Innovation & Intellectual Property:

Some Observations and Insights

Premnath V, PhD

Head, NCL Innovations | Director, Venture Center

Talk at CSIR-IMMT, Bhubhaneshwar, 14 May 2021

Outline

- Innovation
- Intellectual property
- Q&A

Innovation

What is innovation?

Innovation

"market introduction"

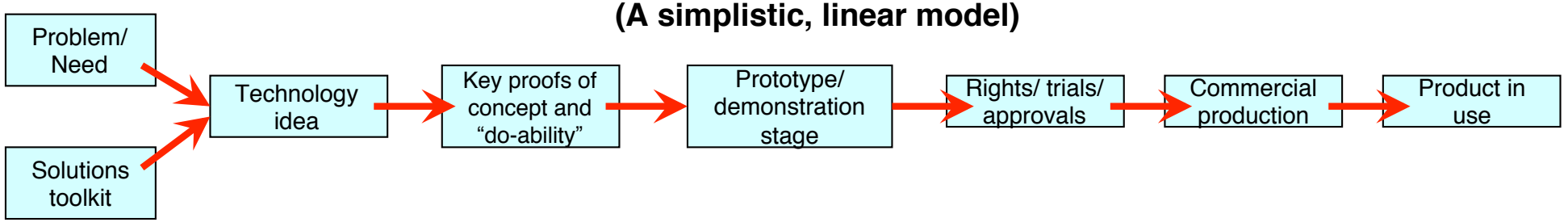
Technical novelty

UBER

Organizational novelty

Innovation: Taking to the market

(A simplistic, linear model)



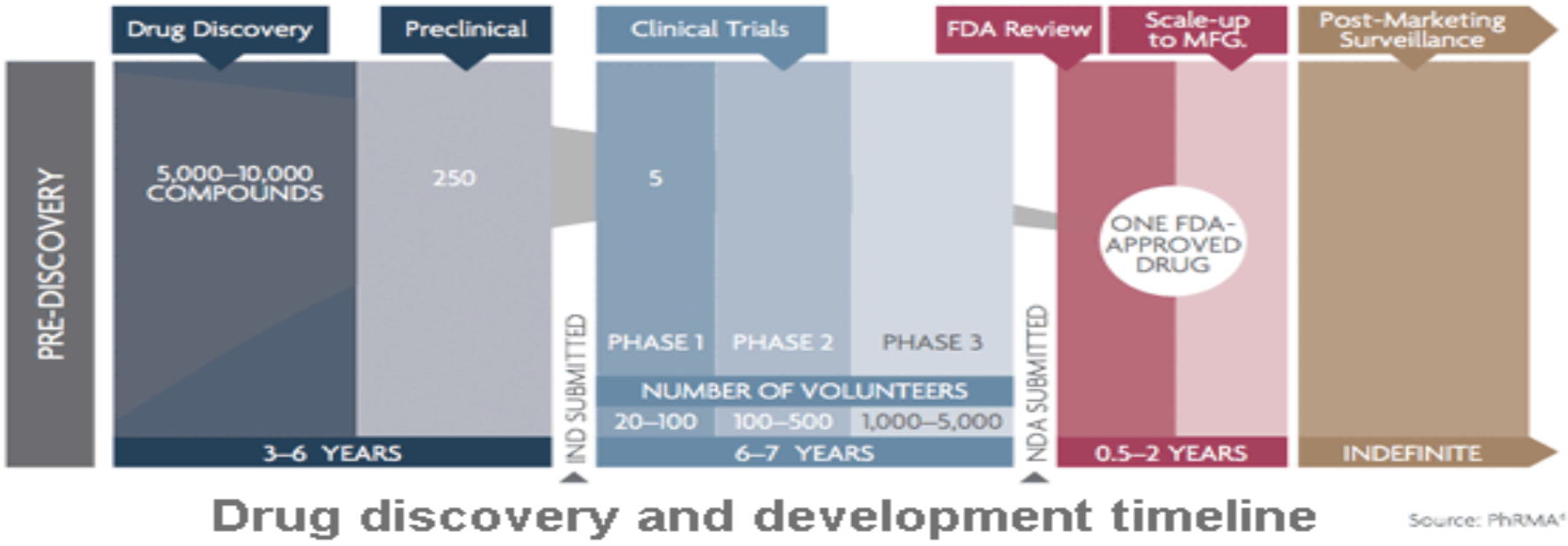
Invention

80% of work, time, investment

Note: All the inventions that are remembered have successfully navigated this process!

Lesson: Those who want to create value (social, economic, ….) with their inventions, need to also find/ create/ build the rest of the journey to the market!

Example: Drug development innovation



Source: http://www.davidfunesbiomed.eu/2016/03/141-clinical-research-overview.html

Technology Transfer: When it works

Problem/ Need

Solutions toolkit

→ Technology idea/ opportunity → Key proofs of concept and "do-ability" → Prototype/ demonstration stage → Rights/ trials/ approvals → Commercial production → Product in use

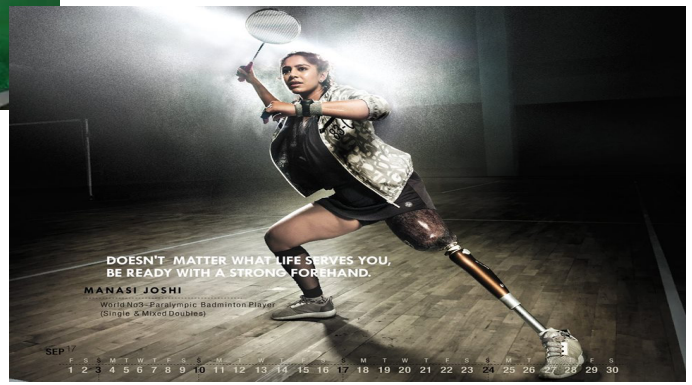
Industry

Academia/ R&D

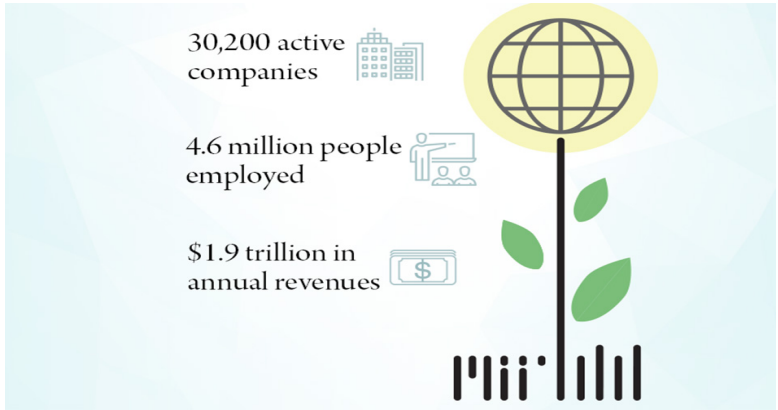
Why innovation?

Role models. Aspirations.

The satisfaction in empowering people with solutions



The power of science and engineering in transforming the economy



Economic Impact

Top Silicon Valley companies founded or co-founded by those with a current or former affiliation with Stanford University, as an alumnus/alumna or faculty/staff.

In fiscal year 2008, the largest companies on our list were responsible for generating revenue totaling $255 billion, or 54% of the total revenues reported by 150 firms that make up the The Silicon Valley 150 (an annual list of the largest Silicon Valley firms.

And as a group, the Stanford-affiliated companies reported income totaling $19.1 billion, compared to an aggregate loss of $7.1 billion for the entire list of Silicon Valley 150 companies.

The Stanford-founded companies on the list had a total market capitalization of $402.5 billion, representing 47% of the $849.9 billion total market capitalization of the combined Silicon Valley 150 firms.

	Company	2008 REVENUES (MILLIONS)	2008 NET INCOME (MILLIONS)	MARKET CAP (MILLIONS) on March 31, 2009
1	Hewlett-Packard	$118,697	$8,050	$76,835
2	Cisco Systems	$39,575	$7,492	$97,887
3	Google	$21,796	$4,227	$109,741
4	Sun Microsystems	$13,256	-$1,832	$5,451
5	eBay	$8,541	$1,780	$16,114
6	Yahoo	$7,209	$424	$17,860
7	Agilent	$5,547	$637	$5,307
8	Electronic Arts	$4,479	-$1,140	$5,854
9	NetApp	$3,465	$101	$4,908
10	Nvidia	$3,425	-$30	$5,349

http://news.mit.edu/2015/report-entrepreneurial-impact-1209

The new role models

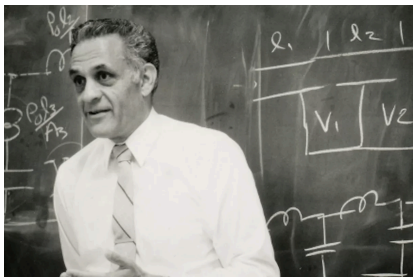
Frances Arnold, Cal Tech
Nobel Prize (2018)
Gevo, Provivi, Aralez Bio

Jennifer Doudna, UC-B
Nobel Prize (2020)
Mammoth Biosciences

Ugur Sahin & Ozlem Tureci
mRNA Vaccine for COVID19
BioNTech

Bob Langer, MIT
Patents 1400; h index 280
More than 20 startups

Richard Friend, Cambridge
1000 publications. 20 patents
3 startups



Amar Bose, MIT
Bose Corporation

Driving the Innovation Economy

Academic Technology Transfer In Numbers

From 1996 to 2017, up to...

$1.7 trillion contributed to **U.S. gross industrial output**

$865 billion contributed to **U.S. gross domestic product**

5.9 million **jobs** supported

490,000+ **inventions disclosed...**

108,000+ **U.S. patents issued...**

to research institutions since 1996

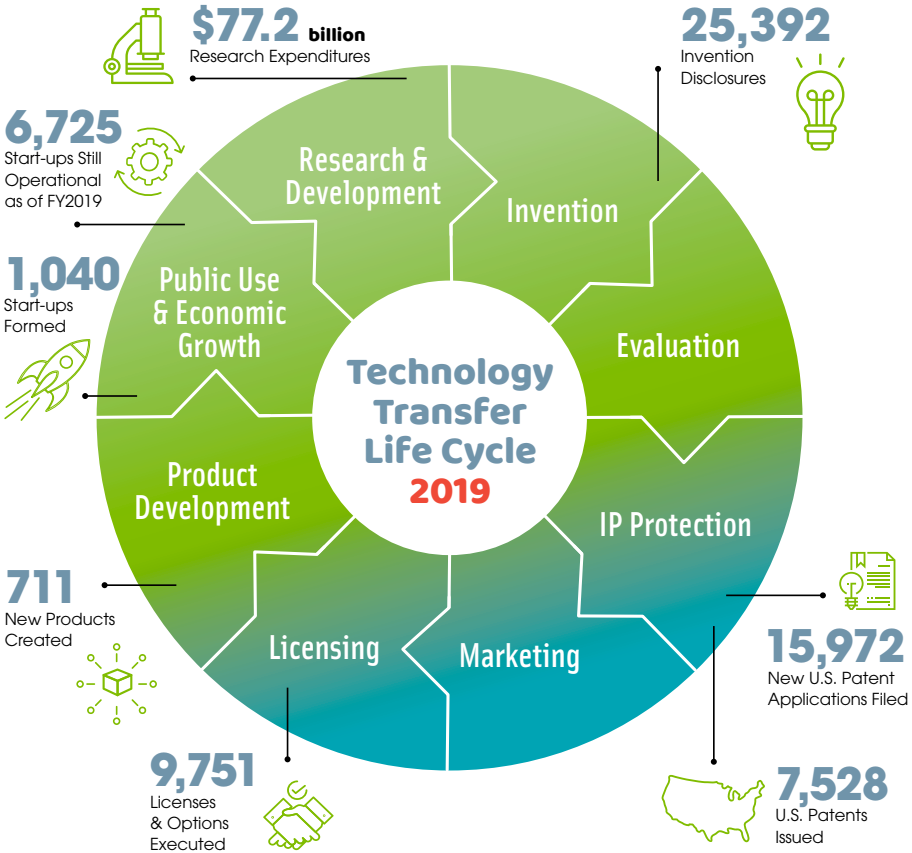
14,000+ **start ups formed**

67% of university licenses are to **start-ups and small companies**

200+ **drugs and vaccines developed** through public-private partnerships since **Bayh-Dole Act** enacted in 1980

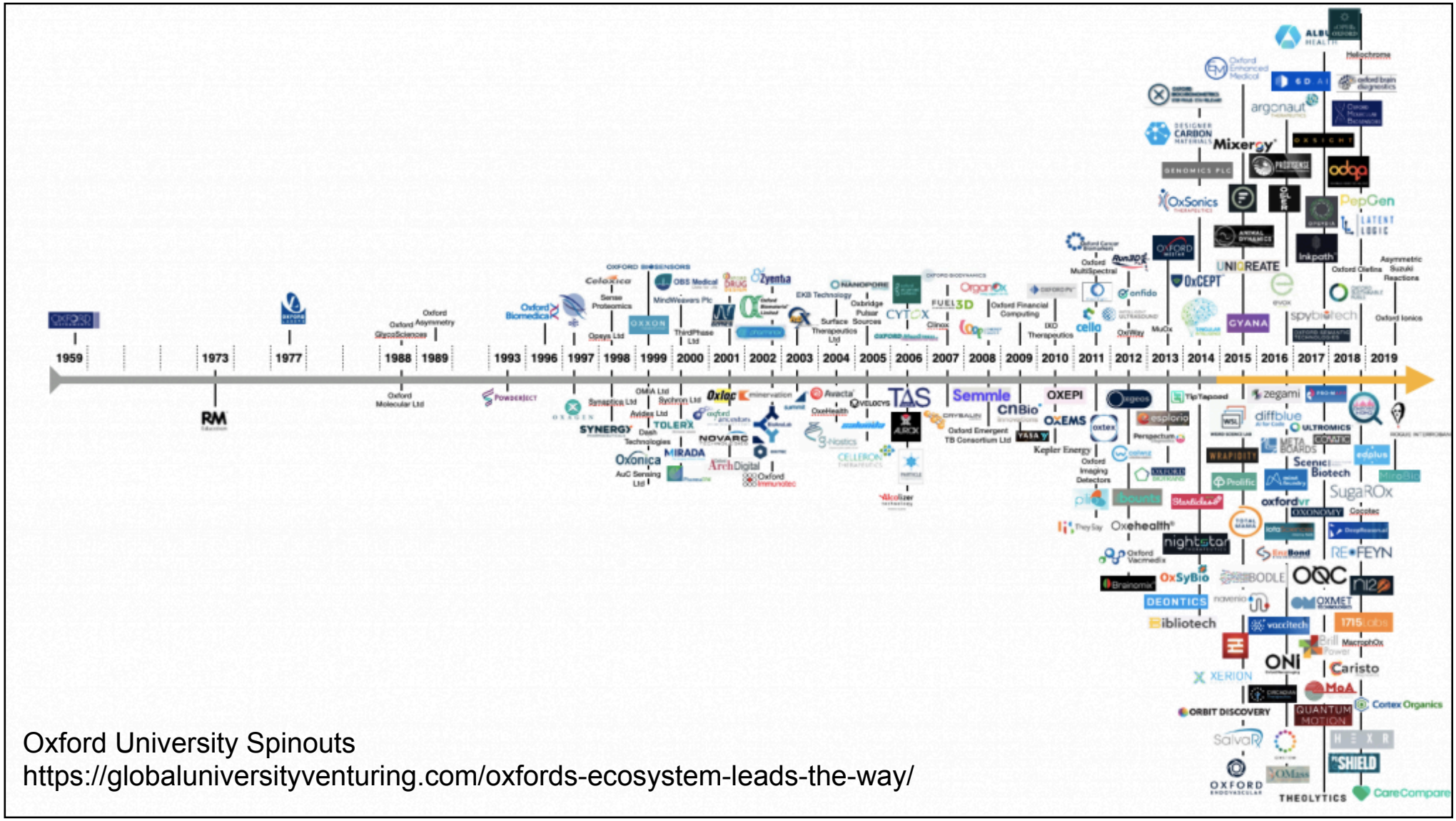
Benefiting Society and the Economy

Academic Technology Transfer For 2019



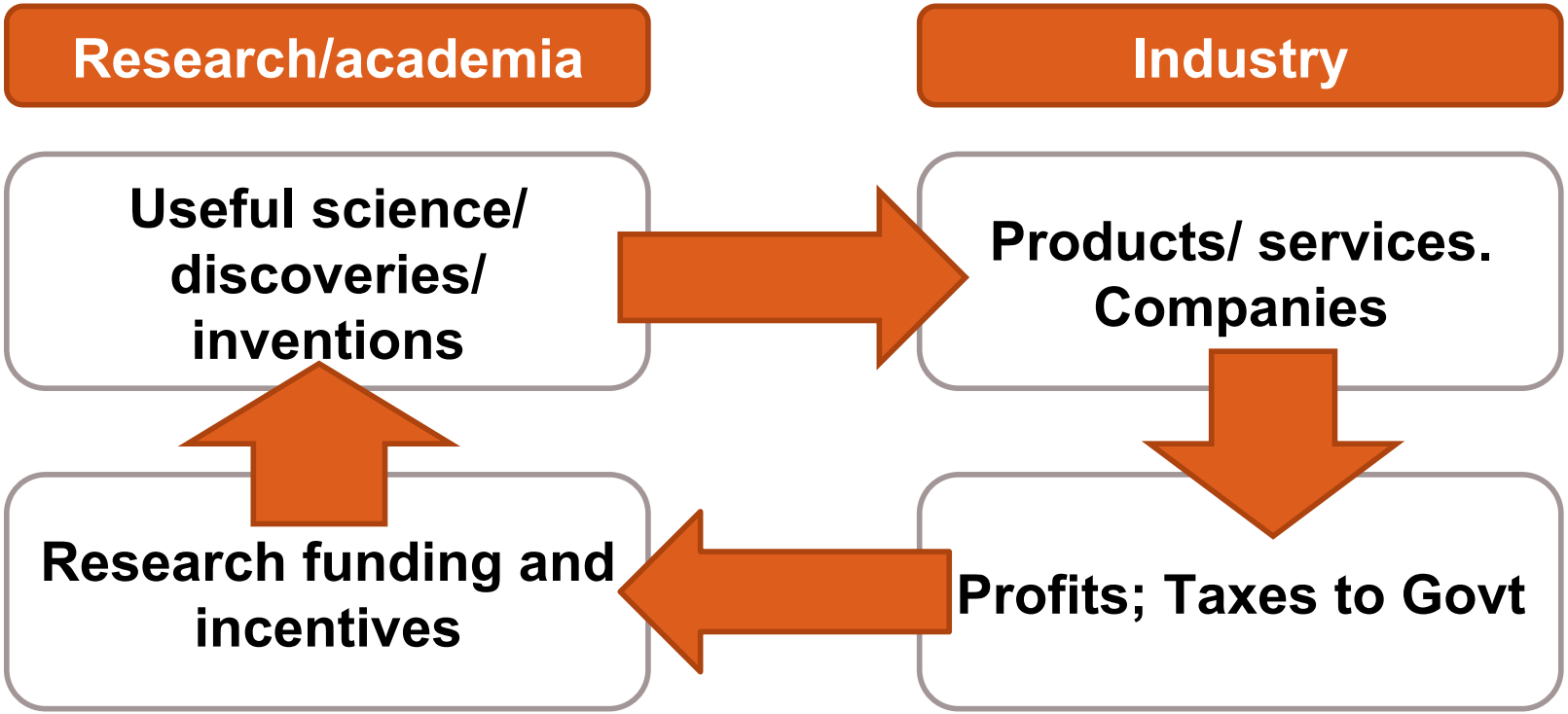
Source: https://autm.net/surveys-and-tools/surveys/licensing-survey/2019-licensing-survey

Source: Stanford University OTL



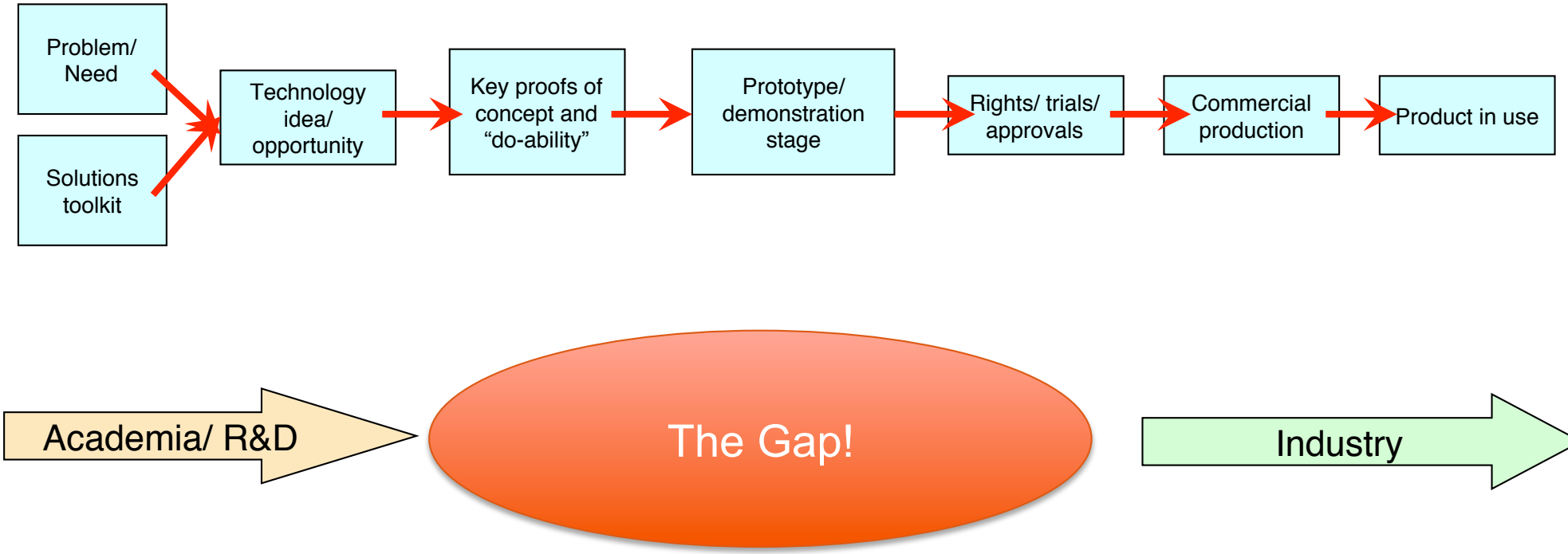
Oxford University Spinouts
https://globaluniversityventuring.com/oxfords-ecosystem-leads-the-way/

The virtuous circle:

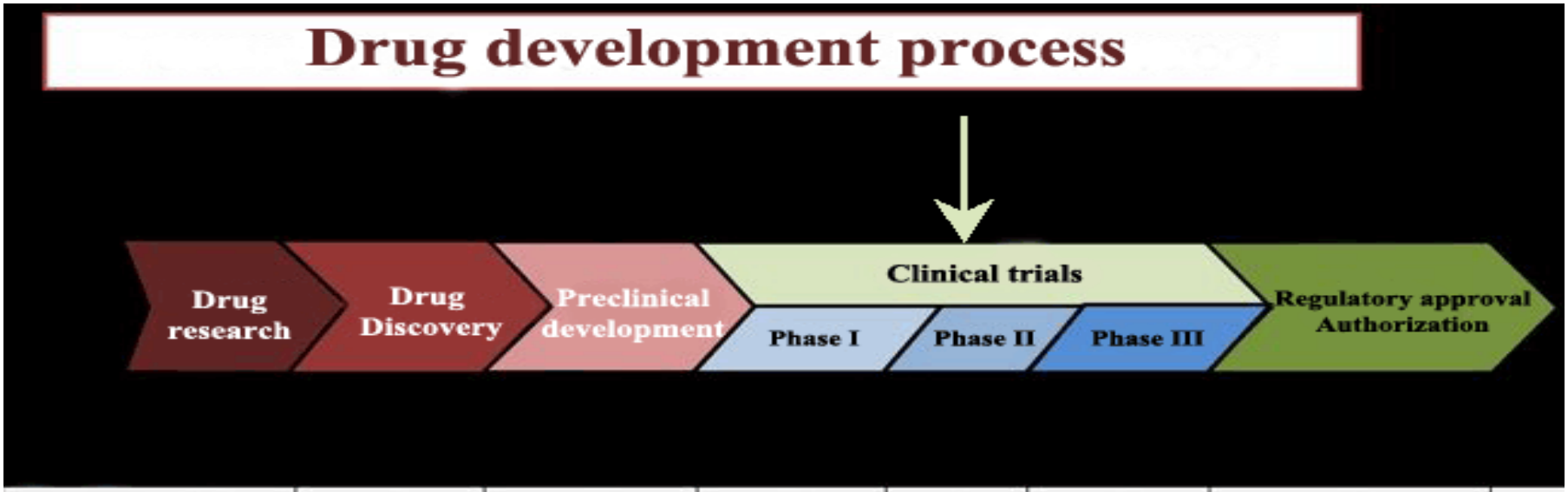


Reality strikes!

The gap: Interests, motivations, expectations, trust



De-risking in drug development



Time (years)	2,5	3	1	1,5	2	2,5	1,5
Cost (% total)	4%	15%	10%	15%	22%	31%	3%
Success probability		0,0001%	1-5%	10%	30%	80%	95%

Source: http://www.davidfunesbiomed.eu/2016/03/141-clinical-research-overview.html

The journey from science to technology can be long!

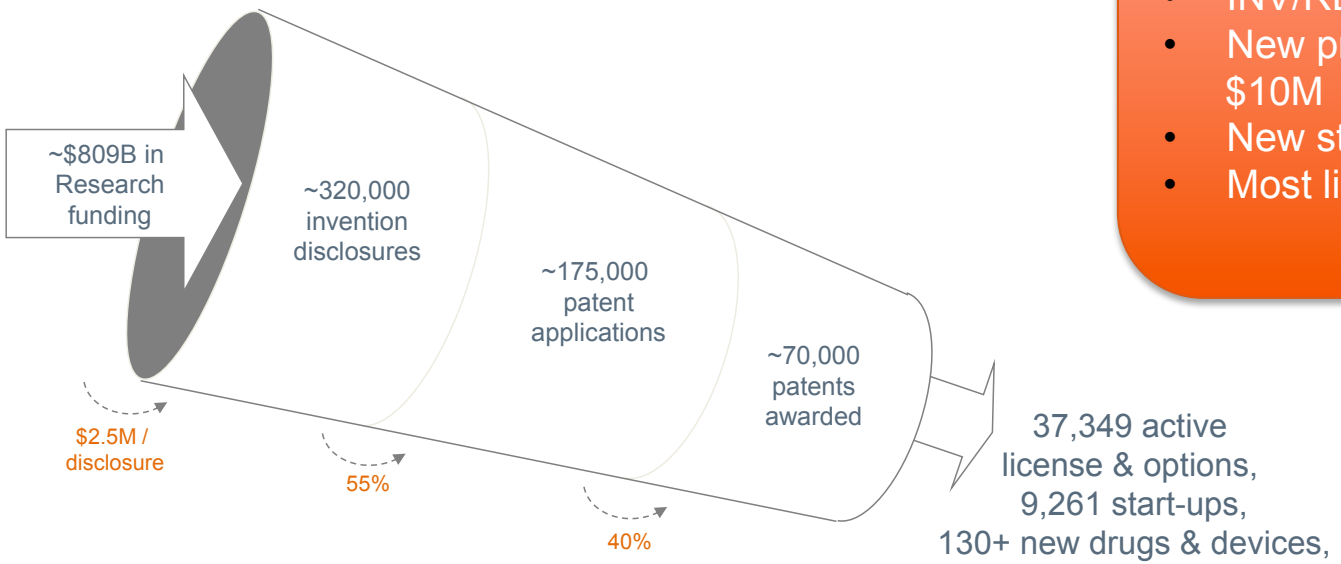
Table 1. Timeline for the Prediction and Discovery of the Raman Effect

Year(s)	Event	Year(s)	Event
1922–1927	Theoretical predictions	1971	First instrument with concave gratings introduced by Jobin Yvon
1928	Raman's publication in *Nature*	1972	Characteristics of triple spectrograph described
1934	Placzek's semi-classical theory	1973	Hirschfeld predicted femtoliter sampling
1939	Development of photomultiplier tube	1974	NBS described Microprobe at ICORS; Jobin Yvon exhibited the prototype MOLE
1953	Introduction of Cary 81	1980–1985	Triple spectrographs with multichannel detectors commercialized by Spex, Jobin Yvon, and Dilor
1961	Townes suggested use of HeNe laser as Raman source	1985	Bruce Chase and John Rabolt demonstrated FT–Raman systems with Nd:YAG laser (1064 nm)
1964	Weber, Porto reported first measurement with ruby and HeNe lasers	1990	Carrabba demonstrated holographic filter with small monochromator for acquiring Raman spectrum
1964	Perkin Elmer LR1 with HeNe laser	1991	CCD detectors introduced
1965	Cary 81 converted to accommodate the laser as excitation source; recorded spectrum of 0.25 μL-benzene sample	1992	Renishaw and Dilor introduced first commercially successful benchtop Raman systems
1965	Spex introduced 1401, double monochromator	1993	Stable 785-nm laser source and red-enhanced CCD for near-IR Raman
1966	Delhaye, Migeon proposed microfocusing	1994	Patent for confocal line-scanning issued
1968	First holographic gratings produced	2002	Combination Raman, FT–IR system introduced at Pittcon

Source: http://www.thermoscientific.com/en/product/truscan-rm-material-verification-analyzer.html

Where Do Universities Play in This Space

Cumulative Inputs and Outputs, 1991 – 2014, US Universities



AUTM CY 2018 data:

- RE: $72 billion
- INV/RE: ~ 4 per $10M
- New products/ RE: ~ 0.12 per $10M
- New startups/RE: ~ 0.15 per $10M
- Most licensing to SME

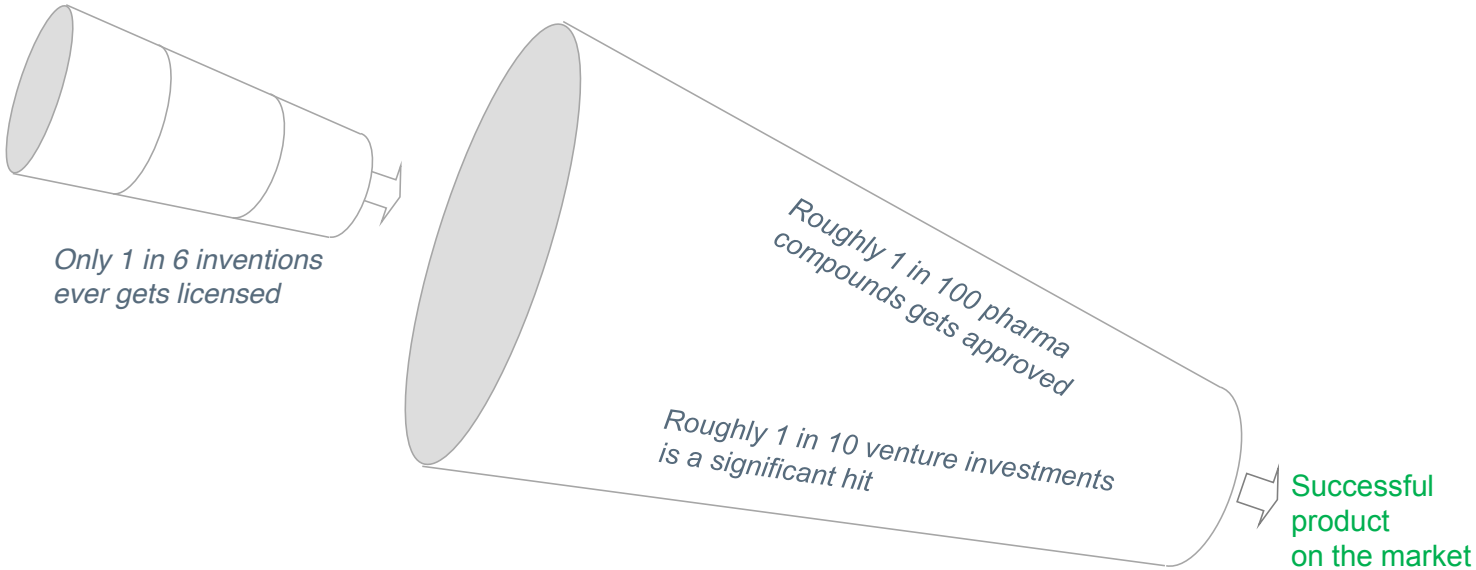
Source: AUTM Licensing Surveys (FY91- FY14)

Courtesy: Orin Hershowitz, Columbia Technology Ventures

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

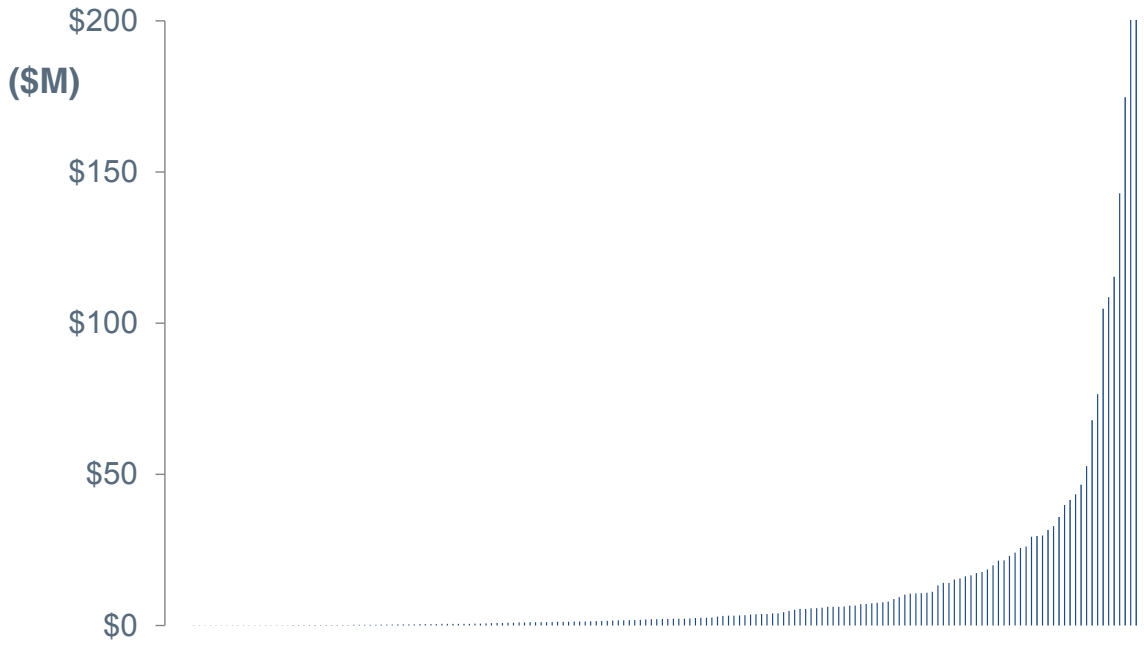
University's Funnel

Industry / VC's Funnel



Courtesy: Orin Hershowitz, Columbia Technology Ventures

Not Surprisingly, Commercial Success is Not Easy



155 U.S. Universities' 2014 Gross Licensing Revenue

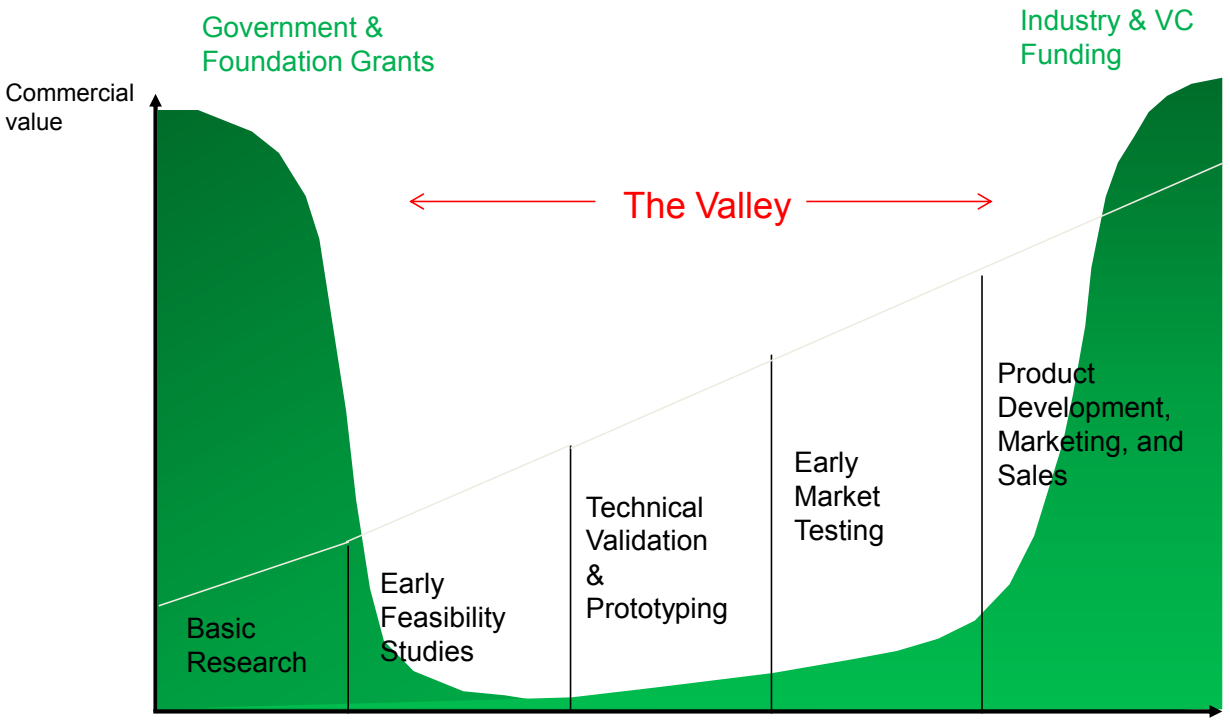
Source: AUTM 2014 Survey Data

Few inventions see the light of day!

Fewer still make any money!

Courtesy: Orin Hershowitz, Columbia Technology Ventures

What is “The Valley of Death”



Courtesy: Orin Hershowitz, Columbia Technology Ventures

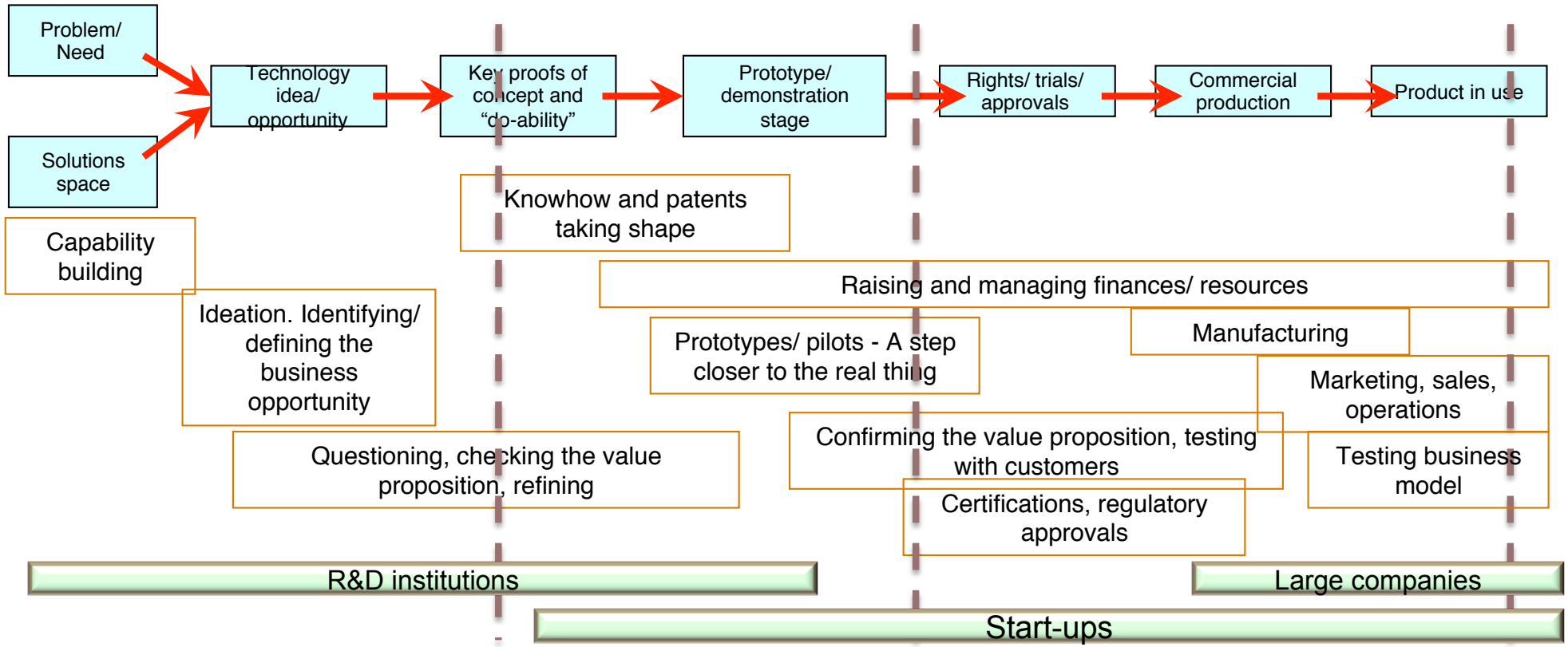
Learning to face & overcome the challenges

Innovation is a team sport!
A marathon and not a sprint

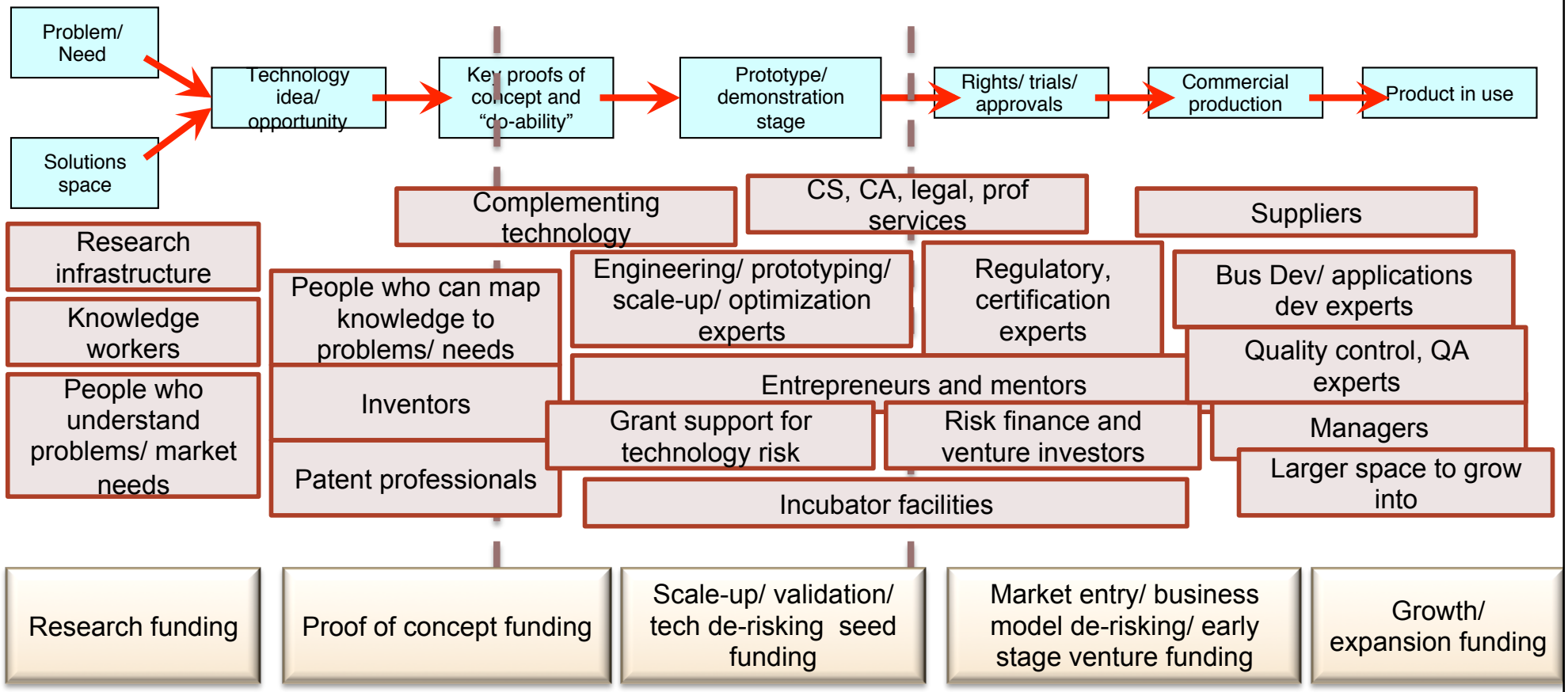
Usain Bolt
100 m dash

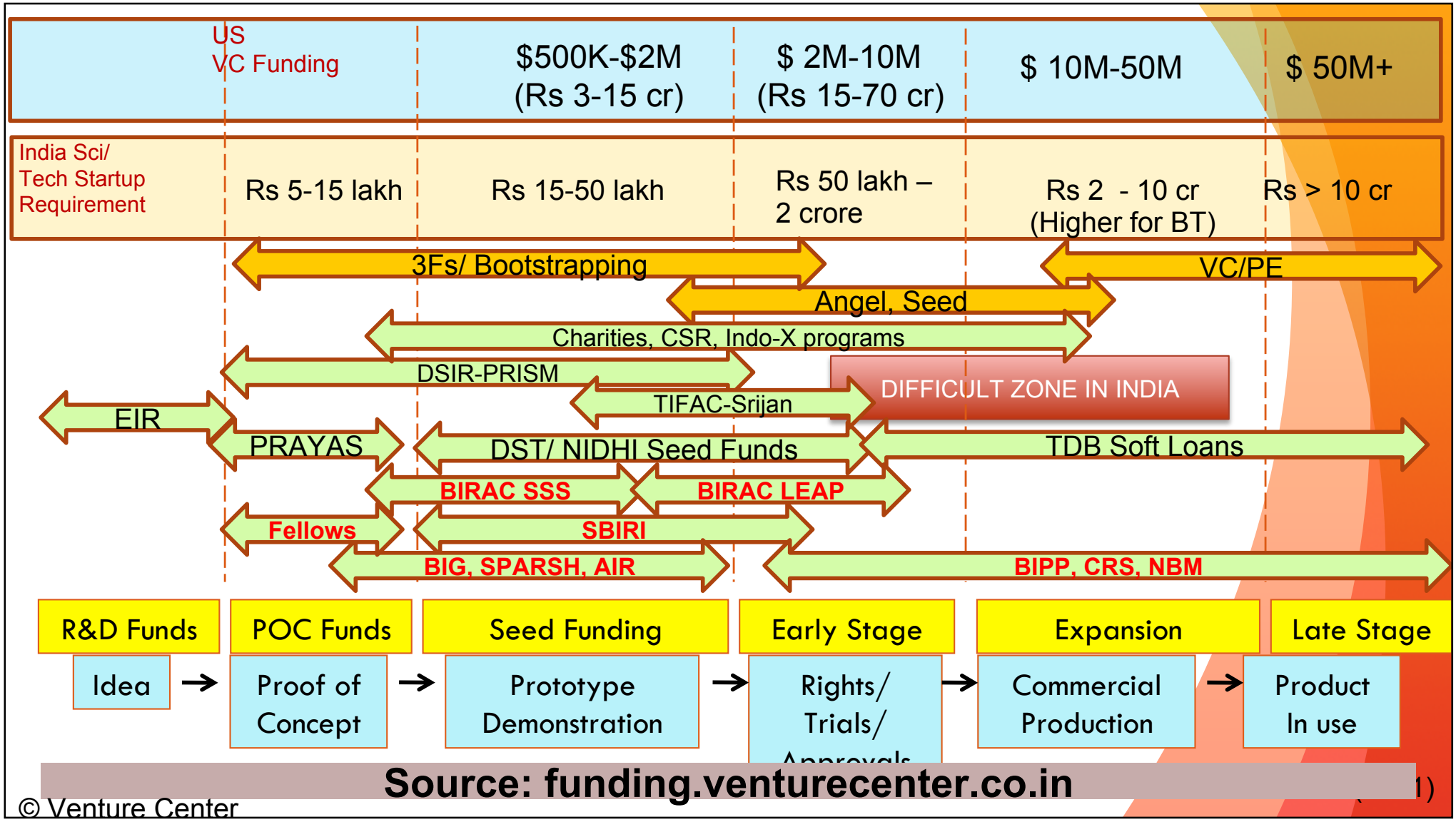
Eliud Kipchoge + 43 world class athletes
Marathon in 2 hours

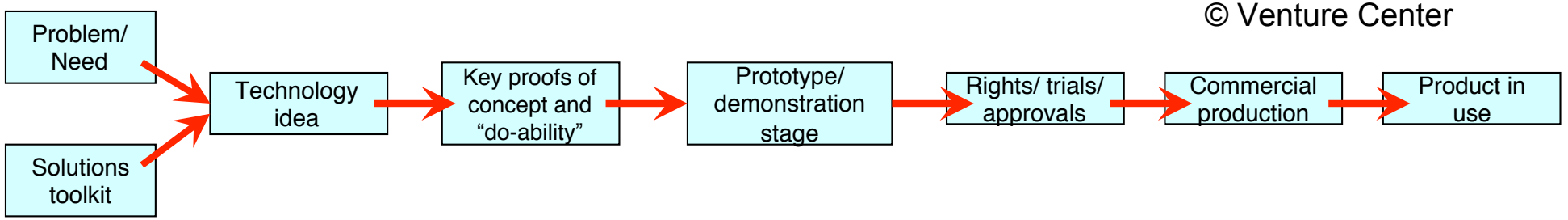
The innovation journey



Tech commercialization – The ecosystem

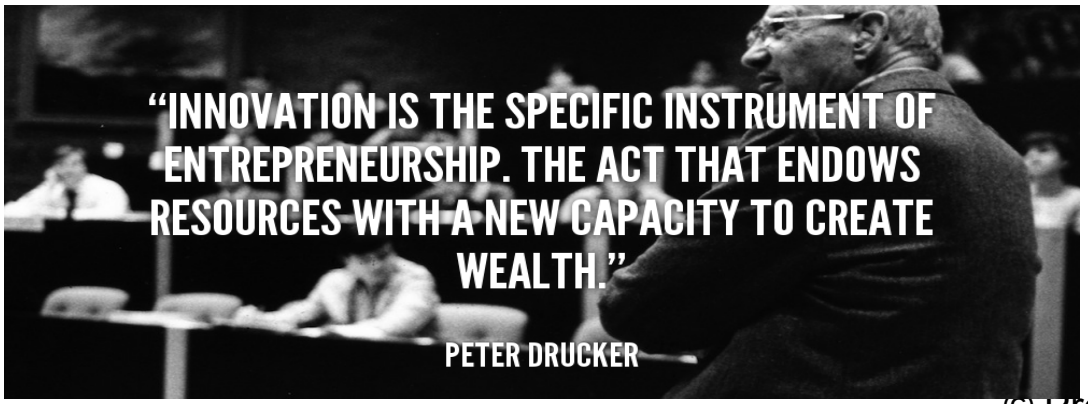



US
VC Funding
$500K-$2M
(Rs 3-15 cr)
$ 2M-10M
(Rs 15-70 cr)
$ 10M-50M
$ 50M+
India Sci/
Tech Startup
Requirement
Rs 5-15 lakh
Rs 15-50 lakh
Rs 50 lakh –
2 crore
Rs 2 - 10 cr
(Higher for BT)
Rs > 10 cr
3Fs/ Bootstrapping
VC/PE
Angel, Seed
Charities, CSR, Indo-X programs
DSIR-PRISM
DIFFICULT ZONE IN INDIA
TIFAC-Srijan
EIR
PRAYAS
DST/ NIDHI Seed Funds
TDB Soft Loans
BIRAC SSS
BIRAC LEAP
Fellows
SBIRI
BIG, SPARSH, AIR
BIPP, CRS, NBM
R&D Funds
POC Funds
Seed Funding
Early Stage
Expansion
Late Stage
Idea
Proof of
Concept
Prototype
Demonstration
Rights/
Trials/
Commercial
Production
Product
In use
Source: funding.venturecenter.co.in
© Venture Center

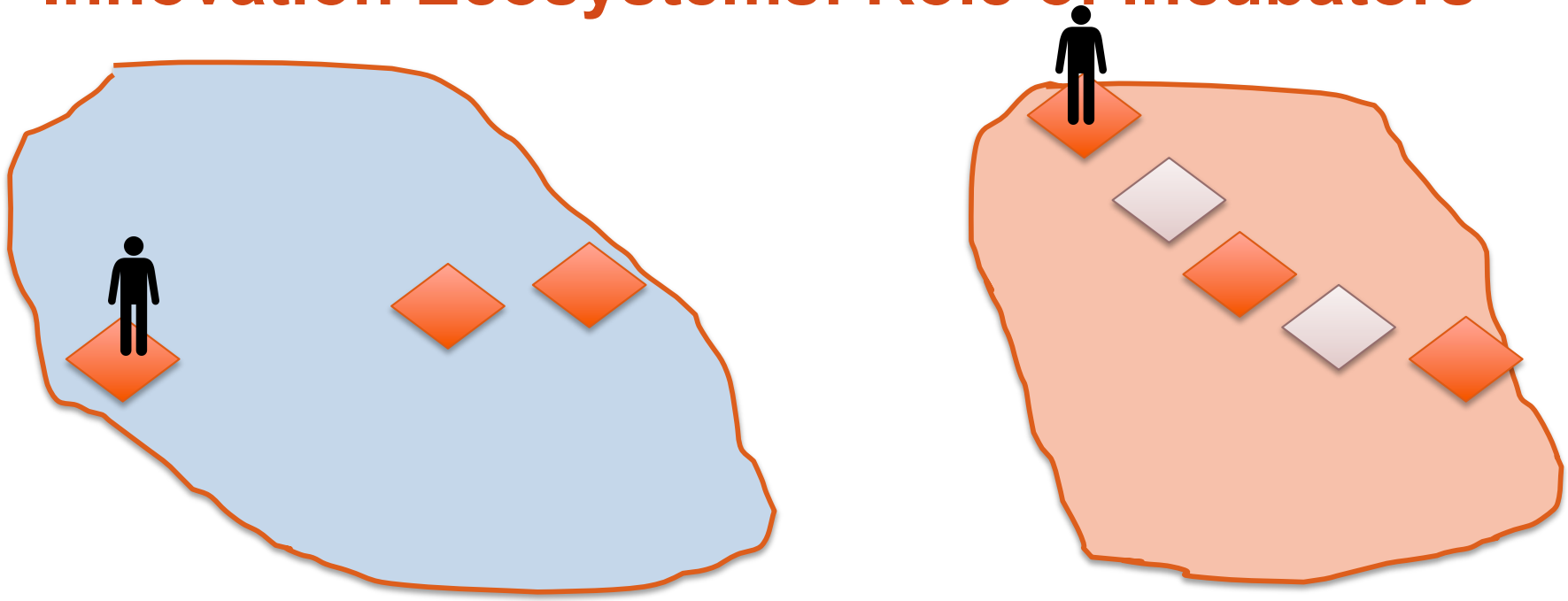


Invention

Entrepreneurship – The vehicle for delivering innovations in a sustainable and scalable manner!



Venture Center's Stepping Stone Model for Innovation Ecosystems: Role of incubators



Which pond? Which path? Which stones are missing? Fill in the missing stones.

Spin-out companies from CSIR-NCL

VENTURE CENTER

SERIGEN

OrthoCrafts

ZeroPlast

GENRICH Membranes Pvt. Ltd.

Silk Biomaterials | PLLA implants | Compostable packaging | Gas separation products

ABHIRUCHI PROBIOTICS
Your Health our Interest

GREENPYRAMID BIOTECH PVT LTD

BAREFEET ANALYTICS

Probiotics for humans and animals | Biosurfactant products | Food industry testing at scale

MODULE INNOVATIONS

FLUOROGENT ANALYTICS

ANNWESON SCITECH

Point of Care Diagnostics for UTI/AMR | Medical Diagnostics | TB Diagnostics

TECHNOLOGY LEADERSHIP

VENTURE CENTER STARTUPS

VENTURE CENTER

Leading Edge Technologies with Global Impact

Showcasing **Venture Center technologies** already in the market

Lessons

- **Innovation is very important for the socio-economic development of India.**
- **Tech transfer income is not a good indicator of economic value created by innovation! Innovation funding attracted by the idea is a better measure.**
- **But we need to have a more nuanced and less naïve understanding of innovation. Ecosystem in India is growing but we have lots to do.**
- **It is important to:**
  - Play a portfolio game & not look for winners upfront
  - Focus on attracting innovation funding & risk capital; rest will follow
  - Build supportive & rich ecosystems anchored by incubators
  - Value & nurture “entrepreneurs” as key success factors
  - It is a marathon and not a sprint

Intellectual Property

What is intellectual property?

Intellectual property rights

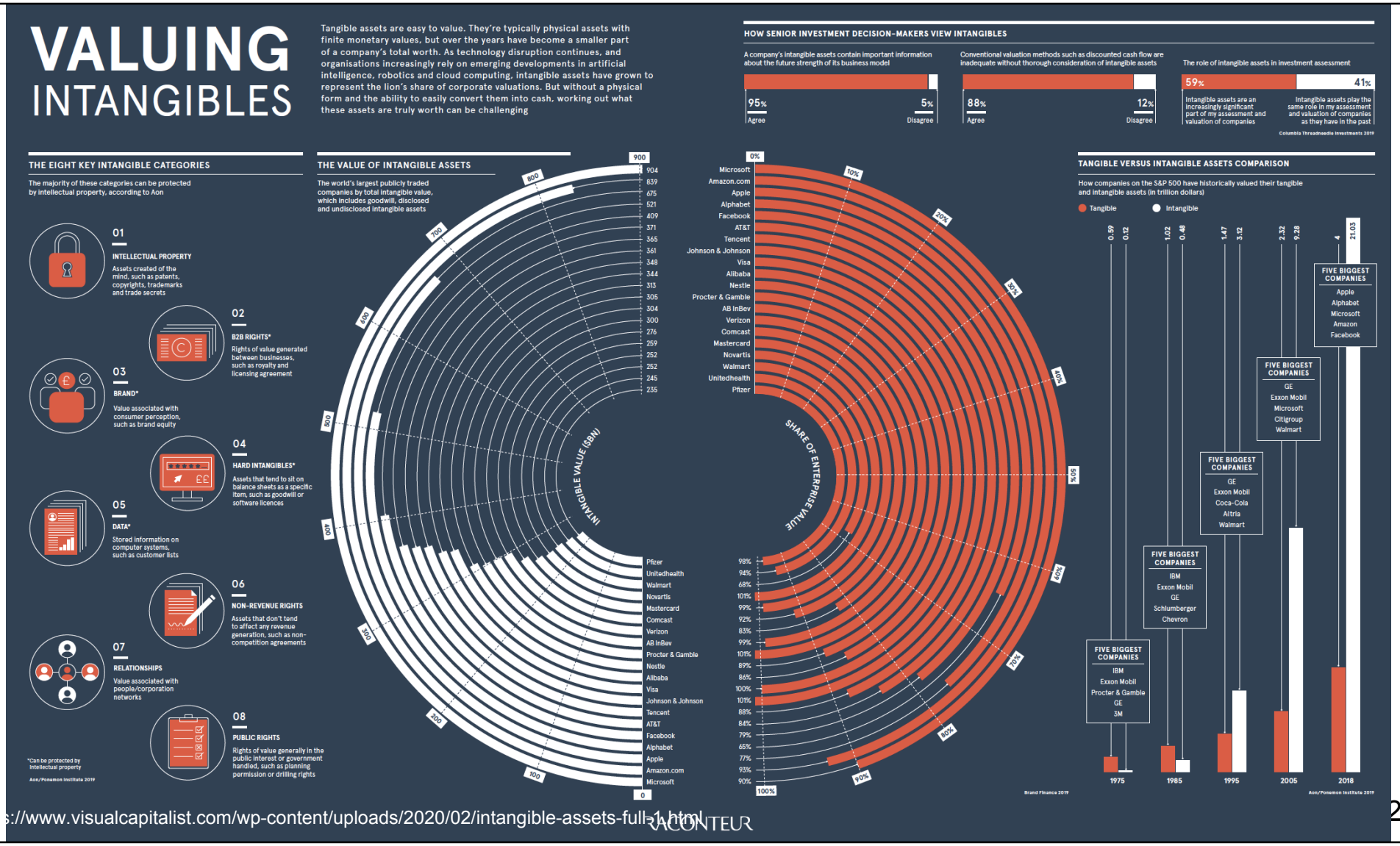
- **Intellectual Property** (**IP**) rights are the legally recognized exclusive rights to creations of the mind like inventions; literary and artistic works; designs; and symbols, names and images used in commerce

- For a limited period of time (varies for each IP)

- Rights are geographically limited to the region where the law applies. (Ex: Indian patents are valid only in India)

- Enable people to earn recognition/ strategic/ financial benefit from what they invent or create

Based on slide of Ashutosh Prachand (http://www.techex.in/)



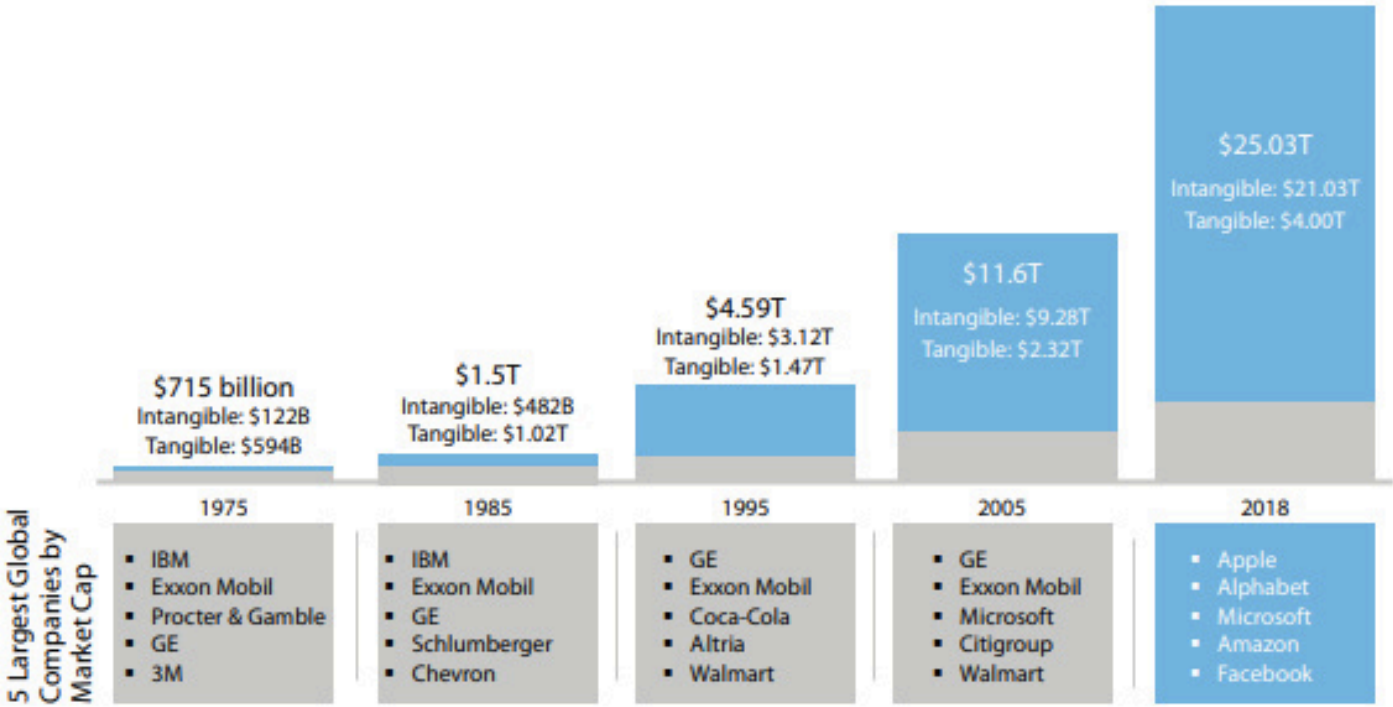
s://www.visualcapitalist.com/wp-content/uploads/2020/02/intangible-assets-full-1.html

21)

Tangible Assets vs. Intangible Assets for S&P 500 Companies, 1975 – 2018

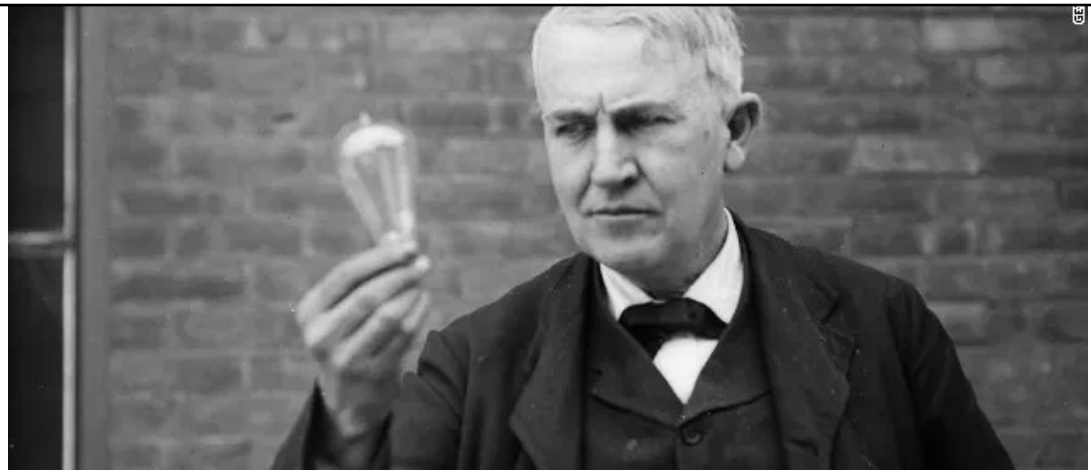
Tangible Assets
- Easy to value
- Thick & efficient secondary markets
- Insurable

Intangible Assets
- Difficult to value
- Thin & inefficient secondary markets
- Difficult to Insure



https://www.visualcapitalist.com/wp-content/uploads/2020/02/intangible-assets-full-1.html


SPECIAL ISSUE
Forbes
www.forbes.com
Billionaires
THE WORLD'S RICHEST PEOPLE
► MEET 64 NEW FACES OF MONEY
► BUFFETT CLOSES IN ON GATES
► LONDON'S BAD BOY BILLIONAIRE
FROM WELFARE TO WEALTH
HARRY POTTER CREATOR
J.K. ROWLING




This man is only going forward
to reach new levels
Neuralink
OpenAI
HyperLoop
SolarCity
Tesla
SpaceX
Paypal
X.com
Zip2
bevy

mnath V (2021)

Quick introduction to IP

No disclosure

- Trade secret: Not publicly disclosed. Information access controlled by CA/NDA.

Disclosure + formal rights

- Patent: Public disclosure. Right to exclude others for 20 years.
- Industrial design
- Copyright
- Trademark
- Plant varieties
- Others (circuit layouts, geographical indications)

One Product many IP rights

Trademark
- Logo
- iPhone
- Ringtones

Copyright
- Software
- User Manual
- Images (Icons)
- User Interface

Patents
- Pinch to Zoom
- Data processing methods
- Imaging techniques

Industrial Design
- Look of the phone
- Shape of buttons
- Shape of icons
- Display

Based on slide of Ashutosh Prachand (http://www.techex.in/)

Patents and their genesis

The deal between the State and the inventor

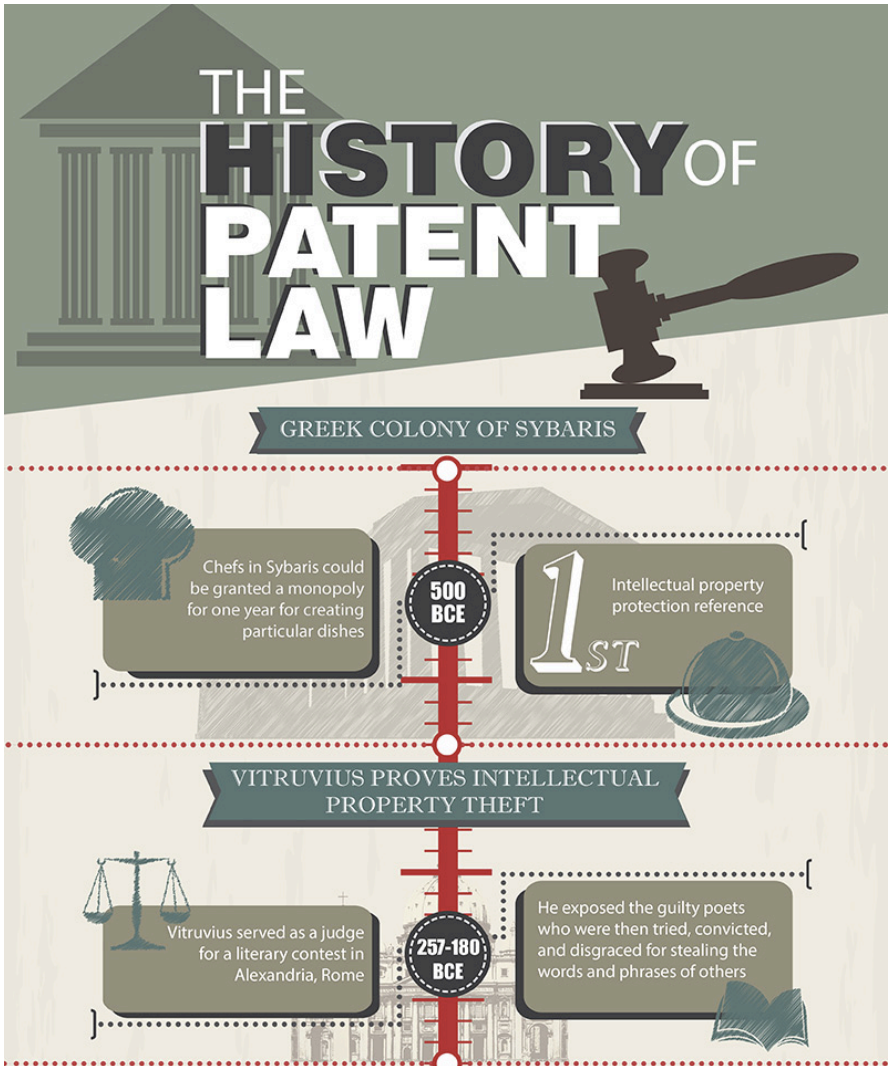
20 years to exclude others from practicing your invention

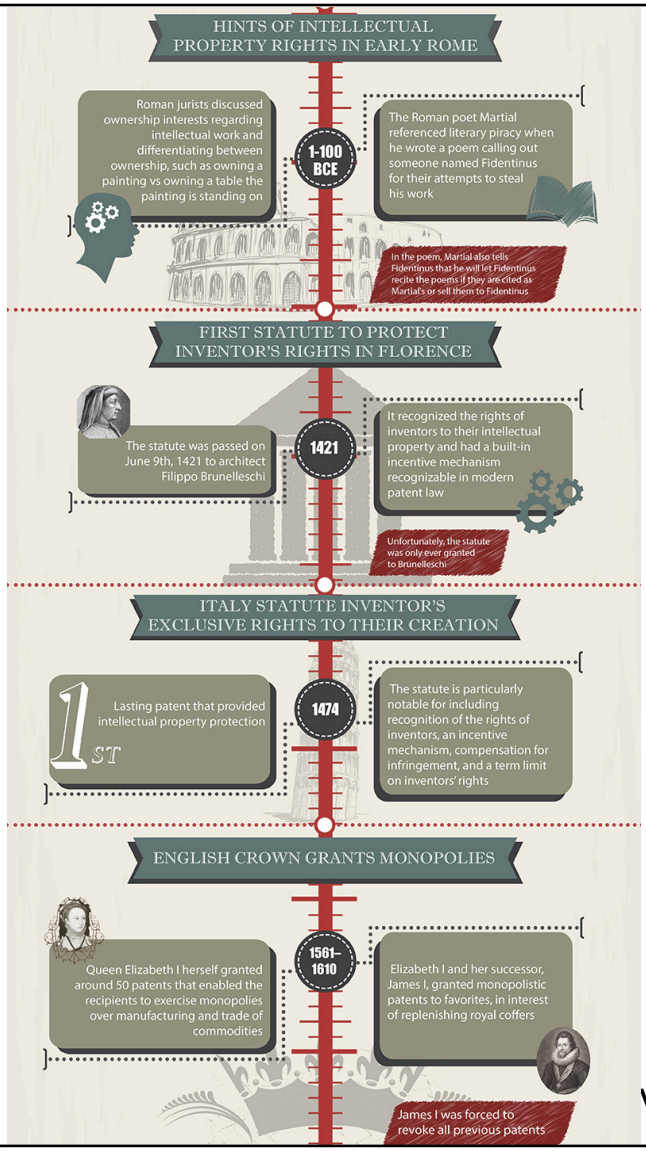
Full disclosure and

practice invention in the State

Why the deal?

- To accelerate the process of inventions in society
- To not loose inventions as a society because of non-disclosure
- To induce inventors to practice the invention in the jurisdiction.





https://onlinellm.usc.edu/blog/history-of-patent-law/

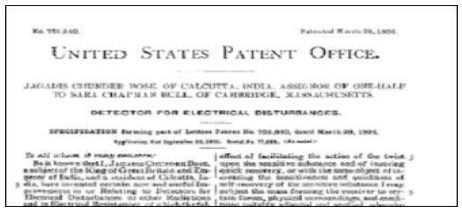
V (2021)

Patents – not really new to India!

M Visvesvaraya, 1899

Automatic gates

JC Bose, 1905

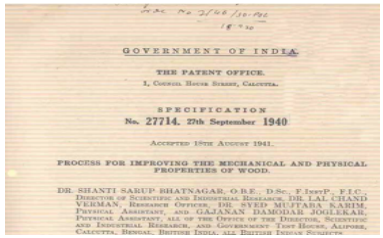


UNITED STATES PATENT OFFICE.

DETECTOR FOR ELECTRICAL DISTURBANCES.

First US patent granted to an Indian

SS Bhatnagar, 1930-1959



GOVERNMENT OF INDIA.

THE PATENT OFFICE.

SPECIFICATION

No. 27714. 27th September 1940.

PROCESS FOR IMPROVING THE MECHANICAL AND PHYSICAL PROPERTIES OF WOOD.

29 patents.
Industrial collaborations

The new role models

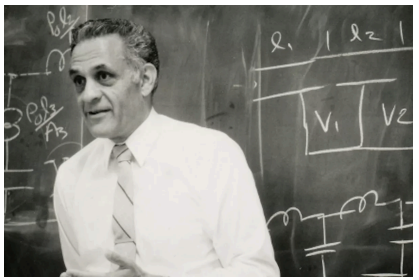
Frances Arnold, Cal Tech
Nobel Prize (2018)
Gevo, Provivi, Aralez Bio

Jennifer Doudna, UC-B
Nobel Prize (2020)
Mammoth Biosciences

Ugur Sahin & Ozlem Tureci
mRNA Vaccine for COVID19
BioNTech

Bob Langer, MIT
Patents 1400; h index 280
More than 20 startups

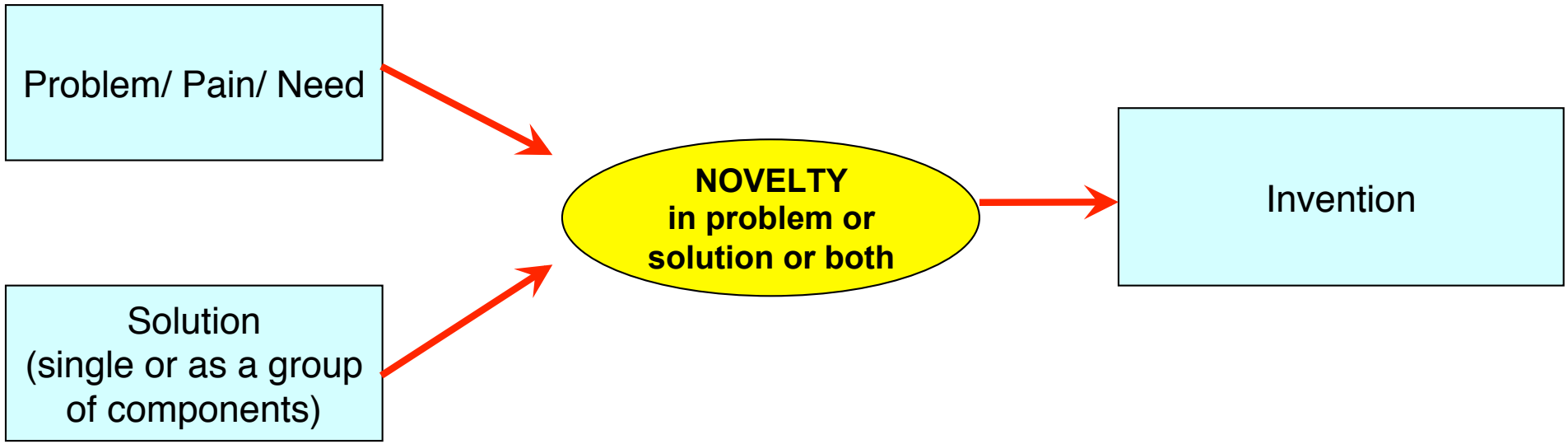
Richard Friend, Cambridge
1000 publications. 20 patents
3 startups



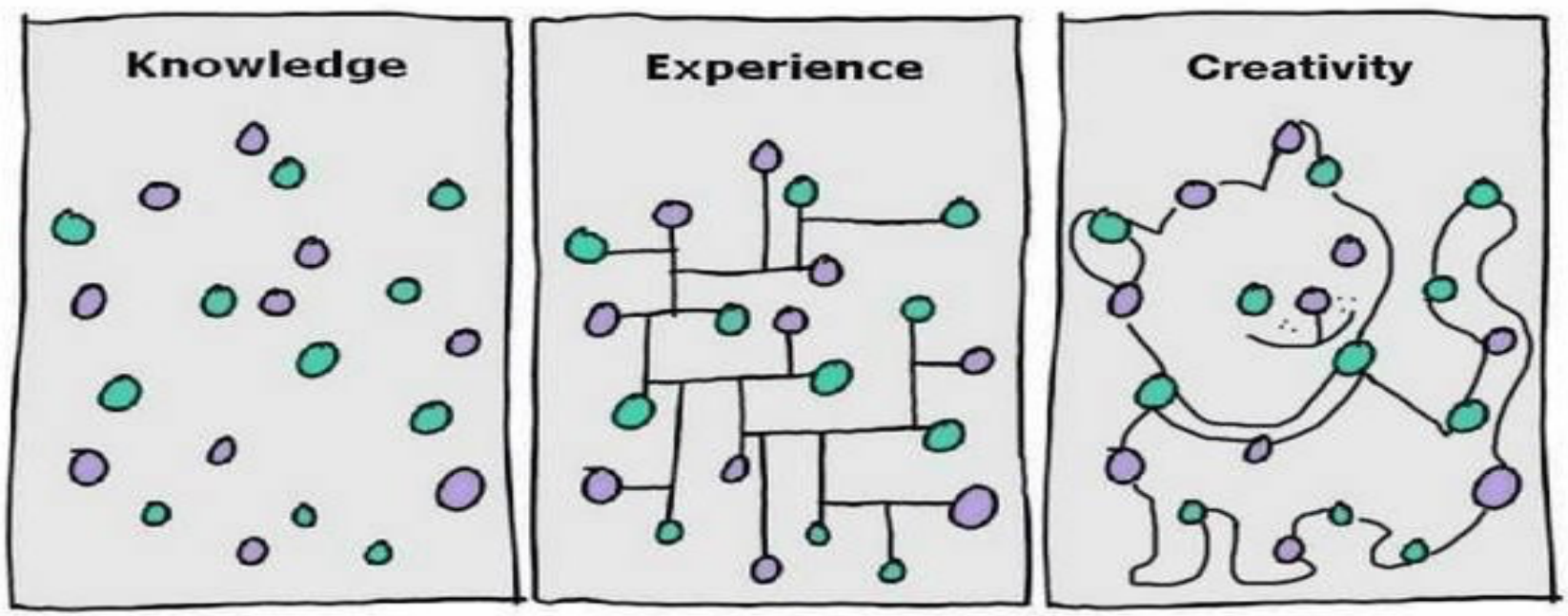
Amar Bose, MIT
Bose Corporation

Creating and identifying inventions

Technology & Invention: Connecting the dots!



Creativity in connecting the dots!



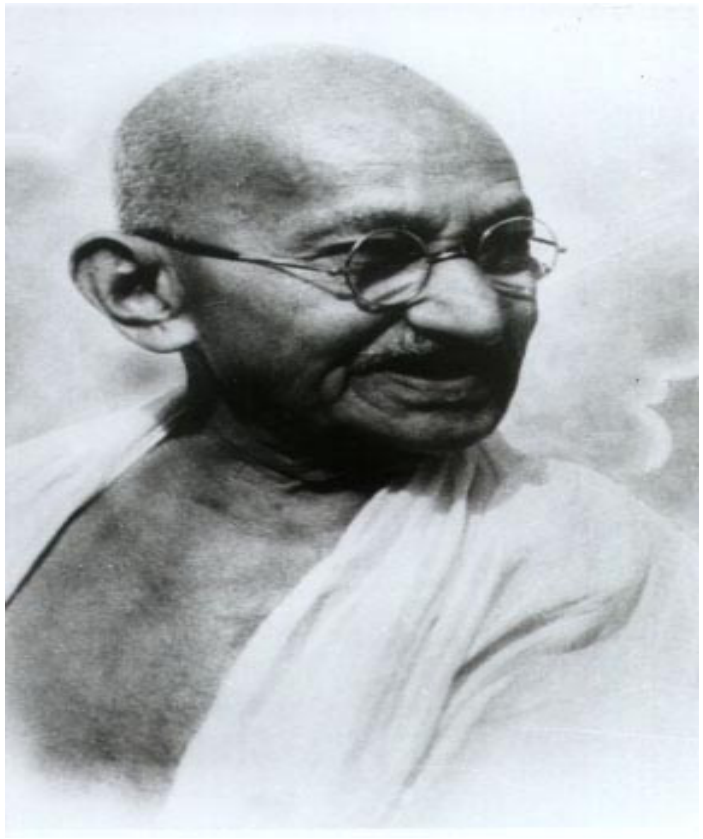
https://www.linkedin.com/pulse/knowledge-experience-creativity-dr-anadi-sahoo/

Spotting inventions

- Most patents/IP are ***incremental***. Do not glamorize "breakthrough" or "disruptive" inventions.
- As long as it serves the strategic/tactical needs of your company and the cost (cash and other costs) is within your reach, consider filing.
- Look for the aspects of your knowhow that are ***technically challenging*** or required a ***key insight/ connect*** (but could be very simple) to arrive at.
- ***Do not shoot down ideas too soon*** on "inventive step/ non-obviousness" grounds

Why you should care?

Patents help attract resources and partners to your ideas.
They actually put inventions in public domain.



"I would prize every invention of science made for the benefit of all.

Uses of patents for startups

- Protecting before disclosure to funding agencies/ investors/ incubators etc ➔ ***freely speak to funding agencies*** and investors.
- Providing ***sharper definition and credibility*** to the knowhow ➔ indicates some prior art assessment has been done.
- Creating ***pockets of value separate from the inventors*** ➔ patents ➔ reduces risks for investors; creates opportunities like licensing
- Indicating awareness and ***sensitivity to IP issues*** ➔ indicates focus on creating shareholder value
- ***Keeps doors open for you*** to pursue a line of R&D before somebody else closes the door on you.
- Tactical uses → ***Getting somebody to the discussion***/ negotiation table. Creating balanced positions.
- Claiming ***credit and visibility*** for your startup. Indicator of inventive capacity.
- Sustainable ***competitive edge*** ➔ hence, interesting for "investors"

In your innovation journey, reduce IP risk

- Do you have freedom to operate/practice? Any uncertainty there that needs checking? Do you need back up plans?
  - File early
  - Do a FTO analysis.
  - Research alternatives for sourcing, methods etc.

- What is the risk to your own patents/ IP getting granted? Contested? Invalidated?
  - Quality of drafting
  - Expedited grant

- What is the risk of somebody bypassing your IP?
  - Draft carefully. Structure claims smartly.
  - Create a portfolio instead of standalone IP

- Risk of theft of IP
  - Sign contracts with employees, partners etc
  - Sign NDAs with collaborators
  - Keep paper trail of sharing confidential information
  - File patents/ IP

Uses of patents for R&D Labs

- ***Keeps doors open for us*** to pursue a line of R&D before somebody else closes the door on you. Time to evaluate emerging technology opportunities.
- Sustainable ***competitive edge*** for licensors. Improves case for commercialization.
- Protecting before disclosure ➔ ***freely speak to other scientists, funding agencies*** and commercial partners.
- Claiming credit and visibility. ***Indicator of inventive capacity.*** Best marketing tool for even sponsored research contracts.
- Alignment with ***National IPR Policy***; Contribution to India's standing in the Global Innovation Index.
- Others

Sources of value in technology transfer

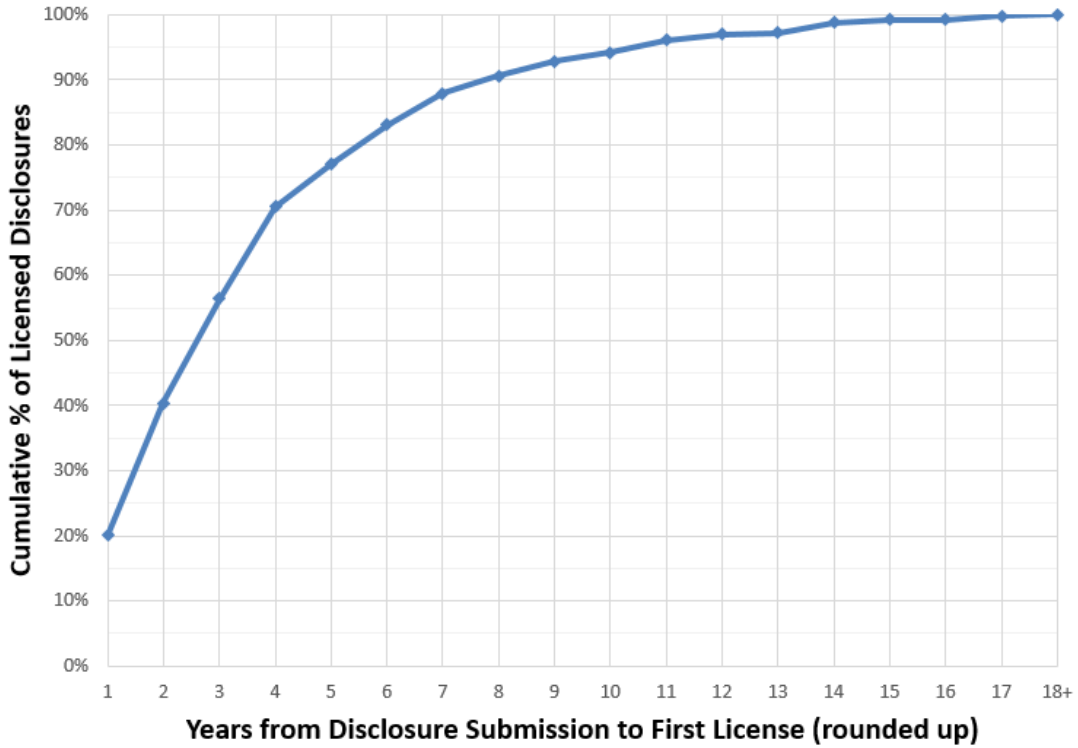
- Knowhow + Freedom to Operate

- Right to exclude others from practicing the art (valid patent rights) ➔ Source of sustainable, competitive advantage !

- Research and technical support for validating, scale-up, valorizing knowhow/patent rights and commissioning.

Inventions Often Take Years to Get Licensed:

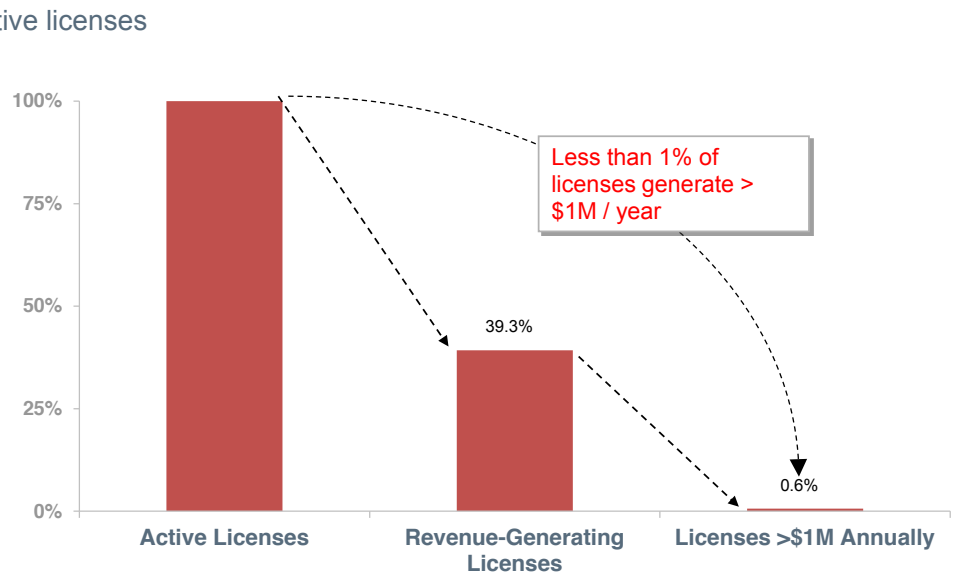
Only ~55% of Deals Done by Year 3, only 85% by Year 6



Source: Review of elapsed time from invention submission to executed license, for ~400 executed licenses covering ~700 inventions, 1982 until 2014 (32 years)

Courtesy: Orin Hershowitz, Columbia Technology Ventures

“Blockbusters” Drive Most of the Revenue, But are Rare

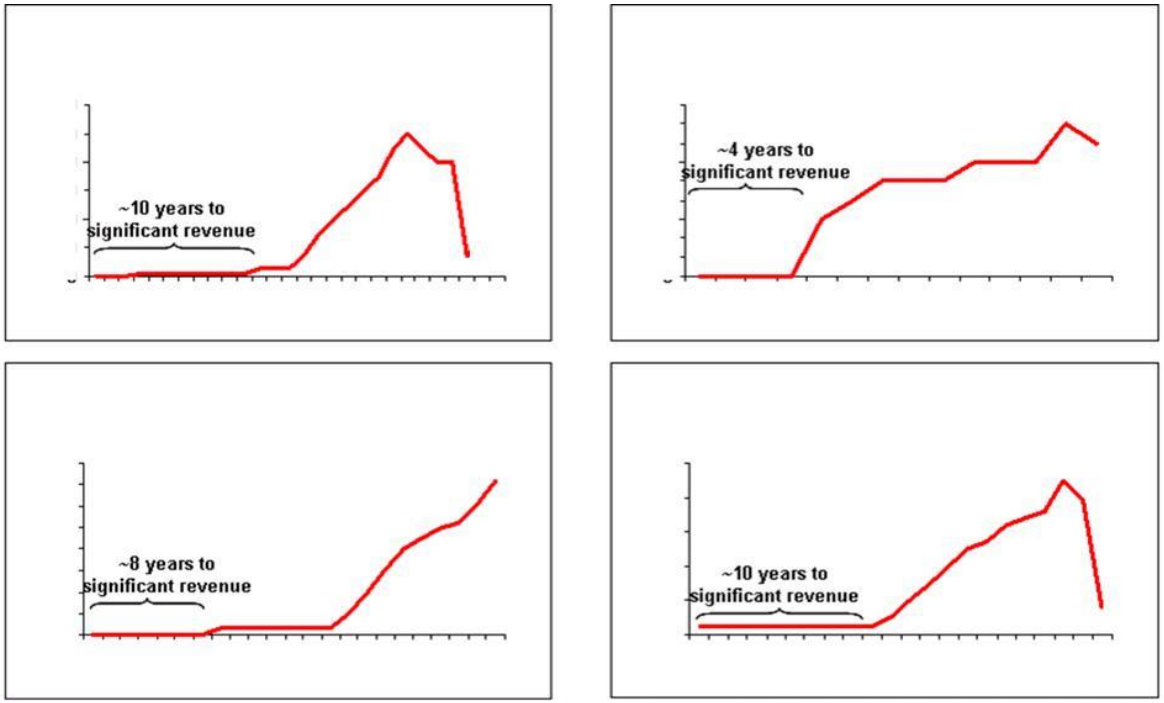


Source: AUTM Licensing Survey (FY04)

Courtesy: Orin Hershowitz, Columbia Technology Ventures

“Big Winners” Take Many Years To Develop ... And Aren’t Always Obvious at the Time

Columbia’s Four Biggest Revenue Producers
(Revenue per Year)



Courtesy: Orin Hershowitz, Columbia Technology Ventures

Lessons

- **Intangible assets rule the world today.**
- **IP is crucial in an economy dominated by intangible assets.**
- **For people in scientific R&D and scientific entrepreneurship, inventions hold a special place.**
- **Patents are the top IPR for protecting inventions**
- **R&D institutions and startups need to build IP portfolios smartly.**
  - Look out for IP opportunities
  - Do not neglect IP. They are reasons why somebody will invest serious resources on your own ideas!
  - Play a portfolio game & do not look for winners upfront
  - Invest to create “Technology Options” and keep door open long enough to explore/reveal commercial potential
  - Ideas take time to show results. Be patient.
  - Success is not entirely in your hands. The ecosystem matters.

Final word

A better mindset –

I want to see my ideas in use.

Can my ideas attract –

- innovation funding to advance the idea
- risk capital investment to advance the idea
- Industry partners to advance the idea
- full-time entrepreneurs to advance the idea

I will start by protecting my ideas to make my idea an attractive candidate to invest in.

Contact for more details

Premnath V, *PhD*

+91-20-2590-2986

director@venturecenter.co.in