

luxexecutivesummit 2018
Tokyo • October 17

Supercharging innovation with Data+Insight

Kevin See, Ph.D.
VP, Digital Products



Agenda

- 1 | The stagnation of the Innovation Process
- 2 | Data + Insight to get at What, Who, and When
- 3 | Evolving for better results

2017 WORLD SERIES CHAMPIONS HO





How big data won the 2017 World Series

Learn what the Houston Astros did to win the analytics arms race in Major League Baseball.

The Boston Globe

Astros at leading edge of analytics and their success is proof positive

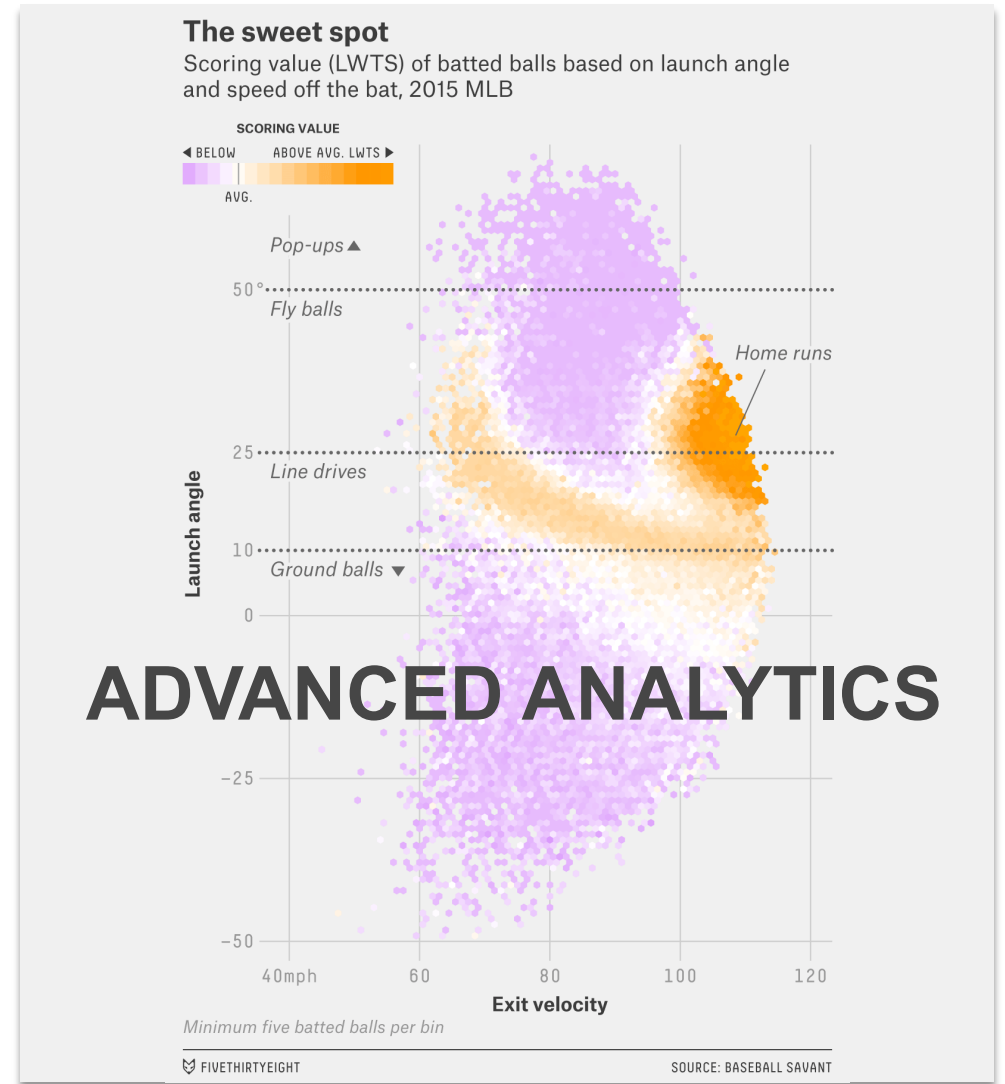


Astros are winning at new, old numbers games





TRADITIONAL



ADVANCED ANALYTICS



Analytics is about helping player development, managers and coaches to make better decisions; better decisions than what your competitors are making.

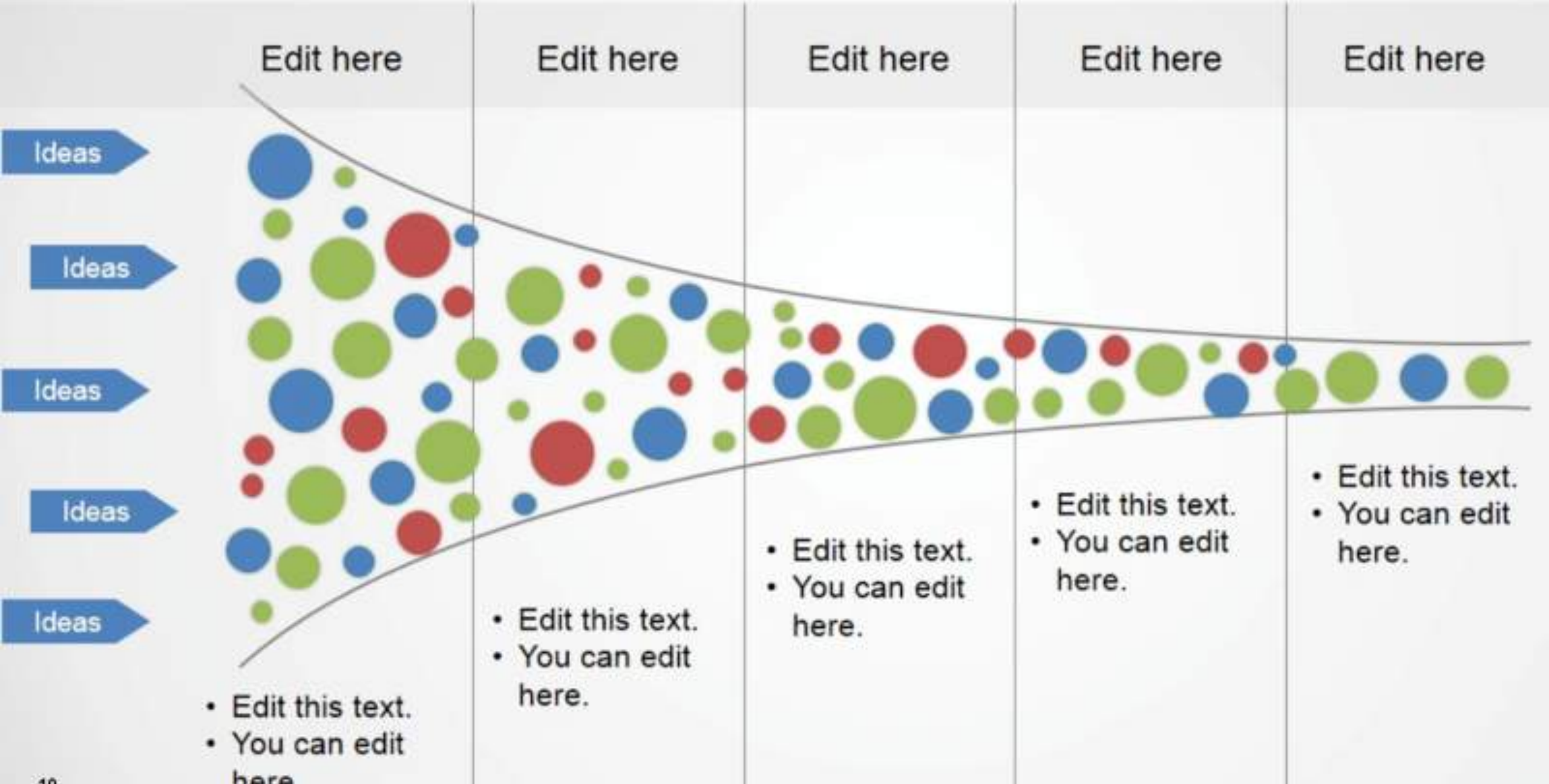




Luhnow recognized the incentives for losing baked into what was then a new collective bargaining agreement. The worst teams would have much more money to spend on amateur talent. **A few years of struggle could lead to many years of success.**



Year	Team	League	Wins	Losses	%
2017	Houston Astros	American League	101	61	.623
2016	Houston Astros	American League	84	78	.519
2015	Houston Astros	American League	86	76	.531
2014	Houston Astros	American League	70	92	.432
2013	Houston Astros	American League	51	111	.315
2012	Houston Astros	National League	55	107	.340



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Ideas

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Ideas

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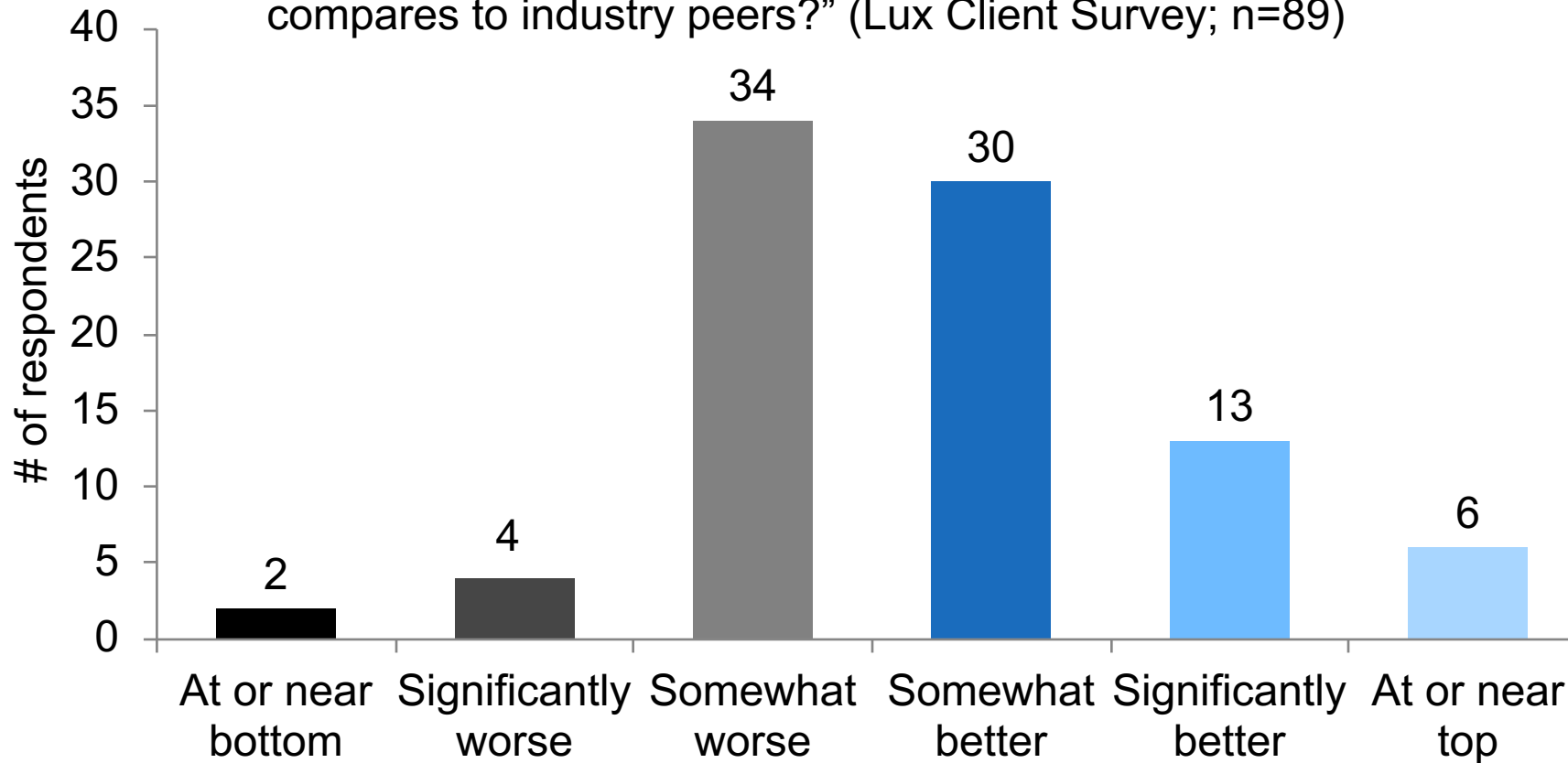
TRADITIONAL

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2013: Most see innovation results as modest

“Overall, how do you think the success of your program compares to industry peers?” (Lux Client Survey; n=89)



“I don’t have any home runs to talk about. Have quite a few singles and doubles – some that are still growing, could become a triple or a home run.”

“We find a lot of singles, haven’t found a home run. It’s not hard, over the course of year, to find a single or two.”

2018: The challenges remain the same



TOP 10 INNOVATION ISSUES LEADERS ARE FOCUSED ON IN 2018

We asked our members: What issues are at the top of your agenda for 2018?

"Top issue is always getting buy-in. Execs want innovation to check a box that they're thinking about the future, but never act on pitches, results, insights produced by the team."

- Anonymous Respondent

- 1 Spotting emerging technologies & disruptive trends
- 2 How to spur cultural change / risk-taking
- 3 Building communities / networks of innovators
- 4 Rolling out successful projects into the business
- 5 Co-creation with customers
- 6 Metrics, reporting, dashboards
- 7 Governance & organizational structure for innovation
- 8 Co-creation with suppliers & business partners
- 9 Interacting with startups & entrepreneurs
- 10 How traditional R&D orgs need to change
Reducing costs/streamlining operations (tie)



**Solution:
Data + Insight**

Approaches to spotting transformational technologies tend to fall into one of two camps

TRADITIONAL FORESIGHT

Characteristics

Examine broad themes (megatrends)
Study markets and tech trends
Get smart people to make judgments

Challenges

Unreliable – vulnerable to bias
Still easy to miss some key trends
Often still a lagging indicator

Approaches to spotting transformational technologies tend to fall into one of two camps

TRADITIONAL FORESIGHT

AUTOMATED DATA

Characteristics

Examine broad themes (megatrends)
Study markets and tech trends
Get smart people to make judgments

Access to various data sources
Look for trends and correlations
Search interface and visualizations

Challenges

Unreliable – vulnerable to bias
Still easy to miss some key trends
Often still a lagging indicator

Lacks context and insight
Contributes to information overload
Often still a lagging indicator

Approaches to spotting transformational technologies tend to fall into one of two camps

TRADITIONAL FORESIGHT

Examine broad themes (macro trends)
Study markets and tech trends
Get smart people to make sense of it

Unreliable – vulnerable to bias
Still easy to miss some key trends
Often still a lagging indicator

DATA-DRIVEN DATA

Use multiple data sources
Identify patterns and correlations
Use charts and visualizations

Can miss important context and insight
Prone to information overload
Often still a lagging indicator

**We need
a way
to synthesize
the best of
both**

TRADITIONAL FORESIGHT CHALLENGES

The perils of fallible insight

1999

The
Economist

“In the early 1980s AT&T asked McKinsey to estimate how many cellular phones would be in use in the world at the turn of the century. The consultancy noted all the problems with the new devices—the handsets were absurdly heavy, the batteries kept running out, the coverage was patchy and the cost per minute was exorbitant—and concluded that the **total market would be about 900,000**. At the time this persuaded **AT&T to pull out of the market**, although it changed its mind later.

These days **900,000 new subscribers join the world's mobile-phone services every three days**”

TRADITIONAL FORESIGHT CHALLENGES

The perils of fallible insight

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These days **900,000 new subscribers join the world's mobile-phone services every three days”**

2006

ZDNet

Gartner: Apple should quit hardware business

The future success of Apple, Dell and Intel lies with a licensing deal between Steve Jobs' company and the PC maker according to analyst Gartner



By Andrew Donoghue | October 18, 2006 -- 15:55 GMT (08:55 PDT) | Topic: Innovation

AUTOMATED DATA CHALLENGES

The perils of automation

Google News

EXAMPLE NEWS ALERT FOR TOYOTA



I'm Turning A Salvage Toyota 86 From Hurricane Harvey For Charity

Jalopnik · 3h ago



Should Value Investors Pick Toyota Motor (TM) Stock?

Zacks.com · 7h ago



Driving the Toyota C-HR R-Tuned, a 600-HP Compact Crossover That Wants to Kill You

The Drive · Mar 29, 2018

RELATED COVERAGE



New Toyota RAV4 revealed with hybrid powertrain

AutoExpress



What to Expect at Richmond Raceway's 2018 Toyota Series NASCAR Event

The Drive · Mar 31, 2018



Toyota Launches Production Model "Sora" Fuel Cell Bus

Composites Manufacturing Magazine · Apr 2, 2018

Solution



+



Expert curation of data and advanced analytics

Domain knowledge sorts the significant from the spurious

Insight on what it means – and what to do about it

Solution



+



-
- Goals:**
- Improve our win rate
 - Make our wins bigger
 - Make our innovation efforts *indispensable* for growth
-

Agenda

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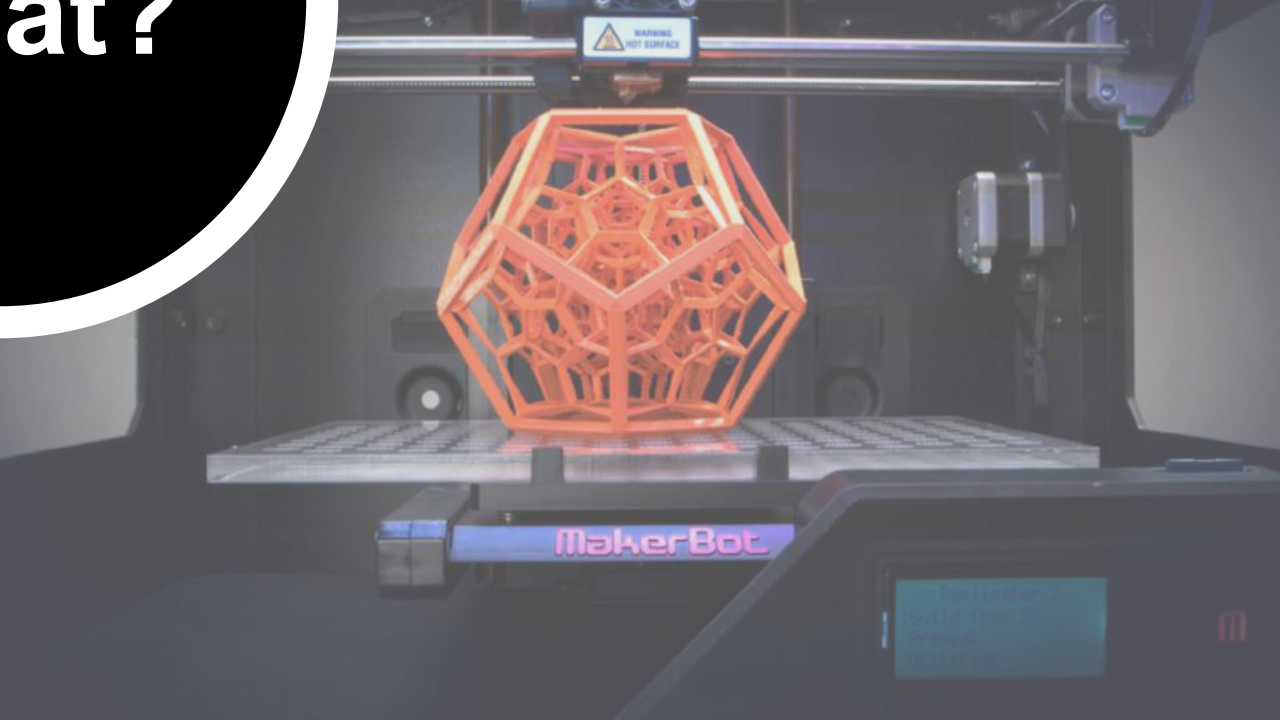
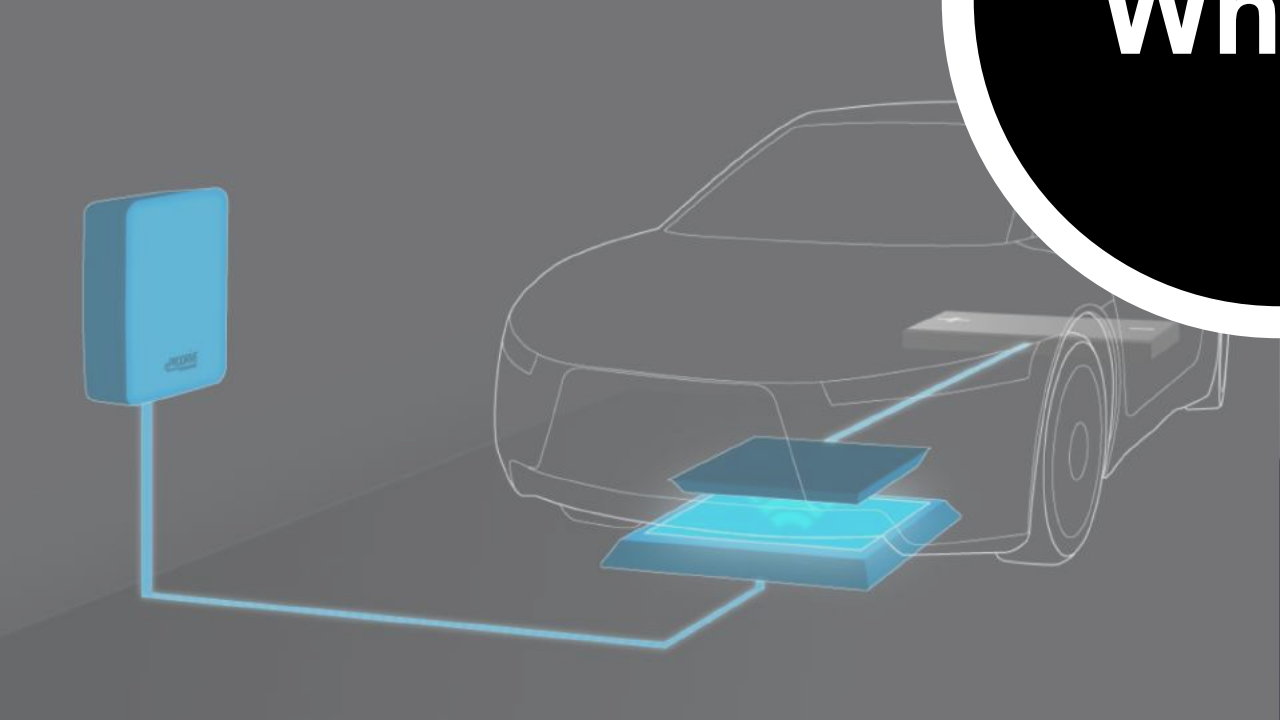
What?

Who?

When?



What?

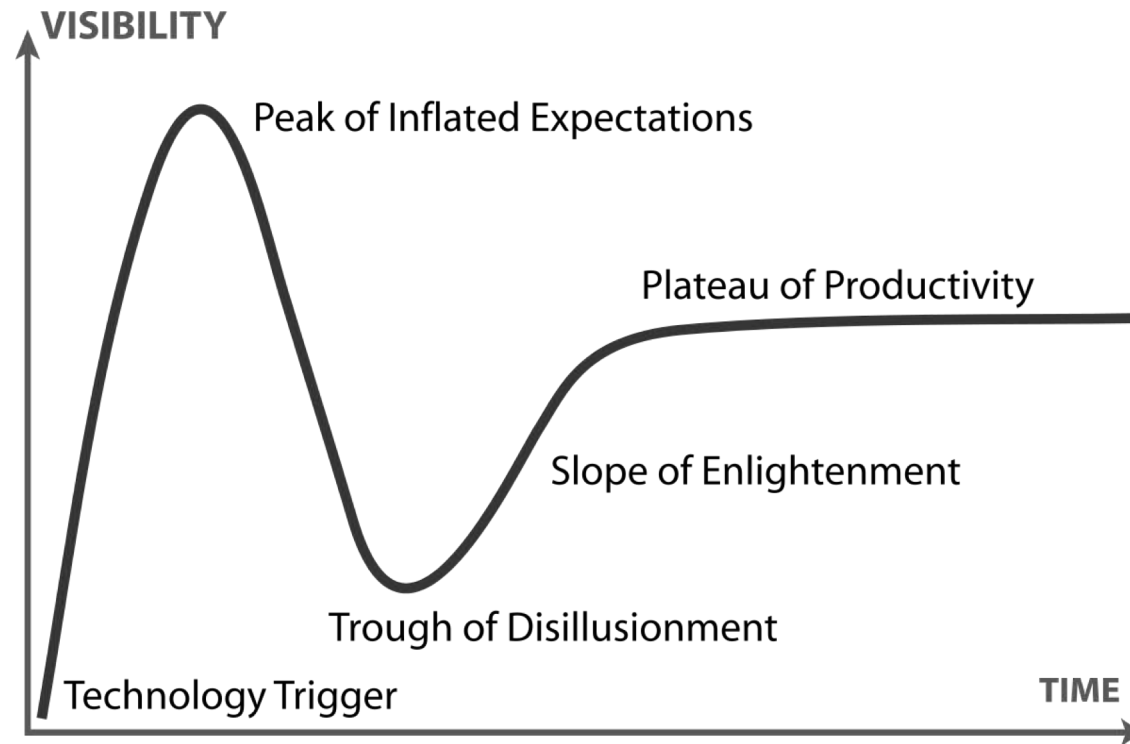




TRADITIONAL FORESIGHT

What technologies should you prioritize?

QUALITATIVE FRAMEWORKS

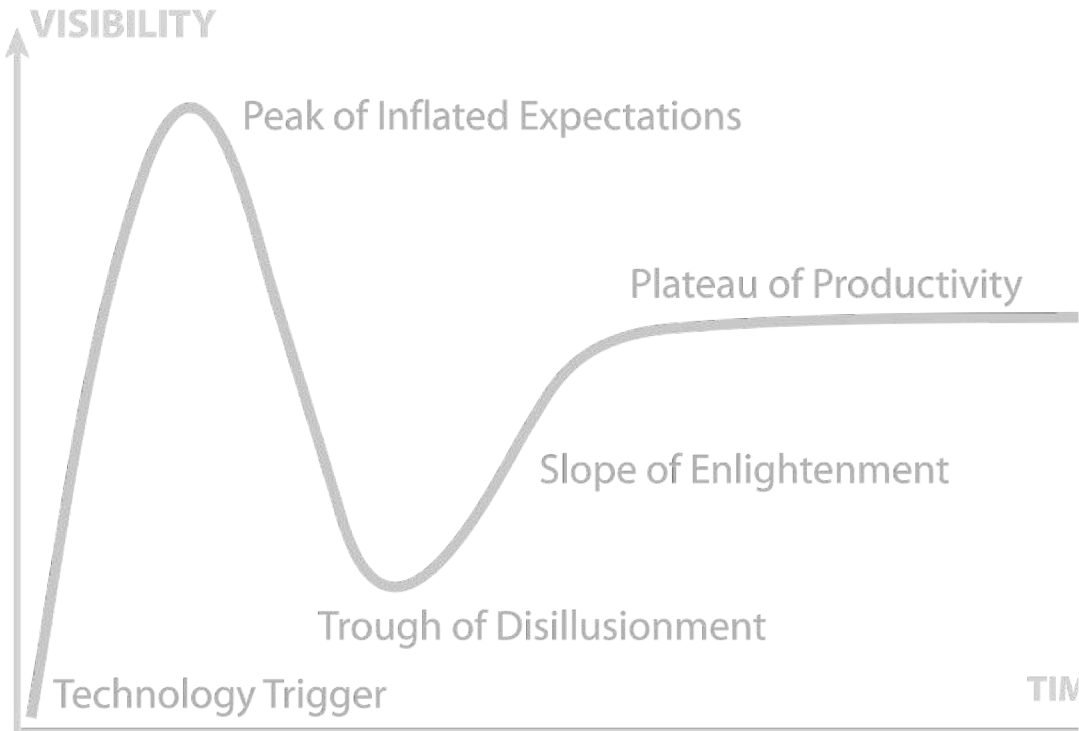




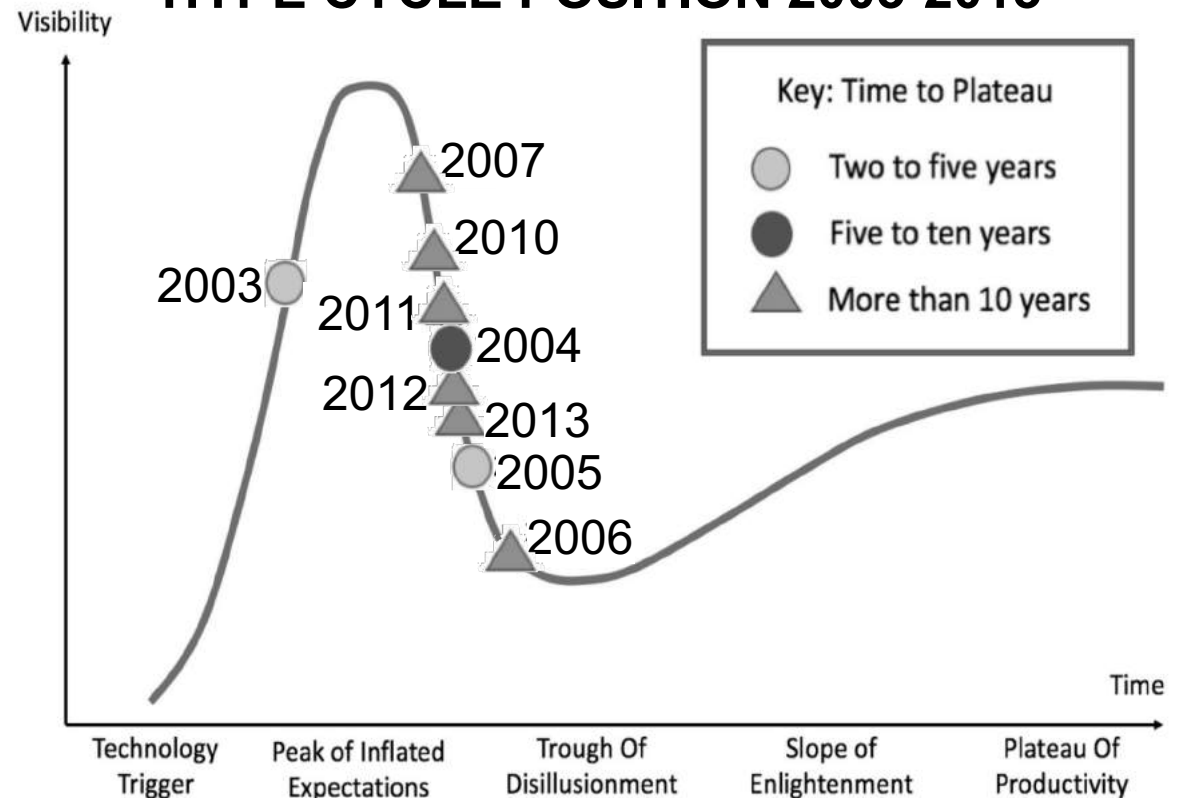
TRADITIONAL FORESIGHT

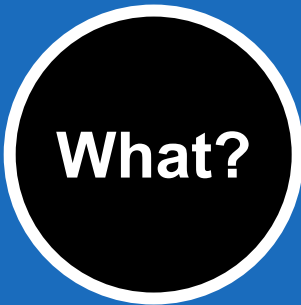
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QUALITATIVE FRAMEWORKS



MESH NETWORKS HYPER CYCLE POSITION 2003-2013

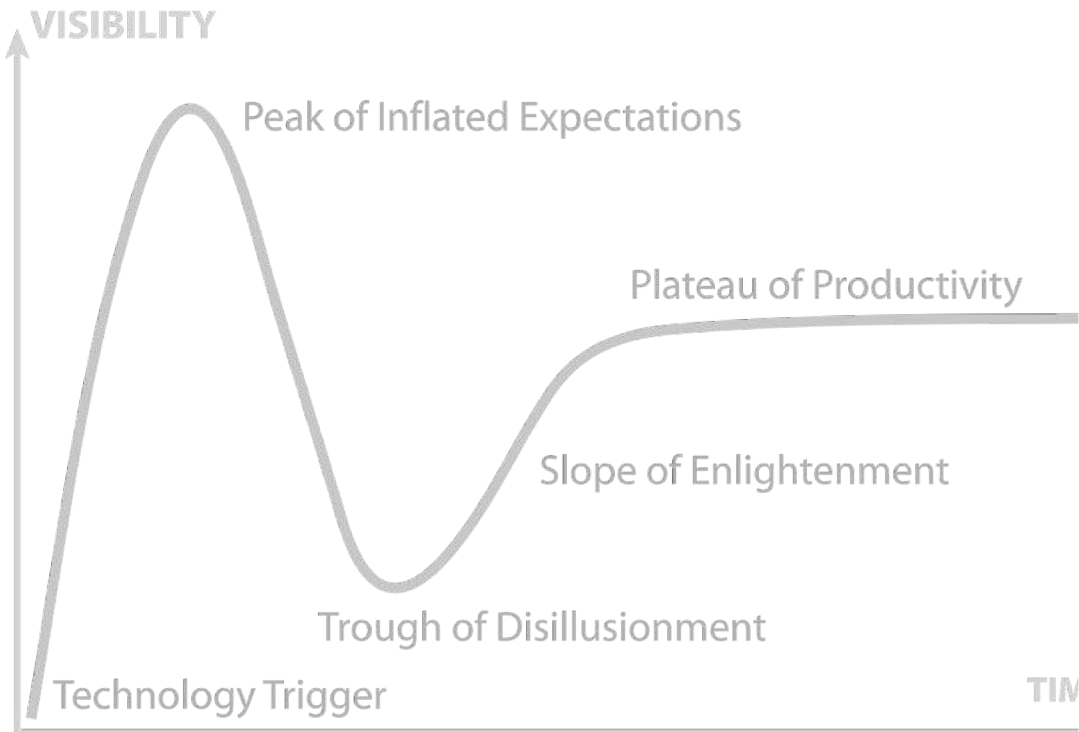




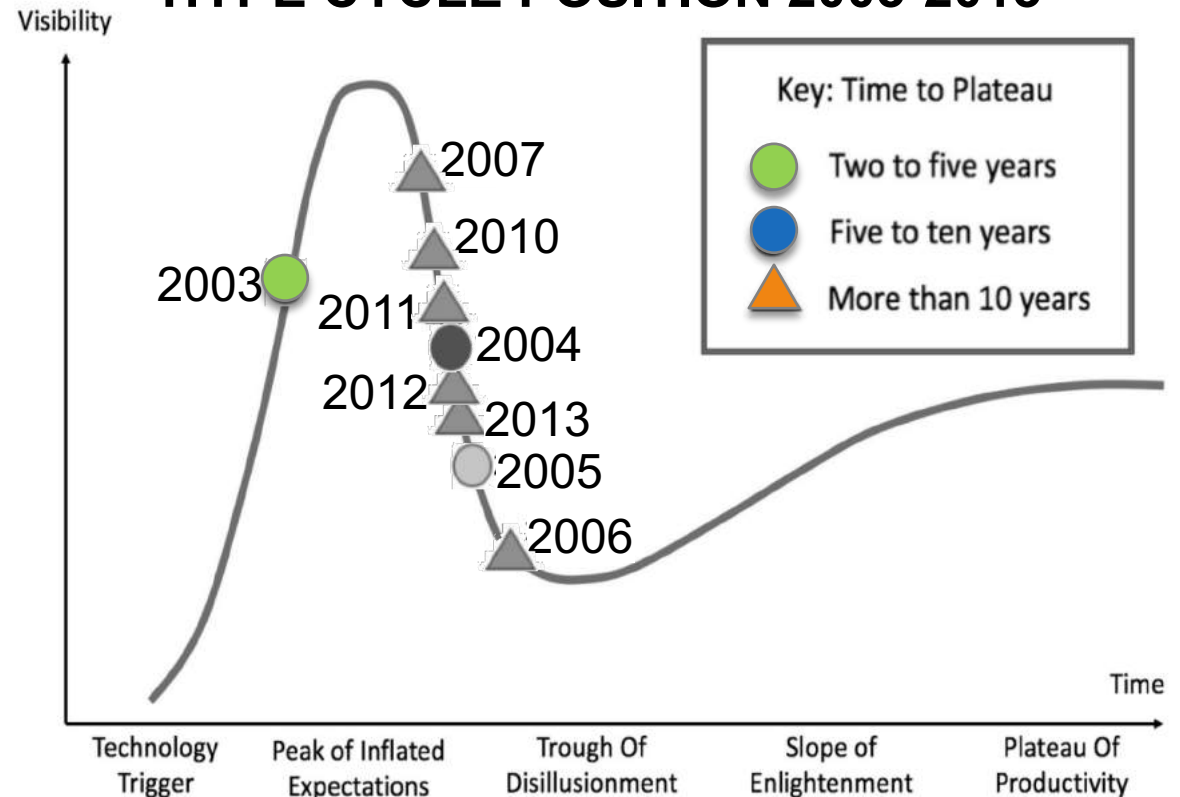
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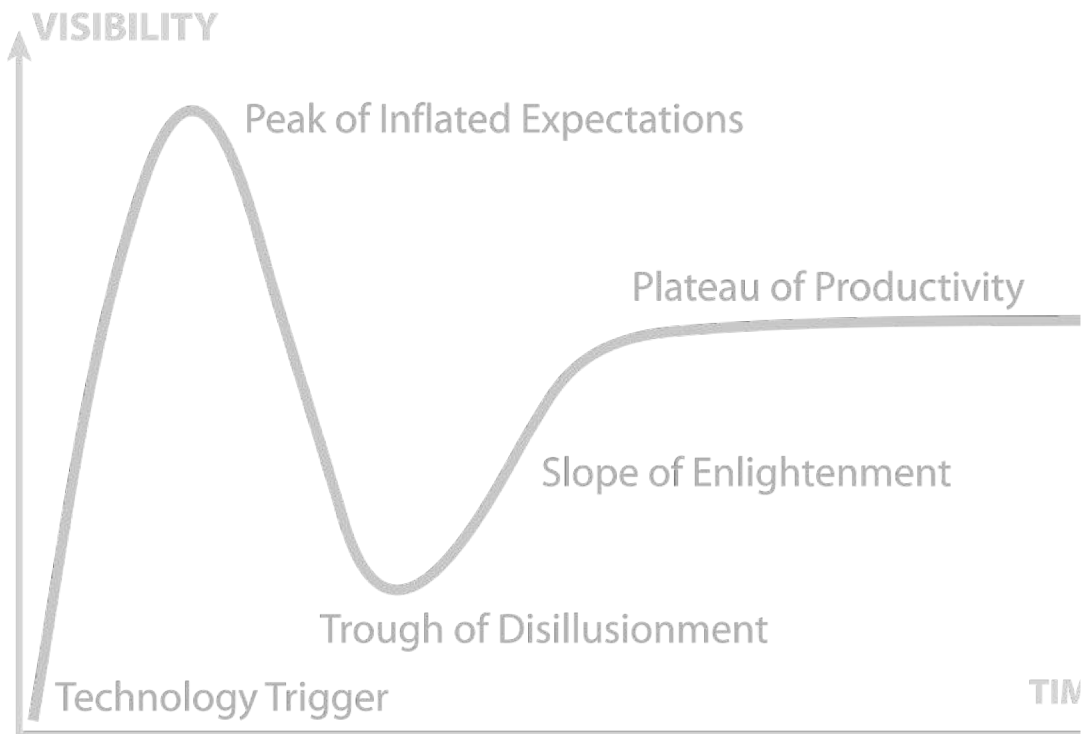




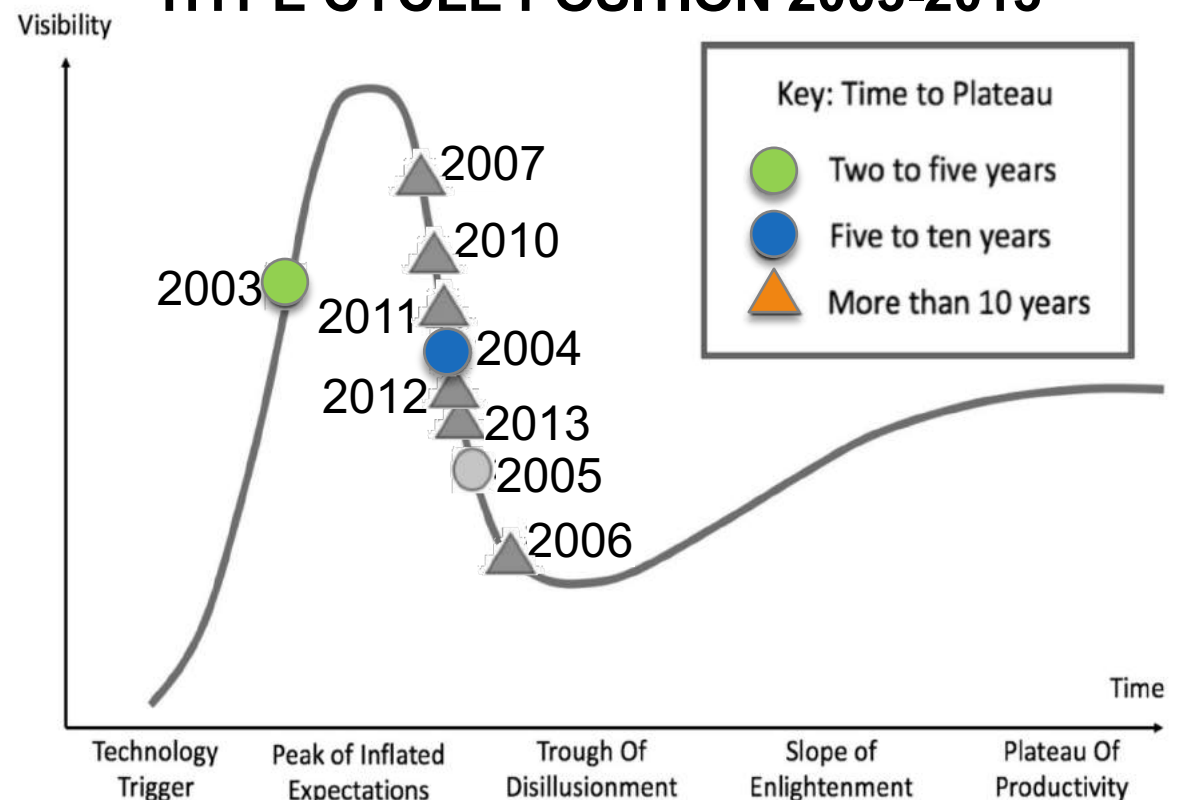
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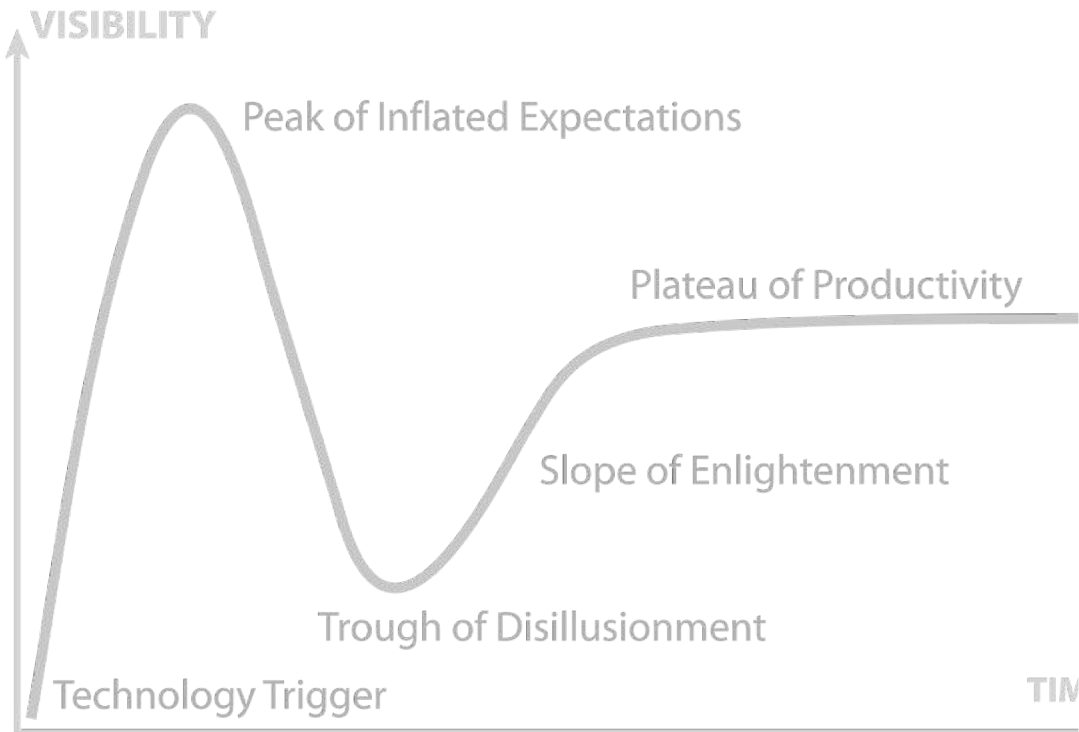




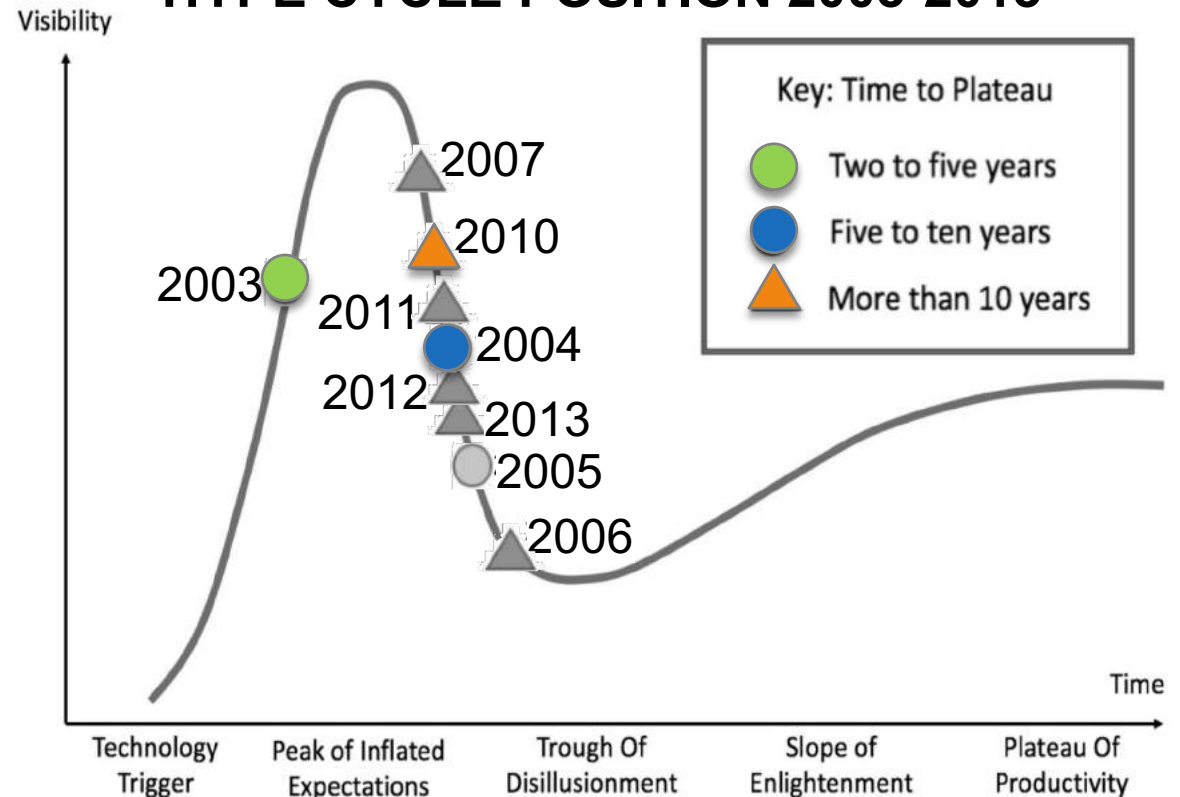
TRADITIONAL FORESIGHT

What technologies should you prioritize?

QUALITATIVE FRAMEWORKS



MESH NETWORKS HYPER CYCLE POSITION 2003-2013





TRADITIONAL FORESIGHT

What technologies should you prioritize?

QUALITATIVE FRAMEWORKS

MESH NETWORKS

HYPE CYCLE POSITION 2003-2013



“ It's remarkable the number of major technologies from the last 20 years that were either identified late or simply never appeared on a Hype Cycle ”

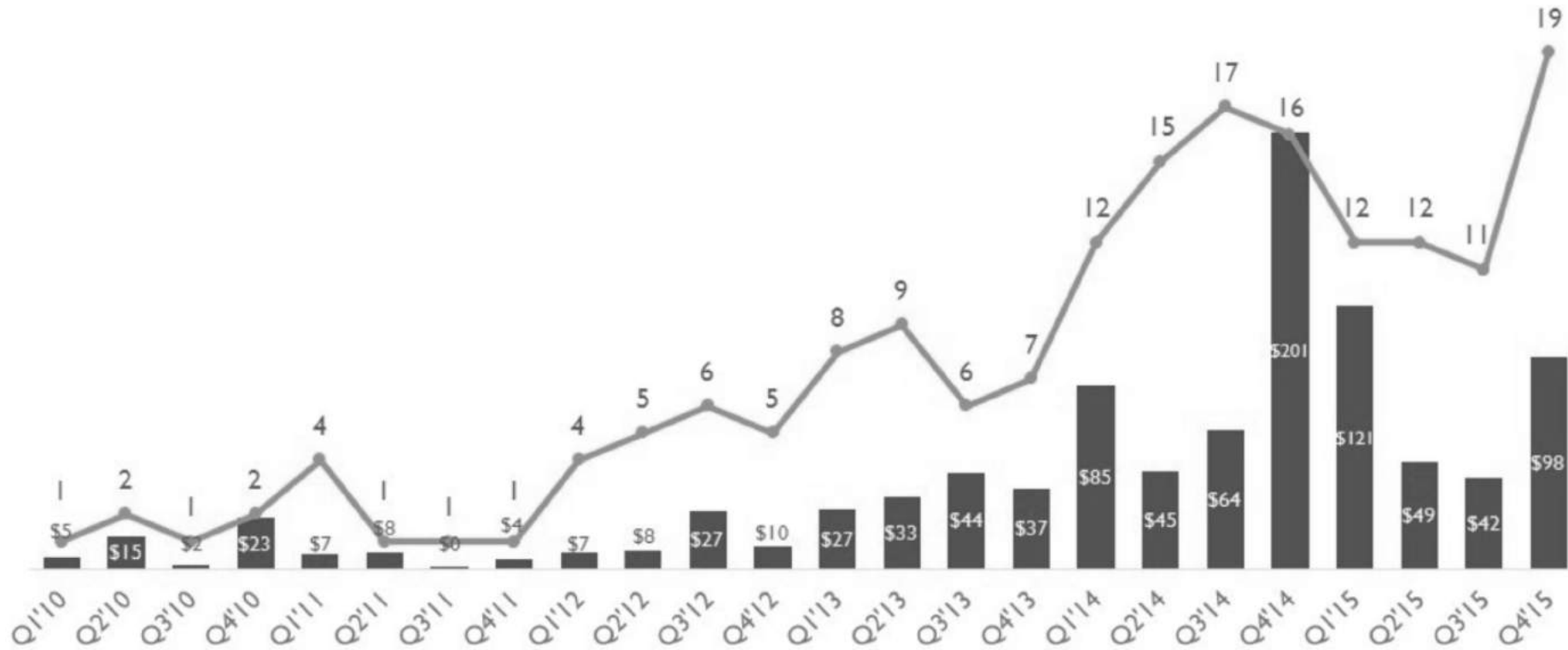
- [Michael Mullany](#), Icon Ventures



AUTOMATED DATA

What technologies should you prioritize?

VC FUNDING





AUTOMATED DATA

What technologies should you prioritize?

VC FUNDING



What?

AUTOMATED DATA

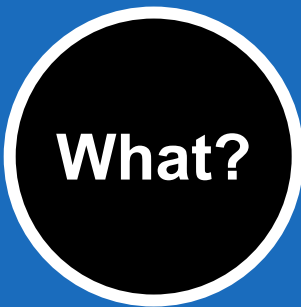
What technologies should you prioritize?

VCs struggle outside of software

Venture Capital and Cleantech:

The Wrong Model for
Clean Energy Innovation





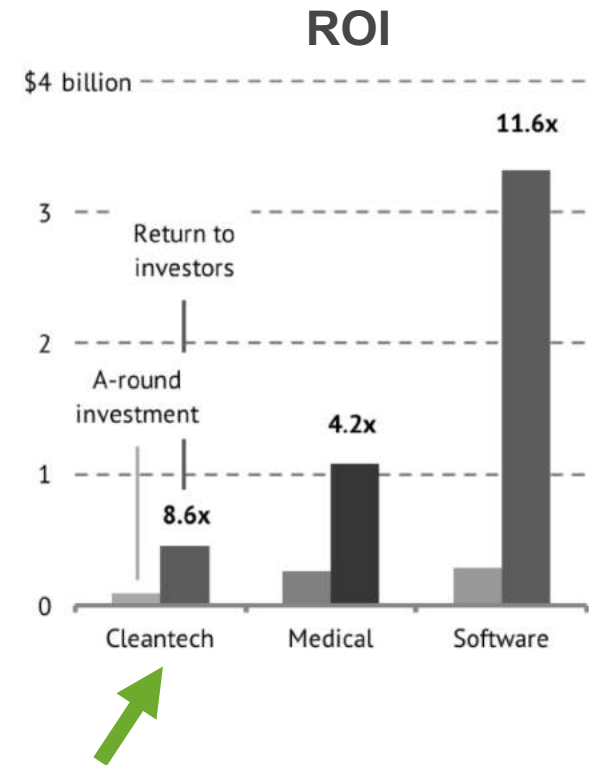
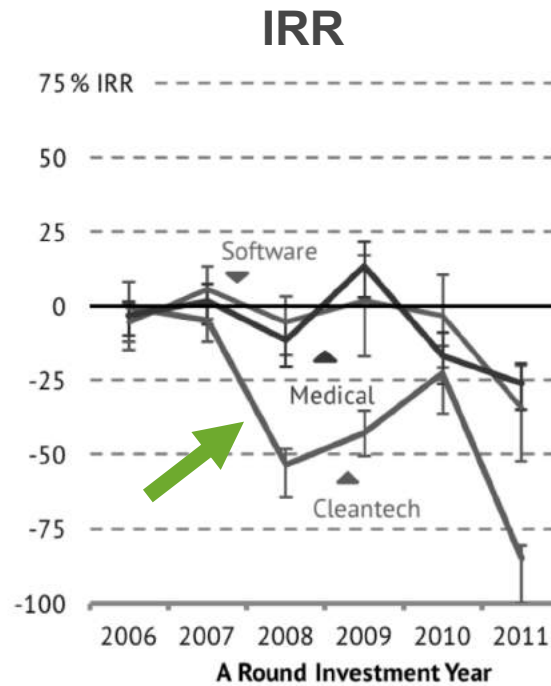
AUTOMATED DATA

What technologies should you prioritize?

VCs struggle outside of software

Venture Capital and Cleantech:

The Wrong Model for
Clean Energy Innovation



Solution



+



The Lux Tech Signal

Lux Tech Signal (LTS) methodology

The Lux Tech Signal is based on our analysis of innovation data including:

- Patents
- Academic papers
- VC funding
- Government funding
- Lux proprietary data

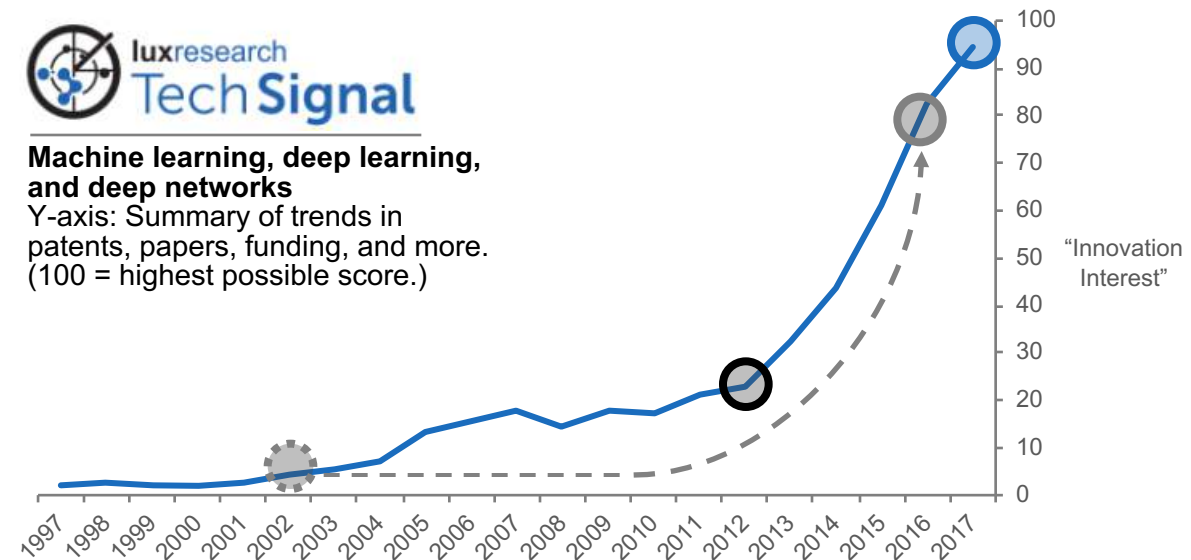
The **Innovation Interest** score is calculated by analyzing multiple, diverse datasets weighted based on our evaluation of the role innovation sources play in each stage of commercial technology development; empirically tested and validated against real world historical data.

The maximum possible score is 100, indicating the highest observed rate of research, patenting, funding, etc.

EXAMPLE:



Machine learning, deep learning, and deep networks
Y-axis: Summary of trends in patents, papers, funding, and more. (100 = highest possible score.)

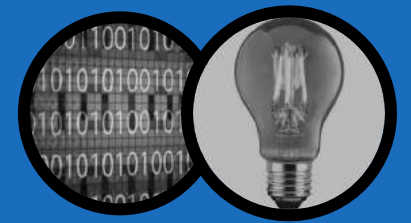


- **Changes over time** signal growing (or shrinking) innovation interest.
- **Inflection points** may point to commercial opportunities or challenges ahead.
- **Current value** indicates innovation maturity, distinguishing established technologies from those that are still emerging.

What?

DATA + INSIGHT

What technologies should you prioritize?



18 for 2018

Executive Summary: Top technologies Lux is following in 2018, using data from the Lux Intelligence Engine and analysts' insight

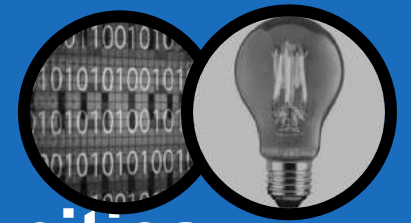
A ranking of the most important technologies to watch, given their potential to transform the world in the next decade

- 1 Machine Learning and Deep Neural Networks**
30% annual increase in machine learning patents
- 2 3D Printing and Additive Manufacturing**
Lux expects 3D printing to be a \$20 billion market by 2025
- 3 Genome Editing**
\$1.2 billion in VC funding to impact industries from food to health care
- 4 5G Networks**
Over 70,000 patents set the stage for 5G network launches in 2018
- 5 Microbiome**
Harnessing the power of microbes for nutrition, agriculture, and more
- 6 Solid-state Batteries**
Safer and better batteries, pursued by start-ups and giants like Toyota
- 7 Synthetic Biology**
A recent \$275 million round for Ginkgo Bioworks highlights the potential
- 8 Augmented Reality (AR)**
Enterprise applications are coming now, on heels of \$4.4 billion in funding
- 9 Smartwatches**
Patents soar from near zero to over 23,000 in less than five years
- 10 Wireless Charging**
Here now for consumer electronics, with R&D pushing for EV uses
- 11 Materials Informatics**
Using IT and AI to break out of slow material development cycles
- 12 IoT Security**
Patents are up 13x as connected devices proliferate
- 13 Edge Computing**
When milliseconds matter, analytics can be local, not in the cloud
- 14 Energy Distribution System Monitoring**
Growing demand and renewables require tech to balance the grid
- 15 Polyethylene Furanoate (PEF)**
Innovation has grown at an 87% annual rate to improve on PET
- 16 Sugar Reduction**
Over 162,000 patents to combat health ills from too much sugar
- 17 Neural Interfaces**
Tech to read and stimulate the brain will see growing validation in 2018
- 18 Syngas and Power-to-Gas**
Producing fuels from CO₂ to drive the energy transition



DATA + INSIGHT FOR PRIORITIZING TECHNOLOGIES

Segment mature areas from emerging opportunities



Y-Axis: Innovation track record

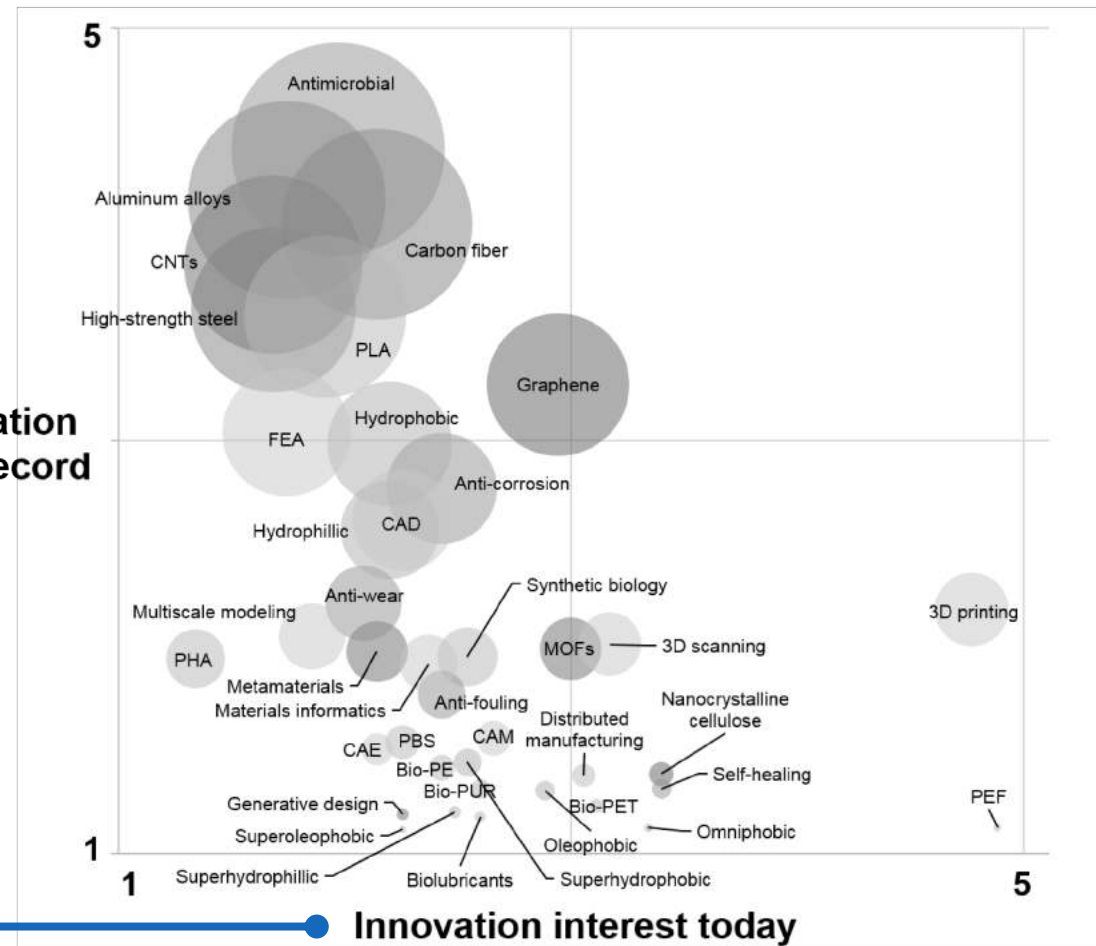
Cumulative number of papers and patents in the past 20 years.
Determines dot size.

X-Axis: Innovation interest today

What is receiving the most interest.
Calculated based on rate of new patents, papers, and funding.

Innovation track record

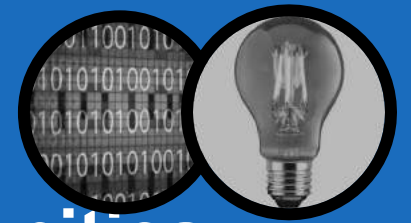
Innovation interest today





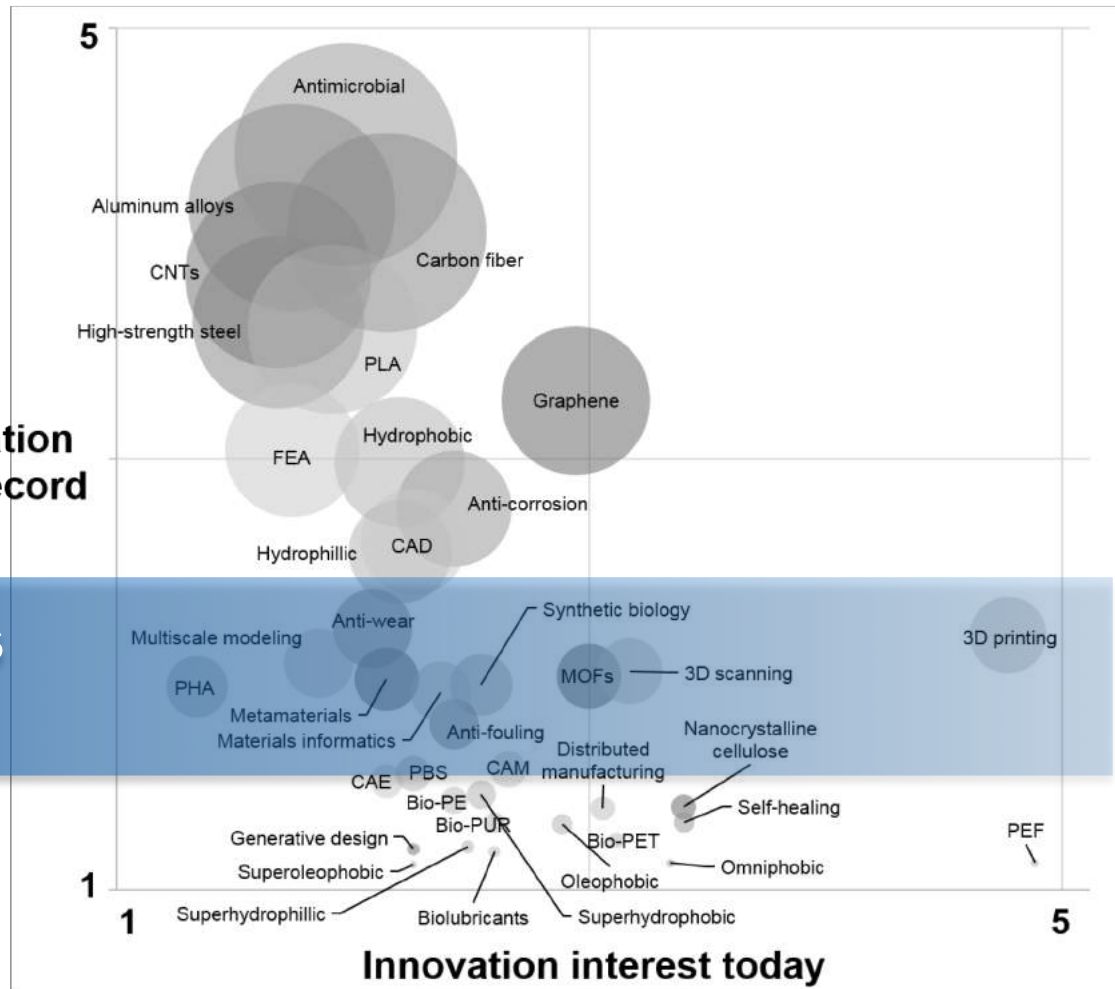
DATA + INSIGHT FOR PRIORITIZING TECHNOLOGIES

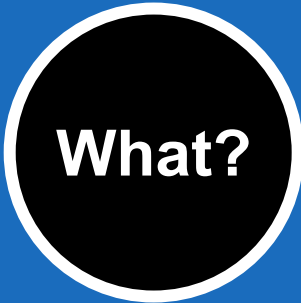
Segment mature areas from emerging opportunities



Innovation track record

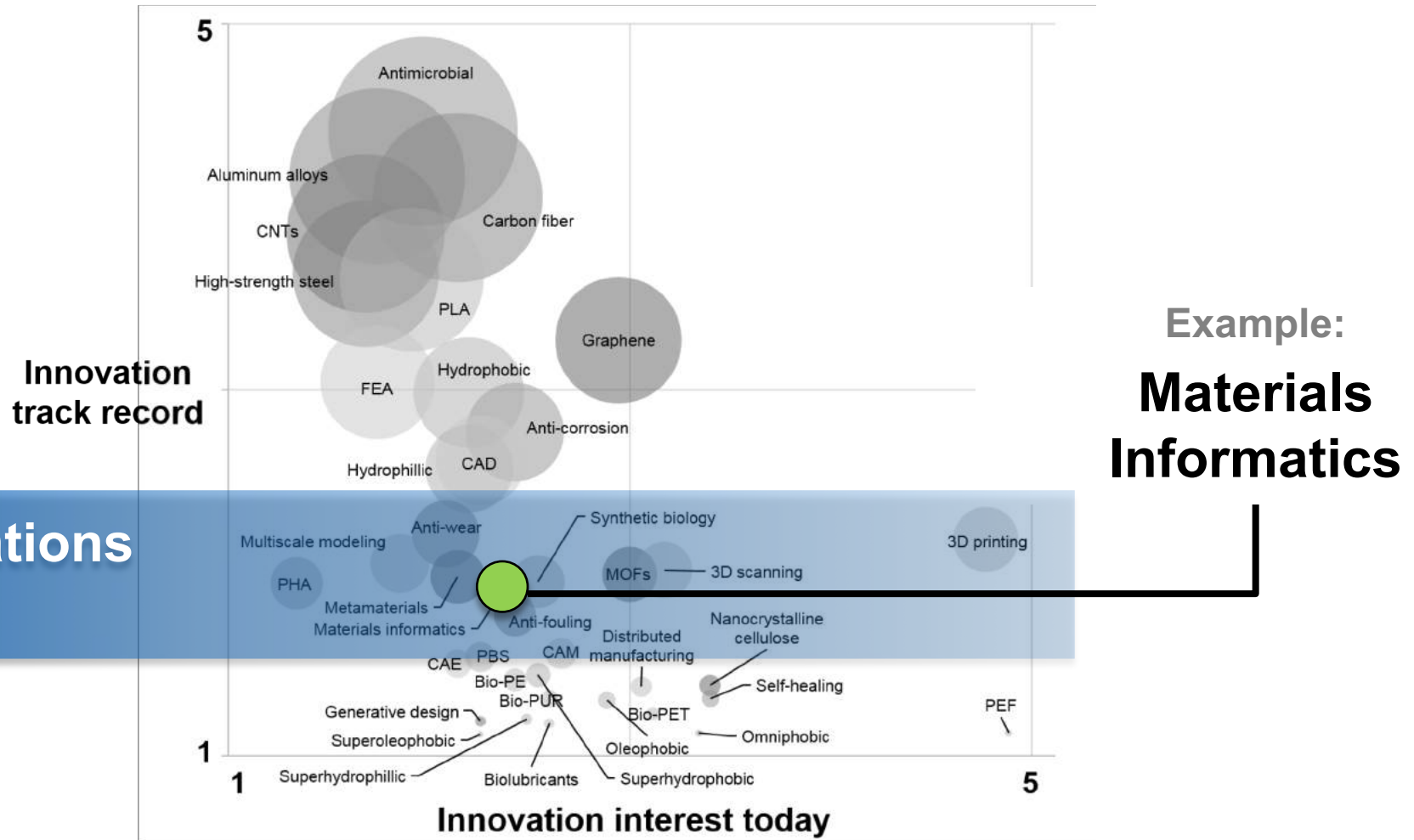
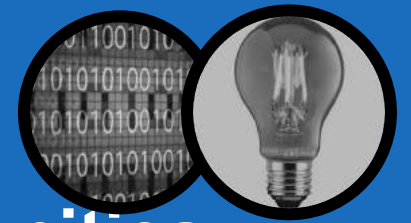
Emerging innovations
“sweet spot”





DATA + INSIGHT FOR PRIORITIZING TECHNOLOGIES

Segment mature areas from emerging opportunities

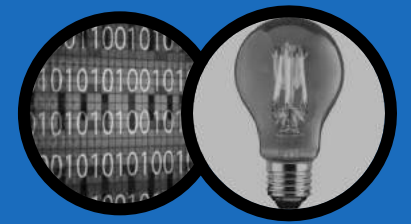


Emerging innovations
“sweet spot”



DATA + INSIGHT FOR PRIORITIZING TECHNOLOGIES

Materials Informatics



DESCRIPTION

Use of data science and artificial intelligence methods to:

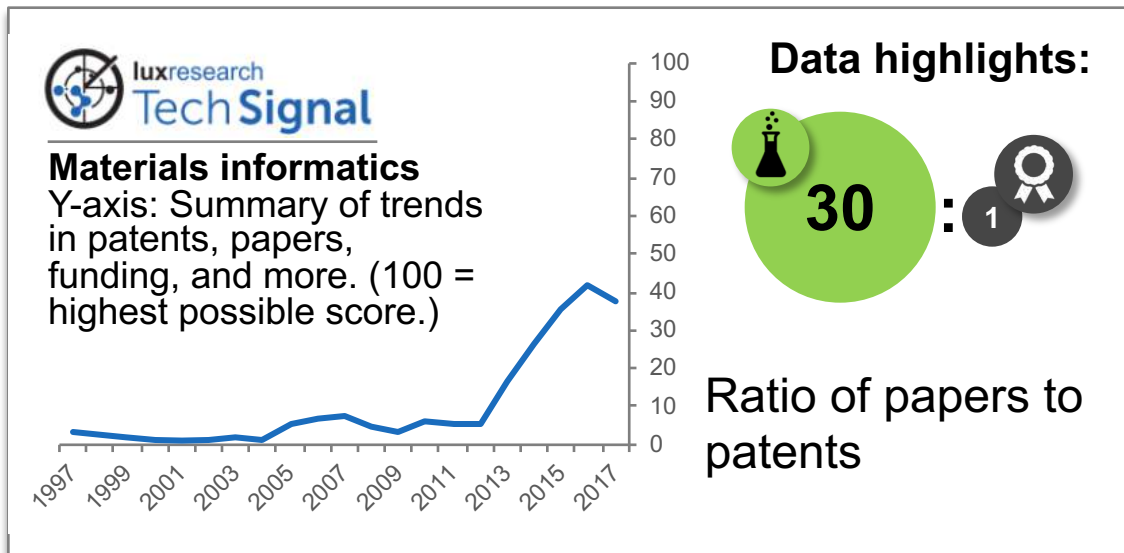
- extract insights from existing materials
- discover new materials matching desired property requirements

KEY BENEFITS

Accelerates materials and chemicals research and product development timelines

Extracts additional value from existing experimental and computational data, leveraging past R&D spending

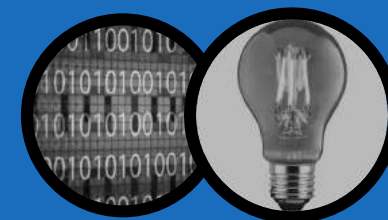
Optimizes experimental designs to attain the most valuable data per experiment



What?

DATA + INSIGHT FOR PRIORITIZING TECHNOLOGIES

Materials Informatics



LUX TAKE BY APPLICATION READINESS FOR MATERIALS INFORMATICS

Application	Data Availability	Experimental Data Cleanliness	Maturity for Machine Learning	Average	Lux Take
Small Molecules	4.7	4.7	4.7	4.7	Strong Positive
Alloys	3.3	3.9	4.5	3.9	Positive
Semiconductors	3.3	3.6	3.6	3.5	Positive
Polymers	2.4	2.9	4.0	3.1	Positive
Pharmaceuticals	3.0	3.0	3.0	3.0	Caution
Glass	2.6	3.0	3.1	2.9	Wait and See
Additive Manufacturing	2.0	2.2	3.8	2.7	Wait and See
Batteries	2.4	2.1	3.1	2.5	Caution
Heterogeneous Catalysis	2.3	1.9	2.1	2.1	Caution

Horizontal Solutions				
Analytics augur BLOCKCHAIN INTELLIGENCE GROUP CHAINALYSIS Skry	Contracts Counterparty ZEPPELIN ETHERPARTY RSK	Sharing slock.it La'Zooz BACKFEED S	Dev Tools blockstack BLOCKFPPS openchain FACTOM	Identity ShoCa KYC-CHA SIGNICA UNIQUID
Dominant Core Infrastructure Enablers		Enterprise Contributors		
bitcoin HYPERLEDGER ETHEREUM	Broadridge vmware CISCO	THE LINUX FOUNDATION pwc SAMSUNG Deloitte HITACHI	NTT DATA WELLS FARGO intel BNP PARIBAS BNY MELLON JPMorganChase NE	
Vertical Solutions				
Finance SETL.io	Energy LO3 ENERGY	Supply Chain CHRONICLED PROVENANCE	IoT oleo	



Who?



Who?

TRADITIONAL FORESIGHT

Few are immune to hype

2015

MIT
Technology
Review



magic
leap

**10 Breakthrough
Technologies**



Who?

TRADITIONAL FORESIGHT

Few are immune to hype



2015

MIT
Technology
Review



magic
leap

10 Breakthrough Technologies

2017

luxresearch



magic
leap

Magic Leap's Mixed Reality

Magic Leap is a mixed reality company currently valued at \$6 billion that has raised \$1.5 billion in funding with no product to show. Rumors of wondrous technical feats followed by massive

Since then, the shiny veneer of this unicorn has started to crack, and its technology claims appear to be highly exaggerated.

and its technology claims appear to be highly exaggerated. In this report, we examine the company's history and patent portfolio to understand Magic Leap's mix of hype and reality.

Who?

TRADITIONAL FORESIGHT

Few are immune to hype

2015

Inc.

theranos

**How Elizabeth Holmes Became America's New
Entrepreneurial Icon**

Who?

TRADITIONAL FORESIGHT

Few are immune to hype

2015

Inc.

theranos

How Elizabeth Holmes Became America's New Entrepreneurial Icon

2018

The Washington Post

theranos

Theranos chief executive Elizabeth Holmes charged with massive fraud



AUTOMATED DATA

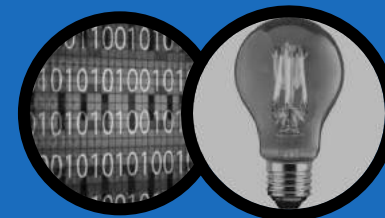
Cherry-picking logos gets you only part of the way

Example:
**LUX BLOCKCHAIN LANDSCAPE
2016**





DATA + INSIGHT FOR WHO TO WORK WITH Key player analysis (for Deep Learning)



Use data

Patents, investment, academic publications – to surface leading players

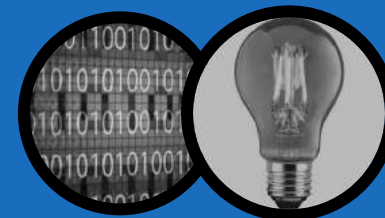
Using data science, segment into:

- 1) large players
- 2) start-ups
- 3) research centers

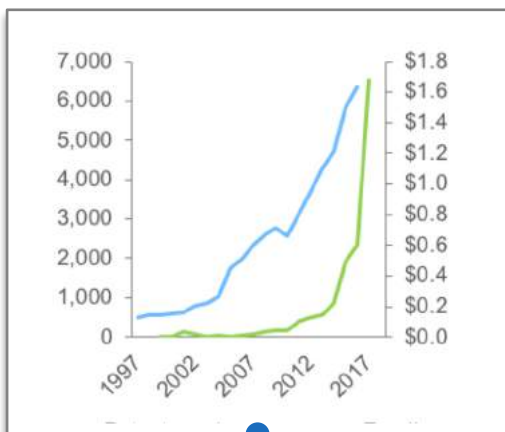
 Lux Take: Strong Positive →	 Lux Take: Positive →	 Lux Take: Positive →	 Lux Take: Positive →
 Lux Take: Positive →	 Lux Take: Wait and See →	 Lux Take: Wait and See →	 Lux Take: Wait and See →

Who?

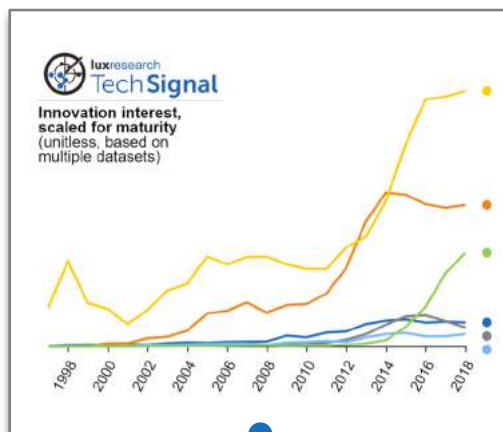
DATA + INSIGHT FOR WHO TO WORK WITH Bolster the data with Insight



PATENTS, PAPERS, FUNDING DATA



LUX TECH SIGNAL LEADING INDICATOR



NEWS & CURRENT EVENTS

SoftBank

nauto

Softbank led a 2017 \$159 million Series B investment in Nauto

LUX ANALYST EXPERTISE



COMPANY PROFILE

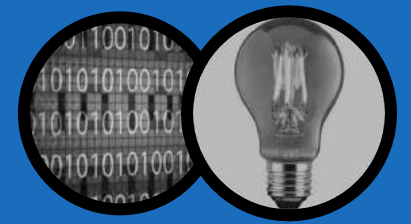
Nauto

Connected hardware for vehicle fleet management

Who?

DATA + INSIGHT FOR WHO TO WORK WITH

Bolster the data with Insight



Nauto Company Profile Summary

Connected hardware for vehicle fleet management

TECHNOLOGY AND DIFFERENTIATORS:

- Develops deep learning enabled retrofit dashboard camera system for occupant and environmental monitoring purposes
- Provides fleet managers with reports on individual driver performance as well as scenarios that could affect the entire fleet

STRATEGY AND MARKETS:

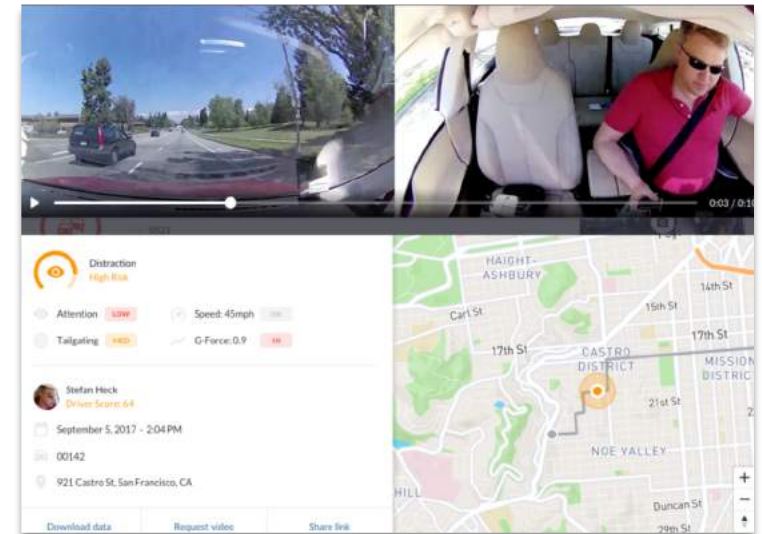
- Sells its cameras at an initial price of \$399 and then offers a SaaS model to access Nauto's cloud processing and reporting services

LUX TAKE:

- *Positive* – Pursuing a cloud platform that would focus on autonomous vehicles, instead of connected car services; **Unique solution leverages deep learning for insight in and out of the car**

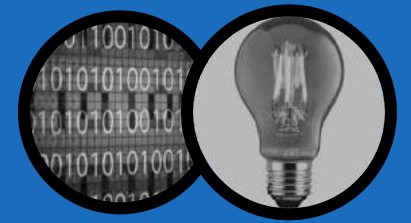
Lux Take

Positive

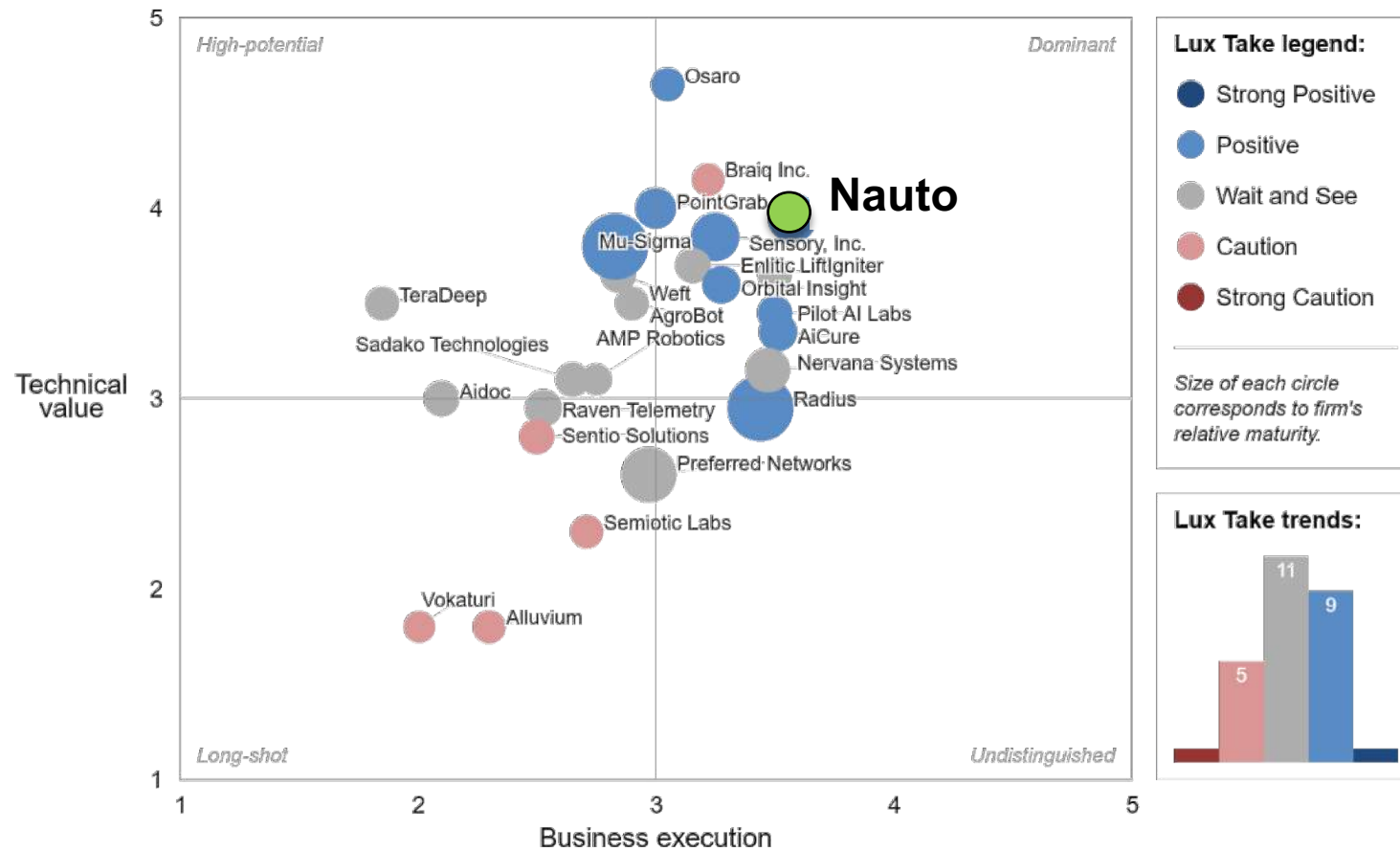




DATA + INSIGHT FOR WHO TO WORK WITH Bolster the data with Insight



Lux Innovation Grid (LIG) for Deep Learning





When?



EVs vs. Fuel Cells



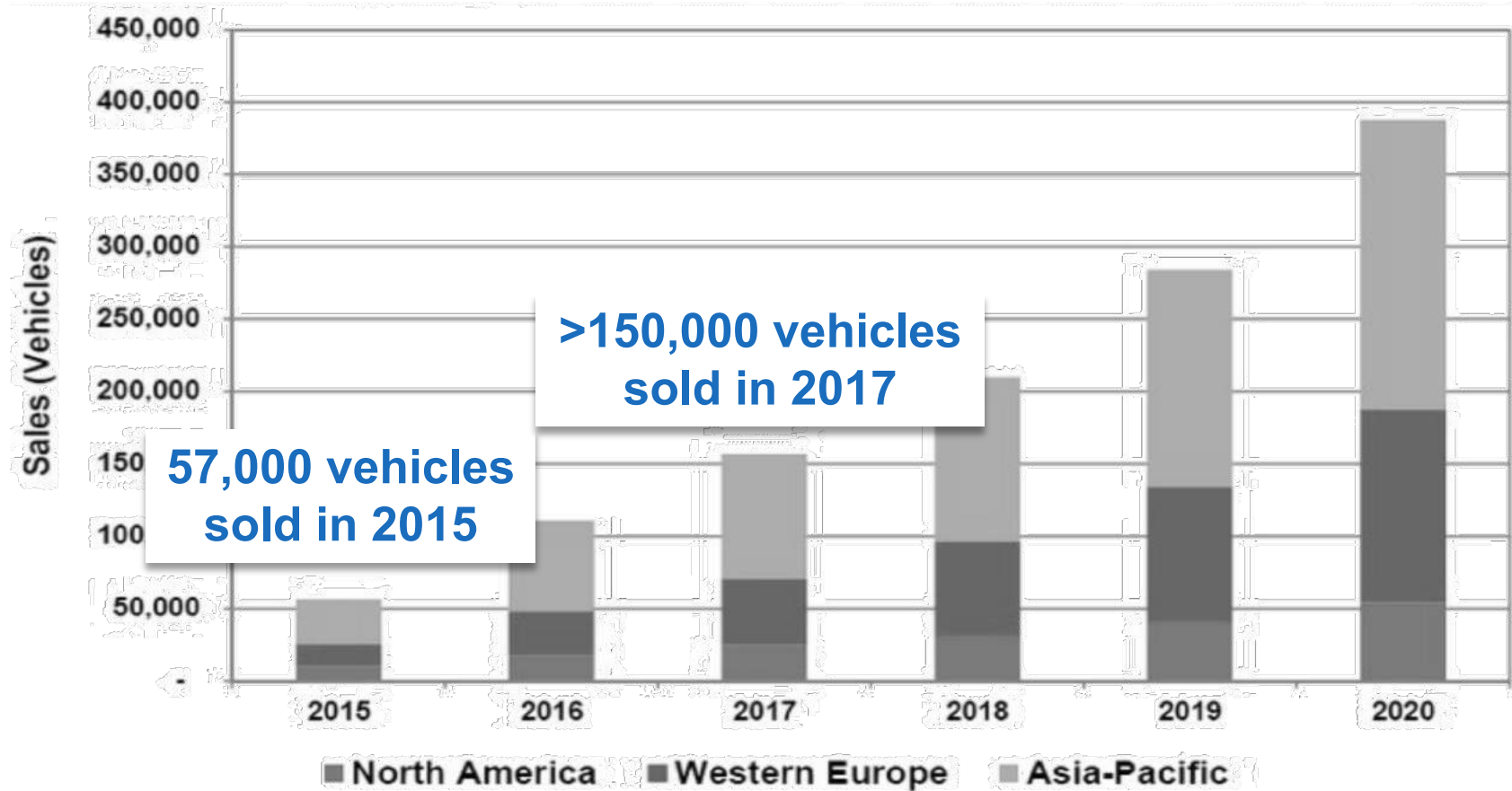


When?

TRADITIONAL FORESIGHT

Fuel cell vehicle adoption – what they said in 2011

2011 Forecast



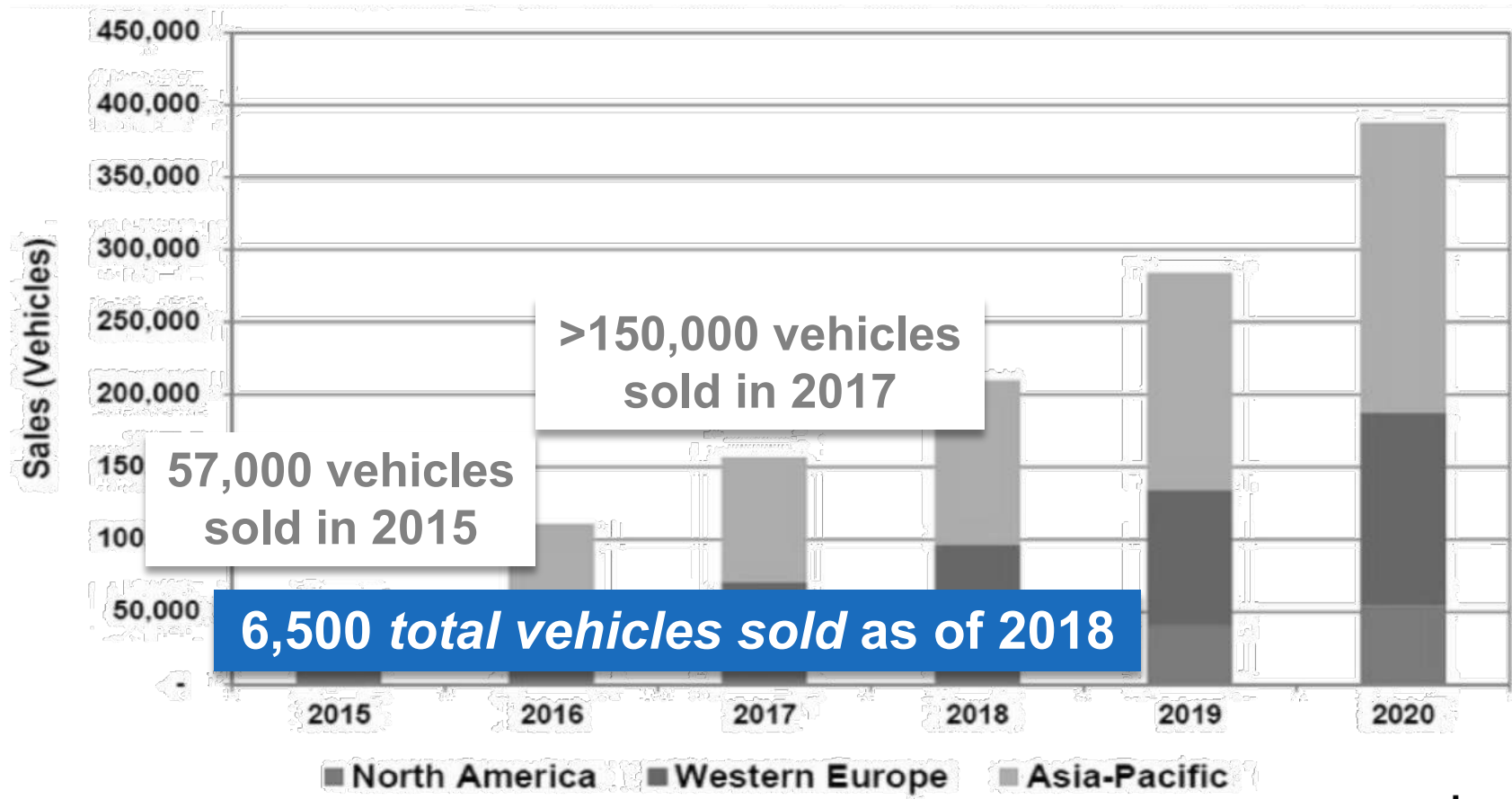


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TRADITIONAL FORESIGHT

Fuel cell vehicle adoption – what they said in 2011

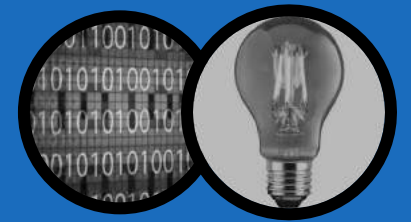
2011 Forecast



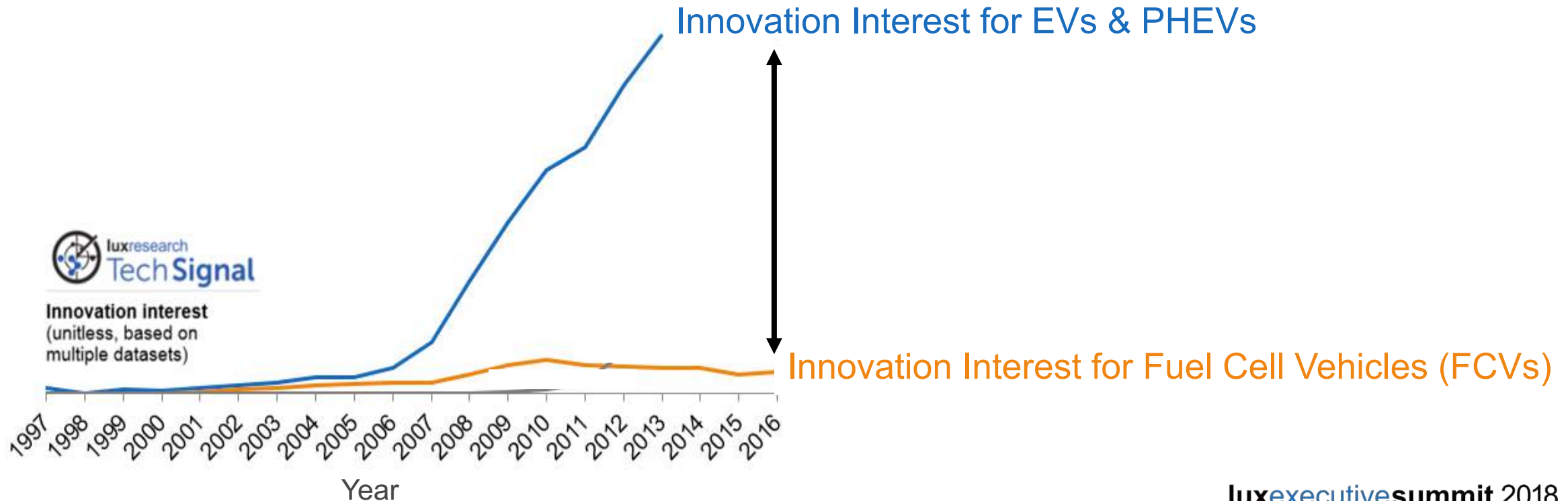


DATA + INSIGHT FOR WHEN TO ACT

The value of leading indicators



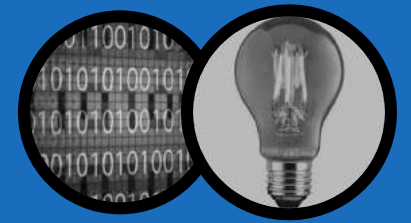
How Lux Tech Signal anticipated the rise of plug-in vehicles and failure of fuel cell vehicles





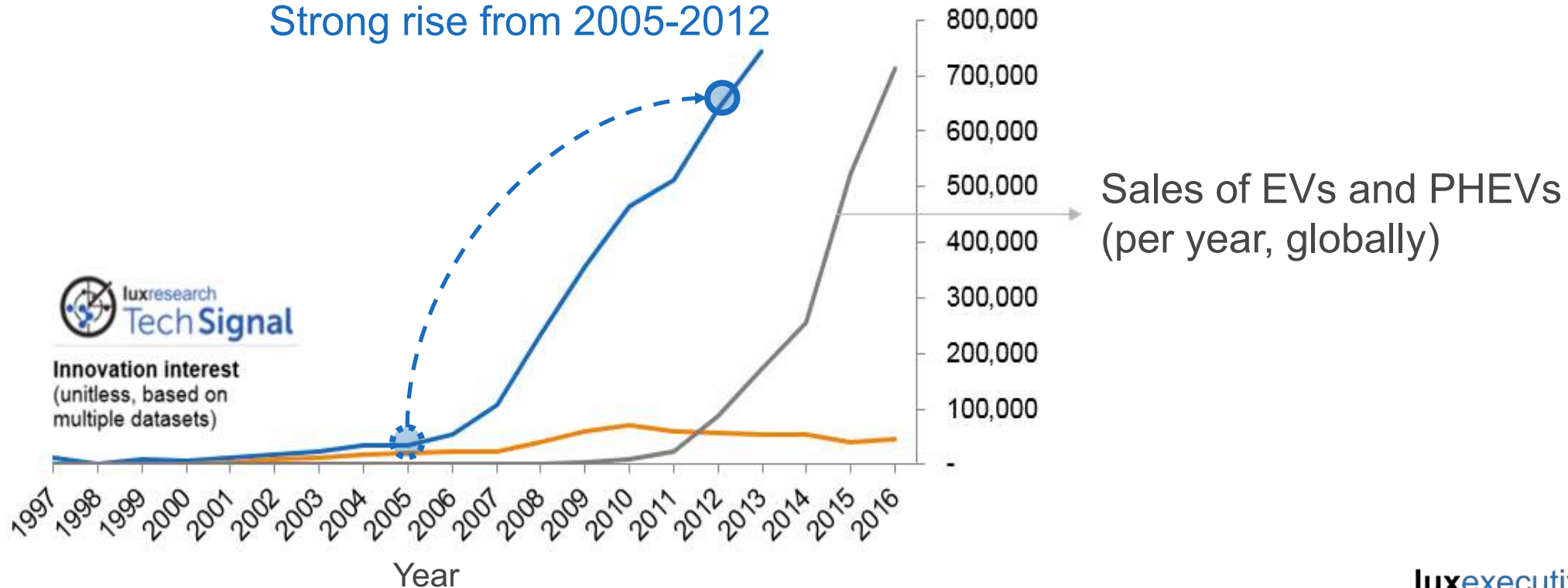
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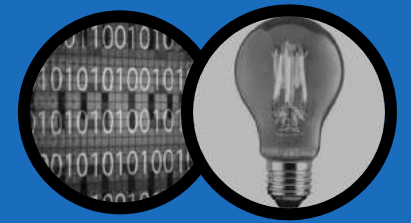
Innovation Interest for EVs & PHEVs
Strong rise from 2005-2012





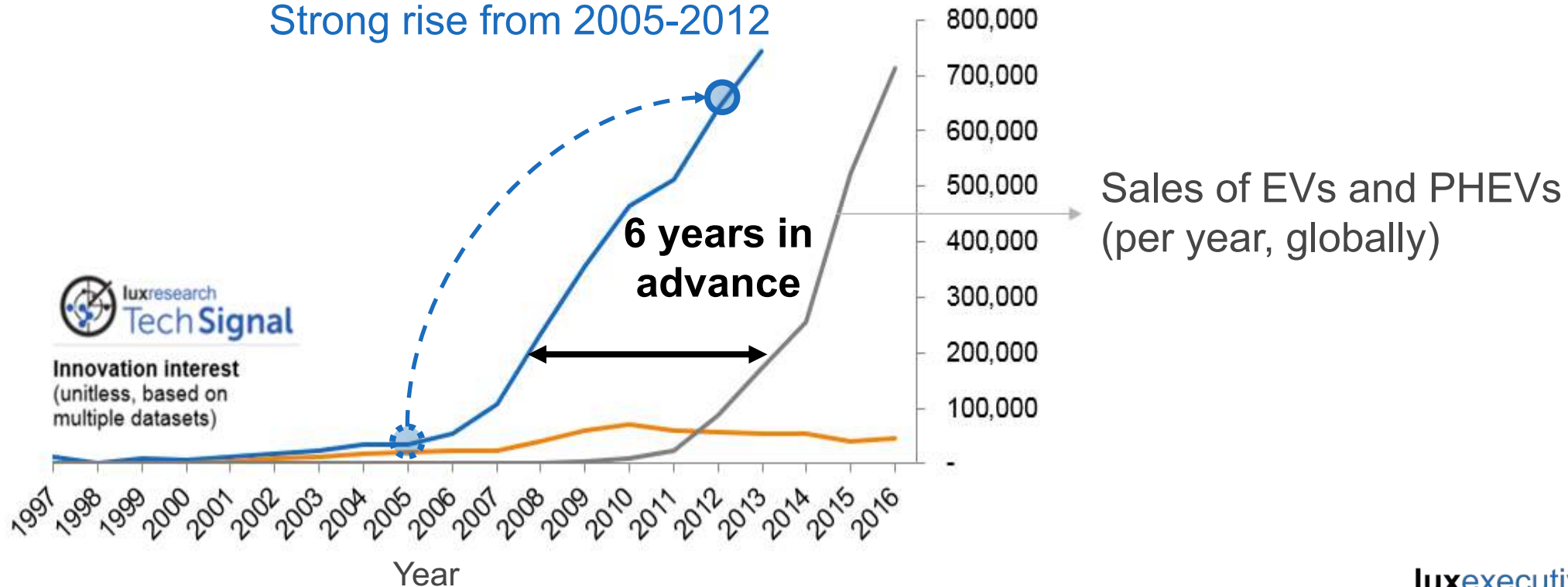
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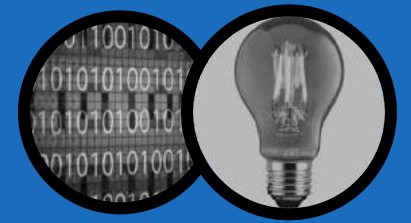
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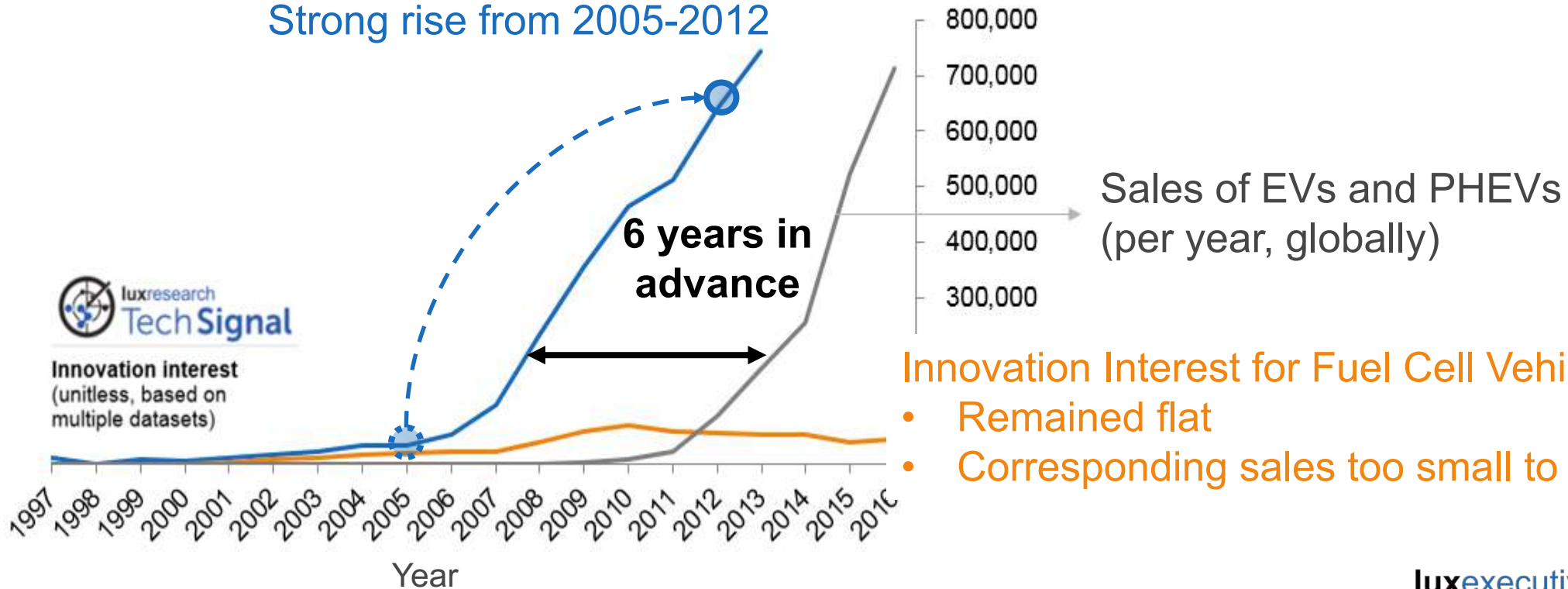


DATA + INSIGHT FOR WHEN TO ACT The value of leading indicators



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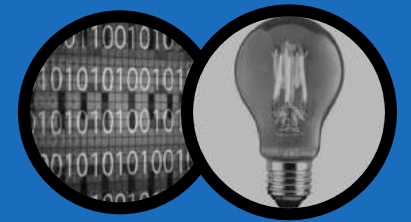
Innovation Interest for Fuel Cell Vehicles (FCVs)

- Remained flat
- Corresponding sales too small to register

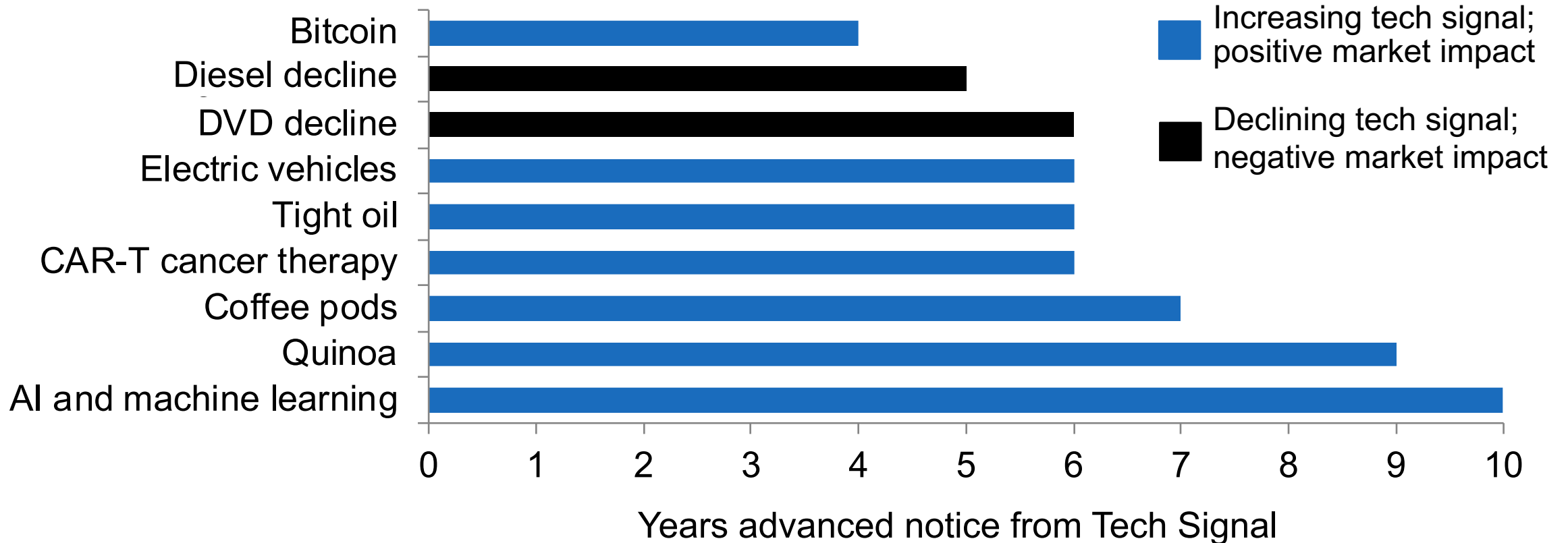


DATA + INSIGHT FOR WHEN TO ACT

The Lux Tech Signal as a leading indicator



Years advanced notice of technology market impact from Tech Signal



The microbiome

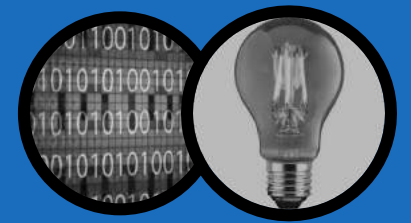


Impacts of microbes in different environments to aid development of ingredients, therapeutics, and diagnostics



DATA + INSIGHT

What technologies should you prioritize?

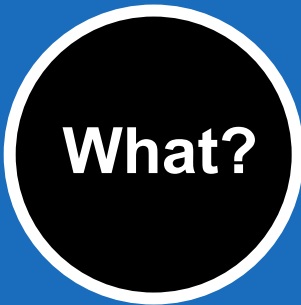


18 for 2018

Executive Summary: Top technologies Lux is following in 2018, using data from the Lux Intelligence Engine and analysts' insight

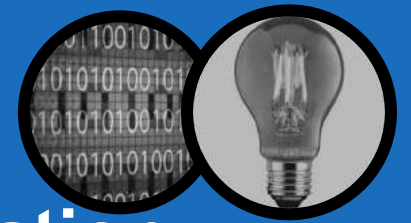
A ranking of the most important technologies to watch, given their potential to transform the world in the next decade

- 1 Machine Learning and Deep Neural Networks**
30% annual increase in machine learning patents
- 2 3D Printing and Additive Manufacturing**
Lux expects 3D printing to be a \$20 billion market by 2025
- 3 Genome Editing**
\$1.2 billion in VC funding to impact industries from food to health care
- 4 5G Networks**
Over 70,000 patents set the stage for 5G network launches in 2018
- 5 Microbiome**
Harnessing the power of microbes for nutrition, agriculture, and more
- 6 Solid-state Batteries**
Safer and better batteries, pursued by start-ups and giants like Toyota
- 7 Synthetic Biology**
A recent \$275 million round for Ginkgo Bioworks highlights the potential
- 8 Augmented Reality (AR)**
Enterprise applications are coming now, on heels of \$4.4 billion in funding
- 9 Smartwatches**
Patents soar from near zero to over 23,000 in less than five years
- 10 Wireless Charging**
Here now for consumer electronics, with R&D pushing for EV uses
- 11 Materials Informatics**
Using IT and AI to break out of slow material development cycles
- 12 IoT Security**
Patents are up 13x as connected devices proliferate
- 13 Edge Computing**
When milliseconds matter, analytics can be local, not in the cloud
- 14 Energy Distribution System Monitoring**
Growing demand and renewables require tech to balance the grid
- 15 Polyethylene Furanoate (PEF)**
Innovation has grown at an 87% annual rate to improve on PET
- 16 Sugar Reduction**
Over 162,000 patents to combat health ills from too much sugar
- 17 Neural Interfaces**
Tech to read and stimulate the brain will see growing validation in 2018
- 18 Syngas and Power-to-Gas**
Producing fuels from CO₂ to drive the energy transition

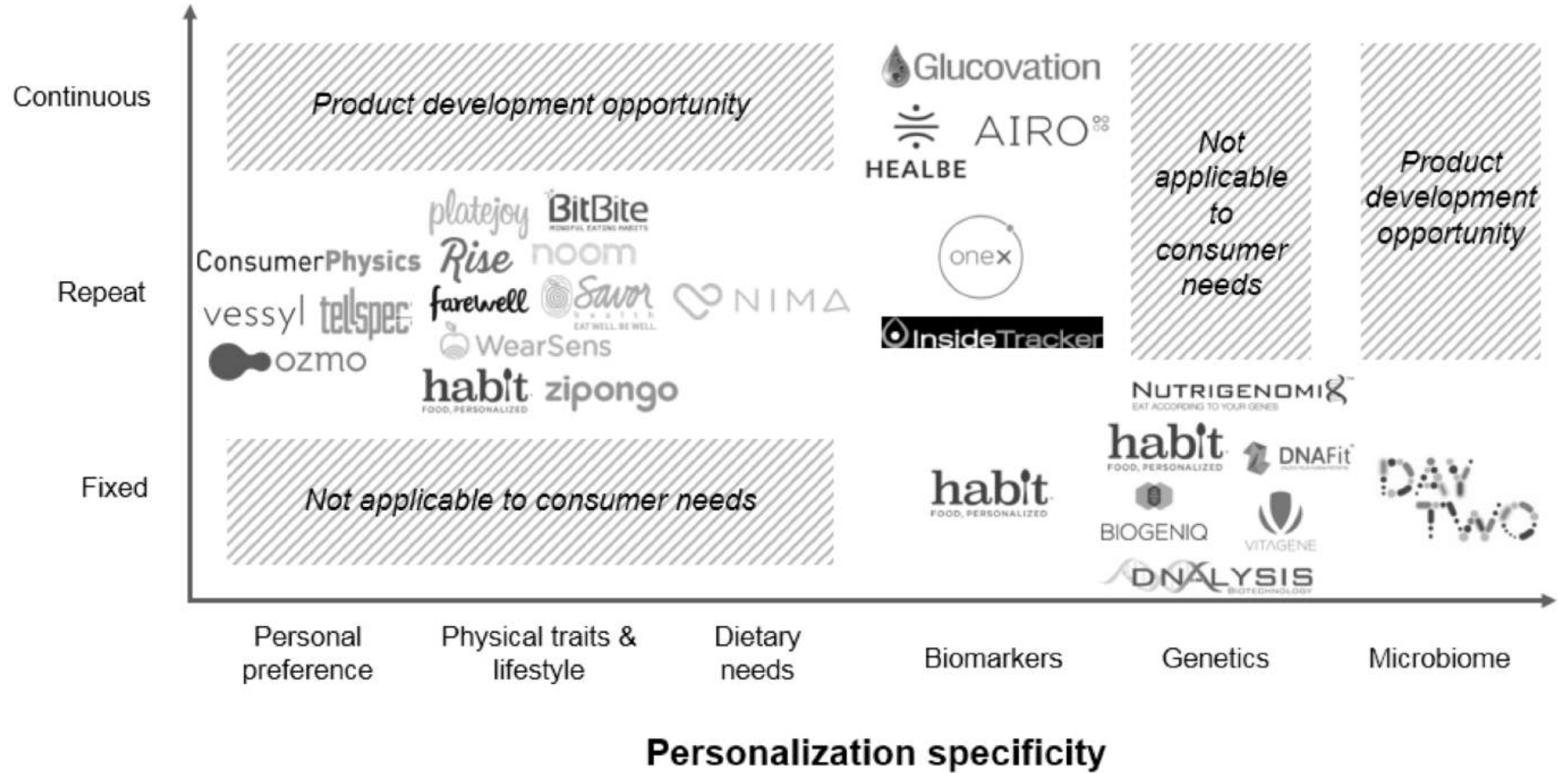


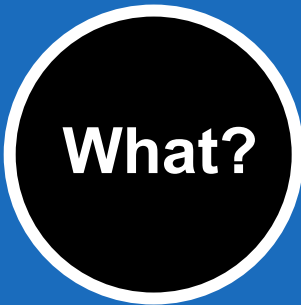
DATA + INSIGHT

The microbiome is the holy grail of personalization



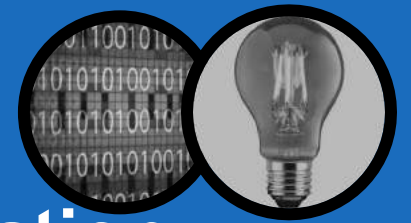
Frequency of recommendations



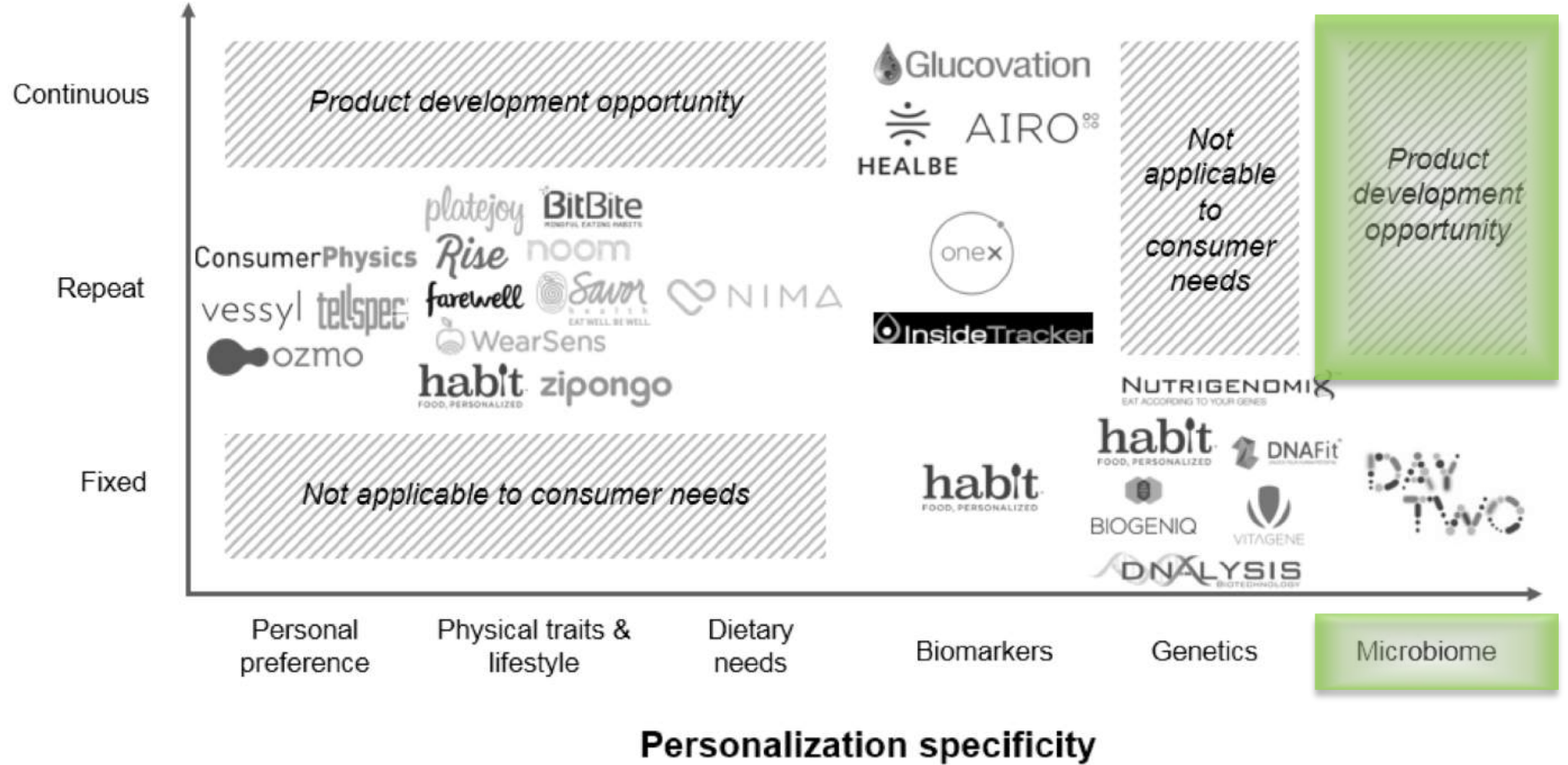


DATA + INSIGHT

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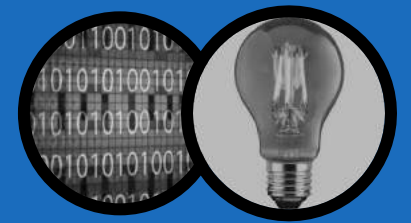
Frequency of recommendations



Who?

DATA + INSIGHT

Development of ingestible sensors capable of measuring gases in the gut



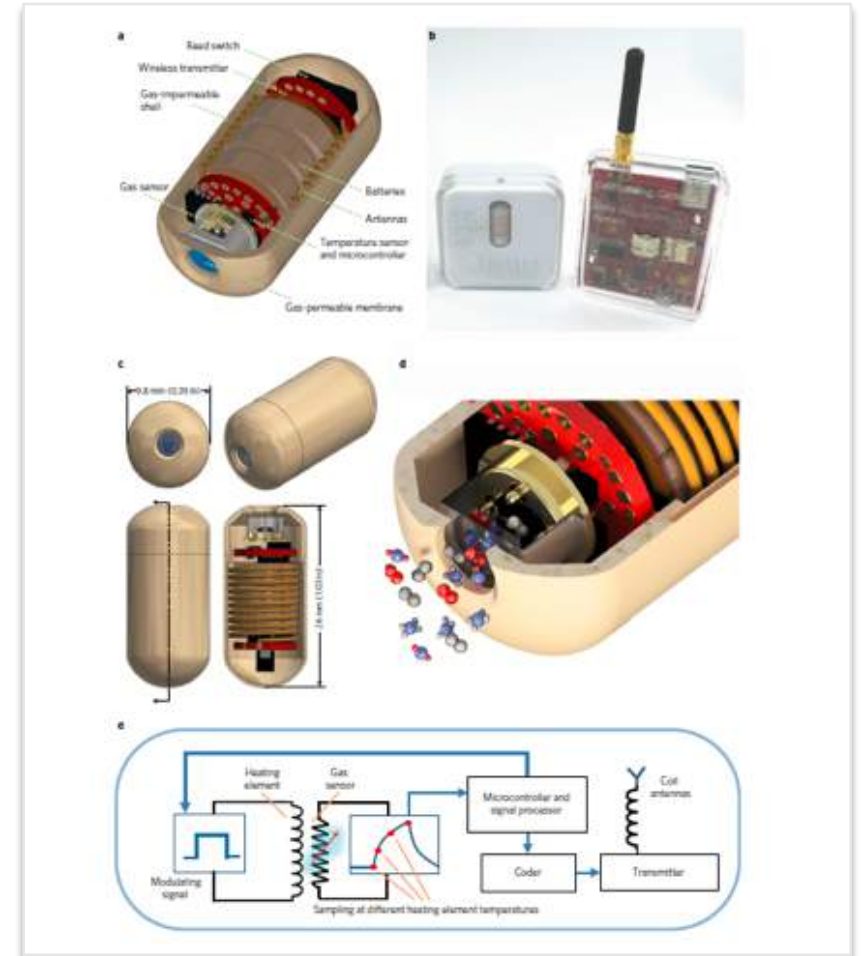
RMIT is **developing an ingestible sensor to measure gases (oxygen, hydrogen, carbon dioxide) in the gut and recently conducted a human pilot trial**

Version 2: add hydrogen sulfide sensing

Version 3: add short-chain fatty acids

Looks to include analytics to convert raw data to actionable insight.

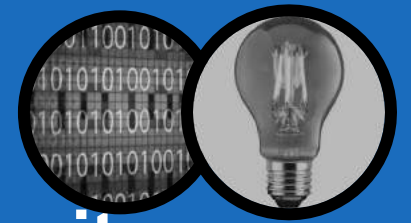
Unique in providing localized, high frequency measurements of the microbiome.





DATA + INSIGHT

Ingestible gas sensor plays into a previously-open product development opportunity

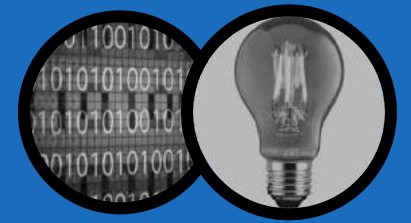


Frequency of recommendations

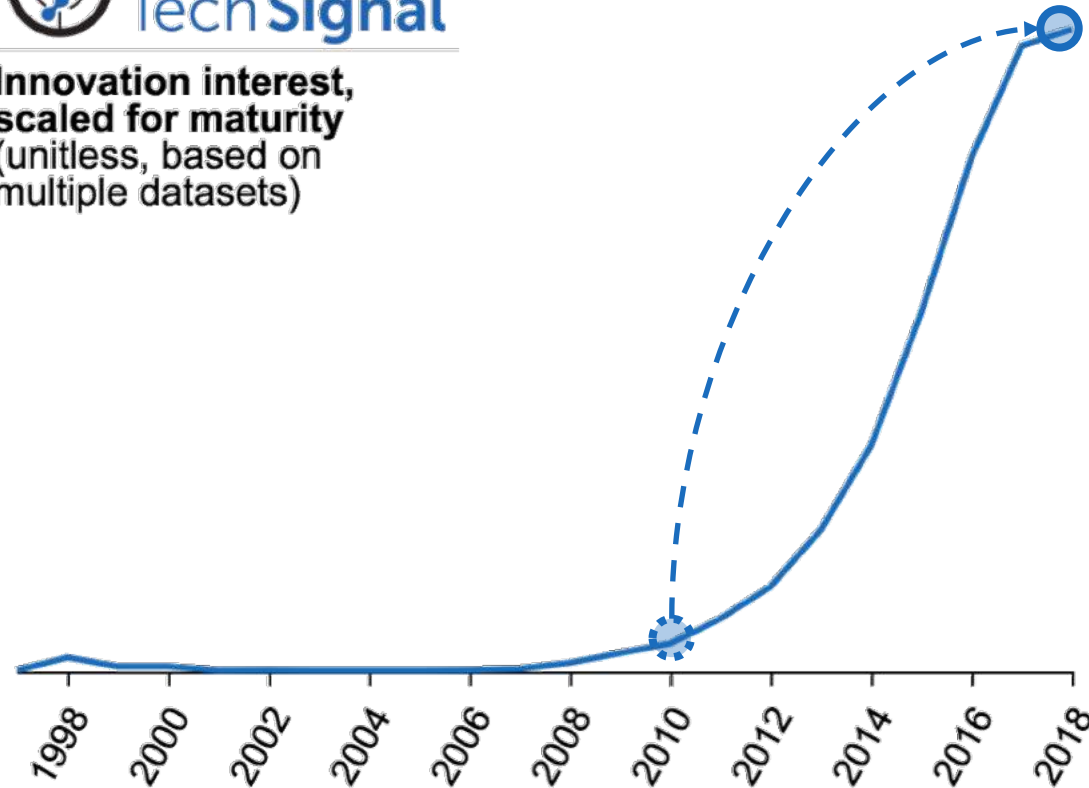


When?

DATA + INSIGHT FOR WHEN TO ACT Microbiome innovation is rising fast



Innovation interest, scaled for maturity
(unitless, based on multiple datasets)

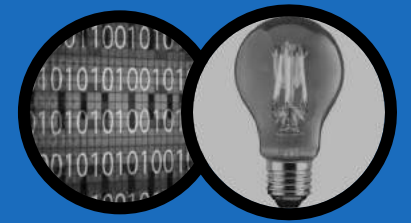


Microbiome innovation interest

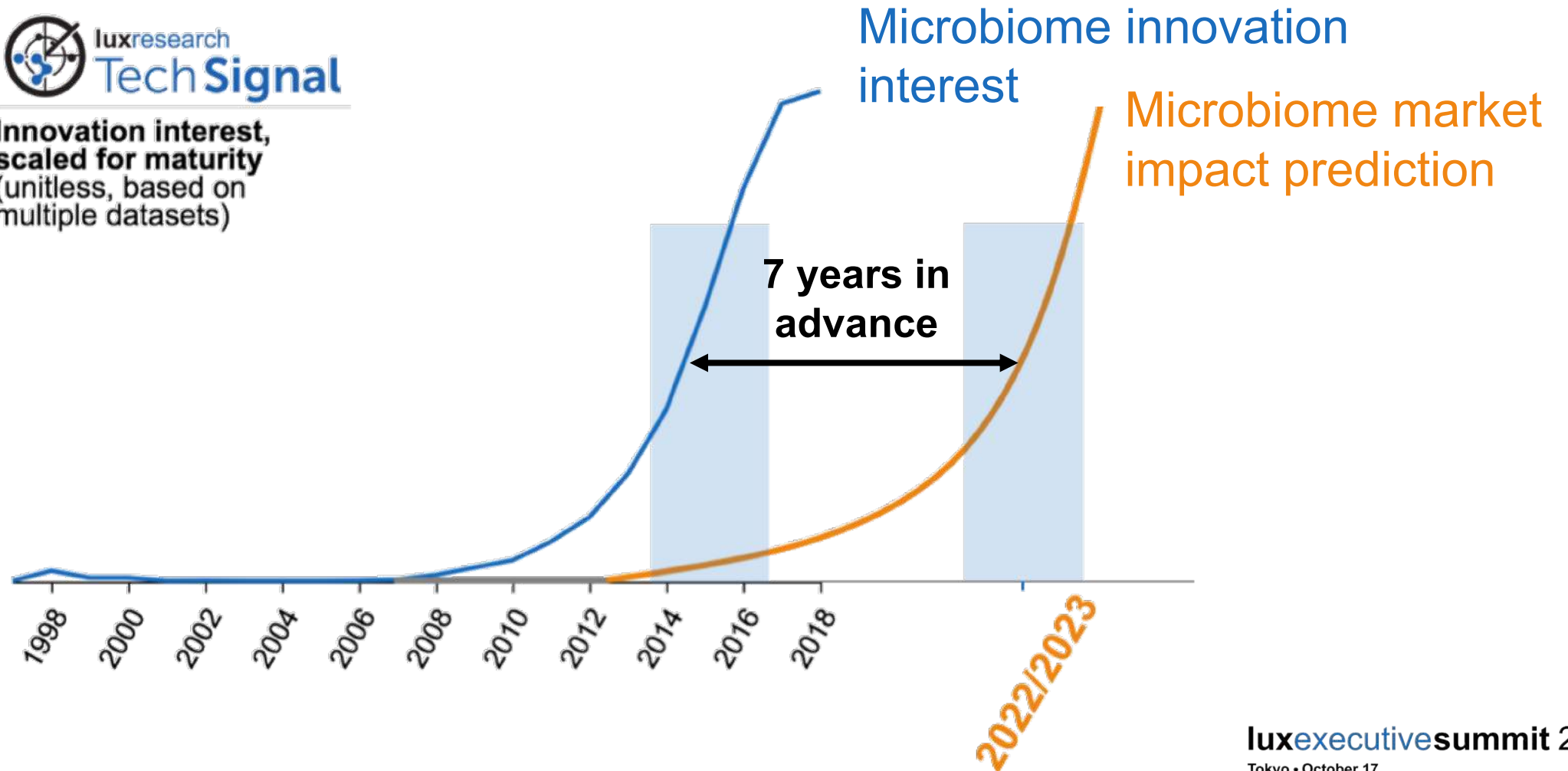
When?

DATA + INSIGHT FOR WHEN TO ACT

Making a call – predicting market impact



Innovation interest, scaled for maturity (unitless, based on multiple datasets)

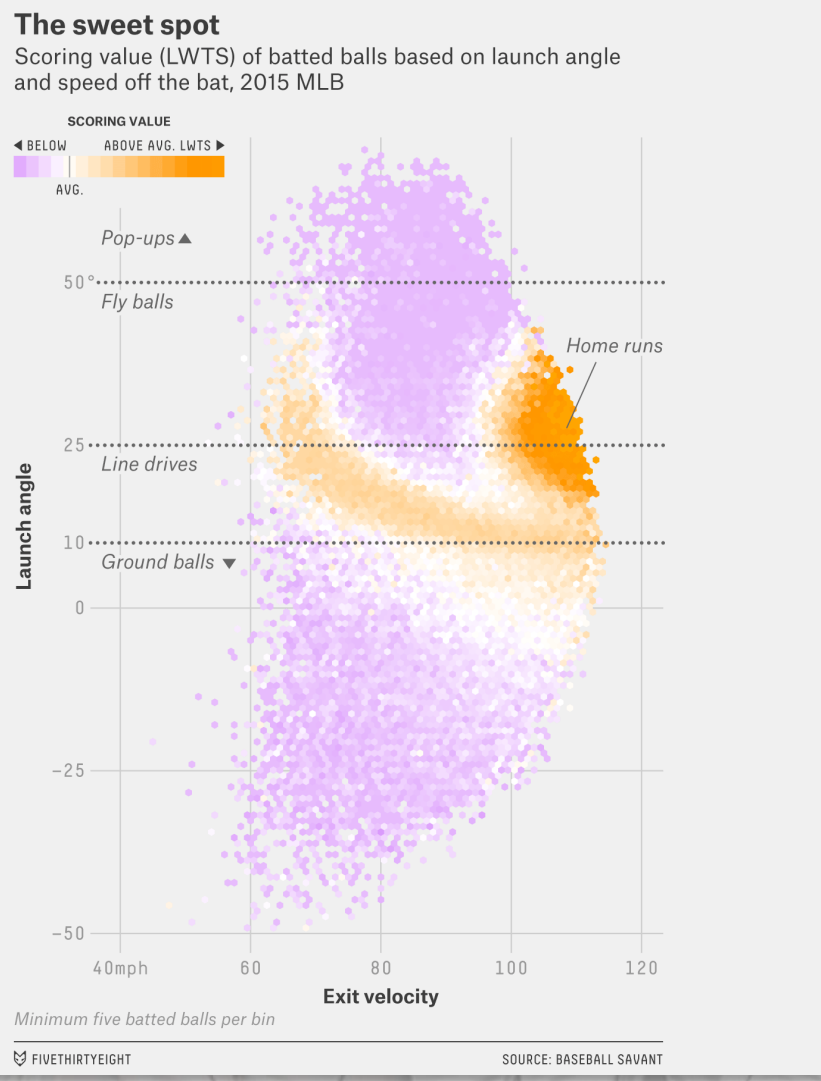


Agenda

- 1 | The stagnation of the Innovation Process
- 2 | Data + Insight to get at What, Who, and When
- 3 | Evolving for better results

2017 WORLD SERIES CHAMPIONS HO





Year	Team	League	Wins	Losses	%
2017	Houston Astros	American League	101	61	.623
2016	Houston Astros	American League	84	78	.519
2015	Houston Astros	American League	86	76	.531
2014	Houston Astros	American League	70	92	.432
2013	Houston Astros	American League	51	111	.315
2012	Houston Astros	National League	55	107	.340

“ ...A few years of struggle could lead to many years of success. ”

Solution



+



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Deep Learning

Advanced machine learning techniques making use of neural networks, for much-improved computer vision, speech recognition, filtering, and more.

LUX TAKE:

Deep learning will have a transformative effect on the future of AI, and on digital transformation as a whole. Clients should believe the hype, although keep expectations in check – the high talent requirements and ongoing need for R&D means deep learning will take a while to impact most applications.

Lux Take Last Updated: August 15, 2018
Data Last Updated: September 27, 2018
Coverage: Digital Transformation [More...](#)

Essentials | News | Key Players | Case Studies | Lux Innovation Grid | Patents and Papers | Investments | Further Reading

What's New

Data last updated on September 27, 2018

Lux Research analysts and the Lux Intelligence Engine have added the following recent deep learning developments.

NEWS COMMENTARIES	NEW LUX CONTENT	NEW PATENTS	NEW INVESTMENT ROUNDS
<p>Nvidia introduces the Clara platform, which allows third-part...</p> <p>Intel acquires Vertex.AI; strengthens AI capabilities (Aug...</p> <p>View All</p>	<p>Augmented Reality In Auto: The State of Innovation In 2018...</p> <p>Overview of EmTech: Lots of AI and quantum computing...</p> <p>View All</p>	<p>NEC: Fine-grained image classification by exploring...</p> <p>Samsung Electronics: Speech recognition apparatus and math...</p> <p>View All</p>	<p>DarwinAI has raised \$3.01 million in seed funding (September 18,...</p> <p>ultimate.ai has raised \$1.3 million in seed funding (September 18,...</p> <p>View All</p>

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COMPANIES TECH MARKETS CHARTS NEWS

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What You Need to Know

Curated by Cosmin Lasiau, Director, Research Products
Questions? [Submit an inquiry](#)
Lux Take last updated on January 3, 2018

LUX TAKE:

Deep learning will have a transformative effect on the future of AI, and on digital transformation as a whole. Clients should believe the hype, although keep expectations in check – the high talent requirements and ongoing need for R&D means deep learning will take a while to impact most applications.

ANALYST OPINION

LUX TECH SIGNAL

WHY IT MATTERS:

Deep learning is making rapid progress on applications that have traditionally stumped artificial intelligence (AI), including accurate image recognition, language processing, and other growing opportunities.

KEY PLAYERS:

Software powerhouses Google and Microsoft are doing leading work and already productizing deep learning; electronics stakeholders, especially Samsung Electronics, IBM, and Qualcomm, are also active; within healthcare, Siemens is off to an early start. [Click for details](#).

HOW IT WORKS:

Analogously to the human brain, deep learning uses multiple layers of neuron-like computing units that together make up complex neural networks.

CHALLENGES TO OVERCOME:

Deep learning remains difficult to use by many, due to its complexity, lack of available talent, and opacity. Moreover, its use cases are still being refined and expanded.

Tech Pages

Understand the landscape of key players, including start-ups, large and mid-sized firms, and research centers...

Key Players



LUX TAKE:

The deep learning landscape has been an interesting mix of corporate R&D and academic breakthroughs, led in particular by the likes of Google, whose Google Brain initiative and Deepmind acquisition both bolstered the company's position in the space. Hardware developers like Qualcomm are also looking at the space with interest, as they look to optimize chipsets for deep learning, while players like Samsung Electronics and Apple look to leverage the technology for consumer electronics. On the academic side, Carnegie Mellon University is a leader, but look to China as well, which has seen an explosion in deep learning interest and ability, as highlighted by our AI in China report here.

This section identifies leading companies, start-ups, and research centers in deep learning. Companies and research centers are chosen based on the strength of their patent portfolio in this technology, with further curation and additions by our Lux Research analysts as necessary; the resulting lists are alphabetically sorted. Meanwhile, the start-ups section is based on companies Lux analysts have profiled and is sorted in order of descending Lux Take.

LARGE & MID-SIZED FIRMS		START-UPS	RESEARCH CENTERS		
	 See Our Case Study			 See Our Case Study	
					 See Our Case Study

Tech Pages

...along with case studies about successful deployments

SIEMENS

GOOGLE

GE HEALTHCARE

FORD MOTOR COMPANY

SIEMENS



Siemens uses Bonsai's deep learning platform to speed up industrial calibration process by 30x

INTRODUCTION

Computer numerical control (CNC) milling machines are automated machining tools often used in manufacturing metal parts that require tight tolerances. However, because of the large amounts of friction involved in the machining process, CNCs need to be recalibrated frequently. Manufacturers typically fly in specialists to recalibrate these machines, during which time the machine is taken offline for several hours. Manufacturers can incur several thousands of dollars in costs related to travel expenses as well as costs associated with downtime.

USE CASE AND BUSINESS IMPACT

Siemens partnered with Bonsai, a deep reinforcement learning platform provider (recently acquired by Microsoft), to develop a proof of concept to reduce the time and cost associated with recalibrating CNC machines. An existing simulation of a CNC machine that needed to be calibrated was fed into the Bonsai platform in order to train the model. At the same time, subject matter experts at Siemens codified their knowledge of the calibration process using Bonsai's high-level programming language. After the AI-model was trained, engineers tested it by recalibrating an actual CNC machine. The company claimed the recalibration process, which normally lasted two hours, took only 12 seconds, thereby significantly cutting down operational costs.

LUX TAKE:

One of the greatest challenges in adopting AI in industrial applications is that AI experts lack subject matter expertise, while subject matter experts often lack critical AI skills. Bonsai's platform helps alleviate that issue by automating many of the low-level details surrounding AI implementation. Furthermore, this proof-of-concept was successful because it focused on a well-defined, constrained problem where there was a simulation available as well as an ample amount of historical data recorded. Clients interested in using AI to automate control or for optimization problems should look to Bonsai's platform as a strong alternative to developing the tools in-house.

Tech Pages

Track trends and updates in key innovation areas like:

- Patents and academic papers

Patents and Papers

Curated by Cosmin Laslau, Director, Research Products

Questions? Submit an inquiry.

Lux Take last updated on August 15, 2018

Data last updated on September 18, 2018



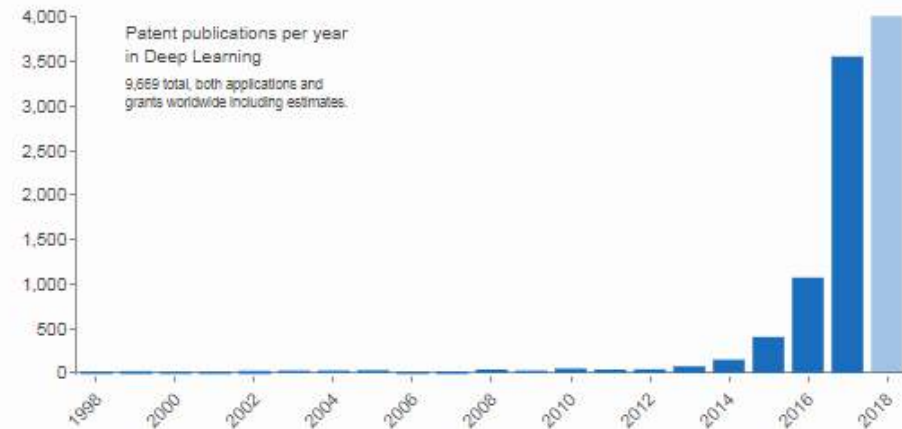
LUX TAKE:

While some like Google and Samsung electronics have investigated both convolutional neural networks and recurrent neural networks for deep learning, most are focusing their attention on the former. Qualcomm in particular is betting heavily on it. The other strong focus is encoding and decoding, which plays a key role in the development of effective deep learning mechanisms. Google is particularly active in this area. (Note: This relative activity is relative to the five topics highlighted above; it is not an exhaustive list.) Remarkably, about half the patents in deep learning are from China, while the U.S. ranks as a distant second in terms of geographic distribution, highlighting the strength of China here; for more details, see our report "AI in China: Analyzing the rise of Baidu, Alibaba, and Tencent".

Overall Patent Trends

Geographic Patent Trends

Patents vs. Papers



Tech Pages

Track trends and updates in key innovation areas like:

- Patents and academic papers
- Investment trends











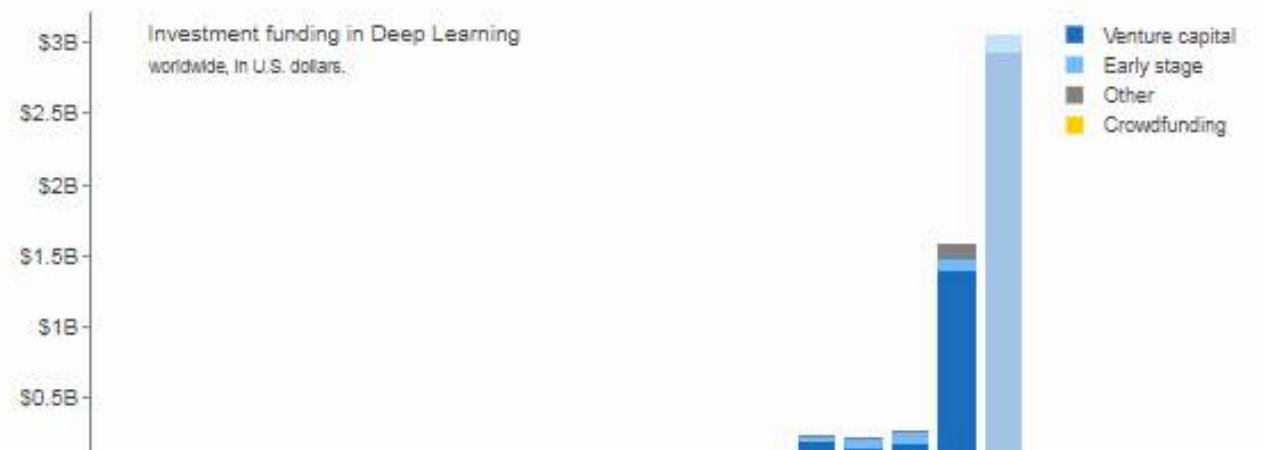
Investment Trends

LUX TAKE:

More and more companies are calling themselves deep learning firms in an effort to attract venture capital investment, but beware of fakes: It is crucial to understand what precisely each company is doing in deep learning, how they are leveraging it in their core product or service, and how defensible and differentiated their approach is. In many cases, we see companies that only use deep learning for a minor part of their overall solution stack, or that use off-the-shelf, undifferentiated deep learning.

HIGHLIGHTED RECENT INVESTMENTS:

		DarwinAI raised \$3.01 million on seed funding on September 18, 2018 from 3 investors including Creative Destruction Lab
		ultimate.ai raised \$1.3 million on seed funding on September 18, 2018 from 2 investors including HV Holtzbrinck Ventures
		Mate Labs raised \$550,000 on seed funding on September 17, 2018 from 5 investors including Eagle10 Ventures
		SenseTime raised \$1 billion on Series D funding on September 10, 2018 from SB China Venture Capital



Tech Pages

Track trends and updates in key innovation areas like:

- Patents and academic papers
- Investment trends
- News commentary
- ...and more

News Commentary

Analyst commentary on selected news:



Very Important

Nvidia introduces the Clara platform, which allows third-party developers to build applications for medical imaging

By Nardev Ramanathan | September 13, 2018

Nvidia took another step in its effort to advance the medical imaging industry. The company just introduced its Clara platform, which combines a new GPU-based computing architecture with a software development kit that will allow third-party developers to build applications on top of...
[read more](#)



Very Important

Intel acquires Vertex.AI; strengthens AI capabilities

By Shiriram Ramanathan | August 16, 2018

With this acquisition, Intel has gained relevant experience and IP to enable flexible deep learning at the edge. This acquisition comes on the back of five other AI acquisitions by Intel – Movidius, Mobileye, and Nervana being the most prominent ones. In the recent years, Intel has...
[read more](#)



Average Importance

Machine learning comes a step closer to interpreting emotions like humans

By Shiriram Ramanathan | July 26, 2018

Researchers at the MIT Media Lab used a new ensemble machine learning technique called Mixture of Experts (MoE) for emotion detection. MoEs use a series of neural networks, each specialized in processing a specific task. Along with MoEs, the MIT team also used a gating...
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Solid-state batteries Blockchain CO₂ Capture Flow batteries
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Commercial drones Smartwatches Heat pumps
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Spider silk Neural interfaces Hydraulic fracturing Wireless charging
Biopesticides Lithium-ion batteries Generative design Materials informatics
Advanced silicon photovoltaics

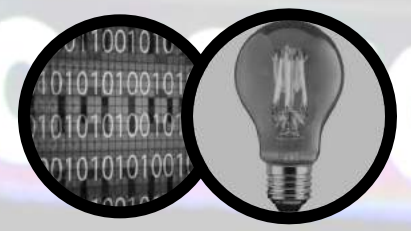


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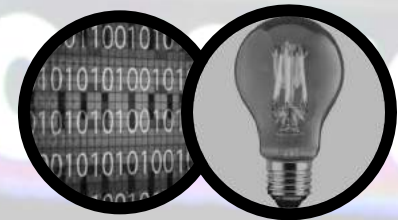
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2017 WORLD SERIES CHAMPIONS



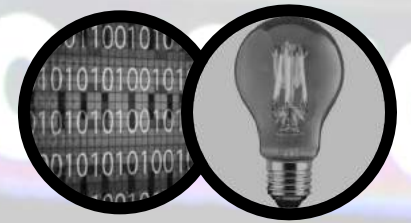
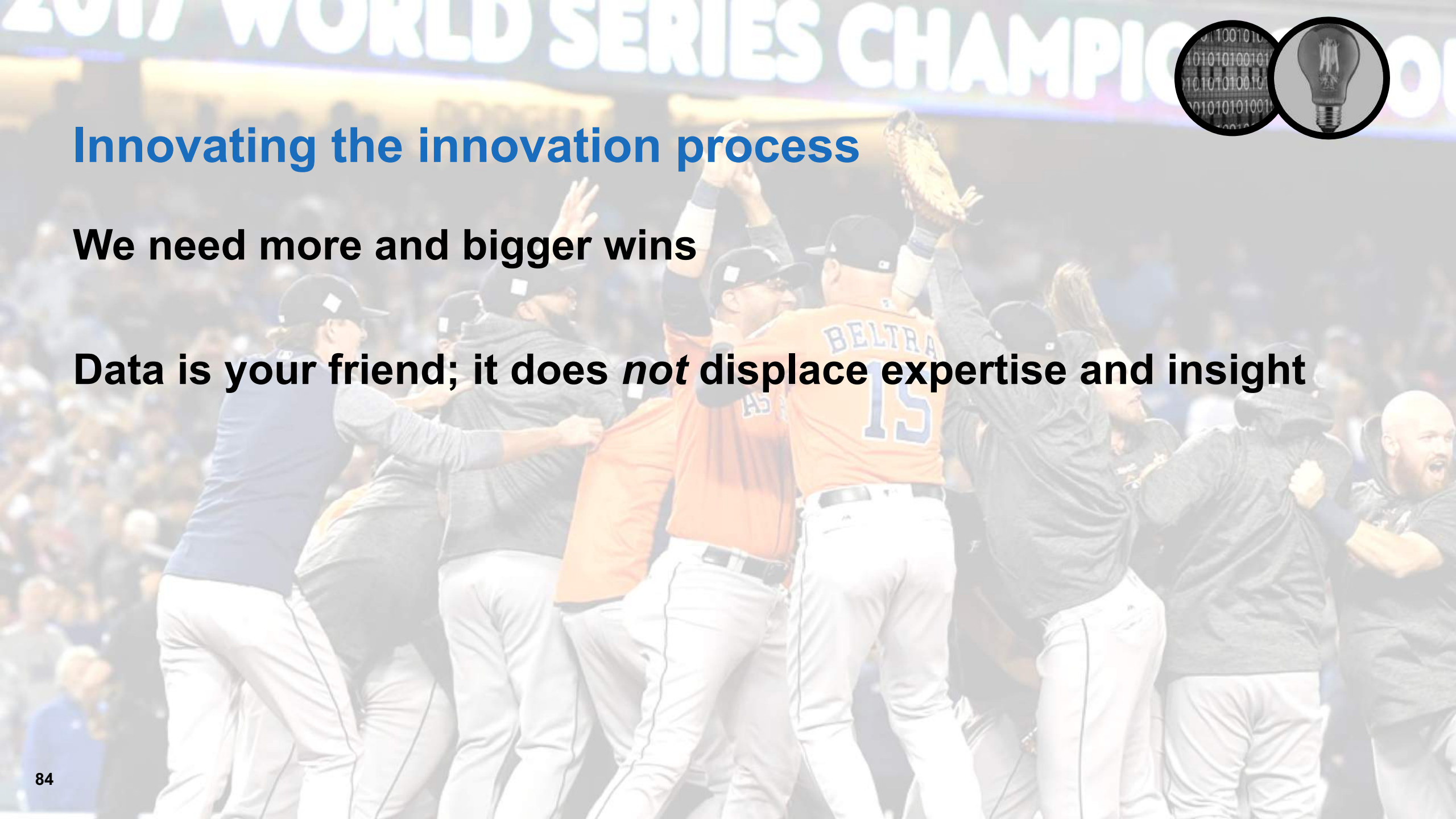
Innovating the innovation process





Innovating the innovation process

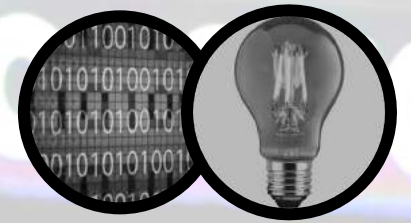
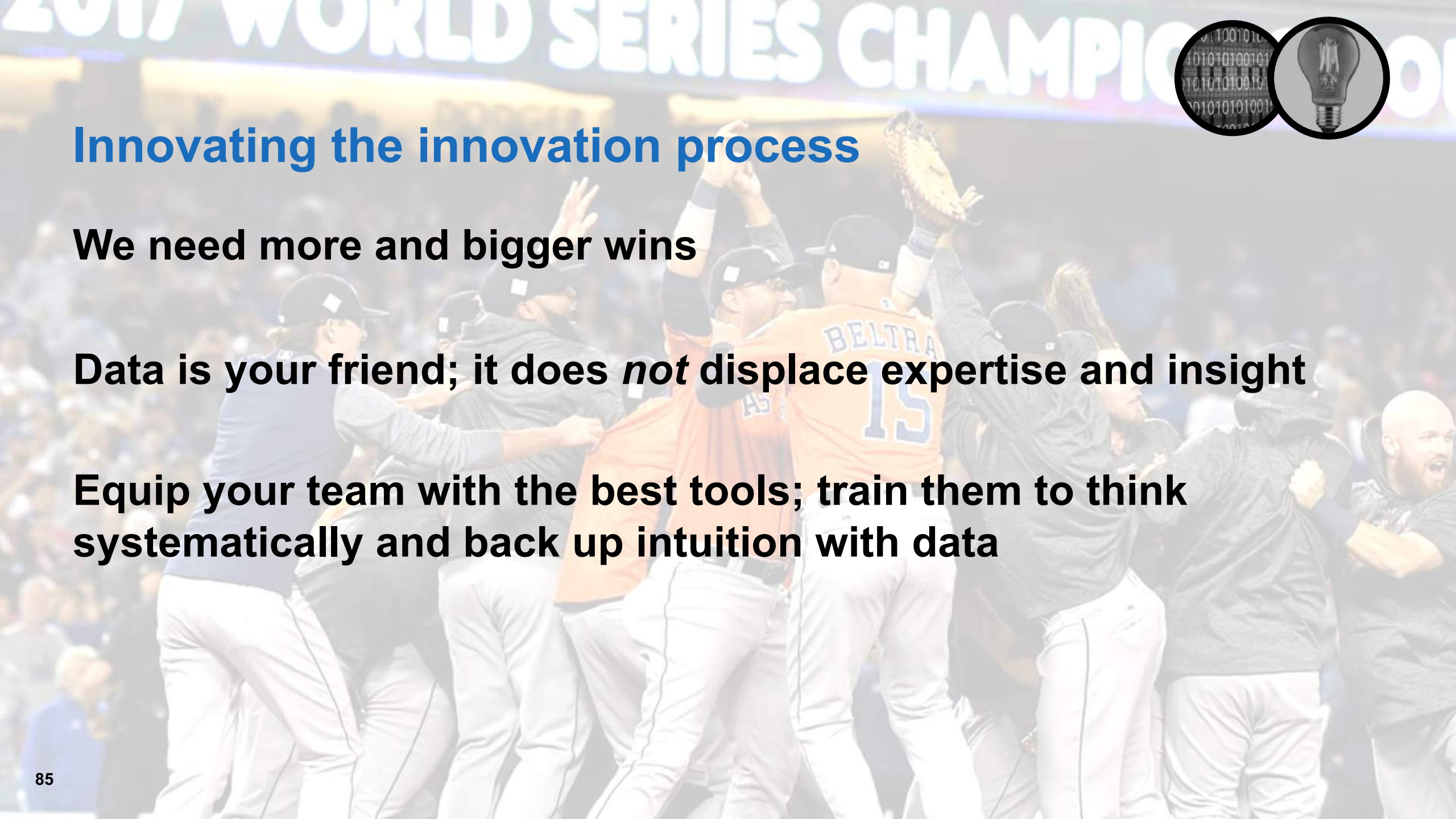
We need more and bigger wins



Innovating the innovation process

We need more and bigger wins

Data is your friend; it does *not* displace expertise and insight



Innovating the innovation process

We need more and bigger wins

Data is your friend; it does *not* displace expertise and insight

Equip your team with the best tools; train them to think systematically and back up intuition with data



2018

luxexecutivesummit

Tokyo • October 17

Thank you for joining us.





Kevin See Ph.D.

857-284-5683

kevin.see@luxresearchinc.com

www.luxresearchinc.com

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