

EGS-CC CDM ENGINEERING SUPPORT TEC-ED & TEC-SW Final Presentation Day – June 1st, 2021

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INTELLIGENT & CYBER-PROTECTED MISSION-CRITICAL SYSTEMS



AGENDA

- Overview of EGS-CC CDM Engineering Support activity
- Conceptual Data Model (CDM) in the context of EGS-CC
- What is a CDM consistency rule?
- Sources for elicitation of consistency rules
- Management of consistency rules in ESA CSDE Jira
- Implementation and testing of consistency rules using OPEN-M
- Validation of CDM datasets outside OPEN-M
- EGS-CC Knowledge Base pages regarding CDM
- Support to CDM Working Groups for improvement of CDM documentation
- Final conclusions and recommendations

PROJECT OVERVIEW

- Romanian GSTP contract
- Schedule August 2018 May 2021 (including a CCN)
- Prime Contractor: CS GROUP ROMANIA
- Work Packages:
 - WP1 Familiarization with CDM,
 - WP2 Expert consultancy and feedback,
 - WP3 Maintenance of CDM models, documents and artefacts,
 - WP4 Management of consistency rules





CONCEPTUAL DATA MODEL (CDM) IN EGS-CC CONTEXT

- European Ground System Common Core (EGS-CC) a European initiative to develop a common infrastructure to support the development of ground space systems for space missions
- Conceptual Data Model (CDM)
 - Defines the data needed to operate an EGS-CC based system
 - Key enabler for the exchange of data between systems
 - Improves the efficient hand-over of data and engineering knowledge on the space system throughout the project phases of engineering, development, verification and operation of a space system
 - WHAT actual data that is exchanged is independent on HOW the data is exchanged
 - Core modelling language is the Eclipse Modelling Framework
 - Robust against future technology changes





CDM TOP LEVEL DECOMPOSITION

- Core model is Space System Model (SSM) which defines concept of System Element (SE) & SE Aspect
- MonitoringControl contains MCM data element definitions, depends on SSM
- MonitoringControlImplementation contains M&C implementation aspect definitions (packets, procedures, scripts, etc), depends on MonitoringControl
- PacketProcessing contains information required for processing of packets and parameters (part of LDM – Logical Data Model)
- ConfigurationTracking contains definition of all Configuration Items (CIs) (part of LDM)



CDM INFORMATION IN CSDE CONFLUENCE

- The versions of the CDM Data Model, documents, artefacts and data consistency rules are available on CSDE CDM page on Confluence
- Documents & Models area, which displays:
 - A list of the CDM versions used for EGS-CC Integration Releases
 - Information for each CDM version, which contains:
 - a short description of the version's objectives,
 - links to all the associated CDM Data Models, documents, artefacts and data consistency rules,
 - link to the relevant DME version (tool for CDM modelling)





EGS-CC CDM Engineering Support 6

WHAT IS A DATA CONSISTENCY RULE?

- A data consistency rule is a requirement which applies to a given set of data population
- It is intended to define when the data definitions are syntactically (as structures of data) and semantically (as meaning of the data) consistent and to determine which specific data definitions are not consistent with others and why
- The consistency rules are defined in a language and format that allows easy implementation of associated consistency checks in software
- Two different but self-consistent ways of defining consistency rules:
 - in a natural language, human readable and understandable,
 - in a formal machine-readable constraint language (i.e. Apache Groovy)
- Data consistency rules are part of the CDM specification



DATA CONSISTENCY RULES - SOURCES FOR ELICITATION

• EGS-CC documents

- Conceptual Data Model (EGSCC-SYS-TN-1004)
- User Requirements Document, Vol. 2: Functional Requirements (EGSCC-SYS-RS-1001)
- User Requirements Document, Vol. 3: Non-functional Requirements (EGSCC-SYS-RS-1002)
- Software Specification and Design Document EGS-CC Kernel (EGSCC-SYS-SSDD-2000)
- ESA documents and standards
 - Ground systems and operations Telemetry and telecommand packet utilization (ECSS-E-70-41A and ECSS-E-70-41C)
 - Ground systems and operations Monitoring and control data Definition (ECSS-E-ST-70-31C)
 - Test and operations procedure language (ECSS-E-ST-70-32C)
 - SCOS-2000 Database Import ICD (EGOS-MCS-S2K-ICD-0001)
- Other sources
 - Change Requests not yet included in the EGS-CC documentation
 - Proposals for data consistency rules received from SET members and other EGS-CC Stakeholders
 - Other documents from EGS-CC Industrial Consortium
- 155 data consistency rules implemented and tested in Apache Groovy, available on Git repository



DATA CONSISTENCY RULES - WORKFLOW





DATA CONSISTENCY RULES – MANAGEMENT USING ESA CSDE JIRA (1/3)

Edit Issue : EGSC	CCDM-261	🗘 Configure Fields 🔻
Summary*	Check rule of argument of ActivityListInstanceArgumentValue	
Consistency Rule ID	ALIAV.01	
	The ID of this consistency rule. Has to be unique.	
Issue Type*	🖸 Consistency Rule	
	There are no issue types with compatible field configuration and/or workflow associations.	
	The issue type can only be changed by moving this issue.	_
Reporter*	😔 Sorin Scortan	
	Start typing to get a list of possible matches.	
Assignee	😌 Sorin Scortan	¥
Applicable CDM	range[1.14.2, INF]	
versions	The CDM versions this Consistency Rule is applicable to. Format for specification	: range< span
	class="error">[version_min,version_max], set(version1, version2). Example:<1 set(1.14.0,1.14.1)	or/> range(1.14.0,INF),
Linked Issues	blocks 🗸	
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	Begin typing to search for issues to link. If you leave it blank, no link will be made.	
Priority	😤 Major 🗸 🕐	
Labels	CDM ×	~
	Begin typing to find and create labels or press down to select a suggested label.	



DATA CONSISTENCY RULES – MANAGEMENT USING ESA CSDE JIRA (2/3)

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DATA CONSISTENCY RULES – MANAGEMENT USING ESA CSDE JIRA (3/3)

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Source Document(s)	1.15		'
Version(s)	The version(s) of the referenced source document(s).		
Source Document(s)	Section 5.3.3.3 Activity List		
Locations(s)	The location(s) in the referenced source document(s).		
Implementation Summary			
	Summary of the result of the implementation and list of main changes.		
Link to Implementation	https://sdereps.esa.int/gerrit/gitweb?p=OPEN-CDM-Maintenance.git;a=blob; f=MissionProject/checks/cdmConstraints/monitoringControlImplementation /activityList/ActivityListInstanceArgumentValueRule.groovy; hb=17cad1fef50b3496a0c4e53e642801f71c09bf26		
	Link to the groovy file implementing the consistency rule.		l
Link to Tests	https://sdereps.esa.int/gerrit/gitweb?p=OPEN-CDM-Maintenance.git;a=blob; f=MissionProject/scripts/cdmConstraintsVerification /monitoringControlImplementation/activityList /ActivityListInstanceArgumentValueRule_Test.groovy; hb=17cad1fef50b3496a0c4e53e642801f71c09bf26		
	Link to the groovy file testing the consistency rule.		
Link to Test Results	https://sdereps.esa.int/gerrit/gitweb?p=OPEN-CDM-Maintenance.git;a=blob; f=MissionProject/scripts/cdmConstraintsVerification /monitoringControlImplementation/activityList /ActivityListInstanceArgumentValueRule_Test.result; hb=17cad1fef50b3496a0c4e53e642801f71c09bf26		



DATA CONSISTENCY RULES – IMPLEMENTATION USING OPEN-M

- OPEN-M Eclipse based preparation environment of MICONYS-CC, ESOC's Mission Control System software suite which includes EGS-CC based data definitions, editors and browsers to support the needs of the Flight Control Teams
- OPEN suite is released under ESA community software license
- OPEN uses Git as the underlying Version Control System (VCS), in combination with Gerrit for reviewing and releasing changes
- OPEN-M is a set of OPEN and OPEN-CC extensions and currently includes the following extensions:
 - OPEN Extension Converter S2K MIB to CDM,
 - OPEN Extension for the delivery of Groovy constraints,
 - OPEN Extension for the table editor OPEN-M Specific configuration
- OPEN-M installer is provided by ESA as a JAR package



OPEN-M CDM MAINTENANCE REPOSITORY

- The maintenance team performs modifications in the following folders (teamwork and tailoring perspectives):
 - /checks/cdmConstraints add consistency rules,
 - /data/testData data population for test scripts,
 - /scripts/cdmConstraintsVerification create test scripts
 - /scripts/cdmScripting examples and utility scripts





CONSISTENCY RULE CLASS IN APACHE GROOVY

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	UniquenessOfMCPacketName.groovy	38 //get the list of Arguments	
	✓ A activityList	<pre>39 def List<argument> argumentList = element.arguments;</argument></pre>	
	ActivityListArgumentAssignmentListInstanceRule.groovy	40	
	ActivityListArgumentAssignmentKule.groovy	41 //Check if the target of an ActivityListArgumentAssigment is member of the list of Argumentasis	nents
	ActivityListArgumentAssignment largetkepeativumberkule.g	<pre>43 if (it.targetArgument != null && !argumentList.contains(it.targetArgument)) {</pre>	
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	> Constant	610 @Override	
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	testActivityListCl (Resource TestActivityListCl.cdm)	63 return "ACTL.01: The assignments of ActivityList arguments can only be made to target argume	ents which are the arguments of contained ActivityList elements";
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	> D ACT_LIST_ALAA_01_01 [Activity List]	public RuleSource getRuleSource() {	Rule Source
Test data	ACT_LIST_ALIAV_01_01 [Activity List]	Construction return Rulesource.specification;	
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TEST DATA FOR CONSISTENCY RULE VALIDATION

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a open.dsld	
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ACT_LIST_ACTL_03_01 [Activity List]	4 errors, 0 warnings, 0 others
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	1 The Activity ist 'ACT_UST_ACT_01_02' has an ArgumentAssignment '6a759690-11eb-11eb-8e3f-9374ef79c0b2' to a target Argument 'FA_ACT_01_01' which is not one of the arguments of the Activity' ist
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SCRIPT FOR TESTING CONSISTENCY RULE

	🗞 Local Explorer 💥 📭 MCM 🔝 Model Types 🦉 🕒 🗖	ActivityListArgumentAssignmentRule.groovy	testActivityListCl/ACT LIST ACTL 01 01	ActivityListArgumentAssignmentRule_Test.groovy		
	type filter text	1 package cdmConstraintsVerification	.monitoringControlImplementation.a	ctivityList;		^
	A Charles Constraints/Verification	2				
		3 import org.eclipse.emt.common.util	BasicDiagnostic			
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	Aincules_suite.resuit	11 /* Set the consistency rule to	be verified */		l est data	
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	V CommonitoringControl	13 def consistencyRuleName = "Act	ivityListArgumentAssignmentRule"		(intentionally wrong	1)
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	McmImplementationItemsRules_Suite.groovy	15 /* Set the input data for vali	dation */			
	McmImplementationItemsRules_Suite.result	15 det resourceDataPopulation = 1	Resource_lestActivityListCl.com			
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	UniquenessOfMonitoringControlImplementationAspectName_Test.resul	19 def expectedSeverity = BasicDia	agnostic.ERROR			
	🗸 🗁 monitoringControlCommon	20	0			
	> 🗁 calibrations	21 // Expected sources to fai	1	A		
	> 🔄 checkAndCondition	22 def expectedSources = ["ACT_LI	ST_ACTL_01_01", "ACT_LIST_ACTL_01_	02", "ACT_LIST_ALAA_01_01",/"ACT_LIST_ALAA_01	L_01"]	
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	ManitoringControllImplementationRules Suite groow	31				
	MonitoringControllImplementationRules_Suite.goovy	32				
	Information MCD a let Name Test access	34 def indices = ["ACT LIST ACTL	01 01" : 0. "ACT LIST ACTL 01 02"	: 0. "ACT LIST ALAA 01 01" : 0]		
	UniquenessOfMCPacketName_test.groovy	35		· · · · · · · · · · · · · · · · · · ·		
		36 def expectedMessages = []			Error message	
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103130110	ActivityListArgumentAssignmentListInstanceRule_Test.result	39 def expectedFeature = [-1- ACTIVITY LICE ADDIMENT ACCTO			
	ActivityListArgumentAssignmentRule_Test.groovy	40 (ACTIVITYLISTPACKage.Liter	als.ACTIVITY_LISTARGUMENT_ASSIGN	mENTS):expectedSources]		
	ActivityListArgumentAssignmentRule_Test.result	42 // Message for the sources exp	ected to fail			
	ActivityListArgumentAssignmentTargetRepeatNumberRule_Test.groovy	43 expectedSources.each				
	ActivityListArgumentAssignmentTargetRepeatNumberRule_Test.result	44 expectedMessages.add("The	ActivityList \'" + it + "\' has an	ArgumentAssignment \'" + values[it][indices[[it]][0] +	
	ActivityListInstanceArgumentValueRule_Test.groovy	45 "\' to a target Argume	<pre>nt \'" + values[it][indices[it]][1</pre>] + "\' which is not one of the arguments of	the ActivityList.")	
	ActivityListInstanceArgumentValueRule_Test.result	46 indices[it] = indices[it] ·	+ 1			
	ActivityListInstanceDefinitionRule_Test.groovy	4/ }				
	ActivityListInstanceDefinitionRule_Test.result	49 def expectedNoOfChecks = Utils	countInstancesOf(ActivityList.cla	ss, resourceDataPopulation, mHelper) + 1		
	MonitoringControllmplementationActivityListRules_Suite.groovy	50	,(,,,		
	MonitoringControlImplementationActivityListRules_Suite.result	51 /* Run consistency rule agains	t provided data population. Evalua	te diagnostic and print test result. */		
	> 🗁 mappings	52 def diagnostic = Utils.checkRu	<pre>leAgainstData(mHelper, vService, r</pre>	esourceDataPopulation, consistencyRulePath, c	consistencyRuleName)	
	> Car packetization	53 def results = Utils.evaluate	eDiagnostic(diagnostic, expectedNo	OfChecks, expectedSeverity, expectedFeature,	expectedSources, expectedMessages);	
	> 🔄 spaceSystemModel	54 return Utils.printTestResultFi	<pre>nal(consistencyRuleName, results)</pre>			
	> Car cdmScripting	56 @SourcelIRT				
	> 🕞 examples					*
	> 🕞 importProcess					
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	R open.dsld	4 errors 0 warnings 0 others				
	> 🔁 validation				1	
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1		
2	# Verification of consistency rule: ActivityListArgumentAssignmentRule	
3		
4	# # Validation against. Resource TestActivituTistCT cdm	
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7	Evaluate diagnostic:	Test results
8	$OK = N_{0}$, of child diagnostics = 4 (expected = 4)	restresuits
9		
10	Evaluate child diagnostics error:	
11	Child diagnostic error 1 of 4	
12	OK Severity = FPROR (expected = FPROR)	
13	OK Source = 207 LIST DOT (01) (expected = 207 LIST 207.01.01)	
14	OK Massarge = The Activitutiet 'Arm TISM Arma (11)' has an ArmmentAssignment '526rdh50-11e9-11eh-8e3f-9374ef79rdh2' to a tarm	at Argument 'FA ACTT. 01 02' which
	the arguments of the Activity is a second a second se	leb-8e3f-9374ef79c0b2! to a target
	TEN ACTUE 01 02' which is not not of the arguments of the Activity into a Argument and an Argument and a second of the second of the Activity into a Argument and a	tes test strictricesz to a carget
15	DK Perture = argumentssignments (expected = [argumentssignments])	
16	Child diagnostic error 2 of 4	
17	OR Senarity = FDDD (synartad = FDDD)	
18	OK Source = 2 m LISH COT LOI 02 (expected = 2 m LISH 2010.01.02)	
19	OK Messare = The Activitutist 'Arm TISM ArmI. (1 02' has an ArmmentAssignment '6a759690-11eb-11eb-8e3f-9374ef79c0b2' to a target	at Argument 'FA ACTT. 01 01' which
	the arguments of the ActivityList. (expected = The ActivityList ACT LIST ACTL 01 02) has an ArgumentAssignment (64759690-116-11	leb-8e3f-9374ef79c0b2' to a target
	'FA ACUL 01 01' which is not one of the arguments of the ActivityList.)	to a cargo
20	OK Feature = argumentssignments (expected = [argument]ssignments])	
21	Child diagnostic error 3 of 4	
22	OK Severity = FRROR (expected = FRROR)	
23	OK Source = ACT LIST ALAA 01 01 (expected = ACT LIST ALAA 01 01)	
24	OK Message = The ActivityList 'ACT LIST ALAA 01 01' has an ArgumentAssignment 'd3de09e0-12a5-11eb-ac36-deef7bf51fd8' to a targe	et Argument 'RA ALAA 01 11' which :
	the arguments of the ActivityList. (expected = The ActivityList 'ACT LIST ALAA 01 01' has an ArgumentAssignment 'd3de09e0-12a5-11	leb-ac36-deef7bf51fd8' to a target
	'RA ALAA 01 11' which is not one of the arguments of the ActivityList.)	···· ···· ···· ···· ··· ··· ··· ··· ··
25	OK Feature = argumentAssignments (expected = [argumentAssignments])	
26	Child diagnostic error 4 of 4	
27	OK Severity = ERROR (expected = ERROR)	
28	OK Source = ACT LIST ALAA 01 01 (expected = ACT LIST ALAA 01 01)	
29	OK Message = The ActivityList 'ACT LIST ALAA 01 01' has an ArgumentAssignment 'f7f14e30-12b1-11eb-881b-ce5a9a0a3026' to a targe	et Argument 'RA ALAA 01 21' which :
	the arguments of the ActivityList. (expected = The ActivityList 'ACT LIST ALAA 01 01' has an ArgumentAssignment 'f7f14e30-12b1-11	Leb-881b-ce5a9a0a3026' to a target
	'RA ALAA 01 21' which is not one of the arguments of the ActivityList.)	
30	OK Feature = argumentAssignments (expected = [argumentAssignments])	
31		
32		
33	Evaluate child diagnostics OK:	
34	OK No. of child diagnostics OK = 0 (expected = 0)	
35		
36	ActivityListArgumentAssignmentRule test result: OK	

TEST SUITES FOR TEST SCRIPTS

	File Edit Window Help Run					
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	type filter text		11	o		^
	Comparison of the second	^	12 13 /************************************	same directory with this	script */	Test suites by package
Test suite for all packages	Common and the second sec	_Test.groo _Test.resul	<pre>18 def envSuite = Utils.prepareSuiteEnvironmer 9 /************************************</pre>	rt(sourceUri);		
CS	 i monitoringControlModel i monitoringControlImplementation i InstancePointedToByDataDisplayFormat_Test.groovy MonitoringControlImplementationRules_Suite.srout UniquenessOfMCPacketName_Test.groovy MonitoringControlImplementationRules_Suite.srout CativityList ActivityListArgumentAssignmentListInstanceRule_Test.result ActivityListArgumentAssignmentBiol_Test.groovy ActivityListInstanceArgumentValueRule_Test.result ActivityListInstanceArgumentValueRule_Test.result ActivityListInstanceArgumentValueRule_Test.result MonitoringControlImplementationActivityListRules_Suite.groovy ActivityListInstanceDefinitionRule_Test.result MonitoringControlImpl	st.groovy st.result it	<pre>2 def resultsList = []; 2 // Suite 1: 3 resultsList.add((new StandardDataTypesRules 3 resultsList.add((new CalibrationsRules_Suit 4 // Suite 2: 3 resultsList.add((new CalibrationsRules_Suit 5 // Suite 3: 3 resultsList.add((new CheckAndConditionRules 7 // Suite 4: 3 resultsList.add((new MonitoringControlModel 4 // Suite 5: 4 // Suite 5: 4 // Suite 6: 4 // Suite 6: 4 // Suite 7: 4 resultsList.add((new SpaceSystemModelRules_ 4 // Suite 7: 5 resultsList.add((new McmImplementationItems 5 // Suite 7: 5 /* Restore output to console */ 5 /* Print final results */ 5 /* Restore output to console */ 5 /* Restore outp</pre>	s_Suite()) - run(modelHelper, val 	<pre>validationService)) idationService)) , validationService)) elper, validationService)) validationService)) elper, validationService)) elper, validationService)) elper, validationService)) elper, validationService) validationService) elper, validationService)</pre>	spendencies ☐ Console ♣ ♥ ♥
GROUP	> 🍃 validation	~			^	FILTERED

SUMMARY RESULTS FOR TEST SUITE OF ALL SCRIPTS

GROUP

	s Suite result 🔀 🔚 Activity List Aroument Assignment Rule. Test result 🔀
5334	OK Facture = namespace (expected = [namespace])
5335	Child diagnostic error 2 of 4
5336	OK Severity = ERROR (expected = ERROR)
5337	OK Source = PACK-EGSCCCDM-40-K002 (expected = PACK-EGSCCCDM-40-K002)
5338	OK Message = The Name of the MonitoringControlImplementationAspect 'PACK-EGSCCCDM-40-K002' is a duplicate name in 'NamespaceOne' namespace. (expected = The Name of the
	MonitoringControlImplementationAspect 'PACK-EGSCCCDM-40-K002' is a duplicate name in 'NamespaceOne' namespace.)
5339	OK Feature = namespace (expected = [namespace])
5340	Child diagnostic error 3 of 4
5341	OK Severity = ERROR (expected = ERROR)
5342	OK Source = VALUE (expected = VALUE)
5343	OK Message = The Name of the MonitoringControlImplementationAspect 'VALUE' is a duplicate name in 'global' namespace. (expected = The Name of the
	MonitoringControlImplementationAspect 'VALUE' is a duplicate name in 'global' namespace.)
5344	OK Feature = namespace (expected = [namespace])
5345	Child diagnostic error 4 of 4
5346	OK Severity = ERROR (expected = ERROR)
5347	OK Source = VALUE (expected = VALUE)
5348	OK Message = The Name of the MonitoringControlImplementationAspect 'VALUE' is a duplicate name in 'global' namespace. (expected = The Name of the
5040	MonitoringControlImplementationAspect 'VALUE' is a duplicate name in 'global' namespace.)
5349	OK reature = namespace (expected = [namespace])
5350	
53531	The last shild dispersion OT
5352	Evaluate child diagnostics $OK = 137$ (evaluated = 137)
5354	
5355	UniquenessOfMonitoringControlImplementationAspectName test result: OK
5356	
5357	******
5358	# MCMImplementationItems Rules Tests Suite results:
5359	UniquenessOfMonitoringControlImplementationAspectName test result: OK
5360	
5361	Total tests in suite: 1
5362	Total tests OK in suite: 1
5363	Total tests NOK in suite: 0
5364	***************************************
5365	***************************************
5366	# All Consistency Rules Verification Suite summary report :
5367	Standard Data Types Consistency Rules Tests Suite: 15 OK / 0 NOK / 15 Total
5368	Calibrations Consistency Rules Tests Suite: 48 OK / 0 NOK / 48 Total Summary results
5369	Check and Condition Consistency Rules Tests Suite: 8 OK / 0 NOK / 8 Total
5370	Monitoring Control Model Consistency Rules Tests Suite: 32 0K / 0 NOK / 32 Total Dy lesi Suile
5371	Monitoring control implementation consistency whiles Tests Sulte: 0 OK / 0 NOK / 0 Total
5272	opade system model consistency Rules rests Sulte: / UK / U NoK / / Total
5374	Monimplementationitems Raiss Fasts Suite. 1 OK / 0 NOK / 1 Total
5375	Total tests in suite: 137
5376	Total tests OK in suite: 137
5377	Total tests NOK in suite: 0
5378	

VALIDATION OF CDM DATASETS OUTSIDE OPEN-M

- Tscl-Light Project
 - Execution of consistency rules on CDM datasets without using OPEN-M
 - Maven project implemented in Java 11
 - Dependencies on various libraries: LDM 0.8.5, EGS-CC Kernel API, Apache Groovy, OPEN Core API, Eclipse EMF, log4J, other utility jars
 - Log4J properties file for log configuration
 - CDM dataset files provided in the specific XML format for EGS-CC datasets
 - Tested on CDM datasets used for implementation of consistency rules and on Azur dataset
 - Execution in Eclipse IDE or on command line using Maven commands
 - Results displayed on the console or saved into a log file



VALIDATION OF CDM DATASETS OUTSIDE OPEN-M – LOG FILE

[INFO] 2021-04-01 12:20:59.400 [main] TsclLight - Running all consistency rules on CDM data.

[INFO] 2021-04-01 12:21:02.533 [main] TsclLight - Running consistency rule E:_PROIECTE\EGS-CC_CDM\tscl-

 $light \verb|checks\verb|cdmConstraints\verb|monitoringControl\verb|controlCommon\verb|calibrations\verb|CalibrationDirectionConsistencyActivityEngineeringArgument.groovy|| \\ light \verb|checks\verb|cdmConstraints\verb|monitoringControl\verb|monitoringControlCommon\verb|calibrations\verb|CalibrationDirectionConsistencyActivityEngineeringArgument.groovy|| \\ light \verb|checks\verb|cdmConstraints\verb|monitoringControl\|monitoringControlCommon\verb|calibrations\verb|CalibrationDirectionConsistencyActivityEngineeringArgument.groovy|| \\ light \verb|checks\verb|cdmConstraints\verb|monitoringControl\|monitoringControlCommon\|calibrations\verb|CalibrationDirectionConsistencyActivityEngineeringArgument.groovy|| \\ light \verb|checks\verb|cdmConstraints\verb|monitoringControl\|monitoringControlCommon\|calibrations\verb|CalibrationDirectionConsistencyActivityEngineeringArgument.groovy|| \\ light \verb|checks\verb|checks\verb|checks\verb|checks\verb|checks\verb|checks\verb|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks\|checks$

[INF0] 2021-04-01 12:21:02.599 [main] ConsistencyRuleRunner - Checks Messages for E:_PROIECTE\EGS-CC_CDM\tscl-light\testData\Resource_TestMcm.cdm:

ERROR, The EngineeringArgumentDefinition 'ENG-ARG-DEF_T02' uses calibration 'RangeEnumeration_T09' with calDirection 'CAL2SRC_Only' which is not allowed (calibration must be done from a source to calibrated value)., ENG-ARG-DEF_T02

ERROR, The EngineeringArgumentDefinition 'ENG-ARG-DEF_T04' uses decalibration 'Interpolation_T10' with calDirection 'SRC2CAL_Only' which is not allowed (decalibration must be done from a calibrated to a source value)., ENG-ARG-DEF_T04

[INFO] 2021-04-01 10:04:22.589 [main] TsclLight - Running consistency rule E:_PROIECTE\EGS-CC_CDM\tscl-

light\checks\cdmConstraints\monitoringControl\monitoringControlCommon\calibrations\NonZeroLeadingCoefficientInPolynomial.groovy

[INF0] 2021-04-01 10:04:22.631 [main] CheckRunner - Checks Messages for E:_PROIECTE\EGS-CC_CDM\tscl-light\testData\Resource_TestMcm.cdm:

- WARNING, The leading coefficient of Polynom 'POLYNOM_T02' is zero., POLYNOM_T02
- WARNING, The leading coefficient of Polynom 'POLYNOM_T01' is zero., POLYNOM_T01
- WARNING, The leading coefficient of Polynom 'POLYNOM_T11' is zero., POLYNOM_T11

[INFO] 2021-04-01 10:04:30.241 [main] TsclLight - Running consistency rule E:_PROIECTE\EGS-CC_CDM\tscl-

light\checks\cdmConstraints\spaceSystemModel\SimilarCorrespondingAspectSEA.groovy

[INFO] 2021-04-01 10:04:30.266 [main] CheckRunner - Checks Messages for E:_PROIECTE\EGS-CC_CDM\tscl-light\testData\Resource_TestMcm.cdm:

ERROR, System Element Aspect 'Enumeration_T09' (Enumeration) is not the same type as its base element 'Interpolation_T07' (Interpolation), Enumeration_T09

ERROR, System Element Aspect 'SYN-PARAM_T04' (SyntheticParameter) is not the same type as its base element 'CompoundCalibration_T03' (CompoundCalibration), SYN-PARAM_T04

[INFO] 2021-04-01 10:04:30.268 [main] TsclLight - Running consistency rule E:_PROIECTE\EGS-CC_CDM\tscl-

light\checks\cdmConstraints\spaceSystemModel\UniqueApplicationProcessID.groovy

[INFO] 2021-04-01 10:04:30.302 [main] CheckRunner - Checks Messages for E:_PROIECTE\EGS-CC_CDM\tscl-light\testData\Resource_TestPUSServices.cdm:

ERROR, The Application Process 'APPPROC-T05' has a duplicate APID: 2047 with Application Process 'APPPROC-T03', APPPROC-T05

ERROR, The Application Process 'APPPROC-TO6' has a duplicate APID: 0 with Application Process 'APPPROC-TO4', APPPROC-TO6

[INFO] 2021-04-01 10:04:30.302 [main] TsclLight - Total errors found: 462

[INFO] 2021-04-01 10:04:30.303 [main] TsclLight - Finished executing all consistency rules.



EGS-CC KNOWLEDGE BASE PAGES IN CONFLUENCE

- Implementation of Confluence pages as part of EGS-CC Knowledge Base, after discussions in the CDM Working Group meetings
- Extended description of various CDM components, UML diagrams, datasets created in OPEN-M, explanations added into web pages
- Confluence pages about various CDM artifacts and PUS Services:
 - Activity Argument Types
 - Activity Pre- and Post-conditions
 - Calibrations and De-calibrations
 - Checks and Conditions
 - PUS Service 2 "Switch On" activity Use Case
 - PUS Service 9 "Time Management" service Use Case
 - PUS Service 11 "On board operations scheduling" activity Use Case



SUPPORT TO CDM WORKING GROUP FOR IMPROVING DOCUMENTATION

- Activities to CDM Working Group Workshops
 - Propositions for improving of CDM documentation (Technical Note and HTML Report)
 - Export of data consistency rule information from CSDE Jira, to be integrated into new CDM documentation
 - Analysis of RIDs about the implemented consistency rules, propositions for updates and new rules to be implemented
 - Presentation of created Confluence pages for EGS-CC Knowledge Base, updates of explanations after the upgrade of CDM to 1.14.2 version
 - Analysis of the Change Requests related to CDM, their scope, comments and investigations
 - Managing Confluence pages with summary of discussions, conclusions and further actions



FINAL CONCLUSIONS AND RECOMMENDATIONS

- The goals and technical objectives of the project were successfully reached
- CS GROUP ROMANIA team gained a solid knowledge of:
 - CDM model, documentation, artefacts and tools,
 - EGS-CC documentation and infrastructure for monitoring and control systems,
 - Implementation and testing of data consistency rules,
 - Preparation of web pages for EGS-CC Knowledge Base,
 - Validation of CDM datasets by executing all the implemented consistency rules without the use of OPEN-M tool,
 - It can act as a reference for the EGS-CC Knowledge regarding CDM
- Further recommendations and activities:
 - Elicit and implement new data consistency rules from various sources,
 - Preparation of new web pages for EGS-CC Knowledge Base,
 - Update and improvement of the CDM documentation
- We consider that this activity and its results will have strategic implications in the space roadmap of Romania and will allow CS GROUP ROMANIA to participate to other EGS-CC related projects (i.e. EGS-CC Phase E, evolutions of OPEN Preparation Environment, etc.)



CS GROUP - ROMANIA COMPANY BACKGROUND

- > Located in Craiova, SW part of Romania
- Subsidiary of CS GROUP (France)
- 30 years of market presence, extended expertise in software development and maintenance for critical information systems in domains such as Aeronautics, Space, Energy, Intelligent Transportation, Telecom





the thread

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THANK YOU!

Q&A

INTELLIGENT & CYBER-PROTECTED MISSION-CRITICAL SYSTEMS