COLUMBIA
TECHNOLOGY
VENTURES

University technology commercialization (for NAS – Nano Committee)

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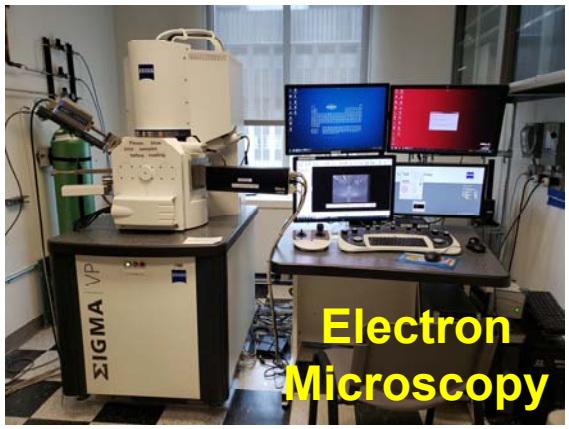
Agenda

- Context on Columbia Nano Initiative
- Columbia's experience commercializing university technology: what's changed?

Context: Columbia Nano Initiative

Knowledge | Facilities | Expertise



- 9,000 square feet of cutting edge equipment
- 8 dedicated scientists and engineers
- Over 400 users from over 120 research groups (10% external companies)
- 16 emerging start-up companies
- Over 280 inventions
- Nanoday: October 29, 2019. https://cniindustryday2019.splashthat.com/

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Context: grants and collaborators supported by work done in CNI labs

Center grants

- MRSEC (**NSF**): Center for Precision Assembly of Superstratic and Superatomic Solids (Materials Research Science and Engineering) plus NYSTAR match
- EFRC (**DOE**): Programmable Quantum Materials (Energy Frontier Research Center)

DOD

NSA	Booz Allen Hamilton
RFSUNY	American Integrated Photonics Institute for Manufacturing Innovation
DARPA PIPES	JASR Systems LLC
DARPA EPOCHS	IBM Thomas J. Watson Research Center
Supervan	BBN Technologies Group
Navy STTR	SA Photonics
DARPA EXTREME	Trex
DARPA TREX	Trex
MOABB	JASR Systems LLC

Industry sponsored research

ETRI
Sungkyunkwan University
Samsung
APIC Corporation
Rockport Networks
Semiconductor Resarch Corporation
Samsung
Magic Leap
Corning
Hypres, Inc
Toyota Motor Corp
Boeing
QEL

DOE

HPE	Hewlett Packard
ARPA-E	Nvidia, AIM Photonics, Freedom Photonics, Microsoft
	Freedom Photonics
	PLC Connections
	Nano Precision
DARPA Vertical GaN	IQE USA, Inc, IBM
ARPA-E Phase II	Nvidia, Quintessent,

NSF

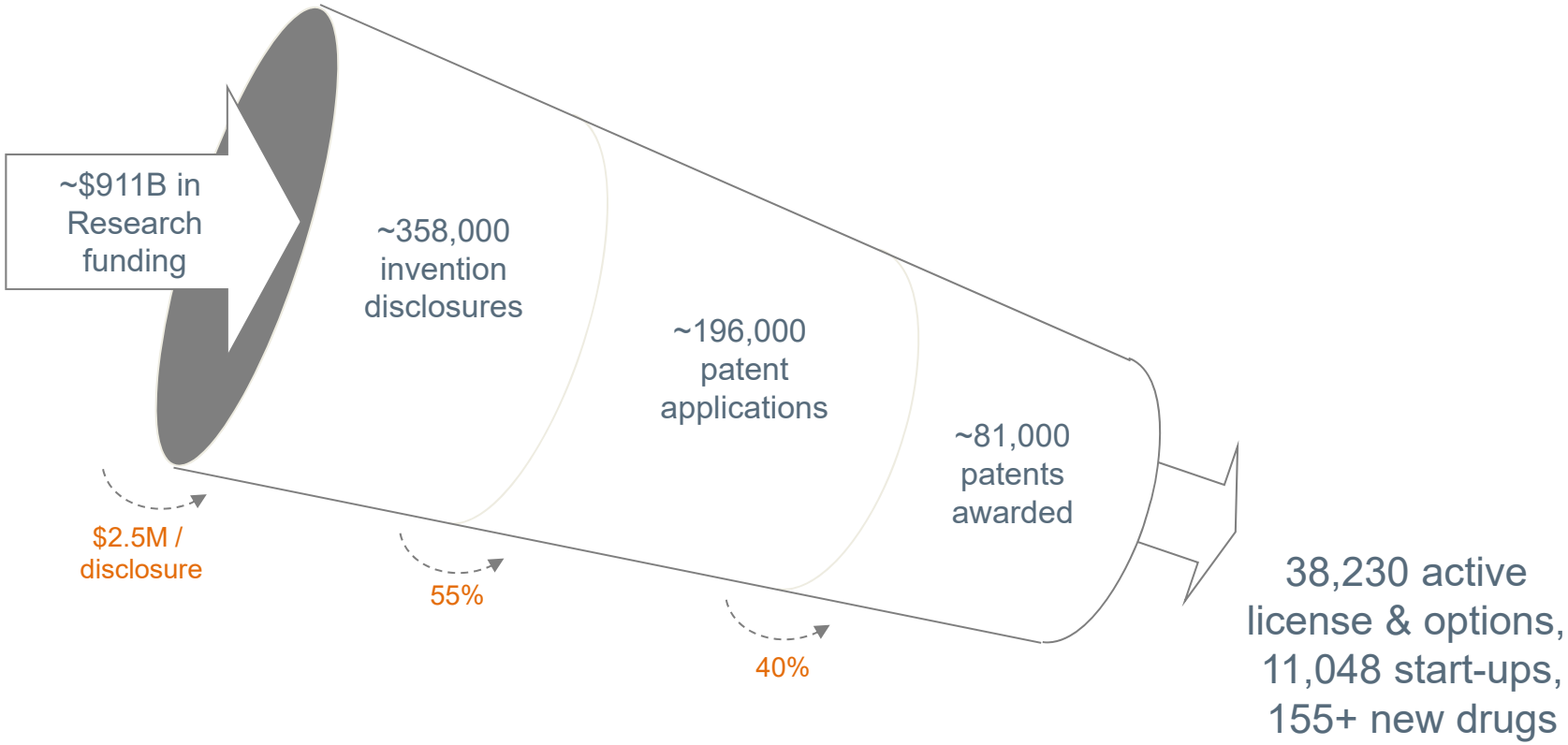
NSF-MRI	IBM, Lumiode, Chromation,
SSTED Technology	Radiation Detection Solutions

NIH

Baylor Prefrontal Cortex	Google DeepMind (GDM)
National Human Genome Research Inst	Pacific Biosciences of California, Inc

Universities Continue to Be a Rich Source of Commercial Innovation

Cumulative Inputs and Outputs, 1991 – 2016, US Universities



Source: AUTM Licensing Surveys (FY91- FY16)
"The Role of Public-Sector Research in the Discovery of Drugs and Vaccines", NEJM, 2011

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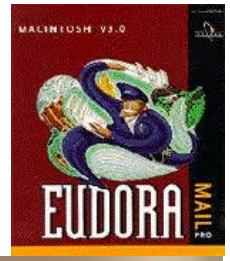
Many Lifesaving or Life Improving Blockbuster Products or Companies Emerged from University Research

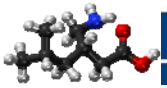
Genentech
A Member of the Roche Group

GARDASIL 9
Human Papillomavirus
9-valent Vaccine, Recombinant

Akamai

Google





LYRICA
PREGABALIN

Enbrel
etanercept

Lex Machina
a LexisNexis® Company

Xalatan

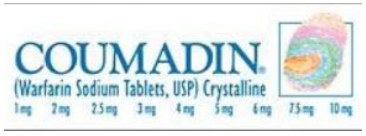
Bigliani/Flatow®
The Complete
Shoulder
Solution TSA
Surgical Technique

FireEye

Remicade®
INFLIXIMAB

vmware

RSA



CRISPR
THERAPEUTICS

editas
MEDICINE

Oculus

DVD

Blu-ray Disc

Kite
A GILEAD Company

JUNO
THERAPEUTICS

duolingo

Blue LED

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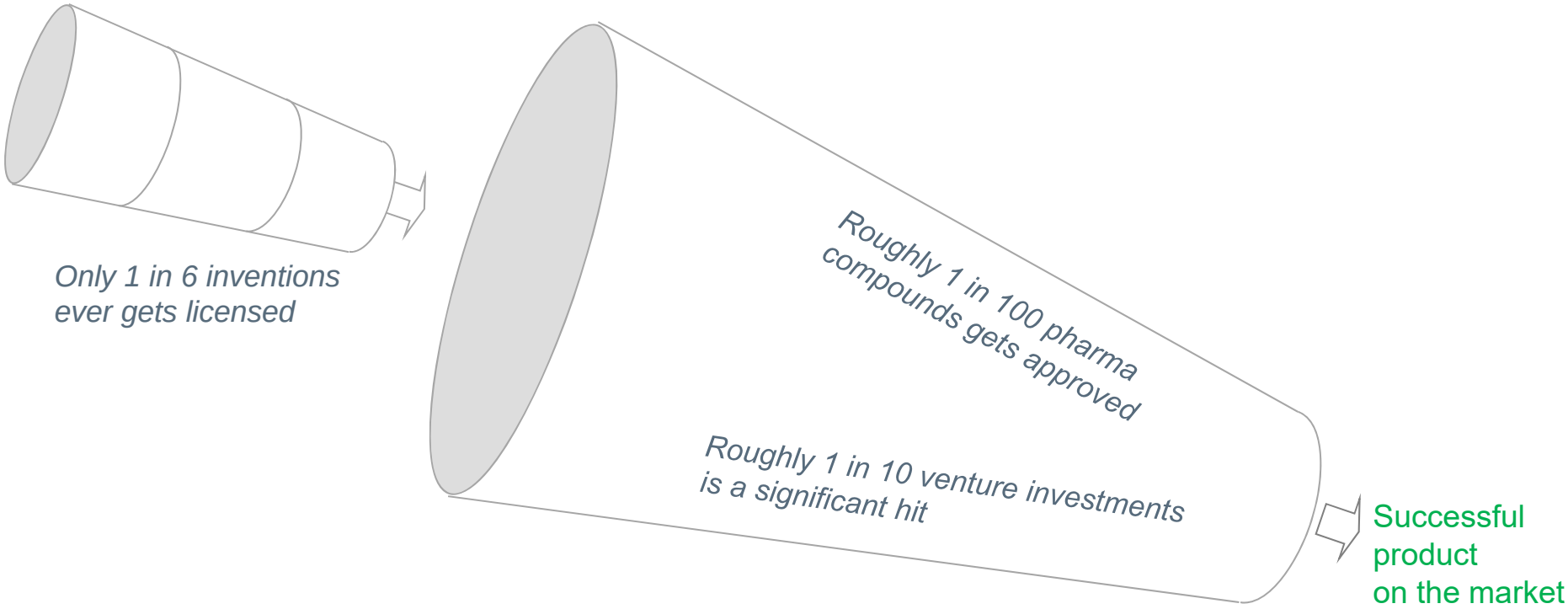
But the End of One Process is Just the Beginning of Another

University's Funnel

Industry / VC's Funnel



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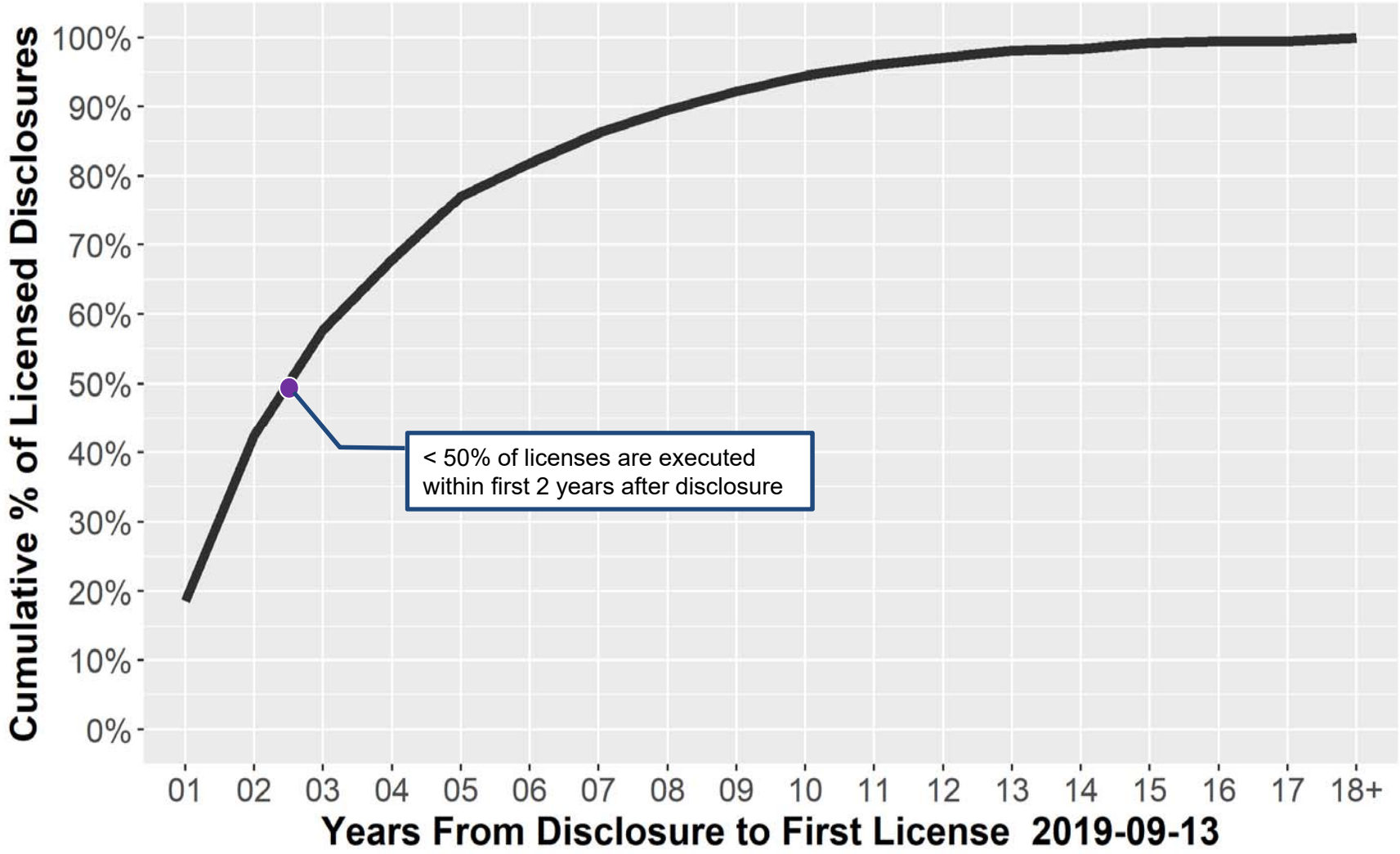
University Technology is on the Bleeding Edge…

… And Therefore Often Takes Years to Find a Home (if it Ever Does!)



Source: Columbia's cumulative deals executed from 1982 to 2019-09-13

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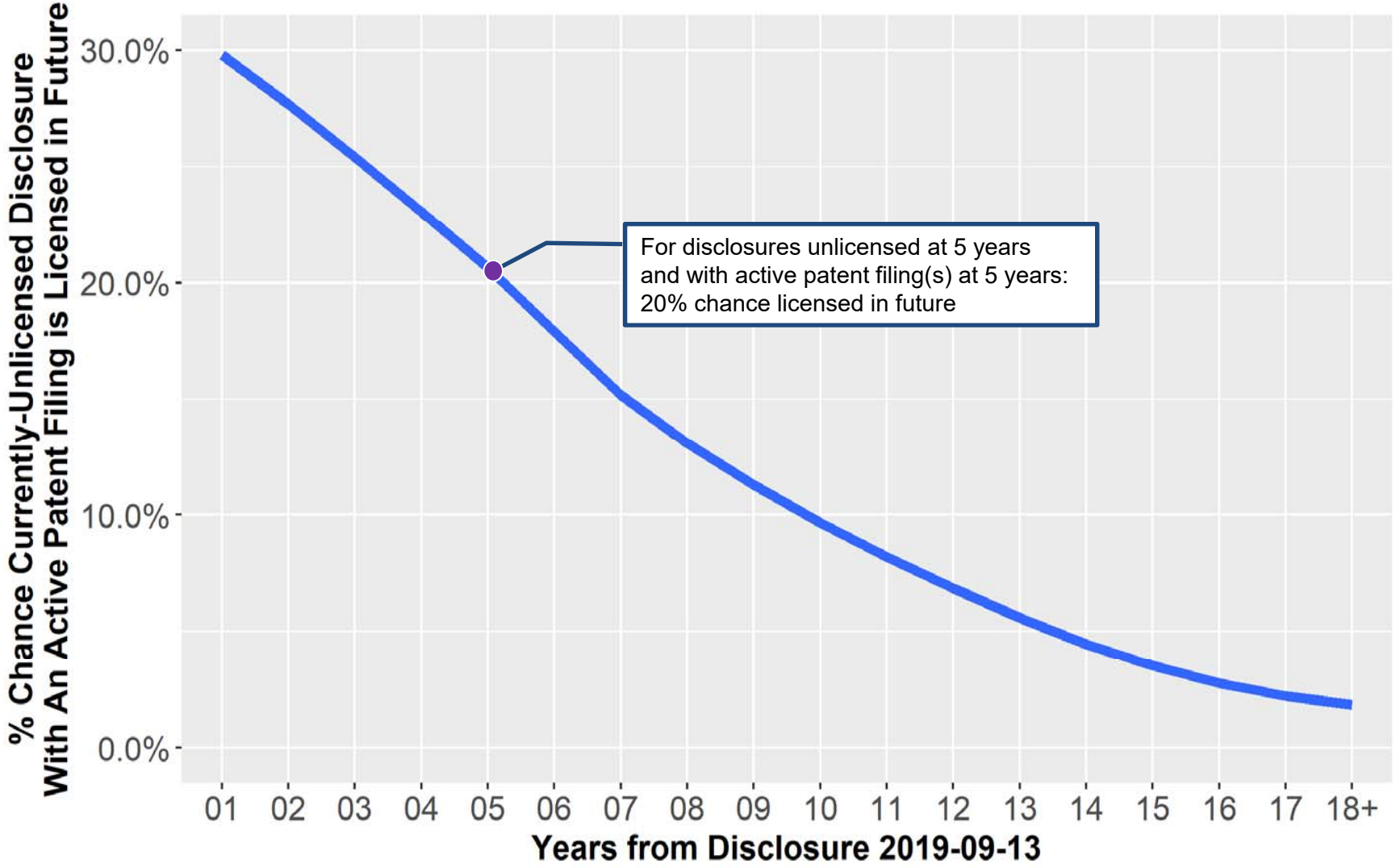
Odds For An Invention to Get Licensed Decline From ~30% Down to ~5% Over Time



Source: Columbia's cumulative deals executed from 1982 to 2019-09-13
Note: Loess best-fit curve

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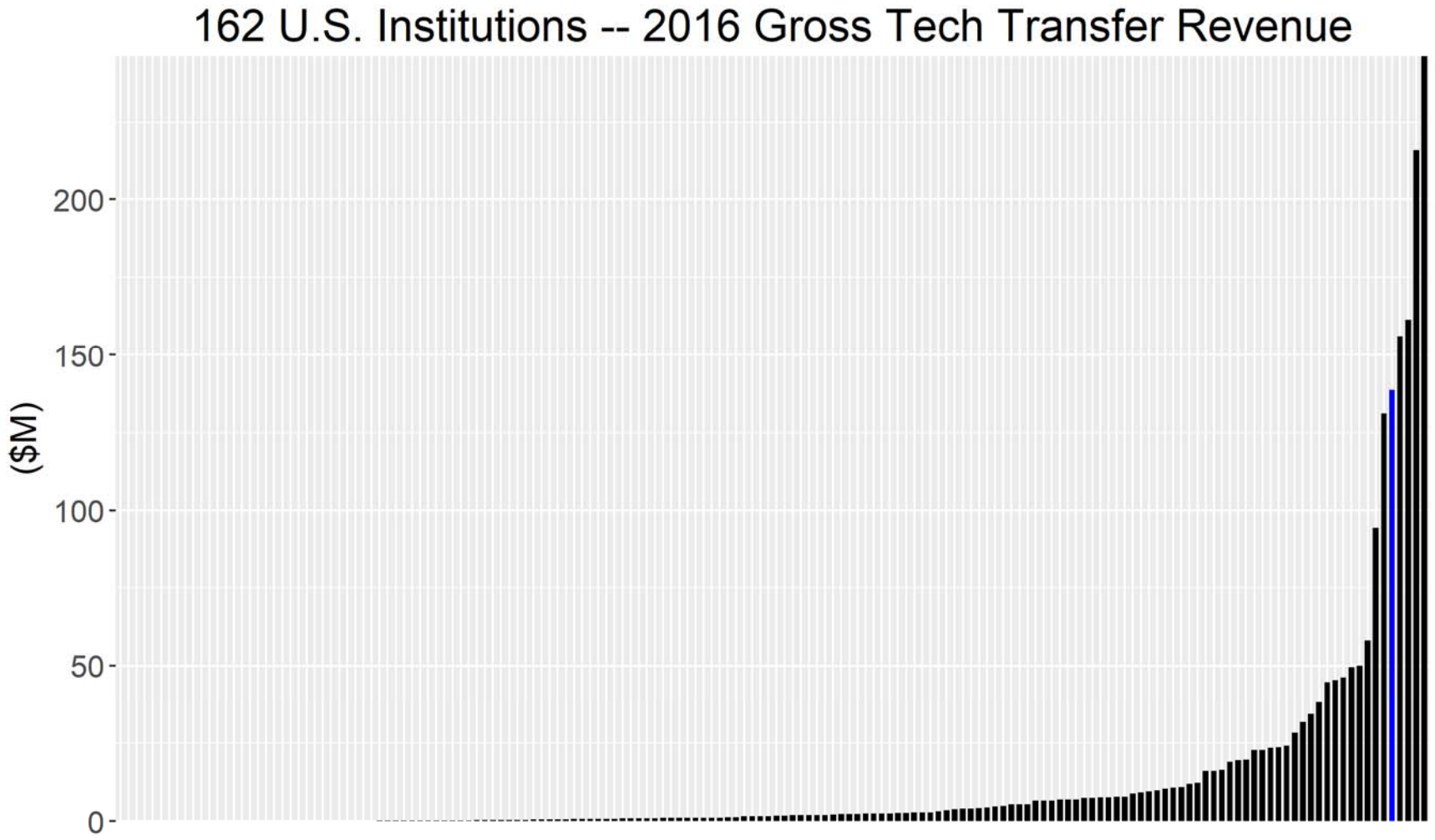
Not Surprisingly,
Commercial Success is Not Equally Distributed



Source: AUTM 2016 Survey Data

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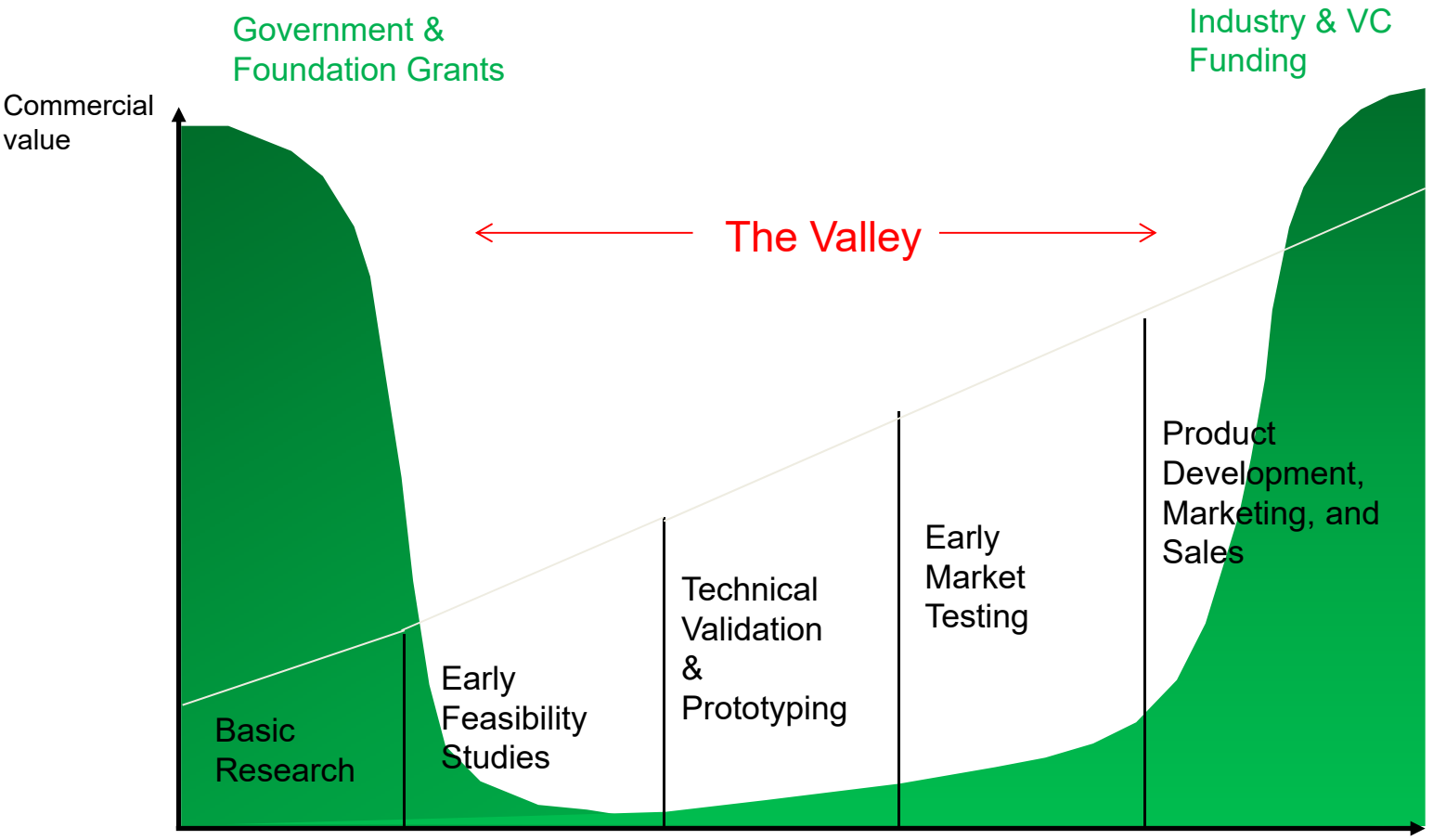
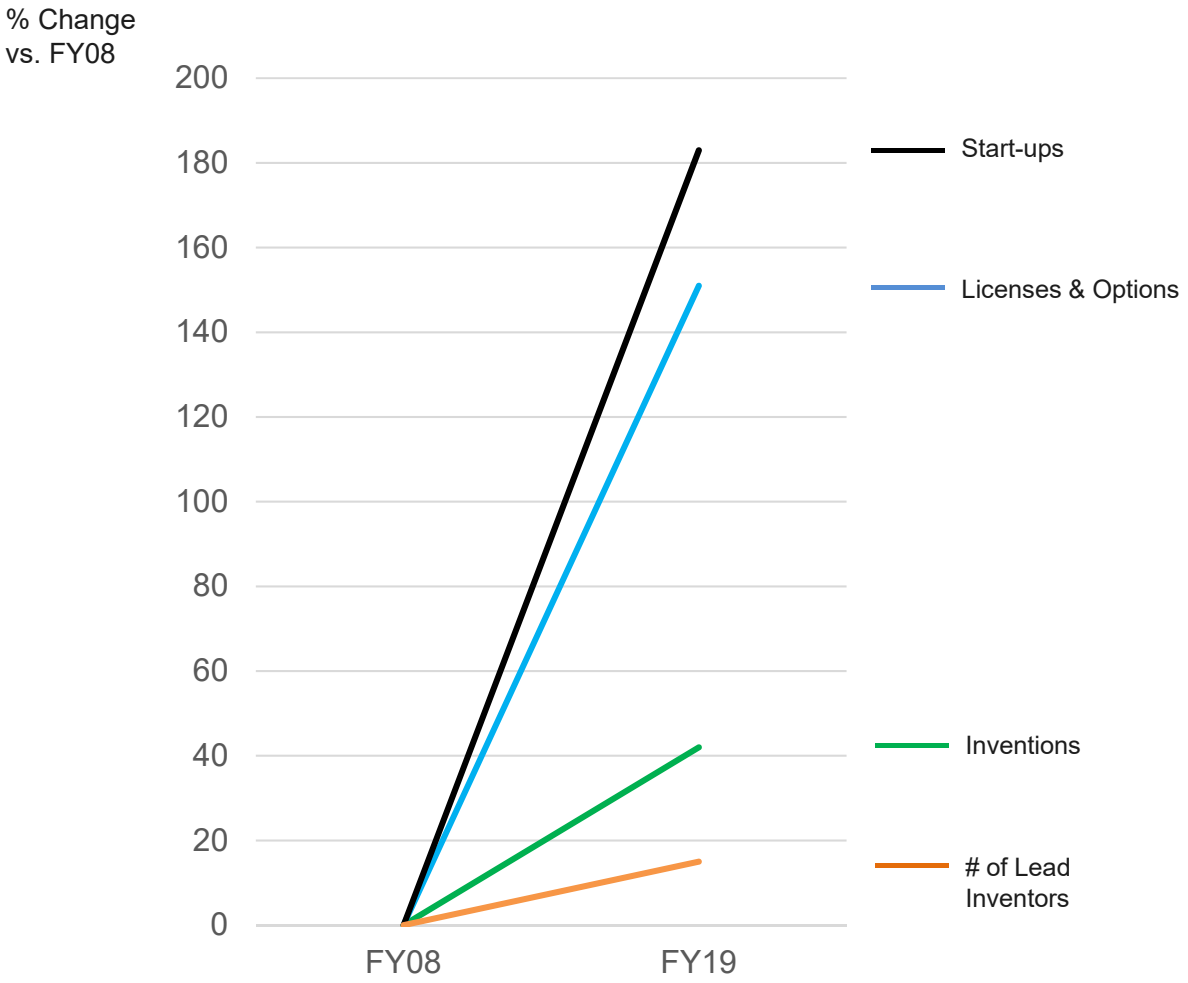
Why is this so hard?

What is “The Valley of Death”



At Columbia, Last 10 Years Have Been Good to Us



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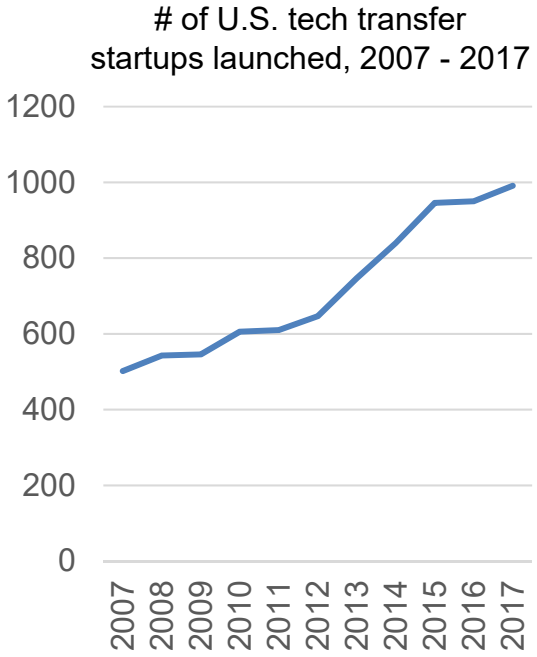
But the Composition of Our Deals Have Changed

True Across All Industries, But Especially in Phys Sci



Source: AUTM STATT database as of 9/16/19

Growth in tech transfer primarily coming from startups, with direct exclusive patent licensing by industry largely flat or down

Many hypotheses as to why, likely combination of:

- Trend towards Big Industry innovating "off balance sheet" via Corporate VC arms, becoming LPs in VC funds, or acquiring startups later stage, vs. investing heavily in internal R&D.
- Increase of "tough tech" VC funding available (though largely in brand-name universities in existing / rising global startup hub cities)
- Increasing focus on "commercial ecosystem" in large NSF / NIH grants
- Prioritization by mayors and governors of startups for local and regional economic development
- Maturation of national and regional ecosystems for entrepreneurship: SBIR programs; accelerators and incubators; co-working spaces;
- Increasing resources available on- or near-campus to support academic entrepreneurship (proof-of-concept funding; mentor networks; EIR programs; campus accelerators)
- General awareness of and enthusiasm for startups on campus by students and faculty

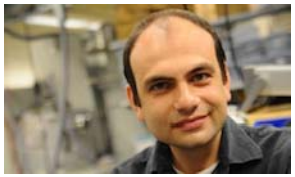
Example: Recent Startups from Columbia's Center for Nanoscale Initiatives Faculty

Michal Lipson → VOYANT PHOTONICS

Peter Kinget → Seamless semi

Harish Krishnaswamy → mixcomm

Colin Nuckolls → *XL Energy*; *Adesso Bioscience*



John Kymissis → chromation; lumiode light engines

Ken Shepard → Ferric; QuickSilver BIOSYSTEMS

Launch *more & stronger* startups, *faster*!

But how?

What Do Great Ideas Need to Survive the “Valley of Death”?

Customer Discovery +

Entrepreneurship Education +

Mentors / Coaches +

Prototyping Resources +

Validation Capital +

Venture-backable Entrepreneurs +

Access to Venture Capital & Industry Scouts +

Early technical & business hires

Survival!

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The following pages are merely
some illustrative examples
of new initiatives
launched at Columbia
to address these startup challenges.

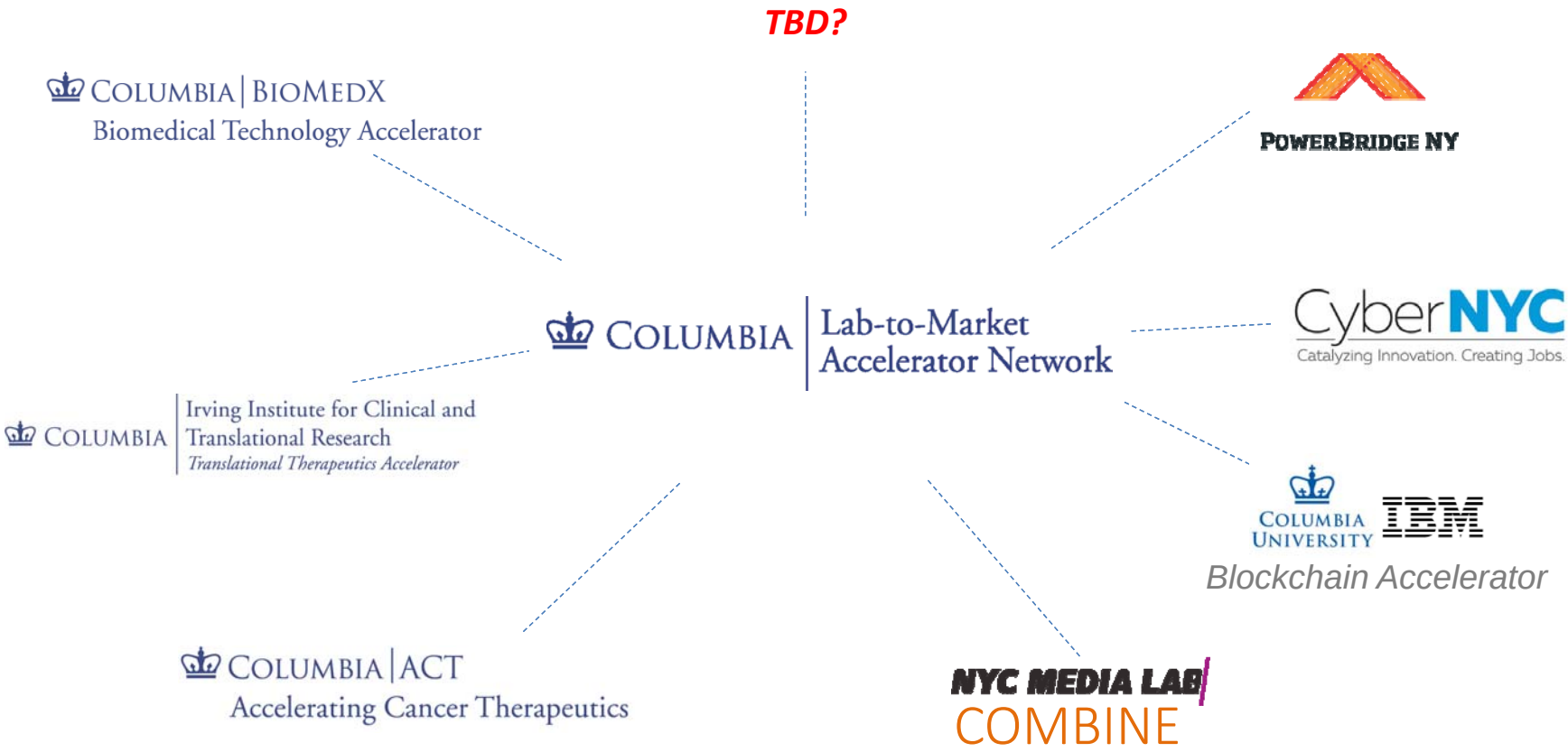
More material on each initiative
freely available upon request.

Validation

Columbia Lab-to-Market Accelerator Network (L2M): Breakthrough Inventions → Life-Saving and Life-Improving Products

Life Sciences

Physical Sciences & Engineering



700+ applications → 325+ teams through bootcamps →
150+ cash awards totaling $12M+ → 40+ commercial launches →
$122M in external follow-on funding raised by those teams

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https://techventures.columbia.edu/inventors/columbia-lab-market-accelerator-network

Strong Network of Mentors and Judges for the Columbia Lab-to-Market Accelerators

Validation

Ben Sampson
GE Ventures

Edward Greer
Dow Chemical

Christian Guirnalda
Verizon 5G Labs

Surya N. Mohapatra
Quest Diagnostics

Sowmya Gottipati
NBCUniversal

David Berlin
BP Ventures

Jonathan Leff
Deerfield

Ari Frankel
Alexandria RE Equities

Lona Vincent
Johnson & Johnson

Michael Wiley
Publicis Groupe

David Post
IBM Blockchain Ventures

Dan Goodman
Watson Health, IBM

Christopher Cavanagh
National Grid

Donna See
TARA Biosystems

Francesco Marconi
The Wall Street Journal

Support & Connections from CTV's Executives in Residence

Linda Masat
Takeda, XOMA

David Pompliano
Lodo Therapeutics,
Revolution Medicines

Lee Rauch
Fortress Biotech,
Global Blood Therapeutics,
Third Rock Ventures

Angela Shen
Arcellx, NKarta Therapeutics,
Cell Therapy Accelerator

Edward Rosen
Elucida Oncology, J&J

Dan Goodman
Relativity Sciences,
Lockheed Martin

Jim Pastoriza
TDF Ventures, AT&T Ventures

http://techventures.columbia.edu/about-ctv/ctv-executives-residence;
http://www.nature.com/bioent/2015/150701/pdf/bioe.2015.8.pdf

Custom Feedback Sessions Where Needed

Recent Example: Lipson / Chen / Yang Labs

Feedback provided on 6 student projects from Hod Lipson & Chen / Yang labs, including

- Synthetic muscle
- Layered assembly
- Laser cooking
- Autonomous crop disease detection
- Powder bed-free 3D printing
- Jamming gripper
- Flexible batteries

Attendees included

- Amazon
- Kairos Ventures
- IP Group
- Osage Ventures
- ff Ventures
- Contour Ventures
- CTV XIRs

IP for Entrepreneurs Course (IEOR 4578)

The life and death of Rockstar: John Veschi...

Understanding standard-essential patent p...

Selecting and working with outside counsel...

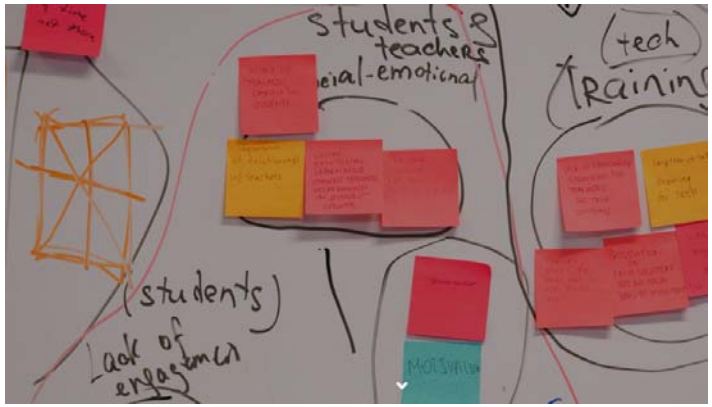
VC and Entrepreneur Perspectives on IP

Entrepreneur perspectives: Greg Blonder, ...

Columbia Entrepreneurship Design Studio

Education

At the Columbia Entrepreneurship Design Studio, students, alumni, and faculty learn customer-centric methodologies for developing innovative and practical solutions to ill-defined problems. These methodologies, called “human-centered design” give entrepreneurs, students, and faculty an agile approach to gaining critical customer insights and integrating them into their products, services, and businesses.



designstudio@columbia.edu

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Lots of Entrepreneurship and Commercialization Video Content Available Online


SBIRs & STTRs: The Inside Story


Entrepreneur perspectives: Steve Blank, pa...

Patents 101 with Jeff Sears


Future of CleanTech Investing


VC Perspectives: Carlo Rizzuto, Versant Ve...

Understanding convertible notes (Mintz Lev...


Patents, Licenses, and Science-based Start...

Financing your startup (Steve Davis, Good...

Entrepreneur perspective: Angela Christian...

Life Science Accelerator Bootcamp: IND/ID...


VC perspectives: Stan Reiss, Matrix Partners


VC Perspectives: "How VCs Evaluate Poten...

VC and Entrepreneur Perspectives on IP

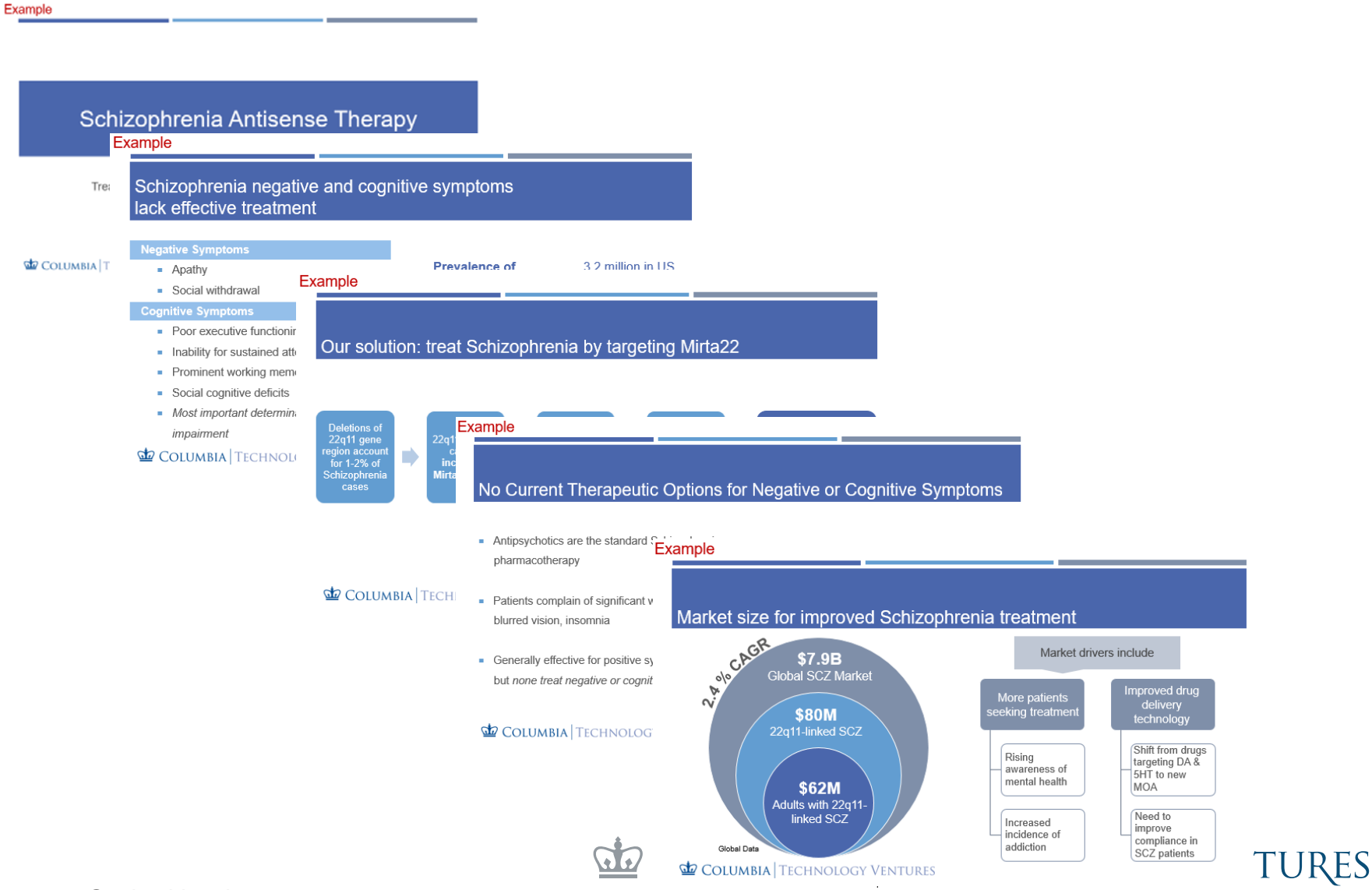

Best practices for negotiating commercial li...


Patent Monetization & Enforcement: Tales f...


Entrepreneur and VC perspectives: Tom Ma...

https://vimeo.com/techventures

Support from CTV Fellows for Startup Pitch Materials



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Launch

Academic Venture Exchange (AVX) – Connecting University Startups to High-Quality CEOs

260+ Startups, 3200+ EIR / startup connections made to date →
18 matches made, 54 pending

70+ of the top US VC funds, including NEA, Two Sigma, Flagship, ARCH, Canaan, Light Speed, Lux, Orbimed, Polaris, Versant, Highland, Atlas, and 5AM

410+ high-quality investable serial entrepreneurs

Parallel networks launching in NYS Energy, NYC Life Science, and NYC Cyber

Stats as of March 2019
https://avx.io/#!/

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Discounted & Deferred Rates from Startup Attorneys

DLA PIPER

WSGR
WILSON SONSINI GOODRICH & ROSATI

MINTZ LEVIN

GOODWIN

https://techventures.columbia.edu/inventors/start-company-0

Active Connections to VC Investors

Semi-annual “Start-up opportunities” email to ~500 venture and angel investors, including

- 5AM
- NEA
- Eclipse
- Deerfield
- Domain
- Kairos
- Arch
- Puretech
- Hemi Ventures
- Matter
- In-Q-Tel
- Two Sigma
- Alexandria Equities
- Andreesen Horowitz
- M12 (Microsoft)
- Breakthrough Energy
- Matrix Partners
- Google Ventures
- Domain
- GE Ventures
- Domain
- Samsung Ventures
- Versant
- Osage Partners
- Atlas
- Apple Tree
- JVP
- IP Group
- Fortress
- First Round
- Horizon X
- New York Angels
- Bain Capital
- MPM Capital
- Intel Capital
- Atlas Ventures
- Flagship Ventures
- Lightspeed

Annual Investor Pitch Day

- ‘17 – w/ Penn; ‘18 – w/ Harvard; ‘19 – w/ MIT
- 150+ investors from 100+ firms
- ~30 startups

Standardized Approach for Tech Transfer Startup Terms

EXCLUSIVE LICENSE AGREEMENT FOR UNIVERSITY STARTUPS

This **Agreement** is dated _____, 20__ (the "**Effective Date**"), and is between THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK, a New York corporation ("**Columbia**"), and _____, a _____ corporation ("**Company**"). Columbia and the Company agree as follows:

1. **Definitions.** In this Agreement, the following definitions apply:

a. "**Affiliate**" means any corporation or other entity that directly or indirectly controls, is controlled by, or is under common control with, another corporation or entity. Control means direct or indirect ownership of, or other beneficial interest in, fifty percent (50%) or more of the voting stock, other voting interest, or income of a corporation or other entity.

b. "**Cover**" or "**Covered By**" means (i) infringes, in the case of a claim in an issued patent, or (ii) would infringe the claim if it existed in an issued patent, in the case of a claim in a pending application.

c. "**Designee**" means a corporation or other entity that is employed by, under contract to, or in partnership with (i) the Company, (ii) a Sublicensee, (iii) an Affiliate of the Company or (iv) an Affiliate of a Sublicensee, wherein such corporation or other entity is granted the right to make, use, sell, promote, distribute, market, import, or export Products.

d. "**Field**" means _____.

e. "**License Year**" means the one-year from the Effective Date of this Agreement or an anniversary thereof to the next anniversary of the Effective Date.

f. "**Materials**" means the tangible physical material, if any, delivered to the Company hereunder, and any progeny or derivatives thereof developed by the Company, its Affiliates or Sublicensees. Any Materials delivered to the Company hereunder shall be listed in an Exhibit hereto.

g. "**Net Sales**" means the greater of the gross invoice or contract price charged to Third Party customers for the Product or the actual consideration paid by Third Party customers for the Product. For all Products used or consumed by any Third Party, the Company may deduct five percent (5%) from Net Sales and shall not deduct taxes, shipping charges, allowances, and the like before calculating royalties due. The intent of this definition of Net Sales is to allow Columbia to derive a royalty on the end sale of a Product to the first Third Party.

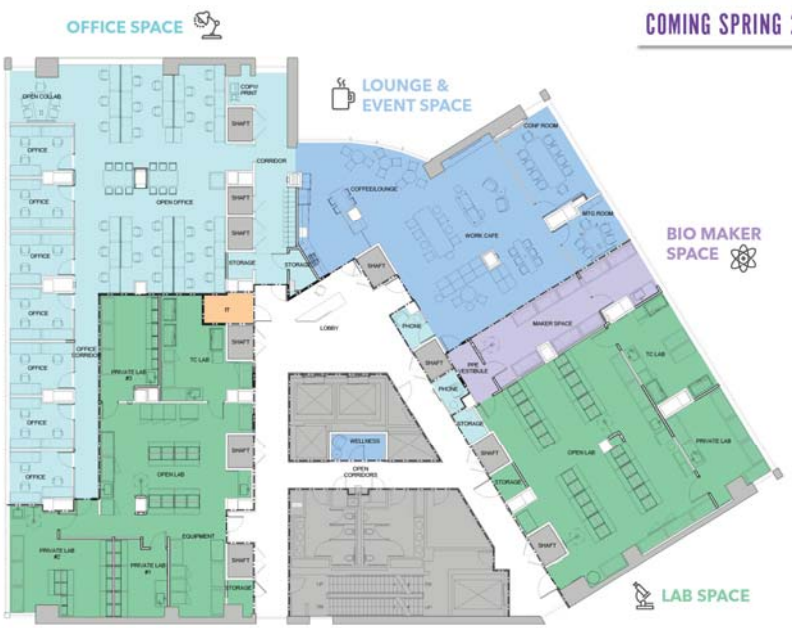
- Based on benchmarking with Stanford, MIT, Cornell, Caltech, and Carnegie Mellon
- Key terms standardized, w/ positive feedback from venture investors, startup attorneys, and entrepreneurs
  - $1K upfront for option or license, not both
  - 5% equity w/ antidilution only through industry-specific Series A
  - Deferred past patent expenses
  - Industry-appropriate success-based milestones & royalties / fixed annual fees
- "No one at Columbia gets a better deal than anyone else at Columbia"

techventures@columbia.edu

Two New Columbia-Affiliated Startup Incubators

Columbia Startup Lab

Alexandria Launch Labs @ Columbia



Located in the Mary Woodard Lasker Building at 166th & Broadway