

CertWare Workbench Metrics

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These metrics are meant to be supported by the workbench to help the case author and project manager collect management and quality indicators. The indicators are derived from those proposed by Walker Royce in “Software Project Management: A Unified Framework”. Walker’s SPM statistics depend a lot on different software change order (SCO) types, where type 0 is for critical defects, type 1 is for normal defects, type 2 is for improvements, and type 3 is for new features.

The initial CertWare workbench implementation employs two metamodels: the SPM metamodel, and the SCO metamodel. The SPM metamodel in turn employs the SMM (OMG’s Software Measurement Metamodel) metamodel for external tool integration. The idea is that we collect change-order related statistics in an SCO model, integrate the SCO model with data collected from the change set repository, then compute metrics to be stored according to SMM in the SPM. The suite implementation expects to gather SCO change data from the version control repository (expected to be EGit for the current version), and expects the user to update the SCO change order counts manually. Eventually, we will connect external application lifecycle management tools with the SCO models to gather these counts automatically. The SPM model then reads the SCO model to gather raw statistics and, together with its own raw statistics, compute the static and dynamic metrics.

SPM Management Indicators

- **Work and progress.**
- **Budgeted cost and expenditures.**
- **Staffing and team dynamics.**

SPM Quality Indicators

- **Change traffic and stability.** Change traffic is the number of software change orders opened and closed over the life cycle. Coupled with the work and progress metrics, it provides insight into the stability of the software and is convergence toward stability. Stability is defined as the relationship between opened versus closed SCOs. The change traffic relative to the release schedule provides insight into schedule predictability.
- **Breakage and modularity.** Breakage is defined as the average extent of change, which is the amount of software baseline that needs rework. Modularity is the average breakage trend over time. Modularity is a measure of breakage localization, with a lower value being better.
- **Rework and adaptability.** Rework is the average cost of change, which is the effort to analyze, resolve, and retest all changes to software baselines. Adaptability is defined as the rework trend over time. Adaptability quantifies the ease of change, with a lower value being better.

- **Mean time between failures and maturity.** MTBF is the average usage time between software faults. In rough terms, MTBF is computed by dividing the test hours by the number of type 0 and type 1 SCOs. Maturity is defined as the MTBF trend over time.

Metric	Purpose	SPM Perspectives	CW Perspectives
Work and progress	Iteration planning, plan versus actuals, management indicator	SLOC, function points, object points, scenarios, test cases, SCOs	Case lines, case nodes, verification nodes, SCOs
Budgeted cost and expenditures	Financial insight, plan versus actuals, management indicator	Cost per month, full-time staff per month, percentage of budget expended	Cost per month (overlay), cost per argument node, done with the CPN model
Staffing and team dynamics	Resource plan versus actuals, hiring rate, attribution rate	People per month added, people per month leaving	Not mapped
Change traffic and stability	Iteration planning, management indicator of schedule convergence	SCOs opened versus SCOs closed, by type, by release and component and subsystem	SCOs opened versus SCOs closed, by type, by repository commit
Breakage and modularity	Convergence, software scrap, quality indicator	Reworked SLOC per change, by type, by release and component and subsystem	Reworked case lines per change, by type, by repository commit
Rework and adaptability	Convergence, software rework, quality indicator	Average hours per change, by type, by release and component and subsystem	Average hours per change, by type, by repository commit

Metric	Purpose	SPM Perspectives	CW Perspectives
MTBF and maturity	Test coverage and adequacy, robustness for use, quality indicator	Failure counts, test hours until failure, by release and component and subsystem	Usage time (property or preference), by repository commit

Collected Statistics

SPM Statistic	SPM Definition	CW Definition
Total SLOC	$SLOC_T$ = total size in SLOC	$SLOC_T$ =total case size in lines; lines used for generic ARM case; extensions may add count by model element type
Configured SLOC	$SLOC_C$ = current baseline SLOC	$SLOC_C$ = current baseline SLOC where repository commit tag identifies baseline
Critical defects	SCO_0 = number of type 0 SCOs	SCO_0 = number of type 0 SCOs in SCO model
Normal defects	SCO_0 = number of type 1 SCOs	SCO_0 = number of type 1 SCOs in SCO model
Improvements	SCO_2 = number of type 2 SCOs	SCO_2 = number of type 2 SCOs in SCO model
New features	SCO_3 = number of type 3 SCOs	SCO_3 = number of type 3 SCOs in SCO model
Number of SCOs	$N = SCO_0 + SCO_1 + SCO_2$	$N = SCO_0 + SCO_1 + SCO_2$
Open rework (breakage)	B = cumulative broken SLOC due to SCO_0 , SCO_1 , and SCO_2	B = cumulative broken SLOC due to SCO_0 , SCO_1 , and SCO_2 ; difference entry deletes
Closed rework (fixes)	F = cumulative fixed SLOC	F = cumulative fixed SLOC; difference entry adds

SPM Statistic	SPM Definition	CW Definition
Rework effort	E = cumulative effort expended fixing SCO ₀ , SCO ₁ , and SCO ₂	E = cumulative effort expended fixing SCO ₀ , SCO ₁ , and SCO ₂ identified by Mylyn task total hours
Usage time	UT = hours that a given baseline has been operating under realistic usage scenarios	UT = hours that a given baseline has been operating under realistic usage scenarios, seeded as commit time difference but edited in SCO model

End-Product Quality Metrics

Metric	SPM Definition	CW Definition
Scrap ratio	B/SLOC _T , percentage of product scrapped	B/SLOC _T , percentage of case scrapped
Rework ratio	E/Effort _{Development} , percentage of rework effort	E/Effort _{Development} , percentage of rework effort
Modularity	B/N, average breakage per SCO	B/N, average breakage per SCO, in SCO model
Adaptability	E/N, average effort per SCO	E/N, average effort per SCO, in SCO model
Maturity	UT/(SCO ₀ + SCO ₁), mean time between defects	UT/(SCO ₀ + SCO ₁), mean time between defects
Maintainability	(scrap ratio)/(rework ratio), maintenance productivity	(scrap ratio)/(rework ratio), maintenance productivity

In-Progress Indicators

Indicator	SPM Definition	
Rework stability	B-F, breakage minus fixes plotted over time	B-F, breakage minus fixes plotted over time

Indicator	SPM Definition	
Rework backlog	(B-F)/SLOC _C , currently open rework	(B-F)/SLOC _C , currently open rework
Modularity trend	Modularity plotted over time	Modularity plotted over time
Adaptability trend	Adaptability plotted over time	Adaptability plotted over time
Maturity trend	Maturity plotted over time	Maturity plotted over time



