



Modern environment for z/OS development

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William Alexander

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Session: **18688**



Purpose and Presentation flow

- Purpose ... to present application development tools as a user might use them through the software development life cycle
- Flow
 - Overview
 - Software development
 - Tools
 - Walk through the life cycle and tooling that supports each step

Four key barriers preventing optimal return on IT investments



Decades of application investments



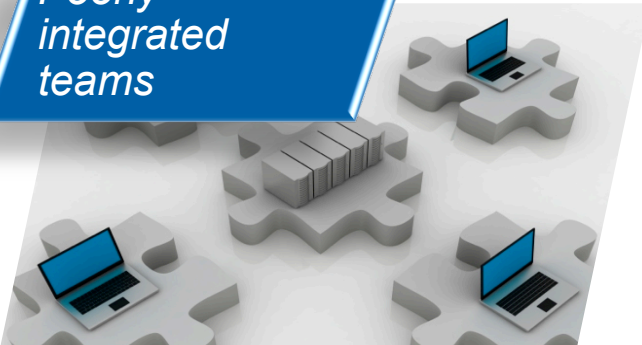
"We don't understand the effort, risk and impact of modernizing our legacy applications."

Islands of skills, languages and platforms



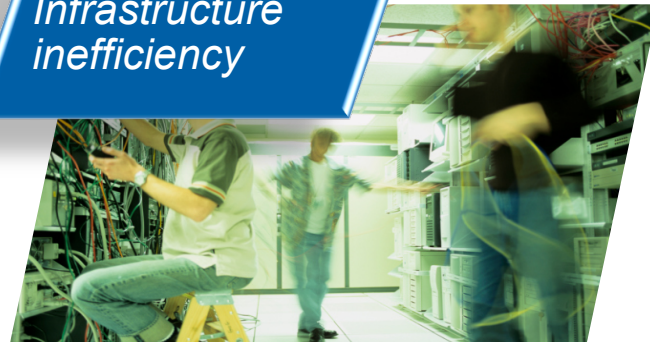
"Our skills gap keeps growing. How do we stay current with all the language and technology changes?"

Poorly integrated teams



"We need to enable our teams to collaborate across platforms, languages, and environments."

Infrastructure inefficiency



"We need a cost effective way to improve our infrastructure efficiency and free up capacity to handle more workload."

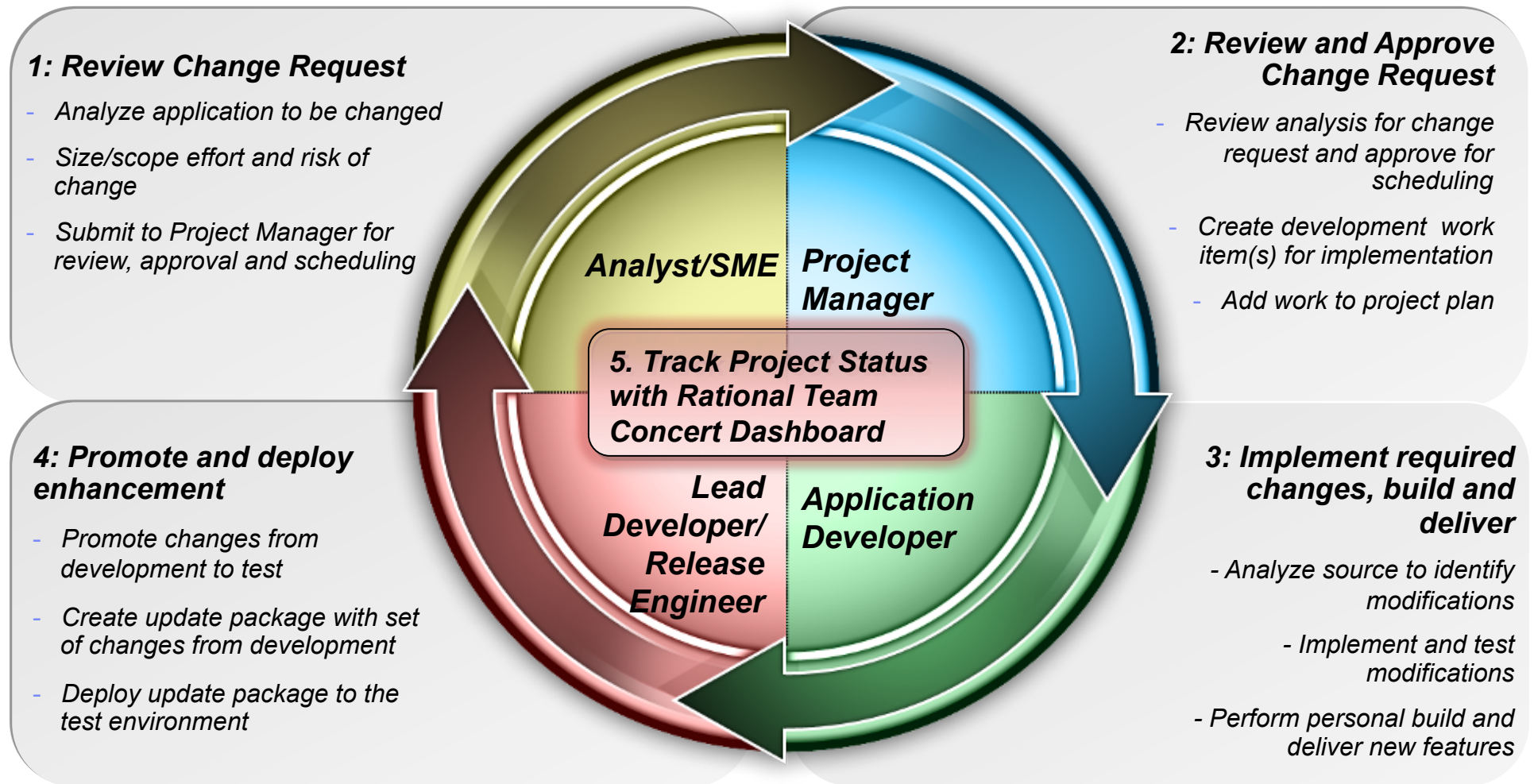
3 Complete your sessions evaluation online at [SHARE.org/BostonEval](https://www.share.org/BostonEval)



Overview of Supported Production Scenario



Project Manager or Support Team has submitted Project Change Request ...



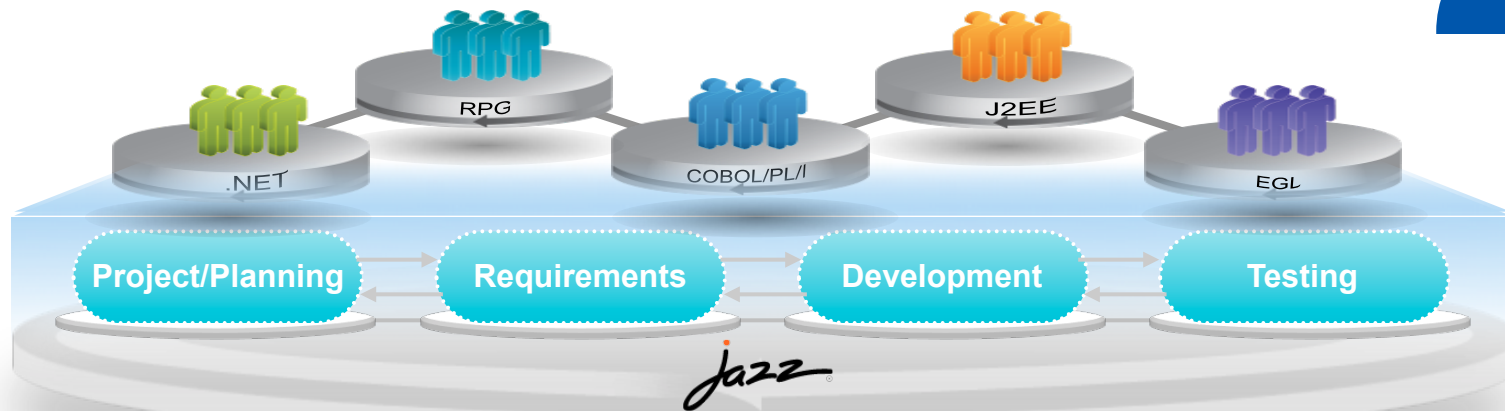
Development Life Cycle



Planning	Source Dev	Governance/Unit test	Build
<ul style="list-style-type: none"> Define the tasks Create a plan Create a work item Assign the work item to a developer 	<ul style="list-style-type: none"> Load the project/ source artifacts from SCM Navigate, Analyze, Edit, Syntax check source code 	<ul style="list-style-type: none"> Compile Quality assurance <ul style="list-style-type: none"> Debug Code Coverage Code review Unit Testing 	<ul style="list-style-type: none"> Check-in/Deliver the source code Build
CLM	RDz RTC	RDz RD&T RTC	RTC RDz

Collaborative application lifecycle management

Deploy new, common team infrastructure for source control, change management and build that empowers your team with integrated collaboration, process automation and reporting



- Rational Team Concert
- Rational Quality Manager
- Rational ClearCase
- Rational Requirements Composer
- Rational Build Forge
- Rational ClearQuest

“Building an agile development team requires a multiplatform approach, and Sodifrance uses Rational Developer for System z and Rational Team Concert for System z to help application teams synchronize their efforts and improve collaboration.

Rational on System z offers a powerful and valuable combination for any company that wants to boost its development team’s productivity.”

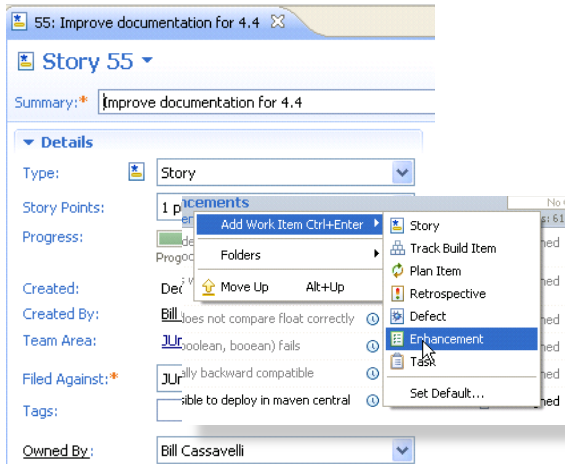
— Hugh Smith, Project Manager, Sodifrance



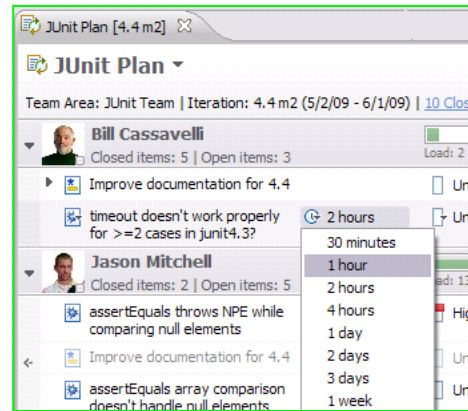
Rational Team Concert – A single tool, many capabilities



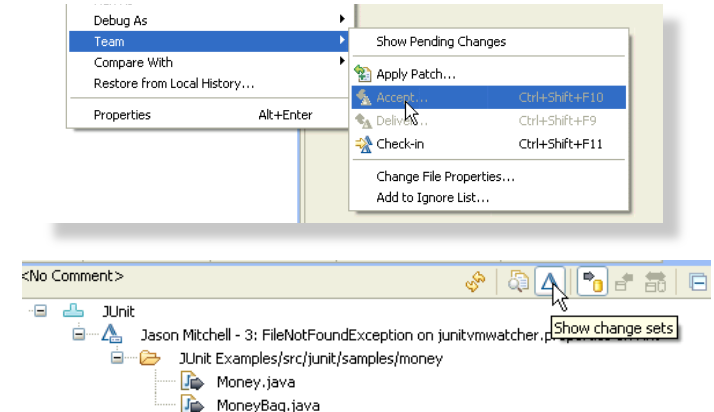
Work Items



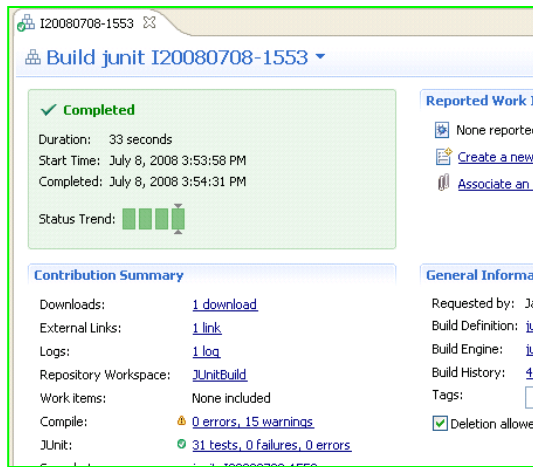
Planning



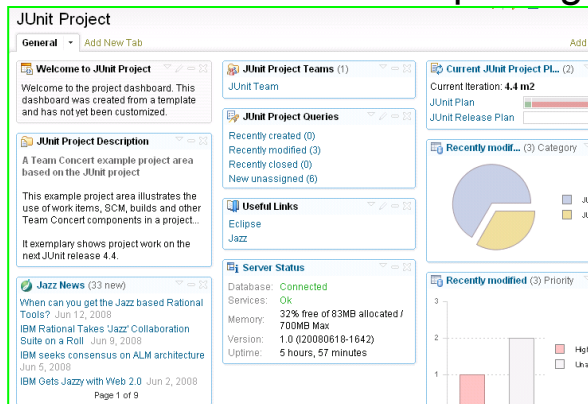
Source Control



Builds – Continuous



Dashboards & Reporting



Method Enforcement and Automation

Problem

A work item must be associated with the change set or a comment must be set.

Reason

All change sets should be associated with a work item which is planned for t

Deliver (Failed)

This makes it e...
through the ite...
why your chan

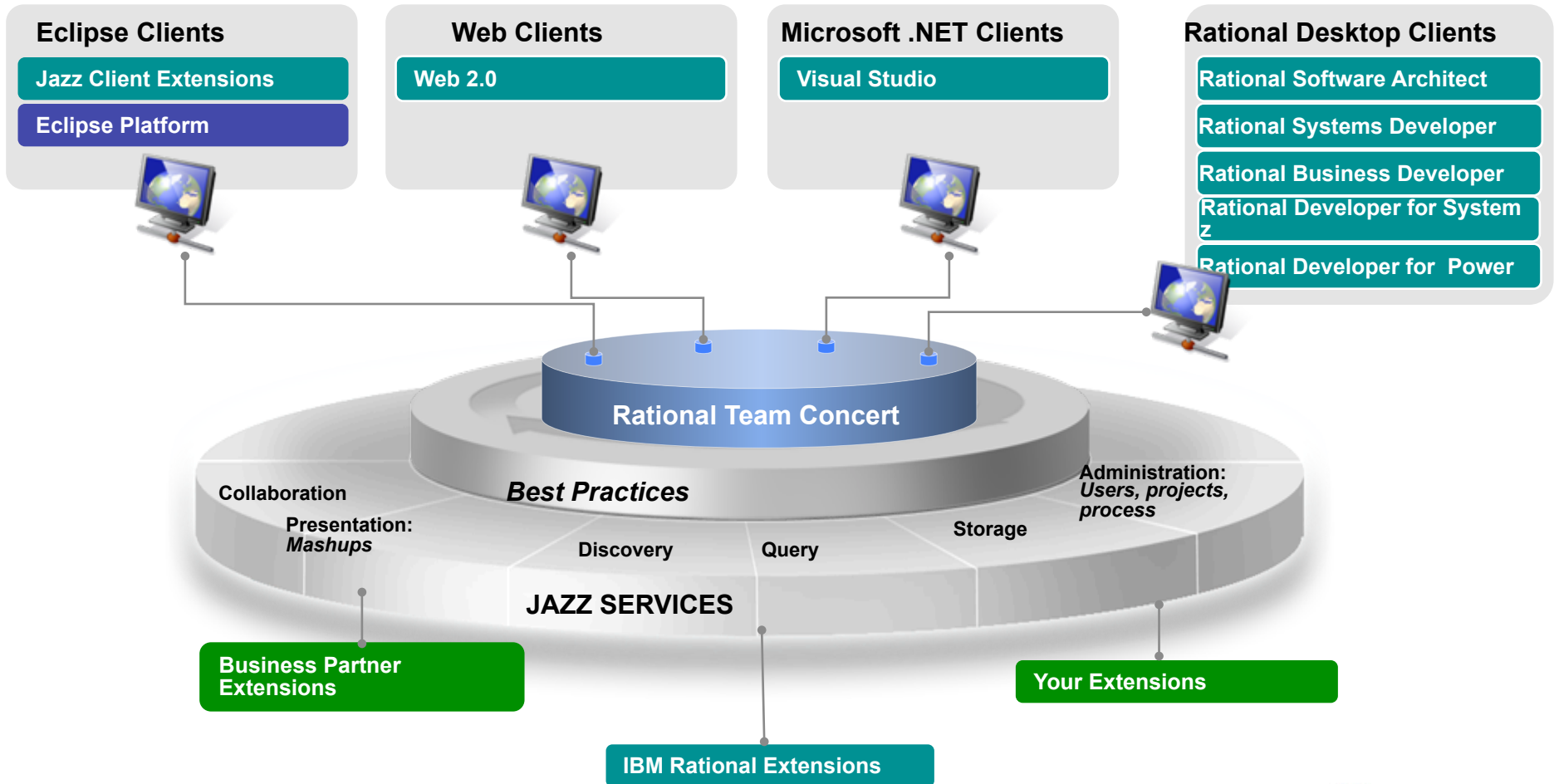
Solutions

- Associate Existing Work Item
- Associate New Work Item
- Associate and Try Again (experimental)
- Override 'Descriptive Change Sets' Precondition

Rational Team Concert: Built on an open, Web 2.0 platform



Supporting a broad range of desktop clients, IDE's and languages



Rational Developer for System z: An Integrated Development Environment for System z

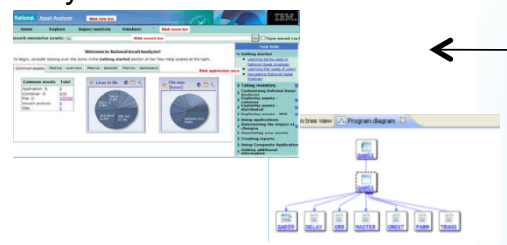
Integration with Team Concert for Lifecycle and Source Management



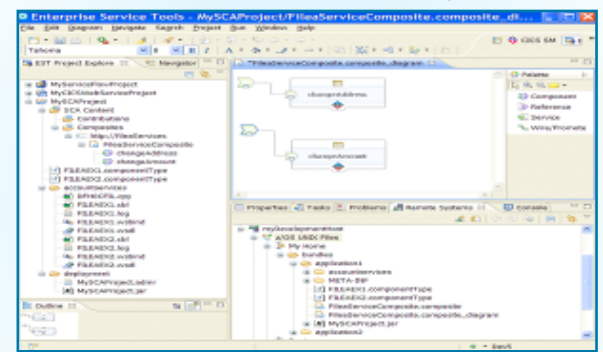
Access to typical System z sub-system functionality in z/OS, CICS, IMS, DB2, WAS



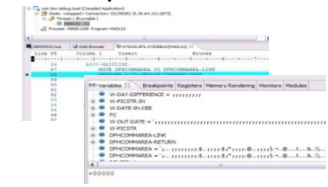
Integration with Asset Analyzer for Application Understanding and Impact Analysis



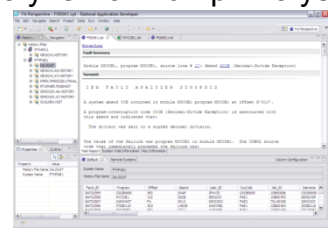
Rational Developer for System z



Integration with Debug Tool for Development and Test



Integration with Fault Analyzer for Dump Analysis

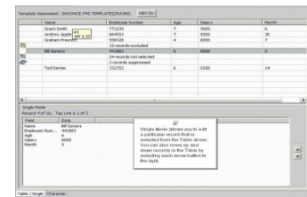


A modern IDE for productive development of cross-platform applications written in COBOL, PL/I, ASM, Java, EGL or C/C++ in System z CICS, IMS, DB2, Batch applications



Integration with RD&T for flexible access to System z environment

Integration with File Manager for file and test data handling



The Benefits of RDz

Instead of maneuvering to access panels and working **sequentially**, in RDz the functionality you need is always in-focus – you work **concurrently**



Edit a program

File Compare

Submit a Compile

File Search

Access Datasets + Dataset Management

Dataset Statistics

Access Jobs (Outlist facility)

Resource	Job ID	Job Name	Job Owner	Job Entry ...	Return Code	Return Info	User return...	Return Sta...	Spool Tracks	Priority
DD50001:TSU16893	TSU16893	DD50001	DD50001	2010/04/07...	S622	ABENDed		ABEND	1	1
DD50001:TSU16				2010/04/07...	S622	ABENDed		ABEND	1	1
DD50001:TSU16				2010/04/07...	S622	ABENDed		ABEND	1	1
DD50001:TSU16				2010/04/07...	S622	ABENDed		ABEND	1	1
DD50001:TSU16				2010/04/07...	S622	ABENDed		ABEND	1	1
DD500011:JOB1				2010/04/07...	U0004	NORMAL	004	COMPLETION	1	1
DD500011:JOB1				2010/04/07...	U0012	NORMAL	00C	COMPLETION	1	1

Traditional development and Enterprise web services



```

Line 49      Column 1      Insert
-----+---+*A-1-B-+-----2-----3-----+
000027      *
000028      *
000028      *
000029      *IDENTIFICATION DIVISION.
000030      *PROGRAM-ID.   GAMOVDE.
000031      *
000032      *DATA DIVISION.
000033      *
000034      *WORKING-STORAGE SECTION.
000035      *
000036      *COPY  GAMOBMD.
000037      *COPY  GAMOBDD.
000038      *COPY  GAMOBED.
000039      *COPY  GAMOBGD.
000040      *COPY  GAMOBPD.
000041      *O1 P
000042
000043
000044
000045
000046
000047
000048
12
000050
000051
000052
    
```

Supports traditional development/maintenance

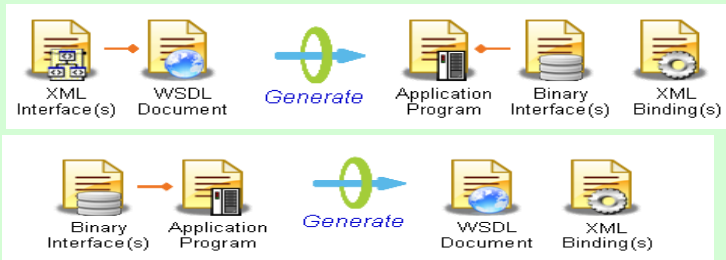
- Cobol, PL/I, Assembler, JCL

Supports modern architecture development

Enterprise Service Tools

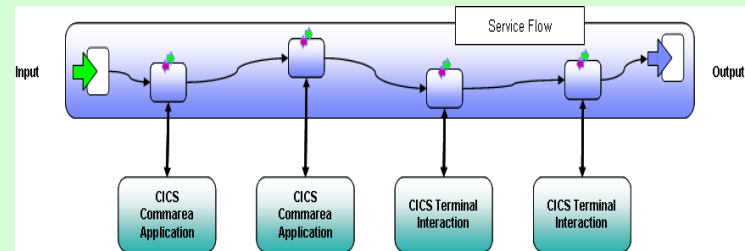
Single service projects

Top down, bottom up, and meet in the middle web service enablement for CICS, IMS, and Batch/TSO environments.



Service flow projects

Graphical composition of CICS applications chained together to form a new business service.



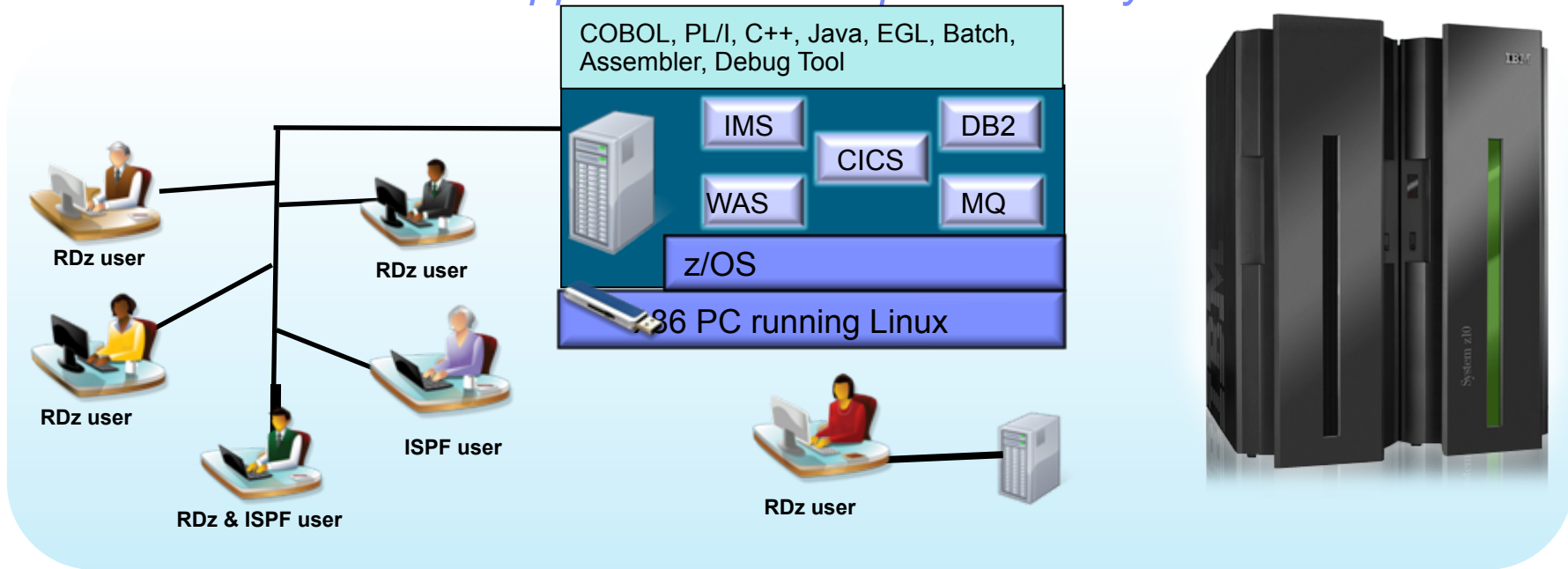
Enable Enterprise Applications for Mobile and Web



Rational Development and Test Environment for System z



The ultimate in modern application development for System z



- Increase availability of z/OS testing environment and resources
 - Liberate developers to rapidly prototype new applications
 - Develop and test System z applications anywhere, anytime!
 - Eliminate costly delays by reducing dependencies on operations staff
- Improve quality and lower risk via automation, measurement, and collaboration
- Focus on what is required for the change at hand, then scale

Development Life Cycle



<p>Planning</p>	<p>Source Dev</p>	<p>Governance/Unit test</p>	<p>Build</p>
<ul style="list-style-type: none"> • Define the tasks • Create a plan • Create a work item • Assign the work item to a developer 	<ul style="list-style-type: none"> • Load the project/ source artifacts from SCM • Navigate, Analyze, Edit, Syntax check source code 	<ul style="list-style-type: none"> • Compile • Quality assurance <ul style="list-style-type: none"> • Debug • Code Coverage • Code review • Unit Testing 	<ul style="list-style-type: none"> • Check-in/Deliver the source code • Build
<p>CLM</p>	<p>RDz RTC</p>	<p>RDz RD&T RTC</p>	<p>RTC RDz</p>



Any process: Executable and repeatable

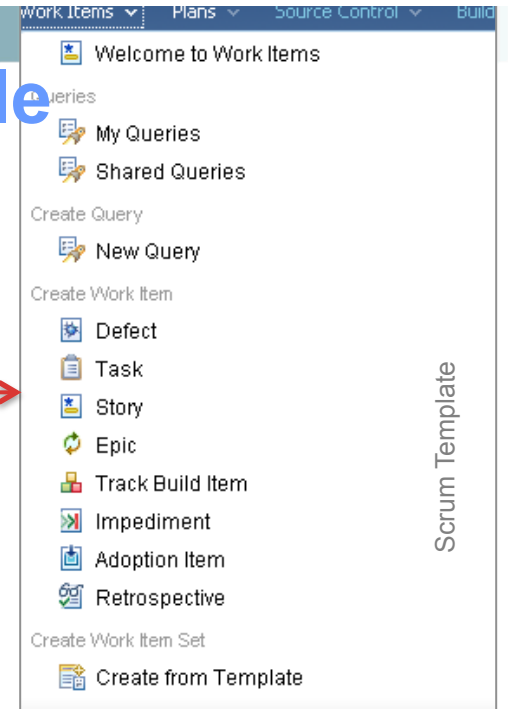
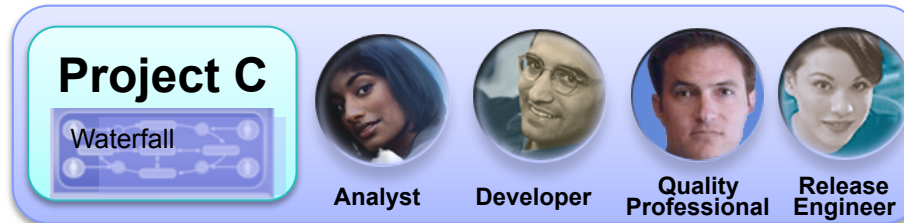
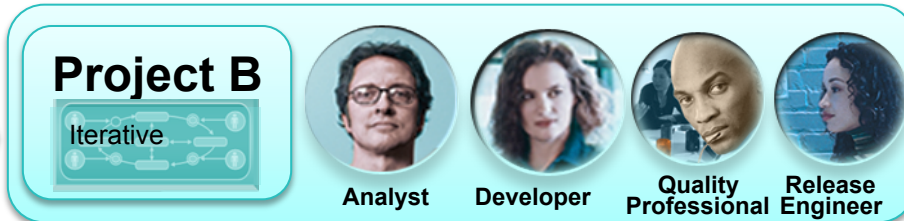
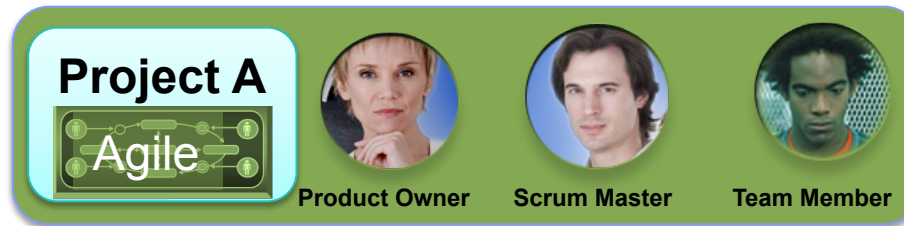
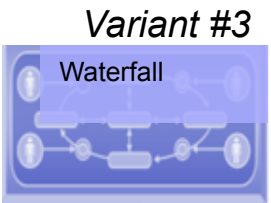
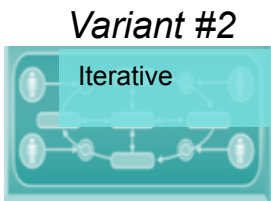
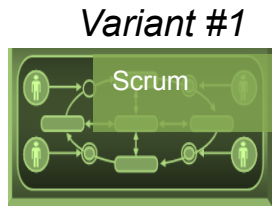
Use **ONE** tool to support both agile and non-agile



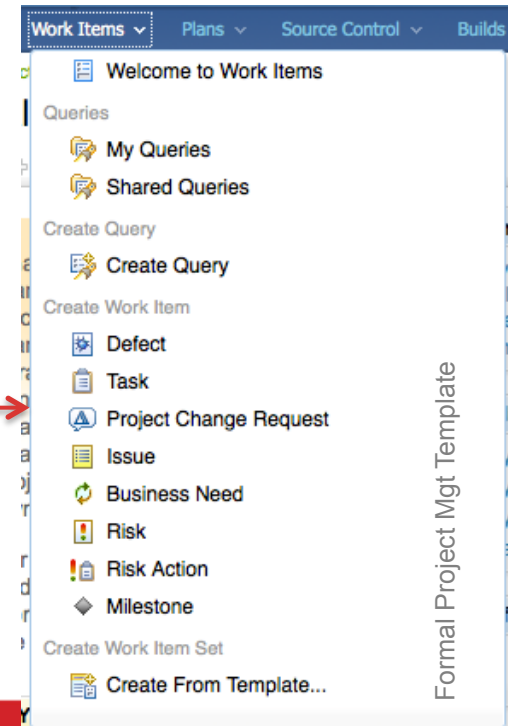
Process Architect



Project Manager



Scrum Template



Formal Project Mgt Template

Multiple plan views facilitate continuous planning



BRM Sprint 2 (1.0) Plan * ?

28 Items: 25 open, 3 closed | Ends in: 10 days

Plan Details [Edit](#)

Planned Items ? [Links](#) [Snapshots](#) [Dashboard](#) [Notes](#)

View As: Roadmap [+](#) [-](#) [x](#) [↔](#) (3 Items filtered) [+](#) [+](#) [+](#) Add Work Item

Actions	Summary	Effective E:	Owned By	Rank	March 13, 2011	March 20, 2011	April 2										
					S	M	T	W	T	F	S	S	M	T	W	T	F
*	Donors Can Choose to Support Multiple Organization	-	Deb	1													
*	Donor Dividend Allocation Criteria	-	Marco	3													
	Widget Disposed Exception	1.2 weeks	Bob	-													
	Browser Exception	2 hours	Bob	-													
*	Requests sent in form of email	-	Tanuj	4													
	Some messages are not externalized	3 days	Bob	-													
	SWT Exception	1.5 days	Marco	-													
*	Frequency of dividend transfer	-	Deb	-													

BRM Sprint 2 (1.0) Plan

30 Items: 25 open, 5 closed | Ends in: 6 days

Plan Details

Planned Items [Links](#) [Snapshots](#) [Dashboard](#) [Notes](#)

View As: Taskboard [+](#) [-](#) [x](#) [↔](#)

Story	Open	In Progress
Donor Dividend Allocation Criteria	Implement - Donor Dividend Allocation Criteria	
Frequency of dividend transfer		Implement - Frequency of dividend transfer

Details

Planned Items [Links](#) [Snapshots](#) [Dashboard](#) [Notes](#)

Planned Time [+](#) [-](#) [x](#) [↔](#)

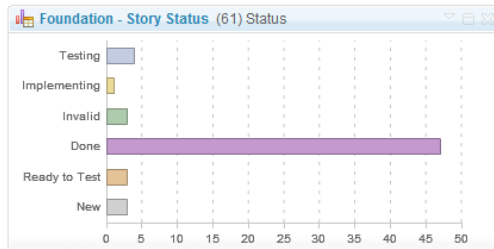
	Bob	Closed Items: 0 Open Items: 1	Load: 0/8 +8 h	No
	cp	Closed Items: 0 Open Items: 1	Load: 0/8 +8 h	No
	Deb	Closed Items: 3 Open Items: 5	Load: 168/8 -160 h	
	Marco	Closed Items: 2 Open Items: 14	Load: 92/8 -84 h	
	Tanuj	Closed Items: 0 Open Items: 0	Load: 0/8 +8 h	

Progress Tracking - Everyone can see live project status



Story Status Current Iteration

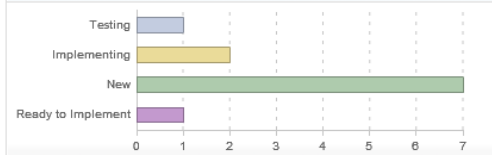
Shows the status of all stories planned for the current iteration



Foundation - Current Stories (61)

- 155918: Provide TVT testcases and testcase updates to TVT team
 - 155399: [Repository - M14] Performance, quality and robustness enhancements
 - 154407: [Continuation] Manage and repair DB inconsistencies during 3.0.1 M14
 - 155024: Track the fixing of hangs occurring on shutdown of the CLM server
 - 155033: Explore servlet dispatching enablement as a backup option
 - 155030: [Application SDK - 14] Performance, quality and robustness enhancements
 - 155120: LPA Web UI fixes and polish
 - 111848: User can validate consistency of configuration information across contexts
 - 155168: Fix bugs and improve the quality of LPA services
 - 155624: update JREs for 3.0 iFix1 and 3.0.1
- Page 1 of 7

CCM - Story Status (11) Status

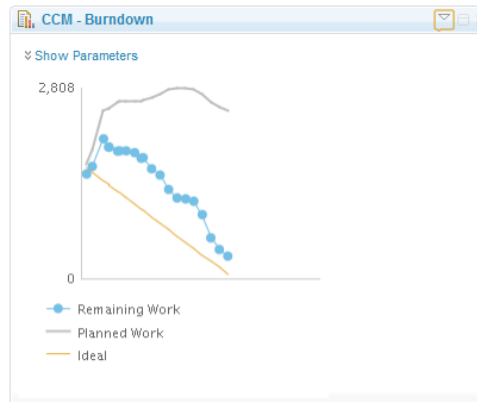
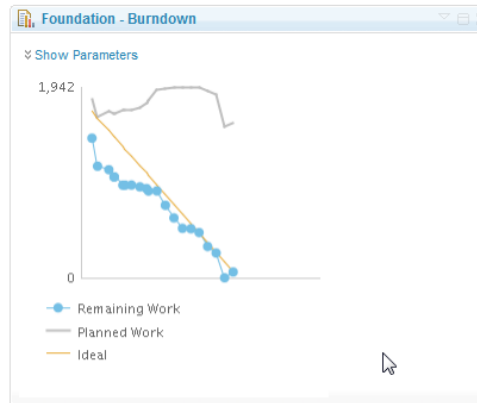


CCM - Current Stories (11)

- 150244: address "run as administrator" issues on win7
- 142127: As a user I want to see all extended state groups in taskboards
- 150956: Improve the performance of loading a work item

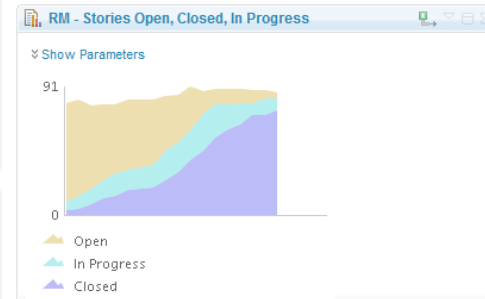
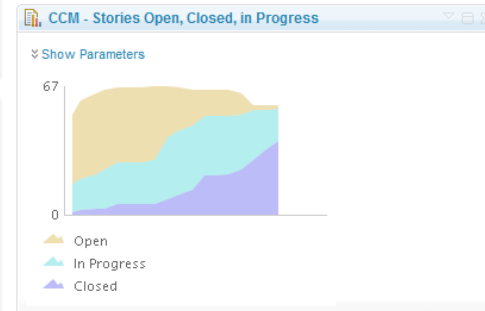
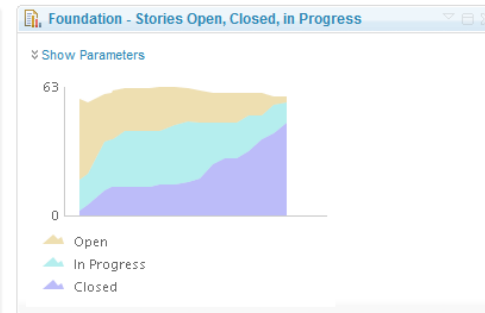
Burndown Current Iteration

Shows the remaining amount of estimated work in hours of work items planned for the current iteration.



Stories Open/Closed/In Progress

Shows the number of stories which are open, in progress, done during the iteration.



In-context Collaboration – Team View



Team Central

- Shows what is happening on project:
 - News & events
 - What's being worked on
 - Changes
- Configurable (RSS feeds) - New kinds of information easily added
- Personalized, Persistent - Each team member can tailor to their needs

The screenshot displays the SHARE Team View interface with several panels:

- News (48 unread):** A list of news items including "Gorkem Ercan: Eclipse moment of competition", "Litnik De Roy: Dark side of the moon Jun 04", "Nick Boldt: Managing Plugins and Features v", "Adam Cabler: Anti-Alias bug in 3.3 with GEF", "Birt World: BIRT Release Candidate 0 New a", and "Ian Skerrett: Europa is a Global Effort Jun 0".
- Team Load:** A section for "Jazz Development, current [0.6 M6]" showing work time left for team members. One member has "No Work Time Left" (Hours: 0/0, Estimated: 0%), and another has "No Work Time Left" (Hours: 0/0, Estimated: 100%).
- My Open Work Items (By Priority (4:07 PM)):** A bar chart showing work items by priority: Unassigned (3963), Low (282), Medium (531), and High (111).
- New Incoming Work Items (By Severity (4:05 PM)):** A bar chart showing work items by severity: Inc... (20), Minor (177), Normal (3159), Major (181), Critical (19), and Blocker (4).
- Event Log (Events (35 unread)):** A list of events, with one highlighted: "[3] JUnit4 should detect and report if it cannot i". A pop-up window shows the details of this event: "JUnit4 should detect and report if it cannot invoke a method (38)", dated "On Nov 27, 2008 5:30:57 PM", with a comment from Markus Kent mentioning a defect and a "Planned For" date of 4.0M1.

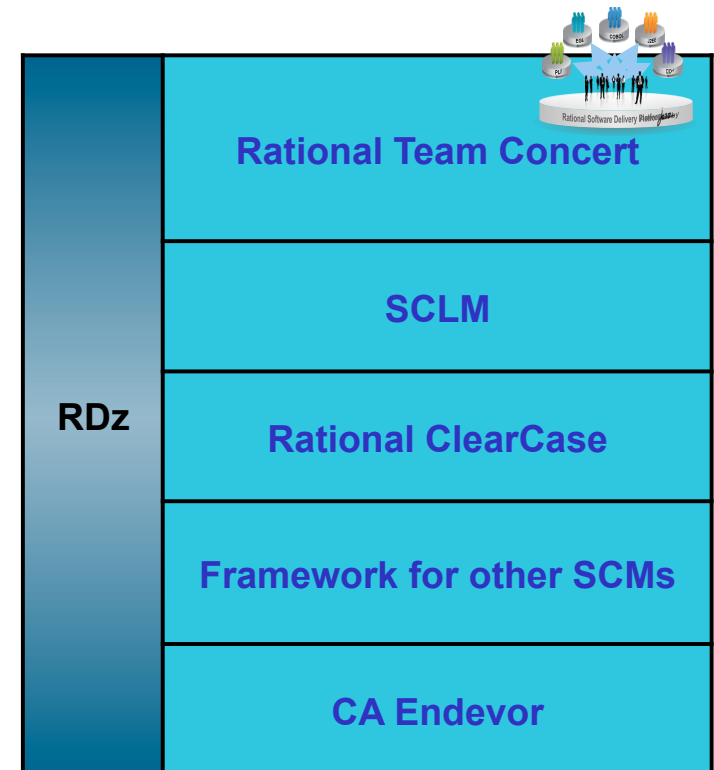
Development Life Cycle



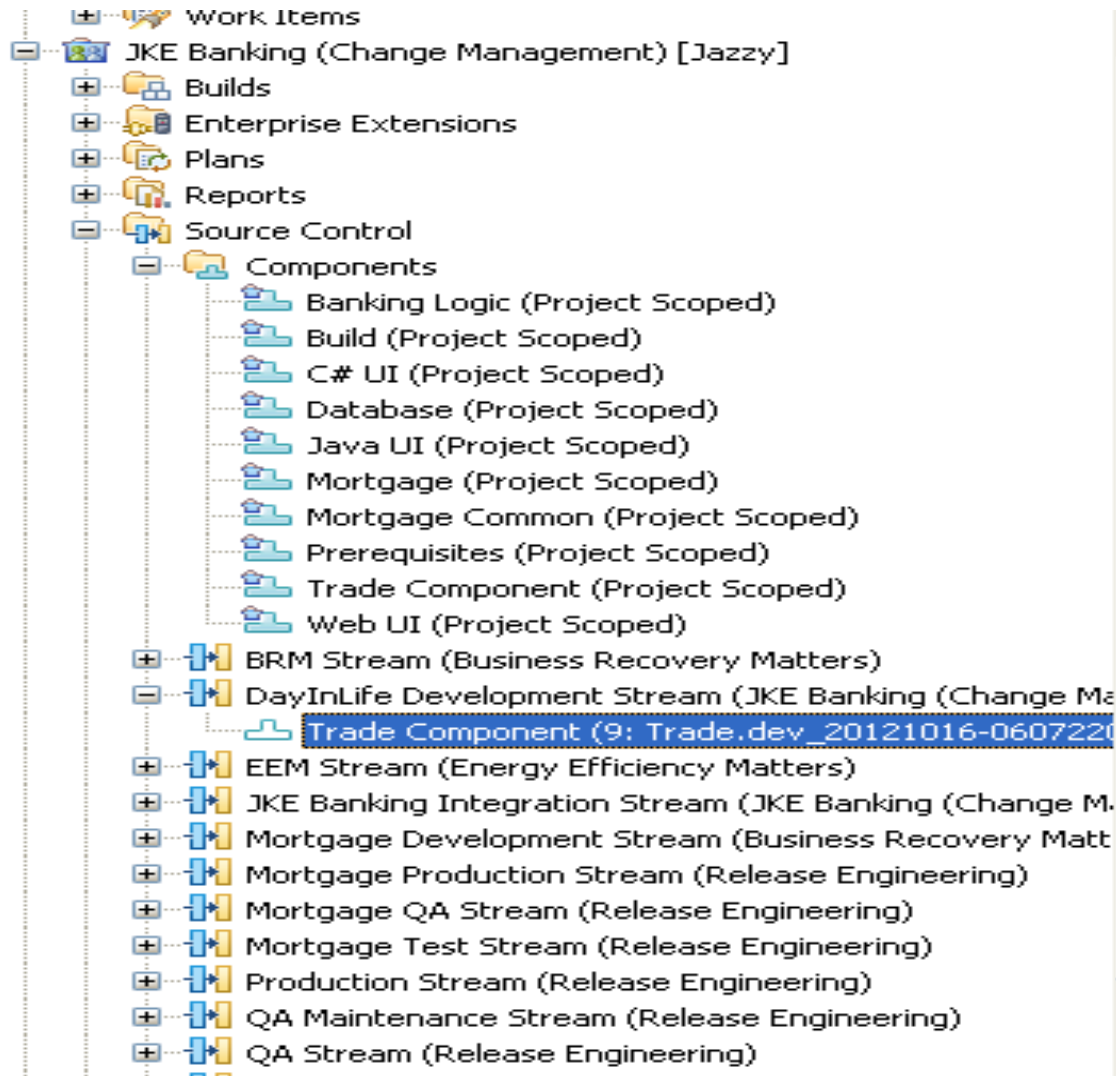
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CLM	RDz RTC	RDz RD&T RTC	RTC RDz

RDz Source Code Integration

- Rational's Strategic Source Code tooling is RTC and RDz provides tight integration
- RDz offers integration into a variety of other Source Code Management (SCM) tools as well as a framework for creating SCM integration on your own (CARMA)
- Variety of vendors supply plug-ins to RDz to provide easy access to processes and source code controlled by their products



Source Control Management



Load the source artifacts



No search results available

Find and load Eclipse projects
Load the root folders of the components as projects
Browse the components to
Load from a load rule file
Reload projects that are out of date

Repository folders to load
Select which folders to load into the Eclipse workspace.

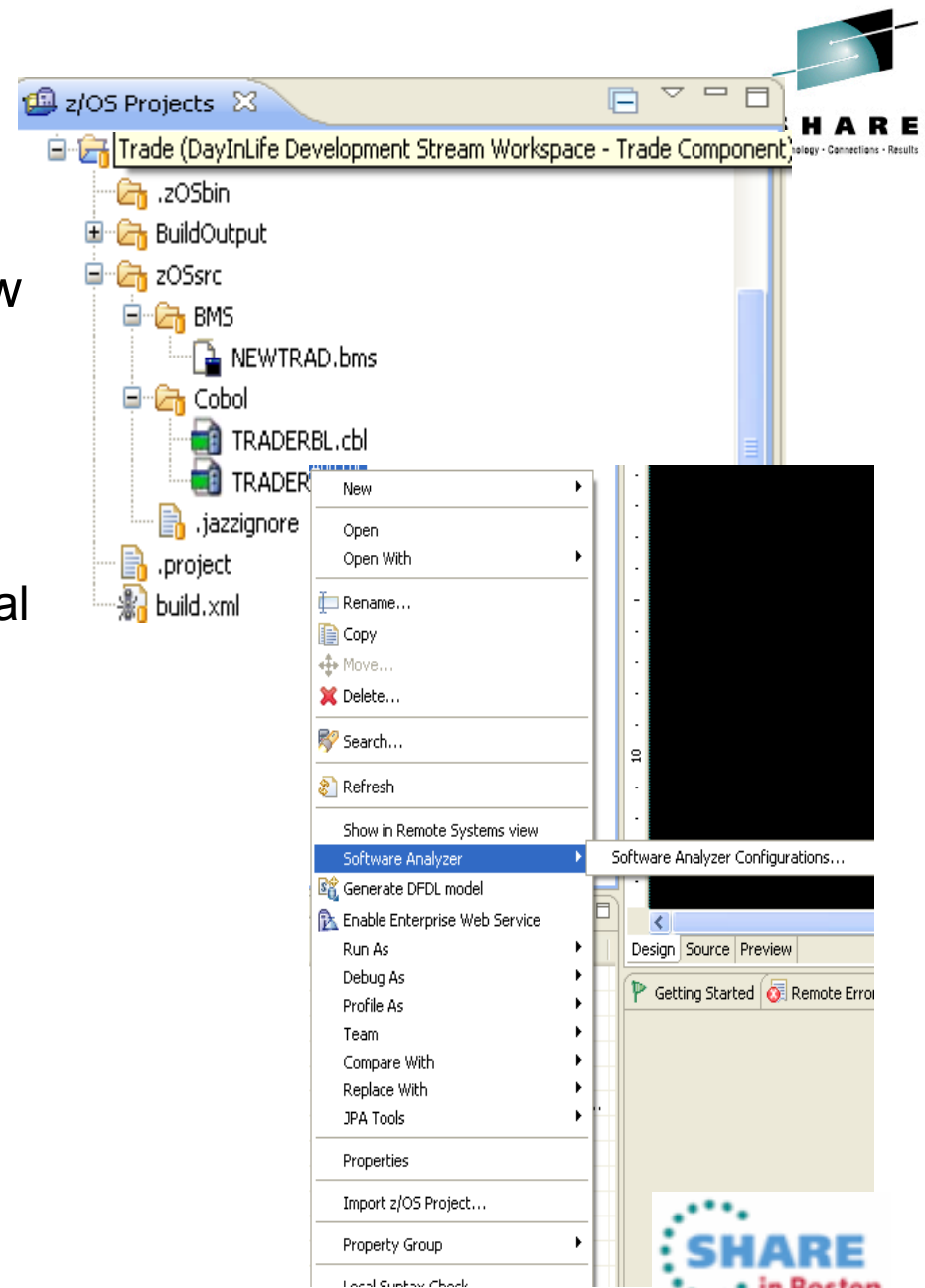
Trade Component
Trade

Select All
Deselect All

< Back Next > Finish Cancel

RDz and RTC together

- Once the project is loaded, it will appear in the RDz z/OS projects view
- RDz augments the development productivity & experience
 - Appropriate editors (COBOL, maps, etc.) and functions (content assist, real time syntax check, etc.)
 - High value functions (Enterprise web services, SFM, Code review, Unit testing, program analysis/control flow etc.)



Create a Property Group



- Generate property groups for your project based on RTC build definition
- Allows RDz to resolve the dependencies and thus offer all the tooling

Generate Property Group

Configure Property Group Generation
Specify how to generate the property group.

Generate using build definition (optional):
GAM zOS Dependency Build

Property group generation

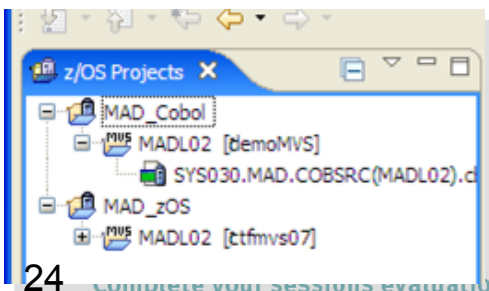
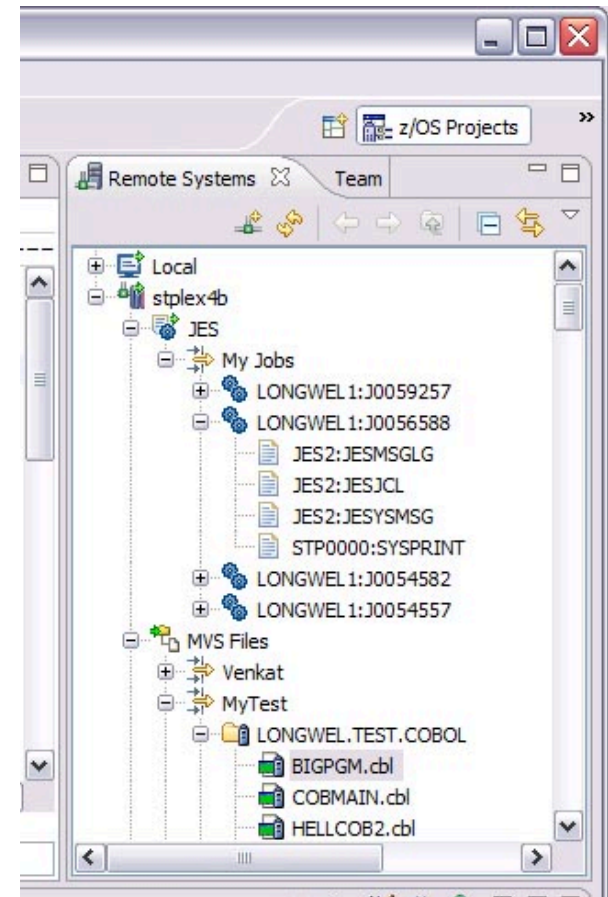
- Local COBOL Settings
- Local PLI Settings

Generate remote library paths for this connection (optional):
mvs114.rtp.raleigh.ibm.com

Finish Cancel

Navigate datasets and jobs live on zOS

- Connect to multiple hosts concurrently
- Respects existing security configurations and user IDs
- Search, filter, browse, edit, compare, migrate, and allocate new MVS datasets and USS files
- Copy source code, members, or datasets between systems with a few mouse clicks.
- Access JES queues submit jobs, view job state, and open output spools
- Submit TSO or USS commands
- Add datasets and members into projects to group applications and work items together logically
- Open an emulator in the IDE to configured hosts



Edit capabilities in RDz



- RDz at a high level has different types of editors
 - LPEX Editor
 - Supports editing of COBOL, PLI, HLASM, JCL, C/C++, Rexx etc.
 - Provides ISPF like edit experience including prefix commands, command line and even look and feel
 - Supports advanced edit functions for COBOL, PLI and HLASM like real time syntax checking, content assist
 - COBOL, PLI, and JCL advanced editors
 - Based on the Eclipse editor infrastructure, provide more advanced edit capabilities like quick fixes, hyper-linking, hover, easy navigation between various edit sessions or within the same edit session.
 - Supports real time syntax checking, content assist, key word highlighting etc.

```
Line 49      Column 1      Insert
-----+-----+-----+-----+-----+-----+-----+-----+-----+
000027      *
000028      *****
000029      IDENTIFICATION DIVISION.
000030      PROGRAM-ID. GAMOVDB.
000031
000032      DATA DIVISION.
000033
000034      WORKING-STORAGE SECTION.
000035
000036      COPY GAMOBMD.
000037      COPY GAMOBDD.
000038      COPY GAMOBED.
000039      COPY GAMOBED.
000040      COPY GAMOBED.
000041      COPY GAMOBPD.
000042      01 DATABASECONNECTION.
000043      49 SCHEMA
000044      49 PIC X VALUE '...'.
000045
000046      01 ITABLEPREPARE.
000047      49 ITABLE-VAR-LEN
000048      49 ITABLE-VAR-TXT
000049
000050      01 INVENTORYPREP.
000051      02 PIC X(12) VALUE 'INSERT'
000052      02 INVNTDBCON PIC X(9).
000053      02 TABLENAME PIC X(11).
```

```
PROCEDURE DIVISION.

INITIALIZE INPUTS-OUTPUTS.
INITIALIZE INVO.
INITIALIZE LOCINVO.
MOVE LOW-VALUE TO LOCINVO.
MVE LOW-VALUE TO INVO.
```

Change to "MOVE"

EA
TPUTS
SE
LISE



Edit capabilities in RDz

- RDz at a high level has different types of editors
 - WYSIWYG editors
 - Creation, edit of BMS and MFS maps
 - Has the source and design view – allows drag and drop of fields in the design view which generates the appropriate source



- Data Editors
 - Edit QSAM data

	1	2	3	4	5	6	7
1	03115AGraham, Holly	000á000003100	Oaktree Ct	Raleigh	NCUSA		
2	05580AMoore, Adeline	00ñi*00004700	S. Syracuse	Denver	COUSA		
3	06075ADubree, Dustin	0000\$00009229	Delegate's Row	Indianapolis	INUSA		
4	06927ABuchs, Jillian	000ræ000041	Avendale Drive	Carlisle	PAUSA		
5	07008AHouston, Roger	000Ñ@00004111	Northside PkWay	Atlanta	GAUSA		
6	07025AMarx, Audrey	00á00000090	South Cascade	Boulder	COUSA		
7	11204ANess, Luke	00é0*00005166	Sprinkle Road	Portage	MIUSA		
8	11544AGraf, Polly	000à000001551	S. Washington	Dowagiac	MIUSA		
9	12689ABoyd, Luke A.	000Ç\$0000221	Yale Rd	South Perth	Aus		

Editor Productivity features - Develop code more efficiently



```
000066 EXIT.  
000067 *-----  
000068 0150-SECOND-PART.  
000069     MOVE 2 TO BRANCHFLAG.  
000070     exec cics s  
000071     MOVE SEND  
000072     MOVE SEND CONTROL  
000073     MOVE SEND MAP(  
000074     MOVE SEND PAGE  
000075 0200-LOGIC.  
000076     IF WHICH SEND PARTNSET(  
000077 * If is LAB2 divide by ZERO  
000078     MOVE SET AUTOINSTALL  
000079     CALL SET BRFACILITY(  
CALLED
```

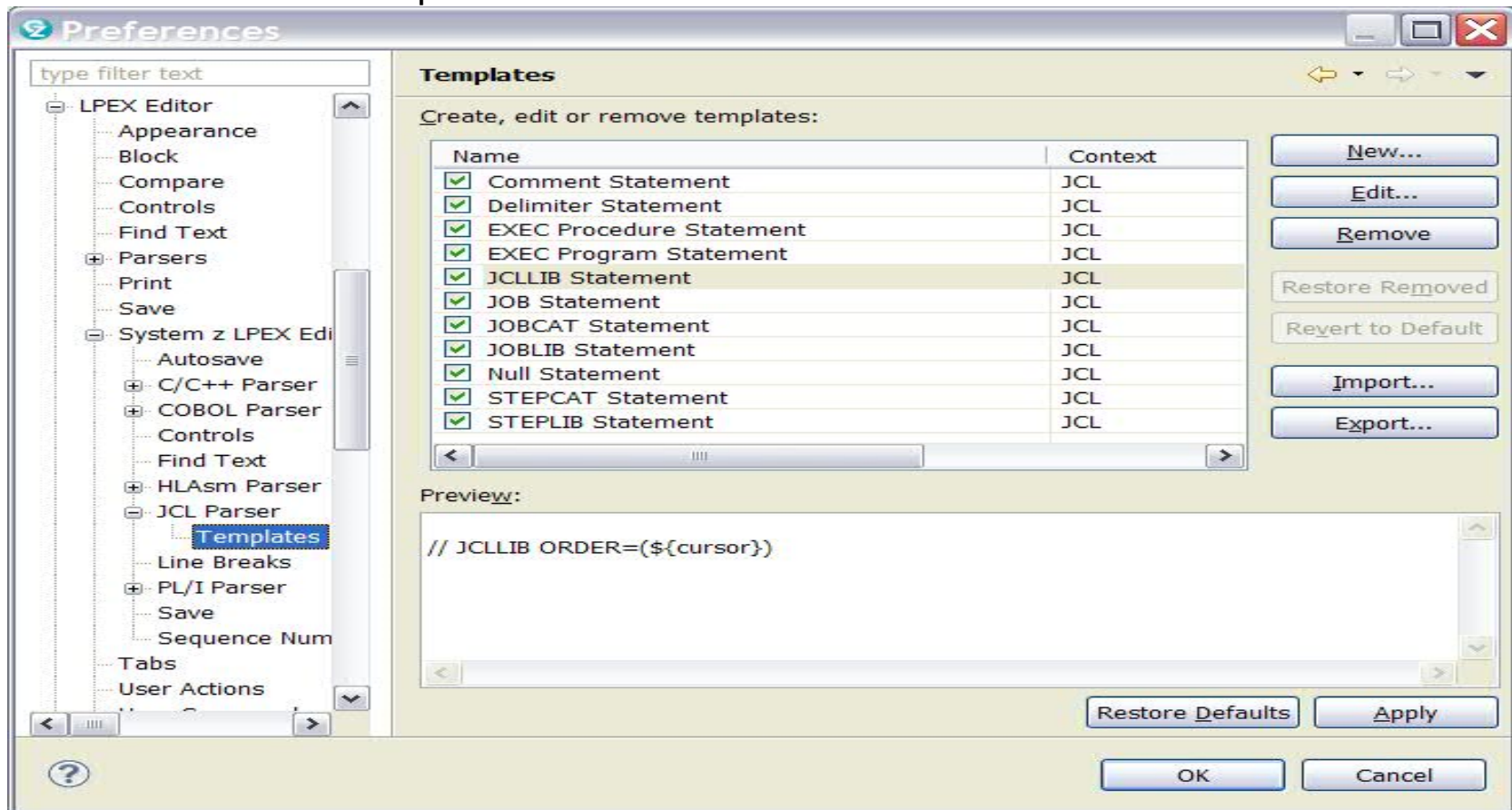
Find all statements and variables (including from COPYBOOKS or INCLUDE)

```
000067 *-----  
000068 0150-SECOND-PART.  
000069     MOVE 2 TO BRANCHFLAG.  
000070     move  
000071     CUST-ADDR1  
000072     CUST-CITY  
000073     CUST-CTRY  
000074     CUST-FN  
000075 0200  
000076     CUST-LN  
000077 * If CUST-NO  
000078     CUST-ST  
000079     POTVSAM-RECORD-REC  
POTVSAM-FILE  
01 POTVSAM-RECORD-REC.  
...  
03 CUST-ADDR1 PIC X(20).  
force a divide by ZERO  
D-FROM-CALLED
```



JCL Template Support

- Templates are provided for standard JCL statements, and users can create their own Templates
- When editing .jcl file using “Ctrl+Space” in the editor will trigger a pop list allowing the user to select the template to insert into the editor contents



Editor Productivity Features – real time syntax checking



Real-time syntax check without requiring code compile or save

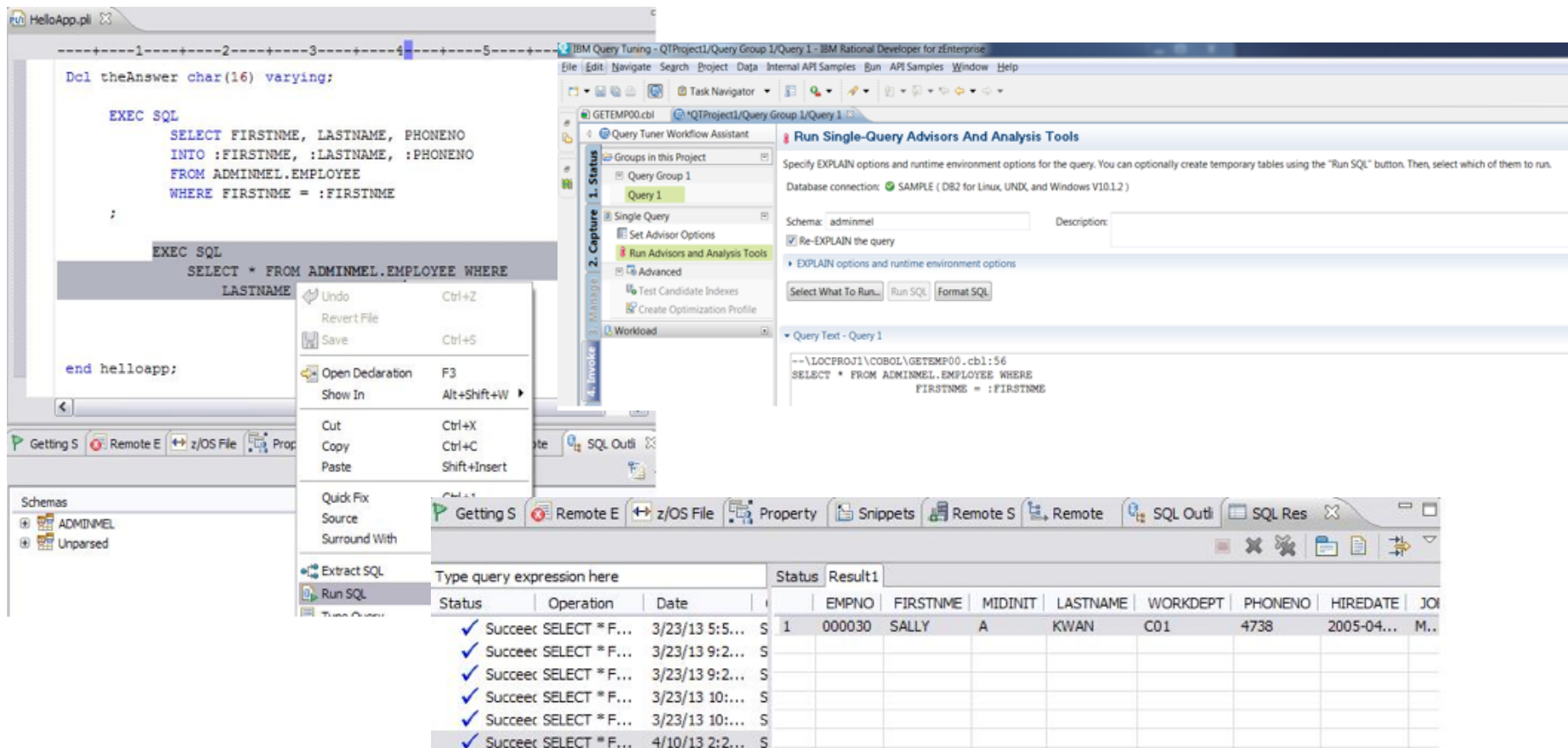
```
*GAMOVCD, jcl
-----1-----2-----3-----4-----5-----6-----7-----8
25 /* path name as the original files/modules. You must not alter or *
26 /* delete any copyright information in the Samples. *
27 /* *
28 /******
29 CUSTC JOB ,
30 MSGCLASS=H,MSGLEVEL=(1,1),TIME=(,32),REGION=0M,COND=(16,LT)
31 PROCS JCLLIB ORDER=(CUST.HEDS500.V7ROM0.$PROCLIB)
32 JOBLIB DD DSN=DB2.V8R1M0.SDSNEXIT,DISP=SHR
33 DD DSN=DB2.V8R1M0.SDSNLOAD,DISP=SHR
34 GAMDROP EXEC PGM=IKJEFT01,DYNAMNBR=20
35 //SYSTSPRT DD SYSOUT=*
36 //SYSPRINT DD SYSOUT=*
37 //SYSUDUMP DD SYSOUT=*
38 //SYSTSIN DD *
39 DSN SYSTEM(DSN8)
40 RUN PROGRAM(DSNTIAD) PLAN(DSNTIA81) -
41 PARM('RCO') -
42 LIB('DB2WK8.RUNLIB.LOAD')
43 END
44 //SYSIN DD *
45 DROP TABLE &SCHEMA.MAKE_MODEL;
46 DROP TABLE &SCHEMA.DEALERSHIP;
47 DROP TABLE &SCHEMA.EASTINVNTRY;
48 DROP TABLE &SCHEMA.CENTINVNTRY;
49 DROP TABLE &SCHEMA.PACINVNTRY;
50 COMMIT WORK;
51 /*
52 //GAMCDB EXEC PGM=IKJEFT01,DYNAMNBR=20
53 //SYSTSPRT DD SYSOUT=*
54 //SYSPRINT DD SYSOUT=*
55 //SYSUDUMP DD SYSOUT=*
56 //SYSTSIN DD *
57 DSN SYSTEM(DSN8)
58 RUN PROGRAM(DSNTIAD) PLAN(DSNTIA81) -
59 LIB('DB2WK8.RUNLIB.LOAD')
```

"DYNAMNBR" expected instead of this input
1 Quick Fix is available:
Change to "DYNAMNBR"
Press 'F2' for focus

```
CUSBATCH.cbl
Line 183 Column 31 Insert
-----+*A-1-B-----2-----3-----4-----5-----6-----
Unable to resolve reference to NON-DEFINED-NAME MOVE ' ' TO NON-DEFINED-NAME.
000179 MOVE ' ' TO CUST-LN-DATA.
000180 MOVE ' ' TO CUST-ADDR1-DATA.
000181 MOVE ' ' TO CUST-CITY-DATA.
000182 MOVE ' ' TO CUST-ST-DATA.
000183 MOVE ' ' TO CUST-CTRY-DATA.
000184 GET-CUST-INFO-EXIT.
000185 EXIT.
000186 NO-CUST-INFO.
000187 IF EXITNOW THEN
000188 STOP RUN
000189 ELSE
000190 MOVE WCUSTNO to CUSTNOO
000191 END-IF.
000192 NO-CUST-INFO-EXIT.
000193 EXIT.
000194 *
000195 -----+-----
FILL-CUST-DATA.
```

Editor Productivity Features – Data Tooling

- Run SQL – Highlight the EXEC SQL statement, and run it on the server
- Results in SQL Results View
- Tune SQL: Opens Query tuning analysis tools



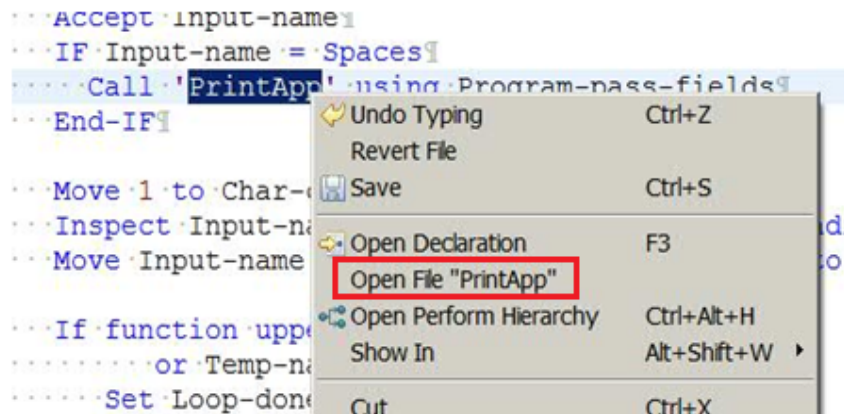
The screenshot displays the IBM Rational Developer for zEnterprise interface. On the left, a code editor shows a COBOL program with an EXEC SQL block containing a SELECT statement. A context menu is open over the EXEC SQL statement, with the 'Run SQL' option selected. The 'Run SQL' dialog box is visible, showing the query text and execution options. The 'SQL Results' window at the bottom displays the execution results in a table format.

Status	Operation	Date	EMPNO	FIRSTNAME	MIDINIT	LASTNAME	WORKDEPT	PHONENO	HIREDATE	JOI	
✓	Succes	3/23/13 5:5...	1	000030	SALLY	A	KWAN	C01	4738	2005-04...	M..
✓	Succes	3/23/13 9:2...									
✓	Succes	3/23/13 9:2...									
✓	Succes	3/23/13 10:...									
✓	Succes	3/23/13 10:...									
✓	Succes	4/10/13 2:2...									

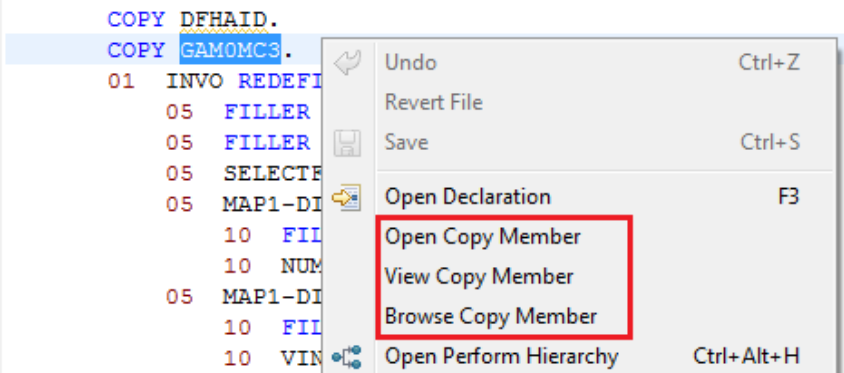
Editor Productivity Features



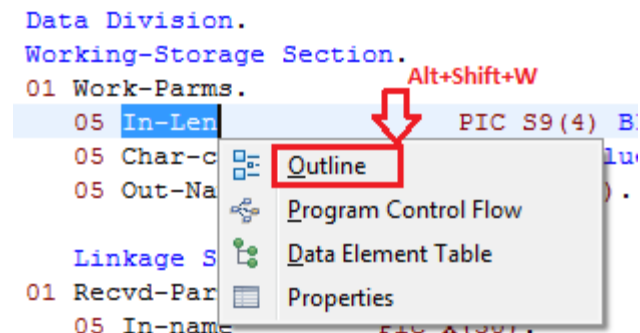
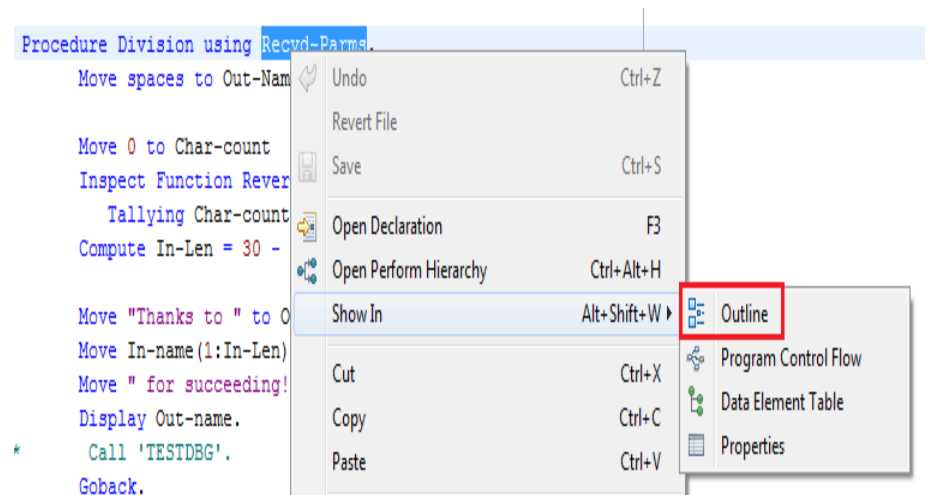
- Provide "Open Called Program" action



- Hyper linking support for Open/ Browse/ View copybooks/include files



- Show In > Outline action to COBOL and PL/I Editor



Editor Productivity Features



- Mark “Write occurrences” capability to the supported EXEC statements

- Occurrences within EXEC statements known to be “writes” are highlighted with a BROWN background

- All “read” statements will continue to be highlighted with a GREY background

```
* PHRASE and NEWPHRASE are read-only data areas;  
* ESMREASON and ESMRESP are write
```

```
EXEC CICS  
CHANGE PHRASE (data-area) PHRASELEN (data-value)  
NEWPHRASE (data-area) NEWPHRASELEN (data-value)  
USERID (data-value)  
ESMREASON (data-area) ESMRESP (data-area)  
END-EXEC.
```

```
/* INTO is write, LENGTH is read */
```

```
EXEC DLI STATISTICS  
USING PCB (expression)  
INTO (areal)  
LENGTH (areal)  
VSAM  
FORMATTED  
;
```

```
* INTO :hv1:ind1, :hv2:ind2 are WRITE, :hv3 is READ
```

```
EXEC SQL  
FETCH ABSOLUTE :hv3 CURSOR1 INTO :hv1:ind1, :hv2:ind2  
END-EXEC.
```

```
* all READ
```

```
EXEC SQL  
FREE LOCATOR :hv1, :HV2, :HV3  
END-EXEC.
```

Search for Occurrences Action



- Once a variable is selected the user triggers the “Find Occurrences” action using the Menu under search or keyboard shortcut “Ctrl+Shift+U”
- The occurrences are shown in the “Search results” page

The screenshot shows an IDE interface. The 'Search' menu is open, and 'Occurrences in Compilation Unit' is selected. The main editor displays the source code for 'WRITEOCD.pli'. The 'Search Results' window at the bottom shows 22 matches for the variable 'area1' in the compilation unit of 'WRITEOCD.pli'. The matches are listed as follows:

- 8: 01 area1 CHAR(1),
- 15: area1 = patarea;
- 20: INTO(area1)
- 21: KEYFEEDBACK(area1)
- 22: FEEDBACKLEN(area1)
- 40: AREA1(area1) LENGTH1(expression1)
- 41: AREA2(area1) LENGTH2(expression1)
- 42: AREA3(area1) LENGTH3(expression1)
- 43: AREA4(area1) LENGTH4(expression1)
- 44: AREA5(area1) LENGTH5(expression1)
- 45: AREA6(area1) LENGTH6(expression1)
- 46: AREA7(area1) LENGTH7(expression1)
- 52: AREA1(area1) LENGTH1(expression1)
- 53: AREA2(area1) LENGTH2(expression1)
- 54: AREA3(area1) LENGTH3(expression1)

Copy book and Include file resolution



- Hover over a COPY book name or a INCLUDE file to see the contents
 - Pressing F2 when hovering will “pin” the hover as shown
 - The window can then be dragged to expand, the Pencil icon shown below can be used to edit the copy book

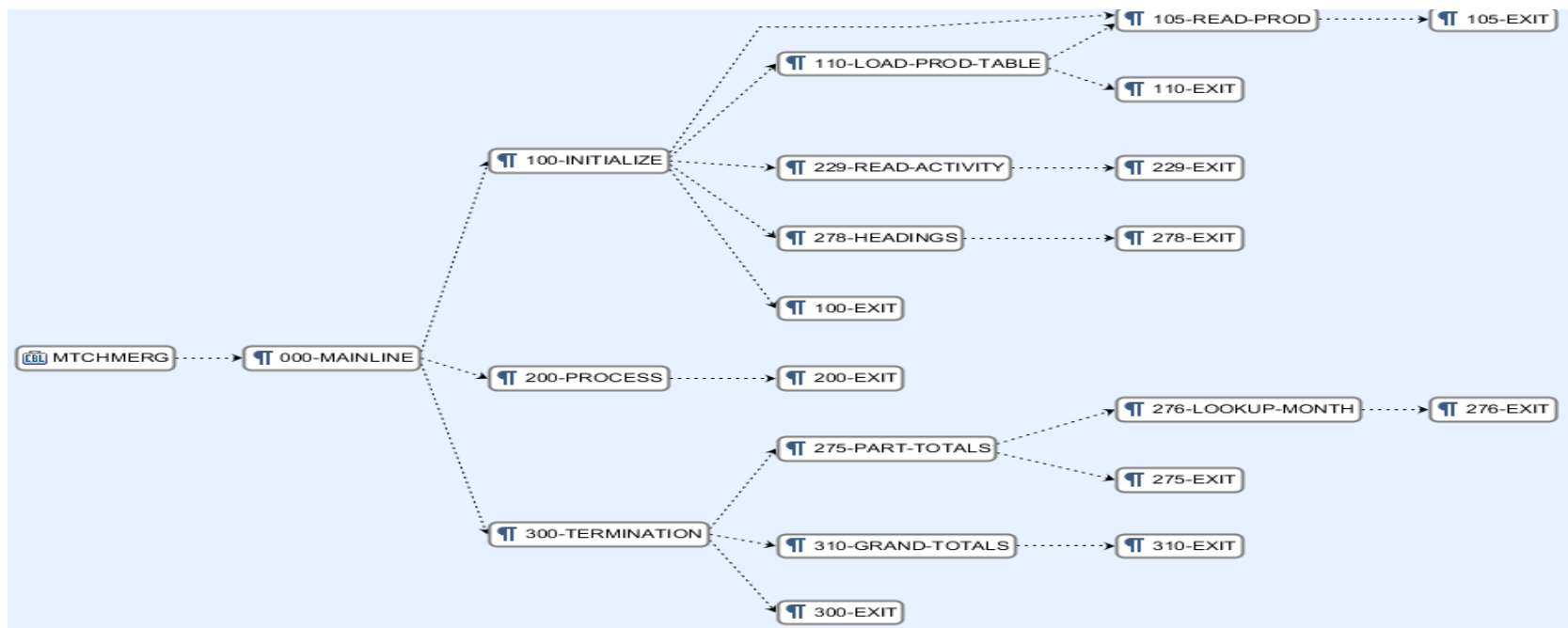
```
000630                                00004440
COPY ACCOUNT.                          00004450
COPY
001710 000640**** ACCOUNT CURRENT ENTRIES 00006200
001720 01 PLATF 000650**** SALES-AVAIL-ADJ FIELDS 00006210
001730 BILL- 000660**** INTEREST FIELDS 00006220
001740 000670 00006300
001750 05 F 000680 01 PLATFORM-ACCOUNT-CURRENT-REC REDEFINES 00006400
001760 05 F 000690 BILL-LADING-REC. 00006500
001770 05 F 000700 00006600
001780 05 F 000710 05 RDZ987-TRAN-CODE PIC 9(03). 00006700
001790 05 F 000720 05 RDZ987-PRICE-NUMBER PIC 9(03). 00006800
001800 05 F 000730 05 FILLER PIC X(07). 00006900
001810 05 F 000740 05 RDZ987-SUPPLR-NUMBER PIC X(05). 00007000
001820 05 F 000750 05 RDZ987-ACCT-NUMBER PIC 9(15) COMP-3. 00007100
001830 05 F 000760 05 RDZ987-ENTRY-NUMBER PIC 9(03). 00007200
001840 05 F 000770 05 FILLER REDEFINES 00007300
001850 F 000780 RDZ987-ENTRY-NUMBER. 00007400
001860 1 000790 10 RDZ987-BANK-NUMBER PIC 9(03) 00007500
001870 1
001880 1
001890                                00004650
```



Enhanced Application Quality & Structure Analysis



- Application Analysis
 - Control flow diagrams for COBOL programs,
 - **Graphical representation of the program flow with links to the source**
 - Helps identify and highlight potential unreachable code



Enhanced Structure Analysis – Data Element Table



- A table representation of the user-defined data items and symbols in a program
 - ▶ Hyperlinks in the table are integrated with the editor allowing easy access to the declaration of the data items.
- Generated by showing the “symbol table” generated when RDz real-time syntax check parses the program

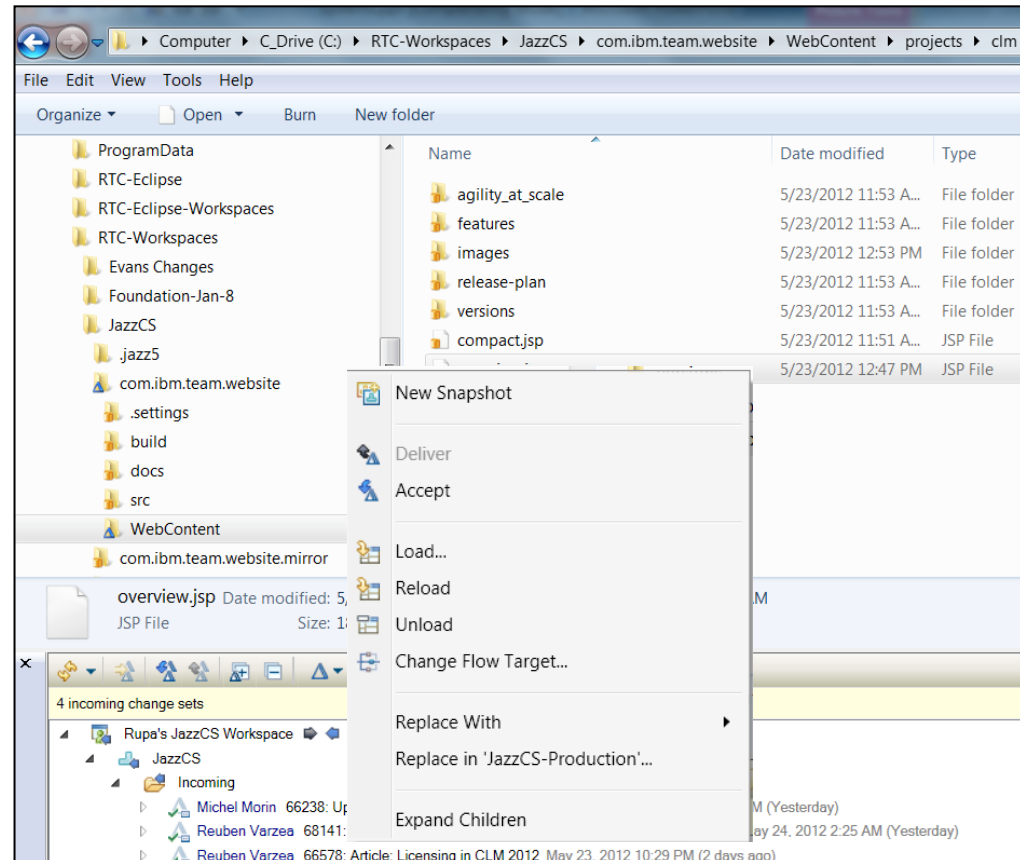
Showing data elements from WARDRPT.cbl

Search:

Data Item Name:	Data Type:	Level:	Top-Level Item:	Declaration:	Initial Value:	Line ...	Reference count:	Full Declaration:
PATLISTEST-S-ID	Data	10	PATIENT-MASTER-REC	PIC X(08)		378	0	10 PATLISTEST-S-ID PIC X
PATMSTR	File Descriptor	0	PATMSTR			116	4	FD PATMSTR RECORD CO.
PATMSTR-FOUND	Data	88	FILE-STATUS-CODES			134	1	88 PATMSTR-FOUND VALUE "0
PATMSTR-KEY	Data	5	PATMSTR	PIC X(06)		120	2	05 PATMSTR-KEY PIC X(06).
PATMSTR-REC	Data	1	PATMSTR			119	1	01 PATMSTR-REC.
PATMSTR-STATUS	Data	5	FILE-STATUS-CODES	PIC X(2)		133	3	05 PATMSTR-STATUS PIC X
PATPERSN	File Descriptor	0	PATPERSN			123	4	FD PATPERSN RECORD CO
PATPERSN-FOUND	Data	88	FILE-STATUS-CODES			136	1	88 PATPERSN-FOUND VALUE "
PATPERSN-KEY	Data	5	PATPERSN	PIC X(06)		127	2	05 PATPERSN-KEY PIC X(06).
PATPERSN-REC	Data	1	PATPERSN			126	2	01 PATPERSN-REC.
PATPERSN-STATUS	Data	5	FILE-STATUS-CODES	PIC X(2)		135	3	05 PATPERSN-STATUS PIC
PATSRCH	File Descriptor	0	PATSRCH			98	4	FD PATSRCH RECORDING
PAYMENT-METHOD-TYPE	Data	5	PATIENT-PERSONAL-...	PIC X(02)		313	0	05 PAYMENT-METHOD-TYPE
PEDIATRICS	Data	88	INPATIENT-DAILY-REC			157	0	88 PEDIATRICS VALUE "1010".

Pending Changes

- If you want finer grained control on your SCM operations, then the Pending Changes view is for you
 - Check in, deliver, accept changes
 - Suspend, resume, discard changes
 - Replace, reload out-of-sync
 - Resolve conflicts
 - Open change sets and work items via the web client



Traceability : Check-in History



- Someone made a costly mistake merging and you want to understand exactly where the mistake was made
 - Problem : Traditional history commands & UI only show before/ after & merge states for a change set ... it does not show intermediates
 - Solution : Use Check-in history in Eclipse, CLI or .NET clients

Merges	Comment	Creator	Date Created
	Fix progress monitor saving and deleting	Dmitry Karasik	Jul 7, 2010 3:18 PM
	118086: make deliver work without a source workspace - Merges	John Camelon	Jun 29, 2010 10:17 AM
	Merges	John Camelon	Jun 22, 2010 2:52 PM
	118086: make deliver work without a source workspace	John Camelon	Jun 21, 2010 5:13 PM
	108873: deprecate atomicStreamUpdate, provide createChangeSetForStream() & postDeliver() - Fix co...	John Camelon	Jun 21, 2010 10:23 AM
	108873: deprecate atomicStreamUpdate, provide createChangeSetForStream() & postDeliver() - Merges	John Camelon	Jun 18, 2010 4:39 PM
	108873: deprecate atomicStreamUpdate, provide createChangeSetForStream() & postDeliver()	John Camelon	Jun 18, 2010 3:54 PM
	119130: Error fetching changeset links - fix	John Camelon	Jun 28, 2010 2:39 PM

Check-in History	Type	Date
	Final - Modified	Jun 18, 2010 4:37 PM
	Proposed	Jun 18, 2010 4:37 PM
	Modified	Jun 18, 2010 4:37 PM
	Initial	Jun 18, 2010 4:37 PM

Development Life Cycle

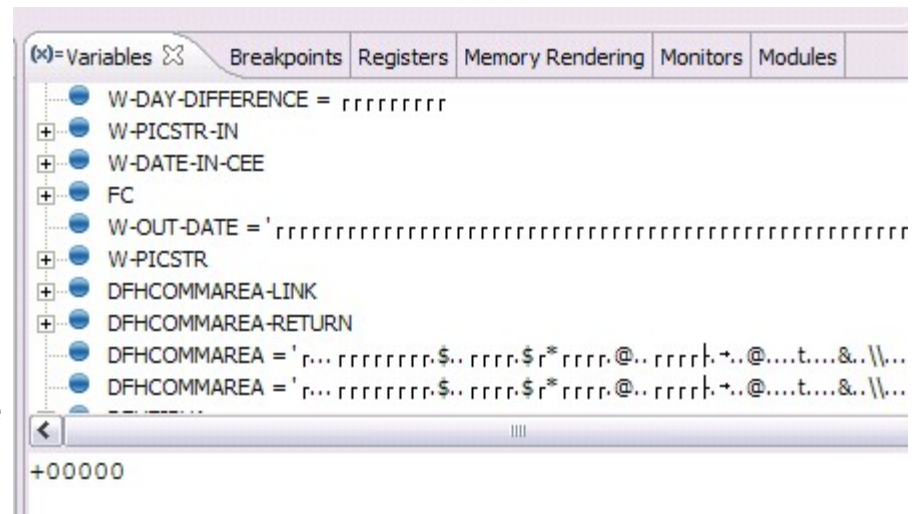
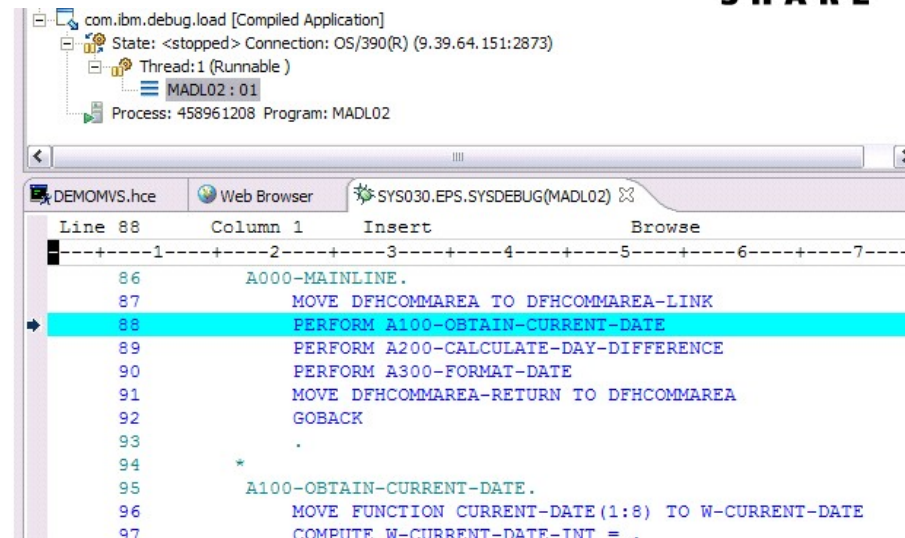


Planning	Source Dev	Governance/Unit test	Build
<ul style="list-style-type: none"> Define the tasks Create a plan Create a work item Assign the work item to a developer 	<ul style="list-style-type: none"> Load the project/ source artifacts from SCM Navigate, Analyze, Edit, Syntax check source code 	<ul style="list-style-type: none"> Compile Quality assurance <ul style="list-style-type: none"> Debug Code Coverage Code review Unit Testing 	<ul style="list-style-type: none"> Check-in/Deliver the source code Build
CLM	RDz RTC	RDz RD&T RTC	RTC RDz

Debug Multiple Runtimes – using IBM Debug tool



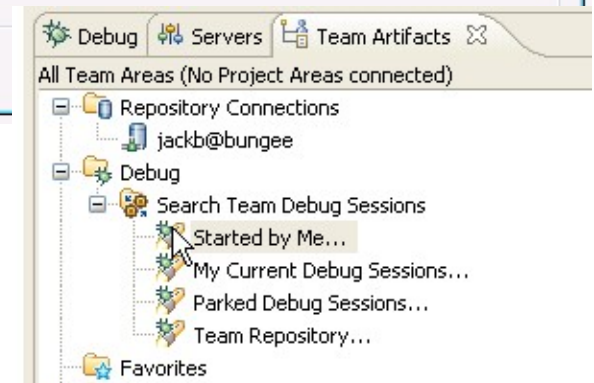
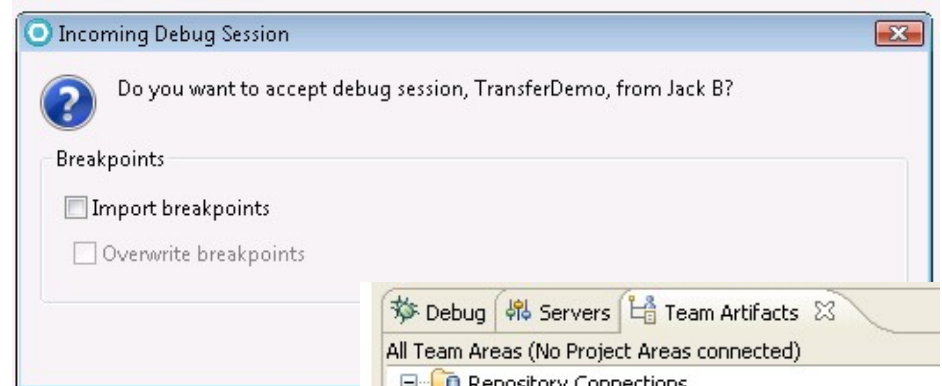
- Use the cross-platform debugger to debug end-to-end systems as they execute in the runtime
 - IMS
 - CICS
 - DB2
 - Batch
 - WAS
 - Java
- From the workstation:
 - View executing source code
 - Step through host code line-by-line
 - Set breakpoints
 - Alter working storage values
 - Alter register values
 - Etc...
- Debug zOS and distributed code in the same interface even stepping between runtimes and platforms!



Innovative Debugging using Collaboration



- Collaborative debug with RDz and IBM Debug Tool via the Rational Team Concert Server!
 - Share breakpoints and monitors with other team members
 - Transfer debug session control to other users
 - Save debugging sessions for later retrieval in the team environment
 - Works for WAS (JEE) and System z applications



Debug Session	Host	Debug Target	Team Repository	Started by	Debugged by	Started at
TransferDemo	justinko.torolab.ibm.com	VM [justinko.torolab.ibm....	https://bungee:9443/jazz/	jackb	kellyc	Mon Sep 22 16:59:21 ED...

Enhanced Application Quality – Code Coverage



- Line Level Code Coverage - provides tools to measure and report on test coverage of an application
- Indicating what source code lines were tested and remain to be tested

Code Coverage Report

Code Coverage Summary

Code coverage report, generated Oct 18, 2011 12:19:59 PM

Element	Coverage	Covered Lines	Total Lines
SAM1	75%	117	156
SAM1	75%	117	156
VENKATU.COBOI.SYSDEBUG(SAM1).cob	75%	117	156
SAM1()	75%	117	156

Report

Remote Error List | z/OS File System | Property Group M | Snippets | Remote System D | Remote Reconcile | Coverage Launch

Launch Name	Launch Date
SAM1-2011_10_18_121959	Oct 18, 2011 12:19:59 PM
SAM1-2011_10_17_163634	Oct 17, 2011 4:36:34 PM
SAM1-2011_10_17_160130	Oct 17, 2011 4:01:30 PM
SAM1-2011_10_14_132043	Oct 14, 2011 1:20:43 PM
SAM1-2011_10_14_130134	Oct 14, 2011 1:01:34 PM
SAM1-2011_10_14_124502	Oct 14, 2011 12:45:02 PM
SAM1-2011_10_14_120040	Oct 14, 2011 12:00:40 PM

```

374-----*A-1-B-----2-----3-----4-----5-----6-----7-----
375      PERFORM 210-PROCESS-ADD-TRAN
376      WHEN 'DELETE'
377      PERFORM 220-PROCESS-DELETE-TRAN
378      WHEN OTHER
379      IF TRAN-COMMENT NOT = '*'
380      MOVE 'INVALID TRAN CODE:' TO ERR-MSG-DATA1
381      MOVE TRAN-CODE TO ERR-MSG-DATA2
382      PERFORM 299-REPORT-BAD-TRAN
383      END-IF
384      END-EVALUATE
385      END-IF
386      MOVE TRAN-KEY TO WS-PREV-TRAN-KEY
387      IF WS-TRAN-OK = 'Y'
388      PERFORM 830-REPORT-TRAN-PROCESSED
389      END-IF
390      END-IF .
391
392
393 200-PROCESS-UPDATE-TRAN.
394  ADD +1 TO NUM-UPDATE-REQUESTS.
395  PERFORM 720-POSITION-CUST-FILE.
396  IF CUST-KEY NOT = TRAN-KEY OR WS-CUST-FILE-EOF = 'Y'
397  MOVE 'NO MATCHING KEY: ' TO ERR-MSG-DATA1
398  MOVE TRAN-KEY TO ERR-MSG-DATA2
399  PERFORM 299-REPORT-BAD-TRAN
400  ELSE
401  *
402  *   Subroutine SAM2 will apply an update to a customer record
403  *
404  CALL 'SAM2' USING CUST-REC, TRANSACTION-RECORD,
405                   WS-TRAN-OK, WS-TRAN-MSG
406  IF WS-TRAN-OK NOT = 'Y'
407  MOVE WS-TRAN-MSG TO ERR-MSG-DATA1
408  MOVE SPACES TO ERR-MSG-DATA2
409  PERFORM 299-REPORT-BAD-TRAN

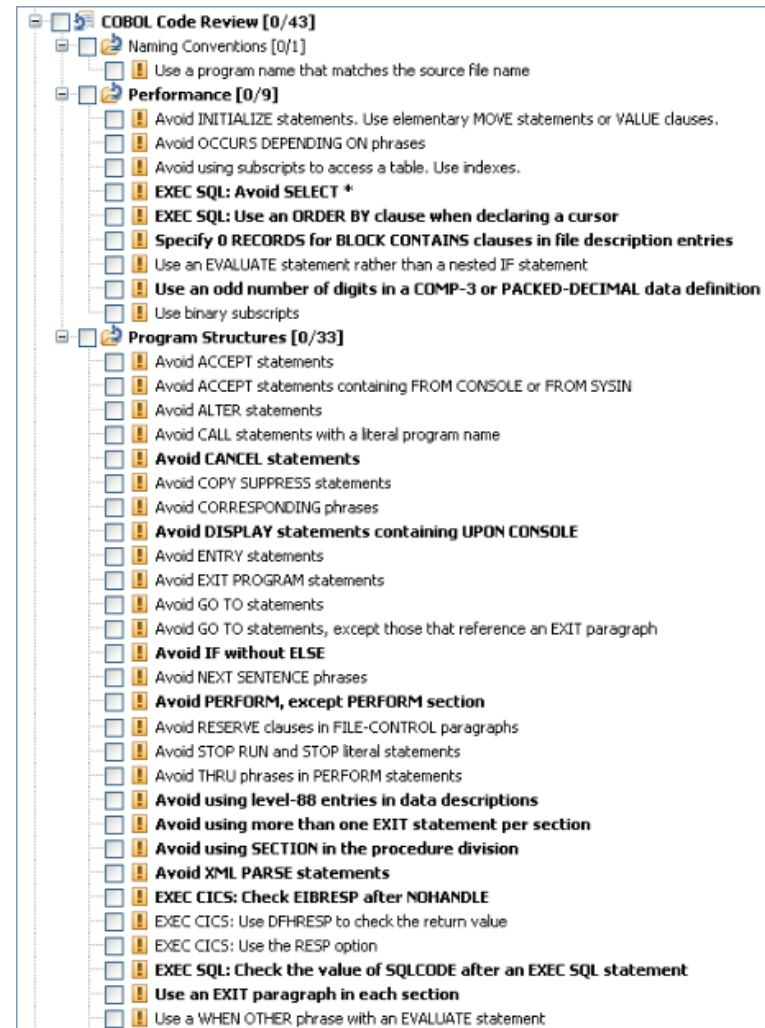
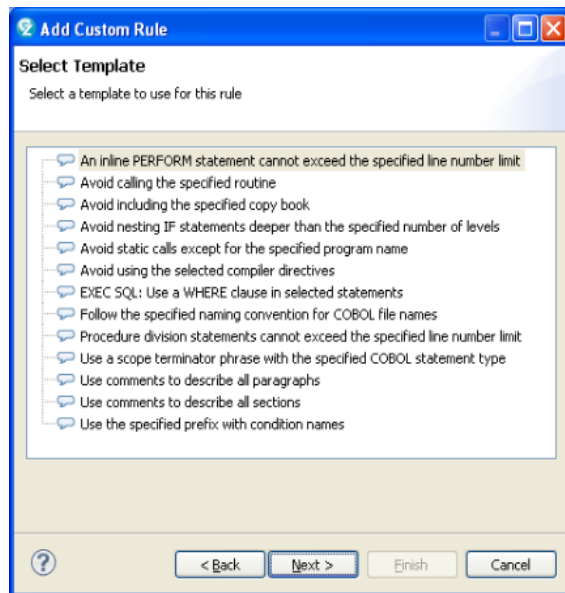
```



Enhanced Quality & Structure Analysis – Code review



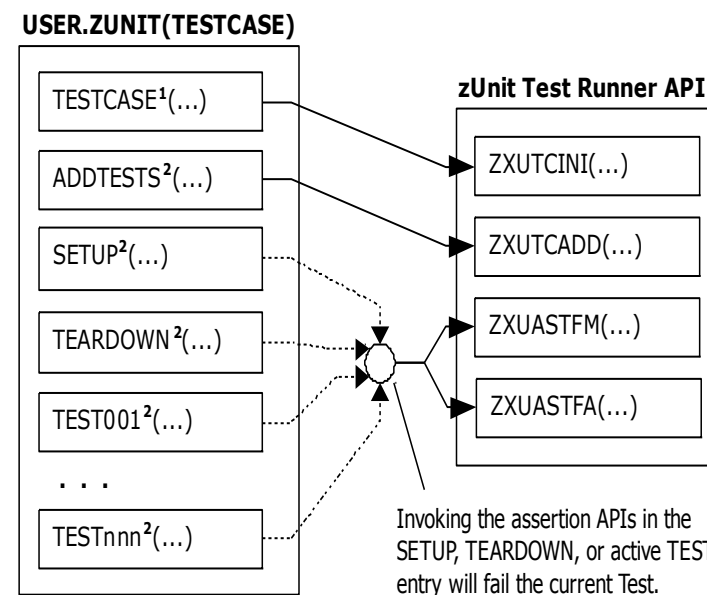
- Code Review/Governance - provides predefined rules and templates for COBOL and PL/I applications
 - Ensure adherence to corporate standards



zUnit – Unit testing framework for z/OS



- Frameworks that assist developers in writing code to perform repeatable, self-checking unit tests are collectively known as xUnit.
- [xUnit](#) defines a set of concepts that together provide a light-weight architecture for implementing unit testing frameworks.
 - JUnit, for example, is a very popular instance of the xUnit architecture.
- **zUnit** is a xUnit instance for System z
- Goal is to encourage the **continuous integration and continuous testing** methodology for System z Application development and maintenance



¹Language-specific details:

- In COBOL, this is the first program appearing in the Test Case source file and it will be invoked by the Test Runner for Test Case initialization.
- In PL/I, this is the procedure declared with option(fetchable) in the Test Case source file and it will be invoked by the Test Runner for Test Case initialization.

²Language-specific details:

- In COBOL, these are expected to be subprograms (non-nested and therefore compatible with FUNCTION-POINTER).
- In PL/I, these are expected to be internal procedures that are declared at the package level (non-nested).

Development Life Cycle

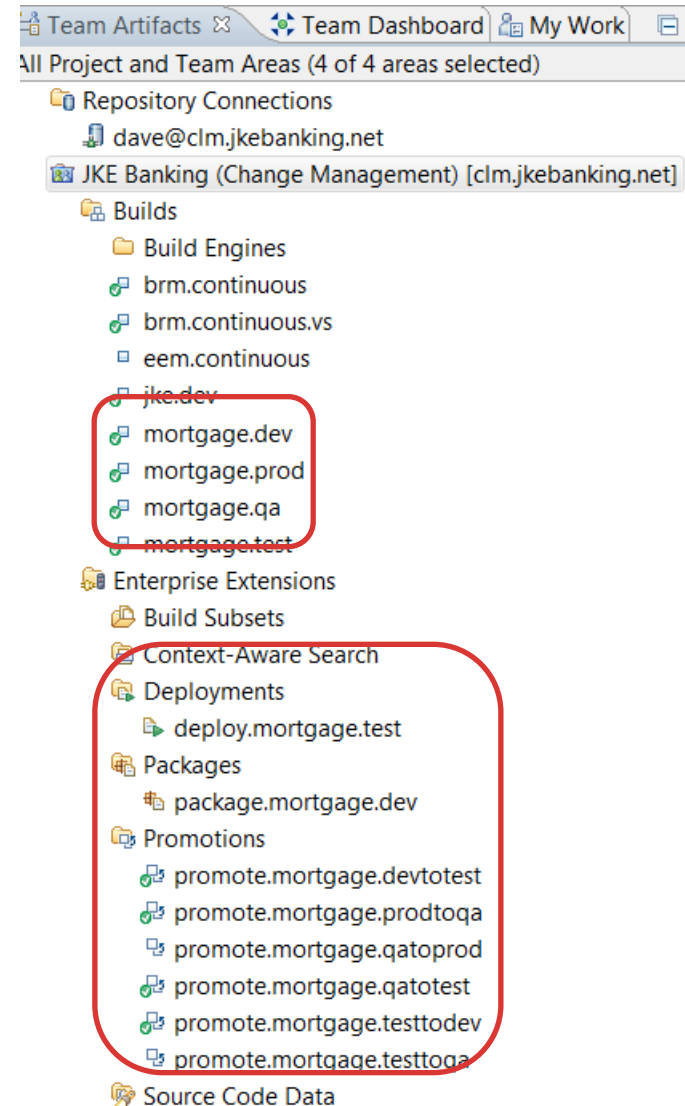


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CLM	RDz RTC	RDz RD&T RTC	RTC RDz

Enterprise Extensions Specific Functions



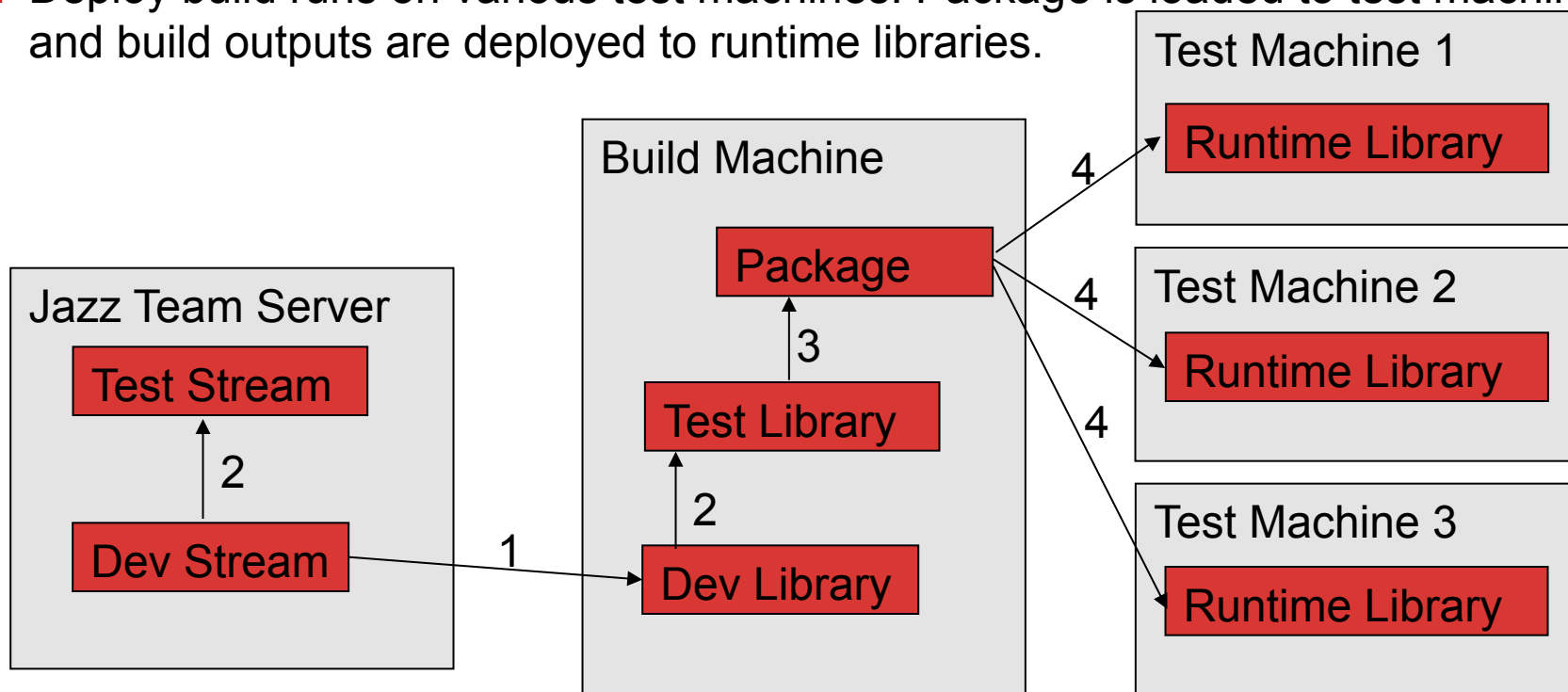
- Dependency build
 - “Smart build” of z/OS and IBM i applications, based on what has changed
- Promotion
 - Flow of source code changes and build outputs through development hierarchy
- Packaging and deployment
 - Package build outputs and deploy to another system (e.g. test environment, QA, production, etc)



The big picture



1. Dependency build runs on build machine. Source is loaded from Dev Stream and outputs are built in Dev Library.
2. Promotion build runs on build machine. Source is promoted from Dev Stream to Test Stream and build outputs are copied from Dev Library to Test Library.
3. Package build runs on build machine. Test Library build outputs are archived in a package.
4. Deploy build runs on various test machines. Package is loaded to test machine and build outputs are deployed to runtime libraries.



Dependency Build Summary

Server

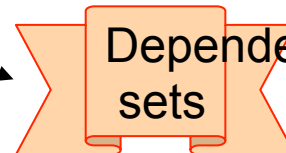
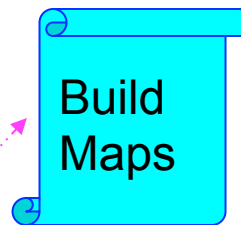
1- Scan

Scan new or changed files
Extract their logical
information and
dependencies

2- Preprocessing

For changed files:
impact on build maps

Calculate dependency
sets



Mainframe (Build machine)

Build processing

Snapshots for every build



Build MVS Dependency Build Test 20120619-0908330825

✓ **Completed**

Duration: 53 seconds
Start Time: June 19, 2012 9:08:33 AM
Completed: June 19, 2012 9:09:27 AM



Contribution Summary

Changes: [Show changes](#)
Downloads: [7 downloads](#)
Logs: [1 log](#)
Snapshot: [MVS Dependency Build Test 20120619-0908330825](#)
Work items: [3 included in build](#)

Reported Work Items

Work items reported against this build to help stabilize it.

- None reported against this build
- [Create a new work item](#)
- [Associate an existing work item](#)

General Information

Requested by: ADMIN
Build Definition: [MVS Dependency Build Test](#)
Build Engine: [Setup engine 15560](#)
Build History: [19 builds](#)
Tags:

Associated Release

Released builds are available as ch

[Create a release to associate v](#)

Snapshot

Name:*

Details

Created by: [ADMIN](#)
Created on: Jun 19, 2012 9:08 AM
Modified on: Jun 19, 2012 9:08 AM
Description:

Links

- [Create a new repository workspace](#)
- [Create a new stream](#)
- [Compare with snapshot](#)
- [Compare with repository workspace or](#)

Components

Shows the components in this snapshot.

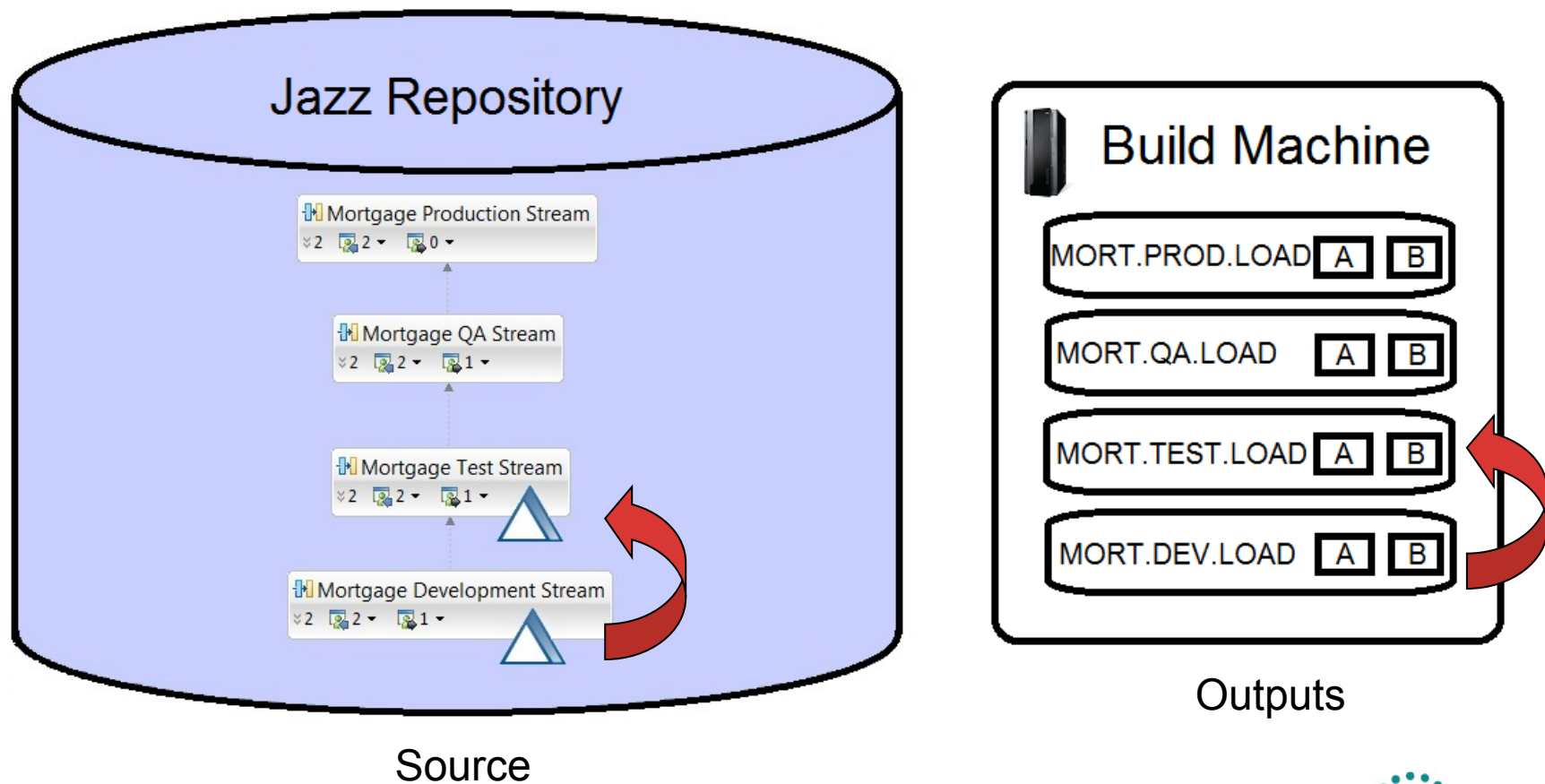
- [Liam Test RWS \(4: MVS Dependency Build Dev_20111108-0955580222\)](#)
- [Mortgage Component \(69: MVS Dependency Build Dev KA_20120619-0853550520\)](#)
- [plx test \(2: MVS Dependency Build Dev_20110328-0857420358\)](#)

Show Repository Files

Promotion



- Flow source code changes and build outputs through the development hierarchy



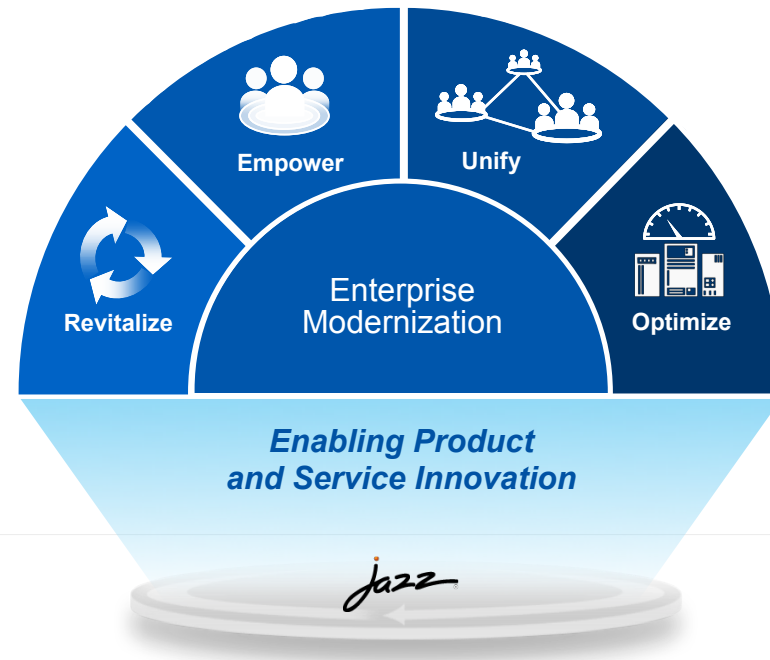
Summary

- Many companies spend more than 70% on keeping lights on, and that amount is increasing
- IT organizations have problems modifying applications at speed of business
- IBM provides a structured approach to incrementally modernize your portfolio based on business priorities
- Change without a plan is chaos
- A Plan without change is stagnation
- Business goals change
 - applications need to change to address them
- Continual renewal is required
 - tools help to guide, govern, drive, and accomplish this change
- Related sessions 13686, 16683 & Exhibit Hall

Getting started

Next steps to modernize your enterprise applications

www.ibm.com/rational/modernization



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Thank You