THE WORLD ACCORDING TO BIG DATA

LARUS TECHNOLOGIES CORPORATION & UNIVERSITY OF OTTAWA

DR. RAMI ABIELMONA | VP RESEARCH & ENGINEERING
LARUS TECHNOLOGIES | JANUARY 23, 2018

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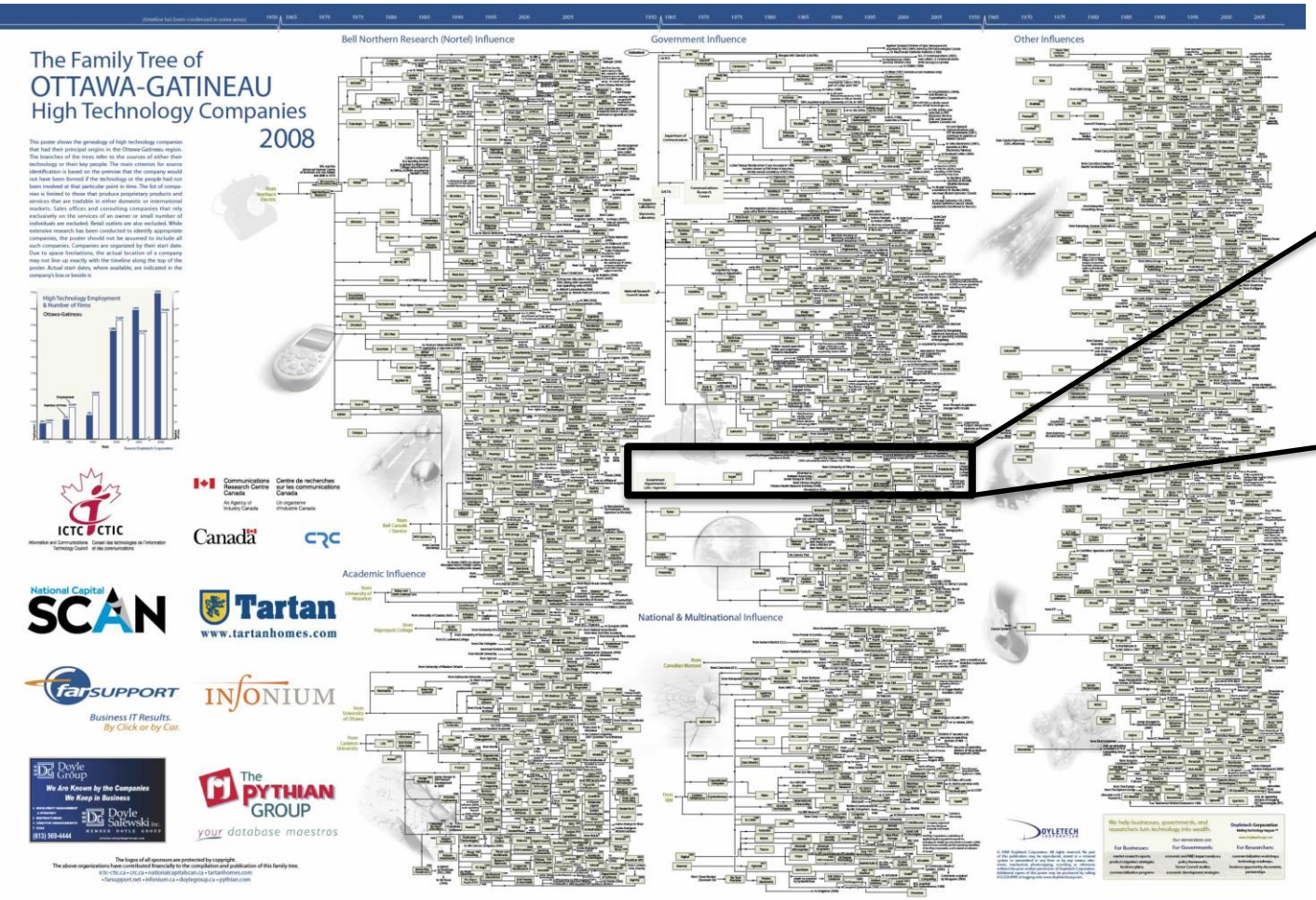
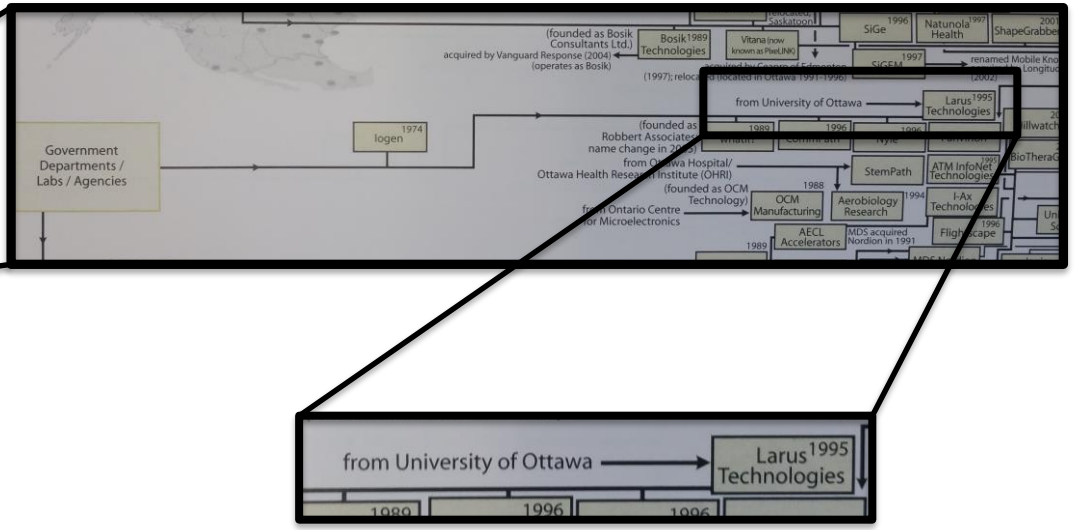
LARUS TECHNOLOGIES

Rami Abielmona, Ph.D., P.Eng., SMIEEE

- ***Assistant Professor at University of Ottawa, 2015-present***
- Senior Member, IEEE, 2011-present
- Adjunct Professor at University of Ottawa, 2010-present
- ***VP Research and Engineering at Larus Technologies, 2008-present***
- Licensed P.Eng. in Ontario (PEO), 2008-present
- ***Chair, IEEE Ottawa Section, 2013-2014***
- (Chief) Research Scientist at Larus Technologies, 2006-2008
- Ph.D. Electrical Engineering, SITE, University of Ottawa, 2007
- Standing Committee Chair, IEEE Computational Intelligence Society, 2006-2012
- Part-Time Professor at University of Ottawa, 2003-2014
- Ottawa Chapter, IEEE Computational Intelligence Society, 2003-2012
- Instructor, Mini-Enrichment Course on Robotics, University of Ottawa, 2003-2006
- M.A.Sc. Computer Engineering, SITE, University of Ottawa, 2002
- Teaching Assistant (x10), SITE, University of Ottawa, 2000-2006
- Research Assistant, SITE, University of Ottawa, 2000-2006
- B.A.Sc. Computer Engineering, SITE, University of Ottawa, 1999 (co-op option)
- Co-op workterms at DND, Newbridge (x2) and Alcatel Networks (1996-1999)

"If a person gives you his time, he can give you no more precious gift." (Frank Tyger)



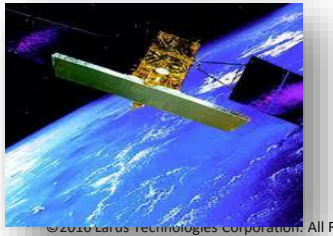


Larus Technologies

- Wholly owned Canadian engineering and product company
  - Over 20 years experience in defence and public safety awareness
  - Specializing in **predictive analytics** and **decision support software** products

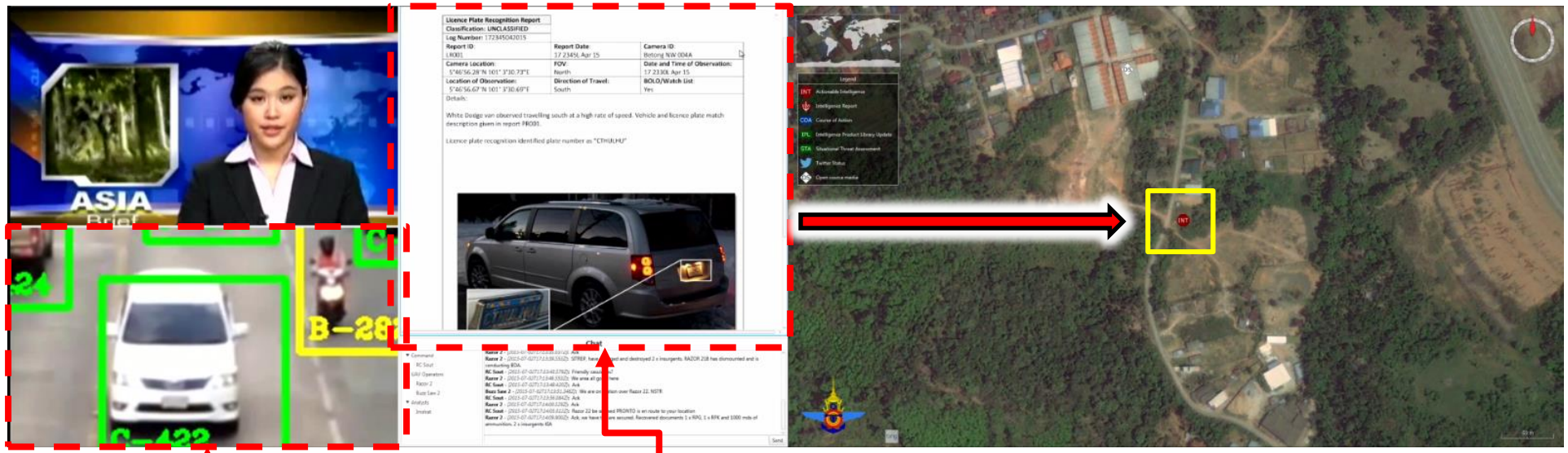
- Products and research capabilities in computational intelligence (CI) and predictive analytics for:
  - National and Public Security and Safety Systems
  - Domain Awareness (Cyber, Land, Sea, Air)
  - Command and Control Decision Support

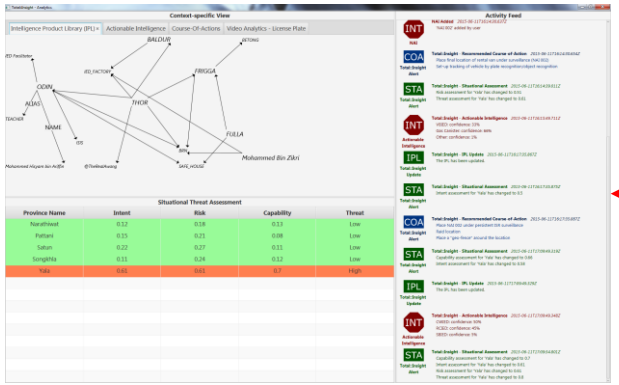
- Recognized leaders in CI and information fusion research and product development
  - ***IEEE CI Society Outstanding Organization Award 2015***
  - ***NSERC Synergy Award for Innovation (Small and Medium Enterprise) 2016***
  - ***NATO Communications and Information Agency (NCIA) Top Innovator Award 2017***



Total::Insight™ Decision Support System

Real-World Deployments

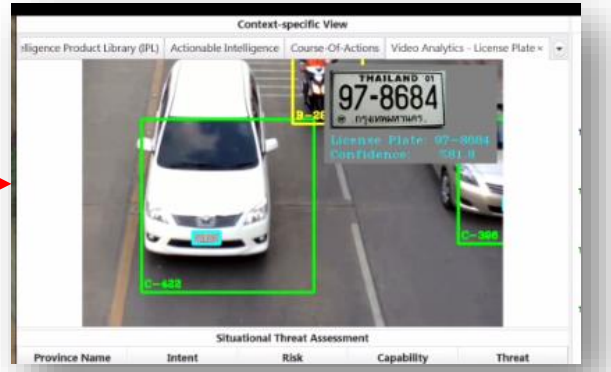




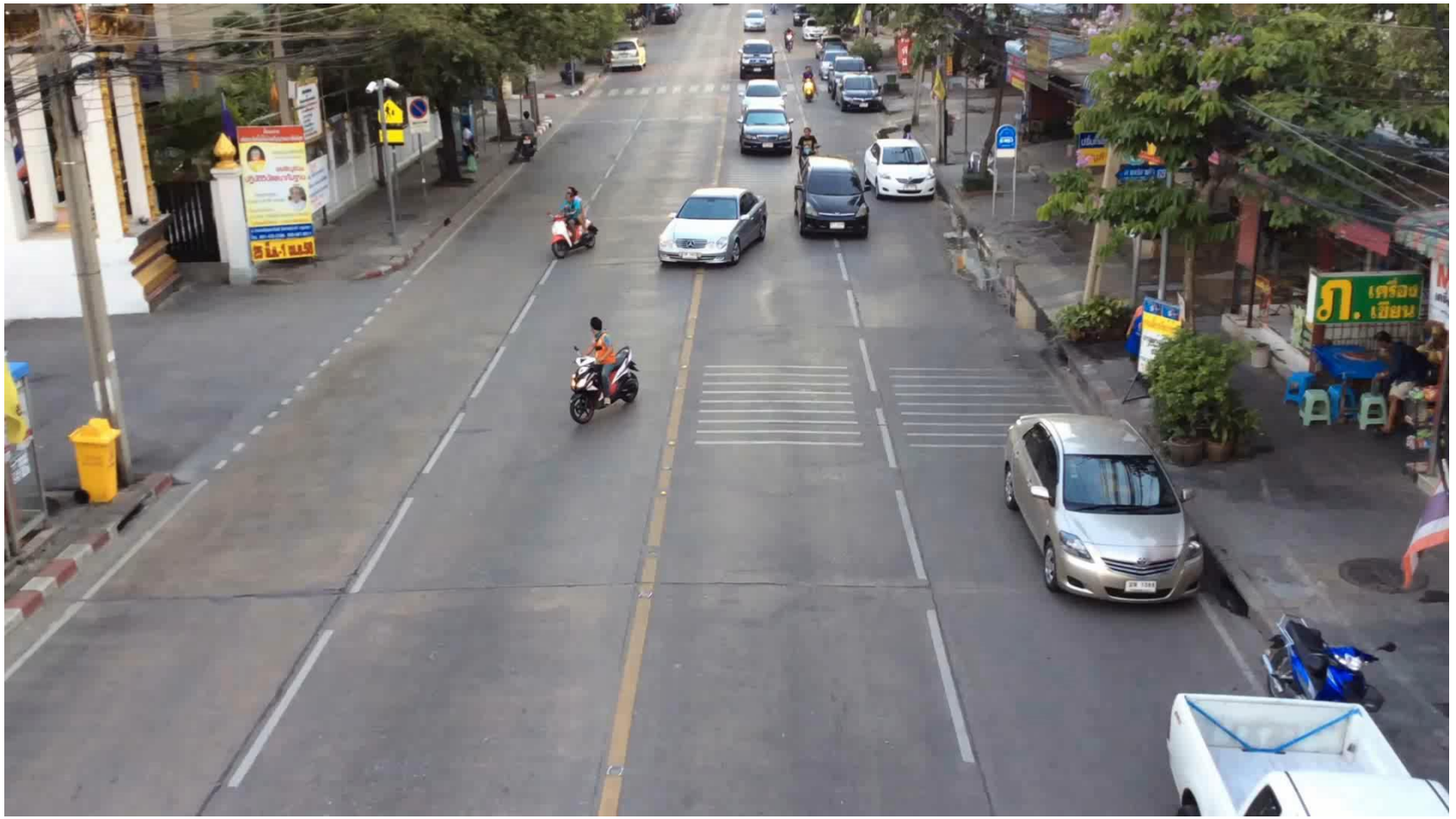
CCTV live video feed through DSS detects vehicle of interest identifying vehicle license plate

DSS Intelligence Products Library

DSS Video Analytics Tool



Total::Insight™ – Video Analytics



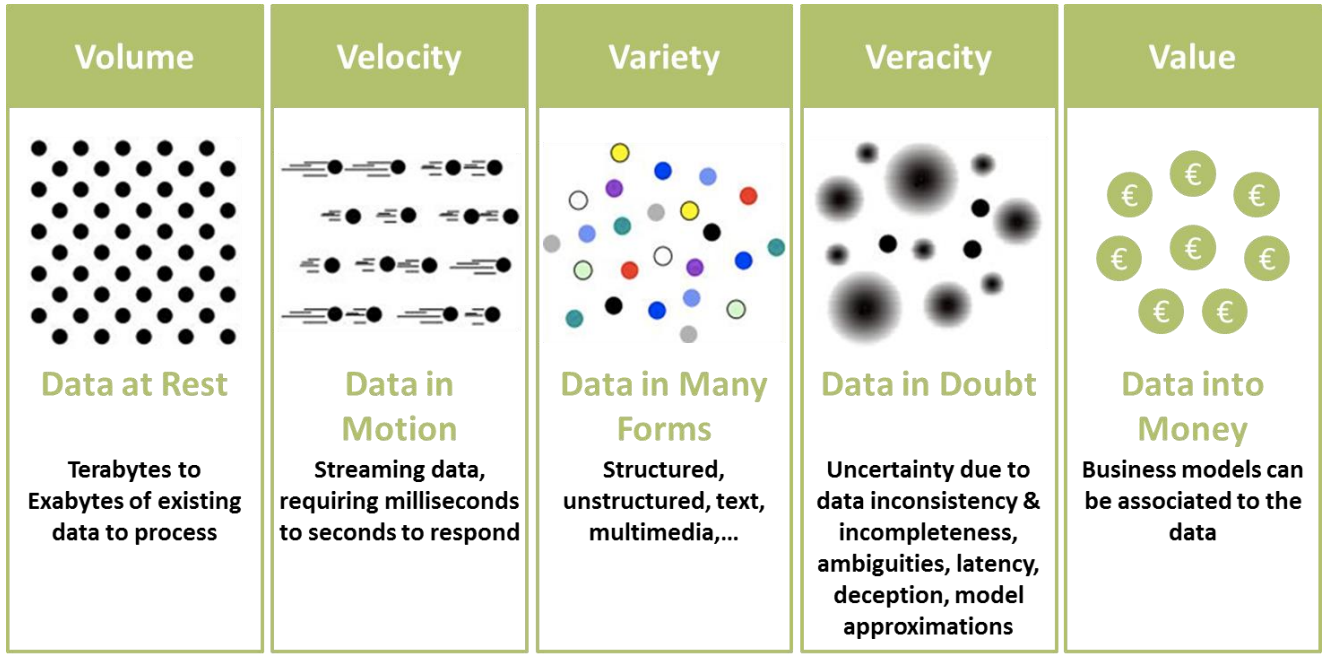
Big Data

- We use the following pretty much daily
  - Email
  - Webpages/websites
  - Social media
  - Web/smartphone applications
  - Financial transactions
  - Streaming video

- It is becoming tough to keep up with the incoming data streams
  - We need applications to help us!
    - Aggregation sites
    - Recommendation algorithms
    - Automated tools
- Operators and analysts are overwhelmed by the tide of incoming data
  - *"Drowning in Big Data, yet starving for wisdom" (E. O. Wilson, 1998)*
  - *"Swimming in sensors and drowning in data" (Lt. Gen. David A. Deptula, 2010)*

Big Data Characteristics

- The 5 Big V's
  - **Volume** (TB HDs? Pish posh! Try Zettabytes!)
  - **Velocity** (Gbps? Yawn!)
  - **Variety** (SQL? No! NoSQL!)
  - **Veracity** (lies, lies, lies!)
  - **Value** ($ → $$ → $$$)
- What about:
  - **Variability** ("Great stuff!" vs. "Great, there goes my stuff!")
  - **Visualization** (3-D? Try seeing in 26-D!)
  - **Venue** (your place or mine?)
  - **Vocabulary** (a virtual *Tower of Babel*)

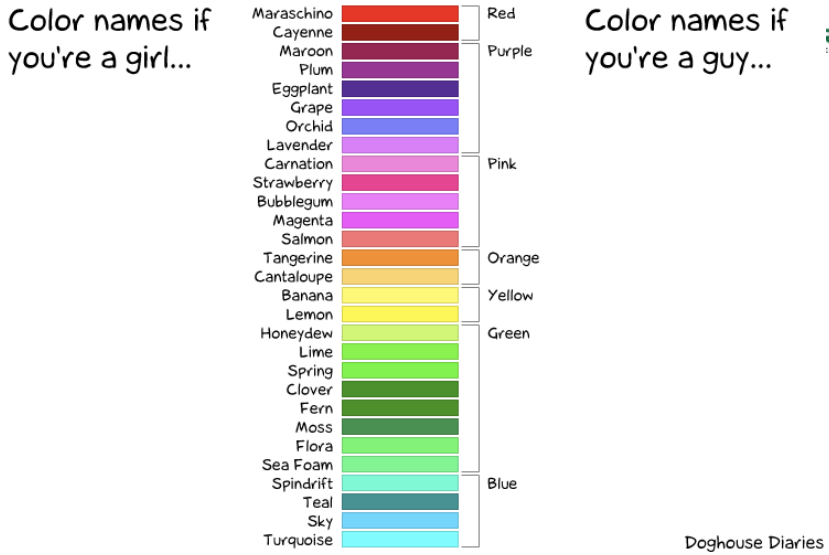


Adapted by a post of Michael Walker on 28 November 2012

http://informationcatalyst.com/index.php/vision-experience/big-data-value

"The tragedy of life is not that man loses, but that he almost wins." (Heywood Broun)

Big Data Analytics



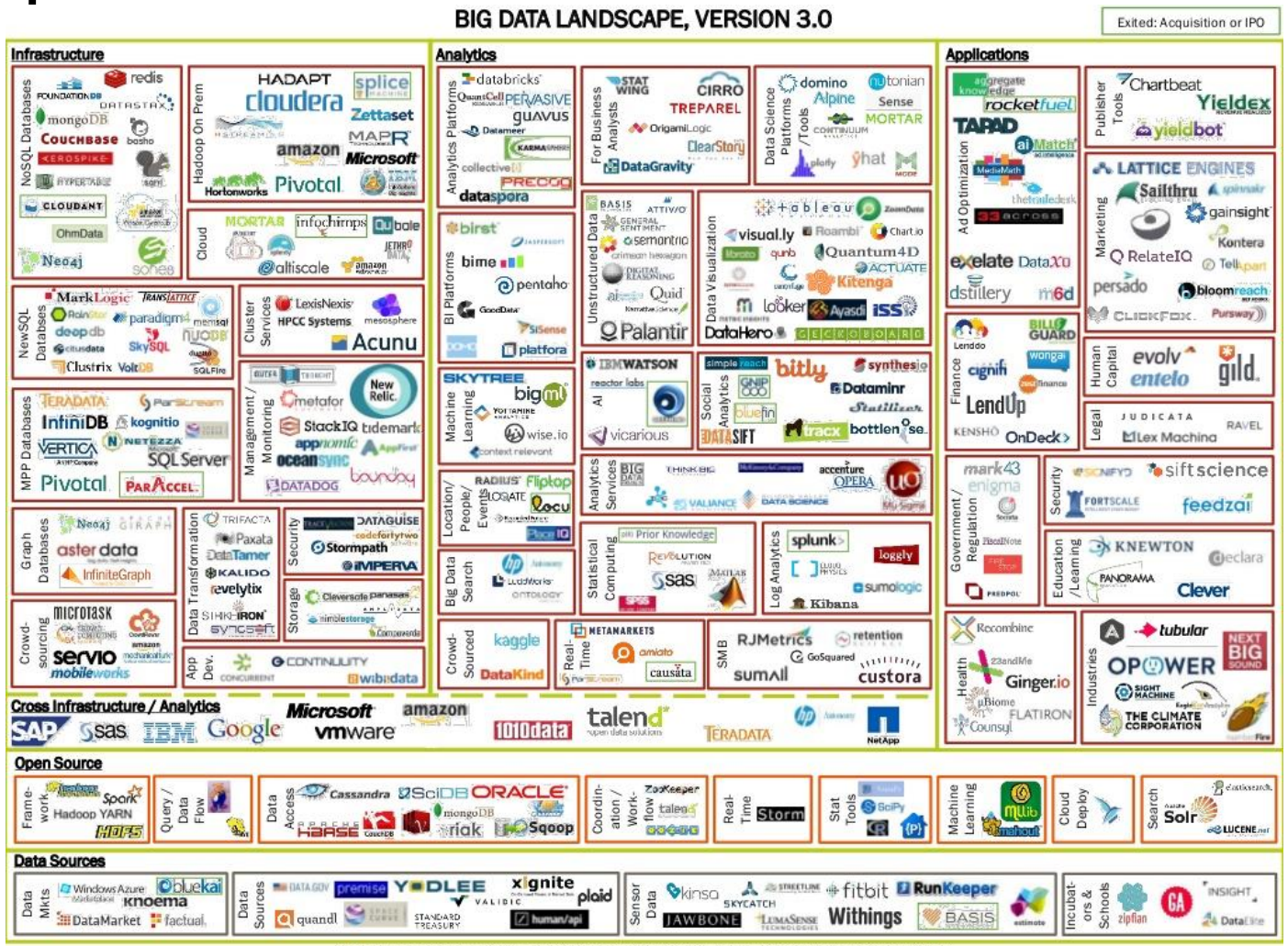
- Numerous diverse and illicit data sources producing lots of data that is bein sent on high-speed interconnecting networks
  - Structured (*hard*) data are calibrated and precise
    - This information can be measured, traced and validated
  - Unstructured (*soft*) data are filled with opinions and uncertainties
    - *"Students hate annoying professors", "I saw her duck", etc.*

- Datafication of our World
  - Activities, conversations, words, voice, social media, images, videos, sensors, browser interactions, purchases, etc...
  - Vast training samples for rich micro-scale model-building and model validation
  - Micro-grained "truth" about every object in your data collection

- Big Data Analytics
  - Text analytics, image/video analytics, movement analytics, sentiment analysis, predictive analytics, pattern analysis, etc.
  - Thought analytics? Whole-population analytics? Pre-crime analytics? ***Minority Report!***

"All men dream, but not equally. Those who dream by night in the dusty recesses of their minds wake in the day to find that it was vanity; but the dreamers of the day are dangerous men, for they may act their dream with open eyes, to make it possible." (Lawrence of Arabia)

Big Data Landscape

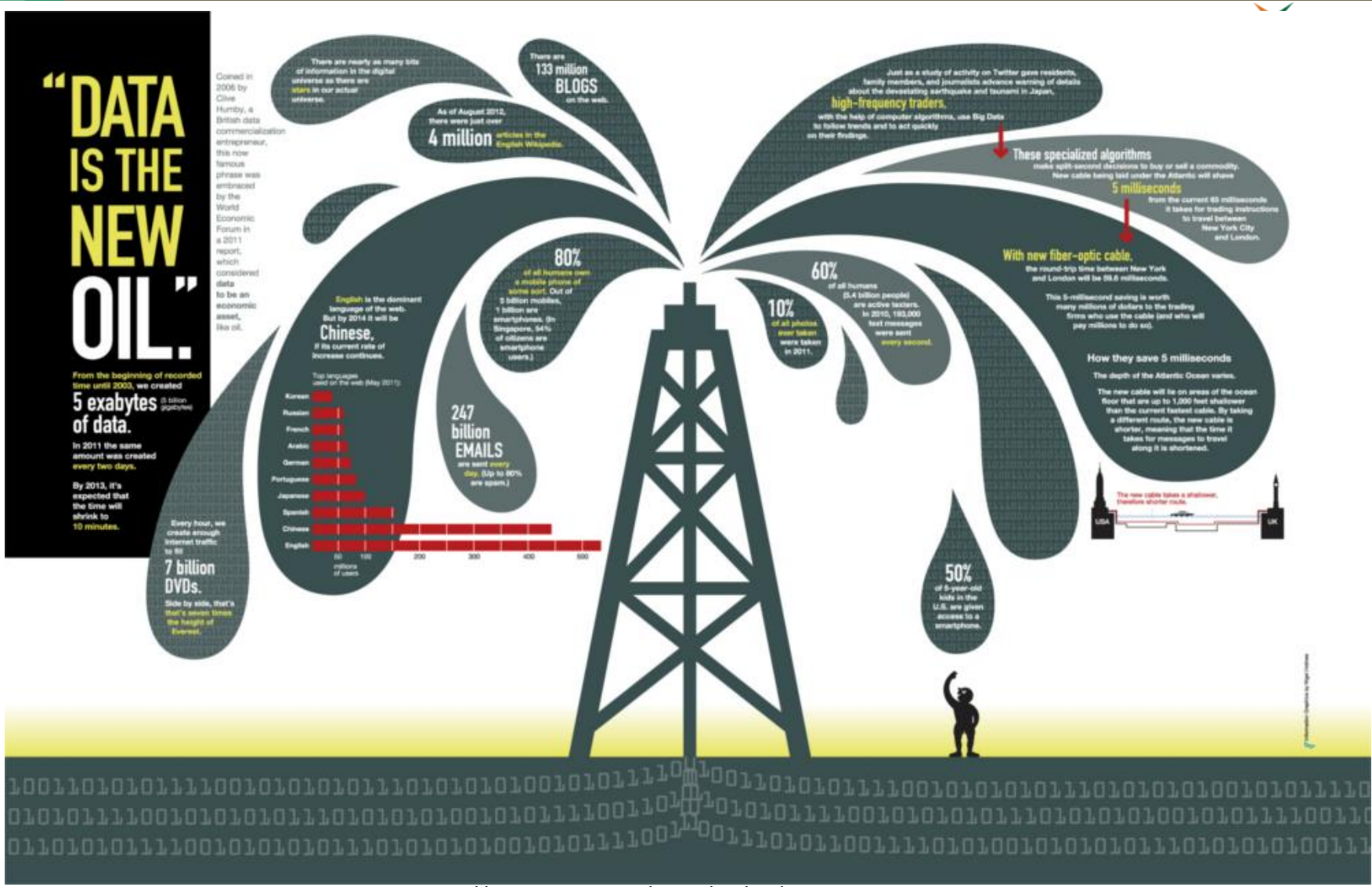


© Matt Turck (@mattturck), Sutian Dong (@sutiandong) & FirstMark Capital (@firstmarkcap)

http://www.ivedix.com/blog/blog/2014/05/15/mivedix-on-the-big-data-landscape

"Data is the New Oil"

- "Data is the new oil. It's valuable, but if unrefined it cannot really be used. It has to be changed into gas, plastic, chemicals, etc to create a valuable entity that drives profitable activity; so must data be broken down, analyzed for it to have value."
  - Clive Humby, UK Mathemetician and architect of Tesco's Clubcard, 2006
- Treat it as such!
  - Don't drill at random
    - Focus your data drilling operations
  - Data Lakes vs. Oil Reserves
    - Drill then refine!
  - Fuel is not what's important
    - It's the car, grill and furnace!



https://blog.ons.digital/2016/01/25/open-data-new-oil-fuels-society

Predictive Analytics

- According to a recent report, the predictive analytics market is set for explosive growth, peaking at USD 6,546.4 Million by 2019
- Gartner says that by 2016, 70 percent of the world's most successful companies will use real-time predictive analytics to plan their business strategies
- Cloud hosted predictive analytics software solution is seen as an emerging market and is expected to drive growth in the near future

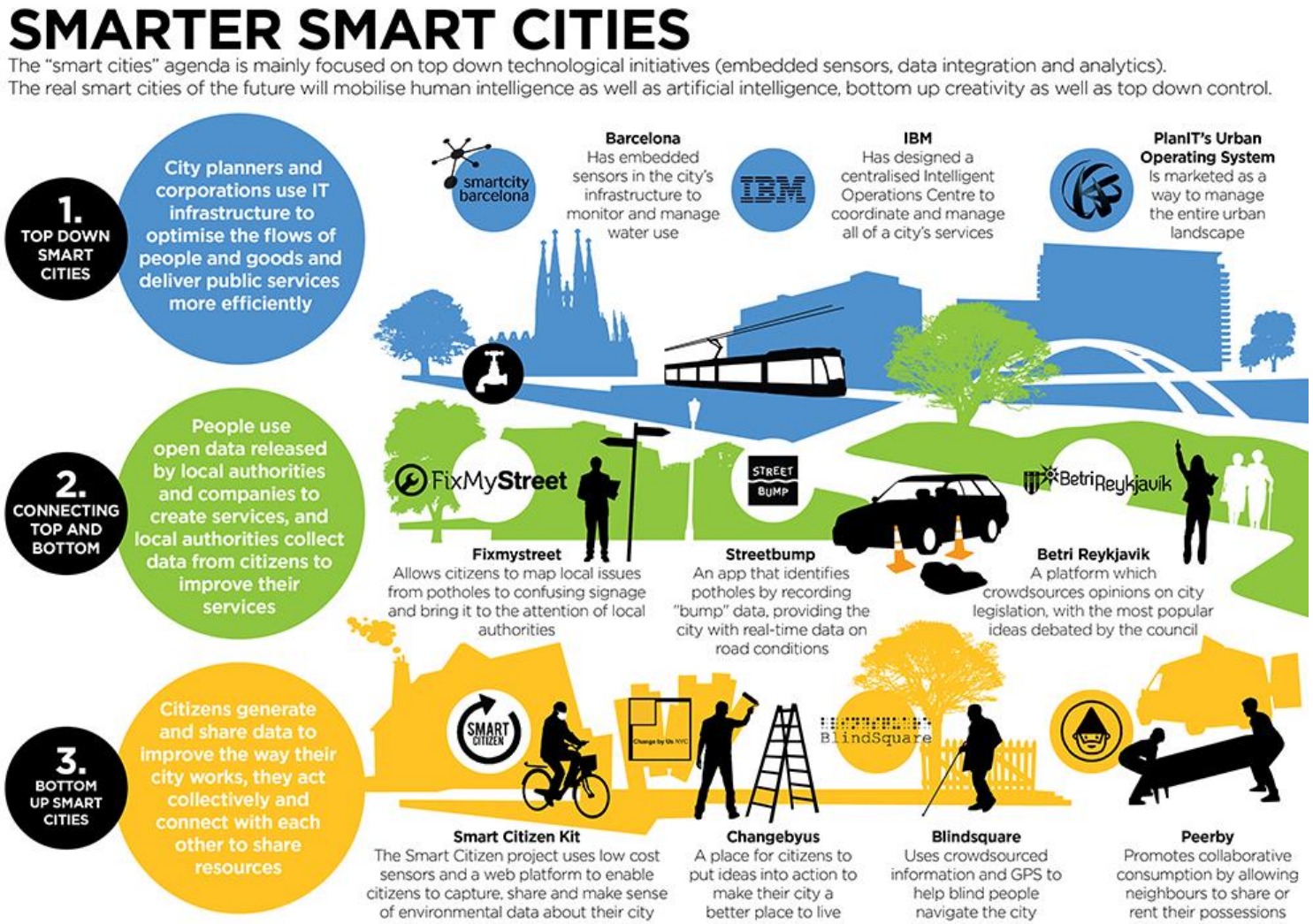
	Descriptive	Predictive	Prescriptive
	What HAS happened?	What COULD happen?	What SHOULD happen?
What the user needs to DO	• Increase asset reliability • Reduce labor and inventory costs	• Predict infrastructure failures • Forecast facilities space demands	• Increase asset utilization • Optimize resource schedules
What the user needs to KNOW	• The number and types of asset failures • Why maintenance costs are high • The value of the materials inventory	• How to anticipate failures for specific asset types • When to consolidate underutilized facilities • How to determine costs to improve service levels	• How to increase asset production • Where to optimally route service technicians • Which strategic facilities plan provides the highest long-term utilization
How analytics gets ANSWERS	• Standard reporting - What happened? • Query/drill down - Where exactly is the problem? • Ad hoc reporting - How many, how often, where?	• Predictive modeling - What will happen next? • Forecasting - What if these trends continue? • Simulation - What could happen? • Alerts - What actions are needed?	• Optimization - What is the best possible outcome? • Random variable optimization - What is the best outcome given the variability in specified areas?
What makes this analysis POSSIBLE	• Alerts, reports, dashboards, business intelligence	• Predictive models, forecasts, statistical analysis, scoring	• Business rules, organization models, comparisons, optimization

Business value →

http://www.kdnuggets.com/2015/12/more-data-science-humor-cartoons.html

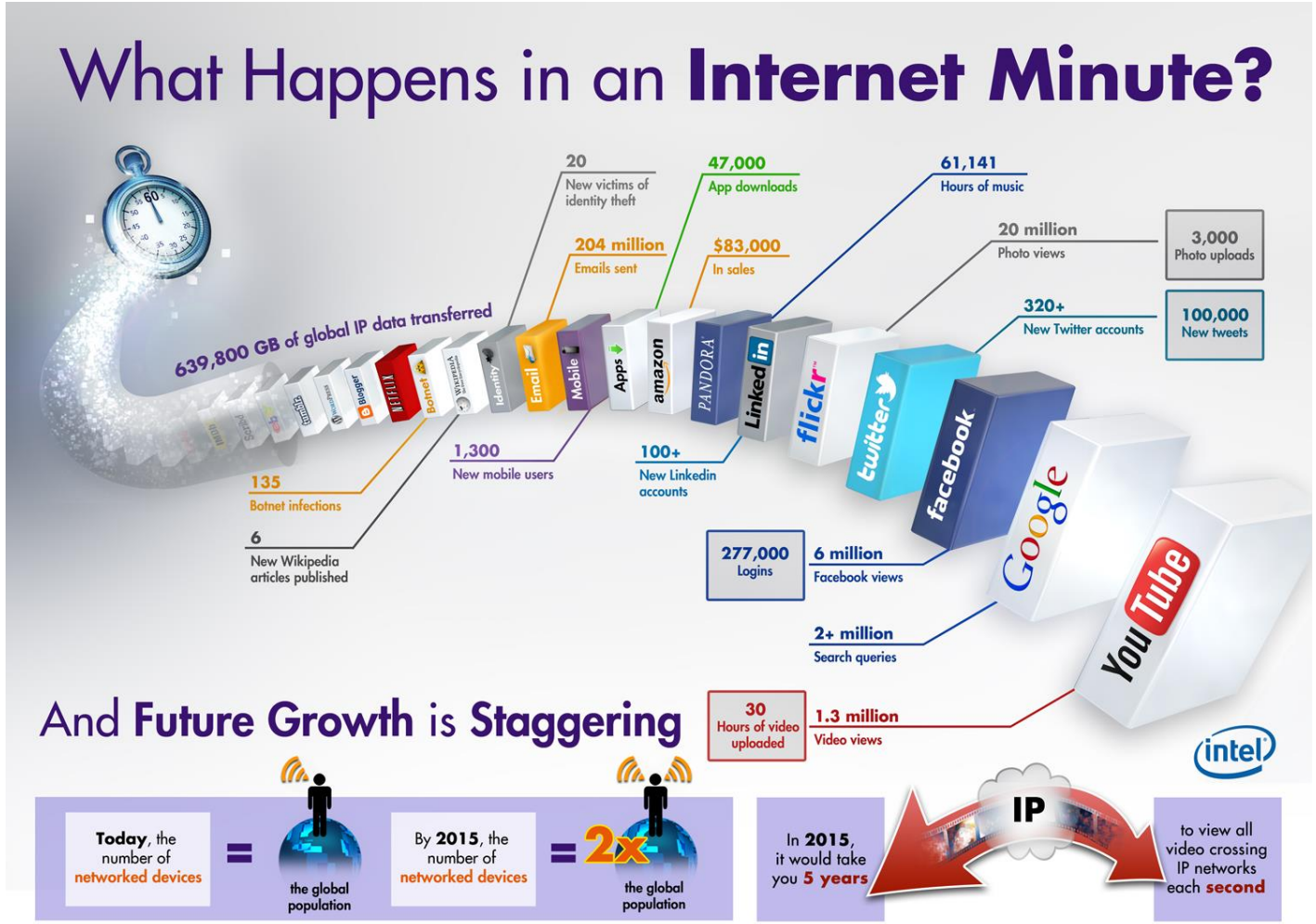
Big Data Applications – City Planning

- **Where is the value?**
  - Predicted that we can reduce CO_2 emissions by more than 2 gigatonnes, equivalent to CAD $116B [OECD, 2013]
- **Killer App?**
  - By recording and analyzing every social/weather/traffic datum and socioeconomic pattern of every neighbourhood, we can monitor, tailor and optimize city services (e.g. snow plowing, parc maintenance)!
- **What else can we do with Big Data?**
  - Predict and mitigate flood damage
  - Minimize traffic jams and optimize traffic flows
  - Crowdsource opinions and issues for public debate



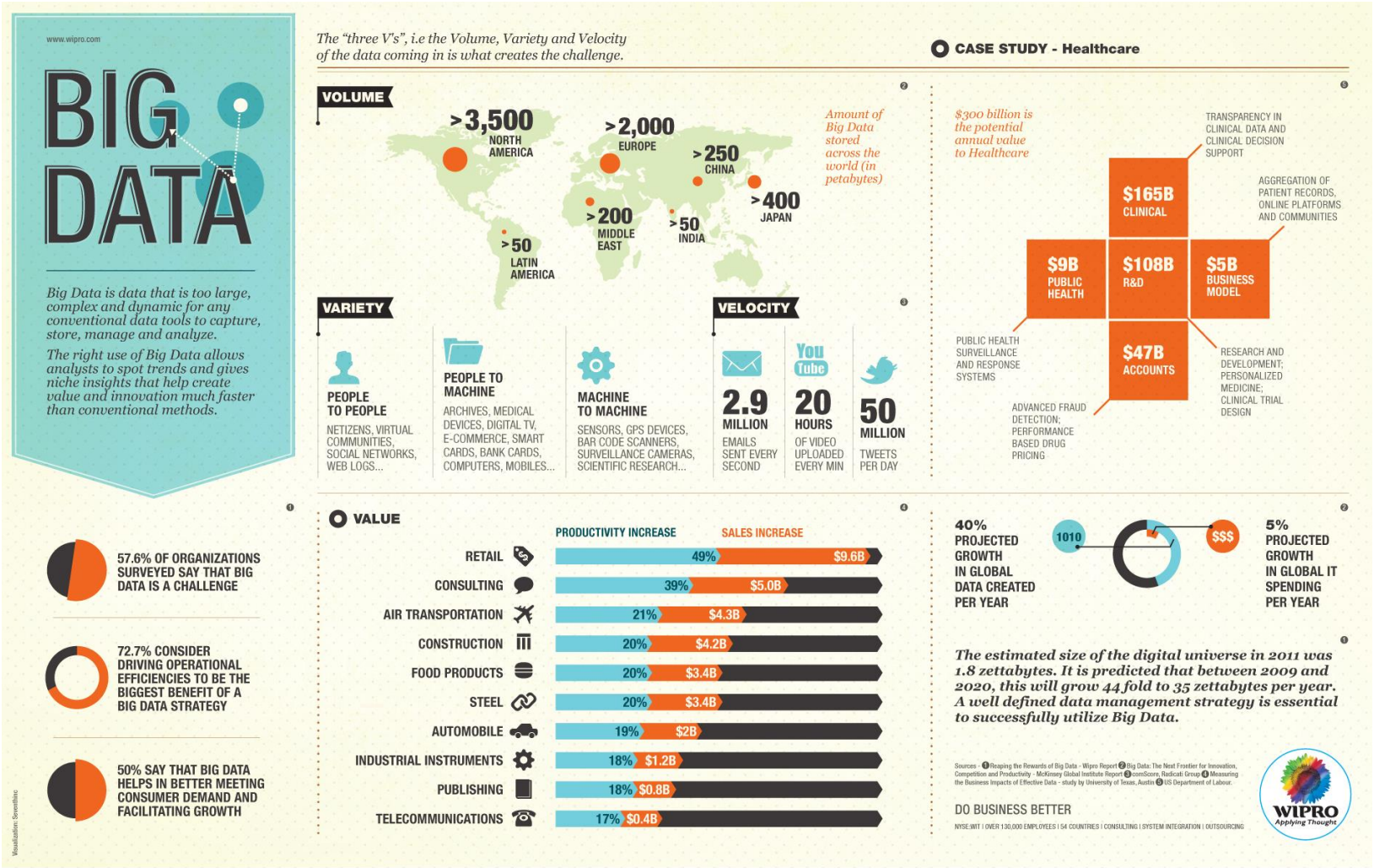
Big Data Applications – Communications

- **Where is the value?**
  - Smartphone apps are to generate CAD $198B by 2017 [Appnation Research, 2013]
- **Killer App?**
  - By recording and analyzing every interaction and its metadata (location, intent, usage) of every customer, we can automatically change plans based on our behaviour!
- **What else can we do with Big Data?**
  - Dynamically improve network/call QoS
  - Rapidly create targeted customer promotions
  - Monitor and learn customer behaviours, preferences and movements to create products and services
  - Sell insights about customers to third parties
  - Identify fraudulent behaviour immediately



Big Data Applications – Healthcare

- **Where is the value?**
  - Predicted that CAD $132B will be saved considering only the reduction of national healthcare expenditure in the EU [McKinsey Global Institute, 2011]
- **Killer App?**
  - By recording and analyzing every heart beat and breathing pattern of every person, we can predict infections before physical symptoms appear!
- **What else can we do with Big Data?**
  - Decode entire DNA strings in minutes
  - Find new cures
  - Better understand and predict disease patterns
  - Monitor and predict the developments of epidemics and disease outbreaks

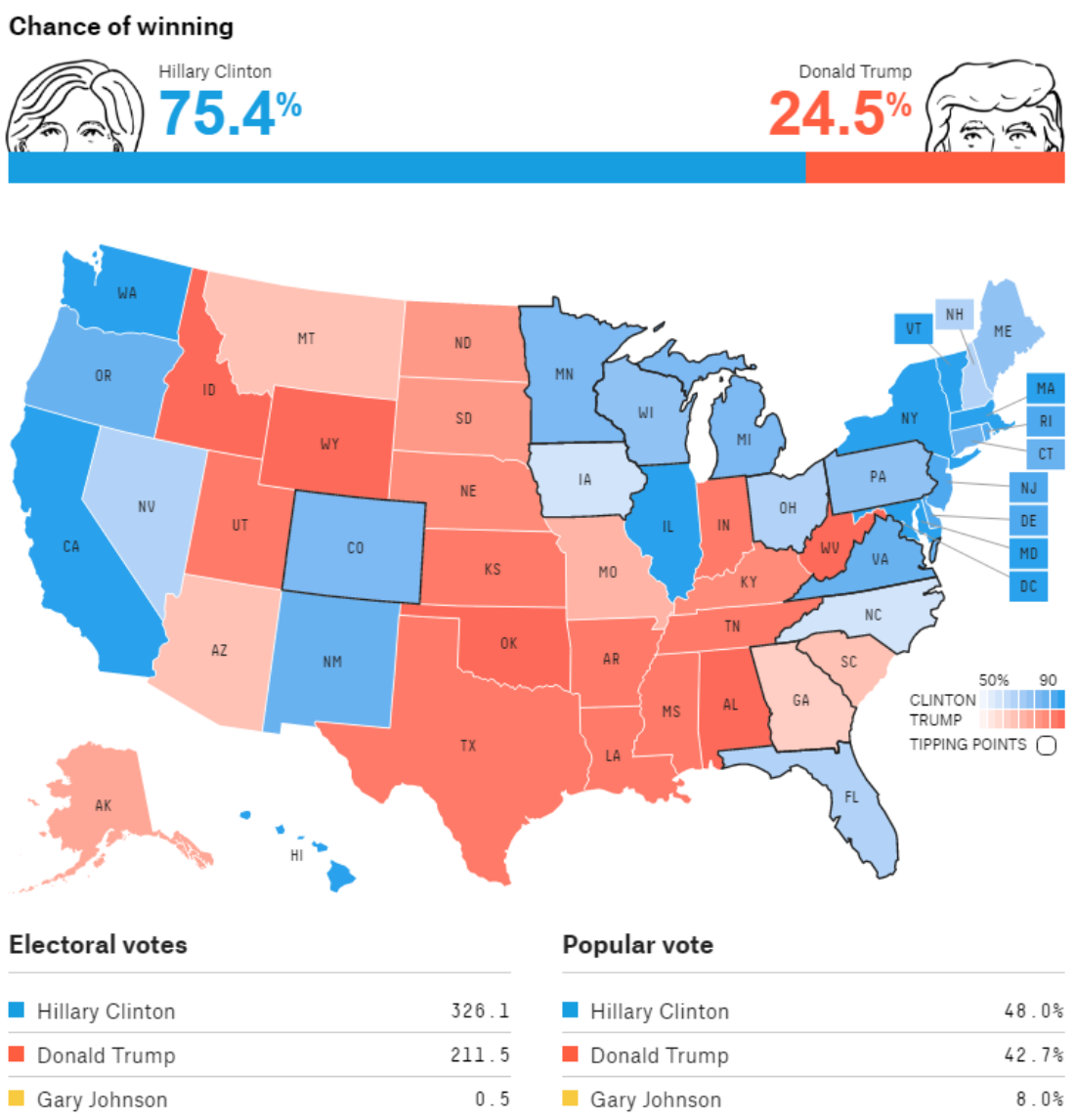


Big Data Applications – Psychology

- **Where is the value?**
  - Google's Ngram service has already datafied over 5.2M books from 1800 to 2000 to let anyone analyze cultural trends [Forbes, 2015]
  - TrackYourHappiness.org – with 250,000 happiness reports from 5000 people across 83 countries
- **Killer App?**
  - By recording and analyzing every little piece of human-derived data (e.g. pages liked, apps used, expressed sentiments), we can better predict and treat depression!
- **What else can we do with Big Data?**
  - Collect behavioral information without sampling human participants at all (smartphones, wearable sensors)
  - Repurposing large data samples to help researchers produce insights that traditional samples cannot
  - Using behavioral logs (e.g. Internet searches) to improve search engines over time

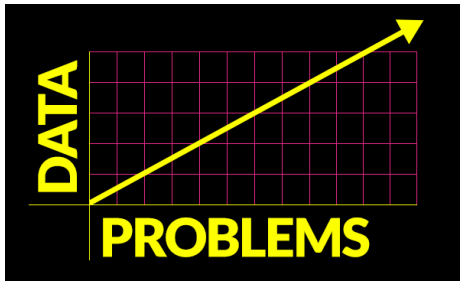
Big Data Applications – Politics

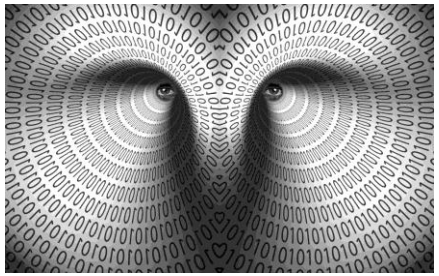
- **Where is the value?**
  - Barack Obama's 2008 and 2012 presidential election campaign wins were mostly due to his team's superior ability to use Big Data analytics [Forbes, 2015]
- **Killer App?**
  - By recording and analyzing every social media post, national/state polls, party registration figures and economic factors of every voter, we can forecast the outcome of elections! [FiveThirtyEight forecast (Nate Silver) 2012]
- **What else can we do with Big Data?**
  - Segment and score all voters
  - Optimize campaign spending on media (TV ads, call center activities, traditional mail campaigns, and neighborhood canvassing)
  - Identify and target voters who are undecided in efforts to sway them in a certain direction
  - Identify champion supporters who can campaign on behalf of their favored candidate



Big Data Meets Big Brother

- **Mo' Data, Mo' Problems!**
  - Detect the underlying patterns, filter out the noise
  - Identify scams, frauds, illegal monitors, investigators, etc
  - Extract the important information from the droves of data

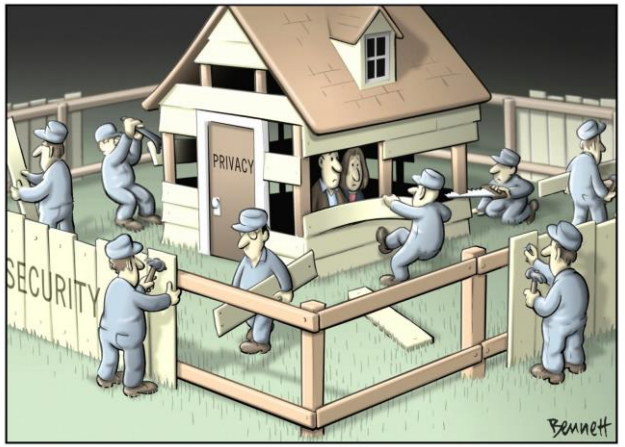




- **"I will tell you everything about me; please don't use it against me!"**
  - Habits, preferences, joys, opinions, pics, videos, secrets, undergarment size
  - Is there anything we will not share??

- **The human has become the ultimate sensor**
  - Situated and embodied within the real world
  - Standing on a pedestal and addressing the e-crowds as we see fit

- **Who's listening? Freedom comes at a price!**
  - We do not always know who is listening in that crowd
    - Health care analytics companies can mine workers' medical claims, pharmacy claims, and search queries to figure out if an employee is trying to conceive or is already pregnant!
    - Or is diagnosed with diabetes, needs surgery, about to adopt a child…
    - Ok, let's hire less women since we cannot afford to have 30% of our workforce on family leave!
  - Health | Communications | City Planning | Psychology | Politics



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