

luxexecutivesummit 2018

Amsterdam • June 6-7

Playing to Win

Strategies for Accelerating Materials Innovation in Turbulent Times | April 11

Ross Kozarsky

Research Director, Lux Research



Who is this guy?

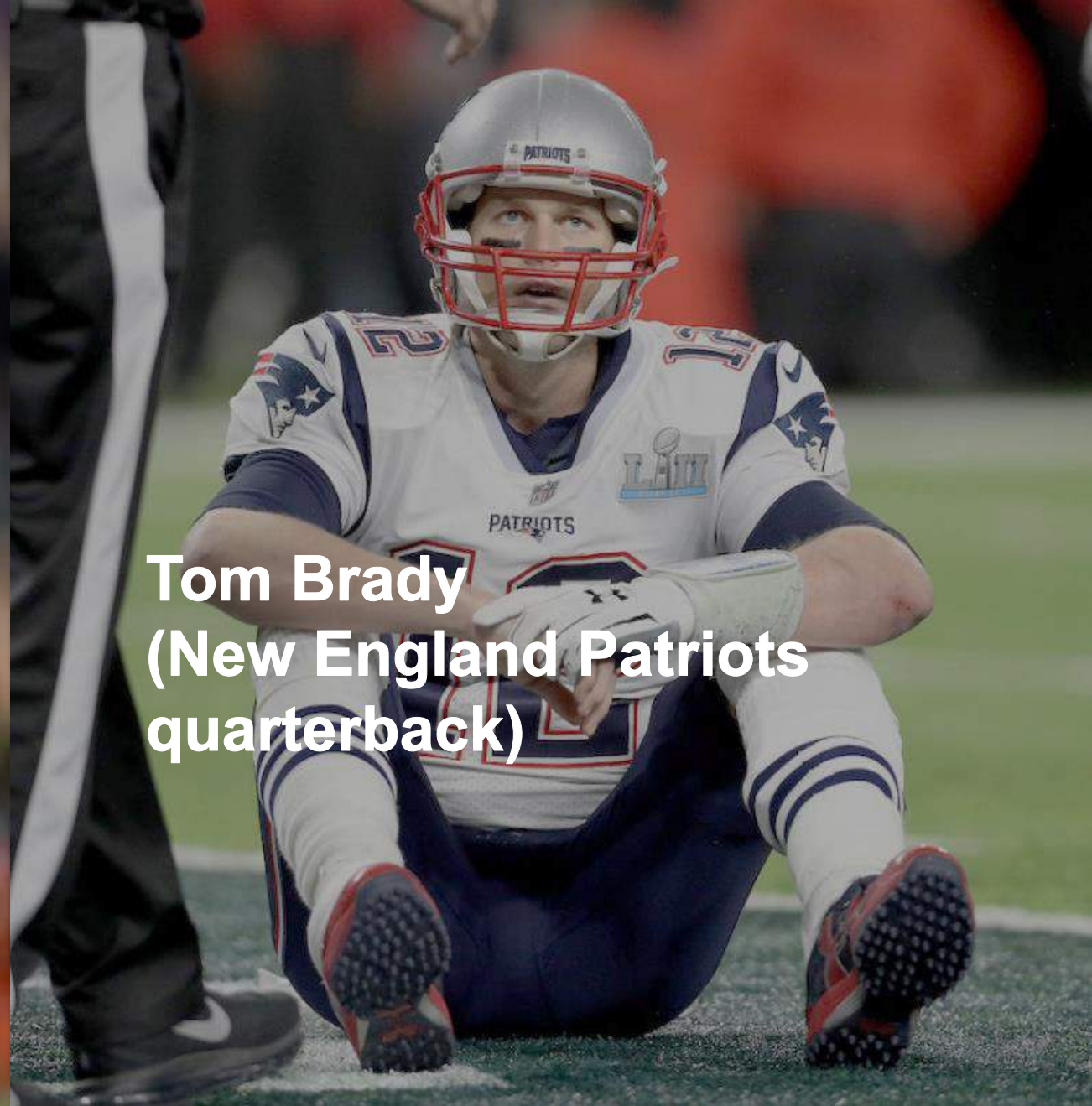




Bill Belichick
(New England Patriots head coach)



Bill Belichick
(New England Patriots head coach)



Tom Brady
(New England Patriots quarterback)



Bill Belichick
(New England Patriots head coach)



Doug Pederson
(Philadelphia Eagles head coach)



Tom Brady
(New England Patriots quarterback)



Playing to win vs. playing not to lose

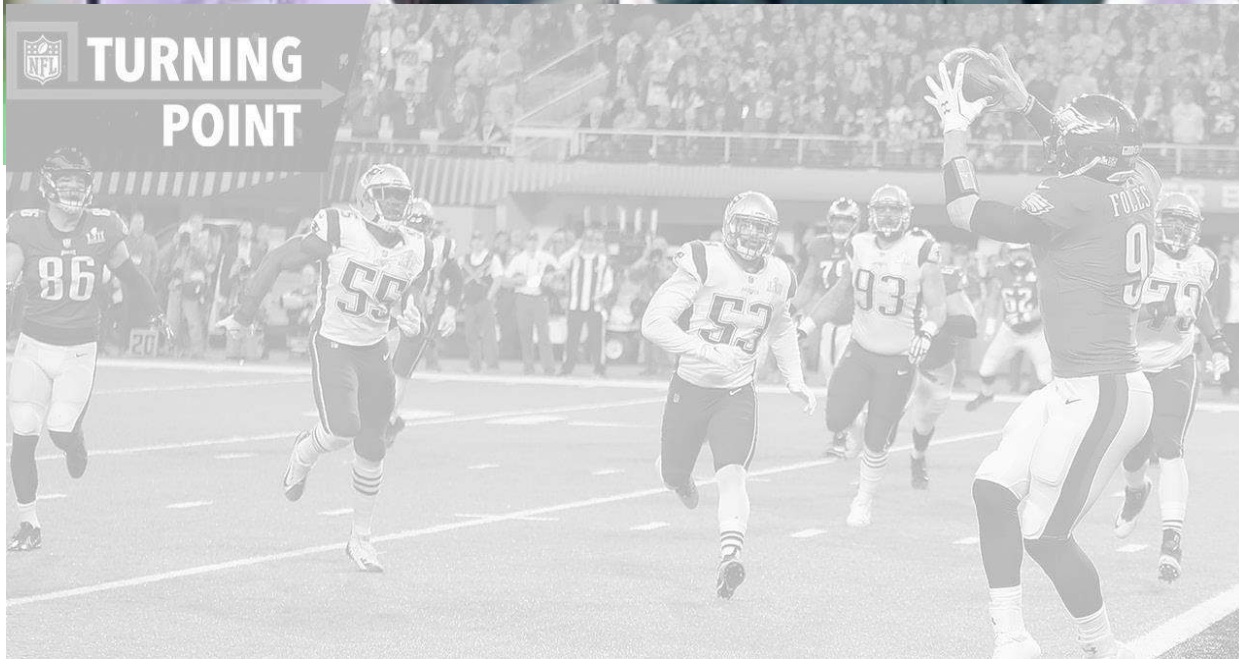


**TURNING
POINT**



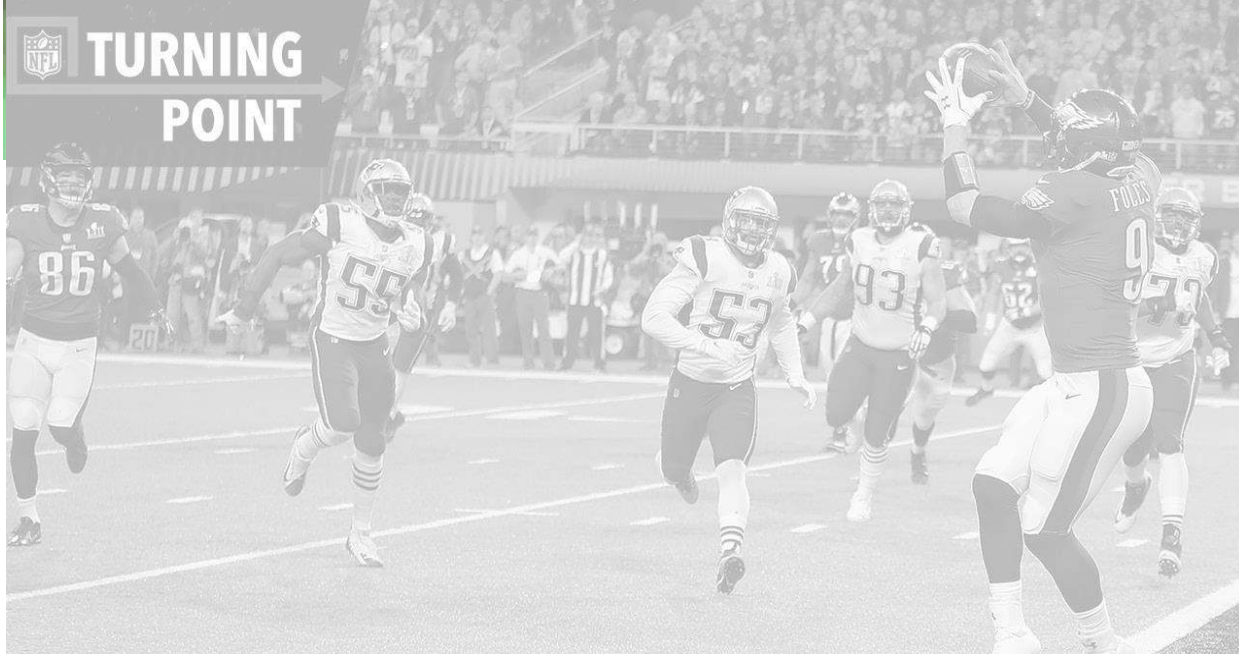


Eagles lost star QB to injury right before playoffs

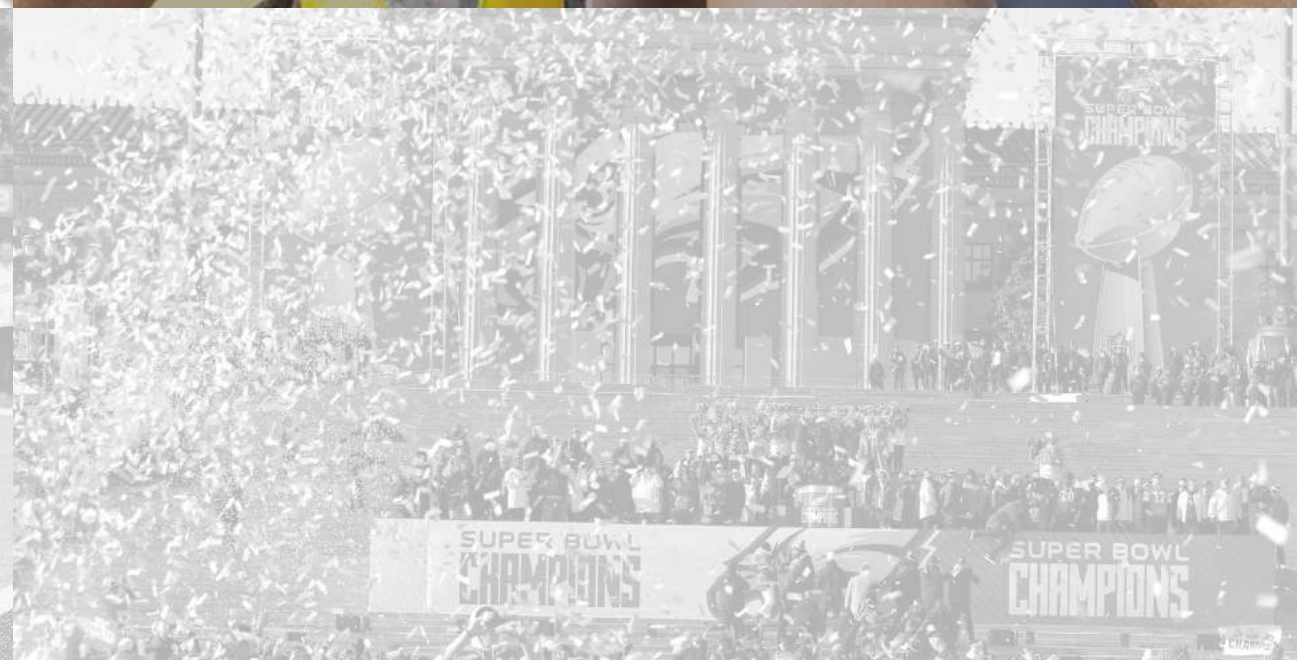


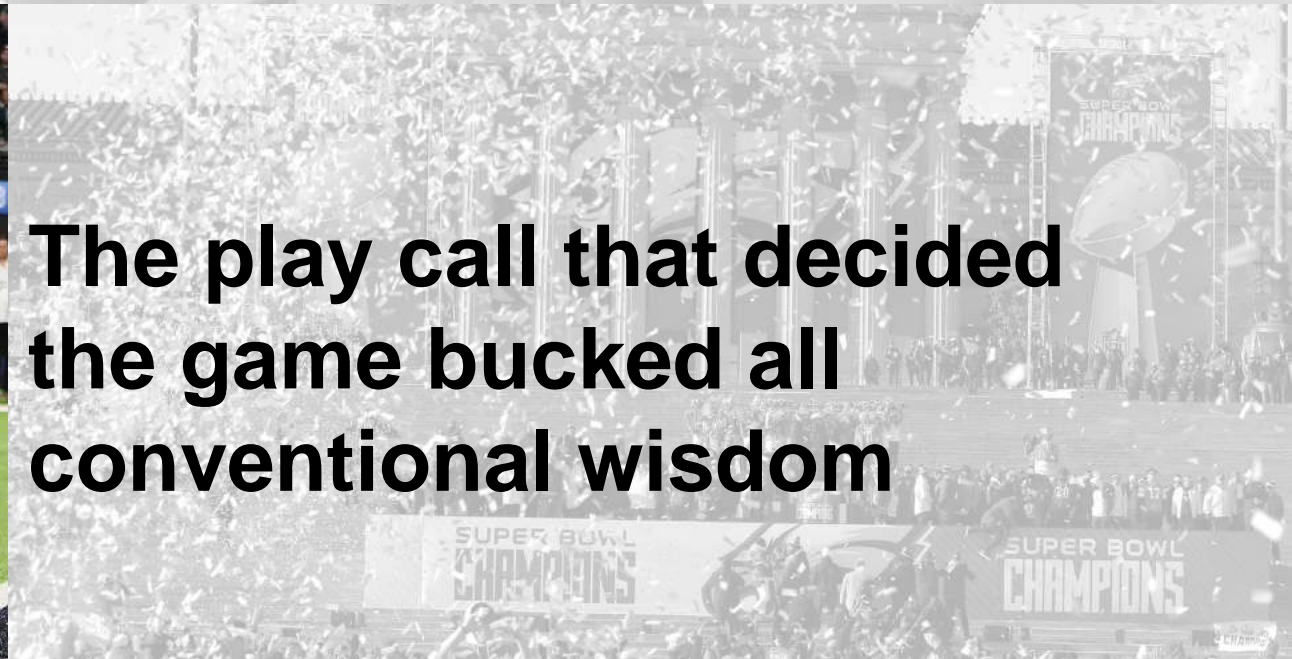


Doug Pederson a very aggressive playcaller, successful on 4th down more than any other team



Not just playing with guts: Eagles apply analytics to in-game strategy









**Many materials
companies are
playing not to
lose – this is a
flawed strategy**

Agenda

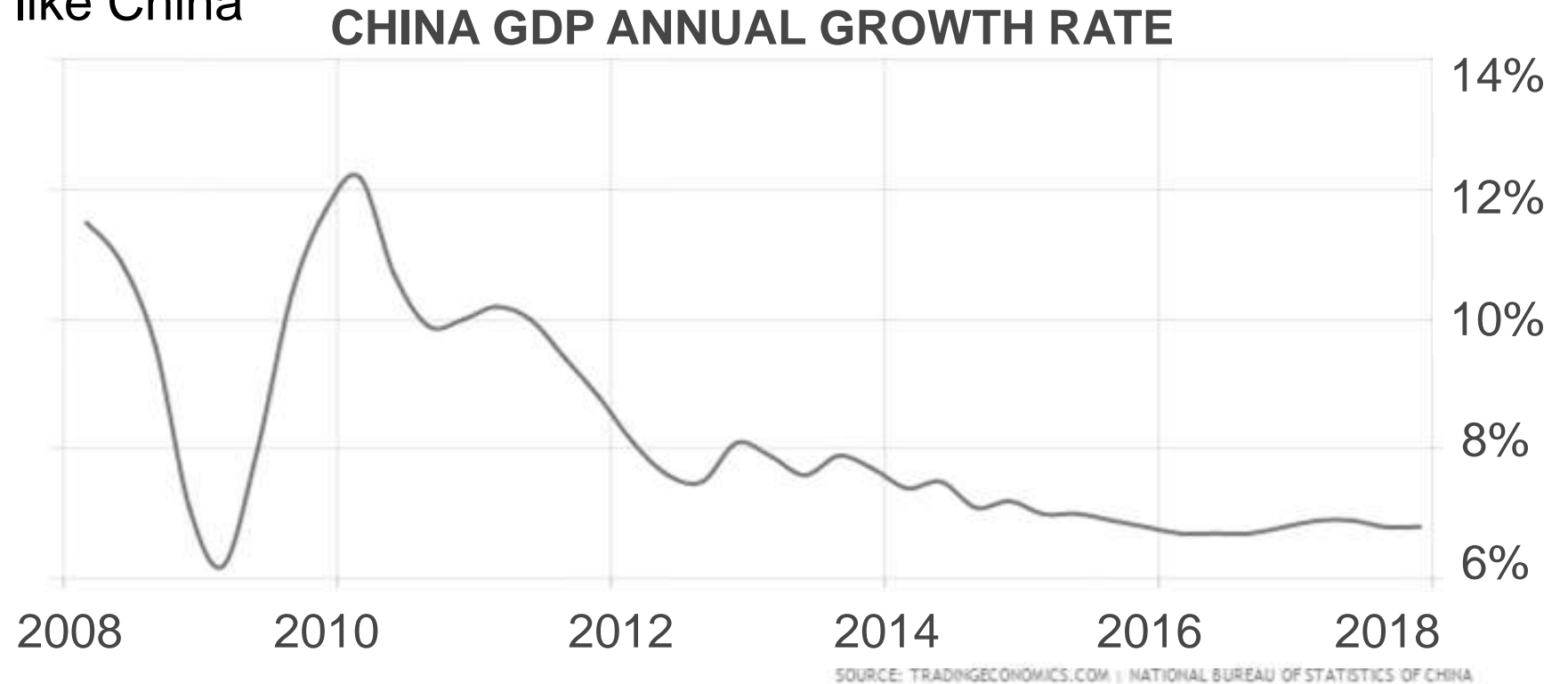
- 1 | Playing not to lose
- 2 | Playing to win
- 3 | Winning strategies

Agenda

- 1 | Playing not to lose
- 2 | Playing to win
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Chemical and material companies face difficult market conditions with no clear end in sight

1. Slowing global demand growth in emerging markets like China



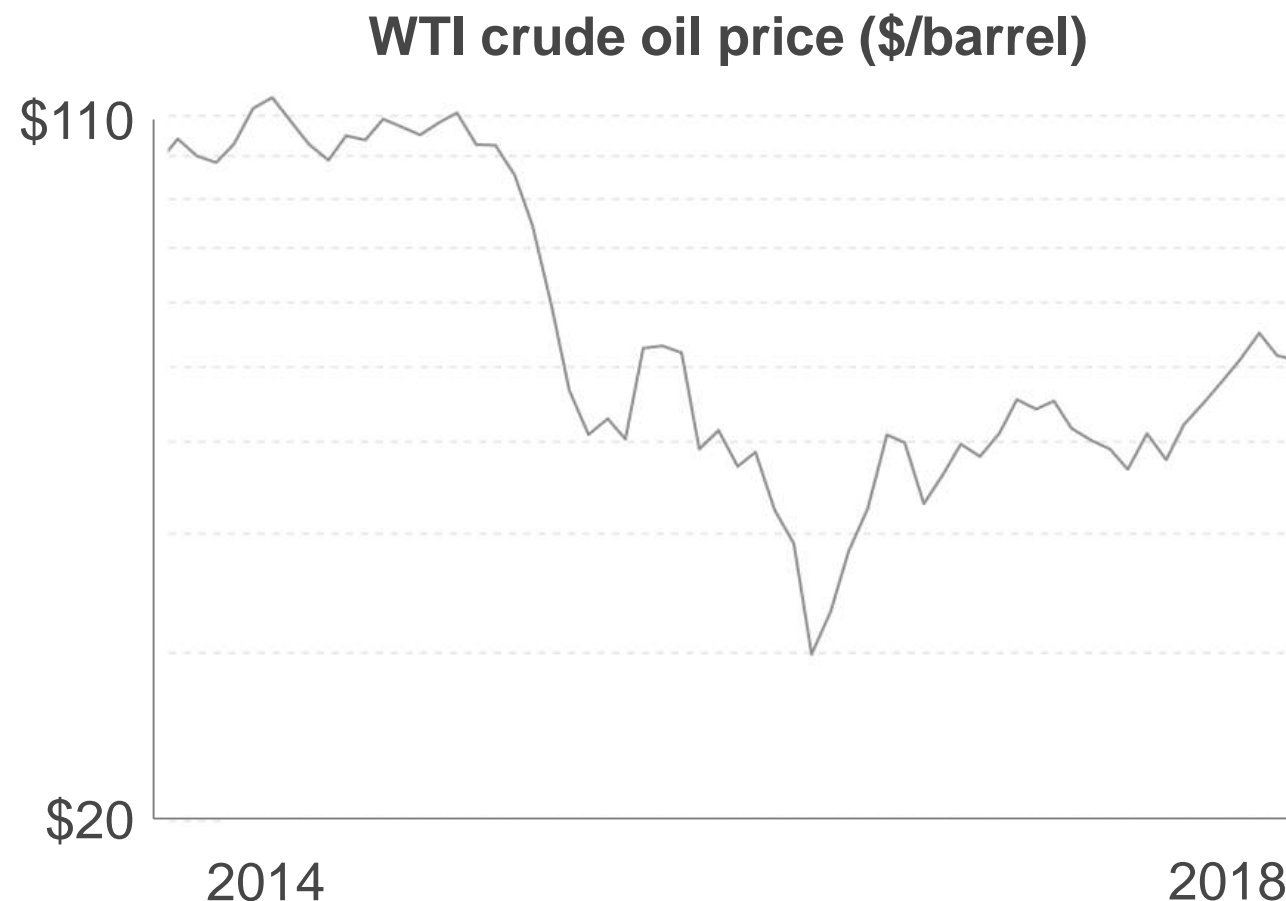
Chemical and material companies face difficult market conditions with no clear end in sight

1. Slowing global demand growth
2. New entrants (mostly Chinese) increase competition and capacity



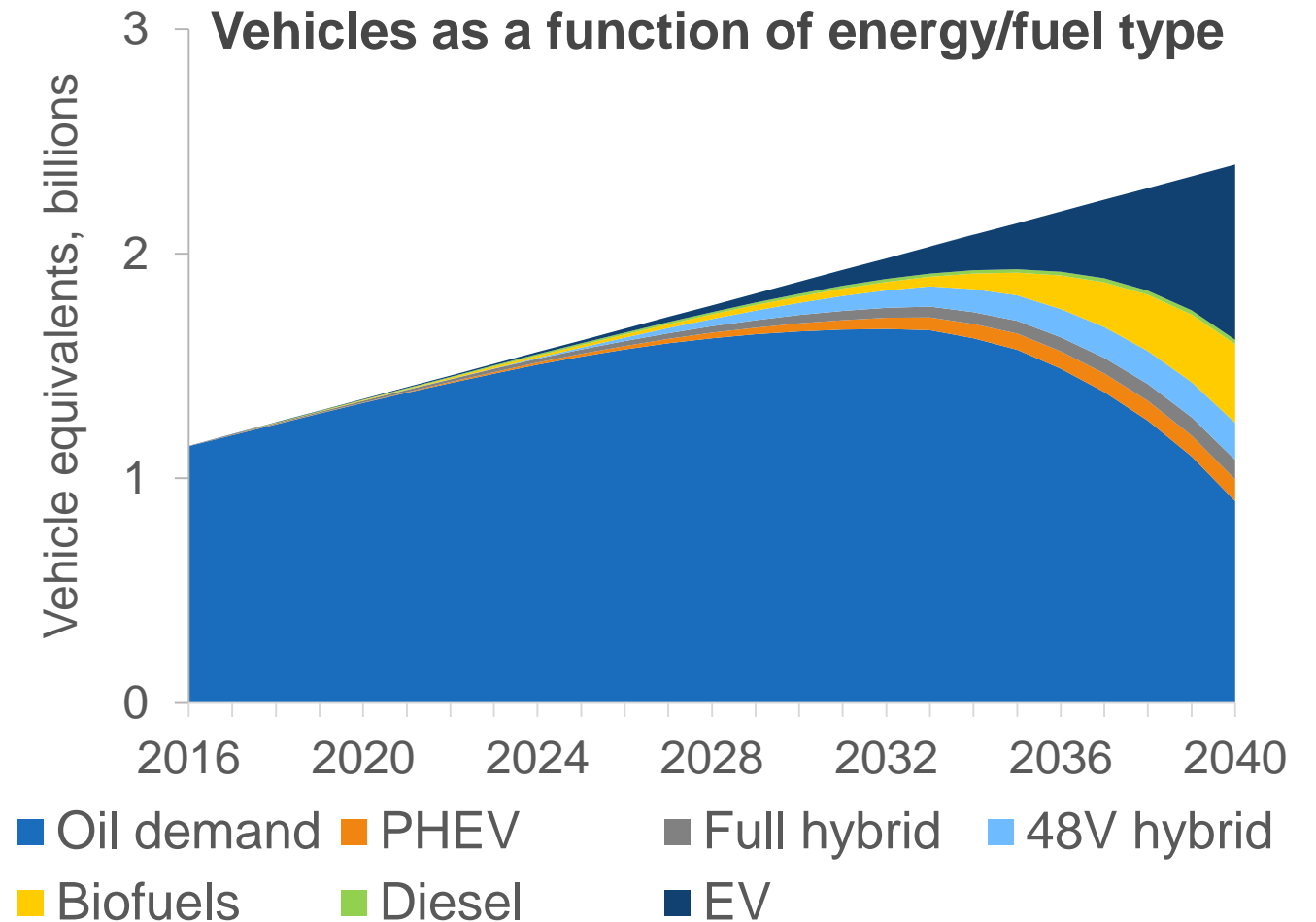
Chemical and material companies face difficult market conditions with no clear end in sight

1. Slowing global demand growth
2. New entrants
3. Low oil prices and slowing demand for oil in the transportation sector push oil majors downstream



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1. Slowing global demand growth

2. New entrants

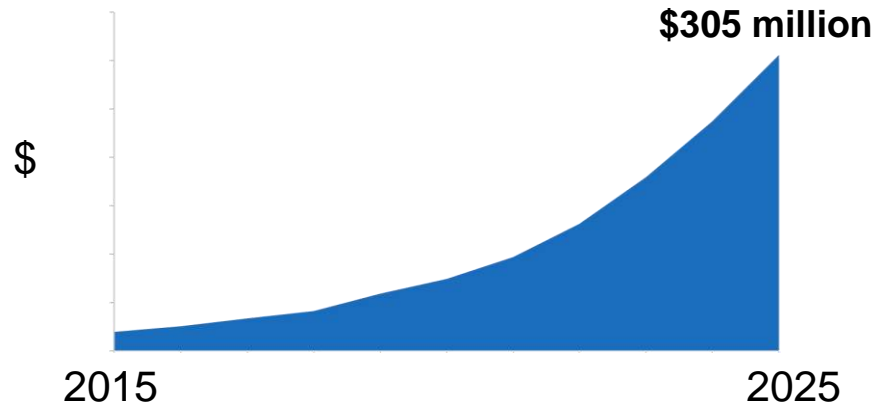
Commoditization continues to encroach on more specialized areas and erode margins

3. Low oil prices and slowing demand push oil majors downstream

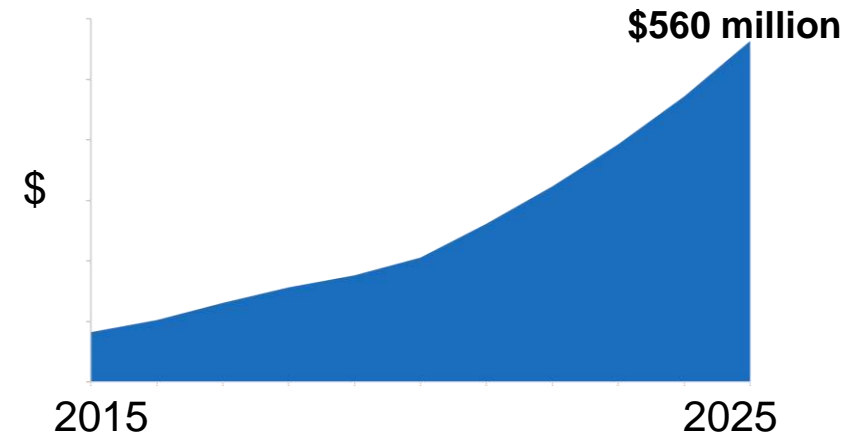
These challenges are exacerbated by platform materials failing to live up to the hype

Commercial reality of carbon nanomaterials appears to be incrementally better replacements.

Graphene market projected growth



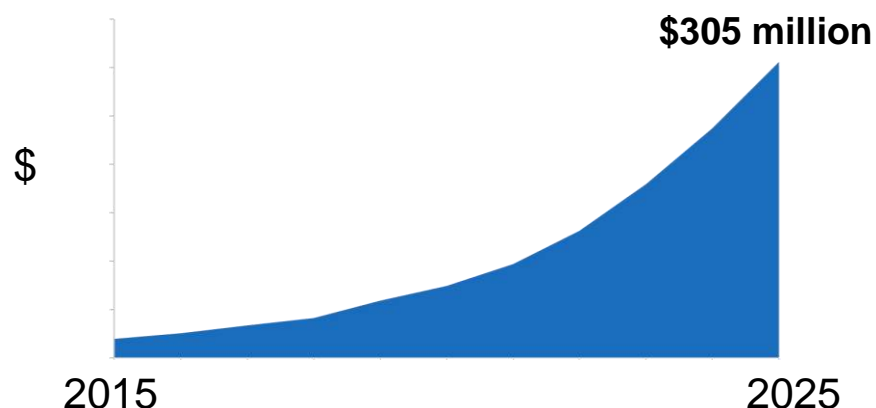
MWNT market projected growth



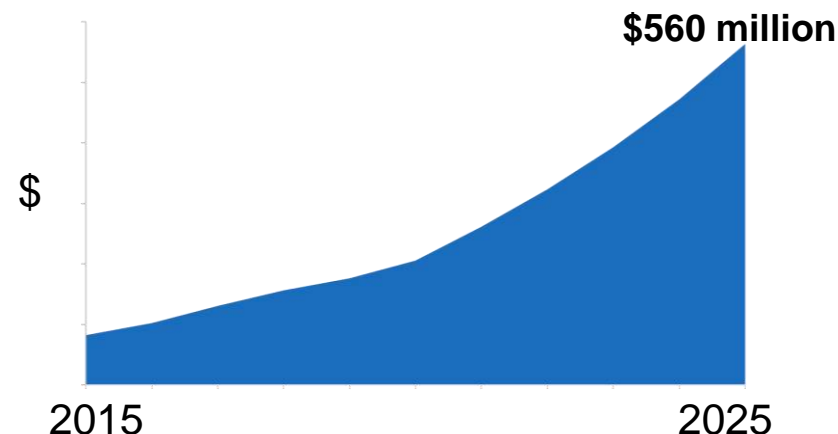
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MWNT market projected growth



In 2016 multiple startups producing bioperformance materials such as nanocrystalline cellulose and spider silk announced planned product launches in 2017 – no confirmed successes to date.



Prolific M&A activity suggests the key to minimizing damage can be achieved through economies of scale



FAILED MERGERS

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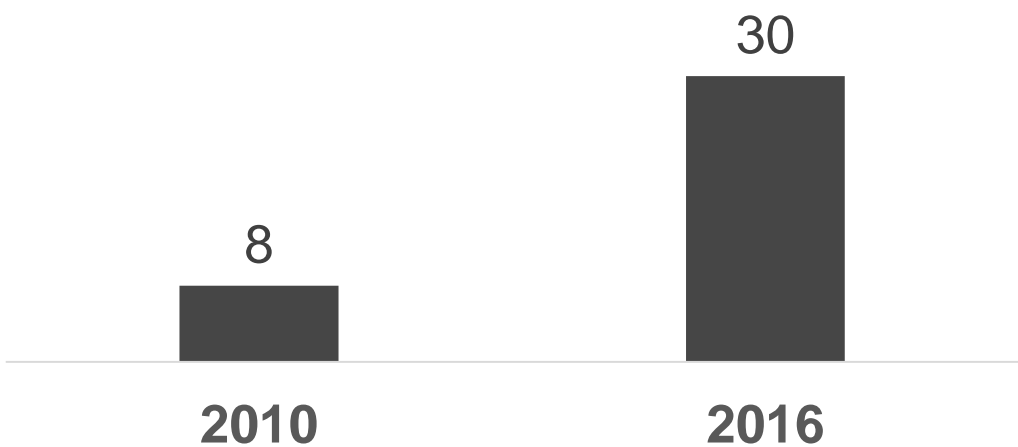


FAILED MERGERS

Playing not to lose strategies risk prioritizing accounting innovation over true emerging technology innovation

Companies are more vulnerable to activist investors in such cost-cutting environments

CHEMICAL INDUSTRY ACTIVIST CAMPAIGN VOLUME



ELLIOTT®



TRIAN PARTNERS

THIRD POINT

White Tale Holdings

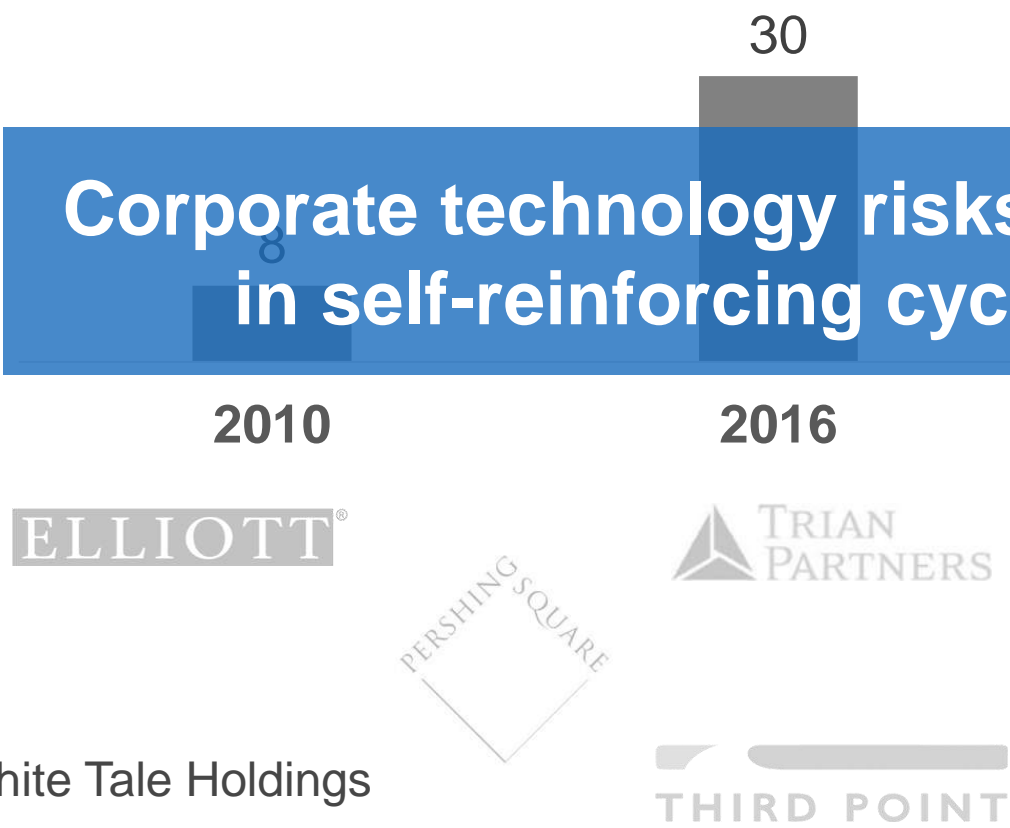
ACTIVIST CAMPAIGN IMPACT ON SHARE PRICE

In recent years, shares of companies whose management defeated activist campaigns have fared better, on average, than those where activists won.

| Median stock price return | Winning campaign | Withdrawn campaign |
|---------------------------|------------------|--------------------|
| After 1 year | -0.7% | 9% |
| After 2 years | -2.4% | 10.9% |

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CHEMICAL INDUSTRY ACTIVIST CAMPAIGN VOLUME



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| return | | |
|---------------|-------|-------|
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Corporate technology risks ceding increasing control to activists in self-reinforcing cycle – Bad for long-term innovation!



**The chemicals industry has
lost its future...It has more to do
with financial engineering than
chemical engineering.**

- Financial Times

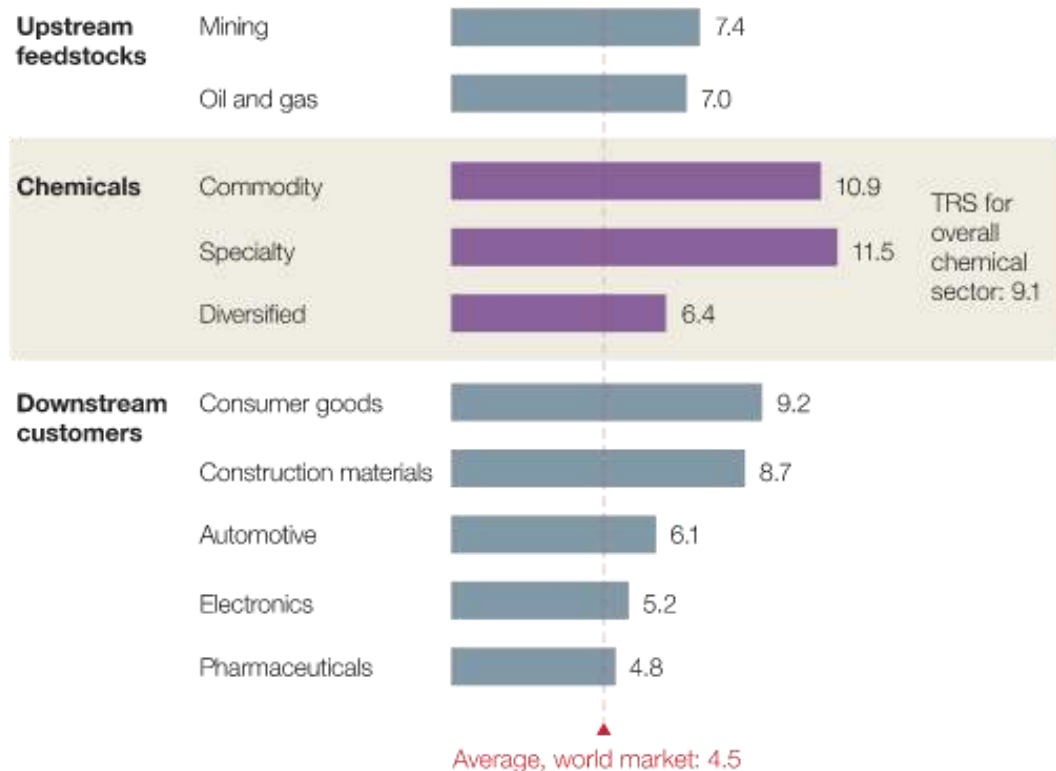


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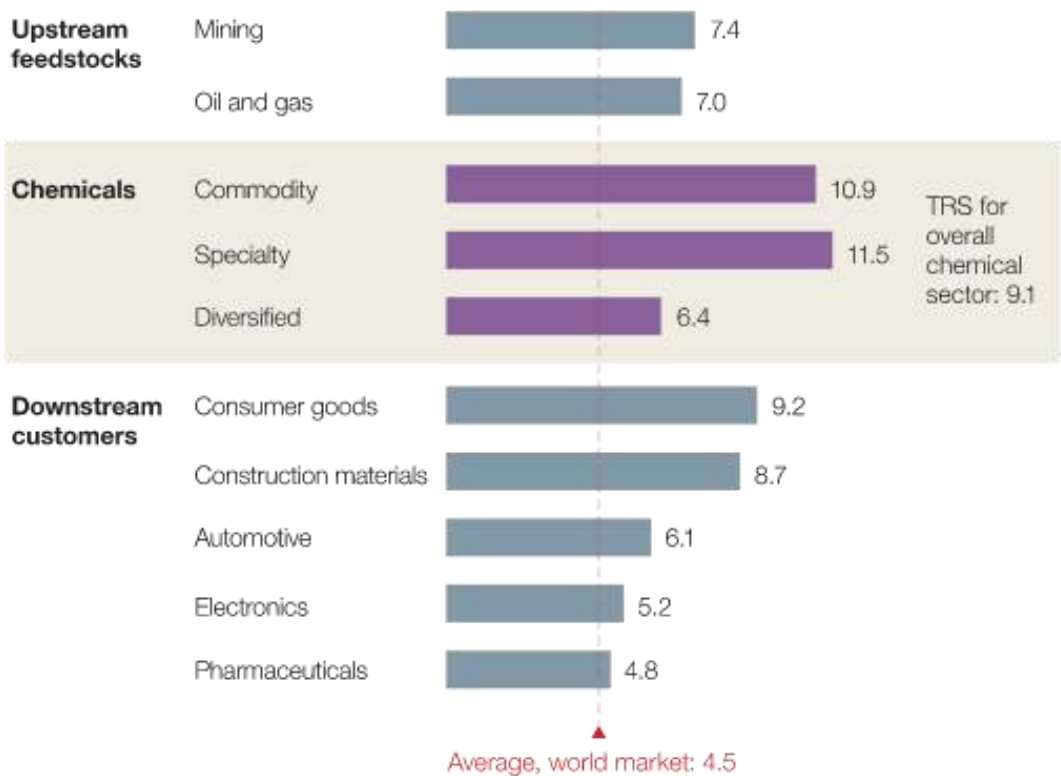
Let's go back to first principles: Why are materials innovations so important (and so historically profitable)?

Total returns to shareholders (TRS) compound annual growth rate, Dec 2000-Mar 2016, %

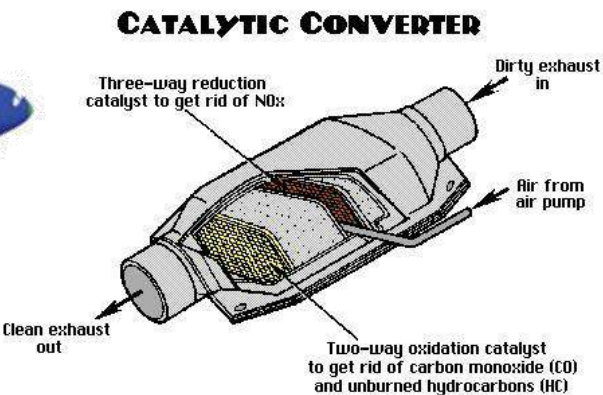
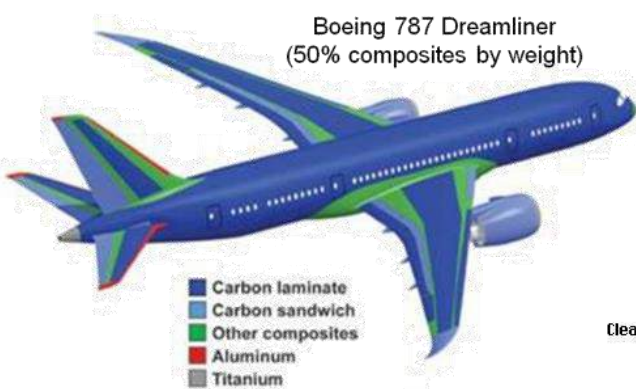


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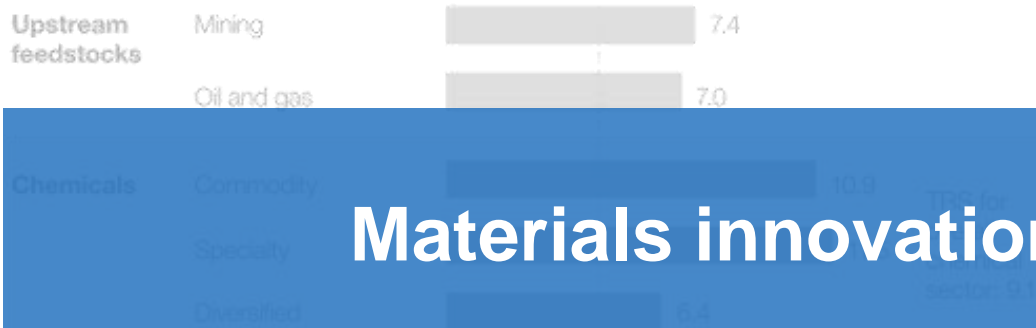
Materials innovations breakthrough examples



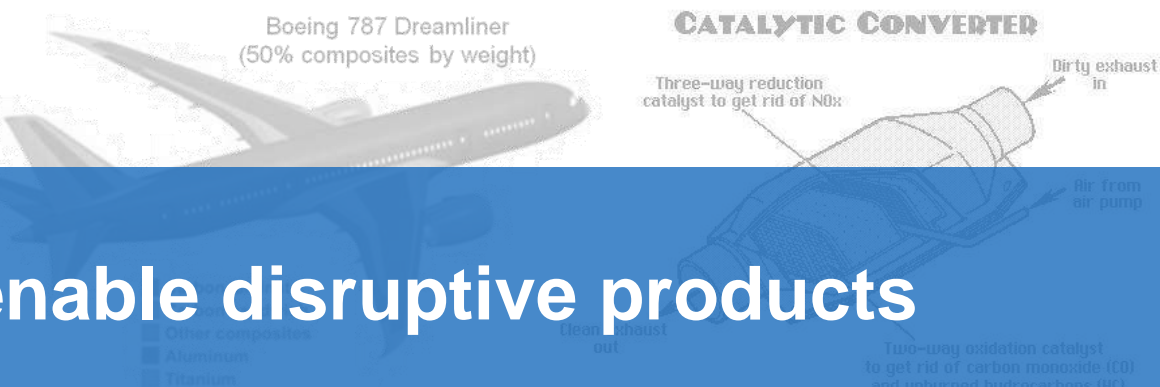
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Materials innovations enable disruptive products

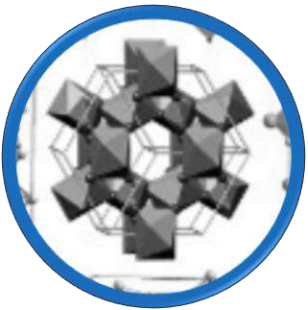


Playing to win requires thinking about materials innovations in tandem with the technologies that enable great products

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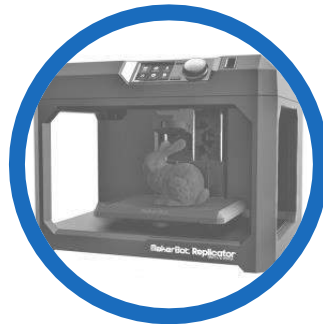
Digital toolbox for accelerating materials innovation



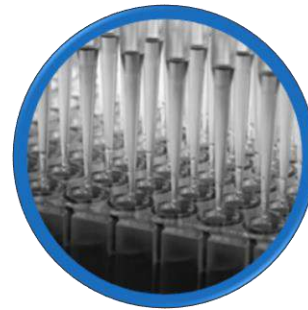
**Materials
Informatics**



**Generative Design
Software**



3D Printing



**Digital Synthetic
Biology**



IIoT

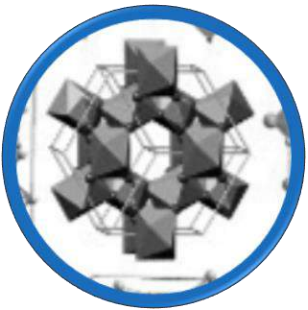


**Digital Sales
Platforms**

Playing to win requires thinking about materials innovations in tandem with the technologies that enable great products



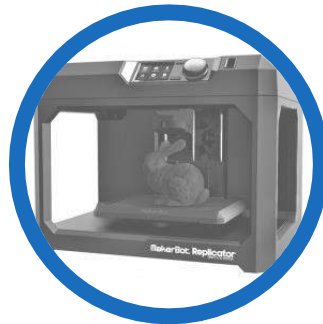
Digital toolbox for accelerating materials innovation



Materials Informatics



Generative Design Software



3D Printing



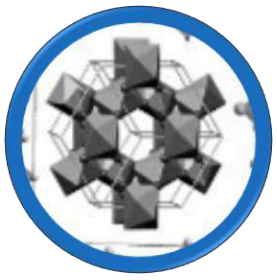
Digital Synthetic Biology



IIoT



Digital Sales Platforms



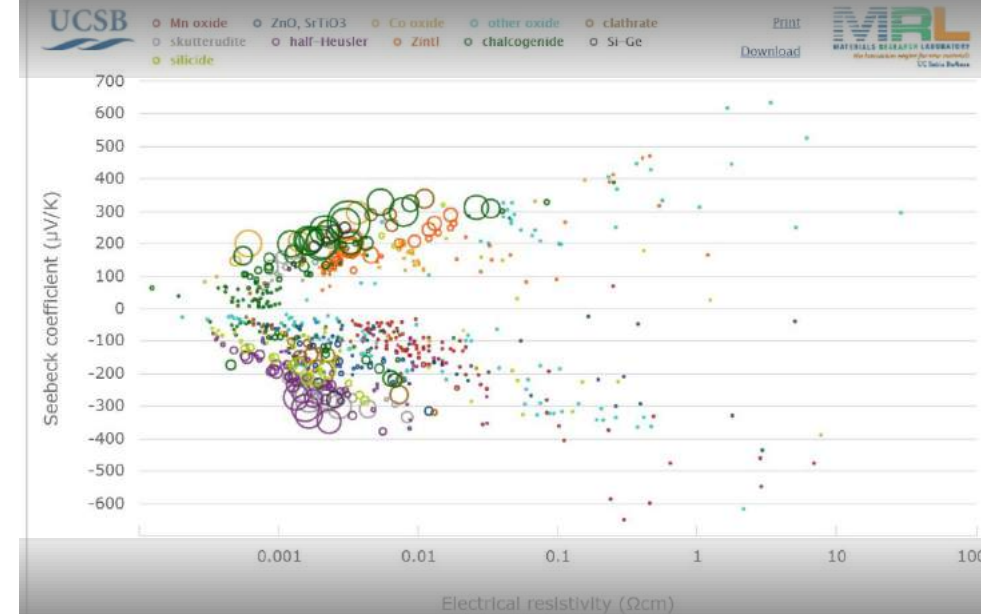
Materials Informatics

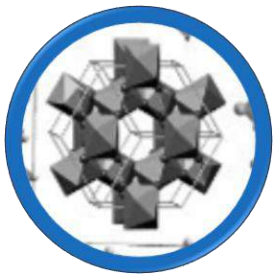
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Using data science and artificial intelligence methods to extract insights from existing materials and discover new materials matching desired property requirements

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





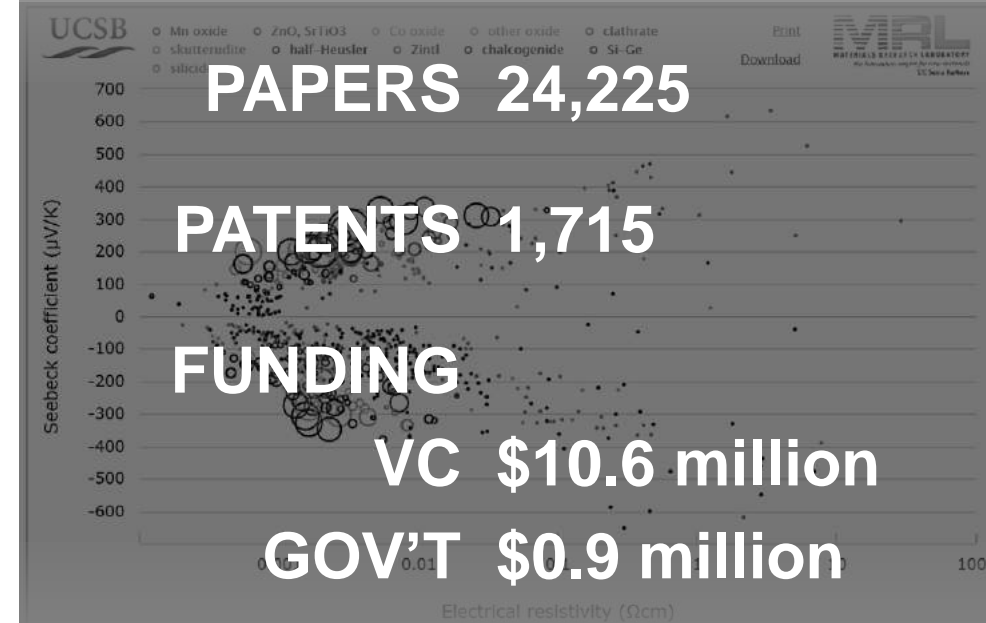
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DATA SINCE 1997



Synthetic biology

Description:

Technologies to create new organisms – including microbes and plants – with valuable capabilities for various applications

Key Benefits:

- Combination with artificial intelligence and automation technologies reduce development timelines and improve performance
- Bio-based processes in which fermentation is able to replace multiple unit operations have a cost-per-ton advantage over conventional processes at smaller production volumes



Image credit: Ginkgo Bioworks



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PAPERS 39,818

PATENTS 8,935

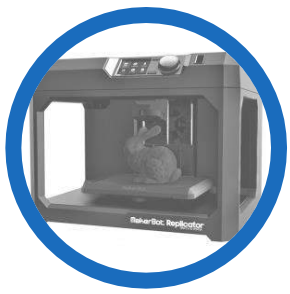
FUNDING

VC \$683 million

GOV'T \$31.3 million

Image credit: Ginkgo Bioworks

DATA SINCE 1997



3D Printing

Description:

Additive manufacturing of objects layer by layer, based on digital design data

Key Benefits:

- Novel geometries and compositions enable better performance and operational efficiencies
- Higher materials utilization saves costs
- Distributed manufacturing simplifies supply chains and reduces distribution costs

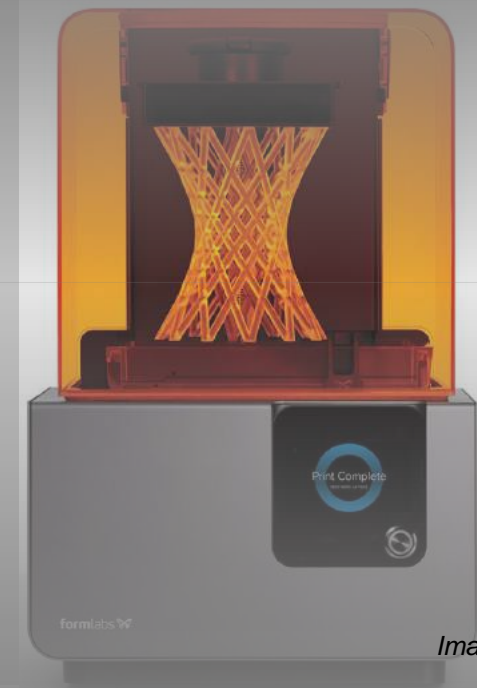
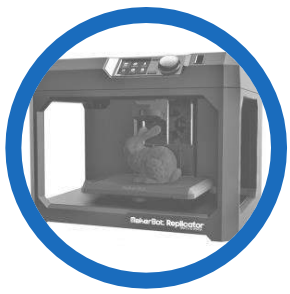


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PAPERS 24,432

PATENTS 79,879

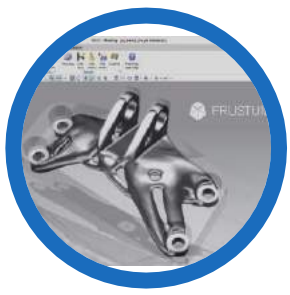
FUNDING

VC \$3,300 million

GOV'T \$131 million

Image credit: Formlabs

DATA SINCE 1997



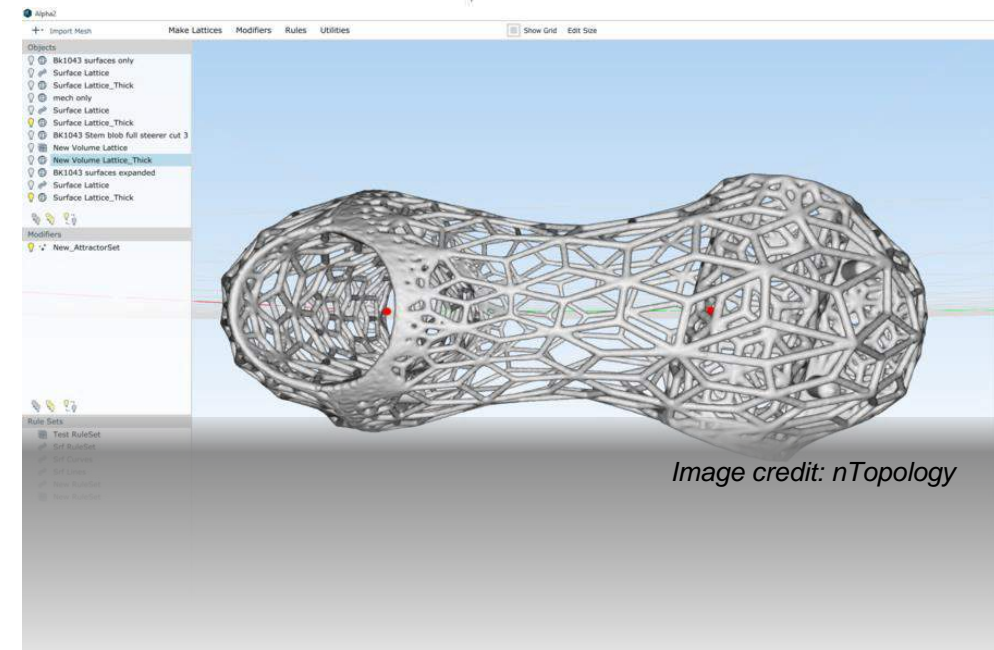
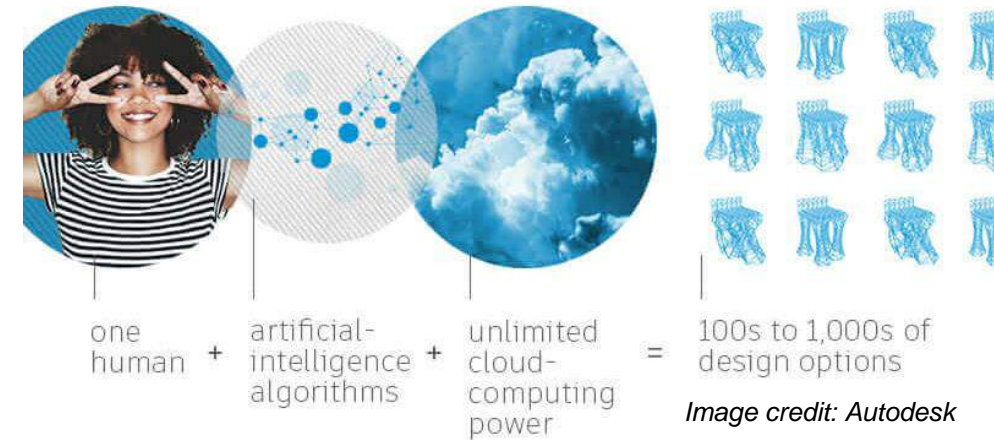
Generative design software

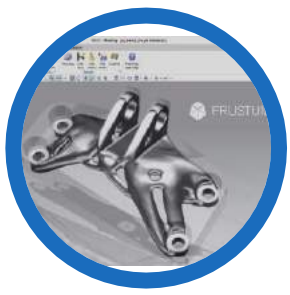
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Optimize design choices by taking initial design constraints and iterating thousands of cycles using artificial intelligence algorithms and cloud computing

Key Benefits:

- Achieving part design goals, such as weight reduction, materials and cost saving, higher strength, and otherwise better functionality
- The combination of generative design and 3D printing leads to product design efficacy improvement





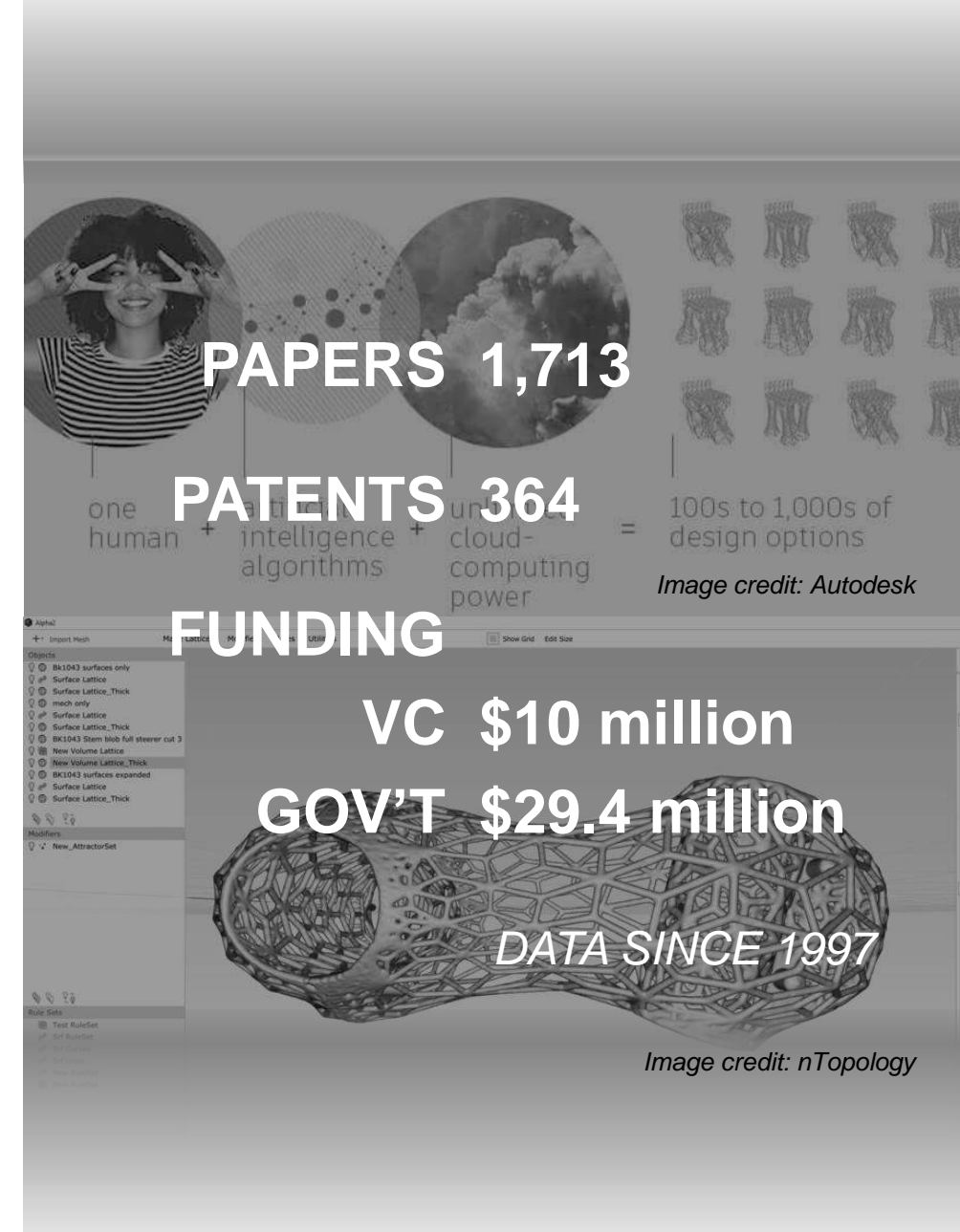
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Do materials startups really deserve software valuations?

Guts without insight is a recipe for poor return on investment

| |  Bolt Threads |  GINKGO BIOWORKS™ THE ORGANISM COMPANY | Carbon | DESKTOP METAL |  view ® |
|-------------------------------|--|---|---------------|----------------------|---|
| Date of latest funding | Nov 2017 | Dec 2017 | Dec 2017 | Mar 2018 | Jun 2017 |
| Latest funding amount | \$123M | \$275M | \$200M | \$65M | \$200M |
| Total funding to date | \$213M | \$429M | \$422M | \$277M | \$716M |

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Playing to win requires combining the right technology with the right strategy

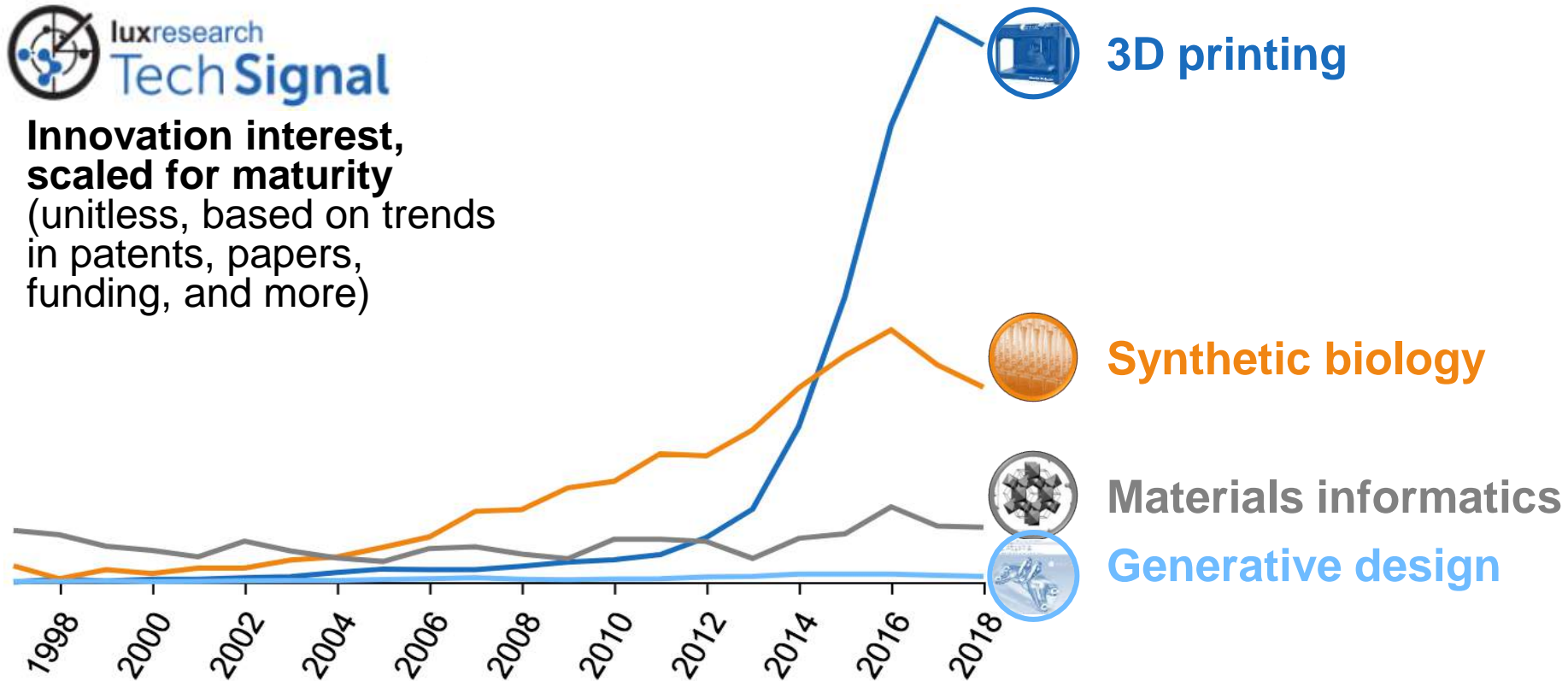
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A strategic framework that combines data + insight

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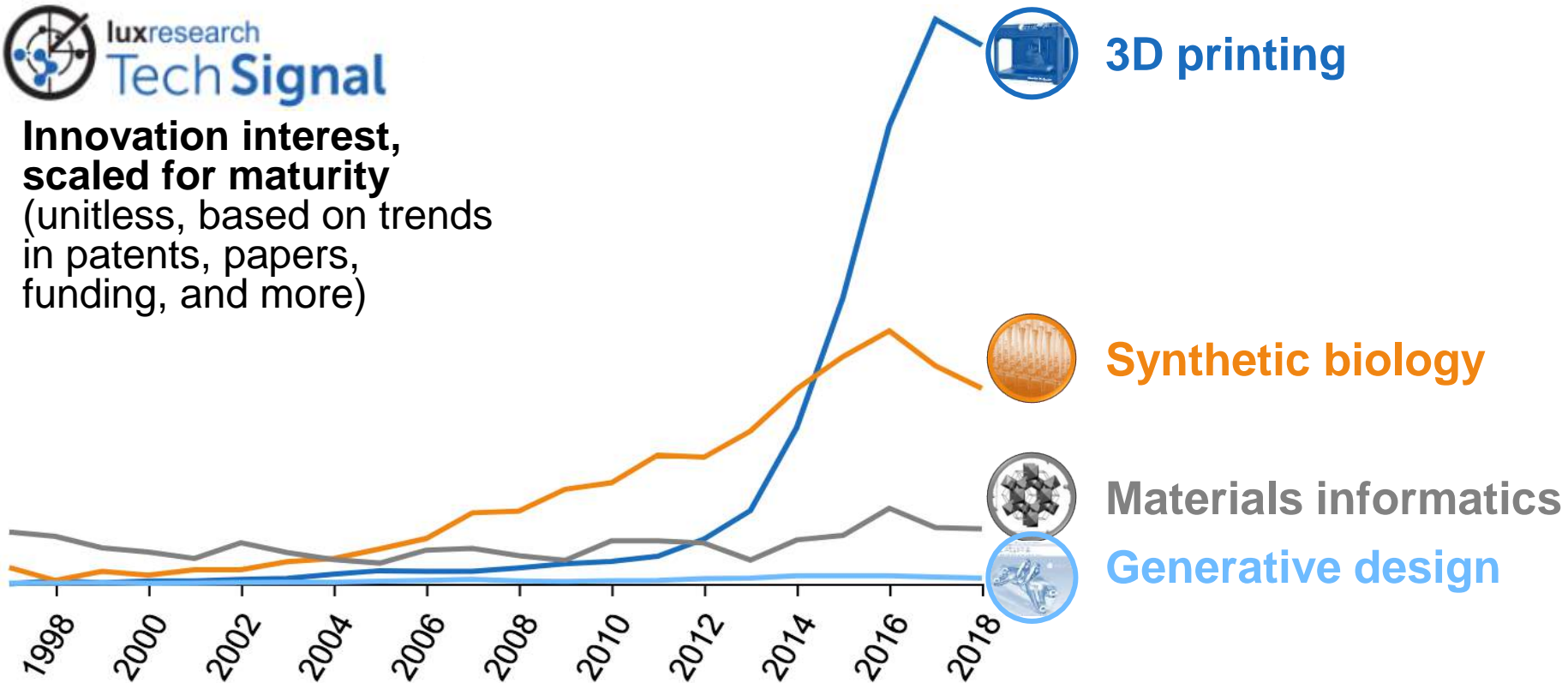
**Innovation interest,
scaled for maturity**
(unitless, based on trends
in patents, papers,
funding, and more)



A strategic framework that combines data + insight



**Innovation interest,
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**MORE
MATURE**



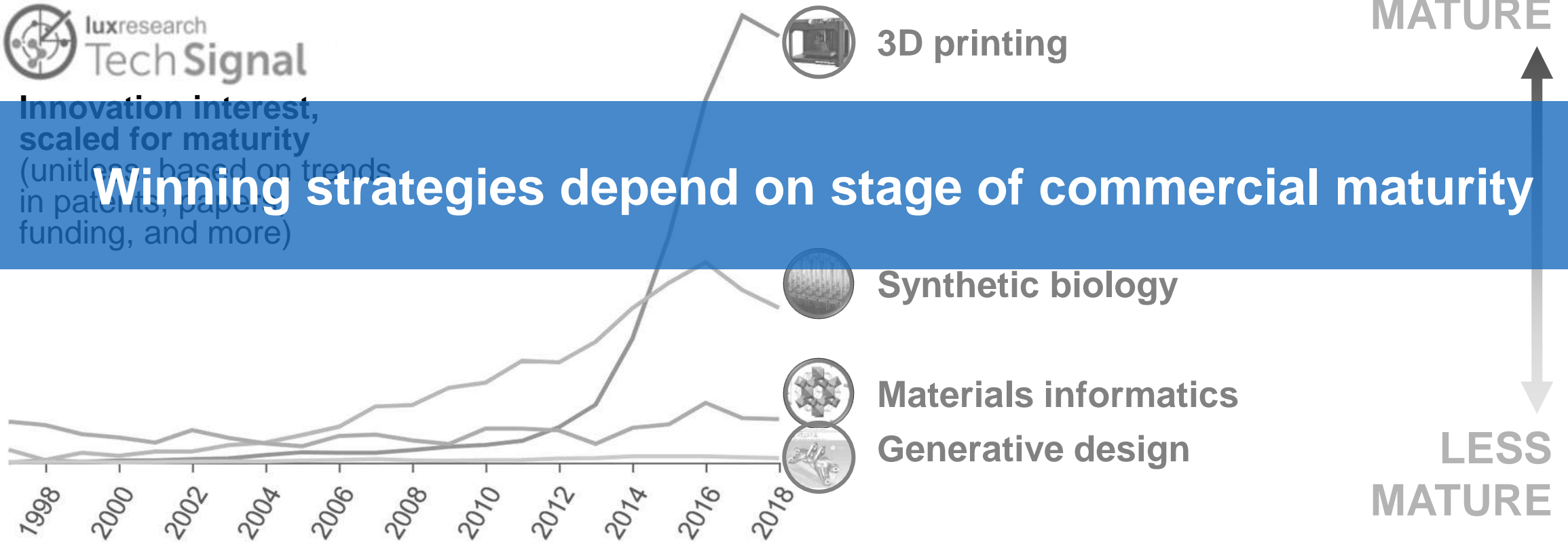
**LESS
MATURE**

A strategic framework that combines data + insight

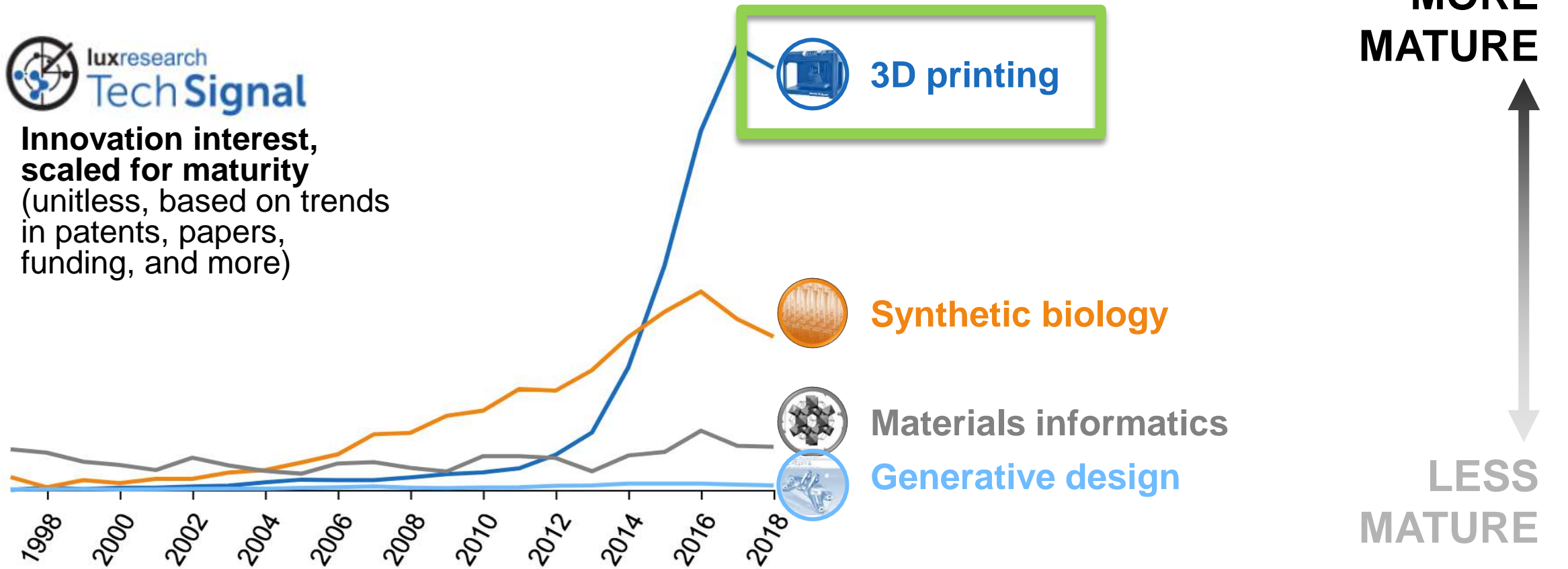


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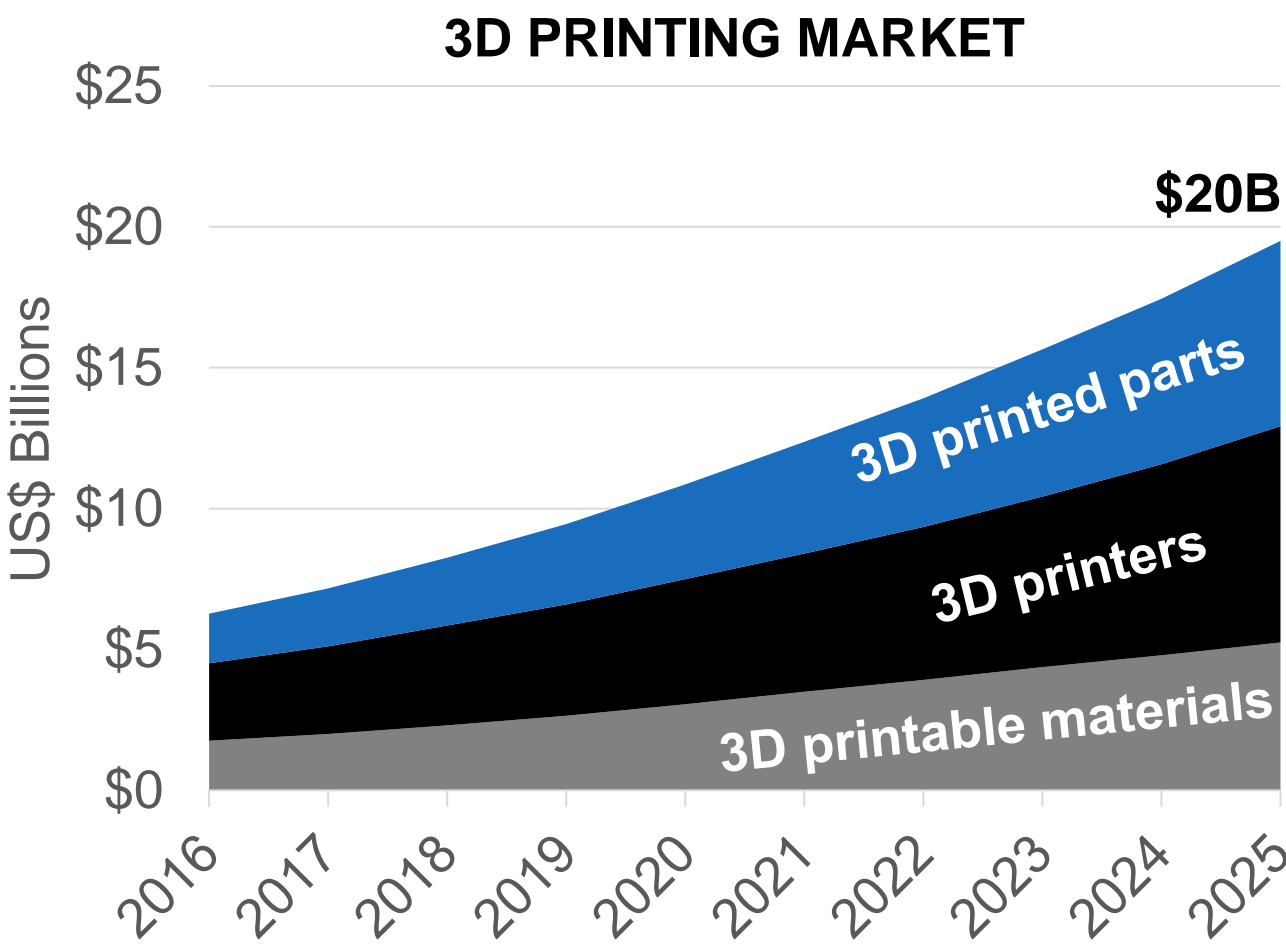
Winning strategies depend on stage of commercial maturity



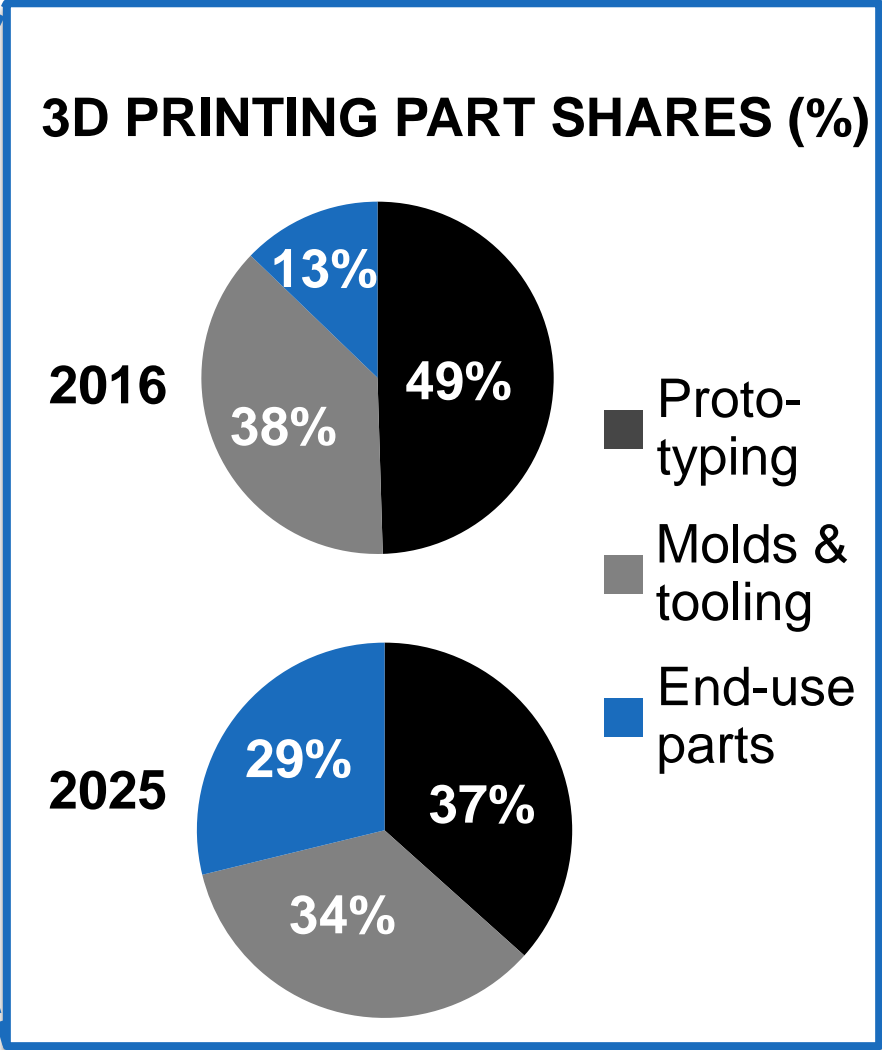
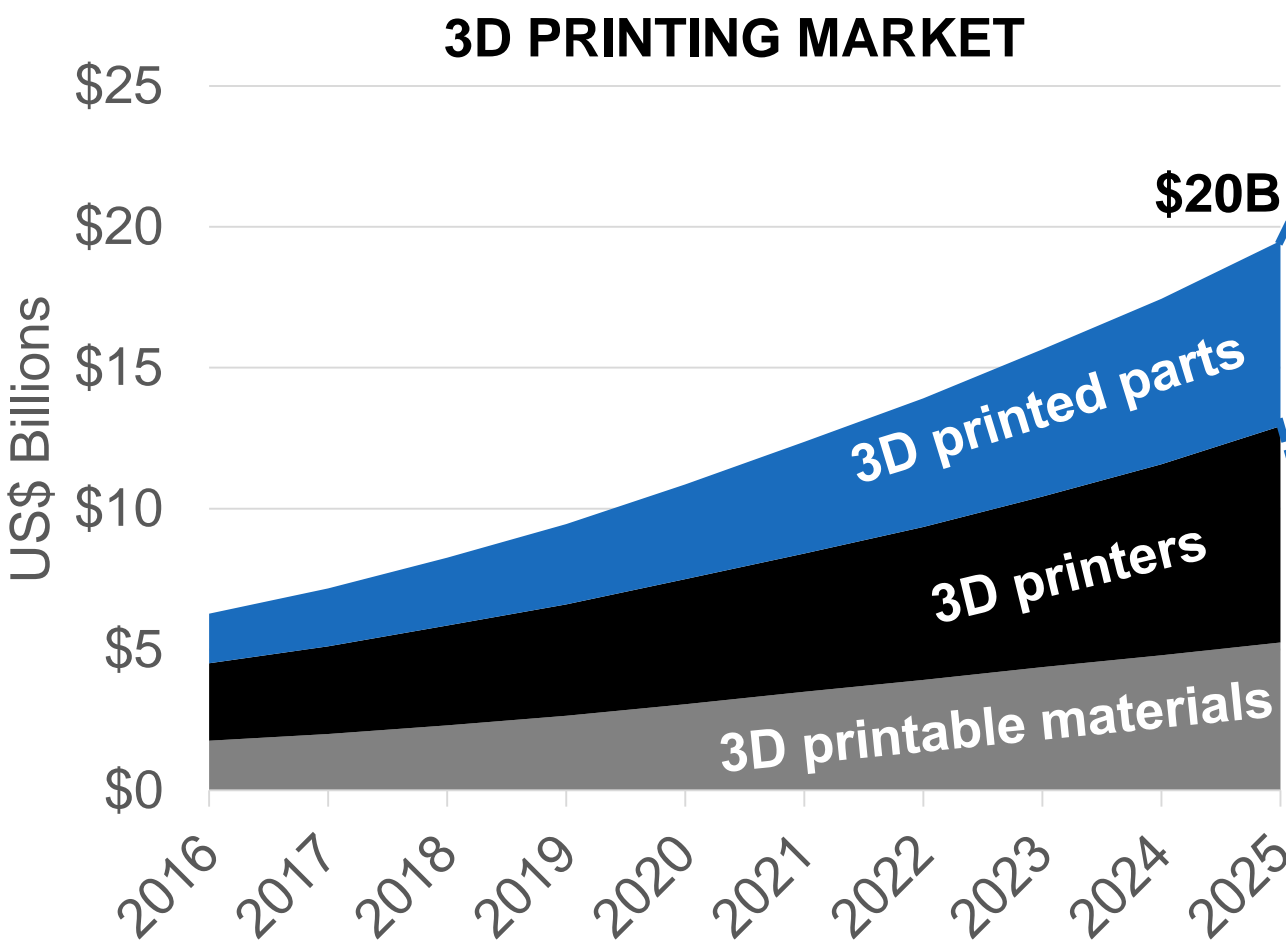
A strategic framework that combines data + insight



3D printing will be a \$20B market by 2025, driven by technologies to make end-use parts



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Focus less on whether 3D printing is going to be disruptive (it will!), and more on what you are going to do about it

DSM Strengthens Additive Manufacturing
Focus with New Integrated Business

BASF establishes new Group company to
pursue business opportunities in 3D printing

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Evonik material production capacity increases by 50% due to 3D printing demand

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Desktop Metal Closes \$65 Million in New Financing Led by Ford, Bringing Total Investment to Date to \$277 Million

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**The time is now to create a 3D printing strategy...
chances are your competitors already have one**

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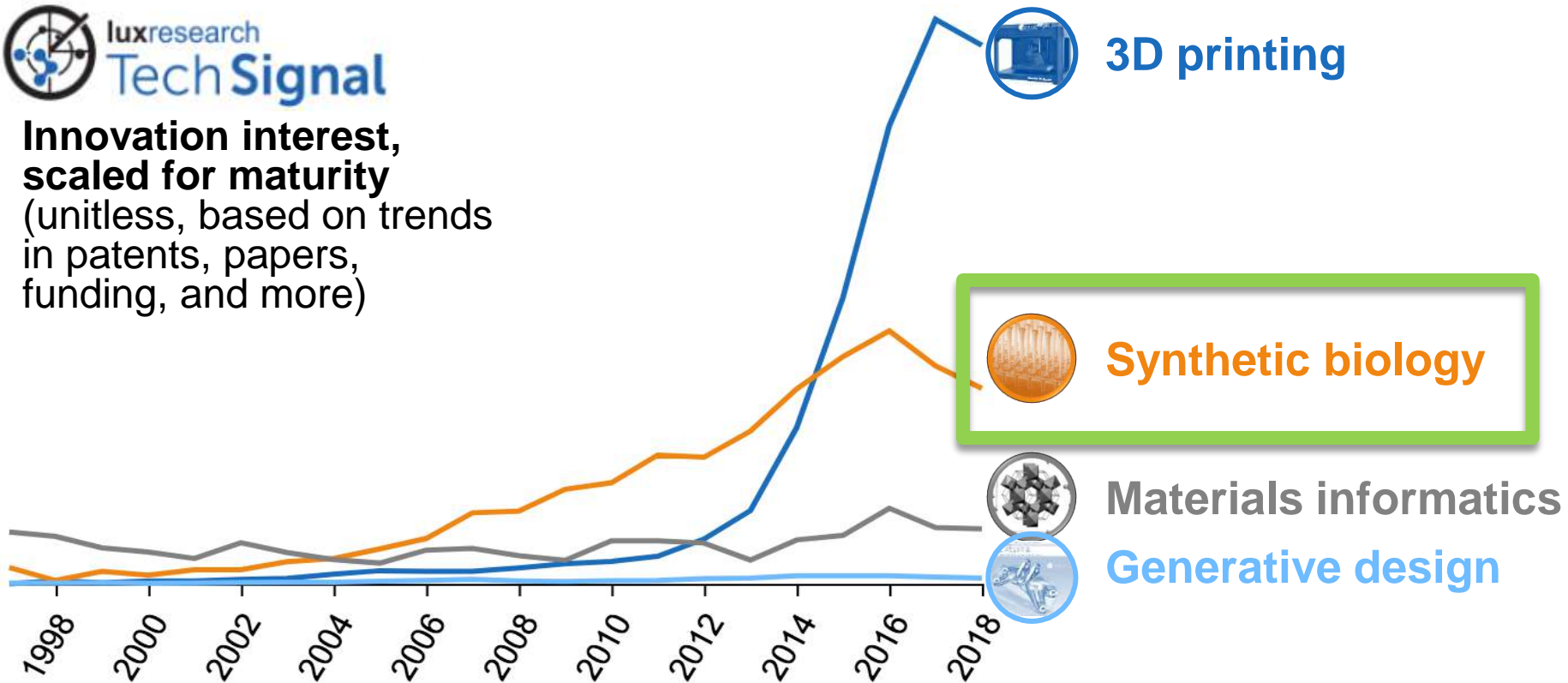
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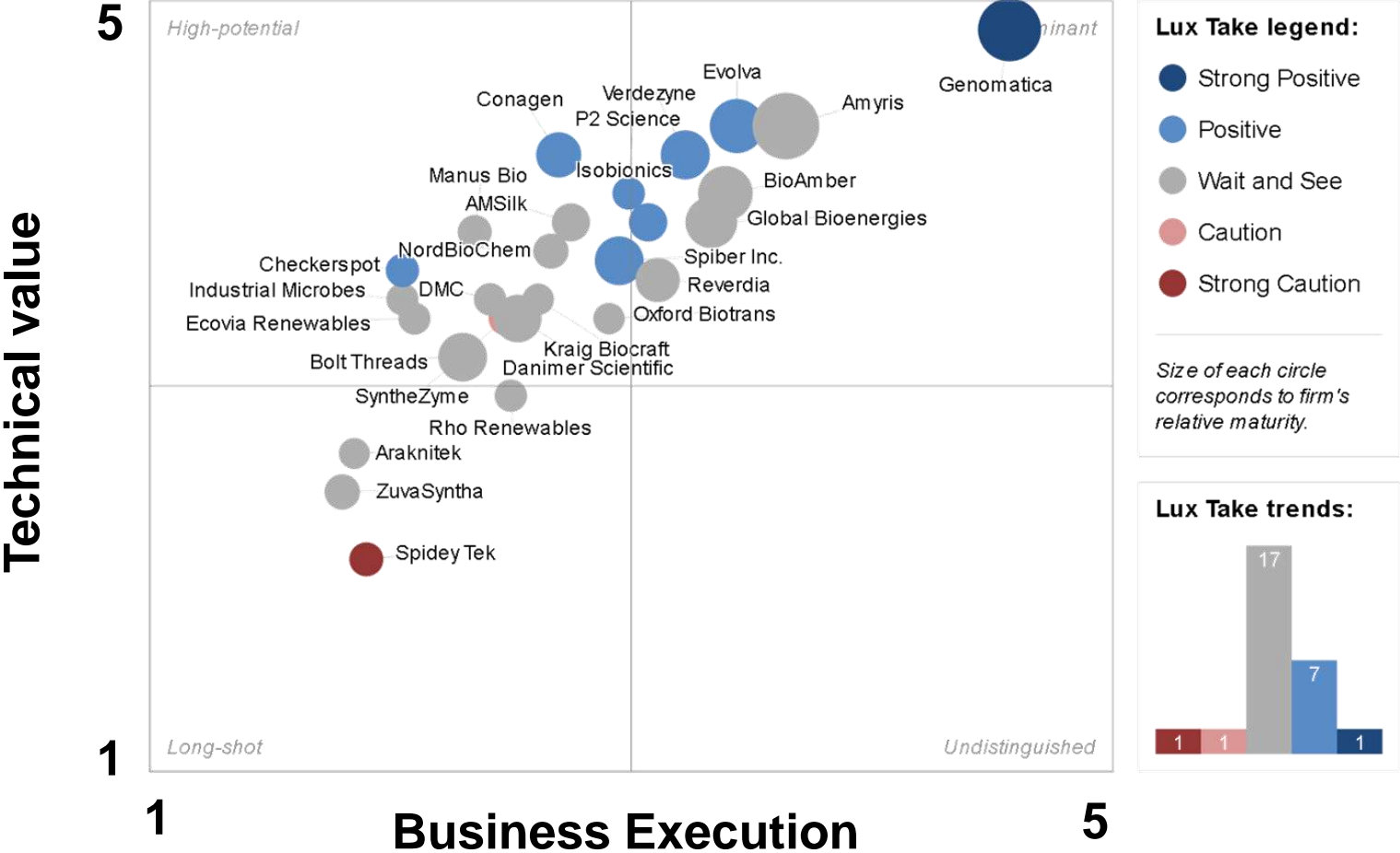
**MORE
MATURE**



**LESS
MATURE**

Recurring theme within the current synthetic biology ecosystem – a lack of commercial success

SYNTHETIC BIOLOGY LUX INNOVATION GRID (LIG)



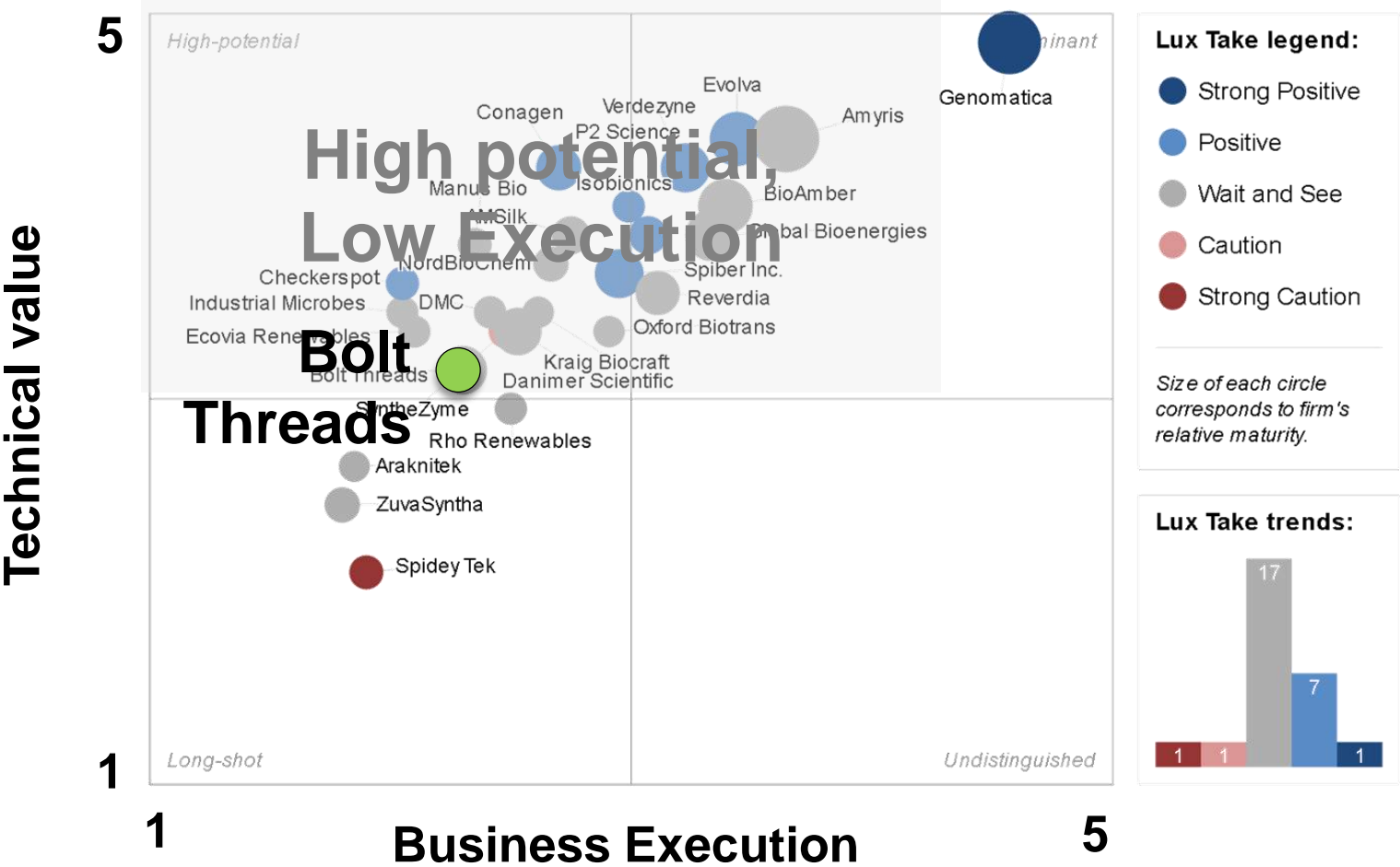
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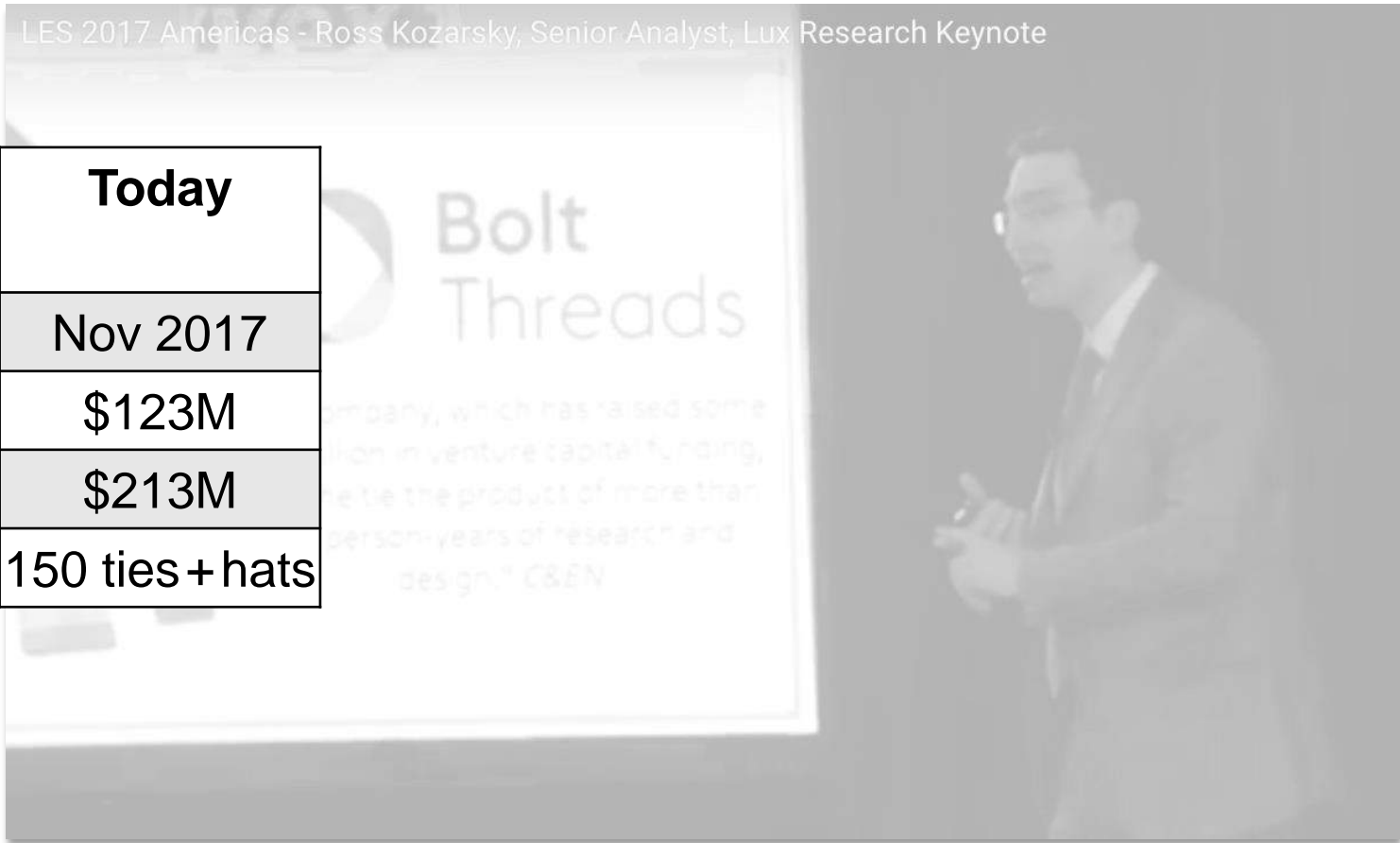


Recurring theme within the current synthetic biology ecosystem – a lack of commercial success

| | |
|---|-------------------|
|  Bolt Threads | 1 year ago |
| Date of latest funding | May 2016 |
| Latest funding amount | \$50M |
| Total funding to date | \$90M |
| Product released | 50 neckties |



Recurring theme within the current synthetic biology ecosystem – a lack of commercial success



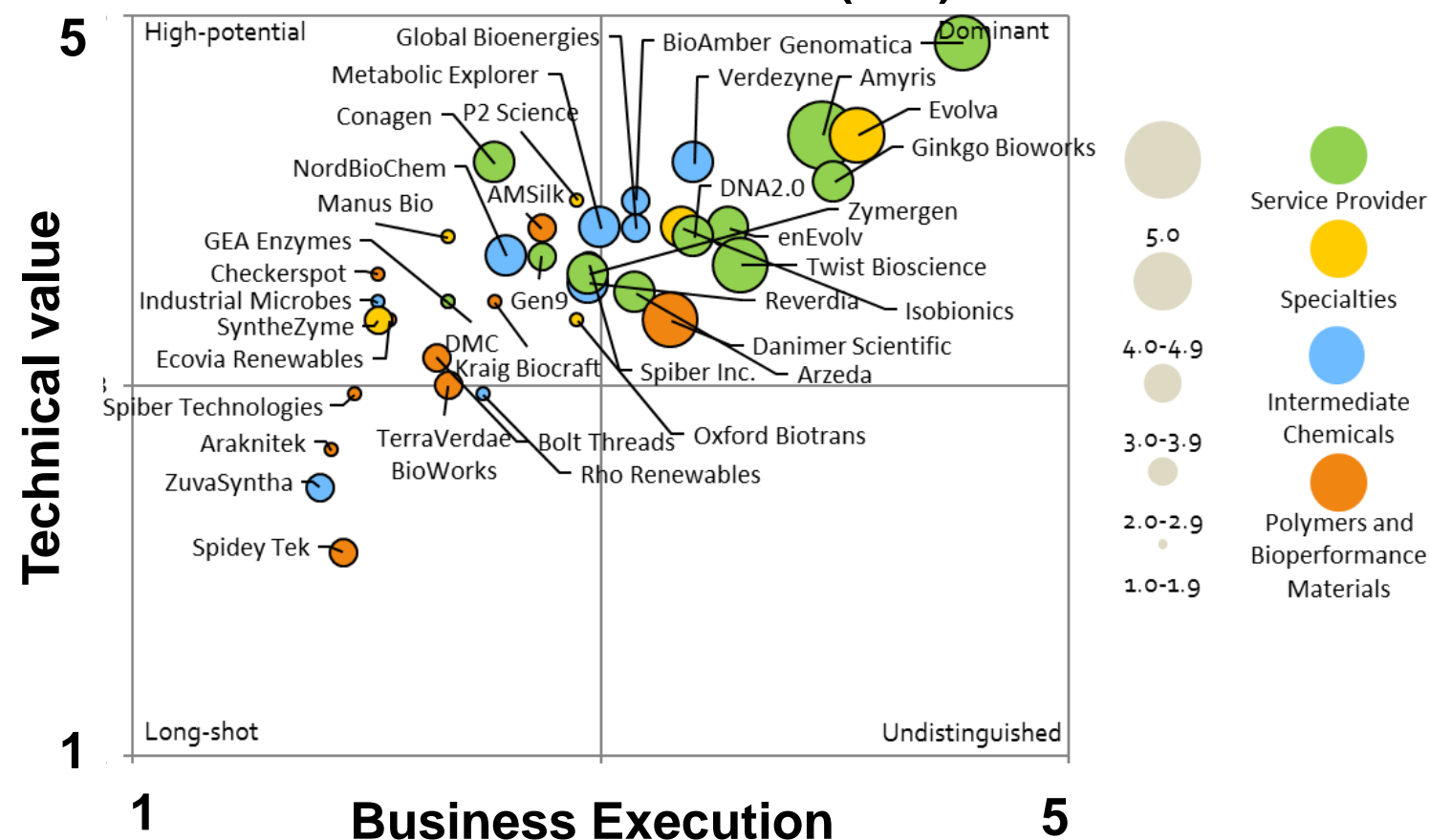
LES 2017 Americas - Ross Kozarsky, Senior Analyst, Lux Research Keynote



| | 1 year ago | Today |
|------------------------|-------------|-----------------|
| Date of latest funding | May 2016 | Nov 2017 |
| Latest funding amount | \$50M | \$123M |
| Total funding to date | \$90M | \$213M |
| Product released | 50 neckties | 150 ties + hats |

Companies providing services along the synthetic biology value chain have shown great promise

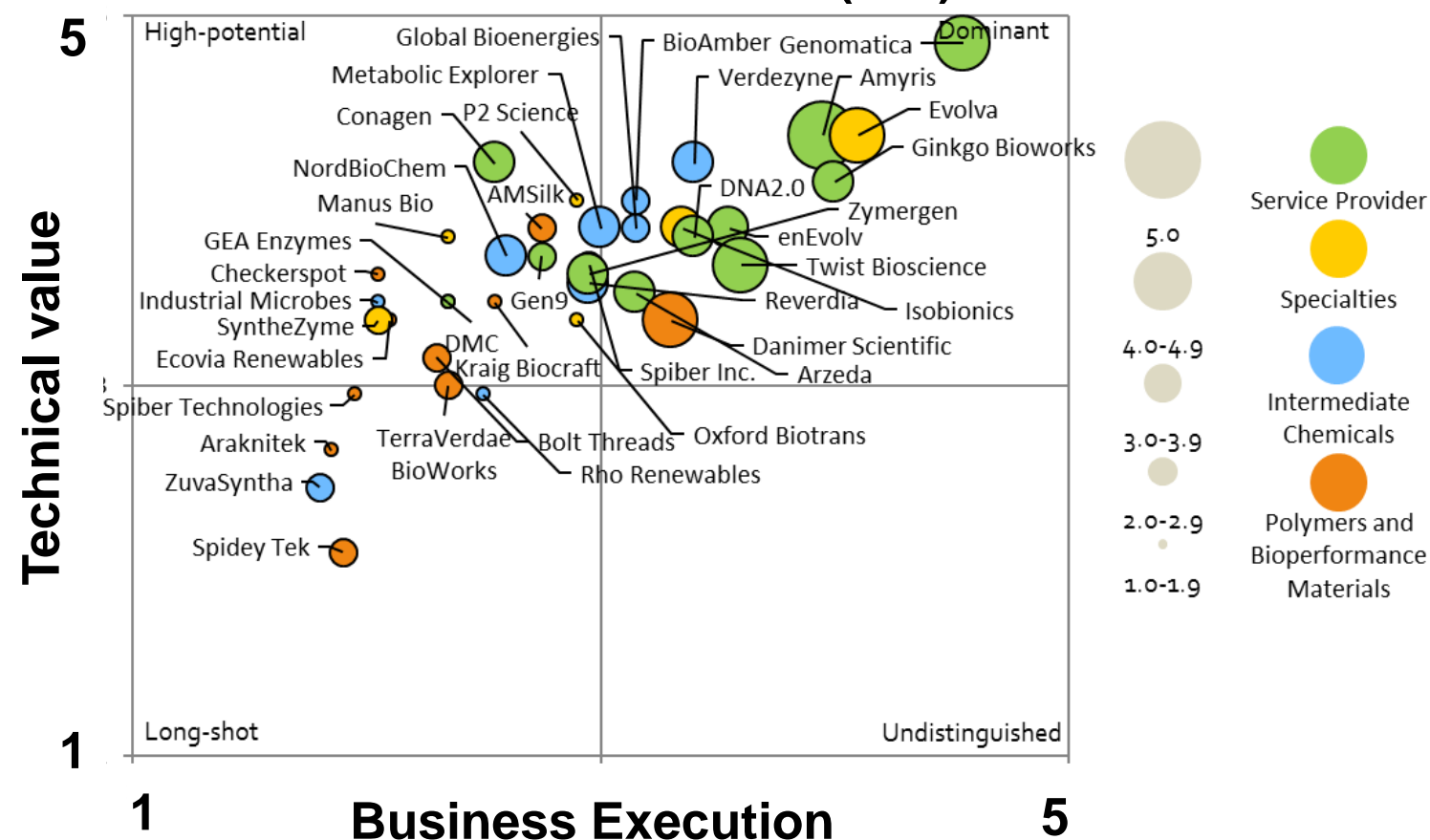
SYNTHETIC BIOLOGY
LUX INNOVATION GRID (LIG)



*DNA2.0 is now known as ATUM

Companies providing services along the synthetic biology value chain have shown great promise

SYNTHETIC BIOLOGY
LUX INNOVATION GRID (LIG)



SAMPLING OF
COMMERCIAL PARTNERS



ROBERTET
GROUPE



GINKGO BIOWORKS™
THE ORGANISM COMPANY

Eat Well, Live Well.



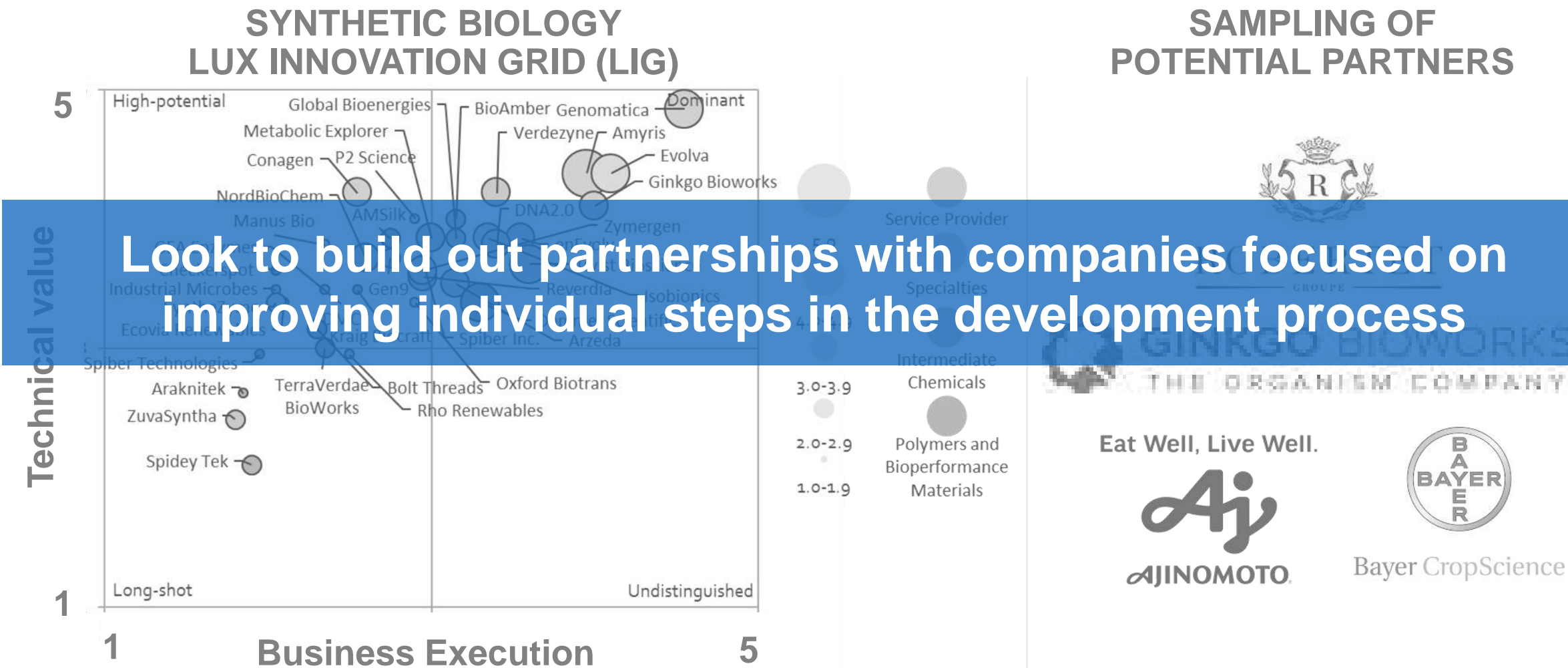
AJINOMOTO



Bayer CropScience

*DNA2.0 is now known as ATUM

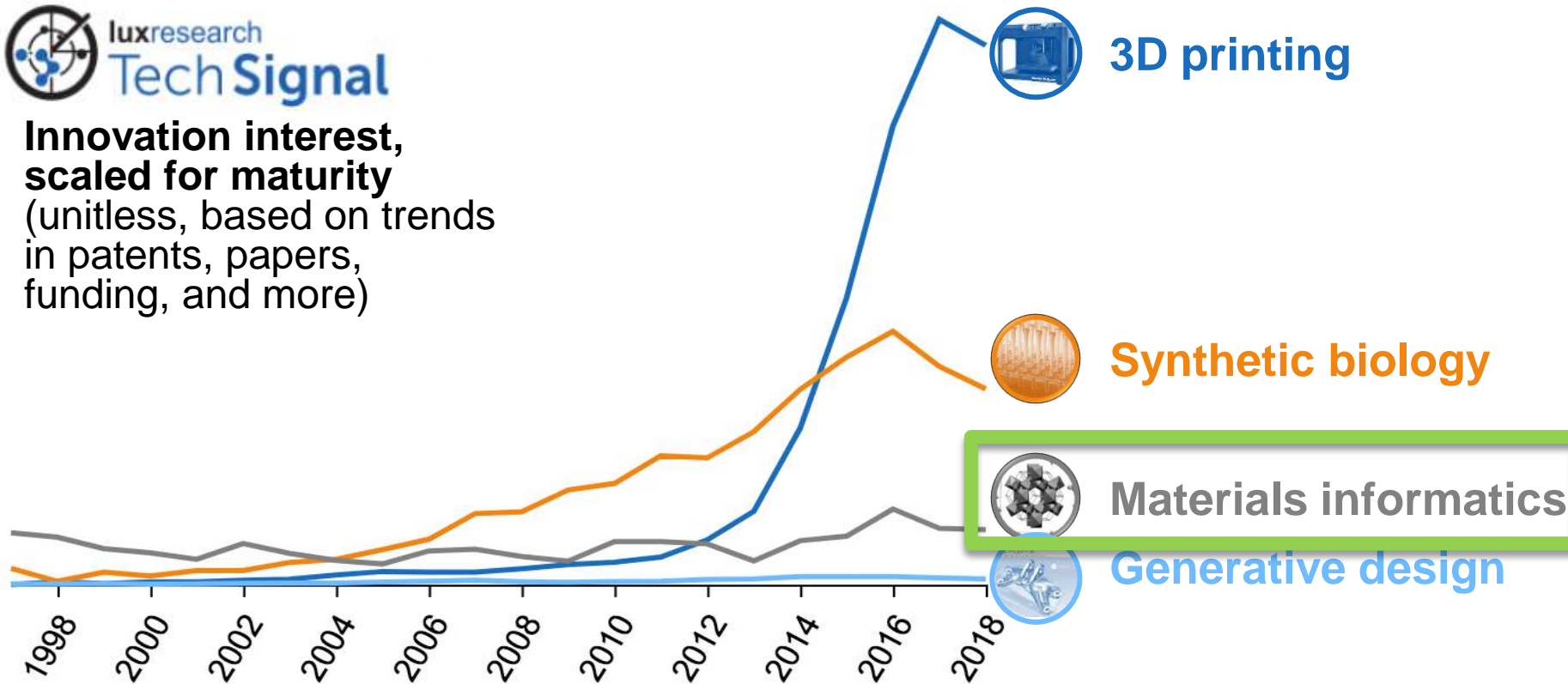
Companies providing services along the synthetic biology value chain have shown great promise



A strategic framework that combines data + insight



**Innovation interest,
scaled for maturity**
(unitless, based on trends
in patents, papers,
funding, and more)



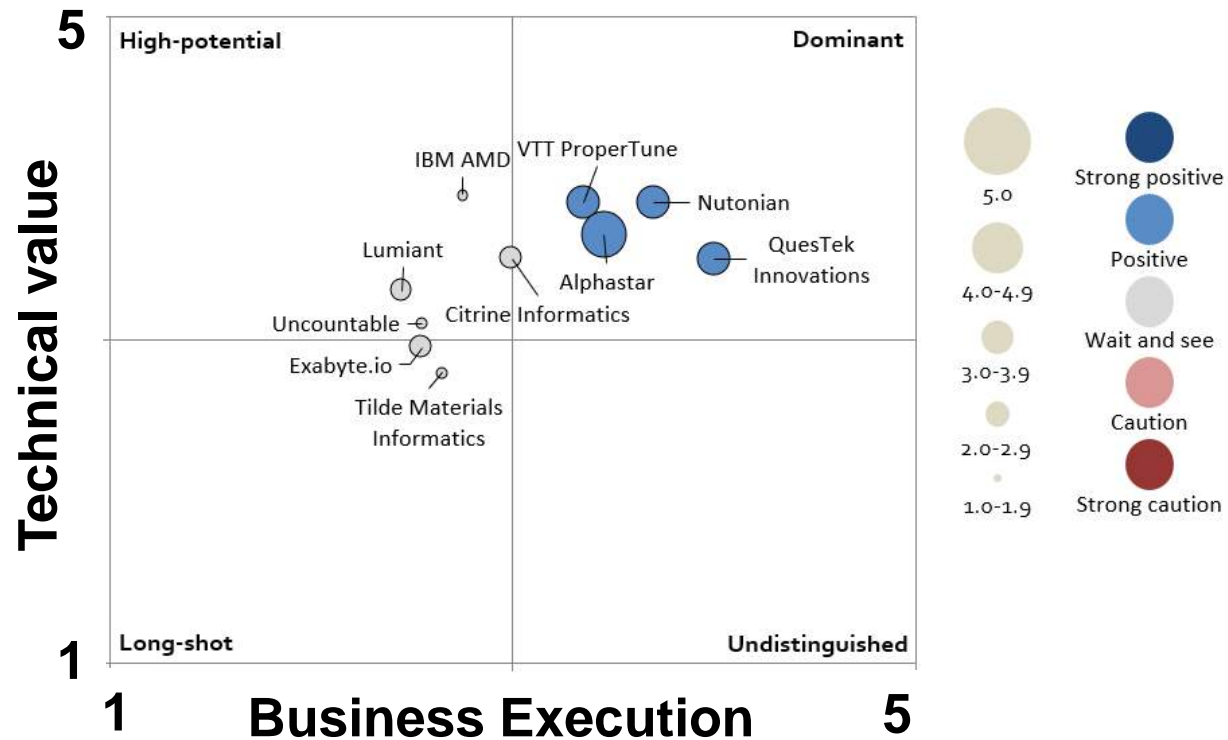
**MORE
MATURE**



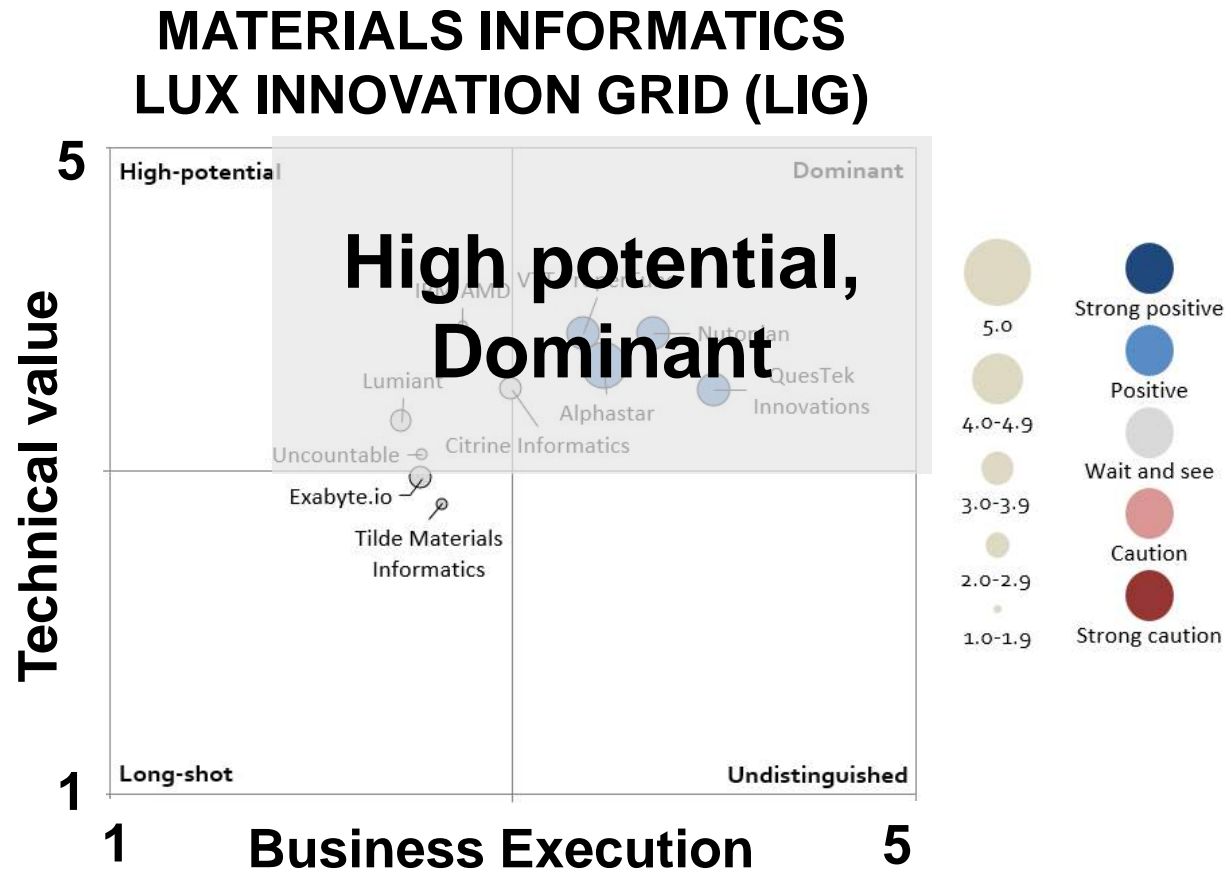
**LESS
MATURE**

Materials informatics landscape is largely precompetitive as players work to define their business models

MATERIALS INFORMATICS LUX INNOVATION GRID (LIG)



Materials informatics landscape is largely precompetitive as players work to define their business models



Making sense of a High Potential and Dominant LIG:

- Materials informatics complements computational materials science
- Lack of significant capital expenditure required to deliver value and scale as needed

Research consortiums form to solve materials informatics' data problem



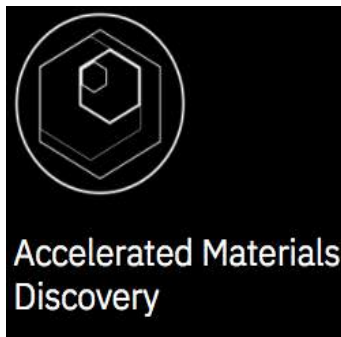
SAMSUNG



IBM Research Frontiers



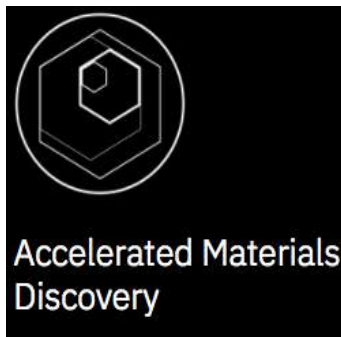
Canon



Research consortiums form to solve materials informatics' data problem



IBM Research Frontiers



Research consortiums form to solve materials informatics' data problem



SAMSUNG



SUMITOMO CHEMICAL Co., Ltd.

Asahi**KASEI**

IBM Research Frontiers

HONDA
The Power of Dreams

Canon

Hitachi Metals, Ltd.

Corporate players must balance
“prisoner’s dilemma” mindset with disruptive potential



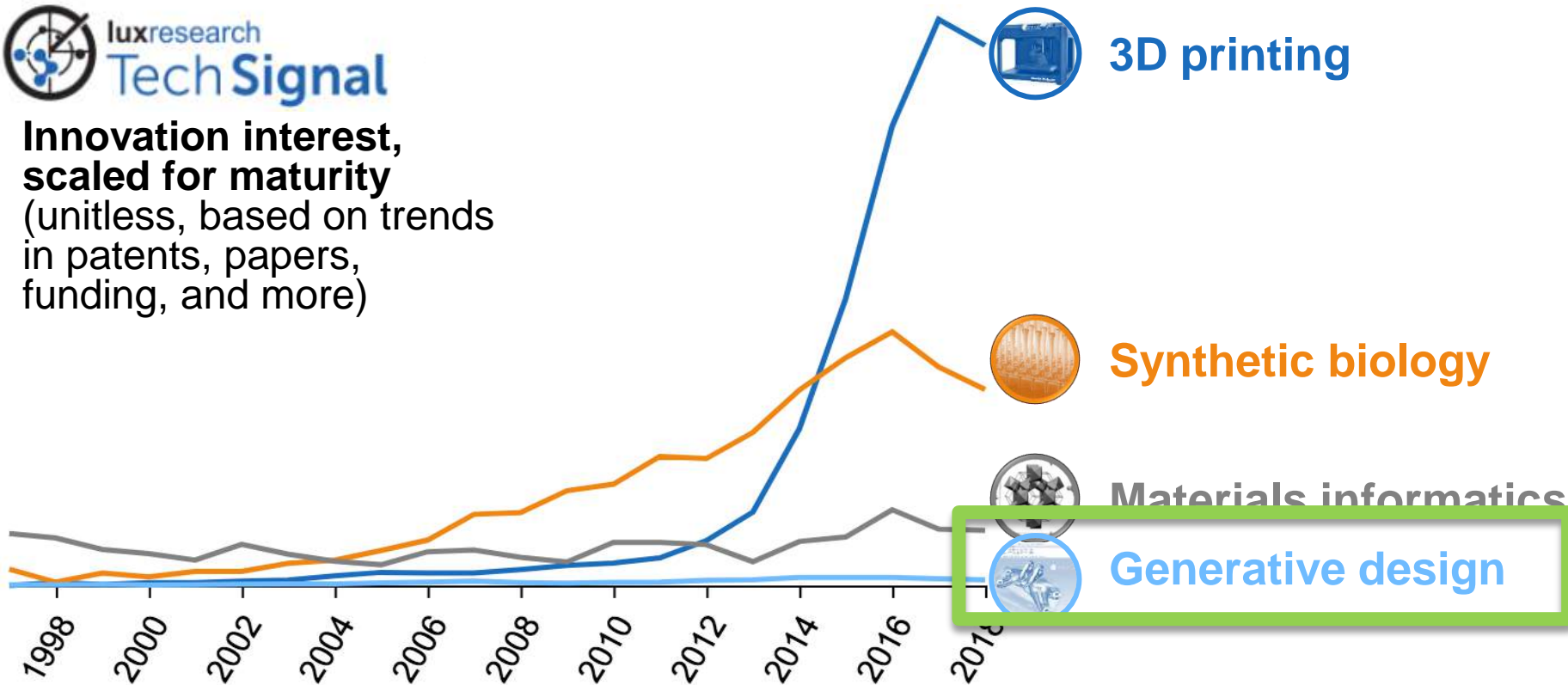
NIMS



A strategic framework that combines data + insight



**Innovation interest,
scaled for maturity**
(unitless, based on trends
in patents, papers,
funding, and more)



**MORE
MATURE**



**LESS
MATURE**

Generative design is still early stage, but emerging technologies are pushing the boundaries of what is possible

Synergies with additive manufacturing and increasing computing power create a new paradigm

START-UPS

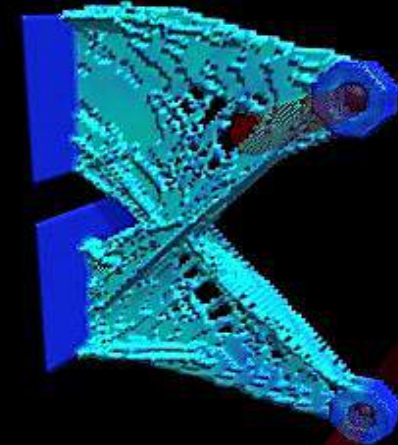
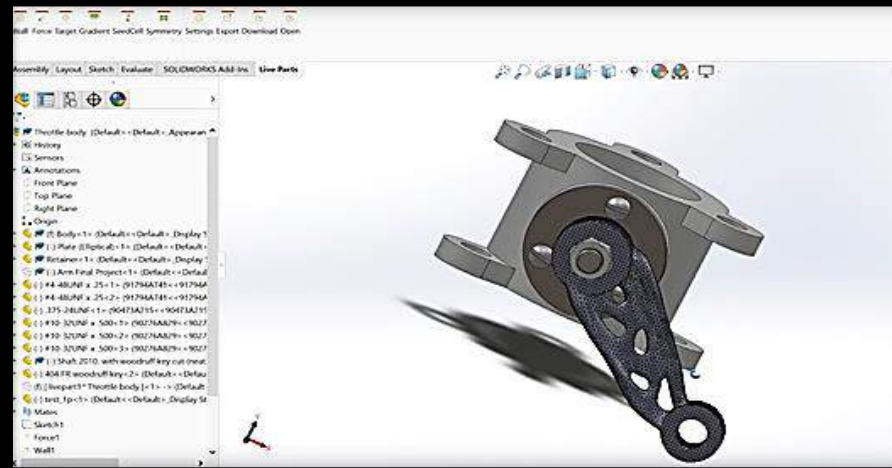


LARGE COMPANIES

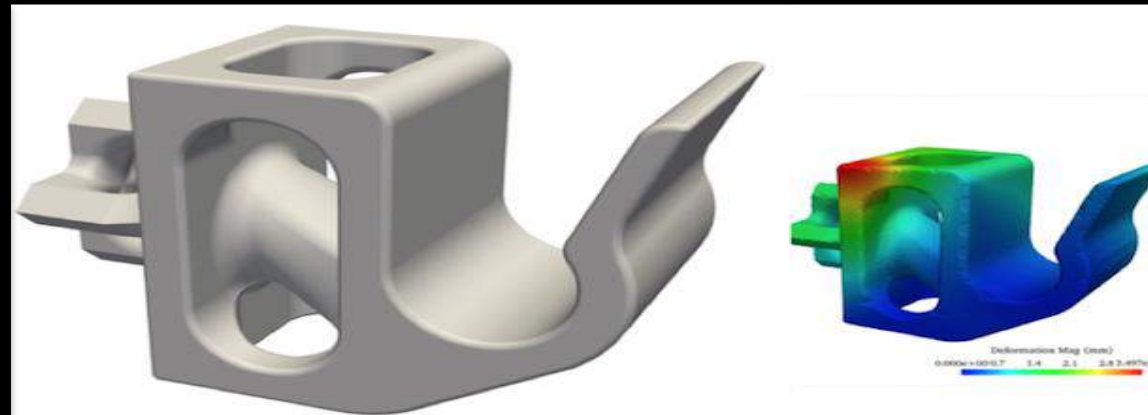


These innovations will blur the lines between material development, product design, and manufacturing

Desktop Metal's Live Parts



Carbon's 3D printing software



Conclusions

Playing not to lose will doom materials companies to future dominated by financial engineering at the expense of long-term innovation – *bad for all!*

Playing to win requires thinking about materials innovations in tandem with the technologies that enable great products.

It is going to be hard, and is sure to disrupt value chains, but the potential success is worth it.



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Amsterdam • June 6-7

Thank you for joining us.





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