Unbundling the University

Ben Reinhardt

February 2025

An extended essay attempting to synthesize the current zeitgeist around universities, our research ecosystem, and technological stagnation; to argue that at least part of the solution is to unbundle the societal roles the university has taken on; and to suggest some concrete actions.

Universities are a tricky thing. Almost everybody has at least one touchpoint with them: attending as an undergraduate, masters, PhD, or professional student; working at or with them; knowing someone who did one of those things; seeing or hearing "expert opinions" in media coming from professors; or perhaps seeing them as another world that many people pour time and resources into. Technology is similar in its many varied touchpoints with our lives (I'll get to the connection between the two in just a moment).

Across a broad swath of domains and political positions, there's agreement that:

1. Universities are important.
2. There is something amiss with universities.
3. Reform of some sort is needed for this important institution.

But there is strong disagreement about:

1. *Why* universities are important
2. *What* is amiss with them
3. *How* things need to change

It's a blind-men-and-an-elephant situation. Each of us is grabbing the part of a massive system that is closest to our lives and priorities. Some people see universities as doing a poor job giving students skills for successful careers; others see them abnegating their duty to provide moral instruction to future leaders; others see universities failing in their role of discovering true things about the universe playing out in the replication crisis and other scandals; from institutional politicization to insufficient political action on important issues, the list goes on.

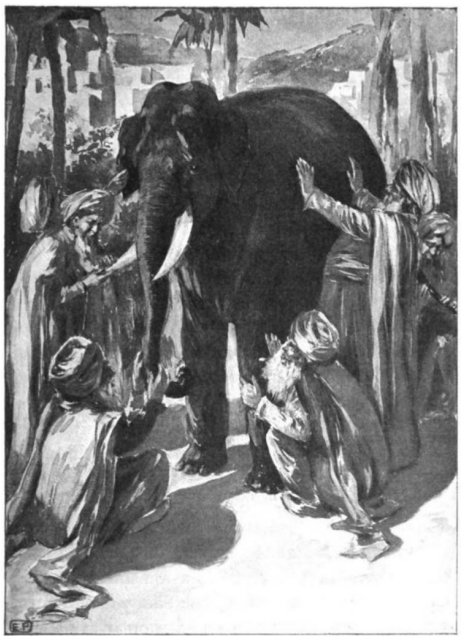


Figure 1: "I will never forget this indignity!"

The part of the beast that I grapple with daily is the university's role in "pre-commercial technology research" – work to create useful new technologies that do not (yet) have a clear business case. An abundant future, new frontiers, and arguably civilization itself all depend on a flourishing ecosystem for this kind of work. But in the years since we started Speculative Technologies to bolster that ecosystem and unlock those technologies, we have experienced first-hand a sobering truth: universities have developed a near-monopoly on many types of research. And, like many monopolies, they are not particularly good at all of them.

It's impossible to talk about any specific university issue without stepping into a much deeper conversation about the institution as a whole and how we got here. During the 20th and early 21st century, universities developed a monopoly on so many societal roles. These coupled monopolies mean that you cannot fix any specific problem without touching many others at the same time. Those changes require understanding the roles that have been bundled into a single institution, their particular pathologies, and how they play tug-of-war with the university's incentives.

There is no single solution here. Silver bullets don't kill wicked problems! But there is a meta-solution: *unbundling the university.*

For those not up on their Silicon Valley Jargon: you can think of universities as a massive bundle of societal roles — from credentialing agency to think tank to

discoverer of the laws of the universe to generator of new technology. Unbundling means creating new institutions that are specialized to excel at small subsets of those roles.

However, the solution is *not* to raze the system to the ground: destroying institutions outright almost never works. Considering the historical longevity of universities and the Lindy effect, the odds are that Harvard will outlast the United States. Unbundling is arguably good for the universities themselves, enabling them to focus on the things they are best at. (Of course, reasonable people disagree about what those things are!)

To be explicit, the point of this piece is severalfold:

1. To try to synthesize the different viewpoints on the university.

2. To argue that the university story is intimately coupled to the technology stagnation story.

3. To create a big tent among the different groups of people who care about the different aspects of #1 and #2.

4. Finally, to suggest a path forward.

We'll follow a path that looks a bit like the "machete order" of Star Wars:

- Part 0 is an executive summary — laying out the core thesis for busy people.

- Part 1 is about pre-commercial technology research: what it is, why it's important, the ways that academia has created a stranglehold on its creation, and why that's bad.

- Part 2 jumps back in time to see the backstory of the university, how it ended up in this monopoly position, and how it's taken on so many important societal roles.

- Part 3 explores possibilities for the future.

0. Executive Summary

21st century universities have become a massive "bundle" of societal roles and missions — from skills training to technology development to discovering the secrets of the universe. For the sake of many of these societal roles and arguably for the sake of the universities themselves, **Universities need to be unbundled** and in particular**, we need to unbundle pre-commercial technology research from academia and universities.**

Universities have been accumulating roles for hundreds of years but the process drastically accelerated during the 20th century. (For an extended version of this story, see section 2.) A non-exclusive list of these missions might include:

- Moral instruction for young people
- General skills training
- Vocational training for undergraduates
- Expert researcher training
- A repository of human knowledge
- A place for intellectual mavericks/ a republic of scholars
- Discovering the secrets of the universe
- Inventing the technology that drives the economy
- Improving and studying technology that already exists
- Credentialing agency
- Policy think tank
- Hedge fund
- Sports league
- Dating site

- Lobbying firm
- Young adult day care

These different missions all come with money, status, and vested stakeholders. Money, status, and stakeholders in turn have created a self-perpetuating bureaucratic mess that many people are unhappy with for drastically different reasons. One point of agreement, regardless of which roles you care most about: Universities are no longer balancing these missions well.

"University issues" evokes many different things in different people's minds. Consider these stylized but true anecdotes:

> Alice went to grad school to advance clean energy technology. She spent five years doing work that was published in top journals but would never actually scale. The technology never left the lab.
>
> Bob enrolled to become a better thinker and engage with great ideas. He found adjuncts racing between campuses teaching standardized intro courses, while tenured professors focused on publishing papers nobody reads.
>
> Carol expected college to open doors to a career. She's now serving coffee while working on her second masters because she was told "your degree doesn't matter, just explore!"
>
> Dave's breakthrough battery chemistry is stuck in tech transfer limbo. After 18 months of negotiations, the university still wants 30% equity and exclusive licensing rights. No investor will touch it.
>
> Eve spent her entire life striving to become a professor because she loved doing math and building experiments. She now spends 80% of her time writing grants, managing bureaucracy, and navigating university politics instead of thinking about physics.
>
> Frank joined a university to start an unconventional new research center after years working in the federal government. Clearly no stranger to slow-moving bureaucratic organizations, he rage-quit after six months because he couldn't get anything done.
>
> Grace joined a prestigious lab hoping to uncover the secrets of human nature. Instead, she spent three years optimizing click-bait paper titles and p-hacking results to maintain grant funding.

This situation grew organically through a series of steps that each made sense at the time: from "Universities are where the literate smart people are, so let's have them educate government administrators instead of just priests" to "the smart people at universities are pretty good at research and it's a war, so let's ask them to expand their scope" to "More and more people are going to college, so let's use graduating from college as a requirement for the large majority of

jobs." (For the full story, see section 2.) But like the peacock evolving to have such a heavy tail that it can't escape predators or the Habsburg Jaw, processes where each step makes sense can still lead to outcomes with a lot of issues.

Figure 2: There are reasons to avoid marrying cousins even if it keeps power in the family...

The university bundle is like expecting every coffee shop to also include a laundromat, a bookstore, and a karaoke bar. There's nothing *wrong* with a laundromat-coffeeshop-bookstore-karaoke bar, and in fact, that may even be exactly what some people want. The problem is that when *every* coffee shop is also a laundromat, bookstore, and karaoke bar, it's hard to imagine them making the best coffee they possibly could. Furthermore, there's work that someone might want to get done in a quiet coffee shop that's hard to do over blasting karaoke music and bad singing; water from leaking washing machines might damage the books, the people waiting for their laundry might ruin the vibe for karaoke singers; and a host of other problems, big and small.

The solution isn't to shut down all the laundromat-coffee shop-bookstore-karaoke bars or make a law that nobody can serve coffee in the same building as a laundry machine. Nor is the solution the common sentiment: "ah, if only we created a *new* laundromat-coffee shop-bookstore-karaoke bar that prioritized the function *I* care about." Instead, we need to encourage people to start places that just serve coffee or just do laundry (or just sell books *and* make coffee but *not* laundry).

For the sake of education, science, and culture, we need a diverse ecosystem of institutions. This ecosystem probably includes universities, but prevents any specific monoculture.

The right mix is probably impossible to know *a priori*. The unpredictability of the new ecosystem is a feature, not a bug; underspecification leaves room for people to try all sorts of experiments. Just for discovering the secrets of the universe you can imagine all sorts of institutions: one rewards the wackiest ideas, one prioritizes just trying stuff really fast, and one is set up to do work that only has external milestones every 100 or more years. Now imagine that for roles from credentialing to education to skills training.

It's fine and good to say "unbundle the university" but *what does that mean concretely?*

There is a whole laundry list of things that will enable other institutions to spring up that *you* can do in many different institutions: from private companies to foundations to governments to your capacity as an agentic individual. Here are some, but nowhere near all of them:

Things organizations (governments, foundations, etc) can do:

- Stop requiring university affiliations for grants.
- Reduce cycle times for funding research.
- Experiment with how universities are run.
- If you have access to spare physical resources like lab spaces or machine shops, make it possible for unaffiliated people to use them.

Things individuals can do:

- Judge people on portfolios, not degrees.
- Give people a hard time for getting unnecessary degrees.
- Focus on how effective organizations are at achieving their stated goals instead of assuming that "the Harvard Center for Making Things Better" is actually making things better even though it's in the name and it has fancy affiliations and lots of money.
- Celebrate institutions and individuals who support weird institutional experiments.
- Create ways for people to learn about culture and the humanities outside of universities.
- Simply stop expecting universities to be the solution to society's ills.

On top of interventions to clear the way for new institutions, unbundling needs people to build genuinely new ways of fulfilling roles that we have heaped onto universities. Think of how Oracle succeeded by specializing in building databases that were just one part of IBMs business and a thousand other examples. These institutions will take many forms: from informal groups to high-growth startups to open-source projects to ambitious nonprofits.

Unbundling pre-commercial technology

While it's not clear what roles should or should not be bundled together, I *am* confident that **pre-commercial technology research** can happen much more effectively in a new institution. Academia's core structures and incentives revolve around education and scientific inquiry, not building useful technologies.

Quick aside on definitions: 'Pre-commercial technology research' is a nebulous term I'm using for work that is intended to create useful technologies but is not a good investment (yet or ever). To a large extent, this is synonymous with work to bridge the 'Valley of Death' between initial work to create a technology and making it into a commercial product. Note that there is lots of research that isn't pre-commercial technology: academia can be good for many inquiries into the nature of the universe. (For a much more thorough explanation of pre-commercial technology research see Section 1.)

Let's look at a specific situation: trying to spin up a program to unlock technology for pulling CO2 and methane out of the atmosphere and turning it into useful complex stuff. (This is a thing we are trying to do at Speculative Technologies, so this isn't just a made-up example.) If we were able to do this, it would enable us to make all the great things we make out of petroleum (plastics, drugs, commodity chemicals) but without the petroleum. This work makes no sense as a startup because it requires a big chunk of up-front research but the chemicals are incredibly low margin. The actual work entails things like finding and engineering the right enzymes, figuring out how to get them working in a continuous flow system, etc. There are about five independent projects that need to happen, each requiring specialized skills and millions of dollars of equipment. Unless you want to buy all that equipment and hire all those specialists, the only place you can turn to is university labs.

But then here's a laundry list of things you then need to do just to get a program like this going:

- First, you need to negotiate with five different professors, none of whom are actually going to be doing the hands-on work and will probably spend at most 20% of their attention managing the project. Those professors' incentives are to get tenure, fund their labs, graduate their students, and publish discrete chunks of work that their community finds new and interesting, in roughly that order. Maybe they have ambitions of doing work that could turn into a company, but none of those priorities are

"make the bigger system work."

- Once things are hashed out with the professors, you need to negotiate with the universities. Chances are that you will need to negotiate with several different parts of each university — the tech transfer office, the grants office, and the general counsel. This can take months and thousands (tens of thousands?) of dollars of legal fees. the univeversities' incentives are to avoid being sued, to follow policy, and get paid – in that order. Many universities default to charging more than 30% overhead (which means that the university gets 30 cents for every dollar that goes to research), and demand ownership over any resulting intellectual property.

- Assuming you can actually get everything settled with five universities and five professors, you then need to wait for the professors to hire the grad students or postdocs who will do the actual work. If you're lucky, a professor has just taken on someone who doesn't have a project, but it might take until the next crop of grad students is admitted in almost a year.

Once the work finally starts months or years later:

- You will constantly need to course-correct teams that want to go down the "most interesting" path. A grad student may discover that an enzyme they were trying to get to regenerate ATP 10% more efficiently (which is critical for the whole system to hit a reasonable efficiency) exhibits some strange behavior and spend weeks down a rabbit hole figuring out why and then writing up a paper about it. There's nothing wrong with pursuing things because they're interesting! But it can be detrimental to bigger goals when you're creating new technology in coordination with a number of other groups.

- You'll inevitably need to adjust timelines for a thousand possible reasons: graduate students graduate, postdocs get permanent positions, or professors shift focus for months at a time to get a paper out, teach, or serve on committees.

Now imagine that the projects have hit their goals and you want to actually get the technology out into the world to have an impact:

- The graduate students who actually did the hands-on work need to get their professor's permission to continue it outside of the university.

- The professor (who spent less than 20% of their time on the program) is unlikely to leave the university to join the company, but they are likely to want a significant chunk of equity and the ability to have a say in the company's operations.

- The university's technology transfer office will want their pound of flesh:

either large licensing fees or a chunk of equity in any resulting companies. Even if you contract with the university to have access to the technology, the university still owns it and any organization that uses it will need to license it from them. The technology transfer office will probably demand upwards of 10% or more equity in a company. Normally, you sell ownership stake in a company for money you can use to build the company, so having a chunk of it gone from day one without any money in the bank makes it that much harder to raise money. Unlike VCs, the people at the tech transfer office don't actually make more money if the company becomes super valuable, so they don't have strong incentives to see spin-out companies actually succeed.

- Now repeat that process several times. Remember, the work happened across several different universities and labs because most technologies are *systems* with different components requiring different technical expertise that all need to work in concert.

Suffice it to say: we have not succeeded in building technology for pulling CO2 and methane out of the atmosphere and turning it into useful complex stuff. There are versions of this story across so many of the roles that universities have taken on.

This is what happens when we allow the world's most bureaucratic institutions to gatekeep the future of civilization.

More abstractly, here's a non-exhaustive list of the ways that academia is misaligned for pre-commercial technology research:

- **Training academics and building technology effectively are at odds.** Having trainees – graduate students and postdocs – do the majority of the work on the knowledge frontier is great for their education (and the pocketbooks of everybody involved except the trainees) but it is at odds with building useful technology. A company where most of the code was written by interns would quickly go out of business, even if they were being supervised by senior engineers. In addition to their inexperience, graduate students have naturally high turnover; they can take years to get up to speed and tacit knowledge is constantly lost. Furthermore, academic labs have no incentive to increase productivity because a lot of research funding is earmarked for training: productivity comes from investing in technology to decrease the number of people you need to do work, which isn't something you do when you have a lot of funds earmarked for heavily subsidized labor.

- **Academia incentivizes new discoveries, not useful inventions.** Academic incentives are built around scientific inquiry to discover the secrets of the universe. These incentives are direct descendants from natural philosophy. As a result, academia incentivizes novelty, discovery, and general theories over usefulness. Paper and grant reviewers ask "Is

this idea new? Does it generalize?" not "Does this scale or work well in the specific case it's built for?" Academic incentives are great for discovering the secrets of the universe, but not for building powerful technology. Often the work that makes a technology actually useful is just elbow grease and trying tons of things out in a serious context of use, long after you've discovered the new thing. This work is something no tenure committee or journal cares about.

- **Academic incentives make large teams hard.** Successful professors and grad students need to build a personal brand by being first (or last, depending on the field) authors on papers. Awkwardly, there can only be one first author.[1] Large academic teams can certainly happen, but it requires pushing against all the incentives the system throws at you. Building useful technologies requires teams with many specialties working together without worrying about who gets the credit.

- **Universities have become a bureaucratic mess.** Arguably, universities have become the most bureaucratic institutions in the world; I know several people who have worked in both government and name-brand universities; they say things move more slowly and it's harder to get things done at the latter. A back of the envelope calculation suggests that there are as many non-medical administrators at Harvard as researchers. Large bureaucracies make it hard to move fast and do weird things, both of which are critical for creating new technologies.

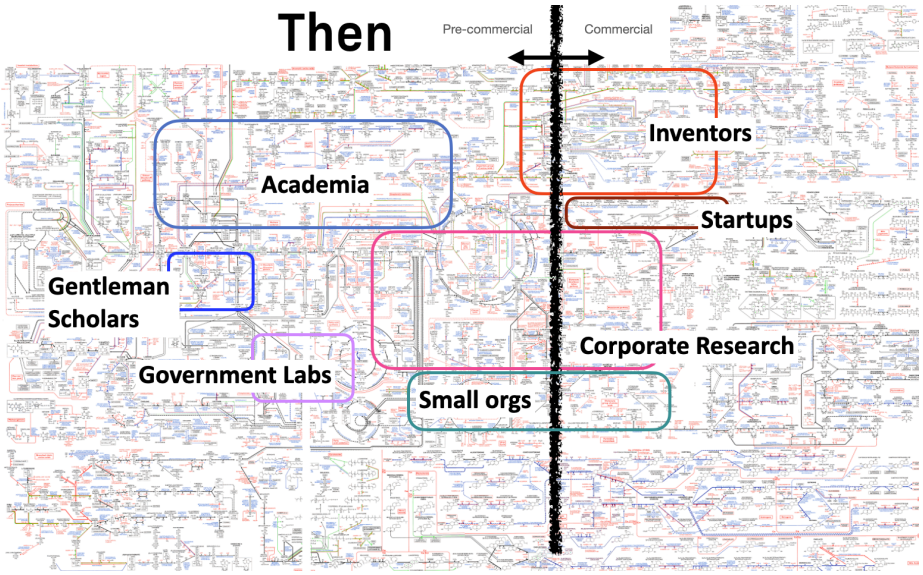
- **University tech transfer offices add massive friction to spinning out technologies.** With a few rare exceptions, universities own any IP that is created within their walls (even when funded with government or corporate money). This arrangement isn't necessarily bad (companies own the IP their employees create as well) but to get out into the world, that IP needs to go through tech transfer offices that have few incentives to actually help the technology succeed. Instead, tech transfer offices can drag out negotiations over draconian licensing terms for months or years. It would be one thing if universities depended heavily on tech transfer to support their other activities, but only 15/155 tech transfer offices in the US are profitable and even *Stanford* only made $1.1B *over four decades* in licensing revenue. At a global tech transfer summit a few years ago, only two of the top 30 tech transfer professionals at the meeting said generating revenue was a goal of the tech transfer office. Instead, 30/30 said the goal was the poorly-defined "economic development." It's a longer discussion, but the best way to achieve that goal may be to just shut down the office. Profit isn't everything, but it should be a major focus of an organization whose job is to spin out companies. These are not serious people.

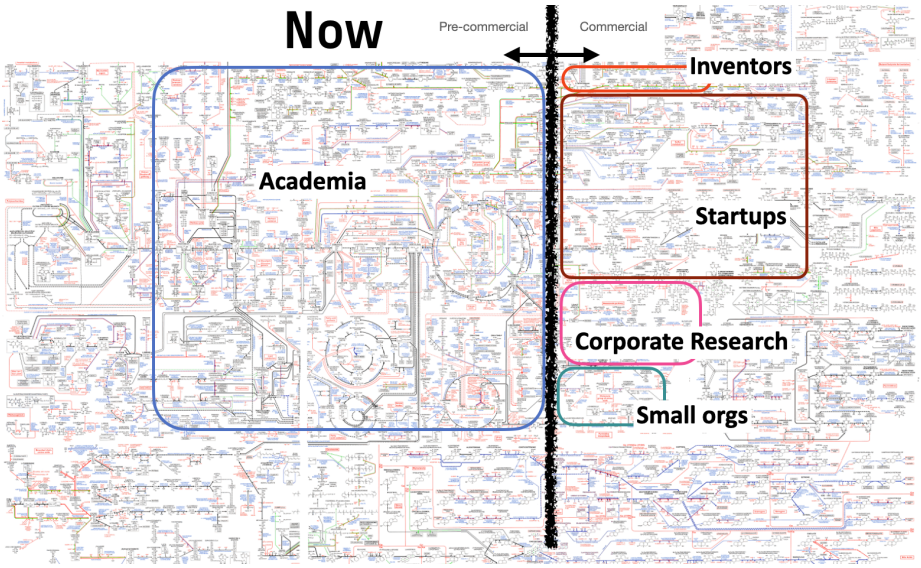
[1] Some fields have a custom of using an asterisk to denote "co-first authors," but everybody knows most of the time one person gets most of the credit and physically, one name will always be first.

(The list goes on but you get the idea)

The poor fit between academia and pre-commercial technology research wouldn't be such a problem if academia hadn't developed a monopoly on pre-commercial research over the course of the 20th century. Pre-commercial technology research once happened in the basements of inventors like Goodyear or Tesla, high-margin research contractors like BBN, and industrial labs like GE Research, Bell Labs, or Dupont Research. How academia gradually took over this critical ecosystem niche and why we can't just "RETVRN" is a complicated story of both government and market forces, pressures towards specialization and efficiency, and increasing technological complexity. The gutting of corporate research, disappearance of inventors, and decline of small research orgs is an involved story for another time.

In the world of laundromat-coffeeshop-bookstore-karaoke bars, the academic monopoly is like looking around the neighborhood and noticing "huh, there used to be a bunch of stand-alone karaoke bars but the big coffeeshop-laundromat chain came through, acquired all of them, and installed espresso machines and dryers."





What about non-university research institutions? There are lots of non-university research organizations ranging from the Broad Institute to the Naval Research Lab. Without students, it's natural to expect them to avoid many tensions that hamstring universities. While they do remove teaching loads and some bureaucracy, the reality is that they're still subject to many of the incentives that make universities a poor place for pre-commercial technology research. Many organizations are attached to universities at the hip — it is common for non-university research organizations to have university-affiliated professors as primary investigators or be actively administered by a university, like many of the national labs. Even within research organizations that have no affiliation with a university, researchers often see academics as their primary peers; in many cases, the role of professor is still the highest status thing one can aspire to. As a result, people still play the same games as academia – scoring points for novelty, discovery, and papers.

The reality is that it's very hard for individuals and organizations to avoid interfacing with academia if they have an ambitious pre-commercial technology idea. If you want to work on a technology idea that isn't yet a clear product, you need to either be in or partner with academic organizations for equipment, skills, or status. That, in turn, means slogging through all those adverse incentives and bureaucracies.

Many people have (correctly) noticed that many of the problems in our research ecosystem are driven by incentives: from p-hacking and fraud to citation obsession, incrementalism, and intense bureaucratization. But most of the solutions unavoidably involve academia: new institutes are housed at universities or have principal investigators (PIs) who are also professors; new grant schemes, prizes or even funding agencies ultimately fund academics; the people joining new fields

or using new ways of publishing are ultimately still embedded in academia.

Academia's monopoly means that shifting incentives in the research ecosystem is incredibly hard because most interventions don't change who is doing the actual work and what institutions they work for.**Changes to the research ecosystem are bottlenecked by where the work is done.**

Most new research orgs still depend on people working in university labs to do the hands-on research because there are many reasons for working with universities: universities have a lot of (often underused) rare or expensive equipment; universities are staffed by graduate students and postdocs, who provide cheap labor in exchange for training; universities are where the people with experience doing research are. Spinning up a new research institution from scratch is slow and expensive. Hiring people full-time can lock you into research projects or directions.

The advantages to working with universities were why when we first started Speculative Technologies, we sought to emulate DARPA's use of exclusively externalized research. However, we've come to realize that *it's incredibly hard to do work that doesn't have a home in existing institutions by working exclusively through existing institutions.*

In retrospect, "duh."

The academic monopoly on pre-commercial research has created a bonanza of *research misfits*: people and technologies with incredible potential who are poor fits for the academic system. These are the same people and technologies that historically have unlocked new industries and material abundance: Many

't%20get%20an%20academic%20job.,on%20to%20chair%20the%20BBC.Nobel prize winners and world-changing technologists have asserted that that they wouldn't have been able to do the work they did in today's system.

Yes, we continue to invent, but how many Kaitlin Karikós *didn't* persevere under similarly adverse circumstances. Is it possible that ever-decreasing research productivity is not because ideas are getting harder to find, but that we just keep injecting more friction into the system?

Speculative Technologies needs to be a home for these misfits. Research misfits need an institution that drives towards neither papers nor products, but instead focuses on *building useful, general-purpose technologies* without being wedded to a specific way that they get out into the world. Sometimes papers are best, sometimes products are best, sometimes none of the above.

Building a home for research misfits

There are at least two ways we are thinking about building a home for these misfits. (Note that these are things we're actively working on making a reality – if you want to help please let us know!):

- **A Hardcore Institute of Technology.** Counterintuitively, the way to train hardcore scientists and technologists is not to build yet another school; instead, you start by building a research lab for experienced misfits that is working on real, serious problems. You then start bringing in "journeymen" who have some training or experience. A bit later you bring in "apprentices." These folks are the equivalent of undergrads and grad students, but there's no grades, no degree, and no accreditation; just experience and trial by fire. This would be like the navy seals of technical training – you know that anybody who comes out of this place is the best of the best. Think about it: portfolios are starting to matter far more than credentials and certain companies are now far better indicators of quality than schools – a successful tour of duty at SpaceX has more signal than a degree from MIT.

- **A crucible for new manufacturing paradigms.** The US industrial base has been hollowed out. The way to manufacture things cost-effectively in the US won't be to try to out-China China – they've gone so far down the learning curves with current paradigms. The way you compete with an entrenched player is to change the game and leapfrog paradigms: minimills were a new paradigm for manufacturing steel that at first produced an inferior product, but new technology allowed it to take huge market share from traditional steel manufacturing and do it in new places. Similarly, cell phones enabled internet access in Africa and other places without requiring desktops; digital payments leapfrogged credit cards, submarines leapfrogged battleships, the list goes on. Successful American manufacturing in the 21st century won't look like American manufacturing in the 20th; it will be based on entirely new paradigms. Creating these new paradigms requires more than just startups creating point solutions – it needs systems-level research happening in tight communication with existing industry. In other words, an ambitious industrial research lab focused on *building useful, general-purpose technologies* and getting them into the world.

All of this requires physical spaces decoupled from the constraints of academia, startups, governments *and* big corporations. A place for people with brilliant ideas to build atom-based technologies that won't necessarily work as high-margin startups; to start projects that don't necessarily fit into a specific bucket. These projects could evolve smoothly into bigger programs, baby Focused Research Organizations, or nascent companies; all united by a common mission to unlock the future.

Conclusion

Speculative Technologies' core mission is *to create an abundant, wonder-filled future by unlocking powerful technologies that don't have a home in other institutions.* Since we launched in 2023, we've learned a lot about what is broken in our research ecosystem and how we can best execute on that mission.

One big thing we have realized is the blunt fact that over the past 50 years,

universities have developed a near-monopoly on many types of research and, like many monopolies, they are not particularly good at all of them.

Pre-commercial technology research is clearly not the only thing that needs to be unbundled from universities — the world needs new institutions for doing everything from credentialing to vocational training to discovering the secrets of the universe. It *is* the place to start because it's one of the poorest-fitting stones in the wall pieces and the upside of doing so is so large.

If you care about universities: Unbundling will not kill academia and universities, but save them. Ask any professor and they will tell you that they have at least 10 jobs, each of which comes at the cost of the others. In large part, these roles are downstream of the laundry list of roles bundled into a single institution. If you ask different people what the role of a university or professor is, you'll get many conflicting answers. Unbundling at least some of the roles would let the teachers teach, the inventors invent, and the scientists discover.

Pragmatically, it's also a bad bet to wager on destruction of one of the longest-lived human institutions. Harvard was here long before the United States and I will bet that it will be here long after. Instead, unbundling will put competitive pressure on universities to up their game and focus on what they're best at.

Regardless of your position, from deep institutionalist to radical revolutionary, it's clear that *something* needs to happen: unbundling pre-commercial technology research is a high bang-for-your-buck start.

Every week, I run into misfits with brilliant, potentially transformative technology ideas that are poor fits for either academia or startups. Giving those people and ideas a home and the resources to execute on those ideas is how we're going to play basketball with our great-grandchildren, jaunt to the other side of the world for an afternoon, and explore the stars.

1. Changes to the research ecosystem are bottlenecked by where the work is done

Our ability to generate and deploy new technologies is critical for the future. *Why* new technology matters depends on who you are: economists want to see total factor productivity increase, politicians want a powerful economy and military, nerds want more awesome sci-fi stuff, researchers want to be able to do their jobs, and everybody wants their children's material life to improve.

Uncountable gallons of ink and man-hours of actual work have been poured into improving this system — from how papers are published and how grants are made to creating entirely new centers and accelerators. But most of these efforts to improve the system go to waste.

It is almost impossible to change a system when the people who are *doing the actual work* — the inventing and discovering — are still heavily embedded in the

institutions that created the need for systemic improvement in the first place. To unpack that:

1. Universities (and academia more broadly) are taking over more and more work that doesn't have immediate commercial applications. In other words, *academia has developed a monopoly on pre- and non-commercial research.*

2. The friction and constraints associated with university research have increased over time.

3. Combined, points #1 and #2 mean that you won't be able to drastically improve how our research ecosystem works without drastically changing the university or building ways to fully route around it.

There are many reasons for doing research at universities. Universities have a lot of (often underused) equipment that is rare or expensive – there are a shockingly large number of pieces of equipment or tacit knowledge that only exist in one or two places in the world. Universities have graduate students and postdocs, who provide cheap labor in exchange for training. Perhaps most importantly, universities are where the people with experience doing research are: spinning up a new research location from scratch is slow and expensive; hiring people full-time locks you into research projects or directions.

Both for these concrete reasons and because it's the cultural default, most efforts to enable pre-commercial research involve funding a university lab, building a university building, or starting a new university-affiliated center or institute. But doing so severely constrains speed, efficiency, and even the kind of work that can be done. (You can jump back to the executive summary for a blow-by-blow of how these constraints play out.)

Behind closed doors, even people in organizations like DARPA or ARPA-E will acknowledge that the frictions imposed by working via academic organizations limit their impact. Despite large budgets and significant leeway about how to spend them, the law requires ARPA program leaders to act through grants or contracts to existing institutions instead of hiring people directly. Those rules almost inevitably mean working with universities. Most new research organizations are no different: they still depend on people working for universities and in university research labs to do the actual hands-on work.

We often think of research as creating abstract knowledge, but the reality is that a lot of that knowledge is tacit – it lives only in people's heads and hands. To a large extent, *technology is people*. If those people are working in an institution that judges them on novelty, they are going to build technology that is novel, not necessarily useful. If they are working in an institution that judges them on growth, margins, or relevance to existing products, they're going to tune technology in those directions, rather than towards impact.

An aside: how technology happens and pre-commercial technology work

To really understand why a university monopoly is so bad for our ability to create and deploy new technology, it's important to briefly unpack how technology actually happens and why there's a big chunk of that work that isn't done by rational, profit-seeking actors like companies.

How does technology happen?

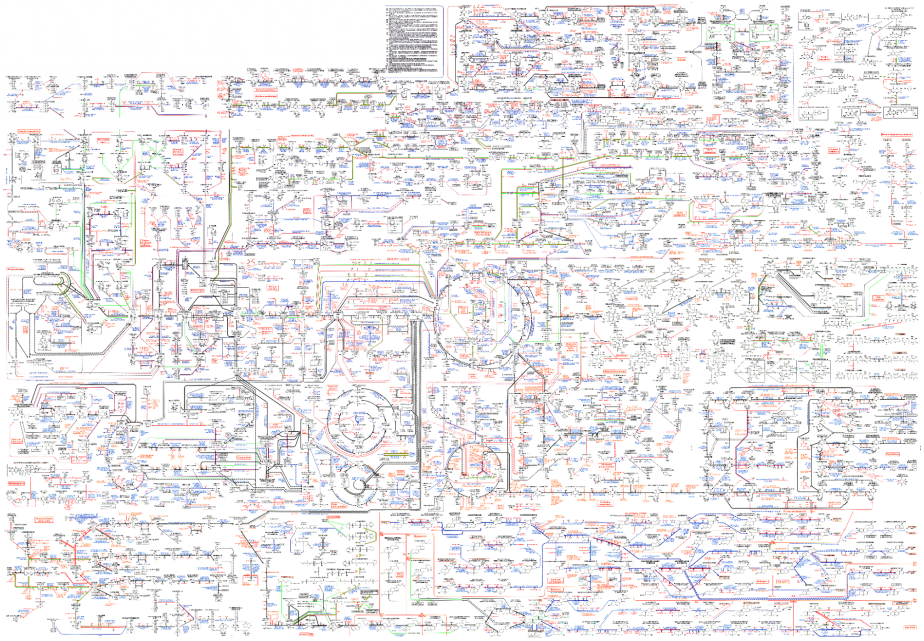
Many people (even very smart, technically trained ones!) imagine that the way new technology happens is that some scientist is doing "**basic science**" — say, measuring the properties of Gila monster saliva because Gila monsters are freaking sweet — when all of a sudden they realize "aha! This molecule in Gila monster saliva might be very useful for lowering blood sugar!" The scientist (or maybe her buddy) then figures out how to make that molecule work in the human body with the idea that it will be a useful drug, ie. "**applied science**." Once that works they figure out how to package it up as a drug, get it FDA approved, and start selling it, ie. "**development**". Once the drug is out in the world, people discover new applications, like suppressing appetite. This is indeed what happened with GLP-1 inhibitors.

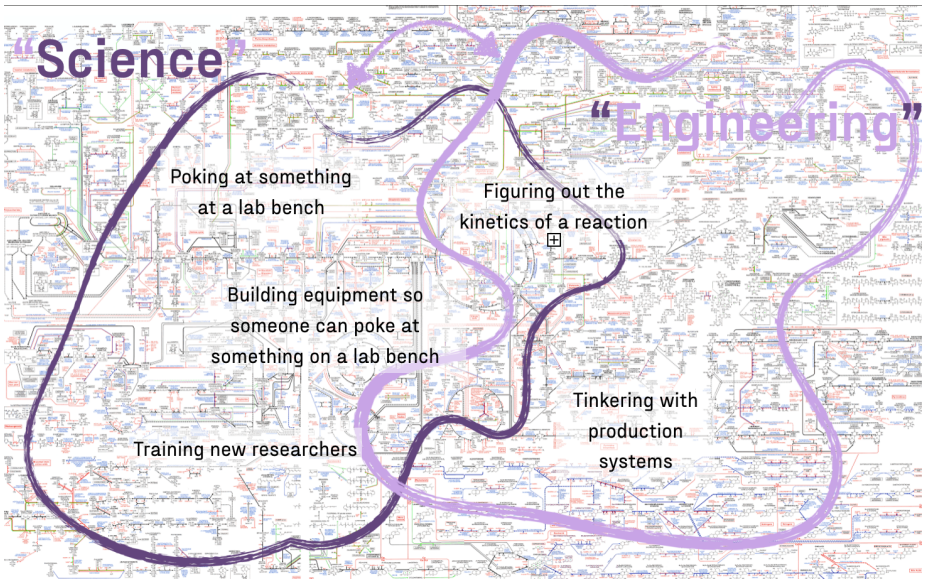
That is not actually how most technology happens.

In reality, the process of creating new technology looks more like how the transistor (that drives all of modern computing) came to be: In the 1920s, Julius Lilienfeld (and others) realize that it would be pretty sweet if we could replace fiddly, expensive vacuum tubes with chunks of metal (ok technically *metalloid).* Several different groups spend years trying to get the metalloid to act like a vacuum tube and then realize that they're getting nowhere and probably won't

make any headway just by trying stuff – they didn't understand the physics of semiconductors well enough. Some Nobel-prize-winning physics later, the thing still doesn't work without some clever technicians figuring out how to machine the metalloid just right. The "transistor" technically works then, but it's not actually *useful* — it's big, expensive, and fiddly. It takes *other folks* realizing that, if they're going to make enough of the transistor to actually matter, they'll need to completely change which metalloid they're using and completely reinvent the process of making them. This process doesn't look anything like a nice linear progression from basic research to applied research to development.

Technology happens through a messy mix of trying to build useful things, shoring up knowledge when you realize you don't know enough about how the underlying phenomenon works, trying to make enough of the thing cheaply enough that people care, going back to the drawing board, tinkering with the entire process, and eventually coming up with a thing that has a combination of capabilities, price, and quantity that people actually want to use it. Sometimes this work looks like your classic scientist pipetting in a lab or scribbling on a whiteboard, sometimes it looks like your soot-covered technician struggling with a giant crucible of molten metal, and everything in between. All this work is connected in a network that almost looks like a metabolism in its complexity. (All credit for this analogy goes to the illustrious Tim Hwang.)



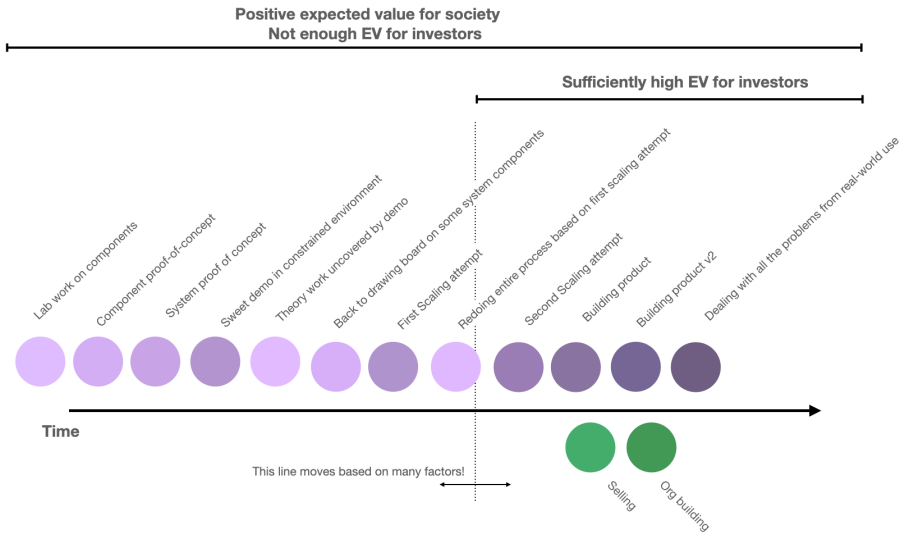


Ultimately, this work needs to culminate in a *product* that people beyond the technology's creators can use: someone needs to buy manufactured technology eventually in a money-based economy. But the work to create a technology is often insufficient for a successful product: you need to do a lot of work to get the thing into the right form factor and sell it (or even give it away and have people actually use it). Very few people want to buy a single transistor or an internet protocol: they want a GPU they can plug straight into a motherboard or a web application.

(This is a speedrun of a much larger topic: if you want to go deeper, I recommend Cycles of Invention and Discovery and The Nature of Technology: What it is and How it Evolves as a start.)

Some of the work to create technology is a poor commercial investment (pre-commercial technology work)

Imagine putting all of the work to create a useful technology on a timeline. If you draw a line at some point in time, you can ask "what is the expected value for an investor of all the work after this point in time (assuming all future work is funded by investment and revenue)?" There will be some point in time where all future work will have a sufficiently large expected value that funding it will be a good investment. All the work *before* that point is pre-commercial technology research. In other words, **pre-commercial technology research is work that has a positive expected value, but its externalities are large enough that private entities cannot capture enough value for funding that work to be a good investment.**



Of course, reasonable people will disagree strongly over where that line is. Some people would argue that any valuable work should be a good investment – these folks would put the line at t=0. Others believe it's after a successful demo, and still others believe it's at the point where there's a product to sell.

Of course, technology research doesn't create a fixed amount of value that then gets divvied up between the public and individuals or organizations. A technology's impact can vary based on where in its development investors and creators start expecting it to be a good investment and start working to capture value by starting companies, patenting, and selling products. Arguably, Google would have had far less impact if Larry Page and Sergey Brin had just open-sourced the algorithm instead of building a VC-backed startup around it; at the same time, transistors would arguably had far less impact if AT&T had imposed draconian licensing terms on them or not licensed them at all.

Frustratingly, there is no straightforward way to find the "correct" line between pre-commercial and commercial technology work in any given situation. It's both wrong to say "everything should be open-source" and "any valuable technology work should be able to both make the world awesome and its inventors obscenely rich at the same time." There is no easy answer to "When should an idea that smells like research be a startup?" or the related question, "When should a large company invest in technology research?"

In other words, the line between pre-commercial and commercial work is fuzzy and context-dependent. It depends heavily both on factors intrinsic to a technology and extrinsic factors like regulations, transaction costs, markets, and even (especially?) culture.

These factors change over time. In the late 19th century, George Eastman could start making camera components during nights and weekends in his mother's

kitchen with the equivalent of $95k (in 2024 dollars) of cash borrowed from a wealthy friend. He used that revenue to build more components, expand the business, eventually go full-time, and invent roll film. Today, some combination of overhead and development costs, combined with expectations around uncertainty, scale, timelines, polish, returns and other factors means that it can take hundreds of millions or billions of dollars to bring a product to market.

In the early 20th century, the stock market was basically gambling – most investors ended up breaking even or negative; in the late 20th century, the stock market reliably returned more than 10% annually. In the early 20th century, vehicles breaking down regularly (or exploding!) was a regular occurrence; now a plane crash is an international incident. Many of these changes are good, but they add up to a world where more technology work falls on the pre-commercial side of the pre-commercial/commercial divide.

This story skips a lot of details, counterarguments, and open questions. One should certainly ask "what would it take to make more technology work commercially viable?" It's likely there are new organizational and financial structures, friction reductions, and cultural changes that could make more technology work commercially viable. But as it stands, pre-commercial technology work is more important than ever. At the same time, it is increasingly dominated by a single institution.

Academia has developed a monopoly on pre- and non-commercial research

In the 21st century, it's almost impossible to avoid interfacing with academia if you have an ambitious pre-commercial research idea. This goes for both individuals and organizations: if you want to *do* ambitious pre-commercial research work, academia is the path of least resistance; if you want to fund or coordinate pre-commercial technology research the dominant model is to fund a lab, build a building, or start a new center or institute associated with a university.

A quick note on definitions: Academia is not just universities — Modern academia is a nebulous institution characterized by some combination of labs with PIs being judged on papers and labor being done by grad students.

You can think of academia as asserting its monopoly in four major areas (ordered in increasing levels of abstraction): physical space, funding, mindsets+skills+incentives, and how we structure research itself.

Physical space If you have a project that requires specialized equipment or even just lab space, the dominant option is to use an academic lab. Companies with lab spaces rarely let anyone but their employees use them. You could get hired and try to start a project but companies have an increasingly shorter timescale and tighter focus that precludes a lot of pre-commercial research.

There are commercial lab spaces but they are prohibitively expensive without a budget that is hard to come by without venture funding or revenue. (That is, it's hard to come by in the context of pre-commercial research!) Furthermore, most grants (especially from the government) preclude working in a rented lab because they require you to prove that you have an established lab space ready to go. The way to prove that you have that is a letter from an existing organization. And the only existing organizations that would sign that letter are universities.

Funding Many research grants are explicitly for people associated with universities and have earmarks for funding graduate students. This $40 million funding call for new ways to create materials is one of many examples of both government and nonprofit funding that is explicitly only for professors or institutions of higher learning.

Synopsis of Program:

DMREF seeks to foster the design, discovery, and development of materials to accelerate their path to deployment by harnessing the power of data and computational tools in concert with experiment and theory. DMREF emphasizes a deep integration of

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch

experimentalists as well as those from academia, industry, and government. DMREF is committed to the education and training of a next-generation materials research and development (R&D) workforce; well-equipped for successful careers as educators and innovators; and able to take full advantage of the materials development continuum and innovation infrastructures that NSF is creating through partnership with other federal and international agencies.

Two main reasonable-at-the-time factors created this situation:

- Government research funding is explicitly dual-purpose: it's both meant to support the actual research but also to train the next generation of technical talent. This combination made more sense before universities took on the role of "technology producing engine."

- Many funders don't have the bandwidth to evaluate whether an individual or organization is qualified so they fall back on heuristics like "is this person a tenure-track professor at an accredited institution?"

As a result, many funding pathways are inaccessible for non-academic, non-profit-maximizing institutions. Restricting non-academic institutions' ability to access funding further solidifies academia's monopoly.

Mindsets, Skills, and Incentives Most deep technical training still happens at universities. But a PhD program doesn't just build technical knowledge and train hands-on skills; it inducts you into the academic mindset. It's certainly possible to do a PhD without adopting this mindset but it's an uphill battle. Our environment shapes our thoughts! Institutions shape how individuals interact! So we end up with a situation where everybody with deep technical training has been marinating in the academic mindset for years.

The dominance of the academic mindset in research has many downstream effects: some are pedestrian, like the prevalence of horrific styles in technical writing; others are profound, like prioritizing novelty as a metric for an idea's quality.

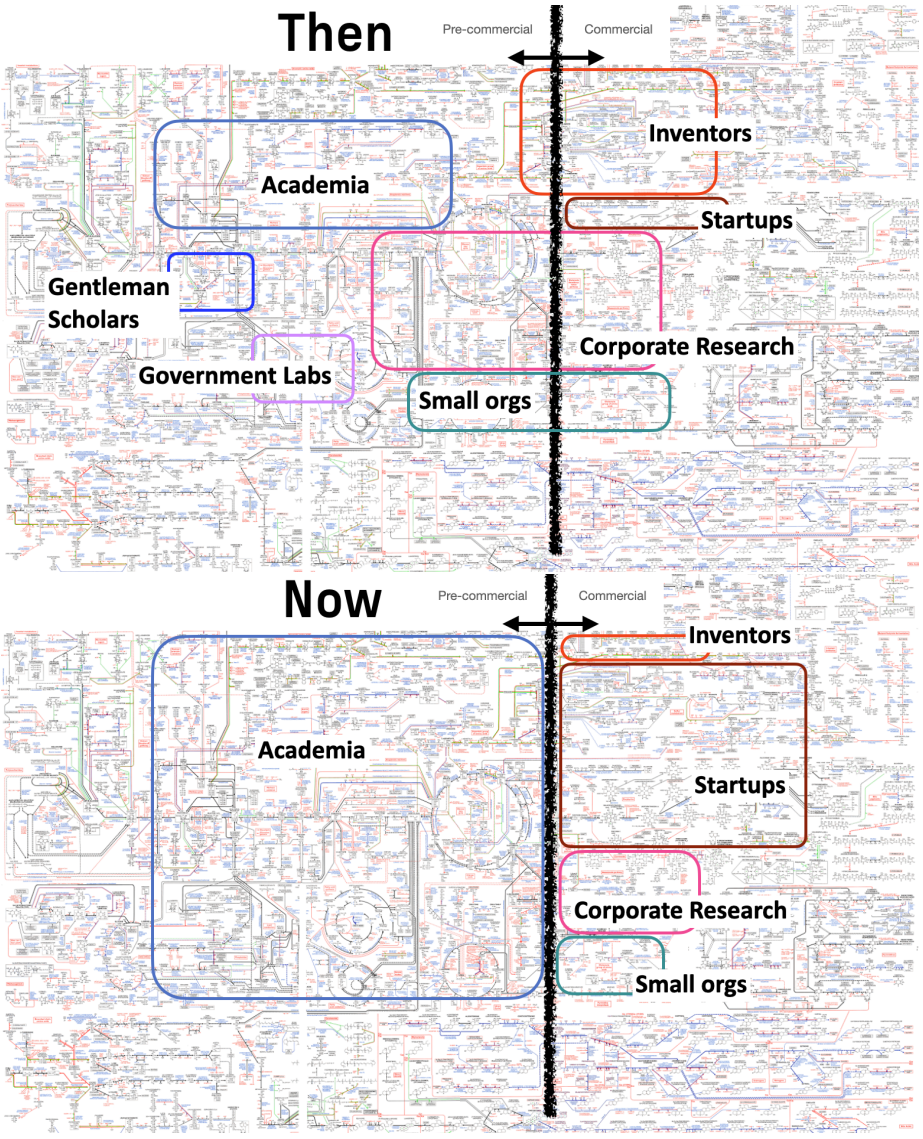
The academic system also shapes the types of skills that these deep technical experts develop; among other things, it makes them very good at discovery and invention, but not necessarily scaling or implementation.

The academic mindset warps incentives far beyond universities. Researchers in many non-university organizations still play the academic incentives game both because they were all trained in academia and because "tenured professor at a top research university" is still the highest-status position in the research world. As a result, academic incentives still warp the work that people do at national labs, nonprofit research organizations, and even corporate research labs.

The structure of research At the most abstract, academia has a monopoly on how society thinks about structuring research. Specifically, that the core unit of research is a principal investigator who is primarily responsible for coming up with research ideas and runs a lab staffed by anywhere from a few to a few dozen other people. This model is implicitly baked into everything from how we talk about research agendas, to how we deploy money, to how researchers think about their careers.

Academia's monopoly on the people actually doing benchwork means that it's very hard to shift incentives in the research ecosystem; most interventions still involve work done by people in the academic system. New institutes are housed at universities or have PIs who are also professors; new grant schemes, prizes or even funding agencies ultimately fund academics; the people joining new fields or using new ways of publishing are ultimately still embedded in academia.

In the not-so-distant past, non- and pre-commercial research happened across a number of different institutions with different sets of incentives: corporate research, small research organizations like BBN, inventors in their basements, gentlemen scholars, and others.



It's funny that at the same time that pre-commercial research has become more important than ever, we've ended up in a world where it is dominated by a single institution that, far from specializing in this critical role, is a massive agglomeration of roles that have been acreting since the Middle Ages. The university's monopoly on pre-commercial research is part of a much bigger story that you should care about *even if you think research is doing fine*. In order to actually unpack it, we need to go back to the 12th century, to understand where the university came from, and how it acquired the massive bundle of roles it has today.

2. Universities have been accumulating roles for hundreds of years

Or, disgustingly abbreviated history of the modern university with a special focus on research and the creation of new knowledge and technology.

Medieval Universities

The first universities emerged in the 12th century to train clergy, who needed to be literate (at least in Latin) and have some idea about theology. Institutions of higher education had existed before, and academia arguably predates Socrates, but we can trace our modern institutions back to these medieval scholastic guilds in places like Paris, Bologna, and Oxford. In a recognizable pattern, the types of people who became professors also were the type of person who also liked trying to figure out how the world worked and arguing about philosophy. Many of the people who became clergy were the second sons of noblemen, who quickly realized that learning to read and a smattering of philosophy was useful. Nobles started sending their other children to universities to learn as well.

So from the start, you have this bundle of vocational training (although very scoped), general skills training, moral instruction, and inquiry into the nature of the universe. The business model was straightforward: donations paid for the original structures, and then students paid instructors directly; there were a small number of endowed positions whose salaries weren't tied to teaching.

Also from the start, university professors spent a lot of time trying to come up with new ideas about the world; however, 'natural philosophy' – what we would now call science – was just a small fraction of that work. "How many angels can dance on the head of a pin?" was as legitimate a research question as "why does light create a rainbow when it goes through a prism?" There was no sense that these questions had any bearing on practical life or should be interesting to anybody besides other philosophers. This thread of "academia = pure ideas about philosophy and the truth of how the world works" remains incredibly strong throughout the university story. The centrality of ideas and philosophical roots created another strong thread that we will see later: the deep importance of who came up with an idea first.

The result of this setup was that professors were incentivized to teach well enough to get paid (unless they had an endowed chair) and create ideas that impress other professors. Academia has always been the game where you gain status by getting attention for new knowledge.

Early Modern Universities

The tight coupling between academia and pure ideas meant that when the idea of empiricism (that is, you should observe things and even do experiments) started to creep into natural philosophy in the 17th century, much of the work that we

would now call "scientific research" happened outside of universities. Creating new technology was even further beyond the pale. Maybe less than a quarter of the Royal Society of London were associated with the university when it was first formed.

(Side note: the terms "science" and "scientist" didn't exist until the 19th century so I will stick with the term "natural philosophy" until then.)

While a lot of natural philosophy was done outside of universities, the people doing natural philosophy still aspired to be academics. They were concerned with philosophy (remember, natural philosophers!) and discovering truths of the universe.

The creation of the Royal society in 1660 and empiricism more broadly also birthed the twin phenomena of:

1. Research becoming expensive: now that research involved more than just sitting around and thinking, natural philosophers needed funding beyond just living living expenses. They needed funding to hire assistants, build experiments, and procure consumable materials. Materials which, in the case of alchemy, could be quite pricey.

2. Researchers justifying their work to wealthy non-technical patrons in order to get that funding. The King was basically a philanthropist and the government fused into one person at this point.

Research papers were invented in the 17th century as well and had several purposes:

1. A way for researchers to know what other researchers were doing. (Note that these papers were in no way meant for public consumption).

2. A way for researchers to claim primacy over an idea. (Remember, the game is to be the first person to come up with a new idea!)

3. A way to get researchers to share intermediate results. Without the incentive of the paper, people would keep all their findings to themselves until they could create a massive groundbreaking book. Not infrequently, a researcher would die before he could create this magnum opus.

During the early modern period, while natural philosophy made great leaps and bounds, the university's role and business model didn't change much: it was still primarily focused on training clergy and teaching philosophy and the arts to young aristocrats. While some scientific researchers were affiliated with universities (Newton famously held the Lucasian Chair of Mathematics which paid his salary independent of teaching) the majority did not. Isaac Newton became a professor mostly as a way to have his living costs covered while doing relatively little work — he lectured but wasn't particularly good at it. Professors being in a role that is notionally about teaching but instead spending most of

their energy doing research instead and being terrible teachers is a tradition that continues to this day.

19th century

The medieval model of the university continued until the 19th century ushered in dramatic changes in the roles and structure of the university. Universities shifted from being effectively an arm of the church to an arm of the state focused primarily on disseminating knowledge and creating the skilled workforce needed for effective bureaucracies, powerful militaries, and strong economies. The 19th century also saw the invention of the research university -- taking on its distinctly modern role as a center of research.

During the 19th century the vast majority of Europe organized itself into nation-states. Everybody now knew that science (which had clearly become its own thing, separate from philosophy) and arts (which at this point included what we would now call engineering) were clearly coupled to the military and economic fates of these nation-states: from the marine chronometer enabling the British navy to know where it was anywhere in the world, to growing and discovering nitre for creating gunpowder, to the looms and other inventions that drove the beginning of the Industrial Revolution. However, at the beginning of the 19th century, most of this work was not happening at universities!

Universities at the beginning of the 19th century looked almost the same as they did during the medieval and early modern period: relatively small-scale educational institutions focused on vocational training for priests and moral/arts instruction for aristocrats. However, modern nation-states needed a legion of competent administrators[2] to staff their new bureaucracies that did many more jobs than previous states: from mass education programs to fielding modern armies. These administrators needed training. Countries noticed that there was already an institution set up to train people with the skills that administrators and bureaucrats needed. Remember, one of the university's earliest roles was to train clergy and for a long time the Catholic Church was the biggest bureaucracy in Europe.

Many continental European countries, starting with Prussia and followed closely by France and Italy, began to build new universities and leverage old ones to train the new administrative class. This is really the point where "training the elite" took off as a big part of the university's portfolio of social roles. Universities and the State became tightly coupled: previously curriculum and doctrine was set by the Church or individual schools — under the new system the state was heavily involved in the internals of universities: in terms of staffing, structure, and purpose.

Technically, not all of these schools were actually "universities." In the 19th century, universities were only one type of institution of higher education among

[2]This is a thing that China figured out centuries earlier.

a whole ecosystem that included polytechnic schools, grandes ecoles, and law and other professional schools. Each of these schools operated very differently from the German university model (which, spoiler alert, eventually won out and is what today we would call a university).

With the exception of Prussia, research was a sideshow during the initial shift of universities from largely insulated institutions for training clergy and doing philosophy to cornerstones of the nation-state. Some scientific researchers continued the tradition of using teaching as an income source to sustain their research side-gig, but nobody outside of Prussia saw the role of the university as doing research. From A History of the University in Europe: Volume 3:

> Claude Bernard (1813–78) had to make his very important physiological discoveries in a cellar. Louis Pasteur (1822– 95) also carried out most of his experiments on fermentation in two attic rooms.

However, the Prussian system put research front and center for both the humanities and the "arts and sciences" (which is what would become what we call STEM — remember, engineering was considered an "art" until the 20th century). Alexander von Humboldt, the architect of the Prussian university system[3] believed universities should not just be places where established knowledge is transmitted to students, but where new knowledge is created through research. He argued that teaching should be closely linked to research, so students could actively participate in the discovery of new knowledge, rather than passively receiving it.

Prussia's 1871 defeat of France in the Franco-Prussian war solidified the Prussian higher education system as the one to emulate. Leaders across the world (including France itself!)[4] chalked Prussia's victory up to their superior education system: Prussian officers were trained to act with far more independence than their French counterparts, which was in part traced back to the Humboldtian research university exposing students to the independent thinking in novel situations that research demands. Superior technology that was downstream of university research was another key component of the Prussian victory — from breech-loading steel cannons enabled by metallurgy research to telegraphs improved by developments in electromagnetism. (From a "where is technology created?" standpoint, these technologies were created at the companies that also manufactured them but built by people who were trained at the new research universities which also advanced scientific understanding of metallurgy well enough that the industrial researchers could apply it.)

Over the next several decades countries and individuals across the world created new institutions explicitly following the German/Humboldtian model (the

[3]While Humboldt's ideas were formative to the Prussian University system (and our entire modern university system), some of his ideas (like complete academic freedom) were conveniently left out of the implementation.

[4]Imagine if people so explicitly chalked national loss or victory up to education systems today!

University of Chicago and Johns Hopkins in the US are prominent examples). Existing institutions from Oxford to MIT shifted towards the German model as well. That trend would continue into the 20th century until today we use the term "university" to mean almost any institution of higher learning.

Over the course of the 19th century, the number of people attending universities drastically increased. In 1840, one in 3375 Europeans attended university and in 1900, one in 1410 did. That is a massive increase in enrollment given population changes, but university degrees were still a rarity and largely unnecessary for many jobs.

Similar dynamics were happening on the other side of the Atlantic — in large part following the European trends.

Before the 19th century, American higher education organizations like Harvard, Yale, and Princeton (which was the College of New Jersey until 1896) were focused on training clergy and liberal arts education for the children of the wealthy. None of these American schools were actually "universities" until they

started following the German model and granting doctorates in the late 19th century.

American higher education also took on a role in disseminating new technical knowledge to boost the economy. In the middle of the 19th century, local, state, and federal governments in the US realized that new research in agriculture and manufacturing could boost farming and industrial productivity. Congress passed legislation that created the land grant colleges in 1862. These colleges (note — not universities yet!) included many names you would recognize like Cornell, Purdue, UC Berkeley, and more. These schools were explicitly chartered to use science and technology to aid industry and farming in their areas. Almost simultaneously, technical institutes were springing up (MIT 1861, Worcester Polytechnic Institute 1865, Stevens Institute of Technology, 1861). Both the land grant colleges and technical institutes were originally focused on imparting knowledge rather than creating it, but this would quickly change.

Like their European counterparts, the Americans became enamored with the German research university. Johns Hopkins was the first American university created explicitly in the Humboldtian model. It was founded in 1876 — four years after the conclusion of the Franco-Prussian war. The University of Chicago, founded in 1890, followed suit. During the same period, existing colleges added graduate schools and started doing research — Harvard College created a graduate school in 1872 and the College of New Jersey became Princeton University in 1896.

By the end of the 19th century, universities on both sides of the Atlantic had transformed from an essentially medieval institution to a modern institution we might recognize today:

- Institutions with heavy emphasis on research both in the humanities and in the sciences.

- Strong coupling between universities and the state — states used the universities both to create and transmit knowledge that improved economic and military capabilities and to train people who would eventually work for the state in bureaucracies or militaries. In exchange, most universities were heavily subsidized by states.

- Vocational training was a big part of the univeversity's role (especially if you look at money flows).

However, there were some notable differences from today:

- The role of the university's research with respect to technology was to figure out underlying principles and train research as inputs to industrial research done by companies and other organizations.

- By the end of the 19th century, only one in 1000 people got higher education, so while University students did have a big effect on politics,

universities were less central to culture.

- While the Humboldtian research university was starting to dominate, there was still an ecosystem of different kinds of schools with different purposes.
- A lot of professional schooling happened primarily outside of the university in independent institutions like law schools and medical schools.
- While vocational training was a function of the universities, lawyers and there were only a few jobs that *required* degrees.
- Instead of being society's primary source of science and technology, a big role of university research was in service of education.

This bundle would last until the middle of the 20th century.

20th Century

The 20th century saw massive shifts in the university's societal roles. A combination of demographic and cultural trends, government policy, and new technologies led to a rapid agglomeration of many of the roles we now associate with the university: as the dominant form of transitioning to adulthood, a credentialing agency, a think tank, a collection of sports teams, a hedge fund, and more. All of this was overlaid on the structures that had evolved in the 19th century and before.

The role of universities in science and technology shifted as well. At the beginning of the 20th century, universities were primarily educational institutions that acted as a *resource* for other institutions and the economy — a stock of knowledge and a training ground for technical experts; driven first by WWII and the Cold War but then by new technologies and economic conditions in the 70s, universities took on the role of an economic engine that we expect to produce a flow of valuable technologies and most of our science.

The WWII Discontinuity

To a large extent, the role of the university in the first half of the 20th century was a continuation of the 19th century. World War II and the subsequent Cold War changed all of that.

World War II started a flood of money to university research that continues today. This influx of research dollars drastically shifted the role of the university. Many people fail to appreciate the magnitude of these shifts and the second-order consequences they created.

A consensus emerged at the highest level of leadership on both sides of WWII that new science-based technologies would be critical to winning the war. This attitude was a shift from WWI, where technologies developed during the war

were used but ultimately had little effect on the outcome. There was no single driving factor for the change — it was some combination of extrapolating what new technologies *could* have done in WWI, developments during the 1930s, early German technology-driven success (blitzkrieg and submarine warfare), and leaders like Hitler and Churchill nerding out about new technologies.

Like almost every institution in the United States, universities were part of the total war effort. In order to compete on technology, the USA needed to drastically increase its R&D capabilities. Industrial research orgs like Bell or GE labs shifted their focus to the war; several new organizations spun up to build everything from radar to the atomic bomb. Universities had a huge population of technically trained people that the war production system heavily leveraged as the production centers of technology. It didn't hurt that the leader of the US Office of Scientific Research and Development, Vannevar Bush, was a former MIT professor — while focusing on applied research and technology wasn't much of a shift for MIT (remember how there were many university niches), it was a big shift for many more traditionally academic institutions.

This surge in government funding didn't end with the surrenders of Germany and Japan. The Cold War arguably began even before WWII ended; both sides deeply internalized the lessons exemplified by radar and the Manhattan Project that scientific and technological superiority were critical for military strength. The US government acted on this by pouring money into research, both in the exact and inexact sciences. A lot of that money ended up at universities, which went on hiring and building sprees.

Globally, the American university and research system that emerged from WWII became basically the only game in town: because of the level of funding, the number of European scientists who had immigrated, and the fact that so much of the developed world had been bombed into rubble. As the world rebuilt, the American university system was one of our cultural exports. That is why, despite focusing primarily on American universities in the second half of the 20th century, the conclusions hold true for a lot of the world.

Second-order consequences of WWII and the Cold War

The changes in university funding and their relationship with the state during WWII and the Cold War had many second-order consequences on the role of universities that still haven't sunk into cultural consciousness:

Top universities are not undergraduate educational institutions. If you're like most people,[5] you think of "universities" as primarily educational institutions; in particular, institutions of undergraduate education that serve as a last educational stop for professionally-destined late-teens-and-early-twenties before going out into the "real world." This perspective makes sense: undergraduate education is the main touchpoint with universities that most people

[5]Anecdotally, the most common response to "I'm a professor" is "oh, what do you teach?"

have (either themselves or through people they know). It's also wrong in some important ways.

While many universities are indeed primarily educational organizations, *the top universities that dominate the conversation about universities are no longer primarily educational institutions.*

Before WWII, research funding was just a fraction of university budgets: tuition, philanthropy, and (in rare cases) industry contracts made up the majority of revenue.[6] Today, major research universities get more money from research grants (much of it from the federal government) than any other source: in 2023, MIT received $608 million in direct research funding, $248M from research overhead, and $415M in tuition; Princeton received $406M in government grants and contracts and $154M in tuition and fees.

These huge pots of money for research and the status that comes with it means that the way that higher education institutions *become* top universities is by increasing the amount of research that they do. Just look at the list of types of institutions of higher education from the Carnegie Classification System and think honestly which of these seem higher status:

- Associate's Colleges
- Baccalaureate/Associate's Colleges
- Baccalaureate Colleges
- Master's Colleges & Universities
- Doctoral Universities
- Special Focus Two-Year
- Special Focus Four-Year
- Tribal Colleges And Universities

Doctoral universities are by far the highest status organizations on the list. Thanks to the Prussians, the thing that distinguishes a doctoral university from other forms of higher education is that it does original research.

The funding and status associated with being a research university exerts a pressure that slowly pushes all forms of higher education to become research universities. That pressure also creates a uniform set of institutional affordances and constraints. It's like institutional carcinization.

Of course, that Carnegie list also includes many institutions of higher education

[6] Frustratingly there is little actual hard data on the breakdown of university revenues and funding sources for research before 1950: a project for an enterprising metascientist!

that are *not* universities. This fact is worth flagging because it means that when the discourse about the role of universities focuses on undergraduate education, people are making a category error. People often use the Ivy League and other top universities as a stand-in for battles over the state of undergraduate education, but those institutions' role is *not primarily undergraduate education.*

Shifts in university research. The paradigm shifts created by WWII and the Cold War also changed how research itself happens.

For the sake of expediency during the war, the government shifted the burden of research contracting and administration from individual labs to centralized offices at universities. This shift did lighten administrative load — it would be absurd for each lab to hire their own grant administrator. However, it also changed the role of the university with respect to researchers: before it was a thin administrative layer across effectively independent operators loosely organized into departments; now the university reaches deep into the affairs of individual labs — from owning patents that labs create to how they pay, hire, and manage graduate students to taking large amounts of grants as overhead.

Federal research funding created multiple goals for university research – both:

1. To train technical experts who were in some ways seen as the front line of national power in WWII and the Cold War.

2. To directly produce the research that would enhance national power.

(Recall that in the 19th and early 20th century, the role of university research was much more the former than the latter.)

This role duality has been encoded in law: many research grants for cutting-edge research are also explicitly "training grants" that earmark the majority of funding for graduate students and postdocs.

I won't dig too deeply into the downstream consequences here, but they include:

- A system where much of our cutting-edge science and technology work is done by trainees. (Imagine if companies had interns build their new products.)

- Artificially depressing the cost of research labor.

- Many labs shifted from being a professor working on their own research and giving advice to a few more-or-less independent graduate students to what is effectively a small or medium-sized business.[7] The role of a professor at a research university looks more like a startup founder crossed with a director in a large organization than anything else.

[7] Large academic labs can have upwards of 40 or 50 people.

- Strong incentives *against* increasing lab efficiency — if most of your funding is earmarked for subsidized labor, there is no incentive to automate anything.

As universities took on a central societal role in science and technology, they became a gravity well for managing research. If someone wants to deploy money towards a new research effort or set up a new research organization, the default choice is to house it in or have it be administered by a university. In addition to numerous centers and institutes, universities administer many federal labs and state initiatives: JPL is administered by Caltech, the University of California administers Lawrence Berkeley National Laboratory, and Princeton runs New Jersey's new AI initiative to name a few.

the univeversity's central role in science and technology has also made it a bottleneck for influencing the culture of research. "Professor" is by far the highest status scientific profession — leaving the university to work at non-university research labs or leave research all together is considered a secondary option. (The words "outcast," "second-class citizen," or "failure" are too extreme but there's definitely an element of it in academic attitudes towards those who have left the university.) In part because almost all researchers were trained in a university and in part because of the status hierarchy, research culture across the ecosystem is downstream of how academia prioritizes things and acts.

Take peer review for example: professors care about it because peer review determines how many grants are awarded and peer reviewed publications are a big component of getting tenure and status more generally. That focus on peer review as the gold standard for research quality then seeps into research culture and beyond.

The university's central role in research culture means that while there are other kinds of research organizations, like R&D contractors and national labs, academic incentives dominate research far beyond the ivory tower. The dominance of academic incentives was exacerbated by the collapse of corporate R&D and consolidation of independent research labs in the 1980s. Previously places like BBN or Bell Labs acted as equally prestigious career pathways for researchers, with people not infrequently hopping between university and non-university roles. Today that is almost unheard of. Now there is a fairly clear hierarchy of research organization status, with universities and their originally medieval academic roots at the top.

Other 20th Century Roles

There are, of course, many other roles that the university acquired in the 20th century besides research. During the second half of the 20th century, universities quickly accumulated a lot of the bundle that we associate with them today:

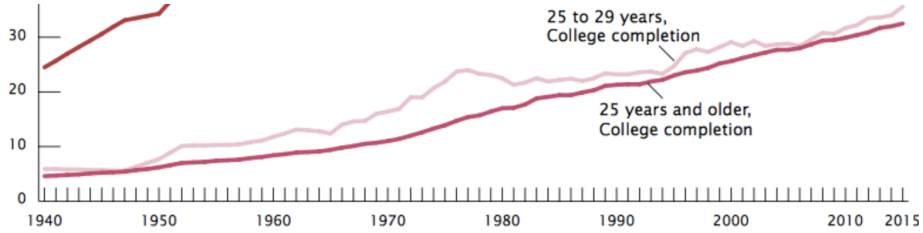
- The roles associated with being the dominant and status-conferring form of transitioning to adulthood ("Where did you go to college?" is now a

standard way of sizing someone up professionally.)
  - Dating site
  - Credentialing agency
  - Dominant thing that 18-22-year-olds do (ie. Adult day care)

- The high-status form of job training. (although this trend has reversed slightly.)
- Policy leadership through social science research
- Sports teams
- Hedge funds
- Top-tier professional schools

Unpacking those:

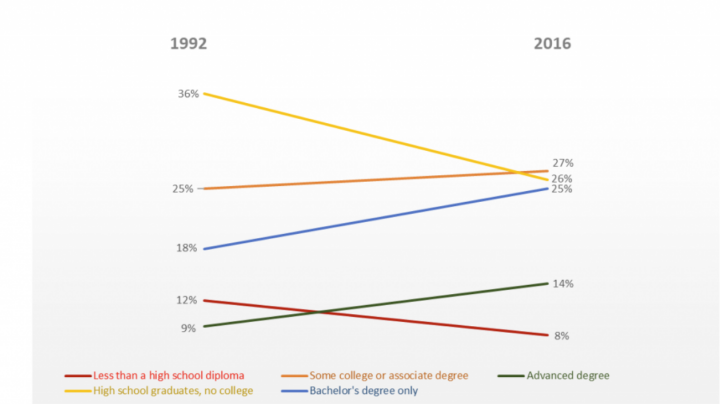
Credentialing Agency The trend of more and more people getting higher education started in the 19th century, but accelerated in the 20th century. As more people went to college, universities (remember how top colleges became universities) took on the role of a credentialing agency: college and graduate degrees and where they were earned became proxies for someone's skill and potential job performance.



Note: Data for every individual year are not available for years prior to 1964.
Source: U.S. Census Bureau, 1947–2015 Current Population Survey and 1940 Decennial Census.

Degrees have always been a form of credential, but when they were rarer they were not the one credential to rule them all: plenty of people without degrees could perform jobs just as well as people with degrees. As the market became flooded with university graduates, *not* having a degree became a negative signal. Today, many jobs require degrees, regardless of whether the job actually demands skills you can only pick up in college.

Percentage of Labor Workforce by Educational Attainment, 25 years and over, 1992-2016 Annual Averages



– Source: U.S. Bureau of Labor Statistics

(Slightly spicy) I would argue that contrary to popular conception, as the university's role as a credentialing agency increased, its role in actually training professional skills has *decreased* (at the college level). This shift is borne out in the grades data. Instead of A's indicating exceptional students, they've become the most common grade. People practically expect A's as a participation prize for completing college (especially at elite universities). Grade inflation makes GPAs hold little signal beyond indicating exceptionally bad students; the phenomenon is not dissimilar from college attendance itself.

(As with college attendance, attitudes towards degrees may be shifting but as of early 2025, universities still maintain a firm grip on their role as credentialing agencies.)

High-status form of transitioning to adulthood Over the 20th century, going to college at an elite university became *the* high-status way to transition to adulthood. Higher education shifted from something for the wealthy and people who were training for specific professions to a thing that all people aspiring to be upper middle-class professionals did.

Today, where you went to college is a status signal; many educated professionals will look askance if you didn't go. (This attitude is changing among some subcultures, so perhaps the curve has inverted, but the vast majority still think of college as the thing you do if you want to be successful.) Universities have taken on the societal role of shepherding people into adulthood and bestowing status as they do so.

The role as high-status-adulthood-transition-path came bundled with a number

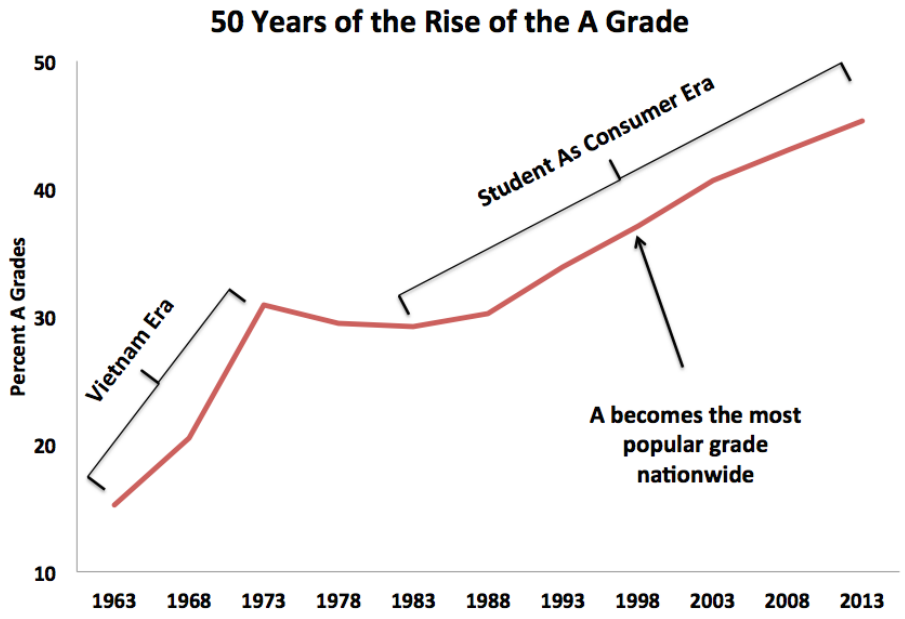


Figure 3: From National Trends in Grade Inflation, American Colleges and Universities

of other roles:

- The default way for people to figure out what to do with their lives.
- A dating market (people want to marry people of similar or higher status).
- A country club for 18-22 year olds. (Many colleges compete on "student experience.")

Think Tank Since WWII, the "inexact sciences" have flourished — fields like sociology, political science, and economics (which was quite older). The research from these fields is naturally more directly applicable to government policy than the humanities or "exact sciences": asking everything from "what is the effect of minimum wage?" to "what interventions increase voter turnout?" As a result, universities became more central to political conversations, with some departments acting similarly to think tanks.

Universities have been a policy apparatus of the nation state since the 19th century -- as a way of increasing economic productivity, training bureaucrats, and promulgating official doctrine — but the rise of the social sciences turned the university from a policy *output* into a policy *input*.

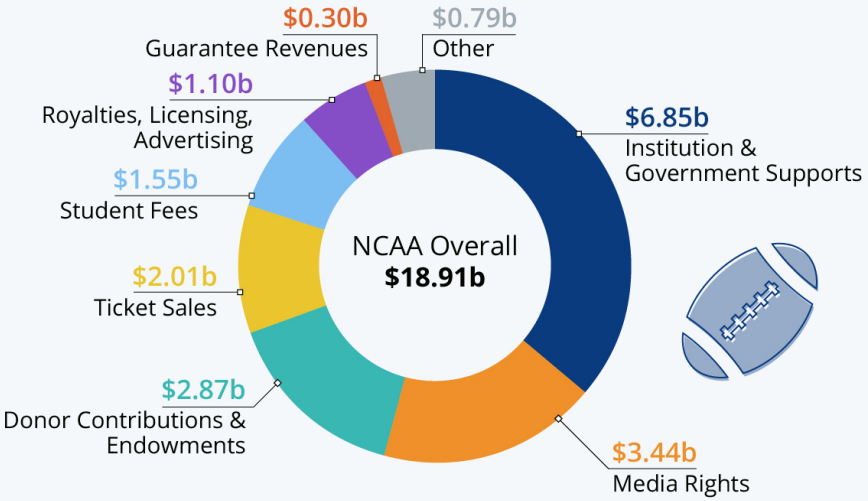
	Faculty %, 1915-35	Faculty %, 1975-95	Change Over Time
Humanities	33.2	19.5	-41%
Natural Sciences	57.5	50.6	-12%
Social Sciences	9.3	29.9	+222%

Figure 4: From https://www.insidehighered.com/news/2006/08/21/rise-social-sciences which in turn got it from https://www.amazon.com/Reconstructing-University-Worldwide-Academia-Century/dp/0804753768. These numbers are for the British commonwealth because of data availability but the authors explicitly say that the US followed very similar trends.

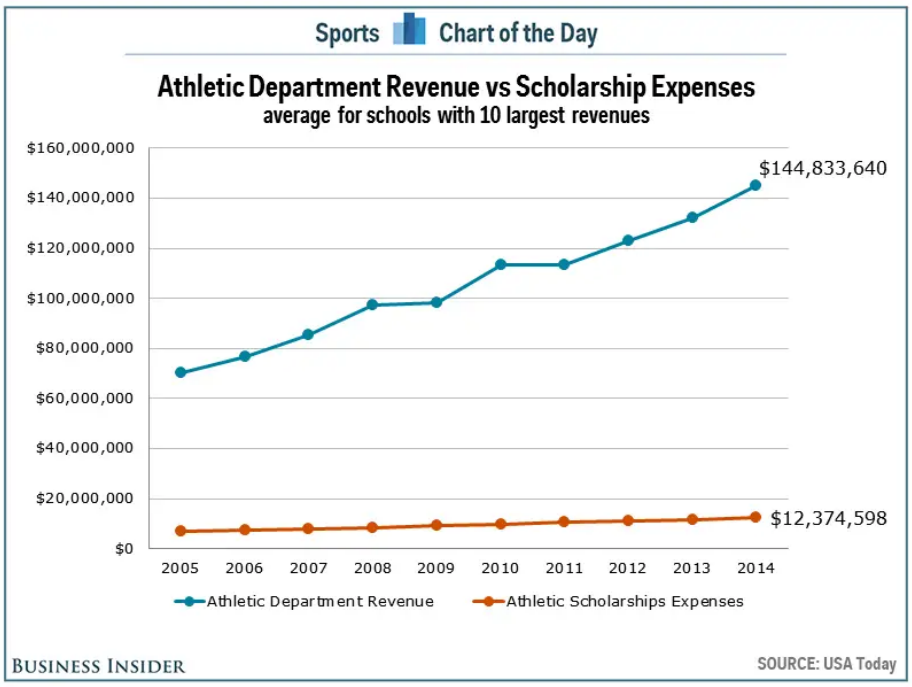
Collection of sports teams College sports morphed from an activity just for students and university communities to a massive entertainment business. College sports are now a billion dollar business; most of that growth happened after WWII. Some college football coaches are paid more than the president of their university.

U.S. College Sports Are A Billion-Dollar Game

Total revenue generated by NCAA athletic departments in 2019, by source



Source: National Collegiate Athletic Association



Hedge Fund University endowments grew enormously in the second half of the 20th century through a combination of favorable market conditions, professionalization, and active investment. 20% of Stanford's $8.9B revenue in 2023 came from their endowment (topped only by the revenue from health services). The largest endowments now control tens of billions of dollars and grow significantly faster than the universities can spend them.

As a result, many universities have become financial institutions that can have significant effects based on what they do or do not invest in.

A home for top-tier professional schools Professional schools and universities became more intertwined over the course of the 20th century. In the 19th century, many top-tier medical and legal schools were independent organizations. Over the 20th century, accreditation, standardization, and the integration of research into professional curricula pushed professional schools towards university affiliations. There are certainly still independent professional schools — nursing, art, etc — but if you think of most top-tier professional schools, they are integrated with a university.

This shift is notable because these professional schools bring in huge amounts of revenue to universities — 23% of Stanford's income comes from Health Care services associated with its hospital and medical school; University of Michigan's Medical activities provide 55.1% of their total operating budge.; In 2013, the university's medical center contributed 45% of the overall university budget of

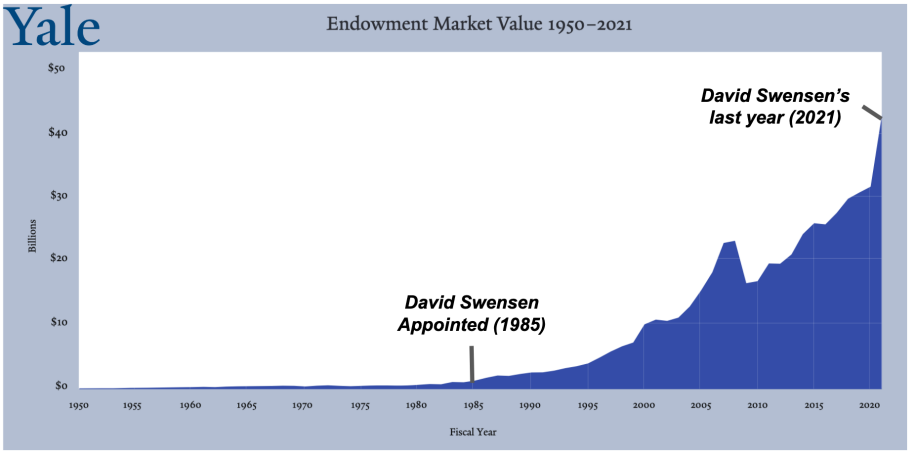


Figure 5: Source https://www.moneylemma.com/p/lessons-from-the-yale-endowment

$2.6 billion. Like major revenue sources for any businesses, these professional schools warp institutional attention and incentives around themselves.

The consolidation of all these roles into a single institution was amplified by a collapse in the *types* of higher education institutions, especially in the United States. At the beginning of the 20th century, a polytechnic institute was a very different thing from an agricultural school and both were very different from a proper liberal arts university. By the end of the century, the distinction is primarily between undergraduate-only institutions and universities that have both colleges and graduate schools.

Post 1980 pre-commercial technology research and bureaucracy

The economic conditions of the 1970s created a major shift in the role of the university around technology creation.

If you ask most people "how does technology happen?" the near-ubiquitous answer will gesture at some form of "people do basic research in a university and then commercialize it by spinning it out into a startup or licensing it to a big company." That is a surprisingly contemporary view.

The role of universities in economically valuable technology shifted in the 1970s from primarily being a resource for other institutions — a stock of knowledge and a training ground for technical experts — to an economic engine that produced a flow of valuable technologies.

This story from Creating the Market University illustrates the shift wonderfully:

> On 4 October 1961, the president of the University of Illinois received

> a letter from Illinois governor Otto Kerner. In the letter, Governor Kerner asked the flagship institution to study the impact of universities on economic growth, with an eye toward "ensuring that Illinois secures a favorable percentage of the highly desirable growth industries that will lead the economy of the future."
>
> In response, the university convened a committee that met for the next eighteen months to discuss the subject. But despite the university's top-ten departments in industrially relevant fields like chemistry, physics, and various kinds of engineering, the committee was somewhat baffled by its mission.? How, it asked, could the university contribute to economic growth? Illinois faculty could act as consultants to companies, as they had done for decades. The university could provide additional training for industrial scientists and engineers. Scholars could undertake research on the economy. But, the committee's final report insisted, "certain basic factors are far more import- ant in attracting industry and in plant location decisions, and therefore in stimulating regional economic growth, than the advantages offered by universities."? In 1963, the University of Illinois —like almost every university in the United States—-had no way of thinking systematically about its role in the economy.
>
> In 1999, thirty-six years later, the university faced a similar request. The Illinois Board of Higher Education declared that its number-one goal was to "help Illinois business and industry sustain strong economic growth." This time, though, the university knew how to respond. It quickly created a Vice President for Economic Development and Corporate Relations and a Board of Trustees Committee on Economic Development.- It titled its annual State of the University report "The University of Illinois: Engine of Economic Development." It expanded its program for patenting and licensing faculty inventions, launched Illinois VENTURES to provide services to startup companies based on university technologies, and substantially enlarged its research parks in Chicago and Urbana-Champaign. It planned to pour tens of millions of dollars into a Post-Genomics Institute and tens more into the National Center for Supercomputing Applications.

Before the late 1970s, technology was primarily created by individuals and companies and then studied and improved by university labs. An airplane company would create a new wing design and then bring it to a university to analyze it with their wind tunnel or a radio company would ask a university lab to understand how their antenna design affected signal propagation. After the 1970s, universities took on the societal role as a *source of innovation* and *an economic engine* fueled by commercializing those innovations. That is, people started looking to universities as the starting point for useful technologies.

Four coupled factors drove this role shift:

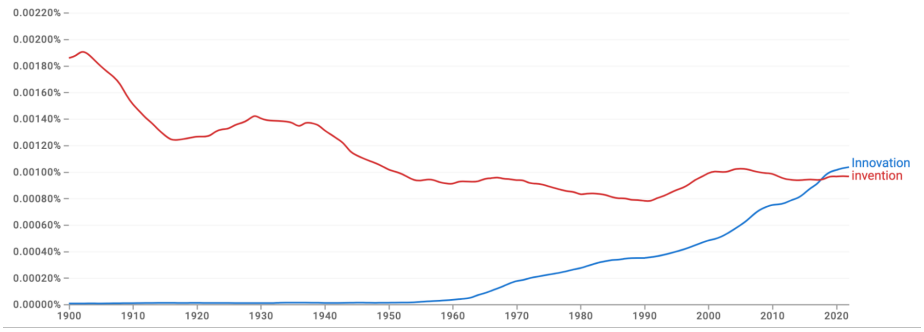
1. New technologies that easily went straight from academic lab to product — particularly biology-based technologies like recombinant DNA that was behind the success of companies like Genentech.

2. The rise of venture capital that could fund those spinouts.

3. Dire economic conditions and the sense that America had lost its innovation mojo which had politicians asking "how do we create more innovation?"

4. Pressure on companies from shareholders and elsewhere caused them to scale back internal R&D work that wasn't focused directly on existing product lines.

(**Quick aside on the term "innovation."** "Innovation" is a fuzzy, ill-defined, overused word but generally has the implication of *both* novelty and impact. Interestingly, it only became a "thing" in the time period we're talking about – the 1970s. My unsubstantiated hypothesis is that as friction to getting things out into the world increased, it was no longer sufficient to just invent something, you also needed to do a lot of work on diffusion in order to turn that invention into an innovation.)



To drastically compress a story that the book Creating the Market University gives the full treatment it deserves: the US economy was in the dumps in the 1970s and politicians were desperate to find a solution. One class of solution was to make it easier to fund and start small technology companies. The 1979 Employee Retirement Income Security Act (ERISA) allowed pension funds to invest in VC firms, which drastically increased the amount of money available to invest in startups: new money to VC firms rose by an order of magnitude from $218M in 1978 to $3.6B in 1983. The Bayh-Dole Act gave universities clear ownership over IP derived from government funded research, with the idea that it would make it easier for university research to become VC-funded startups.

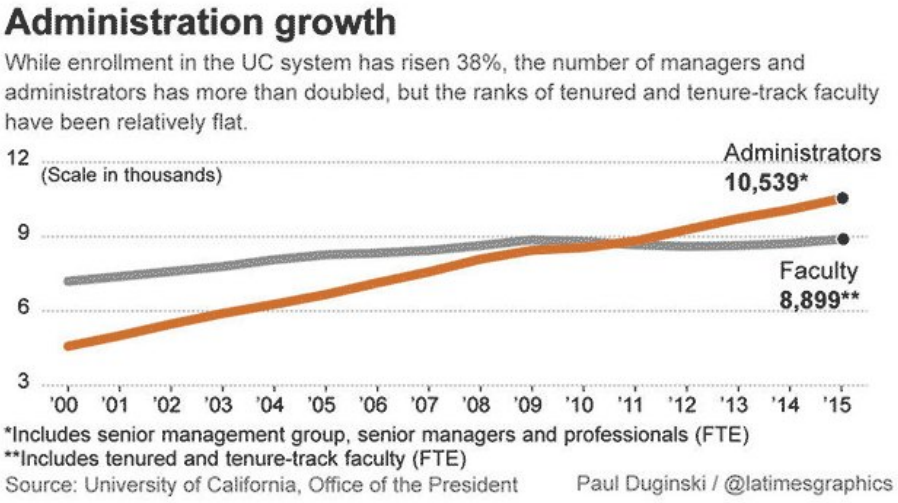
These interventions happened at the same time as the creation of recombinant DNA at Stanford, which kicked off the entire biotech industry. This success created today's cultural template that technology happens by academic lab work spinning out into high-growth startups that go on to change the world, despite

the fact that health-focused biotechnology is amenable to academic lab work spinning off into successful companies for reasons that often don't apply to other technologies.

Legislation encouraging university spinouts and technologies that were especially amenable to being spun out into VC-funded startups coincided with companies scaling back exploratory R&D in corporate research labs. Driven in part by shareholder pressure towards efficiency, companies shifted towards acquiring derisked technology through licensing, working with startups, or buying them. (This explanation of the decline of corporate labs is a gross oversimplification, of course. See The Changing Structure of American Innovation for far more thoroughness or my notes on it here.)

All of these factors combined to effectively give academia a societal monopoly on pre-commercial technology research.

Final role: a massive bureaucracy As universities acquired more and more societal roles, they have both come under more scrutiny and more administrative demands imposed by fulfilling all those roles under one roof. As a result, university bureaucracies have exploded in size.



Part of the administrative growth is simply due to requirements imposed by the university's roles: federal grants have near-book-length compliance requirements, managing buildings being used for everything from chemistry labs to sporting events to dining halls requires a small army, and college rankings take into account how high-touch an experience students get.

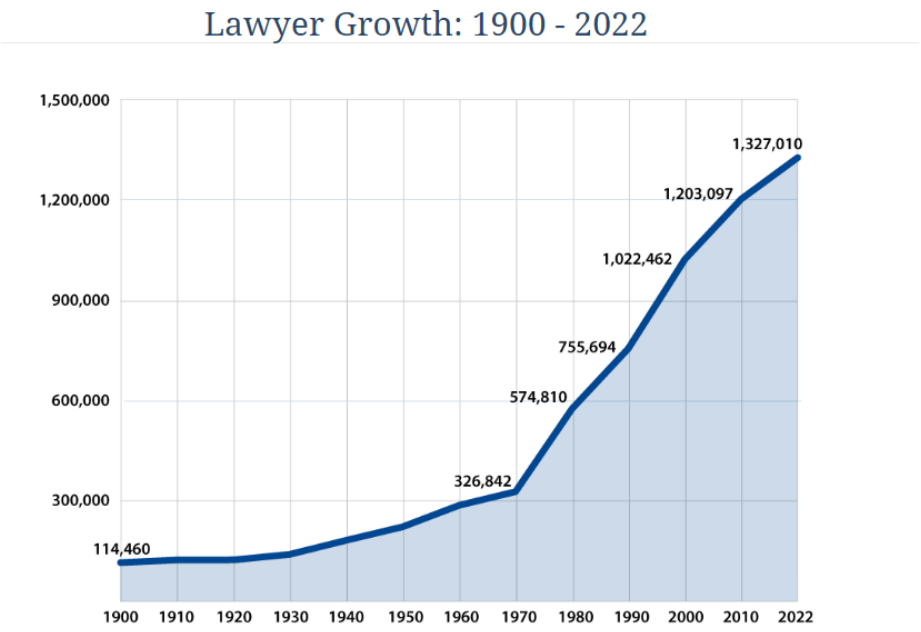
Partially, the bureaucracy is downstream of the forces also reshaping the rest of the world: the internet, rising standards of living, and drastically increased litigiousness.

The internet has flattened the world, making it much easier for people to

realize that college is an option, what the best colleges are, and to apply to them. This is wonderful! But it also means that there is drastically more competition to get into colleges, higher expectations on the college experience, and a wider range of preparation going into college and ideas of what the college "product" is; handling all of this demands more administrators.

Rising standards of living are also a good thing! They also have turned education at top universities into a highly-sought-after luxury good. The way that universities compete is to have more and more "perks," all of which come with more administrative overhead.

Increased litigiousness means that universities have implemented many more bureaucratic procedures to cover their butts and avoid lawsuits. (And their many roles have increased the number of things they can be sued for.) These bureaucratic procedures need bureaucrats to enforce them.



Conclusion

So there you have it: a speed run of the univeversity's transformation from a priest training center that did philosophy on the side to a credential-and-status-granting-rite-of-passage-hedge-fund-sports-team-think-tank-source-of-all-science-and-technology.

3. Universities need to be unbundled

It's clear that universities have multiple conflicting missions. It's fairly uncontroversial to suggest that universities are no longer balancing these missions well. The more contentious question is "how do we fix the university?"

Some people (who care primarily about its cultural role) say "decolonize it" others (who also care about that same cultural role) say "eliminate DEI." People who care about the role as job training say "eliminate useless majors" or "focus on marketable skills." Those who care about discovering the secrets of the universe say "more replication," "change how we do grants,""reform journals," or "increase rigor." For technology: "fund more applied work" "increase industry partnerships" "reform tech transfer offices." The list goes on: "Pay student athletes better" "unionize grad students" "change admissions criteria" "tax the endowments." Suggestions on the more intense end of the spectrum include "reduce the number of scientists" or "fewer people should go to college, period."

"The situation with universities" resembles the theory of epicycles. When planetary motion was locked to a theory that planets needed to move along perfect circles, natural philosophers needed to create more and more complicated solutions to new observations of planetary movements. The solution wasn't adding more circles to address the observations, it was Newton popping up one level to propose a new paradigm of physics where planetary motion is driven by gravity. We need to do the same thing here: popping up one level to propose a new paradigm where universities don't have all of these societal roles.

The meta-solution to "the situation with universities" is to unbundle the university.

"Unbundling" is a concept from the Tech world around the phenomenon of businesses offering individual services eating the market share of businesses that once offered all of those services together. The classic example is the transition from cable to streaming services, unbundling the different channels, or the observation that almost every software-as-a-service business is just a specialized excel spreadsheet.

In our case, unbundling means peeling societal roles away from the university and creating new institutions (and revitalizing old ones) to take them on. It's pruning back a giant tree so that a thousand flowers can bloom. Ideally, this would lead to a whole ecosystem of institutions all experimenting with different ways of doing things better, from credentialing to moral instruction to building technology to discovering the secrets of the universe.

Without the university's monopoly, institutions can actually compete. Imagine a world where there are multiple *kinds* of institutions all trying to discover the secrets of the universe: one rewards the wackiest ideas, one prioritizes just trying stuff really fast, and one is set up to do work that only has external milestones every 100 or more years. From A Vision of Metascience:

science would significantly change the culture of science. It's a long list, to emphasize the many diverse opportunities for imaginative change. Later in the essay we develop deeper ways of thinking that generate many more ideas for change.

- **Fund-by-variance:** Instead of funding grants that get the highest average score from reviewers, a funder should use the variance (or kurtosis or some similar measurement of disagreement[5]) in reviewer scores as a primary signal: only fund things that are highly polarizing (some people love it, some people hate it). One thesis to support such a program is that you may prefer to fund projects with a modest chance of outlier success over projects with a high chance of modest success. An alternate thesis is that you should aspire to fund things *only* you would fund, and so should look for signal to that end: projects everyone agrees are good will certainly get funded elsewhere. And if you merely fund what everyone else is funding, then you have little marginal impact[6,7].

- **Century Grant Program[8]:** Solicit grant applications for projects to be funded for 100 years. Done through an endowment model, the cost would be a small multiple of conventional 5- or 10-year funding. The point is to elicit an important type of intellectual dark matter[9]: problems of immense scientific value that can't be investigated on short timelines. Inspired by seminal projects such as the CO2 monitoring at the Mauna Loa observatory, the Framingham Heart Study, and the Cape Grim Air Archive.

- **Tenure insurance:** Tenure-track scientists often play it safe in the projects they take on. Encourage people to swing for the fences by offering a large payout if they fail to receive tenure. Supposing 80% of tenure-track faculty receive tenure[10], the cost for a large payout would only be a modest addition to an existing benefits package. A premium of $8k per year for 6 years, with a 5x multiplier and reasonable assumptions

Many experiments won't work, but some might unlock the future and right now we have no ways of giving them a fair shot and finding out which are which.

Competition is necessary but not sufficient for a flourishing ecosystem to replace the university monopoly. A flourishing ecosystem also needs mechanisms that direct that competition towards "good" outcomes. Markets are a tried and true way to reward effective institutions, but I'm not convinced that all university roles (perhaps credentialing or sports) are well-served by market logic. Roles that create public goods, are extremely high uncertainty, or have incredibly long timescales require something beyond feedback loops of profit and loss.

This isn't a call to burn everything down: the university should be one of those competing institutions! Academia is uniquely good at some things. More institutional competition would put pressure on academia to be the best that it can be, playing to its strengths and shedding its accumulated encrustations.

Arguments for emergent solutions are particularly unsatisfying — I'm not offering a silver bullet, nor even a concrete solution to the particular issue that concerns

you the most. It's easy to explain how adding more things will solve a problem, but much harder to explain how taking them away will make things better. There is certainly faith involved that good things will fill a vacuum, but we forget how much faith is involved that more concrete institutional interventions will work. It's an especially large leap of faith to believe that adding more rules will fix a problem caused by an already-too-big pile. The added bonus of emergent solutions is that they encourage building and experimenting instead of bitter zero-sum power struggles over a single leverage point like government rules or regulations.

Counterarguments

the univeversity's bundle of roles isn't arbitrary. Many roles co-evolved to support each other: for many years, teaching funded research, which in turn taught skills that are hard to find elsewhere; massive endowments fund startup packages that give professors slack to do work that can't yet be justified to grant committees; there's a lot of value to a self-propagating intergenerational culture that pulls very different people together for different reasons.

There are many examples of beneficial bundling. Bell Labs declined precipitously when AT&T was broken up. One of the reasons Apple products can deliver the experience they do or SpaceX can reduce launch costs is because vertical integration bundles many functions together. The state of streaming content in early 2025 where content is balkanized across a dozen different services makes it clear that unbundling is not an unmitigated good.

Actually-existing university unbundling has mixed results. There are a number of examples of places where research *has* been unbundled from the rest of the university and yet hasn't produced particularly outstanding results. The Perimeter Institute and the Institute for Advanced Study come to mind. This isn't to disparage them as organizations, only to illustrate the point that unbundling alone is not sufficient!

Bundling enables cross-subsidization. Revenue is a strong argument *for* bundling. A university's profitable roles can fund important but unprofitable ones: the university's hedge fund, sports teams, and professional schools subsidize basic science, scholarships, and english departments.

Universities are lindy. Chesterton's Fence is the final argument against unbundling the university. Universities have evolved over hundreds of years to get where they are today. Some of them, like Oxford and Cambridge, have unbroken lineages to when what we call universities became a thing. Harvard predates the United States and I will bet money that it will outlast the Nation in its current form. While there are many problems with universities, they have also been a huge civilizational boon. There are surely hundreds of hidden load-bearing dependencies within the bundle that we'll only discover when we attempt to separate two roles.

That all being said, the bundling pendulum has swung so far to one side that the marginal return to doing some unbundling is too high not to attempt it. But these arguments should impress on us that doing unbundling well will be hard and shouldn't be undertaken lightly.

Concrete steps towards unbundling

It's fine and good to say "unbundle the university" but *what does that mean concretely?* There's a whole laundry list of things *you* can do in many different institutions: from private companies to foundations to governments to your capacity as an agentic individual. Here are some, but nowhere near all of them:

- Stop requiring university affiliations for grants.
- Judge people on portfolios, not degrees.
- Reduce cycle times for funding research.
- Simply stop expecting universities to be the solution to society's ills.
- Experiment with how universities are run.
- Focus on the effectiveness of an organization for achieving its stated goals.
- Celebrate institutions and individuals who support and fund weird institutional experiments.
- Create ways for people to learn about culture and the humanities.
- If you have access to spare physical resources like lab spaces or machine shops, make it possible for unaffiliated people to use them.
- Give people shit for getting unnecessary degrees.
- And more broadly, think about better ways to do the role that you in particular care about than just saying "universities should just . . . "

To illustrate what new institutions might look like, I'll describe two ideas (that are secretly two ways of looking at the same thing). These ideas are focused on the pieces of the university bundle that I particularly care about: pre-commercial technology research (especially in materials and manufacturing) and creating the most hardcore scientists and technologists the world has ever seen. (If you want to help make either of these happen, you know where to find me.)

A hardcore institute of technology

The quality of technical education in the US is abysmal. (Not in small part thanks to overloading university roles.) Elite technical institutions have fallen prey to broader trends in higher education: lower standards, A's becoming the dominant grades, becoming more of a certification than skills generating. You can graduate from an Ivy League school with a degree in chemistry without ever having taken a class in linear algebra. Even the quality of Caltech students (once a bar for brutally hard technical training) has fallen off a cliff. From personal experience, there are almost no schools that carry the signal that "this person is a technical badass."

If we're going to build the future, we need to change this. If we (both the US and globally) are going to make it, we need obscenely hardcore technologists. The US has lost the ability to systematically produce extremely hardcore scientists and technologists.

Counterintuitively, the way to train hardcore scientists and technologists is not to build yet another school. Instead, you start by building a research lab for experienced misfits that is working on real, serious problems. Serious technical training needs to happen in a serious context of use. Smart technical managers know this: portfolios are starting to matter far more than credentials. Working on specific teams at certain companies is now a far better indicator of quality than any degree – a successful tour of duty at SpaceX has more signal than going to MIT.

Once the lab is running, you start bringing in "journeymen" who have some training or experience, but are not yet masters of their craft. These folks would be the equivalent of grad students but with the explicit understanding that they are not students and this is not a degree-granting program: the deal is that they will get some slack for not knowing everything up front, they will work their butts off, and will become the most hardcore scientists and technologists the world has ever seen. This would be like the navy seals of technical training – you know that anybody who comes out of this place is the best of the best.

A bit later you bring in "apprentices." These are high-school graduates or younger who love science, building, and are ready for a trial by fire. Again — no grades, no degree, and no accreditation; just experience and an incredible portfolio.

It's worth reemphasizing that *this needs to primarily be a place devoted to doing serious work* — when most people think about education, they think about schools and toy projects. Learning in the context of serious work was part of Humboldt's original idea behind the German University model, but has been lost in translation over time and between places. From personal experience, the thing that made the Caltech undergraduate education so unique was that it felt bolted on to a place primarily devoted to scientific research, not the main purpose of the organization. We *knew* we weren't the most important thing — we were there to learn from the people who were doing the important thing.

Classes are still important for learning, but they would be directly in service of making journeymen and apprentices as amazing as they can be at doing science and technology, not as an end in and of themselves.

What kind of research would the Hardcore Institute of Technology do? Well, there are no better contexts for people to learn how to manipulate atoms, scale technologies, and do consequential work than materials and manufacturing ...

America's Manufacturing Research Center

Everybody knows that the US industrial base has been hollowed out. And, even outside of geopolitics, we are not going to expand to the stars manufacturing things effectively the same way we have since the 1930s. If we're going to succeed, both as a nation and a species, we need to create entirely new *paradigms* for manufacturing; to do that, we need to build an organization focused on pre-commercial manufacturing research to unlock those new paradigms.

A lot of current reindustrialization discourse and work focuses on building up (particularly high-margin) military manufacturing capabilities. But *military manufacturing capabilities are in large part just general manufacturing capabilities.* The reason the US was able to outproduce everyone else in WWII was because places like General Motors and General Electric transitioned their existing capabilities from making cars and toasters to making tanks and airplane engines. This general capacity looks like the ability to *economically* manufacture several kinds of *low-margin* outputs:

- Precise basic components like bolts
- Multi-material components like electric motors
- Assemblies like toasters

We're not going to build this capacity and manufacture things cost-effectively in the US by putting up tariffs and otherwise trying to out-China China. Even ignoring their heavy government subsidies, they've gone too far down the learning curves of conventional ways of manufacturing things.

The way that we're going to rebuild manufacturing capacity in the US is the same way you disrupt an entrenched player: by changing the game and creating a new paradigm. Changing the game enabled minimills to displace big steel factories as dominant steel producers, cell phones to displace desktops as the most prevalent computing devices, and submarines and aircraft carriers to displace battleships as the most dangerous things on the ocean.

It's tempting to try to create new paradigms by bolting new technology onto old systems. Navies first tried to incorporate airplanes by towing seaplanes or retrofitting battleships with small runways. In retrospect, the correct solution was aircraft carriers. New paradigms require rethinking entire systems around new capabilities. The new systems look strange or even silly through the lens of

an old system — "so you're telling me you're going to create a gigantic ship that just has a big ol' flat runway on top of it?" Successful American manufacturing in the 21st century won't look like American manufacturing in the 20th; it will be based on entirely new paradigms.

These paradigm shifts aren't going to happen solely through startups or modernizing existing shops (the two existing approaches to industrialization). VC-funded startups excel at high-margin work, point solutions, and scaling products. Existing shops don't have the margins to do expensive, high risk experiments. Creating new manufacturing paradigms requires a lot of expensive experiments to create low-margin products.

Creating new manufacturing paradigms needs a network built around an *ambitious industrial research lab* laser-focused on *building useful, general-purpose technologies* and getting them into the world. This is how we can do systems-level research happening in tight communication with existing industry. Analogies to past orgs are fraught, but a good analogy might be "the Xerox PARC of manufacturing": skilled practitioners building new paradigms by "dogfooding" — using their own tools to do serious work.

Manufacturing's low-margin nature and the positive externalities from paradigm-shifting research means that the lab itself will not be a great financial investment. Creating entirely new systems is hard to do, but straightforward to emulate. That's why it looks obvious in retrospect. It's hard to capture the value of new paradigms directly and trying to do so can ultimately hamstring their impact. Instead, the value will be captured by wherever the lab is physically located, the nation, and eventually the world.

These are just two of the hundreds or thousands of other things that need to be built. We need to try...

- Experimentation with state universities
- Industry schools/skill factories
- Science houses
- Focused research organizations
- Alternative credentialing

And so many other things that people have proposed and I don't know about or haven't even been thought of yet.

Beyond Monopoly

Our current university system – where a single type of institution dominates everything from job training to moral instruction to technology creation – is a

historical anomaly. Until shockingly recently, these roles were distributed across diverse institutions: technical skills came from apprenticeships and technical schools, cultural education happened through libraries and cultural societies, technology was created by industrial labs and independent inventors.

This institutional diversity wasn't just about research – it reflected a fundamental reality about human knowledge and development: different kinds of learning, discovery, and creation thrive under different constraints and incentives. A system optimized for teaching philosophy makes a poor environment for training mechanics. An institution focused on scholarly publishing will naturally conflict with one trying to build useful technologies. A bureaucracy designed to shelter young adults and avoid lawsuits is rarely good at fostering breakthrough innovations.

We've spent a century trying to solve problems by adding more requirements, oversight, and complexity onto universities. It hasn't worked. Instead of trying to reform a single overburdened system, we need to create space for new institutional diversity:

- **If you're in a position to make hiring decisions:** evaluate candidates based on demonstrated capabilities and portfolios, not degrees. Create apprenticeship programs that focus on real skills rather than credentials.

- **If you control physical resources like lab spaces, machine shops, or meeting spaces:** find ways to make them available to independent researchers, builders, and learners. The next breakthrough might come from someone who just needs access to basic tools.

- **If you're involved in funding:** question requirements that force everything that isn't a good investment through universities. Create parallel paths for independent researchers, teams, and new institutional forms.

- **If you're a student or parent:** think critically about what you actually want to learn or achieve. There might be better paths than a traditional degree.

- **If you're a builder:** create focused alternatives that do specific things well. The world needs new forms of credentialing, new approaches to cultural education, new ways of organizing research.

This transition won't be neat or predictable. Many experiments will fail. But the alternative – continuing to overload a single institutional form until it breaks under its own weight – is far worse.

The university will remain an important part of any new ecosystem. The university has been around since before the nation-state; it will likely outlast it. But universities should be one institutional form among many, not a monopoly

provider of every high-status form of learning and knowledge creation.

The question isn't whether this transition will happen - it's already beginning as the strains on the current system become unbearable. The question is whether we'll shape it thoughtfully and intentionally, or let it happen chaotically and destructively. The future we want - of breakthrough technologies, deep learning, and expanding human capabilities - depends on our answer.

Gratitude

Thank you to the people who gave feedback on drafts of this piece: Jessica Alfoldi, Adam Mastroianni, Josh Greenberg, Andy Matuschak. And thank you to so many others whose wisdom and ideas contributed to this piece.

References

I primarily tried to link to relevant resources in the body of this piece. There have been far too many things written about this topic to possibly list them all. This bibliography is meant to be an evolving collection of interesting related work that doesn't have a direct connection in the text.

1. The DDOS Attack of Academic Bullshit
2. Caltech Faculty Letter on the State of the Undergrads (Archived version)
3. A Vision of Metascience
4. A Thread on Experimenting with State Universities
5. Arnold Kling's How to Fix Higher Education
6. Two Essays on Boston University's Decision to Pause PhD Admissions
7. A History of the University in Europe Volume III
8. Creating the Market University
9. An Interview with the Stanford President, in particular this bit:

think that's a very good question. I think universities like Stanford have for many years played such an important role in the country as the source of ideas and new knowledge and discovery and innovation and the place that is the magnet for talent from all over the world. People have the chance to explore and learn and go off and make significant contributions.The most important part of university leadership is to try to sustain that crucial mission. So that hasn't changed, that's always there and always will be there in another 20 or 100 years.

10. Dropping College Enrollment
11. Data on R&D Expenditures in the US
12. An article on professors leaving academia to do biomedical research