Mapping the Future of Information and Industry

Information Meets Matter series
Future Computing Platforms service

Mark Bünger, Vice President of Research

Lux Research, Inc.

mark.bunger@luxresearchinc.com

@MarkBungerLux

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Agenda

- Information meets matter – real-world innovation at the speed of light
- The battle for the User Interface for the Internet of Things
- Key new classes of Hardware and Software that will change industry

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Industrial innovation at the speed of light

- Materials-based industries evolve slowly
  - Cars: 60 months and $1 billion in development, 10-25 year production cycle
  - Drugs: 3-15 years in testing, 5-10 years of patent-protected sales
  - Cities: 5-10 year boomtown, 50-100 years with new map and infrastructure
  - Chemicals, foods, transportation…
- The most important innovation in each of these industries today is information
- How does information change the rate of evolution?

Industry to 2030: Autonomous systems, AI, and robots make the real world work like computers

…and it's already started:

SaaS -> X-as-a-service
X=music, cars, CPG

Internet ->
Internet of Things

Cloud computing ->
Cloud manufacturing

Packages move like packets
Uber, Amazon, Apple, and Google in autonomous vehicles
$87 billion in 2030

The Internet of Food
Monsanto $1B for big data firm Climate Corp
$50-100 billion in 2030

Factory as peripheral
GE's $3B+ Industrial Internet of Things
$14.2 trillion* in 2030

Leading companies are already investing billions – why?

The desktop GUI made dozens of desktop technologies obsolete - fast

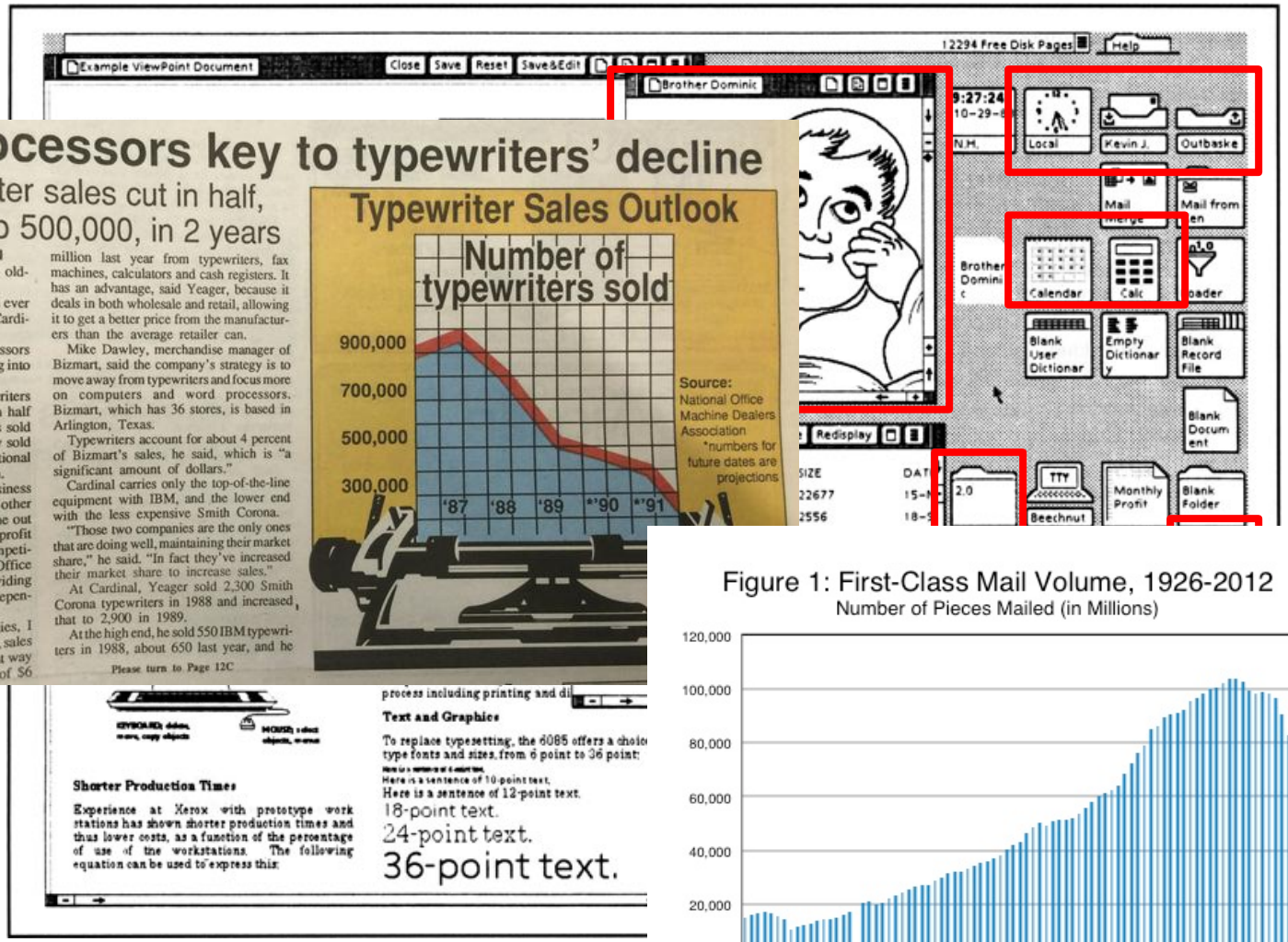

Figure 1: First-Class Mail Volume, 1926-2012

Number of Pieces Mailed (in Millions)

Source: United States Postal Service, "First-Class Mail Volume Since 1926," http://about.usps.com/who-we-are/postal-history/first-class-mail-since-1926.htm

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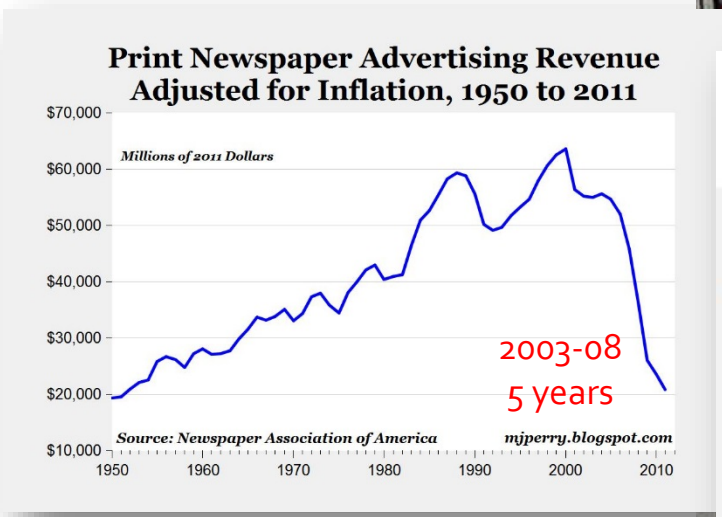
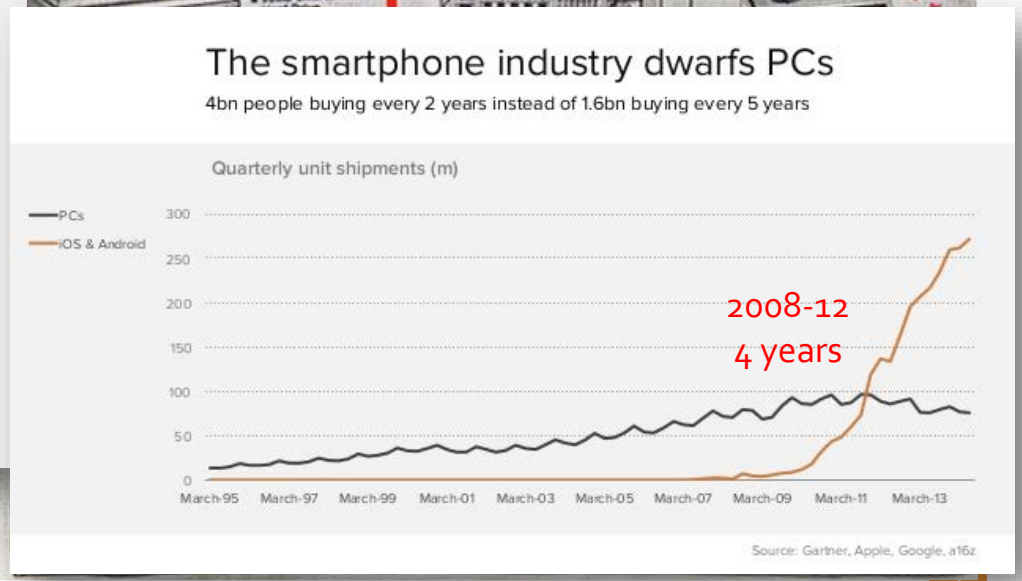
Smartphone UI…

- …made everything in this 1991 ad ($3000+ in goods) obsolete
- including the store and the newspaper
- And even the PC
- *very* quickly





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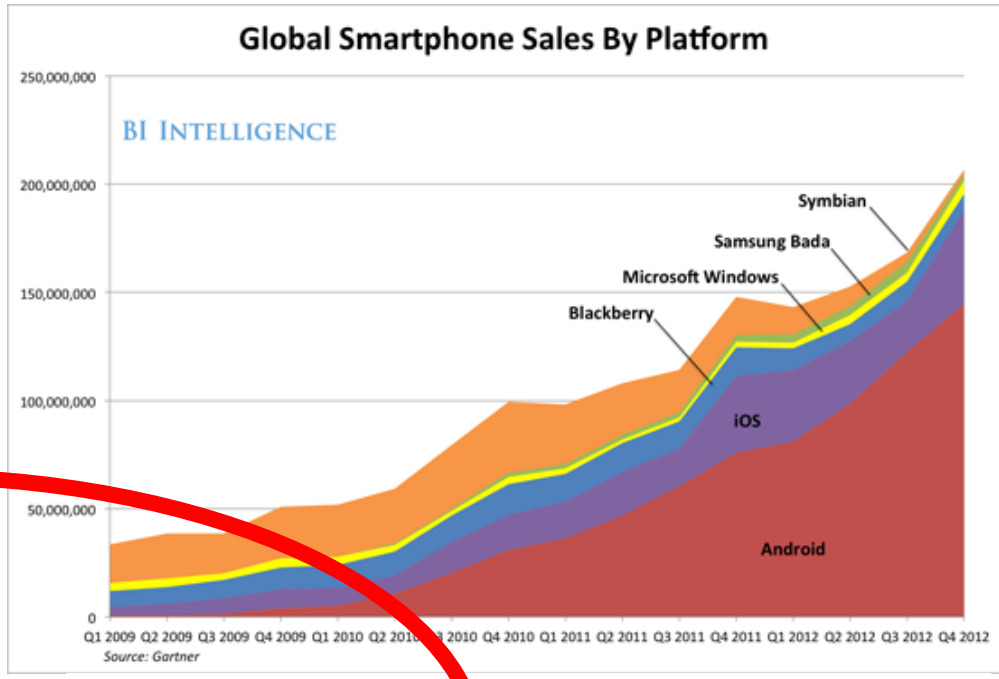
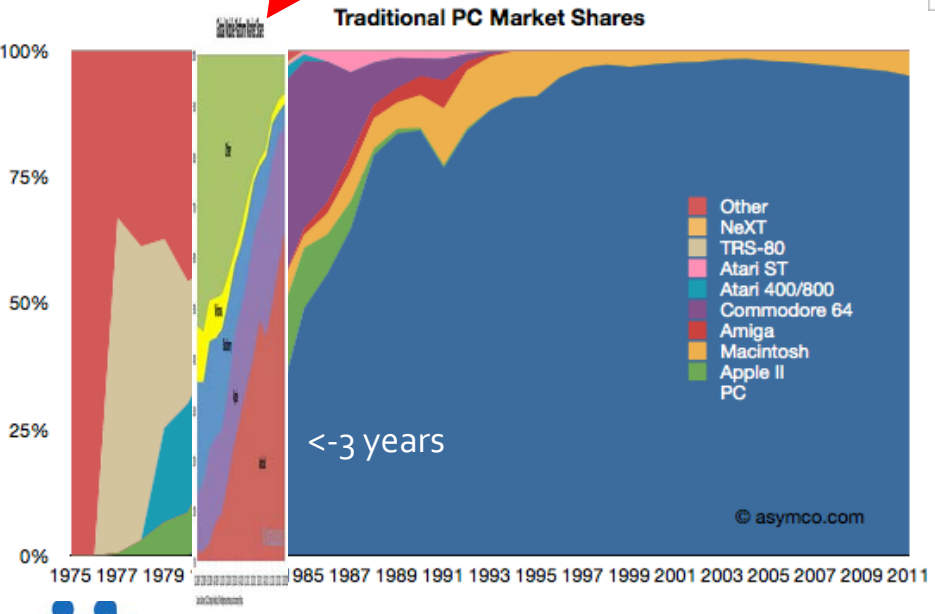
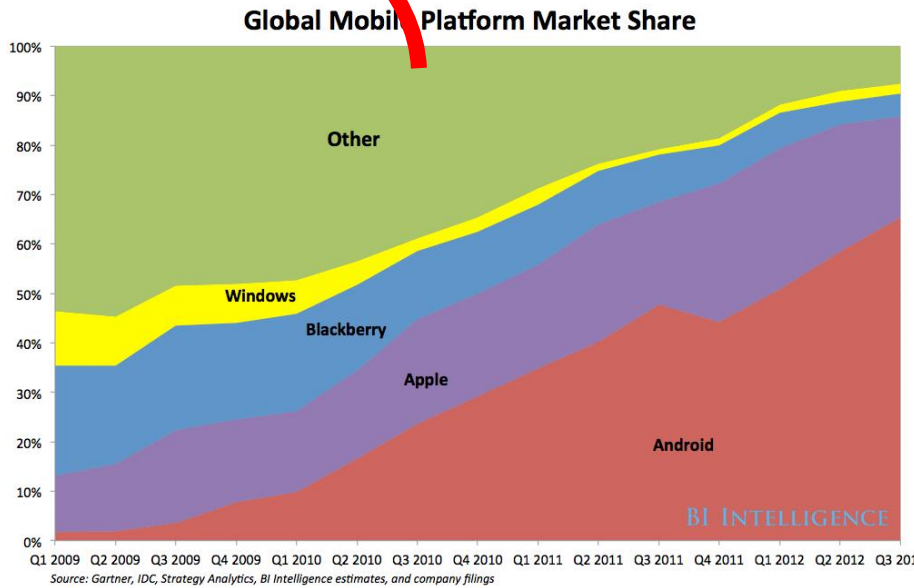
Source: https://www.reddit.com/r/pics/comments/1vfzrw/every_single_item_from_a_1991_radioshack_flyer/

Market lock-in feels slow BUT happens VERY fast

- We are in a cool, growing market!
- Revenue constant, no worries!
- But share declines steadily, then boom
- Timeframe: 2-5 years to lock in
- 30+ years of dominance







2009-12
3 years

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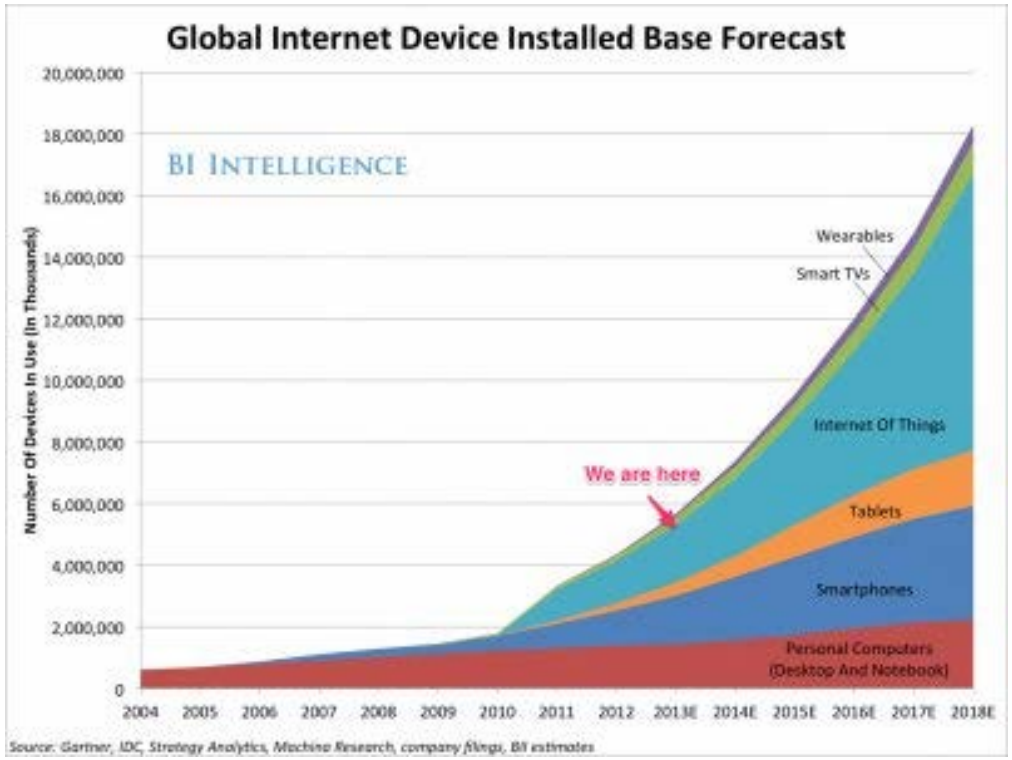
Which two is it going to be this time?



amazon.com

Predix™
From GE. To Everyone.

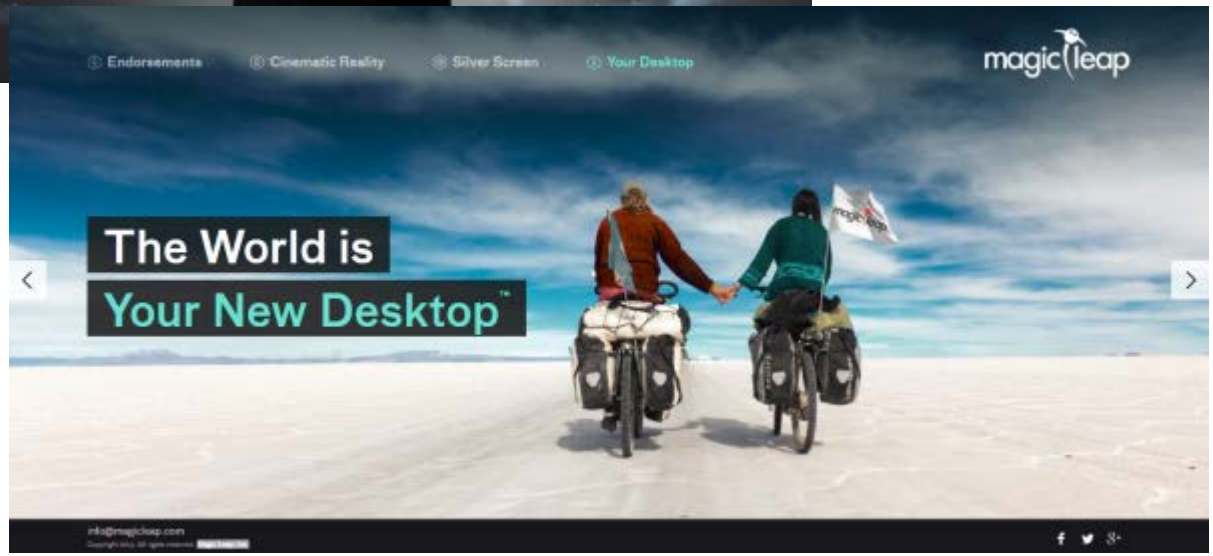
UBER

Microsoft

Google
android

› ...some current players?

…or someone new?



› …or you??

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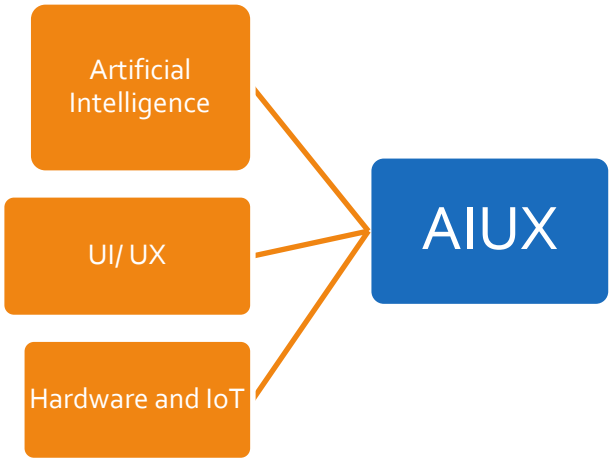
AIUX: a Meeting of the Minds at Stanford and Helsinki Presearch Workshops

Workshop participants using paper prototyping to model AIUX applications



Three Contenders for the UX of Information Work

	Intelligent Buildings	Augmented Workers	Factory Equipment
			
Technology Providers	TeliaSonera, BioInspira, Lucid, Enlighted, Zipato, Iotas	Atheer Labs, Daqri, Total Immersion, Vuzix, Optinvent, Magic Leap	Macrocloud, RoboCV, Sight Machine
Corporate Contenders	Steelcase, Coor, Skanska, Honeywell, Johnson Controls, Leviton	Epson Moverio, Panasonic PanaCIM, Google Glass/Cardboard, Facebook/Oculus	SAP, GE, Siemens, Honeywell, consortia (Industrie4.0, Industrial Internet Consortium)

Source: Lux Research, "Artificial Intelligence User Experience: Identifying Early Leaders in the Interface to the IoT" September 2015

Three Contenders for the UX of Personal Technology

	Wearables	Social Robots	Ambient Computing
			
Technology Providers	Pebble Time, MUV Interactive, LifeQ, Uno	Jibo, Buddy, Cubic, Sonzia, Catalia Health	Viv, MetaMind, Clarifai
Corporate Contenders	Apple Watch, Android Gear, Samsung	Amazon Echo, Softbank Aldebaran Pepper, Intel ARTI	Google Nest, Amazon Dash, IBM, Microsoft, Baidu

Source: Lux Research, "Artificial Intelligence User Experience: Identifying Early Leaders in the Interface to the IoT" September 2015

Amazon Dash - an interface that connects not the last mile, but the last millimeter of the supply chain

- Putting the order buttons…

- …literally at the point of use

- A retrofittable smart home?

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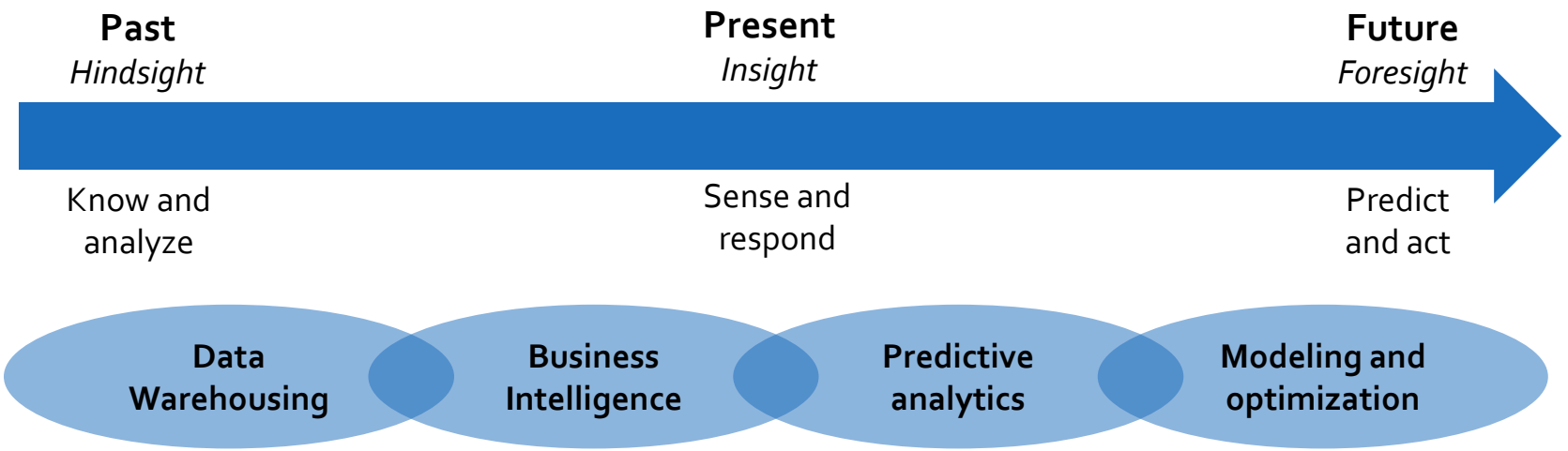
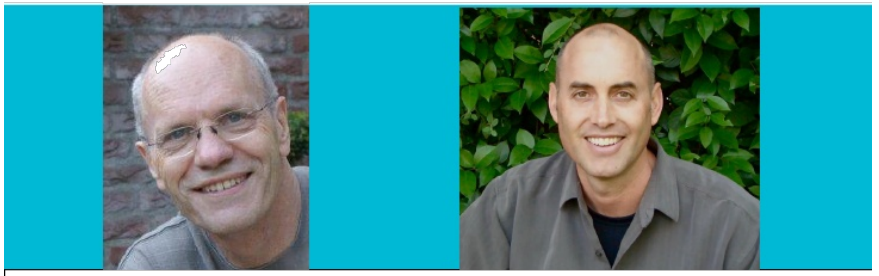
Predictive analytics is part of a past-to-future continuum of data and analysis tools



Predictive to prescriptive with persuasive nudges

- Nudge psychology – small actions to achieve long-term desired effects
- Since PA models can identify optimal/preferred futures, and the prerequisite factors for achieving them, it is likely that it will be increasingly used to affect actions and decisions.
- Using PA to find probable or preferable futures will be integrated with algorithmically-generated (aka procedurally-generated) scenarios (as well as education, news, art, games, music, etc) that would otherwise be fictional, arbitrary, theoretical, or exploratory.

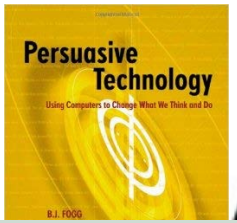
Persuasive Technology

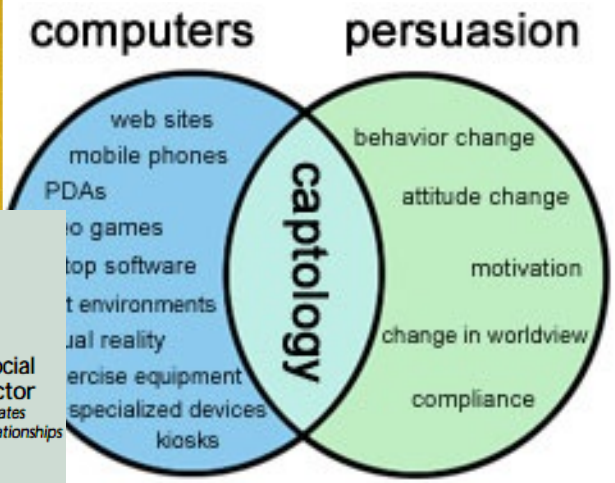


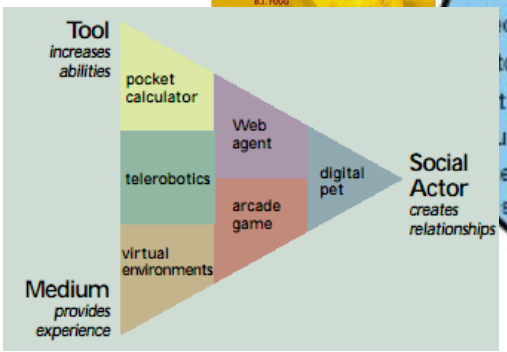
Cees Midden, TU/e — BJ Fogg, Stanford

"technology that is designed to change attitudes or behaviors of the users through persuasion and social influence, but not through coercion" Fogg 2002

Founding Fathers Persuasive Technology







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Everyone's trying drone delivery – why?

Potential benefits

- More path efficient?
- More space efficient?
- More fuel efficient?

"We do not plan to become the Foxconn of Apple"
Dieter Zetsche, CEO Daimler Sept 17, 2015

"In 2007 I pledged that – by 2010 – Nissan would mass market a zero-emission vehicle. Today, the Nissan LEAF is the best-selling electric vehicle in history. ***Now I am committing to be ready to introduce a new ground-breaking technology, Autonomous Drive, by 2020****, and we are on track to realize it."*

"We have seen what Google did to phone manufacturers, and we don't want that to happen to us."

-Nissan CEO Carlos Ghosn

- The auto industry utterly failed in telematics; will they repeat?
- Carmakers must make networked vehicles now, to prevent the rise of third-tier OEMs
- Consortia are collapsing into proprietary, competitive programs

http://www.nytimes.com/2015/09/18/automobiles/apples-auto-inroads-create-a-buzz-at-frankfurt-motor-show.html?ref=technology&_r=2

Manufacturing: Not Daimler, but *Foxconn* might be the "Foxconn of automotive"

- Foxconn (contract manufacturer of iPhones, Tesla components, and other electronics) rumored to be investing $800 million in automotive plant
- Chinese automakers BAIC and SAIC working on electric vehicles and autonomous vehicles
- SAIC has partnership with Silicon Valley battery startup Atieva
  - Goal is now electric, autonomous vehicles
  - $100M+ investment
  - Hiring >10 autonomous vehicle engineers

NEWS

Foxconn invests in building electric cars in China

The company is already a partner with Tesla Motors

By Michael Kan FOLLOW

IDG News Service | Sep 4, 2014 5:32 AM PT

MORE LIKE THIS

Foxconn turns sights to robots, ele wearables

Foxconn CEO blames past worker

From the press release:

Beijing Electric Vehicle Co, an affiliate of government-owned BAIC Motor Corp Ltd (1958.HK), said its new tech center outside San Francisco will focus on development of EVs and eventually self-driving cars.

BAIC follows another large state-owned Chinese automaker, SAIC Motor Corp (600104.SS), which also is setting up a research facility in Silicon Valley and is developing electric and self-driving cars.

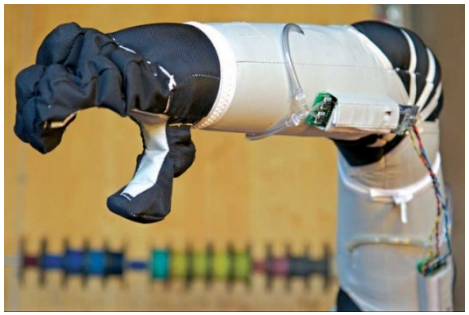
atieva

Soft robots: soft materials + AI allow robots to do many new tasks

pneubotics

- Textile, pneumatic robots
- Own words: "A new class of all-fluidic, membrane based robotics that are entirely constructed out of compliant skins and filled with pressurized fluids to create structure and movement."

- Safe to operate near humans
- New hardware-software integration
- Reduces cost and time to design and build
- Greatly increases the number of robot developers and applications



Summary: Key technologies for industry's future are already here

User Interface

› Intelligent Buildings	› Augmented Workers	› Factory Equipment
› Wearables	› Social Robots	› Ambient Computing

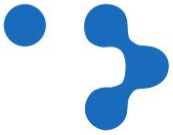
Software

- Big Data
- Predictive analytics
- Nudge technologies

Hardware

- Drones
- Autonomous vehicles
- Soft robotics

Thank you



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Mark Bünger, Research Director
Lux Research, Inc.

mark.bunger@luxresearchinc.com
@MarkBungerLux

Every industry has its own name for IoT/Big Data/Automation/Robotics…

Industry	General IoT/Big Data-related terms	Instigators and branded initatives
Oil and Gas	Intelligent oilfield	ABB Integrated Operations, BP Field of the Future, Chevron i-Field, E&P Magazine Intelligent Oilfield, IBM Smarter Planet/Intelligent Oilfield, OnRamp Smart Oil and Gas, Schlumberger Digital Oilfield, SPE Intelligent Energy, Statoil Integrated Operations, USC Interactive Smart Oilfield
Health and wellness	Personalized medicine (..and nutrition, and exercise), quantified self, electronic patient records, Health Information Exchanges, bioinformatics, systems biology	SAP HANA for Healthcare, IBM Healthcare, Oracle Health Sciences and Healthcare Analytics, 3M Health Information Systems, TeraMedica Evercore, NetApp Healthcare, Apple HealthKit, Epic Care Everywhere, Healthagen/Aetna Medicity, Dell Healthcare, Influence Health Predict
Agriculture	Precision agriculture	Monsanto FieldScripts, John Deere FarmSight, IBM Smarter Agribusiness, SAP Precision Farming, DuPont Pioneer Encirca
Chemicals and materials	Cheminformatics	Chemaxon Hosted Services, Enterra Cheminformatics, Dassault Systemes Biovia and Exalead, Royal Society of Chemistry (RSC) Chemspider, SAP for Chemicals , IBM Chemicals and Petroleum
Automotive	Intelligent transportation systems, autonomous vehicles	Ford SmartMobility, Uber Smart Data, Mercedes-Benz COMAND Online, University of Michigan Transportation Research Institute (UMTRI) Big Data, Univ Southern California TransDec, SQLStream Smart City StreamApp, IBM Connected Car (Continental, BMW, PSA)
Manufacturing	Industrial internet, Industrie 4.0, Advanced manufacturing	GE Industrial Internet and Industrial Big Data, Siemens Advanced Manufacturing, Germany's Industrie4.0, Fujitsu Monozukuri Solutions, Bosch IoT Big Data Management, MapR Hadoop for Manufacturing, TIBCO Spotfire for Manufacturing
Utilities and energy	Smart grid, Smart buildings, Home Energy Management (HEM)	Intel Intelligent Gateways, Pecan Street Smart Communities, SAS Soft Grid, IBM Watson Foundations, AutoGrid DROMS, Leidos Smart Grid as a Service, ABB Ventyx, Cisco Connected Energy Networks, Wipro, Siemens Smart Grid Solutions, Sensus Grid as a Service, Opower Flex, Bidgely Big Data Engine, EcoFactor, C3 Data Integrator, NTT Data Energy and Utilities, Wipro 720-Degree Customer View

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Source: Lux Research
Information Meets Matter: Devising Big Data Strategies for Real-World Industries, March 2015

Predictive analytics vendors apply AI to needs in multiple industries and applications

Application	Name	Description
Chemicals / materials	NuMat Technologies	Metal organic framework development
	Carbon Nexus	Australian research center for carbon fiber and its composites
	Ilika	Rapid material development and solid state-batteries
	Biovista	Computerized mining of medical data for drug repositioning services and products
Agriculture	AgriCircle	Agricultural data management, crop performance, and crop health prediction platform
	aWhere	Global weather information and data management platforms for agriculture
	Dolphin Engineering	Predictive software to prevent spread of fungal pathogens and phytoplasma vectors in vineyards
	Iteris	Weather and agricultural data analytics and advisory services
Mfg and process automation	NDensity	Tools for designing computer vision systems
	Alberta Innovates Centre for Machine Learning	Academic machine-learning center focused on commercialization
	Arago	Artificial-intelligence-based decision engine for IT process automation
	ColdLight (PTC subsidiary)	Machine learning analytics platform for IoT
BioElectronics	XCellCure	POC in-vitro diagnostic panel for predictive myocardial infarction diagnostics
	AgaMatrix	Dynamic electrochemistry for reducing noise in electrochemical sensors
	SpectraScience	Laser-induced fluorescence spectroscopy for colon cancer screening and diagnosis
	Sproutling	Wearable sensor-enabled activity tracker for babies and toddlers
	SensoGo	Wearable gait analysis system

Application/ Industry	Name	Description
Energy	CogniPower Technology	Switched-mode DC-DC and AC-DC power converters
	Green Charge Networks	Energy storage systems with software analytics for demand charge reduction
	Verdande Technology	Real-time predictive drilling analytics for drilling decision support
	Crystallics	Provides preformulation services to optimize API by solid-state selection
	Heliocentris Energy Solutions	Energy efficiency and management systems focusing on off-grid and weak-grid power
	TROVE Predictive Data Science	Predictive data analytics platform targeting utility customer asset optimization
	Vigilent	Energy management systems for datacenters and telecom facilities
	BPL Global	Systems for smart grid monitoring, sensing, automation, and management
Intelligent Buildings	Panoramic Power	Circuit-level metering and energy management platform for commercial and industrial buildings
	Green Energy Options	Home energy-management platform focused on consumer engagement for utilities and telecom companies
	Current Group	Sensing and software for smart grid reliability and optimization
	BuildingIQ	Software-as-a-service (SaaS) for HVAC optimization and demand response
	Entic	SaaS-based technology applying energy-saving business intelligence to commercial buildings
	Retroficiency	Software tools for remote energy assessments and automated energy audits
Water	CitiLogics	Real-time predictive analytical water management software
	UgMO	Wireless soil moisture sensors integrated with smart irrigation analytics
	RedZone Robotics	Robotic pipe inspection services