Hi! As a research & development (r&d) org stewarding a research-heavy ecosystem, thinking through Flashbots', and the MEV ecosystem's, r&d processes and innovation system is an ongoing challenge we are facing, and a topic i've found fascinating to explore.

The post below is a list of all kinds of resources on the r&d process, and innovation systems. It was initially compiled for internal purposes but I figured it's worth sharing it with you all, and most importantly worth getting your own contribution added in there (either as additional links or comments you might have)

Selfishly, I'm also looking for a sparring partner for an unfinished post currently titled 'Building the Bell Labs of Crypto', see below for more details!

Some of the items on the list have my own notes. Also, you'll notice the list is currently quite Ben Reinhardt-ish, shoutout to him and shoutout to Lakshman for introducing me to his work nearly 2 years ago now

Before we start, quick definition from Wikipedia:

Innovation System (def): The concept of the innovation system stresses that the flow of technology and information among people, enterprises, and institutions is key to an innovative process. It contains the interactions between the actors needed in order to turn an idea into a process, product, or service on the market.

Table of Contents

Resources List

- https://benjaminreinhardt.com/wddw Why Does Darpa Work?
- DARPA is an outlier organization in the world of turning science fiction into reality. Since 1958, it has been a driving force in the creation of weather satellites, GPS, personal computers, modern robotics, the Internet, autonomous cars, and voice interfaces, to name a few. However, it is primarily limited to the domain of defense technology – there are DARPA-style ideas that are out of its scope. Which emulatable attributes contributed to DARPA's outlier results? What does a domain-independent "ARPA Model" look like? Is it possible to build other organizations that generate equally huge results in other domains by riffing on that model?
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- https://benjaminreinhardt.com/parpa Follow-on piece, Shifting the impossible to the inevitable – How can we enable more science fiction to become reality?
- Looking to successful outliers from history is a good place to start. After digging into why DARPA works, I asked the follow-up question: how could you follow DARPA's narrow path in a world very different from the one that created it?
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- https://www.ideamachinespodcast.com/ Idea Machines podcast
- a deep dive into the systems and people that bring innovations from glimmers in someone's eye all the way to tools, processes, and ideas that can shift paradigms. We see the outputs of innovation systems everywhere but rarely dig into how they work. Idea Machines digs below the surface into crucial but often unspoken questions to explore themes of how we enable innovations today and how we could do it better tomorrow.
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The following episodes are most relevant to us currently (although many others are interesting)

- Rethinking R&D with Adam Wiggins [Idea Machines #4]

My Guest this week is Adam Wiggins, the cofounder of Ink & Switch — an independent industrial research lab working on digital tools for creativity and productivity. The topic of the conversation is the future of product-focused R&D, the Hollywood Model of work in tech, Ink & Switch's unique organizational structure, and whether it can be extended to other areas of research.

- Bypassing Systems with Gary Bradski [Idea Machines #9]
- In this episode I talk to Gary Bradski about the creation of OpenCV, Willow Garage, and how to get around institutional roadblocks.
- Key Takeaways
- Aligning incentives inside of organizations is both essential and hard for innovation. Organizations are incentivized to focus on current product lines instead of Schumpeterian long shots. Gary basically had to do incentive gymnastics to get OpenCV to exist.
- In research organization there's an inherent tension between pressure to produce and exploration. I love Gary's idea of a slowly decreasing salary.
- Ambitious projects are still totally dependent on a champion. At the end of the day, it means that every ambitious project has a single point of failure. I wonder if there's a way to change that.
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- Sciencing Science with Evan Miyazono [Idea Machines #13]
- In this episode I talk to Evan Miyazono about tackling metaresearch questions, how novel physical phenomena go from "oh that's cool" to devices that harness cutting edge physics, and how we could better incentivize the creators of innovations where traditionally it's hard to capture value, like open-source software and early-stage research.
- Key Takeaways
- There might be ways to demystify both intuition and "big H Hard" research research in order to improve our systems for breakthrough discoveries. It's still super speculative but worth thinking about.

- Observations about physical phenomena and the world are at the core of many innovations, but the most of the process is driven from the top down by the problem, rather than bottom-up by the solution. On top of that, the process of solving the problem can actually feed back and increase our understanding of the underlying phenomena.
- Finally, there might also be new legal structures we could put in place to encourage more open-source development and fundamental research by allowing people to access more of the value they create in those activities.
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- Compounding Ideas with Sam Arbesman [Idea Machines #16]
- In this conversation Sam Arbesman and I talk about unlocking cross-disciplinary innovations, long term organizations, combinatorial creativity and much more. As you might expect from someone with Generalist Thinking as a main area of interest, Sam has out-of-the-box insights in a ton of domains and he’s amazing at capturing them in tight concepts like “knowledge mining” and "jargon barriers.”
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- Systems of Progress with Jason Crawford - [Idea Machines #22]
- In this episode I talk toJason Crawford about his work on the history of progress, funding and incentivizing inventions, ideas behind their time, and more. Jason is the author of the Roots of Progress blog, where he focuses on telling the story of human progress in an amazingly accessible way.
- Key Takeaways
- Funding structures

are understudied as a progress-enabling mechanism

- Why

inventions happen is not so straightforward as we might think*

- Culture may matter more than we think for building the future and there are concrete things we can do to build a

culture of progress

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- Invention, Discovery, and Bell Labs with Venkatesh Narayanamurti [Idea Machines #27]
- In this episode I talk to Venkatesh Narayanamurti about Bell Labs, running research organizations, and why the distinction between basic and applied research is totally wrong. Venkatesh has led organizations across the research landscape: he was a director at Bell Labs during its Golden Age, a VP at Sandia National Lab, the Dean of Engineering at UC Santa Barbara and started Harvard's engineering school.
- Main Takeaways
- Research depends on good people and trusting those people.
- In order for the first point to happen, people who are responsible for research organizations need to grok the research
- We should really stop using the terms basic and applied research

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- Philanthropically Funding the Foundation of Fields with Adam Falk [Idea Machines #45]
- In this conversation, Adam Falk and I talk about running research programs with impact over long timescales, creating new fields, philanthropic science funding, and so much more. Adam is the president of the Alfred P. Sloan Foundation, which was started by the eponymous founder of General Motors and has been funding science and education efforts for almost nine decades.
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- Institutional Experiments with Seemay Chou [Idea Machines #47]
- Seemay Chou talks about the process of building a new research organization, ticks, hiring and managing entrepreneurial scientists, non-model organisms, institutional experiments and a lot more!
- She has thought deeply not just about scientific problems themselves, but the meta questions of how we can build better processes and institutions for discovery and invention. I hope you enjoy my conversation with Seemay Chou
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- She has thought deeply not just about scientific problems themselves, but the meta questions of how we can build better processes and institutions for discovery and invention. I hope you enjoy my conversation with Seemay Chou
- The Idea Factory: Bell Labs and the Great Age of American Innovation by John Gertner– story of Bell Labs and how they nailed r&d for multiple decades.
- some selected quotes from the Idea Factory book about Bell Labs from my own notes (link should be public):The Idea Factory: Bell Labs & The Great Age of American Innovation notes
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- https://benjaminreinhardt.com/innovation-org-principles/ Principles For Innovation Orgs

My (old) notes on the article

- small, ad-hoc teams for innovation
- low barriers to communication
- // Calendly helps, but need free calendar tho
- // Slack - people posting in channels and joining channels organically
- // a forum, should we post research ideas/product ideas there?
- // should we enshrine the 80/20 culture?
- // is there any more we could do to lower barrier of communication?
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- instigators, visionaries and operators

- // who is an instigator at flashbots?
- // do we have the right mix of instigators, visionaries and operators?
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- // do we have the right mix of instigators, visionaries and operators?
- misaligned timescales can stifle innovation, how can we extend our timescale?
- research is an unscheduled activity to leads to unknown results, development is a scheduled activity that leads to known results
- the switch from one to the other should only happen once we're convinced we can get to a known result in a known amount of time
- // hmm don't know if I agree with that
- the switch from one to the other should only happen once we're convinced we can get to a known result in a known amount of time
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- innovations need to be targeting capturable value on some

time horizon

- innovations need to be coupled to a stable money factory
- //how can we make MEV revenue stable to fund innovation? should that be more explicitly one of our core aims?
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Takeaways

- facilitate communication
- look for profiles who can be instigators/visionaries/operators?
- align with capturing value on some time horizon
- how do we make failure ok in research but foster big ambitions?
- should there be a decoupling of research & product over time because the incentives and delivery will be different?
- how do we create a smoother bridge between research & product?
- what should we be doing differently to foster more innovation? do we want to do so? how?
- https://benjaminreinhardt.com/grants On Grants

My (old) notes on the article

- disagree in our case that grants require low touch work
- small grant vs large grants and what they enable
- one-time small scope projects vs large-scale multi-person projects
- ideally, people could use a small grant for trust-generating work that they could use to get larger grants
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- one-time small scope projects vs large-scale multi-person projects
- ideally, people could use a small grant for trust-generating work that they could use to get larger grants
- the shadow of the future looms on grantees and they need to position their work for the next thing, you haven't actually escaped institutional incentives at all
- // nice quote
- // nice quote

- DARPA is a research coordination organization
- // cool
- // cool
- alternatives to one-time ‘small’ financial grants:
- fund someone indefinitely/for a longer period of time
- fund an institution with a different set of incentives eg.
- https://www.convergentresearch.org/
- https://actuateinnovation.org/
- https://dynamicland.org/
- grant status like ‘fellow’ rather than money, sometimes that helps more
- tranched funding
- offer non-monetary support
- nudge people to work on the right things
- proactively match other allocators, // should we look for matching partners for the grants we give?
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Some of these are cool advice to grow the grant program to something more meaningful! Excited about how we can learn from this

- parpa-2-pager.pdf
- PARPA (Private ARPA) is a new organization that aims to unlock robust technology that can open new frontiers both on earth and beyond. We're riffing on the DARPA model to design, fund, and coordinate ambitious research programs that shift the impossible to the inevitable.

These programs focus on new paradigms in manufacturing, near-magical materials, and technologically-empowered human capabilities. This impactful work is often too researchy for startups, too engineering-heavy for academia, and too weird for governments to take on.

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- Richard Hamming, ``You and Your Research'', Transcription of the Bell Communications Research Colloquium Seminar
- This talk centered on Hamming's observations and research on the question ``Why do so few scientists make significant contributions and so many are forgotten in the long run?'' From his more than forty years of experience, thirty of which were at Bell Laboratories, he has made a number of direct observations, asked very pointed questions of scientists about what, how, and why they did things, studied the lives of great scientists and great contributions, and has done introspection and studied theories of creativity. The talk is about what he has learned in terms of the properties of the individual scientists, their abilities, traits, working habits, attitudes, and philosophy.
- related: Hamming, "Creativity" (May 23, 1995) - YouTube, Lecture series from the Naval Postgraduate School. He talks about Bell Labs extensively in this series. (ty Sam B!)
- also related: The Art of Doing Science and Engineering, by Richard Hamming
- What inspires a great idea? Can we train our thinking to develop world-changing understandings and insights? Richard Hamming would say yes. In The Art of Doing Science and Engineering

, he elaborates on his seminal essay "You and Your Research," a provocative challenge to anyone who wants to build something great, and offers a manual of style for how to get there. Playfully framed as a textbook, and rich in its recounting of influential individuals like Albert Einstein and Grace Hopper, this unorthodox memoir by the seminal mathematician and engineer encourages the reader to aspire to, learn from, and surpass the achievements of yesterday's greatest minds. This edition includes the original 1996 compilation of Hamming's lectures for the U.S. Naval Postgraduate School, along with a new foreword by designer and engineer Bret Victor and more than 70 redrawn graphs and charts.

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- Studies on Slack, Slate Star Codex
- Piece of the Action, Vannevar Bush (ty Sam G!)
- In Pieces of the Action

, Vannevar Bush—engineer, inventor, educator, and public face of government-funded science—offers an inside account of one of the most innovative research and development ecosystems of the 20th century. As the architect and administrator of an R&D pipeline that efficiently coordinated the work of civilian scientists and the military during World War II, he was central to catalyzing the development of radar and the proximity fuze, the mass production of penicillin, and the initiation of the Manhattan Project. Pieces of the Action

offers his hard-won lessons on how to operate and manage effectively within complex organizations, build bridges between people and disciplines, and drive ambitious, unprecedented programs to fruition. Originally published in 1970, this updated edition includes a foreword from Ben Reinhardt that contextualizes the lessons Pieces of the Action

can offer to contemporary readers: that change depends both on heroic individuals and effective organizations; that a leader’s job is one of coordination; and that the path from idea to innovation is a long and winding one, inextricably bound to those involved—those enduring figures who have a piece of the action.

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- Scientific Freedom, Donald W. Braben
- So rich was the scientific harvest of the early 20th century that it transformed entire industries and economies. Max Planck laid the foundation for quantum physics, Barbara McClintock for modern genetics, Linus Pauling for chemistry—the list goes on. But in the 1970s, the nature and pace of scientific discovery began to stagnate due to a combination of peer review, mandated justification of spending, and the push for short-term miracles. In Scientific Freedom

, first published in 2008, Donald W. Braben presents a framework to find and support transformative scientific innovation. Even in the earliest stages, groundbreaking research can look unrecognizable to those who are accustomed to the patterns established by the past. As Braben argues, support for this research requires rethinking the processes used to discover and sponsor scientists with revolutionary ideas—and then giving them the freedom to explore.

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- The Dream Machine, M. Mitchell Waldrop

- Behind every great revolution is a vision, and behind one of the greatest revolutions of our time—personal computing—is the vision of J. C. R. Licklider. He wasn't an engineer and he didn't start a company or write code; instead, he was a relentless visionary who saw great potential in the way individuals could interact with computers and software. At a time when computers were a short step removed from mechanical data processors, Licklider was an enthusiastic catalyst for the seminal research that ultimately led to the internet. In a simultaneously compelling personal narrative and comprehensive historical exposition, The Dream Machine

by M. Mitchell Waldrop tells the story of the birth of the computing revolution through the life of a man who shifted our understanding of what computers were and could be. Originally published in 2001, the book now appears in a new edition, which includes the original texts of Licklider's three most influential writings.

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Misc

Unfinished post, wanna collaborate?

If one of you is inspired and feel like collaborating on finishing this blogpost from a while ago 'Building the Bell Labs of Crypto', you're welcome to reach out

The goal with this article is to try to a) distill learnings from Bell Labs, b) reflect what unleashing such intense level of innovation would look like in crypto given the industry's particular characteristics (open source, remote, crypto quirks). The idea to noodle on is wether there will not (and perhaps cannot) be a singular organization like Bell Labs but rather there is (and will be) a network of research nodes that together form the Bell Labs of Crypto (shoutout Tina). Using this mental model, we can now reason about this network as an innovation system, and attempt to apply learnings from Bell Labs & other successful r&d organizations to it to spot gaps and reflect on what we can do better.

Here's the intro:

- Bell Labs is one of the most successful industry research & development organization in history. Between the 1940s and 1990s, the organization was the place where Information Theory, modern cryptography, the transistor, the UNIX operating system, radar technology, satellite communication, cell-network communication and thousands of other breakthroughs saw the light of day, changing our lives forever.What made Bell Labs so successful? What can we learn from it and how can we create the 'Bell Labs of crypto'?

(cool) Diagrams

source: https://benjaminreinhardt.com/inktober-2018/, https://benjaminreinhardt.com/inktober-2021#quadrants

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Research_Management_Quadrants

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