Status of IT Architecting: Progression or Regression?

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Abstract

Today’s IT capabilities are seemingly limitless. From the point of view of last century we have amazing functionality available to consumers, businesses, governments et cetera. Technology advances have made this possible. At the same time we suffer from unwanted, unexpected incidents, ranging from slow or no response to loss or theft of sensitive data. The growth of systems and its complexity play a role. We will look at the role of the human creators of these systems and the available technology to discuss our concurrent progression and regression, and we will look at the role of the architect in particular.
Functionality is Limitless

consumers

businesses
government

financial transactions
anywhere, anytime
financial infrastructure

financial institutes
But Problems seem to be Pervasive

slow response, outages, human-less helpdesks, silly excuses (the computer could not...), identity-theft, lost privacy

financial infrastructure

financial institutes

"entrepreneurial" employees

financial transactions anywhere

employees

consumers

businesses

government

... late delivery of new products, poor scaling of new services, interference of features, ...

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Do we Gain or do we Lose?

desired properties
functionality
performance

not desired
failures
threats

---time---

green line: progression
red dashed line: regression

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PRSITquestion
question gain or lose?

role of architect

example

webshop application

performance

technology

solution? reference architecture

reflection on size and complexity

analysis

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Example, Case Webshop

Up-to-date information:
Bestsellers
What Other Customers Are Looking At Right Now

catalogue entries

main access through search

personalization

styling: frequently updated, fashion!

other advertizements

standard boilerplate

snapshot of www.amazon.com
Some Numbers: New Books per Year

**new books per year**

<table>
<thead>
<tr>
<th>Country</th>
<th>UK (1)</th>
<th>USA (2)</th>
<th>China (3)</th>
<th>India (21)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12k (1996)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: [http://en.wikipedia.org/wiki/Books_published_per_country_per_year](http://en.wikipedia.org/wiki/Books_published_per_country_per_year)

**Amazon "long tail"**

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## Hierarchy of Storage Technology

### Figures of Merit

<table>
<thead>
<tr>
<th>Technology</th>
<th>Latency</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor cache</td>
<td>sub ns</td>
<td>n kB</td>
</tr>
<tr>
<td>L1 cache</td>
<td>ns</td>
<td>n MB</td>
</tr>
<tr>
<td>L2 cache</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L3 cache</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast volatile</td>
<td>tens ns</td>
<td>n GB</td>
</tr>
<tr>
<td>Main memory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent</td>
<td>ms</td>
<td>n*100 GB</td>
</tr>
<tr>
<td>Disks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk arrays</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk farms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archival</td>
<td>&gt;s</td>
<td>n PB</td>
</tr>
<tr>
<td>Robotized optical media tape</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Performance as Function of Data Set Size

random data processing performance in ops/s

data set size in bytes

L1 cache
L3 cache
main memory
hard disk
disk farm
robotized media

10^3 10^6 10^9 10^{12} 10^{15}

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MAFTstoragePerformance
## Communication Technology: Figures of Merit

<table>
<thead>
<tr>
<th>Latency</th>
<th>Frequency</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCB level</td>
<td><strong>connection</strong></td>
<td>sub ns</td>
</tr>
<tr>
<td></td>
<td><strong>network</strong></td>
<td>n ns</td>
</tr>
<tr>
<td>Serial I/O</td>
<td>tens ns</td>
<td>n 100MHz</td>
</tr>
<tr>
<td>network</td>
<td><strong>LAN</strong></td>
<td>n ms</td>
</tr>
<tr>
<td></td>
<td><strong>WAN</strong></td>
<td>n 10ms</td>
</tr>
</tbody>
</table>
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Example Web Shop

- **Server:**
  - Client
  - Web server
  - Database
  - Product descriptions
  - Logistics ERP

- **Network:**
  - Consumer
    - Browse products
    - Order
    - Pay
    - Track
  - Enterprise
    - Logistics
    - Customer relations
  - Customer relation management
  - Update catalogue
  - Advertise
  - After sales support

- **Status of IT Architecting:**
  - Progression or Regression?

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Impact of Picture Cache

Fast response leads to less load and less server costs, enhancing the performance of the system.

- Screen
- Client
- Network
- Mid office server
- Back office server
- Product descriptions
- Logistics ERP
- Financial
- Customer relations

The picture cache improves the response time and reduces server costs.
Multiple Layers of Caching

<table>
<thead>
<tr>
<th>Cache Type</th>
<th>Cache Miss Penalty</th>
<th>Cache Hit Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Cache</td>
<td>1 s</td>
<td>10 ms</td>
</tr>
<tr>
<td>Network Layer Cache</td>
<td>100 ms</td>
<td>1 ms</td>
</tr>
<tr>
<td>File Cache</td>
<td>10 ms</td>
<td>10 µs</td>
</tr>
<tr>
<td>Virtual Memory</td>
<td>1 ms</td>
<td>100 ns</td>
</tr>
<tr>
<td>Memory Caches L1, L2, L3</td>
<td>100 ns</td>
<td>1 ns</td>
</tr>
</tbody>
</table>

Typical cache 2 orders of magnitude faster
Why Caching?

- **project risk**
- **performance**
- **response time**
- **life cycle**
- **cost**

- **long latency**
  - mass storage
  - communication

- **overhead**
  - communication

- **resource intensive**
  - processing

- **limit storage needs to fit**
  - in fast local storage

- **frequently used subset**

- **design parameters**
  - caching algorithm
  - storage location
  - cache size
  - chunk size
  - format

- **low latency**

- **less communication**

- **latency penalty once**
  - overhead once

- **processing once**

- **in (pre)processed format**

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MAFTwhyCaching
Risks of Caching

- Frequently used subset
- Fast storage
- Local storage
- Larger chunks
- In (pre)processed format

- Robustness for application changes
- Ability to benefit from technology improvements
- Robustness for changing context (e.g., scalability)
- Robustness for concurrent applications
- Failure modes in exceptional user space

Life cycle:
- Cost
- Effort

Project risk:
- Cost
- Effort
- Performance

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PRSITlogoSize

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Level of Abstraction Single System

- static system definition
- monodisciplinary
- number of details
- system requirements
- multidisciplinary design
- static system definition
- monodisciplinary
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RAPdiabolo
Number of Details in Today’s Services

- Parts, connections, lines of code
- Multi-disciplinary design
- Systems
- Processes
- Stakeholders
- Enterprise
- Enterprises
- Society

Number of Details:
- 10^12
- 10^9
- 10^6
- 10^3
- 10^0
- 10^{-3}
- 10^{-6}
- 10^{-9}
- 10^{-12}

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PRSITdiabolo
Reference Architecture

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Reference Architecture as Solution?

- Reference architecture
- Some context details are essential
- Some technical details are essential

Diagram:

- Parts, connections, lines of code
- Multi-disciplinary design
- Systems
- Processes
- Stakeholders
- Enterprises
- Society

Number of details:

- $10^{12}$
- $10^9$
- $10^6$
- $10^3$
- $10^0$
- $10^3$
- $10^6$
- $10^9$
- $10^{12}$
1.1 One of several prerequisites for architecture creative synthesis is the definition of *5-7 specific key drivers* that are critical for success, along with the rationale behind the selection of these items.

2.1. The essence of a system can be captured in about *10 models/views*.

2.2. A *diversity* of architecture descriptions and models is needed: languages, schemata and the degree of formalism.

2.3. The level of *formality* increases as we move closer to the implementation level.

from http://www.architectingforum.org/bestpractices.shtml
Possible useful visualizations

actual figures and references to their use at http://www.gaudisite.nl/figures/<name>.html
Ideal Structure does not exist

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OHTstructure
Synthesis, Integration, Relation oriented

1. Functional Decomposition

2. Construction Decomposition

3. Allocation

4. Infrastructure

5. Choice of integrating concepts

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Checklist for RA content

customer context
- business
- financials
- stakeholders
- benefits, concerns
- concept of operations

technical architecture
- key performance parameters
- product features, functions
- business model
- life cycle
- stakeholders
- benefits, concerns

relations guidance
- core technologies
- critical resources
- design issues
- dominant patterns
Role of Architect

- Question: gain or lose?
- Role of architect
- Analysis
  - Example
    - Webshop application
    - Performance
    - Technology
  - Solution?
    - Reference architecture
  - Reflection on size and complexity

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Responsibilities

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LWAstakeholdersArchitecture

Stakeholders

- Customer
  - being informed
  - functionality
  - performance
  - timely available
  - acceptable cost

- Suppliers
  - implementation
  - decoupling
  - solution freedom

- Business manager
  - bottomline
  - future growth

- Engineers
  - guidance
  - understandability
  - accessibility
  - product feasibility

- Feedback Responsiveness
- Open
- Solution Freedom
- Communicable
- Evolution

Architecture
Gain or Lose?

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Conclusion
**Loss Scenario**

- **desired properties**
  - functionality
  - performance

- **not desired**
  - failures
  - threats

**progression**
- complexity
- size
- tech capabilities

**regression**
- understanding
- overview

- = architecting skills

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**Gain Scenario**

Diagram showing the progression and regression over time of desired properties such as functionality and performance, and not desired properties such as failures and threats. The graph illustrates the increase in complexity, size, technology capabilities, and architecting skills over time, leading to an increase in understanding and overview.

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PRSITgainScenario
We need to improve architecting skills to gain.
http://www.gaudisite.nl/
Reference Architecture Primer
Webshop case is part of System Modeling and Analysis
http://www.gaudisite.nl/SystemModelingAndAnalysisBook.pdf
All about Architecting: System Architecting