THE ATLARGE VISION ON THE

DESIGN OF DISTRIBUTED SYSTEMS AND ECOSYSTEMS

bit.ly/AtLargeDesign1Talk

bit.ly/AtLargeDesign1Article

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Prof. dr. ir.
Alexandru
Iosup
& Team
AtLarge

@Large Research
Massivizing Computer Systems

http://atlarge.science

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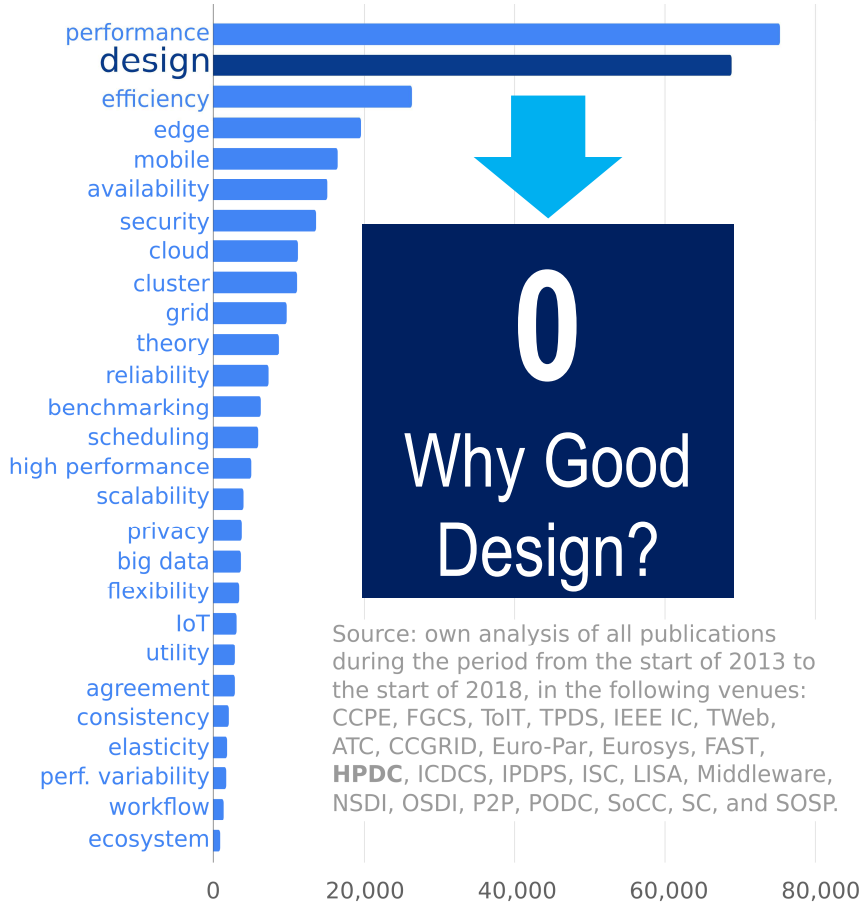
THE DESIGN OF DISTRIBUTED SYSTEMS AND ECOSYSTEMS



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Why Good Design?

Source: own analysis of all publications during the period from the start of 2013 to the start of 2018, in the following venues: CCPE, FGCS, ToIT, TPDS, IEEE IC, TWeb, ATC, CCGRID, Euro-Par, Eurosys, FAST, **HPDC**, ICDCS, IPDPS, ISC, LISA, Middleware, NSDI, OSDI, P2P, PODC, SoCC, SC, and SOSP.

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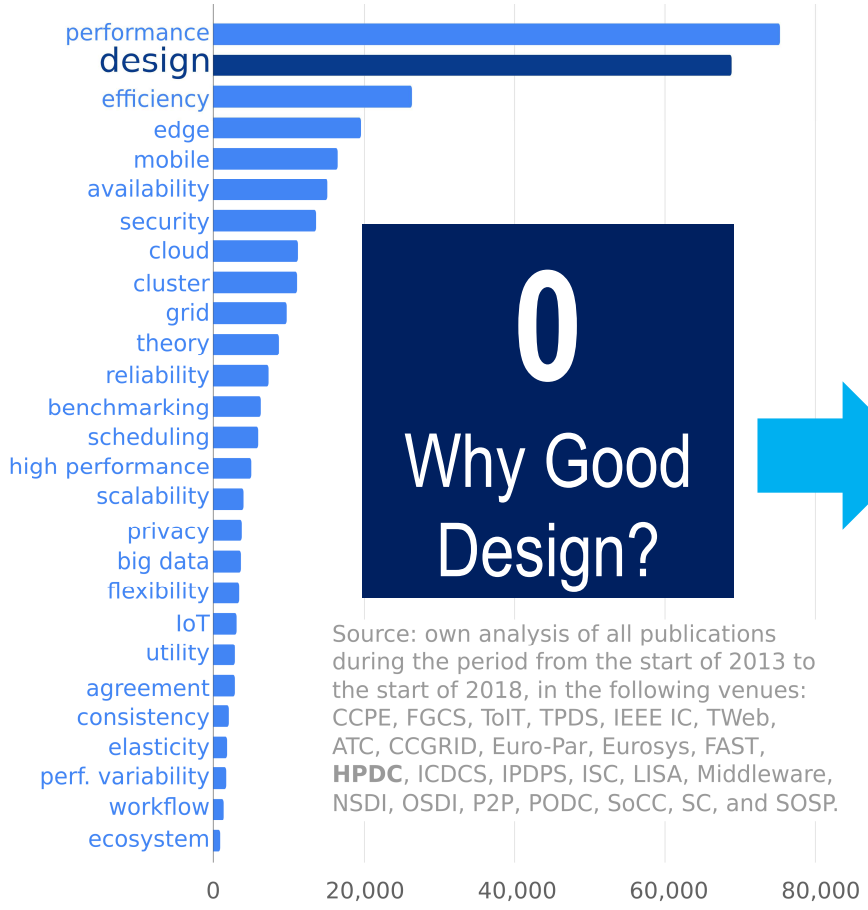

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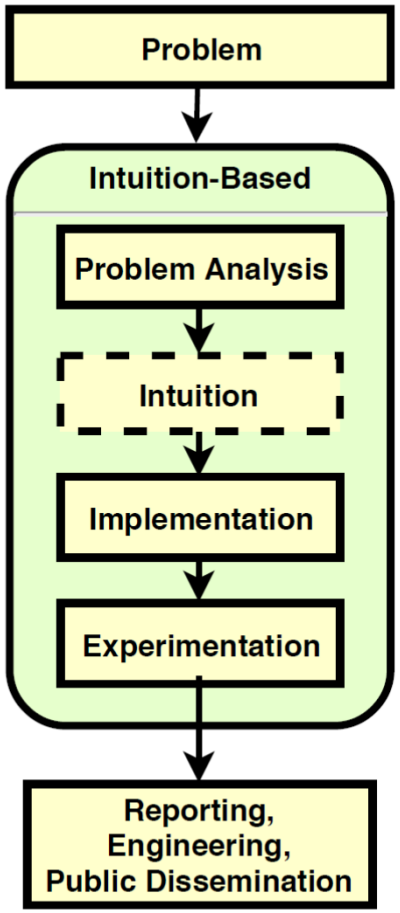

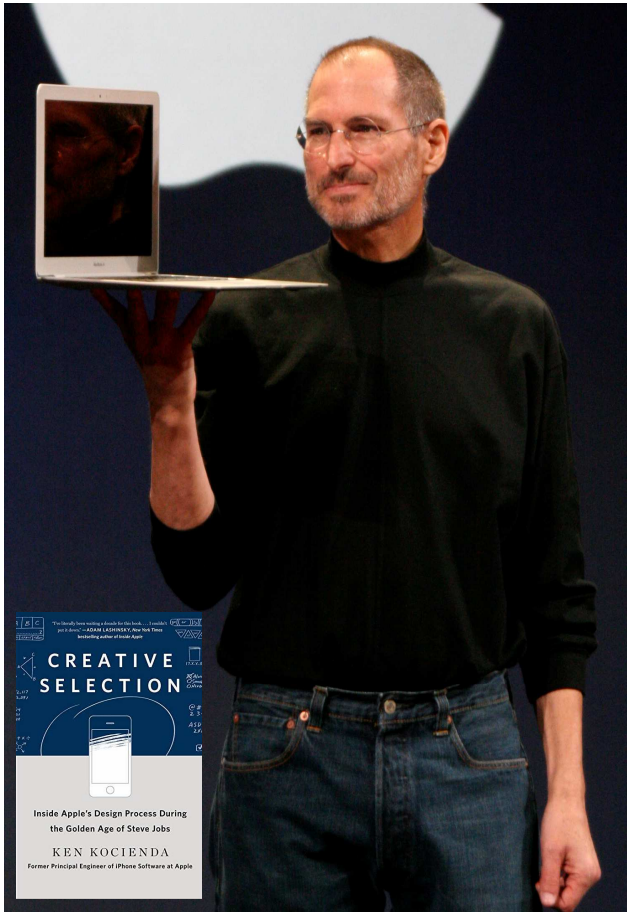

Photo by Matthew Yohe, 2008.

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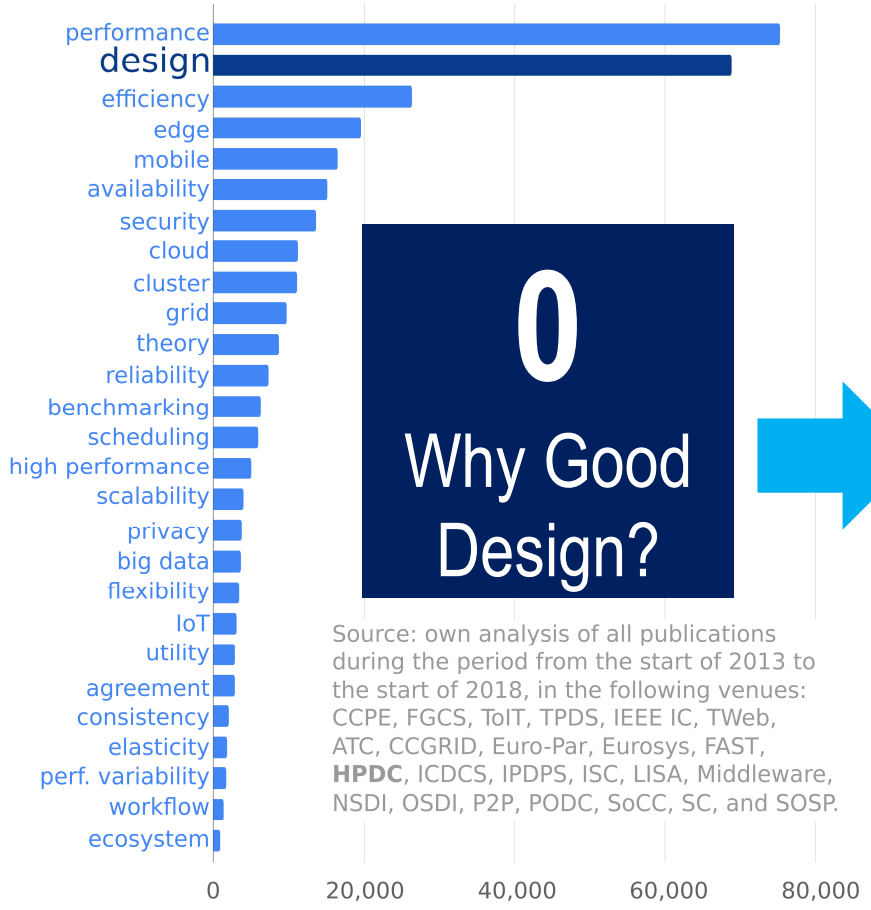

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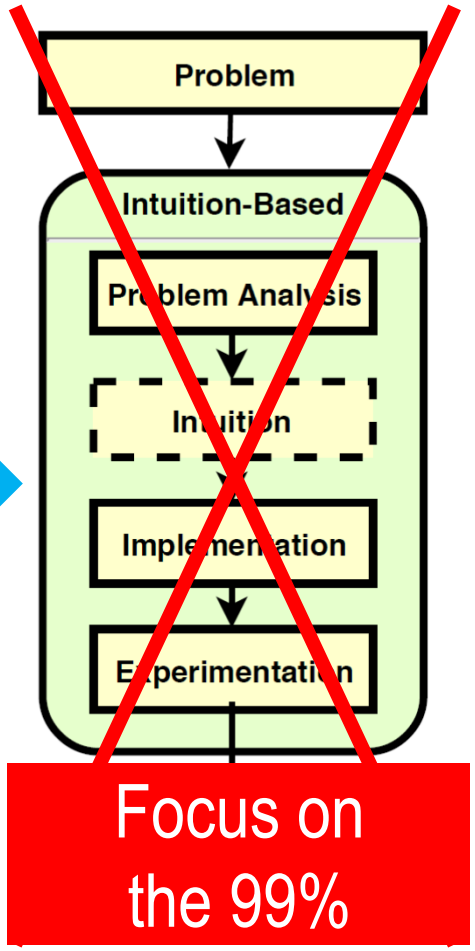

Focus on the 99%

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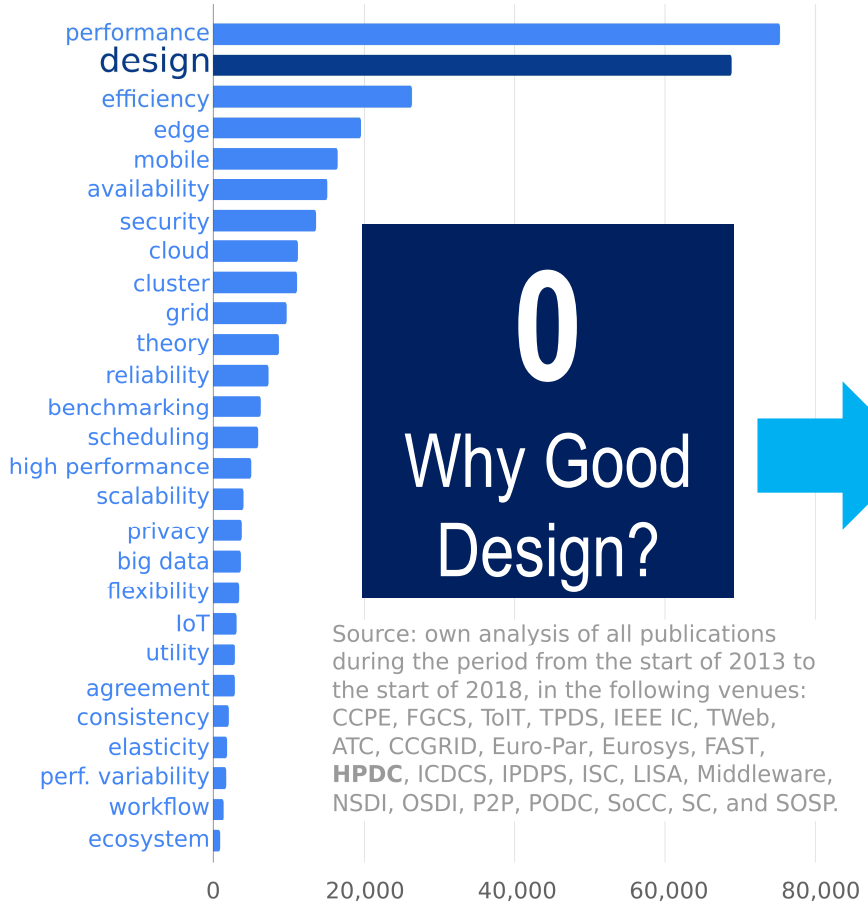

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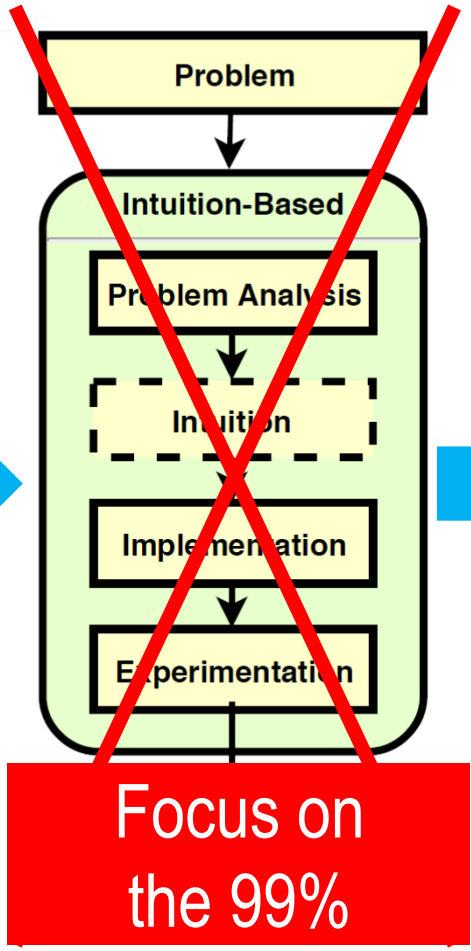


Focus on the 99%

1
Vision

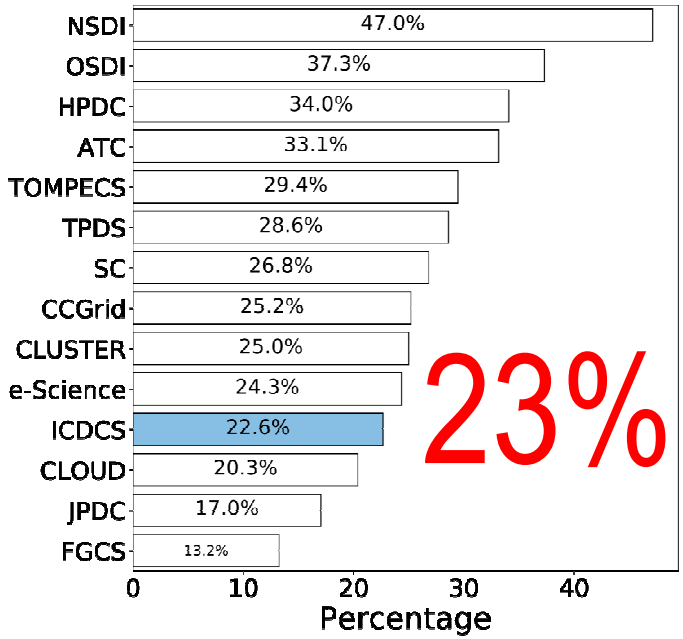
3
Design

2
At Large

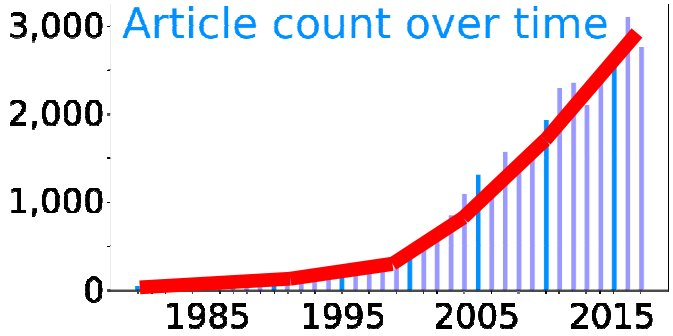
4
Future Work

THE NEED FOR GOOD DESIGN IS GROWING

Highest Demand Ever



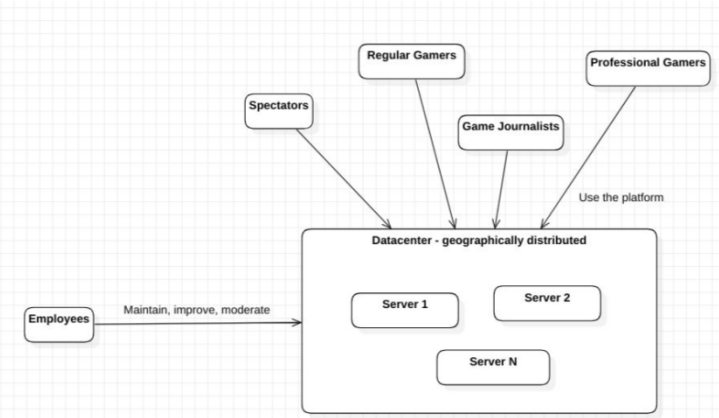
Already large fraction of all published articles



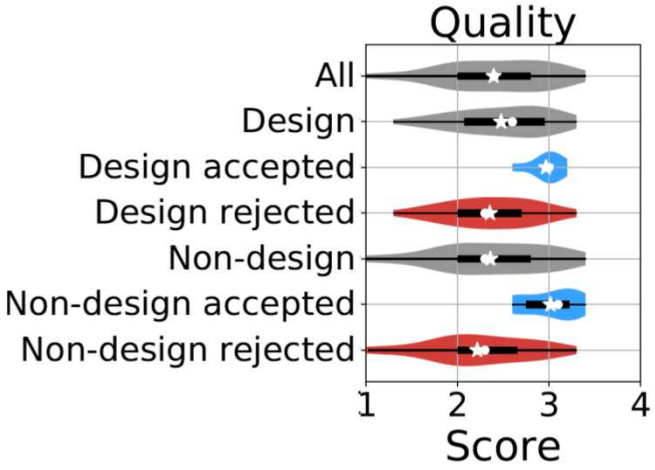
Increasingly more design articles

THE NEED FOR GOOD DESIGN IS GROWING

Offer Seems Insufficient (in Quality)



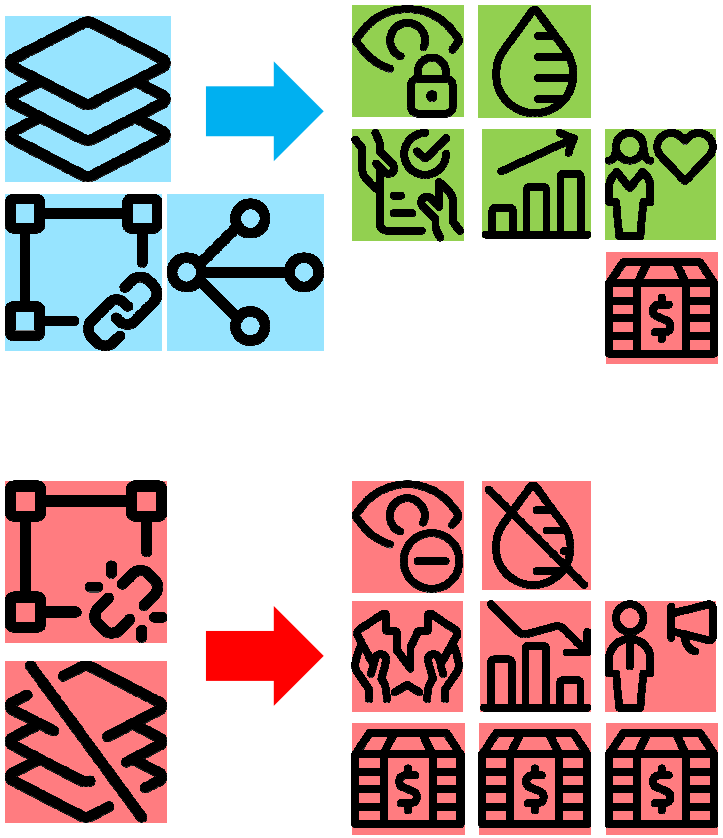
Students need guidance



… but also … Professionals need guidance

THE NEED FOR GOOD DESIGN IS GROWING

Poor Design Quality Is Costly



Lackluster design is costly

+

Bad design can be catastrophic

THE NEED FOR GOOD DESIGN IS GROWING

High Demand

Insufficient Offer

Too Costly to Not Get it Right

THE ATLARGE VISION OF ECOSYSTEM DESIGN

Our Vision = Good Design by Design

What Is Design?

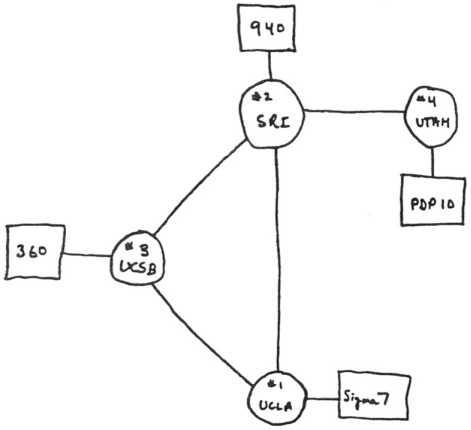
THE ATLARGE VISION OF ECOSYSTEM DESIGN

Our Vision = Good Design by Design

Design

=

intentional solution of a problem,
by the creation of
reasonable plans for
a new solution



THE ARPA NETWORK

DEC 1969

4 NODES

Source: IEEE Annals Hist. Comp.

THE ATLARGE VISION OF ECOSYSTEM DESIGN

Our Vision = Good Design by Design

Design

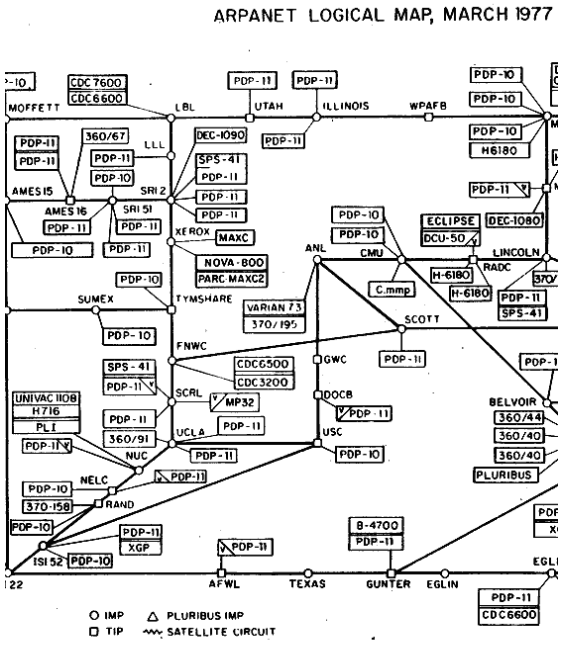
=

intentional solution of a problem, by the creation of reasonable plans for a new solution

Pragmatic design

=

design implemented and validated for production-like s[illegible]s



Source: The Computer History Museum.

THE ATLARGE VISION OF ECOSYSTEM DESIGN

Our Vision = Good Design by Design

Design
=
intentional solution of a problem, by the creation of reasonable plans for a new solution

Pragmatic design
=
implemented and validated for production-like settings

Innovative design
=
the solution is new for everyone

THE ATLARGE FRAMEWORK FOR (ECO)SYSTEM DESIGN

Design as Activity

Co-Evolving Problem-Solutions

Design Process to
Find and Solve Problems
→
Pragmatic and Innovative Designs

Design Principles for Distributed Systems and Ecosystems

15 Years of System-Design Experience

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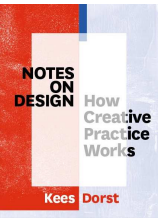

DESIGN IN ACTION: A SEPARATE ACTIVITY

Reasoning	**What?** (concepts, objects, people)	+	**How?** (relationship, law, pattern)	→	**Outcome** (observed phenomenon)
Deduction (Popper on science)	**What?**	+	**How?**	→	**???**
Induction (scientific method)	**What?**	+	**???**	→	**Outcome**
Abduction (problem solving)	**???**	+	**How?**	→	**Outcome**
Abduction (design)	**???**	+	**???**	→	**Outcome**
Unreasoning (facts don't matter)	**???**	+	**???**	→	**???**

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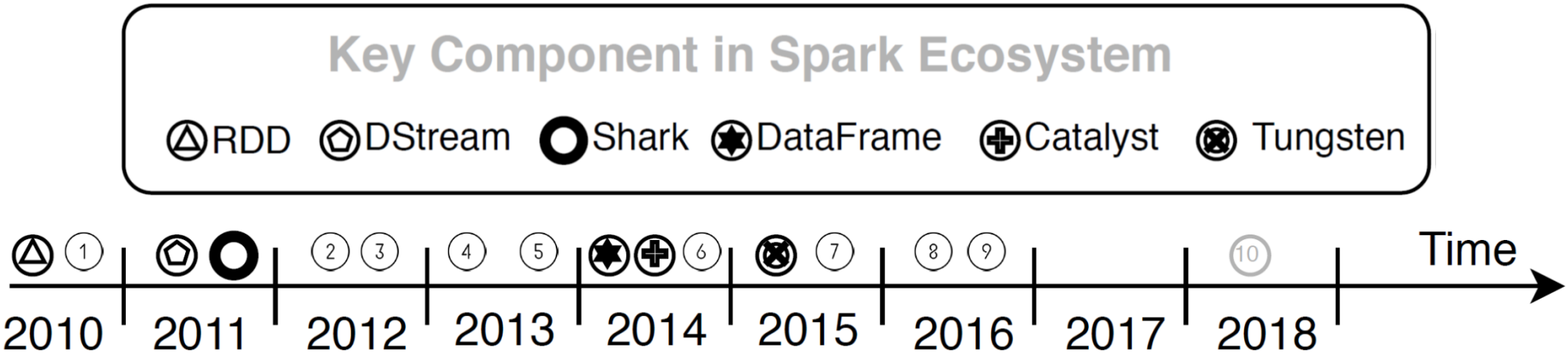
DESIGN IN ACTION: HOW TO EXPLORE THE DESIGN SPACE?

A Concrete Example: Spark

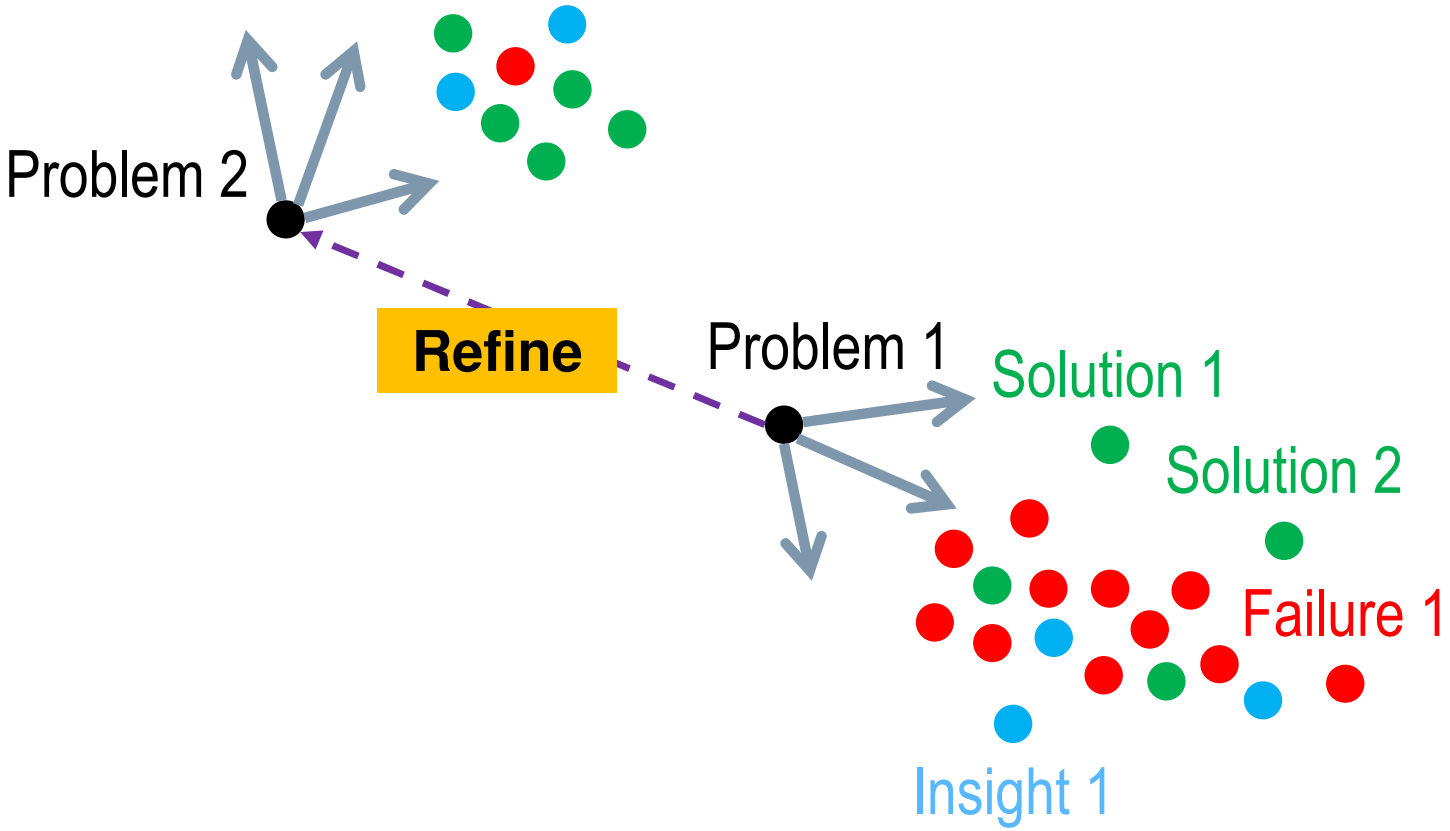


10 Key Scientific Publications

1. Spark - HotCloud
2. RDD - NSDI
3. Discretized Streams - HotCloud
4. Discretized Streams - SOSP
5. Shark (SQL on Spark) - SIGMOD
6. GraphX - OSDI
7. Spark SQL - SIGMOD
8. MLlib (ML on Spark) - JMLR
9. SparkR - SIGMOD
10. Structured Streaming - SIGMOD

DESIGN IN ACTION: HOW TO EXPLORE THE DESIGN SPACE?

An Abstract Example



DESIGN IN ACTION: HOW TO EXPLORE THE DESIGN SPACE?

Reasoning	What? (concepts, objects, people)	+	How? (relationship, law, pattern)	→	Outcome (observed phenomenon)
Free (Pure Exploration)	???	+	???	→	Outcome
Fix the What (iterative, basic cycles)	???	+	???	→	Outcome
			(Tech) Limits		
Fix the How (iterative, basic cycles)	???	+	???	→	Outcome
					Frame
Co-evolving (iterative, advanced cycles) (tech limits, frame apply)	???	+	???	→	Outcome
					Refine

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THE ATLARGE DESIGN PROCESS: PROBLEM-SOLUTIONS

Design Process to Find Problems

Design Process to Solve Problems

THE ATLARGE DESIGN PROCESS: PROBLEM-SOLUTIONS

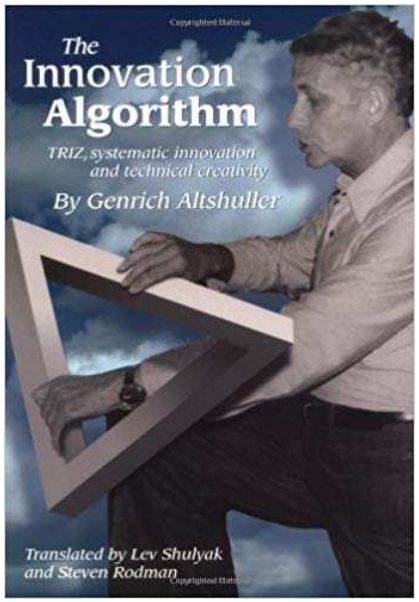
Process to Find Problems

+ Iterative
+ Comprehensive surveys,
  ~ Morphological analysis
+ Simple approaches
+ Complex approaches, ~TRIZ

[see article]

Fritz Zwicky

http://www.zwicky-stiftung.ch/



Genrikh S. Altshuller

Book on Amazon.

THE ATLARGE DESIGN PROCESS: PROBLEM-SOLUTIONS

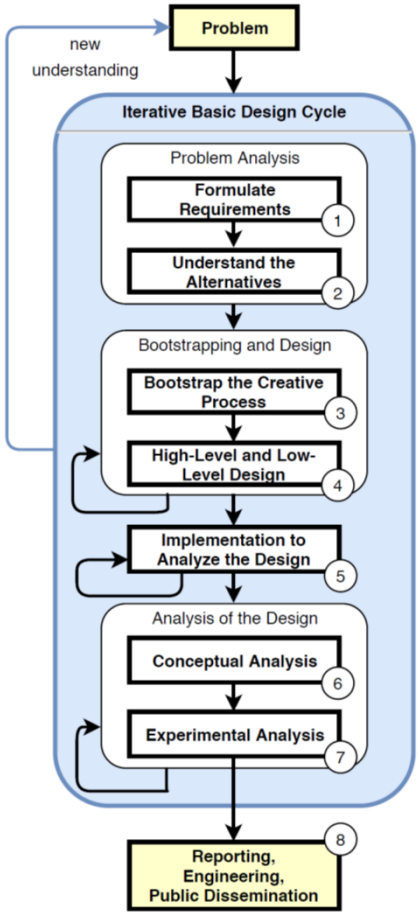
Process to Find Problems

+ Iterative
+ Comprehensive surveys
+ Simple approaches
+ Complex approaches

[see article]

Solving =

+ Innovation first
+ Iterative
+ Bootstrapping
+ High-Level
+ Detailed
+ Analysis



THE ATLARGE DESIGN PROCESS: PRINCIPLES

Highest Principle

Design processes foster good design.

Systems Principles

e.g., Design for ecosystems, not single systems.

Peopleware Principles

e.g., Design education for competence, integrity.

Method. Principles

e.g., A science, culture, and practice of design.

THE ATLARGE DESIGN PROCESS: CHALLENGES

Highest Principle

Design processes foster good design.

How to show?

Systems Principles

e.g., Design for ecosystems, not single systems.

How to do?

Peopleware Principles

e.g., Design education for competence, integrity.

How to do?

Method. Principles

e.g., A science, culture, and practice of design.

How do *you* design?

THE ATLARGE VISION ON THE

DESIGN OF DISTRIBUTED SYSTEMS AND ECOSYSTEMS

We All Need Good Design,

bit.ly/AtLargeDesign1Talk

bit.ly/AtLargeDesign1Article

But We Are Not All Steve Jobs

0 Why Good Design?

1 Design Vision

2 AtLarge Approach

3 In Action

4 Future Work

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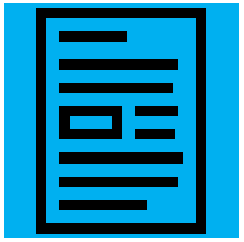
MASSIVIZING COMPUTER SYSTEMS

FURTHER READING https://atlarge-research.com/publications.html



1. Iosup et al. Massivizing Computer Systems. ICDCS 2018 ← start here
2. Andreadis et al. A Reference Architecture for Datacenter Scheduling, SC18
3. Van Eyk et al. Serverless is More: From PaaS to Present Cloud Computing, IEEE IC Sep/Oct 2018
4. Uta et al. Exploring HPC and Big Data Convergence: A Graph Processing Study on Intel Knights Landing, IEEE Cluster 2018

5. Talluri et al. Big Data Storage Workload in the Cloud. ACM/SPEC ICPE 2019.
6. Toader et al. Graphless. IEEE ISPDC'19.
7. Jiang et al. Mirror. CCPE 2018.
8. Ilyushkin et al. Autoscalers. TOMPECS 2018.
9. Versluis et al. Autoscaling Workflows. CCGRID'18.
10. Uta et al. Elasticity in Graph Analytics? IEEE Cluster 2018.

11. Herbst et al. Ready for rain? TOMPECS 2018.
12. Guo et al. Streaming Graph-partitioning. JPDC'18.
13. Iosup et al. The OpenDC Vision. ISPDC'17.
14. Iosup et al. Self-Aware Computing Systems book.
15. Iosup et al. LDBC Graphalytics. PVLDB 2016.

Etc.

SW. ENG. AND THE ATLARGE DESIGN PROCESS