THE QUEST FOR BUGS

A Bugs Orientated Approach to IP Development

Verification Futures 2022
Bryan Dickman, Valytic Consulting Ltd.
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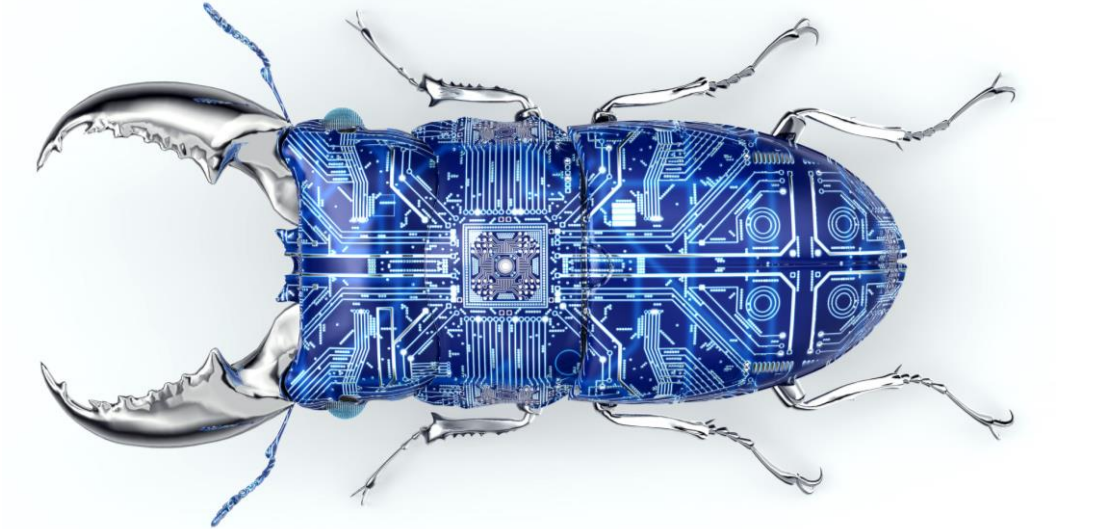
A Bug focused approach… (understanding Bugs)



ASIC Hardware Verification is a resource limited '**quest**' to find as many bugs as possible before shipping.

It's a long, difficult and costly search; constrained by cost, time and quality.

Who are we?

Valytic Consulting Ltd.

Verification

Engineering Leadership

Analytics

Bryan Dickman

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Collaboration to offer

Verification expertise

Capability Baselining

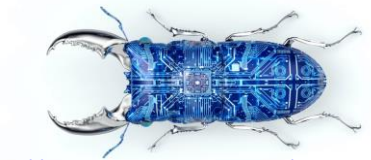
Transformation Strategies

Thought leadership (QfB)

Technical guidance

Senior team advisory

Marketing



See https://www.acuerdo.co.uk/thequestforbugs

Acuerdo Ltd.

Engineering Platform (EDA)

Strategy and Commercial

Technical Marketing

Joe Convey

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Verification Technology is Cool 😎….

- We work in such an intellectually stimulating area of industry
  - Dealing with challenges of building and delivering multi-billion gate ASICs designs and highly complex IP products
  - Where the EDA industry has led the development of some fantastic IC design tooling and methodologies
  - And IC designers are constantly looking for ways to be more effective
    - Deliver faster, at lower cost, with higher quality!
- But….
  - Don’t lose sight of the problem.
    - HOW TO ***FIND*** BUGS!
    - HOW TO ***AVOID*** BUGS!

THE DILEMMAS OF VERIFICATION

1. “The Completeness Dilemma”
2. ”The Complexity Dilemma”
3. ”The Constrained-Random Dilemma”
4. ”The Resources Dilemma”
5. “The Delivery Dilemma”

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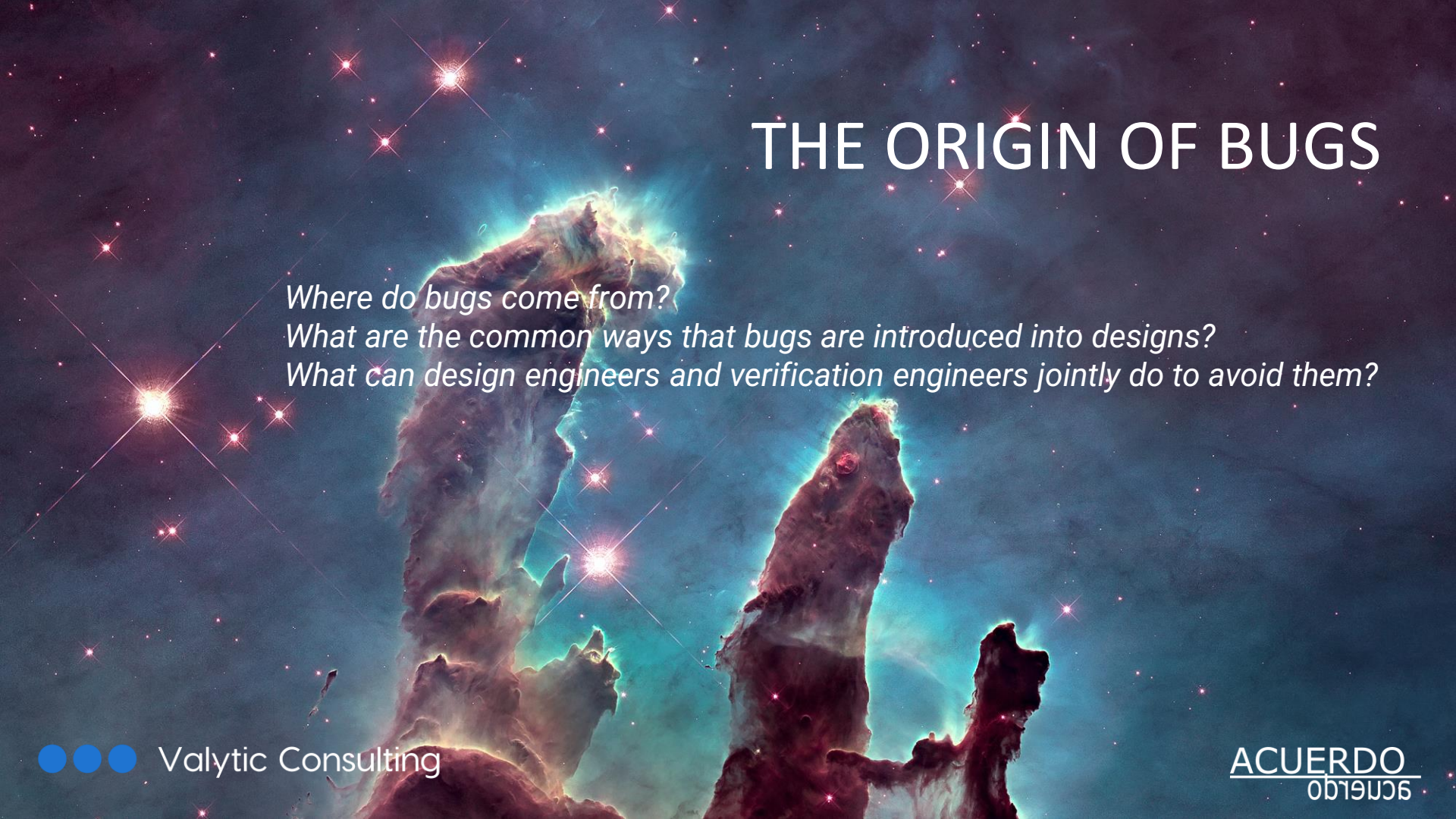
THE ORIGIN OF BUGS



Where do bugs come from?
What are the common ways that bugs are introduced into designs?
What can design engineers and verification engineers jointly do to avoid them?

Where do Bugs come from?

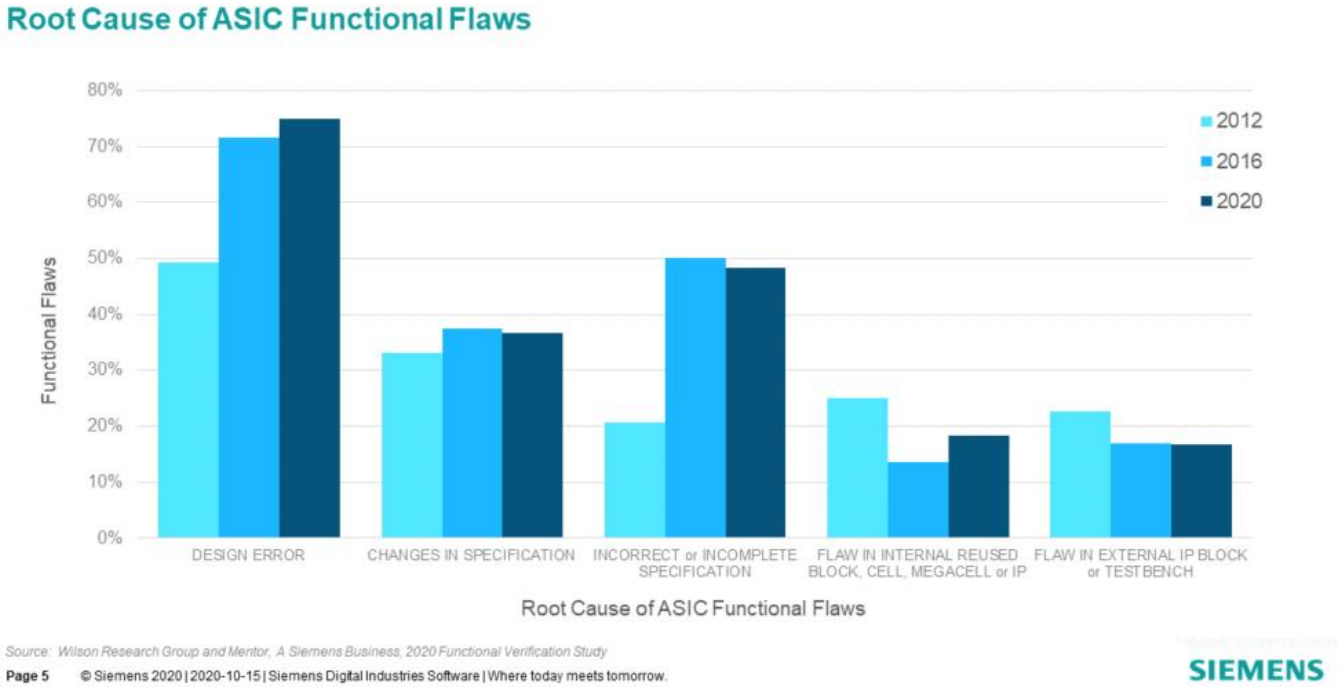


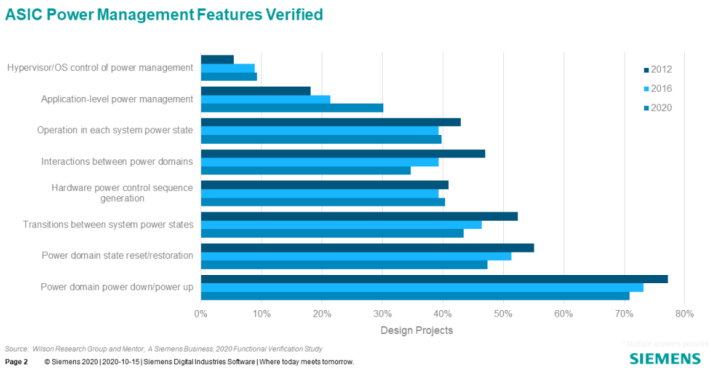
Figure 12-5. Root Cause of Functional Flaws

https://blogs.sw.siemens.com/verificationhorizons/2020/10/27/prologue-the-2020-wilson-research-group-functional-verification-study/

Functional Bugs and other Defects

- Think of Bugs in the following terms:
  - Functional Bugs
  - Performance Bugs
  - Power Bugs
  - Security Vulnerabilities
  - Functional Safety Integrity
  - Architecture/Specification Bugs
  - Implementation Bugs

Power Bugs



- Power Bugs can be catastrophic!
  - Power Intent bugs
  - Failure to meet power budgets
  - Power consumption corner cases presented under real-world SW conditions Power Management complexity is growing
- Power Verification is increasingly complex
- Power Analysis Methodologies increasingly sophisticated
- IC Design Power Issues are in fact “Power Bugs”

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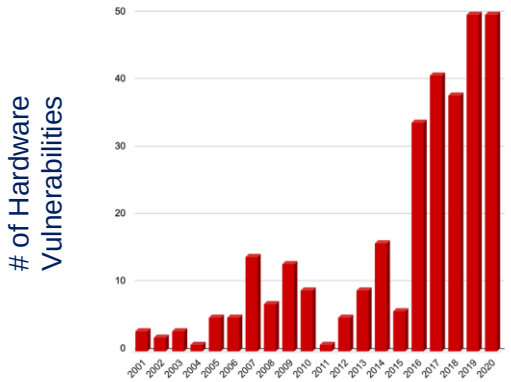
Security Bugs



Source: NIST/MITRE 12/2020

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- Security Bugs can be catastrophic!
  - Increase in number of hardware vulnerabilities in recent years
  - New breeds of bugs – security vulnerabilities that can be harder to detect.
  - CIA bugs: Confidentiality, Integrity, Availability
  - Complex attack scenarios such as Cache Timing Side Channel Attack
  - Security verification e.g. requirements driven threat modeling
    - Build a Threat DB – leverage CWE DB

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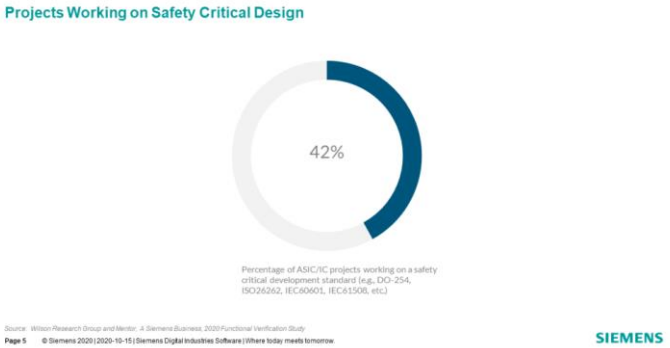
FuSa Bugs



- Guess what? FuSa Bugs can be catastrophic!
  - Normal operation works fine – but ASIL targets can be missed
  - Systematic Failures in the Design Affecting Functional Safety Requirements
  - Complexity: New Bugs injected into Non-Trivial Functional Safety Mechanisms
  - Fault-injection/fault-simulation and FMEA/FMEDA is necessary to find these Bugs

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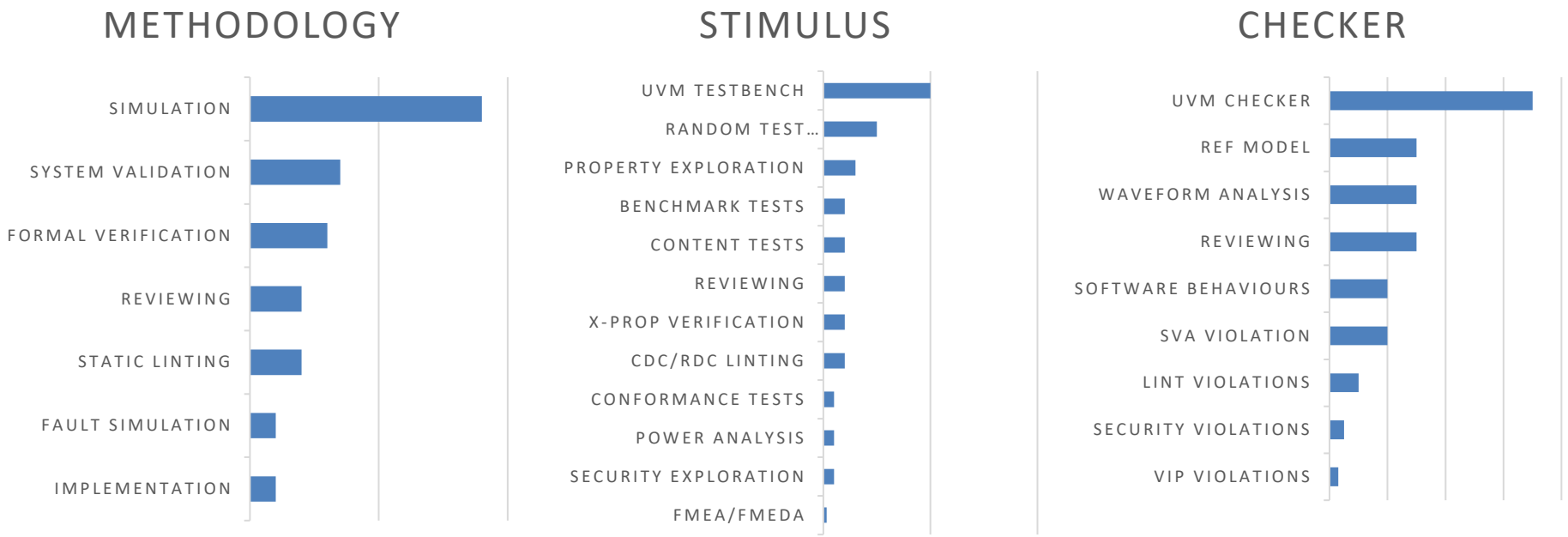
How are bugs found?

(FAKE DATA)



How effective is your verification? Where to invest? Where to divest?

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What are the Root Causes of Bugs?

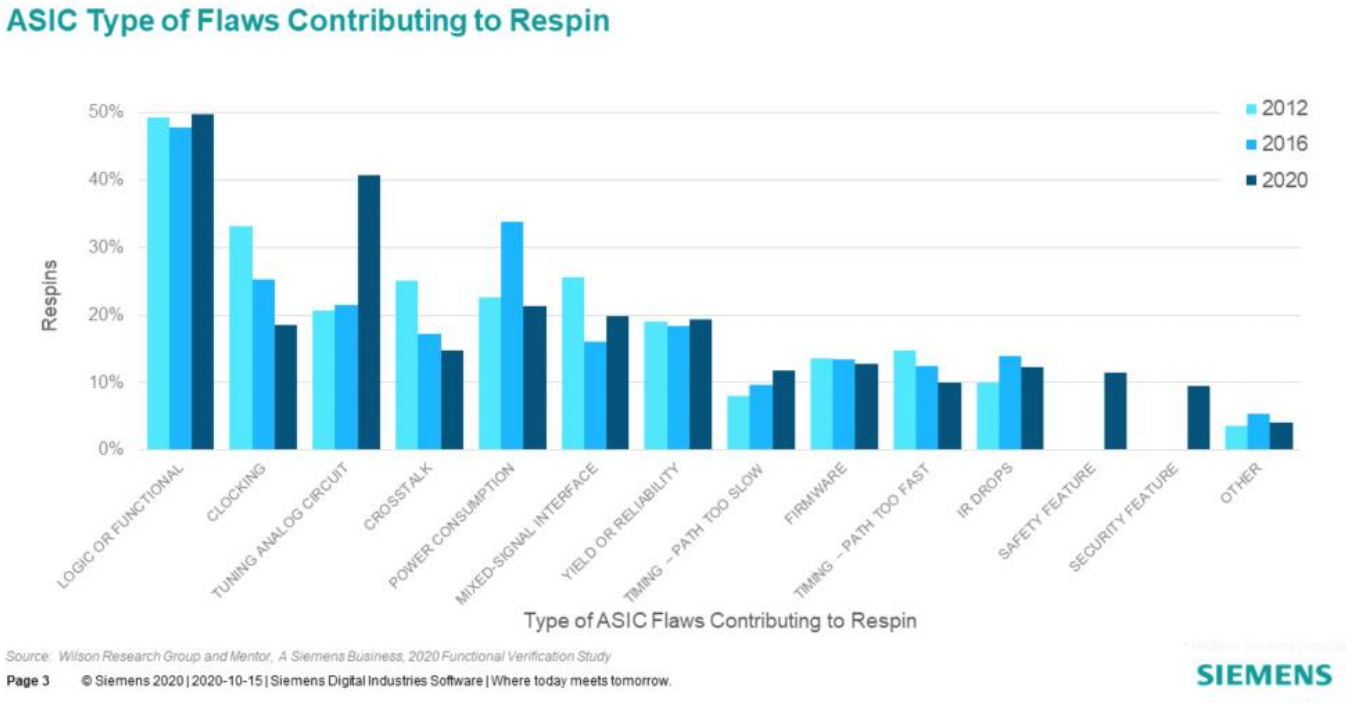


Figure 12-3. Types of Flaws Resulting in Respins

- https://blogs.sw.siemens.com/verificationhorizons/2020/10/27/prologue-the-2020-wilson-research-group-functional-verification-study/

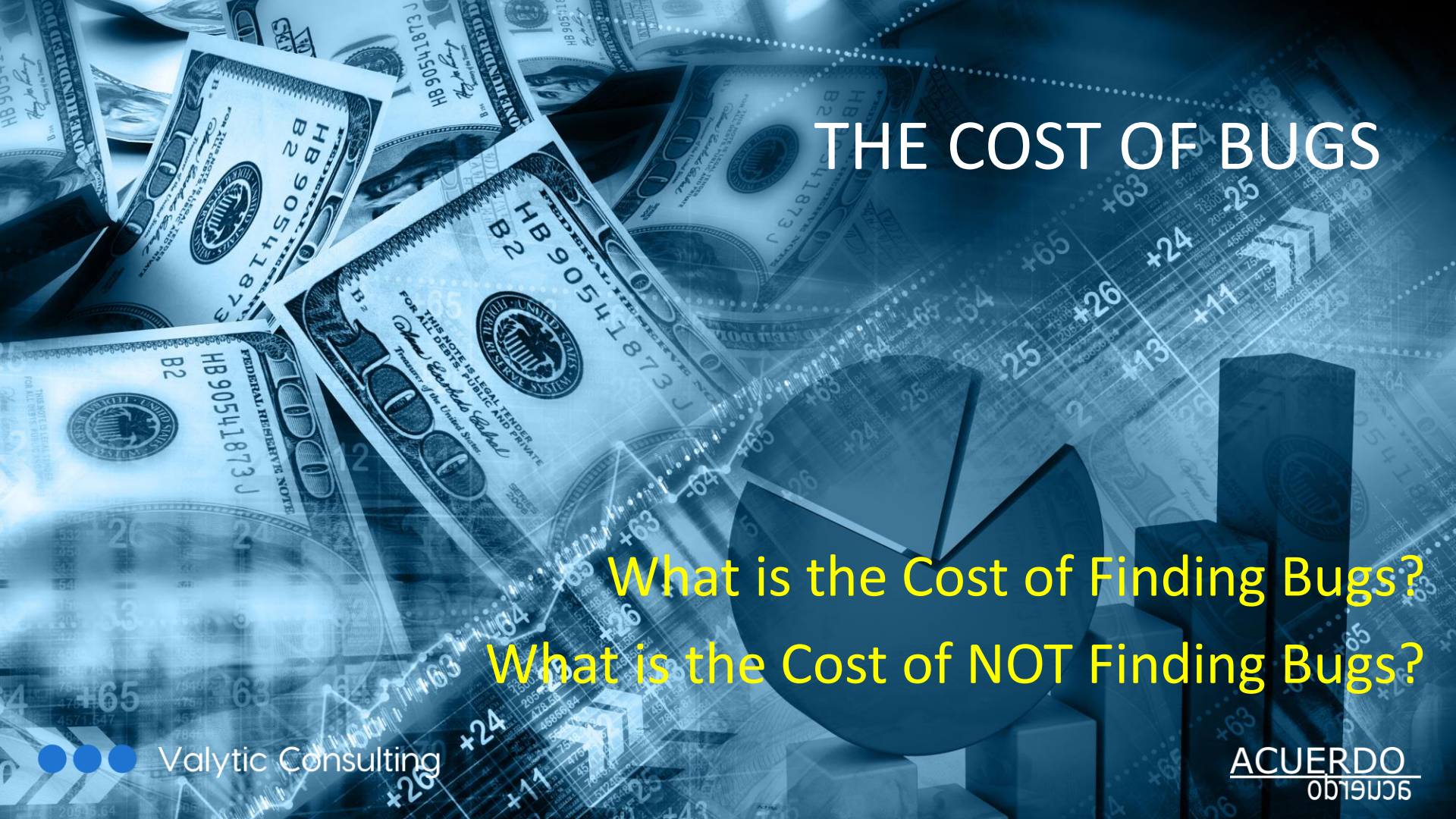
Continuous Improvement through RCA

Design Root Causes

- Why was the bug introduced into the RTL codebase?
  - Poor coding styles?
  - Complexity?
  - Code Churn?
  - Specification Error?
  - Schedule constraints?
  - Etc…

Verification Root Causes

- Why was the bug missed by previous verification?
  - Stimulus gap?
  - Checking gap?
  - Coverage hole?
  - Testplan gap?
  - Methodology gap?
  - Specification Error?
  - Poor coding style?
  - Resource constraints?
  - Schedule constraints?


THE COST OF BUGS
What is the Cost of Finding Bugs?
What is the Cost of NOT Finding Bugs?
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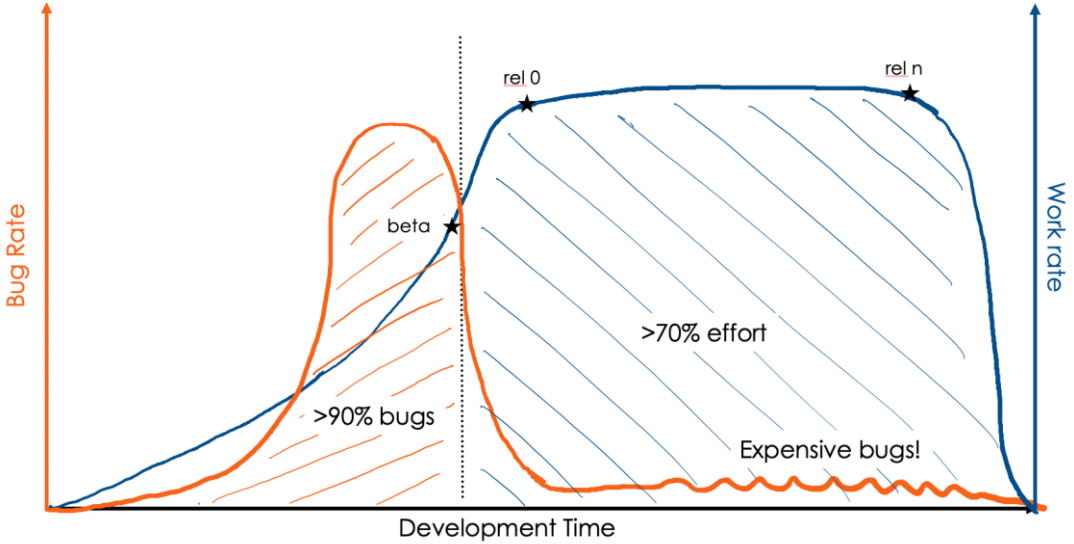
The Cost of Finding Bugs

When are Bugs Found?...The Sooner the Cheaper!!

OPINION: most bugs should be flushed out in the early stages (say with 30% of the work) these are the easy finds

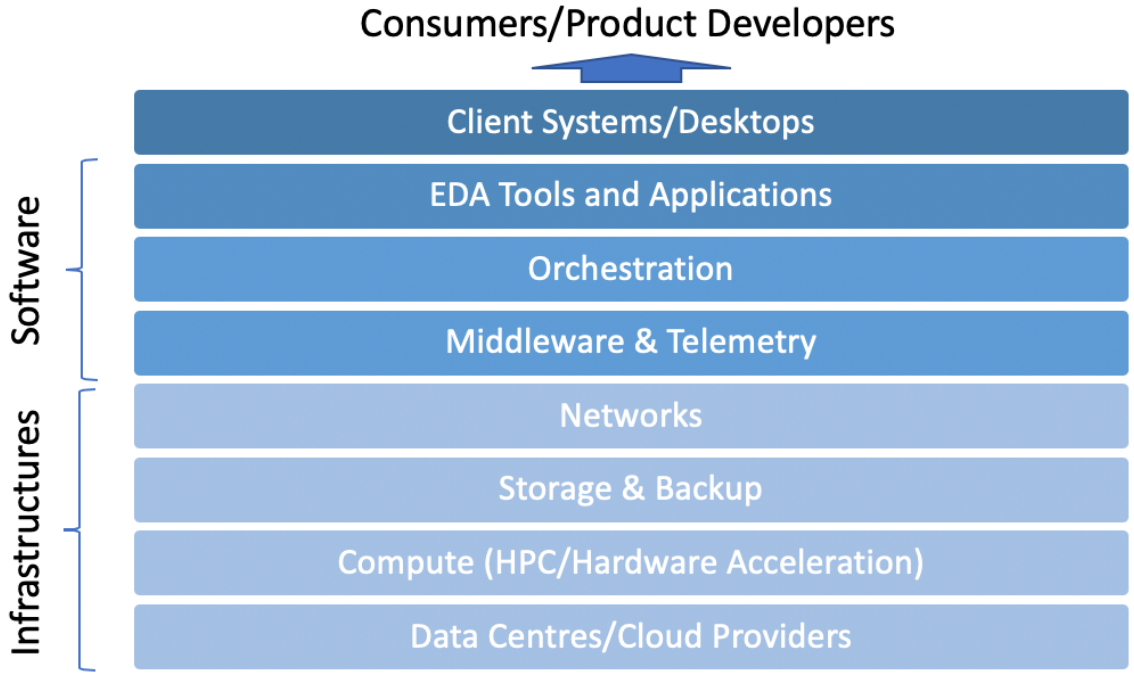
Verification work (consumption of resources and human effort to find, debug and fix) is disproportionately high for the remaining 10% of bugs

Focus workflow and methodology improvements on this later stage for the biggest ROI



The last 10% are often the critical ones!

The Cost of Finding Bugs: The Engineering Platform



Understanding your verification ROI

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Fixed capacity, fixed architecture problem

Scenario

Resource scarcity

Inflexible architecture

Incomplete data to forecast need

Leading to…

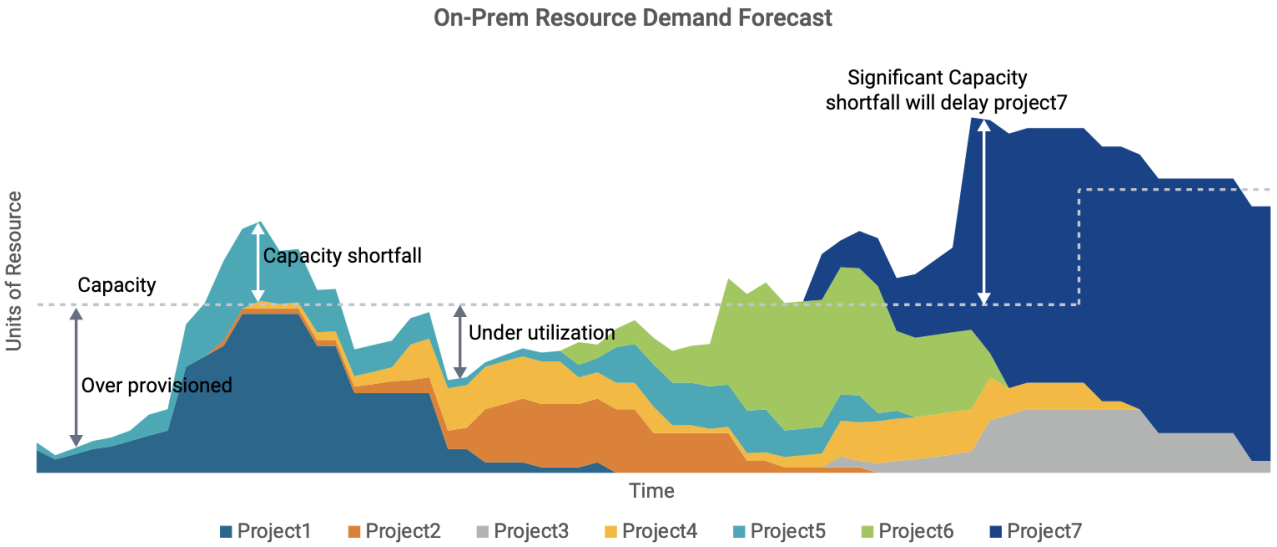
Project delays

Waivers and risk

Drives

Extra spend on compute

Exploration for alternatives



Source – Made in the cloud – Understanding the case for IC hardware development in the cloud. Bryan Dickman, Valytic Consulting, Joe Convey Acuerdo Ltd., Teng Kiat-Lee Synopsys, Inc., Sandeep Mehndiratta Synopsys, Inc.

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CLOUD MATTERS!

Run faster, run leaner, innovate sooner, save money, understand your engineering platform costs better *and* get best-in-class Business Continuity thrown in for free…

Why isn't everyone doing it?

Levelling-up for smaller organizations to compete against larger ones

For larger operations cloud brings capacity flexibility when there are workload peaks and troughs

An opportunity to do things differently

But….

- When is the right time to shift?
- What about lifting and shifting workflows?
- Contractual models for adoption…?

Good data and analytics matters more!

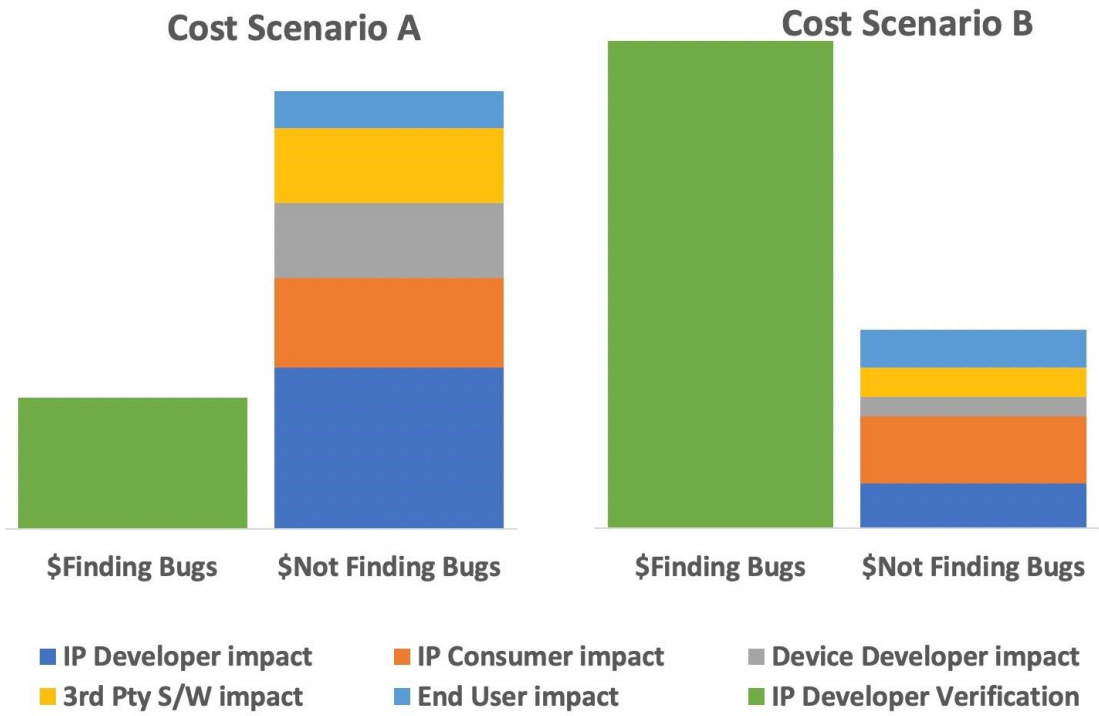
Do you have enough data to reason about your risk profile?

Are you scenario A…?

cost-to-find low, but high risk/impact regretting not having spent enough on verification

Or, are you scenario B…?

cost-to-find high with impact risk/cost low wondering if you are spending too much?



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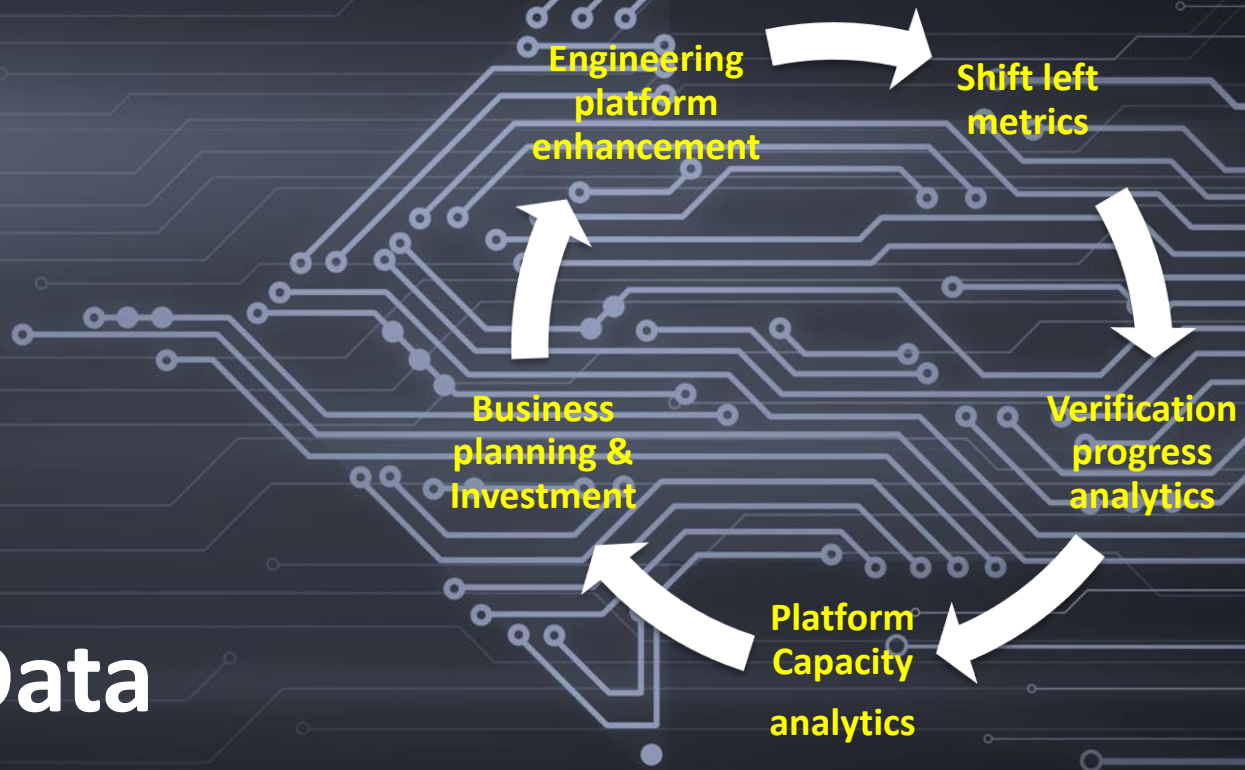
Invest in data to make better decisions, sooner



Data **Matters!**

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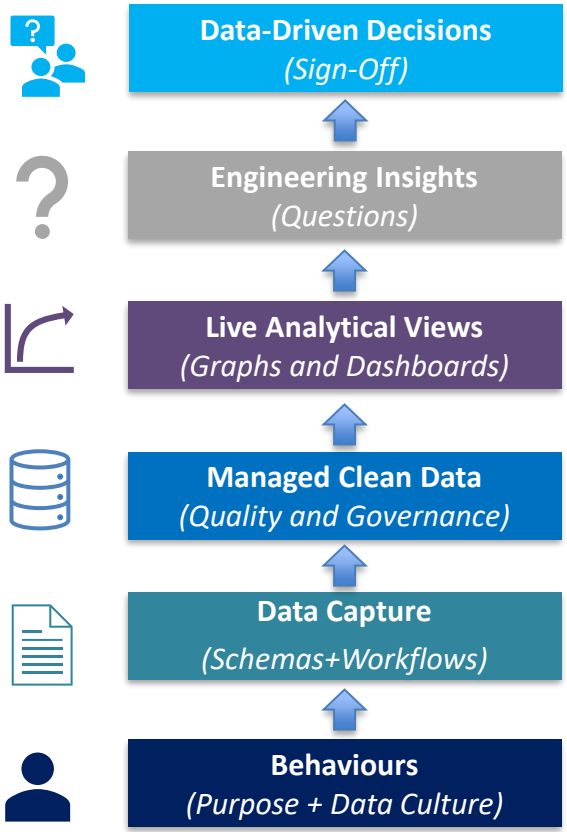
Data-Driven decision making reduces Bugs



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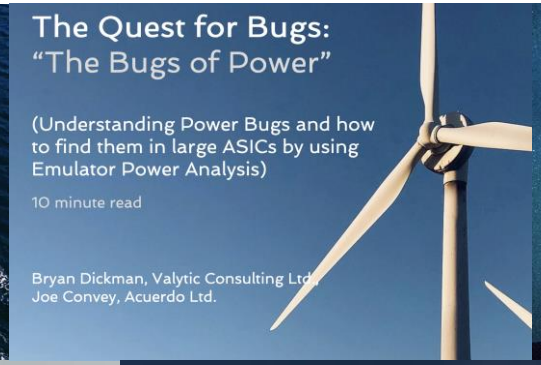
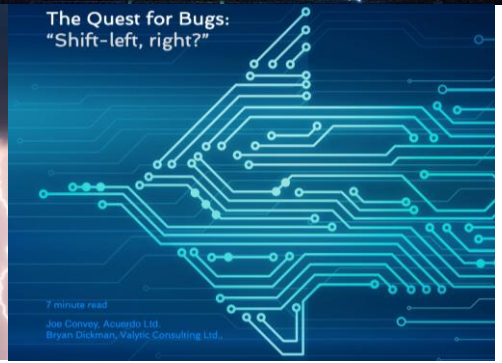
So, the Point is….

The Quest for Bugs

https://www.acuerdo.co.uk/thequestforbugs





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THANK-YOU