ISMA 14

The 14th IFPUG International Software Measurement & Analysis (ISMA14) Conference

Cleveland (USA) – September 15, 2017

Measurements in the IoT

[Joe Schofield](http://joejr.com)

A Quick Look Back at ISMA Presentations

2016	*Agile: From Teenager to Adult;* Metricas 2016; Sao Paulo, Brazil
2015	*Wanted: A GPS to Track My Agile Project;* ISMA11; Sao Paulo, Brazil
2015	*Implications and Opportunities Relevant to "Agile" Measurement*; ISMA10; Charlotte, N.C.
2014	*Have We Forgotten WHY We Measure?*; ISMA 9; Madrid, Spain
2013	*Using Benchmarks to Accelerate Process Improvement*; IT Confidence and ISBSG Workshops; Rio de Janeiro, Brazil
2013	*Automated Function Point Counting: Threat or Opportunity?*; International Software Measurement & Analysis (ISMA8) Conference; Rio de Janeiro, Brazil;
2012	*Measurement Challenges, Obstacles, and Victories;* Metricas 2012; Sao Paulo, Brazil
2012	*IFPUG Update Ten Tips for Prematurely Terminating Your Measurement Program*; International Software Measurement & Analysis (ISMA7) Conference; Phoenix, AZ.
2011	*Competitive Analytics - IT Implications*; International Software Measurement & Analysis Conference; Richmond, VA.; September 12, 2011
2010	*Using Function Point Analysis for Software Measurement and Estimating;* International Software Measurement & Analysis Conference; Sao Paulo, Brazil; September 14, 2010
2009	*Leaning Lean Six Sigma for Results;* ISMA; September, 2009
2008	*Estimating Latent Defects Using Capture-Recapture: Lessons from Biology; Arlington, VA.; 2008 International Software Measurement and Analysis (ISMA) Conference; September 18, 2008*
2007	*'Manda, Panda, and the CMMI(R)*; Las Vegas, NV.; 2007; ISMA Conference; September 14, 2007
2006	*Defect Collection & Analysis – The Basis of Software Quality Improvement*; ISMA Conference, September, 2006
2004	*Applying Lean Six Sigma to Software Engineering;* IFPUG Conference; September, 2004
2003	*Amplified Lessons from the Ant Hill – What Ants and Software Engineers Have in Common*; IFPUG Conference, Sept., 2003 *Lessons from the Ant Hill - What Ants and Software Engineers Have in Common*; Information Systems Management, Winter 2003
2002	*Counting KLOCs – Software Measurement's Ultimate Futility (I can't do this anymore, or who am I fooling?, or why not count ants?);* IFPUG Conference; September, 2002

Abstract as Submitted

Much has changed over the past 30 years. Some 30 billion devices, 6 trillion dollar impact, over 30 trillion addresses, aging systems accruing technical debt faster than it can be resolved; security, privacy, and governance, at risk! Huge numbers, big data. How do we determine meaningful measurements in very non-traditional software systems participating in the IoT? What role does FPA or SNAP play or is this all just fake news? Engage with us as we try to imagine scoping the size of this challenge.

References / Research / Credits:

Beebom

Capers Jones

CyberTrends

Forbes

Forrester Research

Gartner Group

IFPUG: CPM & SNAP

ITU

McKinsey & Company

SANS Institute

WIRED

So, what is the IoT, the Internet of Things?

- Simply put, this is the concept of basically connecting any device with an on and off switch to the Internet (and/or to each other). Forbes , "A Simple Explanation Of 'The Internet Of Things"; Jacob Morgan 5/13/2014
- The **Internet of things** (**IoT**) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data.
- The **Internet of Things (IoT)** has been defined in Recommendation ITU-T Y.2060 (06/2012) as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies. International Telecommunication Union standards group
- The **Internet of Things** revolves around increased machine-to-machine communication; it's built on cloud computing and networks of data-gathering sensors; it's mobile, virtual, and instantaneous connection; and they say it's going to make everything in our lives from streetlights to seaports "smart." The IoT is Far Bigger Than Anyone Realized; Wired
- "any-to-any connectivity"; Internet of Things Summit 2013; SANS Institute

See more at: https://www.cybertrend.com/article/17701/the-dark-side-of-the-internet-of-things#sthash.W5zS8gF5.nCGamC3s.dpuf

So, your best guess please . . . T / F

The IoT is projected to be between a $4T and $7T market by 2020

The number of connected devices is expected to be between 26B and 50B by 2020

25 percent of automobiles sold will be autonomous by 2035

Industry will be able to analyze most of the connected devices data

Fortunately, most of the threats related to security and privacy are addressed

The IoT is today, still a concept awaiting implementation and usage

Connected devices may be implanted, ingested, and even tattooed in / on bodies

Technical debt associated with devices may eclipse $100T by 2025

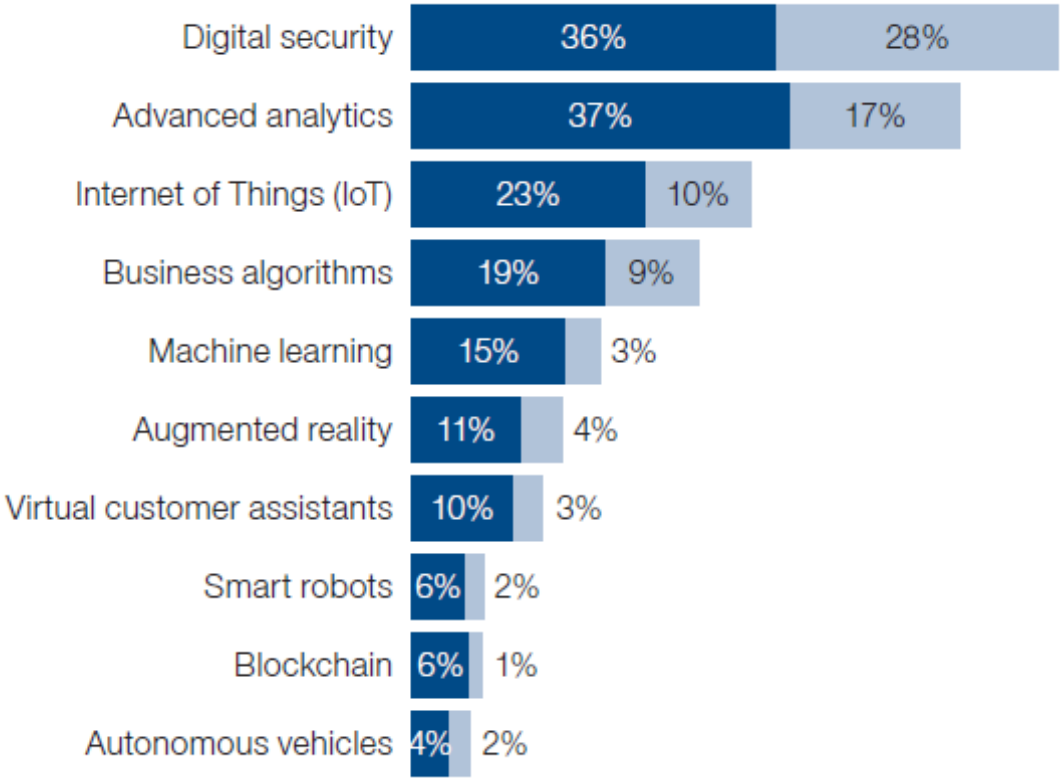
The Internet of Things – How Big is Big?

Somewhere between $4T and $11T by 2025

What's New with the IoT; McKinsey & Company, May, 2017; Mark Patel, Jason Shangkuan, Christopher Thomas

The Internet of Things – Investment $$$

Recent and planned spending



Insights From the 2017 Gartner CIO Agenda Report

The Internet of Things – How Big is Big?

- Gartner forecasts that 8.4 billion connected things will be in use worldwide in 2017, up 31 percent from 2016; related spending will reach almost $2 trillion in 2017.
- Gartner predicts that by 2020 there will be over 26 billion connected devices . . . others estimate this number to be over 100 billion. Gartner Press Release; February 7, 2017
- Analysts have predicted that the installed base for Internet of Things devices will grow from around 10 billion connected devices today to as many as 30 billion devices by 2020. http://www.mckinsey.com/industries/high-tech/our-insights/the-internet-of-things-sizing-up-the-opportunity; By Harald Bauer, Mark Patel, and Jan Veira; December, 2014
- More than 30 billion devices will be wirelessly connected to the Internet of things by 2020. ABI Research
- McKinsey Global Institute research estimates that the impact of the Internet of Things on the global economy might be as high as $6.2 trillion by 2025. For more, see *Disruptive technologies: Advances that will transform life, business, and the global economy*, McKinsey Global Institute, May 2013.
- IDC estimates IoT spending @ 1.4T by 2021. CyberTrend; August, 2017
- Aging Software Applications with Structural Decay, Error-prone Modules, and *Geriatric* Problems. As software applications age, structural complexity increases and bad-fix injections increase. Decay is proportional to application size. Capers Consolidated Life Work; Table 53; circa 2015

When you connect aging technologies with existing technical debt, to current technology, the aging technology is still a weak and fragile link compounding (exponentiating) technical debt –
Joe Schofield; 6/28/2017

The Internet of Things – Not So Fast . . .

- Predictions 2017: (**BUT**) Security And Skills Will Temper Growth Of IoT; Forrester report
- An oil rig may have 30,000 sensors **BUT** only 1 percent of data is being analyzed (digital oil field)
- Growth is expected **BUT** industrial application is lagging
- Lidar (laser-based scanning and recognition sensors) with prices tumbling by falling 65-fold over next two years, are needed to "drive" autonomous cars – 25 percent of cars sold by 2035 **BUT** every IoT connection is a potential hacking opportunity; driven by failure to reset default passwords
- Video and microphone analytics will enable retailers to track customers steps, paces, reactions, turns, as part of consumer demographics / persona **BUT** all of these devices require power sources
- IoT: everything's connected **BUT** the Electronic Frontier Foundation has voiced issues related to companies intentionally disabling customers' devices with remote software updates. "Lifetime Subscription" was voided after the sourcing company changed hands.

What's New with the IoT; McKinsey & Company, May, 2017; Mark Patel, Jason Shangkuan, Christopher Thomas

The Internet of Things – Smarter than Dumb People!

What if:

- While delayed in heavy traffic your car sends a text notifying your family that you will be late?
- Your coffee maker started your morning brew based on a signal from your alarm clock, or a sensor in your bedroom that you actually got up, or your toothbrush?
- Sensors in buildings, bridges, roadways, vehicles (air, sea, and land), machinery, facilities (homes, factories, businesses, hospitals), your "putter," basketball (bet on # of spins for a free throw or tumbles of a football for an extra points) for monitoring, managing, reducing financial risk?
- Smart materials (concrete, steel) alerted civil engineers that weight or perhaps heat were about the cause a roadway or a dam to buckle?

OR, a hacker:

- "updated" the "feed" to your pace maker
- increased the dosage of medication into your bloodstream
- converted your *autonomous* vehicle into a *devious* vehicle
- disrupted traffic flow during a national event
- *hijacked* the controls to your flight on the way home
- injected a *backdoor* into a new drone
- *ransomed* the next election results in your home country
- sent false (fake) financial data that disrupted world stock markets

The Internet of Things – Sources of Connectivity!

Joe's B/Sing:

- Medical devices – see the info on heart monitors alone
- Clothing – performance wear
- Manufacturing
- Agriculture
- Social networks / Life360 / Spyware for monitoring families (elderly, children, babies)
- Environment (DOI / BLM early 2000s)
- Home / Office
- Transportation (air, sea, rail, roadways, traffic control systems (PHX and "smart highways")
- Autonomous vehicles: cars, planes (drones (AF and pilots)),
- Retail
- Marketing
- Construction
- Defense systems
- Accounting / Finance
- Banking
- Energy – grids, power systems, water systems, oil, gas,
- Overlapping, chaining, and hierarchy of import / significance (oil production volumes touch energy, touch retail, touch manufacturing supply chains, touch transportation . . .)

The Internet of Things – Already in Use

- Nest Smart Thermostat
- WeMo Switch Smart Plug
- Philips Hue Smart Bulbs
- August Smart Lock
- Canary Smart Security System
- Samsung SmartThings Hub
- Kolibree Smart Toothbrush
- Petnet Smart Pet Feeder

15 Examples of Internet of Things Technology in Use Today – Beebom
https://beebom.com/examples-of-internet-of-things-technology/

U.S.-based smart home spending reaches $9.8B in 2016; expected to double by 2018.

The Asian smart home market will surpass Europe, the Middle East, and Africa in 2018.

CyberTrend, August, 2018

The Internet of Things – Focus on Health Care

- A "connected" Band-Aid that signals when the wound is healed
- A skin patch (tattoo? Wearable?) that contains all your medical information
- Implantables and ingestibles to provide a stream of data for blood sugar, heart (other muscle and organ) function, dispensing medication and effectiveness, treatment options and recovery

http://infobionic.com/the-system/; http://glysens.com/; www.proteus.com

- Wirelessly connected medical devices enable timely care
- An IoT platform allows for the monitoring of patients, services, medications, equipment
- IoT devices provide ease of access to current data for health care staff

https://www.cybertrend.com/article/23138/medical-connection-iot-in-health-care; 1/6/2017

$154B IoT in Health Care & Pharmaceuticals by 2025

What's New with the IoT; McKinsey & Company, May, 2017; Mark Patel, Jason Shangkuan, Christopher Thomas

Ransomware may come to / through the IoT and cause significant problems, especially in health care.

CyberTrend, August, 2017, pg. 45

The Internet of Things – Focus on the Auto Industry

Ford is partnering with BlackBerry incorporating QNX OS and security already in use in 60+ million vehicles.

With permission, Amanda Travis, © 2017

BMW and Ford plan to integrate with the Amazon Echo enabling "you" to start your car with a voice command.

Cadillac's Super Cruise scheduled for use in late 2018 will notify drivers when they are looking away from the road. A camera will monitor the driver's eye movement.

Connected Cars Trends & Features; CyberTrends; July, 2017, pgs 30 - 35

The Internet of Things – Focus on Retail

- IoT can be used for supply-chain management to track assets throughout the process from manufacturer to store shelf.
- Connected point-of-sale systems allow for on-the-go transactions, more product information, and better customer-support collaboration.
- Beacons can be spread throughout a retail store to offer targeted marketing and promotions to encourage more sales.
- Point-of-sale and employee empowerment
- RFID in items for post-sale usage, service, replacement (creepy?)
- Retailers can use gathered customer data to change processes, improve customer support, and adjust store layouts –

See more at: https://www.cybertrend.com/article/23501/internet-of-things-in-retail#sthash.bLCKHR8k.dpuf

IoT Regulatory "Influence"

The Federal Trade Commission (FTC) published its guidance in January 2015:

- **Data security** – Secure data collection, storage and processing during design.
- **Data consent** – Provide users with choices for IoT-shared data; inform users when data gets compromised.
- **Data minimization** – Minimize collected IoT data and minimize the time it is retained.
- Expect additional guidance

Viewing IoT Through a Capers Inspired Prism

From his life long collection:

Microsoft Excel Worksheet

- Table 42: Costs of Cancelled Projects as a percentage of Costs of Completed Projects of the same size and type

  Note: Because most cancelled projects are late and over budget, they cost substantially more than successful projects of the same size.

- Table 49: Estimated Life Expectancy of Applications before Retirement or Replacement

  Note: Length of service is proportional to size.

- Table 53: Estimated percent of Aging Software Applications with Structural Decay, Error-prone Modules, and Geriatric Problems

  Note: As software applications age, structural complexity increases and bad-fix injections increase. Decay is proportional to application size.

- Table 56: Estimated Number of Aging Legacy Applications that have been fully renovated as of 2015

  Note: Full renovation includes restructuring, refactoring, data mining of business rules, function point analysis of size, removal of error-prone modules.

- Table 61: Estimated Total Growth of Software from Initial Requirements Until Retirement by Size and Type of Application

  Note: Software applications grow if being used continuously. Both the value and the difficulty of renovation increase as application size increases.

- Table 64: Approximate percentage of U.S. Software Applications using technologies which lead to successful development and deployment

  Note: Successful approaches include formal estimates, formal inspections, formal change control, formal tracking, CMM 3 or higher, TSP/PSP, project offices, six-sigma for software, renovation of legacy applications, formal measurements, daily SCRUM sessions, and full testing.

- Table 61: Estimated Total Growth of Software from Initial Requirements Until Retirement by Size and Type of Application

  Note: Software applications grow if being used continuously. The value and the difficulty of renovation increase as application size increases.

- Table 93: $152B spent on software “bugs” 2015

Growth of Technical Debt – How Big is Big?

Assumptions:

per Gartner (last slide) ~ 26B devices by 2020

Per McKinsey (last slide) ~ 20 – 30B devices by 2020 (as many as 100B)

Equates to a growth of 10B items between 2017 and 2020 – a growth of 50%, or about 80% since 2015

Capers estimated a total of $42B in technical debt in 2015

Assertions:

Using Gartner & McKinsey estimates for growth and Capers estimates for Technical Debt, Technical Debt can be expected to grow to about $74B ($42B * 1.8)

If each device had only 1 EI, 1 EQ, and 1 ILF, all with low complexity, that would equate to 13 UFPs 130B UFPs (13 x 10B devices)

Capers has also listed "Waste per FP" @ $1549 and using the numbers above, the total eclipses $201T (I used a calculator and calculated the sum twice since I couldn't believe it myself).

Remember, the amount is worldwide and the amount today is for software and components that have not been remediated; chances are, this amount won't be either!

That sum of $201T does NOT include delayed or canceled projects which would triple that amount!

Certainly such a large number includes: privacy, security (hacking, misuse, "leakage", masquerading, hijacking (cars, planes, anything on any grid), ransomware, sabotage) ownership, social

The Internet of Things – Function & SNAP Points

- Determine the type of count – could be Development, Enhancement, or Application
- Identify the scope and boundary of the count – maybe more challenging with shared ILFs and EIFs (think 2nd through nth *degrees* of touches)
- Determine the unadjusted FP count
- Determine the Value Adjustment Factor
- Calculate the Adjusted FP Count

Prediction: the impact of technical debt as devices become connected in unintended ways will present a more challenging dilemma than the functional or non-functional size of the systems!

SNAP

1. Data Operations
   - 1.1. Data Entry Validations ☑
   - 1.2. Logical and Mathematical Operations
   - 1.3. Data Formatting ☑
   - 1.4. Internal Data Movements
   - 1.5. Delivering Added Value to Users by Data Configuration
2. Interface Design
   - 2.1. User Interfaces ☑
   - 2.2. Help Methods
   - 2.3. Multiple Input Methods ☑
   - 2.4. Multiple Output Formats ☑
3. Technical Environment
   - 3.1. Multiple Platform ☑
   - 3.2. Database Technology ☑
   - 3.3. Batch Processes
4. Architecture
   - 4.1. Component Based Software
   - 4.2. Multiple Input / Output interfaces ☑

So, your best guess please . . . T / F

The IoT is projected to be between a $4T and $7T market by 2020 (F - $11T)

The number of connected devices is expected to be between 26B and 50B by 2020 (T and F – 100B)

25 percent of automobiles sold will be autonomous by 2035 (T)

Industry will be able to analyze most of the connected devices data (F)

Fortunately, most of the threats related to security and privacy are addressed (haha)

The IoT is today, still a concept awaiting implementation and usage (T / F)

Connected devices may be implanted, ingested, and even tattooed in / on bodies (T)

Technical debt associated with devices may eclipse $100T by 2025 (F, > $200T)

Our contribution to technology and measurement is not predicting the future, it is instead, providing the capability to sustain meaningful measures in a future that is not predictable.

About the presenter . . .

http://joejr.com/presentd.htm

http://joejr.com/publishd.htm

Career Summary

Selected Key Roles: Joe Schofield is the President Emeritus of the International Function Point Users Group. He retired from Sandia National Laboratories as a Distinguished Member of the Technical Staff after a 31-year career. During twelve of those years he served as the SEPG Chair for an organization of about 400 personnel which was awarded a SW-CMM® Level 3 in 2005. He continued as the migration lead to CMMI® Level 4 until his departure.

As an enabler and educator: Joe is an Authorized Training Partner with VMEdu and a Scrum Certified Trainer with SCRUMstudy™. He has facilitated ~200 teams in the areas of software specification, team building, and organizational planning using lean six sigma, business process reengineering, and JAD. Joe has taught over 100 college courses, 75 of those at graduate level. He was a certified instructor for the Introduction to the CMMI for most of the past decade. Joe has over 80 published books, papers, conference presentations and keynotes—including contributions to the books: *The IFPUG Guide to IT* and *Software Measurement* (2012), *IT Measurement*, *Certified Function Point Specialist Exam Guide*, and *The Economics of Software Quality*. Joe has presented several worldwide webinars for the Software Best Practices Webinar Series sponsored by Computer Aid, Inc.

Life long learning: Joe holds six agile-related certifications: SA, SCT™, SMC™, SDC™, SPOC™, and SAMC™. Additionally, he is a Certified Software Quality Analyst, Certified Function Point Specialist, and a Certified Software Measurement Specialist. Joe was a CMMI Institute certified Instructor for the Introduction to the CMMI® and a Lockheed Martin certified Lean Six Sigma Black Belt. He completed his Master's degree in MIS at the University of Arizona in 1980.

Community & Family: Joe was a licensed girl's mid-school basketball coach in the state of NM for 21 seasons--the last five undefeated, over a span of 50 games. He served seven years volunteering in his church's children's choir; eventually called to oversee 150 children and 20 staff. Was appointed to serve on the state of New Mexico's Professional Standards Commission. By "others" he is known as a husband, father, and grandfather.

So, your best guess please . . . T / F