

TRANSFORMING DISRUPTIVE TECHNOLOGY *INTO* OPPORTUNITY



INTERNATIONAL DAIRY FOODS ASSOCIATION

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Michael J.T. Steep

Executive Director,

Disruptive Technology & Digital Cities Center

Stanford University Engineering School

创新 *Transform* INNOVATION

DISRUPTIVE TECHNOLOGY DEFINITION

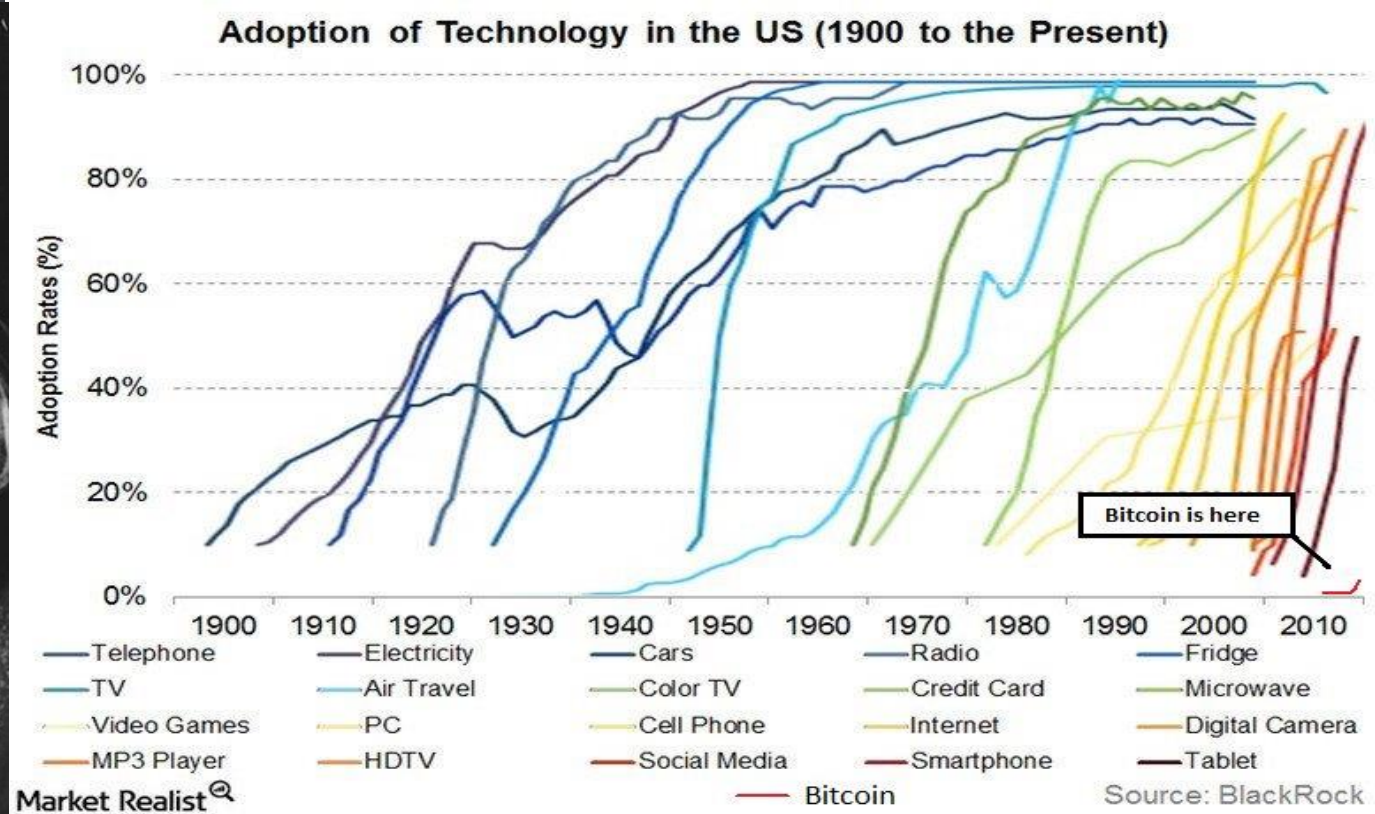
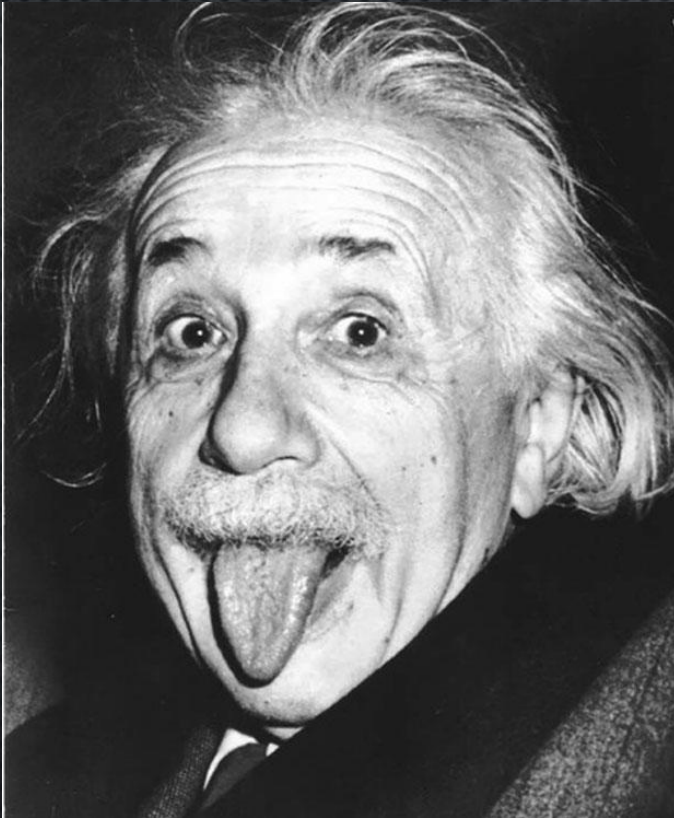
FINANCIAL MODEL

- ✓ CREATES OR ENABLES NEW VALUE PROPOSITION
- ✓ CHANGES UNDERLYING ECONOMICS
- ✓ DISPLACES OR DISRUPTS A BUSINESS MODEL
- ✓ CREATES SUSTAINABLE INNOVATION
- ✓ SPEED OF DISRUPTION OVERCOMES RESISTANCE
- ✓ IMPOSSIBLE TO IGNORE

- ✓ **DISCONNECTED FROM CORPORATE R&D - A REAL CRISIS IN INNOVATION**

ACCELERATED TECHNOLOGY ADOPTION

TRUST WITHOUT DUE DILIGENCE

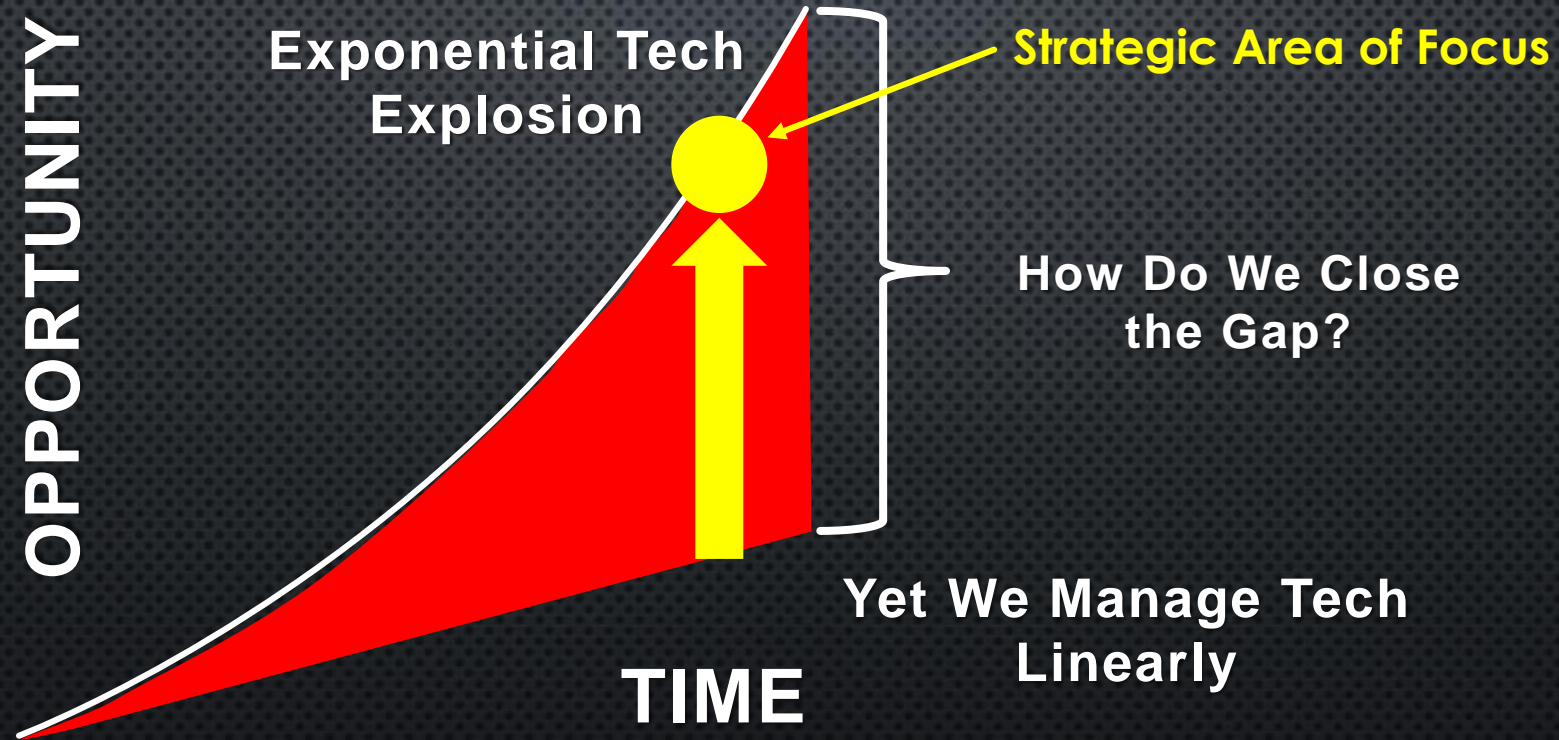


TRUST

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EXPONENTIAL EXPLOSION

UNINTENDED CONSEQUENCES



OUTSIDE INVESTMENT IN DISRUPTIVE TECHNOLOGY EXCEEDS CORPORATE R&D

\$270B OUTSIDE VS. \$200B INSIDE

- TOTAL GLOBAL CORPORATE RESEARCH \$2T ANNUALLY – 10% CORE RESEARCH 90% APPLIED
- AMERICAN UNIVERSITIES SPENT \$70 BILLION ON DISRUPTIVE TECHNOLOGY-HIGHLY CONCENTRATED TOP RESEARCH UNIVERSITIES
- GLOBAL VENTURE INVESTMENTS AMOUNTED TO \$200 BILLION
- \$11 TRILLION OF *PATIENT* FAMILY OFFICE MONEY
- **CHANGE IN MIX FROM 50/50 AT END OF 1950's TO 10/90**

Transform Copyright

VANNEVAR BUSH

FATHER OF THE AMERICAN R&D MODEL



Transform Copyright

Wikipedia: Vannevar Bush (/væˈni:vɑːr/ van-NEE-var; March 11, 1890 – June 28, 1974) was an American engineer, inventor and science administrator, who during World War II headed the U.S. Office of Scientific Research and Development (OSRD), through which almost all wartime military R&D was carried out, including important developments in radar and the initiation and early administration of the Manhattan Project. He emphasized the importance of scientific research to national security and economic well-being, and was chiefly responsible for the movement that led to the creation of the National Science Foundation.

Bush joined the Department of Electrical Engineering at Massachusetts Institute of Technology (MIT) in 1919, and founded the company now known as Raytheon in 1922. Bush became vice president of MIT and dean of the MIT School of Engineering in 1932, and president of the Carnegie Institution of Washington in 1938.

During his career, Bush patented a string of his own inventions. He is known particularly for his engineering work on analog computers, and for the memex. Starting in 1927, Bush constructed a differential analyzer, an analog computer with some digital components that could solve differential equations with as many as 18 independent variables. An offshoot of the work at MIT by Bush and others was the beginning of digital circuit design theory. The memex, which he began developing in the 1930s, was a hypothetical adjustable microfilm viewer with a structure analogous to that of hypertext. The memex and Bush's 1945 essay "As We May Think" influenced generations of computer scientists, who drew inspiration from his vision of the future.

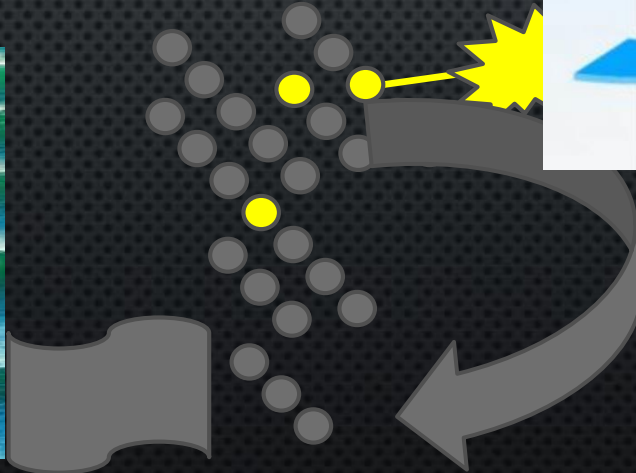
Bush was appointed to the National Advisory Committee for Aeronautics (NACA) in 1938, and soon became its chairman. As chairman of the National Defense Research Committee (NDRC), and later director of OSRD, Bush coordinated the activities of some six thousand leading

\$270 BILLION DISRUPTIVE TECHNOLOGY SPEND OUTSIDE DISRUPTIVE INVESTMENT NOW EXCEEDS INSIDE CORPORATE SPEND

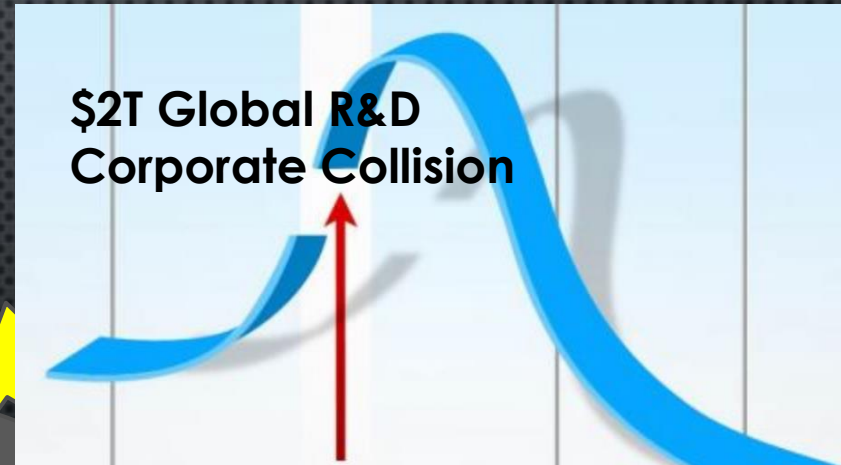
\$270B Global
Venture & Univ.
Investment



10K Startups
10% Survive



\$200B Inside Spend



1 out of 10
Blockbuster

- 90% Applied
- 10% Research
- \$200B Inside versus
- \$270B Outside

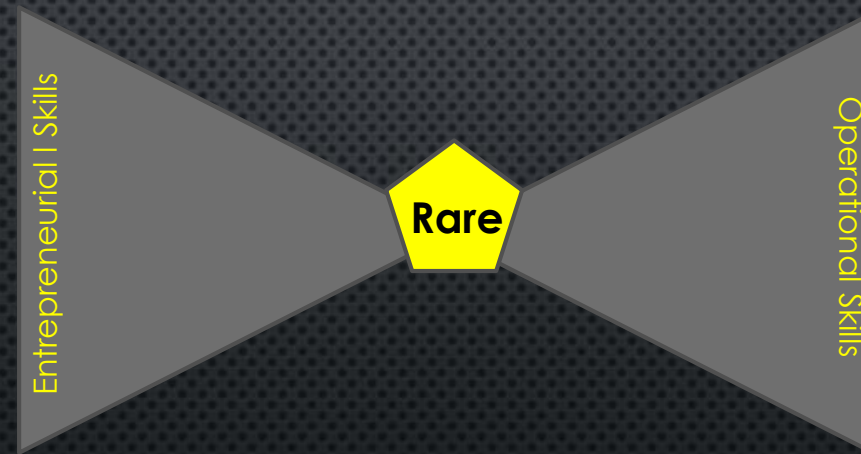
TWO OPPOSING TRIBAL CULTURES

WHY INNOVATION FAILS

Attributes

- Long-term ROI with venture portfolio management expertise
- Goal of beating the Las Vegas odds 1 in 10
- High- risk investment
- Compensation tied to the needle in the haystack
- Risk -taking leadership and behaviors
- Rapidly adapt or die
- “Change the World” story leads to missionary zeal
- **Unknown outcome with Las Vegas odds**

SKILL - NOT UNABATED ENTHUSIAM



Attributes

- Short-term operational execution immediate ROI
- operational execution expertise
- Goal of consistent & sustainable revenue/ earnings growth
- Low-risk investment
- Compensation tied to short-term performance
- Risk adverse leadership and behaviors
- Resist change to sustain growth
- “Legacy of success” story leads to legacy culture
- **R&D internally focused**

OPPORTUNITY
PROACTIVE VS. REACTIVE

**DISRUPTIVE TECHNOLOGY CREATES ENORMOUS ECONOMIC
ADVANTAGE FOR THOSE WHO TAKE ADVANTAGE OF DISRUPTION**

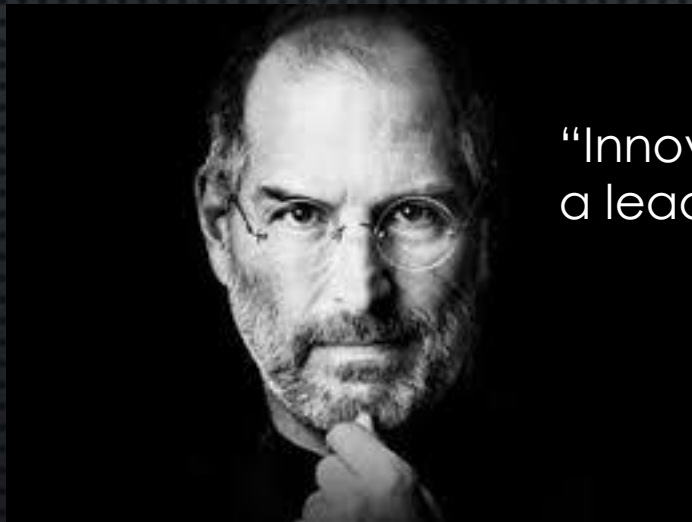
- ✓ LEADERSHIP AND BOARD-LEVEL SUPPORT
- ✓ COMPLEMENTARY OUTSIDE AWARENESS AND EXPERTISE
- ✓ STRATEGIC FOCUS - RIGHT TECHNOLOGY WITH RIGHT BUSINESS MODEL
- ✓ 70 COMPANIES WHO MADE THE TRANSITION SMALL TO LARGE

TWO INNOVATION APPROACHES



TRANSFORMATION OF APPLE INTO ONE OF THE MOST VALUABLE COMPANIES

OUTSIDE IN MODEL



"Innovation distinguishes between a leader and a follower."



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DESTRUCTION OF NOKIA AND MICROSOFT MOBILE PLATFORM

INSIDE OUT MODEL

Microsoft



“The Apple iPhone is a fad that will quickly fade over time.”



Microsoft Spent Billions on a Sinking Ship

Worldwide Nokia / Microsoft mobile phone sales (in million units)*

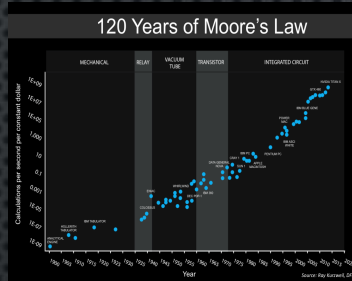


* Includes smartphones and feature phones
Source: Gartner, Microsoft

statista

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EMERGING TECHNOLOGY SOURCES OF DISRUPTION



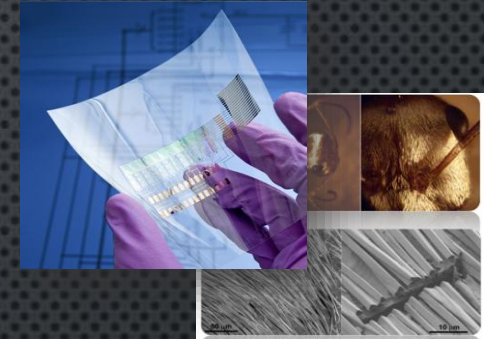
Computational
Power



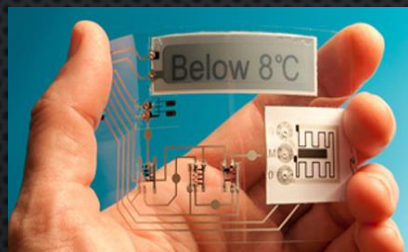
Robotics



Nutrition



Advanced Materials



Smart Tags



Continuously
Connected Customer



Persuasive
Technology



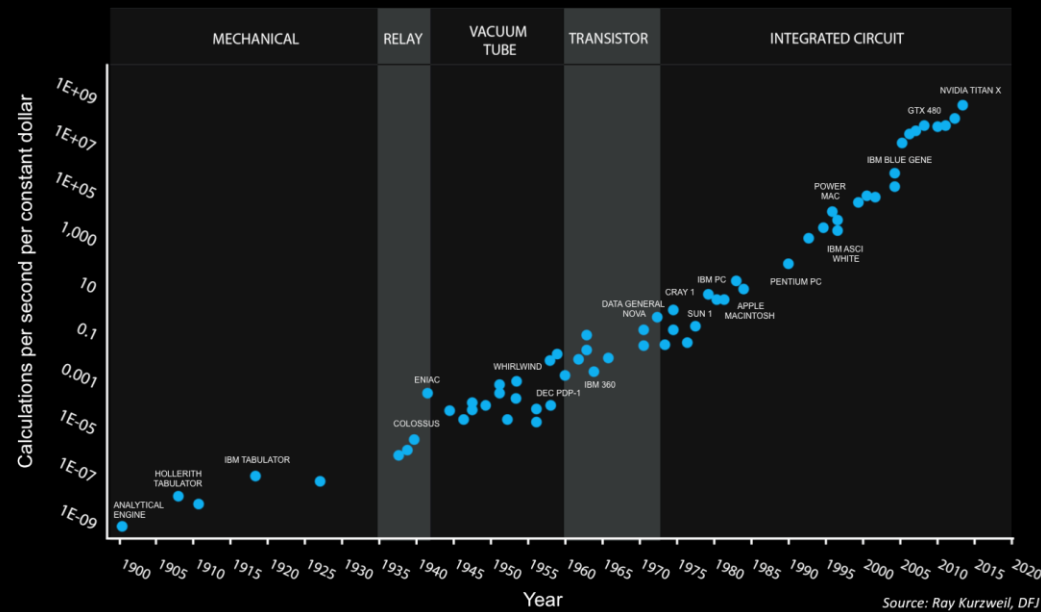
Solar Road
Connected to
Smart Tags

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TECHNOLOGY'S EXPONENTIAL ENGINE

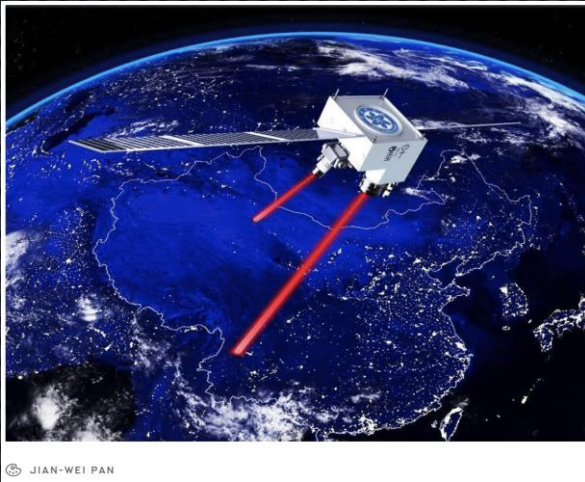
QUANTUM PLATFORM™

120 Years of Moore's Law



1. UBIQUITOUS COMPUTING POWER
2. UNLIMITED FREE STORAGE
3. SOFTWARE ALGORITHMS
4. IMAGING AND SENSORS
5. CONTINUOUS NETWORK CONNECTION

- ROCKET ENGINE UNDER THE HOOD ENABLING "RULE OF 10"



QUANTUM COMPUTING **CHINA'S MOONSHOT**

“Biggest event in human history”
Stephen Hawking



- CHINA NATIONAL LABORATORY FOR QUANTUM INFORMATION SCIENCES - \$10B RESEARCH CENTER
- **VISION:** FIRST QUANTUM COMPUTER WILL HAVE A MILLION TIMES THE COMPUTING POWER OF ALL OTHER COMPUTERS IN THE WORLD

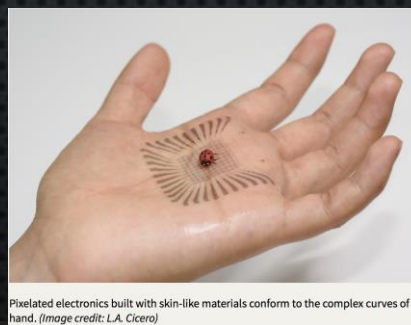


SYNTHETIC SKIN FOR ROBOTS

DATA TO DRIVE "FEELING"

Robotics

- SKIN CONTAINS EMBEDDED SENSORS WITH BUILT-IN NETWORK
- FLEXIBLE MATERIALS
- ENABLES ROBOT TO "FEEL" HIS WAY THROUGH AN ENVIRONMENT
- INDEPENDENT DECISION-MAKING VS. HUMAN DIRECTED



Pixelated electronics built with skin-like materials conform to the complex curves of a hand. (Image credit: L.A. Cicero)

Close X

Bio-inspired, Robust and Low-cost Smart Skin

stretchable multi-modal sensor network
wafer
2-D to 3-D stretching
smart glove

For Enhancing Human-Robot Interaction

RADICAL NEW FARMING MODEL

CUSTOM NUTRITION?



Case



One-Point-One

- PROGRAMABLE PRODUCE TO ADDRESS CHRONIC CONDITIONS
- COMPLETE CHANGE IN THE SUPPLY CHAIN - NEW CONTINUOUSLY-CONNECTED COMMERCIAL PLATFORM
- FULLY-AUTOMATED AEROPONIC CULTIVATION
- HIGHEST QUALITY PRODUCT WITH CUSTOM NUTRIENT DESIGN
- DECIMATES LABOR COSTS – ROBOTIC HARVESTING
- OPTIMIZES FERTILIZER AND WATER USAGE
- URBAN FARM TO TABLE DISTRIBUTION MODEL
- 10,000 SQ. FT. 55 ACRES - 64X INCREASE PROFIT/SQ. FT.

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2 WASHINGTON FOREST GROUPS

INNOVATION IN SMALL-MEDIUM SIZE COMPANIES



- TRADITIONAL INDUSTRY – FOREST PRODUCTS AND HARVESTING
- OLD-SCHOOL METHODS OF CALCULATING BOARD FEET FROM TIMBER
- 4% GROWTH RATE – MATURE INDUSTRY
- OPERATING COSTS IMPAIRED BY LOW-TECH APPROACH
- SIMPLE OUTSIDE-IN APPROACH LOOKING AT THE PROBLEM
- APPLIED EXPERTISE IN IMAGING
- NEW APPROACH THAT COULD ELIMINATE BOTH COST AND TIME
- UP TO 40% IMPROVEMENT IN OPERATING COSTS
- GAME CHANGER

RIVENDALE FARMS – A LABORATORY FOR APPLYING TECHNOLOGY TO SMALLER FARMS

BOUTIQUE, CUTTING EDGE FARM ENABLED BY TECH

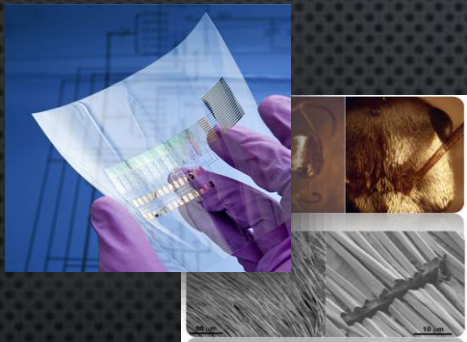


- CARNEGIE MELLON BACKED LAB
- SENSOR-EQUIPPED COWS MONITOR MOVEMENT, SANITATION, FEEDING
- RIVENDALE GREENHOUSE'S AUTOMATION PANEL, WHICH CONTROLS TEMPERATURE, HUMIDITY AND SUNLIGHT
- NO PEOPLE JUST AN AUTOMATED FEED SYSTEM AND THREE ROBOTIC MILKING MACHINES THAT MILK 4 TIMES A DAY
- \$200K MACHINE REPLACES 5 WORKERS

“THEY HAVE A DIFFERENT MIND-SET, AND THEY ARE ALL TRYING TO FIGURE OUT A PATH AHEAD FOR THEIR FAMILY FARMS AND WHERE TECHNOLOGY FITS IN,” SAID JEFF AINSLIE, A VICE PRESIDENT OF RED BARN CONSULTING, WHICH ADVISES FAMILY FARMERS”

ADVANCED MATERIALS AND META-MATERIALS

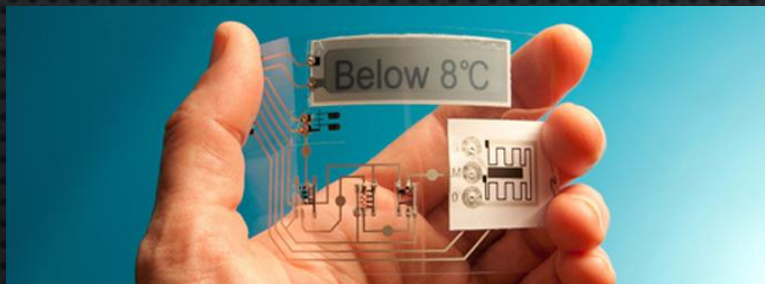
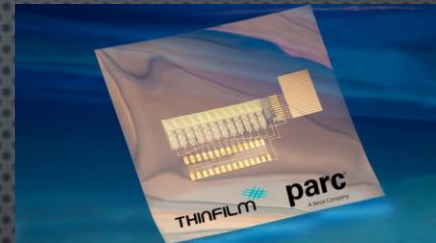
CHANGING FUNDAMENTALS OF VALUE CHAIN



Advanced Materials

- ENABLING PRECISE AND DECENTRALIZED MEASUREMENT OF EVERYTHING AND EVERYONE
- “PRINT” SENSORS INTO EVERY MATERIAL CONVERGING WITH 3D PRINTING
- COST COMING DOWN AT EXPONENTIAL RATE
- PRINT ANTENNAS DIRECTLY INTO TAGS
- SENSORS NOW CAN “HARVEST” POWER
- **REVOLUTIONIZE IOT BECOMING “ALWAYS CONNECTED”**

CONVERGENCE OF MATERIALS



- PLATFORM SUCCESS: CPG AND RETAILERS
- IMBEDDED WIRELESS SENSORS IN PACKAGING
- CONTINUOUS CONNECTION OF INVENTORY DURING JOURNEY
- COLLECTION OF OTHER INFORMATION
- TRANSPORTATION CONNECTED WIRELESSLY
- COMPLETE RECORD OF TRANSIT JOURNEY TO WAREHOUSE TO DEALER TO CUSTOMER

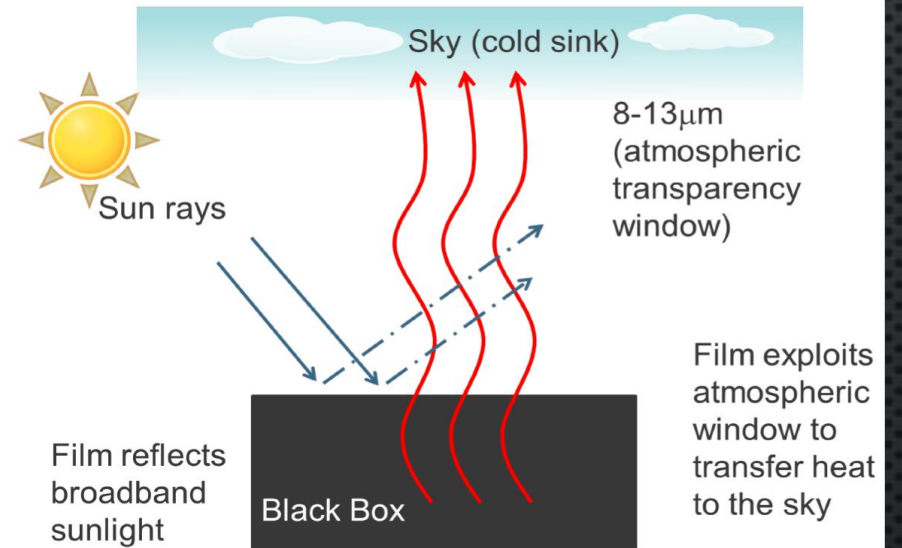
ADVANCED META-MATERIALS

- UNIQUE MATERIAL WITH SPECIAL CHARACTERISTICS
- TEMPERATURE DROP 7-11 DEGREES CELSIUS
- HARVESTING OF POWER
- LOW COST TO PRODUCE
- MASSIVE SENSOR



Norman Nan Shi *et al.* Science 17 Jul 2015:
Vol. 349, Issue 6245, pp. 298-301

The hairs of Saharan silver ants allows them to stay cool in deserts



Low-cost; single layer; massively scalable

DIGITAL MANUFACTURING



Digital Manufacturing

Case

Sandvik

- VARIETY OF PRODUCTS AT LOWER VOLUME & COST
- 3D PRINTING WITH RECONFIGURABLE PRODUCTION LINES
- INTEGRATED COLLABORATIVE DESIGN & MANUFACTURING
- MASS CUSTOMIZATION AND PERSONALIZATION
- DRAMATIC SHIFTS IN PRODUCT DEVELOPMENT, MANUFACTURING, AND DISTRIBUTION
- IOT ENABLES DIGITAL MANUFACTURING
- THREAT TO TODAY'S VERTICALLY INTEGRATED, LARGE-SCALE **MANUFACTURING INDUSTRY**

EVERYTHING & EVERYONE CONNECTED

CHANGING WHAT WE KNOW & WHEN WE KNOW IT



Network Technologies

- WIRELESS TECHNOLOGY UNIFIES EVERY ELEMENT OF VALUE CHAIN
- MASSIVE PROLIFERATION OF LOW-COST SENSORS
- DATA FROM EVERYWHERE AND EVERYTHING
- COLLECTION NOW INCLUDES DEVICES, LOCATION, PEOPLE, AND PROCESSES LIKE MANUFACTURING
- MODEL MOVES TO DATA USAGE VERSUS OWNERSHIP
- MASSIVELY EXPANDED EXPOSURE TO CYBER ATTACK
- TRADITIONAL DIGITAL MARKETING NO LONGER ENOUGH

CONNECTED VALUE CHAIN

MOBILE PLATFORM EXPERIENCE



- CONTINUOUS MONITORING
- FULLY CONNECTED
- COLLISION DATA
- DISTRACTION DETECTION
- MANUFACTURING FEEDBACK



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CONVERGENCE OF ALWAYS-CONNECTED AV DELIVERY TECHNOLOGIES **SOLAR ROADS AND SMART TAGS**



Shandong Pavenergy and Wattway commercializing technology



UPS?



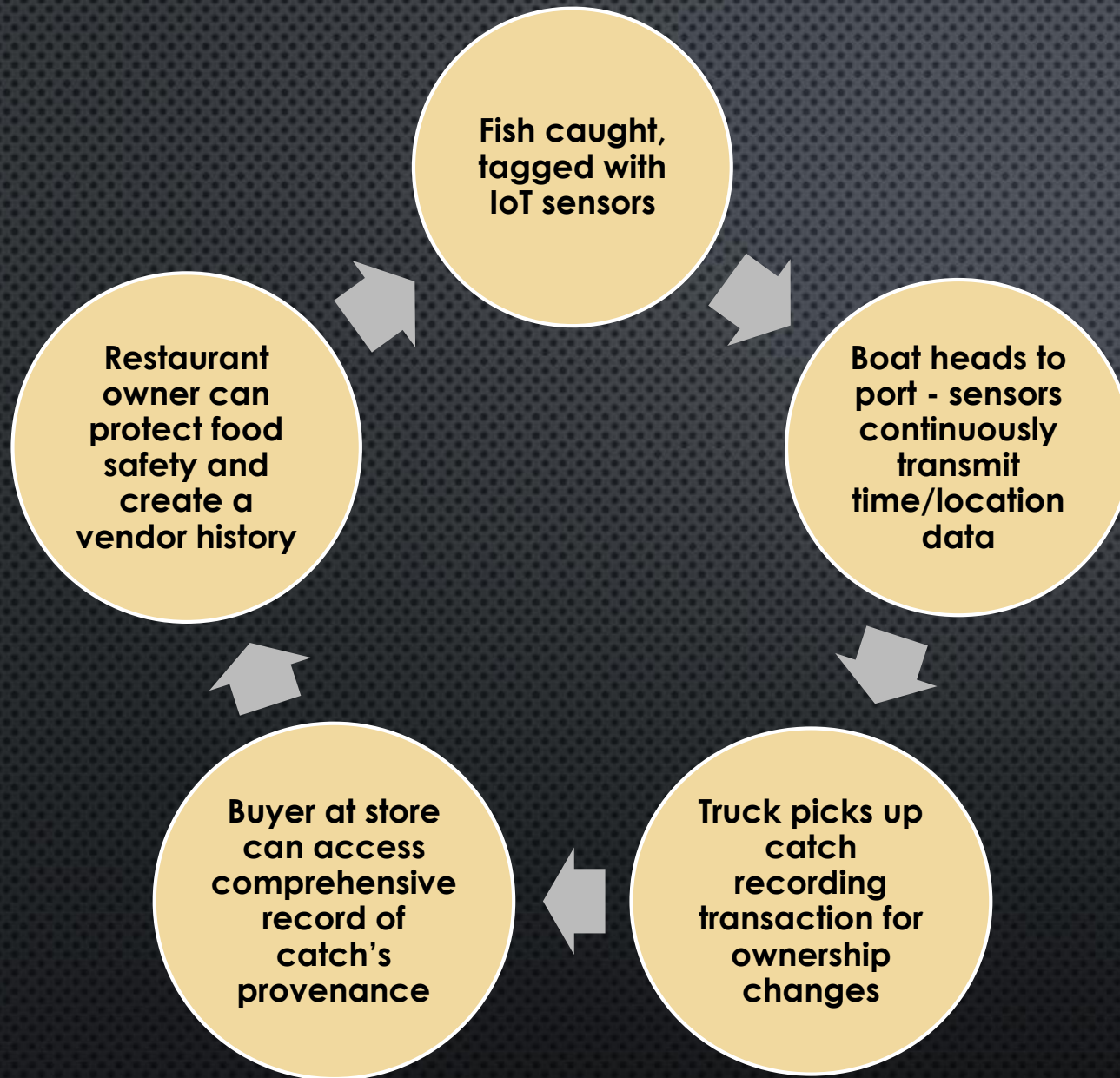
- Solar roads in China produce enough power for 6K houses for every 1 mile of road
- Solar road connects to trucking inventory above
- AV Vehicles and Content always connected
- Connection crosses work, cloud, and home
- Now possible to service customers AND understand exactly what they need and when
- Can also reach beyond current customers to create new relationships
- Everything ever where available

FOOD SAFETY TECHNOLOGIES

- E. COLI FIELD DETECTION TECHNOLOGIES
- CONTINUOUSLY CONNECTED SUPPLY CHAIN
- BLOCKCHAIN APPLICATIONS
- PORTABLE DETECTORS FOR 8 TYPES OF E. COLI

AGRIBUSINESS

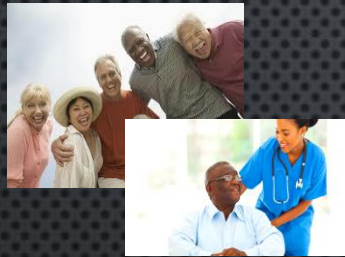
CASE EXAMPLE



- FOOD SAFETY – PROMISE OF FULL TRANSPARENCY (ID BAD ACTORS)
- PINPOINT SOURCE IF THERE IS AN OUTBREAK
- NO MATTER WHERE YOU BOUGHT YOUR FOOD - KNOW WHERE IT CAME FROM, WHEN IT WAS HARVESTED/PROCESSED, AND WHO PRODUCED IT
- PREVENT FOOD FRAUD, FALSE LABELING, ELIMINATE REDUNDANT MIDDLEMEN
- CREATE GLOBAL MARKET - WE DON'T HAVE TO KNOW PRODUCERS TO DEAL WITH THEM IN A BLOCKCHAIN WORLD
- TAG FOOD AND TRACK IT USING SMART TAGS CONTINUOUSLY TRANSMITTING DATA TO BLOCKCHAIN – TIME AND LOCATION
- CHAIN OF TRANSACTIONS RECORDED AND DELIVERED TO END DISTRIBUTOR

PERSUASIVE TECHNOLOGY

HOW TO MOTIVATE BEHAVIOR EFFECTIVELY



Persuasive
Technology

- MEASURE HUMAN AND MACHINE BEHAVIOR
- UNDERSTAND BEHAVIOR VERSUS INTENT
- PEER PRESSURE TO CREATE CHANGE IN BEHAVIOR
- TAKES INTO CONSIDERATION CONTEXT OR CIRCUMSTANCES
- UNCANNY ACCURACY IN PREDICTING BEHAVIOR
- UNDERSTANDS BODY LANGUAGE AND EMOTION
- **NEXT STEP WILL INVOLVE PERSUASIVE BEHAVIORAL MODIFICATION**



Case

COST-EFFECTIVE APPROACH INVESTING IN TECHNOLOGY & INNOVATION

Cost-Effective Framework

SMALL	MEDIUM	LARGE
<i>ASSOCIATION</i>	<i>PARTNER</i>	<i>OUTSIDE IN</i>
Chamber Tech Group	Contracted CTO	CTO
Vanity Fair Tech Conference	Outside In	Outside In
TDP Tool	Partner	Contracted Team
Stanford EMBARK Program	Angle Investor	Stanford Disruptive Tech Program
Silicon Valley Today	Fast Fail	Prototype to Roadmap

EXECUTIVE & BOARD LEVEL LEADERSHIP

ORGANIZATION RESILIENCY & ADAPTABILITY



Path to Innovation

- **AWARENESS** – BOARD LEVEL DIRECTOR FROM THE TECH SECTOR WITH NETWORK
- **ASSESSMENT DISRUPTIVE** – DEDICATED CTO EXPERT IN DISRUPTIVE TECHNOLOGY
- **ORGANIZATION ASSESSMENT** – USING METHODS LIKE RED TEAMING
- **RAPID RESPONSE TEAM** REPORTING TO CEO – COMPRISED OF TECHNICAL EXPERTISE AND INDUSTRY GURUS WITH QUARTERLY BOARD REVIEW PROCESS
- **OUTSIDE-IN APPROACH** – ENDORSEMENT OF THIS APPROACH
- **BUY VS. BUILD** – ENDORSE USE THIRD PARTY COMPANIES TO PROTOTYPE LIKE SRI
- **FAST FAIL** – SMALL INVESTMENTS WITH UNFAIR ADVANTAGES – COUNTING CARDS MODEL
- IDENTIFY A CANARY THAT IS NOT YOU

REINVENTING EFFECTIVE LEADERSHIP FOR DISRUPTIVE INNOVATION ACQUIRING RIGHT TALENT, EXPERTISE, AND ORGANIZATION



*"The explosion in technology
OUTSIDE the company is
resetting how companies do
innovation on the INSIDE."*

- WHAT DOES LEADERSHIP LOOK LIKE THAT CREATES REAL OPPORTUNITY
- HOW TO DESIGN AN ORGANIZATION TO ENABLE EFFECTIVE INNOVATION
- ACQUIRING THE RIGHT TALENT, EXPERTISE, AND ORGANIZATION
- ITS NOT JUST ABOUT THINKING DIFFERENTLY ABOUT INNOVATION, BUT REINVENTING HOW WE DO INNOVATION
- **CONTACT:** STEEP@STANFORD.EDU