Criteria for the Evaluation of Implemented Architectures

Eric Bouwers, Joost Visser, Arie van Deursen
‘Architectures allow or preclude nearly all of the system’s quality attributes’

-- from `Evaluating Software Architectures`
by P. Clements, R. Kazman and M. Klein
Why evaluate implemented architectures?
Why evaluate implemented architectures?
Why do we want criteria for the evaluation?

Criteria for the Evaluation of Implemented Architectures
Literature reviews

A survey on software architecture analysis methods.

L. Dobrica and E. Niemelä.

A framework for classifying and comparing software architecture evaluation methods.

M. Babar, L. Zhu, and D. R. Jeffery
‘Technology transfer remains a major challenge. There is limited out of the box process and tool support for organizations that want to start reviews.’

‘Software Architecture Review: The state of Practice’ by M. Babar, I. Gorton

Criteria for the Evaluation of Implemented Architectures
A one-time investigation into software maintainability and related business risks

Criteria for the Evaluation of Implemented Architectures
Architectural properties

High Level Design:
- GUI
- Business Logic
- Data Access

Modularization:
- Saving
- Paying
- Stocks

Separation of Concerns:

if (hasPayed() && !isAdmin()) {
    showThankYou();
}

Business logic/Safety
Research questions

**Q1:** Which system attributes do experts take into account when evaluating architectural system properties?

**Q2:** How do these system attributes influence the architectural system properties?
Empirical study resources

Criteria for the Evaluation of Implemented Architectures
A selection of our clients

Financials
- ABN-AMRO
- PGGM
- ING
- Rabobank
- Achmea
- Friesland Bank
- LeasePlan
- Eurobank EFG
- Interpolis
- Bank Mendes Gans
- SNS Bank

Public
- Justitie
- Ministerie van Justitie
- Raad voor de Kinderbescherming
- Ministerie van Binnenlandse Zaken en Koninkrijksrelaties
- Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer
- Rijkswaterstaat
- Raad voor Rechtsbijstand
- Belastingdienst

Logistics
- DHL
- Getronics
- PinkRocade
- Centric
- PriceWaterhouseCoopers
- essent
- Capgemini
- Consulta

IT
- KLM
- TNT
- Europax
- Euronext
- Exact Software
- IBM
- KPMG
- NXP
- Gasunie
- Alcatel-Lucent
- Electrabel

Other
- Eneco
- energie
- ING
- Zorg en Zekerheid
- InterBank
- GENERALI vermogensgroep
- Poris
- Swedbank
- Sanoma
- BNP Paribas Fortis
Evaluated systems characteristics

Criteria for the Evaluation of Implemented Architectures
Empirical study design overview

- Create Attribute List
- Create Mapping to Properties
- Validate Attributes & Mapping

Criteria for the Evaluation of Implemented Architectures
For each report:

1) Check table with property ratings for arguments if this table does not exist use specific paragraphs

2) For all arguments found determine system attribute if the attribute is not on the list add system attribute to the list
For each report:

1) Extract arguments per property

2) For all arguments found
determine system attribute
add one to count of attribute for property
Experimental design (3/3)
Validation of Attributes and Mapping
Results of Empirical Study (1/3)

Create Attribute List

Create Mapping to Properties

Validate Attributes & Mapping

Criteria for the Evaluation of Implemented Architectures
15 System attributes

- Abstraction
- Layering
- Logic in Database
- Module Inconsistency
- Module Size
- Source Grouping
- Technology Combination
- Textual Duplication

- Functional Duplication
- Libraries / Frameworks Usage
- Module Dependencies
- Module Functionality
- Relation Documentation and Implementation
- Technology Age
- Technology Usage

Criteria for the Evaluation of Implemented Architectures
More details available in the paper

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Assessment Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Libraries / Frameworks</td>
<td>The usage of standard libraries and frameworks</td>
<td>Inspecting the list of imports and structure of the source- and build-files</td>
</tr>
<tr>
<td>Module Dependencies</td>
<td>The static dependencies (i.e. calls, includes) between modules</td>
<td>Inspecting the call-graph on module level, matching this against expected dependencies</td>
</tr>
</tbody>
</table>
Results of empirical study (2/3)

Create Attribute List

Create Mapping to Properties

Validate Attributes & Mapping

Criteria for the Evaluation of Implemented Architectures
## Attributes used for each property

<table>
<thead>
<tr>
<th></th>
<th>Module Dependencies</th>
<th>Module Functionality</th>
<th>Relation Doc. / Impl.</th>
<th>Functional Duplication</th>
<th>Technology Combination</th>
<th>Technology Age</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Level Design</strong></td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>13</td>
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<tr>
<td><strong>Modularization</strong></td>
<td>11</td>
<td>32</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Separation of Concerns</strong></td>
<td>6</td>
<td>13</td>
<td>0</td>
<td>18</td>
<td>0</td>
<td>0</td>
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<tr>
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<td></td>
<td>X</td>
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Criteria for the Evaluation of Implemented Architectures
Results of empirical study (3/3)

Create Attribute List

Create Mapping to Properties

Validate Attributes & Mapping

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<tr>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td><strong>High Level Design</strong></td>
</tr>
<tr>
<td>E1</td>
</tr>
<tr>
<td>E2</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
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<tr>
<td><strong>Modularization</strong></td>
</tr>
<tr>
<td>E1, E2</td>
</tr>
<tr>
<td>E2</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Separation of Concerns</strong></td>
</tr>
<tr>
<td>E1</td>
</tr>
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**Interview results**
Threats to validity

Representative data

Reliability of measurements

Generalization of the results
‘What is in it for me?’

-- you
Our contributions

• A description of an empirical study using over 40 reports

• The identification of 15 system attributes that have an impact on the maintainability of an architecture

• An analysis of the projection of the found system attributes onto three architectural system properties
Application of the results

Criteria for the Evaluation of Implemented Architectures
Future research opportunities

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Criteria for the Evaluation of Implemented Architectures

- A description of an empirical study using over 40 SRA reports
- The identification of 15 system attributes that have an impact on the maintainability of an implemented architecture
- An analysis of the projection of the found system attributes onto three architectural system properties

Feel free to contact me:
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