Planning & designing
Software architecture in real life
Outline

- Architecture and architectural drift
- Changes and architecture evolution
- Analyses of drift
- Visual exploration
Software Architecture

- “Architecture refers to the conceptual essence of an application, the principal decisions regarding its design, the key abstractions that allows one to characterize the application”

- Software architecture is the blueprint for a software system’s construction and evolution

  Taylor et al. 2009
A Cargo Routing app architecture
Fundamental Understandings

Every application has an architecture
Every application has at least one architect
Architecture is not a phase of development
Architectural drift

- **Architectural drift is the introduction of principal design decisions** into a system’s descriptive architecture that
  - (a) are not included in, encompassed by, or implied by the prescriptive architecture, but which
  - (b) do not violate any of the prescriptive architecture’s design decisions.
Change Analyses & Visualizations
Evolution

- Architecture and design
  - as-designed vs. as-implemented architecture
  - architectural drift
- Code base
  - Co-evolution of modules
  - Change coupling of classes, packages, etc.
- Bugs and Changes
  - Who should fix this bug?
  - How long will it take to fix this bug?
  - When do changes induce fixes?
- Project and Process
  - Project memory for software development
- Software Expertise
  - Identifying expertise from changes and bug reports
Co-evolution of software modules

Software Evolution Metrics

Fan-in
- invoke
- access

Class/module metrics
- files, directories,
- packages, ...
- global variables,
- NOM, NOA, ...

Fan-out
- invoke
- access

Change dependencies
- change couplings
- bugs, issues

Martin Pinzger, Harald C. Gall, Michael Fischer, and Michele Lanza, *Visualizing Multiple Evolution Metrics*  
Mozilla Evolution

Kiviat graph:
26 metrics
7 Mozilla modules
7 subsequent releases
The *gestalt* of Fractal Figures

![Fractal Figures](image)

Fractal Value = $1 - \sum_{a_i \in A} \left( \frac{nc(a_i)}{NC} \right)^2$, with $NC = \sum_{a_i \in A} nc(a_i)$

How many developers per entity?
How many bugs per entity?
Developer networks
Developer networks

- Conway’s law
- Inter-team collaboration
- Ownership changes
- Key personalities in social networks
  - connectors vs. communicators
  - gatekeepers, influencers, innovators, leaders and communicators as trendsetters
- Information for project manager vs. newcomer
Communication in Projects

Bugzilla Bug 55585
Project Description should allow silent setting of invalid Project Nature

Bug List: (This bug is not in your last search results) Show last search results Search Page Enter Bug ID

[ Eclipse] Bug#: 55585
Product: Platform
Component: Resources
Status: CLOSED
Resolution: FIXED
Assigned To: John Arthorne <john_arthorne@ca.ibm.com>

Hardware: PC
OS: Windows 2000
Version: 3.0
Priority: P3
Severity: normal
Target Milestone: 30 RC3

Reporter: Michael D. Elder <mdelder@us.ibm.com>

Description: [reply]

We have built a generic migration engine to ensure N-1 | N-2 compatibility with previous versions of our product which is built on Eclipse. To enable the seamless migration, we sometimes have to add natures and/or builders which are not actually valid in the current version (for backward compatibility, we add natures so that previous versions of the product will recognize them appropriately). When doing so, we are seeing exceptions. Is there a way to set the nature and explicitly allow the error? If not, we need this capability for the final release of Eclipse 3.0.

Comment #1 From John Arthorne 2004-03-22 15:43:19 [reply]

You see exceptions in the new version of the product or the old one? What kinds of exceptions are you seeing? The same thing that should happen when a builder is missing is an informational message in the log file once per session mentioned that a missing builder was encountered and skipped.

Comment #2 From John Arthorne 2004-03-25 13:48:05 [reply]

Closing - not enough info. Please reopen with more details.

Comment #3 From Michael D. Elder 2004-03-25 14:07:35 [reply]

We are using a 3.0 Integration build from early March (03/04).

We get the following exception when setting the Project Description using a nature ID that does not have a valid nature defined.

Comment #4 From Ed Houghton 2004-04-17 16:39:16 [reply]

+1 to fix for RC3.
Scenario: newcomer Kevin

(a) April 2004

(b) April 2004

(c) June 2004

(d) June 2004
Scenario: key person Rafael leaving

(a) April 2005

(b) July 2005

(c) July 2005

(d) November 2005
Scenario: distributed teams

Sub-Group @us.ibm.com

Sub-Group @ch.ibm.com
Evolizer

Our platform for harvesting and provisioning of software evolution data
Evolizer Platform

Harald C. Gall, Beat Fluri, Martin Pinzger, Change Analysis with Evolizer and ChangeDistiller, IEEE Software Vol. 26 (1), January/February 2009
Evolizer Tools

- **ChangeDistiller**: change types and significance
- **ArchView**: evolution metrics
- **SNA Cockpit**: developer networks
- **ChangeCommander (Recommender)**
- **CoCoViz**: Evolution Browser
Visual Exploration
Metaphors: Code City

Software Metrics as Glyphs

- A Shape has multiple visual representations
- A visual representation is mapped to one metric of a metric set
Cognitive architectural elements
Visual & Touch Interfaces
Ingredients for visual exploration

- Meaningful metric sets
- Cognitive metaphors
- Intuitive configuration
Conclusions
Visual Cognitive SwA Exploration