The Polarsys Maturity Model: Assessing and Improving Software Project Quality

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https://polarsys.org/wiki/Maturity_Assessment_WG

Polarsys Meeting
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Structure of the presentation

1. The Big Picture
2. The Quality Model
3. Mining Software Repositories
4. The PolarSys Dashboard
5. Next Steps

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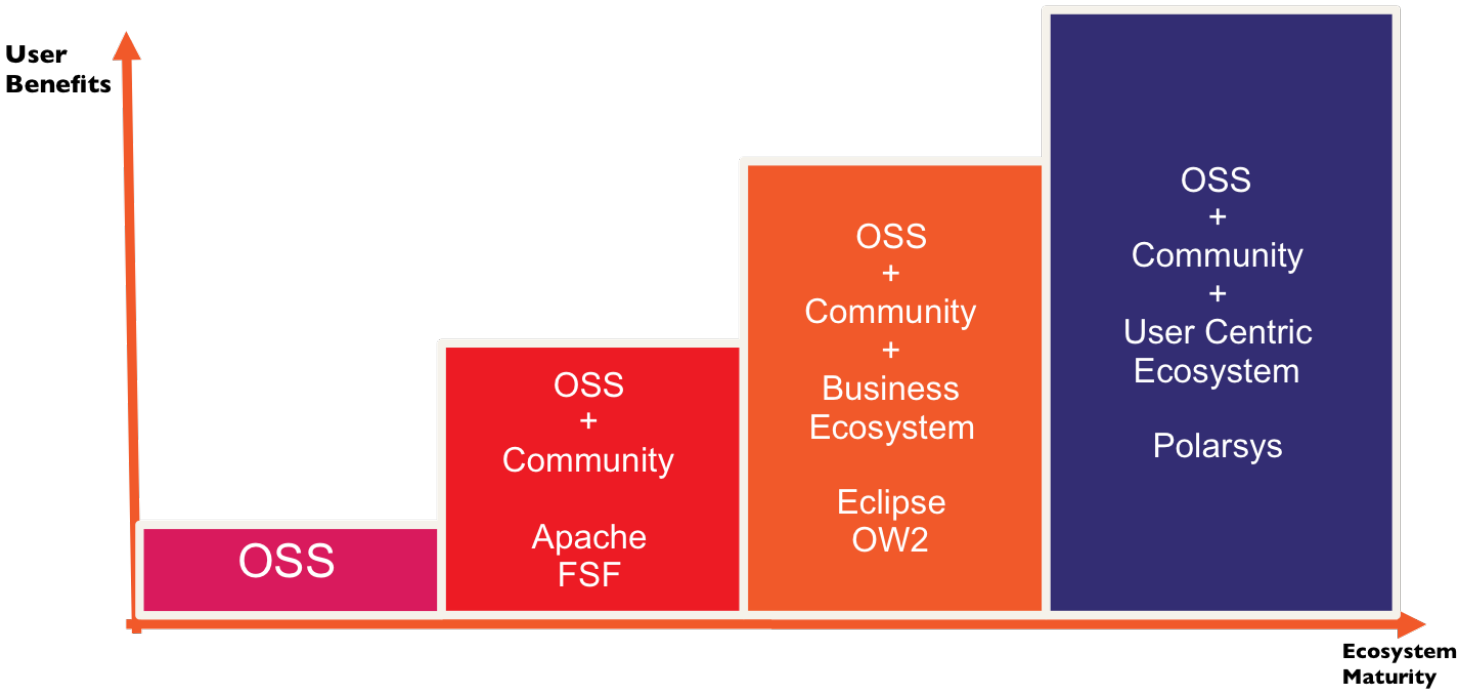
The Big Picture

The PolarSys ecosystem



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PolarSys in a nutshell

PolarSys Working Group

- Open Innovation to create better methods and tools
- Software tools for critical systems
- Interoperability based on Open Standards
- Fostering of exchanges between academics and industrial partners
- Quality and maturity assessment
- Very Long Term Support for more than 10 years

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Objectives...

What we want..

- Assess maturity of components to ensure that the full stack is safe.
- Help people better understand, know and manage their project.
- Propose guidance for good practices and Eclipse processes.
- Involve people to make it a community-driven project.

What we DO NOT want..

- Judge or blame projects or people.
- Address individual characteristics.

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The Quality Model

Defining Quality Requirements

There is no single definition of quality..

- Usual definitions of quality, existing standards and norms are not enough..
- OSS has an impact on the different quality concerns.
- We have to define our own quality requirements for Eclipse *and* PolarSys.
  - Process: predictable outputs, well-defined structure of projects.
  - Ecosystem: nurture communities, good citizenship behaviour.
  - Product: maintainability, reliability, good practices.

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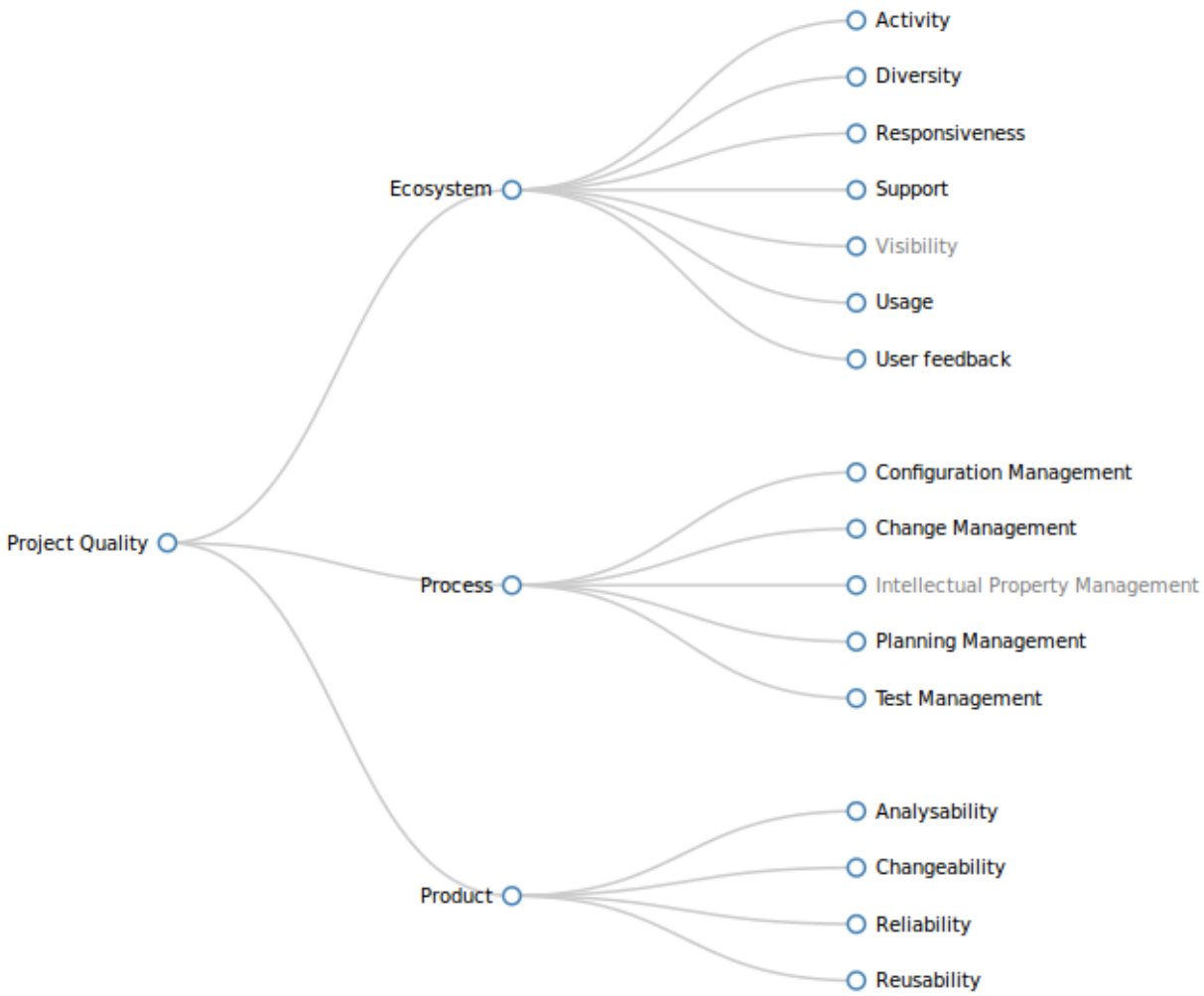
Composition of the Quality Model

Quality Attributes:



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Composition of the Quality Model

We further define:

- **Quality attributes**: define the concerns of quality.
- **Measurement goals**: generic measurement goals that can be applied to all projects.
- **Base metrics**: raw numbers adapted to each project's characteristics.

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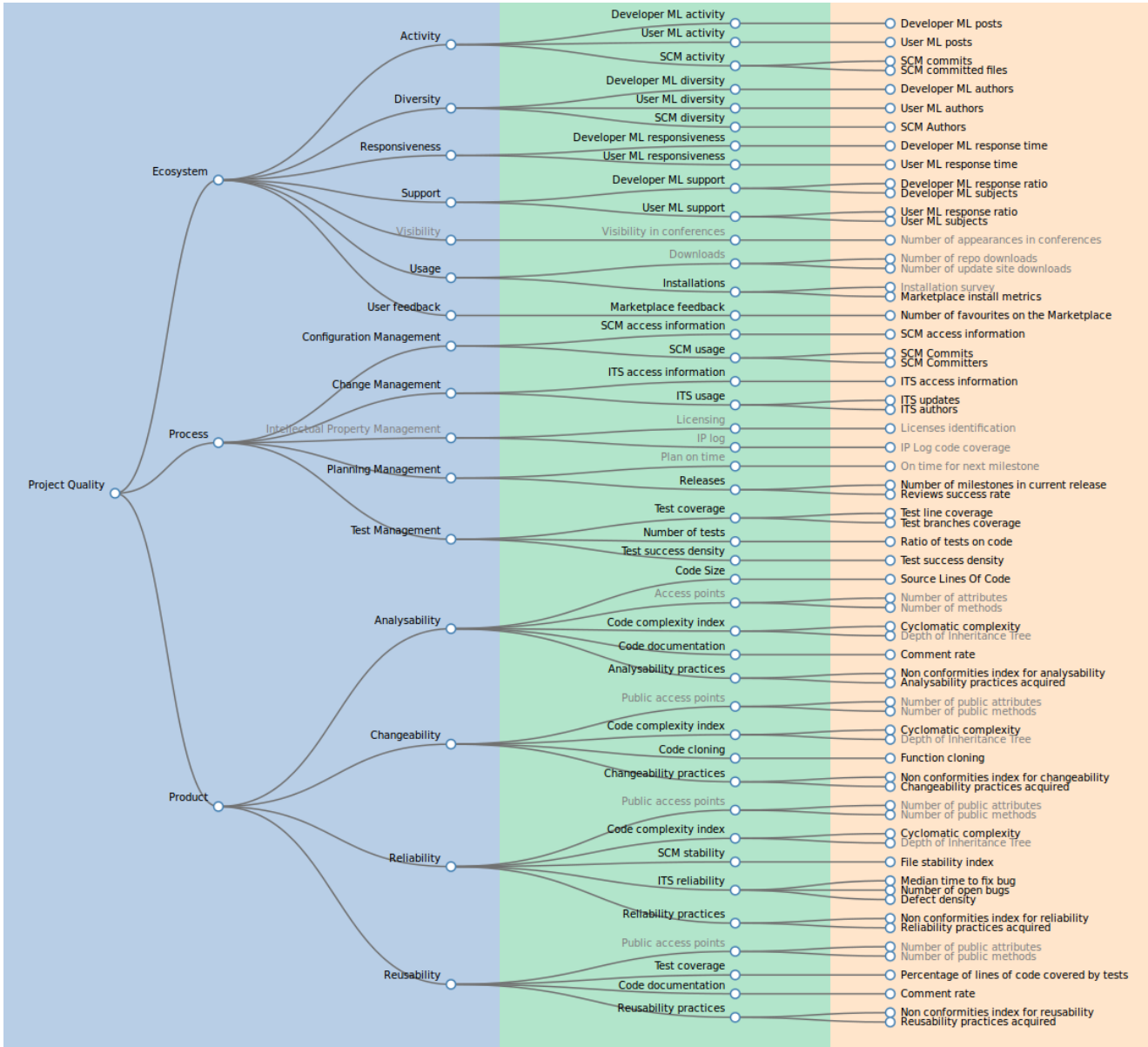
The full quality model



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Mining Software Repositories

Eclipse Software Repositories

The metrics used in the process are retrieved from several sources:

- Source Code: SonarQube, rule-checking tools.
- SCM, ITS, Mailing lists: Eclipse Dashboard (**Grimoire**).
- PMI JSON files from the Project Management Infrastructure project.
- Analysis of Forums, Web sites, or even manual surveys.

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Source code metrics

- Source code metrics are retrieved from SonarQube, but other inputs may be easily added.
- Metrics are computed as a ratio to limit the effect of size of software:
  - **Comment rate**: number of comments per KLOC.
  - **Complexity density**: average number of paths per function.
  - **Duplicated lines density**: amount of duplicated lines per KLOC.
- Some metrics are kept absolute because they are self-explicite:
  - **Source Lines of Code**: representative of the size of the software.
  - **Depth of Inheritance Tree** for OO languages.

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Rule-checking metrics

- Rule-checking tools define **good practices** elaborated by the Open-Source Community.
- PMD 5.2.1 and FindBugs 3.0.0 are used for now, but other tools can be easily included in the framework: e.g. CheckStyle, FxCop, Lint, CppCheck..
- Examples of metrics include:
  - NCC (NCC_ANA, NCC_CHA, etc.): number of violations (related to analysability, changeability, etc.)
  - ROKR (ROKR_ANA, ROKR_CHA, etc.): percentage of acquired practices (related to analysability, changeability, etc.)

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Configuration Management metrics

- Software Configuration Management metrics are extracted from tools metadata.
- Supported tools are Git, Subversion, CVS, Bazaar, Mercurial.
- Examples of metrics include:
  - Number of commits during last month.
  - Number of committers during last month.
  - Number of files committed during last month

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ITS metrics

- Issue Tracking System metrics are extracted from tools metadata.
- Bugzilla, Jira, Redmine, Launchpad, GitHub and SourceForge ITS are supported.
- Examples of metrics include:
  - Number of bugs per thousands Lines of Code during last month.
  - Number of users active on the ITS during last month.
  - Number of updates to the ITS during last month.
  - Median time to fix issues during last month.

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MLS metrics

- Mailing list metrics are extracted from the project's archives.
- MBox and GMane are supported for now (forums are planned).
- Examples of metrics include:
  - Number of mails exchanged during last month.
  - Number of threads exchanged during last month.
  - Number of active authors during last month.
  - Median ratio of answers on questions during last month.

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PMI metrics

The Project Management Infrastructure maintains a list of characteristics for all projects, with:

- Information about repositories: SCM, ITS, MLS.
- Links for published content: web site, wiki, getting started, build process, official documentation.
- Description of releases, date, scope, status of review...

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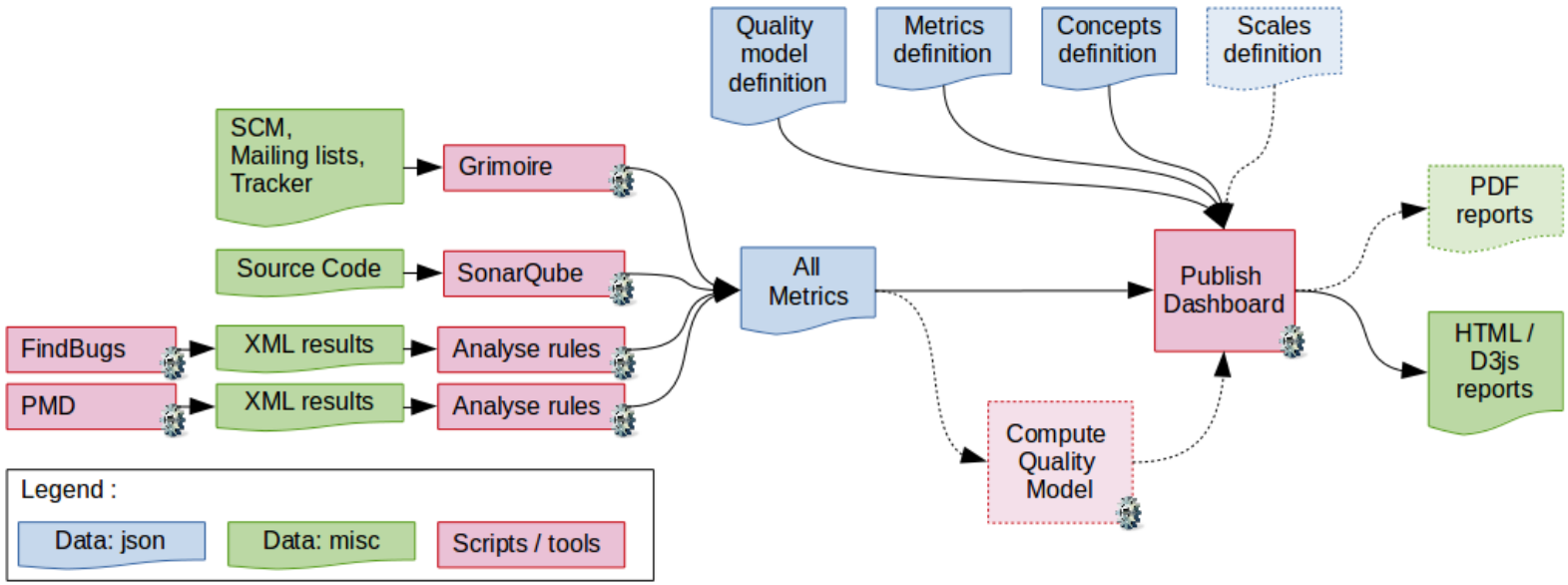
The PolarSys Dashboard

Architecture of the platform



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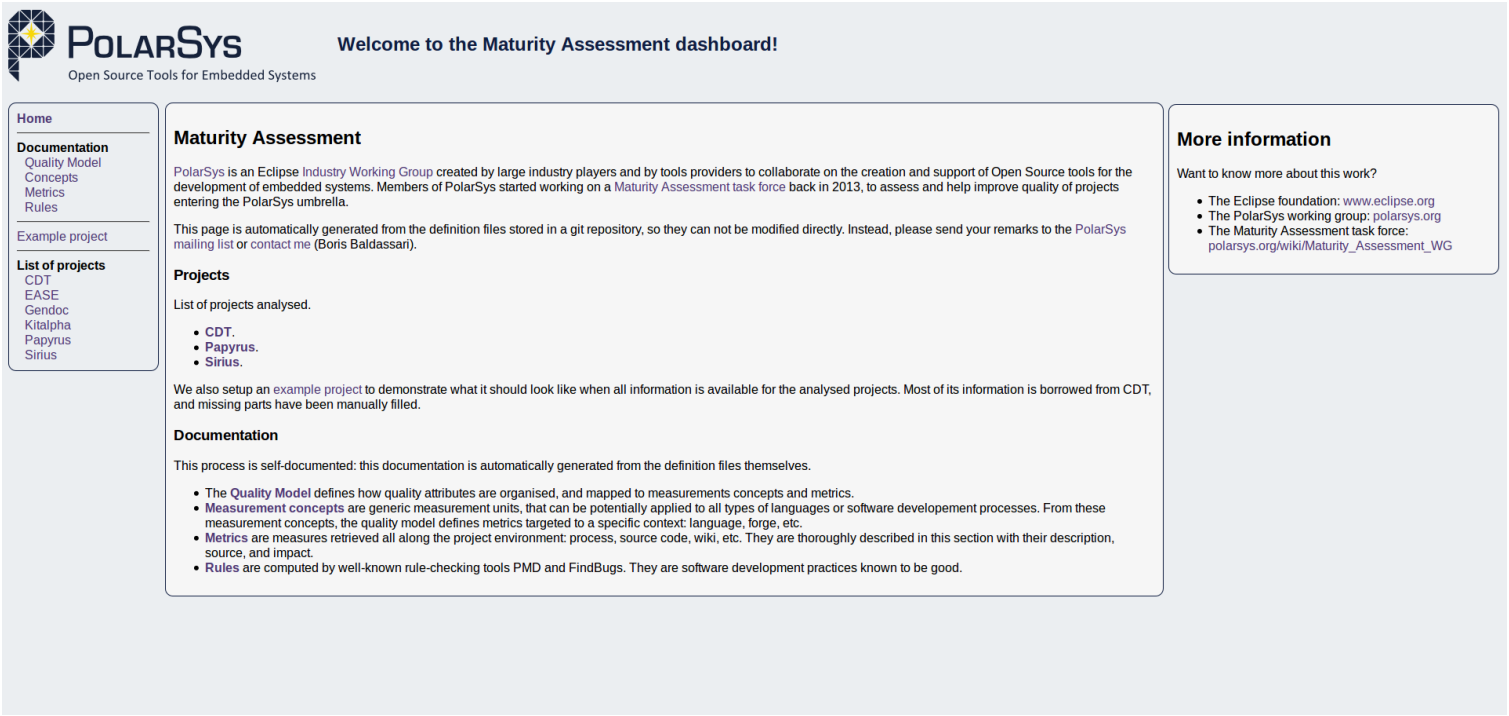
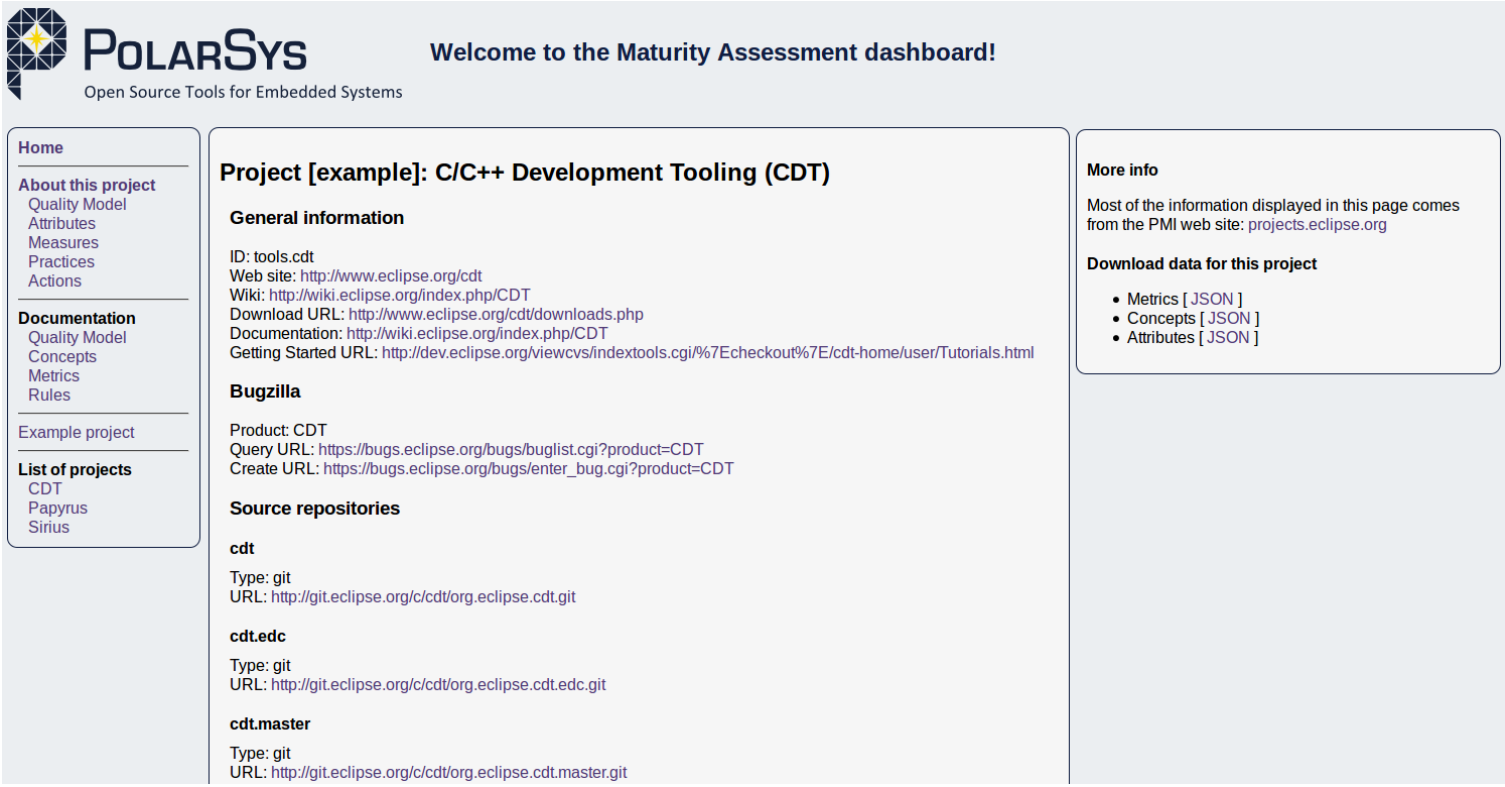
The Dashboard: Home



The Dashboard: project page for CDT



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Welcome to the Maturity Assessment dashboard!

Home

About this project
- Quality Model
- Attributes
- Measures
- Practices
- Actions

Documentation
- Quality Model
- Concepts
- Metrics
- Rules

Example project

List of projects
- CDT
- Papyrus
- Sirius

Project [example]: C/C++ Development Tooling (CDT)

General information

ID: tools.cdt
Web site: http://www.eclipse.org/cdt
Wiki: http://wiki.eclipse.org/index.php/CDT
Download URL: http://www.eclipse.org/cdt/downloads.php
Documentation: http://wiki.eclipse.org/index.php/CDT
Getting Started URL: http://dev.eclipse.org/viewcvs/indextools.cgi/%7Echeckout%7E/cdt-home/user/Tutorials.html

Bugzilla

Product: CDT
Query URL: https://bugs.eclipse.org/bugs/buglist.cgi?product=CDT
Create URL: https://bugs.eclipse.org/bugs/enter_bug.cgi?product=CDT

Source repositories

cdt

Type: git
URL: http://git.eclipse.org/c/cdt/org.eclipse.cdt.git

cdt.edc

Type: git
URL: http://git.eclipse.org/c/cdt/org.eclipse.cdt.edc.git

cdt.master

Type: git
URL: http://git.eclipse.org/c/cdt/org.eclipse.cdt.master.git

More info

Most of the information displayed in this page comes from the PMI web site: projects.eclipse.org

Download data for this project

- Metrics [JSON]
- Concepts [JSON]
- Attributes [JSON]

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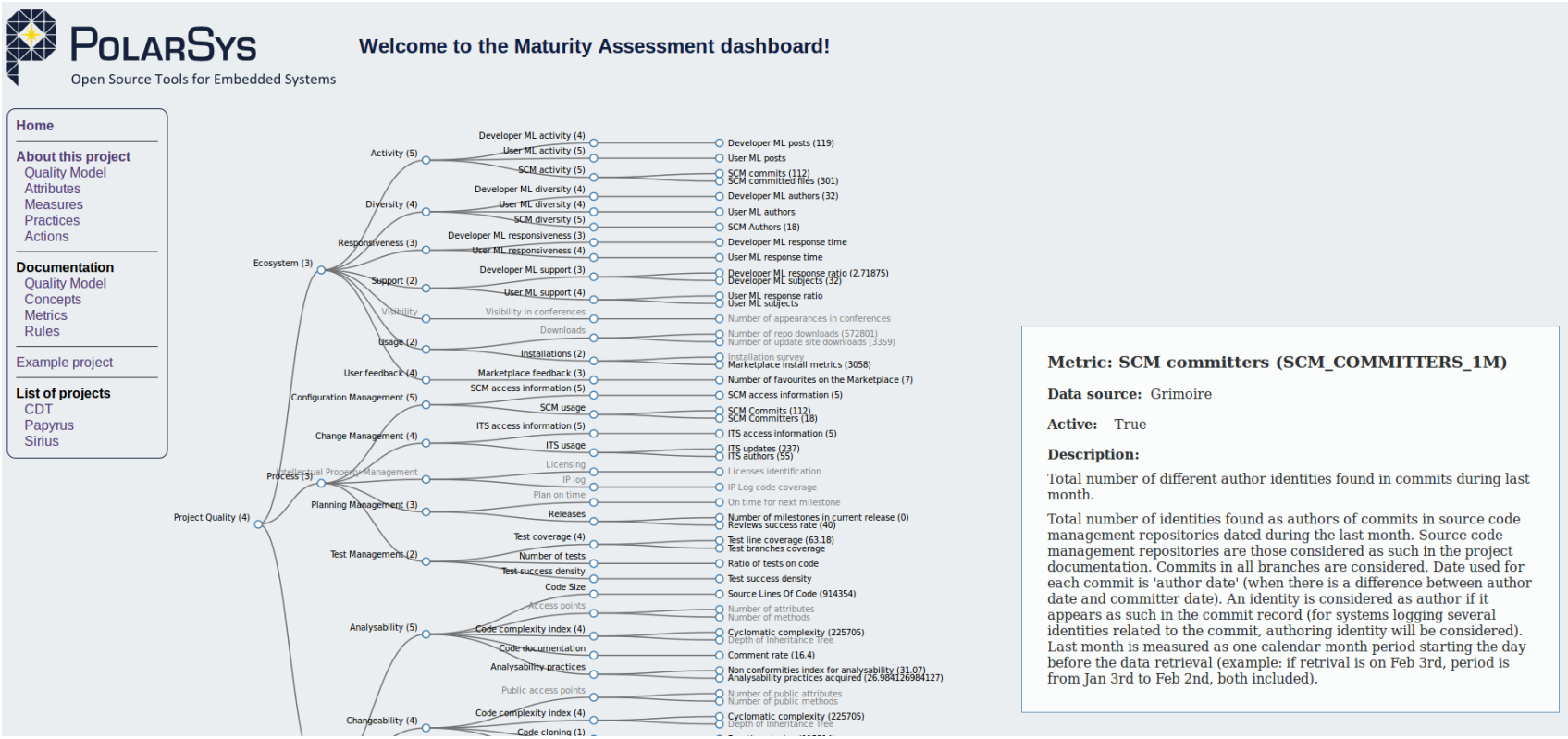
The Dashboard: Quality Model for CDT



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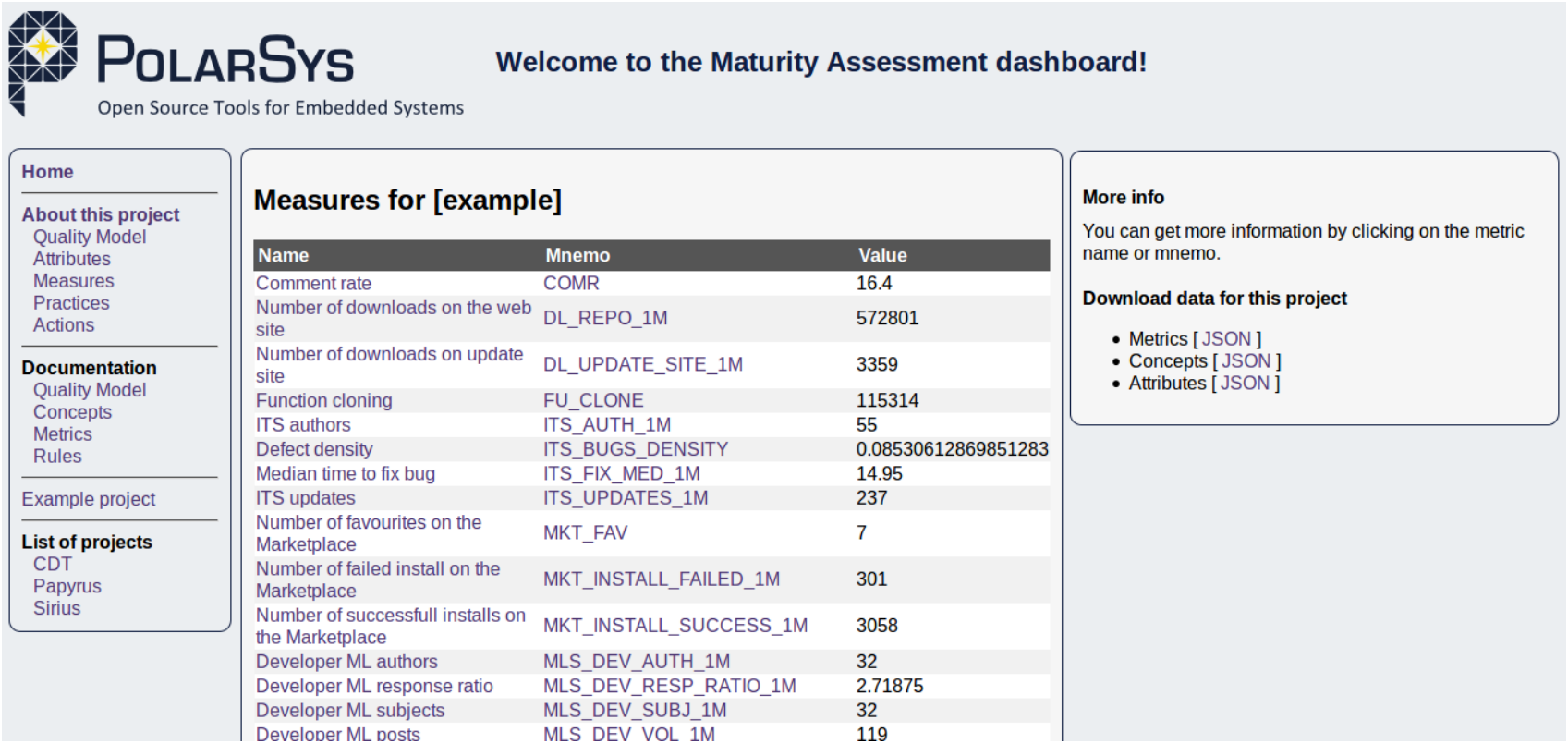
The Dashboard: Measures for CDT



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Measures for [example]

Name	Mnemo	Value
Comment rate	COMR	16.4
Number of downloads on the web site	DL_REPO_1M	572801
Number of downloads on update site	DL_UPDATE_SITE_1M	3359
Function cloning	FU_CLONE	115314
ITS authors	ITS_AUTH_1M	55
Defect density	ITS_BUGS_DENSITY	0.08530612869851283
Median time to fix bug	ITS_FIX_MED_1M	14.95
ITS updates	ITS_UPDATES_1M	237
Number of favourites on the Marketplace	MKT_FAV	7
Number of failed install on the Marketplace	MKT_INSTALL_FAILED_1M	301
Number of successfull installs on the Marketplace	MKT_INSTALL_SUCCESS_1M	3058
Developer ML authors	MLS_DEV_AUTH_1M	32
Developer ML response ratio	MLS_DEV_RESP_RATIO_1M	2.71875
Developer ML subjects	MLS_DEV_SUBJ_1M	32
Developer ML posts	MLS_DEV_VOL_1M	119

More info

You can get more information by clicking on the metric name or mnemo.

Download data for this project

- Metrics [JSON]
- Concepts [JSON]
- Attributes [JSON]

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The Dashboard: attributes for CDT

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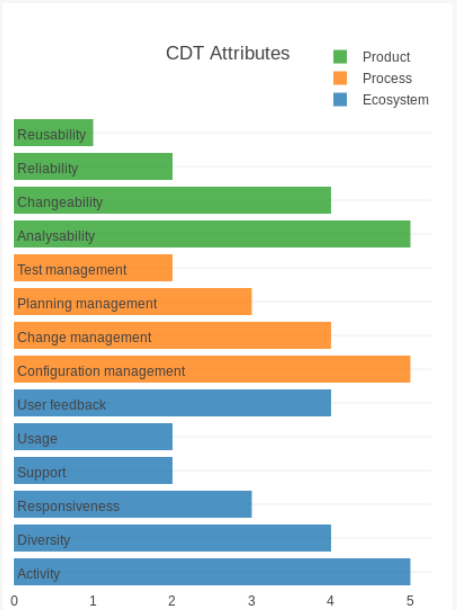
Attributes for [cdt]

Mnemo	Name	Value
QM_ACTIVITY	Activity	5
QM_ANA	Analysability	5
QM_CHA	Changeability	4
QM_COMMUNITY	Community	3
QM_DIVERSITY	Diversity	4
QM_FEEDBACK	Feedback	4
QM_ITS	Change Management	4
QM_PLAN	Planning Management	3
QM_PROCESS	Process	3
QM_PRODUCT	Product	2
QM_QUALITY	Maturity	4
QM_REL	Reliability	2
QM_RESPONSIVENESS	Responsiveness	3
QM_REU	Reusability	1
QM_SCM	Configuration Management	5
QM_SUPPORT	Support	2
QM_TST	Test Management	2
QM_USAGE	Usage	2

More info

You can get more information by clicking on the metric name or mnemo.



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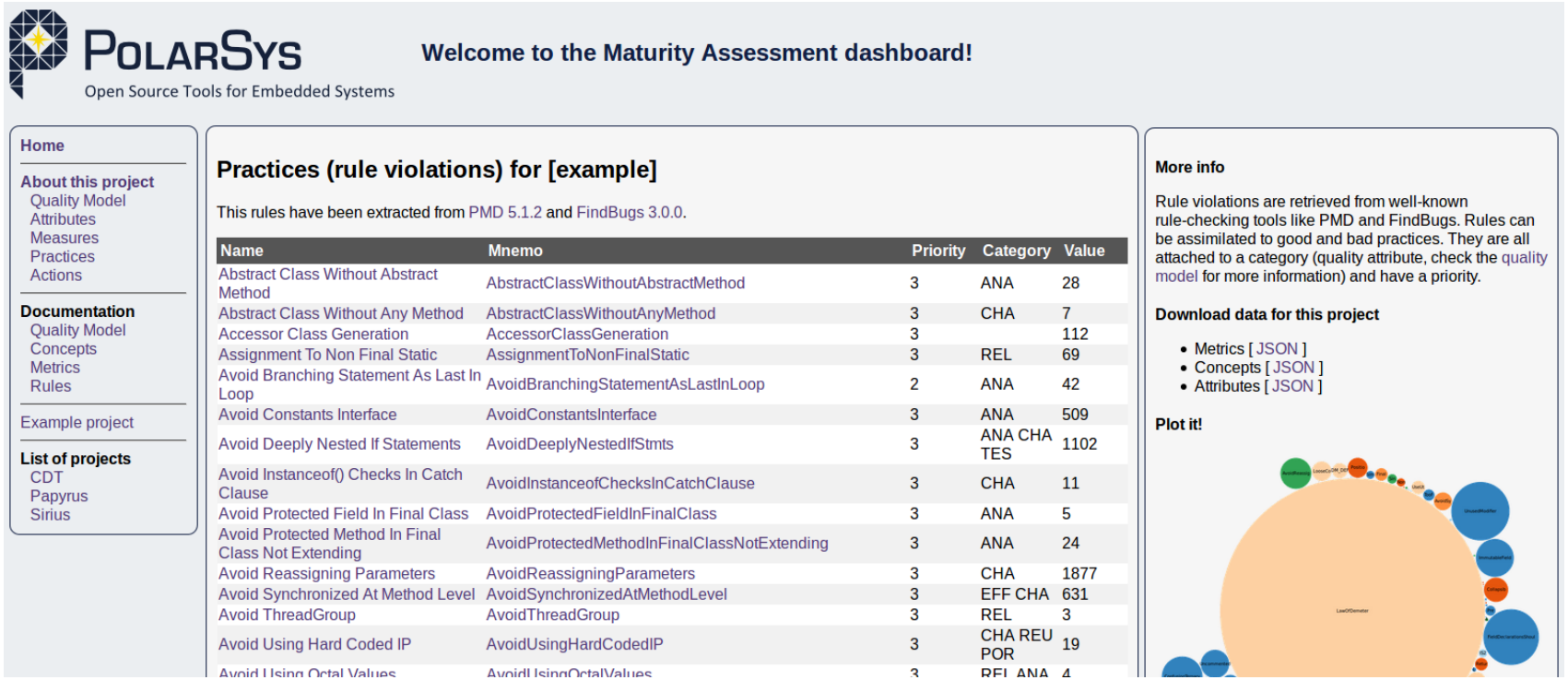
The Dashboard: Practices for CDT



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Practices (rule violations) for [example]

This rules have been extracted from PMD 5.1.2 and FindBugs 3.0.0.

Name	Mnemo	Priority	Category	Value
Abstract Class Without Abstract Method	AbstractClassWithoutAbstractMethod	3	ANA	28
Abstract Class Without Any Method	AbstractClassWithoutAnyMethod	3	CHA	7
Accessor Class Generation	AccessorClassGeneration	3		112
Assignment To Non Final Static	AssignmentToNonFinalStatic	3	REL	69
Avoid Branching Statement As Last In Loop	AvoidBranchingStatementAsLastInLoop	2	ANA	42
Avoid Constants Interface	AvoidConstantsInterface	3	ANA	509
Avoid Deeply Nested If Statements	AvoidDeeplyNestedIfStmts	3	ANA CHA TES	1102
Avoid Instanceof() Checks In Catch Clause	AvoidInstanceofChecksInCatchClause	3	CHA	11
Avoid Protected Field In Final Class	AvoidProtectedFieldInFinalClass	3	ANA	5
Avoid Protected Method In Final Class Not Extending	AvoidProtectedMethodInFinalClassNotExtending	3	ANA	24
Avoid Reassigning Parameters	AvoidReassigningParameters	3	CHA	1877
Avoid Synchronized At Method Level	AvoidSynchronizedAtMethodLevel	3	EFF CHA	631
Avoid ThreadGroup	AvoidThreadGroup	3	REL	3
Avoid Using Hard Coded IP	AvoidUsingHardCodedIP	3	CHA REU POR	19
Avoid Using Octal Values	AvoidUsingOctalValues	3	REL ANA	4

More info

Rule violations are retrieved from well-known rule-checking tools like PMD and FindBugs. Rules can be assimilated to good and bad practices. They are all attached to a category (quality attribute, check the quality model for more information) and have a priority.

Download data for this project

- Metrics [JSON]
- Concepts [JSON]
- Attributes [JSON]

Plot it!

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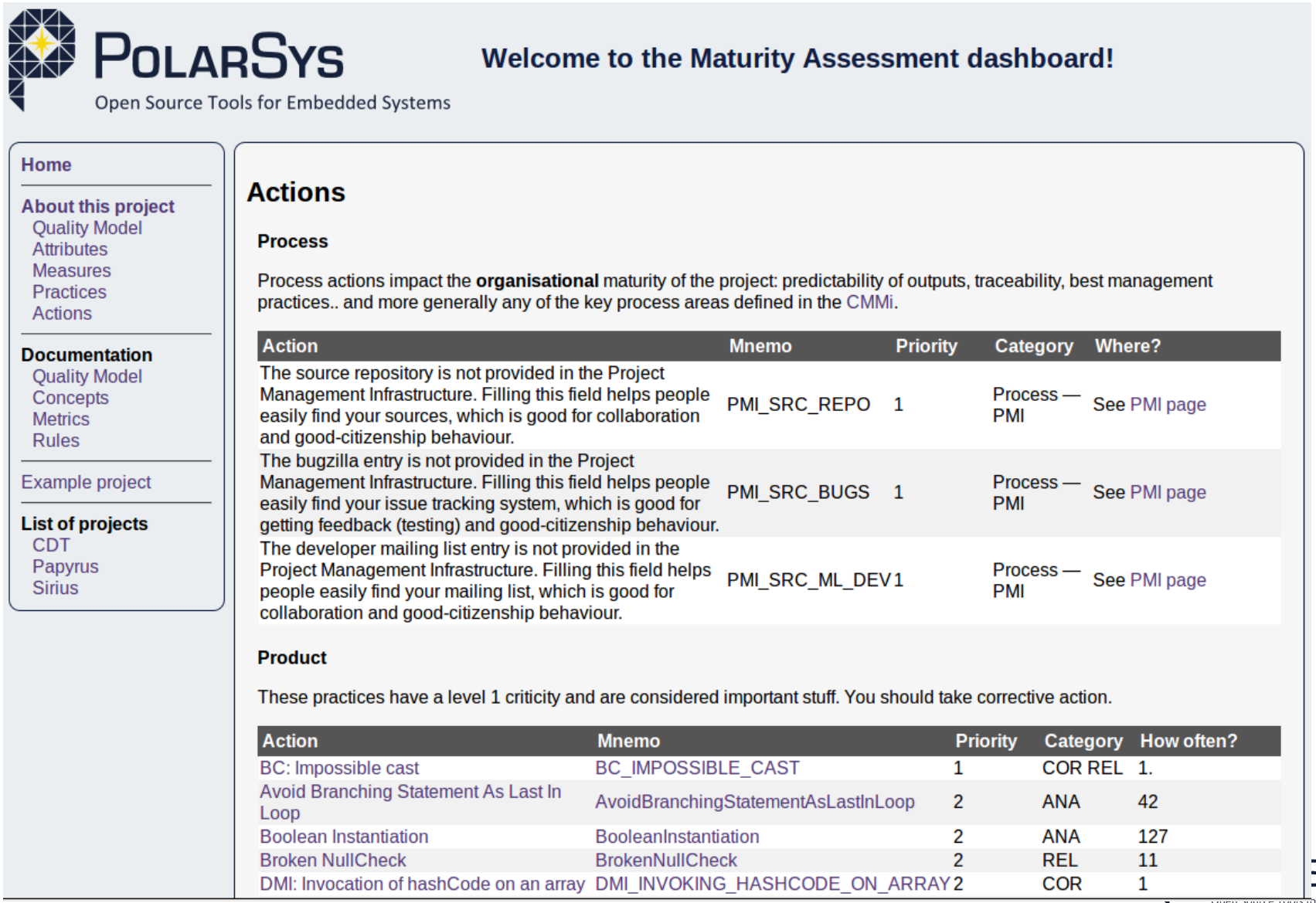
The Dashboard: Actions for CDT



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Actions

Process

Process actions impact the **organisational** maturity of the project: predictability of outputs, traceability, best management practices.. and more generally any of the key process areas defined in the CMMi.

Action	Mnemo	Priority	Category	Where?
The source repository is not provided in the Project Management Infrastructure. Filling this field helps people easily find your sources, which is good for collaboration and good-citizenship behaviour.	PMI_SRC_REPO	1	Process — PMI	See PMI page
The bugzilla entry is not provided in the Project Management Infrastructure. Filling this field helps people easily find your issue tracking system, which is good for getting feedback (testing) and good-citizenship behaviour.	PMI_SRC_BUGS	1	Process — PMI	See PMI page
The developer mailing list entry is not provided in the Project Management Infrastructure. Filling this field helps people easily find your mailing list, which is good for collaboration and good-citizenship behaviour.	PMI_SRC_ML_DEV	1	Process — PMI	See PMI page

Product

These practices have a level 1 criticity and are considered important stuff. You should take corrective action.

Action	Mnemo	Priority	Category	How often?
BC: Impossible cast	BC_IMPOSSIBLE_CAST	1	COR REL	1.
Avoid Branching Statement As Last In Loop	AvoidBranchingStatementAsLastInLoop	2	ANA	42
Boolean Instantiation	BooleanInstantiation	2	ANA	127
Broken NullCheck	BrokenNullCheck	2	REL	11
DMI: Invocation of hashCode on an array	DMI_INVOKING_HASHCODE_ON_ARRAY	2	COR	1

Next Steps

Next steps

- Scales: 1-5 scales to instantly get an idea of what numbers mean.
- Improve presentation of results: visualisation, ergonomy.
- Add more content: metrics, rules, actions.
- Improve automation, ease the adoption setup for new-coming projects.
- Add more projects. What about yours?

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Join us!

- The PolarSys wiki: polarsys.org/wiki
- Maturity Assessment on the wiki: polarsys.org/wiki/Maturity_Assessment_WG
- PolarSys Mailing list: dev.eclipse.org/mailman/listinfo/polarsys-iwg
- Look at the live dashboard prototype: castalia.camp/dl/dashboard/

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References

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y1986 Kearney, J. P., Sedlmeyer, R. L., Thompson, W. B., Gray, M. A., & Adler, M. A. (1986). Software complexity measurement. Communications of the ACM, 29(11), 1044–1050.

er1995 Kemerer, C. F. (1995). Software complexity and software maintenance: A survey of empirical research. Annals of Software Engineering, 1(1), 1–22.

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