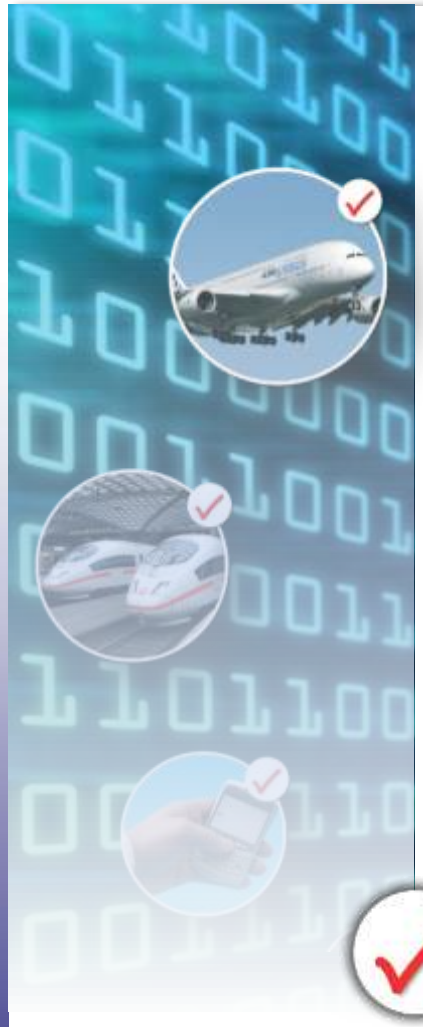
Verifysoft TECHNOLOGY

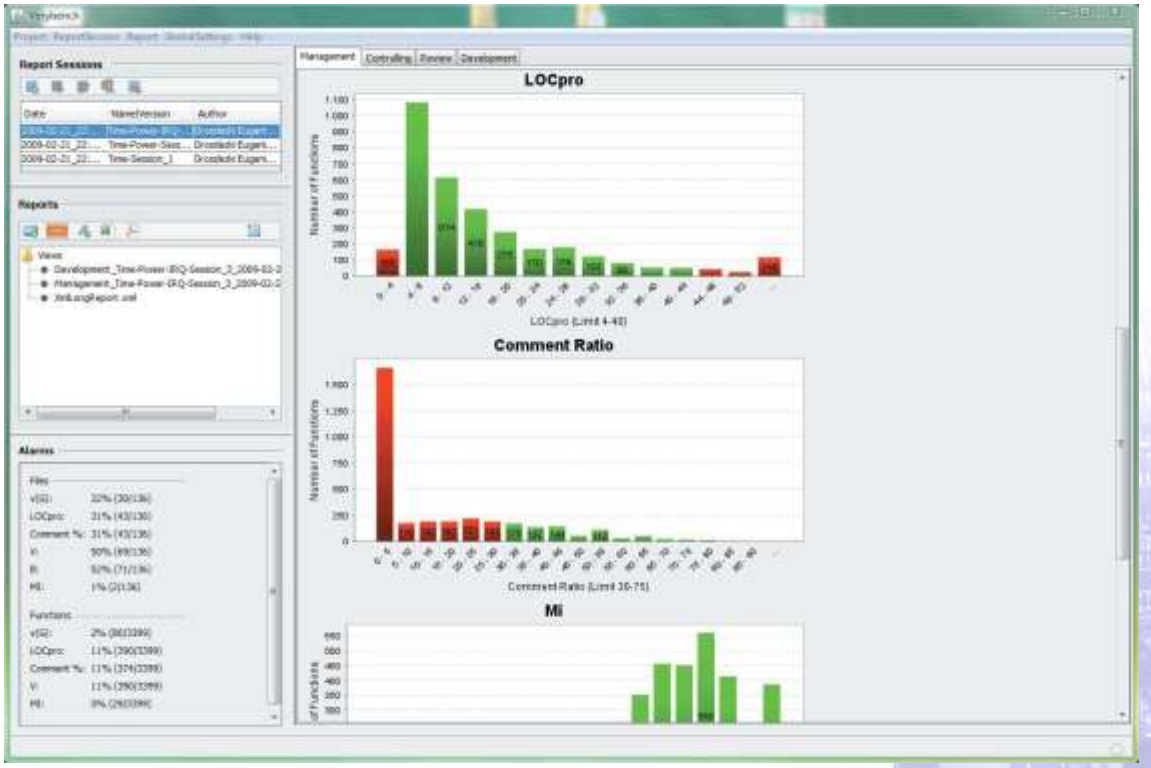
Measurement of Software Complexity with Testwell CMT++ Testwell CMTJava

Code Complexity Measurements

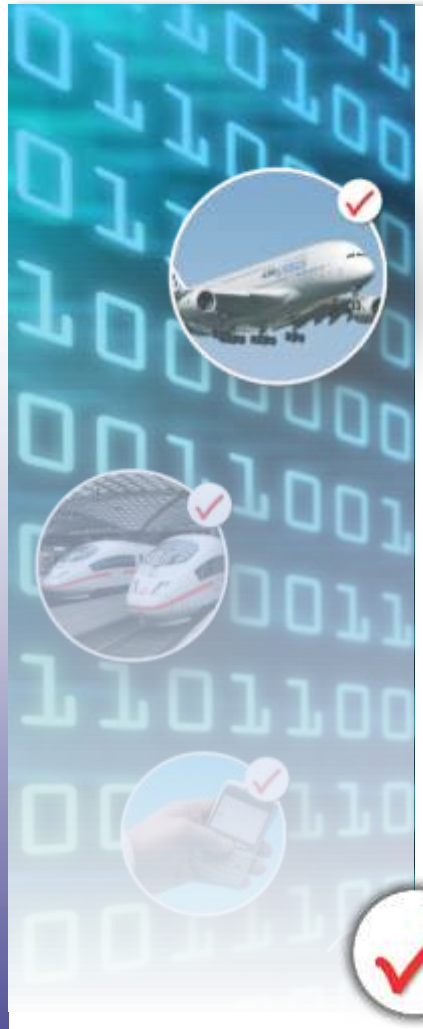


Code Complexity Measurement Tools

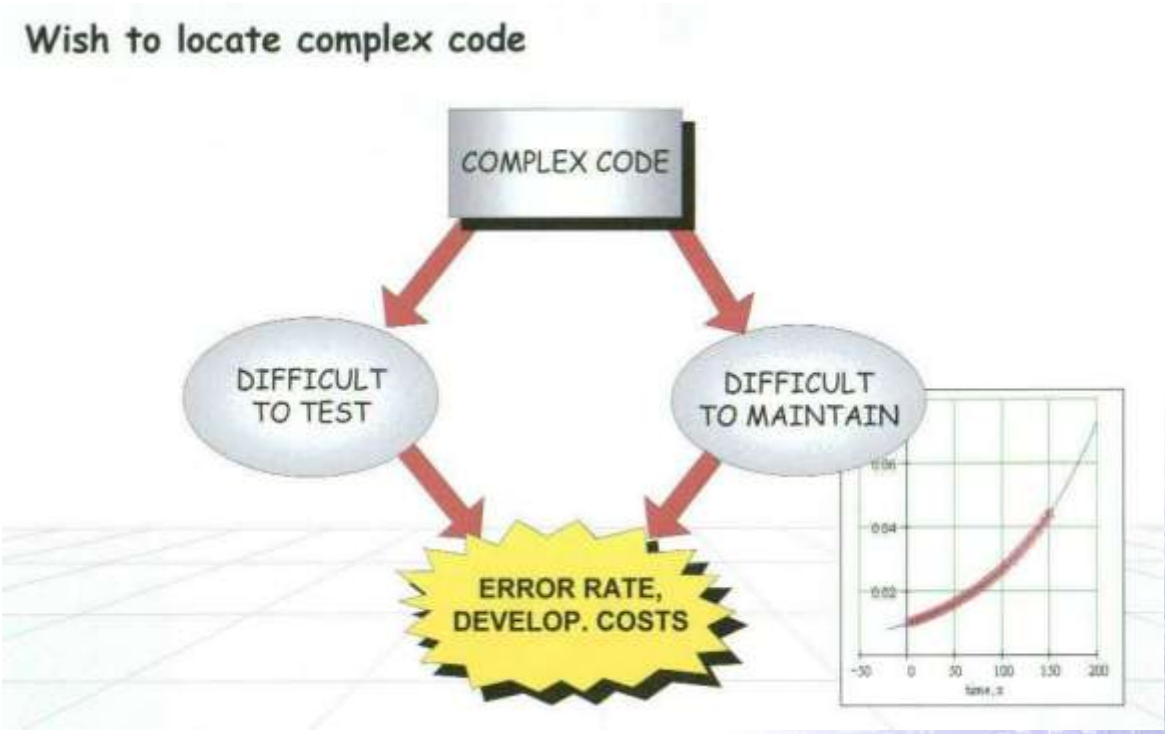
Testwell CMT++	for C, C++ (and C#)
Testwell CMTJava	for Java



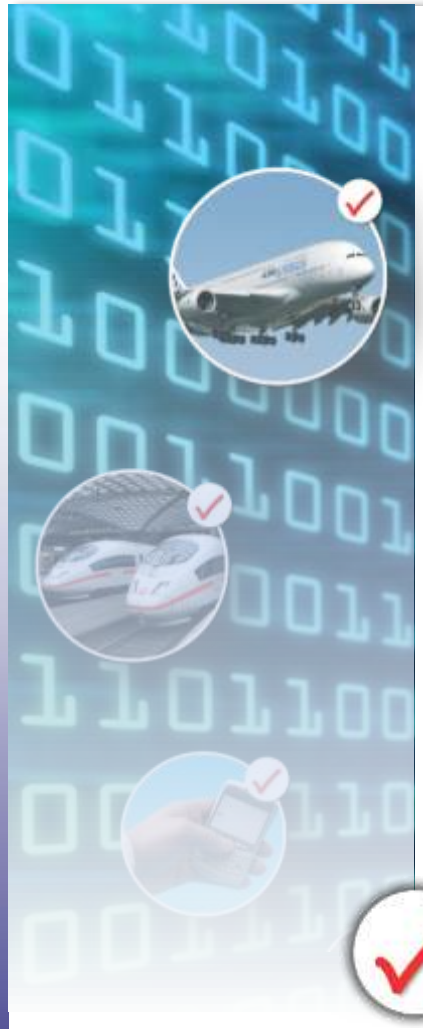
Code Complexity Measurements



Code complexity correlates with the defect rate and robustness of the application program

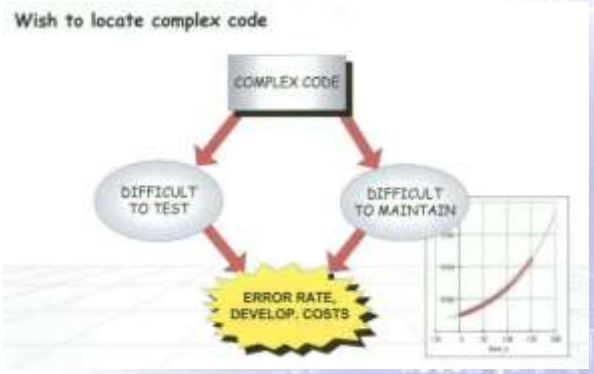


Code Complexity Measurements

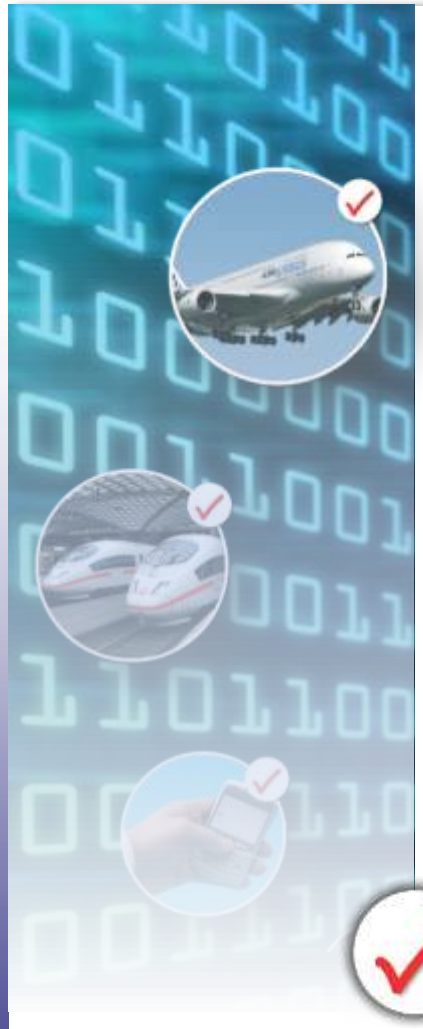


Code with good complexity:

- ✓ contains less errors
- ✓ is easier and faster to test
- ✓ is easier to understand
- ✓ is easier to maintain



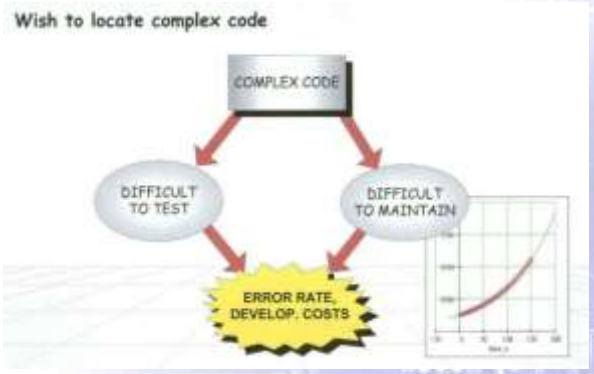
Code Complexity Measurements



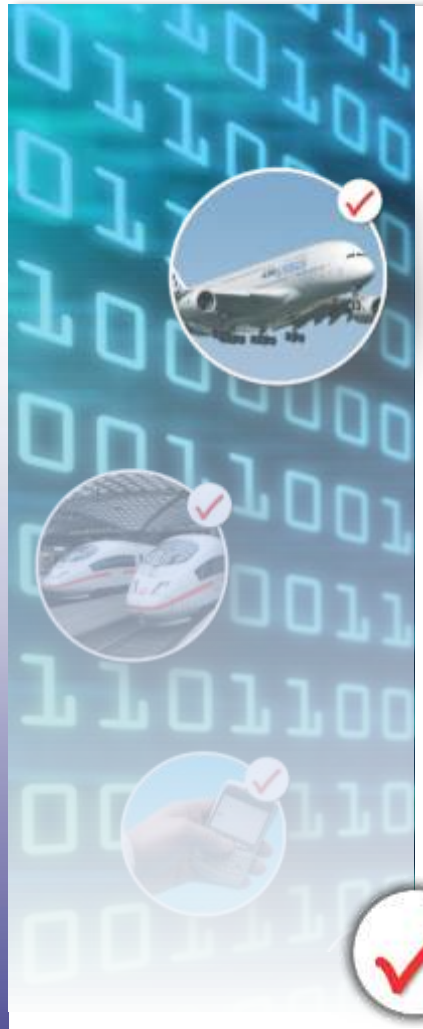
Code complexity metrics are used
to locate complex code

To obtain a high quality software with low cost of testing and maintenance, the code complexity should be measured as early as possible in coding.

➔ developer can adapt his code when recommended values are exceeded.

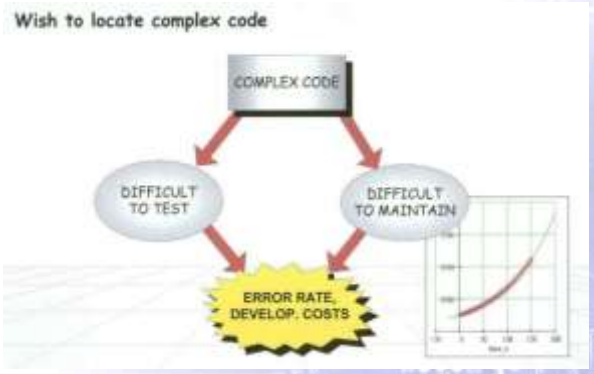


Code Complexity Measurements



Metrics shown by Testwell CMT++ / CMTJava:

- ✓ Lines of Code metrics
- ✓ McCabe Cyclomatic number
- ✓ Halstead Metrics
- ✓ Maintainability Index



Lines of code metrics

Lines of code metrics

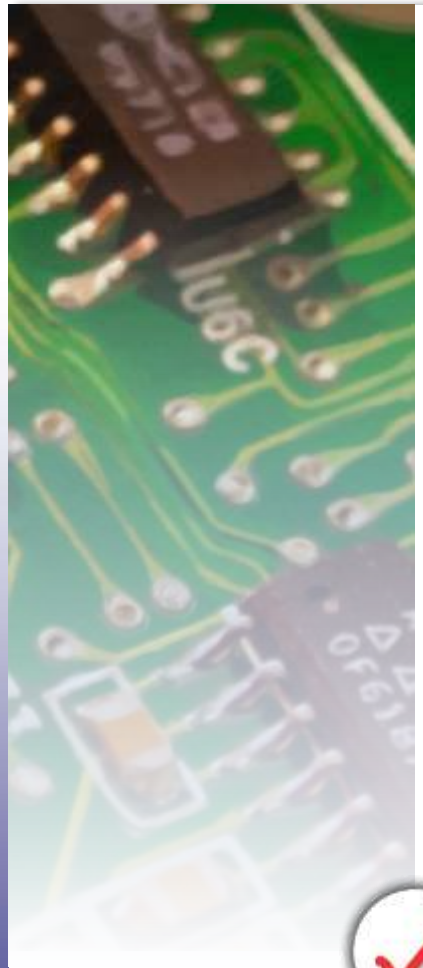
Testwell CMT++/CMTJava calculates the following lines-of-code metrics:

- **LOCphy**: number of physical lines
- **LOCbl**: number of blank lines (a blank line inside a comment block is considered to be a comment line)
- **LOCpro**: number of program lines (declarations, definitions, directives, and code)
- **LOCcom**: number of comment lines

Recommandations:

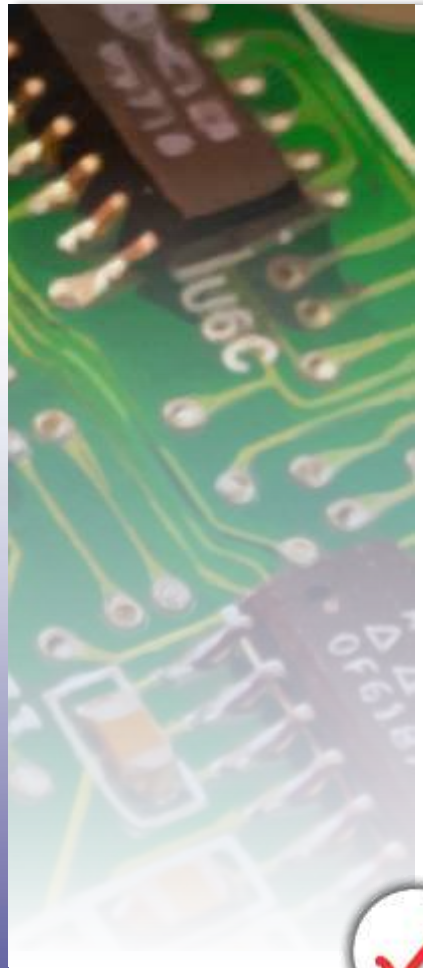
Function length should be 4 to 40 program lines.
File length should be 4 to 400 program lines.

At least 30 % and at most 75 % of a file should be **comments**.
.



McCabe Cyclomatic Number

McCabe Cyclomatic Number

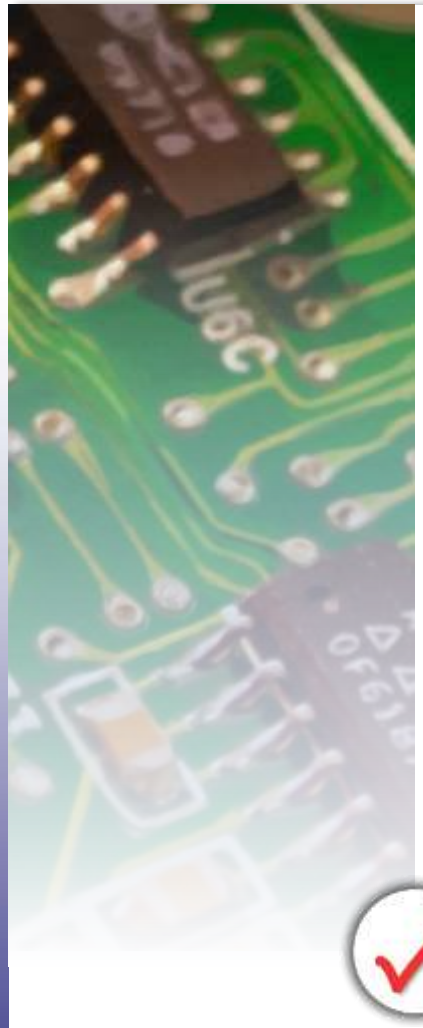


v(G) is the number of conditional branches.
v(G) = 1 for a program consisting of only sequential statements.

For a single function; v(G) is one less than the number of conditional branching points in the function.

The greater the cyclomatic number is the more execution paths there are through the function, and the harder it is to understand.

McCabe Cyclomatic Number



Recommandations:

- The cyclomatic number of a function should be less than 15.
  If a function has a cyclomatic number of 15, there are at least 15 (but probably more) execution paths through it.
- More than 15 paths are hard to identify and test.
  Functions containing one selection statement with many branches make up an exception.
- A reasonable upper limit Cyclomatic number of a file is 100.

Halstead Metrics

Halstead metrics

B	Estimated number of bugs
D	difficulty level, error proneness
E	effort to implement
L	program level
N	program length
N1	number of operators
N2	number of operands
n	vocabulary size (n1+n2)
n1	number of unique operators
n2	number of unique operands
T	implementation time / time to understand
V	volume: size of the implementation of an algorithm

Halstead metrics

B is an important metric for dynamic testing:

The number of delivered bugs approximates the number of errors in a module.

As a goal at least that many errors should be found from the module in its testing.

Maintainability Index (MI)

Maintainability Index (MI)

Maintainability Index (MI, with comments) values:

85 and more	Good maintainability
65-85	Moderate maintainability
< 65	Difficult to maintain

with really bad pieces of code (big, uncommented, unstructured) the MI value can be even negative

Testwell CMT++/ CMTJava

CMT++ Summary Report

file:///C:/Users/ed/cmt/CMTHTML/index.html

Links anpassen

Weitere Lesezeichen

```
*************************************************************************
*          CMT++, Complexity Measures Tool for C/C++, Version 4.2       *
*                                                                       *
*                       COMPLEXITY MEASURES REPORT                      *
*                                                                       *
*                    Copyright (c) 1993-2007 Testwell Oy                *
*************************************************************************

License notice: This is a limited period evaluation copy license.

The input CMT++ report was produced at Mon Jan 12 17:11:08 2009
cmt options: -o C:\Users\ed\cmt\report.tmp -f C:\Users\ed\cmt\files.txt
Html'ized by cmt2html v2.2 at Mon Jan 12 17:11:08 2009
cmt2html options: -i C:\Users\ed\cmt\report.tmp

This is SUMMARY view. Go to DETAILED view. See instructions.
```

Alarms-%	Measured object	v(G)	LOCphy	LOCpro	c%	V	B	MI
	calibrate.c	20	172	107	-	3195	1.24	110
	do_mounts.c	69	406	321	-	11535-	3.18-	105
	do_mounts_md.c	47	280	213	-	8280-	2.39-	88
	do_mounts_rd.c	46	429	313	-	11742-	3.05-	107
	magutil.c	15	127	98	-	2751	1.02	95
	OVERALL (24 %)							

OVERALL SUMMARY:

Measure	5 Files Alarmed	%	Limits	40 Functions Alarmed	%	Limits
Cyclomatic number v(G)	0	0	1-100	4	10	1-15
Program lines LOCpro	0	0	4-400	12	30	4-40
Comment %	5	100	30-75	19	47	30-75
Volume V	3	60	100-8000	9	22	20-1000
Estimated number of bugs B	3	60	0-2	0	0	n/a
Maintainability index MI	0	0	65-	1	2	65-

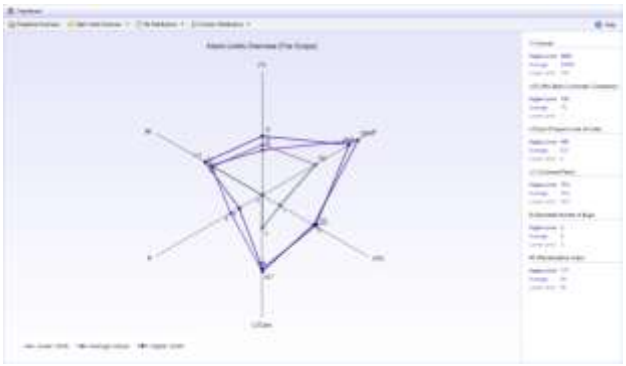
Testwell CMT++/ CMTJava

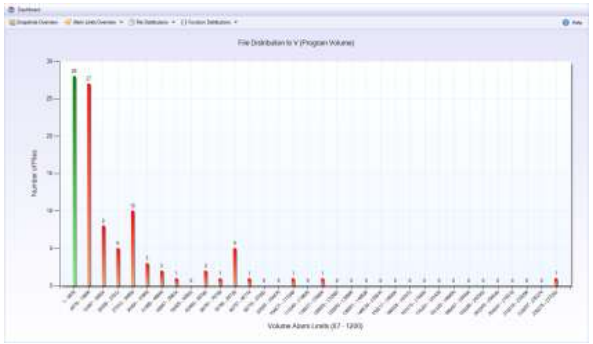
report - Editor

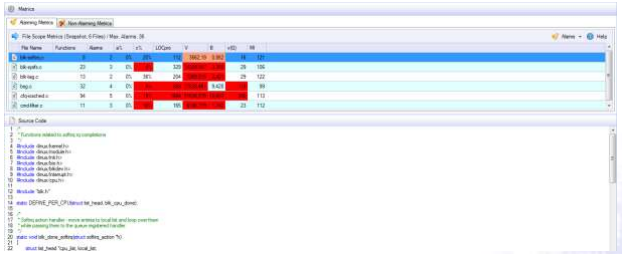
Datei Bearbeiten Format Ansicht ?

```
*******************************************************************************
*           CMT++, Complexity Measures Tool for C/C++, Version 4.2            *
*                                                                             *
*                        COMPLEXITY MEASURES REPORT                           *
*                                                                             *
*                    Copyright (c) 1993-2007 Testwell Oy                      *
*******************************************************************************

License notice: This is a limited period evaluation copy license.

This report was produced at Mon Jan 12 17:17:18 2009
Options: -o C:\Users\ed\cmt\report.txt -f C:\Users\ed\cmt\files.txt


File: C:\Users\ed\Desktop\TestFiles\linux-2.6.26.8\linux-2.6.26.8\init\calibrate.c

Line Measured object                    v(G) LOCphy LOCpro  c%    V      B    MI
================================================================================
  13 lpj_setup()                           1      5      5       92  0.02   121
  31 calibrate_delay_direct()              9     72     42-    1123- 0.39   101
 104 calibrate_delay_direct()              1      1      1-      38  0.01   152
 114 calibrate_delay()                    10     59     47- -  1146- 0.39    96

 172 calibrate.c                          20    172    107  -  3195  1.24   110
================================================================================


File: C:\Users\ed\Desktop\TestFiles\linux-2.6.26.8\linux-2.6.26.8\init\do_mounts.c

Line Measured object                    v(G) LOCphy LOCpro  c%    V      B    MI
================================================================================
  31 load_ramdisk()                        1      5      5      104  0.02   121
  38 readonly()                            2      7      7       90  0.02   116
  46 readwrite()                           2      7      7       96  0.02   115
  57 name_to_dev_t()                      22-    86     55- -  1832- 0.57    90
 144 root_dev_setup()                      1      5      5       88  0.02   121
 152 rootwait_setup()                      2      7      7       88  0.02   116
 163 root_data_setup()                     1      5      5       61  0.01   123
 170 fs_names_setup()                      1      5      5       61  0.01   123
 177 root_delay_setup()                    1      5      5       92  0.02   121
 187 get_fs_names()                        7     26     24  -   615  0.19    83
 214 do_mount_root()                       3     14     13  -   520  0.12    95
 229 mount_block_root()                    9     52     44- -  1127- 0.30    91
 283 mount_nfs_root()                      3     10      9      186  0.04   106
 296 change_floppy()                       3     27     27  -   889  0.22    82
 325 mount_root()                          9     28     26  -   447  0.07    98
 354 prepare_namespace()                  14     52     38  -   955  0.19    91

 406 do_mounts.c                          69    406    321  - 11535- 3.18-  105
================================================================================
```

Verybench for Testwell CMT++/ CMTJava



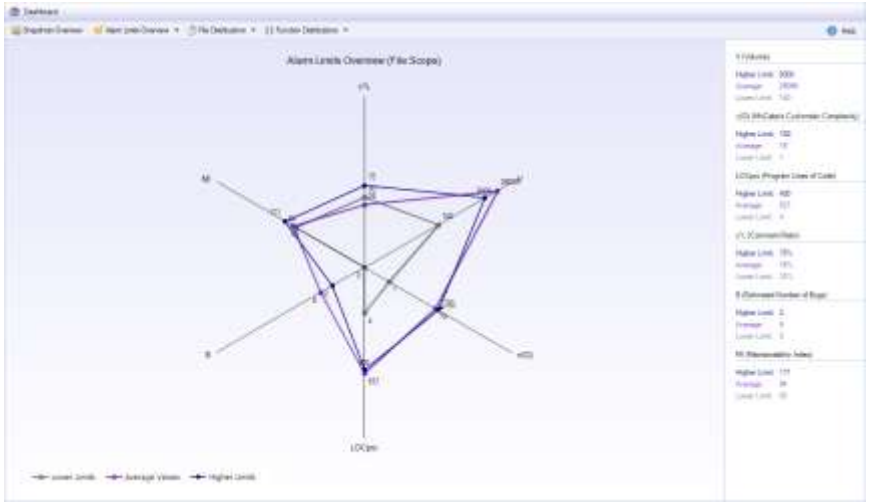




Verybench:
Graphical front-end for Testwell Complexity Measurement Tools

Snapshots Overview
shows the course of the measured source code´s quality over time by stating the alarm ratios of the latest six snapshots.

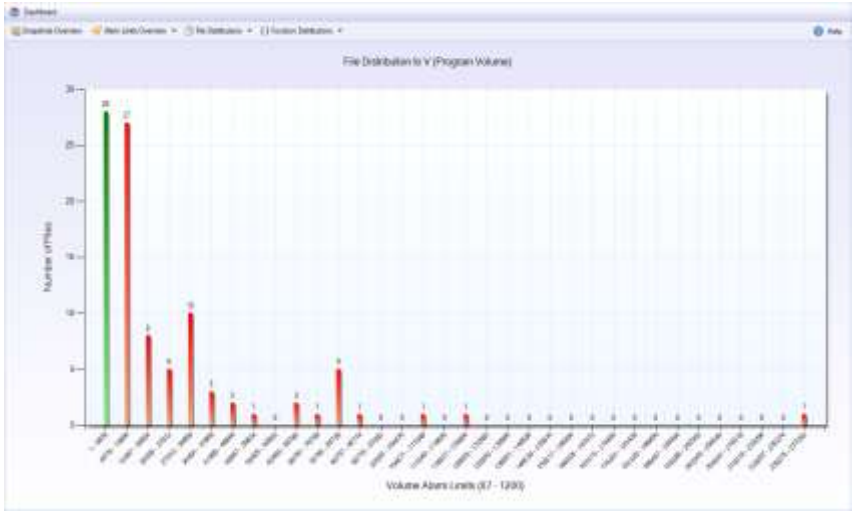
Verybench for Testwell CMT++/ CMTJava



Alarm-Limits Overview
integrates all configurable Alarm Limits into a Radar Chart for each file and function.
Every axis represents a different alarming metric with its configurable lower and higher Alarm Limits.

The Radar Chart basically shows the deviation of a metric´s current value from its lower and higher Alarm Limits.

Verybench for Testwell CMT++/ CMTJava



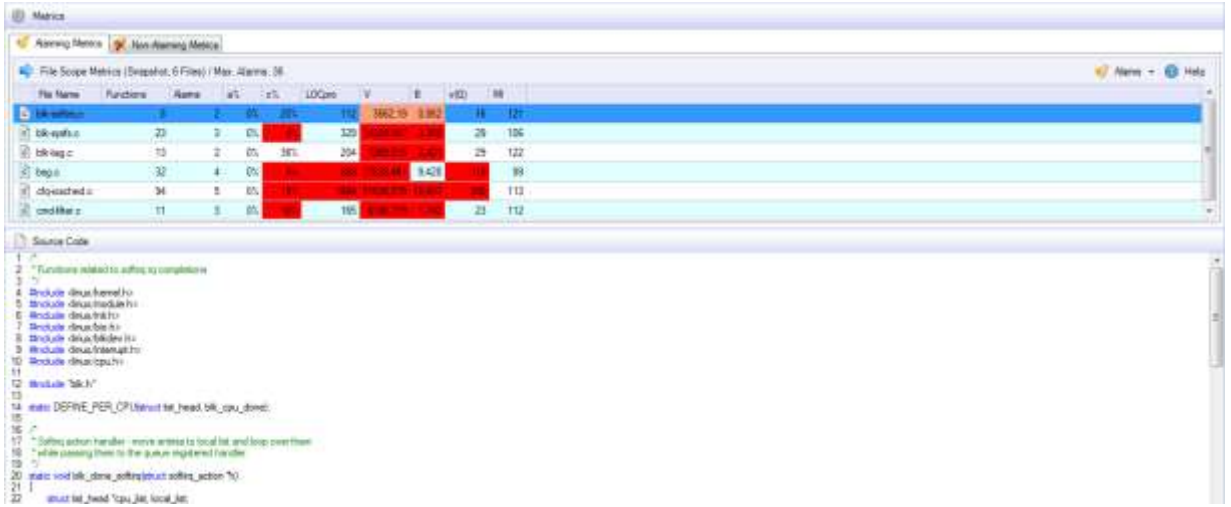
Distribution of Metrics

shown on file and function levels for:

- V (Program Volume)
- c% (Comment Ratio)
- LOCpro (Program Lines of Code)
- v(G) (McCabe´ Cyclomatic Number)

In addion B (Estimated Number of Bugs) is shown on file level

Verybench for Testwell CMT++/ CMTJava



Metrics View

overview over all (both alarming and non-alraming) metrics of the mesured files and functions

Thank You

Thank you for your time!

Your Verifysoft Team