod2> function, procedure, method, ...
- the <PercentageOfSimilarElements> value
- the <MaxPercentageOfSimilarElements> value

### **8.2.117 ASCQM Limit Algorithmic Complexity via Cyclomatic Complexity Value**

#### **Descriptor**

ASCQM Limit Algorithmic Complexity via Cyclomatic Complexity Value(FunctionProcedureOrMethod, CyclomaticComplexityValue, MaxCyclomaticComplexityValue)

#### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- with <CyclomaticComplexityValue> Cyclomatic Complexity
- which is greater than <MaxCyclomaticComplexityValue>

The <MaxCyclomaticComplexityValue> value is a measurement parameter. Its default value is: 20

Reference for Cyclomatic Complexity definition is Watson, A. H., McCabe, T., "Structured Testing: A Testing Methodology Using the Cyclomatic Complexity Metric", NIST Special Publication 500-235, September 1996

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
CallableUnit|MethodUnit id="ce1" name="..."
  ActionElement id="ae1"
    Flow|TrueFlow|FalseFlow|GuardedFlow ...
  ActionElement id="ae2"
    Flow|TrueFlow|FalseFlow|GuardedFlow ...
  ActionElement id="ae3"
    Flow|TrueFlow|FalseFlow|GuardedFlow ...
  ...
...
```

Cyclomatic Complexity v(G) being the difference between the number of ControlFlow elements and the number of ActionElement elements plus 2.

### **What to report**

#### **Roles to report**

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <CyclomaticComplexityValue> value
- the <MaxCyclomaticComplexityValue> value

### **8.2.118 ASCQM Limit Number of Data Access**

#### **Descriptor**

ASCQM Limit Number of Data Access(FunctionProcedureOrMethod, NumberOfDataAccess, MaxNumberOfDataAccess)

#### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- with <NumberOfDataAccess> number of data accesses
- which is greater than <MaxNumberOfDataAccess>

The <MaxNumberOfDataAccess> value is a measurement parameter. Its default value is: 7

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

PlatformModel

```
...  
DataManager id="dml"  
HasContent "rs1"  
FileResource id="fr1"  
HasContent "rf1"  
FileResource id="fr2"  
HasContent "rf2"
```

...

DataModel

```
...  
RelationalSchema id="rs1"  
RelationalTable|RelationalView id="rtv1"  
RelationalTable|RelationalView id="rtv2"  
RelationalTable|RelationalView id="rtv3"  
RecordFile id="rf1"  
RecordFile id="rf2"
```

...

```

    DataAction id="da1" implementation="ae1"
    ReadsColumnSet|WritesColumnSet "rtv1"
    ReadsResource|WritesResource "dml"
    DataAction id="da2" implementation="ae2"
    ReadsColumnSet|WritesColumnSet "rtv2"
    ReadsResource|WritesResource "dml"
    DataAction id="da3" implementation="ae3"
    ReadsColumnSet|WritesColumnSet "rtv3"
    ReadsResource|WritesResource "dml"
    DataAction id="da4" implementation="ae4"
    ReadsColumnSet|WritesColumnSet "rtv3"
    ReadsResource|WritesResource "dml"
    DataAction id="da5" implementation="ae5"
    ReadsColumnSet|WritesColumnSet "rtv3"
    ReadsResource|WritesResource "dml"
    DataAction id="da6" implementation="ae6"
    ReadsColumnSet|WritesColumnSet "rf1"
    ReadsResource|WritesResource "fr1"
    DataAction id="da7" implementation="ae7"
    ReadsColumnSet|WritesColumnSet "rf1"
    ReadsResource|WritesResource "fr1"
    DataAction id="da8" implementation="ae8"
    ReadsColumnSet|WritesColumnSet "rf2"
    ReadsResource|WritesResource "fr2"
    ...
CodeModel
    ...
    CallableUnit|MethodUnit id="ce1" name="..."
    ...
    ActionElement id="ae1" kind="PlatformAction"
    ActionElement id="ae2" kind="PlatformAction"
    ActionElement id="ae3" kind="PlatformAction"
    ActionElement id="ae4" kind="PlatformAction"
    ActionElement id="ae5" kind="PlatformAction"
    ActionElement id="ae6" kind="PlatformAction"
    ActionElement id="ae7" kind="PlatformAction"
    ActionElement id="ae8" kind="PlatformAction"
    ...
    ...

```

### **What to report**

#### **Roles to report**

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <NumberOfDataAccess> value
- the <MaxNumberOfDataAccess> value

### **8.2.119 ASCQM Ban Excessive Number of Children**

**Descriptor**

ASCQM Ban Excessive Number of Children(Class, NumberOfChildren, MaxNumberOfChildren)

**Description**

Identify occurrences in application model where

- the <Class> class
- with <NumberOfChildren> number of children
- which is greater than <MaxNumberOfChildren>

The <MaxNumberOfChildren> value is a measurement parameter. Its default value is: 10

**KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cu0"  
ClassUnit id="cu1" Extends="cu0"  
ClassUnit id="cu2" Extends="cu0"  
ClassUnit id="cu3" Extends="cu0"  
ClassUnit id="cu4" Extends="cu0"  
ClassUnit id="cu5" Extends="cu0"  
ClassUnit id="cu6" Extends="cu0"  
ClassUnit id="cu7" Extends="cu0"  
ClassUnit id="cu8" Extends="cu0"  
ClassUnit id="cu9" Extends="cu0"  
ClassUnit id="cu10" Extends="cu0"  
ClassUnit id="cu11" Extends="cu0"  
...
```

**What to report**

Roles to report

- the <Class> class
- the <NumberOfChildren> value
- the <MaxNumberOfChildren> value

**8.2.120 ASCQM Ban Excessive Number of Inheritance Levels**

**Descriptor**

ASCQM Ban Excessive Number of Inheritance Levels(Class, NumberOfInheritanceLevels, MaxNumberOfInheritanceLevels)

**Description**

Identify occurrences in application model where

- the <Class> class

- with <NumberOfInheritanceLevels> number of inheritance levels
- which is greater than <MaxNumberOfInheritanceLevels>

The <MaxNumberOfInheritanceLevels> value is a measurement parameter. Its default value is:  
7

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cu1"  
ClassUnit id="cu2" Extends="cu1"  
ClassUnit id="cu3" Extends="cu2"  
ClassUnit id="cu4" Extends="cu3"  
ClassUnit id="cu5" Extends="cu4"  
ClassUnit id="cu6" Extends="cu5"  
ClassUnit id="cu7" Extends="cu6"  
ClassUnit id="cu8" Extends="cu7"  
ClassUnit id="cu9" Extends="cu8"  
...
```

#### **What to report**

Roles to report

- the <Class> class
- the <NumberOfInheritanceLevels> value
- the <MaxNumberOfInheritanceLevels> value

### **8.2.121 ASCQM Ban Usage of Data Elements from Other Classes**

#### **Descriptor**

ASCQM Ban Usage of Data Elements from Other Classes(Class, OtherClass, Reference)

#### **Description**

Identify occurrences in application model where

- the <Class> class
- which uses the <Member> non static final member
- of the <OtherClass> other class
- in the <Reference> reference operation

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="c1"
```

```

...
ActionElement id="ae1" kind="MemberSelect|MemberReplace"
  Reads | Writes "mul"
  Addresses "c2"
...
ClassUnit id="c2"
...
MemberUnit id="mul" isFinal="false" isStatic="false"
exportKind="public|protected|private"
...
...

```

### **What to report**

Roles to report are

- the <Class> class
- the <OtherClass> other class
- the <Reference> reference operation

### **8.2.122 ASCQM Ban Control Flow Transfer**

#### **Descriptor**

ASCQM Ban Control Flow Transfer(ControlFlowJumpStatement)

#### **Description**

Identify occurrences in application model where

- the <ControlFlowJumpStatement> unconditional transfer of control flow
- excluding break statement in switch

#### **KDM outline illustration**

##### ***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
ActionElement id="ae1" kind="Goto"
```

##### ***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

ActionElement id="ae1" kind="Switch"
...
GuardedFlow "gf1"
...
FalseFlow "ff1"
ActionElement id="gf1" kind="Guard"
...
Flows "f1"

```



```

...
ActionElement id="f1" kind="Compound"
...
  ActionElement id="g1" kind="Goto"
  Flows "e1"
...

```

**or:**

```

ActionElement id="ae1" kind="Switch"
...
  FalseFlow "ff1"
ActionElement id="ff1" kind="Compound"
...
  ActionElement id="g1" kind="Goto"
  Flows "e1"
...

```

#### **What to report**

Roles to report are

- the <ControlFlowJumpStatement> unconditional transfer of control flow

### **8.2.123 ASCQM Ban Loop Value Update within Incremental and Decremental Loop**

#### **Descriptor**

ASCQM Ban Loop Value Update within Incremental and Decremental Loop(LoopVariable, LoopVariableUpdateStatement)

#### **Description**

Identify occurrences in application model where

- the incremental or decremental loop condition rely on the <LoopVariable> variable
- which is updated in the loop body by the <LoopVariableUpdateStatement> update statement

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```

ActionElement id="a1" kind="compound"
  ActionElement id="a2" kind="Assign"
  Reads ...
  Writes "LoopVariable"
  Flows "a3"
  ActionElement id="a3"
kind="LessThan|LessThanOrEqual|GreaterThan|GreaterThanOrEqual"
  Reads "LoopVariable"
  Reads ...

```

```

TrueFlow "a4"
FalseFlow "a6"
ActionElement id="a4" kind=...
...
ActionElement id="LoopVariableUpdateStatement" kind="Assign"
...
Writes "LoopVariable"
...
...
ActionElement id="a5" kind="Incr|Decr"
Addresses "LoopVariable"
Flows "a3"
ActionElement id="a6" kind="Nop"

```

### **What to report**

#### **Roles to report**

- the <LoopVariable> variable
- the <LoopVariableUpdateStatement> update statement

### **8.2.124 ASCQM Limit Number of Parameters**

#### **Descriptor**

ASCQM Limit Number of Parameters(FunctionProcedureOrMethod, NumberOfParameter, MaxNumberOfParameter)

#### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- has <NumberOfParameter> parameters
- which is greater than <MaxNumberOfParameter>

The <MaxNumberOfParameter> value is a measurement parameter. Its default value is: 7

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```

CallableUnit id="c1" name="c1" callableKind="regular|external|stored"
type="c1_signature"
Signature id="c1_signature"
ParameterUnit id="p1"
paramterKind="byValue|byReference|byName|variadic"
ParameterUnit id="p2"
paramterKind="byValue|byReference|byName|variadic"
ParameterUnit id="p3"
paramterKind="byValue|byReference|byName|variadic"

```

```
ParameterUnit id="p4"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p5"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p6"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p7"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p8"  
parameterKind="byValue|byReference|byName|variadic"  
...
```

and

```
MethodUnit id="m1" name="m1" type="m1_signature"  
Signature id="m1_signature"  
ParameterUnit id="p1"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p2"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p3"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p4"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p5"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p6"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p7"  
parameterKind="byValue|byReference|byName|variadic"  
ParameterUnit id="p8"  
parameterKind="byValue|byReference|byName|variadic"  
...
```

### **What to report**

Roles to report are

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <NumberOfParameter> value
- the <MaxNumberOfParameter> value

### **8.2.125 ASCQM Ban Unreferenced Dead Code**

#### **Descriptor**

ASCQM Ban Unreferenced Dead Code(FunctionProcedureOrMethod)

#### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- which is never called

#### **KDM outline illustration**

##### **KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
CallableUnit|MethodUnit id="ce1" name="..."  
...
```

##### **KDM elements absent from the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"  
  Calls "ce1"  
...
```

#### **What to report**

Roles to report are

- the <FunctionProcedureOrMethod> function, procedure, method, ...

### **8.2.126 ASCQM Ban Excessive Number of Concrete Implementations to Inherit From**

#### **Descriptor**

ASCQM Ban Excessive Number of Concrete Implementations to Inherit From(Class, NumberOfConcreteClassInheritances, MaxNumberOfConcreteClassInheritances)

#### **Description**

Identify occurrences in application model where

- the <Class> class
- inherits from <NumberOfConcreteClassInheritances> classes with concrete implementations
- which is greater than <MaxNumberOfConcreteClassInheritances> threshold value

The <MaxNumberOfConcreteClassInheritances> value is a measurement parameter. Its default value is: 1

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
ClassUnit id="cu1" isAbstract="false"  
ClassUnit id="cu2" isAbstract="false"  
ClassUnit id="cu3" Extends="cu1 cu2"
```

### **What to report**

Roles to report are

- the <Class> class
- the <NumberOfConcreteClassesInheritances> value
- the <MaxNumberOfConcreteClassesInheritances> value

### **8.2.127 ASCQM Limit Number of Outward Calls**

#### **Descriptor**

ASCQM Limit Number of Outward Calls(FunctionProcedureOrMethod, NumberOfOutwardCalls, MaxNumberOfOutwardCalls)

#### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- calls <NumberOfOutwardCalls> other functions, procedures, methods, ...
- which is greater than <MaxNumberOfOutwardCalls> times

The <MaxNumberOfOutwardCalls> value is a measurement parameter. Its default value is: 5

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
CallableUnit|MethodUnit id="ce1" name="..."  
...  
ActionElement id="ae1" kind="Call|PtrCall|MethodCall|VirtualCall"  
ActionElement id="ae2" kind="Call|PtrCall|MethodCall|VirtualCall"  
ActionElement id="ae3" kind="Call|PtrCall|MethodCall|VirtualCall"  
ActionElement id="ae4" kind="Call|PtrCall|MethodCall|VirtualCall"  
ActionElement id="ae5" kind="Call|PtrCall|MethodCall|VirtualCall"  
ActionElement id="ae6" kind="Call|PtrCall|MethodCall|VirtualCall"  
...  
...
```

### **What to report**

Roles to report are

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <NumberOfOutwardCalls> value

- the <MaxNumberOfOutwardCalls> value

### **8.2.128 ASCQM Ban Public Data Elements**

#### **Descriptor**

ASCQM Ban Public Data Elements(PublicVariableDeclaration)

#### **Description**

Identify occurrences in application model where  
- the <PublicVariableDeclaration> declaration of a public variable

#### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
MemberUnit id="mul" exportKind="public"
```

#### **What to report**

Roles to report are  
- the <PublicVariableDeclaration> declaration of a public variable

### **8.2.129 ASCQM Ban Hard-Coded Literals used to Initialize Variables**

#### **Descriptor**

ASCQM Ban Hard-Coded Literals used to Initialize Variables(InitializationStatement)

#### **Description**

Identify occurrences in application model where  
- the <InitializationStatement> initialization statement  
- exceptions are  
-- single digit integers  
-- constants

#### **KDM outline illustration**

***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```
...  
Value id="v1"  
IntegerType|DecimalType|FloatType|StringType|ClassUnit id="dt1"  
StorableUnit|ItemUnit|MemberUnit id="de1" type="dt1"  
...  
ActionElement id="ae1" kind="Assign"
```

```
    Reads "v1"  
    Writes "del"  
    ...
```

#### ***KDM elements absent from the application model***

***KDM outline illustrating only the essential elements related to micro KDM:***

```
StorableUnit|ItemUnit|MemberUnit id="del" isFinal="true"
```

or

```
Value id="v1" name="0|1|2|3|4|5|6|7|8|9"
```

#### **What to report**

**Roles to report are**

- the <InitializationStatement> initialization statement

### **8.2.130 ASCQM Ban Logical Dead Code**

#### **Descriptor**

**ASCQM Ban Logical Dead Code(Statement, FunctionProcedureOrMethod)**

-

#### **Description**

Identify occurrences in application model where - the <Statement> statement

- within the <FunctionProcedureOrMethod> function, procedure, method, ...

- has no path to it from the entry point

-

#### **KDM outline illustration**

***KDM elements present in the application model***

***KDM outline illustrating only the essential elements related to micro KDM:***

```
...  
CallableUnit|MethodUnit id="ce1" name="..."  
...  
ActionElement id="ae1"  
...
```

#### ***KDM elements absent from the application model***

***KDM outline illustrating only the essential elements related to micro KDM:***

```
...  
CallableUnit|MethodUnit id="ce1" name="..."  
EntryFlow id="ef1" from="ce1" to="ae2"  
...
```

```

    ActionElement id="ae2"
    ...
    Flow "ae3"
    ActionElement id="ae3"
    ...
    Flow "ae1"
    ActionElement id="ae1"
    ...
...

```

**What to report**

Roles to report

- the <Statement> statement
- the <FunctionProcedureOrMethod> function, procedure, method, etc.

**8.2.131 ASCQM Ban Exception Definition without Ever Throwing It**

Descriptor

ASCQM Ban Exception Definition without Ever Throwing It(FunctionProcedureOrMethod, Exception)

Description

- Identify occurrences in application model where
- the <FunctionProcedureOrMethod> function, procedure, method, ...
- declares throwing the <Exception> exception - but lacks a path to an actual throw

KDM outline illustration

***KDM elements present in the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

...
DataType id="dt1" ...
CallableUnit|MethodUnit id="cel" name="..." type="cel_signature"
Signature id="cel_signature" ...
ParameterUnit id="pul" kind="throws" type="dt1" ...
...

```

***KDM elements absent from the application model***

KDM outline illustrating only the essential elements related to micro KDM:

```

...
CallableUnit|MethodUnit id="cel" name="..."
EntryFlow id="ef1" from="cel" to="ae2"
StorableUnit id="sul" type="dt1" ...
ActionElement id="ae2"
...

```



```

    Flow "ae3"
ActionElement id="ae3"
    ...
    Flow "ae1"
ActionElement id="ae1" kind="Throw"
Throws "su1"
    ...

```

### **What to report**

#### **Roles to report**

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <Exception> exception

## **8.2.132 ASCQM Ban Switch in Switch Statement**

### **Descriptor**

ASCQM Ban Switch in Switch Statement(NestedSwitch, ParentSwitch)

### **Description**

Identify occurrences in application model where

- the <NestedSwitch> switch = action:ActionElement of kind 'Switch' (as defined in Micro KDM Control Actions), used in 'from' association of action:GuardedFlow and action:FalseFlow  
actionRelations

- is nested = in the branch of control flow determined by action:ActionElement used in 'to' associations of action:GuardedFlow of the parent switch below

- in the <ParentSwitch> switch = action:ActionElement of kind 'Switch' (as defined in Micro KDM Control Actions), used in 'from' association of action:GuardedFlow and action:FalseFlow  
actionRelations

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```

StorableUnit id="su1"
StorableUnit id="su2"
StorableUnit id="su3"
StorableUnit id="su4"
ActionElement id="ae1" kind="Switch"
    Reads "su1"
    GuardedFlow "gf1"
    GuardedFlow "gf2"
    ...
    FalseFlow "ff1"
ActionElement id="gf1" kind="Guard"
    Reads "su2"

```

```

    Flows "f1"
  ActionElement id="gf2" kind="Guard"
    Reads "su3"
    Flows "f2"
  ...
  ActionElement id="ff1|f1|f2|..." kind="Compound"
    ...
    ActionElement id="ae2" kind="Switch"
      Reads "su4"
      GuardedFlow ...
      ...
      FalseFlow ...
    ActionElement id="g1" kind="Goto"
      Flows "e1"
    ...
  ActionElement id="e1" ...

```

#### **What to report**

Roles to report are

- the <NestedSwitch> switch
- the <ParentSwitch> switch

### **8.2.133 ASCQM Limit Algorithmic Complexity via Module Design Complexity Value**

#### **Descriptor**

ASCQM Limit Algorithmic Complexity via Module Design Complexity Value(FunctionProcedureOrMethod, ModuleDesignComplexityValue, MaxModuleDesignComplexityValue)

#### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- with <ModuleDesignComplexityValue> Module Design Complexity
- which is greater than <MaxModuleDesignComplexityValue>

The <MaxModuleDesignComplexityValue> value is a measurement parameter. Its default value is: 10

Reference for Module Design Complexity definition is Watson, A. H., McCabe, T., "Structured Testing: A Testing Methodology Using the Cyclomatic Complexity Metric", NIST Special Publication 500-235, September 1996

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
CallableUnit|MethodUnit id="ce1" name="..."
  ActionElement id="ae1"
    Flow|TrueFlow|FalseFlow|GuardedFlow ...
  ActionElement id="ae2"
    Flow|TrueFlow|FalseFlow|GuardedFlow ...
  ActionElement id="ae3"
    Flow|TrueFlow|FalseFlow|GuardedFlow ...
  ...
  ActionElement id="gt1" kind="Call|PtrCall|MethodCall|VirtualCall"
  Calls ...
  Flow ...
...
```

Module Design Complexity iv(G) being the difference between the number of ControlFlow elements and the number of ActionElement elements plus 2, once removed ControlFlow sequences without "Call" ActionElement elements

### **What to report**

Roles to report

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <ModuleDesignComplexityValue> value
- the <MaxModuleDesignComplexityValue> value

### **8.2.134 ASCQM Limit Algorithmic Complexity via Essential Complexity Value**

#### **Descriptor**

ASCQM Limit Algorithmic Complexity via Essential Complexity Value(FunctionProcedureOrMethod, EssentialComplexityValue, MaxEssentialComplexityValue)

#### **Description**

Identify occurrences in application model where

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- with <EssentialComplexityValue> Essential Complexity
- which is greater than <MaxEssentialComplexityValue>

The <MaxEssentialComplexityValue> value is a measurement parameter. Its default value is: 5

Reference for Essential Complexity definition is Watson, A. H., McCabe, T., "Structured Testing: A Testing Methodology Using the Cyclomatic Complexity Metric", NIST Special Publication 500-235, September 1996

### **KDM outline illustration**

KDM outline illustrating only the essential elements related to micro KDM:

```
CallableUnit|MethodUnit id="ce1" name="..."
  ActionElement id="ae1"
    Flow|TrueFlow|FalseFlow|GuardedFlow ...
  ActionElement id="ae2"
    Flow|TrueFlow|FalseFlow|GuardedFlow ...
  ActionElement id="ae3"
    Flow|TrueFlow|FalseFlow|GuardedFlow ...
  ...
  ActionElement id="gt1" kind="Goto"
    Flow ...
  ...
```

Essential Complexity  $ev(G)$  being the difference between the number of ControlFlow elements and the number of ActionElement elements plus 2, once removed ControlFlow sequences without "Goto" unconditional transfer of control

### **What to report**

Roles to report

- the <FunctionProcedureOrMethod> function, procedure, method, ...
- the <EssentialComplexityValue> value
- the <MaxEssentialComplexityValue> value

## **8.2.135 ASCQM Use Default Case in Switch Statement**

### **Descriptor**

ASCQM Use Default Case in Switch Statement(Switch)

### **Description**

Identify occurrences in application model where

- the <Switch> switch
- does not contain a default case

### **KDM outline illustration**

**KDM elements present in the application model**

KDM outline illustrating only the essential elements related to micro KDM:

```
StorableUnit id="su1"
StorableUnit id="su2"
StorableUnit id="su3"
```

```

ActionElement id="ae1" kind="Switch"
  Reads "su1"
  GuardedFlow "gf1"
  GuardedFlow "gf2"
...
ActionElement id="gf1" kind="Guard"
  Reads "su2"
  Flows "f1"
ActionElement id="gf2" kind="Guard"
  Reads "su3"
  Flows "f2"
...
ActionElement id="f1" kind="Compound"
...
  ActionElement id="g1" kind="Goto"
    Flows "e1"
ActionElement id="f2" kind="Compound"
...
  ActionElement id="g1" kind="Goto"
    Flows "e1"
...
ActionElement id="e1" ...

```

***KDM elements absent from the application model***  
KDM outline illustrating only the essential elements related to micro KDM:

```

ActionElement id="ae1" kind="Switch"
  Reads "su1"
...
  FalseFlow "ff1"
...
ActionElement id="ff1" kind="Compound"
...
  ActionElement id="g1" kind="Goto"
    Flows "e1"
...
ActionElement id="e1" ...

```

**What to report**  
**Roles to report are**  
- the <Switch> switch

## 9. Calculation of Quality and Functional Density Measures

### 9.1 Calculation of the Base Measures (Normative)

After reviewing several alternatives, a count of total violations of quality rules was selected as the best option for a base measure for each of the four software quality characteristics covered in this specification. Software quality characteristic measures have frequently been scored at the component level and then aggregated to develop an overall score for the application. However, scoring at the component level was rejected because many violations of quality rules cannot be isolated to a single component, but rather involve interactions among several components. Therefore, each Automated Source Code Quality Measure score is computed as the sum of its quality measure elements counted across an entire application.

The calculation of an Automated Source Code Quality Measure score progresses as follows:

- Detection pattern score is the count of occurrences,
- Weakness score is its detection pattern score,
- Quality characteristic score is the sum of its weakness scores.

That is,

Occurrence Count of Weakness  $x = \sum (\text{Occurrences of ASCQM-}y)$

Where  $x$  = a CWE weakness (CWE-119, CWE-120, etc.)

$y$  = a detection pattern for weakness  $x$

and

Occurrence Count of Weakness Category  $x = \sum (\text{Occurrence Count of ASCQM-}y)$

Where  $x$  = a software quality characteristic (Reliability, Security, Performance Efficiency, Maintainability)

$y$  = a detection pattern for quality characteristic  $x$

### 9.2 Functional Density of Weaknesses (Non-normative)

In order to compare quality results among different applications, the Automated Source Code Quality Measures can be normalized by size to create a density measure. There are several size measures with which the density of quality violations can be normalized, such as lines of code and Function Points. These size measures, if properly standardized, can be used for creating a density measure for use in benchmarking the quality of applications. OMG's Automated Function Points (AFP) measure [\(ISO, 2019\)](#) offers an automatable size measure that, as an OMG Supported Specification, is standardized. AFP was adapted from the International Function Point User Group's (IFPUG) counting guidelines, and is commercially supported. Although other size measures can be used to evaluate the density of security violations, the following density measure for quality violations is derived from OMG supported

specifications for Automated Function Points and the Automated Source Code Security Measure. Thus, the functional density of Security violations is a simple division expressed as follows.

$$\text{ASCxM-density} = \text{ASCxM} / \text{AFP}$$

where x = a software quality characteristic (R, S, PE, M)

## 10. Alternative Weighted Measures and Uses (Informative)

### 10.1 Additional Derived Measures

There are many additional weighting schemes that can be applied to the Automated Source Code Quality Measures or to the quality measure elements that composing them. Table 6 presents several weighted measure candidates and their potential uses. However, these weighting schemes are not derived from any existing standards and are therefore not normative.

Table 6. Informative Weighting Schemes for Security Measurement

Weighting scheme	Potential uses
Weight each quality measure element by its severity	Measuring risk of quality problems such as data theft, outages, response degradation, etc.
Weight each quality measure element by its effort to fix	Measuring cost of ownership, estimating future corrective maintenance effort and costs
Weight each module or application component by its density of quality weaknesses	Prioritizing modules or application components for corrective maintenance or replacement



## 11. References (Informative)

- Common Weakness Enumeration. <http://cwe.mitre.org> . Bedford, MA: MITRE Corporation.
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- [International Organization for Standards \(2019\). ISO/IEC 19515:2019, Automated Function Points. Information technology -- Object Management Group Automated Function Points \(AFP\), 1.0. Geneva, Switzerland. Also, Object Management Group \(2014\). Automated Function Points. formal 2014-01-03 http://www.omg.org/spec/AFP/. Needham, MA: Object Management Group.](#)
- [International Telecommunications Union \(2012\). ITU-T X.1524 – Series X: Data Networks, Open System Communications and Security – Cybersecurity information exchange – Vulnerability/state exchange – Common weakness enumeration. Geneva:, Switzerland.](#)
- Martin, R.A. & Barnum, S. (2006). *Status update: The Common Weakness Enumeration*. NIST Static Analysis Summit, Gaithersburg, MD Jun 29, 2006.

## Appendix A: Consortium for IT Software Quality (CISQ) (Informative)

The purpose of the Consortium for IT Software Quality (CISQ) is to develop specifications for automated measures of software quality characteristics taken on source code. These measures were designed to provide international standards for measuring software structural quality that can be used by IT organizations, IT service providers, and software vendors in contracting, developing, testing, accepting, and deploying IT software applications. Executives from the member companies that joined CISQ prioritized the quality characteristics of Reliability, Security, Performance Efficiency, and Maintainability to be developed as measurement specifications.

CISQ strives to maintain consistency with ISO/IEC standards to the extent possible, and in particular with the ISO/IEC 25000 series that replaces ISO/IEC 9126 and defines quality measures for software systems. In order to maintain consistency with the quality model presented in ISO/IEC 25010, software quality characteristics are defined for the purpose of this specification as attributes that can be measured from the static properties of software, and can be related to the dynamic properties of a computer system as affected by its software. However, the 25000 series, and in particular ISO/IEC 25023 which elaborates quality characteristic measures, does not define these measures at the source code level. Thus, this and other CISQ quality characteristic specifications supplement ISO/IEC 25023 by providing a deeper level of software measurement, one that is rooted in measuring software attributes in the source code.

Companies interested in joining CISQ held executive forums in Frankfurt, Germany; Arlington, VA; and Bangalore, India to set strategy and direction for the consortium. In these forums four quality characteristics were selected as the most important targets for automation—reliability, security, performance efficiency, and maintainability. These attributes cover four of the eight quality characteristics described in ISO/IEC 25010.

The Consortium for IT Software Quality (CISQ), a consortium managed by OMG, was formed in 2010 to create international standards for automating measures of size and structural quality characteristics from source code. These measures are intended for use by IT organizations, IT service providers, and software vendors in contracting, developing, testing, accepting, and deploying software systems. Executives from the member companies that joined CISQ prioritized Reliability, Security, Performance Efficiency, and Maintainability as the initial structural quality measures to be specified.

An international team of experts drawn from CISQ's 24 original companies formed into working groups to define CISQ measures. Weaknesses that had a high probability of causing reliability, security, performance efficiency, or maintainability problems were selected for inclusion in the four measures. The original CISQ members included IT departments in Fortune 200 companies, system integrators/outsourcers, and vendors that provide quality-related products and services to the IT market. The experts met several times per year for two years in the US, France, and India to develop a broad list of candidate weaknesses. This list was pared down to a set of weaknesses they believed had to be remediated to avoid serious operational or cost problems. These 86 weaknesses became the foundation of the original specifications of the automated source code measures for Reliability, Security, Performance Efficiency, and Maintainability.

## Appendix B: Common Weakness Enumeration (CWE) (Informative)

The Common Weakness Enumeration (CWE) repository (<http://cwe.mitre.org/>) maintained by MITRE Corporation is a collection of over 800 weaknesses in software architecture and source code that malicious actors have used to gain unauthorized entry into systems or to cause malicious actions. The CWE is a widely used industry source (<http://cwe.mitre.org/community/citations.html>) that provides a foundation for ~~the~~ ITU-T X.1524 and ISO/IEC standard, in addition to 2 ISO/IEC technical reports:

- SERIES X: DATA NETWORKS, OPEN SYSTEM COMMUNICATIONS AND SECURITY Cybersecurity information exchange – Vulnerability/state exchange - Common weakness enumeration (CWE)
- ISO/IEC 29147:2014 Information Technology -- Security Techniques -- Vulnerability Disclosure"
- ISO/IEC TR 24772:2013 Information technology -- Programming languages -- Guidance to avoiding vulnerabilities in programming languages through language selection and use
- ISO/IEC Technical Report is ISO/IEC TR 20004:2012 Information Technology -- Security Techniques -- Refining Software Vulnerability Analysis under ISO/IEC 15408 and ISO/IEC 18045

The CWE/SANS Institute Top 25 Most Dangerous Software Errors is a list of the 25 most widespread and frequently exploited security weaknesses in the CWE repository. The previous version of the CISQ Automated Source Code Security Measure (ASCSM) was based on 22 of the CWE/SANS Top 25 that could be detected and counted in source code. In this revision, the number of security weaknesses is being expanded beyond the CWE/SANS Top 25 since there are other weaknesses severe enough to be incorporated in the CISQ measure. In addition, many CWEs also cause reliability problems and are therefore included in the CISQ reliability measure. Wherever a CWE is included in any of the 4 CISQ structural quality measures, its CWE identifier will be noted.

Since the CWE is recognized as the primary industry repository of security weaknesses, it is supported by the majority of vendors providing tools and technology in the software security domain (<http://cwe.mitre.org/compatible/compatible.html>), such as Coverity, HP Fortify, Klockwork, IBM, CAST, Veracode, and others. These vendors already have capabilities for detecting many of the CWEs. Industry experts who developed the CWE purposely worded the CWEs to be language and application agnostic in order to allow vendors to develop detectors specific to a wide range of languages and application types beyond the scope that could be covered in the CWE. Since some of the CWEs may not be relevant in some languages, the reduced opportunity for anti-patterns in those cases will be reflected in the scores.

## Appendix C: Disposition of Weaknesses from the Original CISQ Measures to This Specification (Informative)

Appendix C maps the weaknesses from the previous four specifications referenced in Clause 1.1 to the weaknesses in this specification that succeeds those documents.

### Maintainability Measure

CISQ identifier	Disposition
ASCMM-MNT-1	CWE-1075
ASCMM-MNT-2	CWE-1055
ASCMM-MNT-3	CWE-1052
ASCMM-MNT-4	CWE-1048
ASCMM-MNT-5	CWE-1095
ASCMM-MNT-6	CWE-1085
ASCMM-MNT-7	CWE-1047
ASCMM-MNT-8	CWE-1080
ASCMM-MNT-9:	CWE-424
ASCMM-MNT-10	CWE-424
ASCMM-MNT-11	CWE- <del>1121</del> <sup>1093</sup>
ASCMM-MNT-12	CWE-1054
ASCMM-MNT-13	CWE-1064
ASCMM-MNT-14	CWE-1084
ASCMM-MNT-15	CWE-1081
ASCMM-MNT-16	CWE-1090
ASCMM-MNT-17	CWE-1074
ASCMM-MNT-18	CWE-1086
ASCMM-MNT-19	CWE-1041
ASCMM-MNT-20	CWE- <del>105</del> <sup>561</sup>

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## Performance Efficiency Measure

CISQ identifier	Disposition
ASCPEM-PRF-1	Dropped
ASCPEM-PRF-2	<del>CWE-1046</del>
ASCPEM-PRF-3	CWE-1042
ASCPEM-PRF-4	CWE-1049
ASCPEM-PRF-5	CWE-1067
ASCPEM-PRF-6	CWE-1089
ASCPEM-PRF-7	CWE-1094
ASCPEM-PRF-8	CWE-1050
ASCPEM-PRF-9	CWE-1060
ASCPEM-PRF-10	CWE-1073
ASCPEM-PRF-11	CWE-1057
ASCPEM-PRF-12	CWE-1043
ASCPEM-PRF-13	CWE-1072
ASCPEM-PRF-14	<del>CWE-1074</del> 01
ASCPEM-PRF-15	CWE- <del>1091</del> 404

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## Reliability Measure

CISQ identifier	Disposition
ASCRM-CWE-120	Retained - child of CWE-119
ASCRM-CWE-252data	Dropped
ASCRM-CWE-252resource	Dropped
ASCRM-CWE-396	Dropped
ASCRM-CWE-397	Dropped
ASCRM-CWE-456	Retained
ASCRM-CWE-674	Dropped
ASCRM-CWE-704	Retained
ASCRM-CWE-772	Retained - child of CWE-404
ASCRM-CWE-788	Retained - child of CWE-119
ASCRM-RLB-1	Dropped
ASCRM-RLB-2	CWE-1066
ASCRM-RLB-3	CWE-1070
ASCRM-RLB-4	CWE-1097
ASCRM-RLB-5	CWE-404
ASCRM-RLB-6	CWE-1098
ASCRM-RLB-7	CWE-1082
ASCRM-RLB-8	Dropped
ASCRM-RLB-9	CWE-1077
ASCRM-RLB-10	CWE-1057
ASCRM-RLB-11	CWE-1058
ASCRM-RLB-12	CWE-1096
ASCRM-RLB-13	Moved to Maintainability
ASCRM-RLB-14	CWE-1062
ASCRM-RLB-15	CWE-1087

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ASCRM-RLB-16	CWE-1079
ASCRM-RLB-17	CWE-1045
ASCRM-RLB-18	CWE-1051
ASCRM-RLB-19	CWE-1088

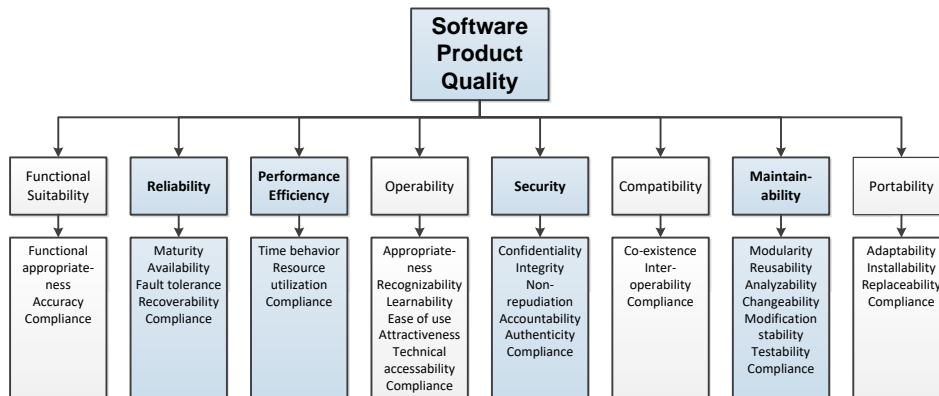
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## Appendix D: Relationship of the CISQ Structural Quality Measures to ISO 25000 Series Standards (SQuaRE)

ISO/IEC 25010 defines the product quality model for software-intensive systems (Figure 1). This model is composed of 8 quality characteristics, four of which are the subject of CISQ structural quality measures (indicated in blue). Each of ISO/IEC 25010's eight quality characteristics consists of several quality sub-characteristics that define the domain of issues covered by their parent quality characteristic. CISQ structural quality measures conform to the definitions in ISO/IEC 25010. The sub-characteristics of each quality characteristic were used to ensure the CISQ measures covered the domain of issues in each of the four areas. ISO/IEC 25010 is currently undergoing revision with CISQ participation. The CISQ measures will conform with definitions in the revised ISO/IEC 25010-2 when published.



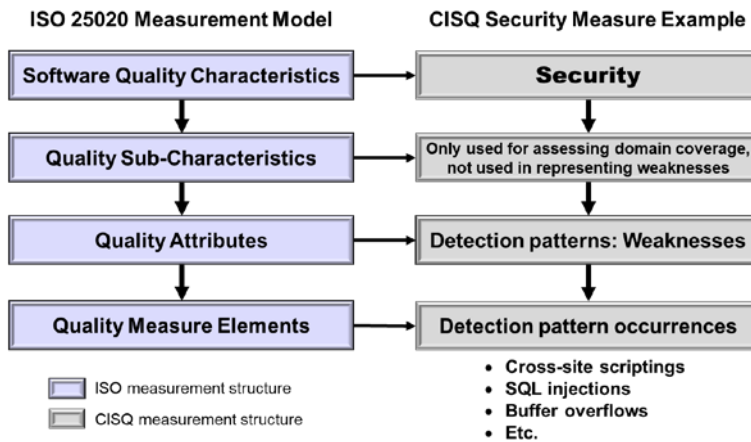
**Figure 1. Software Quality Characteristics from ISO/IEC 25010 with CISQ measure areas highlighted.**

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ISO/IEC 25023 establishes a framework of software quality characteristic measures wherein each quality sub-characteristic consists of a collection of quality attributes that can be quantified as quality measure elements. A quality measure element quantifies a unitary measurable attribute of software, such as the violation of a quality rule. Figure 2 presents an example of the ISO/IEC 25023 quality measurement framework using a partial decomposition for the Automated Source Code Security Measure.

Figure 2 displays the hierarchical relationships indicating how CISQ conforms to the reference measurement structure established in ISO/IEC 25020 that governs software quality measures in ISO/IEC 25023. This structure is presented using the CISQ Security measure as an example. The CISQ measures only use ISO's quality subcharacteristics for ensuring that the CISQ weaknesses covered the measurable domain of an ISO quality characteristic as defined in ISO/IEC 25010. CISQ's weaknesses (CWEs) correspond to ISO's quality attributes. CISQ weaknesses are represented as one or more detection

patterns among structural code elements in the software. Variations in how a weakness may be instantiated are represented by its association with several different detection patterns. Each occurrence of a detection pattern represents an occurrence of a weakness in the software. Occurrences of these detection patterns in the software correspond to ISO's quality measure elements and are the elements calculated in the CISQ measures.



**Figure 2. ISO/IEC 25020 Framework for Software Quality Characteristics Measurement**

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Clause 6 of this specification lists weaknesses grouped by quality characteristic that correspond to ISO/IEC 25020's quality attributes. A weakness is detected by identifying patterns of code elements in the software (called detection patterns) that instantiate the weakness. Each detection pattern equates to a quality measure element used in calculating the CISQ quality measures. In Clause 7, quality attributes (weaknesses) are transformed into the KDM and SPMS-based detection patterns that represent them. The CISQ quality measures are then calculated by detecting and counting occurrences of detection patterns, each of which indicates the existence of a weakness in the software. These calculations are represented in the Structured Metrics Metamodel (SMM).