Dog Atheism

on smart contracts, risk, and value networks

(I'm http://twitter.com/leashless writing this document in an open channel in real time (ish) so people can make comments, contribute ideas, and generally see my creative process at work - collaborative, right :-) - I'm basically working top to bottom, so scroll to the end if you want to see me live writing)

== the cognitive psychology of capitalism as it relates to blockchain-based businesses
== Building companies with current financial tools is like engineering complex machinery before calculus was invented

The two prior pieces in this series:
Programmable Blockchains in Context
https://medium.com/@ConsenSys/programmable-blockchains-in-context-ethereum-s-future-cd8451eb421e#.fjj88ssw6 (the unofficial Ethereum launch post) and

Tell Me Who You Are
https://medium.com/@ConsenSys/tell-me-who-you-are-258268bf3180 which brings real clarity to the digital identity debate

I suspect at about 40k words for all three pieces this is the kernel of an as-yet unwritten book.

========== ROUGH OUTLINE ==========

(the text is below this)

The story is going to have roughly five parts

1. Problematization of the normal ("turns out the world does its own thing, not what our stories say it does.") - this is a story from biology about the amazing nature of dog DNA
yes really

2. Newton and the Royal Mint, pointing out that the best minds in mathematics were also the guardians of the financial system. from this we draw a model that in the same way that acceleration is the mother of momentum, and momentum is the mother of position capital is the mother of productive capacity, which is the mother of cash flow, which is the mother of profit and the case made is that we have very poor tools - basically arithmetic tools - for really understanding the "investment -> capacity -> cashflow -> profit -> investment" relationships that covers equity crowdfunding and the rest

3. is then going to talk about competition between value networks, and the ability to synchronize the higher order factors (i.e. co-ownership of equity) to harmonize a value network, rather than trying to harmonize a value network through a bunch of people bickering about how much to charge each-other for services.

This is directly applicable as a theoretical model to the Consensys Spoke Model but the doc is going to be very fluid.

4. and 5. aren't clearly designed yet, but are basically going to talk about environmental economics and the sharing economy, with the thesis that a smart contract based ecosystem has three fundamental properties

Hyper efficient cooperative capitalism model.

- A. it will out-compete other ecosystems because it can efficiently harmonize higher order factors of productivity than cash.

- B. it can track complex aggregates like tying carbon emissions to a unit of cash and tracking carbon all the way through a set of transactions.

- C. a system which is more profitable
  and more ecological is not only possible, but given our current technological base, likely to be inevitable.

Here's where I need the help: this is very, very speculative and sketchy terrain: if you have the time, could you help me by reading over the drafts and posting a comment on anything that strikes you as questionable, historically inaccurate, or completely unintelligible? There are some pretty substantial logical leaps here, and I might need to footnote and show the steps more clearly from time to time.

Thank you.

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========== TEXT BEGINS =========

We all know that the world is too complex to represent with money. Specifically there are four categories of things that money alone cannot represent:

- agreements around trade, like guarantees or specifications
- choices made now and enacted later, or options for future choies
- things derived from money like interest rates on a loan
- ownership in a broad range of categories, but very specifically equity as embodied by the typical joint stock company

Of course money does a poor job of representing the beauty of a sunrise or the joy of a tree, but (unsurprisingly) we seem to manage to put a price on these things anyway, if vacation prices are anything to go by.

The result is that money is nearly always embedded in a contractual context. Apart from the trivial sums of cash in your pockets, or discretionary spending in your bank account, nearly all the money in the economy is legally encumbered. A good example of this is grants to institutions like the Red Cross: when they raise funds, the money is earmarked to a specific cause, a specific campaign. Money for Darfur legally must go to Darfur, even if something ten times worse (or even 10 times cheaper to help!) happens the very next day. As a result R&D

languishes in humanitarian space, because it is constantly seen as a pure cost center, something which is pulling away money from helping the current generation in favor of a nebulous future. That's why it took IKEA coming from outside of the humanitarian space to bring innovation into the sector with the Better Shelter design, and why the hexayurt followed a parallel unfunded track. The money is there, but it's always "the wrong color of money."

Normally we represent these patterns of encumbrance through contracts and statutes: agreements and laws. Consider the money in a petty cash drawer in a Fortune 50 company. Let's think about who actually owns this money. It's not the employee standing at the cash drawer counting out $11.50 for some new whiteboard markers because the storeroom is out. They are entitled to use the money, but they do not own it. Neither does their boss, or their boss's boss, or the CEO. In fact, you might think that it belongs to the shareholders but if a 99.9% shareholder comes in and takes that $11.50 to pay for a cab waiting outside, it's just as much theft as if a stranger off the street comes in and lifts it. The money exists in a maze of obligations and legalities which make it completely impossible to use or access outside of the narrow bureaucratic *oversight* which created the category that contains it. The money hovers in a netherland without a clear owner other than the corporate body politic (an artificial person according so some parts of the law), and that corporate body is in turn owned by shareholders, some of whom are natural persons, but many or most (by percentage anyway) are likely to be other corporations.

[[note that I did not mention where the money is created by law either - that'll come back in later on]]

Now let's think about the law which regulates this petty cash. There's property law, firstly: the cash belongs to the company. But the company is defined into existence by another canon of law, and is in itself property of its shareholders. Remember we are talking about a hundred bucks in a red sheet metal box, and already we've got a couple of million of pages of law and legal documents which might, in some circumstances, affect the disposition of this money, for example in bankruptcy proceedings. Then there is the issue of the employees who have a right to use the money; now we must consider employment law. A given person with a given legal status is a rightful decider on how this money may be spent, and another person is set over them to assess their decisions and to suggest that perhaps buying the ice cream cone with the change was inappropriate and could they please put that dollar twenty five back, please. The cleaning staff have another budget: you may not buy a new mop with this. And so on right up the chain. The money is embedded in a complex social structure inside of the company, too, a meshwork of roles and responsibilities beyond the laws and articles of incorporation.

This is not incidental complexity, either. Nobody sat down and cooked up a few million pages of legal code because it was fun: every regulation exists to plug a loophole in another regulation. This game of whack-a-mole is infinite. Consider the complexity of commercial kitchen food handling laws. Those stainless steel tables exist because wooden ones trapped bacteria. They are not plastic because steel is the standard - maybe there is a new plastic which is good

enough but in all probability one cannot use it until the regulators catch up with the technology. The shape of the commercial kitchen is determined by this curious mix of factors: tradition, habit, biology, law, materials science, personal preference.

On the other side there is evolution to contend with: the mice and rats and roaches that we labor against are *evolved to live in the world we have created and steal our resources*. They constantly change and adapt their tactics to find holes, and this change transforms their bodies and their minds: rats evolve poison resistance, and then when worse poisons are used, evolve extreme neophobia so they tend to never eat the bait. Law responds by a mix of instruments: mandated maximum pest levels, or administrative decisions about which poisons are legal and which are banned. Law is responding, through many levels of bureaucracy and administration, directly to the biological evolution in our pest species. The same thing happens all the time in agriculture: pesticides lose effectiveness, new ones are tested and found safe - or dangerous. The biological and the legal respond to each other.

Obviously most of the challenges to law do not come from the biological evolution of plants and animals. The challenges come from the evolved intelligence of human beings, sometimes outright breaking the law, but also sometimes identifying things which are notionally legal but which have significant enough negative social effects that the law will, in time, be changed to make them illegal. Law is complex because what evolution manages over generations or through discovery by the minds of animals, human societies do by the guidance of the most complex and sophisticated criminal minds available: the sheer sophistication of corporate tax frauds staggers the imagination. But outside of fraud, there is the murky realm of tax minimization, where tiny implications are poured over looking for an interpretation which makes a mockery of the spirit of the law while remaining true to the very letter of it. Many of our peculiar jurisdictions, like the Channel Islands, are self-governing in ways which are quite hard to transmit into modern legal systems - consider Michael Mainelli's famous story of having to explain to a major American corporation how the City of London Corporation was chartered. The accreted complexity across time is nearly infinite. Inevitably gaps are left, and value slips through those gaps: whack-a-mole between regulator and tax advisor. The thrust-and-parry of these processes only adds complexity to the legal system, each case leaving a few more hundred pages of accreted complexity.

The fact that the evolution of law so closely mirrors the processes which produce the complexity of our DNA is no mystery: it is an extension of all other facets of our primate behavior. Law, or at least the potential for law, is in our very DNA. Seeing law as a mechanism for resolving underlying conflicts of interest between evolving beings is another lens, a fundamental viewpoint from which to see the accretion of complexity in our legal systems.

The saving grace of these systems is that in the final analysis, the decisions are made face to face by the people in the room. In a jury trial, for example, the relevant limit of the law is what you can get through the head of the thickest juror - or the judge. Even the stack of failover

systems which eventually can escalate a case to the Supreme Court eventually terminate in nine very smart (but very busy) people who make a decision, write an opinion, and move on.

In some huge high value case like an antitrust case evaluating a major industry for monopolistic or cartel practices the depositions may run to hundreds of thousands of pages with tens of millions of dollars spent preparing evidence and arguments. But if you can't get it through the heads of the human beings in the room at the end of the day, it doesn't matter: the decision that gets made is the decision that people can understand. Human-in-the-loop and the economic cost of court cases are the limit on the growth of legal complexity. The higher the stakes, the more complicated the argument can afford to be.

Between these two poles, of the near-infinite complexity of written law, and the jury trial or Supreme Court as a final arbiter on the possible complexity of a legal system, society dangles. In the past, prior societies struggled hard with the accumulation of law: Rome is said to have been paralyzed by centuries of competing irrevocable Imperial edicts, and modern Rabbis work with a legal corpus going back most of six thousand years. Our own systems of law exists in a time of electronic document search and cheap printing: the Federal tax code is 75,000 pages and has grown 200-fold in the last century.

http://daviddfriedman.blogspot.co.uk/2010/07/furnace-of-akhnai-story-and-puzzle.html

http://www.washingtonexaminer.com/look-at-how-many-pages-are-in-the-federal-tax-code/article/2563032

Then the smart contract arrives, and we begin to speculate that minds immeasurably greater than ours may one day enter the fray and start to interpret or define the law on our behalf - or that of our opponents.

If the entire corpus of law pertinent to a case is machine readable, or in the case of some classes of contract law, simply a set of smart contracts, it becomes possible to apply machine intelligence to the cases. In the limit, one can imagine a sufficiently unambiguous legal situation (smart contracts dealing with assets which exist only on a blockchain) in which strategies for winning the case are calculated by computers, costed, and a maximum-value strategy carried out dependent on an assessment of risk.

Where could risk be in such an automated system? My guess is that risk would largely cluster around point-of-fact and counterparty risk. For example, a point of fact might be "does the current version of the software pass the new unit tests?" - this can't be established by a smart contract alone, it has to be run by an external process, and the fact reported back by a trustworthy source which can report points of fact to the blockchain-based smart contract system. These systems and/or people are usually called Oracles. A unit testing Oracle could be automated. A warehouse inventory level Oracle probably still requires human intervention in many cases, but is exactly the type of thing that might be automated in future, perhaps by an

inspection robot. Counterparty risk is simpler: questions about, say, claiming on the other party's insurance, and estimating the risk their insurer will refuse to pay or turn out to be bankrupt.

Deterministic systems can be evaluated precisely: where the law or the contract is not dependent on an external Oracle or a risky counterparty or some similar construct. Artificially intelligent systems decide on their estimates risks around the ambiguous areas. Game theory and similar algorithms to chess, wei chi or poker estimate the optimal strategy, and play begins. This is essentially an automation of big corporate law suits which, except in cases of existential risk to a company, are largely evaluated as simple matters of profit and loss: companies generally settle or fight based on estimated outcomes.

Obviously in such systems there are very, very hard limits to the ability of an unaugmented human being to understand what is going on. A computer simulation could run through all the permutations of 200 (or 20,000) interlocking smart contracts and map all the possible inputs and outputs from such a system across a range of scenarios. But a human simply cannot assess, unaided, the full implications of the space. More and more areas are like this: high frequency trading, some of the hairier ends of technical finance, maybe (I'm less familiar) some areas of logistics and supply chains. Software facilitates the constructions of systems far beyond human understanding, and litigation boils down to technical expert witnesses and discussions of intent because almost no human can master both the law and the necessary technical context. But these areas of law are still considered esoteric, and the prospect of a heavily used global smart contract ecosystem, more extensive than the current internet because of its penetration into smart grids, smart property and the internet of things - with complexity beyond the ability of human judges or litigators to comprehend - opens broad and not entirely welcome horizons.

Right now we manage a lot of this implicit complexity through fairly shoddy constructs like massive centralization inside of companies like Google, protected by incredibly broad "clickwrap" EULA licenses in which nearly all grounds for a lawsuit are explicitly disclaimed. That serves to create a ground where there's little litigation because the odds are so unequal, and almost all the grounds for litigation are given away in the initial exchange.

http://www.theatlantic.com/technology/archive/2012/03/reading-the-privacy-policies-you-encounter-in-a-year-would-take-76-work-days/253851/

One possibility for the future smart contract ecosystem is that this kind of centralization will occur largely to simplify the legal situation. Another equilibrium point is a centralization but not around a block of smart contracts or a company, but around a standard set of protocols, like the ISDA contracts which manage credit derivatives: standard smart contracts (with accompanying documentation if they are Ricardian contracts) to cut the complexity of interpreting what is happening to a manageable level.

But the most likely outcome is an ever-accreting disc of complexity, like dust in orbit around a belted planet. This is in keeping with nearly everything else happening in our culture right now,

and not something to be scared of: complexity is a sign of evolution. But perhaps when we have learned a little more about biology and the complexity of our DNA, we can find biologically inspired models (biomimicry) of nature's own complexity control solutions. There must be some long term answer to accreted complexity, or our bodies would have collapsed in their own near-infinite complexity. But, for now, expect a successful smart contract ecosystem to accrete complexity requiring AI-assisted lawyers to manage disputes. Early visionaries in the field foresaw this outcome in 2005, and it looks increasingly likely that the basic direction of travel predicted was correct.

Do not be concerned: nearly every aspect of our modern civilization is engaged in the struggle to control complexity, and, so far, we are just about holding our own. We need better tooling and an awareness of the problem at a political level, but I think we are coping. The complexity sciences are slowly gaining maturity, and the prospect of effective tools for instrumenting complexity of this type (what Rudy Rucker would call "gnarl") grows. We may beat this sucker yet, and gain a stabilizable civilization as a result. If not, it's to the stars with us.

[[Could AIs assist in law much as they do in chess? What would be the implication for the human comprehensibility of law? Could a non-assisted human lawyer ever compete?]]

[[Accelerando! by Stross]]
https://en.wikipedia.org/wiki/Golden_Path_(Dune)

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Constructing a model of value in the universe

[[now we drill down into how property is created, and the calculus-like tiers of action - money > cashflow > profit > equity or cash > options > futures > derivatives > CDS etc.]]

So the one kind of complexity we did not look at is the construction of the money itself. If you think back to the mythic petty cash drawer that started this whole thing off, we assume the cash in the red sheet metal petty cash box is just there, it's just money. But if you stop for a moment, the set of processes which turn green paper into value or even wealth become visible to the eye, and that is an area of very active debate: what is money, and how is it created by societies? Graeber's "Debt" is 500 pages and by no means the last word on the subject.

https://en.wikipedia.org/wiki/Debt:_The_First_5000_Years

In my opinion, and this is a hotly contested point in many sectors, all money and indeed all systems of property are socially constructed. Usually that kind of thinking is a precursor to declaring that "property is theft" and an argument is made for radical redistribution. But I think a

more gentle, historical approach is required: the society of today sees green paper as money, where four centuries before it would only accept gold. Of instead of seeing social construction of money as an invitation to tinker, I view it as a narrative of continuous evolution and mutation, I think this view is more functional - social construction provides a theory of history, not just a theory of change. Courts ratify existing social practices in many cases, but on rare occasions actually lead boldly, and money and the creation of money are one area where the definitions of "legal tender" generally speaking are definitive: money is whatever the government says it is, usually more specifically what you can pay your taxes in. Until Bitcoin.

Bitcoin has its travails, and most of the discussion around bitcoin is technical or hyperbolic. But the simple fact of creating currency by international social assent backed up by technology has genuinely advanced human society and our understanding of money and the meaning of money. It could even be regarded as a profoundly democratic act, even if it was taken by Libertarians! People came together, agreed that this software created tokens which had value, and then proceeded to use them as money. While some legal authorities still argue that Bitcoin is a commodity rather than a currency, de facto it works as a currency in many peole's lives, and they view it casually as money. If any nation state accepted Bitcoin for payment of taxes, even if it was immediately converted to fiat currency (i.e. dollars at spot) there is no doubt that without any further technological improvement, Bitcoin would fulfill the necessary requirements of being money in very nearly all cases: it's good enough that if you defined it as legal tender, it would be. It's past the critical threshold where the technology is good enough to provide the essential functions which make something usable as a currency. This is a remarkable achievement and not to be forgotten. Good enough for legal tender is a high bar for any cryptocurrency project, and (transaction volume issues aside for now) there's no doubt bitcoin's security model has been stable enough so far that future state use of bitcoin-type technologies seems entirely practical, whether or not it actually happens. That's a success from anybody's point of view.

[[I'm writing this a couple of days after the Hernia announced (prematurely) the Death of Bitcoin.]]

So let us return to the mysterious green-and-shiny stuff in the little red sheet metal petty cash drawer. What is it made of?

We've already established that this money is embedded in a legal (and then contractual) framework of nearly infinite complexity, certainly far more than a single human being could ever hope to comprehend. We are preserved from direct confrontation with that complexity by habitual use of the simpler parts of those systems, and by the And while the "money" has the illusion of being made of real stuff, of being an elemental a priori fact of civilization, as money appears to small children and busy adults alike, there's no problem here. But when a philosopher with too much time on their hands begins to poke at money as a concept, something very bad happens.

It vanishes into social construction.

Elemental money, primal money, gold-is-money exists as what people call a “reification”. A thing of dubious reality or integrity is rendered into an absolute construct, nearly as real as a house brick, and from then on always treated like a concrete fact. A good example of reification is the provenance of a piece of art. The statement “this is a Picasso,” once attached to a piece of paper with a single wiggly charcoal line upon it, is a fact. The object’s “paperness” or “charcoalness” is buried in its “Picassoness.” When we see the paper ***we do not see the paper or the charcoal, we only see the invisible-but-transformative Gestalt of “a Picasso.”***

This is a much worse problem than just realizing that money is embedded in a social fabric of near infinite and ever increasing partially automated complexity. Realizing the stuff itself is actually a product of that complexity puts the entire show into an entirely fragile new light.

Peeling back reifications is dangerous business. Deconstruction-gone-wrong can result in postmodernism, nihilism, existentialism or even Marxism - the illusion that *these capitalist constructs are unreal* rapidly escalating into a broader sense of the unreality of life. It takes a religious faith akin to Zen, or the broad wisdom of cultural anthropology, to understand that reification is as natural to humans as making food from plants or taking shelter from rain under umbrella-like structures. Reification is simply how culture operates, how value is created, but also how the myths which allow the large scale social cooperation we enjoy functions: ants coordinate using pheromones, and we coordinate by myths and stories.

These stories which are about the nature of the world are called by some people reifications, and by others terms like “reality tunnels.” It does not matter what you call them: the mind which is aware of the social construction of language and therefore reality [[sapir whorf!!]] is more able to see the places where our language for a thing does not precisely correspond to the nature of the thing itself (i.e. always) and thereby can perform magic.

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

What kind of magic does being able to slip into the gap between reality and our written language for reality allow a person to perform? Innovation, predominantly. A very good example is the discovery of heavier than air flight: although it was common and routine in birds and gliders and kites since antiquity, in the Victorian era the consensus had formed that these were phenomena that did not have the direct power to affect the world in a profound way. In those days, the split between “alive” and “non-alive” as much more concrete than it is today: chemistry is still divided into “organic” and “inorganic” based on the old belief that living matter was made of a completely different set of things than non-living matter. So the heavier-than-air flight of birds seems not to have been within the reach of humans. Hot air balloons were useful tools, providing an overview of the landscape, but the prospect of a human flying like a bird occupied a space where the plates of the mind overlapped and left no real chink for ambition to shine through, at least in learned men: it was a thing which was not really feasible, and so was not

going to happen. Don't waste your time on it. While reality said maybe, common world models and language said not really, and there the matter sat.

[[http://www.internationalskeptics.com/forums/showthread.php?t=111147]]

It took a couple of uneducated high school dropouts to unexposed to intellectual society to know that what they wanted to do was impossible to punch through and actually try - over and over again - inventing the wind tunnel along the way. That's how we got flight: people who didn't know they couldn't do it inventing a new perspective (an ultra-low cost of failure miniature flight testing rig for models), which then led to the transcendent breakthrough.

Mars colonization occupies a similar slot in our culture right now: if Elon Musk was not wealthy enough to be afforded high social status, and a legend among engineers for his work on Tesla and other projects, his pronouncements on Mars would qualify him as a crank. Even if all the math added up, and the engineering was as sound as it is today, Musk-minus-money is in much the same position of as the dozens of engineers he employes to implement his ideas when they were still in the wilderness at NASA asking for a shot at the sky. Musk maintains, with some effort, the chink in the tectonic plates of the conceptual landscape through which Mars can be seen as a potentiality, which it very clearly is! Mars is not possible just because Musk says it is possible, but if Musk stops maintaining that possibility, a dollar at a time, Mars fades out of reality again. Against that background the sheer magnificence of the Bitcoin plan can be see: a self-certifying ***and self-financing*** proof that it is possible for ordinary people to issue currency similar to that issued by nation states, backed by nothing more than social assent and advanced mathematics. You have to hand it to the original Bitcoin team: it was audacious, and victorious, at least so far. Being able to keep something fully real, fully manifest, usually requires money to pay staff. Proving it's possible to issue money by issuing money and using that issue to pay people to keep the issuing system running (mining) is, simply, genius of the highest order. A truly world-changing breakthrough.

This process of seeing the gaps between culture and reality is easier where the *definitions* of words are not out of sync with reality. To see something as impossible after it has become possible is common, and pointing to the reality is not that difficult when the time comes to true up our mental models to the world we actually live in. When the problem is in the beliefs that people hold usually evidence, sustained over time, is enough to get to the truth. People often maintain that things which have actually happened are impossible for years: initially in shock, and later as (say) anti Moon Landing cranks. These are processes of adaptation to the real, and where direct evidence contradicts the plain visible fact of the matter, change is (slowly) inexorable. If the problem is in our beliefs and in compound statements about a fact, change comes over time. But there are problems.

It's much harder when the object we are discussing is already thought to be well understood, and words have hardened (reification again) into a solid, "real" concept. In these instances, the

facts which contradict the common mental models we have are there, but they are subtle and hard to see. The result is that language can remain stuck for generations, or even millennia, locked in an inappropriate model which costs us every time we use the model. Sometimes it's just a little slippage, and at other times it can be an avalanche. When we are confronted with sufficiently radical new technology, from the printing press through to CRISPR, our understanding of the world shifts and blends enough that we require new concepts to describe it. That's the easy part.

The hard part is letting go of the old concepts, the things we are already certain of, what we already know.

Let me reintroduce you to an old friend.

Dog Atheism, or searching for Schrödinger's Dog

[[Darwin's Dog and Schrödinger's Cat?]]

There is no such thing as a dog.

You are basically imagining that dogs exist, but they are actually a ghost, a mirage, a dream in the mind of human beings. There is no dog.

Let me explain. Generally biologists put a species boundary at a point where two animals cannot produce viable offspring together: horses and donkeys make mules, which are sterile, therefore there are two species (horse, donkey) not one (horkey.) But the dog is a malleable thing, with a bunch of funky genetic tricks to enable them to survive a high mutation rate and, by extension, produce viable offspring when breeding a long way from home or under extreme selective pressure. Dogs evolved what some biologists term "slippery" DNA, with duplicate copies of key genes [[I hope I am describing this correctly]] resulting in an animal that literally knows no species boundaries until you hit the fox. It's just one species, with variations, just like humans with skin color and height variation.

Nobody in their right mind would identify a 75% wolf "dog" as a dog - I've dealt with such beasts in the past, and they are wolves with just enough sense about humans to know they are terrifying. I spotted a couple of wolves on a walk through Covent Garden in London recently, staunch beasts on heavy leashes walking with a taut, muscular, wild man. They cut through the crowd like warplanes in empty blue sky, white balls of feral, self-aware restlessness. And that was at 35% wolf, according to their companion leashholder. I could not believe that other people were not stopping and staring as something wild was at our feet.

Not the same animal as a comfy old Labrador. Not at all. Yet, to the genes which make these beasts up, such a huge difference in body type and temperament is insubstantial: there will be

puppies, and strong, viable ones at that, right across the range of four legged canine carnivores, from Fenris to Muttley.

This is not just an abstraction. In the US, coywolves are emerging right now, a malleable, plastic ball of coyote, wolf and dog that is basically more successful under modern conditions than any of its ancestors. And it's still a dog, at least as far as genetics go: it can interbreed with anything from purebred wild wolves through to a greyhound. What you see in the domestic dog is a couch-friendly representative of a protean mass of wilds that have explored and exploited very nearly every evolutionary niche that man has. They have competed with us for our kills on the plains of Africa, chased down our farm animals across Europe and Scandinavia, howled at our doors in Russia, and stalked our old and our weak above the Arctic circle. Marsupials evolved to nearly the same shape - from entirely different stock - in the Antipodes. Constant companions now, once bitter rivals. The wolf is at the door, and the hound within it, but ask not what happens by the light of the moon.

Old Jock the faithful gun dog is made of wolves.

In a very literal sense, the DNA in our everyday mutts is part of a continuous reproductive surface that extends into a range of creatures we would not let our children go anywhere near, and rightly enough.

And you can certainly argue that the "dog" does exist, he's right there on the chair, but in fact what you're looking at is nothing like your mental model of it. The dog, deconstructed, is a phenomenal beast, almost a mythical creature, whose adaptability superpowers are only truly visible over the long view, over hundreds of years and dozens of generations, as "man's best friend" continually reshapes itself into *whatever we want it to be* as long as we're picking up the vet's bills and the grub tab, and housing the pups. And this is before we seriously study the epigenetic factors in dog adaptability: it would not surprise me *at all* if dogs turn out to be masters of epigenetic adaptation too, their acquired traits and gene activation records passed down to the puppies in record time. That's only speculation, but if the profile fits... just how deep does the dog's genetic adaptability go? The dog is that which changes.

In the case of the dog, you may be thinking, "well... all this *dogs and wolves are the same species* stuff doesn't really impact us..." but it does. I have scars on my hands from growing up around Labradors, not because my Labs bit me (although one of them took half the thumb off a close friend of the family - bad news.) The scars are there because they made me casual around dogs that were, in fact, *really different animals.* Perhaps if we saw dogs for *what they are* we could not live them as closely as we do, and given their likely role in *Homo Sapiens* ascendency over our near-human rivals over evolutionary time, perhaps it was more important to love dogs than to always keep all of our fingers... we partner with animals to become, literally, superhuman: the ears and nose of the dog, the digestive system of the goat-pig-cow-chicken, the legs of the horse, and the eyes and quick claws of the cat as a single federated genetic collective that took on all comers and achieved world domination. We even occasionally add the

wings of the hawk and the owl. This genetic federation is unstoppable. Even with the cat on board (the cat is a freeloading parasite - but that's an essay for another day.)

[[Donna Haraway Goes Here]]

This story about us and our animals is that it is really just a story about the Everyday Weird, and how it re-asserts itself again and again and again. We just take things for granted: the mutating protean replicating protoplasmic servitor which is the dog is just as normal-weird as time lapse videos of plants doing judo for access to sunlight, or predatory vines hunting for trees, thrashing around the forest landscape, ensnaring and killing their prey at a speed too slow for us to see without tools[[]]. This Everyday Weird is all around us. If you doubt me, take a magnifying glass to the next spider you see, and make sure there isn't anything behind you to fall over as you recoil in horror. Spiders are *monsters* that we ignore because they are small*. Everything, if you pay close attention to it, is marvelous, and strange to our eyes!

[[*unless we live in Australia]]

This is the world we live in.

It's even stranger when you look at matter in the context of the four fundamental forces. The stuff we look at in front of us *does not exist* except as patterns of forces: the matter is nearly 100% empty space bound together by poorly understood patterns of interaction between tiny, tiny specks we call particles, made of yet smaller particles, which are... we do not understand.

Our stories about the world, the everyday tales of dog-and-armchair that we use to paper over the fantastical and poorly-understood nature of reality are benign folk tales that compress complexity to allow us to get around, make decisions, and live our lives in (if we are lucky) comfort and peace. But where there are significant gaps between our casual models and reality, weird stuff can happen. Things that seem impossible occur, and we are forced to adapt. Errors deeper inside our linguistic modeling apparatus tear apart familiar objects: the sun changes from god's light crossing the sky to light our way to a ball of burning gas we whirl around as gravity binds us. The sun has changed in our minds, but not in the sky.

It could change again. What if in 250 years we discover self-replicating stable plasma vortices which reproduce into similar smaller vortices with inherited characteristics? If the Sun was home to an unimaginable life form, we would look up in yet a different kind of wonder. We have to continually re-see the universe, to keep our vision and our language in keeping with the current manifest reality around us, to remain fully sane.

This is an ongoing struggle: doing the mental work of learning a new language, but every day of your life, as the sphere of human knowledge expands. It is a mental discipline required during times of mental change, lest we slip into reflexive behavior and gradual obsolescence.

Now let's talk about money.

I think that if you actually stop and look at the financial system, and the tools we use to (say) finance food production and making pots, pans and kettles, you will see something which is every bit as weird as the dog or, indeed, the armchair it sits upon. These creations of our human society are taken for granted, yet alien to us upon close examination, as alien-and-familiar as spiders and plants and animals and food crops, as alien as the cites and the buildings, as alien as clothes made of plastics which will far, far outlast the bodies that wear them. As alien as fillings in our teeth or product in our hair.

I want you to just stop and think, for a minute. Pause, look around you, and trace some root causes. It does not have to be like this: we have a generation of tools and technologies which enable change beyond our wildest dreams, things that cannot easily be imagined, and we take them completely for granted. Path dependence got us here, yet we cannot even map where here is - too complicated, too fast moving, too many smart people working on expanding the frontiers and horizons of our knowledge. We are interacting with an existential unknown called "the present" and plotting our path to a future within it.

In order to steer this revolutionary period we are entering into, you have to wake up. That means taking nothing for granted, seeing the full weirdness of the systems and tools that we have in front of us in potentia, and most critically of all, waking up to the unimaginable strangeness of the tools, systems and technologies that we use to operate the world today.

In times of technological change this grand, everything is up for grabs.

What I want to show here is a perspective, in which what we take for granted is seen strange and numinous, the product of a nearly infinitely complex history, most of which is unknown, built on machery we scarcely comprehend (hello, epigenetics, I'm looking at you), from components we definitely do not understand (quantum mechanics, the particle zoo, complex systems and so on.) In a world that works this way - and that is the real world, anything simpler is a convenient user interface, an illusion our culture draws over what we might understand about what is right in front of us.

I believe it's impossible to understand the full implications of what has happened in front of us, and therefore to work with what is to come, to even create and shape it, from an ordinary perspective and still get it right. There is a necessary coming to alert, awakening from mental slumber, from the pressures and predictable risks of the day to day, to re-see the world again not in its routine phase, but as it exists in times of turbulence and powerful change.

Now I'm going to try and do for business what I've just done for dogs. I want to pull apart the story we have, and reveal what the technology really allows. Furthermore, I'm going to make a case for fundamental competitive advantage accruing to those using the new tools. This is a slightly more constructivist view, in that we need to build the understanding of the puzzle and

the complexity, not simply reveal it from science. It's also a little more speculative than the objective truth that there is no dog. But come with me and I'll show you a vista.

To be part of a revolution, start by understanding the weirdness of the present norms. Then proceed to fancy, to dream, and to become.

The Calculus: Newton vs. Leibniz for the soul of matter

So, in this journey in search of perspective, let us turn our attention from biology to the calculus. I'll summarize briefly:
https://en.wikipedia.org/wiki/Leibniz%E2%80%93Newton_calculus_controversy

The calculus was invented simultaneously by two magicians, one British Alchemist (Newton of the Royal Society, a Freemasonic body for natural philosophers) and one German Kabalist (Leibniz) around the time of the Great Fire of London / the Glorious Revolution. In America, European colonists have just reached Pennsylvania and Florida. The calculus opens the doors to understanding not only celestial motion, but a huge class of problems involving dynamic processes: pressure, temperature, springs, elasticity, anything involving curves rather than straight lines, including sound, pressure, and light because the square or the cube is involved, rather than a linear extrapolation. We are working roughly a century before the Age of Steam. Technology is still primitive. America is no more than a restless stirring among moral philosophers and disenfranchised princes. Galileo has been imprisoned for heresy for telling people the earth moved around the sun roughly 50 years before, so these guys are treading on thin ice indeed...

Now, here's why the calculus matters to us. Leibniz, basically, wanted to know God through Matter. Here's the reasoning, very approximately.

- Imagine a planet floating through infinite space.
- If the planet has constant speed, then you can trace its trajectory back along a line to the beginning of time. It works just fine for an idealized linear planet.
- There you will see the hand of god placing it in motion.

At the time it was not at all obvious this would not work. This may sound absurd, but remember this is pushing 200 years before Darwin. Scientists still thought they were reading The Book of Nature, which was a way of knowing God through his creation, rather than through the Bible alone. Science did not exist as a force which ran counter to religion in any fundamental sense yet, except for occasional persecutions. So this was a coherent worldview. Back to our notional planet.

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

- Suppose our planet orbits a sun, and is not alone. There are many planets and their courses interact because of gravity.
- Now to wind back time to the start, to the First Cause, to the position of the planets when God places them in motion, we need new math.
- Specifically, we have to understand the fullness of motion: velocity, acceleration, and changes in acceleration (including changes in the rate that acceleration changes, and so on.)
- So we take the current position of all the matter in the solar system, and with sufficiently advanced mathematics, we can wind time backwards to see God putting all the planets in motion at the beginning of time.
- Or we can wind time forwards in our mathematical model to see the future, and to know the End of Days.

The Clockwork Universe model, popularized 20 years after the public spat between Leibniz and Newton over the origin of the calculus at the end of the 17th century, suggested that in fact the Laws of Nature were immutable: that God had ordained them, and the clockwork would run until Judgement Day. You can see tons of intellectual bridging and evasion to avoid all-out atheism and heresy in this period.

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

It is in this environment that many of our core ideas about how finance operates are created and defined. The first corporations of note come into existence around 1600, and the first genuinely titanic bubble, the South Sea Company bursts in 1720 - right when the Clockwork Universe model is in play. And Isaac Newton is, of course, the Master of the Royal Mint in Britain from the end of the century for the next thirty years.

https://en.wikipedia.org/wiki/Corporation#Mercantilism
http://blog.royalmint.com/sir-isaac-newton-did-you-know-this-about-him/

So at the time the best minds in finance are also the best minds in science. The greatest physicist and mathematician in the world is the guy issuing the leading global empire's currency.

Perspective. Above all things, perspective.

Now, up a rickety ladder, and across into the new age.

- an object is at rest
- in motion, it has a velocity
- if it's velocity is changing, it has an acceleration
- if it has changing acceleration, it has jerk or jolt
- if the jerk (change in acceleration) is changing, it has jounce

Calculus gives us ready access to all of these: the mathematical “derivative” (one of the two fundamental procedures of calculus) applied to position gives the acceleration. Applied to acceleration it gives the jerk. Applied to the jerk it gives the jounce. The same bit of math can be applied over and over again, to it’s own output, an iterative process, to climb up a ladder of causes of change in the position of an object.

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

Imagine an object with a tiny bit of jounce: a microscopic change in the rate that its acceleration is changing. In the first moment, there’s only jounce, an almost imaginary impulse. Then the jerk kicks in, as one is rocked by a sudden start. Then the pressure as one is pinned in one’s seat by the thrust, and the whoosh of speed accumulating. Physical systems don’t normally expose us to prolonged jounce or jerk, partly because it’s unpleasant, partly because sustaining the gain in acceleration for very long required incredible amounts of energy, but every time something moves under the force of an engine, all of these factors play out. This is unlike objects moving in gravity, which simply fall with constant acceleration towards the centre of mass around them: no jerk, no jounce. Again, as with our imaginary dogs and real canines, the trick is to see - and in this case, not to see what we see today, but to see what Newton - alchemist, mathematician and master of the Royal Mint, could see.

The entire universe is made of objects, and change is made of objects in motion. With the right math, the motion of all objects could be understood so perfectly that time could be run forwards and backwards, to see god on both ends: positioning the stars and the planets in the sky and in motion at the start, and at the final finish, descending to rule.

It wasn’t long before the cosmology broke down, but by then, we had an industrial revolution on our hands, and the huge disruption in the theism of earlier centuries was buried under a whole new kind of chaos.

It was not until Lorenz and sensitive dependence on initial conditions, plus the pumping of variability into macroscopic systems from the quantum level, that the mechanical universe finally died.

But we might find purpose in recreating part of it for bringing order to the world of our transactions, particular as finance seeks ever-greater risk to efficiently build a future quite unlike this one: a future in which we have transformed our technology base to create abiding peace and prosperity for all humans, in harmony with nature.

I genuinely believe that blockchains have the capacity to materially aid the creation of such a planet. Come with me on a journey to see why.

The path to profit

On the way to really getting to grips with what smart contracts are going to do to finance, and indeed to our ability to organize the material and people of the world into productive gestalts by all methods, we need to be able to see beyond cash flow.

I want to make a rough analogy between position, velocity, acceleration, jerk and jounce, these successfully higher derivatives of motion and the factors of productivity inside the economy. This is, at best, a rough analogy but I think what comes from it is a sense of precisely why smart contracts might be so incredibly powerful as mechanisms for aligning business interests in a way which unleashes a previously unimaginable wave of profitable cooperation for all businesses from the smallest to the largest, particularly those engaged in trade within complex value networks.

Imagine two objects in space with the same speed, pointed in the same direction. Two little ships in the Starry Night. In theory they'll fly parallel forever.

Now give one a little acceleration - a small jet on the bottom, a millimeter per second per second, a small push. Over time, the paths diverge; slowly at first, but after a few years the motion away from each other will be huge, far larger than the component of the trajectories of the craft which is still parallel. Acceleration swamps velocity given time. Change in acceleration (jerk) swamps acceleration. Change in change in change in change swamps the factor at the bottom of the stack given time. Always. The force concentrates at the bottom over time, as change accumulates in the high order factors like jerk and jounce, and works its way down into momentum and position.

So in a company, what are these factors? I'd suggest the stack is something like this:

1. creation
2. equity
3. capital
4. productive capacity
5. product
6. cash flow
7. profit
8. wealth -> capital, and so the cycle begins again

An idea is created, and given form as equity. Investment buys equity and produces productive capacity which creates products which go to market and make cash flow, and some of the cash flow is profit which accumulates into piles of money called wealth which could be re-invested as capital. Or, in the other direction, capital comes from wealth which comes from profit which comes from cash flow which comes from product which comes from productive capacity which

comes from investment. It's important to think about creation (be it as simple as incorporation, or as complex as a suite of patents embodied in a multi-company tax efficient machine) as something that precedes investment, and equity is created by dividing up what has been created among owners.

The wealth of accumulated profit can then be re-invested, which is a little strange if we are thinking in physics terms (momentum doesn't turn around to be jounce... unless maybe two things collide?), but the analogy holds: the actions higher up the "stack" are the mothers of lower down factors. It's important to note that the "creation" phase precedes the formation of equity (shares in what?) and that equity exists before capital. These are by no means absolute ways of seeing, and I think if this model gets serious use those precise dynamics will get revised into perhaps four different phases, but this is close enough for now. Above investment there is an entire matrix of ideas, hints, ideations which turn into curiosities and thence into action: the domains of science fiction and childhood dreams. But a cultural map of how dreams become engineering realities in the high street is beyond our current scope.

Note too the lag between layers: transactions take time. It takes time to exchange capital for investment, and to turn investment into productive capacity, and so on down the chain. This is why people watch TechCrunch to understand the dotcom scene - where the investment is today, given some latency and some lag, is where the productive capacity will be when the engineers are finished, and later on it hits the market. There is time lag at each step, as it takes months to build productive capacity, and markets take time to build, and capital takes time to accumulate.

However, the tools used to align interests in these processes are relatively old, and relatively crude. The institution of the joint stock company [[]] goes back to a little before Newton's time, and many of the core principles established in that era can be recognized in any dotcom start up today: division of equity between founders. Limited liability is much more readily available now, protecting the personal assets of the joint owners of a company from debts that the company itself might incur. It might seem strange that the basic risk sharing arrangement for small groups of people starting new businesses haven't changed much in the last four hundred or more years, but that's about the same age as the Treaty of Westphalia which established most of the basic concepts around the nation state as an institution, and so perhaps we should not be surprised that notions around property, division of property, transfer of property, responsibilities attendant to property and sharing of property among owners go back to the same general era of history as the division of land into nations - the concepts of property and nation are inexorably linked, because the laws which create most classes of property are implemented at the national level: the strange UK division of leasehold and freehold is archaic to the point of being ancient, and utterly different from (say) Swiss concepts of a similar age.

In the present, we are creating new forms of property at an unprecedented rate, some global (domain names) and some local to a given nation state (also domain names.) Credit Default Swaps are a particularly notorious new form of property. The formation of patent non-aggression pacts between large companies are also a new kind of property. You could also point at Disney's

practice of making movies about common folklore and then using copyright to block later works drawn from the same folklore sources. We just don't stop innovating on the creation of new things to own: ongoing discussions of gene patents, biopiracy etc. are only the beginning of what is going to be the century of DNA.

So why is the joint stock company stuck with a 400 year old abstraction, rather than fluidly adapting to the needs of the day? One could argue that we got it right the first time, and that equity as enshrined in the joint stock company is basically a perfect instrument. But if that was the case, the entire shenanigans about (for example) options for company founders (rather than equity grants), clawback clauses, dilution by issuing more stock and all the rest come from people gaming, exploiting and extending a basically old-and-busted model of value.

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

Let me point out a couple of problems with the conventional joint stock company.

The first is that it seriously conflates ownership and governance. It bakes in shareholder democracy, and the institution of a board of directors. And this is OK to a point, but it leaves complete anomalies like Steve Jobs - who *was* Apple - fighting with its board against the interests of its shareholders about personality conflicts. You *can't* fire Steve Jobs, you can only exile him, and he returns iMac in hand to set the kingdom to rights. But they did it, and the results were awful, then brilliant. But still, he only owned half a percent.

http://www.inc.com/graham-winfrey/why-steve-jobs-left-apple-30-years-ago-today.html
https://www.quora.com/How-much-Apple-stock-did-Steve-Jobs-own

So that's some kind of moral right, a parental right, a right to be recognized. Many founders have fought with this: you dip below 50% ownership of the enterprise, and the people you brought in to scale your vision wind up destroying it. Twitter, Blogger and several other high profile start ups have been through this cycle, original founders in and out, and so on. These names are completely identified with the vision, but nobody will trust them past a certain point. In other cases, Zuckerberg or Musk, the companies might as well be named after the founder, even if they do not have absolute control any more. We all recognize some kind of inherent wrong is committed when a Jobs or an Ev or a Jack are booted, and that's not a kind of right that the current system recognized.

The second problem, perversely, is a tendency to reward people long after their contributions are over. A nick taken at the beginning of the process, a few percent for a few thousand dollars can turn into half a billion dollars later. Y Combinator famously takes 7% for $120k or there abouts, and the result is several billion dollar slices of companies like AirBnB. In theory people are being rewarded for taking risks early, but in practice it can turn into shovelling money into the hands of people that acted early and were nothing but pains in the ass ever after.

Human nature and bragging or property rights

A lot of what is happening here is that the property rights models we have to hand correspond so poorly to the actual human nature of what is going on that we are left with oceans of inefficient failure, strife and conflict because we simply lack the laws and tools to smoothly and efficiently enable cooperation among the parties and partners that could be possible if we had better laws and tools.

It's easy to imagine that there's a kind of "Constitutional Monarch" role which could and should have attached to Steve Jobs and his peers. Not every founder deserves one - some are fully dull business people just turning the handles, while the loving visionary is somebody who joined later. But there's no doubt at all that projects often have hearts, and we have no legal way to recognize these people in joint stock companies. Even the most charismatic and vital founder will dip below 50% ownership pretty quickly, and after that, they are only as relevant to the project as the owners make them. It's possible that a thin-slice shareholder model, with many small shareholders all vigorously exercising their shareholder democracy might be a partial answer to this problem, but is this really a right that should be given or taken by a democratic construct? We still would have a situation in that model where the owners could, in some fundamental sense, remove whatever rights has been granted to the founders by virtue of it being their baby.

Similarly, there is a tribal collegial framework within many companies - the early stage employees who often age like presidents and work like ER doctors, working for somebody who is building out their vision. These people often walk away wealthy (when they are lucky, anyway) but unrecognized. These kinds of soft tribalism are not always unrecognized, however: take the older medieval guild structure, *which still operates in Germany as a real business institution as far as I can tell.* (Germans, please correct me!) In these structures membership means something, these things are real rights. They are, in fact, identities. "Paypal Mafia" is a social group handle that has emerged, but imagine if every start up had a non-revocable membership of a union, club or guild of those who did the slog at the start. These things are very socially important, and there is no doubt that they are in some sense rights which other cultures could have turned into an identity attribute (non-transferrable property, perhaps.) So there are lots of things which are property-like in business which could be enshrined as property of some type and, of course, that property could be managed on a sufficiently advanced blockchain. But the deeper point is that these things could have existed at any point, and just don't: we seem to have plenty of imagination for moving property around, but very little for creating entirely new classes of property. Other than the Credit Default Swap or structured loans.

So the result is a series of perhaps completely unnecessary games, rivalries, tensions and causes of failure in the areas where the rules of company law force structural conflict where none need exist. I don't think fixing this for corporate founders is easy - it's an awful lot of law

and common practice, and who's to say the new idea is better than the current way? - but there's another area where contract law gives us the freedom to create new forms of transferrable property and associated rights without much trouble, and if things don't work out, it's not like the IP of the company is tied up in a possibly-dysfunctional new corporate form.

Let me introduce the value network.

Value Networks: where money really comes from

In the old days, we talked about supply chains. Coffee came out of some former British colony for a buck a bushel, and was sold in Knightsbridge for a quid a cup. Power concentrated in the first world end of the supply chain, and all-too-often the old colony put entirely too much weight in the "chain" part of supply chain. The results were linear, predictable, exploitative and generally hard-restricted by Coasian information / decision cost problems and transaction costs.

https://en.wikipedia.org/wiki/Banana_republic#Examples
https://en.wikipedia.org/wiki/The_Nature_of_the_Firm

And while it is true that an awful lot - far too much - of the world still works this way, the truth is that things have changed.

Today value networks, not value chains, dominate the landscape. There's an exception here, for utilities, which I'm going to come back to below - so when we talk about actors in value networks, don't think I mean the electrical grid or Amazon Web Services. So there is a brutally complex piece here that we have to get over, and then the rest should be fairly easy.

A value network is a set of actors in the global economy whose interaction generates excess value.

Now, the complicated bit. In earlier times, information was expensive, trust was hard to find, credit was difficult and coordinating action was expensive. Henry Ford's factories took in iron ore and rubber at one end and emitted cars at the other. My recollection is that they made everything, right down to the bolts. This is the absolute limit of vertical integration.

In such a system decision making is easy to the extent that is usually easy to identify who is supposed to make the decision. There are chains of command, a boss above, subordinates below, and the whole thing inherits an awful lot from the military: regimented. As with the military different ranks within a hierarchical company typically make different kinds of decisions: a Colonel and a General do different things. Directors mostly deal with people problems, for example. There is an enormous flux between American business culture and the American military, as fighters from wars come home and get jobs and bring military operational culture with them. Fighter pilots are particularly notorious in this regard. Likewise the Pentagon is continually trying to become more agile and efficient like a business. Coase looks at these

zones of command and control as anomalies: if markets are efficient, why aren't all large company jobs done by swarms of small companies in constantly shifting efficient markets.

http://www.forbes.com/sites/davidkwilliams/2013/02/19/what-a-fighter-pilot-knows-about-business-the-ooda-loop/#1e6278f06650

The traditional answer to this is transaction costs and information processing costs: it's simply too hard to organize a swarm. So instead you regiment, pulling ideas from Taylorism and Fordism and Deming and all the rest, aiming for a statistical norming of performance (reliable! predictable!) and very, very high quality decisions about the future at the top. And that's more or less where it stays during the golden age of American manufacturing might: huge companies, huge regimentation, and decades of sustained growth on the back of Cold War stability and then Pax Americana.

Now compare this to Shenzhen today, or perhaps Italy after WW2. Both of these are industrial ecologies that predominantly produced stuff, not software. I think you can make a pretty good argument that the modern open source software ecology is another system of this type, but the switch from hardware to software makes it hard to draw precise parallels for this discussion.

http://joi.ito.com/weblog/2014/09/01/shenzhen-trip-r.html
http://newlearningonline.com/new-learning/chapter-3/after-fordism-piore-and-sabel-on-flexible-specialisation
http://www.benkler.org/CoasesPenguin.html

So what is a value network? Consider a cell phone. Many, many components. Nobody designing a phone GUI wants to worry about surface mount component thermal characteristics. So the immense complexity of the project is divided up into many, many shops doing different things wel. Since one surface mount transistor is much like another, and competitive markets exist for these things, mostly the vendors are not competing on product but on price, on performance out to the second decimal place, but mostly on reliability, niceness and flexible responses to complicated project change. Those flexible responses are really key: if there are a few hundred vendors involved in a mobile phone production line, and maybe a few thousand commodities (copier paper, q tips, toilet paper) behind that line, things are always going to be changing. And even improvements can stress a system: a slightly better battery comes to market between when the phone software is specified and when the product launches: are there additional features that can be enabled now? Even positive change can ripple through an entire network as it attempts to find an optima inside the complex competitive environment it operates in.

Many value networks have a gorilla that acts as the central bank and government of the value network: the phone company, say. But, fascinatingly, not all. Many value networks are made of small, adaptable interlocking parts without any substantial gorilla. Weddings are this way in many places - a wedding planner and a coterie of specialized providers who are brought in to do

different jobs, without the wedding planner actually being the largest entity involved in the transactions. And, of course, “everything has to be right” is critically important here, because nobody is going to remember how great the flowers were if the marquee leaked onto the dance floor.

Value networks share interests. If, once the deal is locked into place, one player fails to perform, everybody is ruined (or at least damaged.) If a player jacks up their prices as far as possible after the deal is locked in (assuming there is any price flexibility) they may get the lion’s share of the spoils but also never be invited back into the collective to do business together again. And while it’s often not easy to grift on price, it’s almost always possible to rip off your partners (and your collective clients) on quality. It does not help that people are buying and selling from each-other down a supply chain within a value network: the caterer buys meat from an organic farm, which buys feed from another farmer. By the time you’re back on the feed farm, the link to the pleasure or distaste of the wedding guests is so remote that it seems almost like a cut corner won’t kill anybody. But, of course, the sum total of many cut corners is the drop from “everything must be perfect” to “it was OK” and that’s a factor of two on the price of the event. Quality has to be a pervasive concern in a “high touch” value network - but in an environment where there are half a dozen links in a supply chain within a value network, each link on the chain is competing with the next link for its rightful share of the spoils all the way at the end of the network. If the guy growing organic cattle feed can’t make a living from our notional wedding because the cattle farmer is eating all the profit from the lucrative organic catering business, where’s the incentive to do the job right?

http://www.amazon.co.uk/High-Tech-Touch-Technology-Meaning/dp/0767903838

Of course it’s easy to see in something like a wedding, but back to our mobile phone: shoddy surface mount components in a minor subsystem by a third tier vendor who stepped in when somebody else jacked their prices and stepped out of the consortium as a result... and now the phones die in the field, and the returns eat three years of profits from that line of phones.

These kinds of things happen all the time because the available financial instruments we use generally speaking represent value networks rather poorly. Perhaps we envisage simply buying everybody involved and rolling them up into a single command-and-control conglomerate? Perhaps feasible in some industries, but if only 20% of the farmer’s output is going into the organic wedding catering business, even the rolled up conglomerate is going to wind up exporting most of their meat to other businesses, and is therefore in the meat business, not just the wedding business. All the same problems now emerge. How much more so for electronics component suppliers, who may have 1000 customers and no interest in being acquired by any of them.

Northern Italy after WW2 was a maze of small industrial shops doing everything from furniture to motorbikes, according to the Second Industrial Divide. Nobody had the tooling or the expertise to do everything, but people sold not only their own capabilities, but the capabilities of the

people within their networks. The resulting wholes were much stronger than the sum of their parts, and this kind of generation, creation and capture of value is very much the norm. In fact, one of the strongest arguments for socialism is that the whole of society is simply one large value network and, with the right incentives for sharing, it can be mutually coprosperous and generative. But even outside of such grand schemes, there's a simple truth: within a value network we would like our interests to be aligned, so that when one sells, all profit, and so the network as a whole can continue to provide high quality, good prices, and compete with its genuine competitors in the wider world.

Conventional supply chain thinking puts a business in competition with its suppliers and its customers, mainly over price and quality. If my company is embedded in a value network, and I can raise my prices high enough to squeeze everybody else, but not enough to get booted out, I am "winning" in some sense - right until the network either starts failing to make sales, or somebody else in the network that I am relying on goes bust. If everybody is playing this game, the prices in the network will be as high as they can possibly be relative to the market, and affairs will be tense. Plus in such a low trust environment, everybody will keep their own contingency funds for each project, which will also bump up the price.

Now compare a value network of this type to a value network which has sorted out its internal pricing in such a way that there is:

- a single contingency fund for all members delivering on a particular job to share
- transparent and equitable pricing between members
- equitable and agreed profit margins, right across the value network
- cooperative decision making
- codesign of products and services to maximize combined revenue opportunities

That last one is really important. Back to our notional wedding planners. Suppose it turns out we've got a couple of the really really big marquees just sitting here after cancellations... so you can have them at the same cost as the smaller marquees, which puts a ton of business the way of the people renting chairs, tables, gets more guests invited, and generally increases the size of the entire show without actually having any cost impact on the supplier of marquees. Or on the other side, "wouldn't it be amazing if..." which turns into brainstorming and cooperation. Sharing of expertise beyond usual customer-vendor relationships, and (all importantly!) whole-network discussion about value creation, a kind of information exchange which almost never happens inside of a linear supply chain because people may talk to their vendors, but it is exceptionally rare for them to talk with their customers and their vendor's vendor's vendor at the same time. If it takes everybody working together to create the value, but price-and-quality negotiations are all that people see of their vendors and customers further up the value chain, real opportunities for learning, growth and cooperation are being left unexplored - and that is very clearly leaving money on the table. Not every business lends itself to this kind of fundamental re-alignment of interests inside a shared value network, but enough do - particular inside of large, complex undertakings (relative to the size of the businesses involved) that these

dynamics are worth exploring as a potential source of a fundamental increases in economic efficiency due to the presence of blockchain technologies and particularly smart contracts.

Thinking together: the primary advantage in value networks

This kind of cooperative networking of elements is core to complexity control in large scale projects. It's not for nothing that a lot of senior management spend their time wandering around and talking to unlikely people to form overviews of who's around, what's happening, and what it might all mean if the pieces were fitted together: whole systems thinking is always at a premium, difficult and expensive as it can be at times to generate an operational overview, sometimes called a *common operational picture*. But with that overview it becomes possible to coordinate previously impossible jumps in productivity by re-asking about the fundamental assumptions of a business, or re-envisaging a whole as far, far more than the sum of its parts. Whole systems thinking, when it works in communities, is like magic: *scenius* (scene genius) as Brian Eno would term it. But inside of market capitalism with joint stock companies it is profoundly hard to arrange the openness, alignment of values and interests, and trust required to bring whole systems thinking or its higher form, scenius, into play. Direct competition lowers our efficiency, limits our options, and constrains our creativity in ways we cannot see. Competition among people that actually share outcomes is almost ubiquitous inside of the constructs we currently use for organizing business and society and it is very expensive indeed overall.

http://kk.org/thetechnium/scenius-or-comm/
http://www.rmi.org/Whole+System+Thinking+and+Integrative+Design

What are the areas of mutual benefit and mutual alignment that could be revealed if the following classes of price conflict could often be resolved using financial instruments that correctly shared the value of the deal between the relevant parties?

- customer and supplier
- company and vendor
- founder and founder
- founders and investors
- company and utility
- citizen and state

Of course, there are tricky areas here. Value networks are not free of internal competition: can one maker of wedding cakes be displaced by another? Perhaps if the quality and price and flexibility and everything else are good. So there is still an element of competition:

- within a given contract, value network members should be tightly aligned
- across given contracts, there may be competition for network membership

Furthermore, the whole spectrum of “last round” phenomena have to be accounted for - somebody booted from a value network may not have any interest in keeping their quality high, for example. Without the shadow of the future to keep people in line, previously mutual interests may indeed sharply diverge. Value networks are not always trust networks in the sense of a presumed long-term relationship.

Of course, the value network itself is in competition against other value networks which aim to supply the same goods and services. But in most cases, competition inside of a value network simply raises the price of the final product, resulting in less sales and lower profits when in competition against another similar value network with lower internal friction. Cooperation and cohesion through systematically aligned incentives inside of a value network is a competitive advantage. But inside of a system where communication is by price signalling, is the information processing level of the available tooling adequate to the task? Perhaps if XMI-EDI or E-SPEAK had succeeded in transforming business much of this would be obvious, but right now the basic business processes in most industries have not transformed into low friction environments by aligning basic operational incentives using tooling which understands the opportunities for cooperation above the level of invoices and price signalling. It is clear that more is possible, but what kind of tooling would be required to liberate these potential efficiencies?

Decaying equity: an imaginary new financial instrument

Now the tricky bit.

Suppose that value networks had a new financial instrument they could use to align their values. I’m going to title this instrument “decaying equity” and it should be thought of as an off-the-cuff conceptual abstract. I’m not saying it’s the right, best or ideal instrument for aligning value networks - but it’s something easy to describe that has some interesting properties, and it should serve to foster some new thinking. I want to do a quick thought experiment where we take a look at a world in which decaying equity is a standard construct, and then figure out what else might be possible.

So decaying equity works just like regular equity, but over time it slowly returns to the care of the company that issued it. There could be a vesting period of, say, a year in which the decaying equity is granted to a new collaborator, and perhaps a two year period in which the equity fades back to the control of the company, for a three year total cycle. Perhaps we envisage doing a major contract together which will take 18 months to complete, and have huge impacts on our collective brand and market positioning. It’s clear that either company involved (let’s say this is a two party partnership for now) could go on to immense future gains from this project, perhaps even being acquired by a large and enthusiastic company with grand ambitions. In short, if

interests are aligned and the work is done well, somebody could get capital-r Rich. But if we attempt to reflect this transaction in a conventional contract, where does it fit?

- A sells to B, and jacks the price up to reflect potential value to B
- B tries to find a vendor who doesn't fully understand the implications, and gets the usual market price rather than the jacked price
- B is now buying from somebody that doesn't understand how important the deal is, and may slack on delivery

It turns out that price signalling doesn't very well reflect the possible breakout conditions represented by something that might be The Big Deal. How's about using regular equity?

- A and B swap 20% of their company stock, each now owning 20% of the other
- The deal goes well, but the anticipated revolution never comes
- The companies go back to hunting independently but are still tethered by equity
- Maybe they arrange to swap it back, but actually B is doing pretty well these days and A would rather hang on to that stock, *if you don't mind*
- We're back at structural conflict because the equity instrument used is a poor fit for the actual nature of the value being cogenerated, created and shared in this instance.

This should not surprise us. Equity in its current form was designed, roughly, for ship captains who needed gold to hire a crew to sail to India and return with peppercorns. 20% of the gold, 20% of the peppercorns, and it was basically a one-shot deal. Next voyage, new equity. Of course this is an oversimplification, but not so very far from the basic roots of joint stock companies as you might thing: the East India company was a very long, very complicated, very expensive "voyage of discovery" (ahem!) to a far off land to bring back... well, anyway, the less said about all that the better, for now. Messy.

But back to decaying equity. Vests in one year, and fades back over the following two. Perhaps our companies agree that they will continually give the other partner small slices of decaying equity at every forward step on their mutual collaboration, so that as some equity begins to decay from the start of the deal, new equity is being piled on at the back as larger and larger shared contracts arrive.

How does this shape up?

- Deal goes well, one company is acquired, the other does very well from the deal
- Deal doesn't go that well, nothing happens, and two years later everybody's equity is back where it started
- Of course, there are edge cases
    - What if the sale takes two years to negotiate?

    - What if the expected 20% turns out to be a poor reflection of actual value generated, and 50% would have been fairer, given the degree of real cooperation?
    - What if the quality is simply terrible, but it takes more than two years to find out?

So the decaying equity instrument clearly doesn't immediately, durably and reliably perfectly align interests between the two companies involved. On a good day or on a bad day it is probably better than using either cash ("position") or equity ("jounce") to align the interests of the two companies involved. In the situation where an immanent acquisition seems possible, and made more possible by companies working together, it probably aligns interests better than either of the commonly used available tools. You can imagine, in fact, a deal which has a whole stack of parallel financial instruments stacked up on top of each other to give a much more precisely engineered exchange of value.

Imagine a deal looks like this:

- 10% decaying equity
- 5% permanent real equity
- 30% profit share
- 10% revenue share
- exchange of non-exclusive royalty free IP licenses
- and we'll all spend Christmas together at a ski lodge in British Columbia

Now we have a situation where in the core case, things line up on a whole stack of different levels in parallel. Perhaps the overall deal performance is pretty close to 20% decaying equity and fair pricing on products. Perhaps it's a little different. But in the edge cases, where things go very right or very wrong, clearly the two deals we are imagining here (basket of aligned factors vs. all decaying equity) have very different performance characteristics.

Complex instruments for managing diverse long term outcomes

These stacked instruments act very much like stock portfolios, in fact: each one (even in a simple two party A + B deal) performs slightly differently across a range of scenarios: perhaps gross goes up but margins go down because of large orders. Perhaps profitability is hit hard by world events, but the share price is semi-stable because it is understood to be a temporary condition. The resilience of using a basket of indicators to align interests is likely to be much higher than using a single indicator, which might even be faked by (say) artificially reducing profitability using transfer pricing to an offshore subsidiary. This approach makes sense for all the same reasons having a portfolio of different stocks and shares and bonds and so on makes sense: absolutely peak performance may be reduced (vs. one lucky bet!) but the reduction in risk and the corresponding improvement in average performance is good enough that, in many cases, complex alignment will seem like a far better option than a simple profit share or a simple

equity swap. A durable, broad-based alignment of interests can be so much more internally diverse than just setting a fair price or co-owning each-other's equity!

Now multiply this effect over a complex value network, including a diversity of investors from hedge funds through to equity crowdfunding from people who may also be customers (or even employees) of the value network. I'm going to push this one step further, and assume that in most of these entities, very nearly all of the value of the company is going to be exported via profit sharing and revenue sharing agreements, leaving the equity basically worthless *except as a way of gaining democratic control of the companies involved.* This approach of stripping the companies of all value by using all the cash flow to pay people or do things is really just an abstract concept so that in this mental model equity = political rights rather than an instrument of speculation on the basis of future value accumulation. This is an absolutely artificial construct, but it strips out something quite cleanly:

- equity-as-control
- profit
- revenue

are now three cleanly separable things. Across a value network is very easy to imagine customer-vendor relationships working in a variety of ways with whole systems design meeting quite tough price negotiations. Then we can add supply chains within a value network, that may wish to do things like equalize profit down that supply chain by taking the payment from the final customer and splitting it fairly using open book accounting so that, say, everybody makes a 25% margin rather than one business making 5% and another 80% in the same fundamental business. Then businesses who wish to minimize their risk might find another company inside of the value network whose business is countercyclical with their own (they're up, we're down, and vise versa) and exchange profit as a way of lessening the overall risk profile of the business. The result is a notional value network which has very, very tightly aligned incentives in some places, and a looser edge in others, all held together using a variety of contracting instruments which exchange value, risk, profit, cash, control and various other kinds of assets in manners that keep everybody (hopefully!) smiling and, more importantly, pointed in the same direction without creating a new type of value network czar in the centre.

Decentralized decision-making within a framework which tightly aligns incentives without creating undue durable interconnection is, I believe, the holy grail of realizing some of the possibilities of Coase's 1940s models about networks of small actors being able to compete with and out-compete the lumbering corporate behemoths of his day. Of course there is no doubt that a sufficiently advanced behemoth (and I'm looking at you, Google-Amazon-Yahoo-Microsoft-Apple) could not use these kinds of mechanisms internally to create fluid and powerful internal capital markets and risk/equity sharing markets (in which one kind of risk is exchanged for another) resulting in companies in which the managerial stick is smoothly replaced by precise alignments of financial incentives to actual value generated, a little like Singapore's bureaucrats getting bonuses if GDP increases.

https://en.wikipedia.org/wiki/Cabinet_of_Singapore#2011_review

You know, of course, that I'm assuming that the implementation method for a set of interlocking financial instruments of this complexity would be smart contracts, probably on a blockchain given that's the only currently viable smart contract platform that I know of. So companies could easily have blockchains shared with vendors in which these kinds of mutual equity, profit, cash flow, and other value are exchanged using smart contracts. However, what if a vendor's assets are already in one blockchain type system, and another vendor is using another system and the two wish to exchange? These kinds of use cases are either going to be met with a forest of protocols for moving value from one blockchain to another (possible) or by One Big Blockchain in which nearly all of this activity occurs. This approach is probably preferable because it does not set up barriers to collaboration at a technical level, where people wish to exchange equity but cannot actually form the necessary vehicles to do so without incurring a severe technical overhead.

So what kind of use cases might we envisage?

The Dotcom Mutual Union

We know from Paul Graham's infamous Black Swan Farming article that nearly all companies that Y Combinator invests in die: a 90% failure rate is discussed (although I think this might be industry wide rather than YC specific.) 10% of companies become healthy little businesses, making their investors back around 10x what they put in, and this is what pays (in principle) for the sea of failures unleashed by dotcom capital culture.

http://paulgraham.com/swan.html

The money is made on the moonshots, the "unicorns" - companies that have brand names you have heard of, that generate wealth extremely quickly, and spectacular valuations. 400 million users at a couple of bucks a user is suddenly a lot of money, even if you only own 7% (the standard YC cut) of the resulting company. YC has obviously done rather well at picking winners: something like 600 investments [[double check everything!!!]] with substantial stakes in AirBnB and DropBox [[and maybe one other]] is a much higher batting average than one might expect for getting into the big money. They have done well, and are rightly famous.

But where does this leave the founders failures? If the capital guys are planning for a 90% failure rate, does that imply the average founder should be planning to be 90% likely to fail? I certainly believe so, but I'm a pessimistic jerk driven by pure reason and unholy, almost machine-like ambition, right? I can accept those odds of failure (see Severe Pandemic Flu Strategies[[]]) and still do brilliant work day in, day out, for years.

http://guptaoption.com/6.SPRS.php

So I'd like to be able to optimize my time at the roulette table by spreading my risk more intelligently. If my startup has a 90% chance of failure, just based on general principles, and I'm not investing in 600 companies so I have a vastly higher chance of getting to the all-elusive moon shot, then my expected outcome is failure and... return to the job market or try again. 90% odds of failure are not great odds even if the prize for a home run is that you get very rich. In fact if it wasn't for the fact that the booby prize in the dotcom game is $100,000 a year working for Google, the entire thing would have fallen to pieces years ago because of the unacceptable risk profile.

So what's a boy like me to do to get a shot at the big time, the brass ring, the equity-in-the-moon-shot story that so animates most of silicon valley at some level?

Here's my suggestion: we should share equity with people who are doing companies that are nothing, nothing at all like our own, on a semi-random basis to avoid the risk our biases will blind us to the odds of success for somebody's venture. This is more or less what the YC investors are doing: they spread their risk over 600 companies. Why shouldn't I do that too? Hell let's round it up to a thousand for easy math.

So let's think about this from the perspective of an early employee, a 1% equity holder in a significant enterprise. Suppose if everything goes well, the payout is $1 billion, which gives our 1% holder a handy $10 million payout when the shares are liquidated.

- I keep $5m, and $5m is split 100 ways to my peers, $50k each.

On the other hand, if 5 companies in that network of 1000 what I'm sharing equity with go big, that's $250k per person in the risk pool. Am I willing to give up $5m I may never see in exchange for $250k that I'm very likely to get?

Hell yes. And there's a lot of room for strategy here: 10% buy in rather than 50%, or some kind of valuation panel that figures out what they think the equity is worth and then makes an offer in return for a person joining this dotcom equivalent of a labor union. Perhaps there could be half a dozen different risk pools that people could join one or more of, depending on how much of their potential future profit they wanted to exchange with other

Here's the fascinating thing: I think that companies where most of the staff are members of these risk guilds - risk unions - are actually going to do better than the average, because membership of a risk guild increases the likelihood that I, personally, am going to do OK from this venture.

- $10m or nothing, vs
- $5m or $250k

really is a no-brainer. And companies with engineers who know that in all probability the price of a small house is going to fall on them simply because they've traded away a slice of their future billionaire bag... which they're less than 1/100 likely to see anyway? I think employees in companies with that kind of safety net are far, far more likely to swing for the fences than people who are in companies where the logical strategy is to pack away the dollars now, and pray that when it all goes wrong you won't lose your house. The Y Combinator doctrine as described in Black Swan Farming is entirely about the need for risk, risk and more risk because the 10x companies just don't really do it for investors, and mutualization of risk for employees actually aligns the incentives for the employees and the investors far, far better than the $10m or nothing strategy. As an investor, you want risk-greedy madmen shooting for a $1bn Unicorn payout, and the big enemy is successful companies that play it safe to protect risk shy founders. By aligning staff, founder and investor interests, in the pursuit of unicorns, horizontal staff risk pools - mutuals for dotcom option risk - could seriously transform the industry into a fairer, more performant version of itself.

And we would reinvent the labour union while we were at it. It all drops out of portfolio theory if you have the financial instruments necessary to make doing the optimal thing affordable, efficient and hassle-free. Let's build one of these tomorrow!

== energy mutuals

[[tk]]

== provenance and other supply chains

[[tk]]

== next gen financial instruments from Robin Hood Coop?

[[tk]]

[[A COUPLE OF PRETTY DAMN CHUNKY CASE STUDIES GO HERE, ILLUSTRATING THAT ALL THIS IS A LOT NEARER MARKET AND MORE CREDIBLE THAT IT MAY, AT FIRST, SEEM.]]

[[fortunately we have the case studies to write up]]

Enabling a new age of better financial machines

So let's restate the case from the beginning

- First we considered the little red cash box, and the many million pages of law required to bring a petty cash drawer in an ordinary company into existence
- Secondly we considered Dog Atheism, showing that the way things are is only one way they could be, and our historic models even (especially!) if they are thousands of years old can be out of step with scientific reality

Together, these factors are the loosening up and shaking out of old ideas of, in fact, the status quo. The default reality that we operate in is in fact extremely arbitrary, and we believe it to be simple and objective for the same reason that I suppose fish lack an awareness that water is wet. In fact if we were to posit the little red cash box in an environment in which one had never existed, and then showed the truck load of paper required to regulate it (complex because of the context it exists in) people would laugh at us. Any asset within a conventional legal and corporate structure exists within this complexity: the simplicity of the part says nothing at all about the complexity of the whole. In problematizing the existing structures, by showing their amazing complexity, built up one broken-and-patched rule at a time, I want to make conceptual space for an alternative to exist. Just because a new thing looks complicated is no reason to argue that it cannot exist, succeed or grow. The everyday things around us are already incredibly complicated, and we have simply learned how to navigate through the simpler, easier, cheaper parts of that complexity in our everyday affairs.

Similarly with our good friend the canine and Dog Atheism: a single species from dog to coyote to wolf, *canis lupus.* Science makes it possible to look at what we think we already know, and to see it again. The same is true of technology, from the microscope and the telescope, through to (for example) large scale monitoring of search by companies like Google. They build new models of human nature based on an ability to observe which only recently became possible. We cannot cling on to the known and the familiar, assuming that things are what they once were, and never get caught out. Dogs are not dogs, phones are not phones, and language lags behind reality at all times, because change is quick and culture is slow. These days the gap is so huge the conversation is fragmenting.

So between understanding fully that the systems we have are complex and arbitrary, and that the old stories we drag heavily around about the world are badly out of date, a legitimate window of possibility exists: new things, with a similar level of complexity to the current instruments we use to manage companies and regulate trade, but closer to the modern technological base (rather than being based on quill-and-vellum ledgers) could come into existence.

- Then we tour around the highly speculative idea that cash and equity are a bit like position and momentum, and that above them are a set of higher order operators which could be used to identify value and align interests in a way that neither cash nor equity currently can, including concepts like profit sharing and revenue sharing.

- Then we then go on a tour around a couple of proposed new systems for small company cooperation, based on the idea of sharing risk and reward in new ways. We take a look at “decaying equity” as one possible construct which might suit one possible situation better than either cash or real, permanent equity does, as an example of the kinds of things that turn up when you stop to look at the financial instrument situation again.

Now, at the end of this long and arduous thesis, I have finally built out enough of the necessary language (and if you think it was hard to read, it was so much harder to write) to express the point of the whole piece simply. Here it is.

Calculus for companies

Building companies with current financial tools is like engineering complex machinery before calculus was invented. It is my belief that smart contracts will enable us to build financial instruments which actually represent modern value accurately enough to fully enable efficient and effective trade. Enormous value and productivity will be liberated as these tools are created, built out, and widely adopted.

There’s a lot of trial and error. There are a lot of unnecessary flying buttresses. There are a lot of steam boiler explosions. Over-all, whatever it is we are doing, in business we appear to be flying by the seat of our pants, against a sea of constantly jostling, changing forces. But what if a lot of that is because we lack the necessary tooling to appropriately hedge and share the risk/reward all the way through the networks which support us and our companies? What if, in fact, with the right set of tools the chaos of business could be buffered and smoothed to remove a lot of the incidental chaos, fog of “war” and unnecessary conflicts?

Such a world is hard to imagine, but perhaps it is **harder to imagine than to implement**. Generation of complex instruments which divide up reward (expressed as a variety of instruments, from cash through to equity via cash flow and dividends) is quite simple in a smart contract environment: define the rules, and write a little code to implement them, relying on the underlying power of the blockchain for security and stability.

For example, let’s imagine a four level value exchange contract between two companies. They agree that they will exchange cash, a percentage of revenue, a percentage of profit, and some equity as part of a package of work. Let’s say that in addition there is a flow of physical goods.

A smart contract to implement this might be a couple of dozen lines. Perhaps it would be tied to supply: for each 10kw diesel generator which company B takes delivery of, company A receives $7400 in cash (paid in a stablecoin), and the companies exchange 0.1% of their profit and 0.3% of their cash flow. A heavier flow of generators more tightly couples the companies - 100 generators so ld turns into a 10% profit sharing arrangement and a 30% revenue share.

Now imagine that one partner hits problems: company A has a cashflow crisis. At this point, the alignment of interests between A and B is very serious. Perhaps B is cash-rich and doesn't want to see their equity stake (and future revenue share) in A nullified by a bankruptcy case... instead of a lethal cash flow crunch which kills A, perhaps B simply extends its pre-existing equity in A a little more, or in exchange for a greater revenue share later (a more flexible instrument than interest.) Complex flows of value between trading partners might deliver flexible response across value networks: alignments of interest at once deeper and more immediate than simply figuring out how much to invoice, or how much of a company one wishes to own.

Think of this kind of flexible arrangement as a ball bearing or a shock absorber between two parts of a value chain. Rather than the naked metal grinding surface of unaligned self-interest, we present a spring-and-rod arrangement. Small shocks are absorbed by the spring, and everything is kept lined up by the rod. Something goes a bit wrong, the spring gets hit hard, but the essential mechanisms on either end are spared a crushing, jarring blow to their inner workings. Now imagine a complex value network made of five dozen small companies, and a few larger ones, delivering a complex product into a global marketplace through a variety of channel partners. In such an environment, if the connections are all bare-metal (self-interest meets self-interest) the odds are that the whole will fall apart. Buffering, if it exists, will be in the form of contingency being added to prices at every step of the process, resulting in a far higher bid to the eventual customers. But, most of all, the complexity of the structure makes it fragile: if the direct grinding of self-interest on self-interest crushes a small-but-vital partner, the entire deal could ship late because one player got squeezed too hard, collapsed, and had to be replaced, delaying the whole project.

Obviously in the real world often the human trust networks which interpenetrate such complexes of contracts usually sorts the issues out before something breaks at a financial level, but all of those human connections take time and attention to generate, and our ability to get solidly settled with large numbers of new people is limited by what appear to be fundamental factors of our sociobiology. If we scale our trust through 60 or 80 new people in a new value network we are part of, who do we forget in another part of our life?

https://en.wikipedia.org/wiki/Dunbar%27s_number

We are only human, after all.

Consulting with smart contracts

So suppose instead we have these complex instruments at our command. Suppose I am a freelance strategy consultant. I can walk into a company for an afternoon and teach them a new way to see the world which will cut their time to understand their response to a fundamental new technological shift affecting society by 50%, and lessen their chance of making a catastrophic

mistake by 10%. I'm clearly adding a ton of value, but this value is not best represented by them paying me £2800 a day, or giving me 0.5% of their company reflecting my value over time. Both of these things may accurately reflect my value: more income in the short term, or more fundamental value in the long term. But what about the medium term? Perhaps my advice is really useful for two years, and then they're out of my league and need to talk to advisors who understand big business strategy more, or maybe they move into a field where the technology is outside of my ken, like software for biotech. Cash now might represent that value accurately. Equity probably doesn't. But ideally as long as they were benefitting from my advice, they'd pay me something, and as soon as they were out of that zone, those payments would stop.

We informally manage these kinds of relationships all the time using instruments like retainers or paying for the benefit from one contract by inflating the price on the next round of consultancy. But these informal mechanisms, again, consume a substantial amount of mental effort as we manage complex, tangled nets of relationships. We are basically bridging the underlying inadequacies of our common contracting frameworks with "emotional labour" - constantly keeping tabs on large numbers of people's lives, keeping our social capital in good repair across a variety of social scenes, and generally being a good citizen of a productive network.

But if we had better underlying contracting instruments, perhaps some of these processes would rely less on constant emotional effort to create and maintain social capital. More could be done by the word on the page (or the contract in the blockchain) leaving a bit more time and emotional energy for us and our personal lives - or (capitalism being capitalism) for further hyper-extension into ever more rarefied areas of risk and return.

Contracts which accurately meet our needs free up resources, or add resilience to the underlying network which generates the value - and to our lives. If each individual element in a value network is more stable because the network of its customers and its vendors do not present the flat, hard, cold surface of naked self-interest, but instead a sprung, padded, blended surface where splits on revenue, profit, and equity result in partially cooperative response in areas where (right now) the rules of the game are kill or be killed. Enormous amounts of time, money and energy are wasted sorting out issues of trust in situations where people's needs would be better met by contracts which fundamentally aligned interests, rather than trusting that come a crisis, somebody will act against their own legal interests to benefit you.

Better to align the interest so that you never have to figure out whether somebody will harm their interests to protect you because it is The Right Thing To Do - rather, make sure that doing the right thing in a crisis is the financially best option for all parties. I'm convinced that it is possible to do this for a large class of current activities, from consortiums of specialists doing web design with several different people handling different parts of the job, up to manufacturing operations like Tesla.

The key is transaction costs. Right now the typical package in a deal with a substantial possible gap between the contract value and the actual utility of the deal is trust: if this turns out well, we'll take care of you on the next round is an absolutely standard construct all over the business world. It's an endemic agreement form. Contracting entities are insufficiently flexible because sufficiently flexible contracts are simply too expensive. Most businesses don't know for sure what their cash flow is, never mind their profit. But for future businesses with a substantial exposure to blockchains, much of this data might be available in real time or monthly rather than annually and in arrears. Contracts can then be written against that data, automatically triggering payouts as resources are registered. This is not dissimilar to the way that companies used to pay dividends to shareholders and, in fact, it may be that dividend payments are part of what is missing in the current landscape. The high growth environment produced by companies reinvesting 100% of their winnings (minus executive compensation's explosive growth!) may also have taken quite a bit of financial transparency out of the system as a whole: there are no fleets of shareholders asking exactly what the company's state is, and are they sure they couldn't afford another guinea on a share this year?

But in a blockchain environment, a lot of that transparency will return. As a result, it becomes possible to write contracts against some of these usually-hidden fundamentals: revenue in this business unit, or profit made on this specific business line. Being able to write contracts against these kinds of internal variables creates the possibility of being able to reward fine-grained creation of value in a complex value network environment, both between but also within companies.

Complex consortia

In a complex business environment where you have, say, 60 legal entities tied together to deliver some big project, it's easy to imagine a situation where this meshing of contracts and value results in a completely impossible tangle of contracts. If these contracts are smart contracts, however, there's an interesting reason for hope: they are machine readable and precise. Of course we would expect most of these smart contracts to be Ricardian contracts - contracts with a legal text, a plain English translation (maybe), and a smart contract which executes the business logic automatically. So, in theory, it is possible to load all of these contracts into a simulator, and *run them through all possibilities* using (say) a Monte Carlo simulation approach. Basically you run through lots and lots of scenarios and see what happens. This ability to simulate contract interactions is likely to be much, much more predictable than situations where the contracts are all written on paper, and there may not be transparency about the status of the contracts or their intentions in the parts of the value network that you cannot see into. A blockchain provides a level playing field for all partners.

So we imagine a fleet of smart contracted partners in a complex value network: 60 companies in a mesh, reaching deep into each-other's pockets on cash flow, profit shares, specific information

about sales, equity perhaps including innovations like decaying equity, and the whole thing is fed by a series of Oracles (perhaps provided by auditors) injecting facts like the price of oil and the amount of steel in the warehouse into the smart contract network. A simulator wargames out all the options available, giving a real time health dashboard on the status of the partnerships.

How is this different from a company?

The answer is simple, but startling: a company is (even in a partnership-based enterprise like a big accounting firm) a hierarchy. Decision-making is as limited as it can be, and wealth is concentrated at the top whenever possible. The ongoing debate about CEO compensation makes it clear how unstable this balance is. But at an even deeper level, so much information is thrown away as information travels up an organization that the people at the top are largely looking out through a miasma of lies spun by their staff trying to gain advantage. Employee retention is also a nightmare in hierarchical systems, because smart people always feel that they could do better if they were in charge - and then leave to do so. Although there are a few titanically successful big companies which have formed in the last few years, Apple, Google/Alphabet and Amazon perhaps prime among them, enormous amounts of the value generation at the heart of those companies was done while they were still relatively small. Growth might be necessary for full exploitation, but there's no doubt, at all, that the structural foundations of extreme wealth generation are being done by smaller and smaller teams as time passes, and those teams are increasingly dependent on external partners to provide the services which permit them to focus on their core value adds: from catering to accounting to cloud infrastructure, the leverage of small teams is dependent on force multipliers.

In software the issue is not the sort of manufacturing logistics and supply chain dynamics that I've focussed on so far in describing this value network approach. The issue is retaining talent.

Really good top flight technologists are rare. They work in a world where a single sufficiently bright individual can cook up an abstraction that automates the work of tens of thousands of skilled individuals, drops the cost of a task (designing a database driven web site) by two orders of magnitude, and six months after it is done there will be fifty imitators building on top of this evolutionary foundation pushing the state of the art forwards again. There is precious little stability, and no resting place.

On the other hand, software projects balloon out surprisingly fast. A project started by a team of ten soon becomes a 250 person enterprise, then tens of thousands as it deploys teams to do technical sales or customer support. There are occasional miracles which stay small and simple (craigslist is a wonderful example of this) but, overall, there is intense early stage value generation followed by a ballooning out exploitation phase.

Early investors know this. Most well-read startup founders know this. The shape of the game is well understood, which is why fighting over equity is such a bloody, nasty, messy, divisive business in many early-stage companies. Because there are only two ways of getting value out

(cash and equity) there's a very limited window to discuss cooperation. The cash is worth too little compared to the equity, and the equity is potentially so very, very valuable that people can sit on top of it like dragons on coin. So the result is a dramatic narrative filled with people being screwed over by double dealing, losing fortunes, and so on. It's a right proper mess, as we'd say up north.

And start ups?

So what if we had a much more complex and subtle range of instruments for expressing value contributions to early stage start ups?

We discussed decaying equity earlier. That's an equity variant on demurrage on currencies, a common mechanism used in local currencies during periods of real financial hardship, such as Germany between WW1 and WW2. We've also discussed stacked value: some cash and some equity is the standard stack, but that stack could be expanded: cash, revenue share, profit share, decaying equity, permanent equity. The stack has very different risk performance from any of the individual components, and the blend can be adjusted to produce whatever range of incentives is required, from short range incentivization of sales staff, through to long term "write maintainable code, avoid technical debt" incentivization of core technical staff.

Similarly, funding relationships could be spread on these axes too. Debt is at one end of a spectrum, going through things like convertible notes, through to non-voting shares and then full equity on the other end. Then you can work your way around lots of potential in-between forms: equity that vests as a company grows (rather than with time) so that employees who create massive growth can go and do it again, rather than being stuck for years waiting to vest for instance. The ability to tie equity to specific contractual tasks or, if not equity, a 5 year revenue share or some other precise instrument of value ("pay by performance") also seems likely to provide mechanisms which might (in the long run) provide a way for open source software providers to get paid: "if you use our software for commercial purposes within these parameters, we can provide a support package in exchange for..." whatever the terms are that suit.

Finally we come to the relationship with our customers. As regulations around equity crowdfunding become more welcoming, the prospect arises that one could finance a company by selling it directly to its first 50,000 users. A proposal, much as would go to VCs, and a prototype get listed somewhere and people rapidly swarm around the idea and buy early shares in the company. Perhaps there's a "value neutral" clause where the initial investors get paid back as soon as cashflow is available, so they are derisked as fast as possible. Perhaps governance structures in addition to the conventional board of directors are created at the same time. These things are all very much within a broad scope of possibility, in that they could be done today with paper contracts and real equity, perhaps using the equity crowdfunding mechanisms provided for under recent American regulatory updates. They could also be implemented on blockchains, or perhaps in a hybrid where the legal instruments are created in

the real world, but traded and managed using smart contracts. The bottom line is that there is an enormous creative space here to create something new.

What would that “new” look like?

Imagine a situation in which a company is founded by a person of good reputation floating stock directly on a crypto-equity market: the first step is essentially an IPO. Perhaps some of the money is raised through loans made against future profits or cash flow, or as direct claims on future payments or products. Already we have tons of possible funding models, all of which put the load on different parts of the company going forwards into the future.

Now imagine the vendor side. For the sake of argument let’s assume we need an awful lot of organic cheese for our new company. Perhaps the lead programmer won’t eat anything else. There’s a supply chain for the stuff, and we could work by simply injecting cash into the supply chain. But suppose our cheesemongers are doing OK for cash, and would quite like to defer payment in return for equity. Now they are both vendors and owners: partners, in other words. And if they have similar partial partnership arrangements with their vendors, we are now tying into a complex value network which provides one of our raw materials. Perhaps the programming talent comes from a guild-like company with a broad, complex equity portfolio - they won’t take cash, but only work for equity and board seats so they have meaningful self-determination. Pretty soon what we are left with is companies which do not look like kingdoms, or like governments at all, but rather are organic formations of value around an opportunity (or a vision) with the conflict around equity and cash diffused by the use of much broader and much more risk-tolerant and risk-aware hybrid/compound compensation packages.

The economist Ronald Coase discussed the idea that in environments with cheap transfer of information, companies tend to grow smaller. The basic idea is that a company is a zone in which decisions are made semi-centrally, and this works because the cost of obtaining and processing information to make a decision is quite high, and the workers are basically “renting” access to that information processing apparatus at the center of the company by accepting lower wages than they would take for the same work if they were freelancing. This, plus insurance that one will get paid during slack periods, get paid vacations and various other things, typically means that employees work for around a third of the day rate they would get consulting/freelancing. The other binding factor is transaction costs. If it takes two days to figure out what is the best new laptop to buy, and 5000 freelances make that decision independently, that’s quite an expensive set of transactions. Most will, in fact, grab whatever is cheap and on their doorstep or on Amazon in 15 minutes and continue with their day: they don’t decide, they default. At a company level, specialized people can drill into the decision further, make a good - a really good - high quality decision and still be left with a huge profit in saved time compared to the freelancers: say 9950 person days profit, in fact. With economics like that, it’s not hard to see how large companies get ahead in information processing terms. The economies of scale are huge, and for companies which are large enough, the ability to ride out the long term cycles in the economy (4 to 8 year cycles, typically, but some longer ones) can provide devastating

advantage to large actors. In particular, having the resources to keep making (even small) investments in R&D right through the economic downturn is how many large fortunes are made: as things swing up again, the companies which manage that have huge competitive advantage over the companies that cut back to core operations only in order to survive. The result of this equilibria is that the large companies, to this very day, survive as dominant forces in many ecosystems, long after a Coasian read might have suggested their wings would have been most thoroughly clipped.

But they survive, and I am convinced that a large part of that is due to the sheer lack of tools enabling value networks made of small, nimble actors to replicate the kind of cohesion and speed of agreement found in large organizations.

a conclusion: back to the calculus.

There's no way to make an argument about the future that is this complex become very precise. There are an enormous number of moving parts, and a lot of this is like interpreting cave paintings: tracing outlines and forms, and trying to guess what people were thinking. It's just in this case I'm not looking at 40,000 year old cave paintings, but looking ahead two or three years during a time of literally unprecedented technological change to guess what we will think then, carried over the event horizon by the flow of events, then lost to sight at the lip of the waterfall. I think a lot of people have seen what I am seeing, and expressed their hunch about the future of business in a networked environment in their own language, with reference to the toolset that triggered this realization in them.

There are a few basic themes:

- less reliance on VC, more reliance on the crowd
- better living and working conditions for people on the technological bleeding edge
- less tendency for companies to grow and become internally authoritarian
- better cooperation between partners
- a reduced role for the platform providers in making the rules for everybody else
- more meaningful work
- possibly less emphasis on moonshots, or at least better outcomes for misses?

Some think of that transformation as mainly being a social phenomena, that better social arrangements will naturally cause these outcomes to manifest. Perhaps because I'm slow to the party, and an engineer, I have a rather different cause-effect model in mind when discussing this possibility.

To me, it looks like an outcome of using better mathematics. As you may know, my oldest project is the Hexayurt Project, a 2002-vintage Open Hardware project that published free designs for a better class of refugee shelters in 2005, and has become a standard fixture at

Burning Man. Thousands are built every year, and the project's only asset is a single HTML web page and some PDF files and videos. It's a pretty spartan thing. It works because it uses better mathematics: from Buckminster Fuller's spherical trigonometry, which minimizes mass, to Edmund Harris's concave tilings, which minimize waste. The result is gorgeous, beautiful domes that are easy and practical to build from panel materials. They really perform!

I know that when you change the math, you change the reality. The same is true for cryptography: the first intuition that two key cryptography was possible has resulted in several generations of cyphers, with different math giving rise to different capabilities. Now we march on homomorphic encryption, and a fundamentally different relationship with truth seems to be in the offing: I can verify something is correct, without ever knowing what the inputs to the process were. This seems like magic, but so did two key cryptography in the early days: one key cryptography was water, and we were fish, and then discoveries are made, and there's no dog.

My feeling is that blockchains give us the necessary mathematics to change business. We know, for sure, that for large financial institutions blockchains bring rapid change, but mostly in terms of doing what they are doing today much, much more efficiently. We do not know where that goes in a few years, but the basic direction of travel seems likely to be reasonably linear: same entities, same transactions, if only because regulatory pressure will prevent anything too crazy (or mad-weird innovative) from happening.

Your bank is not going to turn into a bowl of petunias.

On the other hand, in the wild, wonderful world of pure bitcoin, all that exists is cash: no companies, no contracts, no company formations. You have one construct, the "multisig" wallet, which requires many signatures on a payment before it goes, but other than that, you are on your own. It's not enough to build new complexity and new structures of the kinds that interest me, at least not at scale.

Now you have ethereum.

My belief is that we can build out a set of constructs which do for capitalism what calculus did for mechanical engineering. I believe that the financial instruments powering most companies are, relative to what is possible with our new tools, horse drawn carts. With good blockchain tools, more ways of sharing value and exchanging risk, we could build things which are so much better than modern companies they look like helicopters beside covered wagons. Our current company law and implementation technology are so crude they cause alienation among natural allies (say the founders of a company) and generally encourage brutal competition among people who would be far, far better off financially if they learned to work hand in glove or like choreographed dancers. All of that unnecessary competition does not make for a more effective business environment, any more than extra lines of code makes for better software. It is not essential competition, competition on the fundamental level with people offering genuinely different products, services or options based on different philosophies or actions. Rather it is the

bickering about taxi fares in countries without rate meters - petty, unnecessary friction caused by a lousy, lossy business environment. We are spending enormous effort on incidental competition and petty screw-downs, which are emotionally exhausting, hardening and narrowing, at a time when we most need rapid cooperation, open horizons, and personal flexibility. Incidental competition and conflict waste time, our scarcest and most non-renewable resource.

And that's the vast majority of deals in mainstream capitalism. The tools are prices and equity, neither one accurately reflects what we want, and we bridge the gaps with social capital (which is another way of saying emotional labour.) Because the current instruments do not easily allow for equitable sharing of outcomes in little deals, everything is negotiated down to a T, all cornered looked in with flashlights. We just don't have easy ways of saying "you do well, I do well, and either way we're in this together."

So into this environment come smart contracts. Smart contracts provide an ultra low uncertainty, automated way of taking simple contracts and making them happen automatically. We agree that if the price of eggs is below £2.50 a dozen I'll buy 12 on Friday, and they appear on my doorstep if the price is right. It's that simple. If we build out a new set of much more precise instruments for sharing risk and reward, including things like vest-by-growth stock options for founders and other mechanisms which serve to tightly align interests where the current systems leave such a wide gap that we have to span with trust, social capital, and struggles for cohesion, a process which has spawned an entire literature and culture in Silicon Valley. All of that time and energy is wasted dealing with the incidental complexity and conflict caused by the poor fit - literally the lossy abstraction - between generation of value in dotcom-style companies and the legal frameworks available to entrepreneurs and VCs.

I don't think that the mapping to calculus is precise, of course. I'm also not convinced by the rough outline of capital -> equity -> productive capacity -> cash flow -> profit -> wealth -> capital. I don't think it fits all industries, and I'm sure that I'm describing social norms rather than, say, a lifecycle of value or the phases of some kind of matter. There might be a general principle to be abstracted out there, but in this instance, the value is only in the parallel: once you conceptualize that it's possible to align interests basically at any point up that hierarchy, just as it's possible to match acceleration without immediately matching velocity, everything gets easier.

Similarly, dogs do exist. Our mental model of dogs is quite unreal, quite unlike their true nature. Society is out of step with reality. Similarly for the petty cash box: in practice informal management of petty cash probably hasn't changed much in 600 years while the complexity of the corporate law that contains it has multiplied by many orders of magnitude, from statues written on animal skins to vast tracts of PDF files on government servers.

But to see these things again, and new, requires looking at them as an alien outside, looking in: to see the full strangeness of a million pages of law to manage a buck fifty in change, or keeping canis lupus in our home when it so recently hunted our old and our weak.

I think we could build a system to efficiently allocate capital to new ideas which would revolutionize the world using just the smart contract technology we have today. Every few months that pass that ecosystem will become more mature, with more services, more acceptance, and more code written. I think this could pull a lot of capital into innovation, and that would be a good thing. I also think, along the way, we could produce a new generation of tools for forming value networks and precisely architecting the sharing of cost, value and risk (both good and bad) to take a lot of the fruitless and irrelevant competition out of capitalism, freeing companies (and the talented people within them) to compete where their products and services genuinely differ from each-other.

I think the result of that could be a much better, and fairer, world. It's odd to think of radical political change starting with better contracts and reduced transaction costs, but it's not so strange to think that economics leads politics. Perhaps if we had these kinds of sophisticated tools used to manage most of the value in the economy, fully mature versions might creep into government and help with things like small scale local democracy and precise management of national health services so that public decisions about overall spending priorities are actually reflected accurately in patient care decisions. There is a saying in physics that experimental breakthroughs come from one of three areas: higher energy experiments, more sensitive sensors, or repeating the experiments many more times to see new patterns in the data. Similarly, we typically think that getting a better world starts with fixing government and governance, usually at the policy level. But I think there are very plausible transformations in the core value handling architecture of society which are more or less inevitable, although not so certain in their final forms that they cannot be steered. So I think it is worth starting there, and seeing how far along we can get.

And that, ladies and gentlemen, is dog atheism.

https://www.google.co.uk/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=dyslexic%20atheist

The objective is to explain how inadequate tooling for cooperation leaves us with inefficient competition instead: specifically parallels the formation of multicellular organisms etc. Business-as-symbiosis cannot function effectively without additional constructs for risk sharing

Effective risk sharing likely constitutes an evolutionarily stable strategy within market capitalism.

THE BIG FINISH

complicated stuff about biopolitics, specifically how correct alignment of interests tells us how our friends are, and market capitalism doesn't provide good mechanisms for aligning interests, so we experience a conflictual society

we could still have markets, but with correct use of high order risk alignment mechanisms, we could (at least) rise and fall with our Small World Network neighbours, so that most people, most of the time, experience their business lives as being far more collaborative - right down the value chains.

it's pretty squirrely to make this case, it might have to get done after the second and third case studies are properly tight.

small world networks

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representing value in complex systems like supply chains using smart contracts

========== administrivia =========

There's a life chat button beside the "Comments" button - turn it on if you want a gossip, there may be some interesting people discussing

This piece will end up on the Consensys blog in its final form. I'm just drafting here.

It'll be something along the lines of
https://medium.com/@ConsenSys/programmable-blockchains-in-context-ethereum-s-future-cd8451eb421e?source=latest---

or

https://medium.com/@ConsenSys/tell-me-who-you-are-258268bf3180#.r3el3lptg