

# Software Talks

Are you listening?

Almost ready edition (15 Sep 2015)

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**Julian Harty**

Why bother?

Value

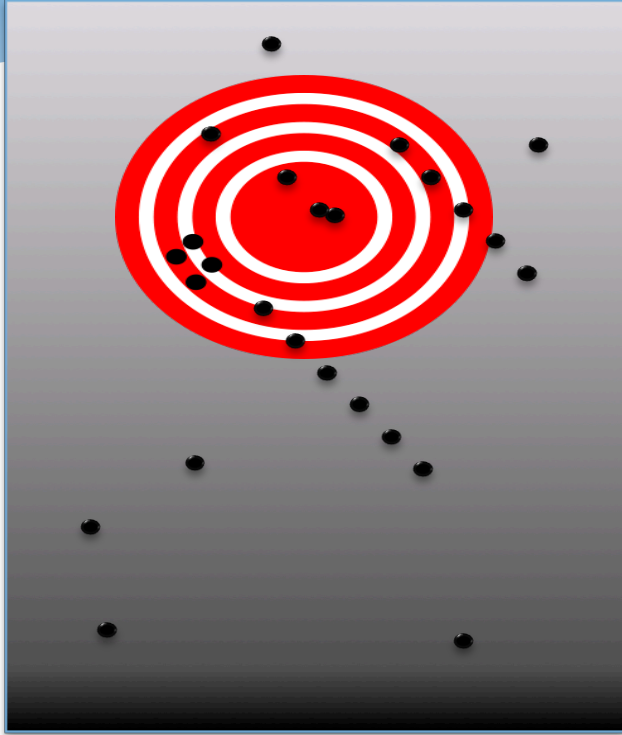


Are you working too hard, on the wrong things?

We struggle to decide what to test,  
how much testing is enough, etc.

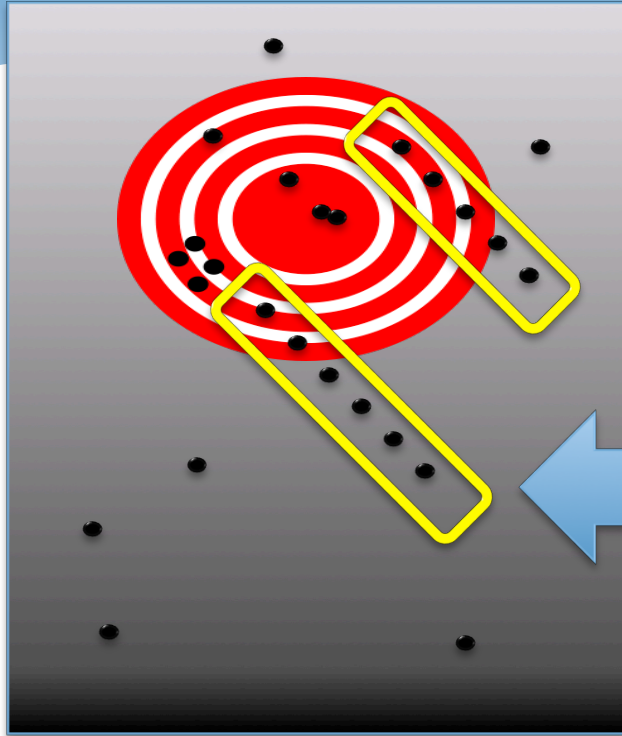
110% effort doesn't cut it...

# Most of our work is wasted effort



How much of our testing is on target?

# Most of our work is wasted effort



How much of our testing is on target?  
80% of reported bugs not addressed

Automated Tests 😊

# Know your users



Custom drink feature removed<sup>[1]</sup>  
=> 1 star feedback ratings



Parallel Kingdom<sup>[2]</sup>  
Regular users generate 2.5x daily revenues

Logos © respective owners

[1] example from App Quality book

[2] example from Tale of Two Apps

# Understand the effects

- \* Battery drain varied by 3x for similar hardware specifications
- \* Custom code added for Kindle Fire to reduce brightness
  - \* 40% less battery drain
- \* Higher network latencies reduced interactivity by 40%
- \* Users preferred Wi-Fi
  - \* 69% for Parallel Kingdom, 58% for StudyBlue
- \* Tablets 2x usage
- \* Pull-out keyboard also increased usage

# Analytics can augment our work

- \* Help us to correct and improve what we do
- \* Reduce waste, reduce latency,
- \* Increase value

## **How**

- \* Insights into the app's behaviour in-the-wild
- \* Feedback loops

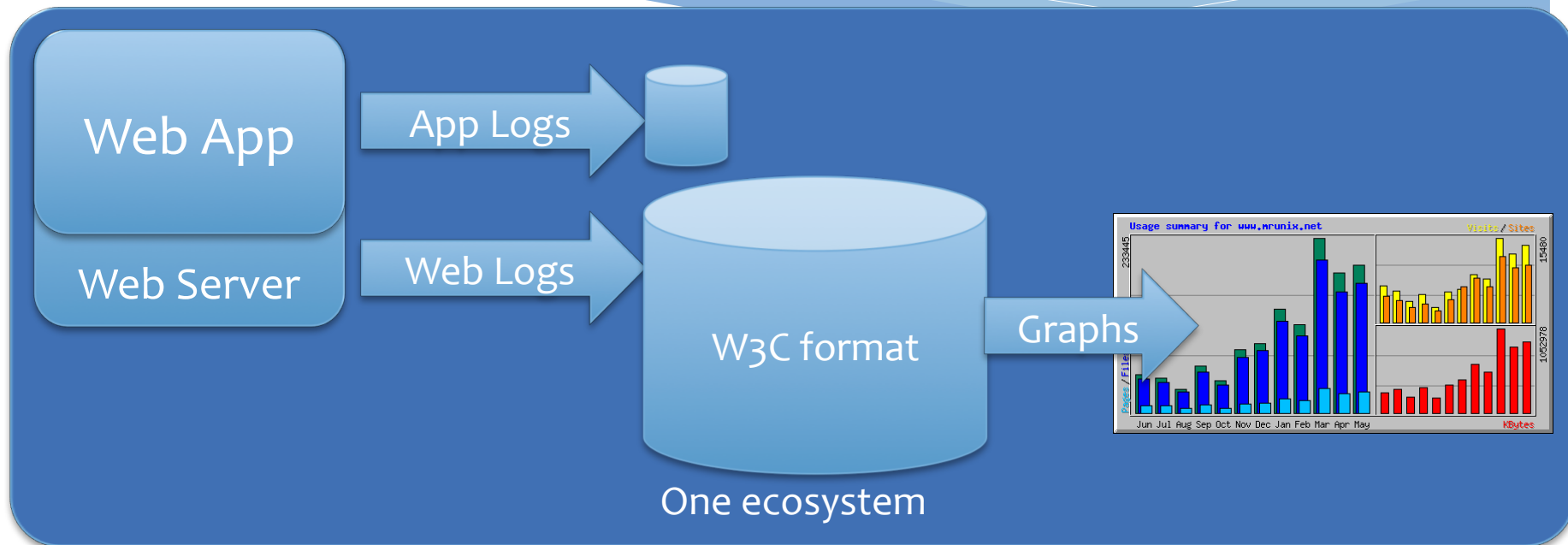


What's it all about?

# Context

# Some history

## Web server logs & analysis



Sources of data

# For Mobile Devices

# Sources of data

- \* Device details
- \* GUI elements and layout
- \* Run-time environment
- \* Run-time behaviours
- \* Network traffic
- \* Test results
- \* App Store Data
- \* Ratings & Reviews
- \* In-app analytics

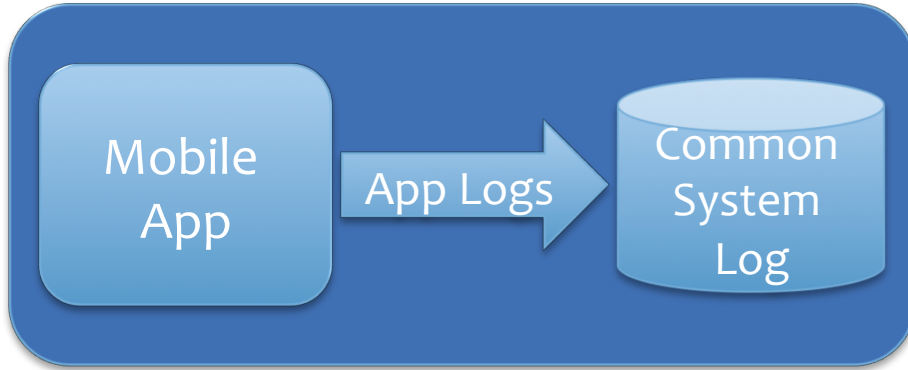
# Data sources for mobile apps

What	On device	Off device
Device details	Y	
GUI elements and layout	Y	
Run-time environment	Y	
Run-time behaviours	Y	
Network traffic	Y	Y
Test results	?	Y
App Store Data		Y
Ratings & Reviews		Y
In-app analytics		Y

# Sources of the data

What	Static	Runtime	Human
Device details	Y		
GUI elements and layout	Y	Y	
Run-time environment		Y	
Run-time behaviours		Y	
Network traffic		Y	
Test results	Y	Y	Y
App Store data		Y	
Ratings & Reviews			Y
In-app analytics		Y	

# What's different about mobile?



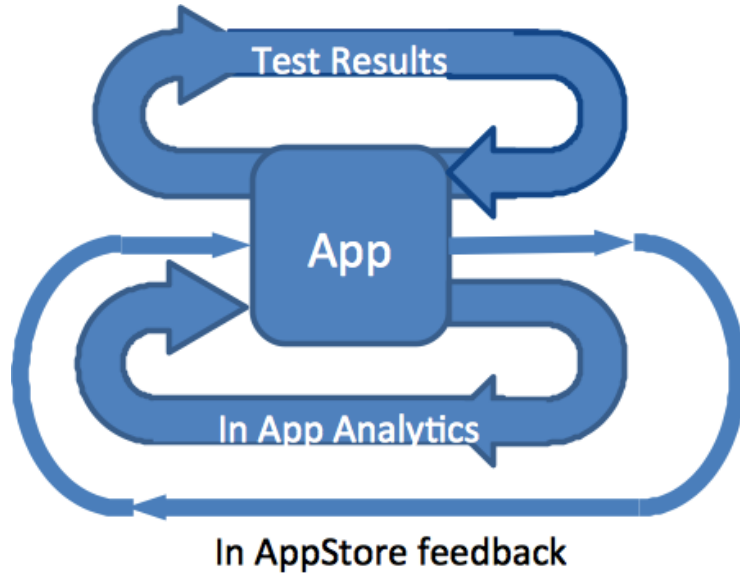
- \* Logs isolated on the device
- \* Connection not guaranteed
- \* Many more sensors
- \* Much more variation

# Ways to collect data

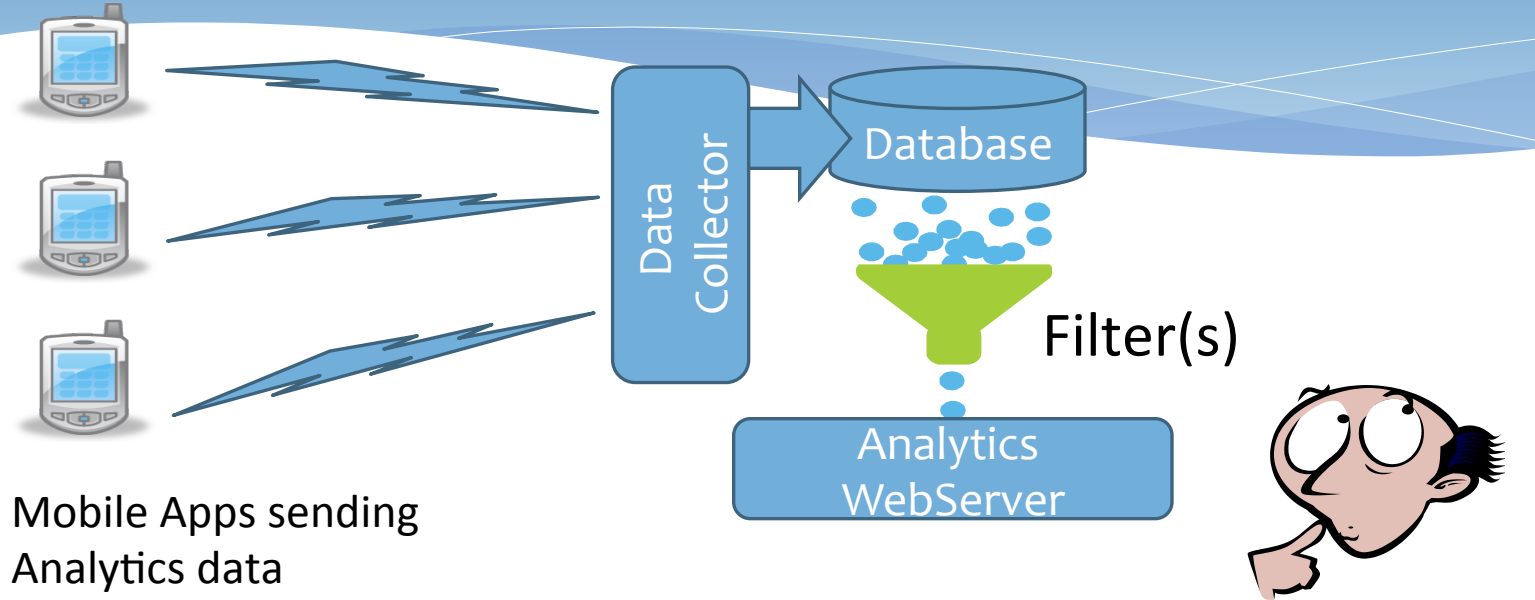
What	Technique	Tool(s)
Device details	Research, App Store, Mobile Analytics	API calls, published
GUI elements and layout	Static Analysis, Dynamic Analysis	Code Quality utilities Test Automation Tools
Run-time environment	Queries, Mobile Analytics	Shell commands
Run-time behaviours	Instrumentation, Logging, Mobile Analytics	Development Tools, Test Automation Tools
Network traffic	Observation, Logging	Network Analyzer
Test results	Explicit collection	Data collection utilities, Test Automation Tools
App Store Data	Developer account access	Provided by App Store
Ratings & Reviews	Online access, data collection	App Store, other sources
In-app analytics	Integration of Mobile Analytics Library	Development tools



# Feedback Cycles



# TOPOLOGY



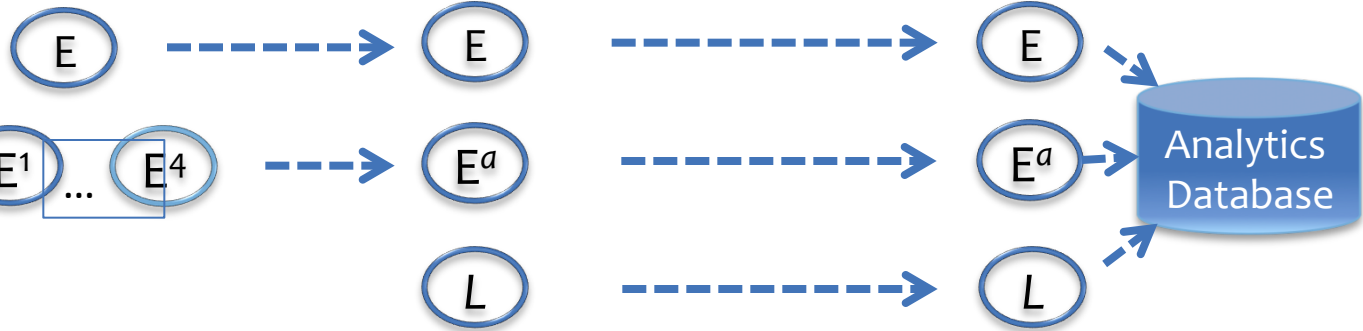
**Overview of Mobile Analytics**  
Each step may be delayed

# Types of Events



## Events

1:1 App-initiated



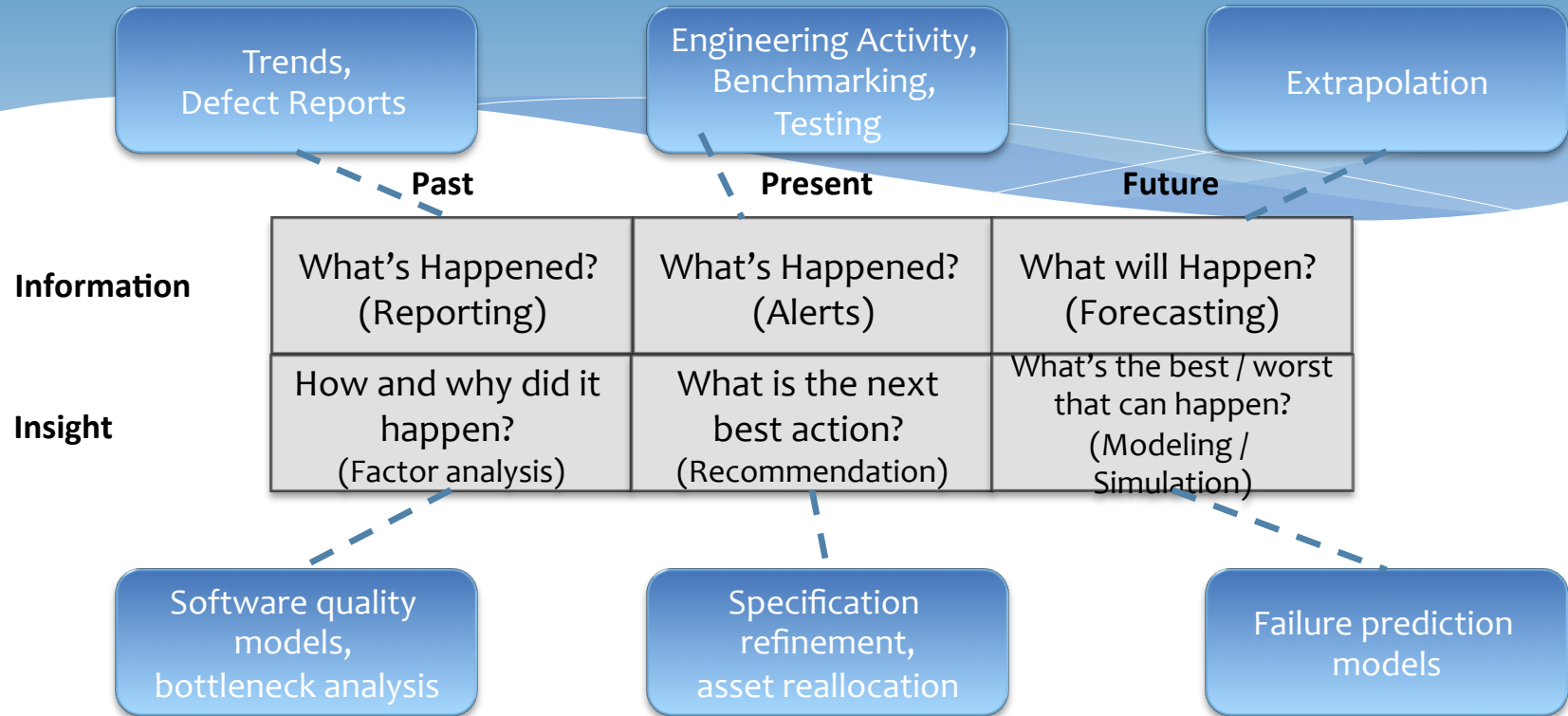
m:1 App-initiated

Library-initiated

Mobile Analytics

# Ways to use the data

# Analytics for Software Development



# Analytical Questions: Past

Trends,  
Defect Reports

What's Happened?  
(Reporting)

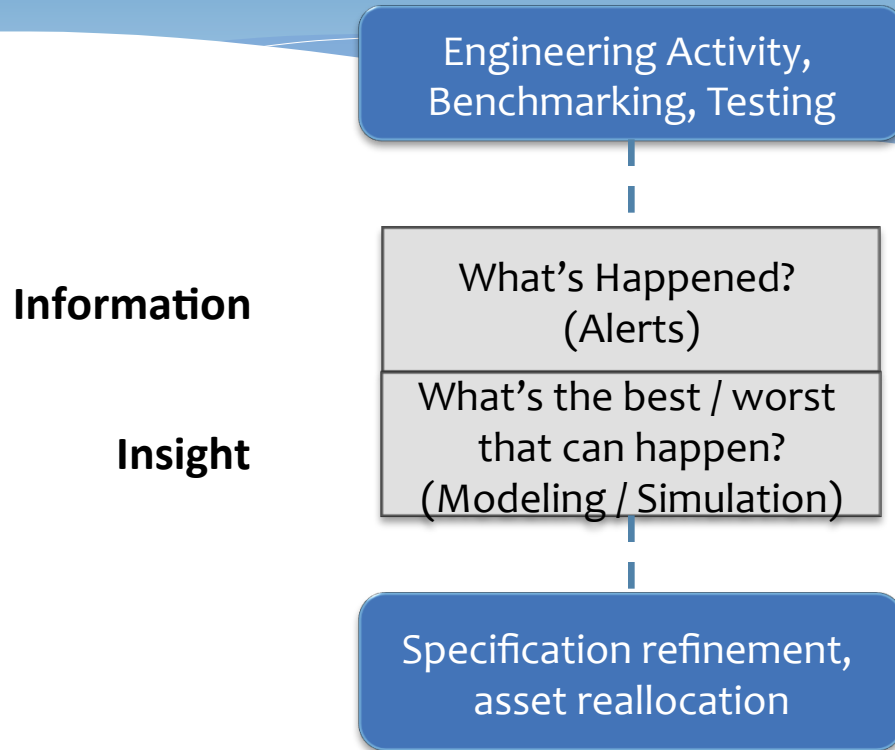
How & why did it  
happen?  
(Factor analysis)

Software quality models,  
bottleneck analysis

**Information**

**Insight**

# Analytical Questions: Present



# Analytical Questions: Future

Extrapolation

What will Happen?  
(Forecasting)

**Information**

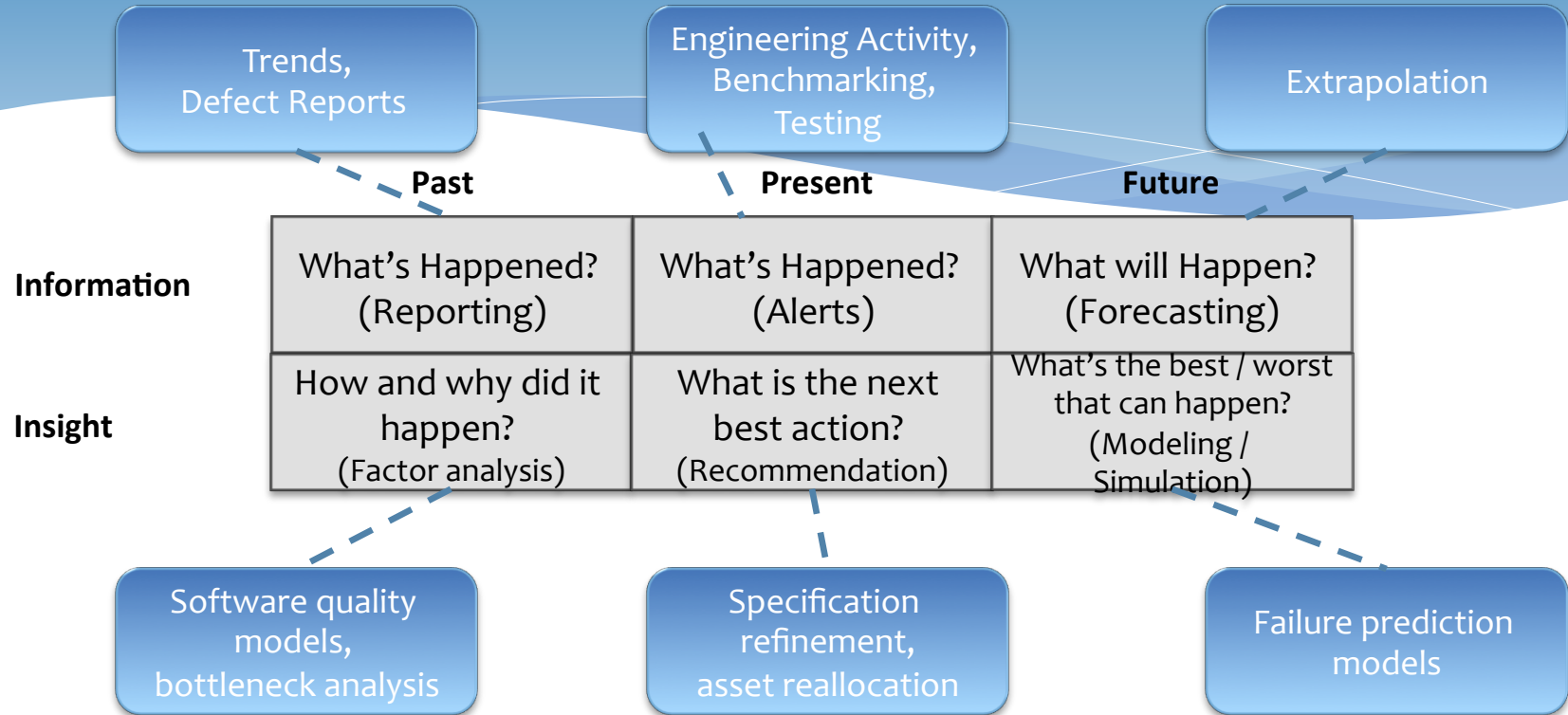
What's the best / worst  
that can happen?  
(Modeling / Simulation)

**Insight**

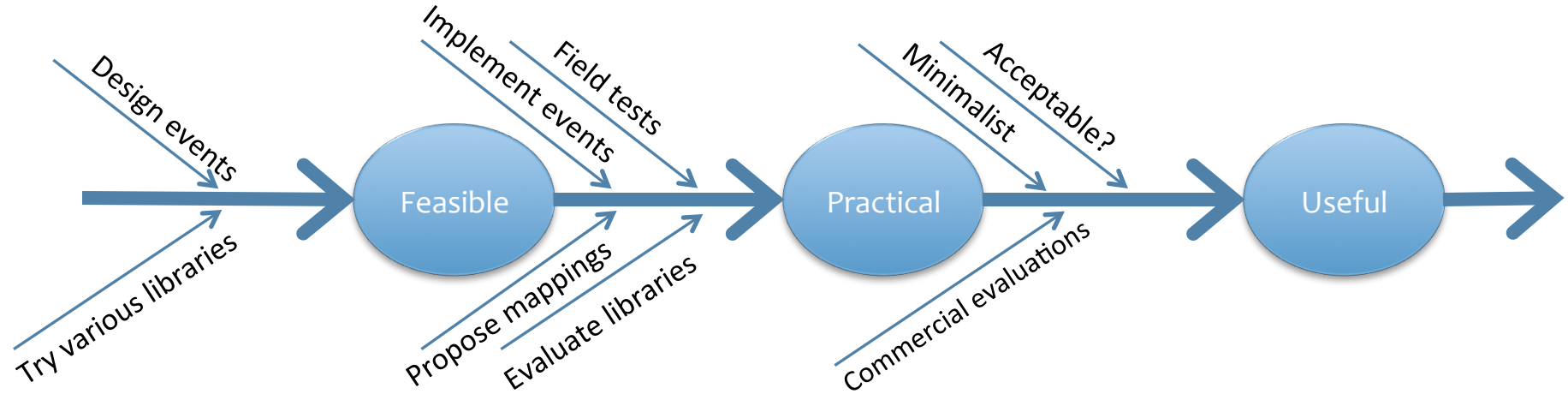
Failure prediction models



# Analytics for Software Development



# Implementation Flow



Accuracy & precision

# Gaining confidence

# Precision & accuracy



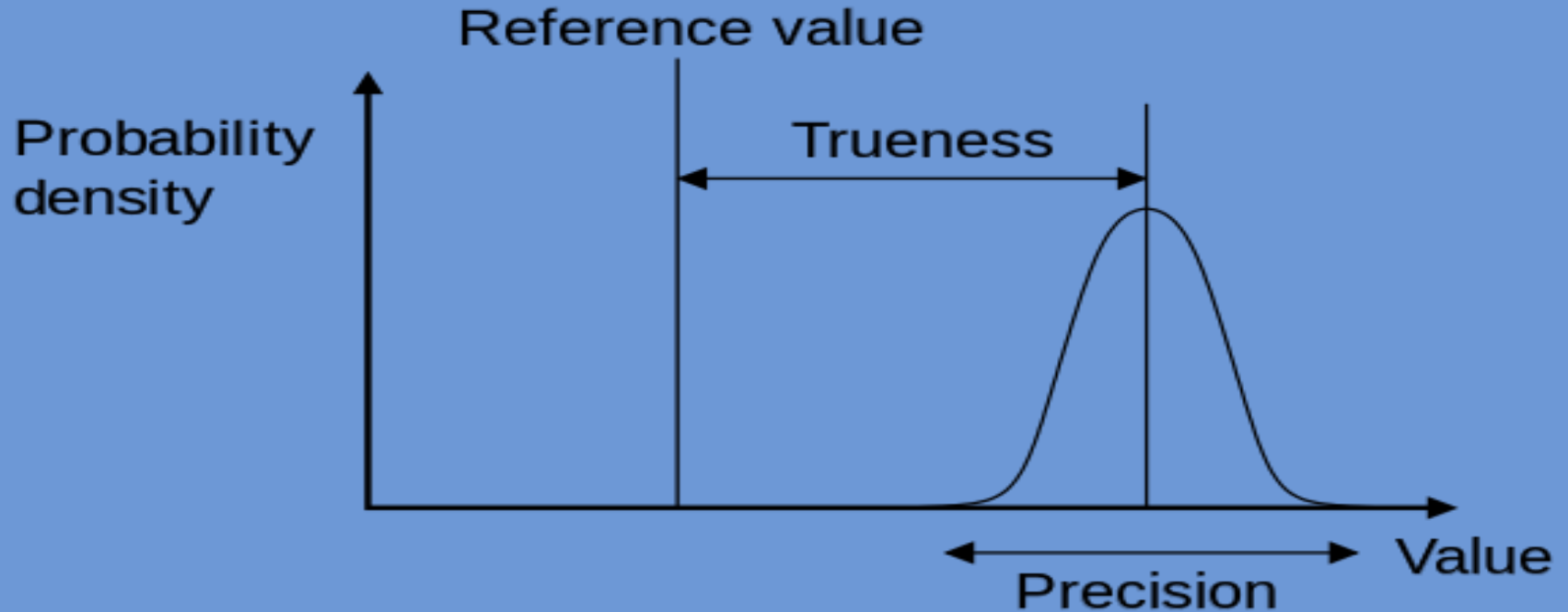
Precision: repeatability

[https://en.wikipedia.org/wiki/Accuracy\\_and\\_precision](https://en.wikipedia.org/wiki/Accuracy_and_precision)



Accuracy: on target

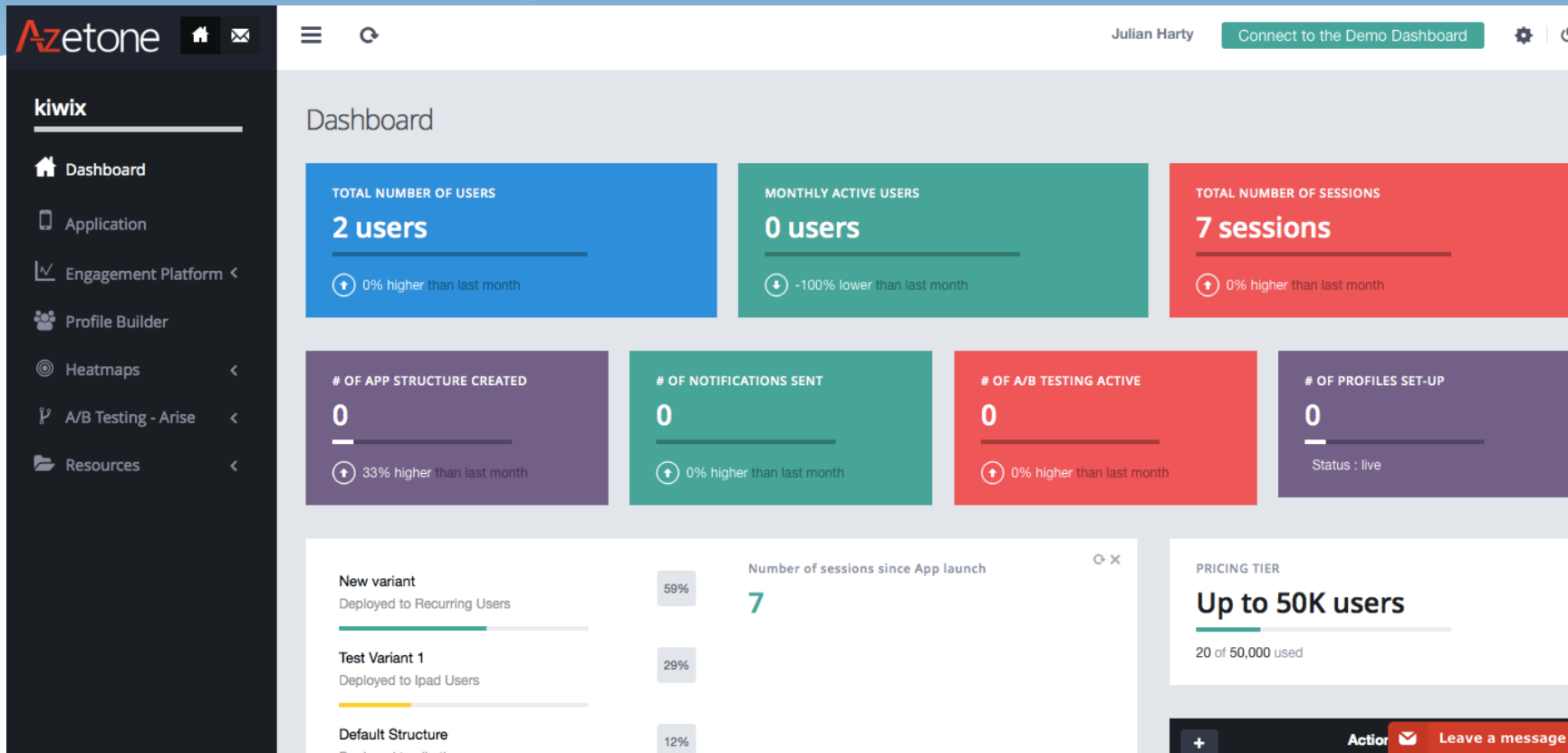
# Precision & accuracy



# Divergent answers increase doubt

- \* A tale of ~~two~~ three mobile analytics libraries (and what happens when bonuses are on the line...)
- \* Where were the testers (part one)?

# A system at rest?

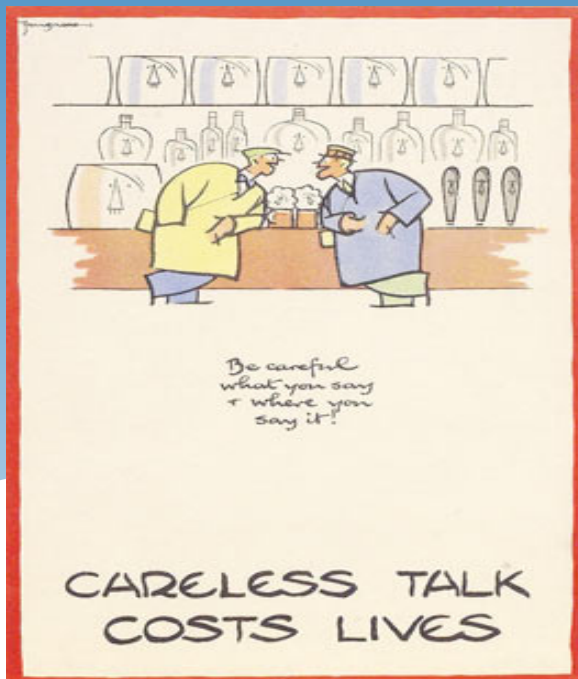


Of Mobile Analytics

# The Dark Side



# Do no harm to a neighbour



## THIS POPULAR FLASHLIGHT APP HAS BEEN SECRETLY SHARING YOUR LOCATION AND DEVICE ID

MORE THAN 50 MILLION USERS WERE LEFT IN THE DARK ABOUT HOW BRIGHTEST FLASHLIGHT SHARED THEIR LOCATION AND DEVICE INFORMATION WITH THIRD PARTIES

Bad stuff happened;

- Location data collected
- Excessive traffic

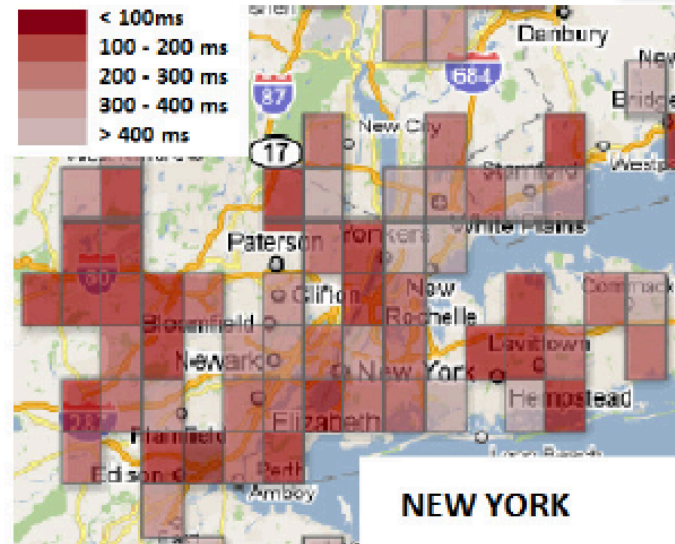
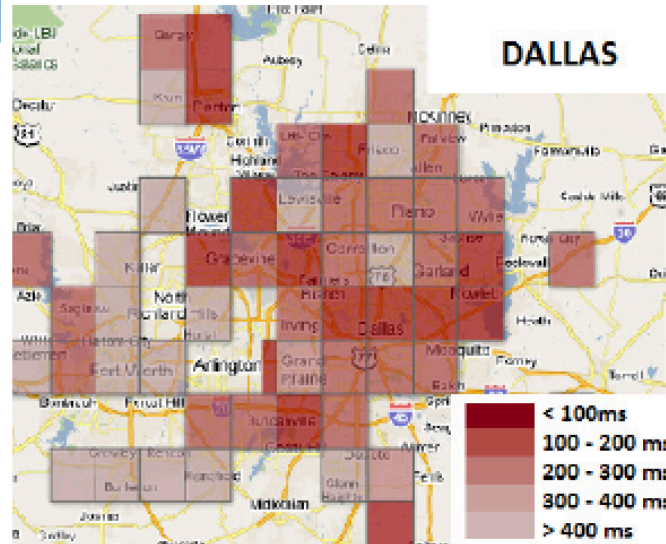
Where were the testers (part two)?

A Study of Third-Party Tracking by Mobile Apps in the Wild

<ftp://ftp.cs.washington.edu/tr/2012/03/UW-CSE-12-03-01.PDF>

<http://www.vam.ac.uk/users/node/1777>

# Reducing precision to protect privacy



10km x 10km squares

From: Capturing Mobile Experience in the Wild: A Tale of Two Apps  
Figure © ACM

# Beware the automation bias

“When presented with an automated solution 40% of pilots reasoned less or none at all”

“Automation bias occurs in decision-making because humans have a tendency to disregard or not search for contradictory information in light of a computer-generated solution that is accepted as correct and can be exacerbated in time critical domains.”

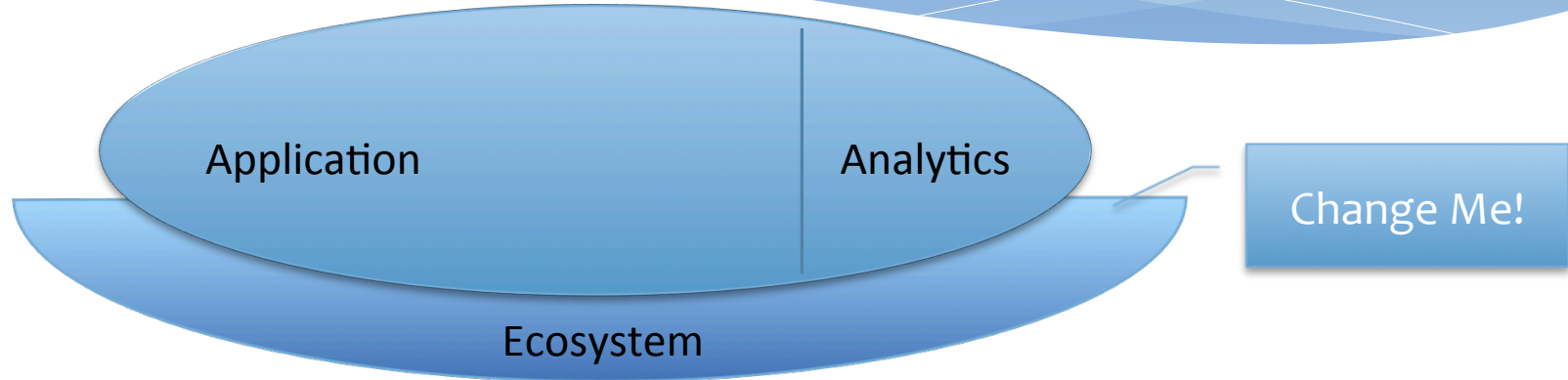
Automation Bias in Intelligent Time Critical Decision Support Systems

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.91.2634&rep=rep1&type=pdf>

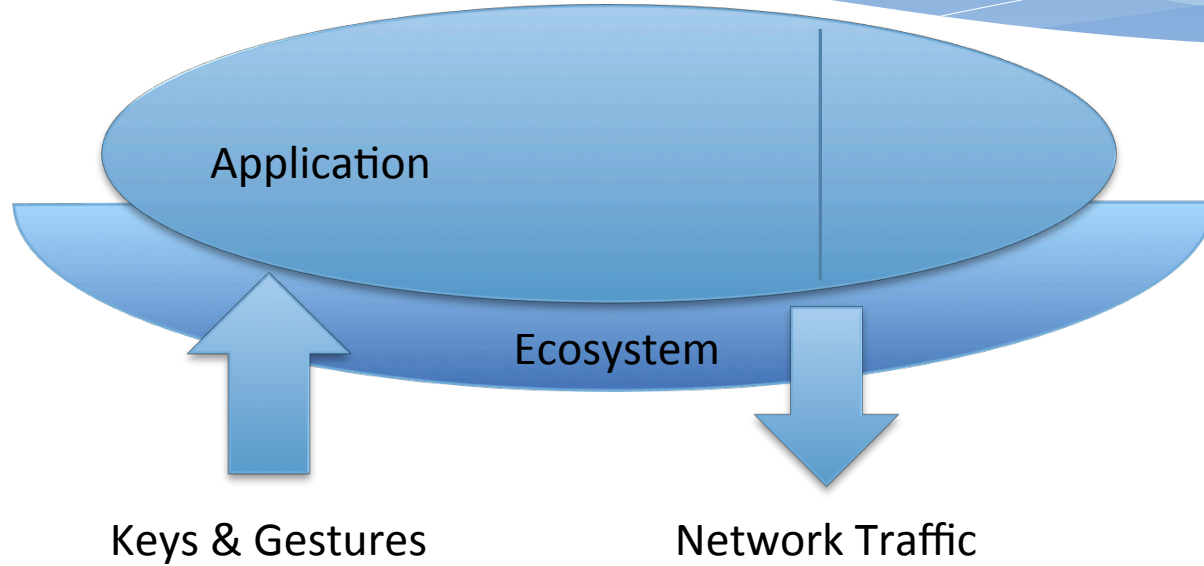
Listening is a means to an end

Necessary but not sufficient

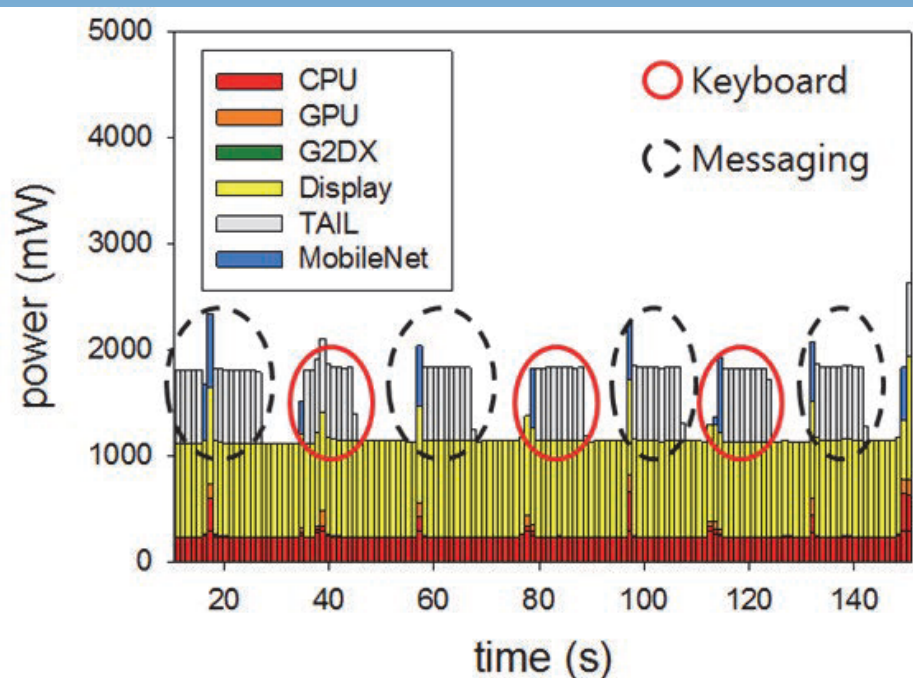
# Instrument the Ecosystem



# Observe the Behaviours



# Correlation? Causation? Appropriate?



From: User Interaction-based Profiling System for Android Application Tuning  
Figure © ACM

From one thing, to another

# Breaking-up is hard to do



# Divorce can be messy, even for software

Changing the code is the easy part...

- \* What about the data?
- \* And the systems & processes that rely on the data?

*Act in Haste, Repent at Leisure*

Mobile Analytics

# Some examples

# Developer Console (Google Play)



**KIWIX, WIKIPEDIA OFFLINE** – org.kiwix.kiwixmobile [View in Google Play store](#)

Statistics

**Ratings & Reviews**

Crashes & ANRs

Optimization Tips

APK

Store Listing

Pricing & Distribution

In-app Products

Services & APIs

 **Download your ratings and reviews**  
Ratings and reviews are now available in CSV format on Google Cloud Storage. [Learn more](#)

**RATINGS & REVIEWS**

# of Ratings  
**1,139**

★★★★★  
★★★★☆  
★★★☆☆  
★★☆☆☆  
★☆☆☆☆

781  
179  
76  
24  
79

**Average Rating**  
**4.37**

**REVIEWS**  

Filters ▾

Page 1 of 1

## CRASHES & ANRS

Type

Crashes ANRs

Show hidden

YES NO

Last reported

Last 7 days ▾

Android version

All versions ▾




Application version

Current production ( ▾

Device

Add filter

1 new crash ⓘ | 3 total crashes

NAME	NEW ⓘ	REPORTS THIS WEEK	REPORTS TOTAL	LAST REPORTED	HIDE
<b>java.lang.IllegalArgumentException</b> in android.app.LoadedApk.forgetReceiverDispatcher	NEW		1	Nov 13 5:51 AM	<div>Hide</div>
<b>Native crash at /system/lib/libc.so</b> in /system/lib/libc.so (tgkill+12), /system/lib/libc.so (pthread_ki...			12	Yesterday, 7:26 AM	<div>Hide</div>
<b>java.lang.IllegalStateException</b> in android.widget.ListView.layoutChildren			4	Nov 13 11:55 AM	<div>Hide</div>

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**KIWIX, WIKIPEDIA OFFLINE** – org.kiwix.kiwixmobile [View in Google Play store](#)

✓ Published

Statistics

Ratings & Reviews

Crashes & ANRs

Optimization Tips

APK

Store Listing

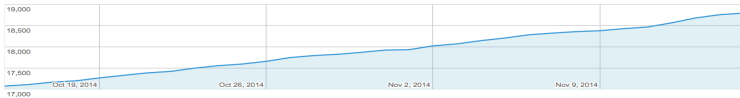
Pricing & Distribution

In-app Products

Services & APIs

**STATISTICS** **Current installs by device** ▾ for Oct 15, 2014 - Nov 15, 2014 [Export as CSV](#) Show: last month 3m 6m 1y all

The number of active devices on which the application is currently installed. [Learn more](#)



Android Version

Device

Tablets

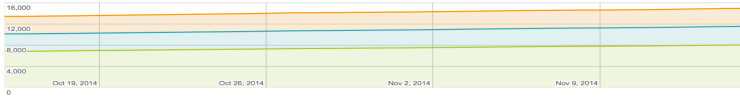
Country

Language

App Version

Carrier

**CURRENT INSTALLS BY DEVICE BY ANDROID VERSION**



**CURRENT INSTALLS BY DEVICE ON NOV 15, 2014**

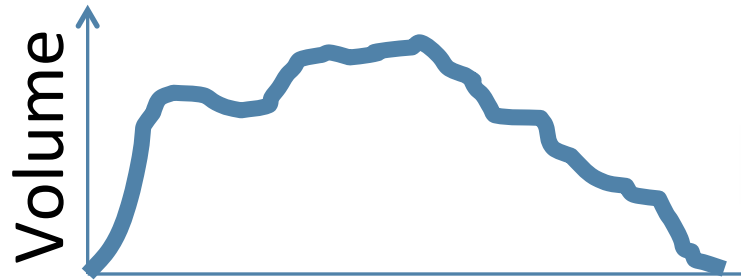
YOUR APP

ALL APPS IN EDUCATION

Android 4.4	8,044	42.80%	30.74%
Android 4.2	3,513	18.69%	16.22%
Android 4.1	3,395	18.06%	21.28%
Android 4.3	1,696	9.02%	7.58%
Android 4.0.3 - 4.0.4	1,544	8.21%	12.92%

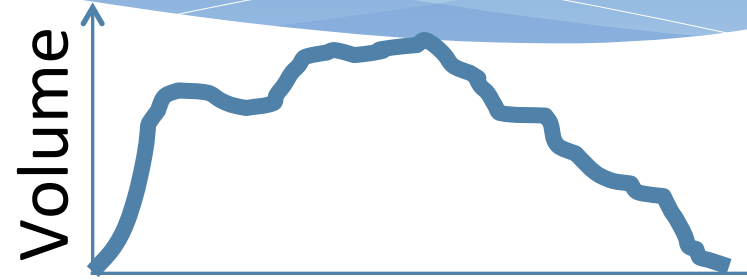
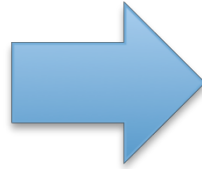
Page 1 of 1

# Network profiling



Time (of day)

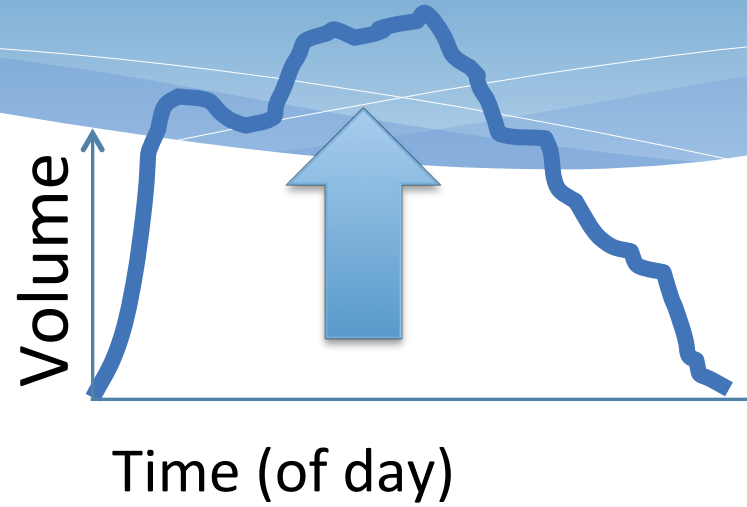
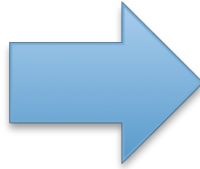
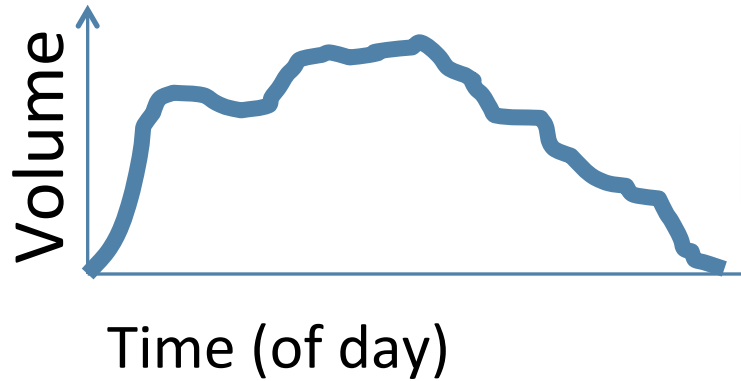
Discover



Time (of day)

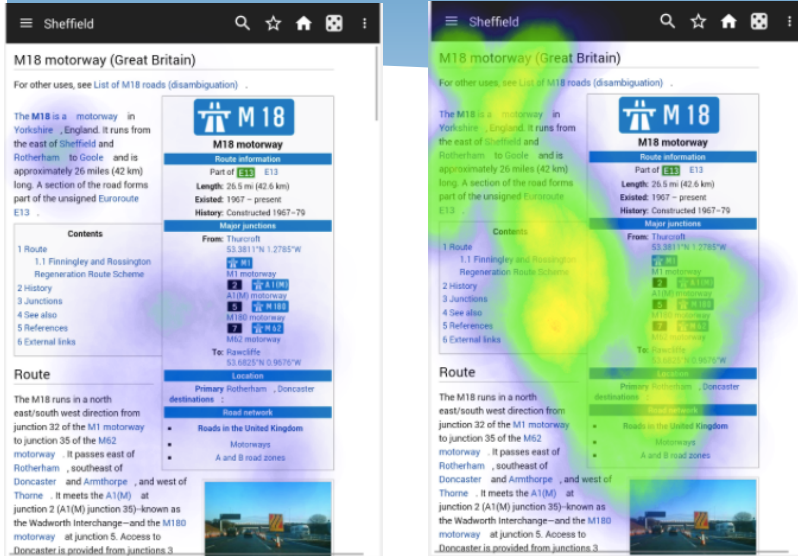
Use

# Network profiling



Transform

# Heatmaps



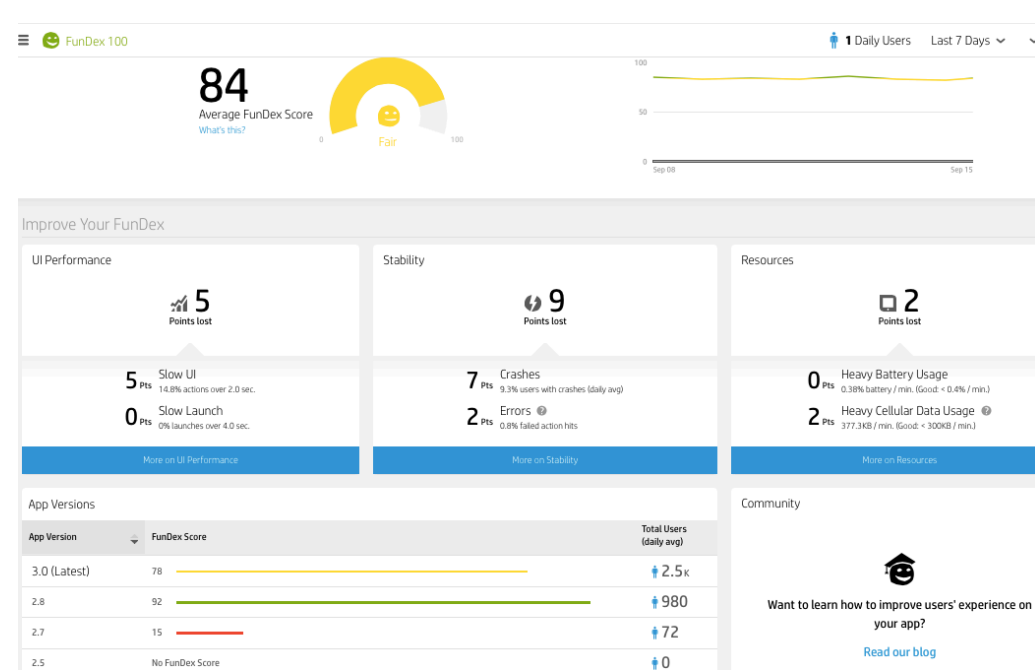
Slide

Zoom/Dezoom

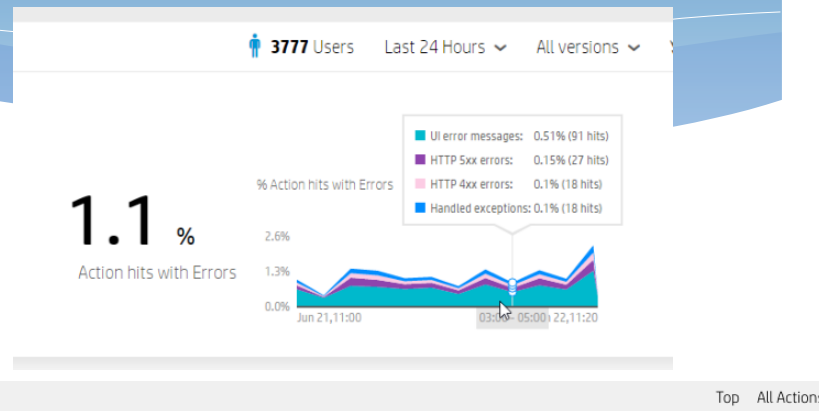
“8 Heatmap Tests that reveal visitor behavior.”

1. [The Link Test](#) – Are visitors clicking on dead ends?
2. [The Distraction Test](#) – Are irrelevant elements distracting visitors?
3. [The Information Test](#) – Is there missing information from your page?
4. [The Device Test](#) – Does your page work on different screen sizes?
5. [The Depth Test](#) – Is all your content easily reachable?
6. [The Engagement Test](#) – What are your site visitors really looking for?
7. [The Fold Test](#) – Does your page have what it takes to keep your visitors?
8. [The Header Test](#) – Is your page header helping or hurting your site?

Source: <https://www.hotjar.com/heatmaps>



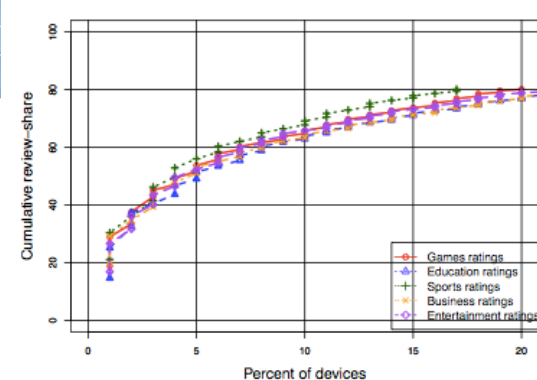
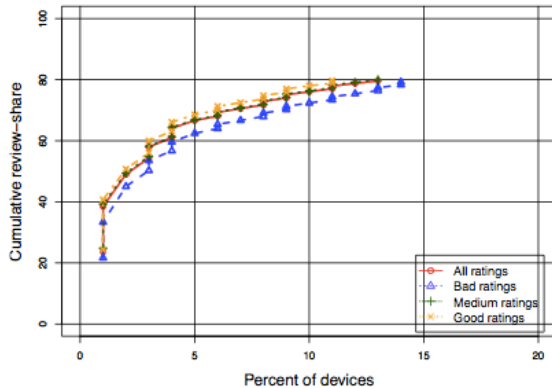
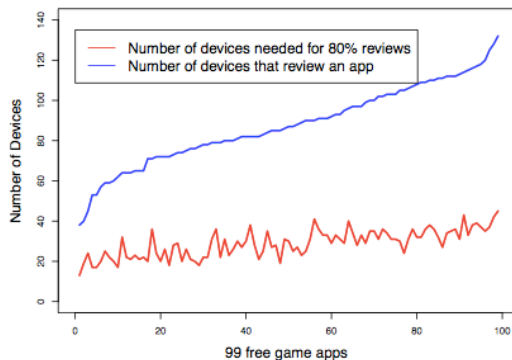
# HP AppPulse Mobile



Most Used Actions

	Users (daily avg)	Hits (daily avg)	Screen	Action	Response Time (avg)	Users with crashes
	1	3	ContextThemeWrapper	Select item from drop down list	0.2s	0%
	1	1	ZimFileSelect	Tap the <u>Done</u> button	0.09s	0%
	1	1	Welcome to Kiwix!	Tap the <u>Roy-Charles-Demo.zim</u> item	0.7s	0%
	1	1	ZimFileSelect	Tap the <u>Rescan SD card</u> button	0.2s	0%
	1	1	KiwixSettings	Navigate back	0.0s	0%
★	1	1	KiwixMobile	Tap the <u>AppCompatEditText</u> button	0.1s	0%

# How many devices are enough?



<= Free

Paid=>

Number of devices to  
cover 80% of reviews

## Prioritizing The Devices To Test Your App On: A Case Study Of Android Game Apps

Hammd Khalid<sup>1</sup>, Meiyappan Nagappan<sup>1</sup>, Emad Shihab<sup>2</sup>, Ahmed E. Hassan<sup>3</sup>

<sup>1</sup>Software Analysis and Intelligence Lab (SAIL), Queen's University, Kingston, Canada

<sup>2</sup>Department of Software Engineering, Rochester Institute of Technology, Rochester, USA

<sup>3</sup>Department of Computer Science and Software Engineering, Concordia University, Montreal, Canada

<sup>1</sup>hammd@cs.queensu.ca, <sup>2</sup>mei@se.rit.edu, <sup>3</sup>eshihab@cse.concordia.ca

<sup>1</sup>ahmed@cs.queensu.ca

### ABSTRACT

Star ratings that are given by the users of mobile apps directly impact the revenue of its developers. At the same time, for popular platforms like Android, these apps must run on hundreds of devices increasing the chance for device-specific problems. Device-specific problems could impact the rating assigned to an app, given the varying capabilities of devices (e.g., hardware and software). To fix device-specific problems developers must test their apps on a large number of Android devices, which is costly and inefficient.

Therefore, to help developers pick which devices to test their apps on, we propose using the devices that are mentioned in user reviews. We mine the user reviews of 99 free game apps and find that, apps receive user reviews from a large number of devices: between 38 to 132 unique devices. However, most of the reviews (80%) originate from a small subset of devices (on average, 33%). Furthermore, we find that developers of new game apps with no reviews can use the review data of similar game apps to select the devices that they should focus on first. Finally, among the set of devices that generate the most reviews for an app, we find that some

and large companies are developing an enormous amount of applications (called mobile apps), designed to run on Android devices. However, the top-rated or the featured apps in the app markets, are the apps with the most downloads, and hence the most revenue [2, 3]. Also the app market is very competitive, especially for game app developers who have to compete with almost 120,000 game apps already in the Google Play store – more than any other category of apps. To compete in this environment, developers need to get (and maintain) good ratings for their apps [2]. This can be difficult since users are easily annoyed by buggy apps, and that annoyance could lead to bad ratings [4, 5]. Hence, app developers need to test their apps thoroughly on different devices to avoid a poor rating.

To make matters worse, there exists a large number of Android devices, each with its own nuances. In fact, dealing with device specific issues of (the many) Android devices is considered one of the biggest challenges developers face when creating an Android app [6]. A 2013 survey from Appearator, which has aggregated results from similar such surveys in the past three years, shows that

“Prioritizing the devices to test your app on : A case study of android game apps”



Questionnaire

# Results

# Aims: to glean 2 perspectives

1. As a potential beneficiary
2. As someone being observed

## Emerging Patterns

1. Takers 3/10
2. Balanced 7/10
3. Dislike 2/10
4. Lagging what's happening

Are you willing to try?

# Two ears to listen

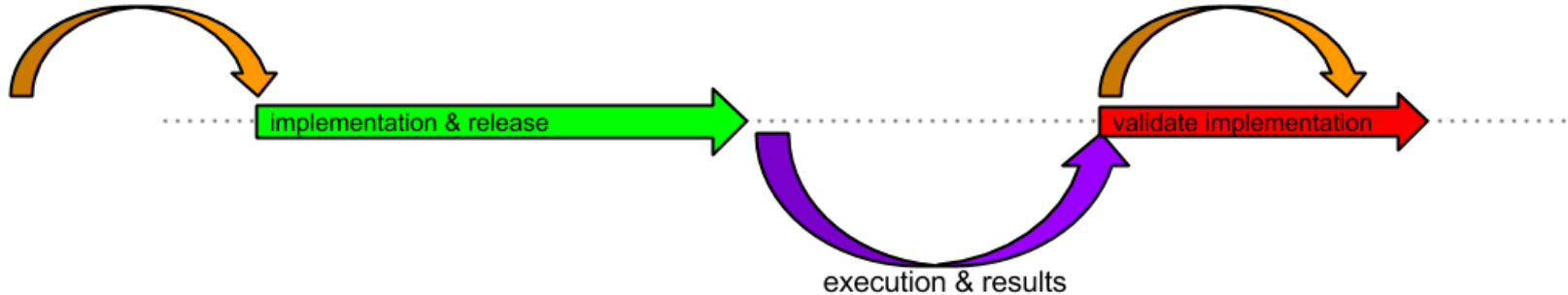
# Getting Involved

Design events to gather data  
to validate ideas, assumptions  
& verify quality-in-use

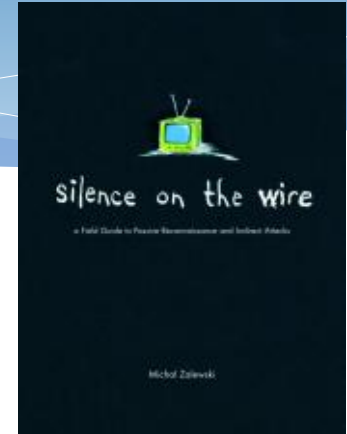
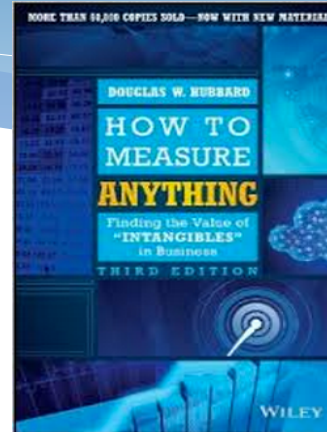
*Testing aspects*

Review and assess the results  
of our work.

Also use the results to design  
tests for the current and future  
releases.



# Further reading



Email me for academic references

These books available at:

- [1] <http://enough.de>
- [2] <http://wip.org/>
- [3] <http://www.appqualitybook.com/>
- [4] <http://www.howtomeasureanything.com/>
- [5] <https://www.nostarch.com/silence.htm>

Later: [julianharty@gmail.com](mailto:julianharty@gmail.com)

Q&A Now?