METRICS FOR ARCHITECTURAL SYNTHESIS AND EVALUATION – REQUIREMENTS AND COMPILATION BY VIEWPOINT

AN INDUSTRIAL EXPERIENCE REPORT

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Background/Context: Three Types of IT Architecting Activities


How do architectural metrics fit in?

Key:
- activity
- dataflow

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Exemplary Enterprise Information System – IT Architect’s View

Multi-Channel Order Management SOA in the Telecommunications Industry (in production since Q1/2005) [OOPSLA 2005]

- **Functional domain**
  - Order entry management
  - Two business processes: new customer, relocation
  - Main SOA drivers: deeper automation grade, share services between domains

- **Service design**
  - Top-down from requirement and bottom-up from existing wholesaler systems
  - Recurring architectural decisions:
    - Protocol choices
    - Transactionality
    - Security policies
    - Interface granularity

Reference: IBM, ECOWS 2007, OOPSLA 2005
SAM Use Cases

- Utilize Architecture Metrics (AMs) during architecture and design reviews
  - to define scope and to assess architectural fitness and adherence to/deviation from recommended practices.

- Indicate complexity and technical risk
  - e.g., to be used as input to effort estimations and project management

- Measure project progress
  - on a technical level (during architectural synthesis)

- Support architect during transition
  - from design-time quality attribute specifications to runtime Service Level Agreements (SLAs) and contracts (still in architectural synthesis)

- Benchmark architectures
  - in domain (business) context as a variant of architectural evaluation
Critical Success Factors (CSFs) for SAM

- **Expressivity and elicitation**
  - AMs should be able to support the five use cases effectively and efficiently.
  - Little extra effort to obtain them from software architecture documents and code.

- **Intuitivity**
  - AMs should be self-explanatory: both unit and unit of measurement as in physics must be defined, value ranges should be specified.
  - The AM semantics should be defined at least informally (e.g., by way of examples and counter examples).

- **Unambiguity**
  - AMs should be well defined and use viewpoint and component/connector terminology, e.g., from IEEE 42010, patterns books, a recognized design method, or from the literature about architectural styles.

- **Sensitivity**
  - Small changes in the architecture should not lead to radically different AM values.
  - AMs should not produce any surprising and misleading evaluation results.
<table>
<thead>
<tr>
<th>Viewpoint</th>
<th>Architectural Metric (AM)</th>
<th>Type (Unit of Measurement)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario Viewpoint</strong></td>
<td>Number and weight of use cases</td>
<td>Counter (1…1000)</td>
</tr>
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<td></td>
<td>Number of secondary actors (and cadence of external interface connections)</td>
<td>Counter and score</td>
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<tr>
<td></td>
<td>Specificity and measurability of NFR/quality attribute specifications</td>
<td>Binary score</td>
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<tr>
<td><strong>Logical Viewpoint</strong></td>
<td>Number of external interfaces and number of interface invocations</td>
<td>Counter</td>
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<td></td>
<td>Number of components and connector per component</td>
<td>Counter</td>
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<tr>
<td><strong>Development Viewpoint</strong></td>
<td>(out of scope of this report)</td>
<td>n/a</td>
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<tr>
<td><strong>Process Viewpoint</strong></td>
<td>Process Counter</td>
<td>Counter</td>
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<tr>
<td></td>
<td>Process Coordination Means</td>
<td>Index/Score</td>
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<td></td>
<td>Interprocess Communication (IPC) and Remote Call Counter</td>
<td>Counters</td>
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<td></td>
<td>Application State and User Session State</td>
<td>Size (Bytes)</td>
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<td></td>
<td>Workload Profile</td>
<td>Aggregated (Complex)</td>
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<td><strong>Physical Viewpoint</strong></td>
<td>Tier Counter</td>
<td>Counter (1…1000)</td>
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<td>Clustering Index</td>
<td>Index/Score</td>
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<tr>
<td><strong>Architectural Decision Viewpoint</strong></td>
<td>Number of architecture design problems solved</td>
<td>Counter (1…1000)</td>
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<td></td>
<td>Number of options considered per problem</td>
<td>Counter</td>
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<tr>
<td><strong>Information Viewpoint</strong></td>
<td>Data model size and structure (e.g., number of entities and entity relationships)</td>
<td>Index/Score</td>
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<tr>
<td></td>
<td>Transaction management profile, e.g. number of system transactions and their size/duration</td>
<td>Aggregated (Complex)</td>
</tr>
<tr>
<td><strong>Patterns Metrics</strong></td>
<td>E.g. number of layers, number of controllers in MVC pattern</td>
<td>Counter (1…1000)</td>
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<tr>
<td>(here: POSA, PoEAA, EIP books)</td>
<td>E.g. length and complexity of EIP integration flows</td>
<td>Index/Score</td>
</tr>
<tr>
<td><strong>Domain- and Style- Specific</strong></td>
<td>E.g. number of servlets, number of message channels</td>
<td>Counter (1…1000)</td>
</tr>
<tr>
<td>Metrics (JEE, SOA, MOM, RDB)</td>
<td>E.g. number of SQL tables, queries, foreign key relationships</td>
<td>Counter</td>
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</tbody>
</table>
Workshop Questions

- **What is your message?**
  - *Metrics matter – if collected and interpreted adequately (“operating range”)*

- **What issues are you facing?**
  - *So many architectural design issues and options (and related metrics), so little time (to compile and interpret the metrics)*

- **What question are you proposing for further discussion?**
  - **Context**
    - *Do we need context metrics?*
    - *Are the use cases and CSFs context-specific?*
    - *Do the metrics and their use change by application domain and software genre?*
  - **Roles and viewpoints**
    - *Do different architects need different metrics (e.g., enterprise architects)?*
    - *Which information to capture per metric?*
  - **Relationship to other specializations in SE**
    - *Why and how must architecture metrics be different from code metrics?*
The Context Octopus: Eight Dimensions

Discussion

- [How the paper made the discussant think differently about his or her own work]
- [Some advice for the authors in continuing their work]
- [Discussion questions based on the presented paper]