Exploring the Temporal Aspects of Software Architecture

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Keynote at ICSOFT 2016

Slides available at: http://www.slideshare.net/henry.muccini/
Exploring the Temporal Aspects of Software Architecture
Let us reason about the Gaudi’s Sagrada Familia
WHATSAPP

WHATSAPP WEB

Mantieni il telefono connesso

WhatsApp si collega al tuo telefono per sincronizzare i messaggi. Per ridurre l'utilizzo della connessione dati, collega il telefono tramite WiFi.
«Store and forward» mechanism for message exchange

no long term storage
Exploring the Temporal Aspects of Software Architecture
For WICSA 2016 the theme was “Architecting in time” – exploring the temporal aspects of software architecture.

continuity, evolution and decay,

the benefits, consequences and debt from delaying decisions,

architecting practices and experiences in different software development processes, or the related collaborative design activities that fit into the life cycles of systems and applications.
Two main dimensions

1. The software architecture field evolution over time
   - 1992 to today

2. Temporal aspects in software architecture design
   - Architecting
? How the Software Architecture field evolved over time?
We could travel over time...
... or, report information based on our own knowledge, pretending to know everything...
... a more systematic way to look at it...

The history of artifacts and works (decorations, wigs, scents) talk about the culture of that time. They are not only historical relics, but they speak about that time.

Val Parks: https://www.youtube.com/watch?v=LMJh1WTkxws
Goal

? How the Software Architecture field evolved over time?
The study (specifically conducted for this speech)
How to travel over time?

Mixed method used for this study:

1. Topics extraction:
   - Personal knowledge + Seminal papers
2. Data mining
   - From the WICSA, CBSE, ECSA, and QoSA conferences
   - From 1999 to 2016
3. Reasoning on the results
Mixed method used for this study:

1. **Topics extraction:**
   - Personal knowledge + Seminal papers

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   - From the CBSE, WICSA, ECSA, and QoSA conferences
   - From 1999 to 2016

3. Reasoning on the results
1. **Topics extraction (by experience)**

20 years of experience in the field

- WICSA 2016 PC co-chair
- ICSA steering committee member
- PC of WICSA, CBSE, ECSA (ICSE, FSE, ASE)
- Member of the IFIP WG 2.10 on Software Architecture

- Design Decisions
- Assessment
- Style
- CPS
- Agile
- SA Description
- ADLs
- Views
- SPL architectures
- DevOps
1. Topics extraction (by reference papers)


Foundations for the Study of Software Architecture

Dewayne E. Perry
AT&T Bell Laboratories
600 Mountain Avenue
Murray Hill, New Jersey 07974
dep@research.att.com

Alexander L. Wolf
Department of Computer Science
University of Colorado
Boulder, Colorado 80309
awl@cc.colorado.edu


An Introduction to Software Architecture

David Garlan and Mary Shaw
January 1994
CMU-CS-94-188

Software Architecture: A Roadmap

Software Architecture: A Travelogue

David Garlan
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213 USA
garlan@cs.cmu.edu

Lightweight and Flexible Emerging Trends in Software Architecture from the SATURN Conferences

Michael Keeling

The Past, Present, and Future of Software Architecture

Philippe Kruchten, University of British Columbia
Henk Obbink, Philips Research Europe
Judith Stafford, Tufts University

IEEE SW
Vote at: goo.gl/Gje2zE

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   - From 1999 to 2016

3. Reasoning on the results
Data Mining from WICSA, CompArch, ECSA

CBSE 2003-2016

WICSA’99 San Antonio
WICSA’00 Montreal
WICSA’01 Amsterdam
WICSA’02 Montreal
WICSA’04 Oslo
WICSA’05 Pittsburgh
WICSA’07 Mumbai
WICSA’08 Vancouver
CompArch’07 Medford
CompArch’08 Karlsruhe
CompArch’10 Prague
CompArch’08 Boulder
CompArch’12 Bertinoro
CompArch’14 Lille
WICSA&ECSA’09 Cambridge
WICSA&ECSA’09 E. Stroudsburg
ECSA’11 British Columbia
ECSA’13 Lille
ECSA’14 Sydney
WICSA&ECSA’12 Helsinki
ECSA’10
CompArch’12 Bertinoro
WICSA&ECSA’14 Venice
CompArch’14 Lille
CompArch’13 E. Stroudsburg
ECSA’15
CompArch’15 Montreal
WICSA&CompArch’16 Venice
ECSA’16

2 Data mining... in numbers

What: 4 conferences, 42 editions, 1999-2016, 811 articles analysed

How: topics search

- Search of topics and synonyms in
  - Title
  - Keyword
  - Abstract
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If Title contains the keyword, paper highly ranked with respect to the keyword

If Keyword/abstract contains the keyword, ...

If synonym contains the keyword, ...

SUM

Max

(1*0.8);(1*0.5)

Max

(0*0.8);(0*0.5)
Tests

This approximation formula has been tested on:

- 50 papers

- Two topics:
  - Ecosystems
  - Design Decisions
Disclaimer...

The results presented here are preliminary and partial, with respect to the...

*25 Years of Software Architecture: impact on the Software discipline*
Want to know more about this work? Leave a comment at www.henrymuccini.com
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3. Reasoning on the results
3 Results and Reasoning

- **Style:** % of papers
- **View:** % of papers
- **Analysis:** % of papers
- **Design Decisions:** % of papers
- **Product Line:** % of papers
- **Agility:** % of papers
- **DevOps:** % of papers
- **Technical Debt:** % of papers
- **CPS:** % of papers
Disclaimer

- Topics Granularity (look at the trend!)
- «Only» four (domain-specific) conferences
- 2016 is incomplete! (ECSA 2016 missing)
OVERALL VIEW ON RESULTS
Overall View on Results: # of publications per year

Publications (WICSA/CBSE/QoSA/ECSA) 1999-2016*

---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---
17 | 18 | 11 | 17 | 44 | 49 | 52 | 71 | 88 | 49 | 56 | 76 | 60 | 74 |
Overall View on Results: Most published topics?

- Quality
- Assessment
- Style
- Product Line Architecture
- Design Decisions
- Languages
- Architecture Description
- Analysis
- Views
- Risks
Vote at: goo.gl/Gje2zE

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or
Open poll in your web browser
Overall View on Results: Most published topics (1/3)

Top five:

1. Analysis (194)
   - Performance (96)
   - Security (27)
   - Consistency (24)
2. Design Decisions (127)
3. Quality (104)
4. Style (68)
5. Views (67)

(TOT=811 papers)
# of papers on a topic

- TOTAL
- Analysis
- Design Decisions
- Quality
- Style
- View

YEAR 1999: 4, 3, 1, 11, 3, 2, 8, 10, 11, 1, 11, 1, 12, 19, 15, 16, 15, 9, 6, 1, 3, 1
YEAR 2000: 17, 18, 11, 17, 14, 33, 10, 8, 10, 12, 77, 11, 44, 49, 52, 52, 71, 19, 9, 8, 3
YEAR 2001: 1, 1, 1, 2, 0, 21, 34, 6, 55, 11, 44, 33, 88, 88, 42, 49, 4, 15, 4, 16, 6
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YEAR 2013: 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1
YEAR 2015: 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6
YEAR 2016: 56, 56, 56, 56, 56, 56, 56, 56, 56, 56, 56, 56, 56, 56, 56, 56, 56, 56, 56

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# of papers on Top5 topics (without repetition)
Overall View on Results: Most published topics (2/3)

Security vs Performance vs Analysis

- Security
- Performance
- Analysis (general)

Design Decisions: % of papers

Quality: % of papers

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Overall View on Results: Most published topics (3/3)

Security vs Performance vs Analysis

View: % of papers

Style: % of papers
Overall View on Results: Trends 1999-2016 (down-up)

Style: % of papers

Product Line: % of papers

Design Decisions: % of papers

Quality: % of papers

Analysis: % of papers
Overall View on Results: Trends 1999-2016

View: % of papers

Reference Architecture: % of papers

{much less than expected}

Cost Estimation: % of papers

{pick 6% in 2016}
Overall View on Results: Trends 1999-2016 (emerging)

- **Agile** [0% -> 3%] {emerging since 2009}
- **DevOps** [0.5% -2%] {emerging since 2011}
- **Tech Debt** [0% - 2%] {emerging since 2012}
- **CPS** [0% - 2%] {emerging since 2012} (pick 4% in 2016)
- **Ecosystems** [0% -2%] {emerging since 2012} (pick 5% in 2016)
- **Risk** [0% -> 3%] (non null since 2005)
Overall View on Results: Trends 2010-2016

- **Style:** % of papers 2010-2016
- **View:** % of papers 2010-2016
- **Analysis:** % of papers 2010-2016
- **Design Decisions:** % of papers 2010-2016
- **Quality:** % of papers 2010-2016
Overall View on Results: Trends 2010-2016 (emerging)

Agility: % of papers 2010-2016

Technical Debt: % of papers 2010-2016

EcoSys: % of papers 2010-2016

CPS: % of papers 2010-2016
? How the Software Architecture field evolved over time?

REFLECTIONS
looking at the near future from the past

1992 today
Where we are today...

application domains: CPS, IoT, Smart mobile systems

type of (concern): Self-Adaptive, autonomous, dynamic, uncertain

process: DevOps & Agile

style: micro services

analysis: security, resilience

description: collaborative, MDE, decisions
Reflections

- Multi-View boom: trends and issues
- Practitioners’ need for SA-based Analysis
- It is time to «collaborate»!
- CPS, IoT, Smart Systems: again from Software to System
- From dependable to resilient systems in the era of self-Adaptive and Autonomous architectures
Multi-View Boom!

An industrial practice, being consolidated over 15 years!
But still...
Multi-View & Multi-stakeholder

IEEE Std 1471 (2000) ->

Multi-view consistency: missing feature

Using multiple views has become standard practice in industry!! [TSE2013]

- 85% uses multiple views
Analysis is a big need... and practiced... but practitioners are quite unhappy!
Practitioners’ needs for Analysis [TSE2013]

Architectural Languages: Type of needs

Kind of analyzed properties

- Extra-functional properties (48%)
- Functional properties (24%)
- HW/SW integration (12%)
- Behavior (8%)
- No info (4%)

Level of satisfaction

- Satisfied (35%)
- Neutral (20%)
- Not satisfied (45%)

Dissatisfaction with ALs
It is time to «collaborate»!

Architecting = Group Decision Making and Collaborative Architectural Design
Collaborative Design

- 5-10 people involved in decision making
  - 21 different macro-roles represented

Issues experienced in GD

Need:
- Collaborative (group) decision making
- Collaborative Design
CPS, IoT, Smart Systems: From Software to System Architecture

New views, new challenges
CPS, IoT, SmartS

Need:
- Sensors and Actuators
- New Modelling Languages
- Control theory
- Physical components

[SANCS2015]
From dependable to resilient systems in the era of self-Adaptive and Autonomous architectures

Self-Adaptive applications shall self-fix themselves?
Concluding

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Keep in touch...

www.henrymuccini.com

http://mobilesoftconf.org/2017/

www.softwarearchitecture.org

MOBILESoft 2017

4th IEEE/ACM International Conference on Mobile Software Engineering and Systems

Welcome to MobileSoft 2017

We are working on an exciting set of calls and tracks for the 2017 edition. Other than the Technical papers, Technical Briefings, and Tool Demo tracks, we will run a Future of Mobile Software Engineering track, as well as New Ideas. Much more is being planned, and we want the entire MobileSoft community to contribute to some of the decisions (e.g., selecting the new logo). For this purpose, please register to the all new MOBILESoft Facebook Group

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Henry Muccini, University of L’Aquila, Italy

Program Committee Co-Chairs

John Grundy, Deakin University, Melbourne, Australia

William G.J. Halfond, University of Southern California, USA
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