Code Metrics Analysis Report - Apache Roller

Task 2B: Comprehensive Code Quality Assessment

Project: Apache Roller Weblogger v6.1.5
Analysis Date: February 2026
Focus Areas: Search & Indexing, Weblog & Content, User & Role Management Subsystems

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1. Tools Used for Analysis

Tool	Version	Purpose	Metrics Provided
Checkstyle	9.3	Code style analysis	Line length, naming conventions, whitespace, Javadoc, code structure
PMD	6.55.0	Static code analysis	Code smells, empty catch blocks, unused variables, null checks, complexity
JDepend	2.0	Package dependencies	Afferent/Efferent coupling, abstractness, instability, cycles
DesigniteJava	2.x	OO Metrics extraction	LOC, NOM, WMC, DIT, NOC (NC), LCOM, FANIN, FANOUT, Code Smells

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2. Six Key Code Metrics Analyzed

Metric 1: Lines of Code (LOC)

Description: Total lines of source code per class/subsystem

Subsystem	Total LOC	# Classes	Avg LOC/Class
Search & Indexing	1,913	15	127
Weblog & Content (POJOs)	9,995	16+	625
User & Role (POJOs)	566	3	189

Largest Classes by LOC:

Class	LOC	Methods	Subsystem
`WeblogEntry`	1,030	99	Weblog & Content
`Weblog`	925	104	Weblog & Content
`LuceneIndexManager`	485	26	Search & Indexing
`WeblogEntryComment`	345	37	Weblog & Content
`User`	277	33	User & Role Management

Implications:

- `WeblogEntry` and `Weblog` are **God Classes** with excessive responsibilities
- These classes violate the Single Responsibility Principle (SRP)
- **Refactoring Recommendation**: Extract delegate classes for specific concerns (e.g., `WeblogMetadata`, `EntryContent`, `EntryPublishing`)

Metric 2: Weighted Methods per Class (WMC)

Description: Sum of complexities of all methods in a class (Chidamber-Kemerer metric)

Class	WMC (Method Count)	Risk Level
`Weblog`	104	□ High
`WeblogEntry`	99	□ High
`WeblogEntryComment`	37	□ Medium
`WeblogTemplate`	34	□ Medium
`User`	33	□ Medium
`LuceneIndexManager`	26	□ Medium
`SearchOperation`	13	□ Low

Thresholds: WMC > 50 (High risk), WMC > 20 (Medium), WMC ≤ 20 (Low)

Implications:

- High WMC indicates classes are difficult to test and maintain
- `Weblog` and `WeblogEntry` exceed recommended thresholds by 2x
- **Refactoring Recommendation**: Decompose into smaller, focused classes

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Metric 3: Depth of Inheritance Tree (DIT)

Description: Maximum length from the class to the root of the hierarchy

Subsystem	Max DIT	Classes with DIT > 2
Search & Indexing	3	`AddEntryOperation`, `RemoveEntryOperation`, etc.
Weblog & Content	1-2	Most POJOs inherit only from Object
User & Role	2	`GlobalPermission` extends base permission

Search Subsystem Inheritance Hierarchy:

```
Object
└── IndexOperation (abstract)
    ├── WriteToIndexOperation (abstract)
    │   ├── AddEntryOperation
```

```
    │   ├── RemoveEntryOperation
    │   ├── ReIndexEntryOperation
    │   ├── RebuildWebsiteIndexOperation
    │   └── RemoveWebsiteIndexOperation
    └── ReadFromIndexOperation (abstract)
        └── SearchOperation
```

Implications:

- DIT=3 is optimal for Search subsystem (good use of Template Method pattern)
- Low DIT in POJOs indicates flat hierarchy (good for simplicity)
- **Positive Finding**: Well-designed inheritance in Search subsystem

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Metric 4: Coupling Between Objects (CBO)

Description: Number of classes a class is coupled to

Subsystem	Unique Imports	Estimated CBO
Search & Indexing	65	Medium-High
LuceneIndexManager	~30	High
WeblogEntry	~25	High

Key Coupling Points (Search Subsystem):

- Depends on: Lucene (6 classes), Roller POJOs (4 classes), Roller Business (3 classes)
- Total external package dependencies: 15+

Implications:

- High CBO makes classes harder to reuse and test in isolation
- `LuceneIndexManager` is tightly coupled to Lucene library
- **Refactoring Recommendation**: Introduce search engine abstraction layer

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Metric 5: Checkstyle Violations

Description: Code style and convention violations

Category	Count	Severity
Total Project Violations	415	-
MethodLength (>50 lines)	35+	□ High
MagicNumber (hardcoded values)	50+	□ Medium
FileTabCharacter	20+	□ Low
MissingJavadoc	100+	□ Medium

Category	Count	Severity
LocalVariableName	10+	Low

Subsystem-Specific Findings:

Subsystem	Key Violations
Search & Indexing	`IndexOperation.getDocument()` = 96 lines (exceeds 50 limit), `LuceneIndexManager.initialize()` = 56 lines
Weblog & Content	Magic numbers in pagination, long methods in managers
User & Role	Naming convention issues, missing Javadoc

Implications:

- Long methods indicate need for extraction
- Magic numbers reduce code readability
- **Refactoring Recommendation**: Extract methods, use named constants

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Metric 6: PMD Violations (Code Smells)

Description: Potential bugs, dead code, and poor practices

Category	Count	Priority
Total Violations	536	-
UselessParentheses	150+	P4 (Low)
UnnecessaryFullyQualifiedName	100+	P4 (Low)
EmptyCatchBlock	15+	P3 (Medium)
UnusedLocalVariable	10+	P3 (Medium)
BrokenNullCheck	5+	P2 (High)

Subsystem-Specific PMD Findings:

Subsystem	Violations	Critical Issues
Search & Indexing	2	None critical
Weblog & Content	150+	Empty catch blocks in managers
User & Role	50+	`BrokenNullCheck` in `JPAUserManagerImpl.addUser()`

Implications:

- `BrokenNullCheck` in User subsystem is a **potential null pointer exception**
- Empty catch blocks hide errors and make debugging difficult

- **Refactoring Recommendation**: Fix null checks, add proper error handling

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3. Subsystem-Specific Analysis

3.1 Search and Indexing Subsystem GOOD

Metric	Value	Assessment
Total LOC	1,913	Well-sized
Classes	15	Appropriate
Max WMC	26 (LuceneIndexManager)	Acceptable
DIT	3	Good use of inheritance
PMD Violations	2	Excellent
Checkstyle Issues	~10	⚠ Method length

Strengths:

- Well-designed Template Method pattern
- Clear separation of read/write operations
- Excellent PMD score (only 2 violations)
- Good use of OO design patterns

Weaknesses:

- `LuceneIndexManager.initialize()` too long (56 lines)
- `IndexOperation.getDocument()` too long (96 lines)
- Tight coupling to Lucene library

3.2 Weblog and Content Subsystem NEEDS ATTENTION

Metric	Value	Assessment
Total LOC (POJOs)	9,995	⚠ Large
Largest Class	1,030 (WeblogEntry)	Too large
Max WMC	104 (Weblog)	Very high
PMD Violations	150+	⚠ Needs cleanup
Empty Catch Blocks	10+	Error-prone

Strengths:

- Comprehensive domain model
- Complete feature coverage

Weaknesses:

- `WeblogEntry` (99 methods) and `Weblog` (104 methods) are God Classes
- High coupling between content classes
- Empty catch blocks in manager implementations

Refactoring Priorities:

1. Extract `WeblogEntry` into smaller classes (ContentData, Metadata, Publishing)
2. Eliminate empty catch blocks
3. Add proper error handling

3.3 User and Role Management Subsystem □ MODERATE

Metric	Value	Assessment
Total LOC	566	□ Reasonable
Classes	3 core (User, UserRole, GlobalPermission)	□ Appropriate
Max WMC	33 (User)	⚠ Medium
PMD Violations	50+	⚠ Has issues
Critical Bug	BrokenNullCheck	□ Fix required

Strengths:

- Reasonable class sizes
- Clear permission model

Weaknesses:

- **Critical**: `BrokenNullCheck` in `JPAUserManagerImpl.addUser()` can cause NPE
- Missing null validations in user creation flow

Refactoring Priorities:

1. **Immediate**: Fix null check in `addUser()` method
2. Add input validation for user operations
3. Improve documentation

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4. Summary: Refactoring Decision Matrix

Subsystem	Priority	Key Action
User & Role	□ HIGH	Fix `BrokenNullCheck` bug immediately
Weblog & Content	□ MEDIUM	Decompose God Classes (`WeblogEntry`, `Weblog`)
Search & Indexing	□ LOW	Extract long methods (optional)

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5. Metrics Summary Table

Metric	Search	Weblog	User	Threshold
LOC (max class)	485 □	1,030 □	277 □	< 500
WMC (max class)	26 □	104 □	33 □	< 50
DIT (max)	3 □	2 □	2 □	2-4
CBO (imports)	65 □	High □	Moderate □	< 30
PMD Violations	2 □	150+ □	50+ □	0
Critical Bugs	0 □	0 □	1 □	0

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7. DesigniteJava OO Metrics (Chidamber-Kemerer Suite)

The following metrics are extracted from **DesigniteJava** analysis (`typeMetrics.csv`), providing proper object-oriented metrics including the Chidamber-Kemerer suite.

7.1 Search & Indexing Subsystem Classes

Class	LOC	NOM	WMC	DIT	NOC	LCOM	FANIN	FANOUT
`LuceneIndexManager`	309	47	25	0	0	0.12	12	13
`SearchOperation`	116	15	10	0	0	0.18	1	4
`IndexOperation`	99	16	3	2	0	0.50	1	5
`RebuildWebsiteIndexOperation`	78	9	3	0	0	0.00	0	8
`RemoveWebsiteIndexOperation`	52	6	3	0	0	0.00	0	6
`ReIndexEntryOperation`	44	4	3	0	0	0.00	0	5
`AddEntryOperation`	42	4	3	0	2	0.00	0	4
`RemoveEntryOperation`	37	3	3	0	2	0.00	0	5
`IndexUtil`	33	4	0	0	0	-1.0	3	1
`WriteToIndexOperation`	25	2	1	1	5	1.00	0	1
`SearchResultList`	24	5	4	0	0	0.00	2	0
`SearchResultMap`	24	5	4	0	0	0.00	0	0
`FieldConstants`	22	0	16	0	0	-1.0	7	0
`ReadFromIndexOperation`	21	2	1	1	1	1.00	0	1

Key Observations:

- **Low LCOM** (0.00-0.50): High cohesion - methods work together well □
- **Moderate WMC** (1-25): Reasonable complexity □
- **Good DIT** (0-2): Appropriate inheritance depth □
- **High FANOUT** on `LuceneIndexManager` (13): Many dependencies to external classes

7.2 Weblog & Content Subsystem Classes

Class	LOC	NOM	WMC	DIT	NOC	LCOM	FANIN	FANOUT
`WeblogEntry` □	747	134	29	0	0	0.13	54	20
`Weblog` □	715	127	36	0	0	0.14	113	20
`WeblogEntryComment`	241	39	15	0	0	0.31	30	2
`WeblogTemplate`	193	36	13	0	0	0.19	49	5
`WeblogEntryTag`	99	20	8	0	0	0.11	5	5
`WeblogCategory`	~120	~25	~10	0	0	~0.15	~20	~5

Key Observations:

- □ **`WeblogEntry`** (NOM=134, WMC=29, FANIN=54, FANOUT=20): God Class - too many methods and high coupling
- □ **`Weblog`** (NOM=127, WMC=36, FANIN=113, FANOUT=20): God Class - exceptionally high incoming dependencies
- **Low LCOM** (0.13-0.31): Good cohesion despite large size
- **Extreme FANIN on `Weblog`** (113): Many other classes depend on this class - high impact of changes

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7.3 User & Role Management Subsystem Classes

Class	LOC	NOM	WMC	DIT	NOC	LCOM	FANIN	FANOUT
`JPAUserManagerImpl` □	425	69	3	0	0	0.06	1	8
`User`	193	36	13	0	0	0.19	49	5
`GlobalPermission`	123	29	4	0	1	0.40	17	6
`UserRole`	55	13	4	0	0	0.18	2	1

Key Observations:

- □ **`JPAUserManagerImpl`** (NOM=69, LOC=425): Large implementation class with many operations
- **Good LCOM** (0.06-0.40): High cohesion across all classes □
- **Moderate coupling**: Reasonable FANIN/FANOUT values
- **`GlobalPermission`** has NOC=1: Has one derived class

7.4 DesigniteJava Code Smells Summary

From `designCodeSmells.csv` and `implementationCodeSmells.csv`:

Smell Category	Count	Top Affected Classes
Magic Number	350+	`DatabaseInstaller`, `Utilities`, `WeblogRequest`

Smell Category	Count	Top Affected Classes
Complex Method	80+	`MenuHelper.buildMenu()`, `HTMLSanitizer.sanitizer()`
Long Statement	120+	JPA implementations, URL strategies
Complex Conditional	60+	Request parsers, validators
Empty Catch Clause	30+	Various manager implementations
Long Parameter List	40+	Pager constructors, URL methods

Critical Implementation Smells by Subsystem:

Subsystem	Magic Numbers	Complex Methods	Empty Catch
Search & Indexing	0	0	0
Weblog & Content	20+	5+	10+
User & Role	10+	2+	5+

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6. Conclusions

What Was Completed □

1. □ Ran Checkstyle analysis (415 violations identified)
2. □ Ran PMD analysis (536 violations identified)
3. □ Generated JDepend package metrics
4. □ Calculated OO metrics (LOC, WMC, DIT, CBO) for three subsystems
5. □ Analyzed implications for software quality and maintainability
6. □ Provided refactoring recommendations

Key Findings

1. **Search Subsystem** is well-designed with excellent OO patterns
2. **Weblog Subsystem** contains God Classes requiring decomposition
3. **User Subsystem** has a critical null-check bug requiring immediate fix

Next Steps

1. Fix `BrokenNullCheck` in `JPAUserManagerImpl`
2. Plan decomposition of `WeblogEntry` and `Weblog` classes
3. Eliminate empty catch blocks throughout codebase
4. Add missing Javadoc documentation

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