Teaching Technological Entrepreneurship -Trends.

Dr. Jack M. Wilson, Distinguished Professor of Higher Education, Emerging Technologies, and Innovation

# Dr Jack M. Wilson   -   http://www.jackmwilson.com/index.html

- President Emeritus of the University of Massachusetts
- Distinguished Professor of Higher Education, Emerging Technologies, and Innovation

- Former Entrepreneur: Founder, CEO,
  Chairman of ILinc Corporation
  http://www.jackmwilson.net/Entrepreneurship/Cases/ILinc-TheFullStory.pdf

- Distinguished Professor –Rensselaer Polytechnic

- Former Executive in US Physics Societies
  – AAPT, APS, AIP

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TECHNOLOGY JOURNAL / NET INTEREST

Software Seeks to Breathe Life Into Corporate Training Classes

Workers Avoid Long Courses — And Long Trips

By REBECCA QUICK
Staff Reporter of The Wall Street Journal

THE INTERNET promises a lot of miracles, but here's one thing even it can't do: make corporate training classes actually enjoyable.

But maybe it can make them a little less painful.

Here is what an instructor using Ilinc software sees. The left side displays a list of students logged on, command buttons for turning the floor over to a student, and a dialog box for typing messages to an individual student. The right side is where the teacher guides the students through presentations via an application like a browser.

Why do Innovation and Entrepreneurship Matter?

- Innovation and Entrepreneurship has proven to be the most successful way to address problems and create both economic and social opportunity.
- Companies that fail to innovate often disappear.
  - Digital Equipment and Wang Computer, both born and operated right here in this region, were once two of the largest and most important computer companies on the globe. They did not see the microcomputer (PC) coming and today they do not exist, and Apple and Microsoft are two of the largest companies in the world.
  - Borders once operated 659 bookstores all across the county. They never saw Amazon.com coming, and by the time they did it was too late. Gone.
  - Blockbuster dominated the video rental business, but now they are gone and video are delivered on demand by Netflix and others.
- Companies that do innovate can succeed wildly.
  - Google, Amazon, Facebook, Twitter, Instagram, and so many others are major companies who are younger than many of our university students!
- Geographic regions that foster and support innovation –often around great research universities are flourishing economically.
- Innovation and Entrepreneurship create jobs for our citizens, cures for our diseases, and new ways for human beings to interact.
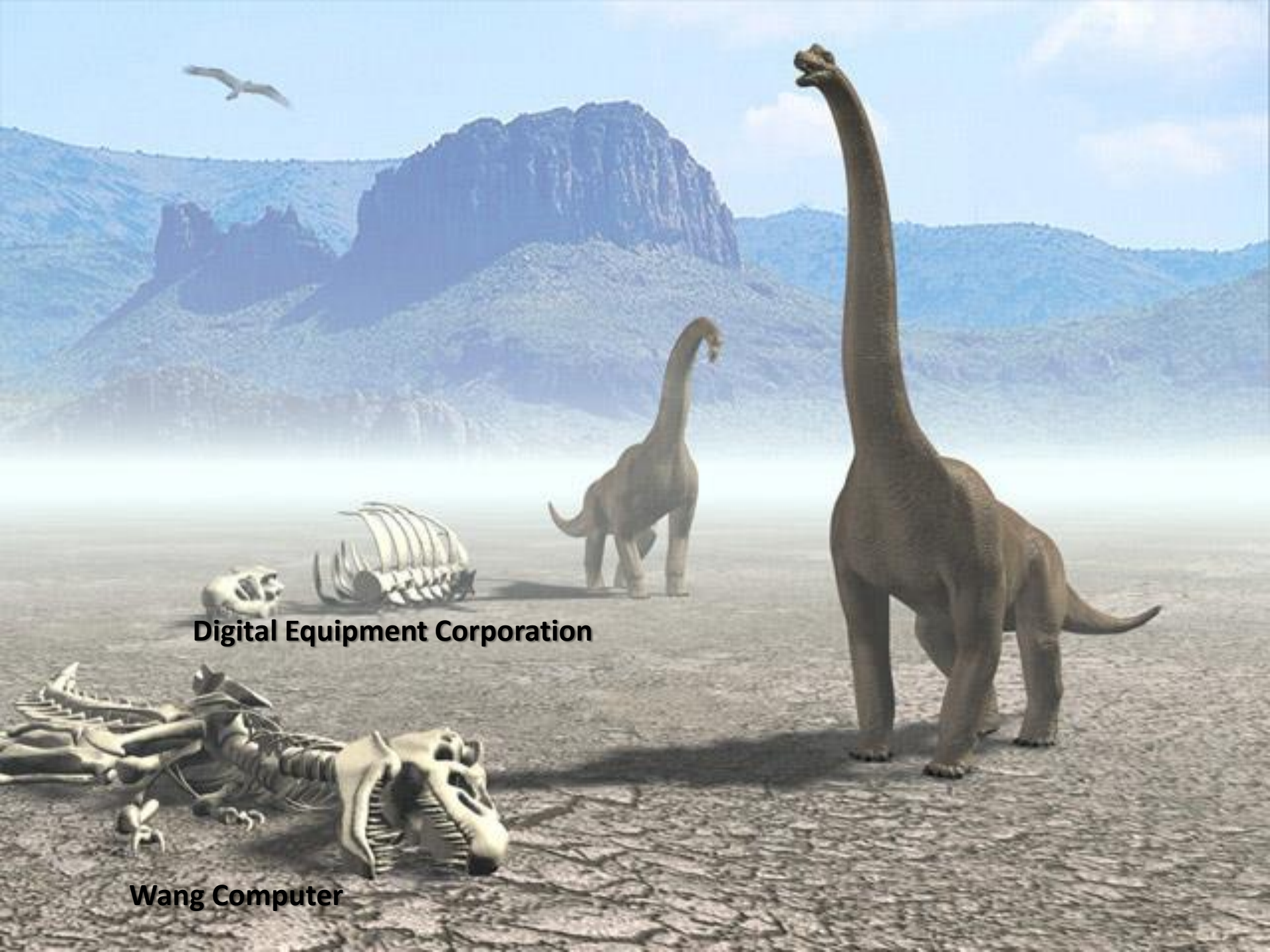
Digital Equipment Corporation

Wang Computer

Two Key Concepts in Innovation

- Joseph Schumpeter –Harvard University economist from Austria
  - **Creative Destruction** – 1934-   new products and technologies make old products and technologies obsolete

- Clayton Christensen –Harvard University Management
  - **Disruptive Innovation**-1997 – new products begin in new, unexplored markets but grow in quality and capability to displace older markets.
    - Mini-computer disrupted mainframes and were in turn disrupted by PC's.
    - Steel mini-mills created poor quality steel at low prices to take the least profitable part of the steel market. They then grew to displace the old-line steel companies.

- I cannot over-emphasize how important these two topics are in understanding entrepreneurship. Creative destruction and disruptive innovation are indeed closely related, disruptive innovation is a very special case when a company enters into a very low end of a market at a place where the dominant players are not so interested because it is not profitable or not able to satisfy their largest customers. But, the company doing the disruption gets a foothold in the market, establishes itself, and then learns how to do the things it needs to do to enter the more profitable and sophisticated portions of the market.
- Often the established companies never see it coming.
  - http://www.claytonchristensen.com/key-concepts/
  - http://en.wikipedia.org/wiki/Clayton_M._Christensen
  - http://en.wikipedia.org/wiki/Disruptive_innovation

Innovation is what makes enterprises sustainable

- In the immortal words of Andy Grove
  - the former Intel Corporation CEO

- **"Only the Paranoid survive!"**

Andy Grove congratulates Mark Bernstein of ILinc

Innovation Matters

"Innovation distinguishes between a leader and a follower."

~ Steve Jobs

PersonalExcellence.co
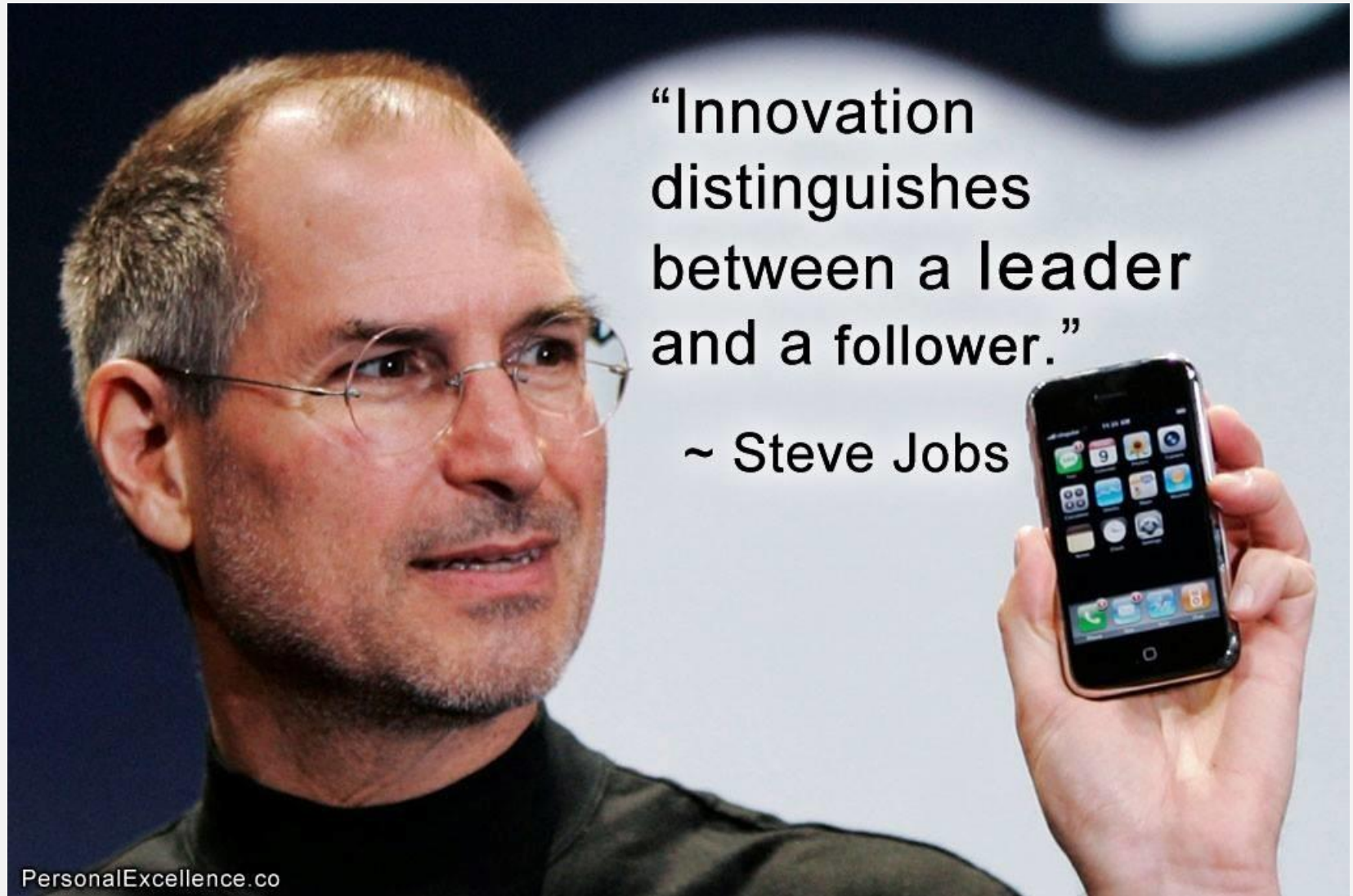
Why do countries care?

Because the more innovative that a country is the larger is their GDP per person.

The economic development of countries is very dependent upon innovation.

Global Innovation Index
2014 or latest available year

○ Efficient innovators
● Inefficient innovators

Circle size = population (1bn)

Global innovation index score, 100= maximum

GDP per person at purchasing-power parity, $ (log scale)

Source: Global Innovation Index, 2015
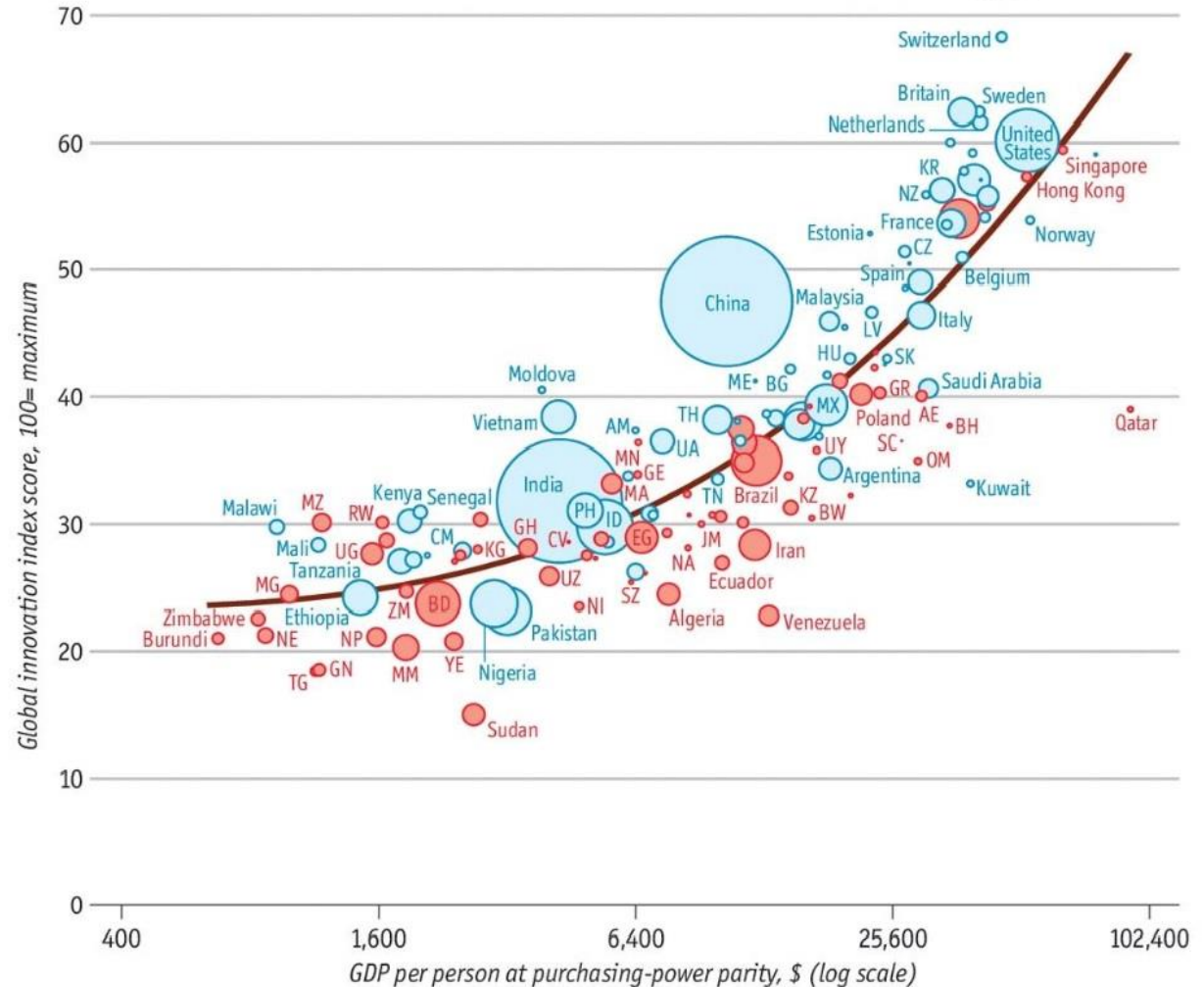
Why study international entrepreneurship?

- World markets are **larger and faster growing** then domestic ones.
- **Changes in technology, transportation, and trade** liberalization have made international trade more accessible to companies, especially new entrepreneurial firms.
- In a global economy, **consumers worldwide** choose from a wide variety of goods and services.
- Collectively, the movement of goods, labor and capital across national borders is part of a growing trend toward globalization—the creation of an **integrated interdependent** world economy.
- Entrepreneurs are on the cutting edge in creating international businesses; they are often the first movers into new markets, new products, and new services.
- Firms that choose to remain domestic miss great opportunities and often face increased risks.
    - For example, a company that has achieved the enviable position of having one-third of the US consumer market for its products has only a 1.5% share of the global market, 98.5% of the market is still available.
   - http://data.worldbank.org/indicator/IC.BUS.NREG/countries

Global Entrepreneurship

- Global Entrepreneurship has flourished over the last 50 years. Major changes in world governments, economic systems, and cultural interactions have created an environment in which entrepreneurship has become a significant factor in regional economic development, global geo-politics, and even cultural change.
- There have been three significant issues that have enabled much of this innovation.
  - **Technology advances**: The incredible advances in technology –particularly in computing and the internet, but also in the life and medical sciences.
  - **Trade Liberalization**: The dismantling of barriers to trade and the movement of goods and ideas across borders that has found expression in world trade organizations like the WTO and in multi-national trade agreements like the European Union (EU), North American Free Trade Agreement (NAFTA) and many others.
  - **Freer movement of people**: The opening of borders to a much freer movement of people who emigrate and immigrate to find better opportunities in education and employment.

Growth in Economies varies by country

Entrepreneurial activities take place within an ecosystem of the countries involved. As we can see below, that ecosystem varies by country and is always changing.

Major Developing Economies by GDP per capita at PPP (2011 int'l $)

Gross Domestic Product
GDP in current U.S. dollars. Not adjusted for inflation.

Data source: World Bank, World Development Indicators - Last updated December 21, 2010
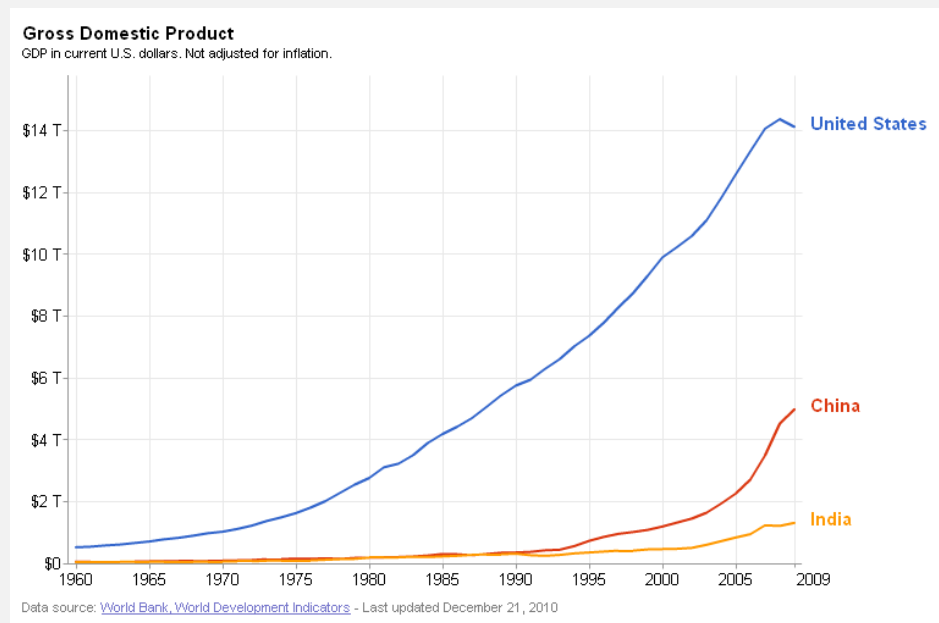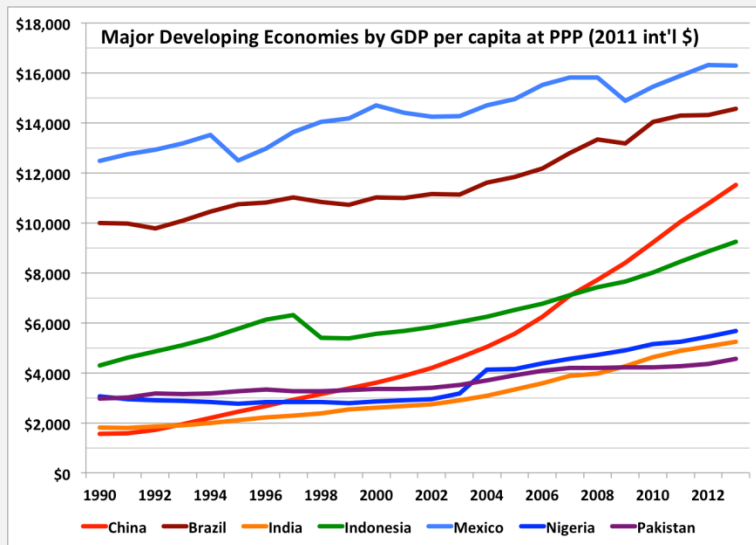
In 1974, China's GDP was about 280 B CNY
In 2014, China's GDP was 63,646 B CNY or $ 10,361 B US.
This is a growth of 22,700 %

Compare the list of Global Unicorns to the list above of US Unicorns

	Name	Value ($ B)	Date Joined	Country
1	Uber	$68.00	8/23/2013	United States
2	Didi Chuxing	$50.00	12/31/2014	China
3	Xiaomi	$46.00	12/21/2011	China
4	Airbnb	$29.30	7/26/2011	United States
5	SpaceX	$21.20	12/1/2012	United States
6	Palantir Technologies	$20.00	5/5/2011	United States
7	WeWork	$20.00	2/3/2014	United States
8	Lu.com	$18.50	12/26/2014	China
9	China Internet Plus Holding	$18.00	12/22/2015	China
10	Pinterest	$12.30	5/19/2012	United States
11	Flipkart	$11.60	8/6/2012	India
12	Toutiao	$11.00	4/7/2017	China
13	DJI Innovations	$10.00	5/6/2015	China
14	Dropbox	$10.00	10/5/2011	United States
15	Infor	$10.00	11/16/2016	United States
16	Stripe	$9.20	1/23/2014	United States
17	Spotify	$8.53	6/17/2011	Sweden
18	Snapdeal	$7.00	5/21/2014	India
19	Lyft	$6.90	3/12/2015	United States
20	Lianjia	$6.20	4/8/2016	China
21	Global Switch	$6.02	12/22/2016	United Kingdom

Great Research Universities are a key to innovation quality.

Innovation quality
300=maximum quality

Legend: Universities* | Patents† | Citations‡

High-income countries — United States, Britain, Japan, Germany, Switzerland, Canada, France, South Korea, Netherlands, Sweden, Average§

Middle-income countries — China, Brazil, India, South Africa, Seychelles, Argentina, Mexico, Hungary, Malaysia, Turkey, Average**
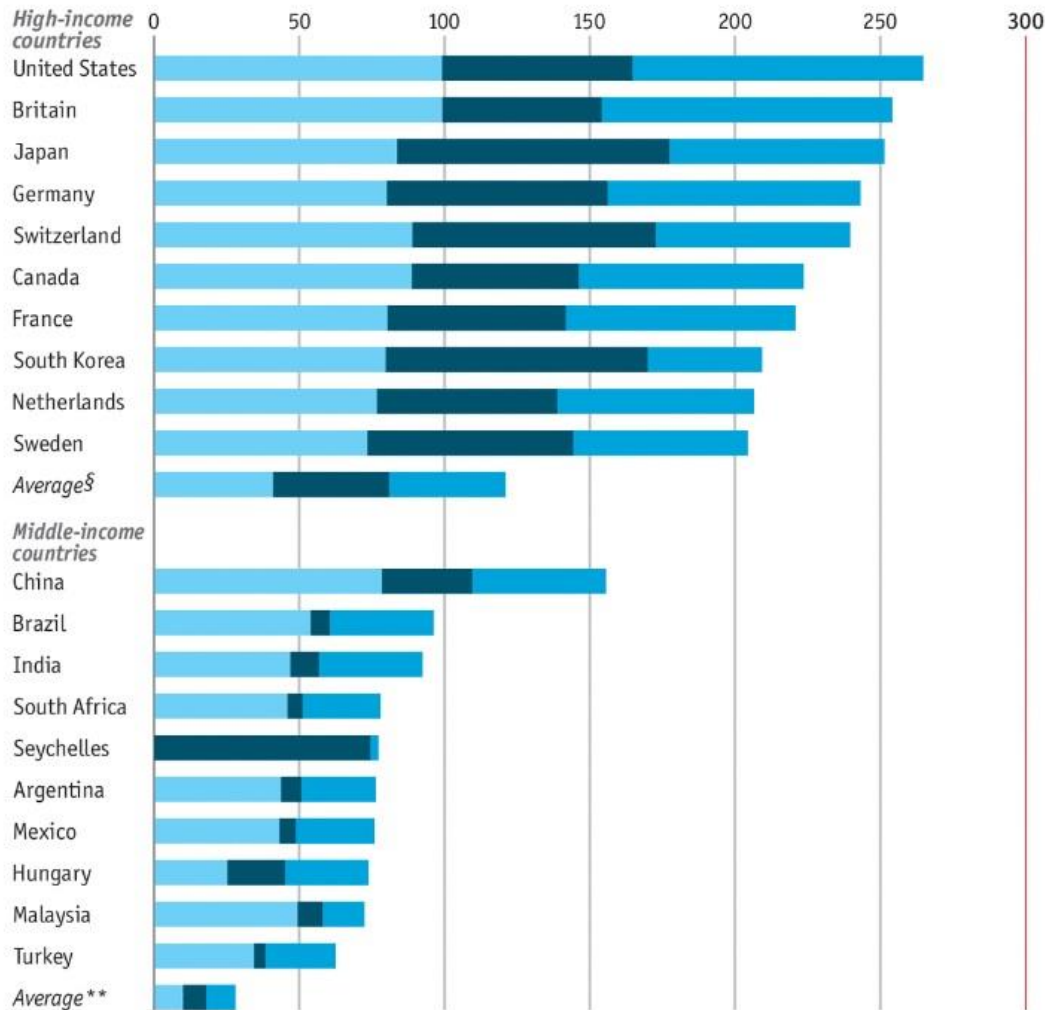
Source: Global Innovation Index, 2015

*Average rating of top three universities   †Number of patents filed per unit of GDP
‡Cited articles as % of published articles   §Of 48 countries   **Of 72 countries

Teaching Entrepreneurship

- For all of these reasons, Universities have increasingly been creating new educational programs in entrepreneurship
  - To encourage students to follow an entrepreneurial path
  - To bring academic research results into products in the marketplace and cures for diseases
  - To galvanize economic development of their countries and regions.

- https://www.worldbank.org/en/topic/education/publication/entrepreneurship-education-and-training-programs-around-the-world-dimensions-for-success

The World Bank (2015 Report)

- Through a review of existing literature and 230 program evaluations, this report sought to address key questions about the global landscape of entrepreneurship education and training (EET) programs:

- **Who are being targeted?**
  - EET programs can be classified under education and training programs. Both aim to stimulate entrepreneurship but they are distinguished from one another by their objectives and target audiences.
  - Entrepreneurship Education Programs- tend to focus on building knowledge and skills about entrepreneurship and target secondary or higher education students.
  - Entrepreneurship Training Programs- tend to focus on building knowledge and skills to start or operate an enterprise. These target potential entrepreneurs (e.g. vulnerable or unemployed individuals) and those who are already practicing (e.g. owners of small or high-growth potential enterprises).

- **What outcomes do EET programs achieve?**
  - Programs are not a silver bullet to address unemployment or foster innovation, but they can lead to positive change. Outcomes can be categorized into:
  - Entrepreneurial mindsets- changes in socio-emotional skills;
  - Entrepreneurial capabilities- changes in knowledge and technical skills;
  - Entrepreneurial status- a change in activities, such as opening an enterprise or finding employment; and
  - Entrepreneurial performance- changes in indicators of a venture's performance.

- **What dimensions shape these outcomes?**
  - The **economic, political and cultural context** in which programs are implemented- different perceptions on risk-taking and failure affect entrepreneurial behaviors and practices.
  - **Participant profiles** - differences in outcomes can be associated with individual characteristics such as gender, personality traits, skills, and experience.
  - **Program characteristics** – features such as the design, content, related wrap-around services and trainers have an important influence on program outcomes.

  https://www.worldbank.org/en/topic/education/publication/entrepreneurship-education-and-training-programs-around-the-world-dimensions-for-success

Kauffman Foundation

- 400 universities offered classes in 1995, compared to over 2,000 universities across the US in 2012 (ed: and many more today)
- "While multiple theories of teaching and training people to become entrepreneurs exist—traditional vs. innovative, awareness increases entrepreneurial activity—there is a great lack of knowledge on which interventions and approaches work best for their given context and aims."

- https://www.kauffman.org/currents/2015/07/entrepreneurship-education-and-training

Universities and Faculty: often conservative and resistant to change.

- Many years ago, I was part of a group presenting results from the research in the cognitive sciences that showed that excessive use of lectures was not effective in generating student learning.

- A famous physicist (and friend) stood up indignantly and exclaimed: "*the lecture is the stable product of many years of evolution.*"

- "*The Dinosaur was a "stable" product of evolution for much longer than human beings*" I replied.
  - "*Evolution does NOT create stable products –they are always evolving to adapt to conditions.*"

- We know that engagement with the material is absolutely imperative to enable students to learn.

- When teaching entrepreneurship we need to think about what kinds of activities will lead to student engagement.

- We should consider the always evolving understanding of the process of entrepreneurship and how to engage students with that.

Models of learning environments

- Lectures can be a part of a good learning environment, but they cannot be effective without other, more engaging activities.
  - We have all heard terrific lectures that engaged us, inspired us, and led to learning.
  - Few of us have heard three hours of those on the same subject in any week.
  - Almost none of us have heard 45 hours of engaging lectures in one semester. (a 3 credit class)
- The case study method has proven itself to be a very effective way to engage students. One may use cases provided by prestigious suppliers or faculty may design their own cases. (I prefer locally designed and shared cases)
  - A case study includes a narrative that presents a situation that requires some analysis and then engages the students in a discussion and analysis of the situation.
- If possible, depending upon the level and format of the course, students would benefit form interviewing or even doing an internship with active entrepreneurs engaged in creating a new venture.
- Textbooks can be a problem for teaching Entrepreneurship since they can quickly become outdated and often use examples that do not appeal to the student's experience.
  - Example: When US Patent Law changed from "First to invent" to "First to file" in 2013, textbooks and examples taught the students incorrect concepts for several years thereafter.

Effective Use of Cases –from my experience

- Students become more engaged with the material if it touches on something that they are familiar with in their own experience
- There are two main approaches to that engagement
  - Use (create your own) cases that are drawn from current events which students might be experiencing.   Recently, cases and examples from Uber, Lyft, Tinder, Instagram, Baidu, Didi Chuxing, FlipKart, Spotify, and others have been useful.
  - Create cases (if available) that describe entrepreneurship activities concerning students or alumni of their own institution or region.
    - At UMass Lowell we are very fortunate to have a number of successful entrepreneurs, some of who graduated very recently or are still students, and others who graduated long ago but have become well known.
    - Students love to see the obstacles that others (much like them) had to overcome to become successful.
    - Just this past year a group of students who first won our "Difference Maker" contest went on the win other competitions, gain investments from others, and ended up on National TV with Invisawear!
    - http://www.jackmwilson.net/Entrepreneurship/Cases/Case-Invisawear.pdf

Cases for Use in Entrepreneurship

- These cases were created for our courses and are available for anyone to use for free under the Creative Commons License
- Find them here: http://www.jackmwilson.net/Entrepreneurship/Cases/index.htm

Case Study Guides	
•Altaeros Energy	•Muhammad Yunas - Grameen
•Alibaba-Jack Ma	•Napster
•Apple Computer -The Supply Chain	•NonSpec-a UMass Lowell spin-off in prosthetics
•Baidu	•NetFlix
•Cloud.com	•Panera Bread
•Champ-HarrisMacNeill-MacNeillEngineering	•Privo Technologies
•CRISPR -Patent War MIT vs Univ. of California	•Richard Branson-Virgin
•DailyWorth and Amanda Steinberg	•Scriptpad
•Dell Computer	•Segway
•"Desh" Gururaj Deshpande	•Smuckers Uncrustables
•D-Light	•Snap Inc. -Snapchat
•EcoSchool-Africa	•Solar electric-Harish Hande
•Google	•Stacy's Pita Chips
•Groupon	•Steve Jobs -An Entrepreneur's Story
•GroupIII-International-Pulichino-Tong	•Tata-Nano-Creating an auto for a specific market.
•ILinc-The Full Story	•Tommy John Underwear
•ILinc-LearnLinc Story and ILinc LearnLinc Slides	•Theranos-ElizabethHolmes
•InvisaWear - A UML student new venture	•TravelMyth-Greece
•James West-Inventor-Physicist-Entrepreneur	•Uber
•Kazoo	•UMassOnline-
•Konarka	•Virgin -Richard Branson
•Kickstarter	•WhatsApp
•Mass Green High Performance Computing Center	•Zipcar
•Mercado Libre	
•Moore's Law, Metcalfe'sLaw, and Gilder's Law	
•Microsoft-Bill Gates	

Models of Entrepreneurship

- In the early days of Entrepreneurship Education, the process was viewed as a rather orderly causal progression from opportunity recognition to success.

- The "Business Plan" was a key component of "Causal" or "Traditional" entrepreneurship

- Business plan competitions sprung up all over the country and remain one of the most common feature of most educational entrepreneurship programs

- However, research was telling us something a bit different

- Effectual Entrepreneurship became one of the first research-based models.

- Then The Lean Launchpad as developed by Steve blank and deployed in the US National Science Foundation I-Corps program began to dominate these programs

Entrepreneurship is more of an Art than a Science

- –from business plan competitions to the lean launch pad.

- Entrepreneurship today is in a state of flux as the field has recoiled from the prescriptive approach of the last decade in which the business plan, and business plan competitions, defined the science of entrepreneurship.
  - The annoying fact that many, if not most, new businesses simply did not use business plans was viewed as something undesirable and needing to be corrected.
- As scholars looked at start-ups in a systematic fashion, they also observed that even those that did have business plans rarely executed those business plans in a linear fashion.
  - In fact, most successful new businesses ended up on a trajectory that was not envisioned in the original plan.
  - The ability of a new venture to change its business model dramatically in mid-course has come to be known as a **pivot**.
  - This has led to many scholars abandoning the idea of the business plan altogether.

An Alternative Viewpoint-Effectual Entrepreneurship

The Effectual Entrepreneurship model was developed by Saras Sarasvathy. She studied entrepreneurship carefully and has criticized the causal process as much too deterministic. Life is simply not that orderly! She has proposed an alternative formulation that she terms "the effectual entrepreneur." In her formulation there are five major principles:

Bird in Hand – Who are you? What do you know? Who do you know? What do you have?

Affordable Loss –Limit risk by focusing on the downside and knowing what you can afford to lose when you go after the upside.

Lemonade – Use your lemons to make lemonade. Use the bad news as a clue to what might work in new markets.

Patchwork Quilt – Form partnerships. Working together can increase the probability of success through co-creation of new markets.

**Pilot in the Plane** –Control rather than predict. The future is created rather than found or predicted.

- http://www.effectuation.org/sites/default/files/documents/what-makes-entrepreneurs-entrepreneurial-sarasvathy.pdf
- http://www.effectuation.org/sites/default/files/documents/effectuation-3-pager.pdf
- http://www.imd.org/news/Creating-entrepreneurs-that-create-opportunities-the-Effectual-Entrepreneurship-textbook.cfm
- see also Effectual Entrepreneurship", by Stuart Read, Saras Sarasvathy, Nick Dew, Robert Wiltbank and Anne-Valérie Ohlsson Routledge Publishing; NY, NT (2010).

The Lean Launchpad

- Now we will introduce the concept of the lean launchpad, as it is used in the National Science Foundation I-Corps Program to encourage scientists and engineers to move their research into the market place through entrepreneurship.
  - http://www.nsf.gov/news/special_reports/i-corps/resources.jsp

- You will no doubt notice the similarities to the approach of Effectual Entrepreneurship and the conclusions that Steve Blank reached in the development of the lean launchpad.

- Sarasvathy is a scholar who has done a careful study and published her work in peer reviewed journals to be evaluated and perhaps substantiated (or refuted) by her peers. She refers to her model as "Effectual Entrepreneurship."

- Blank is a serial entrepreneur of some success who draw on his personal experiences and is a consumer of research rather than a producer. His formidable marketing skills have made the lean launchpad a hot topic around the world.
  - http://www.forbes.com/sites/steveblank/2013/06/18/the-lean-launchpad-educators-course/#df15d0d43a74

Steve Blank and the Customer Development Process

- Steve Blank became the leading apostle of business plan rejection about five years ago. In 2009 he wrote that "*In the real world, most business plans don't survive the first few months of customer contact. And even if they did – customers don't ask to see your business plan*. Steve advocated for the supremacy of business models and he enshrined the concept of the pivot as part of his mantra of the "**Customer Development Process**" with the concepts of

  - "*minimum viable product (MVP)*,"

  - "*iterate and pivot*",

  - "*get out of the building*," and

  - "*no business plan survives first contact with customers*."

- http://www.forbes.com/sites/steveblank/2013/06/18/the-lean-launchpad-educato
- http://steveblank.com/about/
- http://steveblank.com/2009/05/07/business-plan-competitions-2/
- http://www.businessinsider.com/the-lean-launchpad--teaching-entrepreneurship-   1-3
- https://www.udacity.com/course/how-to-build-a-startup--ep245
- http://www.entrepreneur.com/article/219772
- http://nciia.org/sites/default/files/u7/Educators%20Guide%20Jan%202014.pdf

Steve Blank says:

- After decades of watching thousands of startups follow this standard regimen, we've now learned at least three things:
  - As business plans are full of untested assumptions, they rarely survive first contact with customers. As the boxer Mike Tyson once said about his opponents' prefight strategies: "Everybody has a plan until they get punched in the mouth."
  - No one, aside from venture capitalists and the former Soviet Union, requires five-year plans to forecast a series of unknowns. These plans are generally fiction, and conceiving them is almost always a waste of time.
  - Startups are not smaller versions of large companies. They do not unfold in accordance with master plans. Those that ultimately succeed go quickly from failure to failure, all the while adapting, testing new iterations, and improving their initial ideas as they continually learn from customers.
- Existing companies execute a business model, startups search for one. This distinction is at the heart of the Lean Startup approach. It shapes the lean definition of a startup:
  - **a temporary organization designed to search for a repeatable and scalable business model**.

  - http://nciia.org/sites/default/files/u7/Educators%20Guide%20Jan%202014.pdf

Steve Blank looks at new ventures

- He sees them as something entirely different than existing ventures.
- Existing ventures EXECUTE a business model.
- New ventures SEARCH FOR a scalable and sustainable business model.

- Steve Blank: A startup is
  - a **temporary organization**
    - It either goes out of business or finds a solution that customers are willing to pay for.
  - created to **search**, explore, and validate an unmet need
    - The search requires making and testing assumptions and pivoting as you learn . Cycling through the assumptions and the testing is know as iterating.
  - **for a repeatable and scalable business model**
    - Once a sustainable business model is found, the venture is not a startup.

Lean Launchpad – A creative synthesis of research and intuition.

- To be fair to many others in the field, his insights into the shortcomings of the business plan were not entirely new and were probably more a reaction to the way the business plan had become unexamined enshrined dogma that hampered development rather than helped.
- The problem was not that doing a business plan was bad, but that too many people actually believed that the business plan was a realistic "plan" in the sense that large companies create plans.
  - Most of those who taught entrepreneurship already knew that the business plan was something that required regular testing and revision.
  - I often told my students that the last step in the development of ANY plan was to step back and ask yourself what you were going to do when the plan did not go as planned.
- Blank made the significant contribution of pulling together the alternate approaches, rebranding it, and it marketing it into key constituencies –with one of his students, Eric Reis.
- Their Lean-Launchpad model of entrepreneurship now bills itself as the "evidence based entrepreneurship" model and Blank has even trademarked the latter term.

NSF and the I-Corps Program

- The **National Science Foundation** embraced Blank's and Reis' formulation of new venture development when they launched their **I-Corps** program a couple of years ago. In many ways they viewed it as a more scientific approach to venture creation that used the method of hypothesis formation, quick testing, revision, further testing, and continuous refinement. Fields as disparate as science and creative writing would perceive this process as the continuous refinement of drafts while writing. It is indeed the way the world works. We build new models of anything we study as we find out more and more detail through research. And so it is with entrepreneurship.
    - http://www.nsf.gov/news/special_reports/i-corps/

- In the new model, the business model canvas, originally proposed by **Alexander Osterwalder** becomes the starting point. (See an example below)
- http://businessmodelgeneration.com/canvas

- This transition continues to play out in entrepreneurship education programs across the country –as well as at UMass. The most used textbooks are built under the old paradigm. Business plan competitions continue to be held in spite of Steve Blank's pronouncement that "*I hate business plan competitions*."

- Just as physicists teach Newton's Laws and the Einstein Theory of Relativity –which extends and alters Newton's laws, entrepreneurship education needs to introduce students to the process of business planning as well as the limitations and the alternative formulations, like Blank's, that have emerged.

- We also need to alert students to the danger of allowing any model (including Blank's) to morph into a dogma that could constrain innovation.

Technological Entrepreneurship

Inventions and applications of new technologies often change the world in very profound ways. The invention of the practical steam engine in 1765 James Watt drove the following industrial revolution and remade transportation systems eventually creating the steam ship and the steam locomotive. Like all inventors, Watt built on earlier, but less practical work by others like Newcomen and Savery. There was even a crude version of a steam engine created by the Greek scientist Hero of Alexandria in the first century CE.

- http://www.livescience.com/44186-who-invented-the-steam-engine.html
- http://www.history.com/topics/industrial-revolution

Like all technologies, before and since, there were those who resented and resisted the new ways. The Luddites in England often attacked factories and destroyed equipment. Today we often refer to those who resist new technologies as "**Luddites**."

In 1936, Charlie Chaplin, made a film depicting the challenges of living in "**Modern Times**" that captured the angst of those who found technological change difficult.

Today is no different.

Technological Entrepreneurship

Development of the first electrical generators, by Faraday and improved by others, was quickly followed by methods of distribution and widespread deployment of electrical motors and other systems. The world we live in was much shaped by these scientific discoveries.

http://instituteforenergyresearch.org/history-electricity/

The invention of radio by Guglielmo Marconi, an Italian Inventor, in 1895-1899, (also Nikola Tesla who got the first patent!) launched a new wave of technological entrepreneurship and this was quickly followed by the invention of television by Philo T. Farnsworth in 1927.

- http://inventors.about.com/od/rstartinventions/a/radio.htm
- https://www.nyu.edu/classes/stephens/History%20of%20Television%20page.htm

The automobile began in the late 19th century with steam power, but after Rudolph Diesel invented the first petroleum fired engine and Karl Benz used it to power an automobile, the automobile began to become more widespread. Henry Ford applied the principles of "**Mass Production**" to enable the automobile to be afforded by many. Mass production required that the product be very standardized in order to reduce cost and increase output efficiency. It was claimed that Ford said that you could "*have any color that you wanted –as long as it was black.*"

We will see that modern computing has helped to turn that paradigm around and now offer "**mass customization**."

Technological Entrepreneurship – Computing and Networks.

Two major related events have converged to create the boom in technological entrepreneurship in the 90's -which inflated a bubble that burst at the beginning of the new millennium, but which created a medium in which new kinds of industries grew to dominate our economy.

The first of those two events was the invention of personal computing marked by the introduction of the Apple II computer in 1976, created by Steve Wozniak in partnership with Steve Jobs, (https://en.wikipedia.org/wiki/History_of_Apple_Inc.) and the introduction of the IBM PC in 1981 created by a team of IBM "skunk works" engineers in a Boca Raton, FL site under Bill Lowe.
(https://www-03.ibm.com/ibm/history/exhibits/pc25/pc25_birth.html)
Most notably, the PC needed an operating system and, rather than license the popular CPM system, IBM contracted with Harvard drop-out Bill Gates to write a near clone of CPM.

The second event was driven by the first. Computers needed to find a way to speak to one another. Networking was created to allow them to communicate and then the internet was created (first as ARPAnet in 1969) by the Boston based BBN consultancy for the Defense Advanced Research Programs Agency (DARPA) in order to create a communication protocol that would allow worldwide communication that could survive even nuclear warfare. That network was then extended to the National Science Foundation and then became the internet we know today.

https://en.wikipedia.org/wiki/ARPANET

Do these people look like entrepreneurs?

← Apple Founders -1978
Steve Jobs and
Steve "Woz" Wozniak

Microsoft Founders -1978 ->
Top-Steve Wood, Bob Wallace, Jim Lane
Mid- Bob O'Rear, Bob Greenberg, Mark McDonald, Gordon Letwin
Front – Bill Gates, Andrea Lewis, Marla Wood, Paul Allen

The Boom in BioTech

Discoveries in the areas of biology, biochemistry, biophysics, and related fields have driven another wave of technological entrepreneurship.

Biotech: The High Stakes Table of Entrepreneurship

– "*Science and entrepreneurship are both acts of experimentation. Both involve taking risks to reach a positive end, changing course when needed, and attempting the never-been-done. While many start-ups now are focused on creating the next Facebook or some genius e-commerce play, there are also scientists tinkering in labs. Biotechnology is sometimes forgotten about, but the field leads to real products -- new drugs and medical devices that aid human health. Want to cure cancer? These people will be the ones to do it. Biotech is also risky. It's a high cost, high stakes field. These entrepreneurs ask for large sums ($3 to $5 million just to start) without knowing the final outcome. The visions are lofty -- eliminating rare diseases, shrinking tumors, curing cancers.*"

- http://www.forbes.com/sites/lorikozlowski/2012/03/23/biotech-the-high-stakes-table-of-entrepreneurship/#1a88ae6b40e9

Indeed the figure of $ 3 to 5 million is "just to start." Bringing a new drug to market generally reaches to single digit billions.

Internet start-ups can often be bootstrapped or begun with very low funding. Biotech start-ups require far more resource and are thus far more difficult.

Three technology advances that defined our present

- The incredible advances that we have seen in computing, communication, and cognition have been driven by three rules:
- Moore's Law
  - The number of components on a chip, and hence the computing power, doubles every 18 months.
- Metcalfe's Law (Network Economics)
  - The Value of a network scales as the square of the number of those connected to it.
    - Value: economic, personal, societal,....
    - Double the network = four times the value!
    - "network economics" or "network externalities"
  - Social media depends upon capturing the largest network. If you double your network, you quadruple the desirability of your social media network.
- Gilder's Law (Bandwidth deployment)
  - Bandwidth deployment doubles every 6 months (three times as fast as computing power doubles.
- More details on these three can be found at: http://www.jackmwilson.net/Entrepreneurship/Cases/Moores-Meltcalfes-Gilders-Law.pdf

The money flowing into new companies continues to accelerate

The steady return

US technology fundraising $bn
- Venture capital
- IPO

NASDAQ Composite index

THEGLOBE.COM IPO SEES VALUE RISE 606% ON FIRST DAY

GOOGLE REGISTERED AS A DOMAIN NAME

@HOME & EXCITE COMBINE, THE LARGEST INTERNET-RELATED MERGER YET

NASDAQ REACHES AN ALL-TIME HIGH

TECH BUBBLE STARTS TO BURST; "NUCLEAR WINTER" ENSUES

TWITTER IS FOUNDED

FACEBOOK IS FOUNDED

GOOGLE IPO

APPLE LAUNCHES IPHONE

GOOGLE LAUNCHES ANDROID OPERATING SYSTEM

AIRBNB IS FOUNDED

VENTURE CAPITAL FIRM ANDREESSEN HOROWITZ IS FOUNDED

UBER IS LAUNCHED

STEVE JOBS DIES

FACEBOOK BUYS WHATSAPP FOR $22BN

FACEBOOK IPO

TWITTER IPO

NASDAQ'S NEW PEAK

Sources: Bloomberg; Jay Ritter, University of Florida;
National Venture Capital Association/PwC; *The Economist*

*As of June 30th, estimate

Economist.com

http://www.economist.com/news/briefing/21659722-tech-boom-may-get-bumpy-it-will-not-end-repeat-dotcom-crash-fly

Recognizing Opportunities and Generating Ideas.

Where do opportunities start

- Technological opportunities almost always start with breakthroughs in new technologies. Those breakthroughs can come from:
  - University research labs
  - Industry research labs like Bell Labs, Google Labs, IBM Labs, General Electric Labs, Phillips Research Labs, Microsoft Labs, Amazon, Pfizer, Novartis, Sanofi,etc.
    - Industrial laboratories are generally seen as sources of incremental innovation rather than radical innovation.
      - http://www.jstor.org/discover/10.2307/1828511?uid=3739696&uid=2129&uid=2&uid=70&uid=4&uid=3739256&sid=21104913961097
    - Over the last three decades, the center of gravity of research has shifted further toward universities and away from industrial laboratories.
    - The biotech industry has been an exception –particularly in the applied research areas.
  - Government research laboratories like FermiLab, Argonne National Laboratories, Sandia, National Institutes of Health, National Institute of Standards and Technology, and others.
- To get to market they need to either be **licensed** to existing organizations or used to develop **new ventures**.
- Students who graduate and then go into existing organizations also carry the intellectual property with them into their new positons. This is an important flow of ideas into the marketplace or community.

From Idea to Market or Community Use

Idea Generators: University Research, Corporate Innovation, Individual Invention, Government Labs, Social Innovation, Intellectual Capital

Patents

Entrepreneurial Process

Licensing

Flow of Human Capital: Students or Employee migration

New Ventures

Communities and Markets
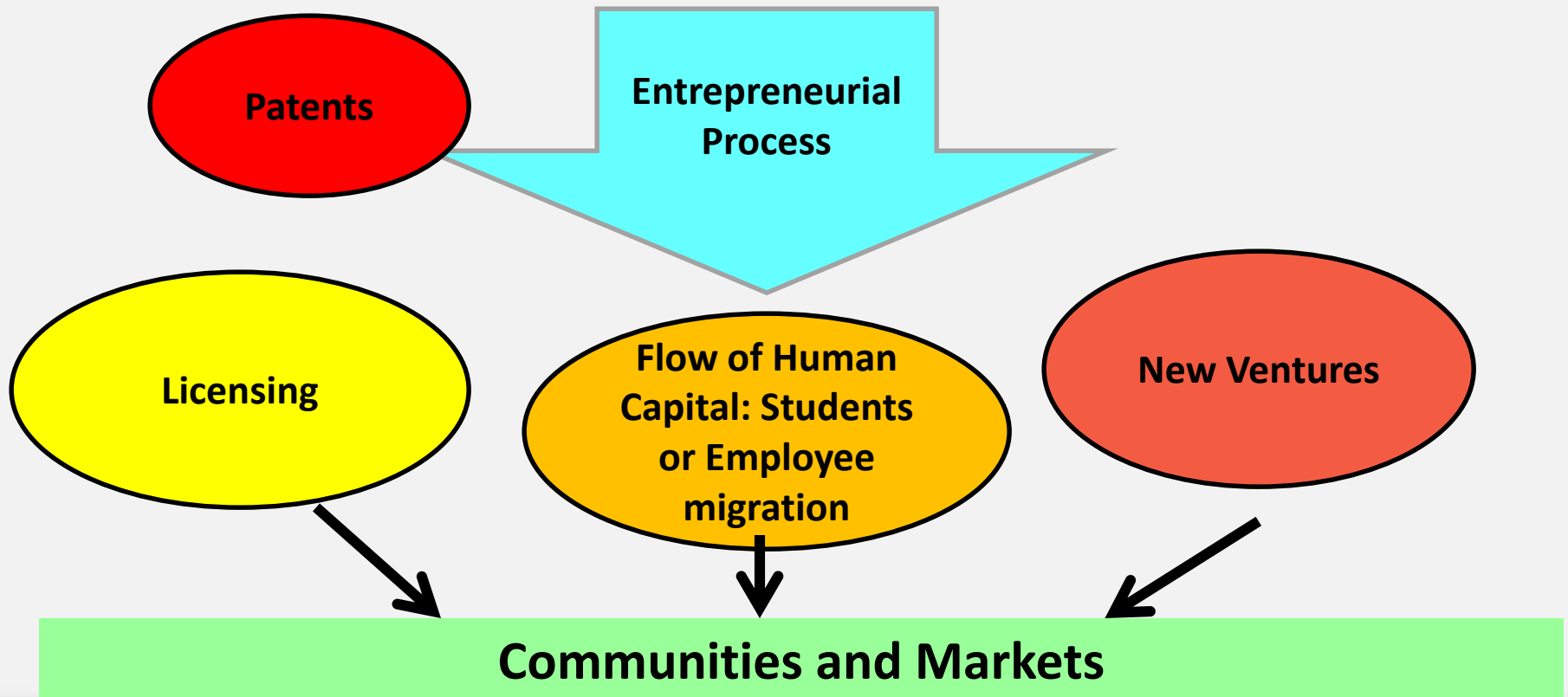
From Trends to Opportunity

- An opportunity takes advantage of the pressures exerted by economic forces, social forces, technology, and political forces

Economic Forces
economy
income
spending

Social Forces
social-cultural
demographic
trendiness

Technology
new
emerging
new use for old

Political Forces
political arena
regulatory

Gap
Business, Product, Service
available vs possible

New
Business, Product, Service
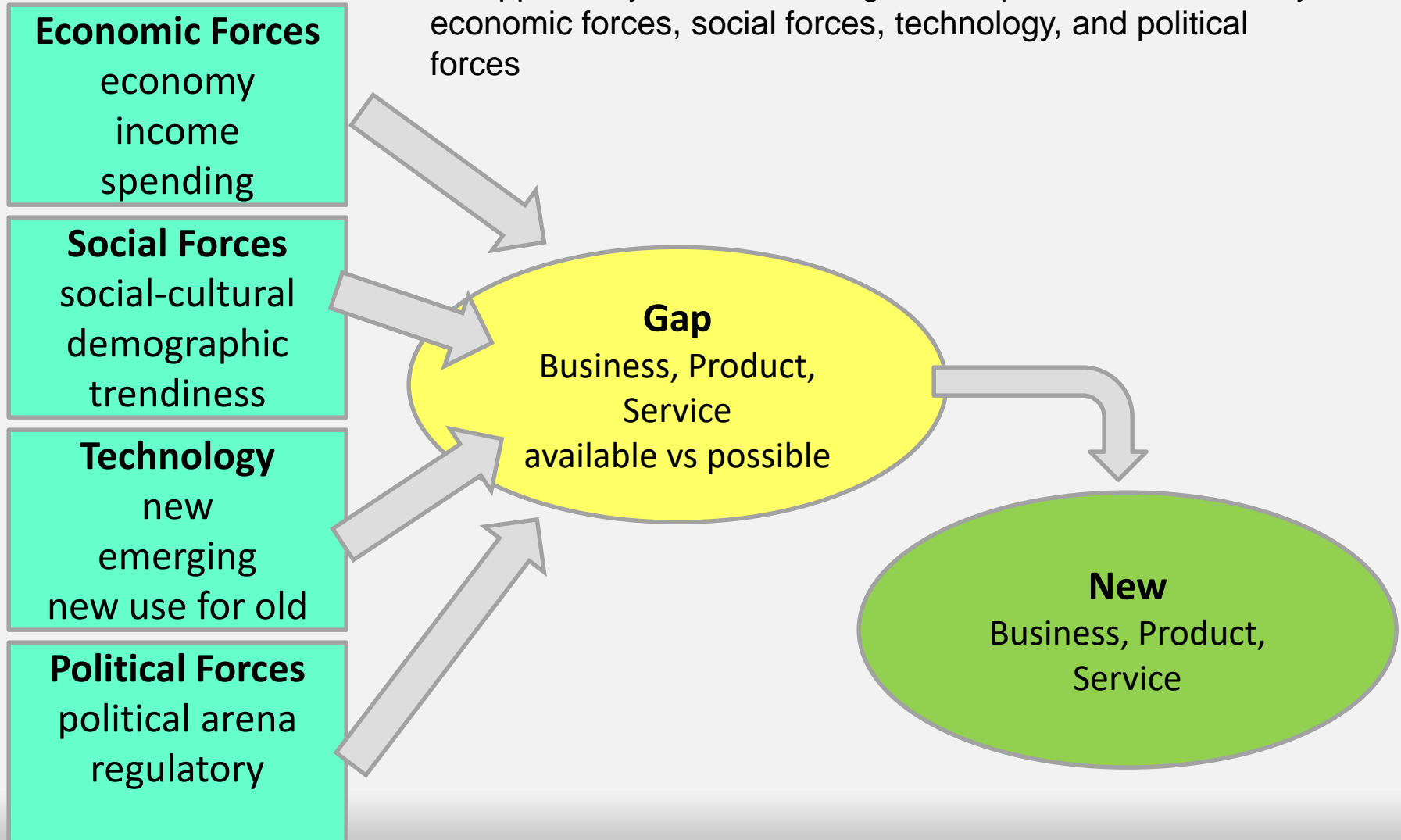
Tesla Motors -all electric high performance cars

- Economic Trend – increasing gas prices
- Social Trend –desire to be green
- Technology Advances –Battery and motor improvements
- Political Regulatory Trend – favorable treatment and support for alternative energy systems.

Nonspec -A student generated company

- Nonspec (previously known as Developing Nation Prosthetics) provides low cost, high functionality replacement limbs with an acceptable amount of customization for children in other nations.

- The team consists of Katherine Cain, Jonathan De Alderete, Brendan Donoghue, Sean Gibson, Olivia Keane and Erin Keaney with majors in plastics and mechanical engineering, as well as minors in business administration and history.

  - https://www.uml.edu/Innovation-Entrepreneurship/DifferenceMaker/Meet-the-DifferenceMakers/DM-Nonspec.aspx

SPORTS — PAGE 11   LOCAL — PAGE 3

THE ☀ SUN

WEDNESDAY

$1.00   June 10, 2015 Lowell, Massachusetts

Two floors, no ceiling on invention

UML business incubator opens in rehabbed canal district building

By Robert Mills
rmills@lowellsun.com

LOWELL — Catherine Pujol-Baxley started on Tuesday about 9 a.m., the first scientist to work in the new research space at UMass Lowell's business incubator in the Hamilton Canal District.

The incubator is the first commercial property to open its doors in the Hamilton Canal District, a prominent part of the city at the edge of the downtown, long home to little but abandoned buildings and vacant lots. It makes its home on the top floor of the former Freudenberg Nonwovens mill at 110 Canal St.

Pujol-Baxley is director of research and development for KnipBio, a start-up that is engineering micro-organisms to improve the quality of food used in aquaculture, also known as fish farming.

UMass Lowell leases the top

A PLACE TO EXPLORE: Erin Keaney, co-founder and CEO of Nonspec, and Brendan Donoghue, right, a 2015 UML graduate who is an intern at Nonspec, show a prosthetic foot to UMass President Emeritus Jack Wilson at UML's new incubator at 110 Canal St.

Below, from left, Steve O'Riorden, UML associate vice chairman for financial services, UML Government Relations Associate Colleen Brady and Director of University Events Rick Sherburne take in the view.

SUN PHOTOS / JULIA MALAKIE

two floors of the building, with 11,000 square feet of space on each floor meant to help grow start-ups in the biotech and medical-device fields.

The facility is home to two separate but related programs — the UMass Lowell Innovation Hub, on the fourth floor, and an extension of the university's Massachusetts Medical Device Development Center,

Please see **INCUBATOR/10**

Global Entrepreneurship

- Global Entrepreneurship has flourished over the last 50 years. Major changes in world governments, economic systems, and cultural interactions have created an environment in which entrepreneurship has become a significant factor in regional economic development, global geo-politics, and even cultural change.
- There have been three significant issues that have enabled much of this innovation.
  - The incredible advances in technology –particularly in computing and the internet, but also in the life and medical sciences.
  - The dismantling of barriers to trade and the movement of goods and ideas across borders that has found expression in world trade organizations like the WTO and in multi-national trade agreements like the European Union (EU), North American Free Trade Agreement (NAFTA) and many others.
  - The opening of borders to a much freer movement of people who emigrate and immigrate to find better opportunities in education and employment.

ILinc –LearnLinc:
A case study

Dr. Jack M. Wilson

Distinguished Professor of Higher Education, Emerging Technologies, and Innovation

Here is what an instructor using Ilinc software sees. The left side displays a list of students logged on, command buttons for turning the floor over to a student, and a dialog box for typing messages to an individual student. The right side is where the teacher guides the students through presentations via an application like a browser.

Opportunity Recognition

- Solving a problem
  - Every problem is a brilliantly disguised opportunity –Gardner

- A major problem in the 90's: The Learning Corporation
  - Rapid changes in technology, computers, the internet, globalization, and intense economic competitiveness were forcing companies to adapt. To adapt, their employees had to learn many new things.
  - Employee training is expensive –especially for large geographically distributed firms.
  - How could they provide rapid learning opportunities to employees without breaking the bank at a time when economic competition was ferocious?

- ## Do you think the pace of change is accelerating?

Market Value of Tech Companies

$ Trillions

Initial Development…	1967
University Networks…	1981
Regional Networks (NYSERNET)…	1988
Early ISP,s…	1992
World Wide Web…	1995

Microprocessor

PCs

Data Communications

Client/Server Software

Internet

Incl. Int'l Tech Companies

1970   1970s   1980   1980s   1990   1990s   2000
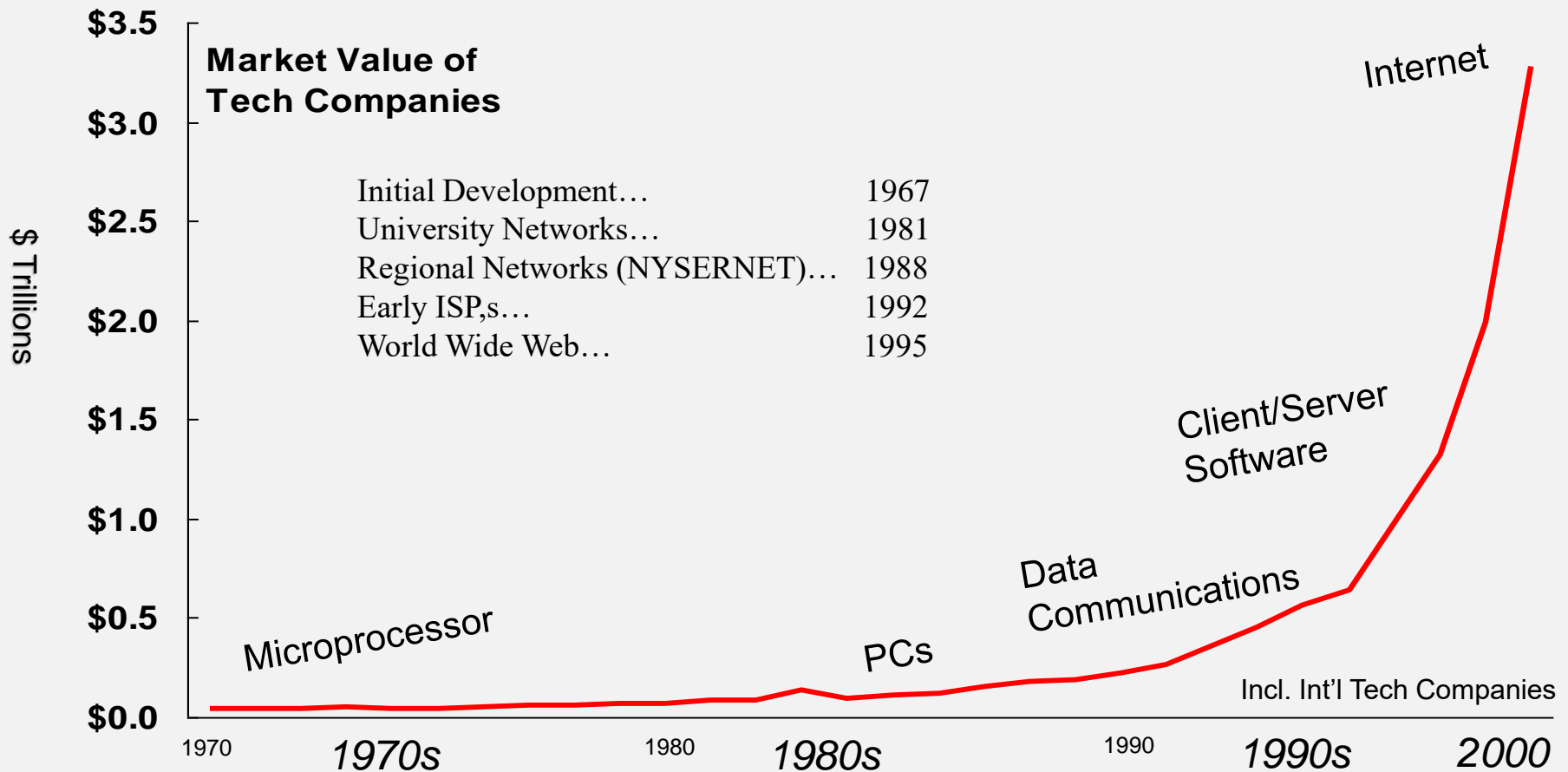
Source: Securities Data Company

Introduction

- The founding, growth and eventual acquisition of the ILINC Corporation is a typical small example of technological entrepreneurship.

- ILINC was founded in 1993 by a professor (the author) and two students at Rensselaer Polytechnic Institute.

- Later the name was changed to LearnLinc to match the name of its popular product and eventually

- LearnLinc entered a triple merger in early 2000 with Gilat Communications and Allen Communications to form the Mentergy Corporation (NASDAQ).

The Research:

- It all began with an idea, and that idea eventually became a research project.
- In the late 80's and early 90's, my scientific colleagues and I were working on the application of computing and communication technologies to science and engineering education.
  - After producing several multimedia projects, I turned my attention to the management of large quantities of educational materials on networks.
    - The early focus was on the modularization of materials and the ability to store and retrieve those modules in an object oriented fashion.
- In order to fund my research I had obtained research grants from the
  - National Science Foundation (NSF),
  - the Dept. of Ed. Fund for the Improvement of Post-Secondary Education,
  - The Research Corporation for Scientific Advancement,
  - the Annenberg/CPB Foundation,
  - The Sloan Foundation,
  - the AT&T Foundation,
  - Lucent Technologies,
  - The Defense Advanced Research Projects Agency (ARPA), and the IBM Corporation.

The Idea.   The Research

- Managing learning on networks
- Consulting with IBM, AT&T, GTE, Boeing, NeXT, Microsoft, Intel, etc
- I had served as an IBM Consulting Scholar and was a frequent speaker at conferences on multimedia on networks.
  - At one point I was invited to present my vision of the future of networked multimedia education to a group of executives that included several key executives from AT&T. That speech led to an invitation to Bell Laboratories to discuss potential cooperation and to present my vision to a broader and more technical audience.
- Apparently the speech was a great hit with the audience, because the AT&T Executives asked me to create a prototype of the vision -in partial collaboration with scientists from Bell Laboratories
- Joint Venture between AT&T Bell Labs and RPI
  - WorldWorx product released

- New technology releases allow a better idea.

The Opportunity

- Propose a significantly enhanced and advanced version to AT&T
  - AT&T declines
  - But Bell Labs excited!
- Research continues in Wilson's Lab
- Design and Manufacturing Learning Environment
- Degerhan Usluel, MBA student, BSEE, former entrepreneur
- Degerhan recruits Mark Bernstein, former CA "TopGun."
- They want to start company and want Wilson to lead it.
- Distributed learning environment with multicast video, application sharing, agents to control bandwidth.
  - None of these had been done reliably and internet was not ready.

The Team: ILinc LearnLinc Founders

- Degerhan Usluel,   Mark Bernstein,   Jack Wilson

Chief Technology Officer

Vice President Marketing

Chairman and CEO

Exit Strategy

- Need to decide ahead of time how we wanted this to end.
  - Private Company
  - Public Company
    - IPO or acquisition
  - Life Style Company

- We all wanted to create a public company and either IPO or Sell.

ILinc Business Model Canvas

Key Partners	Key Activities	Value Proposition	Customer Relationships	Customer Segments
Microsoft – Early OS Intel – ProShare Video and Capital AT&T – Early OEM Customer CISCO – Router software	Create multi-cast video and audio conferencing to large #s Screen sharing Training Development tools Market to Fortune 500	Allow customer to provide "just in time training to large numbers of employees at a very low cost. Reduce employee down time (cost) for training. Improve quality and quantity of training. Reduce cost of training programs by eliminating travel and ending large corporate training centers.	Close partnerships with companies that want our software and are willing to help development. Early relationships with AT&T, IBM, Intel, News Corp. Business model is sales and customization of software for Fortune 500	Our most important customers are Fortune 500 companies with large training needs, large training expenses, and a recognition that success required the deployment of new technologies.
	Key Resources Early access to new hardware and software tech. Solving the video multicast problem. Deployment of networks with sufficient bandwidth. Customers who buy and test and fund early products.		**Channel**s: Direct sales to Fortune 500. First addressed the Corporate training dept. Pivot: Sell to CEO/COO/CFO Use Wilson's extensive corporate contacts to gain an audience. Presentations at large conferences like ComDex, Educom, etc.	

Cost Structure	Revenue Streams
Cost Structure: Costs are primarily personnel costs for a development team, a quality assurance team, and a sales/marketing team. Smaller expenses for leased office space, tech. acquisition (some provided by partners for free) Business is primarily value driven. Costs small in comparison to the saving of corporate expense. Because we have very low variable expenses, the ability to achieve scale will quickly lead to profits. Building ten thousand units of software is only marginally more expensive than building ten.	**Revenue Streams**: Sales of software in the form of corporate licenses to Fortune 500 firms. Software costs are small in comparison to training costs. Want revenue now in return for software later. A challenge in selling to trainers since this sidelined them and reduced their budget. Qui Bono? Executives with bottom line responsibility.

Intellectual Property

- The Team considered whether to patent the software or proceed while trying to make it a trade secret.

- Advantage of patenting
  - Protect our intellectual property from being copied.
  - Dissuade competitors.
- Disadvantages:
  - Could get to market faster,
  - patenting (and defending) is a long and expensive process.
 - Potential dispute with AT&T who had funded earlier project.

Creating a Prototype

- Need a prototype to raise money.

- Need a prototype to acquire early customers.
  - In order to create the prototype, we had to solve the problem of excess bandwidth on the network due to so many interacting individuals on computers. The primary problem was the video and graphics.
  - The problem was solved by creating agents to shut off video that was not being used and by making reliable IP multi-casting work.

- Need a polished pitch

LearnLinc

LearnLinc Instructor

Funding the Enterprise

- Met with many successful entrepreneurs
  - Bugle Boy, Wellfleet, Interlan, Bay Networks, Nortel, MapInfo, etc
- Went against advice
- Decided to sell vaporware.
- Success magazine called it the "Wimpy method"
  - Wimpy: "I'll gladly pay you Tuesday for a hamburger today!"
  - ILinc: "I'll gladly give you software next year for $300,000 today."
- Against all odds (and reason): It worked!
- First Customers: IBM, AT&T, GTE, Sprint, Office Depot, and News Corp.
- We also had received funding from the Air Force SBIR program.

Building the Product

- Degerhan actually conquered the reliable multicasting challenge and made the product work!

- Bernstein sold lots of vaporware.

- Every customer, except for one, was very satisfied.

A real classroom experience. Virtually.
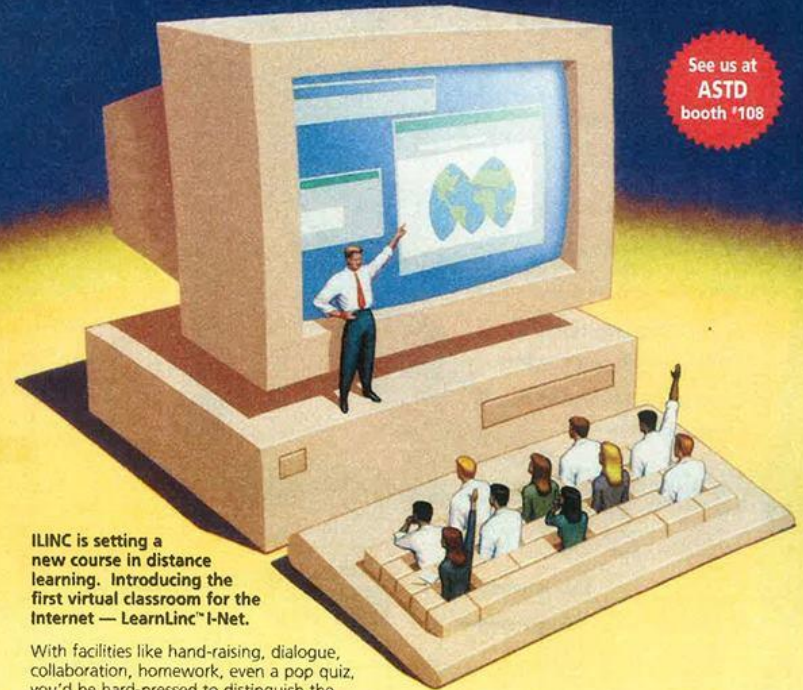
See us at ASTD booth #108

ILINC is setting a new course in distance learning. Introducing the first virtual classroom for the Internet — LearnLinc™ I-Net.

With facilities like hand-raising, dialogue, collaboration, homework, even a pop quiz, you'd be hard-pressed to distinguish the LearnLinc I-Net virtual classroom from the real thing.

Truth is, this award-winning software for distance learning is boosting retention rates and bottom lines around the world.

Only LearnLinc I-Net allows for instructor-led learning with synchronized multimedia and Web-based content. And with text chat, shared whiteboard, and flexible floor controls, you've got a host of tools to maximize your training.

Plus, LearnLinc I-Net runs over the Internet or your corporate intranet. So it offers easy access to students, either at home or at work, with just a PC and phone line (or any number of audio/video options).

The classroom is virtual, but the results are concrete. You'll reach more students with the best instructors, cut costs, eliminate travel, reduce workflow interruptions, and boost the learning power of your people.

For a **FREE** Internet demonstration of how our virtual classroom can save your organization time and money, call ILINC at **518-283-8799** for the name of a LearnLinc Reseller near you.

LearnLinc I-Net is shipping. Today!

LearnLinc I·Net
The first virtual classroom for the Internet.

ILINC Setting a new course in distance learning.

Visit our web site: www.ilinc.com

FOR MORE INFO, CIRCLE # 166

Winning Many Awards

Venture Capital

- Once company was up and running, we were short of working capital and tired of co-signing bridge loans!
- First Round of Venture Capital:
  - Exponential Investors and New York state development fund.
- Board asks Wilson to leave RPI permanently to continue as CEO of ILinc.
- Instead Wilson hires a new CEO who would bring advanced start-up experience.
- Second and Third Rounds of Venture Capital:
  - GeoCapital Investors, Intel, and original investors.
- Total outside investment was less than 50% of the company.
  - Very rare, but left the company short of cash compared to new arrivals.
  - We were using the old model. They used the TechBoom model.

Intel Invests millions

- I made a presentation to Andy Grove, CEO of Intel, at their headquarters. They told me that I would only have ten minutes to present and answer questions and then he had to run to another appointment. He ended up sitting down and spending a fascinated hour with me exploring the software.

- They then made their investment.

- Here is Andy Grove with Mark Bernstein when he presented the ILinc software at a major conference before thousands.

Fortune Magazine on ILinc:

- "Interactive Learning International Corp. (ILINC), a two-year-old company in Troy, New York, has shown what's possible in today's world of limited telecommunications bandwidth. ILINC's interactive training programs can be transmitted to users' PCs over local- and wide-area networks, as well as high-speed communications links such as ISDN (integrated services digital networks).
A live instructor can appear in a window on the screen and address students in dozens of locations. He can launch video and audio clips for all the "class" to see and hear. And at discussion time, a student can click on a "raise hand" icon to get the floor. "
  - REPORTER ASSOCIATE Alicia Hills Moore
  - *Copyright © 1996, Time Inc., all rights reserved.*

Wall Street Journal on ILinc -1998

- "It's great -- by using it, we've cut our travel expenses substantially," says Gary Schweikhart, a spokesman for Office Depot, an office-supply company in Delray Beach, Fla. Office Depot first took its corporate training sessions on-line in May 1996. It was one of the first customers of Interactive Learning International Inc., or ILINC, a Troy, N.Y., maker of distance-learning software. Since then, about 1,500 Office Depot employees have completed on-line training, on everything from how to write a business letter to how to use the company's proprietary order-taking system.

- "We were in a situation where we were doing a lot of training of trainers" in order to have enough qualified instructors to teach employees at 629 stores and 68 sales offices across the country, says Doug Kendig, the company's manager of training technology. "We had to deputize a lot of people [to train employees], and you don't always get the best results that way."

- But now Office Depot uses the ILINC software for about 20% of its training, with classes in Florida, California and Texas using just six instructors. "I think it's fantastic," says Jeannette Perez, who works in Office Depot's commercial credit-card department. "It just holds my attention more, because you're interacting with the computer."
  - Wall Street Journal –Thursday August 6, 1998

Going Public

- Rapid Growth meant much more capital needed.

- Arrival of several "fast-followers" meant that we had competitors nipping at our heels.

- Potential IPO was about $100 million.

- Acquisition was only about $50 million but could create some beneficial alliances.

- Investment Banker hired.

Mentergy formed

- With help of Investment Banker and VC advisors:

- A triple reverse merger.

- Sold control of LearnLinc to GILAT Communication of Israel and at the same time used LearnLinc to acquire Allen Communications, John Bryce Training, and GILAT itself.

- Closed deal on February 29, 2000 for $52 million.

- Combination called Mentergy
  - Value was $500 million in March
  - New York, Salt Lake City, Europe, and Israel.
  - Created headquarters in Atlanta
  - As tech bust came they entered bankruptcy in 2002.
  - Text: http://www.jackmwilson.net/ILincLearnLincStory-text.htm

Some concluding thoughts on teaching entrepreneurship

- Create an engaging learning environment by utilizing lectures, cases, activities, and even practical internships.

- Connect students to the latest ideas in models of entrepreneurship and innovation but caution them that this is a continuously evolving environment.
  - The ability to adapt (pivot in some case) is more important than a dogmatic adherence to any particular model.