develop new technologies! The fundamental input into all technologies is human labour and we are that labour! You are that Labour! You have no clue how good the future is going to get when you work harder!

Appendix: More Examples of Applications of S-Curves

I'm currently reading *Eccentric Orbits: How a single man saved the world's largest satellite constallation from fiery destruction*. This book covers the Iridium satellite cellphone call constellation and it goes through a great example of an S-curve that looks like many discrete processes at first glance. The first stage began with the Motorola study into building a satellite constellation for handling phone calls began around 1988 (phase 1). The Iridium constallation began deployement in 1997 and the first call was made over the network in 1998 (Still phase 1). They had a brief encounter with bankruptcy and later began scaling the constellation and launching a new generation of satellites as revenue increased (Phase 2). At this point the Iridium phones were still a very niche product without much market penetration except in the very unique cases in which there was no better alternative. Next, Starlink entered the satellite internet market and began growing exponentially (Phase 3) (Note: I keep stubling upon this Brian Wang guy writing about SpaceX). We're currently living through phase 3 of the S-curve, in a decade or two we'll see Starlink reach market saturation and a few decades after that Starlink will be replaced by a new, better techonlogy.

If you imagine yourself at any stage in the story detailed above except the current one, it would not look like any exponential growth was occuring or like you could apply learning rate to understand the future of the industry - part of the reason for this is that little data would exist to determine learning rate or see the S-curve. You could be living through the brief bankruptcy of Iridium and think that the technology was a failure, but the underlying technology was still improving either through direct research or through external development. For example, while the original proposal for Iridium was being worked on at Motorola, satellite buses and other components were gradually becoming less expensive, and by extension the cost to develop a satellite internet/call constellation constellation was decreasing (Exponential Growth).

Appendix: Latent Demand

Latent demand is desire for a product or service that currently isn't offered in the market. Like I mentioned in the previous appendix, there are situations in which the fundamental technologies behind a product improve without direct investment into that product. For example, solar cells leverage semiconductor lithography which has been improving for decades due to investments into integrated curcuits. Over several decades, the fundamental technology behind solar cells was

improving and decreasing in cost even while there was little direct investment into solar cells.

So, the theoretical price for solar was decreasing and hence the theoretical demand for solar was increasing. However, these prices had to be realized by increasing production through direct investment into solar cells. This means a technology can have a long period of indirect advancement, followed by a period of brief extreme growth that realizes the gains of the previous time period.

Another example is Starlink. There is a lot of latent demand for internet in rural areas and other locations that are not adequately served by current internet providers. However, there was no way to affordibly meet this demand. Existing companies like Iridium and all the others tried to meet this demand but could not do so. In comes SpaceX, which leveraged decades of materials science, electronics, and rocketry advancements to build the partially-reusable Falcon 9 which allowed them to launch the Starlink constellation at a low enough cost that they could provide affordable and high performance satellite internet service to underserved customers.

Throughout the decades before Starlink, satellite and launch vehicle technology was improving but these improvements were not being properly realized. Legacy launch companies like ULA had very little incentive to decrease cost and increase cadence. This never allowed an opportunity to get the exponential, compounding growth that learning rate describes. My blog post NASA's fucked - Here's my vision goes into some of the perverse incentives in the space industry that prevented this growth. In short, there was never a good enough opportunity for a company to create a satellite internet constellation before SpaceX came along. SpaceX realized decades of improvements in rocketery and pushed the field forward themselves to build the fundamental technology needed for a successful and profitable satellite internet constellation.

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Geohot made a blog too. You should be working on hardware

Why You Should Accumulate Capital

Oct 21, 2024 • Christopher Kalitin

What Money Is

This blog post is not "Why You Should Be Rich." When most people think about being rich the first thing that comes to mind is buying power. "I want to win the lottery so I can live on a yacht with a Lamborgini and an expensive watch." This is fundamentally spending your money to purchase goods and services - you do not get this spent money back. This spending is used to increase your quality of life or for other mainly hedonistic reasons.

Many self-made millionaire types (Real estate brokers / builders, sweaty startup founders, etc.) often call this hedonistic spending "burning capital." The transactions described above are not net positives for your bank balance. You spend money to receive goods that depreciate or for services that are consumed. For the purposes of this blog post, I will use this colloquial definition of money.

Fundamentally, prices are a mechanism for the allocation of scarce resources. You spend money to purchase these scarce goods/services. This basic economic principle is why spending money is a net negative for your bank balance.

For this next section, it's useful to temporarily remove the word money from your vocabulary. We need to solve the problem of allocating scarce resources. You require food, shelter, a mate, etc. to live and all these resources are scarce. This poses the problem of how best to allocate these resources to individuals. Under almost all economic systems you earn the right to scarce resources through providing value - even under Communism this basic meritocratic principle exists. You provide value through your work and are paid in a currency that can be exchanged for resources. For example, in feudal times you could work to produce wheat which is exchanged for other goods and services or given to your lord for the right to produce more wheat. Our modern economic system uses money as a measurement of both produced and consumed value. For this reason, in edge cases, it is possible to gain the right to scarce resources (eg. winning the lottery) without providing value (working).

What Capital Is

Money quantifies inputs into production processes and is often treated as an input itself. Just like all the other inputs - people, materials, land, etc. - it is consumed by an enterprise. However, the most important difference between money and other resources is that money is both an input and an output of all production processes. Unlike wood or steel, money doesn't constitute any physical object because money is a measurement of value. You cannot recoup the exact wood and steel that were used to build a factory, but you can recoup the exact money that was used to purchase those materials because every dollar is the same as every other dollar. Dollars are measurements, not anything physical.

Because money is fundamentally both an input and output, we don't need to consider it in the same way we consider other inputs. The most important element of capital is that it can gain value over time. Unlike money - which is spent and never returns to your bank account (mostly) - allocated capital can turn into more capital. An investor can put capital into a project and receive more capital in return - they receive the same exact resource they put in. This is not also true of lumber because lumber is consumed and not used as a currency. Fundamentally, money is spent on goods and services while capital is used to make more capital. Unlike money, capital is allocated, not spent. Put more simply, capital is money that turns into more money over time.

Capital is fundamentally productive because each production step adds value. If this isn't true, there is a negative return on invested capital. For any production done in a competitive free market, the value of the output must be greater than the value of the inputs. This is an axiom that applies to all production. If this axiom isn't satisfied, the market quickly corrects itself and either the producer adapts or goes bankrupt.

It should be clear why capital is more useful than money from the perspective of individuals (using the colloquial definitions described above). Capital makes more of itself and can be converted into money at any time by making purchases. This is fundamentally why investing works. Instead of spending your entire paycheque, you can invest in the S&P 500 and bet on the absolute productivity of those 500 companies increasing. Later, you can withdraw your capital and spend it on more goods and services than you could have purchased otherwise.

Capital Is Power

Allocate Capital to Issues You Care About

"A market economy allows accurate knowledge to be effective in influencing decision-making even if 99% of the population does not have that knowledge. In politics, however, the 99% who do not understand can create immediate political success for elected officials and for policies that will turn out in the end to be harmful to society as a whole."
Thomas Sowell, Basic Economics, Chapter 15

Under our current democracy, every voter has roughly even say in all issues. This is inefficient because not every voter has sufficient knowledge in every field to make an effective decision. Representative democracy tries to solve this by having the voter elect a representative to make decisions on their behalf. The reason this fails is that if you know less than someone in a particular field, you are not the best judge of their skill in that field. You cannot grade a math test if you know less than the students taking the test.

Instead of evenly allocating decision-making on all issues among all voters we can allocate decision-making to those who have capital allocated in a particular field. This solves the problem of having a lack of focus in a democracy where you have a say in all issues. There are likely only a small subset of issues that actually affect you and that you care about. The vast majority of decisions to be made in your country are likely uninteresting and irrelevant to you. If instead, you could allocate your votes to the particular issues you care about, you could have far more of an impact.

This system of allocating your vote to a particular issue exists today. If you want to steer a corporation in a particular direction, you can buy stock and vote as a shareholder. Anyone can acquire enough shares of any company to have more of a say in the management of that company than they do in the management of their country. For example, there are 161 million voters in the US. To acquire one 161 millionth of Tesla, you would need to spend ~$5,000. It's important to note that your interests may more closely align with a company of a smaller market cap, making your capital more powerful in that company.

Battling in the Free Market Of Ideas Leads to Better Results

"*The best way to predict the future is to create it.*"
Peter Drucker / Alan Kay

This system of allocating decision-making with capital invested in a particular field is even more powerful if you work in that field. Those who have the most power to steer a particular field in a certain direction are those who work in it. If you have your life savings invested in your field, you are likely to have a tremendous knowledge of the field and a great incentive to steer it in the direction you believe is right.

The participants in this kind of democracy are the most invested and most knowledgeable. They battle in the market to see which ideas are the best. Because this is an idea that gets to economic markets, economic principles decide who wins. By extension, the agents in a field that produce the most value are the ones that win. This is an extremely important point to understand because the winners in this battle of capital and ideas are those who will benefit the market - and by extension humanity - the most.

Capital is Meritocratic Allocation of Power Over The Future

"You may not be interested in politics, but politics is interested in you."

Capital allows you to participate in the debate over the future of humanity. What's more important than this is that you aren't being allowed to participate by some other power. You aren't at the behest of the government, which has a monopoly on violence and can forcibly take away your vote if suboptimal events transpire. Your capital is power, and you are the one who decides to enter the game.

This system of allocating power is fundamentally meritocratic. To accumulate a large amount of capital you must first invest a large amount of time, intelligence, and focus into your particular field. These are table stakes to enter the debate over the future of humanity. This is unlike a political class where you only get in the door if you kiss enough ass and backstab a critical mass of individuals. Your success in a free market is dependent on you, and by extension, your influence on the future of humanity is completely dependent on you. Under extremely political systems, power is allocated to those who have the right connections and not those who have demonstrated their ability to do the job. Stalin did not come to lead the Soviet Union by proving his skills in managing a nation.

Distributing Power Is a Moral Good

"The utopians who have dreamed of avoiding this struggle always land in some variant where they force others to perform it for them."
The Capitalist Manifesto, Chapter 2

Under capitalism, power is concentrated under the rich and under the political class. Under communism, there is only the political class. Concentrating power in the hands of a small number of people is how we get evil and suffering. For this reason, distributing power is extremely important to have a bright future for humanity.

The Free Market Allows Autonomy For All

"A government is just a corporation in the limit."
E

The defining feature of a free market is that market participants are free to make their own decisions about which transactions to partake in. If you apply this principle to a society, everyone is free from the control of anyone other individual or group - so long as we all have the power to decide if we do or do not want to participate in transactions. Because a true free market allows individuals to make their own decisions, it is not purely rule by capital. A problem arises when you

consider how to maintain these individual freedoms and not degenerate into rule by capital, or, in the limit (Using the mathematic definition of a limit), rule by violence.

One of the beautiful manifestations of the mutual benefits of the free market is the "double thank you" as described in chapter 2 of The Capitalist Manifesto. Every time I've sold something on Facebook Marketplace both I and the buyer say thank you. We both agree to participate in a mutually beneficial transaction and both come out ahead. Thank you for allowing me to purchase this and thank you for taking it off my hands.

Liberal governments (in the classical sense of the word liberal: read What's Our Problem by Tim Urban and The Road to Serfdom by F.A. Hayek) have historically played the extremely important role of ensuring individuals have the freedom to make their own decisions. Violence is fundamentally required to ensure this fundamental freedom continues to exist because those with the power of violence have the ability to take away the freedom of others. For this reason, along with many others, the government has maintained its monopoly on violence within its own borders.

The issue arises when the government starts to abuse its absolute power of violence to impose its own will on the populace. Using capital to decentralize this power is a step in the right direction because it is far easier for a single entity with absolute power to control you rather than 1000 smaller entities. Individuals or groups with vast amounts of capital can also use this to control you, but from recent events, it is clear that the government exercises this power far more than private entities. The government is just a corporation in the limit. Would you rather have a single monopolistic corporation to transact with, or 1000 smaller corporations in competition where you can choose which one to transact with?

Concluding Thoughts

Get The Fucking Money

Chamath Palihapitiya did a great talk at Stanford in 2018, before the All-in Pod. This was the first place I was exposed to these ideas about gaining capital to be able to steer humanity into the path you see as the best possible future. The most memorable quote of his from this talk is, "Get the fucking money."

This is all on you. No one is going to implement your vision of the future for you. There's this idea from democracy that you can influence the future just by being given a vote. That is not true. There are vast currents in politics that you have very little control over by design - a tiny drop in a tsunami. You can either work hard to gain political power and become a member of this system that concentrates power or work hard to accumulate power and compete in the free market of

ideas.

Capital Vs. Genius

td;lr

The point of this blog post was to illustrate how you can acquire capital to be able to build your vision of the future and why it is good for many decentralized individuals to all work towards building their own visions of the future. I'm mainly going into this theoretical idea and not how to actually implement it. How to acquire vast amounts of capital is left as an exercise to the reader. However, how to allocate this capital to maximize impact on the future is a theoretical topic that is important to mention in this context.

Capital efficiency is an extremely difficult metric to optimize for. You can't throw capital at this problem because it is fundamentally determined by the intelligence and ability of those involved in a particular enterprise. Companies that amass vast amounts of capital famously become less efficient at spending this capital. Government agencies also suffer from this inefficiency of complacency.

Consider Blue Origin and SpaceX. Blue Origin had more access to capital in its early days while SpaceX was far more limited. This is inferred from Jeff Bezos's higher net worth than Elon Musk at the time. SpaceX has obviously been far more capital-efficient and successful than Blue Origin. This is not purely due to the frugality of a startup with limited ability to raise capital, but also the genius of Elon Musk.

Human capital is what most often drives new advances forward. Once an idea is fleshed out and proven, capital can be thrown at it to scale until it takes over the world. It takes a Frtiz Haber to invent and prove the process to synthesise ammonia and a Carl Bosch with a massive corporation, BASF, to scale this technology to the point where it can feed the world. Many have tried to throw capital at reusable rockets and all failed, Elon Musk was the genius that succeeded. This was a situation where genius was far more important than capital. To have extreme impact on the future of humanity you have to be a genius, but we are not all geniuses so the best you can do is accumulate capital and allocate it to where you believe the geniuses are.

You Should Sit In The Sauna

The idea for the blog post came to be when I was half-dead in the sauna. My brain had completely shut down from the complete drain of energy that saunas impose on you, and out of this deep sleepy pit, I recovered my energy and pointed my mind in the direction of thinking about capital allocation. This is a beautiful meditative process and you need to do it. Completely shut down your brain and when it starts back up, point it in a specific direction. I imagine this is

what Ayahuasca is like. I agree, I should take LSD.

One of the problems my recovering brain threw at me while I was still recovering my energy is how this philosophy of capital allocation connects with the idea of marriage. All your assets and money is shared in a marriage, which is a completely beautiful thing. But. My primary motivation in life is to maximize my impact on the future of humanity. Maybe it is wise for buying power (money) to be shared with my wife, and capital to be mine. Yeah, I should just read the Bible and go to church.

If you listen to economists for dozens of hours, you'll learn economics through Osmosis. I was halfway through Basic Economics by Thomas Sowell when I started writing this blog post. Now I'm reading The Capitalist Manifesto by Johan Norberg. Before this I read 1984 and The Road to Serfdom by Hayek. This was all through audiobooks I listened to (and took notes on) while on the bus or Skytrain in Vancouver. You can learn a tremendous amount just through diligent reading and taking notes. You should do this. You'll become a wizard in no time.

How to Teach Engineering

Sep 15, 2024 • Christopher Kalitin

I've started university. I have a lot of ideas on university that'll probably evolve over my time here, might as well write them down in the early weeks to be able to look back on this in the coming

years.

The Problem

I have an introduction to engineering class. I'm in a group of 5 and our purpose is to design a cardboard chair. We brainstorm cardboard chair ideas. We take quizzes on how to brainstorm. Then take more quizzes on how to pick which idea to take. Then finally after 4 weeks maybe we get to actually pick one of our own ideas. But it's very important that before that we play with paper for two hours and carefully observe how paper bends when we play with it. This is a requirement for playing with cardboard later in the class.

Who the actual fuck teaches engineering like this?

Ah yes make me wake up at 6 am every morning to take your quiz on how to play with cardboard. You haven't even given us cardboard yet, just paper. We have to work our way up to cardboard? really?

Make us write 3000 words over a month before you let us play with cardboard. I'm going to give my 2 year old cardboard out of spite. Watch him build a better chair at 3 than your months of lead up to giving 18 year olds cardboard.

The Real Process

I've had a tiny bit of experience with engineering projects.

This experience - and importantly comparing it to how my peers think about engineering - has illustrated to me exactly how useless this APSC 100 class is.

Engineering processes are emergent. You can't teach programming by focusing on syntax for two months before actually writing your own programs. Put ideas before implementation skills.

My intro to C programming class is only slightly better than intro to engineering. At least we build. It may be building a single function to output the value of x * y, but it's something. Afterwards you can show your classmates your 2 line solution versus their 10 lines and brag about how you're a better programmer. No one in the class has any idea what projects they want to make, but we at least get to build.

Out of this process of building, you start to understand why you actually do need to understand syntax and proper programming conventions. Then, you'll gladly read the textbook and learn the proper methods - you see the exact manifestations and efficiency gains by doing things the proper way.

Instead of this exciting process of exploration and figuring things out yourself - literally the process of science - you are forced to write 1000 words and with your group discuss the stakeholders for your cardboard chair.

The process of brainstorming -> evaluating -> building (and iterating back to any given step) is very useful. Let us figure that out ourselves.

The ideal of an engineer is someone who can turn dirt into value. How will you ever be able to do anything new if you're told everything that you must do by an authority?

A Beacon of Beauty in a Sea of Depressed Teenagers

I applied to the UBC Solar design team. Did my interview where I asked questions for 2 hours and answer questions for one hour. I was accepted.

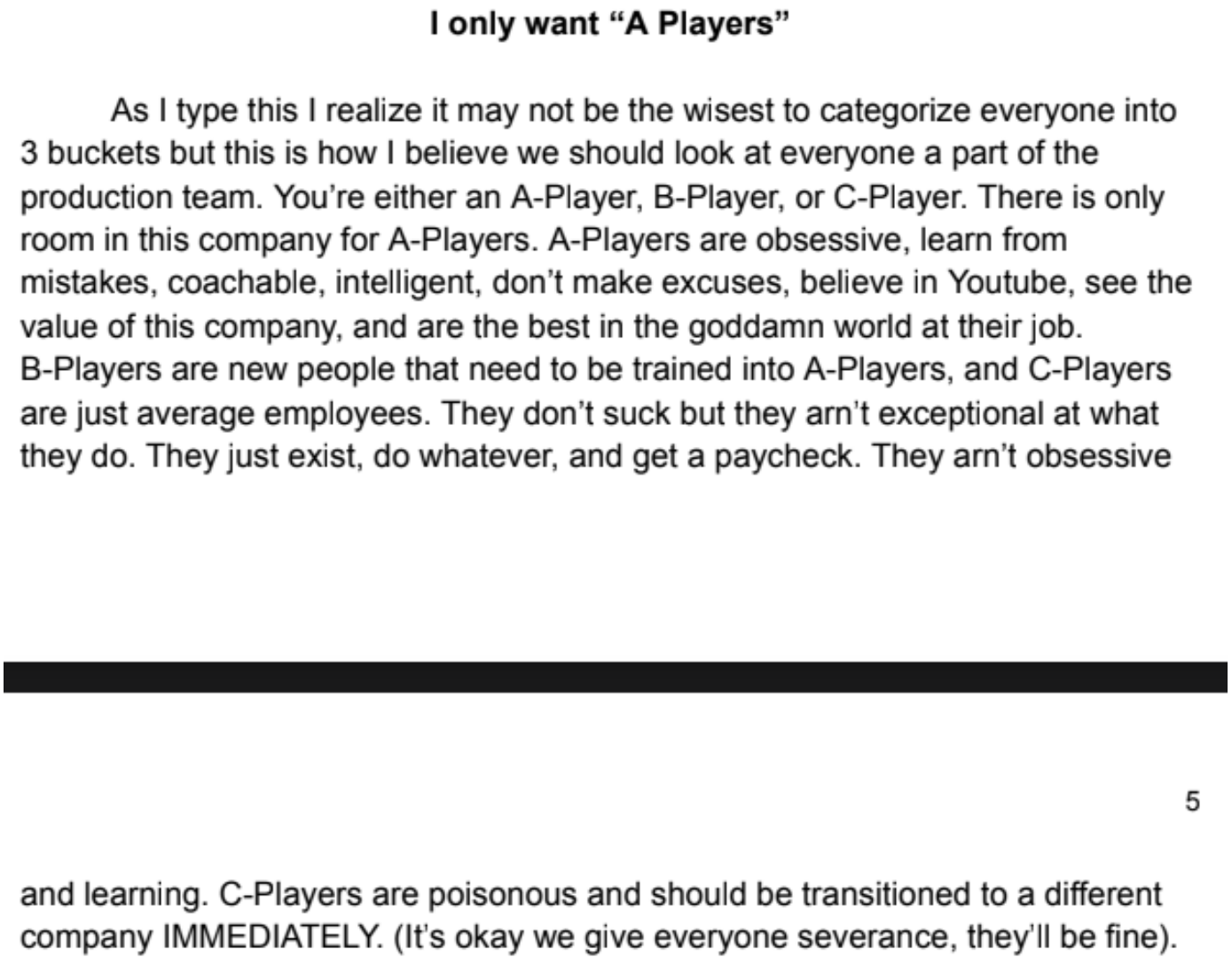
By asking endless technical questions to the team I explored the space of ideas and drew my own insights. This process was the most fun I've had in months. Talking to techincal people and asking endless questions is the most fun and useful things in the world. I didn't fundamentally understand how engines or fuel cells worked before this week. By asking 2 hours of technical questions, I finally grokked it.

All kids are born explorers, it takes years - sometimes decades - for schools to beat this out of them. Science is the process of exploring the space of ideas and understanding the universe. This is fundamentally a self driven and explorative process. The way you get great engineers and scientists is by letting them practice this process, not by telling them to follow your arbitrary rules on how to build a chair.

The vast majority of students probably would have trouble if you simply said, "You have one month to build a cardboard chair that fits these criteria. Go do it." Wait where do we start? Brainstorm ideas? But I don't like my teammates ideas, how do we manage that? EXACTLY! How do you manage this? You will have to figure it out yourself and in doing this, you'll learn far more than being told what to do. ALL KIDS ARE BORN EXPLORERS. Let them explore and find out how to climb a tree without breaking bones.

Like I said above, if your process of planning how to build a chair is really the best way to do it, we will all reverse engineer our way into it and figure it out ourselves. Through this process we will understand a tremendous amount about how to execute on engineering projects.

Life is a Skill Issue



I only want "A Players"

As I type this I realize it may not be the wisest to categorize everyone into 3 buckets but this is how I believe we should look at everyone a part of the production team. You're either an A-Player, B-Player, or C-Player. There is only room in this company for A-Players. A-Players are obsessive, learn from mistakes, coachable, intelligent, don't make excuses, believe in Youtube, see the value of this company, and are the best in the goddamn world at their job. B-Players are new people that need to be trained into A-Players, and C-Players are just average employees. They don't suck but they arn't exceptional at what they do. They just exist, do whatever, and get a paycheck. They arn't obsessive

5

and learning. C-Players are poisonous and should be transitioned to a different company IMMEDIATELY. (It's okay we give everyone severance, they'll be fine).

Mr Beast's memo/book to new employees got leaked. Everyone has to read this.

Teaching processes makes C tier humans. Making your own processes breeds A tier engineers. God put me on this planet to build, and you're wasting my time by stopping me from exploring the space of ideas.

Everything in life is a skill issue and all skill issues can be solved by increasing your skills. That's why "Skill Issue" is such a powerful term, you are in complete control of whether your problems remain skill issues.

Some of my group members care more about grades than learning engineering. SKILL ISSUE C TIER BEHAVIOUR. You need to learn engineering yourself. It is fundamentally a self driven process of exploration. School isn't trying to help you, the members of the design teams would love to help you, but you need to ask the right questions!

This has been the first in a series of posts I'll probably do on University. My guess is that the principles behind my words will remain true for eternity. This is a one-shot blog post, I've been

inspired by Mr Beasts constant spelling mistakes, just show your raw thoughts and yap. Eventually, your yapping will be intelligent enough that people want to listen.

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Geohot made a blog too. You should be working on hardware

Extrapolating Demand and Competition for the 1-ton Rocket Class

Aug 12, 2024 • Christopher Kalitin

Tell me where I'm wrong or just give compliments here.

Today four of the best space investing Youtubers posted their interview with Peter Beck and Adam Spice of Rocket Lab. Responding to one of Dave G's questions, Peter Beck said this about the 1-ton rocket class: "Our view of 1-ton is it's kind of a no man's land."

During this year I've written a few blog posts on the topic of 1-ton class rockets: Comparing Demand for Firefly's Alpha vs. Electron, Small Sat Constellations: The line between Electron and Rideshare, and Visualizing Small Sat Constellation Tradeoffs with Charts. The primary insights

from this research have been that there is little competition between the 1-ton rockets and Electron and that currently there is only a small niche of the constellation market that is optimal for the 1-ton class. Peter Beck's comments help to confirm some of my conclusions and prompts more research into the small sat constellation market.

In this blog post, I'll use my dataset (Based on Jonathan Mcdowell's public data, Gunter's Space Page, and others) to quantify how big the market for the 1-ton class rockets is.

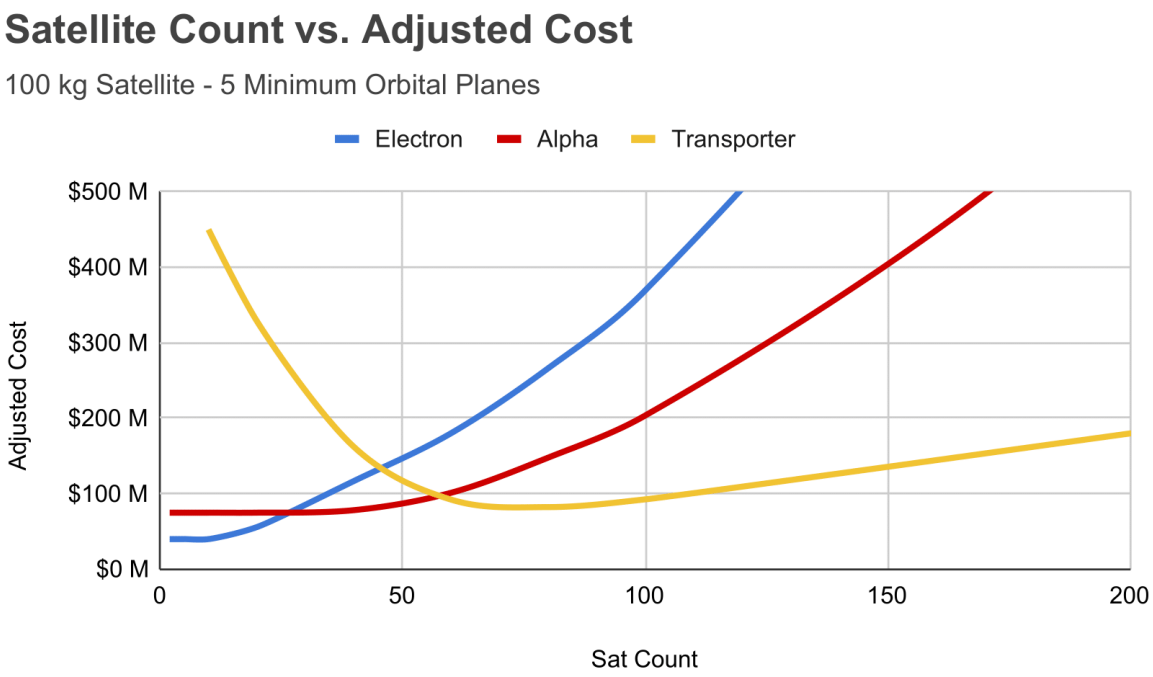
Don't Extrapolate the Early Launches

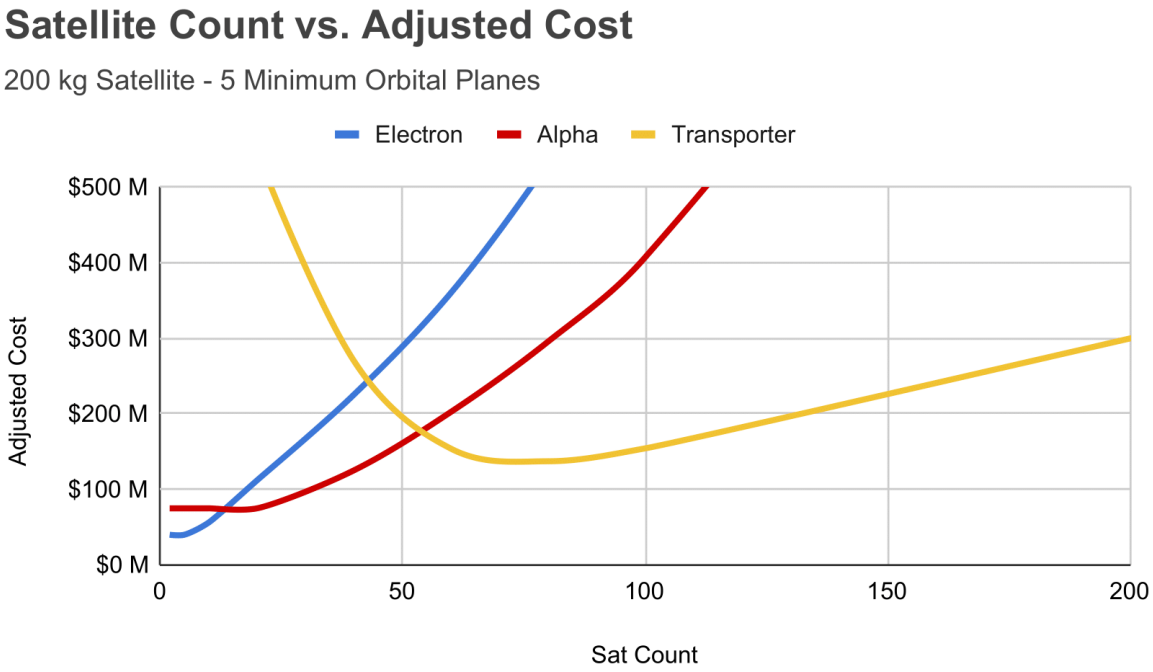
Despite the difference in size, Alpha's and Electron's first few flights resembled each other closely. Firefly's Alpha has flown 5 times to date and 3 of these missions were rideshare as part of their DREAM program or for NASA. This is the same as the first five Electron launches, 3 of them were rideshare carrying assorted satellites for Planet Labs, Spire Global, or NASA's ELaNa program.

As Alpha's and Electron's early launches proved, the first few launches of any vehicle are risky. This means that the first few launches of a new rocket are underpriced to account for the risk. The effect of this is the first few launches are not indicative of the future market due to the cheaper pricing. For example, in the last 3 years, Electron has launched 3 rideshare missions out of 28 total launches. "Beginning Of The Swarm", "Baby Come Back", and "There And Back Again". This amounts to ~10% of their launches vs. 60% during the first 5 launches. This is why we cannot directly extrapolate the first 5 Firefly launches and expect an accurate result.

"It's too small to be a useful rideshare vehicle and it's too big to be a dedicated vehicle." - Peter Beck. In this quote - again from the Dave G interview - Beck is referring to competing with Falcon 9 rideshare missions where specific orbit parameters and timing are worth sacrificing for a significantly lower cost. This reflects the early Alpha and Electron flights which were underpriced to account for the risk. However, Rideshare missions are not sustainable long-term on small launch vehicles because SpaceX has far better pricing power. In the second half of the quote, he says a 1-ton class rocket is too big to be a dedicated vehicle. This is because the vast majority of payloads that need the specific orbits and launch dates only available on dedicated launches are light enough to be launched on Electron, which is ~2x cheaper than Firefly's Alpha.

Most Constellations Are Optimized for Electron





The over-representation of rideshare missions is not the only source of uncertainty. The biggest upcoming market for rockets of all classes is constellations (70% of Rocket Labs 2024 launches so far). Small sat constellations are an even younger market than small sats themselves, so assumptions will have to be made in extrapolating the size of the market. The biggest assumption is what the distribution of satellite mass and total satellite count will be in upcoming constellations.

The competition between Alpha and Electron to launch constellations has parallels to the

competition between Electron and Falcon 9 to launch small satellites. Electron fills the niche of payloads that either need unique orbits or an accelerated launch date. Because Falcon 9 is unable to properly serve these satellites, Electron can charge a higher price for a dedicated launch. Electron can't compete for the vast majority of small satellites launched by SpaceX on price, but they have a strong niche in the satellites that require their services. Alpha won't be able to compete for most Electron payloads because of cost, but they can create their own niche in the 1-ton class. The largest component of this niche is constellations that are optimized for 1-ton class launch vehicles.

In my previous blog post I created the beautiful charts you can see above that visualise the trade-offs between Electron, Alpha, and Rideshare in launching small sat constellations. Assuming you are using 100kg satellites, only when you exceed 25 satellites in your constellation does a rocket on the scale of Alpha become economical. Furthermore, the lower cadence of Alpha means Electron sees a further cost advantage.

The cost advantage of Electron starts to diminish when you increase the mass of the satellites. This is the strength of the 1-ton class rockets, they are the most efficient way to launch heavy and relatively small constellations. Satellites between 150-500kg in constellations of between ~25-100 total satellites are the optimal market for the 1-ton class rockets. The issue is none of these constellations currently exist, hence Peter Beck saying: "Our view of 1-ton is it's kind of a no man's land."

The heaviest commercial Earth Observation satellites are operated by Capella. Six of these 112kg satellites are currently in orbit and were launched on either Electron or Falcon 9 rideshare missions. These satellites are not heavy enough and not launched at a high enough scale to take advantage of Alpha's 1-ton payload capacity.

Are We Seeing a Military Constellation?

Lockheed Martin and L3 Harris have purchased up to 20 and 25 launches from Firefly respectively. It is not clear what payloads will fly on these missions and even if Lockheed Martin purchased flights on Alpha or MLV.

However, if launches are being purchased this far ahead in bulk it may be likely that these are for a potential constellation. The national security nature of these companies may also mean there is a responsive space aspect to these contracts that takes advantage of the capability Firefly developed for their Victus Nox mission.

Assuming these satellites are for a constellation, the choice of Firefly to launch them may be due to the fact that the satellites are heavy enough to take advantage of Alpha's payload capacity. Earth Observation satellites seem to level out at the ~100kg mark, but other applications may

require heavier satellites. For example, various Starlink satellite iterations have been between ~250kg and ~800kg. If we are seeing the early stages of a military constellation, it may be that the hardware required for these satellites makes them fit into the class that can leverage the Alpha's 1-ton payload capacity.

The very forward-looking nature of these contracts may mean they don't materialize as This Guy (hilarious name) has theorised. Furthermore, my analysis is based on the data shown in the charts above. This doesn't take into account industry partnerships and other business factors.

The Two Categories of Satellites That Will Use Dedicated Small Launches

The first category of satellites that get their own dedicated small sat launch we've seen are those that use Electron for one of its unique capabilites. Compared to rideshare, Electron can launch to a specific orbit on a specific date. For commercial customers, this has meant a quicker time to revenue which should not be underestimated. Government customers have also taken advantage of the ability to launch to a specific orbit. For example in April they won a contract to launch a set of satellites for the US Space Force to a Very Low Earth Orbit (VLEO).

This category of payloads isn't very well addressed by Alpha because of the low mass of the payloads. For example, the USSF VLEO satellites weigh 200 kg in total. When payload capacity is not a concern, the cost advantage of Electron is a very large factor.

Peter Beck addressed this in his interview with Dave G: "If you look at the payloads that we're lifting they're all sort of in that 200kg class, so the whole reason someone comes to a dedicated rocket is because they want a dedicated rocket. So putting a 200 kg payload in a one-ton lift class, I just don't see how you can be economic to be able to compete with a smaller 300 kg lift class."

The second category of payloads we will see launch in the next few years are those that are too heavy for Electron and too light for Falcon 9. Just as Electron launches all satellites too light for Alpha, Alpha will be able to launch all satellites for light for Falcon 9. Because of the lack of competition and Falcon 9's utter dominance of the launch market during the last few years, it has launched several satellites to LEO that are far below its 18-ton payload capacity.

In order of most recent to least recent:

1. Korea Project 425 (800kg) (Anchor customer on Bandwagon-1)
2. iMECE (800kg)
3. EROS C3 (400kg)
4. Globalstar-2 FM15 (715 kg) (Rideshare with Starshield)

5. IXPE (330kg)
6. Paz (1,400kg)
7. Formosat 5 (525kg)
8. Jason-3 (553kg)
9. CASSIOPE (481kg) (First commercial Falcon 9 launch)

Given the 4x lower cost of an Alpha launch compared to a Falcon 9 launch, it is likely that Alpha will be able to compete for these payloads. Falcon 9 has launched less than one of these satellites per year over its lifetime, so the market is not large on SpaceX's scale. However, on the scale of Alpha, one launch per year is significant enough to mention.

Responsive Space

Sticking with the common theme of the 1-ton class filling niches, Responsive Space is a potential market for Firefly. Alpha's third launch was Victus Nox, a launch for the USSF that demonstrated its ability to launch a satellite within 24 hours of receiving the payload. To be able to launch a satellite so quickly, Firefly already had a vehicle at the launch site ready to receive the satellite and launch.

Rocket Lab was recently awardly a contract for the Victus Haze Tractically Responsive Space (TacRS) mission. This entails two launches, first True Anomaly's Jackal autonomous orbital vehicle, then a modified Photon spacecraft. The launch of the modified Photon will prove Rocket Lab's ability to launch in under 24 hours from receiving an order to and then maneuvering in orbit and performing rendezvous and proximity operations (RPO). Just like Firefly's Victus Nox mission, Rocket Lab will keep a vehicle in a "Hot Standby Phase" before the launch is ordered.

Awarding Rocket Lab this contract shows that the US Military is interested in multiple providers for responsive launches. Furthermore, tasking Rocket Lab with modifying a Photon spacecraft to perform RPO operations hints at the goals of creating responsive space assets. RPO allows you to shoot down enemy satellites. Firefly also builds Elytra, their orbital kick stage. We could see competition between the two companies for responsive space launches in the future.

Quantifying the Size of the Market

In the future, there will be four primary categories of launches for Firefly's Alpha, the most prolific 1-ton class rocket. These are constellations, dedicated large satellites, responsive space launches, and rideshare missions. The primary source of uncertainty in predicting the future of this market is the unknown requirements and goals of military customers. The military is understandably secretive about their plans and this makes it difficult to predict how many responsive space or constellation launches they will purchase in the future.