

MAI4CAREU

Master Programs in Artificial Intelligence for Careers in EU (MAI4CAREU)

Master Programs in Artificial Intelligence for Careers in EU (MAI4CAREU)

MAI 622: AI Entrepreneurship

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University of Cyprus
Department of Computer Science

Course Objective



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Department of Computer Science

Help students master concepts of relevance to AI and Data-driven entrepreneurship, by:

- Introducing basic **terminology** and **concepts of innovation, entrepreneurship, and intellectual property**
- Discussing **case studies** of turning ideas to successful companies, and **visions** for the future of AI
- Learning and practicing steps entailed in **start-up foundation**, as captured in MIT's **Disciplined Entrepreneurship** methodology.
- Understanding and practicing **business model development**.
- Learning how to **pitch** to attract investment

M. D. Dikaikakos

Learning Objectives



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After taking this course, students should be able to:

- Recognize and describe **key concepts** and **terminology** related to **innovation, entrepreneurship, AI** and **data-driven economy**.
- Understand and explain the **interplay** between **AI, Machine Learning, Big Data**, and various **application domains**.
- Analyze, evaluate and propose **entrepreneurial ideas**, especially for innovative products, processes or services based on AI, and **apply the key stages of turning an idea or invention** into a **commercial product**.
- Understand issues of **Intellectual Property (IP)** and methods for **IP protection**.
- Understand the basics of **incorporation** and **company structure**.
- Understand the key challenges for **attracting talent, establishing and managing a startup team**.

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Learning Outcomes and Acquired Skills



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The students who complete this course successfully, will be able to:

- Understand, describe and apply methodologies and tools for innovative entrepreneurship, such as the **Disciplined Entrepreneurship Methodology**, the **Lean Product Methodology** and **Lean AI**.
- Understand and **create Business Models** using the **Business Model Canvas**.
- Define and apply techniques for **market analysis, product design, value proposition definition, customer acquisition, pricing** products or services, and **sales**.
- Understand the basics of **fundraising** and **financing options** for startups.
- **Prepare pitch decks**, and **pitch** in front of potential investors, an AI-related business idea/product/service.
- Use state-of-the-art **collaboration, ideation** and **rapid prototyping tools**.

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Web Site



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Department of Computer Science

MAI4CAREU MAI622: AI Entrepreneurship Spring Semester 2023
Homepage

Homepage Syllabus Resources Assignments Contract Moodle Online Forum

Objectives

This course is part of the new M.Sc. in Artificial Intelligence, developed as part of the [Master programmes in Artificial Intelligence 4 Careers in Europe](#), and is offered within the network of partner universities promoting new careers in AI for students from any EU country.

The course aspires to help students explore and master key concepts and challenges of relevance to AI and Data-driven entrepreneurship. It introduces students to the world of high-technology entrepreneurship through case studies that demonstrate successes, failures, and challenges. The course provides also an overview of, and an introduction to key steps to develop a start-up, design a business model, explore product-market fit, manage intellectual property, and attract investment. Students will explore acknowledged innovation-driven entrepreneurship methodologies and experiment with them and associated tools to pursue the translation of their ideas into entrepreneurial endeavors. The course examines issues faced by Start-up Founders and Chief Technology Officers who need to innovate at the boundaries of AI, Information Technology, and Business by understanding all perspectives.

Instructor: Professor Marios D. Dikaikakos.

Teaching Assistant: TBA

Prerequisites: none

Lectures: Monday, 15:00-18:00, B101 Lab, @EE01

Recitation: Wednesday, 16:00-17:00, B101 or as announced in [C4E News and Events](#).

Announcements and Communication: [Discord](#)

<http://www.cs.ucy.ac.cy/courses/MAI622/>

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MAI4CAREU MAI622: AI Entrepreneurship Spring Semester 2023
Syllabus

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Course Syllabus

Module 1: Innovation, Entrepreneurship, and AI

Topic 1.1 **Key Concepts of Innovation and Entrepreneurship** • Learning Objective • Readings • Videos

Topic 1.2 **Technological Innovation Ecosystems** • Learning Objective • Readings • Videos

Topic 1.3 **From Invention to commercial product: Disclosure, Novelty, Competition, Risk** • Learning Objective • Readings • Videos

Topic 1.4 **Teams and Ideas: team formation, idea selection and development** • Learning Objective • Readings • Videos

Module 2: Business Modeling

Topic 2.1 **Business Model Canvas** • Learning Objective • Readings • Videos

Topic 2.2 **Mission Statement** • Learning Objective • Readings • Videos

Topic 2.3 **AI Companies** • Learning Objective • Readings • Videos

Module 3: Disciplined Entrepreneurship

Introduction to 24 Steps

Topic 3.1 **Disciplined Entrepreneurship: Overview of 24 Steps** • Learning Objective • Readings • Videos

Theme 1: Who is your customer?

Topic 3.2 **Steps 1, 2, 3: Market Segmentation** • Learning Objective • Readings • Videos

Topic 3.3 **Steps 4, 5: Beachhead Market Analysis and End User Profiling.** • Learning Objective • Readings • Videos

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Resources

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Resources

Centre for Entrepreneurship

- [C4E Web site](#).
- [Announcements of Seminars and Activities](#).
- [The Student Innovators Competition - SINN2021](#).

Textbooks

- Bill Aulet, "Disciplined Entrepreneurship." Wiley, 2013.
- Dan Olsen, "The Lean Product Playbook. How to Innovate with Minimum Viable Products and Rapid Customer Feedback." Wiley, 2015.
- Alexander Osterwalder and Yves Pigneur, "Business Model Generation." Wiley, 2010.
- Kai-Fu Lee and Chen Qiufan, "AI 2041: Ten Visions for Our Future." Currency, 2021.
- Ash Fontana, "The AI-First Company: How to Compete and Win with Artificial Intelligence." Penguin, 2021.

Learning Material - Slides

- [Learning Material \(slides etc\)](#) from the Master programmes in Artificial Intelligence 4 Careers in Europe – University of Cyprus.

Suggested Readings

The Impact of AI

- Kai-Fu Lee, "AI Superpowers: China, Silicon Valley, and the New World Order." Houghton Mifflin Harcourt, 2018.
- Henry Kissinger, Eric Schmidt, Daniel Huttenlocher, "The Age of AI And Our Human Future." John Murray, 2021.
- Cassie Metz, "The Genius Makers: The Mavericks Who Brought AI to Google, Facebook, and the World." Random House Business, 2021.
- Eric Topol, "Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again." Basic Books, 2019.
- Cathy O'Neil, "Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy." Crown, 2016.
- Brad Smith and C.A. Browne, "Tools and Weapons: The Promise and the Peril of the Digital Age" Penguin, 2019.

Entrepreneurship Methodologies and Workbooks

- Bill Aulet, "Disciplined Entrepreneurship Workbook." Wiley, 2017.

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Assignments

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Assignments and Guidelines

Below you will find the list of the course's compulsory assignments, with details about what is expected and how the assignments will be graded.

Guest Lectures' Reports

Students are expected to submit at least **three write-ups** after attending a selection of guest lectures, which are part of the [Series of Lectures in Innovation and Entrepreneurship \(KEP101\)](#) of the Centre for Entrepreneurship. Besides the lectures organized in the context of KEP101, the Centre may announce in its [Facebook Page](#), talks or seminars organised by other entities, inside or outside the University, which are labeled as "C4E101 Approved." You are entitled to attend these lectures and submit a writeup about them; alternatively, in each write-up, the points you need to address are:

- What are the three most useful things that you learned from this guest speaker or session that you didn't know before, or that you hadn't thought about much before, and that you think you are likely to carry with you going forward?
- What surprised you most?
- What did you like most about the speaker or the session?
- What did you not like most about the speaker or session?
- Do you think we should invite this speaker back in future semesters? Any other reasons than the above why or why not?

Case Study Business Model

Students working in groups of 3-4 people will undertake the study of a chapter from the book by Kai-Fu Lee and Chen Qiufan, "[AI 2041: Ten Visions for Our Future](#)".

Each group is expected to:

1. Identify a business opportunity arising from the chapter's story.
2. Prepare and submit the **Mission Statement** for a startup targeting the identified business opportunity.
3. Prepare, submit, and present a **business model canvas** for the proposed startup.


Group project

Students working in groups of 3-4 people are expected to come up with an entrepreneurial idea driven by AI technology with a strong exploitation potential and explore its transformation into a business venture or a social enterprise. The teams are required to apply the 24 steps of the Disciplined Entrepreneurship methodology, to develop a strong business and technology development plan and prepare a final oral presentation to seek funding (Venture Capital pitch), which will be submitted for participation to the Student Innovators Competition SINN (see the [SINN 2022](#) announcement for more information). The Group project comprises four deliverables:

- **Mission statement:** A report on the mission statement of the envisioned company, which clarifies your purpose and planning.
- **Midterm report:** This presents the first layout of the business model and product offering, and is expected to evolve throughout the semester as each team validates its initial

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Contract

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Instructor: Dr. Marios D. Dikaikakos, Professor
Teaching Assistant:
ECTS Credits: 0
Semester: Spring
Academic Year: 2022-2023
Course Level: Post-graduate.
Course Type: Restricted choice, Free Elective.
Programme of Study: Compulsory course for the M.Sc. in Artificial Intelligence; Advanced Elective for the M.Sc. in Data Science, M.Sc. in Computer Science, Professional M.Sc. in Advanced Information Technologies, and Ph.D. of the University of Cyprus.
Prerequisites: None.
Language of instruction: English.
Online Forum: Discord
Class Scheduling and Assignments: Moodle
Teaching Schedule: Three hours of lectures and one hour of recitation per week.
Lectures: Monday, 15:00-18:00, B101 Lab, OEE01.
Recitation: Wednesday, 16:00-17:00. Meetings will take place in B101. For information on Centre for Entrepreneurship Seminars please consult with their News and Events announcements.

Objectives

This course aspires to help students explore and master key concepts and challenges of relevance to AI and Data-driven entrepreneurship. The course introduces students to the world of AI entrepreneurship through case studies that demonstrate successes, failures and challenges. The course provides also an overview of and an introduction to key steps to develop a company, design a business model, explore product-market fit, manage intellectual property, and attract investment. Students will explore acknowledged innovation-driven entrepreneurship methodologies and experiment with them and associated tools to pursue the translation of their ideas into entrepreneurial endeavors. The course examines issues faced by Startup Founders and Chief Technology Officers who need to innovate at the boundaries of AI, Information Technology and Business by understanding all perspectives.

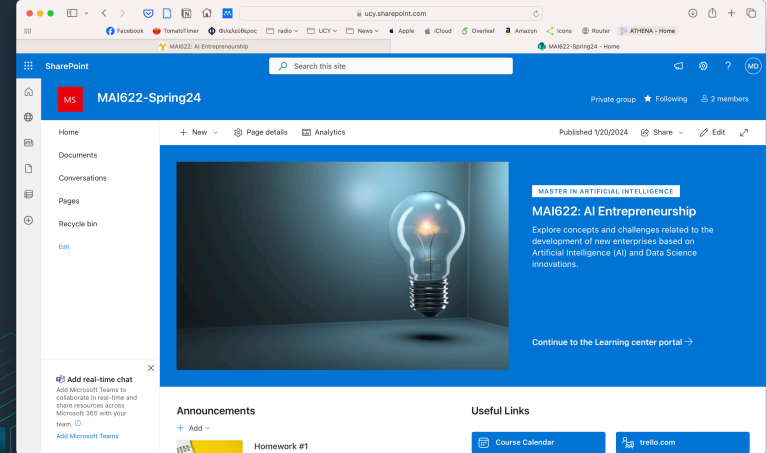
Learning outcomes and skills

The students who complete this course successfully, will be able to:

1. Recognize and define key concepts and terminology related to entrepreneurship.
2. Analyze and evaluate entrepreneurial ideas, especially for AI-based, innovative products, processes or services based on advanced technologies or scientific inventions.
3. Consider issues of Intellectual Property (IP) and IP protection.
4. Understand Business Planning and create Business Plans.

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Announcements, Documents Repository: Sharepoint

SharePoint MAI622-Spring24

Home Documents Conversations Pages Recycle bin

MAI622: AI Entrepreneurship

Explore concepts and challenges related to the development of new enterprises based on Artificial Intelligence (AI) and Data Science innovations.

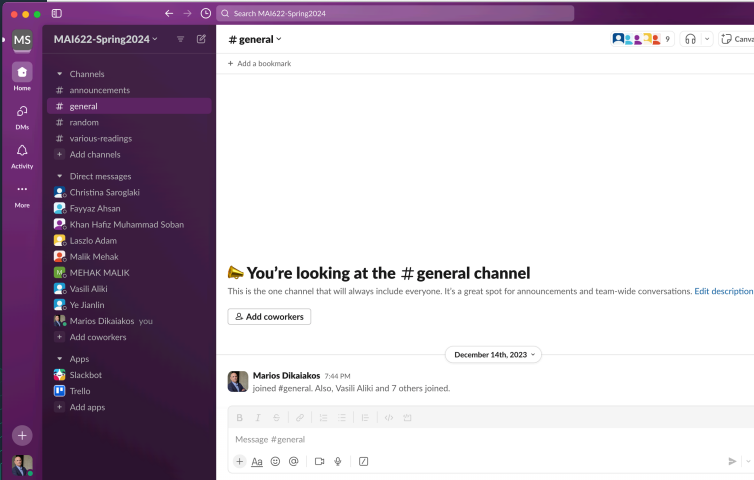
Continue to the Learning center portal →

Announcements Useful Links

Homework #1 Course Calendar trello.com

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Slack

MAI622-Spring2024 #general

You're looking at the #general channel

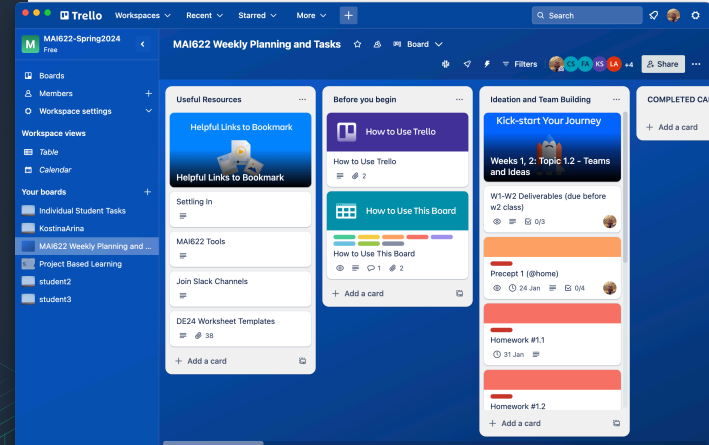
This is the one channel that will always include everyone. It's a great spot for announcements and team-wide conversations. Edit description

Marios Dikaikakos 7:44 PM
joined #general. Also, Vasilii Ailki and 7 others joined.

For class communication

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Trello

MAI622-Spring2024 MAI622 Weekly Planning and Tasks

Useful Resources

Helpful Links to Bookmark

Before you begin

How to Use Trello

How to Use This Board

Ideation and Team Building

Kick-start Your Journey

Weeks 1, 2: Topic 1.2 - Teams and Ideas

W1-W2 Deliverables (due before W2 class)

Precept 1 (@Home)

Homework #1

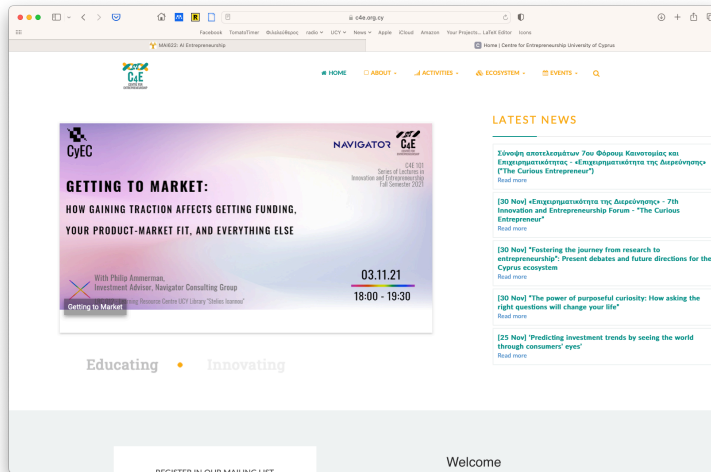
Homework #1.2

For project management

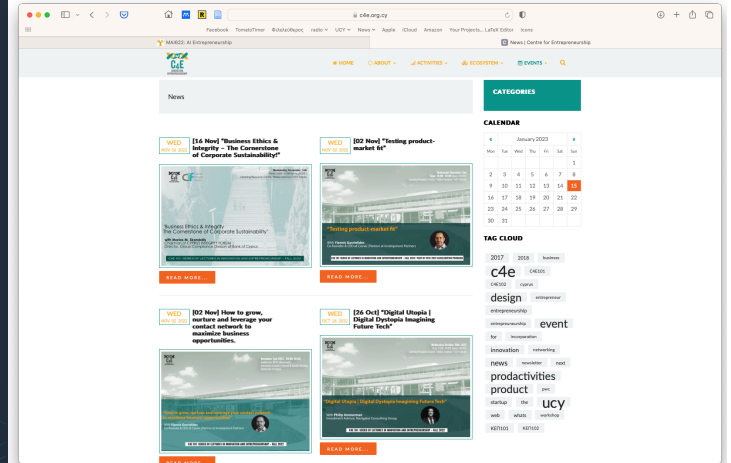
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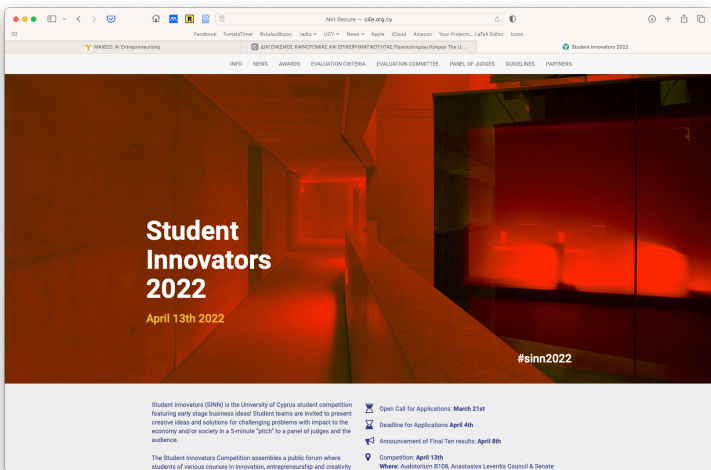
<https://c4e.org.cy/>



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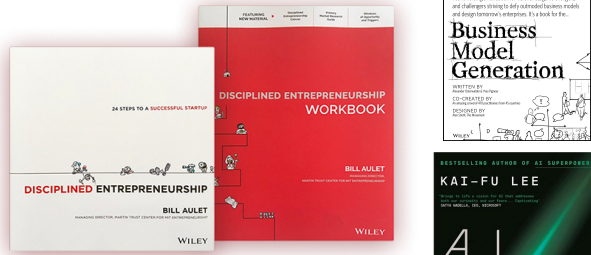


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Main Sources for Learning Materials



 Startup School



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Textbooks

Reading List



- Bill Aulet (2013) “**Disciplined Entrepreneurship.**” Wiley.
- Bill Aulet (2017) “**Disciplined Entrepreneurship Workbook.**” Wiley.
- Alexander Osterwalder et al (2010) “**Business Model Generation.**” Wiley.
- Ash Fontana (2021) “**The AI-First Company.**” Penguin.
- European Patent Office. “**Inventors' Handbook.**” <https://www.epo.org/learning-events/materials/inventors-handbook.html>

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Additional Readings



AI Case Studies & Vision

- ▶ Kai-Fu Lee & Chen Qiufan (2021). “**AI 2041. Ten Visions for Our Future.**” Penguin.
- ▶ Cade Metz (2021). “**The Genius Makers: The Mavericks Who Brought A.I. to Google, Facebook, and the World.**” Random House Business.
- ▶ Eric Topol (2019). “**Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again.**” Basic Books.

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Online Videos & Courses



- Y Combinator's Resources
 - ▶ <https://www.ycombinator.com/resources/>
- Steve Blank, “**How to build a startup?**” Udacity
 - ▶ <https://classroom.udacity.com/courses/ep245>
- Sam Altman, “**How to start a startup?**”
 - ▶ <http://startupclass.samaltman.com/>
- Centre for Entrepreneurship: **C4E video lectures library**
 - ▶ <https://www.youtube.com/c/c4eOrgCy/videos>



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Additional Readings

Context & Policy



- Henry A Kissinger, Eric Schmidt, Daniel Huttenlocher (2021) **"The Age of AI and Our Human Future."** Little, Brown and Company.
- Smith, B. and Browne C.A. (2019) **"Tools and Weapons. The Promise and the Peril of the Digital Age."** Penguin.
- Lee, Kai-Fu (2018) **"AI Superpowers: China, Silicon Valley, And The New World Order."** Houghton Mifflin Harcourt Company.
- O'Neil, C. (2016) **"Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy."** Crown.
- Sinan Aral (2021) **"The Hype Machine."** Penguin.

Additional Readings

Disruptive Startups



- Ben Horowitz (2014) **"The Hard Thing about Hard Things."** Harper Business.
- Steven G. Blank (2006) **"The Four Steps to the Epiphany. Successful Strategies for Products that Win."** Lulu.
- Peter Thiel with Blake Masters (2015) **"Zero to One: Notes on Startups, or How to Build the Future."** Virgin Books.
- Jeff Bezos (2014) **"The Everything Store: Jeff Bezos and the Age of Amazon."** Corgi.
- Clayton Christensen (2016) **"The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail"** (Management of Innovation and Change). Harvard Business Review Press.
- Alexander Osterwalder et al (2014) **"Value Proposition Design: How to Create Products and Services Customers Want."** Wiley.

Course Structure



- Module 1: Introduction to Innovation and Entrepreneurship
- Module 2: Business Modeling
- Module 3: AI Companies
- Module 4: Disciplined Entrepreneurship

Module 1 Contents



- Key Concepts of Innovation and Entrepreneurship
- Technological Innovation Ecosystems
- Teams and ideas: team formation, ideation, idea selection and development.
- From invention to commercial products: Intellectual Property, Disclosure, Novelty, Competition, Risk.
- Understanding Funding Terminology and Series.
- Exploring Different Types of Funding.
- Identifying Funding Sources for Your Startup
- Preparing and Delivering Investor Pitches

Module 2 Contents



- Business Model Canvas
- Business Model Patterns in the Knowledge/Digital Economy
- Mission Statement

Module 4 Contents



Introduction to Disciplined Entrepreneurship

Theme 1: Who is your Customer?

- ▶ Market segmentation – DE Step 1
- ▶ Beachhead market selection – DE Step 2
- ▶ End-user Profile Definition – DE Step 3
- ▶ Total Addressable Market Size (TAM) of Beachhead – DE Step 4
- ▶ Profile Persona development for the Beachhead – DE Step 5
- ▶ Identify your Next 10 Customers – DE Step 9

Theme 2: What can you do for your Customer?

- ▶ Full Life Cycle Use Case – DE Step 6
- ▶ High-level Product Specification – DE Step 7
- ▶ Value Proposition: Definition and Quantification – DE Step 8
- ▶ Define your Core – DE Step 10
- ▶ Charting your Competitive Position – DE Step 11

Module 3 Contents



Theme 3: How does your Customer acquire your Product?

- ▶ Customer's Decision-Making Unit Definition – DE Step 12
- ▶ Map Process to Acquire Paying Customer – DE Step 13
- ▶ Map the Process to Acquire a Customer – DE Step 18

Theme 4: How do you make money off your product?

- ▶ Design a Business Model – DE Step 15
- ▶ Set Your Pricing Framework – DE Step 16
- ▶ Calculate Lifetime Value of Acquired Customer – DE Step 17
- ▶ Cost of Customer Acquisition (COCA) Analysis – DE Step 19
- ▶ Business Model Patterns
- ▶ Introduction to Platform Economy, Network effects, Platform-based services
- ▶ Business Model Generation – Business Model Canvas

Theme 5: How do you design and build your product?

- ▶ Design and test key assumptions – DE Steps 20, 21
- ▶ Minimum Viable Business Product – DE Step 22
- ▶ Product demonstration and customer-satisfaction assessment – DE Step 23
- ▶ Lean Product Methodology Overview

Theme 6: How do you Scale your Business?

- ▶ Calculate TAM Size for Follow-on Markets – DE Step 14
- ▶ Develop a Product Plan – DE Step 24

“Today the image of the **heroic entrepreneur** is someone who is **ultra-focused** on **turning an idea into a start-up that will attract investors.**”

Steve Jobs and Bill Gates, both of whom dropped out of college, are icons of American ingenuity.

Despite what each has said about **the importance of a broad learning across a variety of fields**, what their admirers take away is **“learn only what you need to know to monetize your idea.”**



MAI 622: AI Entrepreneurship - Module 1

Topic 1.1: Introduction to Innovation and Entrepreneurship

Module 1 Contents



- Key Concepts of Innovation and Entrepreneurship
- Technological Innovation Ecosystems
- Teams and ideas: team formation, ideation, idea selection and development.
- From invention to commercial products: Intellectual Property, Disclosure, Novelty, Competition, Risk.
- Understanding Funding Terminology and Series.
- Exploring Different Types of Funding.
- Identifying Funding Sources for Your Startup
- Preparing and Delivering Investor Pitches

Suggested Readings



- Peter Thiel with Blake Masters (2014) **"Zero to One"**
- European Patent Office. **"Inventors' Handbook"** <https://www.epo.org/learning-events/materials/inventors-handbook.html>
- Judy Estrin (2008) **"Closing the Innovation Gap"**
- Kai-Fu Lee (2018) **"AI Super-Powers"**
- Cade Metz (2021) **"Genius Makers"**
- Ouellette, Lisa Larrimore and Masur, Jonathan S., (November 8, 2022) **"Introduction to Intellectual Property Law."** <https://ssrn.com/abstract=4271894> or <http://dx.doi.org/10.2139/ssrn.4271894>

Online Videos & Courses



- Navigating Data and AI Opportunities and Risks: New Challenges for Business and Regulators. Professor Theodoros Evgeniou, INSEAD. C4E IEF2020 - PwC Distinguished Lecture.
▶ <https://www.youtube.com/watch?v=O1D2fr1Bo6A>
- The Challenges of AI for Business and Policy Making . Panel Discussion, C4E IEF2020.
▶ https://www.youtube.com/watch?v=eYh_O67r2w8
- Closing the Innovation Gap. Judith Estrin, U. of Washington Colloquium, Feb. 2000.
▶ <https://www.youtube.com/watch?v=l24T28z6jJU>
- Computers and Humans Will Each Do Their Best. Eric Schmidt, The G.S. Beckwith Gilbert '63 Lectures, Princeton Univ. May 2015
▶ https://mediacentral.princeton.edu/media/The+G.S.+Beckwith+Gilbert+'63+LecturesA+Eric+Schmidt+'76+-+ 'Computers+and+Humans+Will+Each+Do+Their+Best'%22/1_ndnym9sd
- IP law / Commercializing IP. Nick Kounoupas. C4E, Feb. 2018 (slides)
▶ <https://youtu.be/3IP9WaNvaqU>
- EU Intellectual Property Helpdesk videos:
▶ <https://www.youtube.com/playlist?list=PLNhmWKRzktjFb0JRJgLSzEeGFpNwOkGN>

Module 1: Introduction to Innovation and Entrepreneurship

Topic 1.2: Key Concepts

Key Concepts



Understanding some key concepts:

- Invention
- Innovation
- Entrepreneurship
- Intangibles
- Risk
- Disruption
- Ecosystem
- Research & Education

Key Concepts

Innovation



**INNOVATION:
WHY IS IT IMPORTANT?**

The Importance of Innovation

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Technological innovation is the ultimate source of productivity

[Robert Solow, MIT, Nobel Prize in Economics, 1987]

Now, more than ever, productivity is the main driver of future growth and prosperity

[OECD, "The Future of Productivity", 2015]

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The Importance of Innovation

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Without new technology, globalisation is unsustainable in a world of scarce resources.

[Peter Thiel with Blake Masters, "Zero to One" 2014]

Who gets to control innovation is a central question of our time.

[Susan Liataud, Public Policy Program, Stanford University, "Ethical Innovation Means Giving Society a Say," WIRED, 12/6/2017]

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Invention

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- Invention: **anything novel**
 - ▶ scientific-technological (including medicine)
 - ▶ socio-political (including economics and law)
 - ▶ humanistic, or cultural
- **Patentable** Invention
 - ▶ Novel, non-obvious, possible industrial application
 - ▶ Not all the inventions can be patented
 - ▶ Patents: not the only way to protect or exploit inventions

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Innovation

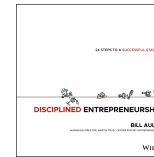
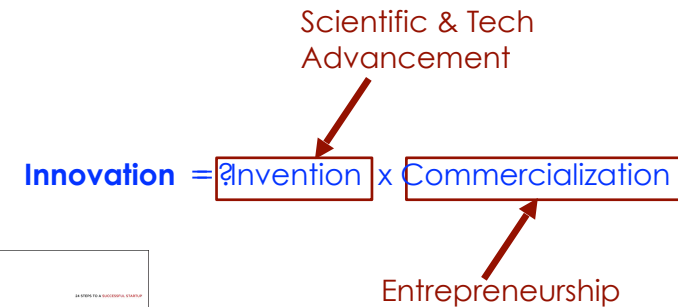
- A new or changed entity, which **creates or redistributes value** [ISO TC 279 on innovation management, standard ISO 56000:2020]
- Something **original** and **effective** which **creates value**, including the **creation of a new market/new needs/new business models**.
- Involves the practical implementation of an invention to have **impact** in a **market** or **society**.

Invention vs Innovation

*Invention **may or may not result** in innovation
(creation of value)*

*Innovation does **not strictly need** an invention.*

Innovation



Bill Aulet, Martin Trust Center for MIT Entrepreneurship, 2017

Entrepreneurship

- “Entrepreneurship is the **creation** or **extraction** of **economic value**. With this definition, entrepreneurship is viewed as change, generally entailing **risk** beyond what is normally encountered in starting a business, which may include other values than simply economic ones.”

Source: Wikipedia



Entrepreneurship

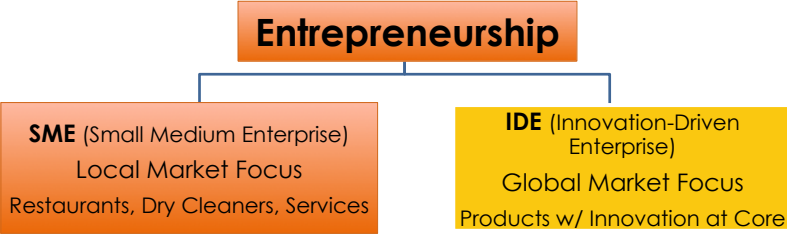
“Entrepreneurship is the creation or extraction of economic value.

“The formation of a new venture that produces a product or offering that

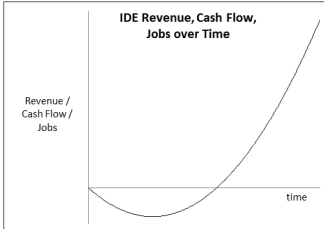
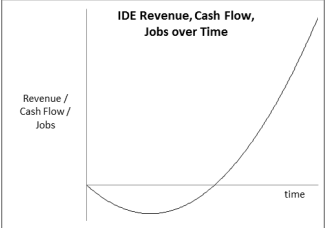
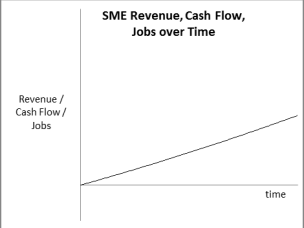
With this definition, entrepreneurship is viewed as change, generally entailing risk beyond what is normally encountered in starting a business, which may include other values than simply economic ones.”

creates some value for which your new venture can capture some value to make it economically sustainable.”

WHY IS ENTREPRENEURSHIP IMPORTANT?



IDE (Innovation-Driven Enterprise)
Global Market Focus
Products w/ Innovation at Core



Entrepreneurship - Επιχειρείν

The principal mechanism through which **developed** and **developing economies** can take advantage of inventions and manage to **evolve** and **regenerate**

Entrepreneurship

is the principal mechanism through which **developed** and **developing economies** can take advantage of inventions and manage to **evolve** and **regenerate**

[Monitor Group. Paths to Prosperity: Promoting Entrepreneurship in the 21st Century. 2009]

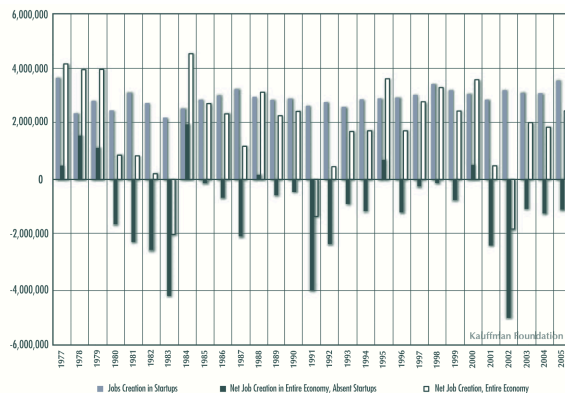
[Monitor Group. Paths to Prosperity: Promoting Entrepreneurship in the 21st Century. 2009]

Importance of Entrepreneurship

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“Without start-ups, the net rate of increase in **employment** in the **USA** between 1980-2005 would have been negative.”

[US Census Bureau, circa 2009]



Section 1 Outline

Understanding some key concepts:

- Invention
- Innovation
- Entrepreneurship
- **Disruption**
- Intangibles
- Risk
- Ecosystem
- Research & Education



Disruption

- **Disruption** describes a **process whereby a smaller company with fewer resources** is able to successfully **challenge established** incumbent businesses. [Clayton M. Christensen, Michael E. Raynor, and Rory McDonald, "What is Disruptive Innovation?" HBR, Dec. 2015]
- **Disruptive innovation**: innovation that **creates a new market and value network** or **enters at the bottom of an existing market** and eventually **displaces established market-leading firms**, products, and alliances. [Wikipedia]

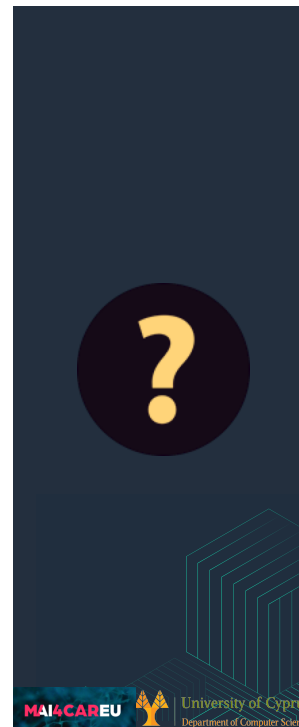


What drives disruption?

Ideas **Needs**

Sources of Disruption

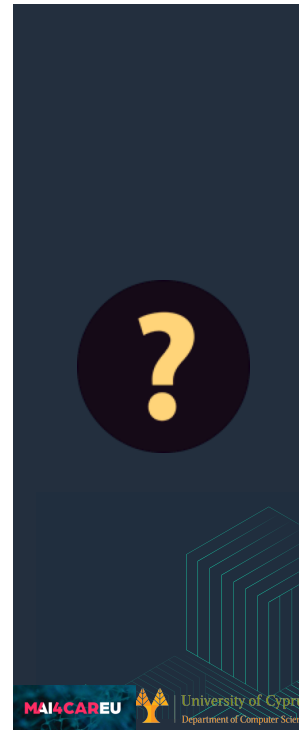
- **Ideas**
 - ▶ Scientific and Technological progress
- **Needs**
 - ▶ Planetary-scale Problems and Challenges



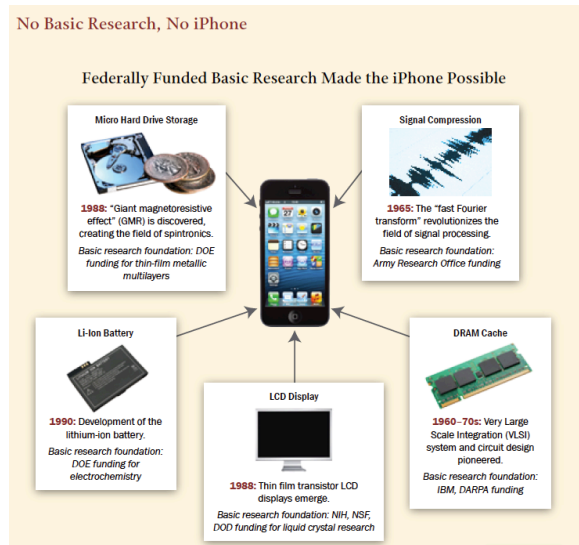
**CAN YOU IDENTIFY SOME
DISRUPTIVE INNOVATION?**



Steve Jobs "We're here to make a dent in the universe"



WHICH IDEAS ARE BEHIND THE I-PHONE?



"Restoring the Foundation." American Academy of Arts & Sciences, 2014.



"Stand out of my light"

Plutarch's, Alexander

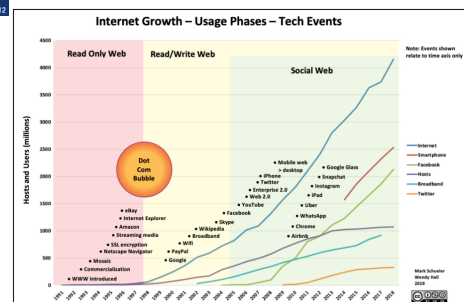
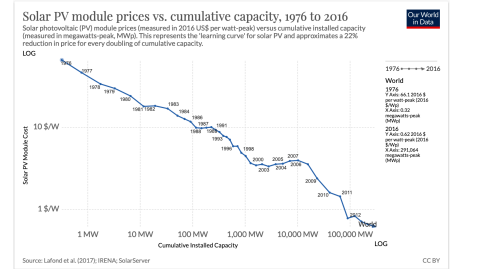
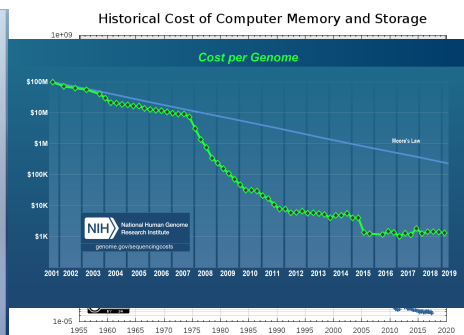
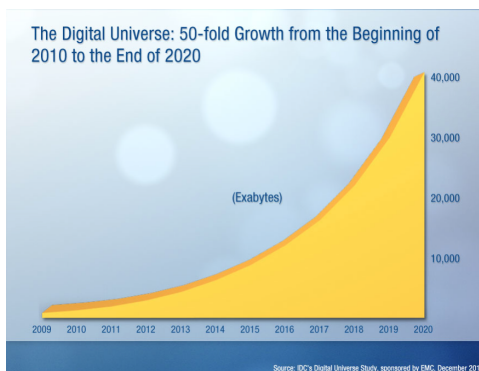
Ideas

- Behind the Scientific & Technological Progress in the 21st Century Landscape
- We are on the verge of a large scale revolution enabled by the **emergence the next-generation of innovation**
- Thanks to **exponential advances** in Technology & Scientific knowledge:
 - Computing, Big Data, AI, Robotics
 - Renewable Energy, Materials, 3D Printing, Nanotechnology
 - Genomics & Biology



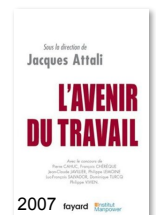
«Ninety-five Theses: propositions for debate concerned with the question of indulgences»

Disputatio pro declaratione virtutis indulgentiarum
Martin Luther (31/10/1517)



The Knowledge Avalanche

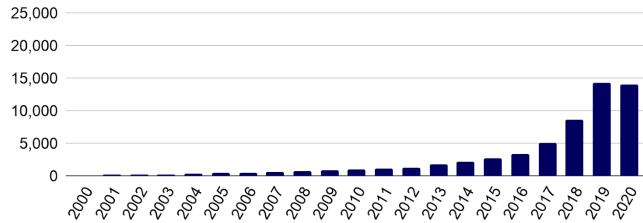
- **Rapid pace of knowledge creation:** available technical knowledge (number of pages published in scientific journals)
 - 2007: doubles every **7 years**
 - 2030: doubles every **72 days**



- **80%** of the knowledge required to perform an advanced technical job is rendered **obsolete within 10 years.**
- In 25 years from the time of that study, the **employment landscape** would be profoundly different.

Knowledge Avalanche in AI

- Publications involving **AI methods in biology** (e.g. deep learning, NLP, computer vision, RL) are growing >50% year-on-year since 2017. Papers published since 2019 account for 25% of all output since 2000.



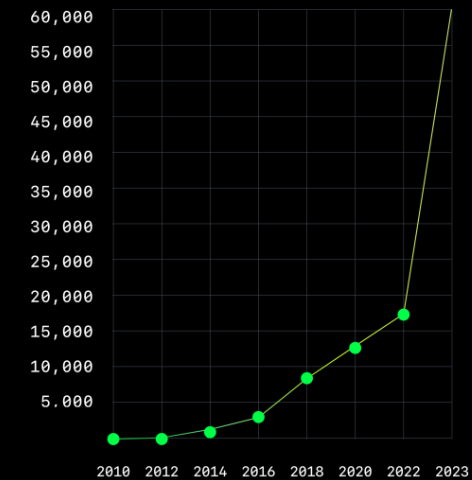
Source: State of AI Report 2020 & PubMed

Investment in AI

- In 2020, AI start-ups raised funds of:
 - Almost **\$38 billion** (USA)
 - \$25 billion** (Asia)
 - \$8 billion** (Europe)

AI Software growth

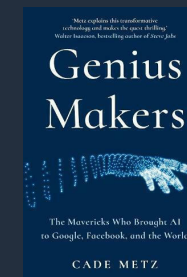
The global growth in generative AI projects on GitHub



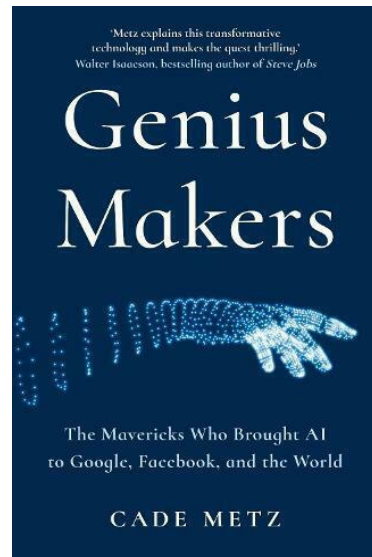
<https://github.blog/2023-11-08-the-state-of-open-source-and-ai/>

Key Concepts

Innovation: The Case of Deep Learning



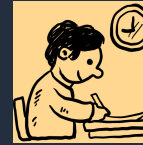
The Case of Deep Learning



<https://www.wired.com/story/secret-auction-race-ai-supremacy-google-microsoft-baidu/>

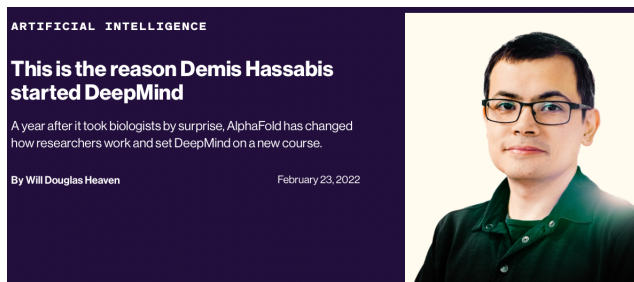
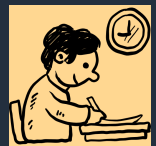
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The Case of Deep Learning



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The Case of Deep Learning



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nature

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Published 27 January 2016

Mastering the game of Go with deep neural networks and tree search

David Silver, Aja Huang, Chris J. Maddison, Arthur Guez, Laurent Sifre, George van den Driessche, Julian Schrittwieser, Ioannis Antonoglou, Veda Panneershelvam, Marc Lanctot, Sander Dieleman, Dominik Grewe, John Nham, Nal Kalchbrenner, Ilya Sutskever, Timothy Lillicrap, Madeleine Leach, Koray Kavukcuoglu, Thore Graepel & Demis Hassabis

Nature 529, 484–489 (2016) | Cite this article

413k Accesses | 5965 Citations | 3052 Altmetric | Metrics



"our program AlphaGo achieved a 99.8% winning rate against other Go programs, and defeated the human European Go champion by 5 games to 0. This is the first time that a computer program has defeated a human professional player in the full-sized game of Go, a feat previously thought to be at least a decade away."

A Deep Learning Approach to Antibiotic Discovery

Jonathan M. Stokes,^{1,2,3} Kevin Yang,^{2,4,19} Kyle Swanson,^{3,4,19} Wengong Jin,^{2,4} Andres Cubillos-Ruiz,^{1,2} Nina M. Donghia,^{1,2} Craig R. MacNair,² Shawn French,² Lindsey A. Carraee,² Zohar Bloom-Ackermann,¹ Victoria M. Tran,² Anush Chhappino-Pepe,^{2,11} Ahmed H. Badran,² Ian W. Andrews,^{1,2,12} Emma J. Chory,² George M. Church,^{2,13} Eric D. Brown,² Tommi S. Jaakkola,² Regina Barzilay,^{2,14} and James J. Collins²

¹Department of Biological Engineering, Synthetic Biology Center, Institute for Medical Engineering and Science, Massachusetts Institute of Technology, Cambridge, MA 02139, USA
²Broad Institute of MIT and Harvard, Cambridge, MA 02142, USA
³Machine Learning for Pharmaceutical Discovery and Synthesis Consortium, Massachusetts Institute of Technology, Cambridge, MA 02139, USA
⁴Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Cambridge, MA 02139, USA
⁵Wyss Institute for Biologically Inspired Engineering, Harvard University, Boston, MA 02115, USA
⁶Department of Biochemistry and Biomedical Sciences, Michael G. DeGroote Institute for Infectious Disease Research, Hamilton, ON L8N 3Z5, Canada
⁷Department of Genetics, Harvard Medical School, Boston, MA 02115, USA
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⁹Abdul Latif Jameel Clinic for Machine Learning in Health, Massachusetts Institute of Technology, Cambridge, MA 02139, USA
¹⁰These authors contributed equally
¹¹Lead Contact
¹²Correspondence: jma@csail.mit.edu (R.B.), jmc@mit.edu (J.J.C.)
¹³https://doi.org/10.1016/j.cell.2020.01.021

“A pioneering machine-learning approach has identified powerful new types of antibiotic from a pool of more than 100 million molecules — including one that works against a wide range of bacteria, including tuberculosis and strains considered untreatable [...] the antibiotic, called **halicin**, is the first discovered with artificial intelligence (AI).
 [...] this is the first time AI has identified completely new kinds of antibiotic from scratch, without using any previous human assumptions.”



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nature > news > article

NEWS 20 February 2020

Powerful antibiotics discovered using AI

Machine learning spots molecules that work even against 'untreatable' strains of bacteria.

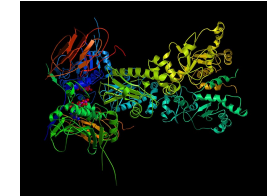
Jo Marchant



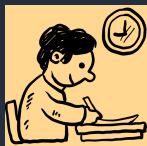
'It will change everything': DeepMind's AI makes gigantic leap in solving protein structures

Google's deep-learning program for determining the 3D shapes of proteins stands to transform biology, say scientists.



“The announcement [30/11/2020] by DeepMind that its **AlphaFold** technology is able to predict protein structure with accuracy comparable to slow and costly experimental methods is a harbinger of breakthroughs to come.”

The case of AlphaFold by DeepMind

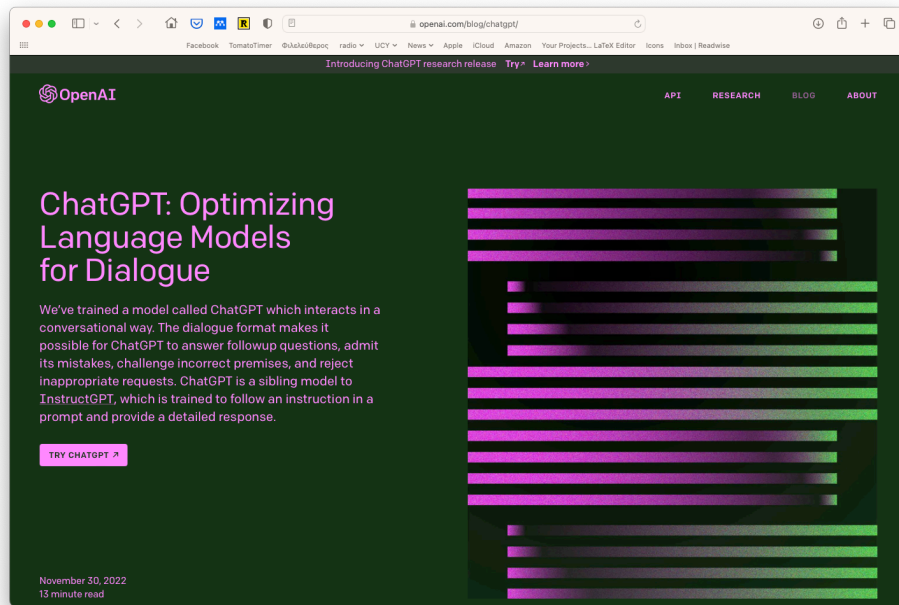


- 2021: DeepMind releases and open sources AlphaFold, an AI system to predict the 3D structure of a protein just from its 1D amino acid sequence.
- Proteins are the building blocks of life, they underpin every biological process in every living thing.
- A protein's shape is closely linked with its function: thus, knowing a protein's structure unlocks a greater understanding of what it does and how it works.

“The genomes we believed were blueprints for life, were effectively encrypted—this will unlock them and transform biological and biomedical research.”

[Tim Hubbard, Kings College]

<https://deepmind.com/blog/article/alphafold-a-solution-to-a-50-year-old-grand-challenge-in-biology>



Previous Week

MAI4CAREU University of Cyprus Department of Computer Science

- Overview of MAI622:
 - ▶ Learning Objectives
 - ▶ Structure
 - ▶ Teaching & Learning Methodologies
 - ▶ Projects and Evaluation
 - ▶ Communication
- Introduction and Key Concepts
 - ▶ Innovation
 - ▶ Entrepreneurship
 - ▶ Disruption and its sources

OPINION
GUEST ESSAY

How ChatGPT Hijacks Democracy

Jan. 15, 2023 5 MIN READ

Launched just weeks ago, ChatGPT is already threatening to upend how we draft everyday communications like [emails](#), [college essays](#) and myriad [other forms](#) of writing.

Created by the company OpenAI, ChatGPT is a chatbot that can automatically respond to written prompts in a manner that is sometimes eerily close to human.

What drives disruption?

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Ideas **Needs**

Needs (21st century)

- In the physical world:
 - ▶ Climate Change, Depletion of Natural Resources, Food Production, Epidemics
- In the cyberspace:
 - ▶ Cybercrime & Cyberterrorism, Privacy, Sovereignty
- In the society:
 - ▶ Globalisation, Work, Ageing, Migration, Human Cognition, Education

Ideas lead to new Needs

The Threat of Automation

Nearly **half of 702 professions** in the U.S. could be susceptible to **elimination** due to diminishing costs of ICT and exponential improvements in hardware, algorithms and software.

Frey & Osborne, "The Future Of Employment: How susceptible Are Jobs To Computerisation." 9/2013

Based on the current trends of technology advancement and adoption, I **predict that within fifteen years, artificial intelligence will technically be able to replace around 40 to 50 % of jobs in the United States.** Actual job losses may end up lagging those technical capabilities by an additional decade.



Kai-Fu Lee, "AI Super-Powers, China, Silicon Valley, and the New World Order." 2018

18 / 1 / 2014

Section 1 Outline



Understanding some key concepts:

- Invention
- Innovation
- Entrepreneurship
- Disruption
- **Intangibles**
- Risk
- Ecosystem
- Research & Education

Key Concepts

Intangibles



The Rise of the Intangible Economy

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- A society's **capital stock** comprises
 - all the things in which people, businesses, and governments have invested over time with the goal of delivering an enduring benefit.
- Since the 1980s: a steady shift in the world's capital stock is observed
 - As a society gets richer, **most business investment goes to intangible assets**
- **Intangible assets** are:
 - Things that you **can't touch**: **Research and development, branding, organizational development, and software.**
 - Things that are **costly to acquire, last a long time**, and are **valuable** to a company/society, but are **not physical.**
- Over the decades, intangible investment has become more and more important to the economies of the world; growing since at least the 1980s.

85 ["Capitalism without Capital", Haskel & Westlake, 2018]



Intangible vs Tangible Assets

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Intangible assets tend to differ from tangible assets in four main ways:

1. Are often **highly scalable**: an asset like an algorithm can be used across a very large business
2. Have **spillovers**: a business investing in, say, R&D cannot be sure it will be the only entity to benefit from its investment
3. Are **sunk costs**: they are often not worth much to creditors if a business fails
4. Have **synergies**: they are often massively more valuable when combined with other intangibles

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["Restarting the Future", Haskel & Westlake, 2018]

Intangibles Example

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Apple's intangible assets include:



- **Knowledge** gained from R&D
- **Design** of its products
- Its widely **trusted brands**
- The valuable and durable **relationships** with its **suppliers** (including both its physical supply chain and the developers who support the Apple ecosystem)
- Staffers' **internal firm knowledge** and **relationships**
- **Software** in its operating system, and its vast **data** resources.

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Implications of Intangibles

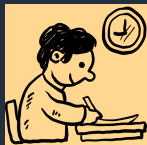
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- Businesses that own **scalable** intangibles can **grow very rapidly** and become large, as in the case of today's tech giants.
- Businesses that invest in intangibles may find that their **competitors end up reaping the benefits** through **spillovers** (e.g. Xerox, BlackBerry and Nokia):
 - ▶ They strengthen the case for governments to subsidize investment in scientific research, training, and education.

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["Restarting the Future", Haskel & Westlake, 2018]

The case of Xerox



XEROX
PARC

M. D. Dikaikakos

The case of Xerox



• Xerox PARC has been the inventor and incubator of many elements of modern computing in the contemporary office work place:

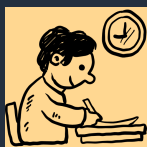
- ▶ Laser printers,
- ▶ Computer-generated **bitmap** graphics
- ▶ The **graphical user interface**, featuring windows and icons, operated with a **mouse**
- ▶ The **WYSIWYG** text editor
- ▶ **Interpress**, a resolution-independent graphical page-description language and the precursor to **PostScript**
- ▶ **Ethernet** as a local-area computer network
- ▶ Fully formed **object-oriented programming** in the **Smalltalk programming language** and integrated development environment.
- ▶ **Model-view-controller** software architecture



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The case of AlphaFold by DeepMind



DeepMind's Announcement (28/7/22)

"It's been one year since:

- ▶ we **released and open sourced** AlphaFold, our **AI system to predict the 3D structure of a protein** just from its **1D amino acid sequence**, and

created the **AlphaFold Protein Structure Database** (AlphaFold DB) to freely share this scientific knowledge with the world.

Just twelve months later, AlphaFold has been **accessed by more than half a million** researchers and used to accelerate progress on important real-world problems ranging from **plastic pollution** to **antibiotic resistance**.

In partnership with EMBL's European Bioinformatics Institute (EMBL-EBI), AlphaFold released the predicted structures for nearly all catalogued proteins known to science, expanding the AlphaFold DB by over 200x - from nearly 1 million structures to over 200 million structures."

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Implications of Intangibles

- The fact that intangibles are often **sunk costs** raises **challenges for business finance**, especially for small businesses where debt finance is often ultimately secured against a business's assets.
 - ▶ Businesses whose assets are worth little if the business fails are **less attractive lending prospects for banks**-a problem in a world where debt finance and bank lending are the main sources of external finance for most businesses.
- **Synergies** increase the **importance of combining the right intangibles**, hence the inexorable growth of jobs involving **brokering** ideas, brands, or skills, and the prosperity of **dynamic cities** in which this kind of activity happens most easily.

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Intangibles-Rich Economy

- Often associated to the “**Knowledge Economy**” or the “**Postindustrial Economy.**”
- However, intangibles comprise also more things besides knowledge-related assets.

93 ["Restarting the Future", Haskel & Westlake, 2018]

About the Knowledge Economy

- An economic system in which the production of goods and services is based principally on **knowledge-intensive activities** that contribute to advancement in technical and scientific **innovation.**
- Key element of value: **greater dependence on human capital** and **intellectual property (IP)** for the source of the innovative ideas, information and practices.
- Organizations are required to **capitalize this "knowledge"** into **their production** to stimulate and deepen the business development process.
- **Less reliance on physical input and natural resources:** knowledge-based economy relies on the crucial role of intangible assets in facilitating modern economic growth.

94 ["Restarting the Future", Haskel & Westlake, 2018]

Intangibles vs Knowledge

- Some intangibles can fairly be described as **knowledge** or **information.** E.g.:
 - ▶ **Results of R&D** to develop a new drug, a new production technique, or the results of training a worker in a new skill.
 - ▶ **Software programs** or **databases,** consist of information, which is very similar to knowledge, if not precisely synonymous with it.
- But other intangibles are about something more than knowledge or information: **relational** or **expressive capital.**
- E.g., the value of a **brand,** does not lie only in the informational content of the name and the logo. The **brand** is both **relational** and **expressive:**
 - ▶ **Relational:** it is a sort of promise and a reminder of the past, tacitly referencing countless past transactions that make up the brand's reputation and purporting to offer customers a particular experience or quality.
 - ▶ **Expressive:** it conveys an emotional message about the product, one consumers often value.

95 ["Restarting the Future", Haskel & Westlake, 2018]

Intangible Economy: Summary

- If you want to think about how intangible-intensive economies differ from less intangible-intensive economies, don't think about knowledge work, small manufacturing sectors, or big tech companies.
- Think instead of an economy where:
 - ▶ what people do is more heavily and intimately connected in **economic relationships;**
 - ▶ **activities** of all sorts, from factory production to supermarket shopping, are more **information rich;**
 - ▶ economic activity is more conveyed with **meaning, association,** and with **emotional significance.**

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Intangible Economy's Crisis

Intangibles' characteristics often have important effects; this leads to an "Intangibles Crisis":

- Increased inequality
- Weaker competitive dynamics.
- They change the type of institutions that a society needs for continued, healthy economic growth.

Section 1 Outline



Understanding some key concepts:

- Invention
- Innovation
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- Disruption
- Intangibles
- **Risk**
- Ecosystem
- Research & Education

Section 1 Outline



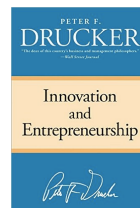
Understanding some key concepts:

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Risk

- Reliance on technology is hugely **risky**.
- Relatively few technical innovations bring **immediate economic benefit** that will *justify required investments* of time and resources

Peter Drucker, "Innovation and Entrepreneurship"



Ecosystem

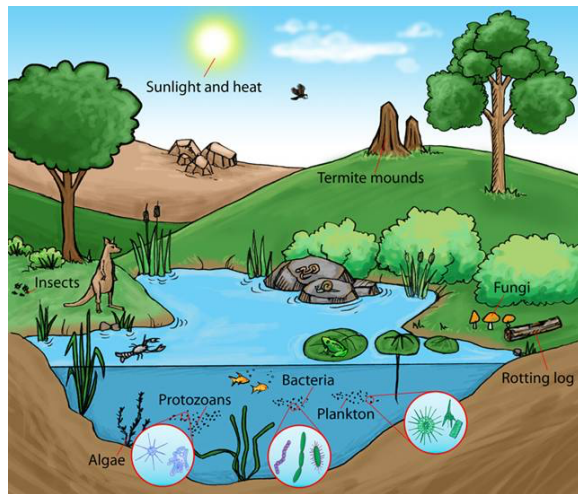


Image Source: <https://www.zmescience.com/ecology/ecosystems-what-they-are-and-why-they-are-important/>

Innovation Ecosystem

“An innovation ecosystem refers to a loosely interconnected network of companies and other entities that **coevolve capabilities** around a **shared set of technologies, knowledge, or skills**, and work **cooperatively** and **competitively** to develop new **products and services.**”

Predators and Prey: A New Ecology of Competition, James F. Moore, HBR, 1993

Ecosystem: Traits

- **Dynamic** rather than **static**
- **Organically grown** but maybe **some design** too
- **Heterogeneous** rather than **monoculture**
- **Symbiotic** rather than **competitive**
- **Competitive** rather than **symbiotic..**

The Trust Factor

- The entrepreneur-investor relationship characterized by **uncertainty** and **information asymmetry**:
 - ▶ Entrepreneurs always possess more accurate information about themselves and their business than their investors possibly can;
 - ▶ and no one knows whether products can be developed, customers will purchase them, or new businesses will compete successfully against others.
- To secure capital from investors, entrepreneurs must overcome the information asymmetry and uncertainty problems by:
 - ▶ sharing as much information about themselves and their business as they can, in order to
 - ▶ creating **trust with investors**

Dimensions of Trustworthiness

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- Ability
- Benevolence
- Integrity

Values: need to be prevalent in an ecosystem and its members

Section 1 Outline



Understanding some key concepts:

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Research & Education

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- Governments around the world are looking to **technology innovation** as a **driver** for national economic growth.
- Governments increasingly see **universities** as the incubators of the **national innovation capacity**.
- "Universities are at the centre of national and international efforts to **solve global challenges**."

[A new mission for public research, EPO, 2013.]

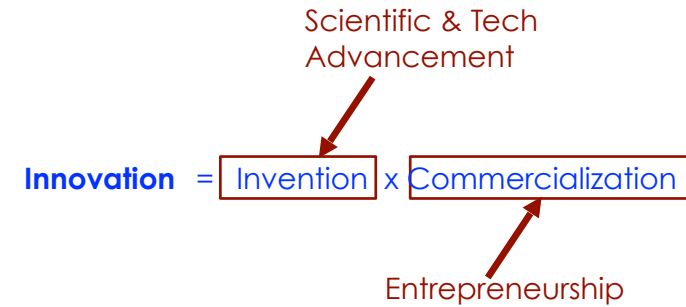
[Raimun Lutz, Vice-President, EPO, 2013]

Key Concepts

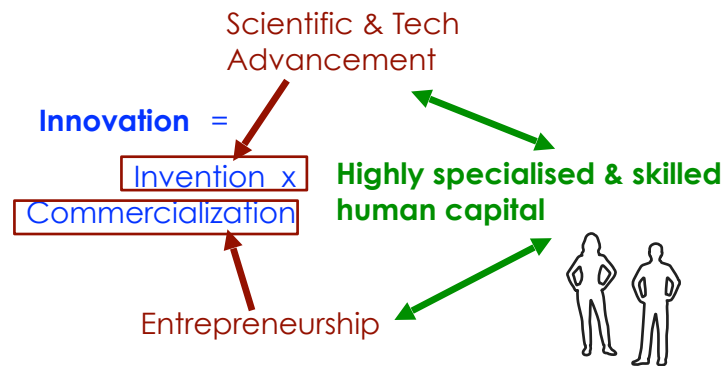
Research and Education

Why Universities?

Why Universities?



Why Universities?



Why Universities?

Human Capital

“Highly specialized human capital is a scarce resource that can be used either for innovation of products and services or for educating future innovators.”

Kenneth Arrow. Economic Welfare and the Allocation of Resources for Invention (1962)

Knowledge Check



- Describe the difference between Invention, Research, Innovation
- Explain how AlphaGo became a source of future Innovation
- What is the business model that Martin Luther disrupted?

Knowledge Check



- Discuss if universities can catalyze or produce innovations and create synergies required to address these challenges?
- Discuss if Universities around the world can respond to these aspirations successfully in a period of disruption?

Module 1: Introduction to Innovation and Entrepreneurship

Topic 1.3: Technological Innovation Ecosystems

Innovation Ecosystems



- Successful Ecosystems
- Cargo Cults and Simulacra
- Silicon Valley's Origins
- Research Commercialization
- Start-ups and Technology Transfer
- Overcoming Barriers
- Concluding Remarks



WHICH UNIVERSITIES HAVE CREATED THE WORLD'S MOST SUCCESSFUL TECHNOLOGY INNOVATION ECOSYSTEMS?

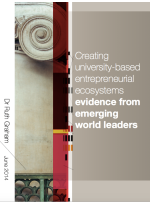
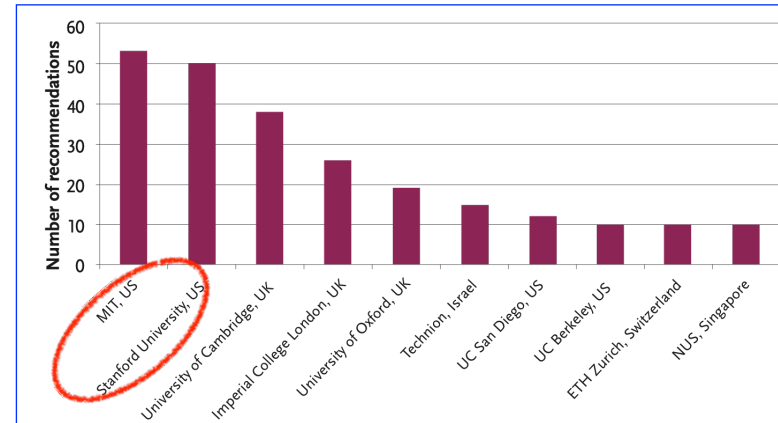
This document has been produced with the support of the EUROPEAN COMMISSION, under the CONNECTING EUROPE FACILITY - TELECOMMUNICATIONS FOR GROWTH AND EMPLOYMENT in the context of the project 'MAIACAREU - Master Programs in Artificial Intelligence for Careers in EU (MAIACAREU)'. The views only of the author, and the content only, are those of the author and do not necessarily represent those of the Commission.

M. D. Dikaiakos



'Which universities would you identify as having created/ supported the world's most successful technology innovation ecosystems?'

[MIT-Skoltech Study, June 2014: 61 experts from 20 countries]

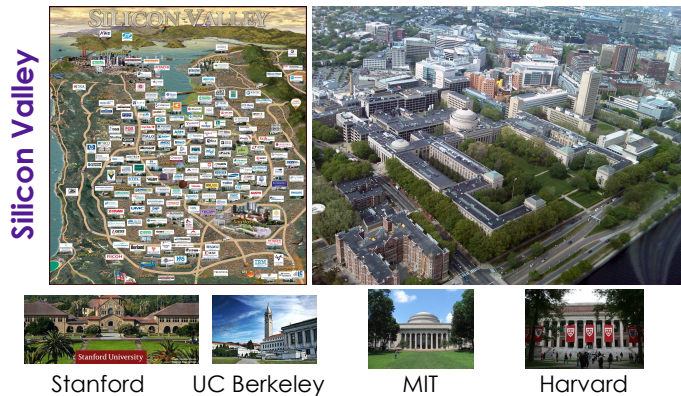


118 M. D. Dikaiakos



Most Successful Ecosystems

Master Programs in Artificial Intelligence for Careers in EU (MAIACAREU)



Some evidence: Stanford

Master Programs in Artificial Intelligence for Careers in EU (MAIACAREU)

- Stanford's Office of Technology Licensing (circa 2014)
 - ▶ licensed 8000 campus-inspired inventions
 - ▶ generated \$1.3 billion in royalties for the university
- Five thousand companies "trace their origins to Stanford ideas or to Stanford faculty and students"
 - ▶ Hewlett-Packard, Yahoo, Cisco Systems, Sun Microsystems, eBay, Netflix, Electronic Arts, Intuit, Fairchild Semiconductor, Agilent Technologies, Silicon Graphics, LinkedIn, and E*Trade



Some evidence: MIT

- 30,000 active companies founded by MIT alumni:
 - ▶ employ 4.6 million people
 - ▶ generate annual world revenues of \$1.9 trillion
 - ▶ producing the equivalent of the 10th-largest economy in the world as of 2014



"Entrepreneurship and Innovation at MIT: Continuing Global Growth and Impact"
Edward B. Roberts, Fiona Murray, and J. Daniel Kim (2015)

Entrepreneurship and Innovation at MIT
Continuing Global Growth and Impact

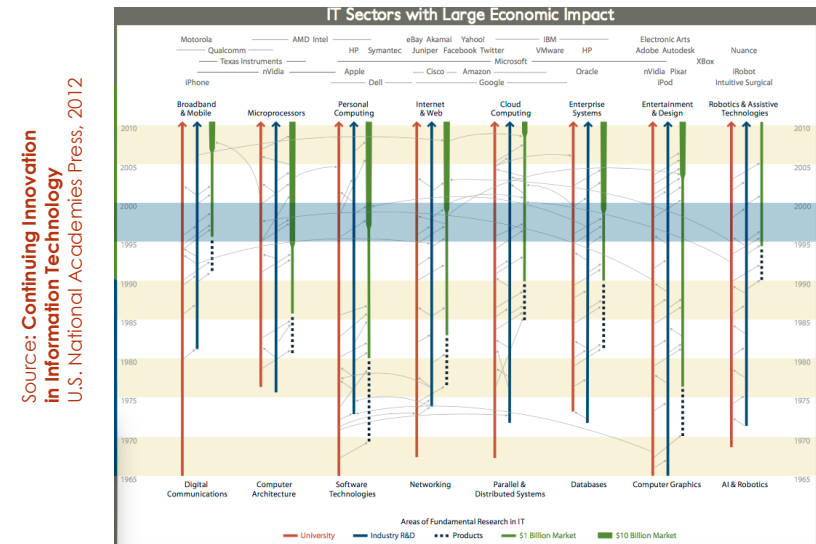


Key Lessons: the role of the University

- A clear link exists between building indigenous research capacity and economic growth in a post-industrial knowledge economy
- University-based research is the most effective driver of scientific discovery and economically relevant new technologies
- World-class Universities provide ideal context for educating students for careers in science, industry, government, and civil society.
- Produce graduates with the intellectual breadth and critical-thinking skills to solve problems, innovate and lead.

R. Levin, "The Rise of Asia's Universities". Foreign Affairs, May/June 2010

Some evidence: US ICT Sector



Let's do the next Silicon Valley!

"I've had dozens of meetings over the years with leaders from around the world who asked how they can build their own Silicon Valley.

It never works."

J. Breyer, Breyer Capital & Accel Partners [WEF '14, Bloomberg's GII 2014]

"It would be much better to study the early history of Silicon Valley than trying to copy what they are doing now"

MIT-Skoltech Study, June 2014

The End of Silicon Valley?

- Four trends that may shape the future of Silicon Valley:
 - ▶ Consumer internet entrepreneurs lack many of the skills needed for the [life sciences revolution](#).
 - ▶ [Internet regulation](#) is upon us.
 - ▶ [Climate response](#) is [capital intensive](#), and [inherently local](#).
 - ▶ The [end of the betting economy](#).
- Prediction: **The nexus of machine learning and medicine, biology, and materials science will be to the coming decades what Silicon Valley has been to the late 20th and early 21st century.**

Reading Assignment



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TEAMS INDIVIDUALS FEATURES WHAT'S NEW

Radar / Radar Column

The End of Silicon Valley as We Know It?

Four ways the party may be coming to an end

By Tim O'Reilly

March 11, 2021

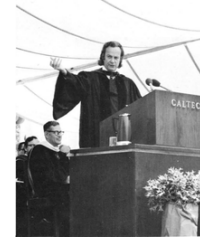
Innovation Ecosystems



- Successful Ecosystems
- **Cargo Cults and Simulacra**
- Silicon Valley's Origins
- Research Commercialization
- Start-ups and Technology Transfer
- Overcoming Barriers
- Concluding Remarks

The Cargo Cult Danger

"In the South Seas there is a Cargo Cult of people. During the war they saw airplanes land with lots of good materials, and they want the same thing to happen now. So they've arranged to make things like runways, to put fires along the sides of the runways ...



They're doing everything right.
The form is perfect.
It looks exactly the way it looked before.
But it doesn't work!
No airplanes land.
They follow all the apparent precepts and forms
but they're missing something essential"

Cargo Cults

- "Cargo cults are religious practices that have appeared in many traditional tribal societies in the wake of interaction with technologically advanced cultures.
- They focus on obtaining the material wealth (the "cargo") of the advanced culture by imitating the actions they believe cause the appearance of cargo: by building landing strips, mock aircraft, mock radios, and the like."



Simulacra

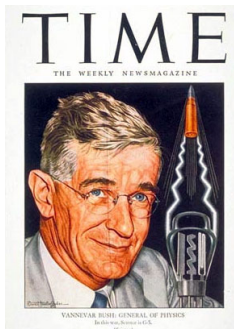
- Simulacra, a concept introduced by cultural theorist Jean Baudrillard to describe inauthenticity in modern societies ["*Simulacres et Simulation.*" Jean Baudrillard, 1981]
- Simulacra, refers to: conditions defined by imitations and driven by symbols that, like Disneyland, take on a new a new life of their own that is, however, detached from the underlying reality.

"The simulacrum is never that which conceals the truth—it is the truth which conceals that there is none."



The Origins of Silicon Valley

Origin #1: Vannevar Bush

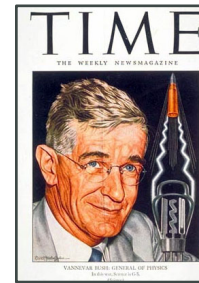


Director, Office of Scientific Research & Development, 1941- 1947

- "Science, The Endless Frontier" report to US president Truman (July 1945)
 - ▶ Basic research is "the pacemaker of technological progress"
 - ▶ Supported federal patronage for the advancement of knowledge in the United States
 - ▶ Establishment of [National Science Foundation](#) (NSF)
 - ▶ By late 1970s: [US\\$75 billion per year](#) US Govt spending on R&D.

"No American has had greater influence in the growth of science and technology than Vannevar Bush" (Wiesner, Biographical Memoir, National Academy of Sciences)

The Origins



Eric Schmidt, Former executive Chairman of Google; US President's Council of Advisors on Science and Technology; UK Prime Minister's Advisory Council.

- G.S. Beckwith Gilbert '63 Lecture, Princeton University (April 30, 2015): "Computers and Humans Will Each Do Their Best"



Three driving principles

- **Government**: bears primary responsibility for funding basic research and determines the total amount of funding available in different fields
- **Universities**: primary institutions responsible for carrying out government-funded research
- **Assessment**: based not on political or commercial grounds but on meritocracy, through an intensely competitive process of peer review by independent experts based on scientific merit alone

R. Levin, "The Rise of Asia's Universities". Foreign Affairs, May/June 2010

Why the government?

“Because the full economic benefit of a breakthrough in pure science **can rarely be captured by the original inventor**, private enterprises will typically have **insufficient incentive** to make many socially productive investments”

R. Levin, “The Rise of Asia's Universities”. Foreign Affairs, May/June 2010

Why the University?

- Exposes postgraduate scientists-in-training to the **most cutting edge techniques and areas of research**
- Allows undergraduates to **witness meaningful science first-hand**, rather than merely reading about last decade's milestones in textbooks
- Students develop **ability to collaborate and assimilate new information, solve problems, and create new knowledge**
- **Best research gets funded** - not research proposed by those who are politically well-connected

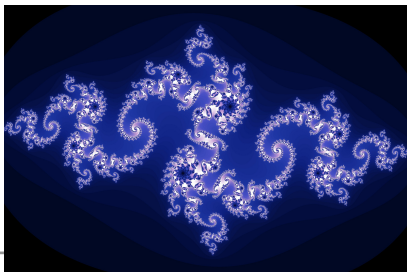
R. Levin, “The Rise of Asia's Universities”. Foreign Affairs, May/June 2010

What kind of University?

“If you think of technology as something that's spreading like a sort of **fractal stain**, every point on the edge represents an interesting problem.

One guaranteed way to turn your mind into the type to start up ideas [...] is to **get yourself to the leading edge of some technology**. [...] when you get there, ideas that seem uncannily prescient to other people will seem **obvious to you**”

Paul Graham, Y Combinator, 2014



(btw) The “short-termism” curse

“Americans think everything had to happen yesterday; they have a very short time frame.

My company is 108 years old. Most of my American counterparts are thinking about what's happening this quarter.
But, we think in generational terms.”

W. Fung, Chairman of Li & Fung (world's largest consumer-goods sourcing and logistics company), 2014



(btw) The “short-termism” curse

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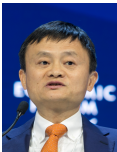
"When Alibaba was founded in 1999, our goal was to build a company that could make China and the world proud and **one that could cross three centuries to last 102 years.**

However, we all knew that no one could stay with the company for 102 years.

A sustainable Alibaba would have to be built on **sound governance, culture-centric philosophy, and consistency in developing talent.**

No company can rely solely on its founders. [...] Because of physical limits on one's ability and energy, no one can shoulder the responsibilities of chairman and CEO forever."

Jack Ma, Founder of Alibaba, Letter on retirement, Sept. 2018



Origin #2: Arthur Rock

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"I think my biggest accomplishment was starting the venture capital business if, in fact, I did that. If I have to go down in history for doing one thing, I guess that's it.

But **success for me is in helping to build great companies.** Having money is nice. Being able to travel and do the things I want to do is all very nice.

But I would give up some of that for **the feeling of success, of having created jobs. I helped create jobs. I helped create companies. I helped create wealth for a lot of people.** That gives me a great deal of satisfaction."

Arthur Rock's interview with Harvard Business School, 2001

Origin #2: Arthur Rock

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Arthur Rock
America's first venture
capitalist
Key role in launching
Intel & Apple.

One of America's first **venture capitalists**

- He played a key role in launching **Fairchild Semiconductor, Teledyne, Intel, Apple**, and many other high- tech companies.
- A driving force in the emergence of Silicon Valley as a centre of innovation and entrepreneurship.
- Between **1961 and 1968**, **invested \$3 million** and **returned \$100 million** to their investors.

Venture Capital

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(MAIACAREU)

- A type of funding for **new or growing businesses**, which typically pursue **innovative products or services**, in **high growth technology industries**.
- Usually comes from **venture capital firms** that specialize in **building high risk financial portfolios**.
- Venture capital firms give funding to the startup company **in exchange for equity** in the startup.



Innovation Ecosystems



- Successful Ecosystems
- Cargo Cults and Simulacra
- Silicon Valley's Origins
- **Research Commercialization**
- Start-ups and Technology Transfer
- Overcoming Barriers
- Concluding Remarks

Research Commercialization

- By late 1970s:
 - ▶ US\$75 billion per year US Govt spending on R&D.
 - ▶ 28,000 patents accumulated.
- However, **less than 20 patents** commercialised, although Universities engaged in licensing, joint ventures, or spinoffs from university research.

Bayh and Dole



Birch Bayh
U.S. Senator
(D) Indiana



Bob Dole
U.S. Senator
(R) Kansas

- 1980 Bayh-Dole Act: allowed federally-funded intellectual property to be **owned by Universities**

"It is not government's responsibility ... to assume the commercialisation function. Unless private industry has the protection of some exclusive use under patent or license agreements, they cannot afford the risk of commercialisation expenditure."

- 1980-1997: **>7000 patents** granted to academic institutions; **>2,200 new companies formed** based on licensing of academic inventions

M. Ehrlich, "The National Science Foundation's Lean Startup Push" *Venture Findings*, Issue#4(2016), CIV, Tel Aviv University

Possibly the most inspired piece of legislation to be enacted in America over the past half-century. More than anything, this single policy measure helped reverse America's precipitous slide into industrial irrelevance.
The Economist, December 14, 2002.

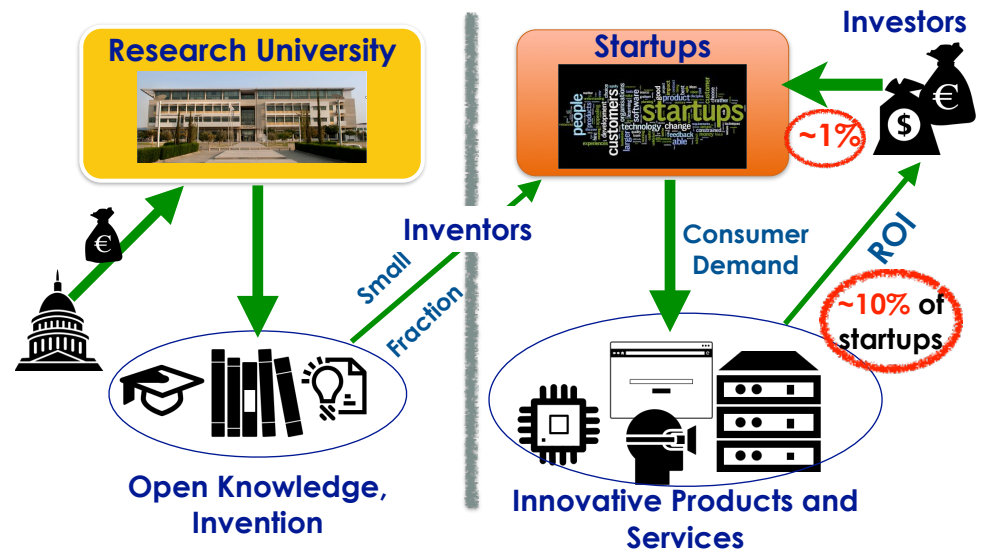
Innovation Ecosystems



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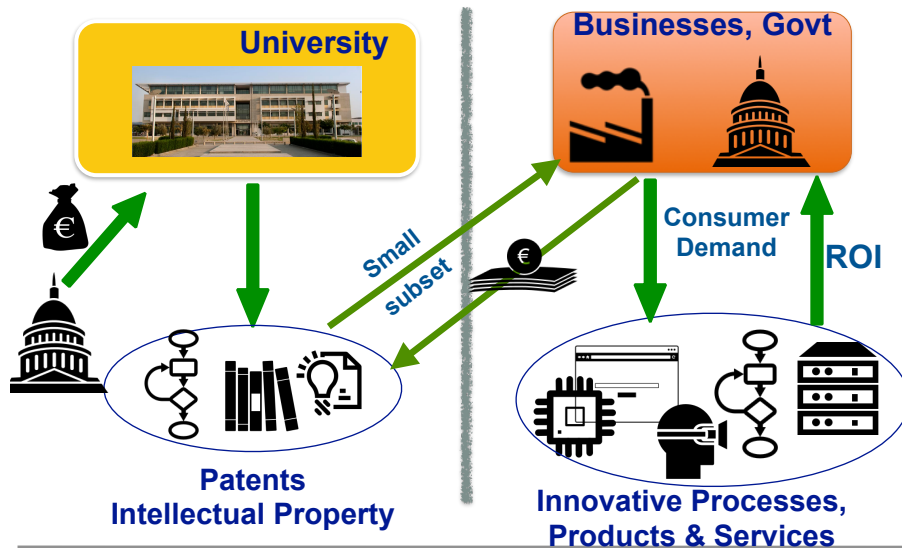
Start-ups vs Tech Transfer

How does it work? Start-ups



150 Source: prof. Kai Li, Princeton Univ.

How does it work? Tech Transfer



Another way to see Innovation

- **Government-funded Research:** transformation of money into knowledge
- **Innovation:** transformation of knowledge into money

[Geoffrey Nicholson, 3M (Inventor of the Post-It Note)]

Key factors for commercial success



“the most important task in business – the creation of **new value** - cannot be reduced to a formula”

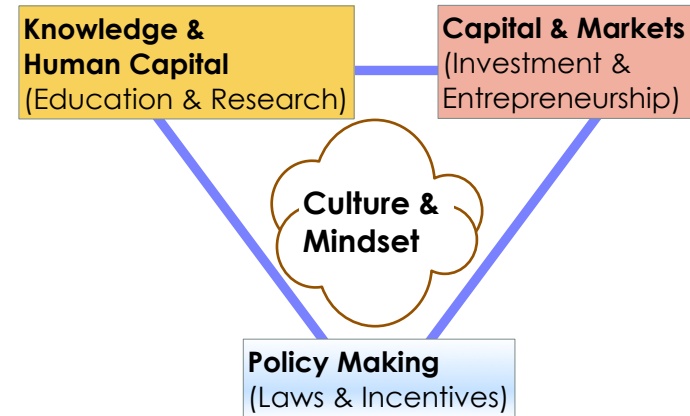
[Peter Thiel with Blake Masters, "Zero to One" 2014]

Outline



- Successful Ecosystems
- The risk of the Cargo Cult
- Silicon Valley's Origins
- Research Commercialization
- Start-ups and Technology Transfer
- Overcoming Barriers
- Concluding Remarks

The Environment



Section 2: Technological Innovation Ecosystems

Overcoming Barriers

A proliferation of “Silicon Valleys”

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Common barriers

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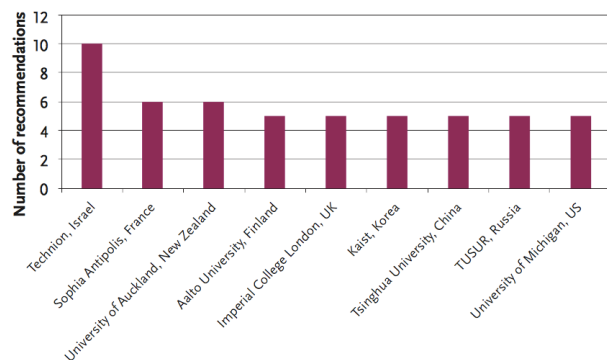
- National **culture** that does not support entrepreneurial behavior and **risk-taking**.
- Geographical **isolation** and/or **limited local market**.
- Lack of venture **capital** or **multinational companies** in the region.
- No existing **high-ranking research-led university** within the ecosystem base.



Success in the face of challenges

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“Which **universities** would you identify as having created/supported highly effective technology innovation ecosystems **despite a challenging environment?**”



Factors to Identify Emerging Leaders

Master Programs in Artificial Intelligence for Careers in EU (MAIACAREU)

- **Not simply** a result of strong **government funding**.
- Playing an **active** role in **establishing** / growing a vibrant **ecosystem**.
- Critical **entrepreneurial development** still in its 'startup phase'.
- Key Entrepreneurship & Innovation **components driving change still in place**.
- Taken a **distinctive path in their E&I policy** in response to particular barriers faced in their environment.
- A significant **focus on engineering and technology** in their entrepreneurship activities.



Key features of Emerging Leaders

Master Programs in Artificial Intelligence for Careers in EU (MAIACAREU)

- **Well-connected champions** with common vision, rich connections
 - ▶ Inspire, implement and sustain the effort
- **Public endorsement** by senior management of university engagement with entrepreneurship
 - ▶ Prominence in regional and national strategies for economic growth
- **Regional, national or government support**, on a sustained basis, often responsive and flexible in nature
 - ▶ Prioritising high-potential players, supporting international strategic partnerships
- **Relationships of trust** with the regional E&I community
 - ▶ A focal point through which university and local E&I community come together to establish necessary synergies and "support the next generation of entrepreneurs"
- **Mobilisation and drive of student** entrepreneurial movement
 - ▶ Often a result of strong culture and direct communication lines between this group and university management
- **Creating a market for university entrepreneurship** when limited existing E&I strengths in immediate environment
 - ▶ Partnerships with alumni entrepreneurs, establishing agency for international industry partnerships, open-access support for entrepreneurial development and start-up creation



Key building blocks of E&I strength

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- University senior management - **leadership & governance**
 - ▶ excellence in strategy & implementation
- University departments - **academic culture**
 - ▶ excellence in disciplinary and cross-disciplinary research, curricular and co-curricular activities
- University-led E&I activity - **E&I training and skills**
 - ▶ proper focus and alignment
- Student-led E&I activity - **need-driven**
 - ▶ enthusiasm and "can-do" attitude
- External E&I community - **wider context**
 - ▶ robust relationships of trust, synergies and flow of people & ideas



Development models

Master Programs in Artificial Intelligence for Careers in EU (MAIACAREU)

- Model A: '**bottom-up**' and community-led, catalysed by students, alumni, entrepreneurs in the regional economy with a '**loose IP control**'
 - ▶ Strong partnerships of trust with regional entrepreneurial community
 - ▶ Investment focused on regional rather than institutional capacity
- Model B: '**top-down**' and university-led, working through established university structures, with a '**tight IP control**'
 - ▶ Driven by and focused on strong TTO
 - ▶ Emphasis on university-owned IP - often leaves students and alumni marginalised



Main success factors

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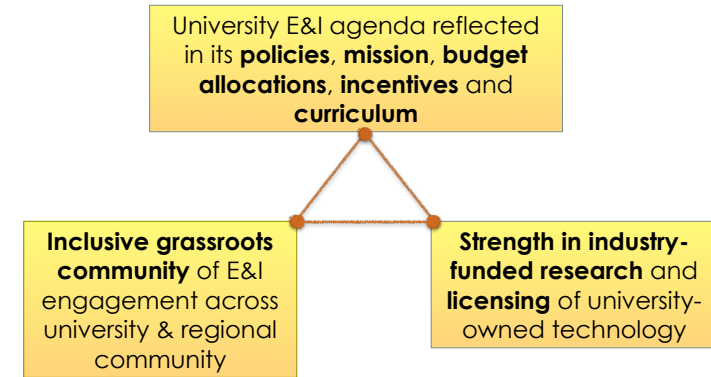
- Institutional Entrepreneurship & Innovation **culture**
- Strength of university **leadership**
- University **research capability**
- The local or regional **quality of life**
- Regional or **government** support
- Effective institutional **strategy**
- Powerful **student-led** entrepreneurship **drive**
- Strong partnerships of **trust** with regional entrepreneurial community



Ongoing challenges

- Potential conflict between research excellence and entrepreneurial ambitions
- Disconnect between grassroots, community-driven E&I and formal university channels
- Integration of E&I into the university's mission, policies and incentive systems
- Definition of proper E&I metrics

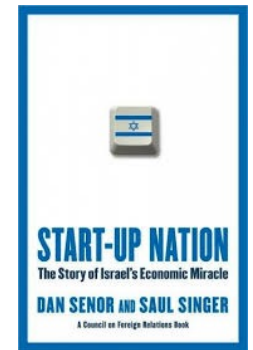
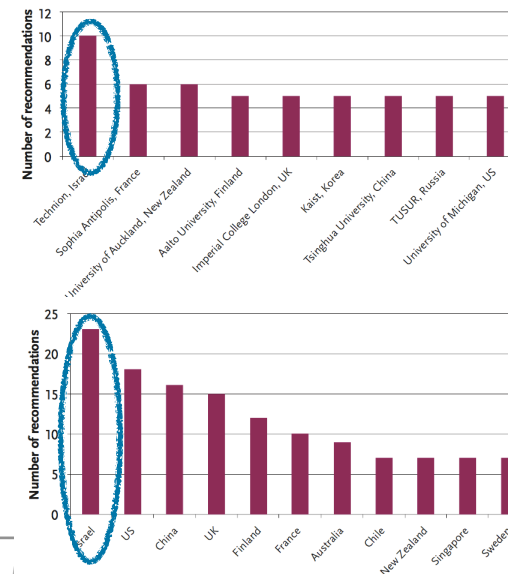
Balancing critical components



Section 2: Technological Innovation Ecosystems

Success in challenging environments

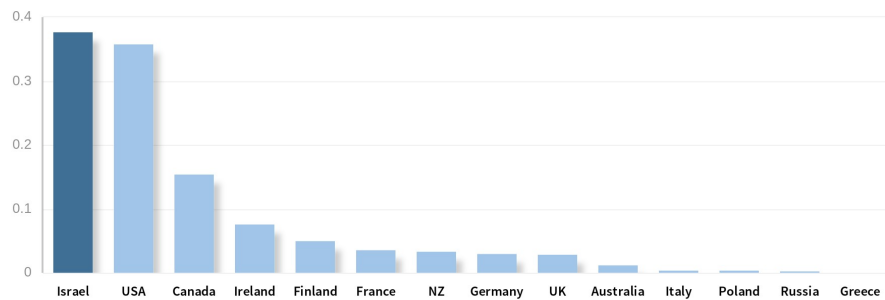
A Start-up Nation



VC Investment

VENTURE CAPITAL INVESTMENTS AS A PERCENTAGE OF GDP

Selected OECD Countries, 2016



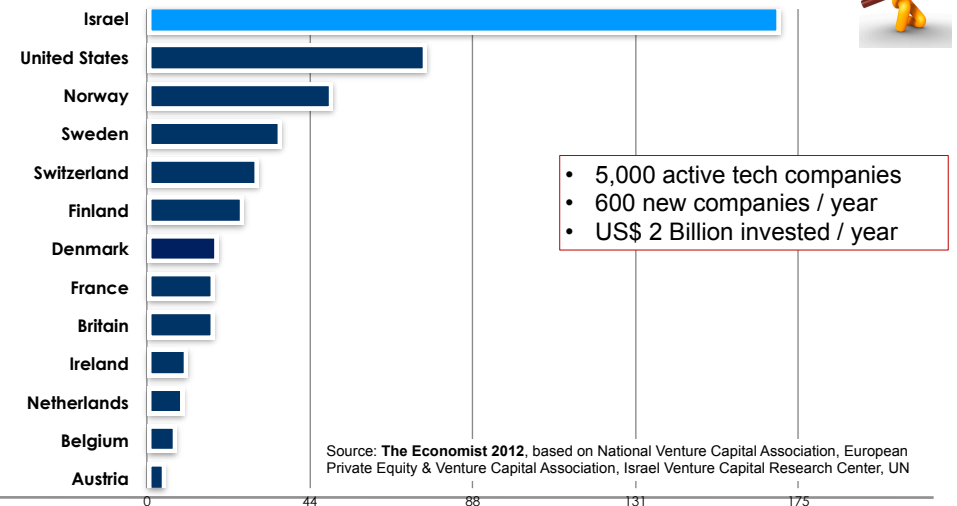
Source: OECD

300 Multinational R&D Centres Employing 50,000 People



Highest Venture Capital Availability

Venture Capital investment per person, selected countries, 2010, US\$



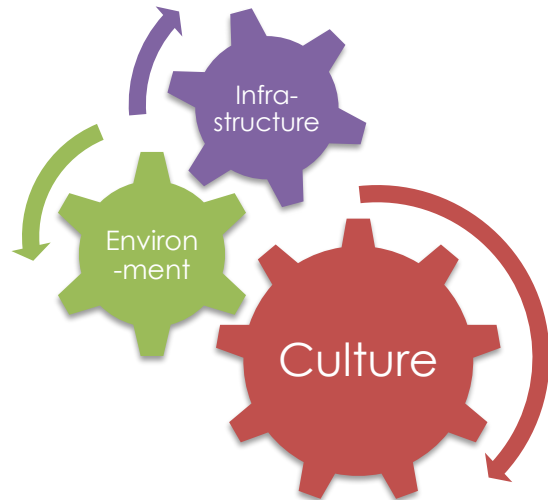
- 5,000 active tech companies
- 600 new companies / year
- US\$ 2 Billion invested / year

Source: The Economist 2012, based on National Venture Capital Association, European Private Equity & Venture Capital Association, Israel Venture Capital Research Center, UN

Hardship breeds Innovation

- Small
 - New
 - Isolated
 - No natural resources, not even water
 - Immigration – from 600k to 8 million in 65 years
- ▶ Interdisciplinary
 - ▶ No strong traditions => Open to change
 - ▶ Strong military => training, innovative technology
 - ▶ International outlook
 - ▶ Brain power, education => innovation
 - ▶ Novel job creation schemes

The Innovation Recipe

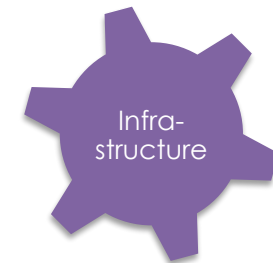


Highly-educated workforce

- Very **high-quality education infrastructure**
 - Highest ratio of university degrees to population in the world
- **Bill Gates**: "The **quality of education** is one of the key factors that has made Israel so unique in the great companies and partners we've had..."
- **Warren Buffet**: "If you go to the Middle-East looking for oil, you do not need to stop in Israel. But, if you are looking for **brains**, for **energy** and for **integrity**, the only stop you need is in Israel."

Infrastructure

- Education
- Innovative research
- Smart funding
- Management
- Facilities
- IP system



Successful Academic Commercialization

- World pioneer in technology transfer since **1959**
- Two of world's top tech transfer companies
 - Yeda, Weizmann Institute of Science (est. **1959**)
 - Yissum, Hebrew University of Jerusalem (est. **1964**)
- **>\$22 Billion** in licensed product sales per annum
- **>\$500 Million** in tech transfer revenues annually
- Hundreds of **spin-off companies**
- Many success stories
 - Copaxone®, Exelon™, Erbitux®, Azilect™, Doxil™, Rebif®, Cherry tomatoes, peppers, NDS Ltd. encryption algorithm, MobilEye driver assistance system...

Tech Transfer in Israel, UK, US & Japan

2012 Figures	Israel	UK	USA	Japan
Invention disclosures	528	4,300	23,741	8,949
Patent applications	431	1,942	14,224	6,962
License agreements	1,056	4,300	5,130	8,808
Spin-off companies	29	191	705	54
IP-related revenues (\$M)	481	111	2,600	410

Smart Government Intervention

- Office of the Chief Scientist supporting private sector innovation since **1969**
- Strategic decision to create military R&D capabilities
- **Venture industry** created by government => privatised
- **Incubators**: from job creation scheme to pillar of national innovation eco-system
- Innovative **industry/academia** support mechanisms
- **Evolving policies** addressing market needs, e.g.
 - ▶ Early stage funding
 - ▶ Multinationals
- Strategic initiatives, e.g. **nanotechnology, cybersecurity**

Environment

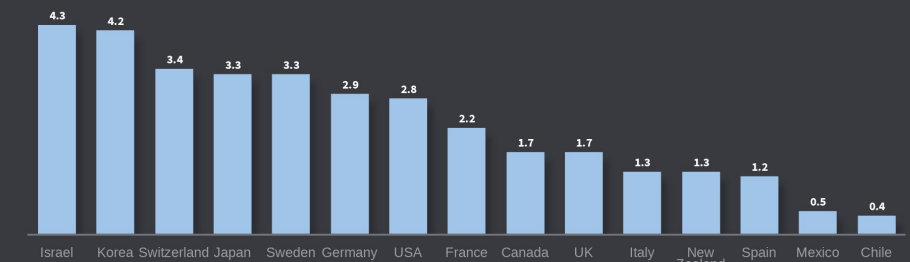
- Regulation
- Market access
- Tax credits
- Institutional investment



Strong R&D Investment

CIVILIAN R&D EXPENDITURE

% of GDP, OECD Countries, 2015

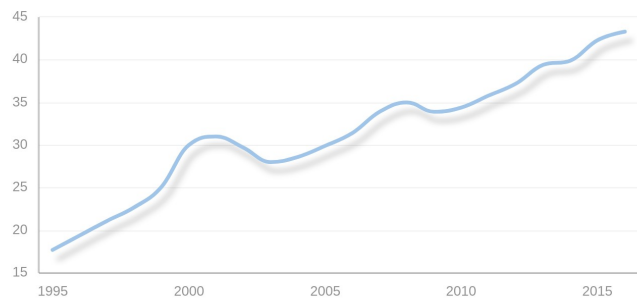


Source: OECD Data (<https://www.data.oecd.org/>)

Strong R&D Investment

A DEEPER LOOK: ISRAEL'S R&D EXPENDITURE

Civilian R&D Expenditure, 1995-2016 (Billions of NIS)



Source: Israel Central Bureau of Statistics



Courtesy: Oren Gershtheim, IdealityRoads Ltd.

The Innovation Recipe

- Make best use of available assets
 - ▶ Research
 - ▶ Facilities
 - ▶ Funding
 - ▶ Supportive environment
- Focus on areas of strength
- Import best practices
 - ▶ Fine tune for local needs
- Culture change takes time

Culture

- Breaking old habits
- Encouraging entrepreneurship
- Learning to embrace failure. It's part of the package



A "copycat" nation?



- Critics have accused China of being a "copycat" nation characterised by wide-spread infringement of intellectual property rights
- Copying is an accepted practice, and competitors will stop at nothing to win a new market"
- Prevailing western attitudes suggested that:
 - Familiar stories of Asian copycat production demonstrated that China is not a place that indeed threatened Silicon Valley's leadership in good innovation.
 - A copycat mentality is a core stumbling block on the path to true innovation, killing imagination and chances of creating original and innovative products.
 - The Chinese would never access the innovation magic that drove Silicon Valley.

The "Cloner"

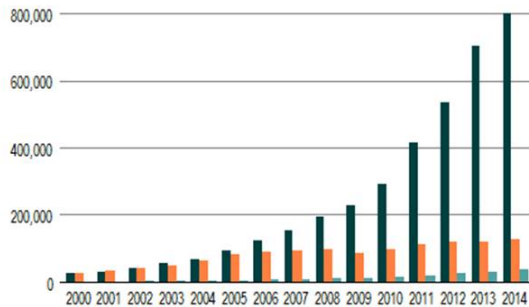


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- Wang Xing - a serial copycat
- In 2003, 2005, 2007, and 2010 he took America's hottest startup of the year and copied it for Chinese users
[Gady Epstein, "The Cloner." Forbes, 4/2011]
- However...
 - China has more recently been investing in technology, leading to a huge jump in the numbers of patents filed — seen as one yardstick with which to measure innovation.
- btw, Wang Xing's Meituan-Diangping, "Most Innovative Company" by FastCompany, 2019.



Fig.3 Patent Applications - Chinese Patent Office



Roughly equal resident to non-resident applications in 2004

By 2014, dramatic growth in patent applications from residents – 12 fold inc. over 2004

Non resident filings doubled

Starting to see more abroad applications

	Resident	Non-Resident	Total	Abroad
2004	65,786	64,598	130,384	3231
2014	801,135	127,042	928,177	36,682

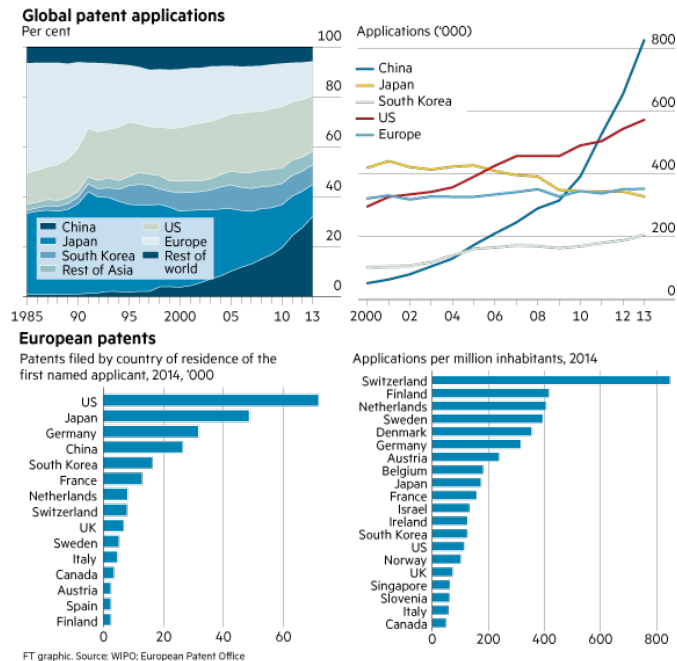
Source: WIPO statistics database, last updated December 2015

Chinese patenting activity

Master Programs in Artificial Intelligence for Careers in EU (MAIACAREU)

- Growing exponentially!
- In 2008 Chinese authorities received 204,268 patent filings, compared with 428,881 in the US.
- By 2017 China's State Intellectual Property Office received 1.3m applications — more than double the number received by the US.
- Patent applications coming out of China reflect a geographical shift of innovation from west to east

Francis Gurry, World Intellectual Property Organisation director-general, Financial Times, July 9, 2019



FT graphic. Source: WIPO; European Patent Office

Learning through copying

- By cloning early versions of Google, Facebook, Twitter, Groupon etc, Chinese entrepreneurs:
 - Built up **baseline engineering and digital entrepreneurship skills**, totally absent in China at the time.
 - Took inspiration from American business models and through **fierce local competition adapted** and **optimised** them for Chinese users.

189 [Kai-Fu Lee, "AI Super-powers. China, Silicon Valley and the New World Order" 2018]

A National Strategy

“to promote **original innovation in scientific research** and the innovation and integration of key technologies, so as to scale the **heights of world science** and technology, and make **fundamental**, strategic and forward-looking **contributions** to **China's** economic reconstruction, national security and sustainable development”



[Guidelines. Chinese Academy of Sciences, 2017]

“Our history of copycat is nothing to be ashamed of. **Copying means learning**. It means you are **redoing it, but in your own way**.

It's like learning a language.
It's a very natural process. It's nothing to be ashamed of or blamed for.’

Eric Pan, founder and CEO of Sseed Studio as quoted in **Silvia Lindtner**, “Hacking with Chinese Characteristics: The Promises of the Maker Movement against China's Manufacturing Culture.” *Science, Technology & Human Values* 40(5):854-879 · July 2015

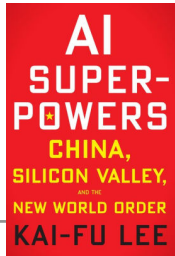
A National Strategy

- “**Mass Entrepreneurship - Mass Innovation**” aspiration announced by Premier Li Keqiang, 9/2014, WEF @ Tianjin, “Summer Davos”]
- 5/2015: State Council's directive on advancing “Mass Entrepreneurship - Mass Innovation” by:
 - Directly subsidising Chinese technology entrepreneurs.
 - Encouraging the creation of thousands of technology incubators and entrepreneurship zones.
 - Establishing government-backed “guiding funds” to attract VCs.
 - Offering tax breaks and simplifying administrative procedures.
- Central government set the goals, for regional and local administrations to implement them.
- **Move from “Made in China” to “Create in China”**: “Only through owning independent intelligence property and developing its own patents and brands, will China be able to stand out in the world, and Chinese people will then live a life of “equality, freedom and dignity.” [H. Chen, COO, TusPark]

How Does it work?

“The central government **does not simply issue commands** that are instantly implemented throughout the nation.

But it does have the ability to **pick out certain long-term goals** and **mobilise epic resources** to move to push in that direction”



Conclusions

- Cannot cut and paste. Each country/place/university has to find its own model:
 - ▶ **Silicon Valley** was developed in an environment of abundance, building on top of a long tradition and strong foundations of strong science, education, mentorship, and inspiration - mission driven.
 - ▶ **Israel** success was a needs-based evolution supported by culture.
 - ▶ **China** - market-driven, profit-hungry, cut-throat entrepreneurship but with government orchestration.
 - ▶ **New York & London** – financial industry and media.
 - ▶ **Singapore** and **Korea** - by design.
- Creative innovative mindset requires changing attitudes – takes time.
- Strong, consistent, and persistent policy making requires changing attitudes and social pressure.

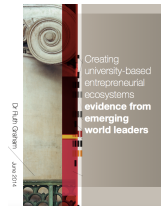
Section 2: Technological Innovation Ecosystems

Concluding Remarks

Concluding Remarks

“the stable development of a research commercialisation activity, outside a one-off “blockbuster” innovation, would take

at least 10-15 years”



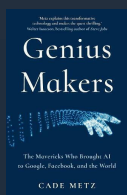
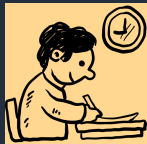
Concluding Remarks

universities develop the entrepreneurs of the future
not
the ventures of today...

Concluding Remarks

"Start-ups and the Entrepreneurs who found them are not born in a vacuum. Their business models, products and core values constitute an expression of the unique cultural time and place in which they come of age."

Reading Assignment



Read Part 1 – Chapters 1-6 (A New Kind of Machine) of the book "Genius Makers" by Cade Metz.

- These chapters discuss the scientific and technical evolutions that brought neural networks to the forefront of the present AI revolution.
- How long did it take for this evolution to materialize?
- Who were the key persons and what each of them achieved?
- What were the main factors that led to the successes of AI and ML after so many failures?

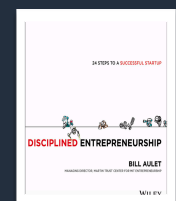


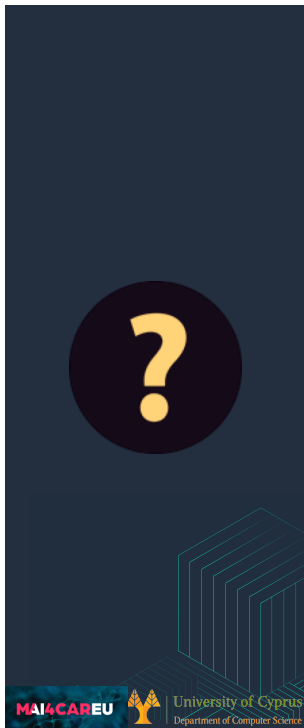
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Module 1: Introduction to Innovation and Entrepreneurship

Topic 1.4: Teams and Ideas

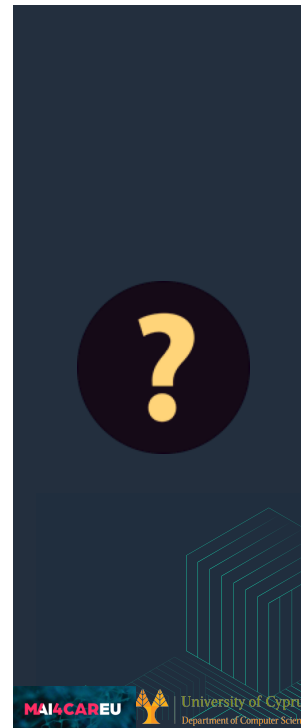
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WHY / WHEN WOULD YOU START A NEW VENTURE?

M. D. Dikaikakos



WHY / WHEN WOULD YOU START A NEW VENTURE?

- HAVE AN IDEA
- HAVE A TECHNOLOGY
- HAVE A PASSION

M. D. Dikaikakos

Three ways to start a new venture

Master Programs in Artificial Intelligence for Careers in EU (MAI4CAREU)

- **Have an Idea:** You have thought of something new that can change the world—or some small part of it—in a positive way, or something that can improve an existing process you're familiar with and you want to **implement** it.
- **Have a Technology:** You have come up with a **technological breakthrough** and want to capitalize on it, or simply expedite its deployment to have a positive effect on society. Or, you have learned about a technological breakthrough and you see great potential for a business.
- **Have a Passion:** You are confident and you are comfortable pushing yourself to develop your skills in the most comprehensive way possible. You also might believe that being an entrepreneur is the way to have the biggest impact on the world. You simply might know that you want to work for yourself and control your own destiny, so you'd like to learn about entrepreneurship while looking for a good idea, technology, and/or partner.



Idea:

"I want to start a company in Africa that will create a sustainable business model to improve life for the people there and empower them with jobs."

Here, the idea is that a sustainable business model will reduce poverty in Africa more effectively than charitable contributions to the poor. This sentence is enough to move on to the next step of Market Segmentation, though as you will see, you will have to be much more specific before you can turn the idea into a business.

Technology:

"I have a robot that allows you to feel objects rendered by a computer."

I have a technological breakthrough!



This statement radiates with potential. How could someone benefit from being able to have a three-dimensional object on their computer screen and still be able to feel it, in some way, in physical space?

SensAble Technologies, featured in the D24 book, is a company built around this very technology.

How Do You Know If your Idea is Good?

- You don't for sure. It is really just a start but ...
- Ideas are **necessary** but **not the most important** thing
- You can fix them if you are headed in the right direction with the right team
- But still you need one to get started

Passion:

"I have a master's in mechanical engineering and I can quickly prototype most any technological gadget you want and I want to put my skills to use in the most impactful way possible, and be my own boss."

I have a passion!



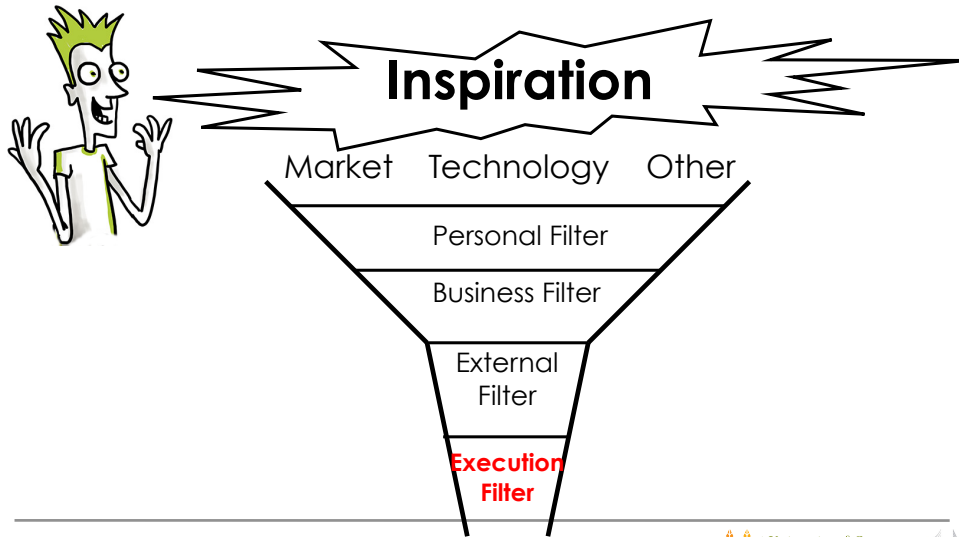
This person has identified a personal comparative advantage, the ability to prototype gadgets quickly, which can help a business go through product iterations faster.

The person may want to consider a hardware-based business, as it would line up well with the comparative advantage.

Reasons to Have a Good Idea

- Is this important?
- **No:**
 - It will change
 - You get 1-2 major adjustments ✗
 - Don't use as an excuse not to do the job properly up front
- **Yes:**
 - If you are not over a good target, your efforts will be much less effective
 - Your ability to recruit people
 - Your ability to put your head down and go and not look back at least for some time
 - Credibility in the longer term with customers & others ✔
 - Build your expertise that makes you unique

Sifting Out Good Ideas from Bad



Personal Filter

- The idea won't go away
- You really, really care
- You can explain it
- Will making it happen be fun to you?
- Can you see yourself doing it for 5+ years?
- Can you get the other people you need excited about it?
- Is it within your domain of expertise?
- Does it fit with your overall personal goals?

Superfantastic!!!
Awesome!!!
Sooooo much better
than anyone else's!!!



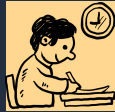
External Filter

- Do the people you need to convince **get it?**
- Can you recruit the **team you need?**
- Does the **customer buy it?**
- Do the **business partners** you need buy it, **buy it?**
- If you need **investors**, do they **buy the story?**
- Is the **timing right?** (personal too)

Execution Filter

- **Market** adoption rate and issues
- What things need to go right? How many?
- What things, if they went wrong, would **kill you?**
- What **competitors** will you have as soon as you launch your new venture? How will they react?
- How do you assess the **overall risk?**
- What did you miss? Did you **ask experts** in this area?
- Does the idea **continue to motivate** you and others when honestly facing with the downside?

Quick Exercise



- Consider your best idea
- Do these filters make you feel better, same or worse about your idea? (2 minutes)
- Now discuss with a colleague next to you why it is and see if they buy it (4 minutes)

Consider your skill set

- **Knowledge:** What was the focus of your education or career?
- **Capability:** What are you most proficient at?
- **Connections:** Who do you know that has expertise in different industries? Do you know other entrepreneurs?
- **Financial assets:** Do you have access to significant financial capital, or will you be relying on a meagre savings account to start out?
- **Name recognition:** What are you or your partners well-known for? Skills in engineering? Understanding fiber optics?
- **Past work experience:** In previous jobs you've held, what inefficiencies or "pain points" existed?
- **Passion for a particular market:** Does the idea of improving healthcare excite you? How about education? Energy? Transportation?
- **Commitment:** Do you have the time and effort to devote to this endeavor? Are you ready to make a new venture your primary (or only) focus?



KEY QUESTION:

WHAT CAN I DO WELL THAT I WOULD LOVE TO DO FOR AN EXTENDED PERIOD OF TIME?

User entrepreneurship

- Often, you will find an idea or technology that *improves something for you personally*, then realize that idea or technology has the potential to help many **others**.
- Nearly *half of all innovation-based startups* that are at least five years old were founded by user entrepreneurs.

Find a great team

- Your choice of co-founders is extremely important.
- Businesses with multiple founders are more successful than those founded by an individual.
- There are many resources that go into more depth about finding good co-founders.

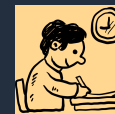
Key Considerations and Alternative Approaches

- Networking for More Options:
 - ▶ If unsure about someone, still discuss with them for **potential referrals**.
- Repetition and Clarity:
 - ▶ **Repeat** the process multiple times for best results.
 - ▶ Maintain **clarity** and **honesty** in communication.
- No Mandatory Need for a Cofounder:
 - ▶ Starting alone is also viable; don't add a cofounder just for the sake of it.
 - ▶ A good cofounder can ease the process, but a bad one can be **detrimental**.
- Respecting Different Work Styles:
 - ▶ Acknowledge different methods of working (consistent grinding vs. short bursts).
 - ▶ **Ensure mutual comfort** with each other's work style to prevent conflict.

Finding the Right Cofounder in University

- Opportunity at University:
 - ▶ University is an ideal place to find a cofounder.
 - ▶ Surrounded by smart, motivated individuals.
- Identifying Potential Cofounders:
 - ▶ Look within your circle of friends and project collaborators.
 - ▶ Assess if you would like to work with them closely.
- Initial Steps:
 - ▶ Start by working on a small project to test compatibility.
 - ▶ Be honest about goals and expectations.
 - ▶ Evaluate if work styles and goals align.
- Communication and Expectations:
 - ▶ If the first project is successful, discuss company ownership and roles.
 - ▶ Set clear expectations from the beginning.

Reading & Video Assignment



Watch the following videos:

- Finding a Co-founder in College, Y Combinator
 - ▶ <https://blog.ycombinator.com/advice-on-finding-a-cofounder/>



How to Find a Cofounder - Kat Manalac
12,608 views · Published on May 23, 2019



Kevin Hale - How to Work Together
13,155 views · Published on Aug 22, 2019

Focus!

- Your first goal is to assess the needs of potential customers, **focusing on a target customer with the goal of achieving product-market fit**—
 - a product that matches what customers in a specific market are interested in buying.
- **Focus** is very important because entrepreneurs have very **limited time and resources** and so must be **hyper-efficient**.
- Focus is so crucial to determining your target customer that **the first five steps** of the 24 Steps—from Market Segmentation to profiling your Persona—is defined as **“The Search for the Holy Grail of Specificity.”**

KEY REQUIREMENT

FOCUS

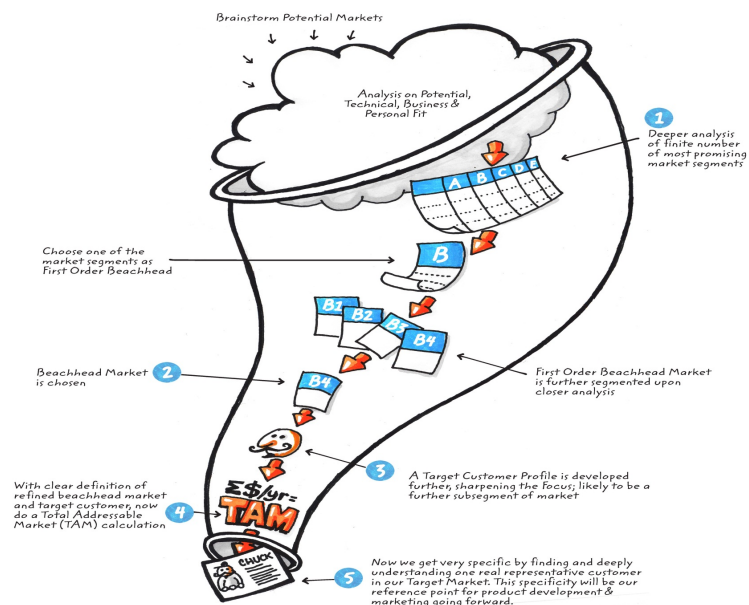


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THE JOURNEY FOR THE HOLY GRAIL OF SPECIFICITY

Source: **DISCIPLINED ENTREPRENEURSHIP**



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Module 1: Introduction to Innovation and Entrepreneurship

Topic 1.5: From invention to commercial product

Source:



Section 4 Outline



- From invention to commercial product
- Disclosure and confidentiality
- Assessing Novelty
- Competition and Market Potential
- Risk Assessment
- Exploitation Routes
- Prototyping and Proof of Concept
- Protecting your Invention

Introduction

- Review key stages of turning an invention into a commercial product...
- ... or turning an idea into an enterprise, if we are to widen our definition of 'invention' to include:
 - ▶ novel processes
 - ▶ business methods
 - ▶ social interactions etc

The element of risk

- Any new business venture involves risk, but
- invention carries extra risk because it is impossible to predict how well an unknown, untried product will perform in the market-place.
- No matter how thoroughly the market is researched, no one can guarantee success.
- Most companies and investors know this, and it is the main reason why they are reluctant to gamble on inventions. There are always safer ways to invest money!

The element of risk

- A single, simple lesson that inventors need to learn, to maximise chances of success:
 - ▶ **reduce risk** and **control costs** at **all times**
- Most risk is financial, so controlling costs is vital.
 - ▶ It is easy to overspend on an invention because optimism tends to overrule caution.
 - ▶ Many invention projects fail because **too much money** has been spent **too soon**, or on the wrong things.

The element of risk

- As an inventor you must be able to demonstrate that you have done everything you possibly can to **eliminate risk** from your project.
- This means not just the risk to you, but also the risk to:
 - ▶ potential **investors**,
 - ▶ **licensees** and
 - ▶ business **associates**.
- If you can show **a positive attitude to risk reduction**, you are much more likely to attract investment and support.
- You should therefore regard **reducing risk as essential** to improving the chances for your invention - perhaps even more essential than acquiring strong IP rights!

Disclosure and confidentiality

- What is **disclosure**?
- The **dangers of disclosure are real**, and need to be taken seriously as soon as you start thinking about your invention.
- Protecting your idea against disclosure is not quite the same as protecting your idea against **infringement**.
 - ▶ It depends largely on your own common-sense measures, which you should take from the day you first think of your idea.
- Protecting your idea against **infringement** depends largely on the correct use of formal legal procedures when the time is right to use them.

Section 4: From invention to commercial product

Disclosure and confidentiality

Source:



Assessing the risk of disclosure

- Disclosing an idea **without adequate legal protection** is always dangerous. The main risks are:
 - ▶ Someone may use the knowledge of your idea for their own gain - which usually means your loss.
 - ▶ Disclosure now may prevent you from obtaining a worthwhile patent later.
- In the very earliest stages of an idea, the problem for many inventors is twofold:
 - ▶ It is usually **inadvisable to apply too early for a patent**. The **timing** of a patent application can be **critical**.
 - ▶ Yet in order to make progress with an invention, **some disclosure may be unavoidable**.
- How then should you protect your idea in the early stages of its development?

Disclosure risks

- Disclosure to individuals during **private meetings**
 - This type of risk is controllable as long as you take a few basic precautions, detailed below.
- **Public disclosure**: the dangers here are less obvious. Particularly **problematic areas** are:
 - **Media publicity and competitions**. Both may be useful after you have legally protected your idea but definitely not before it.
 - Inventions which originate as **student projects** - especially if there is a requirement to exhibit or publish your work.
 - Any form of public display of an idea legally constitutes disclosure and can have serious consequences.

Who can you trust?

- You should be **safe** disclosing details of your idea to people whose professions require them to observe confidence in all dealings with clients:
 - patent attorneys, other legal professionals, EPO and national IP office personnel
 - public servants such as business or technology advisers and funding scheme administrators.
- When dealing with anyone else - companies in particular - you should **disclose nothing without** at least (a) a signed **non-disclosure agreement (NDA)** and (b) free **forms of legal protection in place**, such as **copyright** or **unregistered design right**.

Disclosure strategy

- You should try to avoid:
 - Obsessive secrecy.
 - A demand for payment before disclosing any detail of your idea.
- Few people will be willing or able to help you if you use such negative tactics.
- Instead before talking to companies or individuals not bound by confidentiality (either a professional code or a signed NDA), **decide exactly how much you can tell them without describing the inventive parts** of your idea.
 - Revealing broadly what it is ('It is a novel mousetrap') may be safe; revealing what makes it novel is dangerous.
- The more you discuss the technical aspects of your idea, the greater the risk of disclosing secrets. Try instead to **focus your presentation on the competitive benefits of your invention**: for example, 'It is cheaper', 'It is more reliable', 'It is easier to use'.
- Be **diplomatic but firm** about your need to restrict disclosure. If the people you are talking to want more detail from you, insist that they **sign your NDA**.
 - If they refuse to sign, walk away! Even if they do sign, disclose as little as possible.
- Even if protected by an NDA, **be very careful what you reveal to experts** in your field of invention. They may need only one or two small details to guess the unique features of your invention.

Protecting your idea (IP)

- At some point you must legally protect your intellectual property (IP) or you will not be able to:
 - Disclose it safely.
 - Be recognized in law as its owner.
 - Profit from its commercial exploitation.
 - Prevent or discourage its unauthorized use by others.
- There are several forms of protection known as **intellectual property rights (IPR)**. Usually, the best way to protect an invention as it evolves is to use a strategic combination of IPR.
 - Many inventors assume that the only way to protect their idea is to **patent** it. While patents tend to be of primary importance, other forms of IPR should also be considered.

Patent Attorneys

Master Programs in
Artificial Intelligence for
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- IPR is a complex area of law that holds many dangers for inexperienced inventors. A patent attorney's advice will be **helpful** when you are planning an effective IP protection strategy, and **essential** if you decide to patent your idea.
- Patent attorneys are usually experts in all forms of IPR. They can improve your chances of obtaining worthwhile protection for your idea, and can act for you when problems arise.
- Your patent attorney should be able to advise you fully on IP matters in your own country and all of Europe. For IP matters outside Europe, most patent attorney firms in your own country will be able to act for you, or arrange representation, in any country.
- However, it is important to understand that **no patent attorney can ensure that your IPR will bring you any financial reward**. You or your team of other experts must take responsibility for the commercial success of your invention.

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IP Law



<https://www.youtube.com/watch?v=3iP9WaNvaqU>

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Section 3 Outline



- From invention to commercial product
- Disclosure and confidentiality
- Assessing Novelty
- Competition and Market Potential
- Risk Assessment
- Exploitation Routes
- Prototyping and Proof of Concept
- Protecting your Invention

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Section 4: From invention to commercial product

Novelty

Source:



What is an invention?

- For your idea to be regarded as an invention, at least one significant part of its technology must be **completely novel** (that is, new).
 - ▶ There must be no evidence that this novel aspect of your idea has ever been described before, or used for the same purpose before.
- Not all the technology of an invention needs to be novel.
 - ▶ An idea may be an invention **if existing technologies are combined** in a way that is **novel**, or used in a way that is novel.
 - ▶ The inventive element **might be only a small part of the whole idea**. But if that small part makes a big difference to the commercial prospects of the idea, it could be an important and valuable invention.
- Many people claim to have thought of a novel use of technology. The reality is that in most cases, the idea is already known. It therefore cannot be novel and so there may be little point trying to commercialise it.
 - ▶ The inventor will usually be unable to protect it strongly, and without strong intellectual property protection to attract them, few companies or investors will be interested.

HOW DO YOU FIND OUT IF YOUR IDEA IS NOVEL?



You do it by **searching for prior art**.

Prior art

WHAT IS PRIOR ART?

Prior art is **any evidence that your invention is already known**.

- Prior art **does not need to exist physically or be commercially available**. It is enough that someone, somewhere, sometime previously has described or shown or made something that contains a use of technology that is very similar to your invention.
- An existing product is the **most obvious form of prior art**. This can lead many inventors to make a common mistake: just because they cannot find a product containing their invention for sale in any shops, they assume that their invention must be novel.
- The reality is very different. **Many inventions never become products**, yet there may be evidence of them somewhere. That evidence - whatever form it may take - will be prior art.
- Some experts estimate that **for every recorded invention that eventually reaches the market, ten never will**. This means that if you want to find out if your invention is novel, you should indeed search products past and present - but you should also search much further.

Competing art

- While looking for prior art, you should also look for **competing art**. These are ideas that may not be at all like yours but **do the same job**.
- It is important to study competing art for two reasons:
 - ▶ Most inventions are a solution to a problem, and most problems have more than one possible solution. You need to examine other solutions, as some may offer more advantages than yours.
 - ▶ If you try to exploit your idea commercially, alternative solutions may be strong competition. In order to argue successfully that your solution is better than alternatives, you need to know what the alternatives are!

WHERE CAN YOU SEARCH FOR PRIOR ART?

Worldwide patent system

Some patent databases - including the **European Patent Office's free database Espacenet** - contain **90 million documents** collected and indexed over many years by patent offices in many countries.

Thanks to the internet, and to the international classification systems used to organise inventions by subject, it is quite easy for inventors to do their own patent searching.

Why is novelty important?

- Even if an idea is novel, **novelty on its own may not mean much**.
- For an invention to have **good commercial potential**, it needs to be **a significant improvement on prior art**. This depends on many factors.
 - ▶ Some improvements may be small in technology terms but have high commercial value.
- For example, the **drinks can ring-pull** is simple technology, but its advantages -
 - ▶ it is secured by a rivet that does not penetrate the can, and
 - ▶ the underside of the ring is shaped to give mechanical advantage - made it a significant invention with huge commercial value.



Why is novelty important?

- For an invention, a lack of novelty matters for 2 main reasons:
 - ▶ Unlikely to obtain worthwhile IP rights for not novel idea.
 - In most cases this means that your idea will have little or no commercial value. (Exceptions include ideas that rely more for their success on skillful marketing than IPR, or where a rights owner agrees to license the IPR.)
 - ▶ Not novel idea cannot legally belong to you.
 - If someone else owns the rights, you risk having legal action taken against you if you try to exploit it without their permission.
 - Nor can you claim the idea as yours even if it has no legal owner (for example, if it is an old idea).



Why is novelty important?

- It is possible for a commercially successful idea to be novel but not particularly inventive.



- ▶ For example, electric toothbrushes used to be too expensive to sell well.
- ▶ Then someone discovered that it was possible to use a **much cheaper motor**. Prices fell and sales soared.
- ▶ This new type of electric toothbrush simply included a **well known motor**, and functioned in a well known way, so there was no invention - but **the novelty of combining motor and toothbrush** gave it a large commercial advantage.

Why is novelty important?



“Reinventing the Suitcase by Adding the Wheel” NYT 4/10/2010
<https://www.nytimes.com/2010/10/05/business/05road.html>

Is the idea obvious?

- To be regarded as an **invention**, an idea needs to include an **inventive step**, i.e. something:
 - ▶ **non-obvious**
 - ▶ does not **readily occur to an expert** in the relevant technology.
- **Obvious**: something that would be the next logical step along your path from the problem to the solution.

Obvious is not so ... obvious

- Judging what might be **obvious** can be very difficult. The following inventions could be **considered as obvious**:
 - ▶ Inventions which involve **combining equipment**, the result of which combinations might be a new product, but its properties or functionality might be entirely predictable as soon as one knew its components.
 - ▶ A product in which **one component has been replaced for a different one with equivalent properties**.
 - ▶ A **new problem** which can be **solved with a well known piece of equipment**: the 'novel' process for solving this problem might be considered obvious if there was only one solution to the problem, and it would be known to the typical technician facing the problem (the so-called 'person skilled in the art').

Non-obvious Inventions

- When components are **combined** to make a product or process with **properties** which are **greater than the sum of its parts**, or **better than expected**.
- In a problem with **many possible solutions**, where the inventor:
 - ▶ did research to select the best one
 - ▶ defied some technical prejudice and solved it by doing something every other expert had previously believed would not work.



The inventor of an odourless toilet bowl visited many companies with a complete working toilet, performing 1600 demonstration flushes.

But he had never done a patent search.

Eventually he found a company interested enough to do its own patent search.

They soon found so much prior art that it became obvious that the idea was unprotectable.

The inventor threw away his toilet.

Where do inventors go wrong?

- When it comes to prior art searching, many inventors simply **scratch the surface**.
- By far the **most common mistake** they make is to **assume that their idea is novel**, when a simple patent search would tell them that it was not.
 - ▶ They then make things worse by spending often large sums of money on an idea that is extremely unlikely to be commercially successful.

Prior art searching

- Prior art search processes: a **product search** and a **patent search**.
 - ▶ Do **both** to be confident that you have done a thorough prior art search.
 - ▶ Do them **before** spending significant amounts of time and money on your idea.
- Warnings:
 - ▶ It may take only minutes on the internet to find prior art. If you do not look for it, companies and investors almost certainly will. You are **unlikely to get help or funding** if they find crucial prior art that you have missed.
 - ▶ **Do not ignore evidence you do not like**. The purpose of a prior art search is to go looking for evidence you may not like.
 - ▶ An absence of prior art at the time of your searches may not be a permanent absence. You should **update your prior art searches periodically** as you develop your idea.

Prior art searching Steps

- Step 1: Finding the right keywords
- Step 2: Product searching
- Step 3: Patent searching

Find the keywords

- To maximise your chances spend some time thinking of key words or search terms which best describe your idea.
- When using search engines, the **most obvious key words may be unhelpful**. For example, let us say your idea is a **mousetrap**
 - ▶ A search for 'mousetrap' produces over two million hits - many of them irrelevant, and an impossible number to search.
 - ▶ But a search for 'rodent trap' (what else it is) and 'trapping mice' (what it does) produces 20,000 and 700 hits respectively. These are still not small numbers but they are likely to be more relevant, so we can usefully start searching here.
- The **most productive search terms** may be **specialist technical terms** that **you do not know**. For example, a search for external devices that pump blood round the human body required the crucial medical term 'extra corporeal'.
 - ▶ A searcher with no medical knowledge would be unlikely to know this term, but might find it while examining the results of other key word searches. It may therefore take a few preliminary searches to find better keywords to use for more accurate searches.
- **Look out too for new terms for new technologies**: for example, 'virtual fit' for software systems to replace trying on clothes in shops, and 'telemedicine' for remote monitoring of patients in their own homes.

Product searching

- You need to find out what is already on the market:
 - ▶ That is similar to your idea (prior art).
 - ▶ That tackles the same problem (competing art).
- **Obsolete technologies** or **products** may be prior art, so:
 - ▶ check historical as well as current sources of information.
- **Products in development but not yet on the market** may be prior art, so
 - ▶ Search **news sites**, industry **journals**, trade **show** and **exhibition websites**. Perhaps especially search **academic research activity**, as this is where many new products start out, often years before a commercial product appears.
 - ▶ **Search offline** - in shops, books, periodicals, printed catalogues etc.
 - ▶ **Talk to people** with relevant experience - for example, retailers and suppliers - who will have seen products come and go over the years and may have seen your idea among them.

Patent searching

- For many ideas, **patent searching** will be **far more important** than **product searching**.
 - ▶ Although many products on the market do not have a patent, they are probably heavily outnumbered by the many ideas that are successfully patented but never reach the market.
- Patent searching involves two skills:
 - ▶ **Finding every patent document** that is relevant to your invention.
 - ▶ **Interpreting the significance** of your findings.

How long will your search take?

- From a **few minutes** (if your first keywords are accurate and there is a great deal of prior art) **to many hours**.
- Be prepared to **spend all the time it takes** to be confident that you have done a proper job.
- Your **mission** is: **find evidence that disproves the novelty of your invention!**
 - Your hope is that you will fail, but in the interests of a thorough search you must put that to the back of your mind.
- Assume that if you are not finding prior art, you are **looking in the wrong places**.
- **Keep searching** until you are confident that there is nowhere else left to look.
- **Keep records** of everywhere you look and everything relevant that you find.
- You are unlikely to be as good as a professional searcher, so in some cases it may be advisable to **ask a professional to search for you**



Simple Espacenet Searching

- Use your keywords to find at least some relevant patents: prepare search strings of up to ten keywords (Use **Espacenet's** wildcard feature to find plurals and other variants).
 - This may produce enough prior art to end your search.
 - If not, go back to Smart Search and try different search strings.
- Work with bibliographic screens to look for patent abstracts and/or examining individual patents.
- If you have not found enough prior art after repeating this procedure a few times, try shifting the basis of your search from keywords to classifications or CPCs (**Cooperation Patent Classifications**).
 - Use relevant patents found to identify relevant subject classification for your idea.
 - Try combining keywords with CPC terms to refine your search.





The screenshot shows the Espacenet patent search interface. The search term 'heat pump' is entered in the search bar. The results page shows 2,362,637 results found. The first four results are listed:

- 1. ELECTROCHEMICAL HEAT PUMP SYSTEM**
WO0244610A1 • 2002-06-06 • BORST INC [US]
Earliest priority: 2000-12-01 • Earliest publication: 2002-06-06
An electrochemical heat pump (112) comprising an electrochemical heat pump (112) capable of reversibly producing and consuming gas, a refrigerant-base cooling system (154), and a gas-driven compressor (152) in fluid communication with the electrochemical heat pump (112) and cooling system (154). The gas produced by the electrochemical heat pump (112) and cooling system (154).
- 2. HEAT PUMP FLUID HEATING SYSTEM**
CA2385760A1 (C) • 2001-03-29 • THOMPSON PETER FORREST [NZ]
Earliest priority: 1999-09-24 • Earliest publication: 2001-03-29
...A heat pump system (6) for raising the temperature of a fluid comprises: a compressor (7) for compressing a working... condenser heat exchanger fluid outlet (16) being communicated directly with the desuperheater heat exchanger fluid inlet (9), and the condenser heat exchanger working fluid inlet (17) being communicated directly with the desuperheater...
- 3. PRE-HEATING OF A LIQUID IN AN AIRCRAFT RESERVOIR**
CA2643465A1 (C) • 2007-11-01 • PRAIT & WHITNEY CANADA [CA]
Earliest priority: 2006-04-21 • Earliest publication: 2007-10-24
... cold start, the method comprising providing an electric motor (34), a pump (32) and a controller (42), the electric motor being connected to the pump for pumping the liquid in the reservoir and being thermally associated with the reservoir, and ...
- 4. MEANS FOR DELIVERY OF FLOWABLE MEDIA, ESPECIALLY LUBRICANTS**
CA2642865A1 (C) • 2007-10-25 • HYDAC SYSTEM GMBH [DE]

Professional patent searching

- It is advisable to use professional patent search services if you can afford them. Such services typically include:
 - ▶ A **PATLIB (PATent LIBrary)** centre. A joint initiative of the national patent offices of the EPO member states and their regional patent information centres, the PATLIB network consists of over 320 centres throughout Europe. Qualified and experienced staff can provide a range of search and other information services.
 - ▶ **Database searches** offered by many libraries and business information services. Many of these are provided at low cost as a public service, but may not be performed by qualified or experienced patent searchers.
 - ▶ **Commercial search services** offered by national Patent Offices. Options and costs may vary.
 - ▶ **Commercial search service providers**. There are several major companies in this market, and many smaller specialist consultancies. See, for example, the members of PATCOM . Fees and services vary, so shop around.
 - ▶ **Searches by patent attorneys**. Fees usually vary according to the type of search you need. A patent attorney will also be able to help you interpret your search findings. This is the real skill in patent searching.

A word of caution

- Most documents in patent databases will be **applications only** and **not granted patents**.
- Although the **claims in applications count as disclosure**, they are often modified later and so may be no guide to:
 - ▶ the claims - if any - eventually granted
 - ▶ the extent to which your idea might infringe someone else's patent.

Section 4: From invention to commercial product

Competition and Market Potential



Competition and Market Potential

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- Is your idea a good business opportunity?
 - ▶ Novelty alone doesn't guarantee success; **commercial viability is paramount.**
 - ▶ **Convincing investors** of profit potential is **crucial** for attracting funding.
 - ▶ **Mitigate financial risks** by thinking commercially throughout the development process.
 - ▶ Prioritize demonstrating **clear market demand** and **competitive advantage.**

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Competition and Market Potential

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- Is your idea a good business opportunity?
 - ▶ **Novelty alone may mean nothing** if your idea does not have **good commercial potential**. Very few people will buy a product simply because it is an invention. They will buy it only if they **have a use for it and prefer it to competing products.**
 - ▶ Therefore, if you hope to interest companies and investors in your idea, you must **convince** them that it offers **a lucrative business opportunity with as few risks as possible**. They must see **enough profit potential** in your idea to **recover their investment many times over.**
 - ▶ Thinking commercially also helps to **reduce your own financial risk**, which will increase as you develop your idea.

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Competition and Market Potential

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- When thinking about the market potential of your idea, you must consider how it might cope with **competition**.
- You also need to study competition for another reason: if your idea is completely new, what you can find out about competing products or companies may be the **only reliable market data available**.
- **Competition means anything currently used or done** to solve the problem your idea addresses.
- For example, if your idea is a *novel mousetrap*, competition is not just all other mousetraps. It must include all methods of getting rid of mice - even *cats!*

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Assessing your competition

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- Key questions:
 - ▶ Who are your competitors?
 - ▶ How much of a threat are they?
 - ▶ Can your idea compete successfully against them?

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Who are your competitors?

- Using the internet, it should be quite easy to find competing products and technologies anywhere in the world. Do not ignore a product simply because it is not sold in your country. Markets are now global, and products currently sold in only one country could be available worldwide within months.
- As with prior art, look also in shops, trade-only outlets, catalogues etc. Read industry journals and visit trade exhibitions to find out what people are buying and not buying, and to find out about new product launches.
- Talk to people who work in relevant trades or professions. Ask them which products and methods they use or do not use, and why. **(Do not, of course, disclose your invention.)**
 - Retired experts in particular may be able to give you valuable information that they would not have been free to disclose when they were employed. They may also have time to spare, and if they like what you are doing, they may be happy to become involved in your project.

How much of a threat are they?

- You need to know as much as possible about each competing company. If the company sells many products, consider only those that will compete with your idea. For example:
 - How much money are they making from those products?
 - How do they price products?
 - How often do they improve or replace products?
 - What is their market share, and is it rising or falling?
 - How and where do they distribute their products?
 - How widely do they advertise their products and their brand?
 - How good is their technical and after-sales support?
 - What is their reputation among customers and within the trade?
- Be aware that **a company's ability to compete may depend more on marketing than on technology**: do not underestimate the threat from a technically inferior product **if the company selling it can afford to spend a lot of money marketing it**.

Can your idea compete successfully?

- Launching a new product is never easy because **the market already belongs to the competition**.
- They are **known, experienced** and **perhaps trusted**, while your product is an unknown quantity.
- You must consider carefully whether your idea really does have the potential to take enough of the market to be a tempting business opportunity for a company or investor.

Assessing your product's potential

- Does anyone actually **need** your product?
 - The problem your invention solves may interest you, but do enough other people feel the same way? If they do not, the **market may be too small and unprofitable** to be worth bothering with.
- What is the **best market** for your product?
 - This is rarely as easy to answer as many inventors think. The same invention can often be developed in different ways, so **look for gaps in the market** - areas where existing provision or competition is weak.
- What is the **easiest market** to enter?
 - **Minimising risk** has to be a priority when launching a new product. If your 'best' market is costly to enter, it may be a good idea to start with one that is cheaper to enter, even if it is less profitable. Success in this market may make it easier to enter more profitable markets later.

Assessing your product's potential

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- How **healthy** is your **target market**?
 - ▶ Is it growing or shrinking? You should hesitate to enter a declining market unless you feel your product can revive it. Looking into the future, are there any emerging technological, social, regulatory or legal changes that might radically affect its fortunes?
- At **what price** might your product have to sell?
 - ▶ If the price of your product is not similar to prices charged by competitors, you may find it difficult either to make sales or make a profit. **Your competitors have done much of your research for you**: they have discovered the price the market will bear.
- Will your product **meet standards**?
 - ▶ Most products need to meet national or international standards of safety, performance etc before they can legally be sold. Achieving **compliance** can be a long and expensive process, so find out what will be required.

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Free or cheap market information sources

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- Mainly the internet. Be careful though, as much of the data you find may be outdated or inaccurate.
- Many academic and large public libraries have business information departments, staffed by helpful librarians with fact-finding expertise.
- Use Espacenet to look at recent patent applications. This can give you clues about the products and technologies major companies may be working on.
- Visit relevant trade fairs and exhibitions. Talk to people, find out who is doing what.

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Research guidelines

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- You will probably have to do your own **market research**. Professional research is often too expensive, and if your idea is still at concept stage there is a risk that other people will not fully understand it.
- **Universities** are a possible source of **low cost research assistance**. For example, some departments may need real-life project material for their students. A problem is that students differ in ability, and so quality cannot be guaranteed.
- All your research needs to **look professional**. This is important because at some point you may have to present your research to other professionals as part of a proposal for funding.
- Use only **reliable or first-hand sources of information**, and **record each source**. Never do what some inventors do, and present as evidence a collection of articles from popular newspapers and magazines.
- **Consumer surveys** may seem like a good idea, but many people say one thing to researchers and do the exact opposite later. **Surveys may therefore be a poor guide** to actual buying behaviour.
- **Do not trust the opinions of family and friends!** Most will lie to you in order to avoid arguments, or because they do not want to hurt your feelings.
- Do **not ignore someone whose opinion is different from all the rest**. That person may be the only one to identify a major weakness in your idea.

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Section 4: From invention to commercial product

Risk Assessment

Assessing the risk ahead

- 'Is there enough evidence to justify taking my idea any further?'
- This matters for three reasons:
 - ▶ Even if an idea is novel and appears to have market potential, that does not automatically make it worth exploiting.
 - ▶ Up to now, your idea should have cost you little. But if you decide to exploit it commercially, the **costs and risks will soon become much higher**.
 - ▶ Thinking about exploiting an idea is easy. **Doing it is much more difficult**. You will therefore need to be confident of your own skills and abilities before deciding to go ahead.

Significant novelty

- Your idea should be different from existing products or documented ideas. But being only **a little bit different will not be enough**. Your idea should offer **clear technical or commercial advantages** that existing products or other ideas do not offer.
- These advantages should also have the **potential to be strongly protectable in law**, because in **most cases only strong intellectual property (IP) has commercial value**.
- To estimate the degree of novelty of your idea, you need to **look in detail at the products and patents** you have found in your searches:
 - ▶ Any element of your idea that can be found in existing products and ideas will reduce its novelty.
 - ▶ And anything that reduces the novelty of your idea is likely also to reduce its potential commercial value.

Key questions

- To help you make the big decision - do I take this idea further or not? - you should address three key questions:
 - ▶ Is my idea **significantly novel**?
 - ▶ Does my idea have **significant commercial potential**?
 - ▶ Am I **ready for the personal challenge** of turning my idea into a business opportunity?

Evaluating patents

- This is an exercise that must be done thoroughly, and patents can be complex, highly technical documents. You may therefore need the help of a patent attorney to do some or all of the following. If you think your idea has good commercial potential, this will be money well spent.
 1. **List**, in order of importance, **the novel features of your idea**.
 2. **Assemble all the patents** you have found that seem relevant to your idea.
 3. **Search each patent** in full for similarities to your idea. Look particularly closely at the claims made or granted for it, and at official search reports.
 4. Whenever you find a **feature** of your idea **covered by prior art**, remove it from your list.
 5. At the end of the exercise, how many features of your idea remain on your list?
 - ▶ If one or more of its main features are gone, what remains may be too weak to be of significant commercial value.

Is there room for your idea?

- If there are large numbers of patents in a particular technology area, there may be few strong prospects for new ideas.
 - ▶ For example, there are currently over 60 patents for floating soap - a fairly simple product, so one has to question how strong many of those patents can be.
 - ▶ Anyone with yet another idea for floating soap might find it difficult to acquire worthwhile IP.

Who owns what?

- Find **who owns the patents** that are most relevant to your idea.
- If major companies have a strong IP presence in 'your' technology area, it may be difficult to compete with them even if your idea is different from any of theirs.
 - ▶ Inventors occasionally win in 'David and Goliath' encounters, but in such a situation your idea will need to have outstanding commercial potential if you are to stand any chance of success - particularly when it comes to attracting investment.

Significant commercial potential

- You may think your idea has good commercial potential, but something else matters more: **other people have to think so too.**
- Significant commercial potential means the prospect of **sales** and **profit** on a **large enough scale** to make all the risk generated by your idea worth taking.
- Businesses in particular will need strong evidence that your product will sell, as they are the ones who may have to spend millions of euros to get it to market.
- In business there is no such thing as a guaranteed winner. For every new product that sells well, there will be other new products that sell poorly.

Significant commercial potential

- What most companies will look for is:
 - ▶ Something that can give them (usually through strong IP) **a commanding or even monopoly position** in the market.
 - ▶ Something that **consumers will want in preference to competing products.**
 - ▶ Something that offers a **good return on investment.**
 - ▶ Something that offers a **clear, low-risk route to market.**
- From your searches and investigations, what evidence can you present to companies or investors that your idea has the potential to meet these requirements?

New product categories

- New products tend to fall into **three broad categories**:
 - ▶ **Exceptional** products which dominate their market and set new standards.
 - ▶ Good but unexciting products which offer opportunities for a business to **increase its profits or its market share**.
 - ▶ Unexceptional products which offer **just one more choice** among alternatives.
- **In which category would most people place your idea?**
- You need to evaluate any opinion you have had so far from businesses or individuals with expert knowledge of relevant markets.
- A lack of evidence in favour of your idea could mean one of three things:
 - ▶ The commercial prospects for your idea are **poor**.
 - ▶ Your idea may need re-thinking to make it **more commercially viable**.
 - ▶ Your idea may only succeed if **you become an entrepreneur and market it yourself**.

Personal challenge

- Inventors often fail to appreciate how much of the spotlight will be on them when they present their idea to businesses.
- Experienced **investors tend to back the person rather than the idea**, so they will look closely at your ability to help make your idea succeed.
- How do you think you might measure up to the challenge?
 - ▶ Do you know how far you want to take your idea?
 - ▶ Do you have a plan for getting there?
 - ▶ How much of the actual work will you do?
 - ▶ Who will perform the tasks you cannot do?
- It is important to understand that:
 - ▶ Few individuals possess all the skills needed to develop an invention.
 - ▶ Many investors are reluctant to back one-person ventures.
 - ▶ Many businesses will not deal with individuals.
- Therefore, some **kind of team effort is usually needed**.
- Before you can answer this question, you perhaps need to **consider the different ways in which you might benefit financially from your idea**.

Exploitation routes

- There are basically **four ways** of exploiting an invention:
 1. A **licensing agreement** with a company
 2. **Business start-up**: get your idea to market yourself
 3. A **joint venture**
 4. Outright **sale** of your idea

Section 4: From invention to commercial product

Exploitation routes

Licensing (αδειοδότηση)

- A **complex process** with a **simple outcome**: **permission** given by the owner (Licensor) to a user (Licensee) to use the IP in return for some form of consideration.
 - ▶ Without a license, the owner could prevent the use of the IP by the user.
 - ▶ A license agreement must be carefully drafted to avoid future pitfalls or drawbacks.
 - ▶ No license = risk and risk can materialize.

Licensing

- One or more companies enter into a **licensing agreement** with you that allows them to use your IP in return for payment to you.
 - ▶ Payment normally takes the form of **royalties** paid at agreed, regular intervals for the duration of the agreement.
- The exact terms of the license must be **negotiated** in a process that can be lengthy (often many months) and complex.
- The license is a **binding legal document (contract)**, so it is usually essential to involve patent attorneys and other legal professionals:
 - ▶ ideally is well-negotiated, balanced and comprehensive
 - ▶ it can be oral (not recommended).
- The licensor **remains the owner of the IP**.

Licensing benefits

- Broadly, a license:
 - ▶ **Benefits you** by making the **licensee reward** you for the use of your IP.
 - ▶ **Benefits the licensee** by giving them a product or technology **advantage** over competitors.
 - ▶ Allows **you** or the **licensee** (depending on the terms of the license) to take **legal action** against others who steal or copy the idea.

Common IP licensing situations

- Generating revenue
- Expanding a business geographically or into new business lines
- Avoiding or settling infringement claims
- Selling a business or assets

License Types

- sole
- (non-) exclusive
- cross-license
- (ir)revocable
- (non-)assignable (i.e. (non-)transferable)
- worldwide (or not)
- perpetual (or not)
- hybrid or addressing specific IP rights
- for a specific business activity or field of use (or not) – sub-licensable (or not)
- royalty-free or royalty-bearing
- other terms

KEY INGREDIENTS IN A LICENCE

It takes a variety of different ingredients to prepare a good licence agreement. Each licence is unique, depending on the specific terms which are agreed. It is a bit like creating a new dish.
You need to pick the right ingredients – in the appropriate quantity and with the right treatment.
Take a peek into our cooking pot and learn more about key ingredients in a licence.



License structure

1. Parties
2. Recitals ('whereas' clauses)
3. Definitions
4. Grant of rights
5. Consideration and payment terms
6. Obligations of licensor and licensee
7. Confidentiality
8. Improvements, enhancements and modifications
9. Warranties and indemnities
10. Term and termination
11. Boiler plate clauses

SUBLICENSING

Sublicensing rights should be explicitly granted or explicitly prohibited. This is particularly important for software.

THE SUBJECT & TYPE OF THE LICENCE

It is important to be clear about what you are licensing. Usually this involves several pieces of Intellectual Property (IP) and IP Rights (IPR). In addition to IP protection by formal legal rights (e.g. patent, copyright, design right, etc.), it may also include secrets protected by a non-disclosure agreement, or know-how to be transferred. A licence can be exclusive, non-exclusive or sole. It may also be limited by geographical territory or field of use.

THE PAYMENT

The payment is normally divided into a down payment on signature of the agreement, and royalties. It is also possible to include milestone payments (for agreed milestones). Each of these may have several variations.

THE TERRITORY & FIELD OF USE

The territory can extend to wherever the IPR exists. It is possible to license different people exclusively (or non-exclusively) for different territories. As for the field of use, it is possible to only grant (or exclude) rights for a particular market or technological sector – for example “only for use in the healthcare market” or “excluding telecommunications applications”. It is possible to license different people exclusively (or non-exclusively) for different fields of use.

Licensing advantages

- For many inventors, licensing is the **best way to benefit** from an invention:
 - ▶ The **licensee bears the costs and risks** of production and marketing.
 - ▶ Only established companies may have the **resources to exploit** an idea with major potential.
 - ▶ Licensing can provide the inventor with an **income** over many years for relatively **little effort**.
- Some inventors - mostly in high technology fields - **set up companies solely to license out their IP and monitor the progress of their licensing agreements**.
 - ▶ This is a possible option if you want to start your own business but do not want it to grow too large.

IMPROVEMENTS, DEVELOPMENTS & MODIFICATIONS

There are many ways of handling this, but the first thing is to agree how to determine what is an improvement on the licensed IP, and what is new.

THE LENGTH OF THE LICENCE

The length of the licence is usually determined by the lifetime of the IPR. Patents expire after 20 years in most countries. In the case of pharmaceuticals, this might be extended. Other forms of IP have different lifetimes. There are rights which could go on indefinitely, such as trademarks (provided they are used and registration fees are paid), or secrets (as long as they are kept secret).

PERFORMANCE CRITERIA

It is important that the licensee performs well if value is to be returned to the licensor (and ultimately the inventor). This is particularly important for exclusive licences, so consideration should be given to performance minimums to retain exclusivity.

OBLIGATIONS OF LICENSOR & LICENSEE

For the licensor, typical obligations include transferring the IP, and maintaining the legal rights, but there could be many others. The obligations placed on the licensee, on the other hand, include exploiting the invention in the best interests of both parties. It may also include obligations to install and maintain efficient systems to monitor use and royalty payments.

AUDITING

The licensor should ensure that they have the right to audit the licensee, to safeguard that royalty payments are correct.

When to go for licensing?

- Types of invention that may be better licensed include:
 - ▶ **Components** that **many companies depend on**, such as the drinks can ring-pull.
 - ▶ **Accessories** or **peripherals dependent on a specific existing product**. These may have little future unless licensed to the company controlling the host product.
 - ▶ Products with **high set-up costs**.
- However, **only the strongest forms of IP will interest potential licensees**. In most cases this means a **patent**.
 - ▶ If your idea cannot be patented, or if the claims you are allowed are not very strong, few companies are likely to want a license from you.
 - ▶ Even if they are interested, they may not want to pay much for the license.

Business start-up

- Business start-up may be your first choice if you have ambitions to be an entrepreneur, or it may be an option that you have to consider if you cannot interest any companies in a licensing agreement.
- Types of invention that may succeed as business start-ups include:
 - ▶ Products in **knowledge-based industries** - for example IT or high-value medical technology - where small companies can thrive.
 - ▶ **Cheap-to-make** products which depend primarily on **marketing**.
 - ▶ Products that **cannot be patented strongly**.
 - ▶ Products that do **not have enough profit potential** to interest larger companies.
- Starting a business is not for everyone. However, experience suggests that **inventors who become entrepreneurs tend to be more likely to succeed than those who rely on finding licensees**.

Joint venture

- Another form of entrepreneurship: a joint venture with a company - or an individual, or perhaps a university - **whose expertise and resources you need**.
 - ▶ For example, your joint venture partner could be a company willing to help you to develop your idea further in order to give them a better idea of its potential.
- Such a joint venture is perhaps best viewed as an experiment that may or may not succeed. You should therefore not expect to make a profit from it.
 - ▶ If successful, it could result in a **licensing agreement**, a **spin-off company** or some other form of more **permanent business relationship**.

Outright sale

- It is possible that a company may offer to buy the IP in your invention for a **fixed sum**.
 - ▶ If you have an **invention with good market potential**, it might be **wiser to refuse**.
 - ▶ A sale may be **worth considering if** idea is of relatively **low or short-term value**, both to the company and you.
 - ▶ The company benefits by not being tied for years to a licensing agreement.
 - ▶ You benefit from (a) a **cash windfall** and (b) **freedom** from all responsibilities and expenses of ownership of the idea, which may include the maintenance of patents.
- Much, of course, depends on the size of the sum offered. You should **seek professional advice on a realistic valuation of your idea**, but for both sides it will always be something of a gamble.
 - ▶ You may regret it if the product goes on to make unexpectedly large profits.
 - ▶ The company may regret it if the product fails to sell.

Invention promotion agencies

- Some companies would like you to think that there is a fifth option - **paying them to market your idea**. Be **very cautious** about dealing with any such company.
- Invention promotion companies tend to operate in broadly the same way.
 - ▶ They will offer to give you an opinion of the market prospects of your idea, **for a fee of typically a few hundred euros**.
 - ▶ They will usually send you a highly favourable report, with little or no mention of prior art. (It is not in their interests to tell you about prior art!)
 - ▶ They will then tell you that for **a fee of several thousand euros**, they can help you market your idea.
 - ▶ In many cases, their 'help' amounts to little more than a supply of stationery and a list of company addresses. You have to contact the companies yourself.
 - ▶ Often the invention promoter will be based in a different country from you, making it difficult for you to seek compensation.
- **Untrustworthy invention promotion companies only thrive because of the gullibility of some inventors**, so you must **be suspicious of anyone who praises your invention and offers to market it at your expense**.

Entrepreneurial option

- What if your idea is not novel but does have commercial potential?
- If **there is prior art** for your idea but **no commercial product**, and you are convinced that a product could be successful, a possible strategy is to **stop trying to be an inventor** and **consider becoming an entrepreneur**.
 - ▶ Try contacting the owner of the IP in the idea. If the owner is not 'working' the IP, it may be worth discussing a deal in which you take a license to exploit the idea.
- Or there may be an existing product but it is not being sold in your country. You could consider **becoming an importer**, or **a manufacturer under license**.
- Or you might discuss with the IP owner the possibility of your redesigning or modifying the invention for a different application or a different market.
- If you are entrepreneurially minded, something may be possible!

Section 4: From invention to commercial product

Prototyping and Proof of Concept

Proving the invention

- The need for **prototypes**: you need to prove - first to yourself, later to investors or companies - that your idea works.
- If your invention is:
 - ▶ a **process** or a **business method**, physical proof may not be possible / necessary.
 - ▶ a **substance** (e.g, a new kind of shampoo), samples to test may be sufficient.
 - ▶ a **manufacturable product**, you need to show it looking as close to a finished article as you can manage or afford. That usually means **producing at least one and often a series of prototypes**. This may be where your first serious costs begin, so you need to plan and control your prototyping activities.
- For some inherently costly ideas you may need to **seek funding** for the prototype itself. In that case you must gather convincing evidence that your idea will work, and has the potential to make enough profit to justify the much greater level of risk.

Planning an MVP



Watch the video from Y Combinator:

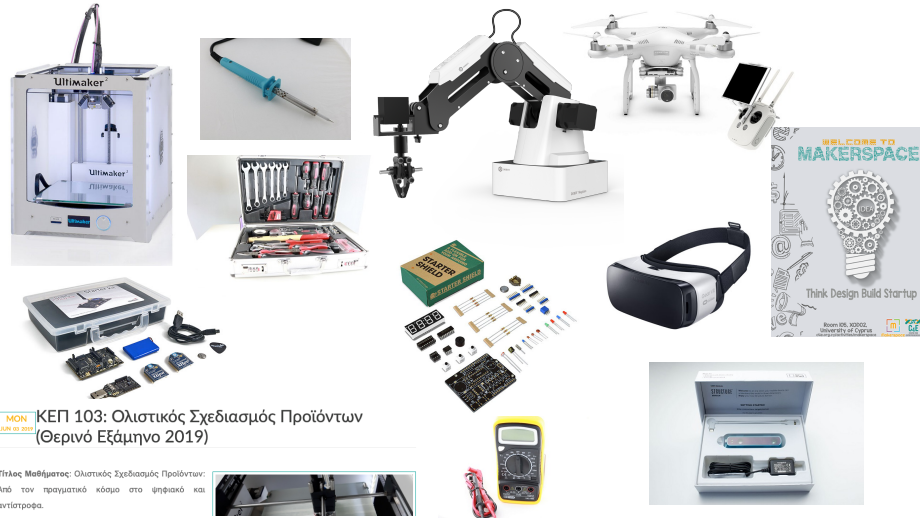


<https://www.startupschool.org/videos/65>

Prototype Strategy: First prototypes

- Create initial prototypes using inexpensive materials to **validate your idea privately** and troubleshoot technical and design challenges.
- Utilize **computer aided design (CAD) / rapid prototyping tools** to expedite the prototyping process, saving time and costs, and gathering valuable data.
- **Avoid progressing beyond the initial prototype phase until** all possible design refinements and problem-solving efforts have been exhausted to mitigate future challenges and expenses.

Prototyping @ UCY: C4E Makerspace

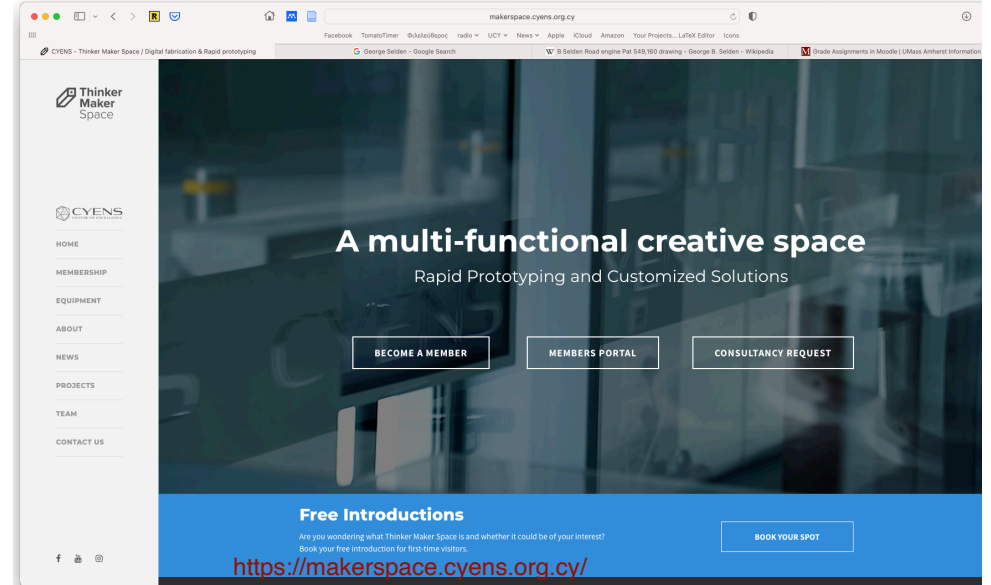


ΜΟΝ ΚΕΠ 103: Ολιστικός Σχεδιασμός Προϊόντων (Θερινό Εξάμηνο 2019)

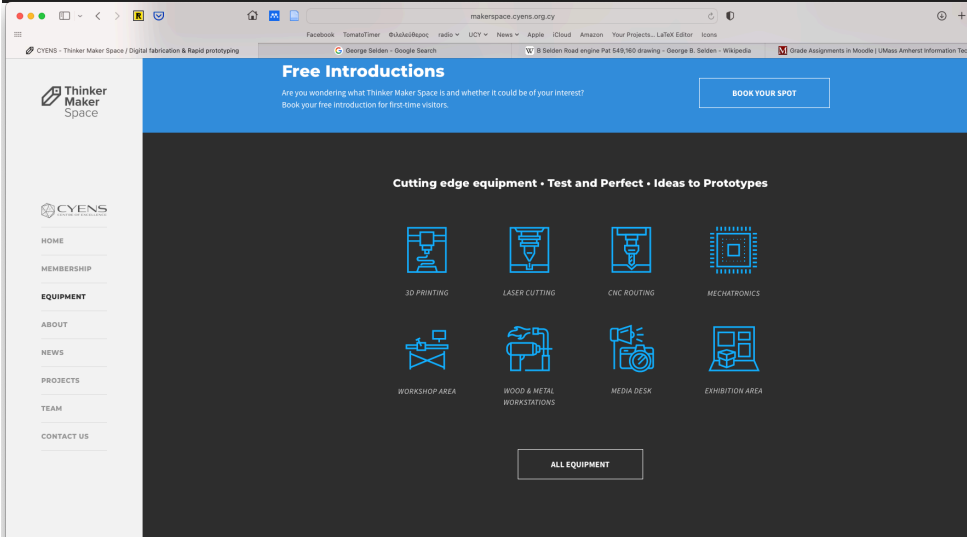
Τίτλος Μαθήματος: Ολιστικός Σχεδιασμός Προϊόντων: Από τον πραγματικό κόσμο στο ψηφιακό και αντίστροφα.



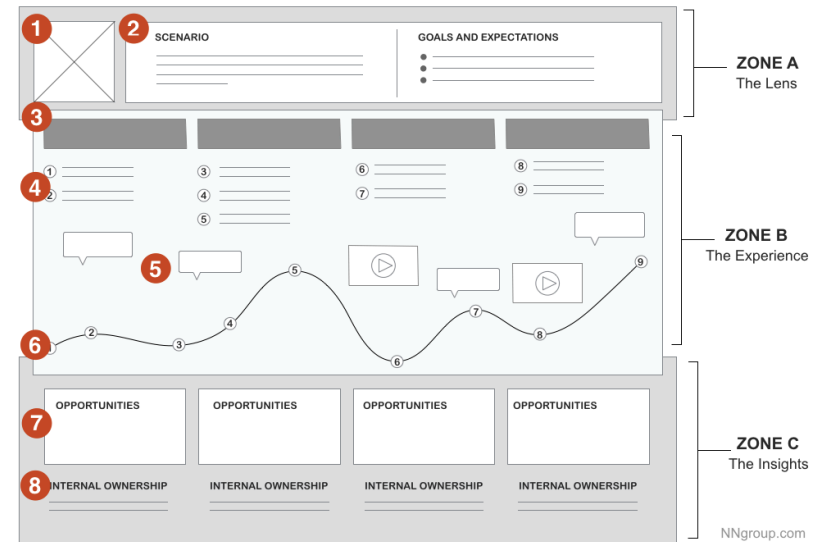
CYENS Makerspace



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Customer-journey Maps



Customer-experience design

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Screenshot

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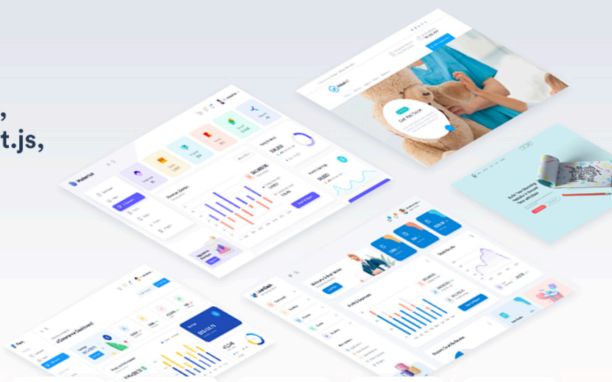
Rapid prototyping

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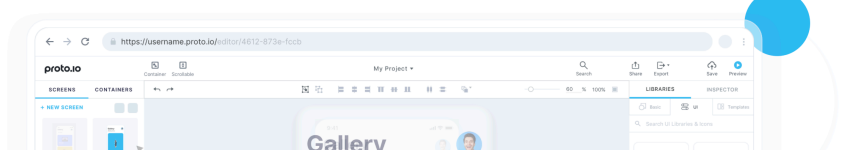
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Prototype Strategy: First prototypes

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- **First prototypes are for you alone.** No one else need see them, so they can be made from any suitable cheap materials. Their purpose is:
 - ▶ To convince you that your idea works.
 - ▶ To enable you to solve or at least identify technical and design problems.
 - ▶ To enable you to improve the idea through trial and error.
- If you can, use **computer aided design (CAD)** for much of this stage.
 - ▶ CAD can save significant time and cost, and may provide you with much additional data that might be difficult or impossible to collect from physical prototypes.
- It is advisable not to move beyond first prototype stage until you have done all the problem-solving and design refinement you can. This may be frustrating, but solving problems or redesigning your idea at a later stage is likely to be much more difficult and expensive.

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Finished or presentation prototypes

- These are prototypes that you can use to [showcase your idea to potential investors or licensees](#), aiming for a **polished appearance** and **performance** resembling a **finished product** to minimize perceived risks and facilitate understanding.
- [Seeking professional assistance](#) for prototype production can enhance perception of your invention's potential and your commitment, but
 - ▶ **strive to minimize costs** by incorporating standard components or existing parts where feasible.
- [Establish a budget](#) that balances **quality** with **affordability**, scrutinizing proposals that inflate costs for marginal improvements in function or appearance.

Working prototype plus model

- If you cannot afford a high quality prototype, an acceptable alternative may be [a combination of](#):
 - ▶ the best of your first prototypes (to demonstrate performance) and
 - ▶ a non-working model (to demonstrate appearance).
- For the model you can use any cheap workable material - for example, painted wood to represent plastic.

Finished product

- Without doubt, the best form of finished prototype is a [saleable product](#):
 - ▶ You can prove that your idea sells, even if only on a small scale, and you have a supply of samples to speed up evaluation by companies.
- This strategy will not be suitable for every invention, but it may be worth considering if there is relatively little difference between the cost of a single prototype and the cost of a trial batch of, for example, 100 further units.
 - ▶ In most forms of [manufacturing](#), the **greatest cost** is the **set-up**; the products themselves cost relatively little.

A short video

- A video may be essential support material if:
 - ▶ Your prototype has a lengthy operating cycle.
 - ▶ Demonstrating your prototype requires a site visit or a special environment.
 - ▶ You have to show people using your prototype.
 - ▶ Your prototype cannot be guaranteed to work on every occasion.
 - ▶ You need to record a unique event: for example, trials of your prototype tested against competing products.
- Edit the video to [no longer than a few minutes](#) so that it does not occupy too much time during [a typical first meeting of 30-45 minutes](#).

Other support materials

- Additional material that may help you present your idea could include:
 - ▶ **Product packaging.** This may be expensive to do well, and so may only be worth the effort if packaging is of more than usual importance to your target market.
 - ▶ A draft **advertisement** or **brochure** to show how you see the product being marketed.
 - ▶ A website on which you can put information about your idea (**landing page**). This can be an inexpensive way of meeting business information needs.
- However, **seek advice from a patent attorney** to **ensure that you do not disclose anything that may compromise a future patent application.**

IS THERE A RISK SHOWING A VIDEO?

Video can be easily copied and will count as **disclosure**, so be careful to ensure that:

your idea has **adequate legal protection** and

you **do not allow unauthorised viewing and copying** of the video

the video itself should be protected by **copyright!**

Help with design or re-design

- Need to **prioritize thoughtful design (functionality and aesthetics)**: significantly influences the success of commercial products.
- **Engage an experienced product designer early on** to ensure practical and appealing design, potentially **improving product quality** and **reducing manufacturing costs**.
- **Establish clear agreements regarding intellectual property (IP) rights** with the designer before commencing work to prevent future disputes, seeking guidance from a patent attorney.

Help with design or re-design

- **Design** - in terms of both function and appearance - is a key factor in the success of commercial products.
 - ▶ You therefore need to think about the design of your invention from day one, because its potential may not be recognised if all other people can see is an impractical or unappealing design.
- An experienced product designer can help you deal with **manufacturers or component suppliers**, either at prototype or full production stage.
 - ▶ Manufacturers need **detailed specifications** before they can make anything, and if queries or problems arise they need to talk to someone who is technically knowledgeable.
- The cost of professional design may be offset if your designer can find ways of **improving product quality** or **reducing manufacturing costs** through **good design**.
- However, if your designer contributes ideas which significantly improve your invention, the **designer may be legally entitled to a share of the IP**.
 - ▶ You should first discuss how any new IP in the idea will be shared, in order to prevent disputes arising later. Your agreement should be based on advice from a patent attorney and documented before work starts.

Manufacturing prototypes

- If you need to involve a manufacturer in prototyping your idea, ask **several companies for prices** as manufacturing **costs can vary widely**:
 - ▶ **Small companies** tend to be cheaper and more prepared to accept very small orders.
 - ▶ **Larger companies** tend to be **cheaper only at high volume** - it may be useful to know how cheaply your product could be manufactured in larger quantities.
- **Ask for prices based on the detailed drawings** that you or your designer have produced but make sure that those drawings represent exactly what you want.
 - ▶ A late request for even a minor modification may increase costs considerably.

Proof of concept

- If you cannot make a prototype without financial help, you must focus on **proof of concept**: presenting enough evidence to persuade an investor or innovation support organisation to pay for at least a prototype.
- Proof of concept, aims:
 - ▶ Make it difficult for anyone to say: 'You have not told us this' or 'Where is your evidence for that?'
 - ▶ Produce **detailed** and **credible data** - including mathematical proof where relevant - to **support every technical claim** you make for your idea. You must also make a strong case that your idea has excellent commercial prospects.
- It may help greatly if you can produce **independent expert evaluations** of your idea alongside your proof of concept.
 - ▶ E.g., it may be possible to obtain expert opinion at relatively low cost from a university that specialises in your technology area.

Proof of concept

- If financial means for prototyping are **not** available, focus on presenting a **compelling proof of concept** to secure investor or innovation support funding.
- Ensure your proof of concept **addresses all potential questions** and provides **detailed, credible data**, including **expert evaluations** and **mathematical proof**, to support technical and commercial claims.
 - ▶ Consider obtaining independent expert evaluations, such as from specialized university departments, to bolster the credibility of your proof of concept.

Subcontracting product development

- After establishing proof of concept, **consider partnering** with a product development company willing to invest in your idea in exchange for a share in your IP.
- This approach is **suitable for ideas requiring substantial funding** and **specialized expertise** for development or prototyping.
- Be aware that product development companies **prioritize ideas with exceptional profit potential** in **high-value markets** and may not be interested in ordinary consumer products.
- **Seek impartial advice** from government-approved technology support agencies when selecting potential partners, and consult with your patent attorney before finalizing any agreements involving IP.

Subcontracting product development

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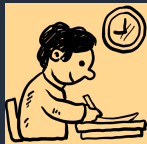
- Armed with proof of concept, it may be possible to approach a company specializing in [product development and prototyping](#).
 - ▶ They may be prepared to [develop your invention](#) in return for [a stake in your IP](#).
- This solution may be worth considering if it is clear that your idea cannot be developed or even prototyped without substantial funding and specialist expertise.
 - ▶ However, companies willing to share the product development risk are likely to consider only ideas with [outstanding profit](#) and [growth potential in high-value markets](#).
 - ▶ They may have [little interest in 'ordinary' consumer products](#).
 - ▶ For that reason, they [typically reject most of the ideas](#) offered to them for development.
- Such companies should not be confused with invention promoters. None-the-less, they should be selected with care:
 - ▶ You could start by seeking impartial advice from government approved technology support agencies.
 - ▶ Before entering into any agreement to share your IP, you will certainly need detailed advice from your own patent attorney.

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Section 4: From invention to commercial product

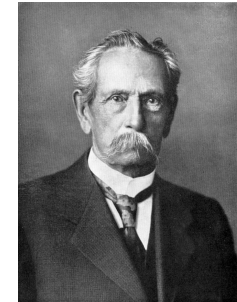
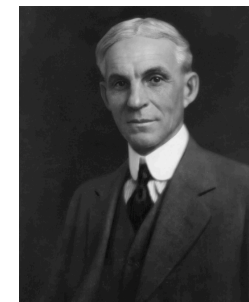
Protecting your invention

One of the key inventions that defined the twentieth century



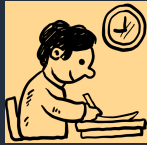
M. D. Dikaikakos

**CAN YOU NAME TWO
INVENTORS WHO SHAPED THE
AUTOMOBILE INDUSTRY OF
THE 20TH CENTURY?**



M. D. Dikaikakos

The Selden Story



- If you look at vintage American automobiles from around 1900, you'll see that many of them share an **unusual feature**:



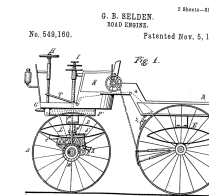
- A brass plate stating that the car is the design of a man named **George Selden**.

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The Selden Patent

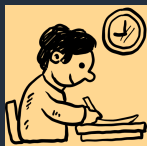


- Selden was not an engineer but a **patent attorney**, and at the time he had **not produced a single car**.
- Selden filed a **patent in 1879** that he claimed covered **all gasoline-powered cars** (US patent 549,160).¹
- He made the most of this patent, forming in due course a **cartel** with a number of other businesses to demand **royalties** from every car sold:
 - In 1899 he sold his patent rights to William C. Whitney, owner of the Electric Vehicle Company, for a **royalty of US\$15 per car** with a **minimum annual payment of US\$5,000**.
 - Whitney and Selden then worked together to collect royalties from other budding automobile manufacturers, negotiating a **0.75% royalty** on **all cars sold** by the Association of Licensed Automobile Manufacturers.
- A precursor of: **patent trolls** who **acquire obscure patents and use them to shake down tech companies today**.
- A dynamic industry looked like it might fall victim to a greedy collective.



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Patent Wars



- Several years later, Henry Ford challenged Selden's patent, eventually prevailing after an **eight-year lawsuit**.
- The legal fight lasted **eight years**, generating a case record of **14,000 pages**.
- Ford's testimony included the comment: *"It is perfectly safe to say that George Selden has never advanced the automobile industry in a single particular...and it would perhaps be further advanced than it is now if he had never been born."*
- But the situation could have turned out differently, moving the American auto industry onto a different path and affecting the wider history of the motorcar, too.
- The brass plaque is a reminder that the development of the automobile was not, in fact, a sure thing.



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Patent wars

- Patent wars have not been limited to the auto industry.
- America's **aviation industry** was defined, and nearly derailed, by a similar patent war only a few years later.
- Hollywood is synonymous with cinema in part because early moviemakers went there to escape the **legal constraints of Thomas Edison's Motion Picture Patents Company**.



- The evolution of many new technologies, and their economic consequences, depended on good fortune in terms of **rules**, **laws**, and **institutions**.

- Selden's brass plaques are a reminder of a **lucky economic escape from bad rules** that nearly held back a major technology in its earliest days.

- Sometimes society is not so lucky, and **bad institutions bring material progress grinding to a halt**.

["Restarting the Future", Haskel & Westlake, 2018]

Section 3 Outline



- From invention to commercial product
- Disclosure and confidentiality
- Assessing Novelty
- Competition and Market Potential
- Risk Assessment
- Exploitation Routes
- Prototyping and Proof of Concept
- **Protecting your Invention**



At some point you must legally protect your intellectual property (IP) or you will not be able to:

- ▶ Disclose it safely.
- ▶ Be recognised in law as its owner.
- ▶ Profit from its commercial exploitation.
- ▶ Prevent or discourage its unauthorised use by others.

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Protecting your idea

- There are several **forms of protection** known as **intellectual property rights (IPR)**.
- Usually, the best way to protect an invention as it evolves is to **use a strategic combination of IPR**.
- Patents tend to be of primary importance but not the only way for protecting your idea/invention.

IP Protection

- Confidentiality and Non-disclosure agreements.
- Know-how / trade secrets.
- Copyright
- Protected designs: Unregistered Design Rights (UDR), protected designs & trademarks
- Patents

Confidential information & NDAs

- **Confidential information** is closely related to, and often regarded as, **intellectual property** - although **not covered by any statutory IPRs**.
- The most common form of **protection** for confidential information is a **non-disclosure agreement (NDA)**.
- An NDA can protect you:
 - ▶ By **documenting someone's promise not to use or pass on information about your idea**. Anyone who breaks the terms of an NDA **risks legal action**.
 - ▶ **At every stage of the development of your idea** - no matter what other forms of IPR you have, and even long after your invention is on the market.

Section 4: From invention to commercial product

Confidentiality

Confidential information & NDAs

- NDAs are widely used in all forms of business, so you should certainly consider using them yourself.
- NDAs are **binding legal agreements**, and use them only when **both parties accept** that **significant disclosure is necessary**.
- NDAs can only restrain others from disclosing or exploiting specific and unique secrets which they get **only from you**.

WHEN NDA ARE NOT USEFUL?



- Any information that is **already general knowledge** is free for anyone to continue using, regardless of the NDA.
- If the confidential information covered by the NDA **later becomes public** knowledge by some other means, then the original parties to the **NDA will no longer be bound** by it.

WHERE CAN YOU FIND TEMPLATES FOR NDA?



You can find many free examples of NDAs on the internet.

Lambert Toolkit:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/551428/lambert-sample-nondisclosure-agreement.doc

It may be wise to seek the advice of a patent attorney when constructing your own version.

Guidance

University and business collaboration agreements: Lambert Toolkit

The Lambert toolkit is for universities and companies that wish to undertake collaborative research projects with each other.

From: [Intellectual Property Office](#)

Published 6 October 2016

Last updated 5 January 2022 — [See all updates](#)

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Contents

- Overview
- Benefits from owning IP
- Maximising innovation
- How do I get started?
- Which agreement should I use?

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[University and business collaboration agreements: model heads of terms](#)

Section 4: From invention to commercial product

Know-how

University of Cyprus Department of Computer Science

Know-how

- Know-how is **undocumented information known only to you**. It is similar to trade secrets.
- Without your know-how, others may find it difficult or unrewarding to exploit your idea.
 - ▶ For example, you may know how to reduce production costs significantly by using conventional equipment in an unconventional way.
- Know-how can be **commercially valuable**, and can be included in **licensing agreements**.

Challenges with Know-how

- Genuinely valuable know-how is **rare**.
- There is also **no way of registering** it and **its theft can be hard to establish** (theft usually by employees or associates).
- **Risk**: if your know-how is information that ought to be included in a patent, you may invalidate the patent by leaving it out.
- Seek advice of a patent attorney when considering what to treat as know-how.

Copyright

- Protects for many years against the **unauthorised copying** or **adapting of drawn, written or photographic descriptions of your idea**.
- **Does not protect the idea itself**, but in some cases - for example **computer code** - may be the **only effective way of protecting your IP**.
- Arises **automatically** and is **free**.
- Important because it can easily **establish dates of origin** of an idea, or of **changes to an idea**.

Section 4: From invention to commercial product

Copyright

Challenges with Copyright

- It gives you no protection against someone who **independently** comes up with the **same** or a **similar idea**.
- A competitor may say that their idea is similar to yours by coincidence, or that your idea is a copy of theirs.
- Challenge: How can you prove that your idea was the original?

Proving copyright ownership

- The following steps may help you to prove that you are the copyright owner in a later dispute:
 - ▶ Make written descriptions, drawings, photos etc of your idea and print them out or perhaps burn them to a CD or DVD.
 - ▶ Place your documents or disc in a securely sealed envelope bearing a signed and dated statement from an independent witness, certifying that the envelope was sealed on the date when he or she examined it.
 - ▶ Send the envelope by registered mail to yourself or a place of safe keeping, and keep the clearly dated postage receipt.
 - ▶ The envelope must remain unopened until required by a court of law. (It may be advisable to have more than one envelope, in case your copyright claim is tested more than once. An opened envelope is no longer valid as proof of copyright.)

Unregistered Design Right (UDR)

- Protects the **outward appearance of a product**, including its shape, pattern, texture and decorations(EU).
- In some national UDR laws (for example, the UK) **internal configurations** may be protected even if these are invisible to the user.
- UDR may **protect features** of the design which are **new**, have an **individual character**, and which come from a '**freedom**' of design.
- UDR is **similar to copyright**:
 - ▶ Free
 - ▶ Gives you a right to prevent unauthorised copying for a number of years.
- However, there is **no official design right registry** and so it can be difficult for others to know of your design.

Protecting Designs & Trademarks

Challenges with UDR

- UDR **may not protect** designs that are:
 - ▶ copied or routine designs;
 - ▶ immediately suggestive of other designs;
 - ▶ parts of a design which are dictated by functional needs to fit or match with other components.
 - For example, a novel wing tea pot can be shaped in many different ways, and so can be protected because the designer has exercised his or her design 'freedom'.
 - But a vehicle brake pad can only have one shape if it is to fit in the brake callipers. It therefore has no design 'freedom' and so no protection.
- Though often useful as part of an IPR strategy, UDR on its own **will not protect most inventions**.

UDR protection

- UDR arises automatically when the design is created
- However, you should follow the **'sealed envelope' procedure** for evidence of a priority date.
 - ▶ This is because you can only take legal action against someone when **you can prove that they must have copied your design**, rather than made something similar by coincidence.

Design registration



- More robust protection for designs comes through **formal registration**, which can last **up to 25 years**.
- Applications can be made to **most national IP offices**, or to the **European Union Intellectual Property Office (EUIPO)** where a single application can be registered for the whole of the European Community.
- You **can take action** against anyone who makes, sells, uses or imports articles which look like the article registered.
 - ▶ Unlike UDR, there is no need to prove that another design was copied from yours - you only **need to prove that it looks similar**.
 - ▶ Even designs which are similar by accident can be challenged by the owner of a registered design.
- **Application process is fast and relatively cheap**, but design registration usually **only makes sense if the outward appearance** of your invention is going to be a **strong selling feature**.

Design registration criteria

- To be validly registered the design must be:
 - ▶ new
 - ▶ have 'individual character' and
 - ▶ be the result of a 'freedom' of design.
- A single registration may protect **patterns, ornaments, decorations and logos** which are **suitable for application across a range of articles**
 - ▶ For example, a floral design applied to table linen, bedding, curtains, crockery etc.

Trade marks

- A **word, slogan, logo** or **combination** that **distinguishes** your product or business from others.
- Trade marks can be **valid indefinitely** if correctly used and maintained, so a trade mark associated with a popular brand name can be of **enormous value** to its owner.
- The **granting** and **registration** of trade marks is administered by **national IP offices**, to whom you apply.
- For **multinational cover** you can make a single application for either an **International Trade Mark** under the **Madrid system** at the **World Intellectual Property Organization (WIPO)**, or a **Community Trade Mark** (for protection in the EU) at the **EUIPO**.
 - ▶ To avoid problems, you will probably need help from a **trade mark attorney**.

Trade marks' challenges

- Trade marks **do not protect ideas**, or **products** per se.
- But if you want to **market your own invention**, a trade mark could be a very **worthwhile long-term investment**.
- It might eventually become **your most valuable form of IPR**.

Section 4: From invention to commercial product

Patents

Patent

- A patent is **a form of legal monopoly** - the right to say:
'This is mine and you cannot use it without paying me'
- **Governments grant patents in return for public disclosure of ideas. And that is all it is.**
- **Patent systems** exist in most countries and their **purpose** is to **encourage the development of new technologies**.
- It is important to understand what a patent can and cannot do:
 - ▶ Patenting your idea will not necessarily increase its commercial value.
 - ▶ If no one wants your invention, a patent is unlikely to make any difference.
 - ▶ But if your invention **has commercial potential**, a patent may be your only way of ensuring that you can benefit financially from it.
 - ▶ Many inventors of commercially successful products acknowledge that they owe their financial rewards almost entirely to **strong patent protection**.

Patents' challenges

- The **cost** and **complexity** of patenting can be a problem for many inventors.
- Therefore, a decision to apply for a patent should never be taken without **careful consideration** of several factors.
- Ideally seek the advice of patent attorney before deciding.
- If you decide to go ahead, you should let a patent attorney represent you during the **lengthy, complicated** and **rigorous application process**.
- If you do not use a patent attorney, you run a **large risk of making mistakes** which could leave you with **no effective patent protection**.
 - ▶ There may then be little prospect of ever benefiting from your invention.
- In general, patents **last for 20 years** but **only if annual renewal fees are paid**.

The patenting process

- An invention is patentable only if it is:
 - ▶ **New** and **previously undisclosed**.
 - ▶ Distinguished by an **inventive step not obvious** to someone expert in that technology.
 - ▶ **Capable of industrial application** - that is, it is physically possible to make the invention.
 - ▶ Computer **software** on its own can be protected by **copyright** but not by patents in Europe.
 - However, an invention that is implemented on computers by means of software - for example, an improved data handling system - is patentable in Europe.
 - Get advice of a patent attorney for differences between Europe and USA.
 - ▶ **Business methods** may be patentable in the **USA** but not easily patentable elsewhere.

Always seek advice from a patent attorney if you have concerns about whether your idea is patentable.

Issues to consider

- **Do you really need a patent?**
 - ▶ Applying for a patent is a **legal process** governed by **strict timescales** and usually **immovable deadlines**. It is not something to rush into!
 - ▶ Would some combination of other forms of IPR protect your idea adequately?
 - ▶ Be honest with yourself: are you motivated more by **vanity** than by **commercial necessity**?
- **Have you studied the total cost of patenting?**
 - ▶ Should include annual renewal fees in every country in which you have protection.
- **Is your invention likely to earn enough income to justify the cost?**
 - ▶ Normally, you should not apply for a patent until you have thoroughly researched the commercial and financial potential of your idea.
- **Is the time right to apply for a patent?**
 - ▶ Application starts a sequence of events which cannot be delayed.
 - ▶ Do you apply for a patent early on, or wait until the invention is market-ready and more capable of quickly recouping its IPR costs?
 - ▶ Later may be better than sooner, but circumstances will vary so you should always seek the advice of a patent attorney.

Issues to consider

- **Does your invention have a short product life cycle?**
 - ▶ Patenting process typically takes 3-4 years.
 - ▶ If your invention is aimed at a **highly competitive market** in which **products are rapidly replaced or improved**, your patent may be worth little by the time it is granted.
- **Who will pay to enforce your patent?**
 - ▶ National IP offices **do not enforce patents** or **monitor** them for **infringement**.
 - ▶ These are the responsibilities of the patent owner or a licensee. Until funds are potentially available to enforce your patent - from royalties or sales income - it may offer **limited practical protection**.
- **How strongly might your patent resist legal challenge?**
 - ▶ The validity of patent claims is often challenged, usually by competitors who want to copy a successful product.
 - ▶ If they succeed, you may be left with a valueless patent and an order to pay the victor's legal costs.

Applying for a patent: playbook

- To maximise your chances of a worthwhile patent you should:
 - ▶ [Study the application procedure](#) in detail.
 - ▶ **Aim to apply not in haste, but strategically** - at a time and for a reason that most benefits your exploitation plans.
 - ▶ **Use a patent attorney!** Do not do it all yourself - the risk of making mistakes is too great.
- See guide for the application process for a European Patent according to the [European Patent Convention \(EPC\)](#): <https://www.epo.org/applying/basics.html>
 - ▶ Applying for a patent at a **national IP** office is roughly similar to **stages 1-6** (below) but an application must be made in the local language.
 - ▶ Making an international application through the **Patent Co-operation Treaty (PCT)** involves a single procedure for **stages 1-4** (below) but **30 months after filing** the application goes through **stages 5 and 6** in every national or regional IP office where you wish to take up protection.
 - ▶ For more information on the PCT see www.wipo.int/pct

Where to apply?

- Choosing your route for a patent application (EPC, PCT, national and regional, or combinations thereof) will depend on:
 - ▶ Your invention.
 - ▶ Your business plan.
 - ▶ Your available funds.
 - ▶ Your intended market.
 - ▶ The likeliest sources of infringing products.

Section 4: From invention to commercial product

Patenting process

9 stages

1. Patent attorney hiring, Initial documentation, filling
2. Setup of priority date & initial examination by patent office
3. Receipt of Search report by Patent Office; initial opinion
4. Publication, decision whether to continue
5. Substantive examination & discussion (optional)
- 6. Decision to grant patent**
7. Validation to other states
8. Opposition
9. Appeals

Applying for a patent: Stage 1

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- Your patent attorney must provide documentation consisting of:
 - ▶ A request for a patent.
 - ▶ Details of the applicant (you).
 - ▶ A description of the invention.
 - ▶ Claims.
 - ▶ Drawings (if any).
 - ▶ An abstract.
- A fee must also be paid. In order to avoid delay, it is vital that all documentation conforms in every detail to official requirements.
- At the EPO, applications are accepted in [English](#), [French](#) or [German](#).
- Patent attorney's role:
 - ▶ For your patent attorney to prepare all the information about your invention, he or she will obviously need to work closely with you.
 - ▶ Do not assume that you know best because it is your invention. You must trust the skill and judgement of your patent attorney, as patenting involves [a complex mix of law and technology](#).
 - ▶ The claims in particular need to be drafted with skill, as they are the most important aspect of a patent.

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Stage 3: Search

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- A search report is sent to you, listing and including copies of all [prior art documents](#) found by an experienced examiner and regarded as relevant to your invention.
- The search is based mainly on your claims for novelty, but your description and any drawings will also be taken into account.
- The report will often include an [initial opinion](#) on the patentability of your invention.

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Stage 2: Filing date & initial examination

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- If your documentation appears correct, your application is given a [filing date](#) - also known as your [priority date](#).
 - ▶ After filing there is a formalities examination to ensure that your documentation is correct and complete.
- At [any time in the next 12 months](#) you can file for [patent protection in other countries](#) and have those later filings treated as *if they had been filed on your priority date*.
- In practice, this gives you a year to decide how many countries you wish to include in your patent protection.

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Stage 4: Publication

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- Your application is [published 18 months after the filing date](#).
 - ▶ Your invention will appear in databases accessible to other people around the world.
 - ▶ It will act as [prior art against any future patent applications](#) from other inventors or companies for similar inventions.
- You then have [6 further months](#) to make **two decisions**:
 - ▶ **Do you want to continue with your application?** You indicate 'yes' by requesting a more thorough ('[substantive](#)') examination.
 - ▶ **Which countries do you want to include ('[designate](#)') in your patent protection?** Designation fees must be paid.
- After your patent is granted, you may claim damages for infringements originating [as far back as the publication date](#) of your application.
 - ▶ However, to enjoy this right in some countries it may be necessary to file a translation of your claims with their national IP office and for them to publish the translated claims.

380 M. D. Dikaikakos

Stage 5: Substantive examination

- If you request substantive examination, the EPO has to decide whether your invention and your application meet the requirements of the European Patent Convention.
- For maximum objectivity there are usually **three EPO examiners**, one of whom maintains contact with your patent attorney.
- This stage will often involve **dialogue** between the examiners and your patent attorney, which may result in the re-drafting of key parts of your application.
- Your patent attorney will **defend your application**, and this is one more reason why it is essential to have professional representation.

Stage 6: Decision to grant a patent

- If:
 - ▶ the examiners decide to grant a patent, **and**
 - ▶ all fees have been paid **and**
 - ▶ any claims translations filed,
- the decision is **reported** in the **European Patent Bulletin**.
- The decision to grant takes effect on the date of publication.

Stage 7: Validation

- What you have now got is a 'bundle' of individual national patents.
- After the EPO decision to grant is published, your patent has to be **validated** in each designated state within a specific time limit.
- If this is not done, your patent may not be enforceable in that state.
- In some states, validation may include having to file (and pay for) a translation of the whole patent, or just a translation of the granted claims.

Stage 8: Opposition

- A **granted patent may be opposed by third parties** - usually the applicant's competitors - if they believe it should not have been granted.
- After the grant is reported in the European Patent Bulletin they have **nine months** in which to **file notice of opposition**.
 - ▶ The most common charge is that the invention is not novel or lacks an inventive step.
 - ▶ The case will be examined by an EPO team, again of three examiners.
- Opposition is the **last chance to attack** a European patent as **a single entity in a single forum**.
- Later, the patent **can only be challenged in national courts** and a ruling in one country has **no effect** on the patents for the same invention **in other countries**.
- This gives competitors **a strong incentive** to challenge an invention **during the opposition period**, as challenging patents in separate national courts can be much more expensive.

Stage 9: Appeal

- All EPO decisions are open to appeal.
- Responsibility for decisions on appeals is taken by independent boards of appeal.

Patenting strategy

- There is more to patenting than simply meeting the formal requirements of a patent office.
- You should try to fit your patent application into the broader framework of developing your invention.
- Points to discuss with your patent attorney may include these:
 - ▶ When to apply
 - ▶ Pressure to patent
 - ▶ Continuing prior art searching
 - ▶ Licensing or business start-up?
 - ▶ Re-filing
 - ▶ Temporary advantage
 - ▶ Funding

When to apply?

- Because of the formality of the patent application process, the timing of your application may make a big difference to the pressures you find yourself under later.
- Is it better to apply for a patent **earlier, or later?**
 - ▶ There is **no easy answer** to this question. Many inventors are **keen to apply** for a patent as early as possible - yet many successful companies delay filing until products are **almost ready for market**.
- One **disadvantage of early filing** is that you may incur substantial costs before you know whether your idea is commercially viable.
 - ▶ Applicants have **up to two years from filing before becoming liable for significant patent fees**, but this is rarely long enough to reach a licensing agreement with a company. It may not even be long enough to establish the commercial prospects of an invention.
- One **disadvantage of late filing** is that someone may file a very similar idea before you.
- For many private inventors, cost will be a major factor. The later you file, the longer you delay the costs. But how late can you afford to leave it?
- As long as your patent attorney knows all the facts, they may be able to identify an optimum date for filing, and advise on the steps you can take to protect your idea in the meantime.

Pressure to patent

- You may be tempted to apply for a patent prematurely because business advisers or potential licensee companies tell you that this is what you should do.
- Always consider whose interests are best served by this advice.
- In many cases there will be little benefit in it for you.

Continuing prior art searching

- The world does not stand still once you have filed your application.
- You must **keep up** your patent and product searching, as something may happen after you have filed which may affect your later decision whether to continue with your application.

Licensing or business start-up?

- The period between filing and requesting substantive examination should be used to **seek opportunities to exploit the invention**.
- Even if you prefer a **licensing agreement**, it may be worth setting a date after which you plan for **business start-up**.
- The reason is that *if no company shows interest in your idea, you do not want to reach substantive examination* stage with no other option to pursue.

Re-filing

- You may be able to gain extra time to seek a licensing agreement by withdrawing your application and re-filing it later.
- This is a tactic that you must discuss with your patent attorney, or you may lose more than you gain.

Temporary advantage

- It is possible to use a patent application for purely **temporary advantage**, and to **decline substantive examination**.
 - For example, you might wish to use it to protect your idea for long enough to achieve your exploitation objectives.
 - There may be risks that you have not considered in this approach: One almost certain outcome of abandoning an application is that you will find it much more difficult - in fact, probably **impossible - to license your invention to anyone**.
- Just having your patent application published may be enough. Once published, potential customers and business partners can find out about your invention and contact you if they are interested.
- Your published application will also be **prior art**, which could prevent competitors from patenting the same or a similar idea in the future. This might leave you free to operate in that market even if your application is not subsequently granted.
- If this suits your business strategy, you might then choose to go no further with the patenting process, especially if you could not afford the expense of acquiring or subsequently enforcing a patent.

Funding

- A granted patent may help persuade investors that your idea is worth backing, and by that means the cost of patenting may be covered.
- You should therefore think of a patent not just as a means of protecting the idea, but also as an **instrument for raising funding**.

Module 1: Introduction to Innovation and Entrepreneurship

Topic 1.6: Fundraising and Pitching

Module 4 Contents



- ▶ Fundraising: Key Terminology and Concepts
- ▶ Pitching your idea

Learning Objectives



After attending this module, studying its case studies and reading assignments, and watching suggested videos you should be able to:

- Describe and explain the different types of funding for a new company.
- Understand the terminology of funding and the series of funding.
- Identify sources of funding for your startup.
- Describe the purpose, the structure, and the content of a presentation to seek funding for your idea/company.
- Prepare and deliver convincing pitch of your idea/ company to potential investors .

Section 5: Fundraising and Pitching

Fundraising

Online Videos & Courses



- **Fundraising** by Sam Altman, *Startup Playbook*
<https://playbook.samaltman.com/#fundraising>
- **Modern Startup Financing** byCarolynn Levy, Y Combinator (2019).
<https://www.startupschool.org/videos/79>
- **Fundraising fundamentals** by Geoff Ralston, Y Combinator (2018).
<https://youtu.be/gcevHkNGrWQ>
- **The Why and How of Angel Investing** by Sam Altman, Y Combinator (2018)
<https://www.startupschool.org/videos/31>
- **How to Talk to Investors** by Tyler Bosmeny, Y Combinator Partners
<https://youtu.be/SHAh6WKBgiE>
- **Fundraising and Meeting with Investors** with Aaron Harris, Y Combinator.
<https://blog.ycombinator.com/aaron-harris-on-fundraising-and-meeting-with-investors/>
- **Fundamentals of Entrepreneurial Finance: What Every Entrepreneur Should Know** with Bill Aulet on edX

<https://www.edx.org/course/fundamentals-of-entrepreneurial-finance-what-every-entrepreneur-should-know>

Reading List



- How to fund a startup? by Paul Graham, Y Combinator
‣ <http://paulgraham.com/startupfunding.html>
- How to raise money? by Paul Graham, Y Combinator.
‣ <http://paulgraham.com/fr.html>
- Fundraising at Y Combinator's Startup School.
‣ <https://www.ycombinator.com/library>
- 10 Terms You Must Know Before Raising Startup Capital by J. Colao, Forbes, 2013.
‣ <https://www.forbes.com/sites/jicolao/2013/10/14/10-terms-you-must-know-before-raising-startup-capital/#21c123d46d6e>
- The different types of funding for new entrepreneurs by Shelley Pasqual, Startup Guide.
‣ <https://startupguide.com/different-types-of-business-funding>
- How to raise venture capital: Valuating your company by Ryan Allis, Startup Guide.
‣ <https://startupguide.com/how-to-raise-venture-capital-valuating-your-company>
- How to raise venture capital: Bootstrapping and beyond by Ryan Allis, Startup Guide.
‣ <https://startupguide.com/how-to-raise-venture-capital-bootstrapping>
- 4 reasons why your startup should not raise capital by Eran Laniado, VentureBeat, 2013.
‣ <https://venturebeat.com/2013/07/05/dont-raise-money/>

Some Terminology

- **Startup:** it's a company in the early or growth stages of operation, usually under three years old and (if not already) becoming profitable.
- **Lean startup:** a method used to validate a business concept quickly and cheaply when founding a new company or introducing a new product.
- **Research spin-off:** a company that: a) has an equity investment from a national library or university; b) licenses technology from a public research institute or university; c) has as founder a university or public sector employee, or d) has been established directly by a public research institution.
- **University spin-offs (or spin-out):** companies that transform technological inventions developed from university research that are likely to remain unexploited otherwise – a subcategory of research spin-offs.
- **Scale up:** refers to a company that has already validated its product in a market and is economically sustainable.
- **Unicorn:** A company often in the tech or software sector worth over US\$1 billion.

Some Terminology

- **MVP (Minimum viable product):** A technique which involves the development of a basic version of a new product that aims to satisfy its early adopters. The product is then developed with further features only after considering feedback from initial users.
- **Pivot:** when a company quickly changes directions after previously targeting a different market segment.
- **Pitch deck:** a short version of a business plan which presents key figures to potential investors in hopes of winning them over.

Some Terminology

- **Accelerator:** an organization or program that offers advice, mentorship and resources to help small businesses grow.
- **Incubator:** An organization that nurtures young firms during their first few months or years, usually in exchange for equity. An incubator differs from an accelerator in that it supports startups in their early development stages.
- **Angel investment:** typically happens when a startup is in its early stages; it's when an investor, or a "business angel," provides startups with initial or growth capital for a stake in the company.
- **VC (Venture capital/Venture capitalist):** Venture capital is financing provided by firms to small, high-risk, startup companies with large growth potential in return for equity. Investors working for venture capital firms that choose to invest in specific companies are typically called VCs.

Related Terminology

- **Bootstrapping:** self-fund using personal resources, like friends and family, to get cash going.
- **Seed funding:** The first round of small, early-stage investment from family members, friends, banks or an investor.
- **Bridge loan:** a loan taken out for a short-term period, typically between two weeks and three years, until long-term financing can be arranged. Also known as a *swing loan*.
- **Term sheet/Letter of intent:** The document between an investor and a startup including the basic terms and conditions for financing which is commonly non-binding. Once an agreement is reached between the parties involved, a binding agreement based on the term sheet is drawn up.
- **Burn rate:** how fast you are spending your money. Alternatively referred to as a *run rate*.
- **Vesting:** A process that involves giving or earning a right to a present or future payment, benefit or asset.
- **Exit:** Founders sometimes develop an exit business strategy before or during their entrepreneurial journey. An exit is a way to transition the ownership of your company to another company and pay back your investors.

The Role of Venture Capital

"VC funding-early investments in high-risk, high-potential companies -barely existed before the 1970s.

Inventors and innovators during the first two Industrial Revolutions had to rely on a thin patchwork of financing mechanisms to get their products off the ground, usually via personal wealth, family members, rich patrons, or bank loans. None of these have incentive structures built for the high-risk, high-reward game of funding transformative innovation.

That dearth of innovation financing meant many good ideas likely never got off the ground, and successful implementation of the GPTs scaled far more slowly."

Source: Kai-Fu Lee (2018) "AI Super-Powers"

The Role of Venture Capital

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"Today, VC funding is a well-oiled machine dedicated to the creation and commercialization of new technology.

In 2017, global venture funding set a new record with **\$148 billion invested**, egged on by the creation of Softbank's \$100 billion "vision fund; which will be disbursed in the coming years.

That same year, global VC funding for A startups leaped to **\$15.2 billion**, a 141% increase over 2016. That money relentlessly seeks out ways to wring every dollar of productivity out of a General-Purpose Technology like AI, with a particular fondness for moonshot ideas that could disrupt and recreate an entire industry.

Over the coming decade, voracious VCs will drive the rapid application of the technology and the iteration of business models, leaving no stone unturned in exploring everything that AI can do."

Source: Kai-Fu Lee (2018) "AI Super-Powers"

Different types of funding for new entrepreneurs

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- Bootstrapping
- Angel investment
- Venture capital (VC)
- Banks
- Seed investment

Source: Shelley Pasqual (2018) <https://startupguide.com/different-types-of-bu-funding>

10 Terms You Must Know Before Raising Startup Capital

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- Pre-money vs. Post-money Valuation
- Convertible Debt (Convertible Notes)
- Capped Notes vs. Uncapped Notes
- Preferred Stock
- Liquidation Preferences
- Participating Preferred vs. Non-participating Preferred Stock
- Pro-rata Rights
- Option Pool
- Board Control
- Vesting

Source: <https://www.forbes.com/sites/jjcolao/2013/10/14/10-terms-you-must-know-before-raising-startup-capital>

How to Raise Money?

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- Fundraising is hard
- Don't raise money unless you want it and it wants you
- Be in fundraising mode or not
- Get introductions to investors
- Hear no fill you hear yes.
- Do breadth-first search weighted by expected value
- Know where you stand
- Get the first commitment
- Close committed money
- Avoid investors who don't "lead"
- Have multiple plans
- Underestimate how much you want
- Be profitable if you can
- Don't optimize for valuation
- Yes/no before valuation
- Beware "valuation sensitive" investors
- Accept offers greedily
- Don't sell more than 25% in phase 2
- Have one person handle fundraising
- You'll need an executive summary and (maybe) a deck
- Stop fundraising when it stops working
- Don't get addicted to fundraising
- Don't raise too much
- Be nice
- The bar will be higher next time
- Don't make things complicated

Video Assignments

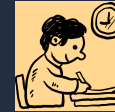


Watch the following videos and discuss:

- Fundraising Fundamentals, Geoff Ralston (2018) Y Combinator
▶ <https://www.youtube.com/watch?v=gcevHkNGrWQ>
- The Why and How of Angel Investing, Sam Altaman (2018) Y Combinator
▶ <https://www.ycombinator.com/library/8A-the-why-and-how-of-angel-investing-is-2018>
- Fundraising and Meeting with Investors, Aaron Harris (2019) Y Combinator
▶ <https://www.ycombinator.com/blog/aaron-harris-on-fundraising-and-meeting-with-investors/>
- Modern Startup Funding,Carolynn Levy

(2019) Y Combinator
▶ <https://www.ycombinator.com/library/8F-modern-startup-funding-sus-2019>
- Understanding SAFEs and Priced Equity Rounds, Kirsty Nathoo, Y Startup School
▶ <https://www.ycombinator.com/library/6m-understanding-safes-and-priced-equity-rounds>

Reading Assignment

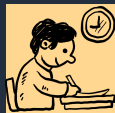


Read the following blog post and review the financing documents developed for the SAFE (simple agreement for future equity) financing approach documents
Watch the following videos and discuss

- Fundraising Templates: Safe Financing Documents
▶ <https://www.ycombinator.com/library/6z-fundraising-templates-safe-financing-documents>



Reading Assignment

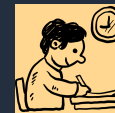


Read the blog post by Bill Aulet “The Basics of Finance” and review the key concepts analyzed therein:

- <https://www.d-eship.com/articles/featured/chapter-2-the-basics-of-finance/>

DISCIPLINED
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Reading Assignment



Read the following blog post on Financial Modeling by Bill Aulet

- Financial Modeling (Part 1)
▶ <https://www.d-eship.com/articles/featured/chapter-3-financial-modeling-part-1>
- Financial Modeling (Part 2)
▶ <https://www.d-eship.com/articles/featured/chapter-3-financial-modeling-part-2/>

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Section 5: Fundraising and Pitching

Pitching

Reading List



- Pitch Advice for Entrepreneurs by Reid Hoffman
 - <https://www.reidhoffman.org/linkedin-pitch-to-greylock/>
- The YC Seed Deck Template by Aaron Harris, Y Combinator (2018).
 - <https://blog.ycombinator.com/intro-to-the-yc-seed-deck/>
- How to Design a Better Pitch Deck by Kevin Hale, Y Combinator (2015).
 - <https://blog.ycombinator.com/how-to-design-a-better-pitch-deck/>
- How to Effectively Pitch Business Ideas to Investors by Sarath CP.
 - <https://medium.com/swlh/how-to-effectively-pitch-business-ideas-to-investors-dd76661b02f1>
- It's time to Rethink the Startup Pitch Deck (Here's a Start) by Rob Go (2015).
 - <https://nextviewventures.com/blog/startup-pitch-deck-founder-vc-interactions/>
- 10 Things to Include in Your Startup Pitch Presentation by Bill Clark, Mashable.
 - <https://mashable.com/2011/06/24/startup-pitch-presentation>
- 10 questions for a perfect pitch by Linda Plano, MITEF Greece.
 - <https://www.planoandsimple.com/10questions/>
- How to Create an Enchanting Pitch by Guy Kawasaki.
 - <https://guykawasaki.com/how-to-create-an-enchanting-pitch-officeandguyk/>

HOW TO PRESENT YOUR PLAN?

How To Present Your Plan?

- If you are successful, you **will** present your business plan to people.
- They may (probably) not have read your plan.
- It is important to have a logical flow and capture their attention
- It all starts with telling a **Compelling Story**

Key Considerations

- Turn your pitch into a story: **Storytelling** is the best way to attract the audience.
- Know your **audience** and **target the right ones**.
- Determine what the audience is **most interested in**.
- Have a **simple** yet incisive Pitch.
- Set Strict **Timelines** and be **brief**.
- Speak Up About the **Sales**.
- Be **Courageous**.
- The purpose of a successful pitch is to have investors willing to **invest** in your company.

Objectives and Criteria of Success

- Gives you and your new venture credibility
- Gain concurrence, or enthusiasm, for follow-on meeting
- Sets a mental model in person's mind so you can later succeed

Pitching Importance

- Attacker vs. Defender
 - ▶ As an attacker, this is more important
- Gain needed resources
 - ▶ You need to get resources & this is the way
- Instantaneous view into your abilities
 - ▶ Employees, Advisors, Board Members, Investors, Customers, etc. will all get to see your skills in this exercise

Baseline Expectations

- **Connect immediately** – it is about them not you
- Be **professional** and **likeable** – must prove to be someone they want to do business with
- **Stand out** – you are an attacker not a defender; a tie or incremental benefit does you no good
- **Smile!**

Key Elements

- Pain today (1st)
- Customers (1st)
- Preferably in the form of a question which will be answered "yes!"
- Your offering (product/service)
- Value Proposition
- Why you?
- Why now?
- Vision of what it can be (economic and non-economic)
- What I am asking of you and what you will gain

421 Source: **DISCIPLINED ENTREPRENEURSHIP**

Intangibles for Success

- **Passion** – enthusiasm
- **Empathy** – make them feel like the most important person in the world
- **Preparation** – do your homework & practice, practice, practice

422 Source: **DISCIPLINED ENTREPRENEURSHIP**

Critical Success Factors

- Passion
- Referenced in
- Market opportunity
- Proven customer value proposition/traction
- Team → Quality of Presentation and Ability to Tell the Story
- Sustainable competitive advantage
- Return on Investment
- Technology
- Partnership/trust/fun factor
- Synergies with rest of portfolio

423 Source: **DISCIPLINED ENTREPRENEURSHIP**

Recipe for Failure

- **Talk about technology** – technology is a means to an end; this is a venture creation exercise not a science fair
- **Talk about yourself** – it is about them
- **Not prepared** and go **too long** – disrespectful
- **Lack confidence** – who will follow you then?
Ans: Nobody
- **Fishing expedition** – not clear on objectives

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Pitch types

- Elevator Pitch (1 minute)
- Escalator Pitch (3 minutes)
- Taxi Cab Pitch (10 minute)
- Commuter Train Pitch (30 minutes)
- Plane Pitch (45 minutes)
- Also: Don't forget the power of your company name, logo, 1st image & tag line

426 Source: **DISCIPLINED ENTREPRENEURSHIP**

The Ten Minute Business Plan

- Seven slides
- Apply these suggestions with reason
- Feel free to remove or consolidate

428 Source: **DISCIPLINED ENTREPRENEURSHIP**

Section 5: Fundraising and Pitching

Taxi Cab Pitch: the MIT Approach

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First Question

- What does your audience want?
- And remember, the responsibility is not on them to “get it” but rather on you to explain it in such a way that they understand it and are excited about it.

427 Source: **DISCIPLINED ENTREPRENEURSHIP**

Slide #1: Introduction

- Name of Company – important to help frame things
- Compelling Tag Line
- Visual – the power of the first image
- Tell a compelling story demonstrating target customer, as is state, urgency, desired & possible state, your value proposition (usually the persona and use case)
- Tell them what you want them to remember – **three key points** – and **what you will be asking for** at the end

429 Source: **DISCIPLINED ENTREPRENEURSHIP**

Slide #2: Target Customer/Pain

- Who is the Target Customer? How many of them are there? (Who)
- What is their pain or opportunity? (Why)
- Speed of adoption? (Why Now)
- Who has the money? (Who Pays)
- Specific examples you have met...
- Your first ten customers
- This is too much but think of what you can effectively get into a minute or so and one slide – remember stories help

430 Source: **DISCIPLINED ENTREPRENEURSHIP**

Slide #3: Your Solution

- Explain your solution (“pencil sell”) (What)
- Quantified Value Proposition (How Much)
- Unique Selling Proposition (Why You)
- Be very visual here ... remember, 1 minute and 1 clear easy to understand slide

431 Source: **DISCIPLINED ENTREPRENEURSHIP**

Slide #4: Go To Market Strategy

- How will you get to the customer and drive demand? Fulfill demand?
- Who will be your first set of customers? (by name)
- What will be your Cost of Customer Acquisition (COCA)
 - Initially
 - Overtime
 - Market penetration
 - Investment required → ROI

432 Source: **DISCIPLINED ENTREPRENEURSHIP**

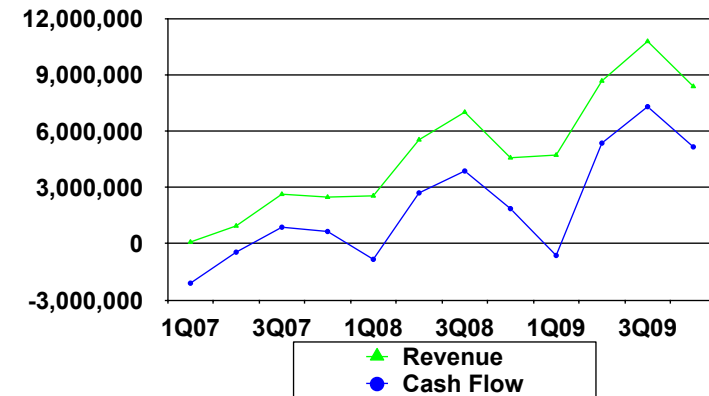
Slide #5: Financials

- Be careful not to overload!
- Simple graph with top line **growth** and **cash flow** –and a few other things (less is more)
- Be ready to explain top line because that is where it all starts -- Key Factors to know and possibly include:
 - ▶ Units installed
 - ▶ Costs
 - ▶ Key Milestones driving financials
 - ▶ Value of company estimations & exit strategy

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Source: **DISCIPLINED ENTREPRENEURSHIP**

Summary Quarterly Financials



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Source: **DISCIPLINED ENTREPRENEURSHIP**

Slide #6: Team & Competition

- Team today (Why You II)
- Team future
- Competitors and Sustainable Competitive Advantage

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Source: **DISCIPLINED ENTREPRENEURSHIP**

Slide #7: Summary and ASK!

- Summary of three key points
- Call to Action
 - ▶ How much are you asking them for?
 - ▶ What are the possible exits?
 - ▶ What types of returns are possible and/or likely?
- Then have your “ASK”!

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Back Up Slides

- Have a good set of back up slides for frequently asked questions
- Especially for financials
 - ▶ Top line explanation
 - ▶ Expense explanation
- Primary Market Research Data in Structured and Statistically Valid Manner

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Pitch Deck Structure I

- Cover Page
- Summary
- Team
- Problem
- Solution
- Marketing/Sales
- Projections or Milestones
- Competition
- Business Model
- Financing

Section 5: Fundraising and Pitching

The Y Combinator's Deck



The YC Seed Deck Template

- Focus on narrative. The rest is commentary.
- Suggested contents:
 - ▶ Title page: name of your company and a one line description of what you do
 - ▶ Clear problem statement
 - ▶ Solution explanation, in as few words as possible, with concrete benefits you provide described
 - ▶ Show off your traction (if you have it). Make the numbers clear and meaningful
 - ▶ Give more metrics, if available.
 - ▶ Tell the investor what makes you so special, what makes this work, what your insights are (possibly more than one slide).
 - ▶ Lay out your business model.
 - ▶ Present future growth potential and convince the investor that they're going to make lots of money with you.
 - ▶ Talk about what makes your team particularly well suited to the problem.
 - ▶ Tell the investor how much money you need, and what it gets you.

The YC Seed Deck Template



Read the following posts and discuss:

- “It’s Time to Rethink the Startup Pitch Deck (Here’s a Start)” by Rob Go (2015):
 - ▶ <https://nextview.vc/blog/startup-pitch-deck-founder-vc-interactions/>

Suggested Readings



Check out the following resources on how to improve your communication skills:

- 9 Simple Things Great Speakers Always Do, Jrrf Heyden (2014)
 - ▶ <https://www.businessinsider.com/9-simple-things-great-speakers-always-do-2014-2>
- English Communication for Scientists
 - ▶ <https://www.nature.com/scitable/ebooks/english-communication-for-scientists-14053993/contents/>

