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“There seems to be a strong wind pushing us in the direction of a very digital, data-centric, and connected era to better understand our customers and eventually drive higher revenue and profit — albeit tempered with ongoing security and ethical challenges.”

— *Cutter IT Journal* team

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In Remembrance of Ed Yourdon, founder, *Cutter IT Journal*



As many of you will know by the time you read this, Ed Yourdon, a guru in our field, passed away on January 20th. He was a pioneer in software engineering, author of 26 computer books and hundreds of computer articles, a prominent consultant and lecturer, and, here at Cutter, founder and longtime Editor of what is now known as *Cutter IT Journal*. Ed also cofounded the Consortium part of Cutter, authored many Cutter technology journals, and wrote thousands of Cutter *Advisors*. Most importantly, Ed was a great friend to all of us. His influence on Cutter's mission and values endures.

My first encounter with Ed was at a CASE conference. He had just delivered a brilliant keynote that, true to form, was as entertaining as it was insightful. Admirers swarmed him like a rock star, so it was not until one of the last sessions that I was able to grab a seat next to his and approach him. My reason for tailing Ed was to discuss his monthly journal, *American Programmer*, which he had launched following the sale of Yourdon Inc. I was a fan, and I thought Cutter could be a terrific future home for this exceptional publication.

American Programmer addressed all the key issues facing the software industry at the time, but in a revolutionary format. Ed focused each issue on a single topic, beginning with a call for papers that

generated thoughtful, and sometimes controversial, contributions from around the world. This was pre-Internet, so the international perspective was unique. Painstaking editing by Ed's wife, Toni Nash, transformed brilliant articles that had been a challenge to read into lucent, beautifully crafted pieces. And Ed gave perspective to the differing viewpoints, drawing conclusions and identifying trends for the diverse and global readership.

Before I had the good fortune of getting to know Ed, I thought it odd that a journal with readers and contributors worldwide, covering issues of interest to IT executives, was called "*American Programmer*." But I came to understand that it made total sense. Ed was always on the side of the person in the trenches. When students or programmers wrote to Ed seeking advice, he invariably took time to answer them in detail, to encourage them, to invest the effort someone else would have reserved for an important thought leader or client. Ed was a mentor to all.

It was everyone's good fortune that Ed continued on as Editor for many years of what we together renamed *Cutter IT Journal*. When he finally decided he was ready to transition to Editor Emeritus, we realized Ed was irreplaceable. No one had the same deep understanding of such a diverse range of technology topics, coupled with his level of intellectual curiosity, passion, and extraordinary writing skills. There was no one who could take Ed's place. That's when *CITJ* began its current tradition of using an expert Guest Editor for each issue.

Cutter IT Journal continues to be one of Cutter's most popular research vehicles, thanks to Ed's inspiration. We owe so much to Ed, not only for *CITJ*, but equally for his role in helping to shape so many of our products and services. Yet despite his many contributions, what we all remember most is Ed's kind and generous nature, his wit and humor, his perfect prose, and his great wisdom — about life and everything IT. Thank you, Ed, for all you gave us.

— Karen Fine Coburn, CEO, Cutter Consortium



Opening Statement

Technology seems to be moving at the speed of light these days, so we decided to ask Cutter's team of experts for their insights on some of the technologies and trends that are going to be game changers in 2016 and beyond. In true *Cutter IT Journal* fashion, our call produced a wide range of opinions on what everyone from C-suite executives to technology managers should plan for as they strive to meet their business and technology goals.

Some of the game-changing technologies our authors discuss include those related to the Internet of Things, analytics of structured and unstructured data, wearables, machine learning, data visualization, social media, location-based services, and even AI, robotics, and quantum computing — technologies no longer confined to the realm of science fiction. In the more established areas, the discussions center around implementing more robust EA and security approaches to prepare for and respond to terrorist attacks; using Agile to “keep hammering at barriers to the faster, more reliable delivery of greater software value”; and building in quality from the start to gain market advantage.

From our authors' perspectives, there seems to be a strong wind pushing us in the direction of a very digital, data-centric, and connected era to better understand our customers and eventually drive higher revenue and profit — albeit tempered with ongoing security and ethical challenges. Let's find out more about what they see in their crystal balls.

In our first article, Steve Andriole asks “C-suite(rs)” to consider the following questions: What's your technology plan? What game-changing technologies are you tracking? How will these technologies drive revenue and profit? Andriole then provides the answers he believes will ensure your technology plans contribute significantly to the bottom line.

Next, Robert Charette speaks to the ethical concerns associated with the increased use of algorithms in smart machines such as robotics-enabled warfare and autonomously driven vehicles and discusses how AI can be used for the benefit, and not harm, of humankind.

Paul Clermont's predictions focus on the need for better security policies and technologies to stem the tide of hacking and terrorism, some of which might include cracking down on social networking. He highlights the need to strike a balance between the protection of national interests and personal privacy.

Next up, Darren Meister explores three trends he thinks will push demands on corporate IT departments and the IT industry broadly: wearables, machine intelligence, and data visualization. He demonstrates how each trend will allow us to work smarter and simplify our lives — a win-win all around.

According to Tom Grant, 2016 will be a celebratory year for Agilists. “Not only has Agile enjoyed mainstream status for several years now,” Grant argues, “but its success has also allowed Agile to become a laboratory for other innovations, from new techniques for customer insights to delivery of software as fast as you produce it.”

Next, Carl Pritchard predicts that “2016 is the year we can all look forward to a host of ‘new’ Agile practices, each with its own nuance, and each with its own subset of practitioners.” Organizations “will adapt or adopt the practices that have the greatest appeal or best fit within [their] cultures.”

In our next article, Roger Evernden considers the role enterprise architecture plays in this age of terrorism. In an emergency response situation, EA can ensure that “information and resources from a wide variety of different teams are effectively deployed” as well as provide the processes and frameworks to expedite these operations.

Addressing the nine lives of QA in software engineering, Maurizio Mancini believes that organizations should use multiple tools to do test automation, including open source tools. He also feels that organizations that work at building in quality rather than trying to test it in will have a significant market advantage.

Lastly, Alexander Rodrigues takes us on a scientific journey exploring the idea of quantum computing, a technology “capable of breaking the barriers of time and space.” With significant advances underway, IT might realize its vast potential within the next decade.

Our authors paint a bright and promising future for those organizations that wish to leverage the vast opportunities these new technologies will provide. The only question that remains is, are you ready to take this quantum leap of technology faith?

— *Cutter IT Journal* team



Talking the Talk: Advice to C-Suite(rs) About “Game-Changing” Technology

by Steve Andriole

The Internet of Things.

Location-based services.

Automated reasoning.

Social media.

Wearables.

Analytics.

I could extend this list of “game-changing” technologies, and so could you.

What’s a CEO, CIO, CTO, CFO, or business unit president to do? Especially when they go to an investor conference and they’re asked to explain “the game-changing technology plan”?

Game changers need context; otherwise, C-suite(rs) end up chasing “the next great things,” which is what many companies have done for decades.

Those who work in the C-suite need smart people, budgets, and technology solutions to impact their business processes and overall business model. In other words, game changers need context; otherwise, C-suite(rs) end up chasing “the next great things,” which is what many companies have done for decades. Remember business process reengineering, Six Sigma, matrix management, and management by objectives? Who created Six Sigma “Black Belts,” anyway? Brilliant. (Again, I could go on, and so could you.)

ANSWERING THREE CRITICAL QUESTIONS

Here are three questions that all C-suite residents must answer without hesitation and ideally with the clarity of Bill Clinton, the designated “Secretary of Explaining Stuff”¹:

1. What’s your technology plan?
2. What game-changing technologies are you tracking?
3. How will these technologies drive revenue and profit?

These questions are fundamental, especially as everyone aspires to “digital transformation.”² The answers need some themes, however, such as “continuous,” “ongoing,” and even “risky.” This means that the most effective digital transformation should be explicitly branded as something companies pursue continuously and are willing to take some risk for to achieve transformative goals. This necessarily assumes uncertainty, an especially complicated concept to communicate to shareholders, who always want definitive answers to their questions. But given the pace of technology change, it’s impossible to guarantee specificity — or results. Some time and money will be wasted, regardless of how many Black Belts are hanging around. Said a little differently, digital transformation cannot be guaranteed — even if companies commit to long-term transformation investments.

So in answer to the three questions, here’s what C-suite(rs) should say.

What’s Your Technology Plan?

“First, we plan to move all our technology infrastructure (email, storage, office applications, etc.) to the cloud in 2016 and 2017. The team agrees on moving both infrastructure *and* applications to the cloud. This will save us money and enable us to focus more on the business than the technology infrastructure that enables it: we cannot *wait* to get out of the technology business. (Nervous laughter.)

“We will listen much more closely to what the business units are telling us about technology, and we will pay closer attention to what our competitors are doing with it. There’s no reason to be the earliest adopter of game-changing technology. We can do quite well as fast followers *through the demonstration pilot process.*

“We want to keep technology costs from rising too quickly while at the same time investing in game-changing technologies. We realize that we, like everyone, must spend more money on digital security — maybe a lot more money. We also realize that it’s a challenge to stay competitive while spending less. Since technology costs have generally fallen, though, we think we can invest more — and more wisely.”

What Game-Changing Technologies Are You Tracking?

“I read *Wired*, *Forbes*, *Bloomberg*, and *Fast Company*. I just saw *Steve Jobs*. Does that help? (Expect a lot of laughter.)

“We have a list of technologies we plan to pilot. The whole notion of ‘piloting’ again deserves special mention. Pilots assume uncertainty. They’re designed to test technologies against specific problems. Our list of game-changing technologies is a hypothesis about what *might* work. Not what *will* work. Our pilots will show us the way — or not — depending on how the technologies actually perform. In our case, as retailers, we have some specific objectives we’d like to achieve. Our pilots will focus on the high-leverage areas.

“We need to leverage the *Internet of Things*, otherwise known as ‘IoT.’ Our retail supply chain can benefit from the connectivity and processes that IoT enables. Always-on sensors can change our business, making us more adaptive, efficient, and profitable. We plan to integrate our connected devices and products to learn more about where our customers are, what they do, and how we can attract them to make additional purchases. This initiative will dovetail with our analytics initiatives. We already have three IoT pilots underway.

“*Location-based services* are definitely on our radar. The pilots we’ve launched integrate sensors with the locations of our customers. We also have pilots that track customers over time to determine patterns in their buying activity. We expect to be able to optimize our communication with customers, suppliers, and employees through location-based technology and the services it enables.

“Everyone knows that it’s only a matter of time before processes become *automated*. Much of this automation will initially be focused on deductive inferential problems like ‘If the symptoms look like this, then the disease is likely this.’ In our case, we’re looking for ‘reasoning’ that automates sales, digital ad placement, distribution, and customer service.

“We plan to closely listen to what our customers are saying about our products and services. We will expand our investments in *social media*, including all outward-bound communications and not just through the usual social suspects like Facebook and Twitter. We will invest in descriptive, predictive, and prescriptive analytics based on the analysis of social and other unstructured data. Prescriptive analytics based on social and other data will permit us to intervene when customers ‘signal’ unhappiness, or worse, the decision to stop buying our products.

One thing is for sure: wearable technology will create enormous streams of data, many of which will be in real time.

“Any list of game-changing technologies must include *wearables*. One thing is for sure: wearable technology will create enormous streams of data, many of which will be in real time. We plan to pilot the connectivity possibilities among wearables, location awareness, sales, marketing, and service. Like all retailers, we need to understand the role that wearables will play in our sales, distribution, and service processes.

“We need to extensively pilot *analytics* methods, tools, and techniques. This means all kinds of analytics: big data analytics, unstructured data analytics, and the integration of structured and unstructured data to get a full view of processes, customers, suppliers, and employees. We need to make sure that our data professionals can identify, collect, and organize structured and unstructured data, because if they can’t, we cannot see enough into our operations, cost, or profitability. We must better understand the ‘voice of the customer.’ We have several major analytics pilots planned for 2016 and 2017. While many of the game changers we plan to pilot will be ranked according to their solution impact, we already expect analytics to become a core competency.”

How Will These Technologies Drive Revenue and Profit?

“One of the outcomes of our technology strategy is deeper knowledge about customers. Technologies like analytics and social media enable segmentation, location, and real-time marketing. Personalization and customization are the objectives here. Segmentation can be

monetized. We anticipate significant up-selling and cross-selling opportunities. Location-based selling will become a major revenue stream.

“We plan to reduce our technology capital expenditures by 50% over the next five years while increasing our technology operating expenses by 25% over the same period of time. We also plan to reduce spending on physical assets by 50% over the next five years. We expect to have fewer offices and much smaller travel budgets. If well executed, our technology plan will contribute significantly to our bottom line. Investments in global teleconferencing will save us *and* make us money.

“New performance metrics will be defined and employed to assess the return on all of our game-changing technology investments. Open innovation initiatives will enable us to pilot technologies quickly and cheaply. These metrics will be published.

“Thank you for your time. We are willing to answer any questions you might have about the technology pilots and pivots we plan to make. But make no mistake: we will be tracking and testing as many potential game-changing technologies as we can find. Remember also that the list I described today will be replaced with yet more game changers, a process that’s unlikely to ever abate.”

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Let's Hope 2016 Is the Year of the Ethical Algorithm

by Robert N. Charette

One cannot have superior science and inferior morals.
The combination is unstable and self-destructing.

— Arthur C. Clarke

The late futurist and science fiction writer Arthur C. Clarke's observation has long been a staple theme of science fiction stories, especially those involving smart machines and whether the algorithms used to make decisions would be for the benefit of humankind or its destruction.¹ As artificial intelligence (AI) and robotics research has progressed along with growth in computing power, that programming question has steadily moved out of the realm of science fiction and into the computing technical community over the past decade. This has been especially true in the military establishment as the use of robotics rapidly increased far beyond even the most optimistic projections made only a decade ago.

Yet the widespread use of robotics in war, and the implications for programming smart machines, didn't really penetrate the general public's consciousness. P.W. Singer, the author of *Wired for War*, a book that delves into the military's use of robotic warriors, told me he was amazed that even senior military leadership didn't seem to fully understand what transitioning to smart machines involved. While they acknowledged that robotics-enabled warfare was "revolutionary," they didn't fully comprehend that "technologies are revolutionary not only because of the incredible new capabilities they offer you, but because of the incredible new questions they force you to ask — questions about what's possible that was never possible before and also new questions about what's proper, what's right or wrong that you didn't have to think about before."²

RISE OF THE ROBOTIC KILLING MACHINES

In 2015, the question of what's right or wrong when using ever smarter machines started to filter into more mainstream public discussion. One reason has been the very public statements from Elon Musk, Stephen Hawking, and other scientists warning that AI technology has reached a point of practicality where there is a real threat of a "global AI arms race."³ They worry that

countries are already vying to build ever more capable autonomous weapons that can select and engage targets without human intervention. 2015 also saw more urgent calls to formally ban such weapons as part of current military treaties prohibiting the use of inhumane weapons.⁴ As a response to what they perceive as a potential "existential threat" to humanity, Musk and several other venture capitalists pledged over US \$1 billion to set up a nonprofit AI research center in hopes of ensuring that AI is used for the benefit of humankind.^{5,6}

In 2015, the question of what's right or wrong when using ever smarter machines started to filter into more mainstream public discussion.

AUTONOMOUSLY DRIVEN VEHICLES BECOME A REALITY

Another force bringing the question of increasing algorithmic control of our lives to the forefront of the public's mind has been the extraordinary improvement in autonomously driven vehicles since 2005, to the point that all major car manufacturers and many technology firms have promised to have such cars available for sale by 2020 if not before.⁷ The sticking point to their introduction has been less technological and more legal and political. California's Department of Motor Vehicles (DMV), for example, recently published draft regulations on self-driving cars requiring that all such cars in California have a steering wheel and operating pedals, and that a licensed driver with an "autonomous vehicle operator certificate" be present to take control in case of an emergency.⁸

The contentious legal arguments over defining what is considered to be acceptable smart machine operation have involved not only autonomously driven vehicles, but commercial unmanned aerial vehicles (UAVs) as well. The US Federal Aviation Administration (FAA) issued regulations in December 2015 mandating that nearly all UAVs for sale in the US (including those already sold) will need to be registered with the federal government.⁹ The rationale for the regulation is the

worrying increase in the number of UAV-aircraft near misses that have been reported and UAV crashes that have resulted in property damage and personal injuries. It is a first step toward future regulations that the FAA is drafting in regard to fully out-of-sight UAVs, such as those that some companies want to use for package delivery.

If 2016 is not the year that we start paying attention to the ethics of algorithms, it had better be soon.

AUTOMATED DUPLICITY, RAPACITY, AND PERFIDY

A third driving force that has brought the question of what should be considered acceptable smart machine practice has been the increasing number of incidents of companies using software to defraud the government, their customers, or both.

For example, in September 2015 Volkswagen admitted that, since 2008, it had used engine control software to illegally help some 11 million of its vehicles sold around the world pass emission tests.¹⁰ The company has set aside \$7.2 billion dollars to cover the anticipated costs of governmental fines and consumer lawsuits. In another case, Barclay's Bank agreed to pay \$635 million in penalties in 2015 for twice manipulating its electronic foreign exchange trading, one instance relating to manipulating spot market trading and the other involving its "Last Look" trade system.¹¹ In the latter instance, which began in 2011, Barclay's dishonestly rejected client trades whenever they would cost the bank money and then lied to their clients as to the real reasons why their trades were rejected. And in a third case, both Honda Motors and Fiat Chrysler were fined \$70 million apiece by the US National Highway Transportation Safety Administration for failing for more than a decade to report vehicle safety issues to the government as required.^{12, 13} Both auto companies blamed inadvertent "computer programming errors" for the oversight, a claim that did not seem credible to anyone.

THE LAW AND ETHICS AND THE ERA OF SMART TECHNOLOGY

It is a truism that policy makers and legislators struggle to keep up with the societal implications of emerging

technologies.¹⁴ On one hand, there is the desire not to stifle technological innovation and the benefits it brings, but on the other, it is also important to protect the public from harm. In this nascent era of smart machines, where technology is moving from artifacts that are used to artifacts that we interact with, the law is falling further and further behind in providing needed guidance. For instance, US states such as Texas have no legal constraints on self-driving cars, and state officials indicate that they won't impose any anytime soon.¹⁵ That could set up an interesting situation where a self-driving car that would be "street legal" in Texas would be illegal to drive in California.

There are even more vexing issues to consider. For example, what path should a self-driving car be programmed to take in the event it finds itself in a situation where it may either have to crash into a bus stop full of schoolchildren or a nearby single adult pedestrian? The "trolley problem," as it is called, is just one ethical dilemma that the designers of smart machines now have to confront, solve, and defend to politicians, the public, and their lawyers.¹⁶ Similar trolley problems are arising as smart machines are being developed for use in health-care, aviation, finance, law enforcement, and so on.

TURNING POINT

When the law doesn't exist, our only guidance to programming the algorithms of our smart machines is the ethics or value judgments we hold regarding what does and does not constitute acceptable behavior. But the question is — as it has been for thousands of years — in whose ethics and whose interests should we ultimately place our trust?¹⁷ I predict 2016 will be a year when that question becomes a topic of major public interest.

One reason is that, according to a Bloomberg News story, the year 2015 marked a turning point for AI.¹⁸ Significant progress has been made on a host of difficult problems, ranging from image recognition to machine learning. Furthermore, we can expect improvements in AI to start accelerating in 2016, making the question of whether the algorithms being used to control smart machines are ethical — with all that word signifies — more important than ever.

If 2016 is not the year that we start paying attention to the ethics of algorithms, it had better be soon. For as Noel Sharkey, cofounder and executive chair of the newly formed Foundation for Responsible Robotics, has observed:

We are rushing headlong into the robotics revolution without consideration for the many unforeseen problems lying around the corner. It is time now to step back and think hard about the future of the technology before it sneaks up and bites us when we are least expecting it.¹⁹

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Technology Forecasting Is Not Just About Technology

by Paul Clermont

Never make forecasts, especially about the future.

— Sam Goldwyn

This is particularly good advice for those with the courage (temerity? foolhardiness?) to forecast trends in technology. We can safely predict that technologies will get better/faster/cheaper/smaller, but which ones? Who will use them? How? For what? Back in the days when fairly standard IT was just bought by organizations with cost-conscious and risk-averse CFOs, the only question was how much technology would be bought, which depended largely on the overall economy. Starting in the 1980s, when ordinary people began buying IT, much of it from brand-new companies, predicting consumers' tastes and quantifying their demand presented a whole new challenge. Add in the Internet, and what technologies consumers use that matters to the companies from whom they obtain goods and services. Getting specific about which technologies will be game changers in the coming year is not a game for the faint-hearted, and I don't pretend to know enough even to try to play.

THREE PREDICTIONS

That said, I have three predictions for 2016 that cut across existing technologies and how they're used, managed, and protected:

1. We Will See More Action on Security

The increased frequency of hacking into company and government computers and the data theft we've been seeing will result in more and stronger actions on the *security* front. They will be driven from three directions:

- a. The IT industry will make more of a full-court press in response to demand from both business customers and consumers, plus the threat of government intervention, especially now that terrorism is back on the front pages. Business opportunities should increase for startups and small companies offering clever and innovative tools and techniques.

- b. Companies using IT will focus more on improving their own business practices and will spring for more effective technology, publicizing their investments for competitive advantage. They have a lot at stake. Companies in the business-to-consumer space depend on their customers' continuing confidence in the safety of financial transactions. Companies in the business-to-business space maintain proprietary customer and product information of likely value to competitors.
- c. Governments will increasingly demand better security for their data and equipment. The negative consequences of malicious hacking into, say, the US Department of Defense (DoD), Central Intelligence Agency (CIA), or Internal Revenue Service (IRS) stagger the imagination.

As an aside, this increased focus should spur some rationality in dealing with hackers. Clearly, those who hack into systems for personal gain — by stealing credit card information, for example, or wreaking havoc in critical systems (cyberterrorists) — should encounter the full harshness of the law. But those hackers who successfully break in solely for the intellectual gratification of proving it can be done are potentially national treasures and should be put to work for the good guys. Yes, they have trespassed, but.... Perhaps the latest reminders of the reality of terrorism will cause prosecutors and judges to think twice about taking critical talent out of circulation. (Then again, the US military drummed out a number of Arabic speakers for being gay even as the army was invading Iraq, so I suppose we shouldn't get overly optimistic about the triumph of common sense.)

2. We Will Begin to Curb the Excesses of Social Networking

The Wild West of *social networking* will start to be tamed as concerns regarding its use by really bad people for really bad purposes, such as recruiting terrorists or planning attacks, will call into question the libertarian

paradigm in which it has operated. Providers of platforms will have much more trouble making the case that they're just like common carriers who have no responsibility for what passes through their servers. Unlike telephones, the data is digital and thus easily captured, stored, and analyzed. US Senator Diane Feinstein (D-CA) was only the first to announce plans to introduce legislation that moves in this direction. If such a thing happens, there will be a market for sophisticated approaches to text and picture analysis and pattern recognition.

Misuse of social networks is not just a national security and public safety issue, where legislation and executive orders are real possibilities. As more cases of cyberbullying with tragic consequences come to the surface, it would seem inevitable that victims would try to recover damages from social network operators (although to my knowledge this has not happened so far).

3. Governments Will Move on Metadata Analysis and Data Decryption

In the wake of the Paris and San Bernardino attacks, governments will have a stronger case to make for mass collection, storage, and analysis of *metadata* and their ability to *decrypt* actual data. The privacy concerns raised by Edward Snowden's revelations will likely be overridden by here-and-now concerns about public safety. The reality of concrete threats usually trumps abstract principles, however noble.

In the decryption area, there's tension between governments' efforts to improve national security and industry's efforts to improve system security. Governments may try to outlaw end-to-end encryption or force companies to deploy encryption with backdoors, all of which would increase the surface area for hackers to attack. We can expect a serious policy-related back-and-forth.

However this plays out, opportunities will emerge for inventors and purveyors of sophisticated algorithms and heuristics to analyze the metadata and whatever is decrypted. Expertise in search and pattern recognition in both text and images will be good to have. This is big data analysis on steroids. Advanced research and development funded by governments under the rubric of national security will provide lots of private sector benefits. (I hardly need to tell this audience that the Internet started out in the 1970s as ARPAnet, a US DoD program.)

CONCLUSION

People who make predictions often succumb to a bias in favor of predicting what they would like to see happen. Several months ago I argued strongly for better security in an article on technology backlash,¹ so I hope I'm right there. I had no *a priori* position on social networking, but having thought about it, I would favor some change. My prediction about increased capability for government snooping was easy to make, given the emotional power of the recent scenes of carnage, yet I remain ambivalent about hoping I'm correct — though perhaps less ambivalent than before Paris.

In the decryption area, there's tension between governments' efforts to improve national security and industry's efforts to improve system security.

ENDNOTE

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2016 Trends Hitting the Mainstream: Wearables, Machine Intelligence, and Data Visualization

by Darren Meister

I spend most of my time looking at how individuals access data, information, and knowledge in ways that allow them to make better decisions and to enjoy themselves. With that in mind, here are a few thoughts about some trends that I think will push demands on corporate IT departments and the IT industry broadly: wearables, machine intelligence, and data visualization.

Many companies are still trying to work out their BYOD (bring your own device) policies, and wearables have the potential to ignite exponentially greater user-driven disruption.

WEARABLES

If you look at most phones, tablets, and laptops, you see a continuing clumsy interaction between human and device. A phone flipping through the air as the user loses her handle on it is not a surprising event. Laptops crash to the ground, and there is a thriving industry in screen replacement. While watches do not seem to be the ideal solution, wearables will continue to grow. The gap between the appearance of the first handhelds and the development of truly usable handheld devices was probably 10-15 years. I think the elapsed time between the first wearables, which appeared about five years ago, and the mass-adopted ones is going to be much shorter. Intel is making significant acquisitions to ensure that it leads users out of the smartphone era, as it isn't a player in that market. Companies such as Garmin, Samsung, and Microsoft are also pushing very hard to grow the value of this market. So I believe we will see very significant advances in this segment due to market forces.

Many companies are still trying to work out their BYOD (bring your own device) policies, and wearables have the potential to ignite exponentially greater user-driven disruption. This will occur for a few reasons. One, a

wearable is a more personal choice than any previous technology. Our clothes are key in creating our self-image. People will not want *a* smart coat but *that* smart coat — maybe from Donna Karan, but just as likely from that quirky little designer located in Soho. The allure of “smart” clothes will drive this market, and the confluence of design, technology, and manufacturability is nearing the point of critical mass. And every one of these devices will have the potential to create security issues that organizations will be challenged to address.

MACHINE INTELLIGENCE

Machine intelligence can conjure up smart robots buying our food, driving it home themselves, and then, for good measure, cooking the meal. I'll be shocked if 2016 gives us that. However, I do see 2016 as the year where vast quantities of sensors building the Internet of Things will meet up with the ever-increasing amount of processing power we can apply to a specific place at a point of time. I expect that we will witness massive advances in worker safety that will combine wearables with the ability to sense dangerous situations and patterns faster than any human can reasonably do. As many of these settings relate to worker safety or directly to productivity, adoption will happen quickly once the business case is finalized.

Machine intelligence offers obvious benefits in situations like these: complex and rapidly changing environments where it is possible to measure many elements of the situation. As the situations occur repeatedly, we can train machine intelligence systems to recognize patterns and simplify complex environments for human action. The human will not be removed, but thousands of stimuli will be reduced to a manageable set of conditions.

DATA VISUALIZATION

Remember presentations with acetates or maybe 35 mm slides? Remember how quickly PowerPoint replaced these as a standard for professional presentations? This

past year has seen the release of fantastic tools for data visualization, but perhaps even more importantly, informative and captivating examples of the use of data visualization to inform audiences. Examples are FusionCharts, Datawrapper, and Leaflet, along with offerings from stalwarts Google and Microsoft. Senior executives can use these tools to explain the complex business environments within which their companies are operating. Analyst teams can use them to trigger discussions about previously underappreciated facts. Pictures are great for helping humans recognize patterns and identify trends and outliers (think of how the simple but powerful scatter plot can show both of these). As these types of presentations become more common, the demand for IT departments to support the tools, and underlying databases, will grow rapidly. 2016 looks like the year where these powerful visualization tools could make the jump from unusual to common.

WHY NOW?

These three trends come to my mind for simple reasons:

- **The basic technologies, processes, and capabilities exist.** They are still relatively experimental, but thousands of trials are running. We are learning quickly, and all that is missing is for the learning to become complete enough.
- **Each trend allows us to simplify our lives.** Wearables integrate into how we work. What if we did not have to remember our smartphones? Instead, we'd just get dressed, and whatever we wore would connect us to

our information, like *Peanuts'* Pigpen was connected to his cloud behind him? Machine intelligence can take a tsunami of information and turn it into a few clear islands of information. Data visualization lets us more easily see the important rather than be overwhelmed by streams of the usual. These trends bring "easy."

- **The benefits of each trend are obvious.** Convenience, reduced mental complexity, and improved insight clearly connect to our jobs and our desire to work smarter, better, and in a more interesting way.

It boils down to a complete and easy win. And really that's always why we've seen successful technologies take off. Their benefit is obvious, they're easy to understand, and they're compatible with how we want to work. For these reasons, wearables, machine intelligence, and data visualization are well positioned to transition into the mainstream and the daily lives of corporate IT departments in 2016.

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Agile in 2016: Party out of Bounds

by Tom Grant

For Agilists, 2016 will be a celebratory year. Not only has Agile enjoyed mainstream status for several years now, its success has allowed Agile to become a laboratory for other innovations, from new techniques for customer insights to delivery of software as fast as you can produce it.

When you join a party where everyone is having the best time imaginable, the last thing on your mind is how annoyed the people next door are, and how happy the people paying for it are. Those are two major considerations for Agile in 2016, which will appear as the not-too-subtle subtext for several ongoing developments.

It's no surprise that some of the best Agilists are familiar with organizational sociology, motivational psychology, statistical analysis, and other topics that their CS professors did not teach them.

THE AGILE PARTY HAS A BIG PLAYLIST

Soon after you walk into one of these Agile gatherings (like, say, the yearly Agile Alliance or Agile Roots conferences), you'll find yourself in interesting conversations about a broad range of topics. DevOps, scaled Agile, UX and Agile, interpersonal dynamics among team members, story mapping, serious games, better estimation, no estimation, Kanban, mob programming, automated testing, exploratory testing, technical debt, Cynefin, organizational models, continuous delivery, measurement, metrics, Agile BI... And that's just a small sampling of a long, long list of topics that Agilists are discussing. They feel passionately about these topics, too, so these conversations are rarely dull.

This explosion of innovation means that there are a significant number of people who are being Agile, not just doing Agile. The core Agile ethic of continuous improvement drives teams to keep hammering at barriers to the faster, more reliable delivery of greater

software value. What's the point of doing a two-week sprint if it takes weeks to push production-ready code into production? Can we get better insights into what customers really want? How do we reduce the burden of technical debt?

Agilists have looked within computer science for some solutions and outside that domain for others. It's no surprise that some of the best Agilists are familiar with organizational sociology, motivational psychology, statistical analysis, and other topics that their CS professors did not teach them.

CRANKING AGILE TO 11 SHAKES THE WALLS

The first-generation Agile practices and principles focused on the team. People outside the team had to make changes to accommodate the Agile team. For example, customers had to agree to participate in a demo every couple of weeks. The data center had to accommodate a faster rate of releases.

Next-generation Agile (aka Modern Agile, or Agile Plus) incorporates new techniques that have a much greater impact on the rest of the software value stream, beyond the team. Continuous delivery puts even greater stress on the relationship between development teams and operations professionals. Agile teams want to invite UX designers into the fold, but the price tag is abandoning UX approaches that don't mesh with the sprint-driven cadence of work. Crowdsourcing can give corporate lawyers and HR managers conniptions.

The more deeply rooted Agile is, the more leverage Agilists have to make these requests of people outside the team. To date, it is still hard to tell exactly how mainstream Agile really is. The available statistics on Agile adoption, from sources like the Dr. Dobb's and VersionOne surveys, certainly indicate that Agile has spread into many, if not most, organizations that do software development. Within these organizations, Agile teams are a strong minority, not yet a majority. That gives Agile teams staying power, to be sure, and some organizational clout for implementing the next generation of Agile practices.

However, even widespread adoption of Agile within an organization does not make it impregnable. Anyone who has been part of the Agile community has heard sad stories about very successful Agile experiments that met tragic fates from reorganizations, backlash from other groups, executive indifference, and other familiar “anti-patterns.” If, in some organizations, even highly successful teams can’t always defend the use of Agile methods within their own ranks, what are the odds of these teams making demands of other groups?

WHY ARE WE HAVING THIS PARTY, EXACTLY?

Agile teams would be on much firmer ground if the objectives for Agile were clearer. Unfortunately, strategic incoherence about Agile is a common malady, including in places where you might think Agile should be a major strategic asset.

During engagements with clients across the adoption spectrum, from first-timers to veterans, I use some light-weight exercises to assess alignment over the goals for Agile. How do people across the organization, from top to bottom, from within teams and from the rest of the value stream, describe the contribution that Agile makes to the organization’s larger objectives? Among these benefits (quality, customer satisfaction, time to market, etc.), which is primary?

Except in rare cases, the answers usually vary widely, even in organizations where Agile is deeply rooted and widespread. Where there is no clear goal for Agile, it should be no surprise that when Agilists make greater demands from a larger number of people, they meet resistance.

We often see this “static” complicate discussions about Agile frameworks (among many other topics), because of the organizational changes they require. Military institutions organize for the wars they plan to fight. For example, in the 2000s the US Army went through a painful evolution to go from being an institution built

to fight the Soviets in Central Europe to one that could fight the Taliban effectively in Afghanistan.

In a similar fashion, software innovators build organizations to win their battles. Are we trying to expand into new markets? Create outstanding digital experiences that keep our existing customers happy? Increase our organizational agility in a rapidly changing marketplace? Not only will the “Agile Plus” practices we adopt differ, based on which objective we choose, but we will structure the software value stream differently, too.

In 2016, therefore, Agilists will have to pause to ask, “Why are we doing Agile in the first place?” There may not be a clear answer — or there may be conflicting answers, depending on whom you ask. The success of efforts to implement Agile frameworks, DevOps, or many other Agile Plus approaches will depend on finding better answers to fundamental strategic questions.

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2016: The Year That Agile Explodes

by Carl Pritchard

“Agile” — it’s an intriguing notion. Iterative, progressively elaborated projects with core deliverables to maintain motivation and progress along the way. It makes an extraordinary amount of sense both from a project management and leadership perspective. And up until now, true Agile practice has been refined and confined to a relatively narrow province, guided by trained scrum masters and captured as a distinct (yet, niche) practice within the project management community.

This will be the year that the dam breaks, and everyone will begin to expect Agile to do everything.

2016 is the year we can all look forward to a host of “new” Agile practices, each with its own nuance, and each with its own subset of practitioners. We’ve been seeing the cracks in the wall for several years, as organizations come up with new challenges and struggle to find an Agile solution for them. This will be the year that the dam breaks, and everyone will begin to expect Agile to do everything. The hope and promise of Agile practices will morph into a variety of different sub-practices, each jockeying for a position in the pantheon of “official” practice. For all of these, there are already organizations that will lay claim to being the first to the practice, but what will matter ultimately is which becomes the predominant approach.

AGILE LITE

Already out in a host of different forms is what organizations like to refer to as “Agile Lite.” It’s all of the essential practices of a quality Agile program, as long as you leave out the “quality” part. For some organizations, this is Agile without the follow-up

and documentation. For others, the daily scrum is relegated to a twice-weekly scrum (or less). For others still, Agile Lite implies that the organization is not necessarily committed to hard deliverables at the end of every sprint.

Despite flying in the face of conventional Agile practice, Agile Lite will grow in appeal for the very simple reason that it’s easier. Easier, however, does not equate to “better,” which is why some practitioners will look at this approach with some very serious disdain.

AGILE WATERFALL

In the list of business oxymorons, this is at the top. Waterfall is the long-standing convention of plan, plan, plan, build, test. Agile is an approach of small tastes. Little increments. Nominal deliverables. Despite the fact that professionals on both sides argue that their approach is best when performed as intended, expect 2016 to bring with it a number of new pros who will contend that there is a middle ground between the practices. That middle ground will come in a variety of forms, but each organization that attempts to occupy it will be firm in the belief that they have the “magic bullet.”

AGILE SLOW ROLL

One of the big advantages of Agile has been its ability to generate deliverables from the very beginning. The fact that Agile projects move quickly opens the door to a rapid evaluation of what might work. Surprisingly, not all organizations are anxious to move quickly. Some seek the opportunity to build deliverables at a more sluggish pace. They like the Agile practices, but they aren’t ready to review or introduce a new deliverable on a monthly basis. Consequently, 2016 may also see the more torpid version of Agile, with less frequent scrums, less frequent deliverables, and a willingness to acknowledge that a sprint can be more of a slow walk.

AGILE EARNED VALUE

Perhaps the most intriguing component of the Agile landscape in 2016 will be the attempts at integrating earned value management practice with Agile. The requirement that earned value incorporate a clearly defined baseline and Agile's amorphous baseline practices create a seemingly irreconcilable situation where the managers need to be able to track variance from a baseline that largely doesn't exist. The seeming diametric opposition of the two practices will likely generate some serious mutations of both practices, but how it will ultimately shake out is anyone's guess.

Some organizations will attempt a reconciliation by identifying the sprint as the baseline, while others will evaluate each sprint as its own mini-project with a distinct estimate at completion for the sprint but not for the project as a whole. Still others will revamp the terms, the labels, and the math to accommodate the flexibility afforded in the Agile environment.

WHO CARES?

Anyone who's considering Agile in the year ahead will care. For a time, most of the texts and work on Agile protocols has been reasonably consistent, but over time, as with any business practice, there is a craving for improvement and enhancement. 2016 is the year when those enhancements will begin to take on a life of their own.

This opens the door for us to have a better understanding of what elements of Agile practice we value organizationally, and to adapt or adopt the practices that have the greatest appeal or best fit within our cultures. If we don't care to join in the explosion, we also have the

opportunity to paint ourselves as Agile purists who have not been drawn in by the latest flavor of the day. Knowing how we're going to manage the proliferation of AgileA, AgileB, and AgileC will give us the distinct edge in either bracing for the change or remaining stalwart in our defense of classic Agile practice.

For 2016, this is just one of the elements on the management horizon. But the rules for all of them remain largely the same. Identify what's coming, determine where you and your organization will fit in the new paradigm, and publish/affirm your intentions. For what's coming in 2016 — be it different versions of Agile management or flying cars (which I believe *are* coming eventually) — if we know where we fit in the larger scheme of management practice, we have a higher probability of making our organizations succeed.

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EA in an Age of Terrorism

by Roger Evernden

Clearly we live in a world where terrorism is a major global threat. So when the *Cutter IT Journal* team asked me for my thoughts about technology trends and predictions for 2016, I started thinking about the role of enterprise architecture (EA) in an age of terrorism.

Terrorism can affect any enterprise at any time, and by its very nature, the impact and consequences of a terrorist attack cannot be predicted. In some ways, this is no different from many other external events — political, economic, environmental, social, or technological — that have a direct effect on an enterprise. To be resilient and sustainable, enterprise architectures must be able to respond and adapt positively to unpredictable and unanticipated situations. So what can EA do to anticipate, prepare for, respond to, and possibly prevent a terrorist attack?

EA can play a vital role in ensuring that information and resources from a wide variety of different teams are effectively deployed.

EA IN ATTACK RESPONSE

Much has already been achieved to define ways in which EA can respond to terrorism. Version 2.0 of the Information Sharing Environment (ISE) EA Framework was published in September 2008.¹ It provides a strategic roadmap to enable a standard information-sharing environment to support defense, foreign affairs, homeland security, intelligence, and law enforcement. The framework covers relevant goals, processes, services, data, technologies, and operational capabilities. At the heart of this, and other similar initiatives, are the concepts of cooperation, collaboration, and sharing. This starts with the sharing of information and intelligence, but it can easily move on to sharing other architectural components in order to respond to terrorist attacks.

Terrorism has also become a topic for EA-related research. For example, recent studies have covered ways in which we can use different types of models to fuse diverse information sources to help detect terrorism² and how structural factors might contribute to or produce political terrorism.³

EA IN SERVICE COORDINATION

Following an attack, the most immediate need is coordination of the emergency services and other responses. This broadly falls under the banner of emergency response management (ERM).⁴ Increasingly, this is necessary across organizational, jurisdictional, and geographical boundaries. In EA terms, this forces us to think of a much broader definition of “enterprise”; in this case the enterprise is the full coordinated response to a terrorist event. EA can play a vital role in ensuring that information and resources from a wide variety of different teams are effectively deployed. This is already happening in many countries and across some country boundaries.

Another good example, although not specifically aimed at terrorism, is the cross-government enterprise architecture that was published as part of a UK government initiative to bring together CTOs from across the public sector.⁵ Formed in 2005, the CTO Council has been tasked with improving government practices related to the design, interoperability, development, modernization, use, reuse, sharing, performance, and efficient use of IT resources. The potential for cost cutting was a key motivation, but opportunities for sharing information resources are likely to be the greatest benefit.

Following the immediate response to a terrorist attack, there may be an additional need for humanitarian aid or civil protection.⁶ One organization that helps provide the necessary conditions for a successful emergency response is the UN Office for the Coordination of Humanitarian Affairs (OCHA).⁷ Once again, EA could provide techniques, processes, and frameworks that

would make OCHA's (and other agencies') tasks much easier. For example, an EA content framework would allow diverse organizations to share information about where aid was most needed and the location and availability of vital resources. Enterprise patterns could be used to identify more effective ways to leverage architectural components to maximize benefits from donations and funds. To my knowledge, this is an area where the potential for EA support has yet to be fully realized.

WHAT DOES THIS MEAN FOR YOUR ORGANIZATION?

In terms of trends and predictions, what are the key takeaways? First, all organizations need to consider the risk to their enterprise architecture from terrorism. This should include infrastructural impact, such as damage to operational platforms, as well as the business impacts. Terrorism does not even have to occur locally, as an incident can easily cause global repercussions; for example, following the shooting down of a passenger plane or damage to energy supplies. Second, companies should consider the need for collaboration with other enterprises or across a range of enterprises — either for the sharing of information or the sharing of resources.

Terrorism is not going to go away. It is highly likely that we will see more terrorist attacks and that their impact will be more devastating. It is even possible that terrorist organizations will use EA techniques to support their own cruel and malicious ends. EA can and should be used both within the enterprise and between enterprises to anticipate and sense the terrorist threat, to produce architectures that are resilient and responsive to attack, and to help us recover from the fear, violence, and disruption caused by terrorism.

ENDNOTES

¹"Information Sharing Environment Enterprise Architecture Framework, Version 2.0." US Nationwide SAR Initiative, September 2008 (https://nsi.ncirc.gov/documents/ISE_EntArchFramework_v2.0_20081021.pdf?).

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As architect of the Information Framework (IFW), Mr. Evernden pioneered many contemporary techniques, including the use of industry reference models, business capability analysis, and component-based building blocks. His work has been the basis for more than 400 business and IT architecture initiatives worldwide. Past clients include Alcatel-Lucent, Allied Irish Banks, AstraZeneca, Bancomer, Bank Austria, Barclays, Credit Suisse, DnB NOR, HSBC, IBM, ING, Lombard, Lloyds Banking Group, Microsoft, National Australia Bank, and Westpac. Mr. Evernden has written articles appearing in major publications and books, including the seminal article on IFW in IBM Systems Journal. He is the author of two books about EA: Enterprise Architecture — The Eight Fundamental Factors and 101 Lessons from Enterprise Architecture. He can be reached at revernden@cutter.com.



The Nine Lives of QA in Software Engineering

by Maurizio Mancini

As we begin another year and try to predict where quality assurance (QA) will go in the next few years, we need to reflect for a moment on where QA has been — especially with the dire predictions in recent years that QA in software engineering is dead.

One thing that *is* dead is the traditional way of doing QA. The days of huge QA departments conducting testing mainly using manual methods, and usually as a phase after the development team is done, are gone. Market pressures and the fast-paced demand of software releases have made sure that relying on only manual testing as your QA strategy is no longer acceptable.

Having said this, organizations that think that test automation can be used as their sole method of testing software have already realized — or are in the process of realizing — that this method alone is also not adequate. So where will the QA pendulum stop?

In the middle, as it usually does.

Test automation was going to be the magic bullet that would finally enable QA to keep up with the development team.

MANUAL TESTING IS DEAD ... OR IS IT?

As managers debate what their testing strategy should be in 2016 and beyond, looking back to see how the QA of software has changed over the last decade can help prepare them for what will happen. To help *me* reflect on what was happening in QA a decade ago, I decided to review what I was doing in 2005 as a QA director in a security software firm. Here is what was at the top of my priority list in 2005:

- Windows XP was the main OS. How could we test it and all of the associated issues with drivers and all the service packs? The phrase of the moment was “testing matrix.”

- Internet Explorer 6 was the main browser, and we faced the challenges of how to test it given all the issues we had with this older browser and the technologies it used.
- Firefox 1 was starting to gain some favor with users, but it was still early.
- Netscape was the other main browser.
- How could we test everything before we had to ship the software on a CD? (Remember when we used to ship software?)
- How could we automate the testing of the software?
- How much manual testing should we do?
- How could we keep up with the development team?

Smartphones were something we had heard about, but they really had no implications for most software teams. We all had flip phones back then.

Most QA managers and directors at the time were being pushed to do more automation when it came to testing. Test automation was going to be the magic bullet that would finally enable QA to keep up with the development team. (I am sure I heard the same thing in the 1990s about test automation — it seems like *déjà vu*.)

In 2005, manual testing was just not cutting it and was on the way out. Or was it?

2016 AND BEYOND

As I consider what managers and directors are facing today, it looks and feels different, but the challenges are still the same.

Sure, we have come a long way since 2005 in terms of QA. Browsers have matured, and it is this maturity that has simplified the lives of QA teams. Shipping of software is now a foreign concept because all software is delivered via downloads, so the implications of releasing a bug into the field have been significantly reduced. Updating software on consumer devices is now a common everyday task that even the most basic user of a

device understands. The flip side of that coin, though, is that releasing a significant bug into the field is now much more damaging to an organization's reputation thanks to social media. For proof of this, just peruse any of the "top 10 software blunders" lists of the last decade.¹

"Older" technologies have gotten more mature, but there is a whole slew of new technologies that will help to ensure that both automated and manual testing will be required not only in 2016 but beyond. Software engineering managers and directors will need to keep up and make sure they have the right mix of both kinds of testing. You cannot just plan to use one type given the endless ways that software is being used and will be used in the future. Software has spread to almost every corner of our lives. In addition to the obvious computers and smartphones, here is just a short list of the things in which software is being used today:

- Cars
- Entertainment devices (Blu-ray players, personal video recorders, music players)
- Appliances (refrigerators, washers, dryers)
- Light bulbs and home lighting systems
- Security devices (cameras, deadlocks)
- Exercise machines
- Wearables (watches, fitness trackers, etc.)
- WiFi everywhere

This Internet of Things (IoT) will require software engineering teams to have the right level of automated testing developed by both development and QA engineers, and they will need to take a balanced approach to manual testing as well. Automated testing is essential to being able to deliver and meet the aggressive deadlines to stay competitive. However, until we have robots delivering software for other robots (somewhere Isaac Asimov² is smiling), at the end of the day it is human beings that are using this software. And anybody who has been delivering software for a while knows how unpredictable these humans can be!

TEST AUTOMATION

When it comes to test automation, the question of which tools to use is the same one that QA people have faced for years. What has changed — and will continue to be true in 2016 and beyond — is that no one tool will do it all. Given the proliferation of Internet-aware devices,

software engineering teams have to have many tools in their tool belt, and among these they must consider open source tools. Open source tools have proven to be as good as, and in many cases superior to, the tools that vendors are selling. The reason for the move to open source tools is that the packaged tools have either failed to advance test automation, or the exorbitant cost of these tools has forced organizations to rethink their test automation strategies and consider using free open source tools. Some organizations will argue that the commercial tools can be used "out of the box," but the reality is you still need someone who knows how to run the tools and maintain the test automation scripts, just as for open source tools, so there are no savings in this area.

In 2016 and beyond, organizations should look at open source tools like Selenium, Appium, Calabash, Ruby, and Swift for iOS; Python as a scripting language for test automation; TLIB test automation library; and other open source tools. Commercial tools are no longer the only option for test automation, and organizations need to weigh the alternatives depending on their particular reality.

There is a whole slew of new technologies that will help to ensure that both automated and manual testing will be required not only in 2016 but beyond.

AGILE AND QUALITY

The last decade has seen a big push for everyone to become "Agile." While becoming more Agile in your software development processes is a great goal to set for your organization, we should not forget one of the fundamental reasons for doing so: increasing the quality output of the team. As Ken Schwaber and Jeff Sutherland say in their *Scrum Guide*:

The Scrum Master encourages the Scrum Team to improve, within the Scrum process framework, its development process and practices to make it more effective and enjoyable for the next Sprint. During each Sprint Retrospective, the Scrum Team plans ways to increase product quality by adapting the definition of "Done" as appropriate.³

Companies that grasp this fundamental concept about quality in Agile/Scrum and set it as a goal for their team(s) will be the ones that are successful in the future, as the demands for faster releases and more features will surely continue. If you build a culture of quality

in your organization it will pay for itself, and in the end it will help your company make money. Organizations that work to build in quality rather than trying to test it in will have a significant market advantage, as many companies (Apple, Honda, and Toyota, to name just a few) have shown.

ENDNOTES

¹For just one list of software fiascos, see: Austin, Ben. "Top 10 Software Blunders of the Last Decade." *Smartbear*, 30 April 2014 (<http://blog.smartbear.com/code-review/top-10-software-blunders-of-the-last-decade>).

²"I, Robot" (Wikipedia).

³*Scrum Guide* (www.scrumguides.org).

Maurizio Mancini is a Senior Consultant with Cutter Consortium's Agile Project Management & Software Engineering Excellence practice. He is a leader in the QA and process industries with a sixth sense for QA, Agile, and business process and is best known for cutting through the noise and getting to the heart of the problem. Mr. Mancini has built and managed QA teams working in Agile and incremental/iterative development for more than 25 years and is recognized for his ability to build QA teams for all kinds of software (e.g., mobile, back end, websites, search, security, analytics, fulfillment systems, and SaaS). He has deployed Agile across numerous teams working on software used by millions of users. His last engagement consisted of building a team of more than 100 geographically dispersed QA people embedded into more than 15 development teams, testing complex software systems from mobile devices to mainframes. Mr. Mancini is a frequent speaker at such conferences as Agile 2014, Atlassian Summit, and Quest 2015. He can be reached at mmancini@cutter.com or Twitter (@qaandprocessguy).



IT Trends for the Next Decade: Does an IT Quantum Leap Lie Ahead?

by Alexandre Rodrigues

IT continues to revolutionize on a daily basis the way in which human society operates, to the extent that change itself is no longer perceived as something new, but rather has become the normal state of affairs. Amongst all areas of human and economic activity, IT continues to lead and stimulate further this fast pace of change.

As hard evidence of this fact, we could describe an almost endless set of recent developments, including applications in aerospace, astronomy, medicine, cloud computing, smartphones, artificial intelligence (AI), drones, robots, voice and image recognition, Internet security, and so on. So what novelties and trends can we expect for 2016 and the years ahead?

OVERCOMING LIMITS TO GROWTH

An important phenomenon to consider in order to understand where we currently stand in the IT arena, and where we might be in the near future, is the concept of *limits to growth*. It stems from the principle of social systems, according to which any system will evolve rapidly toward a certain limit, but will evolve no further unless subjected to some form of discrete *step change*. This limit to growth results from the accelerated depletion of the available resources, or from an impaired ability to access and/or make use of those resources.

Examples of this phenomenon abound, from the history of the universe, life on earth, and human history. A fairly recent and familiar example is the step change achieved with the principles of mass production and economies of scale brought about by the Industrial Revolution. Another even more familiar example is the discrete step change brought about by the invention of computers. The emergence of the Internet is probably the most significant step change recently achieved in the IT world after the creation of computers in the 1950s.

So what “Internet-like” step change can we expect that will revolutionize business and society in the decade ahead? Are we at the point of achieving a new step change? Do we really need one?

STEP CHANGE AHEAD?

A first symptom that a step change lies ahead is when an unchanging constraint starts having a limiting effect on growth. Do we currently face such constraints? In my opinion, yes. One obvious constraint is socio-economic: unlike what we foresaw less than a decade ago, at the present time we do not enjoy a global environment of substantial economic growth and expansion. The world has become smaller and smaller, and Earth’s resources are becoming too few to fuel growth and prosperity in a way capable of sustaining continuous massive funding and practical use of technological developments.

Am I being too pessimistic? Let us look at an example and ask a simple question: is Internet *speed* growing exponentially worldwide? Looking at the latest statistics from Akamai, the content delivery network services provider, the global average Internet speed grew just 10% (year over year) to 5.0 Mbps, with only 4.6% of users worldwide having broadband.¹ Is this a sign of exponential sustained growth of Internet speed and usage across the world population? No. This is not because we lack the technology; it is primarily due to economic constraints. We can see that there is clearly a constraint imposed on growth that results from limited resources.

If we are to expect a significant step change in what IT has to offer business and society in general, it will have to do with a radical increase in the speed with which information and data are processed and transmitted. Information and data storage capacity will necessarily come hand in hand with this increase in speed; the faster we process information, the more data we produce in a single time unit, which then needs to be stored in greater quantities.

FULFILLING THE NEED FOR SPEED

Recent developments in astronomy and space exploration remind us that we are subject to a severely limiting constraint on speed, which Einstein discovered back

in the early 20th century: the speed of light. For despite how fast light may appear to our eyes and mind, even if humanity were able to develop a spacecraft capable of traveling at the speed of light, it would take far more than a lifetime to visit the nearest planet in our universe that could sustain conditions for life as we know it. Therefore, unless we overcome this speed barrier, we will be forever limited to our growth in technology. And while Einstein would say (and indeed demonstrated) that the speed of light cannot be overcome, recent developments and physics also demonstrate that nature supports the *instantaneous* transmittal of information — a phenomenon called *quantum entanglement*.

Quantum computing will allow computers to process and transmit information — and thereby solve complex problems — at speeds not otherwise achievable with current computers.

Quantum Mechanics/Physics

How does this affect the IT world? The search for the ideal *instantaneous speed* to transmit information is well underway; it is already influencing the way we build computers and promises to revolutionize computing speed in both processing and information transmittal. This achievement has been in the making since the beginning of the 21st century: it is called *quantum computing* and is based on the principles of the most impacting and yet least understood branch of science, *quantum mechanics*, more broadly referred to as *quantum physics*. What is it about? In short, quantum mechanics tells us that the elementary particles of matter like electrons (and unlike the macroscopic objects we perceive in the macroscopic world) *can be at many places at the same time*, behaving like a wave of probability, as opposed to a discrete particle that *can only be in one single place at a given moment in time*.

As unreal and absurd as this might sound — and it surely is highly counterintuitive — the quantum theory has been tested repeatedly in laboratories and has always been confirmed. Not only is it very real, we have been making use of it all along in the digital world of computers to master the underlying phenomenon of electricity and electronics.

As it happens, scientists are now moving further into exploring in practice this “weird” property of simultaneity that breaks the barriers of space and time. Quantum

physics has also revealed that the properties of elementary particles can become *entangled*, and hence if the status of one particle changes, the other entangled particle will also change its state *instantaneously*, regardless of the physical distance between the two particles. The full mastery of this quantum reality may even, eventually, hold the key to teleportation in space-time. For now, however, we are just aiming to make use of these “weird” properties to achieve an enormous discrete step change in computing processing power and speed.

Quantum Computers

The idea of quantum computing leads to the development of *quantum computers*. These new computers make use of the quantum properties of the physical elementary particles, through the concept of quantum-bits (or “qubits”), elementary particles of information that can be in the state of 0 and 1 *at the same time*, as opposed to the “traditional” digital computers where a bit can only be in the state of 0 or 1 at a given moment in time. This new computing paradigm will allow computers to process and transmit information — and thereby solve complex problems — at speeds not otherwise achievable with current computers.

Over the last three years alone, an array of events indicate the explosive interest in and potential of quantum computing. These range from a Nobel Prize in Physics for work in quantum physics that supports quantum computing (October 2012) to NASA’s public display of the world’s first fully operational quantum computer, developed by the Canadian company D-Wave Systems (December 2015).² Other organizations currently involved and investing in quantum computing include Google, Microsoft, and IBM.

Quantum Biology

Coupled with these developments are parallel revolutionary developments in the areas of nanotechnology, biocomputing, biological computing, and DNA computing, amongst others, in which researchers are exploring the potential of biological elements (e.g., living cells, DNA strings) for use in data storage and processing. In terms of data storage capacity, natural evolution is well ahead of humanity; the amount of information that can be found in a DNA string, for example, far outstrips the information storage capacity of the most sophisticated computer-based data storage system developed to date. The exploration of these biological elements is in turn being integrated with quantum physics through the new field of *quantum biology*.

As we explore the physics of the elementary matter to master the technology with which we develop computers and understand life and biology, the more the universe seems to fit the workings of an immensely powerful computer. These discoveries are now enabling us to bring into our own computers the formidable power of the very elementary laws of nature, in particular the instantaneous transmittal of information.

Turning Point in Sight

Over the next decade, we are on the verge of seeing a turning point taking place in computer speed and processing power. This will be the result of a discrete step change, the precise moment of which is difficult to predict, just as it is difficult to predict the broad implications for the IT world and business models and society in general. Nevertheless, we can surely anticipate a high-way opening very soon to a number of developments that we have been pursuing in the last decade. At the top of my list of predictions is the further development of AI to that point that smart machines and *intelligent robots* will be integral elements of our daily life.

CONCLUSION

With resources becoming more limited as the world grows smaller, we might expect a slowdown in the pace of revolutionary IT developments. As we reach the inevitable limits to growth, we could end up focusing only on optimizing what we already have and, thus, just becoming more efficient in doing practically the same thing.

However, we've seen this scenario before in the development of human society and of systems in general. When we reach this point of potential deadlock, stagnation is overcome by discrete step changes, accidental or human-made, which suddenly open avenues for new developments based on new paradigms. Examples range from the agricultural revolution to the rise of democracy in Greece and Rome (which social model still shapes the western cultures today), to the discovery of the New World, to the Industrial Revolution, to the invention of modern computers and the Internet.

Today we face a new forthcoming step change in our ability to manage information and the physical environment around us through information technology. The technology most likely to trigger and sustain such a

discrete change, capable of breaking the barriers of time and space (which are starting to limit us to further progress), is quantum computing. This paradigm is based on perhaps the most powerful discovery of all time for our understanding of the universe: quantum physics. Well beyond science fiction, quantum computers are just now becoming something the major players in the IT and aerospace worlds are seriously exploring, as they aim to become the innovators and leaders of the "IT quantum leap."

ENDNOTES

¹Protalinski, Emil. "Akamai: Global Average Internet Speed Grew 10% Year over Year to 5.0 Mbps, but Only 4.6% Have Broadband." VentureBeat (VB), 23 June 2015.

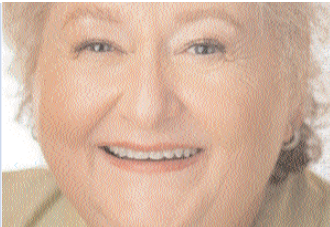
²"NASA, Google Show Off D-Wave Quantum Computer for 1st Time." CBC News, 14 December 2015.

Alexandre Rodrigues is a Senior Consultant with Cutter Consortium's Agile Product Management & Software Engineering Excellence practice. He is the Executive Partner of PMO Projects Group, where his expertise focuses on the implementation of organizational project offices, earned value management (EVM), and cost management systems. Clients include a wide range of major international organizations across all continents, including NATO in Brussels and The Hague. Dr. Rodrigues worked for several years in project management for the military and consulting industries in the UK and the US, where he extensively used system dynamics simulation modeling to analyze the complex dynamics of large projects and programs.

Dr. Rodrigues is a certified PMP and was the founding President of PMI's Portugal Chapter, having served as PMI Component Mentor for the EMEA region in 2004-2007. Dr. Rodrigues was an active member of the PMI teams that developed the PMBOK Guide (3rd edition) and the Organizational Project Management Maturity Model (OPM3). He was a member of the PMI core team that developed the second edition of PMI's Practice Standard for Earned Value Management.

For over a decade, Dr. Rodrigues has lectured on project management and system dynamics computer simulation modeling in various universities throughout Europe. Dr. Rodrigues publishes regularly in scientific and business journals, has served as Guest Editor for Cutter IT Journal, and has been a guest speaker at international conferences and other project management events. He received the 1996 Mike Simpson Award from the UK's Operational Research Society for research developed in the fields of project management and system dynamics modeling. Dr. Rodrigues holds a five-year licentiate degree in systems and informatics engineering from the University of Minho (Portugal) and a PhD in project management and system dynamics from the University of Strathclyde (UK). He can be reached at arodrigues@cutter.com.

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Giving Teams an Accelerated Start (or Restart)

Webinar with Diana Larsen, Senior Consultant, Cutter Consortium

Date: Wednesday, 24 February 2016

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Location: At your desk — just dial in!

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Fee: Complimentary

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Every new product initiative has many parts, including:

- A visionary with a *big idea*
- Individuals who are directly and indirectly involved in achieving the result

- A particular physical space(s) and psychological climate

- Process tools and techniques

The first time these parts come together sets the tone and lays the foundation for everything to come later. In this webinar, Cutter Senior Consultant Diana Larsen will lead you through an overview of the process for planning, designing, and conducting a liftoff, with Agile chartering at its core. Register now at www.cutter.com/events.



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Digital transformation has become the biggest hurdle in change management, in large part because it impacts all levels of an organization. In her latest Cutter webinar, Senior Consultant Sheila Cox will address the tricky leadership challenges that could spell success (or failure) for your organization's digital transformation.

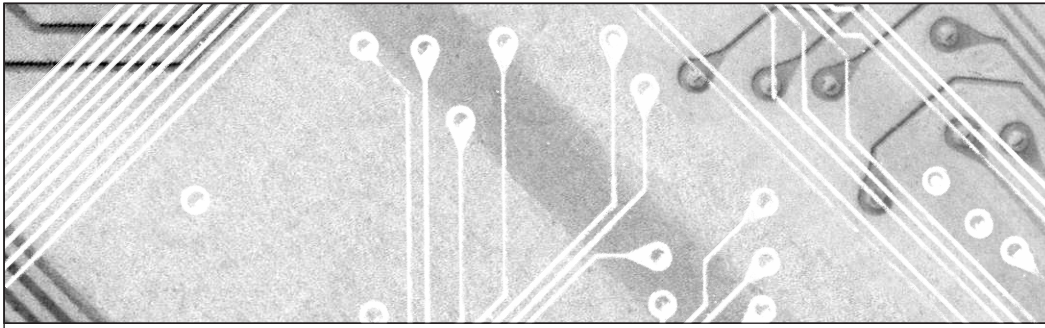
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- A vision for digital transformation that is clear, communicated, and fully understood

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Cutter IT Journal

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