

MULTI-DOMAIN MEGATRENDS (MT) DRIVEN BY ICT: FUTURE DIGITAL QUAKE CAUSING 80% GLOBAL DISRUPTION

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Writer, Investments IDG-IT World (Canada) <http://www.itworldcanada.com/author/sibaraki>

Multi-domain Megatrends (MT)

All domains are powered by their underlying dependence upon ICT. These multiple domains include: government, industry, business, civil society (non-profits), education, media, society, all areas of science, research, jobs, entrepreneurship/start-ups, and investments. This is clearly seen in the UN SDGs and UN/ITU WSIS Action Lines.

There are impending multi-domain megatrends which can cause a future Digital Quake with over 80% global disruption—entire industries and jobs will change.

We are entering a new era in our world history with dramatic innovations/inventions so significant that this point in time represents a historical inflection point like never before.

In this presentation, we will examine, “What are these global innovation megatrends/disruptions and daily discoveries that will shape our lives -- so we can best prepare?”

Megatrends (MT): United Nations Sustainable Development Goals (SDGs): affordable, reliable, everywhere, safe, inclusive, fair, equal, resilient, sustainable, all ages

1.End poverty

2.End hunger
Agriculture

3.Health
Well-being

4.Education
Lifelong-learning

5.Gender-
equality
Empowerment

6.Water
Sanitation

7.Energy-access

8.Economic-
growth
Decent work

9.Infrastructure
Industrialization
Innovation

MT: United Nations Sustainable Development Goals (SDGs): affordable, reliable, everywhere, safe, inclusive, fair, equal, resilient, sustainable, all ages

10. Inequality-
reduction

11. Safe cities

12. Consumption
Production

13. Climate-
change

14. Marine –
resources
Oceans/seas

15. Earth-
ecosystems
(forests, land,
biodiversity)

16. Peace
Justice
Fair Institutions

17. Global Partnership: Finance, Technology,
Capacity Building, Trade, Systemic Issues (policy/institutional
coherence, multi-stakeholder, data, monitoring, accountability)

MT: United Nations/ITU World Summit on the Information Society (WSIS) Action Lines

C1.Gov, Stakeholder
promotion ICTs

C2.ICT
infrastructure

C3.Access
information
knowledge

C4.Capacity
building

C5.Confidence
Security in ICT

C6.Enabling
environment

*C7.Applications

C8.Cultural,
language diversity,
identity, local
content

C9.Media

C10.Ethics

C11.Cooperation

*C7. e-gov, e-bus, e-learn, e-health, e-employ, e-environ, e-agri, e-sci

Megatrends (MT): Pedro Domingos



- Professor of computer science University of Washington
- SIGKDD Innovation Award, Data Science “Nobel Prize” highest honor
- Fellow of the Association for the Advancement of Artificial Intelligence
- Fulbright Scholarship, a Sloan Fellowship, the National Science Foundation’s CAREER Award, numerous best paper awards
- Author or co-author of over 200 technical publications
- Visiting positions at Stanford, Carnegie Mellon, and MIT
- Co-founded the International Machine Learning Society in 2001
- Paper Top prize in July 2015 at the 24th International Joint Conference on Artificial Intelligence, the world’s largest AI conference. [**The RDIS optimization** approach, on average, performed tasks between **100,000 and 10 billion times** more accurately than previous methods and has broad applications in all areas of science, engineering and business.]
- KDD 2015 Test of Time Award
- Publishing a new book, *The Master Algorithm*, Sept 2015

5 Megatrends: Pedro Domingos

- 1.The transition from computers that are programmed by us to computers that learn on their own.** This is enabled by big data, and in turn enables the personalization of everything, from medicine to shopping, and the increasing automation of every function in an organization.
- 2.The automation of scientific discovery.** Increasingly, each step of the scientific method, from gathering data to formulating hypotheses, is carried out by computers. This enables, for example, new drugs to be discovered at a much faster rate than before.
- 3.The replacement of white-collar workers by machines, not just blue-collar ones.** Routine intellectual work can increasingly be done by AI; what's hard to replace is physical dexterity, common sense, and integrative intelligence.

5 Megatrends: Pedro Domingos



4. The transition from deterministic to probabilistic computing.

From hardware to software, rigidly deterministic computations are giving way to probabilistic ones, enabling faster, cheaper, lower-power, larger-scale, more ubiquitous, more flexible, data-driven information systems.

5. The rise of evidence-based X, where X includes medicine, policy-making, development aid, and ultimately all important societal decisions. Instead of guesswork and mixed results, we have randomized controlled trials that quickly weed out what doesn't work from what does.

Recommend Book: The Master Algorithm, Sept 2015

Interview: <http://www.itworldcanada.com/author/sibaraki>

Megatrends (MT): Big Questions?

The primitive forms of artificial intelligence we already have, have proved very useful. But I think the development of full artificial intelligence could spell the end of the human race...It would take off on its own, and re-design itself at an ever increasing rate...Humans, who are limited by slow biological evolution, couldn't compete, and would be superseded.

--Stephen Hawking, BBC December 2014

We recommend expanded research aimed at ensuring that increasingly capable AI systems are robust and beneficial: our AI systems must do what we want them to do.

--Open letter, Future of Life Institute, array of luminaries

<http://futureoflife.org/who>, January 2015

MT: Big Questions?

AI technology has reached a point where the deployment of [autonomous weapons] is – practically if not legally – feasible within years, not decades, and the stakes are high: autonomous weapons have been described as the third revolution in warfare, after gunpowder and nuclear arms...The endpoint of this technological trajectory is obvious: autonomous weapons will become the Kalashnikovs of tomorrow. The key question for humanity today is whether to start a global AI arms race or to prevent it from starting.

--[Open letter](#), signed by 1,000 high-profile AI experts, International Joint Conference on Artificial Intelligence [Elon Musk, Steve Wozniak, Google DeepMind chief executive Demis Hassabis, Stephen Hawking, ... July 2015]

MT: Big Questions?

Hope we're not just the biological boot loader for digital super intelligence. Unfortunately, that is increasingly probable.

--Elon Musk August 3, 2014

The mind is computable.

The cosmos itself may be digital.

Privacy is a recent illusion.

Computing is a moral activity.

--Assertions Grady Booch, NSF PACE Workshop August 21, 2014

I may be working to create tools which will enable the construction of the technology that may replace our species.
How do I feel about this? Very uncomfortable.

--Bill Joy

MT: Big Questions?

Bill Gates (REDDIT AMA 2015):

Even in the next 10 problems like vision and speech understanding and translation will be very good. Mechanical robot tasks like picking fruit or moving a hospital patient will be solved. Once computers/robots get to a level of capability where seeing and moving is easy for them then they will be used very extensively.

One project I am working on with Microsoft is the Personal Agent which will remember everything and help you go back and find things and help you pick what things to pay attention to. The idea that you have to find applications and pick them and they each are trying to tell you what is new is just not the efficient model - the agent will help solve this. It will work across all your devices.

....

I am in the camp that is concerned about super intelligence. First the machines will do a lot of jobs for us and not be super intelligent. That should be positive if we manage it well. A few decades after that though the intelligence is strong enough to be a concern. I agree with Elon Musk and some others on this and don't understand why some people are not concerned.

MT: Big Questions?

“Second Machine Age”: Erik Brynjolfsson and Andrew McAfee

- Professors from MIT “global economy is on the cusp of a dramatic growth spurt driven by smart machines that finally take full advantage of advances in computer processing, artificial intelligence, networked communication and the digitization of just about everything.”
- Exponential growth: computing power, digital information, cheap IoT communicating, Big Data, unlimited speed, data recombination, ubiquity
- Evidence: Driverless cars, cell-reported traffic patterns, robots scanning and understanding environments, HoloLens, Skype language translation, computers writing reviews/resumes/grading essays
- Instagram: 400+ million/mthly users, 100+ million photos/videos/daily; in 18 months sold for \$1B to Facebook; Kodak declares bankruptcy same month—FB Market Value ~\$250B, many times Kodak at peak; FB 7 billionaires each 10x greater wealth than George Eastman

MT: Big Questions?

- “Second Machine Age” : Erik Brynjolfsson and Andrew McAfee
- First machine age (Kodak), rising and related together with jobs: productivity, employment and income
 - Second machine age (FB), existing separately, productivity from jobs/income; with few employees, products/services for unlimited customers, at little cost

 - Future need: Driving greater demand for high-level programmers; education system focussed on skills for smart machines

MT: Big Questions?

The Reality:

- Unlimited computational resources and connections
- Pervasive computational thinking
- Whatever the future, it will depend on computing
- Everything is recorded, nothing is forgotten
- Organizational, geographical boundaries disappearing
- Moving towards a master algorithm—universal learner

Digital quake – 2030 80+% companies and jobs change?

What are the economic implications?

What is the social impact?

What will the world look like?

What are the intended and unintended consequences?

Is there a need for ICT accountability, ethical conduct, credentialing which EQUALS professionalism?

Megatrends (MT): Changing economies 2015 GDP (ppp) Rankings

1. China \$18,975,871T
(1820 33% global GDP)

2. US \$18,124,731T

3. India \$7,996,623T

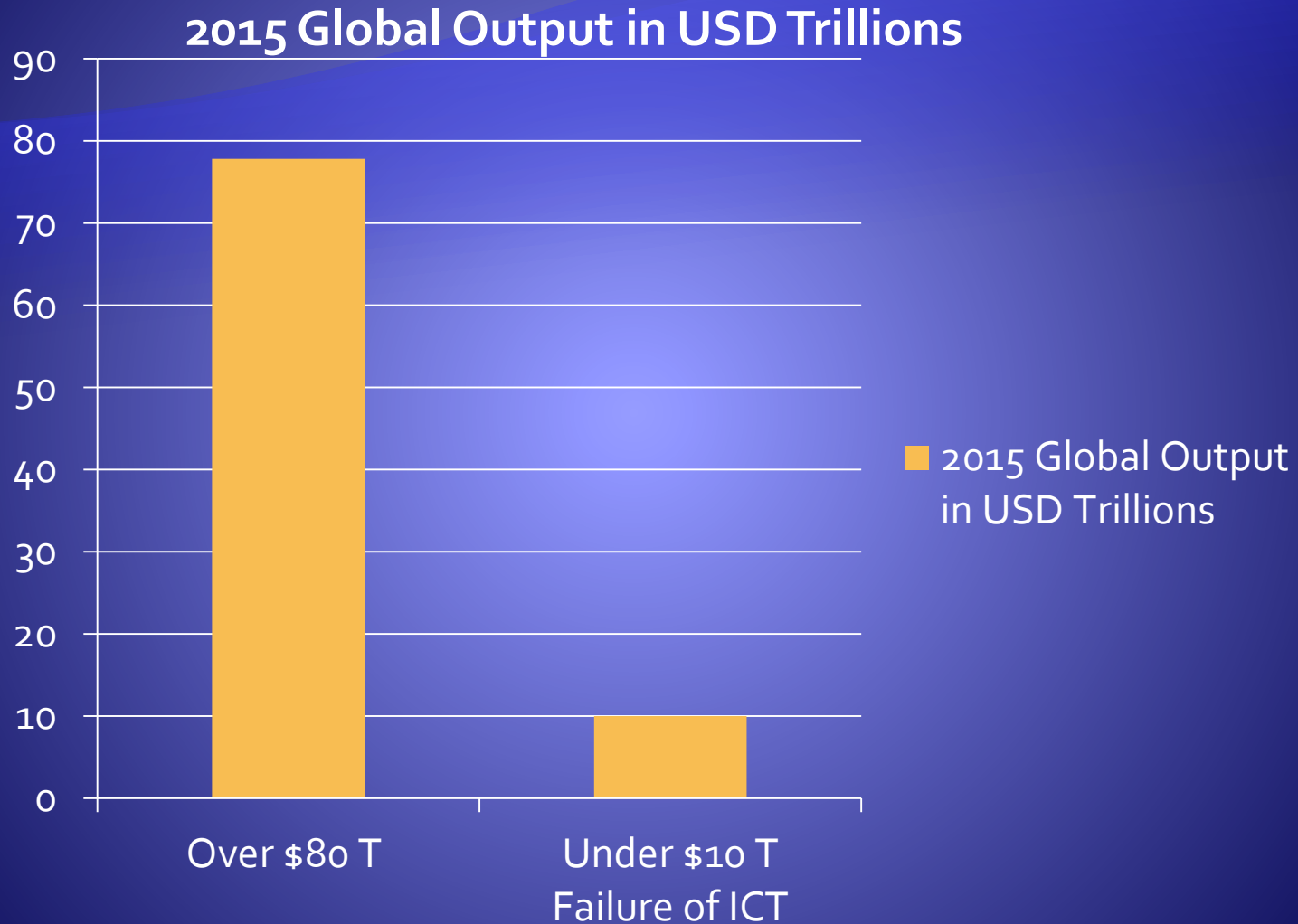
MT: Changing economies 2020 GDP (ppp)

1. China \$28,229,144T
(1820 33% global GDP)

2. US \$22,488,616T

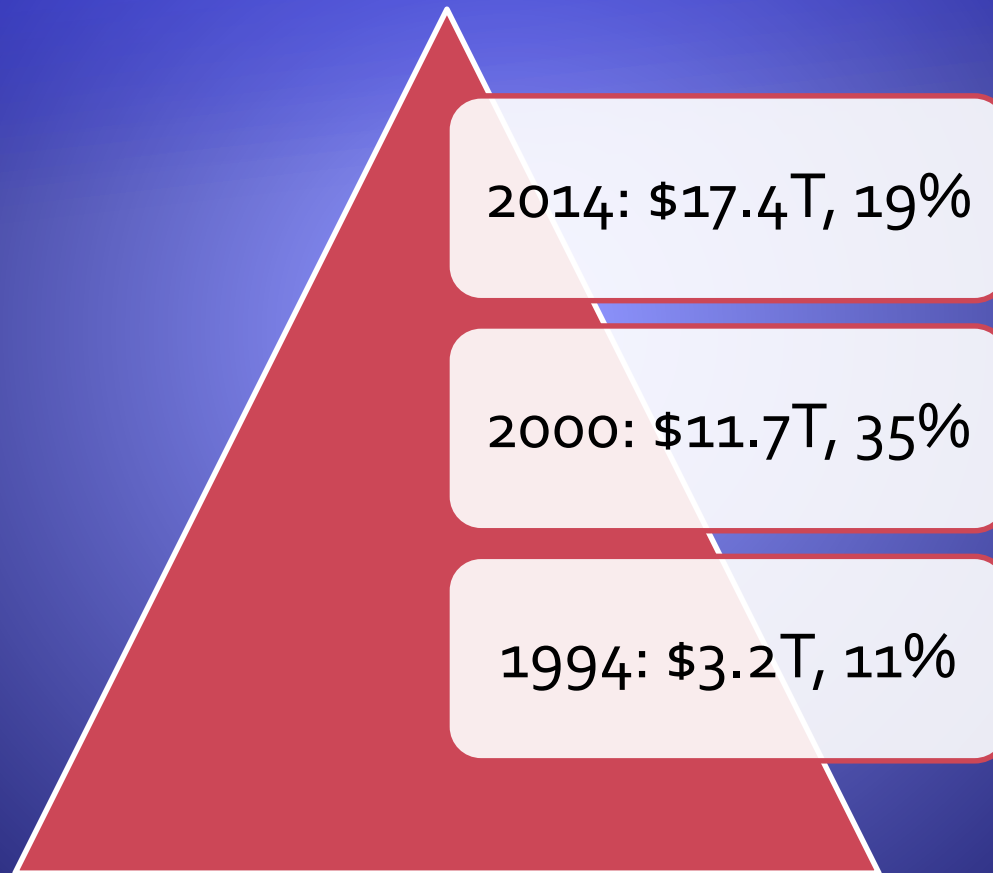
3. India \$12,708,363T

MT: Global Output/Dependence ICT



SRC: IMF, UN, World Bank, Wikipedia, CIA, ..., estimates

MT: Tech S&P 500 Market Cap & %



Megatrends (MT): Threats

- ◆ +95% of networks compromised
- ◆ Happens in < 15 minutes
- ◆ Mobile is vulnerable
- ◆ Backup communications required (Sony hack)
- ◆ Network-level insufficient – application level
- ◆ Declining ethical conduct
- ◆ Resource: Free Ethics Exam:
 - ◆ <http://open2.senecac.on.ca/cips/>

MT: Sharing (Caring) Economy

- ◆ Uber (O2O—online to offline)—largest transport company with no vehicles (future autonomous vehicles—no drivers)
- ◆ AirBnB (O2O)—largest space-rental company with no rooms
- ◆ Facebook (1B+ daily users)—largest media company that produces no content
- ◆ iHeartLocal (O2O)—Connecting and sharing places you love
- ◆ Curely/Kuddly—largest medical (people/pets) marketplace
- ◆ Unetizen—largest knowledge base from sharing caring writers/editors
- ◆ Space (O2O)—growing across smaller cities; Sustainability Platforms for accessing/sharing community excess
- ◆ Amazon Mechanical Turk—use human intelligence crowdsourced to perform tasks for a small fee

Megatrends: ICT Usage

Now:

3B Internet Users --+\$4T Commerce

(USA: 29% e-commerce 2-1/tablet/phone)

~7B Mobile Subscriptions (10 sensors)

+81% Mobile Data Growth; video driver

36% Smartphones (+20% annual growth)

avg \$318, -5% per year

25% Total Web Usage

+4 zettabytes data (4B TB)

34% useful, 7% tagged, 1% analyzed

*ICT ~20% GDP Growth

+10% Broadband =

+1.3% Economic Growth

2018:

>4B Internet users (internet.org)

(USA: 54% e-comm 2-1/tablet/ph)

+60% Smart

+50% Total Web

Smart Internet

+1B Wearables (20 sensors)

20 ZB data (NELL)

***ICT = "Super Capital" 5x
productivity gain**

\$1 ICT = \$5 return

Megatrends: ICT Usage

Now:

- IOS, Android, Windows 98% share from 5% 2005
- Tablets stagnant growth
- 90 million Windows 10 (one OS, updating as a service)
- >1B messaging users
- Multi-purpose web apps to same mobile to single purpose apps to invisible (idling waiting)
- Streaming +32%, digital track -6%

2018:

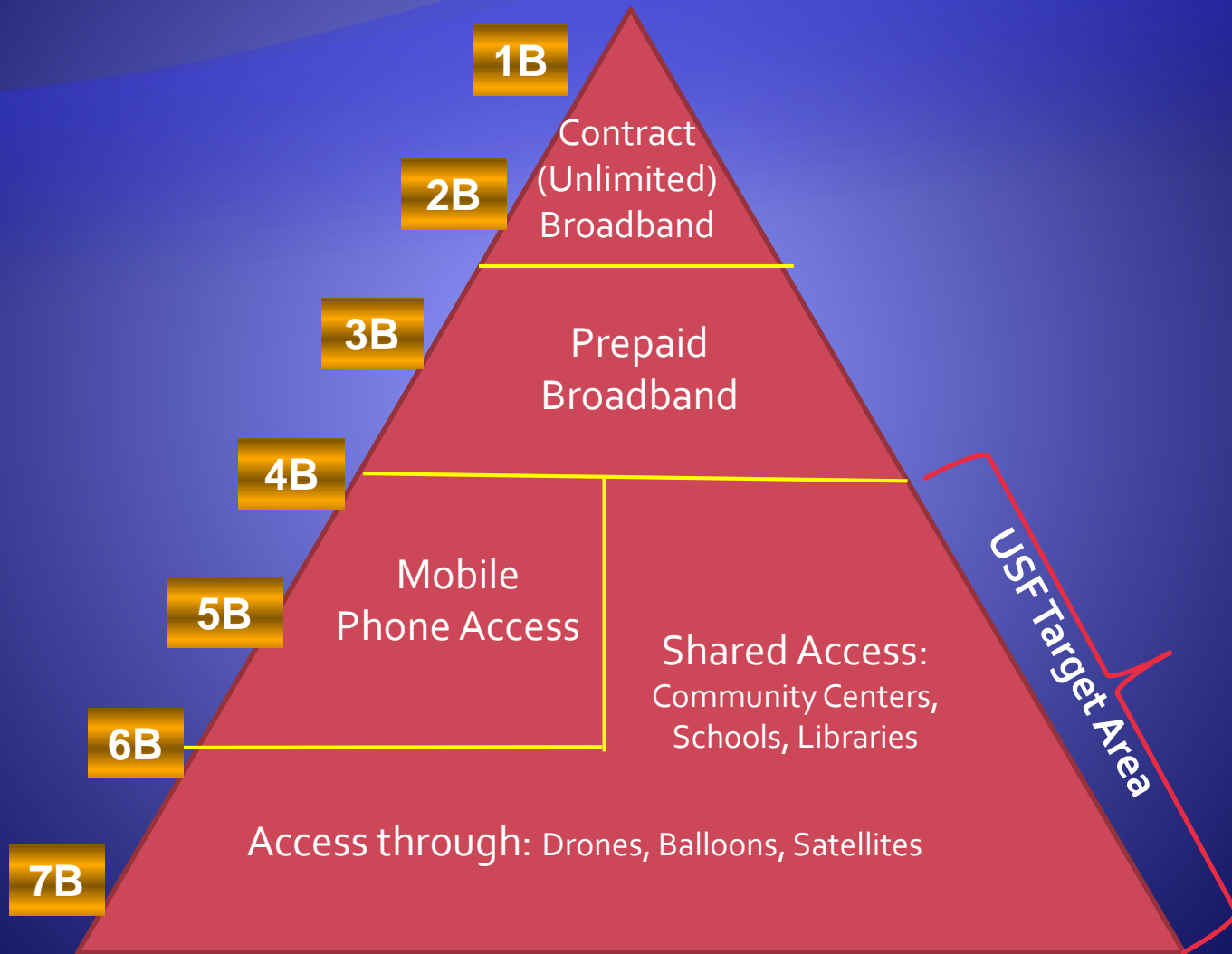
- Mobile internet 10B units vs 1B desktop early 2000
- >50% online content, community, commerce

-Big Data Trends

Mobile growing + Sensors rising + IoT planetary nervous system = Big Data: real-time, findable, shareable, transparency, data patterns with data mining / analytics, processing costs falling, cloud rising, better user interfaces, machine learning / deep learning / recommender / prediction (problem solving)

- >5B photos, videos per day
- >80% digital content from consumers videos, social media, images
- processing costs falling 33% per year
- storage costs falling 38% per year
- bandwidth cost falling 27% per year
- IoT—Internet of Things, fastest growing data segment

Megatrends: Connecting the 7 B



MT: GIC 2020 Skills Assessment

- ♦ ICT skills shortage
- ♦ ~150 million in ICT industries
- ♦ Chief Information Officer, Chief Data Officer, Chief Legacy Officer, Chief Digital Officer, ...?
- ♦ Specialised skills required
 - ♦ Bioinformatics
 - ♦ Health informatics
 - ♦ Biometrics
 - ♦ Cybersecurity
 - ♦ Cybernetics
 - ♦ Data Science

MT: GIC 2020 Skills Assessment

- ♦ Changing environments:
 - ♦ 3D printing – Driving changes in logistics management; what is intellectual property; new pricing models
 - ♦ Data Equity – The value of data internally, externally and the ways in which that information can be monetised. What are the right types of information and ways to get this information to enable business improvement
 - ♦ The cloud – The value that it can bring short term and the restrictions that it can bring longer term
 - ♦ Automation – driving new self service capabilities
 - ♦ Open source – growing trend in providing support, customer service and consultancy
 - ♦ Integration – need for standards, reliable and trusted systems in healthcare integration in wearables, in car info-entertainment, smart metering, industrialising architectures, joining the supply chain together across suppliers, and buyers

Megatrends (MT): Autonomous Capabilities, Robots, AI

- ◆ Google producing 100 self-driving car prototypes
- ◆ DARPA Robotics challenge
- ◆ NELL and NEIL – Tom Mitchell
 - ◆ <http://learning.acm.org/multimedia.cfm> [podcasts]
- ◆ Deep Learning – Andrew Ng (Coursera)
 - ◆ <http://learning.acm.org/multimedia.cfm> [podcasts]
- ◆ Brain simulation projects (MS Adam, Bing Predict)
 - ◆ <http://bit.ly/1pKWiXB>

MT: Autonomous Capabilities, Robots, AI

- ◆ Baidu (O2O—online to offline): Medical voice-translation virtual robot, AskADoctor, knows 520 different diseases gives diagnosis with odds, links to nearby specialist
- ◆ Baidu: AI StockMaster analyses news, markets predicting sectors, stocks or markets changes
- ◆ Robot experiments shows signs of self-awareness (Rensselaer Polytechnic Institute NY)
 - ◆ 3 could speak
 - ◆ 2 muted
 - ◆ Asked to figure out who could speak; no one could solve the problem
 - ◆ Each tried to say “I do not know”, one heard itself and said, “Sorry, I know now” then saying more indicating it knew it could speak.

MT: Autonomous Capabilities, Robots, AI

- ◆ Beats humans: how often AI top five guesses for a given image miss the correct answer
 - ◆ 4.82 percent, Google March 2015
 - ◆ 4.94 percent, Microsoft February 2015
 - ◆ First time to better average human performance of 5.1 percent
- ◆ Drones: commercial (Amazon), military, personal (CES)

MT: Autonomous Capabilities, Robots, AI

- ◆ DARPA—Defense research (Defense Advanced Research Projects Agency)
 - ◆ IBM SyNAPSE neuromorphic chip—modelled on brains, 1 million neurons, 256 million synapses (human—100bn, 100 trn)
 - ◆ ElectRX—injected nano-chips acting as pacemakers to nervous system giving stimulating signals treating arthritis, mental illness, ...
 - ◆ BRAIN initiative--human brain modulation and recording
 - ◆ RAM--implantable neural device with the ability to record and stimulate neurons within the brain to help restore memory

MT: Virtual, Augmented Reality

- ◆ HoloLens: Augmented reality, Windows 10, NASA, release 2016
- ◆ Magic Leap: Augmented reality, \$542 million investment, release 2016
- ◆ Oculus: Facebook \$2.3 billion purchase, Virtual Reality, release 2016
- ◆ Ex. National Football League (NFL) teams – using virtual reality to reduce injuries & improve play

MT: IoT – Internet of Things

- ◆ McKinsey 2025: \$11.1 trillion per year
 - ◆ \$850B logistics/navigations
 - ◆ \$930B worksite equipment maintenance/optimization
 - ◆ \$1.2 T retail checkout/inventory
 - ◆ \$3.7 T factories optimization
 - ◆ Issues: interoperability, privacy, security, talent, policy,...
- ◆ Example--Vertical farms: Green Sense Farms harvests crops 26 times a year, 85% less energy, one-tenth the water, no pesticides/herbicides, lower CO₂ output, creating oxygen (reduces 70% water consumed by global agriculture, 33% of food lost/wasted)

MT: Education Online

- ♦ Adaptive learning: Knewton discovers how you learn, adapts, offers content
- ♦ MOOCs: Massive Open Online Courses; Example Stanford course: 160K students, 190 countries, 44 languages
 - ♦ Coursera: 100+ universities, 12+ mm students, 500+ courses
 - ♦ <http://www.itworldcanada.com/blog/interview-andrew-ng-chairman-and-co-founder-of-coursera/94863>
 - ♦ eDx: MIT/Harvard, 60+ providers, 2.1+ mm students, 176+ courses
- ♦ iTunes U open university, 70mm courses downloaded
- ♦ Khan Academy: 5500+ videos, 400+ mm lessons, 10+ mm users/mth, 500+ m teachers
- ♦ Seoul Accord
 - ♦ Global accreditation program for Computing Education

Megatrends: Education Potential

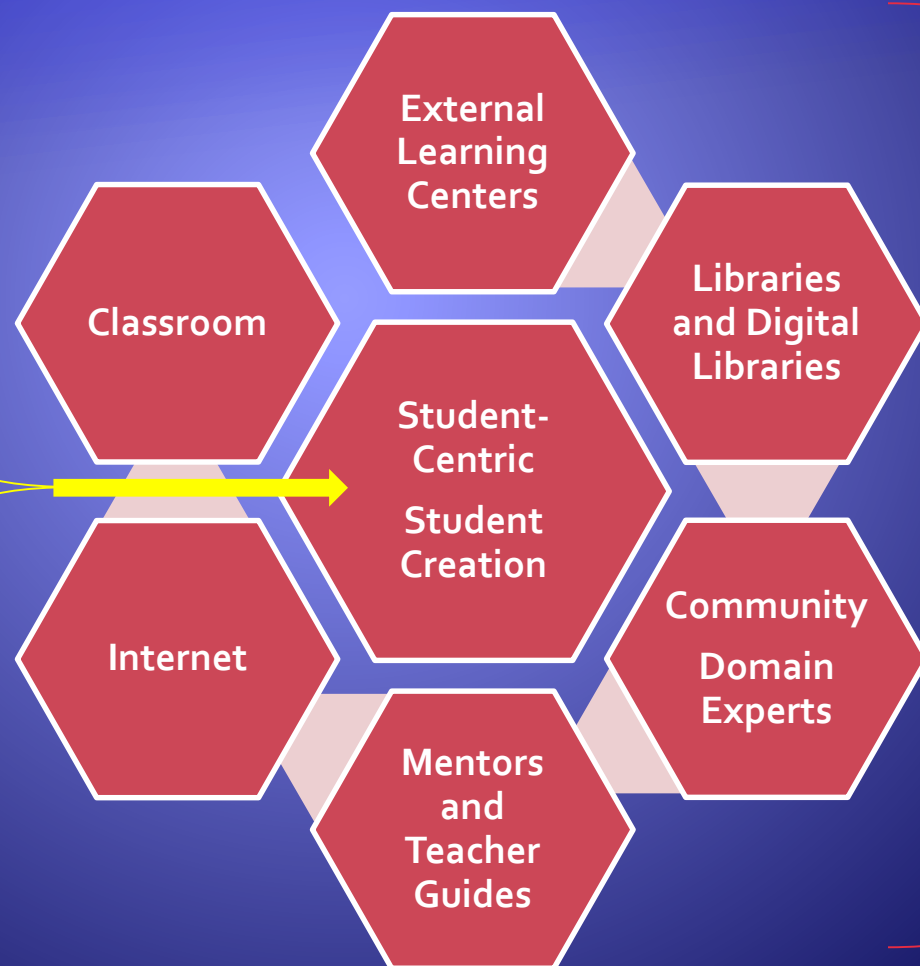
ICT-enabled 21st Century Skills

- ◆ Data analysis, problem solving and innovation
- ◆ Information synthesis, evaluation, creation
- ◆ Global insight and collaboration
- ◆ Knowledge understanding, applying, creation/invention
- ◆ Multi-media skilled communication
- ◆ Self-regulation and assessment
- ◆ Research insight: concept, research and development, transfer, production/deployment, usage
- ◆ Innovation insight: products, services, processes, organization models, business models, social-mediated, AI
- ◆ Entrepreneurial insight: customer development, lean start-up, compass, business model canvas

Megatrends: Learning Paradigm Shift—1:1

NEW: STUDENT-CENTRIC / STUDENT CREATION -- interactive content delivery, educational methodology / training, multimedia, smart devices / connectivity, monitoring, parental involvement, security

- 1:1 Learning
- Collaboration
- Standards-based
- Self-assessment
- Personalized learning communities
- Real Projects
- ICT-enabled Curriculum and Learning Resources



Parents

MT Innovation: Using Education Models

New: interactive content delivery, educational methodology, multimedia, smart devices, monitoring, parental involvement, security



Embodiment of the latest innovations in education thus world model, Harvey Mudd College New Teaching and Learning Center





University of California Kay Family Foundation Lab: Medical Mobile Application JAM:
http://www.som.uci.edu/news_releases/medappjam.asp

MT Innovation: Digital Libraries, Ex. ACM

- ◆ World's largest scientific, educational and professional computing association
- ◆ 3.4 million reach
- ◆ Educators, researchers, developers, students
- ◆ +200 conferences / workshops / events
- ◆ 78 publications / newsletters
- ◆ 37 Special Interest Groups or SIGS (such as SIGGRAPH)
- ◆ Awards (such as Turing "Nobel Prize of Computing")
- ◆ 1.5 million worldwide users of the Digital Library
 - ◆ individuals, academic institutions, government research centers, corporations...<http://dl.acm.org/>
- ◆ ACM Learning Center, webcasts, videos, books, courses,...
<http://learning.acm.org/>

MT: Types of Innovation vs. Development Phases Matrix

	Development Phases 					
Types of Innovation 	Concept	Research & Development (R&D)	Transfer	Production & Deployment	Usage	Key: <i>8 Internet, IoT</i> <i>4 iPhone</i> <i>2 smartphone upgrade</i>
Products	8,4	8,4	8,2,4	8,2,4	8,2,4	<u>10 Master Algorithm</u>
Services	8	8	8	8,4	8,4	
Process	8	8	8	8,4	8,4	
Organization Model	8	8	8	8,4	8,4	
Business Model or 9 areas of the Business Model Canvas	8	8	8	8,4	8,4	
Social-mediated	8	8	8	8,4	8,4	
Machine-learning	8	8	8	8	8	

SRC: adapted from IT Innovation Foundation and OECD

MT: Innovation: Healthcare

- ◆ Costs, up to 17% of GDP
- ◆ \$660K lifetime costs: <http://bit.ly/1ppFLGc>
- ◆ 52% consumers want web tools
 - ◆ 62% want to use email for health concerns
- ◆ Smart wearable's: Samsung, Apple, MS, ...
- ◆ mHealth or Mobile Health
- ◆ Telemedicine, [Curely](#), [JioHealth](#)
 - ◆ <http://learning.acm.org/multimedia.cfm> [podcasts]
- ◆ Research: Optogenetics, Epigenetics

MT: Innovation: Healthcare

- ♦ Optogenetics/optoclamp (closed loop control)—activate cells (eg. Neurons) with light signals; optimize signals from feedback with continuous real-time adjustments
- ♦ Epigenetics: external or environmental factors that switch genes on and off
- ♦ Precision genetic medicine:
 - ♦ CRISPR/Cas9 gene editing: cheap, easy, snipping gene segments and replacing them
 - ♦ CRISPR, clustered regularly interspaced palindromic repeats—matches DNA sequences
 - ♦ Cas9 enzyme cut out the matched DNA, allows replacement

MT: Innovation: Healthcare

- ♦ Neuroscience:

- ♦ Neuroticism linked to creative genius
- ♦ Insect brains controlling robots
- ♦ Brain-to-brain networks (BRAIN-NETS) in primates, rodents working together for tasks, predict weather (better than working alone)
- ♦ Transplanted embryonic GABA-expressing neurons increasing plasticity in the brains of adult mice, allowing for extensive rewiring and the creation of new neural connections -- comparable to that which occurs during important stages of brain development

MT: Innovation: Healthcare

- ♦ Neuroscience:

- ♦ Passive frame theory—Consciousness—passive conduit rather than an active force that exerts control; more reflexive and less purposeful interpreter presenting information but is not the one making any arguments or acting upon the knowledge that is shared; “free will” “decider” does not exist, consciousness only relays information to control “voluntary” action, or goal-oriented movement involving the skeletal muscle system
- ♦ Algorithm for Simplifying the Brain's Deep Complexity--Machine learning dimensionality reduction, interprets large-scale neural recordings
- ♦ Brain signature predicts human emotions—90+% accuracy, neural activation pattern across brain, found by machine learning with neural imaging

MT Innovation: Entrepreneurship

- ♦ Compass.co: success framework, active feedback, global ecosystem
- ♦ Steve Blank (customer development), Eric Ries (Lean Start-up), Alexander Osterwalder (business model canvas)
- ♦ Jump-start Our Business Start-ups
 - ♦ US: JOBS Act Model (Regulated crowdfunding)
- ♦ \$100B Crowdfunding: Reward/Donation, Debt, Equity
<http://bit.ly/1oSab81>
- ♦ Crypto currency, Bitcoin 5mm wallets
- ♦ Unicorns—start-ups worth \$1B, 133 at \$.5 Trillion

MT Innovation: Entrepreneurship

- ♦ Harvard Business Review (Jeff Dyer, Hal Gregersen, Clay Christensen): 6 yr study, 25 successful innovators, 3000 executives, 500 who started innovative companies/invented new products
 - ♦ Innovative entrepreneurs spend 50% more time on 5 skills
 - ♦ Innovator's DNA—can be cultivated
 - ♦ QOEAN: Questioning, observing, experimenting, associating, networking
- ♦ Forbes (Michael Simmons): No 1 predictor of success; 50% of career success due to Open Networks (links with diverse people clusters)
 - ♦ Better — forecasters, first movers, connectors
 - ♦ More — disruptive innovations
 - ♦ Millions of studies: top research studies (eg. citations)—90% typical references, 10% diverse

MT Innovation: Blue Sky

EmDrive—electromagnetic space propulsion technology

Fusion—Lockheed announces compact design; prototype in under 10 years

D-Wave 1,000+ qubits—quantum computing (Nasa, Google, Lockheed)

Nanomaterials—nanorobots in medicine, extra capacity/life batteries, quantum dot solar windows, ...

No limits

MT: Defining Professionalism

- ♦ *"Do you feel computing should be a recognized profession on par with accounting, medicine and law with demonstrated professional development, adherence to a code of ethics, personal responsibility, public accountability, quality assurance and recognized credentials?"*

MT: Professionalism

- ♦ Vint Cerf co-creator of the internet.

<http://bit.ly/1JqYiwK>

- ♦ “...I know that many of my colleagues don’t like this idea very much, but I think with the degree of software that we’re surrounded by everywhere, that at some point we may be called to task for failing to do something that protects people’s interests and there may be liability, and as soon as that happens I think that some point of accreditation will be inescapable”

MT: Professionalism

- ◆ EC E-Skills: Promotion of ICT Professionalism in Europe, Pan-European ICT BOK
 - ◆ Sustainable model for the promotion of ICT professionalism in Europe
 - ◆ Reducing risk and strengthen ICT professionalism
- ◆ ISO/IEC 24773 provides new conformance (accreditation) service of certification schemes in software and systems engineering
- ◆ IFIP IP3: <http://ipthree.org/>
- ◆ Licensing (registration and regulation) making progress with Software Engineering – 2013 10 states to 40+ US states today

MT: Big Questions?

The Reality:

- Unlimited computational resources and connections
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Digital quake – 2030 80+% companies and jobs change?

What are the economic implications?

What is the social impact?

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What are the intended and unintended consequences?

Is there a need for ICT accountability, ethical conduct, credentialing which EQUALS professionalism?

Thank you

Resources—discussions with over 1000 experts,
most here: <http://bit.ly/1mbO2MG>

Computing Educators Oral History Project
<http://www.southwestern.edu/departments/mathcomp/hcompsci/OHProject/other-ohprojects.html>