OS Leadership Summit Talk.

Translating Linux Success to Open Hardware

This presentation explores the challenges of scaling an open hardware business. The presenter's team builds open source industrial machines and houses - and they are pushing the limits towards non-proprietary development across the ~$70 trillion economy of the non-software, physical goods. Marcin will share his experience with the Global Village Construction Set experiment - an initiative to open source critical infrastructure machines for building modern civilization. As Linux has changed the world of software development to non-proprietary - what are the key ingredients and lessons learned for translating this model to physical goods - to shifting the proprietary and patented norm to open source? Marcin discusses Open Source Ecology's program aimed at this transition, and how OSE is approaching financial feedback loops in volunteer-based, non-proprietary hardware development.

Intended audience is anyone who is exploring open source business models in general. It is also for anyone who is interested in how open source business models apply beyond software to physical hardware - and what common models exist between both fields. The presentation should be especially interesting to ethical entrepreneurs committed to open source development that creates one's own competition. How does one still thrive in such a distributive enterprise, when the business model actively trains its own competition? Anyone considering open hardware entrepreneurship is likely to gain encouragement from an innovative model that is working for us. We are exploring business issues of operations, recruiting, marketing for an open organization, so this should shed light on common challenges for any open source startup.

Benefit to Ecosystem: Our work is a good example of an open source startup business model, but in hardware - so cross fertilization of ideas is likely. I think providing the hardware angle will help people frame open source business opportunities from a different light. We are engrossed in scalable, modular project architecture, so that we can learn a lot from open source software and vice versa. We are also exploring issues of licensing/franchising, recruiting, collaborative literacy, certifications of products and producers, business operations, etc - all of which appears to be common interest throughout. We are especially interested in large-scale collaboration, so I would like to glean insights from peers at the conference.

1/5/18 notes - re-position as the Bible for students. Aligning contributors is key. Parallel to Linux - free OS, here free Society OS. Align Dev Method to Recruiting (copy) to Fundamental approach (Pattern Language Primitives)

ToC

1. Foreword
   1. My history. Poland. Until I discovered...that I was useless.
   2. GVCS. Practical experiment at utopia, like Paul Romer’s Charter Cities. The Campus.
   3. Civilization reboot - of our mind, and of our world. Clean up mental models, and clean up earth.
   4. Approach Transparency - open-source centric, secular, apolitical. Distributive. Responsible. Entrepreneurial. Bootstrapped and ethical. General semantics, the map is not the territory. Lifelong learningn. Abundance. Freedom. Responsibility. Governance. Practical, not academic. 10x. Exponential. Ecological. Transparency. Material approach. Spritual evolution. Capitalism, to Natural Capitalism, to Distributive Capitalism (internalizes perfect competition and a level playing field)
      1. Imagine you are playing football (or soccer, but the metaphor doesn’t work as well), and the field slants at a 30 degree angle to the other side. Now clearly, any sports fan would notice this as unfair. So when the economic playing field is just as slanted, why don’t we correct that?
   5. Part 1 of a 4 part series. Every decade. 2018, 2028, 2038, 2048. Focusing on infrastructures for now. Second, on information and algorithms. Third, on evolving as humans: augmented and integrated.
   6. Distribution: Podcast, speaking tour, press release, Distributive Enterprise Mastermind Group - quarterly product dev cycles, OSE Dev Team, Community (Forum), Website. [HeroX + DE Mastermind + 3DP Webiste are business #1.
   7. Part 1 Workbook - is the operations, protocols
      1. Social experiment: is it possible to match ‘employees’ numbers of large corporations with self-employment across different products to create Distributive Monopolies?
         1. That is - is ti possible to create an organization which lowers barriers to entry such that more people would be self-employed?
      2. How to handle autonomous teams of 100? 10 of them? High commitment, high autonomy
   8. What I Could not talk about in the TED Talk
2. State of the World and Civilization Infrastructures. Prelim [Notes](#j92m9jo4q0wg)
   1. The Economy. Wealth and poverty. Wealth distribution.
   2. Software - Linux case
   3. Hardware
   4. Government. Innovation
      1. Politics are ignored, as we are interested in underlying causes.
   5. Human Development - Culture, Self-Determination, Transcendence
   6. Summary of [Walking through 50 techs and their economic impact](#mtwcar2ekn4)
      1. How many of you here use Linux? Google? A tractor?
      2. Summary of the economy, and that the 50 tools can create about $50T of it. - highlight paragraphs and 2 figures
         1. Myth of the Information Economy. (Ag, Industry, Service, Experience) Clear up what we mean by ‘information economy’ so we can ground people in hope. The old agriculture and industry is commoditized = concentrated, but it still exists and has huge inherent value overall, albeit captured by value add, not raw production.
      3. The greatest news since the beginning of time - miniaturization and info (digitization) allows for unprecedented distributed economy
         1. But that’s not what’s happening - power concentration data. 66. Dekabillionaires.
            1. **Clarify once and for all if we are better today than 100 years ago in terms of wealth and poverty, as this is very confusing for most people starting with myself**
         2. How do we reconcile this with Abundance by Diamandis. But extreme poverty, and $1/day? Disgrace.
         3. Continuation of enclosures. Land, IP, and lately, internet.
         4. Reconciling enclosure with free enterprise. Stop the Bastards for now, but encourage Good People as the playing field levels.
      4. Towards Decent Economies - Decentralized and Networked - show centralized-decentratilized-netwrked graph, and a disconnect between the internet infrastructure, and centralization of economies
         1. The critical concept of [Distribution](#yhgnt6pe1tc3) vs Production. We need to understand this to understand one of the central potentially existential threats to society.
         2. Financial Infrastructures
            1. Concentrated: VC, the Fed, The Corporation, Stock Market, the Fed.
            2. Distributed: Crowdfunding [[1]](https://www.forbes.com/sites/chancebarnett/2015/06/09/trends-show-crowdfunding-to-surpass-vc-in-2016/#5b1585aa4547) and [[2]](https://www.forbes.com/sites/chancebarnett/2015/06/09/trends-show-crowdfunding-to-surpass-vc-in-2016/#5b1585aa4547) , cryptos, the DAO,, and ICOs ([$708B](https://data.worldbank.org/indicator/SL.EMP.SELF.ZS?end=2017&start=1987&view=chart)), and HeroX
            3. OSE - Productive Equity Crowdfunding - you don’t need money; you need the things that money can buy. First example - plastic filament and CEBs
         3. Algorithms as threat to equaility (O’Reilly)? Solution must address underlying system of enclosure that favors concentrative algorithms. Algorithms are just an expressio of human thought, at least until the Singularity.
         4. Self-employment is on the fall. [[1]](http://www.dartmouth.edu/~blnchflr/papers/EntrepLeague.pdf) wannabe. [[2]](https://data.worldbank.org/indicator/SL.EMP.SELF.ZS?end=2017&start=1987&view=chart), [[3]](https://data.oecd.org/emp/self-employment-rate.htm) are global. [[4]](https://data.worldbank.org/indicator/SL.EMP.SELF.ZS?end=2017&start=1987&view=chart) - self employment is dropping significantly, consistent with reduced freedom
         5. Distributism
         6. Distributive Enterprise. Decommodification - with perfect competition.
   7. Creating the Distributed Economy
      1. Agriculture and Mining - dirt and twigs to the substance of modern civilization.
         1. Perennial Polycultures vs GMOs - it’s our choice
      2. [Flexible Micromachines](#8msqm4x5brcm)
   8. [What if you aren’t a Hillbilly with a PhD?](#mq6jh1am941w)
   9. [Economic Feedback Loops - the Distributive Enterprise Mastermind Groups.](#87wpj0m38fc4)
3. Large Scale Collaboration - OSE Development
   1. Introduction - how do you get massive participation like Linux or Wikipedia while avoiding Brook’s Law
   2. **OSE Vision - Modular 100 Person Realtime Collaboration Ecology**
      1. **Show how 100 people work in parallel. Avoid gory details to make this engaging, fill in details on the wiki.**
      2. **Clairity of X90-1000 towards quarterly release cycles.**
      3. **Show the numbers on the wiki - 120,000 development hours per quarter**
   3. OSE Values
      1. Mass creation of right livelihood via open sourcce
      2. Business model of Extreme Manufacturing - experience economy focus
      3. Distributive Monopoly replaces monopoly/commodity capitalism - this is supported by entry into experience economy
      4. We produce more integrated people. One or few Einsteins are good, but if they are 20% or more of the population, we are in trouble.
   4. MTP - open source blueprints for civilization
      1. [Open Source Appropriate Technology (OSAT)](#z0fas8ujvn3y)
      2. Distributive Enterprise
   5. Development Method - combing lessons learned from Product Development and Open Source Software
      1. Modularization - key to large parallel effort
         1. Extreme Design - part libraries and modules
         2. Extreme Manufacturing
      2. Taking it Further: Construction Set Approach Explained
   6. Primitive Module-Based Approach: a Pattern Language
      1. [50 Technologies Treated In Groups](#gcqp0wvclcvn)
      2. Construction Sets and Primitives
      3. Product Ecologies in a Nutshell
4. The open enterprise - **Distributive Enterprise.** Dominates a market in a distributed way. The Future of Enterprise - The Distributive Monopoly Paradox
   1. The Perfect Economy - [Does Current Economic Theory Support the Notion of Distributive Enterprise?](#awa24ddqzena)
   2. Mass Collaboration - [The Basic Model](#9jsud4gfkdgu)
5. [**Introduction**](#im7rkm7n5vte) **- An inspiration.** The importance of hardware production vs the hype of Silicon Valley. New economics are startups, reorganizing the existing economy, but not pulling the rug from under it. Which is a great relief - we can reconnect to nature, and deliver the unrealized potential of the distributed economy. Isn’t it ironic that with distributed internets, concentration is ongoing? In this book we ask how we can be more resilient, clear people of depression. Solve the “myth of technology”. Allow for wholesale pursuit of self-determination. Make people happy. Produce freedom. Produce democracy. Clean up some mental models. Including governance, money, environment. And usher in appropriate scale. Appropriate technology. Civilization reboot, based on best practices. Small scale republics, city states, charter cities. Call for personal responsibility.
   1. Society’s Infrastructures and Evolution of the Economy
      1. **Importance of infrastructure** - Haiti vs next door; North Korea night satellite picture - they are kept in the dark (Paul Romer)
      2. **The Myth of the Next Economy** - when we are ‘in the information economy’, it does not mean that we left agriculture or manufacturing. Hardware is still key, and is between 50-95% of the economy. The issue is that we think we no longer have any impact on the former - or it’s just boring. Our case is that we can’t neglect it, or otherwise, you give all the power to oversized companies that do business-as-usual. Exxons and Monsantos.
   2. **Assessment of abundance vs doom.** Which is it? It’s your choice.
      1. [Abundance](https://www.amazon.com/Abundance-Future-Better-Than-Think/dp/145161683X/ref=sr_1_3?s=books&ie=UTF8&qid=1514649965&sr=1-3&keywords=abundance), [Homo Deus](https://www.youtube.com/watch?v=4ChHc5jhZxs), climate change, diseases, pollution, war, poverty. History of enclosure ([ZMCS](http://opensourceecology.org/wiki/The_Zero_Marginal_Cost_Society) + [TRAGB](https://www.amazon.com/Throwing-Rocks-Google-Bus-Prosperity/product-reviews/1617230170/ref=cm_cr_dp_d_hist_1?ie=UTF8&filterByStar=one_star&reviewerType=all_reviews#reviews-filter-bar) + Second Industrial Divide). [Paul Romer](https://www.youtube.com/watch?time_continue=41&v=mSHBma0Ithk) - there is plenty of space left. And there is always a choice.
      2. **Numeracy, with feelings. Y**ou have to understand basic principles, and graphs will lie to you if you let them.
      3. **Understanding possibilities** - bad chemicals to good chemicals, evil process to good process, disintegrated to integrated, closed to open. Systems Design, hence the Ecology in Open Source Ecology
   3. Evolving to Freedom. How to create abundance: Societal issues related to the material base vs. information economy vs need to evolve as humans
      1. Case for distributed material abundance (not current artificial scarcity) as a prerequisite who general human progress.
         1. What you do for a living - funding your own oppression
      2. GRAT Best writing and perspectives on what does work in society today - industry, environment, education, culture, gummit, Singularity
   4. The limits of dematerialization: limit of economy is not information but information-physical, and the essential question of lifetime design. Scarce resources and scarce information. In the limit, information is abundant (open source)
      1. Reconcile
   5. Ethics of scarce information. Perversion of the ‘open letter’, the initial name for patents. Patent system and proprietary development. Nobody has shown to date that patents increase innovation.
   6. Open source. What is it? Difference between open source hardware and [free-design hardware](https://www.gnu.org/philosophy/free-hardware-designs.en.html)
      1. Why CC-BY-SA coercion is libertarian - it gives you a choice. Revolves around preventing enclosure.
      2. Difference between open source and free/libre
      3. How [GPL can protect you when yo](https://www.gnu.org/licenses/quick-guide-gplv3.html)u break DRM?
   7. The GVCS: What is it. Why the experiment? Applications. Resilience. Disaster. Space. World Fix.
      1. GVCS top 12 specific technologies.
      2. The rest thrown into bundles of ag, industry, construction, etc.
   8. Trends
      1. Prosumers- via better and smaller tech + 3D printing + automation + robotics. Small is beautiful -> Second Industrial Divide -> Open Source Microfactories
      2. Experience Economy
      3. Open Source, Modular Product Design - OSPD literature
      4. The singularity
      5. Blockchain For Dummies
   9. How the GVCS was selected. Metrics: performance. Minimum Set for Completeness. Substitutability. Scalability. Modularity. Lifetime design. Ecological. Universal Constructor.
   10. Approach: machines, derivative machines, products of machines, and systems. Product Ecologies
   11. The GVCS Experiment: we can make the road only by walking. Choice is not set in stone, and one size will not fit all.

TOC 2 - OSE Platform

1. GVCS
   1. [Sectors of the Economy](#w5qlrkdfioy7)
   2. About The Machines and Products of the Machines
   3. About The Derivative Machines and services. Such as cordless drills, video cameras, semiconductor fab, and internet systems.
   4. About The Systems - serving specific functions; may be used in multiple Prod
      1. Housing, Food, Energy, Transportation, Manufacturing
   5. About Product Ecologies
2. [The End State](#i51kx8t9wm3n)
   1. End State - a person achieving the Growth Mindset. Healing trauma, becoming an Integrated Human. Flow.
      1. Surpassing trauma
      2. Learning the growth mindset
      3. Learning the abundance mindset
   2. End End State - preview of the GRAT ideal world
   3. Getting There - $1B level as sufficient for establishment and wide uptake
3. OSE Appropriate Technology
   1. History of AT
   2. OSE OSAT
   3. OSE Specifications
      1. Dunbar scale. Village of tomorrow is where you and your clan live. The city is a collection of Global Villages
      2. Open Source
      3. Ecological
      4. Human Scale
      5. Simple, Scalable, Modular
      6. Distributive. Distributive Enterprise.
      7. Pattern language and construction set
         1. Top 24 icons
         2. 120 Icons for Civilization - parts and mechanisms
      8. Technological Recursion: down to silicon from sand and aluminum from clay
   4. Applying OSE Specifications to any technology
4. Product Ecologies: living and working ecosystems
   * 1. The cookie cutter development for consumers vs. the live lifestyle. Gummit and Admin lifestyle vs R&D&G lifestyle of constant growth.
     2. Towards Prosumers
     3. Towards the OSE Prosumers
        1. Different systems: house, microfactory, greenhouse, materials
        2. Details of complete ecologies - see Appendix
5. The OSE Platform
   1. Plant trees, produce PV panels, and make hydrogen.
   2. Starting with Home Economics - The Seed Eco-Home-Microfactory-Greenhouse.
      1. Manageable effort required to set up and operate
      2. Importance of open source design
      3. Detailed Business Plan
   3. Manufacturing - open source microfactory
      1. Distributed production model based on 3D Printing
         1. Phase 1 - critical easy machines - 3DP, filament maker, $1B cordless drill
         2. Phase 2 - advanced products - phone, camera with libre upload
      2. The Full Microfactory Model - industrial robot, metal rolling
   4. Fast moving consumer goods - hyperlocal production
      1. Vertical growing - percentages achievable
      2. Integrated perennial polyculture
      3. The Home Production Unit - from fuel to electricity to food to personal microfactory
      4. The village scale enterprise - 200 people - can handle up to semiconductor manufacturing. The division of labor and efficiencies required.
   5. Education free from political or religious agendas
   6. Charter cities, free states, autonomous republics
   7. Government by smart contracts
   8. Money by blockchain
   9. One Day machines, one week houses, one month villages, one year city states - and their respective business models
   10. Construction Sets
       1. Mechanical
       2. Electronic Devices - limit of open source production laptops as the standard
       3. Power Electronics
       4. Materials
       5. Microprocessors
       6. Advanced Materials
       7. How to design a computer microprocessor
   11. The Growth Model
       1. Open source replication of small eneterprise that works
       2. The Distributed Enterprise Website + auto fulfillment + 3DP + CNC circuit mill or fabbed circuits
       3. Widespread Collaboration Invitation
6. Development Approach:
   1. **Development Pattern Language, Technology Primitives Icons, Marketing Websites**
      1. Development Pattern Language - Dev Template
         1. [Wide Participation](#crhbcbdzhrgt)
         2. [Understanding the Process](#fsfqsd7pim1g)
         3. Breaking Down the Process into small parts
         4. Making the process autonomous
      2. Technologigy Primitives Icons + Construction Sets
      3. Marketing Website for synergistic product line
   2. Agile: Crowdsourced and Blockchained Heavyweight Product Management. OSPD. Industry standards for product development. Learnings from Linux - how did Linus organize so many people?
      1. xTreme Programming
      2. Agile
      3. Waterfall
      4. Heavyweight Product Management
      5. The future of Product Development
   3. 100x on Design, Build, and Organization.
      1. Extreme Manufacturing. 6 milestones reached.
      2. Design & Build - team ecology and effort - in principle
      3. Organization and enterprise. We built machines...and then we sold them. HR, Operations, Marketing. Automation, smart contracts, smart money.
   4. Contributing
      1. Microcontributions
      2. Dev Team
      3. Enterprise
7. Movement Entrepreneurship and solving pressing world issues
   * 1. [Startups and Finance Capital](#n09i26ryhfo4). About advantages/disadvantages of existing methods. Private, venture, IPO, crowd, ICO, incentive prize.
     2. Generally regarded existential risks: environment, war, poverty, corruption, wealth disparity, out-of-control technology
     3. Solution: decentralization, transparency, integrated systems design, ethics, eco-technology, personal growth (general semantics, language, reason and spirituality)
     4. Diffusion of Technology
        1. Historical Trends of diffusion
        2. Linux and Microsoft
        3. What is different today, and what needs to happen still (evolution, distributive enterprise)
        4. Scalability. MTP + Execution
8. Conclusion
   1. Evolving to Freedom
   2. Integrated systems approach
   3. Leaving nobody behind
9. Appendix
   1. The specifics of OSE OSAT - the full OSE Specifications. Refactor existing OSE Spec
   2. The 50 Machines
   3. Derivatives of the 50
   4. Systems
   5. Product Ecologies
   6. Construction Sets
   7. Open Source Personal Microfactory Product List (3DP, CNC Circuit Mill, and Filament Maker, and MicroPower Tool Construction Set)
   8. Forward!
      1. Here’s What we Propose - motivate those who have an open source ecology mindset. Align the contributors
      2. Creating Civilization from Scratch - 1000 Global Villages
         1. Enterprise Back End
         2. Product Development
         3. Scaling Model
   9. [Free Cities or Microstates](#9pjcg83whlf7)
   10. [Podcast](#9se7235f06o1)
10. [Background Research](#oa6eo8hvd9rl)
    1. [Who owns the internet](#epkqq14ku4k)

**Foreword**

Definition of terms is important - assumptions and mental models from which the discussion in this book makes more sense. Some concepts:

1. **Regenerative.** Optimistically beyond sustainable. Because the world is messed up (desertification, deforestation, water pollution, 30% of people being happy) - we need to put recovery or regeneration on the front burner - as opposed to sustainability - which means more of the same mess.
2. **Growth, transcendence, flow.** We cannot solve problems with the same level of thinking that created them. We must transcend.
3. **Optimism**. We are not in the doomsayer crowd. If you think it can, or can’t be, done - you are write in both cases. Our choice. However, we don’t deny hard data. We are also aware that graphs can lie.
4. **General semantics** - the map is not the territory. Even quantum mechanics says that.
5. **Distributive** - the concept that in the perfect economy, a large number of producers produce custom goods in the experience economy. This internalizes closed loop material cycles, where the agility of a producer allows them to have service as part of their business model, where part reuse, repair, recycling diverts high embodied energy materials from the junkyard. This is consistent with the experience economy, automation, miniaturization, and mastery aspect of self-determination theory

**The Perfect Economy: Does Current Economic Theory Support Distributive Enterprise?**

Cut 2: Emergy of 2 Hours Per Day

The case for why the transition to the Open Source and Distributive Economy (where culturally we give away our trade secrets) is inevitable.

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Open source is more efficient. Unbeknownst to many, it has absolutely hands down dominated the open source software market. (explained in State of the World chapter). Why? Because it has more developers, it’s better. Why is it better? Because its license attracted so much talent because it stipulates economic sharing - an open platform- a paradigm where cooperation is funded by underlying economic feedback loops. Hobbyists scratching their itch as the primary cause? Nonsense - the real reason was the economic feedback that put bread and butter on peoples’ tables.

Let’s extend it beyond the 0.3% of the world population who are programmers.[[1]](#footnote-0) Yes, we are talking of a small fraction of the breads and butters. If this happened to software, it’s worthwhile examining a potentially much larger societal impact.

Revenue models aside - the efficiency wins. People want to work for themselves - 70%. Zero marginal cost is approaching on many fronts - raising the standard of living for many. Monopolies are still thriving, leaving many people behind.. Many people are getting extracted (50% government fees, average debt of $7k, 30% are happy, and 70% want to work for themselves but 7% do); $66k and no more makes you happy in Mississippi[[2]](#footnote-1). Environmental destruction is continuing. 12M hectares are lost every year - or more than a square 200 miles on the side!!!!!![[3]](#footnote-2) 170,000 square km - about 3x as large - are deforested every year. Fortunately, if we put up as many solar panels as we deforest and desertify - we would have enough electricity for the entire earth in 2 years.[[4]](#footnote-3)

With due respect to equifinality, this is one option: the open source economy.

1. As open source and distributing wealth, this favors self-employment by lowering barriers to entry. The very premise of the distributive enterprise paradigm is that businesses aim to create their own coopetition. Because the focus is on financial benefit, not financial profit.
2. Open source is a key to cost reduction. Lowered development costs mean lower cost of everything. With open source hardware, this means lowered production costs.
3. Monopolies - are reduced as everyone gains access. And what about regulatory capture? If open source is the fundamental model, then we have open source regulatory capture: governance that supports open innovation and access. Regardless of open source, the sorry fact is that open source lost in practice: google, facebook, and amazon use open source servers and Linux, but as platforms, they are highly proprietary- a reason for which the Oracle of Silicon Valley, Tim O’Reilly, claims that open source is effectively not important. But the OSE paradigm states that Open Source has failed because it has been captured by proprietary interest. This is good for business, but overall it’s part of a business climate that reduces innovation - making a certain few corporations very successful as they monopolize marketplaces. This benefits many in terms of increasing the standard of living, but is very suboptimal in the overall depressing effect on the economy. 30% of people are not happy, and the average household debt is $16k.[[5]](#footnote-4) This is much better than about 25% extreme poverty in the 1850s USA, compared to less than 5% today[[6]](#footnote-5).

Continuous improvement indicates that we can get to much greater happiness - where nearly everyone is on their path to self-determination.

The theory that we aim to prove is that it is possible to create mechanisms that go beyond the Linux success of open source - which paradoxically brings about the ‘failure of open source’ in that linux is rocket fuel for platform monopolies in terms of supplying the giants with software for their back ends.

Linux thus appears to have been usurped.

Thus the question for the next phase of societal freedom-fighting revolves an a two-fold path of extending the open source model to hardware - for reducing the barriers to entry there - while avoiding the pitfall of platform monopolies.

Feasibility of Linux-scale collaborative hardware development aside - is there a bigger opportunity for avoiding capture by platform monopolies?

My obervation of the system leads me to a loud and clear ‘yes.’ This is because if we can extend radical cost reduction to the cost of living (not just taxis and computer programs) - we can free ourselves from largest costs - housing, food, cars - which can truly unplug us and make us prosumers of energy, food, and household goods. The open source microfactory could extend to every future city state - freeing our time to 1-2 hours of necessary work per day - and then pursuing self-determination in the other time. And that two hours as well would be life-work integration - it would not be cruel and dangerous work in the coal mines - as we have introduced appropriate technologies for everything - and we can be free.

The poin is, by not having to work, we make profound change. We no longer need to feed corporations because we ‘need to make a living’ - we are largely prosumers, self-employed, gigged joyously, and the effects of environmental regeneration and social justice can take full effect.

The OSE paradigm does not envision that environmental regeneration and social justicce are compatible with current rules (B corp charter (The Evil Corporation, separation between owner and operator (IPO), patents (prevention of best practice from being disseminated widely). These are all exclusive of the Distributive Enterprise model, and as such, the logical conclusion is that the only way to create the world we want to live in is via the open source economy with distributive enterprise as the operating system.

We claim that this is the inevitable choice because the distributive enterprise is as efficient as it gets. It provides livelihood, un-employs are, and then nature can take a break to recover. We step up to an even higher standard of living, as unleashed innovation, combined with elimination of planned obsolescence - provide for even higher resource efficiency. There is enough for everyone, and we live happily ever after.

**Nice Dreams**

These are nice dreams, but how do we realize them? The above has many obstacles. Financial feedback loops when the system is rewards greed. Egos. Fear of not being employed. Fear of change. Inability of people to collaborate. Fear of responsibility. Fear of not knowing what to do with oneself if one is free.

The way to get there starts with radical collaboration. Starting a new economic operating system is hard, when we are surrounded by the old one. The GVCS is intended to be a small and finite set of tools that can become a comprehensive shift in the underlying economic pattern. But it’s difficult, largely because of the inertia. As the pressure to save the environment while taking care of everybody mounts - it is imperative that we either have genocide, or we get more effective and efficient, and holistic systems-oriented. The latter means open source, and distributive. We are talking about not only preventing catastrophe, but absolutely thriving, given that the sun provides the earth with 10,000 times power power than we use in today’s economy.

Hints from Perfect Competition

Perfect competition is where zero barriers to entry allow numerous players to enter onto a transparent and level economic playing field.[[7]](#footnote-6) The “perfect competition” model (PC for short), by nature of being a model or map (general semantics) is incomplete.

PC does not consider human motivation - or self-determination theory. OSE logic states that if we consider self-determination (SDT), right livelihood is the right thing to do. Even without SDT, right livelihood is the ethical route.

If we want a perfect world - we need to create it.

The basic premise is that most institutions today are suboptimal or plain corrupt. (ref) - and largely by force of oversize (ref like Schumacher). Different choices are possible (Piore) Autonomy in SDT appears to be a case against external control (big government) and a case for responsibility (governnance). Milton Freedman calls for a tax of 10%.[[8]](#footnote-7) In general, seminal economic thinkers agree that goernment which governs least governs best - that’s just another way to state that there is no substitute for empowerment of the populace to be as informed and powersul as they can be.

If autonomy, mastery, and relatedness are fundamental drivers, this implies: We favor self-employment vs working for someone else. Check.[[9]](#footnote-8) We want to be challenged. We want to relate to others. Check - for the open source distributive economy. There is no shortage of challenge as we transition to solving pressing world issues. Not pushing paper. Relating to others - what better way to share love than to truly give to others - in terms of their economic empowerment? The fundamental viruous cycle of the human spirit is the core of distributive enterprise.

And the evolution of right livelihood leads to work-life integration[[10]](#footnote-9) - in other words work-life integration may be deduced from right livelihood. How can we separate that which is most wholesome from that we do every day? To sell short of this is to lead an empty life. The perfect economy may thus be defined as a system where not only PC - but right livelihood also exist - and also work-life integration results. Such integration involves the pursuit of one’s true needs/desires that the only possible outcome is work-life integration.

And technology enables mass collaboration, and distributed technologies that provide the internet of things - including internets of production, energy, information - we are wired to the world, empowered towards resilient local economies because the technology base allows for miniaturization. We can produce anything in local microfactories running on solar energy - down to smelting sand to silicon and making computer chips.[[11]](#footnote-10)

Mass Collaboration

How to extend the Linux model to hardware? By modularity of design, and a refined collaboration architecture. “How is the Brook’s law avoided” - becomes the main question. We must add collaborative literacy to this list - and take a deep dive into each topic.

**The Basic Mass Creation of Right Livelihood Model**

By lowering barriers to entry, it is in principle possible to create massive amounts of human potential, as people gain economic freedom and move on towards self-determination. This is the working model in self-determination theory[[12]](#footnote-11). In today’s world, over 50% of the population lives in democratic countries[[13]](#footnote-12). Of those, only ⅓ have job satisfaction (ref), meaning that they are doing what they want to be doing - meaning that they can be considered ‘free’ or on a path of evolving to freedom. Or, 20% consider themselves libertarian[[14]](#footnote-13) - meaning that only 10% of the people on earth consider themselves free, for if they don’t even ask the question, they don’t qualify. There’s a potential here to unleash massive amounts of human potential. Admittedly, we are much better off in the developed world than we were 100 years ago (ref), so let’s make it better.

There are many ways to approach a “Perfect Economy” (discuss what the Perfect Economy is, as in last section. The basic OSE model is to: (this is inital cut only, based on Perfect Economy disussion, refine and validate this.)

1. Gather a team of 100-1000 developers for a 90 day development cycle
2. Develop according to OSE Specification and refined collaboration architecture
3. Release a product open to anyone for generating revenue, without protectionism to the development team outside of priority access

This has never been done yet in history, but it is worthwhile. So we are trying.

The program requires an MTP (ref) for it to succeed, and it must leverage best practices of crowd development learned from projects like Linux or Wikipedia to allow for massive parallel results. A refined collaboration architecture must be applied to slot developers into many development positions, and this should learn from Amazon prjecct teams (ref) on setting clear goals.

The goals and collaboration are brought to the table first, and then a massive process can be spawned, with clear visible results.

**Press Release**

Release Date: January 2019. Open Source Ecology, a nonprofit organization dedicated to creating a distributive economy, has reached a milestone of recruiting 1000 developers for 90 day development cycles as a replicable method of doing open source product development.

According to the OSE Founder, “We can now develop a full product from requirements to marketing - in 90 days by leveraging 1000 volunteers at a time.” With code name for the extreme development - X90-1000 - the process relies on open collaboration, motivated by the possibility of anyone starting up an enterprise. All the assets that are generated, from blueprints to business plans - are absolutely open source, indented for wide replication by anyone who has the initiative to do so.

Jeremiah Johnson, one of the developers on the team, shares that “We live in a world of abundance, and we make sure that as a result of our development, nobody gets left behind. That is why I joined in an instant as part of the 1000 person team.

OSE has been developing its crowdsourced, open source product development techniques since 2008. The techniques that were developed leverage a careful breakdown of development projects into as many modules or parts as possible - such that teams can work on all of them in parallel. Because a development protocol - a development architecture - is defined and executed carefully for each module - the process can go on essentially in an autonomous way. The keys that were discovered for the success of such projects are: (1) is a clear definition of requirements - (2) an incentive from the possibility of enterprise startup , and (3) a contemporaneous incentive prize competition that is funded by the crowd.

The development process works with a development challenge being announced a

**GVCS 50 Notes**

To summarize the technology choice for the GVCS: everyone uses it, it’s a huge part of the glabal economy, it can be produced anywhere, it frees people up from a high cost of living, it can support a livelihood for many people, and it is otherwise quite centralized before it becomes open source.

With this said, if full distribution of livelihood were to happen, every person on earth would be earning $10,000 per year.[[15]](#footnote-14) If the economic playing field and ambition were equal for all people- which neither are. The top 50 billionaires have a net worth of about $50B, (ref), while the last billion people make $500 per year. That’s a 100,000 fold disparity, which is probably not good for society.

It is timeless wisdom that a decent distribution of wealth is desirable. There is an ongoing debate whether prosumership is on the rise - people who are no longer pure consumers, but who transition to making real things instead of producing no real value, such as bureaucracies. There is a compelling argument for the future of society that all mundane, brainless tasks are going to disappear (ref), and only creative and productive work remains. For the productive work, human-robot friendships can take over (ref) - but if humanoid robots are really so capable - then the argument is strong for localization of the economy.

The case we make is that if societies could produce all their goods locally, up to computer chips, then the case for resource conflicts and destabilizing bubbles and geopolitics disappear. (ref). That is also the case for Charter Cities (ref), where the idea is that clear contracts can provide for stable governance, and improved technology can pull resources from thin air or rock (ref) - such as water and electricity - but also silicon semiconductors and metals.

The GVCS makes the case for such radical localization - with the political goal of freedom. If we are satisfied materially, then we do not need to kick someone else’s ass to take their resources. Unless we are psychopaths - for which there is a remedy. Mental health advancements for ready healing of personal traumas (ref- Gabor Mate), careful understanding of political ponerology (ref - Lobaczewski), learning how our mind works so we do not propagate faulty thinking throughout society (general semantics, logic) and mental health testing for political candidates (if they remain in the future economy) (ref) could solve the problems outside the realm of material abundance. So in essence, the next economy requires that we evolve as humans.

It is also our claim, unsupported by known research (ref) that the current world, which puts much financial stress on people (ref) does not allow for an honest opportunity for people to evolve as people - as the preoccupation with making it through the day is too strong. This is consistent with Maslow’s hierarchy, where basic needs need to be met first, before we open up the inverted maslow pyramid of self-determination theory (ref) where personal growth and transcendence is an important human goal.

As we describe the GVCS - one background thought that we must hold is financial feedback loops. Linux has succeeded as 20 years from its inception, the first billion dollar open source company, Redhat, arose from Linux. (ref) While discussions on open source development emphasize the ‘voluntary’ nature of the endeavor - the underlying motivation is far from non-financial. The open source software economy is valued at $1T in size today - about 80% of the software world - and what made it so was the financial freedom that is part of the open source social contract: any individual is allowed to sell the product. When a programmer engages in open source development - he sets himself up for a job selling that product - whether as a startup, or providing software services for hire by someone else. This is the key point that we need to make about translating open development to hardware: there must be financial feedback loops.

Financial feedback loops could at best be built into the hardware development process - and we make this an explicit part of our open source development work. Development can be monetized - for example by crowd-development incentive prizes such as HeroX (ref), which provide a prize for solving a problem. This prize itself can be crowd-funded.

Our specific idea on formalizing financial feedback into the process revolves around lowering the barriers to entry. In the digital world, digital assets related to enterprise startup can be open sourced. For example, operations manuals, (ref on Lulzbot OS OM) marketing materials, e-commerce templates, website templates, training materials, development protocols, and other assets can be provided via the development process itself. Goal being, to reduce the barriers to entry by providing a virtuous circle for open product development. Just like Linux has a sophisticated development process in place, the equivalent needs to be created for open hardware product development, and that is part of our work.

Explain the 6Ds of diamandis (ref) - for how any enterprise that enters the digital realm can now provide unleashed enterprise opportunities. However, it should be noted that such enterprise opportunities can lead to platform monopolies like Uber or Amazon - and in our general design thinking, we want to create distributed, distributive enterprises (ref) as opposed to monopolies. Not that we wouldn’t like our open source enterprises to dominate the marketplace - but we would like to have that happen via the effort of millions of independent market players, not by single corporations.

Because fabrication can be digitized and made scalable, and because materials and ordering logistics can likewise be digitized, and because home-scale microfactory automation is now accessible in the form of 3D printing, laser cutting, routing, CNC metal cutting, and circuit manufacturing - let’s go through an example how these forces can combine to a wide distribution of prosumer power. This is the same idea as FabLabs (ref), TechShop (ref) , Local Motors (ref)m and 100k Garages (ref), among others. However, all of these rely on proprietary equipment or are created by companies with proprietary equipment. This is not consistent with distributive enterprise because they are not optimized for reducing barriers to entry in terms of the manufacturing equipment. The design, manufacturing equipment, and the business model must be open source in a distributive enterprise - if the goal is the widespread distribution of productive power instead of its continued centralization.

At the end of the day - materials become very important. If manufacturing can be distributed, what about the feedstocks for that production? That is one of the key elements that the GVCS addresses - in that production of metals can occur from recycling or smelting from abundant rocks or clay - production of bioplastics can occur from abundant biomass - production of hydrogen for the next economy can happen from water and the sun - sand can be converted to microchips or solar panels - rocks can be turned to ceramics - and rubber can be produced from dandelion root resin. There are really no limits to local production, though where do we get the trace elements for making solar cells, such as boron and

The distributive enterprise model has the power to take down Amazon itself - applying the amazon effect[[16]](#footnote-15) in the form of distributed enterprises taking over through the internet of manufacturing and open source microfactories. It is no wonder that Amazon has considered transitioning its fulfillment centers to on-demand production via digital microfactories with 3D printers and other high power fab devices.[[17]](#footnote-16) That is the ultimate efficiency: from digital design to a customer as directly as possible via the power of an internet-powered microfactory. The good part is - such technology lends itself to complete production by the masses - a Ghandian notion (ref) which we now have the technical know-how to execute - and much of that know-how can be accessed as open source.

Let’s take a look at how the open source microfactory can play out. Take home scale microfactory with a 3D Printer, with interchangeable heads that can also do laser cutting and circuit milling. Some products can be fully 3D printed. Buyers log online, pay a fee, get a product made, and even watch it online through a webcam. A small robot arm harvests the parts for packing, or a 3D printed box is printed as part of the print job, ready for shipping. An autonomous cart could then send the shipment down to the mailbox from one’s home, for pickup by USPS.

Imagine that all this software and hardware is open source. Imagine that the feedstock is ground up plastic that is extruded into 3D printing filament with an open source filament maker. Imagine that the

With a circuit mill and a 3D printer, plus perhaps some small laser cutting - we can create 3D objects, electronic circuits, and cases. This covers a wide range of durable consumer goods - from new 3D pritner parts (ref), aerial drones (ref), laptop computers (ref), digital cameras (ref), 3D printed microscopes (ref) , robotic arms (ref). Glazing such as polycarbonate, or plumbing fittings, or rubber tires can be printed - if the 3D printer is big enough. With a filament maker, and a grinder to grind the filament maker up - all the feedstock can be obtained from the waste stream.

In the most automated operation like this - kits can be sold readily. Circuit boards, 3D printed parts, and cases are shipped - and the buyer has to solder, glue, or otherwise assemble the products into finished goods. For the open source microfactory - solid product design would be needed to optimize for the production of high value items - with one-click drop shiping of additional parts such as electric motors or metal parts. By combining basic manufacturing with APIs for part ordering - sourcing can be automatic - and products can be sold as kits for a fully automated business - from one’s home.

If the goal is to provide finished products - the entrepreneur would to the soldering or assembly work themselves and charge a higher price for that.

This model of automated manufacturing can scale to prividing kits for heavy equipment, finished heavy equipment if an industrial robot is involved. Small scale steel production from scrap - using a compact and efficient induction furnace, could provide virgin steel from local feedstocks.

For agriculture production, imagine an aquaponic greenhouse seeded via Farmbot and towers planted via an autonomous drone. Then the human does the harvest, and an autonomous drone or car delivers to customers. The case can be made that highly diversified agriculatural csas are enabled by modern technology and automation, when robotic tractors are added to the mix for autonomous farms.

Is the likelihood high that this will be distributed? With open source technology - yes.

**Walking through the 50 Technologies and Their Economic Impact**

**Disclaimer - Graph of completion**

Here we discuss all the tools, but please remember that in Part 1 of the 4 Part Series, many of the machines are still on the drawing board.

**1 . Agriculture**

If you eat, you use a Tractor. Maybe not you directly, but the farmer that grew your food. And food is a $8T industry.[[18]](#footnote-17) The GVCS field agriculture machinery that support this $8T industry are:

**Fig 1**. The Tractor, Microtractor, Microcombine, Universal Seeder, Spader, Hay Cutter, Hay Rake, Baler, and Dairy Milker, and a Bakery Oven are critical tools of the $8T food industry.

**3. Tractor, MicroTractor, Bulldozer and Power Cubes**

The tractor is a cornerstone of a farm, construction, or other materials production industries. A tractor has the traction to pull things, and to do utility work with variou implements that can be added to a tractor and use the tractor’s mechanical power through a Power Take-off (PTO). As such, the tractor can be a swiss army knife of heavy duty work. For the smaller individual or home scale, we have the MicroTractor in the set, which is a small, walk-behind or ride-on tractor at the 16-32 hp size that can perform many gardening and utility functions and can fit in a smaller areas where a large tractor would be impractical. If we go up in scale - use a stronger frame and at least 64 hp, and add a bulldozer blade to the tractor - then we have a bulldozer.

The tractor is a machine on the scale of 50-320 hp in the GVCS ecosystem, and unlike traditional tractors, we focus on modular power. We currently use small 16 hp engine units at $17/hp (ref), which is the lowest cost way to obtain engine power, while making maintenance very easy. Like in nature where a tree is made of many branches, our tractor is made of many small engine units. This way, the same design pattern can be used in the 16 hp tractor as in the 320 hp tractor. The price for using larger diesel engines is 2-4 times larger.[[19]](#footnote-18)

By using the modularity concept, we create our typical construction set approach for heavy machines. For example, if a large tractor frame is fitted with a bulldozer blade - then we don’t require a separate bulldozer in addition to a tractor. This saves a lot of resources - making technology significantly lower cost to maintain. Exploring the limits of modularity, we found that it is much less expensive to scale our machines usig modular and overbuilt parts that make sense both for small and large machines. For example, we can use 4 of our identical track units, each rated for up to 80 hp - Our track unit, for example, allows for a $30k version[[20]](#footnote-19) that matches the traction of a Cat D7 - a sizeable cost savings base price of ½ a million.[[21]](#footnote-20)

Fig. Pattern Language for a Tractor - up to automated control.

The key is making it easy and quick to interchange parts - from small parts to large implements. This is a great challenge for advanced industrial design.

Fig. Industrial smaller parallel and trained configuration. OSE machines can be designed like this, but higher flexibility of the OSE platform can allow for an improved configuration.

Fig. The flexibility of a modular OSE tractor. The modular OSE tractor can be built from the same components, but apply to 16 hp or 320 hp machines while using the same over-engineered components such as the ½” thick steel tracks.[[22]](#footnote-21)

**Spader, Seeder, Bulldozer**

Your food today is grown largely by tractor-driven tilling and seeding, unless you’re a breatharian. Tillage in the OSE system chooses the spader as a more progressive technology compared to the age-old plow.

Fig. (Image of 1800 steam tractor with 50 bottom plow)

The spader works essentially like a bunch of shovels moving rapidly - which till soil without crating a hardpan typical of the more common plow. Manufacturers claim that spading uses 40% less fuel than plowing - because a spader can combine tilling, harrowing, and planting in one operation.[[23]](#footnote-22) A plow, which drags through the soil, requires a lot of wheel-to-ground traction, whereas a spader requires very little - thus avoiding soil compaction. It takes a spader under 9 minutes and 2 gallons of fuel per acre of field - such that feeding Dunbar Village[[24]](#footnote-23) would take 6 hours to plant for a whole year of crop[[25]](#footnote-24). Thus, one day to plant, two days to harvest - and the village has food for the year.

The tractor and universal seeder is an example of how we approach multiple purpose machines. The tractor is a large-size swiss army knife for doing many different tasks. The Universal seeder is designed to plant all types of seed, from alfalfa to wheat, to tubers, and to live plants like sweet potato slips. Modifying the device rapidly is key to this flexibility.

Fig. Swiss army knife tractor concept

The point of using powerful machines wisely is that in the OSE perspective of lifetime growth - life could become easy so we can focus on evolving as humans. Our experiment involves building a college campus where peole live this. When they graduate, they know how to organize a village to spend 2 hours per day working on survival, and then the rest of their life they pursue their highest ideals.

The experimental village thus requires one farmer who is employed 3 days of the year, assuming the equipment does not break down, and generates 30 acres \* $20k/acre of sweet potato, and $5k/acre for 10 acres of wheat if that is turned into bread - or $650k worth of food for the community with direct marketing. That is $27k/hour if baking is automated - a decent pay, but not like the $25k/minute rate of Warren Buffett[[26]](#footnote-25).

Now it would take more time to do a diversified operation, but this is shown just as a baseline to see what’s possible in terms of the effort. Several Ph.D.’s can be granted to develop a diversified, 40 acre subscription farm, using open source equipment and Local Food Nodes as part of a distribution platform[[27]](#footnote-26). The OSE project will develop such a food enterprise both for its campuses and for the outside community - once all the farming machines are done, the aquaponic greenhouse production is optimized, and derivative food processing tools are developed.

The open source tractor can be built at a cost of $125/hp at a scale of 80 hp, compared to $370-$1000 for other brands. It is useful to understand the basic cost breakdown based on off-the shelf parts:

**Fig.** Cost breakdown of a tractor by Frame, engine, hydraulics, control, automation, and balance of system - $125/hp. (p590MJ)

The cost advantage is less visible at the 32 hp MicroTrac, at $160 per hp - though but a comparable mahine like the tracked Toro Ding costs around $1000/hp (ref).

Fig. Microtrac with tooth bar bucket can till your garden, and provide valuable utility work. It is an indidspensible utility machine for any prosumer.

**6. Hay Cutter, Rake, Baler**

If farm animals are involved, then you need these. Or if you want to move large quantities of materials, then a bale is a useful form: from a bale of hay, brush, cotton, cardboard, or plastic - bales allow large scale moving of materials. Bales of aluminum cans are likewise useful for melting down in your induction furnace. If you are making fuel pellets from biomass, plastic pellets for making 3D printer filament - you will need a baler to make 1 ton bales.

**7. Dairy Milker**

For animal husbandry, hay baling stores hay for the winter. Unless you are talking about the fish in your home aquaponic system. Dairy products themselves are $116B[[28]](#footnote-27) of the global economy - hence the relevance of the dairy milker.

**Table: values of the overall food, dairy, cattle, vegetable markets worldwide.**

Combining the dairy milker with computer vision and automation, we envision a solar robotic milker - our MicroTrac with a milking stall - that drives up to a cow to milk her, and then brings the milk back for storage and processing. This allows field milking without human labor for small diversified robofarms that combine the best of regenerative agriculture with modern tehnology to relocalize farming.

Fig. Robotic milker

**8 . MicroTrac**

A very interesting use arises with a small, solar, robot tractor - the MicroTrac driven by a solar panel. By adding a $35 Raspberry Pi Controller (ref[[29]](#footnote-28)) and a $100 solar panel you can be your robotic tractor - for agriculture and other. You can now mow your lawn automatically, and even pelletize it for fuel for a pellet stove. This is possible because today - advanced microelectronics such as the Raspberry Pi is 100 times faster that the first supercomputer, which cost $9M[[30]](#footnote-29) in 1975.

Fig. A solar-driven MicroTrac concept with solar panel and $50 arduino controller can provide autonomous agriculture

**9. Bulldozer**

Now add a bulldozer blade to a beefed up, tracked tractor - and you have one of the most powerful devices for regeneration - or destruction - depending on how you use the machine. Bulldozers are powerful earth moving machines - to build roads, grade house foundations, and in agriculture - to build regenerative earthworks for water and erosion. The biggest example is the 12,000 square miles that have been regreened in China - the Loess Plateau.[[31]](#footnote-30)

Fig. Loess Plateau reforestation

So, if you ever drove on a road - you used a bulldozer. Maybe not you, but whoever graded the road base.

**9. Microcombine**

The Microombine is used to harvest grains and seeds of any type. This is the core of human harvests world wide. For the OSE case, we have a much more flexible and modular machine in mind. Based on our module-based aproach, we can use the same drive platform as the tractor

Fig. Showing the base drive platform that can be used

**10. Bakery Oven.**

The humble bread is a $419B global market.[[32]](#footnote-31) It is the 12th most popular food in the world.[[33]](#footnote-32) And 49% of Americans eat bread[[34]](#footnote-33).

Now bulldozers, tractors, and combines are all good - but the next step for gobal agriculture is the transition to perennial polyculture[[35]](#footnote-34), with only a small fraction of tillage ramaining.

**2 .Construction - 13 Tools**

If you want to build a charter city or a smaller campus, you will need construction equipment - and a trencher to put in gigabit internet fiber between the locations.

The tools in the construction part outside of the tractors include the backhoe, trencher, cement mixer, sawmill, CEB press, well-drilling rig, soil pulverizer, hammermill. The universal rotor is a tool used in other sectors of the GVCS - and the SeedHouse is a living machine.



**Fig. 13 tools of the construction part of the Global Village Construction Set.**

**6 Backhoe, Trencher, Cement Mixer**

The backhoe or excavator can be used to dig aquaponic ponds, foundation trenches. It can be used to remove stumps, do trenching, and with a grapple it can be used to lift logs or to hoist heavy objects. Backhoes are relatively simple devices - a set of pivot joints that use hydraulic cylinders for their motion - producing thousands of pounds of digging force at the touch of control levers. There are both side-to-side moving backhoes, but a 360 degree rotating backhoe is much more flexible. The small side to side version can be used on a front quick attach of a tractor.

Fig. OSE [backhoe from 2010](https://www.google.com/search?q=ose+backhoe&client=ubuntu&hs=ToH&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjLzZKelOLYAhULbawKHQo-DVwQ_AUICigB&biw=1351&bih=731#imgrc=t8j52U9--mn6BM:) mounted on he original lifetrac, a small one used for water line trenching in [2012](http://opensourceecology.org/wiki/File:Bhp1.jpg), and a larger one from [2013](https://www.youtube.com/playlist?list=PL6Jpysxw3Ty-oH4bggp32PR_rPWr8bKC1). Next iteration is the 360 degree backhoe with remote control drive to facilitate hydraulic line routing.

The trencher in the original GVCS icon is a wheel trencher. We built 2 prototypes, and the next iteration will be a chain-based trencher based on our favorable experience with oversized chain drive on the bulldozer tracks.

**Fig. OSE** [**Trencher**](http://opensourceecology.org/wiki/Trencher) **- 2011 and 2013 builds.**

The cement mixer is indispensable. Cement has been used in ancient Rome and in mesoamerican temples. Scotland's County Cork had 23,000 lime kilns at one time - had one kiln per 80 acres. Wood or coal was used as fuel. [[1]](http://www.lowtechmagazine.com/2013/09/lime-kilns.html).[[36]](#footnote-35) Portland cement tool over lime cement in the last 100 years, but lime concrete is favorable in foundations becaue it doesn’t crack as easily as Portland. Using modern appropriate technology, lime cement production in solar microfactories is a viable enterprise at the 1 ton per day scale using an open source microkiln the size of a refrigerator. Limestone goes in one end, and lime comes out the other. With such small appliances costing around $1k, cement production can be distributed - while making cement production carbon neutral, annihilating the current 5% CO2 emission share of the the concrete industry.[[37]](#footnote-36) This is possible in about 50% of America, where the bedrock is made of limestone. That’s a $10B industry in the USA alone.[[38]](#footnote-37)

The cement fryer - a rotary lime kiln - is much like the cement mixer: a Universal Rotor with a heating element. A rotating pipe heated by PV, and an Arduino microcontroller to measure temperatures and guide the process to efficient completion. While not part of the 50 GVCS technologies, it’s a ready derivative:

**Fig. PV of the Open Source Materials Production Facility, a solar Power Cube, a Universal Rotor, metal pipe and an Arduino microcontroller constitute the lime cement maker.**

If we want to go to the essence of construction, take the backhoe excavator, chase it with a bulldozer with ripper shanks, and then rock under a site could be extracted to build a pond. This rock, if limestone, is feedstock for your lime kiln. In some places, rock outcroppings make access to limestone easy.

**9. CEB Press , Soil Pulverizer, and Sawmill**

The Compressed Earth Brick press and sawmill are critical tools for construction in that they produce materials. The CEB Press allows one operator to load raw dirt right from the building site to produce about 5000 bricks in a day - enough for a small house.

**Fig. The CEB Press is the first machine that we have prototyped, and it is ready for widespread replication around the world.**

We have used the soil pulverizer to prepare soil for pressing CEB blocks. The soil pulverizer was used to both pulverize the soil, and its bucket was used to press bricks for CEB construction.

**Fig. Soil pulverizer - Aidan on the tractor + loading the brick press by Yoonseo**

Our next step on the CEB press is a full soil conditioner which pulverizes soi, adds cement at a measured quantity of 5%, and then loads the mixture into the CEB press - to allow for production of high quality, stabilized block.

**Fig. The soil conditioner accepts raw soil from a tractor loader, mixes a measured amount of cement, and loads the prepared mixture into the CEB press for effective production of stabilized block at 12 cents[[39]](#footnote-38) per block in materials. This means that we can build a 1’ thick CEB wall section for $50 in materials.**

The sawmill is a machine that can produce dimensional lumber - a staple of construction. Our sawmill is a variety known as a swing-blade sawmill, which has a single blade that can rotate 90 degrees and make a dimensional piece of lumber by going forward and back on a piece of wood. We chose the dimensional sawmill for its simplicity over a bandsaw mill, as blade sharpening is much easier - and maintenance is the larger cost of any equipment if that equipment is designed for a lifetime.

The sawmill is a good example of how we can use GVCS product ecologies to reduce complexity and reduce the cost of equipment. We design not just individual machines, but machine ecosystems that feed off one another. We can obtain drastic cost reduction by borrowing existing modules from the GVCS. For our case, it makes sense to design the sawmill as a Bobcat standard quick attach implement. We borrow the tractor as a quick attach point, so that we do not need a bed upon which the sawmill head would otherwise ride. We borrow 32 hp from the tractor Power Cubes. We also borrow the hydraulic motor which we attach with hydraulic quick-connect hoses. Thus, we have essentially stripped down the entire sawmill to the long carriage with the cutting head - saving $2k[[40]](#footnote-39) on the engine, $2k[[41]](#footnote-40) on a trailer. The greatest advantage would be the setup time - if designed as a quick attach implement, the sawmill can be taken to a log, rested right by the log, and ready for action - as compared to systems where the carriage base must be set up or the log moved into cutting position. If the sawmill can straddle right over a log or be raised with the loader arms, there is no limit ot the side of log that the mill can handle.

**Fig. The simplicity of the OSE swing-blade sawmill involves a long linear track mounted as an implement for the tractor. To provide 3 axes of motion - the loader mounting includes height adjustment (z motion), and a lightweight cantilevered head provides side-to-side motion. The cost of about $1500 is significantly lower than the $15k[[42]](#footnote-41) minimum for a comparable 32 hp sawmill. (ref)**

And the sawdust that we generate can be used as animal bedding, insulation, or it can be pelletized to make fuel pellets.

**10. Universal Rotor**

The Universal Rotor is a fundamental building block for just about any moving machine. It is a combination of rotary motion and a useful tool-head. As a design pattern consisting of a shaft, bearings, and a motor - a wide array of working tools can be attached to it - so that the Universal Rotor can constitute a drill, a wind turbine, a wheel, a hammermill, cement mixer, sawmill - etc - essentially any machine at any size - from small cordless electric drills to a larger 50kW rotor of a wind turbine.

The [Pelletizer](http://opensourceecology.org/portfolio/pelletizer/), [Chipper/Hammermill](http://opensourceecology.org/portfolio/chipperhammermill/), [Dimensional Sawmill](http://opensourceecology.org/portfolio/sawmill/), Rototiler/Soil Pulverizer, Cement Mixer, [Well-Drilling Rig](http://opensourceecology.org/portfolio/well-drilling-rig/), [50 kW Wind Turbine](http://opensourceecology.org/portfolio/50-kw-wind-turbine/), [Microcombine Thresher](http://opensourceecology.org/portfolio/microcombine/), and [Bioplastic Extruder](http://opensourceecology.org/portfolio/bioplastic-extruder/) are direct applications of the universal rotor, and combined with precision machining structures, the Universal Rotor also include the heavy duty [CNC Multimachine](http://opensourceecology.org/portfolio/multimachine/) with lathe, drill press, slow cutoff saw, surface grinder, and other machines of fabrication.

If we can build a Universal Rotor, a Power Cube, and weld together a supporting structure - then we have - broadly speaking - build 23 of the 50 machines of the GVCS. For example, if we consider the electric motor - it is a a shaft, 2 bearings, a structure, and the ‘tool head’ could be considered the electrical windings that make the shaft spin. Or, if we consider the metal lathe - a part of the Multimachine - then it is clear that the lathe consistr faksdjdfjks of a heavy shaft, 2 heavy bearings, and the tool-head is a chuck for holding work-pieces.

**12. Well-Drilling Rig and Chipper/Hammermill**

The well-drilling rig is a machine used to dig deep water wells. It consists of a universal rotor which uses 3”[[43]](#footnote-42) or 4” drill pipe to drill down to a depth of 100m or more using hydraulic rotary drilling. In this method, a stream of water is sent down the pipe during the drilling operation to send up tailings and soften the area of the drill point. A heavy duty hydraulic motor spins the drill rod - and new sections of drill rod are attached one after another. When the operation is done, the drill pipe is left underground and a submersible pump is inserted to pump water from the well.

**Fig. A hydraulic deep well pump drilling system explained. The water swivel is the key part here. Otherwise 3” pipe that an be used as drill pipe and casign is $12/foot.[[44]](#footnote-43)**

The chipper/hammermill is another application of a universal heavy rotor with swinging or fixed blades. This machine shreds or pulverizes materials, and can be as small or large as needed.

**Fig. Hammermill variations with various blades to chip wood or crush rock. A modified version of a heavy rotor can be a grinder. The scale can be from the largest - shredding cars - to the smallest - with small electric motors - if you have hydraulic drive and electric drive.**

**13. The House - Seed Eco-Home and Aquaponic Greenhouse**

The Seed Eco-Home is a living machine - and becase it is the single largest cost of living today, we dediced to include that in the GVCS.[[45]](#footnote-44) The Seed Eco-Home is the culmination of all the construction machines put to use. Homes are also about $3T[[46]](#footnote-45) market worldwide - which if open-sourced, could provide 30 million regenerative housing jobs for open source home building entrepreneurs.[[47]](#footnote-46) This is 30 million potential collaborators - through we need only about 1000 at this time.

The OSE/OBI[[48]](#footnote-47) Seed Eco-Home is a an affordable, expandable eco-home that can be built for ⅓ the cost of a typical home, while including ecological features. Rather than building a large house, we propose starting with a seed home, and then growing it as the need arises.

We are pushing ecological limits in our autonomous house design. The house is off-grid with PV, provides its own cooking fuel from a biodigester, includes roof-top rainwater collection, and grows its own food with an aquaponic greenhouse. Mowed lawn or biomass is used to provide heating biomass pellets for a hydronic stove that is fueled by pellets. The eventual product vision is a house that produces fuel for cars as compressed biogas or compressed hydrogen - by splitting water. Thus, we are correcting the oil and gas industry with 100% renewable energy, using simple, proven technologies. We are not relying on advancements in battery technology as a prerequisite to sustainable transportation, and by not requiring scarce lithium for batteries, we are aiming for an abundant and environmentally friendly energy future.[[49]](#footnote-48) We favor rooftop PV plus electrolysis as the preferred route for transportation fuels, where every house becomes a gas station. Using medium pressure electrolyzers that can produce hydrogen up to 33 atmospheres without needing a compressor - we can readily store hydrogen in large propane tanks or higher pressure steel pipe.

Fig. Seed Eco-Home

Fig. Aquaponic greenhouse glamour shot.

The aquaponic greenhouse is designed to provide a year-round supply of fresh eggs, vegetables, fish, and mushrooms. The goal is to include automated planting with a small Farmbot[[50]](#footnote-49), where the resulting deep pots are planted in the towers. With a 1000 plant growing capacity in the main towers, the greenhouse can provide a robust salad daily, where we plant and harvest 15 plants per day from a small 800 sf greenhouse. A mushroom yield of 1lb is obtained per week from a tower that takes only 1 square foot. We also intend to use automated 3D printed aerial drones for planting seeds directly into towers - a great example of useful product ecology. Local food addresses the issue of food miles, where food travels an average of 1500 miles in the USA before ending up on someone’s plate.[[51]](#footnote-50) This is one of the numerous inefficiencies that will be addressed by a more efficient, open source economy. This brings us to transportation.

**Transportation.**

The microcar, truck, electric motor, and hydraulic motor are the 4 GVCS machines directly related to transportation.

The worldwide production of cars is a total of 95M per year, 75% of which is done by the top 15 companies.[[52]](#footnote-51) This lends itself to massive distribution of power. The OSE paradigm proposes instead that there would be on the order of million distributed enterprises - essentially one per 10,000 people. Each facility would produce cars on the scale of dozens or hundreds in the community-supported manufacturing (CSM) scenario. Thus, car producers replace car dealership - as the producer takes to dealing. This would go well with a gas station at every home, splitting Seed Eo-Home rooftop water for fuel at a cost of 80 cent per gallon of gasoline equivalent.[[53]](#footnote-52)

**Fig. Seed Eco-Home to car fuel infrastructure consists of rooftop water collection, 10kW of PV panels, a storage tank for hydrogen, and compression to 200 bar. Piece of cake if you consider not doing this - wars for oil. This gives us about 100 miles of fuel worth per day in a 100mpg microcar.**

1 OSE Microcar

The OSE Microar is a Hydrogen Hybrid Hydraulic (H3) vehicle. Hydrogen is chosen because an internal combustion (ICE) engine running on hydrogen is twice as efficient (40%) as a normal ICE (20%), and only 25% under the 50% efficiency of fuel cells.[[54]](#footnote-53) A hydraulic drive train (71% efficiency) - has a higher efficiency than a continuously variable transmission (60%) for fuel cell electric vehicles - meaning that the humble hydrogen hydraulic car gets a higher mileage than a fuel cell car, at significantly lower cost. At a design weight of only 850 lb, less than ¼ of a typical car, the OSE microcar focuses on moving the passenger, not a large chunk of metal accessory to the core purpose. Lighter cars have a good safety record. Before the S.U.V. boom, the country (USA) had the world's lowest highway death rate.[[55]](#footnote-54) Additionally, gas mileage for the OSE Microcar is specified for 100mpg. While not as testicular as a Tesla, the OSE specification requires higher self-esteem on the part of the driver to accept acceleration from 0-60 of 12 seconds, as opposed to under 3 seconds for a Tesla Model S.[[56]](#footnote-55)

**Fig. The OSE Microcar concept.**

Can smaller cars are safer? This is controversial.[[57]](#footnote-56) Physics says that energy of motion is proportional to v squared, and data shows that 56% of car deaths are single-car collisions. So unless you are going to hit another oncoming car or an immovable object like a large tree, your tiny car of under 1000 lb has 36x less energy to dissipate than a Chevy Suburban of 6000 lb. And, the lightest car - the Smart Carfortwo at 1800 lb[[58]](#footnote-57) and it certainly does get eaten up in a frontal 2 car collision with a larger car. And crashes took more than 37k lives in the US[[59]](#footnote-58), with 20-50x more if injuries are counted.[[60]](#footnote-59) (are injuries better or worse in large cars?)

But this is all before self-driving cars enter the scene - which have been tested for 0 driverless car crashes over 1.8 million miles by Google - with 13 fender benders caused by other cars.[[61]](#footnote-60) In other words, the case is there for super-small, super-efficient cars that are robotically controlled.

What we have in mind follows the standard of the 200 mpg fuel efficiency of the VW L1 first prototype car, at 640 lb weight, 8 hp, top speed of 75 mph, with tandem seating for 2.[[62]](#footnote-61) If OSE achieves the same with 16 hp instead of 8 hp, and using hydraulics while not needing to go to a hybrid drive-train that apparently reduced its initial mileage performance - then we will have a major victory for open source.[[63]](#footnote-62) Plus, we’d like to achieve this with hydrogen as fuel in later versions.

More specifically - our model is an H3E car - including a hybrid electric component. The hydraulic component is a peak power electric-hydraulic micro-Power Cube of about 40 lb additional weight - powered by the onboard starter battery for its cranking amps. This additional 30 seconds of a starter battery would double the power of the 16 hp engine - such that burst of energy for passing and sudden acceleration can be achieved easily.

1 B The Solar Car

The Solar Challenge is a fascinating event that shows PV-covered cars traveling 62 mph average across Australia. Granted that the driving is in expensive prototypes ad a sunny country - only in daytime - this still bodes well for the feasibility of solar transportation. The typical cars used are small - surface area of a Toyota Prius - and the OSE version would be twice as large 24x8 feet for 3kW of installed PV + 44 lb Lithium ion batteries + 2.5 kW small engine.[[64]](#footnote-63) This allows for a total of 7kW of continuous power for one hour, or 4 kW total power continuous - at 750 lbs of weight. This just may work - if we 3D print a form frame for carbon fiber layup. 3D printing here may be the enabling technology.

**2 Truck**

The truck is a medium-size, hydraulic, 80 hp driven vehicle comparable to the Mercedes Unimog.[[65]](#footnote-64) With a design top speed of 62 mph, a weight of 6550 lb, and a hydraulic power take-off, the OSEmog could function as an agricultural tractor as well. The OSEmog is designed to accept a loader or various implements on the front or back. Using basic hydraulic circuits, the machine would have high and low gear, and speed cotrol via simple flow control valves.

**Fig. The OSEmog is a multipurpose truck for carryng loads or operating various implements. With off-the shelf parts, it is designed to be field serviceable, and the working hydraulic fluid can be grown - canola oil with additives.**

**3 4 Hydraulic and Electric Motors**

Both the car have a choice of using hydraulic or electric drive. The advantages of hydraulics are low-cost, high torque, and simplicity of resulting drive design. Hydraulic motors cost only $10/hp, half that of electric motors - but a typical 40 hp hydraulic motor weighs about 50 lb[[66]](#footnote-65) as opposed to about 350 lb[[67]](#footnote-66). Typically electric motors are high speed and need to be geared down - whereas hydraulics can be used largely with direct drive. If high torque electric motors are used - these are more like $100/hp when the controller is included - making the drive system 10x as expensive for larger machines. Electric motors are sensitive to moisture and dirt, while hydraulics are designed for dirty environments.

We electric motors and generators - in solar electric power cubes - or in wind turbines. But the flexibility, power, and simplicity of hydraulics is a better choice for practical applications - especially when powered by hydrogen and transmitted by canola oil as the hydraulic fluid.

The electric motor can also be 3D printed, making it fit with the OSE product ecology.

**Fig. A proprietary, 3D printed, 600W, 80% efficient electric motor. The equivalent is worthwhile to open-source.**

Electric motors can be both linear and rotary. In the linear form, they are known as solenoids - very useful devices that are used to make valves. For automation - we use dydraulic valves to control machines like the brick press - and solenoids are used wherever pneumatic or hydraulic controls are needed. This means any automated system - from the water control in aquaponics to the control of an industrial robot.

The electric motor of interest ranges from a small 5W one to power a cordless drill - to the 50kW scale for use in the 50kW wind turbine.

This brings us to the energy sector.

**How Everything Works -**

**In new chapter -** [**https://docs.google.com/document/d/1SQQ1v47bODnPC0fR6xTU9RwJHeLfhK7HovvMGANZwPc/edit**](https://docs.google.com/document/d/1SQQ1v47bODnPC0fR6xTU9RwJHeLfhK7HovvMGANZwPc/edit)

**The Problem of Distributio****n Revolves Around Scale**

It is critical to understand and unravel the concept of *distribution* if one is interested in a civilization reboot experiment. Using the food sector provides a good example. You may have heard that poverty - or the world economy - is not a problem of production - but distribution. Technology allows us to make vast amounts of everything, to the point that marketing had to be invented as a core function of enterprise in the 20th century.[[68]](#footnote-67)

I was for a long time confused about this blanket statement - “poverty is not a problem of production, but distribution” Do we not have trucks to deliver the food - and ⅓ of all food goes to waste as 1 in 7 people are hungry?[[69]](#footnote-68) - while 3 million children die of malnutrition per year[[70]](#footnote-69)?

Taking the last sentence s back to simplicity that you can explain to a kindergarten child - it’s inexplicable. It’s a major breakdown of human infrastructures.

The issue is much more complex - and the complexity lies in the human infrastructures of centralization. Director of the World Bank (and Vietnam era U.S. Secretary of Defense) Robert McNamara, summarized the Green Revolution in food production[[71]](#footnote-70):

"The data suggest that the decade of rapid growth has been accompanied by greater maldistribution of income in many developing countries and that the problem is most severe in the countryside", and ... "an increasingly inequitable situation will pose a growing threat to political stability" (McNamara, 1973, as quoted by Huizer, 1997)

This is one manifestation of the obvious conclusion of one of the founders of the appropriate technology movement, E. F. Schumacher - that once an organization or infrastructure becomes too large in size, it simply breaks down and begins to cause harm. This case has been made in Schumacher’s seminal but largely unheeded book, *Small is Beautiful*.[[72]](#footnote-71) Seminal studies of appropriate scale in today’s organizations at\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Research Institute, conclude that the optimum size of a company or human organization is \_\_\_\_\_\_\_\_.[[73]](#footnote-72) Interestingly - once more this is related to Dunbar’s number. This is much larger than today’s average, which is more than 500 employees, and is in the millions for the world’s largest corporation.[[74]](#footnote-73)

Back to the distribution problem of food. The point is, it is not that we don’t have the trucks to deliver the food - it’s just how the current system works via its inherent rules and operating principles. There are structures and infrastructures that make deprivation a natural catastrophe persistent in the system. We will discuss these structures and infrastructures in the next chapter, as these are important features of the operating system that we are trying to change.

In economic terms, the ‘distribution problem’ is an ‘inefficiency,’ which both capitalism and socialist have failed to address. So we look for a third way.

This third way has historically been defined as *distributism*. Generally based on the concept of widely distributed production where small business, self-employment, and widespread home ownership are favorable features. One of its lead thinkers, Hilaire Belloc[[75]](#footnote-74) proposed a “savage denunciation of laissez-faire capitalism”, which he argued “was re-establishing feudal servility on economic lines.” He continues a similar denunciation of socialism, which (ironically presaging the later words of free market economist Friedrich Hayek) he called “no less a road to serfdom.”

We add the notion of open source to distributism, and call it Distributive Enterprise (DE).[[76]](#footnote-75) DE agrees with Distributism’s small business, self-employment, and widespread home ownership. We define small business just like the official US definition - as a business of under a Dunbar’s number of people.[[77]](#footnote-76) The DE is explicit in its drive for open source collaboraton and zero barriers to entry - as the most equitable, regenerative,[[78]](#footnote-77) and at the same time most productive enterprise. Such a mission is difficult to carry out in the standard for-profit corporation, though easier to do in a for-benefit enterprise.[[79]](#footnote-78) The co-operative can also be a suitable corporate form for a Distributive Enterprise, but we point out that its most successful example, Mondragon Corporation, is not founded on open source product development.[[80]](#footnote-79)

Distributive Enerpise also build upon flexible production, as defined in the seminal work fo M. J Piore in The Second industrial Divide.[[81]](#footnote-80) The key takehome message is that flexible fabrication - using multipurpose machines with more highly skilled workers - as opposed to dedicated maximum throughput machines and dumb labor - is viable alternative to mass production. Mass production became the norm not because it achieved the best, integrated economic results, but because certain political forces have steered it towards mass production. Flexible Fabrication is the basis for our Extreme Manufacturing builds, where a team of people builds heavy machines in a single day is a $10k microfactory instead of a $10B plant - scale differenes of 1 million times.

**Flexible Micromachines**

Flexible manufacturing and the drive for distributive enterprise explains the design behind the GVCS machines.

The microcombine and other micromachines in the GVCS reflect the idea of approprieate scale, and that bigger isn’t always better. We do not see a compelling reason to engage in global trade for goods that can be produced bioregionally. Instead, more emphasis could be placed on regenerative ecosystems that retain wealth within the community - so that a producer is not redeced to a commodity price, but instead, would serve the local community with more value added or experience-based economies. Thus, we may not need a supersized combine with a 60’ cutting head[[82]](#footnote-81), as a 10’ cutting head will suffice to harvest 40 acres in a single day - allowing for a one-day harvest for an entire Dunbar’s number size village.

Scalability

df

Modularity:

dfa

Fig. 8 modules make 30 machines

Construction Set Approach

daf

Fig. 9.

**It’s not only for Hillbillys with PhDs**

What if you have no use for production and infrastructure machinery? For one, you certainly have an interest in the products of these machines, as they create your life regardless of how conscious you are of this fact. .Or, if you think you have 2 left hands but would want to have only 1? If you *think* you have 2 left hands, then we encourage you to examine the mindset that is causing you to *think* that.

We encourage people to re-evaluate their approach to productive technology. The prosumer movement is telling us that \_\_\_% of the population is interested in producing at least some physical good - and \_\_\_\_% express a desire to be creative/productive in some tangible way if they were given a chance. (Ref) The Maker movement, which claims to have a membership of \_\_% of the population - is a manifestation that people are yearning for creativity. Psychologically speaking, the desire to build things is a deep subconscious desire (ref).

The ramifications of democratizing productivity are profound. On a personal level, the fulfillment of building things is unparalleled by any non-material creativity - even though software gurus like to claim that there’s nothing more powerful than programming a computer (ref and famous quote). The personal transformation obtained from building tangible things enhances one’s feeling of security, and thus makes that person less susceptible to social and political manipulation. (ref) Insecurity is delicious fodder for tyranny, as the insecure individual is responsible for feeding those who prey on them. Oppression is a two way street, so empowered individuals are key to assuring universal freedom. (ref)

[[83]](#footnote-82)

**Economic Development: Distributive Enterprise Mastermind Groups**

We develop products collaboratively, and the way we do that is with Open Source Product Development (OSPD) mastermind groups - the Distributive Enterprise (DE) Mastermind Groups. These are invitation-only, commitment-based, ethics-focused[[84]](#footnote-83) learning communities that develop businesses collaboratively. I have mentioned that the OSPD method requires specific focus on business development - based first on OSE’s goal of open source mass creation of right livelihoods - and on the extra challenges of hardware enterprises compared to the open source software Linux case. As such, the DE Enterprise Mastermind Groups serve this function

Each person joining the group must provide some form of expertise that creates the enterprise. The agreement is that every single asset generated is not only open source but also distributive - meaning that we share aggressively. That means that all assets created can be digitized, templated, and replicated by anyone in the group - and anyone else in the world.[[85]](#footnote-84) To provide maximum incentive and a distributed operating model - each person in the groups is encouraged to start their own enterprise and develop their own community. However, the agreement is that everyone commits to a roadmap of continued development. The core social contracts requires a level of psychological maturity in participants that allows them to share freely without any fear whatsoever. This involves the willingness to develop and offer training programs for others interested in replicating the enterprise.

This route provides a community, financial feedback loops, and a continuing learning environment because of the people in the group and the ethical motivation of the team.

The growth model of the distributive enterprise aims at the Distributed Monopoly - a potential Amazon Effect on Amazon itself.[[86]](#footnote-85) What I mean by that is a paradox - that a truly distributive, open source enterprise can dominate a market segment rapidly - possibly on the time scale of a couple years. The theory that we are currently aiming to prove is that the most rapid scaling of an enterprise across an industry segment is possible only when the enterprise is open source and distributive. That is, we aim to demonstrate that the time to reach a $1B revenue by this humble open source enterprise - without any venture capitalization can compete with the 2 year time frame of the rise of the most ‘capitalistic’[[87]](#footnote-86) platform monopolies.[[88]](#footnote-87)

There is a great opportunity there, given that society is losing out in the bargain and most people are unhappy[[89]](#footnote-88). If products, totaling a market of bout $40T - are as good and inexpensive - and could be made locally and spread via open source distributive enterprise, that could be a game changer. Our theory is that if a product is as good, as low cost as industry standards - but it is provided locally to distribute wealth about 100x more equitably - then we have a winner.

How do we quantify *100x more equitably*? If the Global 500 top corporations have 40% of the global GDP - with $1.5Trillion profit[[90]](#footnote-89) - and the top 67 wealthy people own as much wealth as the 3.5 billion of the poorest[[91]](#footnote-90) - wow, is that not an opportunity to at least 100x-improve global wealth distribution? And last month, the 67 just fell to 66.[[92]](#footnote-91) “100x more equtably” would mean that instead of say 4 top monopolies owning 40% of a global market, they would own only 0.4%. That would still make for megacorporations of up to $4B scale - but not $400B scale.

Does crappy wealth distribution matter? Not if you don’t care about wars, poverty, and environmental destruction.

One may question the sanity of this approach. And they are right. Concentration of power and monopoly is on the rise, and is an accepted part of capitalism.[[93]](#footnote-92) Further, one may question the efficiency and feasibility of the distributive enterprise, in that we know of no other enterprise that is both open source (publishes its own business plan, key financial performance metrics, and a detailed opearations manual) and helps its competition to replicate.[[94]](#footnote-93) From the mainstream perspective - distributive enterprise is insane - and the claims of it rivaling the growth curves of other digital monopolies such as Uber, or even the much longer-term growth curve of Amazon - is even more insane. But it’s worth it.

Open source ecology does not call for theft from these top 66 dogs, but for a change in the rules of the game. We do call for the distributive enterprise.

**Open Source Appropriate Technology**

Our goal is to create an appropriate technology infrastructure that can support any human activity up to scientific and cultural advancement. The word *appropriate technology[[95]](#footnote-94)* (AT)commonly refers to less-advanced technology choices promoted to the developing world. AT typically involves more labor, under the assumption that machine capital is expensive or inappropriate. While machines may have been inappropriate historically, we challenge this notion of machines if they are open source, low-cost, simple, highly efficient and optimized, and based on lifetime design - not designed for obsolescence. Further, if our goal is scientific and cultural advancement, it is imperative that the machines are efficient and optimized - and thus labor intensive only if the operator desires them to be so - not because the operator cannot afford them. Thus we favor machines that are both advanced and appropriate. That is the notion behind open source appropriate technology (OSAT).[[96]](#footnote-95) We envision OSAT as applicable to regenerative development in the first and fourth world[[97]](#footnote-96) - in addition to leapfrogging the third world. We believe that appropriateness and advance-ness of a machine are not exclusive, because we can design advanced machines to be human centric. Extended to the technological singularity,[[98]](#footnote-97) this means that effective members of society in the digital age will learn to befriend and work with robots[[99]](#footnote-98) - which is more likely to be appropriate and life-giving if the robots are open source.[[100]](#footnote-99)

Human consciousness regarding the appropriateness and ethics in technology would extend the technological narrative beyond “the latest iPhone™” - and related assumptions of proprietary development and concentration of power. Currently, capitalism carries with it the inherent assumption of externalized environmental and social issues, though the concept of Natural Capitalism[[101]](#footnote-100) aims to close this gap. We are extending the concept of natural capitalism to notions of the forthcoming open source economy, where distribution of wealth is an essential feature build into its operating principles.

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50 Technologies Treated in Groups

**Introduction**

The set of 50 technologies has been chosen to be comprehensive, in order to create all aspects of human infrastructures. How could such a small number suffice? The number of technologies - 50 - must be small enough that people can wrap their head around them - if the goal is to gain wide support in development[[102]](#footnote-101). An ambitious project of a civilization starter kit (CSK) literally means being able to recreate an advanced civilization with an equipment base that can fit in a 40 foot shipping container. That is a well-bounded goal.

To achieve the minimum set, multipurpose machines must be chosen. The machines must be simple, and have many interchangeable parts - so that overall parts count allows the entire set to be manageable by a small group. This applies to civilization startups - whether a new settlement in the desert or as we attempt to take life to Mars - and anywhere in between. The machines must be easy to maintain. They must embody a product ecology - an interaction between machines. Some machines produce other machines. The products of other machine may be feedstocks yet for other machines. If the machines are a complete set that can build human infrastructures, then the machines must be able to use local feedstocks, and must be able to recycle themselves at the end of their useful lifetime. Thus, a closed loop material cycles must be a byproduct, on a small scale.

To achieve completeness in a civilization starter kit - there must be productive machines in the self that can build other machines. In this sense the CSK is generative. For the set to continue its existence, it must be able to replicate itself.

The GVCS technologies also embody a culture in their implementation. The full set of properties that embody the technical, social, and economic aspects of open source ecology are embodied in the OSE Specifications.[[103]](#footnote-102)

If our goal is to invite wide participation in the development of the open source economy, we must enable broad understanding of how to apply the OSE Specifications to product designs of the GVCS. And we must make the GVCS as easy to understand as possible. The GVCS itself is divided into related product groups, such as agriculture or energy. And also, the there are the product ecologies - supportive interactions between the machines and their environment. And finally, there is the aspect of modules.

Modularity, and module-based design is a critical aspect that makes the GVCS doable. Module-based design leads to a construction set approach - where we design building blocks first, and then we design multiple products based on these building blocks. A small number of building blocks - for example - can be used to create all the mechanical machines. The building blocks are expressed ultimately as parametric CAD files in FreeCAD - and they can be reused and modified in other machines.

Modularity can apply not only to submodules of the GVCS - but whole GVCS machines. For example, the Power Cube - one of the GVCS 50 - is a universal power source that can be used to power the tractor, brick press, sawmill, CNC lathe, press forge, and even a 3D printer - just about any powered machine in the GVCS. The electric motor, nickel iron batteries, and hydraulic motor - can be used in dozens of other GCVS machines.

**The OSE Vision for Technology Choice: Rationales for Today’s Systems Compared to the OSE Minimum Set**

* Cover agriculture, energy infrastructure, transport, manufacturing, etc.
* Cover the OSE Specifications
* How tech was chosen
* Make salient arguments for what really makes sense and why. Explain my thinking from the physics, not make unsupported statements
* Approach from a holistic view
* Degeneracy concept

Choices for the GVCS are based on a Product Selection Metric - a Scorecard on a scale of 1-5. The main points for selection are:

1. **Market size** - how much the product contributes to the global economy. How many people worldwide use it.
2. **Abundance of feedstocks** -whether the feedstocks needed to build or run the machine are abundant and widely distributed throughout the earth
3. **Livelihood creation** - the number of livelihoods that can be created worldwide by people using the technology
4. **Liberatory potential** - part of one’s time that is liberated if the technology does not contribute to the cost of living
5. **Barriers to entry** - whether the capital or knowledge required to produce something is a significant barrier to entry today. In other words, if a technology in today’s world is centralized with only a few producers, it is worthwhile to open source and distribute production more widely.

The concept of degeneracy emerges - the idea that if OSE specifications are applied - a specific set of technology choices arise as the preferred options. This is how only certain technologies are selected, and many others are eliminated as less suitable. In the field of energy, for example - PV, wind, charcoal, wood, and hydrogen are preferable to natural gas, oil, diesel, kerosene, fuel alcohol, coal, nuclear power, and fusion. The former are all part of the 50 GVCS machines or their products. A single flexible, modular tractor of the GVCS - of 1000 unique parts is preferable to 1000 brands of other machines, which total millions of unique parts. So on and so forth - until we obtain a pruned set of technology - as the choice branch from the entire technological tree of choices.

If the Product Selection Metric and OSE Specifications are applied to create a top 50 technology set - then distinct groups of people making the selection of top machines from scratch should be able to derive the GVCS 50 set from scratch. Barring some arguments on what one calls a machine vs a part vs a set of machines - the different results by different groups should be identical. If they are not identical, clear understanding should be pursued to determine why they are not identical - and if good reasons exist - the GVCS 50 should be modified. As such, the GVCS 50 is intended to be fluid in its composition - especially with the innovation of new technologies. Changes may arise as new technologies become available - or as the buildout of the GVCS determines that the product ecology does not fit. The latter is not known until the GVCS is finished and numerous instances are operating and providing data on the overall system performance.

**Applications of the GVCS**

The applications and instances of the GVCS can span many areas. Starting new enterprises is the first option - but the enterprise can take many forms from a small business to a new civilization. Starting charter cities, farms, microfactories, or campuses - or even starting life on other planets - are all intended applications. The latter gives clarity as to why the set must be minimal yet sufficient, and generative. It becomes clear that in adverse conditions - the set must be regenerative - both in the sense of resource recycling and in terms of improving the surrounding environment.

**Lifetime Design**

The GVCS must be low cost to maintain and operate. This is so that we can transcend the myth of machine[[104]](#footnote-103), where technology requires an immense amount of energy for its upkeep instead of making life easier or more fulfilling.[[105]](#footnote-104) Maintenance and cost over a lifetime is significantly greatedr than the cost of acquiring a machine in the first place. It should be noted that maintenance is typically the largest cost of any endeavor, so long lifetimes mean lower cost of ownership. Startup is easy - such as in the build environment, the initial structure is typically only 20% of what the structure ends up as over time, (ref) and 3x more to operate than to build.[[106]](#footnote-105) In road construction, as much money is spent on maintaining a road every 2 years as it costs to build the road in the first place.[[107]](#footnote-106) A 180 hp tractor that costs $1k/hp has an economic lifetime of only 15 years.[[108]](#footnote-107)

Lifetime design is a core value of the OSE system. Any part that breaks should be easily accessible off-the-shelf at low cost, and design-for-maintenance should make it easy to make repairs. For example, I paid $2000 for a transmission repair on my tractor, only to have the transmission break again after 2 weeks. That’s when I decided to design my own open source, lifetime design tractor. There is no reason why a person should not be able to keep a machine alive for as long as they like - not being forced to dispose of machines becuase parts or repair costs simply make it cost prohibitive. Lifetime design with design-for-repair and design-for-disassembly means a 10-fold resource efficiency improvement.

Using the Product Selection Metric, OSE Specifications, and Degeneracy - the technology set is selected as follows.

**First, Product Selection Metric and Discussion**

Each of the technology choces is passed by the Product Selection Metric and is tabulated on teh wiki (ref). Here are some examples.

* House.
* Car.
* Microfactory.
* PV Hydrogen.

**GVCS 50 - Groups**

* Show notable features of each tech
* Show how you can scale and modify, and put together in different combinations.
  + A Microfactory
  + A farm
  + A house
* Make the road by walking - we throw out some if not needed.

There are products of machines or components of machines that extend the actual size of the ecosystem from 50 machines - to a total of about 500 modules. These lead to a specific best guess of infrastructure. AS we are building the road by walking - we are testing the infrastructure in real life. Such as: do our CEB houses work? Is our tractor reliable? Does the 3D printer provide a sound basis for the a home-based workshop that can scale to many locations and provide turnkey shippable products harvested and shipped by a robotic arm? Can the aquaponic greenhouse auto seed itself with an automatic seeder and a drone that plants all of our aquaponic towers autonomously, while deliering to local customers - so we can run a diversified CSA?

**Notable Product Ecologies**

Go through striking examples of dirt and twigs to advanced civilization.

**Derivative Products and how the GVCS Expands to meet the OSE Vision for Technology Choice: There is more to the GVCS than it first seems. But that’s ok because some are just parts, but we included them simply because they are so common that gaining mastery over these opens up new options.**

Main idea: while there are only 50 machines - and only 8 modules make 30 machines - we need a total of 500 modules to attain completion. That may seem a lot - but if we consider that civilization has tens of thousands of different technologies - 500 is manageable - since some of these 500 are just parts. This set gets us 99% of human technology in existence. Each is graded according to OSE Specifications, and comes up with an OSE Spec score. Localization Level is included in the OSE Spec score - reflecting the fact that when truly open source technology infrastructures exist - anyone can make anything from local resources on any parcel of land. In other words, autonomous and prosperous city states of the future can become a reality.

**50 Technologies and Submodules**

The modular approach allows a small number of modules to produce a large number of machines.

Let’s look at how only 8 submodules are used to create about 30 different machines - most of the agriculture, construction, and utility machines. Take the Power Cube, Hydraulic Motor, Electric Motor/Generator, Frame, nad Universal Rotor, Hydraulic Controls, CNC Circuit Mill, and Universal Power Supply.

Using 5 of these in different combinations, we get a tractor (show pattern language icons)

Windmill example:

Sawmill Example -

Induction furnace -

Car -

**Going More Modular: Submodules**

There are a total of approximately 250 submodules in the entire set.

**50 Tehnologies and 500 Mechanisms**

Once we get into the details, though, we obviously note that the number of distinct submodules in civilization’s technology set is more than 8. It is useful to identify a set of the top, most used technology elements - the mechanisms - tjh

Wide Participation

**Introduction**

Democratization of Livelihood is an abundance opportunity brought about by unleashed human productive capacity. In today’s advanced world, there is ample production[[109]](#footnote-108) to meet everyone’s needs so that everyone could thrive. In practice, that does not happen, as there are still about a billion people[[110]](#footnote-109) around the world that live in extreme poverty - about $1 per day. We can bring this statistic to 0.

We define the Democratization of Livelihood as the condition in humanity whereby people have the capacity to make livelihood choices based on meaning, fulfillment, and self-determination[[111]](#footnote-110), as opposed to making the choice due to poverty, external control, or deprivation. This is related to right livelihood.[[112]](#footnote-111)

Right livelihood is a critical assumption of OSE. OSE (define distinction between capital and small ose/OSE) assumes that an excellent world is not possible without right livelihood. It is simply not possible for a wholesome society to exist if what people do for a living hurts others or hurts ecological integrity.

Most people do not pursue a massively transformative purspose,[[113]](#footnote-112) as money issues remain a top concern. Surveys show that “80% of us have felt the worry and anxiety associated with losing a job, living on an income that's near the poverty level, or being reliant on some form of welfare.”[[114]](#footnote-113) If we have such stress in our life, it is unlikely that we are pursuing a higher purpose - or self-determination and right livelihood at the same time..

Self-determination is a fundamental human driver: the search for autonomy, mastery, and purpose. Autonomy - as in the freedom. Mastery - is learning, improvement - achieved through a growth mindset. Purpose - is search for something greater than yourself.

**The critical point of self-determination is that this is the most current theory of human motivation. This is why any movement entrepreneur interested in societal change must consider self-determination theory (SDT). SDT builds upon Freud (ref), who was bumped by Maslow (ref), who was superceded by Csikszentmihalyi[[115]](#footnote-114), and we have arrived at autonomy, mastery, and purpose (define these) as the fundamental driver of human behavior.**

While crappy livelihoods may arise from being born in a disadvantaged location such as Chad[[116]](#footnote-115), a similar crappy livelihood arises in ‘advanced’ economies. In the USA, 31%[[117]](#footnote-116) of the people were happy according to the Harris Poll. and this graph by Csikszentmihalyi that this figure has not changed with increasing income.[[118]](#footnote-117)

About 50% of the people are not happy according to The Conference Board.[[119]](#footnote-118) One way to secure work happiness is to unjob[[120]](#footnote-119) - or create your own livelihood. Yet only 17M of the US population are self employed[[121]](#footnote-120) - only about 8% of the working population.[[122]](#footnote-121) However - now about 35% of the workforce is freelancing[[123]](#footnote-122) - about a $1T contribution to the USA economy. There are also about 4M software developers in the USA[[124]](#footnote-123) - about 2%.

The best way to predict the future is to create it. This book is promoting a lifestlyle where we pursue work that fulfills and changes the world for the better.

Time spent in our working life is the largest fraction of our time. It can thus be said that work is life. I do not believe that work should be seprate from your life - it’s not about work-life balance - it’s about work-life integration. For how can one separate their work from their life - if work is the single greatest time commitment?

For life and work integration to happen, one must be truly passionate about their work. It must be their joy and entertainment. And knowing that one is doing useful work, money should be a byproduct, not a goal.

But how do we do exactly that which we love for our ‘job’? While maximizing freedom, including freedom in a global sense? I am here making a call out for those individuals who want to work on this together. Work on what? Work on creating a subset of the economy which is a complete subsystem allowing individuals to thrive in that system, in which one can collaborate and the results are synergistic. Contributions do not diminish any person.

The properties of such a system or platform must be:

1. **Provides right livelihood** - this means that a clear relationship exists between the work and a means to generate a livelihood.
2. **Decentralized** - based on the learnings that any centralized system breaks down when it reaches a certain size.[[125]](#footnote-124) Thus, a distributed replication of the enterprise can occur.
3. **Collaborative** - replications are encouraged in so far as they continue to collaborate with the system or platform.
4. Sca
5. **Appropriate technology** - the system must be based on appropriate techology that truly meets human needs, as influenced by the ideal of a growth mindset and evolution of society to ideals of universal access to happiness and freedom.
6. **It is glocal** - global in information access, local in implementation. Thus, it focuses on local materials as feedstocks. The system internalizes the environment and social justice as part of a sound economy. The system builds information infrastruture to communicate with the rest of the world.
7. **Contributes to Distributive Enterprise**[[126]](#footnote-125) - in other words, it is financially completely collaborative, encouraging its own competition from the perspective of truly free enterprise. This extends the notion of capitalism from the 2018 standard of monopoly capitalism (platform monopolies, proprietary development) to a wider distribution of wealth via open publishing and open source economic development.
8. **Contributes to the Experience Economy** - the approach of OSE is reskilling people with productive skills for hardware, and cosistent with the evolution of the experience economy after the service economy, OSE promotes experiential workshops - Extreme Manufacturing - as its business model.
9. **Integrated Systems Approach** - the platform strives to create an integrated operating system for earth. More specifically - for bulding hardware, and therefore, building infrastructures of civilization, and therefore - converting the economy to open sourcce across the 3 sectors of the economy and across all areas of human endeavor.
10. **Scalable to any new person who wants to join** - It is accessible - low barriers to entry - such that anyone can begin participating and can gain full financial autonomy in a year or a few years. There are no fees or costs, just the initiative is required to learn system collaboration guidelines.
11. **Collaboration Guidelines** - clear procedures for contributing must be definied and easily accessible, and new contributors can begin to gain merit with zero onboarding cost to the platform
12. **Meritocracy** - measurement of contributions must be present so that contributors gain in their reputation. Initiative is encouraged as the fuel for gaining merit.
13. **Measurability** - contributor metrics need to be tracked, but are designed to be un-gameable. Numbers of contributions, hours spent, duration of ongoing contributions, and numbers of commits.
14. **Synergistic** - contributions add to the power of the system, making everyone better off. Synergy also occurs between human and artificial intelligence, for rapid learning and performance augmentation.
15. **Training** - rapid learning materials exist for teaching new people to enter the system at zero barriers to entry.
16. **Open source** - As Thomas Jefferson— himself an inventor, as well as the first Patent Examiner in the U.S.—wrote, “He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me. “He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me.”[[127]](#footnote-126)
17. **Standards** - standards for development, contributions, design, tools must exist in order for scalable, collaborative development to exist. There is a language and pattern language in operation, such that contributors can gain understanding of the system easily. The standads promote collaborative literacy - the ability of people to communicate easily within the system.
18. **Open software tools** - allow for zero entry barriers to participation. Open source software has no costs associated with it, and developers are encouraged bo build upon the software.
19. **Open hardware tools** - open source microfactory infrastructures are developed to promote physical production at low cost. Startup cost of a Minimum Microfactory are $1000, allowing individuals to set up a digital fabrication node of key products to bootstrap themselves.
20. **Modular** - If parts of the system are modular, then massive parallel development can occur when the system is transparent and open.
21. **Governance is via heavyweight product management meritocracy**. A benign dictator rules, lieutenants are selected to manage parts, and people essentially self-select for all the development roles.
22. **The process is voluntary.** There is no central payment authority which remunerates contributors.
23. **Financial feedback loops are created deliberately.** Strategy includes the development of such feedback, such that the process can be self-sustaining.
24. **Financial bootstrapping** - for infinite scalability independent of top-down funding sources, the ideal system generates its funding as it goes along, starting with clear purpose and objectives. A current preferred bootstrapping approach is incentive collaborative prize competitions.
25. **Automation** - in order to promote easy access, web templates are made available for product development and product marketing, such that a distributed network of producers arises across the world. Automation includes access to web templates, software for running automated production, and hardware for doing the production.
26. **Marketing automation** - collaborative product development results in open operations models and templates for
27. **Exchange systems** - ICOs or other mechanisms are considered for keeping track of accounts.
28. **Blockchains** - blockchains are used as records of smart contracts.
29. **Internet of Things up to Internet of Production** - the system contributes to the iternet of information, energy, and material production. Website templates for automated 3D printing with automated shipping allow for robotic operation, augmenting the capacity of the operator.

What we’re describing is an open source product development system which gains momentum synergistically, and converts the world to the open source economy of non-proprietary development by virtue of a significantly increased innovation rate. The key is creating financial feedback loops that support further development, which is done via open source product development and marketing- using incentive challenges as the main route to rapid innovation.

Understanding the Process

Discussion in The Success of Open Source describes the software development process:

...it is certainly not an idyllic community fo like-minded friends in which consensus reigns and agreemnet is easy...The management of conflicctis politics nad indeed there is a a political organization at work hee,with the standard accouutrements of power, interests, rules, behavioral norms, decision-making procedures, and sanctioning mechanisms.[[128]](#footnote-127)

But it does not look like the logic of the industrial-era political economy.

**Contributor Guide**

**Enterprise Level**

Once GVCS designs are working and an Extreme Manufacturing model is created, anyone can participate in generating revenue via productive or information sector activity. The OSE license encourages sharing and prevents enclosure, so we hold true to providing maximum benefit to the greatest number of people.

To generate true economic collaboration, we encourage the development of open source business plans and supporting operations manuals for enterprises. This allows for product development - specifically the productization part that allows for financial feedback loops - to be socialized. The goal is delivering on the promise of a life free from inefficiency such as reinventing the wheel, or competitive waste such as 100 different companies competing to sell the same product. The application of collaboratively-developed physical goods has large economic significance - in that the overall market size is about $50T.[[129]](#footnote-128)

When these enterprises are designed with open source templates, other users can readily take the enterprise infrastructure and clone them on their own website. New entrepreneurs would have to set up production, but production can also be digitized, so that a service of packaging a product into a turn-key package is one clear business opportunity. Let’s take a look at the sales of CEB Presses or Tractors as examples of heavy machines developed and marketed in a collaborative fashion, and the case of smaller products such as 3D printers and 3D printed goods.

**Digital vs Physical Enterprise**

It is useful do distinguish between information-based digital product-service systems and physical products. The digital version falls into the realm of scalability and widespread collaboration ability - perfect ground for global, digital collaboration and rapid scaling by the action of many agents. Capitalization requirements for startup are zero - outside of a computer terminal and one person’s time to learn and execute the enterprise.

As an example - observe how such an enterprise could work. An open source entrepreneur can take our CEB press - which includes digital files for CNC fabrication of the structure and electronics. The entrepreneur can prepare a website for CEB press sales in kit form. The kit could be outsourced from a local fabrication shop with CNC metal cutting. The open source owner operator can order balance of system parts online and drop ship them. A website can help automate this entire process, and can include other products such as swag, consulting, and information products.

Thus, the main requirement for the entrepreneur is to learn a sufficient amount about the enterprise in order to provide value to the customer. Open source blueprints and other assets held in a public commons help bring the barriers of entry to zero. The onus is upon the entrepreneur to provide value - thereby eliminating the freeloader dilemma. The entrepreneur must become knowledgeable or therwise provide significant value on top of the open source assets. There are many ways that this can happen - from packaging, to consulting, to providing guided experiences - but in all cases, they are an exchange of value for value. Thus, the open source enterprise system protects honest work, where the entrepreneur must add value - a value other than value by scarcity. This stands the modern economic system upside down on its head, and is the reason why the transition to open source value creation is invevitable.

**Design Open Hardware Ecosystems for Immunity to Platform Monopolization**

If Linux is a guide - then it looks like open hardware will dominate. But what effect will that have on the balancing of the global economy (from the perspective of a democratic society). Linux dominates the software world, but at the same time the services that Linux fuels - from Amazon to Apple and Google - are highly monopolistic. And wealth distribution is not improving (ref)[[130]](#footnote-129) Thus in designing the open hardware ecosystem for the world - what features of the ecosystem favor a turn in the distributive direction? How do we design the ecosystem to minimize enclosure? These are improtant questions to ask - such that we clarify specific points of design for the open source economy.

A question that arises is, *What prevents platform monopolies from dominating the open source product ecosystem*? Ie, if Google controls all of the data, is that a risk? Yes. But the antidote to monopolization lies in the distributed, decentralized, distributive nature of the open source firm. If people can gain a livelihood in the open source ecosystem, they will not sell their labor at a fraction of its value to Google or the like. This is the true beauty of free enterprise - assuming that free enterprise will be operative. While free enterprise exists largely in theory in 2012 - ie, the economy is largely proprietary today - there is writing on the wall that the ultimate efficiency can be achieved only via open source, distributive development. That is - just as natural capitalism has made a precedent by calling for an internalization of environental and social factors into the capitalist model - open source calls for a further evolution. That evolution is one to internalizing non-monopolization into the DNA of the economic system.

The non-co-optability of labor into ‘evil’ enterprise would mark a major milestone in the evolution of humanity. In the last paragraph I assumed that barriers to entry would be so low that people would begin startup enterprise en masse - thereby preventing the usual trend of platform monopolization. From today’s perspective, that appears to be wishful thinking - in that only about 7% of the US population is self-employed.[[131]](#footnote-130) Thus, the OSE target audience is definitely 7% of the population. Another study is more optimistic, showing that entrepreneurs make up 14% of the US population.[[132]](#footnote-131)

Whatever the true percentage of entrepreneurs - is it likely that lower barriers to entry would mean more startup? By definition - yes - but in practice? If we speculate that self-determination[[133]](#footnote-132) is a deep driver of human behavior - and if we combine that with the fact that job satisfaction is 50% in the USA, then it is reasonable to assume that many people would jump onto a livelihood bandwagon based on collaborative enterprise.

Thus, how many people would pursue an open source, collaboratively developed enterprise? The only way to predict the future is to create it. If the promise is right livelihood with zero contribution to war and poverty - but instead an inherent grounding in abundance, environmental regeneration, and social justice - the we believe that such an effort is extremely valueable.

To summarize, the practical design points for the open source economy are:

1. Viral license - don’t be an Apple OS BSD
2. Design an explicit mecahnism for lowering barriers to entry for promoting mass creation of right livelihood, and thereby the popular adoption
3. Build in rapid learning, and make this aspect a key value proposition
4. Design for the Experience Economy

The End State

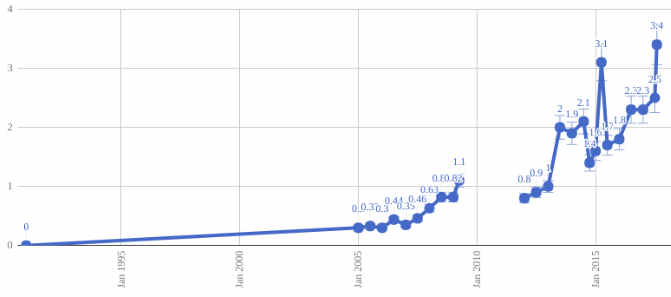
**Intro - Beginning - Solving the Compiler Dilemma - Narrow Compiler: the Open Source Microfactory - Broad Compiler: the Distributive Enterprise and the Incubation Support for Open Source Enterprises.**

**Introduction**

It takes only appoximately $1B per year of development to change a sector of the economy with open source development techniques. At least that is what Linux did - and Linux - the open source computer operating system that now runs about 60% of the world economy. $1B is the annual estimated value of contributions that the Linux operating system currently receives from volunteer contributors.

It is useful to determine if there is a parallel between the Linux case and the potential for open source hardware. Defining terms - by Open Source Hardware - we mean the entire global productive economy of food, housing, cars, electricity and manufacturing of all sorts. This is roughly speaking

And linux and open source now dominates these major parts of the information economy in terms of market share: Cell Phones ([80%, open source Android operating system](https://en.wikipedia.org/wiki/Linux_adoption#Mobile_devices)); supercomputers ([99% run Linux](https://en.wikipedia.org/wiki/Linux_adoption#Mobile_devices)); servers ([Apache open sourcce server is 46%](https://news.netcraft.com/archives/2017/02/27/february-2017-web-server-survey.html) of the market share with the next closest at 20%). Linux is only 3-5% of the desktop computer market share, with Microsoft being the great majority. However, the growth curve of the Linux market share appears to be in the deceptive exponential growth phase -



Few people know it, but open source runs the information economy. Given that there are [8B mobile devices](https://www.gsmaintelligence.com/), and about [2B](http://www.worldometers.info/computers/) computers - then open source software is powering about 60% of the computing devices that people use.

The world of the information economy is open source - though the majority of the hardware world is quite proprietary.

Based on the model for computer software, we can model the rise of hardware. Here I make the proposition that by the time R&D of open source hardware infrastructures (homes, cars, agriculature, energy systems, etc.) reaches the $1B mark - the level currently enjoyed by Linux - then the economy will turn largely open source - just as the software economy today is largely open source. Linux started in 1991. OSE’s Global Village Construction set - an operating system for hardware - started in [2018](http://opensourceecology.org/wiki/Global_Village_Construction_Set), about 27 years after Linux. Today we are in the early days of open source ecology - the open source operating system for infrastructures.

Linux took about [20 years to attain the $1B annual development effort](https://www.linuxfoundation.org/press-release/linux-foundation-publishes-study-estimating-the-value-of-linux/) - with volunteers. Currently, Linux has [1400 full time equivalent](https://arstechnica.com/information-technology/2015/02/linux-has-2000-new-developers-and-gets-10000-patches-for-each-version/) volunteer developers. This is the model that we are adopting for OSE.

But the challenge for hardware is greater. We call it the Compiler Dilemma. While it is cheap to compile source code and run working programs - it is not cheap to compile the source code of hardware - its design blueprints - to convert them to physical products. Electrons are cheap, but atoms are not.

In the software world, economic feedback loops of the software industry paid the developers for producing working code - now responsible for fueling large sectors of the economy:

From the [Linux Foundation](https://www.linuxfoundation.org/about/) site -

* Linux is the operating system for over 95% of the top one million domains
* More than 80% of new smartphones sold run Android, which is based on the Linux kernel
* All of the top 500 supercomputers in the world run on Linux
* Most of the global markets run on Linux, including the New York Stock Exchange, NASDAQ, the London Exchange, and the Tokyo Stock Exchange
* The majority of consumer electronics devices use Linux for its small footprint
* More than 75% of cloud-enabled enterprises report using Linux as their primary cloud platform
* Linux is the go-to infrastructure supporting the world’s ecommerce leaders, including Amazon, eBay, PayPal, Walmart, and others

It may be said that [open source has won](https://www.computerworld.com/article/3144063/open-source-tools/open-source-has-won-and-microsoft-has-surrendered.html), and Microsoft has surrendered.

**Hardware Case - Extending the Linux case to Hardware**

We can in principle generate the source code for hardware inexpensively - the source code is design blueprints - which can be generated on a computer just as easily as software can be written - in terms on requiring no more than intellectual time and a computer powered by electricity.

For hardware - the challenge is compiling design into products: that is called manufacturing and production, which is typically capital intensive.

How to overcome this dilemma? The only way to overcome this dilemma is to provide economic feedback loops to the designers. In the computer world, software developers got paid by companies who wanted their product. In the hardware world, designers would also have to sell their designs. But because it is so expensive to compile the designs, there is a significant barrier to the development of working products, and to the resulting financial feedback loops.

This is a significant challenge, and it is a business problem. While a software guy can test their program and sell it - the cost for a hardware guy is higher.

This is where a company like Open Source Ecology - operating in the civic sector - plays a part. To succeed, this company must inherently develop not only the product - but the operations necessary to design, build, and test the products. Thus, an inherent part for any scalable open hardware project is that the project must develop its own operations - and elements related to running a typical enterprise with many moving parts.

That is the role that Open Source Ecology intends to play - to provide the design, build, testing, certification, and training for open hardware enterprises. The goal is nothing short of developing a scalable open source product development methodology - which would have a chance to compete as a free enterprise.

The success of open source hardware relies much more on a drive for entrereneurship rather than on a hobbyist effort. Because a hobbyist typically has another job so they can make a living. It is a core OSE belief that world transformation boils down to livelihood - what people do for a living. And we believe in right livelihood, in that what we do has to connect to ethical practice - meaning that in our choice of livelihood - we feed whatever global politic corresponds to that livelihood choice. From the open source ecology perspective, we care most about livelihoods that lead to a distributed, decent(ralized) economy - which doesn’t leave anyone behind. That means that we care about the environment as well.

The critical question for OSE is how to reach the $1B mark. If it took Linux 20 years, then we are on schedule to deliver the open source hardware domination by 2028. There is a decade left. I’ll report back in a decade in Towards the Open Source Economy, Part 2 - regarding whether we got there. If we double every year, we will be 1000x larger.

**Why Did Linux Succeed**

There were a numbe of other Unix projects that failed. Why did Linus succeed? [Ref 1](http://www.channelfutures.com/open-source/open-source-history-why-did-linux-succeed).

1. **It worked. Thus a financial feedback loop**. Likewise, OSE must produce a working product up front. Then optimize the whole. Hence, we work with broad systems that work - the larger the better - but to enable working system, they have to be minimal. Within a few years, institutions and companies began adopting Linux. OSE issue - teh pull from customers must be built when products begin to work.
2. It was written from scratch. (if BSD was clean from lawsuit, Linus may not have needed to start linux) Likewise, all OSE products are taken from scratch, but don’t throw out the baby with the bathwater as they build on industry standards. No legal complications by building upon only clearly defined open source projects.
3. It was integrated - many moving parts - unlike other utlilites in GNU which were standalone. The integration - into an actaul working product - is a huge value. For OSE, the integration is key - we are proposing an operatinig system - not individual parts, just like Linux.
4. It was a decentralized effort. But with heavyweight product management (linux approved all changes for a long time). Likewise, OSE uses Modularity to enable decentralization.
5. It had a benevolent dictator. So does OSE. But also, some form of committing is allowed - unlike in code, where it’s either in or out. The wiki allows contributions - which is an unofficial form of commits, which can be upgraded to official commits into part libraries. This is done by lieutenants or project managers.
6. It switched to an open source-compliant license (free to use commercially). Likewise, OSE is open source to allow the next $1T economy.
7. Monolithic (what linux used) vs modular architecture did not seem to matter. OSE is modular, as it is more complex.
8. It was pragmatic, not ideological. Ideology does not put bread on your table. Likewise, we have to provide products that people use - and even more - logos, pathos, ethos.
9. Viral clause. BSD encouraged defection (not keeping stuff open because it was too permissive). [Ref](https://linux.slashdot.org/story/15/05/06/1647252/why-was-linux-the-kernel-that-succeeded) For this reason, OSE uses viral clause - requiring downstream to be open, and thus contributing upstream.
10. Linus kept rolling in contributors. For this reason, OSE has an HR effort.
11. Right time - email allowed sharing. Just like for OSE - wiki allows sharing. FreeCAD allows design. Docs allow crowd collaborative.

**The Compiler Dilemma and 3D Printing of Practical Products**

There is no easy answer regarding the domination of open hardware. The scope of the task is similar.

The Linux Kernel has 20M lines of code.

Code - [10 lines](https://www.quora.com/How-long-would-it-take-an-average-programmer-to-write-1000-lines-of-code-For-arguments-sake-the-lines-of-code-make-up-a-moderately-advanced-2D-game) written per day. [1000 per month](https://www.quora.com/How-long-would-it-take-an-average-programmer-to-write-1000-lines-of-code-For-arguments-sake-the-lines-of-code-make-up-a-moderately-advanced-2D-game) for efficient code.

If 20M lines - assume quality code that works - then $16B total (according to estimates of code cost).

3 years to [176k](http://learn.linksprite.com/pcduino/linux-applications/a-complete-historical-timeline-of-linux-evolution/) lines of code v1 - 1994. V2 in 1996 - 500k lines. 2011 v3 12M lines. V4 - 2015 - [15M](https://www.google.com/search?q=linux+lines+of+code+graph&client=ubuntu&hs=hJp&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjQrOKh1bfYAhVI7IMKHUODCt0Q_AUICigB&biw=1438&bih=815#imgrc=n83gPvITsg8-7M:). 4 years for 5 million lines once mature. First 5 years - 100k lines per year.

For 50 GVCS machines and 500 modules - divide 20M by 500 - get 40000 lines of code per machine. That’s about right. But note that from the beginning the thing worked - and that’s why it could continue.

**The Broad Compiler: Distributive Enterprise**

This

Study of the System for Kindergarteners

Various Fictions of the Human Mind

If somee social system is so complicated that a school child or kindergartener cannot understand it - then we may want to question why it exists in the first place. So let’s pass some systems through the Kindergarted Test - namely - the patent system, IPOs, the stock market, derivatives, country boundaries, newspaper and media, regulatory capture, taxation,political ponerology, and artificial intelligence as a potentially corrective force..

Startup Capital

Say you want to create the next trillion dollar enterprise sector. The typical route for world-impact projects is to invoke finance capital. The critical question for OSE scaling, through, it not about finance capital - but what resources that finance capital will buy. Thus, if we believe that you cannot buy the next trillion dollar economy - what can we substitute for finance capital? It is those resources that finance capital would buy.

Those resources are people, operations, marketing, education - and the like - all the ingredients of a successful enterprise. OSE’s approach to minimizing financial costs of scaling is to provide open access and knowhow to scaling. By open source documentation - how do we facilitate efficient oerations, accounting, hiring, marketing, and education, to name a few aspects of a successful business?

Open sourcing these aspects could lead to great efficiencies. Imagine having the best mentor in the world helping you out - you as an open source entrepreneur - to navigate through startup and success. OSE can provide a number of open resources to faciliteate this, such as: operation manuals, proven business plans, project management templates, part libraries for design, website templates, collaborative product marketing, and many other resources.

Let’s take a look at one scenario of the stratup costs of business that succeeds to the $100k-$1M/year level:

(case study of startup costs, tabulating BAU costs and Open Source Access costs)

Or an eneterprise that succeeds to the $10M-$100M level:

(case study of startup costs, tabulating BAU costs and Open Source Access costs)

The OSE approach is that thousands or millions of varied enterprises can start up at the above levels. A million $1M enterprises is a 1 trillion dollar open source sector - and a chance to normalize the collaborative economy. For reference, there are [15M](https://www.google.com/search?q=how+many+millionaires+in+the+world&oq=how+many+millionaires+&aqs=chrome.1.69i57j0l5.6544j0j7&client=ubuntu&sourceid=chrome&ie=UTF-8) millionaires in the world. The more millionaires the better. Greed? Not necessarily. A millionaire is someone who has assets of $1M or more. The nature of these assets is important. If the assets are used to serve others and make the world better, then that is a good thing

There are issues with finance capital. Finance capital is capable of propping up business and industries that do not grow on the virtue of their merit, but on the virtue of having lots of money thrown behind them. This is the dilemma of finance capital that we are trying to solve.

Ok, thus, what is the case for IPOs. Pros: money. Cons: lose control, need to meet revenue goals leading to short-term thinking; and - a fundemental conflict of interest between investors and operators. The Investor’s goal is completely different than the operator’s goal. In sum, an IPO is “selling out” in the full negative sense of the word.

If [trading volume matches and exceeds](https://data.worldbank.org/indicator/CM.MKT.TRAD.GD.ZS?view=chart) the size of global GPD, is there something wrong with this picture?

A case can be made that the thoroughly fucked up military industrial state is a result of short term thinking which may be attributed to the very structure of public corporations? First, what share of global revenue comes from publicly traded corporations?

Thus, get rid of IPOs, and replace that with the OSPO - the Open Source Public Offering, or Initial Coin Offering, or other smarter contracts.

OSPO. Just replace the financial requirements to those of long term goals, as well as full conrol by the company operators. That’s it. Is that possible? We could try. This is a great assignement for a Juris Doctor thesis. Today, the IPO has specific rules. Those rules are not natural laws - they are plain human fictions. Simpy replace the existing fiction with a new one with a couple of tweaks. That way, we are retaining accountability: operators are accountable to their baby (business they created) - and the investors are there only to help, not to rule the world. Thus, the IPO clauses mandating profit maximization are gone, and the world becomes a different place. This is an idea worth spreading. Does it collapse today’s capitalism? No, it just makes it more integrated, fair, and accountable. If this means that the company cannot raise a lot of capital - that is good. There is a check and balance for its growth, so it doesn’t grow like a cancer - but expands only on its merit.

Capital In General

When raising capital (by taxation, IPO, or church tithes) - the question that one should ask is not how much captital is neede, but what are the goods and services that that capital will provide? To reduce those costs, we an ask, how can we prove those goods and services most efficiently? In order to reduce that capital requirement - ie, lower your taxes, or not lose control of your company through an IPO) - we simply ask - what is that capital buying you - and how does open source address lowering those costs?

Take taxes and county roads. If we were to develop an open source robotic road grader, then the maintenance cost of roads decreases. We still need capital to buy and maintain a grader - but if open source lifetime design - can that cost be 10x less? So taxes go from 50% to a manageable 5% when extrapolated throughout the economy?

To achieve lower cost, we must ask systematically what the real costs are, and how open source efficiency reduces those costs drastically for everyone.

OSE Specifications

Introduction. The OSE Specifications define the properties and qualities of products that OSE develops - as well as the processes that are used to develop the products. Based on the goal of creating an appropriate technology infrastructure for earth, the intent of OSE Specifications is to inform the practical design choices of products and systems. The OSE specifications are based on the concept of a minimum but sufficient technology set that allows humanity to thrive, serving as a basis for scientific and cultural advancement.

The properties, qualities, and processes revolve around open source design.

The OSE Specifications are designs to be complete and sufficient for informing design choices. Thus, based on a specific need - such as a bicycle -

GVCS Product Ecologies

Introduction. The GVCS is the set of the 50 most important machines that it takes for modern life to exist...But can we really create a new civilization with 50 machines? Here we show how this can happen. Imagine a global village where nobody is left behind and where everyone exists in a state of peak performance - namely - where material survival issues were eliminated. (ref) The selection for the 50 machines is based on these properties:

1. Modular
2. Scalable
3. Generative
4. Open source
5. Provide at least one way to provide every single need of humans
6. Can be used to bootstrap to other machines

Here is the scale of the economy for comparison that can be created with these 50 machines: 100T! How do we get that? Let’s look at every sector of society, and examine how it’s produced today. But before we do that - let’s discuss how the tools were selected.

It’s simple. Pick anything in the entire economy. Such as your food. Or car. Or house. These machines - or other machines that produce these machines directly - are included in the global village construction set of 50 machines. A house, too? Yes, we’re cheating here, as a house is not a simple machine - but since it’s the [number one cost](http://opensourceecology.org/wiki/Cost_of_Living) in peoples’ lives, we had to include it.

Our goal is to distribute production as far as possible - so that everyone on the planet has access.

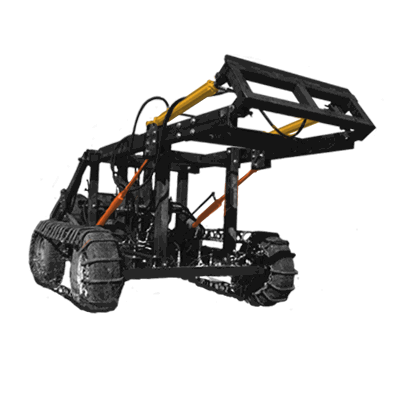
OSE is all about converting scarce resources into abundant resources, while removing artificial scarcity from the equation.

To do this, we involve you in production. Who says that production can happen only on megafarms and megafactories of yesterday? Today, we can reclaim whole industries, with our lifestyle. What we fund determines the global economy.

* Distributed hydrogen production - displacing the $5T oil and gas industry, and correcting geopolitics in the process
* Open source Seed Eco-Homes for everyone, with aquaponic greenhouse production, and a microfactory in the garage. Here we convert the $8.5T construction industry and the $8T food and ag industry.
* The microfactory in the garage - can produce a few trillion more.

Here we are at over 25T of the global economy, and we just started. That is ¼ of the global economy - where everyone can get involved.

Let’s talk more about curious facts about the 50 machines.

If you eat, you use a tractor. Whether you know it or not. That is a [$122B](https://www.freedoniagroup.com/World-Tractors.html) industry. Facts.

**New Civilization for $10k**

Download the open source plans, build a sawmill ($500) + Tractor ($3k), CEB Press ($3k), 3D printer ($1k), induction furnace ($2k), Welder ($200), PV ($4k, 12.5kW), Filament Maker ($500), lathe ($500), metal rolling.

Say you start from raw land. You need a sawmill, CEB press, and tractor. You need some PV on your rooftop. And a pelletizer/continuous charcoal maker.

How do you bootstrap? Get a bunch of steel, melt it, cast it into rods, build a tractor. But you need a lathe to build an engine, which is obtained from 3D printing casting molds via lost plastic or lost wax casting.

**Sectors of the Economy**

**Economic Sectors and Historical Evolution of the Economy.**

Man will never be free until the last king is strangled with the entrails of the last priest. - [Denis Diderot](https://www.brainyquote.com/quotes/denis_diderot_105429)

Many economists recognize the following five economic sectors; the primary sector which includes agriculture, mining and other natural resource industries; the secondary sector covering manufacturing, engineering and construction; a tertiary sector for the service industries, the quaternary sector for intellectual activities involving education and research and the quinary sector reserved for high level decision makers in government and industry.

Read more: http://www.businessdictionary.com/definition/economic-sector.html

The historical evolution of the economy went from agrarian, to industrial, to service, to experience. [Product-services](https://en.wikipedia.org/wiki/Product-service_system) have replaced production - with accompanying positive effects upon reducing resource use for a given service provided. Now, the [experience economy](https://en.wikipedia.org/wiki/The_Experience_Economy) is in style.

Construction is [$8.5T](https://www.prnewswire.com/news-releases/global-construction-market-worth-103-trillion-in-2020-50-largest-most-influential-markets-292235961.html). Global Food and Agriculture is [$8T](https://www.plunkettresearch.com/statistics/Industry-Statistics-Global-Food-Industry-Statistics-and-Market-Size-Overview/). Electronics - [$2T](https://www.statista.com/statistics/268398/market-size-of-the-global-electronics-industry-by-country/). Oil and gas production is a [$5 Trillion](https://www.investopedia.com/ask/answers/030915/what-percentage-global-economy-comprised-oil-gas-drilling-sector.asp) economy worldwide. Auto industry is [$4T](https://dailykanban.com/2015/03/auto-industry-101-today-big/). Steel industry is [$1.5](https://www.businesswire.com/news/home/20160630005563/en/Global-Steel-Industry-Report-2016---Analysis) trillion. Mining - [$1.8T](http://www.lucintel.com/mining-market-2017.aspx). Electricity - roughly [21,000 TWhr](https://en.wikipedia.org/wiki/Electric_energy_consumption#World_electricity_consumption_(2012)) =$21^11=$2.1T

Education - [$4.9T](https://worldsofeducation.org/en/woe_homepage/woe_detail/4850/the-rise-of-the-global-education-industry-some-concepts-facts-and-figures)

Global cement industry - [$395B](https://www.statista.com/statistics/248667/size-of-the-global-cement-market/). Smart phones - [$1T](https://www.gsmaintelligence.com/). Same as software. Aluminum is [$150B](http://www.lucintel.com/aluminum-market-2017.aspx). Software industry: [$400B](https://en.wikipedia.org/wiki/Software_industry). Liner shipping - [$400B](http://www.worldshipping.org/). Computers - [$395B](https://www.ibisworld.com/industry-trends/global-industry-reports/manufacturing/computer-hardware-manufacturing.html).

Good one - software is [$400B of 3.5Trillion](https://www.gartner.com/newsroom/id/3482917) - or about 10% of the IT industry. However, if we assume that software is another 10% of the other IT industry sections outside specifically of software - then the figure for software is really $600B.

These are some numbers conspiring to a roughly 75T economic GDP level.

[Wikipedia](https://en.wikipedia.org/wiki/List_of_countries_by_GDP_sector_composition#cite_note-GDP_-_Composition,_by_Sector_of_Origin-1) breaks it into 3 simple sectors - Agriculture - $4.5T, Industry - $23T - Services (nonmaterial) - $48T - or about 64% of the global economy. This follows the [3 Sector Theory](https://en.wikipedia.org/wiki/Tertiary_sector_of_the_economy). About 80% of the people in the developed world operate in the nonmaterial Tertiary Economy, which includes information and knowledge services/

**The Material Basis of the Nonmaterial Economy**

Even though the service sector is now a global majority - a majority of the service sector is based on materials. The services sector includes [sales, transportation and distribution, restaurants, clerical services, media, tourism, insurance, banking, healthcare, law, information and knowledge, and government.](https://www.thoughtco.com/sectors-of-the-economy-1435795) But sales include the sales of products, transportation relies on vehicles, restaurants depend on food - and so forth.

Thus, the service sector is not so non-material after all.

Are computer people going to take over the world economy? No.. The information and knowledge industry requires a computer and a person. But everything else around that situation: the building, the food the person eats, the house they live in, the car that they take to work - those are still a much larger part of the economy.

This is the reason why we say that the hardware economy, whether we know it or not, continues to be important, and fundamental to creating the political systems around us. If we want to change the world, we must change the hardware economy.

No, it’s not the next app. It’s how you are going to plant potatoes. How will you build your house. Where is your energy coming from.

**Full Information Automation**

What happens at the limit of full automation where everything has been digitized? There will be more knowledge workers, and hopefully, people have transitioned to human development as integrated humans - powerful and capable, augmented by robot helpers.

But everything else around that situation: the building, the food the person eats, the house they live in, the vehicle that they take to move around - those are still a much larger part of the economy.

The limit of the economy is energy input. Accounting of the future will shift from [Natural Capitalism](https://en.wikipedia.org/wiki/Natural_Capitalism) - where the human economic model has finally internalized natural capital and human capital into its accounting system - to accounting of energy input. When information is free, and open source microfactories, and universal autonomous constructors are available - then wealth becomes dependent on information and logistics.

Given that energy is currently abundant and distributed on earth (10000 more power from the sun than we use) - the future bodes well for abundance and distribution of power. Since logistics systems may also be dematerialized (open source distributed - wireless communications, autonomous vehicle, local production) - this also bodes well for humanity.

Hence, the limit to human progress is is intelligence, unbridled sharing of intelligence, and the ability to learn and have access. In the digital age, augmented reality, augmented intelligence, artificial intelligencce, biological-machanical interfaces - are wyas that people can become more powerful or skilled. For justice sake, open source access to all of the world’s techologies - from the primary sector to artificial intelligence, full automation, and experience economy - must be guaranteed.

To guarantee that, we must do 2 things: evolve as humans, ensure open access to information in today’s institutional infrastructure (get rid of fear and patents), and ensure a free internet, which has recently been struck a blow with Net Neutrality. Making a better world requires a [systems approach](https://en.wikipedia.org/wiki/Systems_theory), because things are connected. You are not free until the last person on the earth is free,

**Evolving as Humans**

**Free Information**

Patent system.

**Free Internet**

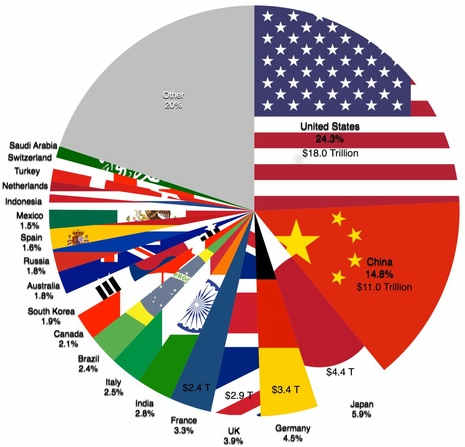
There is hope. Wireless communications now reach 20 miles for $100 (ref) and 10GB throughput (ref). That is 1000 connections - or 10 cents a pop capital cost. Why then am I paying for a $500 annual internet bill? Hmm.

But today’s system - means that Verizon et al own all the fiber. $500B of fiber in fact (ref). [$6 per foot for 288 fiber bundle](https://www.google.com/search?client=ubuntu&hs=Rto&ei=VdJLWqyaBYGPjwTLx42wAg&q=cost+of+fiber+optic+cable+per+kilometer&oq=cost+of+fiber+opti&gs_l=psy-ab.1.3.0l10.2143.23000.0.24513.108.62.24.3.3.0.342.7667.0j29j10j3.44.0....0...1c.1.64.psy-ab..45.61.6509.0..0i131k1j0i131i67k1j0i67k1j0i22i30k1j33i22i29i30k1j33i160k1j33i21k1.149.N95bfvnqBM0).

**Practice of Change**

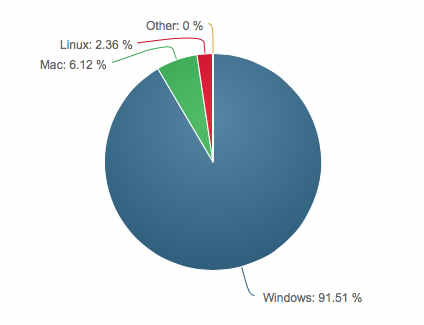
How do you change political relationships? By changing the economy. Economy drives politics. Thus, for political change, we need economic change. For economic change, we need open source product development to transition from the proprietary economy to an unleashed innovation economy of the future. Wouldn’t it be good if problems were solved faster than they are created, because we now have an earth operating system that fosters maximum creativity by virtue of access - and truly building upon other peoples’ work?

Going to the hydrogen economy pegs the value of hydrogen filling stations at $5T.

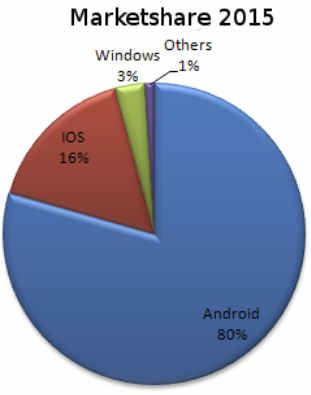


[GDP by country](https://en.wikipedia.org/wiki/World_economy), wikipedia.

Look at Linux Market Share: [Linux Desktop/Laptop](http://www.omgubuntu.co.uk/2017/07/stats-say-linux-marketshare-hit-time-high-last-month) -



This has been [manufactured illegally by Microsoft](http://www.ecis.eu/documents/Finalversion_Consumerchoicepaper.pdf).



There are 75M servers. And 1B computers. 7B mobile. So about 6B open source devices, compared to 1B macwin. So depending on computing power, we get about 80% open source OSs. If most servers are linux, then the actual traffic attributed to [Linux is about 43%](https://www.google.com/search?q=apache+server+market+share+2017&client=ubuntu&hs=FeI&source=lnms&tbm=isch&sa=X&ved=0ahUKEwj74LLiuajYAhXNqYMKHVTpCqUQ_AUICigB&biw=1181&bih=745#imgrc=v33Sw-2jHX2cYM:) (if servers are the predominant source of traffic)- with others at the 20% mark for several of them -

Nickel Iron Batteries. As the world’s only known lifetime-design battery (old batteries recycled from 100 years ago work as new (ref)), it is worth pursuing. No, it won’t get you the kW/kg storage capacity as Lithium Ion, and it has a 1% per day leakage, but the sun comes out daily, so for resilience purposes this is a great choice, especially when distributed manufacturing is considered. Known world lithium resources will last between [17-50 years](https://www.greentechmedia.com/articles/read/is-there-enough-lithium-to-maintain-the-growth-of-the-lithium-ion-battery-m#gs.0fKPiRw) if battery gigafactories are built.

Hydrogen - [energy internet](https://youtu.be/5-iDUcETjvo?t=2731) by Rifkin. Hydrogen is a great candidate for a global energy internet. It can be produced anywhere, and Not to mention H storage for Seed Eco-Home, oxyhydrogen cutting, and integration with liquid oxygen for space travel and industrial cutting gas. Compressed for cars. So if we develop the personal hydrogen filling station - we can replace $5T of the global oil and gas industry.

House - Combining PV, biogas for cooking, and hydrogen for night time storage, a 6 kW PV system for $5k, means a $35k house-greenhouse combo that produces its own heat, electricity, food, water, and recycles its waste to provide cooking gas. And by the way, the excess PV, 18kWhr per day - goes to high pressure compression of hydrogen gas at 300 bar for [$340](https://www.ebay.com/i/263158811104?chn=ps) - with hydrogen storage tanks at [$1500](https://www.alibaba.com/product-detail/High-Pressure-350-BAR-5000-psi_138064699.html?spm=a2700.7724857.main07.15.22a96c66okJyTE), and a hydrogen generaot at $1000 for 3 kw capacity. If we use the rooftop PV, then we have a sub-dollar per gallon fuel equivalent.

Gasifier - carbon, carbon fiber, carbon nanotubes, graphene

Introduction 1

If you want to transform the secondary economy (the government, finance, education) you must first transform the primary economy (production - agriculture, manufacturing, construction, etc). This is because the secondary economy depends on the primary economy. So if you are a world change maker, you would have to start with transforming the primary economy - or infrastructures.

Ok, but what about [Google](https://en.wikipedia.org/wiki/In_the_Plex) saying that all of the economy is really information, implying that the primary economy no longer matters? That’s not true, because the software economy - namely [artificial intelligence](https://en.wikipedia.org/wiki/The_Singularity_Is_Near) in the broad sense - is only 20% of the economy in terms of revenue. That is today. What about in the future? We need to clarify what is today, what is a desirable future, and how to get there.

But predicting the future is not easy. Different scenarios can play out. The best way to predict the future is to invent it.

Technological optimists such as Ray Kurzweil claim that humanoid robots that can perform most agricultural / construction tasks without other machines are around the corner in as little as 10 years - decreasing the primacy of the material economy. Just one robot with extreme accuracy and strength could replace 100s of specialized agricultural and manufacturing machines. Hence Google's position that in the end information (how to build such a power robot and its brains) is the most important. Does this position hold? Not yet. Let’s start with the next 30 years, after which it is all speculation due to the rapidly increasing rate of technological change. [Kevin Kelly makes a reasonable prediction](http://longnow.org/seminars/02016/jul/14/next-30-digital-years/) - that it won’t be about robots superseding humans, but about humans collaborating with robots. Successful humans in the next 30 years will learn how to work with AI and robots - to assist human capacity.

Hence the mental model of this book - that the hardware economy far overshadows the information economy today as the source of value. Take a look at the numbers: the auto, construction, and food industries total $25T today. Software totals $0.4T (see above), and computers total about the same.

This is interesting. As large as Apple and Google are, they are still a tiny fraction of the global economy. Others claim that the information economy stands at 20%.

We should understand this deeply to get a good check on reality. Yes, many people spend their whole day on a computer. But the actions of the computer correspond to moving atoms. And the atoms are the expensive, not electrons. Global electricity production (the current fuel of the information economy) - is [25,000 TWhrs](https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/electricity.html). =25 to the 15th power. It is 10 cents for to the 3rd power per hour. So 10 cents x 25 x 10 to the 12 = 2.5 to the 12th dollars - or 2.5 Trillion dollars.

That’s a couple of percent, and servers are [2% of the world electricity](https://www.elektormagazine.com/articles/how-much-electricity-does-the-internet-use) consumption. So the information economy is in principle very small.

This brings up the [Kardashev scale](https://en.wikipedia.org/wiki/Kardashev_scale), and the [Zero Marginal Cost Society](https://www.thezeromarginalcostsociety.com/) proposition. And we must touch on the concept of Lifetime Design.

It appears fair to say that for the foreseeable future, the hardware economy is much more important than information.

And yes, dematerialization is a real issue.

However, for us to not pay attention to making peoples’ lives better via hardware - the sustainable use of resources - and improving the ecological initegrity of the planet - today - is not responsible. Yes, we might attain the singularity - and all our problems will be solved - but to think of this saving force is much akin to religioun - and a substitute for responsibility.

Thus, we must still ground ourselves in improving or correcting the physical infrastructures of the world. This is a materialist perspective, but it is not inconsistent with the information age. The key to information age integrity is dispersing information far and wide - but largely for the purpose of affecting the physical world.

That’s what I suggested in my 2011 TED talk on the Global Village Construction Set:

“Hi, my name is Marcin -- farmer, technologist. I was born in Poland, now in the U.S. I started a group called Open Source Ecology. We've identified the 50 most important machines that we think it takes for modern life to exist -- everything from a tractor, bread oven, to a circuit maker. Then we set out to create an open source, DIY, do it yourself version that anyone can build and maintain at a fraction of the cost. We call this the Global Village Construction Set.https://en.wikipedia.org/wiki/Kardashev\_scale

So let me tell you a story. So I finished my 20s with a Ph.D. in fusion energy, and I discovered I was useless. I had no practical skills. The world presented me with options, and I took them. I guess you can call it the consumer lifestyle. So I started a farm in Missouri and learned about the economics of farming. I bought a tractor -- then it broke. I paid to get it repaired -- then it broke again. Then pretty soon, I was broke too.

I realized that the truly appropriate, low-cost tools that I needed to start a sustainable farm and settlement just didn't exist yet. I needed tools that were robust, modular, highly efficient and optimized, low-cost, made from local and recycled materials that would last a lifetime, not designed for obsolescence. I found that I would have to build them myself. So I did just that. And I tested them.And I found that industrial productivity can be achieved on a small scale.

So then I published the 3D designs, schematics, instructional videos and budgetson a wiki. Then contributors from all over the world began showing up, prototyping new machines during dedicated project visits. So far, we have prototyped eight of the 50 machines. And now the project is beginning to grow on its own.

We know that open source has succeeded with tools for managing knowledge and creativity. And the same is starting to happen with hardware too. We're focusing on hardware because it is hardware that can change people's lives in such tangible material ways. If we can lower the barriers to farming, building, manufacturing, then we can unleash just massive amounts of human potential.

That's not only in the developing world. Our tools are being made for the American farmer, builder, entrepreneur, maker. We've seen lots of excitement from these people, who can now start a construction business, parts manufacturing, organic CSA or just selling power back to the grid. Our goal is a repository of published designs so clear, so complete, that a single burned DVD is effectively a civilization starter kit.

I've planted a hundred trees in a day. I've pressed 5,000 bricks in one day from the dirt beneath my feet and built a tractor in six days. From what I've seen, this is only the beginning.

If this idea is truly sound, then the implications are significant. A greater distribution of the means of production, environmentally sound supply chains, and a newly relevant DIY maker culture can hope to transcend artificial scarcity. We're exploring the limits of what we all can do to make a better world with open hardware technology.”

But now back to Kardashev. Once we are super advanced and reach 1 on the scale….who knows what will happen. So let’s remain ignorant, with the immediate task at hand: to make it through the next 30 years of human civilization.

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I have now been at the Global Village Construction Set for a decade. We can claim for the public record that the first machine was built at the end of 2007 - the [brick press](http://opensourceecology.org/wiki/Prototypes_Built_and_Cost). a So I decided to write a book reviewing our progress and mobilizing the community to the next phase of accomplishments. Within a decade, I’d like OSE to have a billion dollar impact on civilization, and a trillion dollar impact by the decade after next. In order to do that - we need to scale our effort - but not like the [platform monopolies of today](https://www.fastcompany.com/40432885/its-time-to-break-up-amazon) - but in a distributive way of progress where nobody is left behind.

This is the good old fight of good versus evil - of decentralization and centralization. We all agree to Jeffersonian democracy in principle - the concept of a level economic field with room for a large number of players.

But the infrastructures of society today favor centralization - the historical enclosures. Of land. Of imperial colonies of the 1800s - that prevent producers from using their raw materials - but instead selling them to England so they can they could buy the finished goods (ref). Sound familiar today? The modern equivalent is that many people sell themselves at a fraction of their worth, producing goods for others, and after getting paid, they can buy these goods back. Why not produce and use these goods without going through intermediaries?

Amazon is good in that it removes those intermediaries. The whole economy is getting more efficient. But it’s not becoming distributive of its wealth - as wealth inequality is rising (graph)

What are some of the critical issues of today? Environmental decline. Poor wealth distribution. Economic bubbles and collapses that funnel even more wealth to the few. Poverty and material deprivation - like we couldn’t solve these problems readily if we wanted to. Or war and competion. Corruption.

All of these features of modern civilization revolve around humans not yet having learned to get along with one another. This means that cooperation is not as strong as competition, though it sounds obvious that we can get further by cooperation than by competition, as written about eloquently in the book [SuperCooperators](https://www.amazon.com/SuperCooperators-Altruism-Evolution-Other-Succeed/dp/1451626630).

"Many problems that challenge us today can be traced back to a profound tension between what is good and desirable for society as a whole and what is good and desirable for an individual. That conflict can be found in global problems such as climate change, pollution, resource depletion, poverty, hunger, and overpopulation. The biggest issues of all - saving the planet and maximizing the collective lifetime of the species Homo sapiens - cannot be solved by technology alone. They require novel ways for us to work in harmony. If we are to continue to thrive, we have but one option. We now have to manage the planet as a whole. If we are to win the struggle for existence, and avoid a precipitous fall, there's no choice but to harness this extraordinary creative force. We now have to refine and to extend our ability to cooperate. We must become familiar with the science of cooperation. Now, more than ever, the world needs SuperCooperators."

But as an economic paradigm - we are far from cooperation. Structures of patents, including patents on life forms themselves, communications monopolies like Verizon threatening net neutrality, competitive waste in corporations that don’t work together. In kindergarden we are taught to share, but as soon as we graduate college we are told to proprietize.

Proprietary production is in my view the single most dangerous existential risk affecting our civilization. The ramifications of proprietary production are profound. It systematically reinforces the dumbing down of people - in other words people not gaining full education towards becoming productive members of society. This is because as a norm - individuals practice protectionism of their knowledge. While you may easily access low quality information - that information which is most effective is in general a trade secret. This is pervasive throughout our life - professors won’t teach you information that is state of art - as that information is patented or trade secret. Your peers won’t tell you the insides of their innovation - as it’s their source of competive advantage. In general, mediocrity is reinforced throughout civlization, as people are not freely building upon each others’ work.

And those that secure a patent have the arrogance to claim that their work is original - and not a small addition building on all of prior human knowledge. That is what society rewards today - most patent holders probably do not consider their action arrogance. But once again, this is a manifestation that society has not evolved enough to collaborate.

The critic of the above statement will say, but how do you recover your R&D investment if you don’t monopolize the fruits of that R&D? Well, that’s the wrong question to ask. The correct question is, why did we create a patent system in the first place? While founders of patents claim it’s to protect one’s investment, the better question would be, why are we forced to protect our investments against freeloaders? Well, the clear answer is to make money - but once again we are trapped in the dilemma of what’s good for society and what’s good for the individual.

This boild down to value judgments. Do we value greed, or do we value true collaboration?

This book is written for those who value collaboration. The bottom line is - how do we create more infrastructures for distributing wealth to more people? And without creating a welfare state. How do we empower more people? How do people truly gain access to learning effecively? How do we prevent further enclosures by platform monopolies?

Our economy is proprietary to the bone. Through patents galore - did you know that Google and Apple spent more on patents than on R&D in 2012?

What does that mean in practice? Say you’re trying to learn something productive, such as building a hydrogen-fueled car. Good luck in accessing state-of-art information on that. You have to pay your dues to get it. And those that pay their dues, do not share back. If you point to Tesla open sourcing their patents? BS. Please show me the actaul technical designs, supply chain informaiton, and production engineering that would allow me to replicate without having to go through reinventing the wheel myself?

That’s why open source information is critical, as a key to distributing economic power.

In this book, my goal is to propose a program for building civilization from scratch, for five dollars. Well, not exactly, but at 1/100 the cost of the existing options. My goal is to explain the Global Village Construction Set - so that today, we can build eco-homes, hydrogen cars - all of our infrastructures and key products in an open source way. Which would have profound effects on the rest of civilization

Today the primary economy is 73 Trillion large (pie chart by sector - construction, agriculture, transportation, manufacturing).

The primary economy is called primary because it’s the foundation for the systems that build upon it: government, financial sector, entertainment, education, etc.

It is the primary economy that has the most profound impact upon everyone. Simply put - if we want to tranform the secondary economy (ie, the government, the corporation, the education sytem, etc) - we must first transform the primary economy upon which the secondary economy depends.

Platform Monoplies

Platform monopolies are just the latest development in humanity’s enclosures. First we enclosed land, so that workers began to depend on the land owner. We enslaved people, so they could sell raw resources and buy the finished products. Then comes patents, DRM, Walmart, and finally, Amazon, Google. Apple. The corporation. Show how the corporation encloses property. Class struggle. Why is everywhere a system of oppression being built? That is a curious feature of human civilization.

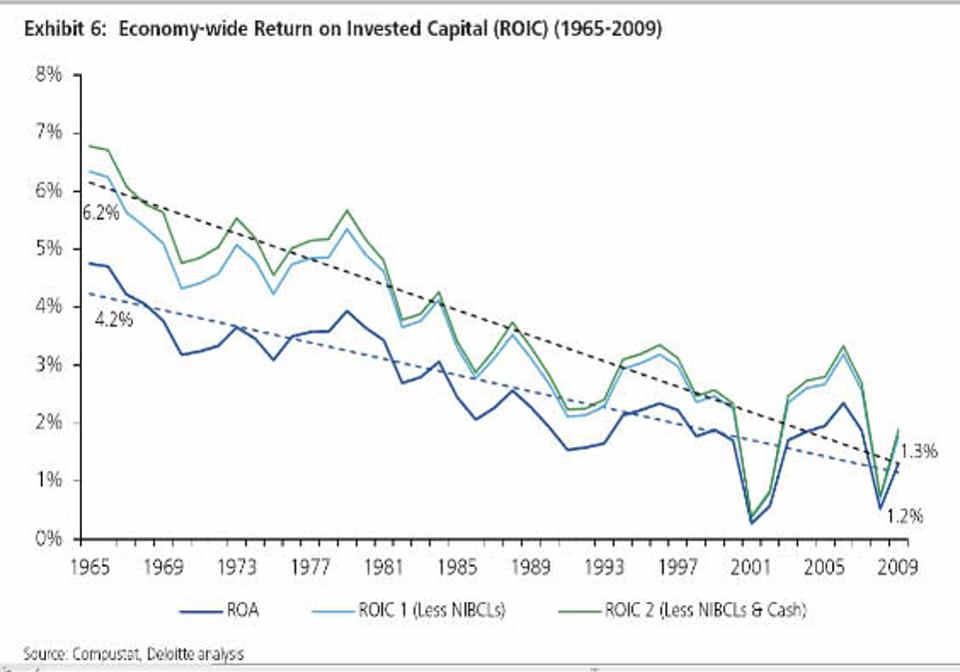
Capitalism

Capitalism has a paradox. Rifkin. Upon succeeding, capitalism truly distributes wealth, because that is the most efficient state? That is quite hopeful. You mean we can make Gabon as rich as the USA? You mean we can get rid of all poverty? You mean we can protect the environment? Yes, to all of the above. If you have 100x lower cost goods, and 100x more efficiency.

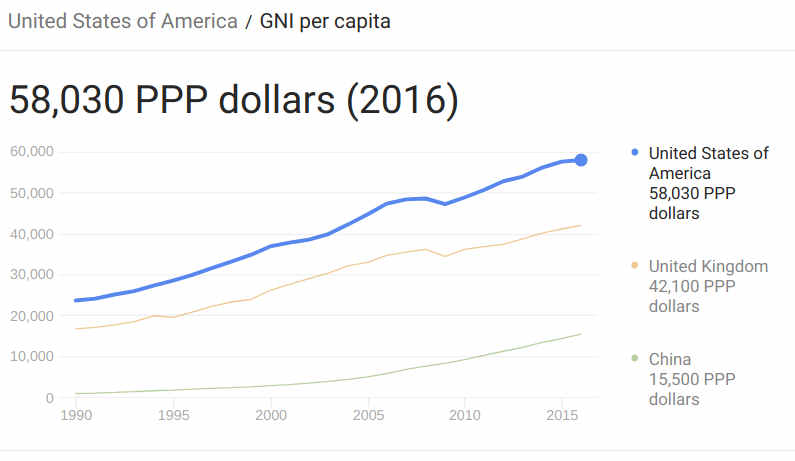
Rifkin predicts that corporations are cannibalizing themselves (Amazon ate Borders and Circuit City, Uber ate many taxi services, Walmart ate many local stores). Is unemployment the actual result? Does Amazon actually create lower prices? Yes. What is the cost? Is there a high cost of low price?

[Ceative Destruction](https://www.forbes.com/sites/stevedenning/2012/01/25/shift-index-2011-the-most-important-business-study-ever/#503a1fc63a6e)?

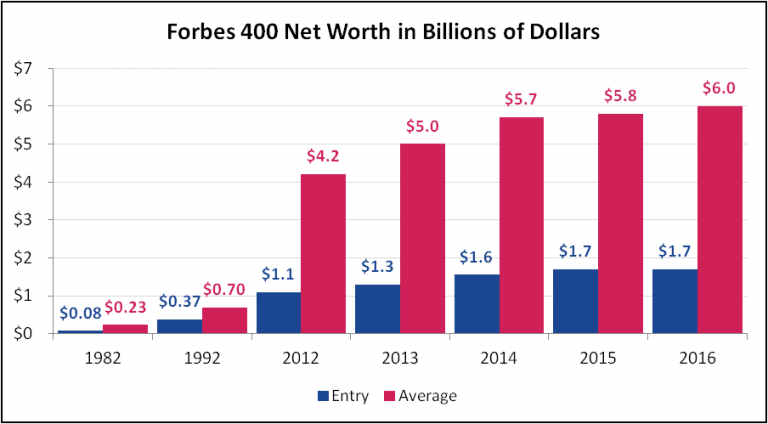
The Shift Index builds on Richard Foster’s book, [Creative Destruction](http://www.amazon.com/gp/product/038550134X/ref=as_li_ss_tl?ie=UTF8&tag=stevdenndotco-20&linkCode=as2&camp=1789&creative=390957&creativeASIN=038550134X) (2001) which showed that the life expectancy of firms in the Fortune 500 had declined from 75 years half a century ago to less than 15 years.

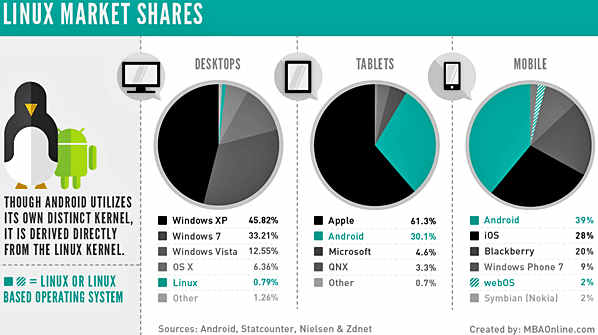
Return on assets is [declining](https://www.forbes.com/sites/stevedenning/2012/01/25/shift-index-2011-the-most-important-business-study-ever/#17e346333a6e) - 

Per capita income is increasing



Top [400 richest people](https://inequality.org/facts/wealth-inequality/) in USA from 1982 to present -



Linux market share - 

Introduction 2

* This is a book that asks the question - what does it take to create society from scratch? Free from various and sundry ills, from genocide, to war, and other hobgoblins of power concentration?
* Who closed Main Street? Ladies and gentlemen, Main Street is closed. This refers to Wall Street taking a lead. Let’s explore this for a second, as this is a critical point to understand regarding the structure of the modern infrastructure.
* Claim that under the current state of the world - lies a bellicose mindset of fear and scarcity - manifesting as enclosure of numerous commons and a general retardation of human intelligence.
* We propose a program of the open source economy as a solution. Anyone can take on this program. We analyze the current state, and propose the adjto bring society to its next level of evolution. This is a story of personal repsonsibility: ask not what the world can do for you, but what you can do to the world - to make it better. While the end point technical (building infrastructures for a new civilization) the motivation is sociological: asking how everyone can prosper, so nobody is left behind. Assumption is that ‘we are all in it together’
* For anyone to act effectively, they have to ‘know what time it is.’ What is the state of the world? Which stories that we are told are political manipulation by specific agendas - and which are authentic issues? How do we differentiate between the two?
* So the chapter on the State of the World: Abundance or Demise - must begin with how humans process information, so we are more aware of what is ‘true’ and what is not. This invariably gets to socilogical topics of general semantics, mass cultural creation, political ponerology, and the scientific method. Yet the rationality must be tempered with uncertainty, as inherent in the scientific method. For even the best scientists used to think that the world was flat - until someone showed otherwise. [Kardashev Scale 0](https://en.wikipedia.org/wiki/Kardashev_scale) at present.
* The state of the world assesses the major infrastructures of civilization - from economic, to political, to social - to bring common understanding to the state of affairs. It’s an assessment of abundance thinking, and scarcity thinking - aiming to come up with common ground that we may all agree is generally regarded as true. The goal is to set the record straight, as much as such a task is possible. Of course there will be assumptions in the background - and those will be made explicit as we go along.
* What I propose is the open source ecocnomy, and I will explain why I think open source collaborative economies are where society is going - in terms of an operating paradigm - as opposed to the current competitive, proprietary norm, where wealth concentration is build thoroughly into the operating system of human transactions. Thus the claim that wealth distributed far and wide is the best option for a democratic society.
* In the State of the World discussion, key paradoxes must be explored. First, the paradox of capitalism, where the ultimate success of capitalism - a power/wealth concentrating enterprise - results in thorough distribution. What are the facs and figures behind this? Is the very end point of capitalism its complete opposite - the open source economy? We will of course define the terms here - what is capitalism as understood today, and what is the open source economy?
* The Paradox of Capitalism has been questioned by Adam Smith (ref), and other well-known economists. But to date - this remains a riddle without solution.
* Second, the Paradox of Democracy: the Struggle between liberty and equality ([Victor David Hanson](https://youtu.be/2cGnzUfgfsc?t=1489)). That issue has never been resolved. If you err on the side of liberty, you accept some inequality. If you err on the side of equality, you compromise liberty (make people equal even if they are not). US founding fathers said that democracy (erring on the side of Athenian equality) was an evolutionary dead end. USA liked an enlightened oligarchy, not democracy - which meant coarcion in the style of ‘majority mob rule’ - that led to deaths such as of Aristotle or of Lesbians. Equality is coercion. Democracy started in the 507 BC, ended in 338 BC. Democracy remained an undelivered promise of numerous intellectuals. What worked instead was a constitutional system, an enlightened oligarchy (such as the USA where only land owners voted), with checks and balances, and checks on the mob rule. They did not trust people to have absolute power. This left a legacy of constitutional governments. Democracy is not rule by people, it’s rule by [poor people](https://youtu.be/2cGnzUfgfsc?t=2270). Right wing critique: people are not equal; if you force them to be, it requires 2 things: loss of individual liberty and coercion.
  + Open source solution: not take from the ‘rich’, but provide tools to the ‘poor’ - while leveling the field from extractive institutions and monopolies
  + Practical outcome: the struggle between ‘democrats’ and ‘republicans’ in the USA?
* Considering the paradoxes of the economy and of governance, we will be on a better footing to begin addressing the question of prosperity for everyone.

Diffusion of Technology

Patents

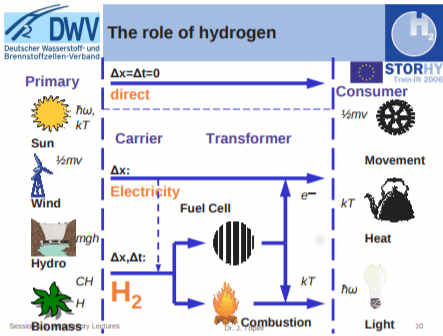
* Ideas are not naturally scarce. However, by recognizing a right in an ideal object, one creates scarcity where none existed before. As Arnold Plant explains: “It is a peculiarity of property rights in patents (and copyrights) that they do not arise out of the scarcity of the objects which become appropriated. They are not a consequence of scarcity. They are the deliberate creation of statute law, and, whereas in general the institution of private property makes for the preservation of scarce goods, tending . . . to lead us “to make the most of them,” property rights in patents and copyrights make possible the creation of a scarcity of the products appropriated which could not otherwise be maintained. - [Plant, “The Economic Theory Concerning Patents for Inventions,” p. 36. Also Mises, Human Action](https://mises.org/system/tdf/Against%20Intellectual%20Property_2.pdf?file=1&type=document)
* Bouckaert also argues that natural scarcity is what gives rise to the need for property rules, and that IP laws create an artificial, unjustifiable scarcity. As he notes: Natural scarcity is that which follows from the relationship between man and nature. Scarcity is natural when it is possible to conceive of it before any human, institutional, contractual arrangement. Artificial scarcity, on the other hand, is the outcome of such arrangements. Artificial scarcity can hardly serve as a justification for the legal framework that causes that scarcity. Such an argument would be completely circular. On the contrary, artificial scarcity itself needs a justification.- Bouckaert, “What is Property?” p. 793; see also pp. 797–99.
* That is, by merely authoring an original expression of ideas, by merely thinking of and recording some original pattern of information, or by finding a new way to use his own property (recipe), the IP creator instantly, magically becomes a partial owner of others’ property. - [mises.org](https://mises.org/system/tdf/Against%20Intellectual%20Property_2.pdf?file=1&type=document)

Research

Infrastructures

* Infrastructures - nice article on Steemit [here](https://steemit.com/networking/@daowisp/building-the-infrastructure-of-decentralized-civilization)
* Digital Infrastructures - [LinkedIn article](https://www.linkedin.com/pulse/think-scale-civilization-infrastructure-plan-digital-business-butler/) by Butler
* You will be paid by how well you work with an AI - [Long Now Kevin Kelly](http://longnow.org/seminars/02016/jul/14/next-30-digital-years/) on the next 30 years
* Civilization infrastructure referring to [digital](https://www.helpnetsecurity.com/2016/10/19/civilization-infrastructure/)

Hydrogen

* SME on hydrogen filling station - [Stan](http://opensourceecology.org/wiki/Hydrogen_Filling_Station).
* PDF, [Toepler](http://www.storhy.net/train-in/PDF-TI/03_StorHy-Train-IN-Session-1_3_JToepler.pdf)
* 
* [Compressed Gas Storage](http://opensourceecology.org/wiki/Compressed_Gas_Storage) - wiki
* Compressed hydrogen - assuming near free solar energy - compressed hydrogen makes sense. 3000 PSI, 250 mile range is accommodated by 14 cubic feet (100 gal) of hydrogen - a [7.5 gal gasoline equivalent](http://www.fsec.ucf.edu/en/consumer/hydrogen/basics/documents/task2_gaseous_h2.pdf).
  + If this is 140 cubic feet at 300 PSI

Generators

* [Quieting a Generator](http://opensourceecology.org/wiki/Quieting_a_Generator)

Lithium + Nickel

* [$3/lb cost](https://www.greentechmedia.com/articles/read/is-there-enough-lithium-to-maintain-the-growth-of-the-lithium-ion-battery-m#gs.0fKPiRw) of commodity lithium
* What Tesla battery [looks like](https://www.bloomberg.com/graphics/2017-lithium-battery-future/) -
* Nickel resources - 300M MT - or 175 years supply at current use.

**Who Owns the Internet**

* [South-East Asia, Mid East, Western Europe](https://en.wikipedia.org/wiki/SEA-ME-WE_4) cable. 18000km.
* [Wavelength multiplexing](https://en.wikipedia.org/wiki/Wavelength-division_multiplexing) - 100GB/s for a single cable, x160 - for 16Tbps cable
* 6 fibers with 100 wavelengths - [$300M/6000miles](https://www.computerworld.com/article/2939316/networking-hardware/googles-60tbps-pacific-cable-welcomed-in-japan.html). $50k/mile. 60 Tbps. 1 gig can take 100 10MB connections. 60 TB can do 6M 10Mbps connections. For 2 cm of width. 100 km between repeaters.
* Direct burial fiber optic cable - 6 strand, multimode - [$1/ft](https://www.discount-low-voltage.com/Cable/Direct-Burial-Singlemode-Fiber/96EUC-T4101D20_2). Gbps per wire. Multimode [specs](https://www.discount-low-voltage.com/core/media/media.nl/id.388435/c.1259044/.f?h=85950235558906646433). But this is only 1 Gbps for 1km.
* [Single mode fiber](https://www.cablewholesale.com/products/fiber-optic/singlemode-duplex-9-125/product-10f3-006nh.php) - 18 cents for 6 fibers. 3 pairs
* Single mode transceiver - 10Gbps for 80 km. [$500](https://www.fs.com/products/11703.html).

So there we have it. 50 mile radius, 10Gbps x3, for $3000 in transceivers (3 pair sets) and $50k in fiber. 30Gbps gets us 3000 connections - or $17 per connection. Not bad for a lifetime of internet at 10-100MB. Then imagine everyone paid a one time fee of $17 for a lifetime of internet, plus maintenance costs (which should be comparable to that every year). Time for some Open Source Public Works Fiber?

Now, who owns the right-of-ways? Becaue we can take care of trenching with OSE machines. This would be very interesting granted there are a ton of MESH Wifi networks popping up globally. …..

* [LimeSDR](https://www.crowdsupply.com/lime-micro/limesdr) - Open source hardware Wireless Radio Transceiver for cell phones and internet -

**Autonomous Republics**

* Self employed - [70%](https://20somethingfinance.com/self-employment-poll/) wannabe, [10% are](https://www.cbsnews.com/news/on-the-decline-1-in-10-u-s-workers-self-employed/)
* [Free private cities](https://freeprivatecities.com/information/) - includes 10 basic rules
* [Liberland](http://investment.ll.land/mobile/index.html#p=18)
* [Paul Romer](https://www.youtube.com/watch?time_continue=41&v=mSHBma0Ithk) - rules for changing rules. Ideas are 2fold: technologies, and rules. Let’s innovate the rules.
* [Jamestown Seventy](http://opensourceecology.org/wiki/Book)

**Cordless Tools**

* Stanley Black & Decker [buys Crasftsman for $900M](http://www.hbsdealer.com/article/stanley-black-decker-buy-craftsman).
* Craftsman has [different attachments](https://www.google.com/search?client=ubuntu&hs=llW&biw=1275&bih=730&tbm=isch&sa=1&ei=IWVOWpndK-XOjwSulrXIBQ&q=bolt-on+attachments+craftsman+products&oq=bolt-on+attachments+craftsman+products&gs_l=psy-ab.3...506367.515298.0.515495.35.31.2.0.0.0.172.3143.0j24.24.0....0...1c.1.64.psy-ab..10.4.597...0i7i30k1j0i8i7i30k1j0i24k1.0.g2MFQ0epPLI) - modular

**The Success of Open Source**

* **Code and Other Laws of Cyberspac**e, Lessig - open source as a major challenge to gummit/corporates in shaping future society
* **The Logic of Collective Action** - issue of difficulty of coordinating people - freeloaders, self-interest, sustainability issues, no pay. Freeloaders are accepte because of SDT, self-interest limits your product as you don’t get an opus dei, sustainability is addressed with MTP and leadership, and pay is there - now at trillions.
* **The Mythical Man Month** - what is the solution of Brook’s Law
* [Apache is 100M](https://projects.apache.org/statistics.html) lines of code, Linux about ⅙ of that
* Why does explaining individual motivation not explain the success of open source?
* <https://www.linuxcounter.net/statistics>
* [Submitting Kernel Patches](http://halobates.de/on-submitting-kernel-patches.pdf) pdf

Notes:

1. Mastermind tasks - clear distinction between architecture and implementation
   1. GVCS
   2. Submodules that can be large projects in themselves
   3. Product ecologies at the fabrication level
   4. Product ecologies at the user level
   5. Ultimately it boils down to restructuring as construction sets
      1. Define modules for construction sets - essentially, functional mechanisms
         1. Develop specific instances of functional mechanisms
            1. Ex - a hydraulic univeral rotor vs electric universal rotor vs stepper-based universal rotor
      2. Iconize the modules (team binding and scoping)
      3. Digitize in FreeCAD models - this is the ultimate commit
   6. Develop various products from modules - allowing for rapid development. We have already proven this
2. Divide into subtasks
3. Train process managers to be sub-architects
   1. Provide design training on all the background research
   2. Generate a process for background research
   3. Differentiate between informal commits and formal commits
4. Define specifications as the measure against which to measure monitor
   1. Apply test driven design for self-evaluation - this scales the commit process by automating the verification step
5. Develop teams that integrate development into a marketable product
   1. Develop modular, micro-marketing website for initial financial feedback loop
6. Work in pairs to remove dependencies
7. Formal commits have a procedure for self-test and -evaluation of the submission. Submission is then passed through:
   1. Maintainers who are responsible for a part of the code
   2. Lieutentants who oversee larger parts of the project
   3. Finally approval by Marcin. This last step is a simply a verification of the tests and evaluations of others
   4. Initially the submitter is maintainer, so you don’t just pitch something over the fence and walk away. It is a responsibility.
8. Contributor Guide
9. Commit Guide - formal definition of process for formal commits

Systems

1. <https://en.wikipedia.org/wiki/Distributism> - “socialism is the logical conclusion of capitalism as capitalism's concentrated powers eventually capture the state, resulting in a form of socialism.”
2. <http://www.hsnsw.asn.au/Distributism.html> - nice definitions

Podcast

1. Lewis Dartnell - The Knowledge
2. Weber - The Success of Open Source. What was the key that avoided the Paradox?
3. Piore - We must conceptualize a world in which technology can develop in various ways: a world that might have turned out differently from the way it did, and thus a world with a history of abandoned but viable alternatives to what exists.—Michael Piore and Charles Sabel (1984, 5). What tehnologies specifically do you see as options that did not develop but could have?
4. Lessig - open source and gummit
5. Torvalds or another high level lieutenant
6. Apache
7. Wordpress Matt
8. Rifkin
9. Lovins
10. Paul Romer
11. Free State Project
12. King of Bitcoin
13. Steele
14. Jeff Moe
15. Sam Altman, Y Combinator
16. Deci and Ryan - self-determination theory
17. Enspiral - growing an open enterprise
18. Enterprise - open source enterprise system - Peter Senge

1. 20M of 7B people are programmers. <https://www.google.com/search?q=desertification+rate+world&oq=desertification+rate+world&aqs=chrome..69i57j0l5.4422j1j7&client=ubuntu&sourceid=chrome&ie=UTF-8> [↑](#footnote-ref-0)
2. <https://www.huffingtonpost.com/2014/07/17/map-happiness-benchmark_n_5592194.html> [↑](#footnote-ref-1)
3. <https://www.ifad.org/topic/tags/desertification/1953395> [↑](#footnote-ref-2)
4. <http://landartgenerator.org/blagi/archives/127> [↑](#footnote-ref-3)
5. <https://www.google.com/search?q=average+us+credit+card+debt&oq=average+u&aqs=chrome.0.69i59l2j69i57j69i59j69i60l2.3880j0j7&client=ubuntu&sourceid=chrome&ie=UTF-8> [↑](#footnote-ref-4)
6. <https://ourworldindata.org/extreme-poverty#extreme-poverty-in-a-historical-perspective> [↑](#footnote-ref-5)
7. <https://www.youtube.com/watch?v=_NznT4Cn8As> [↑](#footnote-ref-6)
8. <http://opensourceecology.org/wiki/Milton_Frieman_on_Wiping_the_Slate_Clean> [↑](#footnote-ref-7)
9. <https://20somethingfinance.com/self-employment-poll/> [↑](#footnote-ref-8)
10. <https://www.business.com/articles/stuart-hearn-work-life-integration/> [↑](#footnote-ref-9)
11. Only $20B for the most advanced microchip making. But also, this can be done at a much smaller scale. It the open source economy, cost reduction should be a factor of about 1000x. 10x for open IP, 10x for lifetime design, and 10x for collaboration. [↑](#footnote-ref-10)
12. <http://selfdeterminationtheory.org/> [↑](#footnote-ref-11)
13. <https://ourworldindata.org/democracy> [↑](#footnote-ref-12)
14. <http://reason.com/blog/2015/04/30/19-of-americans-self-identify-as-liberta> and also see <https://en.wikipedia.org/wiki/Libertarianism> [↑](#footnote-ref-13)
15. Based on the $75T global economy and 7.5 billion people. [↑](#footnote-ref-14)
16. <http://whatis.techtarget.com/definition/Amazon-effect> [↑](#footnote-ref-15)
17. Ashley Vance, The Everything Store [↑](#footnote-ref-16)
18. <https://www.plunkettresearch.com/statistics/Industry-Statistics-Global-Food-Industry-Statistics-and-Market-Size-Overview/> [↑](#footnote-ref-17)
19. <http://opensourceecology.org/wiki/Diesel_Engine_Cost> [↑](#footnote-ref-18)
20. <http://opensourceecology.org/wiki/Modular_Track_Unit_v18.01> [↑](#footnote-ref-19)
21. <https://www.caranddriver.com/reviews/caterpillar-d7e-feature-test> [↑](#footnote-ref-20)
22. Current design is rated for rated for 40 hp per track or 80 hp with double drive, . (ref - do calculations) and 3600 lbs or 7200 of pull each. Thus, a four-tracked machine can have 29,000 lb of pulling force with direct drive using our current 15k in-lb motors. [↑](#footnote-ref-21)
23. <https://www.farmax.info/PDF/Magazine-Farmax-EN.pdf> [↑](#footnote-ref-22)
24. A village of 200 - based on Dunbar’s number <https://en.wikipedia.org/wiki/Dunbar%27s_number> [↑](#footnote-ref-23)
25. Assuming field crops planted with a seeder, not slips like sweet potatoes. <http://opensourceecology.org/wiki/Acres_Needed_to_Feed_Dunbar_Village> [↑](#footnote-ref-24)
26. <http://www.businessinsider.com/what-warren-buffett-makes-per-hour-2013-12> [↑](#footnote-ref-25)
27. <https://localfoodnodes.org/> [↑](#footnote-ref-26)
28. <https://www.ibisworld.com/industry-trends/market-research-reports/manufacturing/food/dairy-product-production.html> [↑](#footnote-ref-27)
29. <https://www.raspberrypi.org/blog/raspberry-pi-3-on-sale/> [↑](#footnote-ref-28)
30. <https://www.theregister.co.uk/2008/01/05/tob_cray1/> [↑](#footnote-ref-29)
31. John Liu reported on this - <http://www.aquinta.org/news/2016/10/6/greening-the-desert> [↑](#footnote-ref-30)
32. <https://www.ibisworld.com/industry-trends/global-industry-reports/manufacturing/bakery-goods-manufacturing.html> [↑](#footnote-ref-31)
33. <https://www.farmflavor.com/at-home/what-is-the-most-popular-food-in-the-world/> [↑](#footnote-ref-32)
34. <https://www.smithsonianmag.com/smart-news/each-day-50-percent-america-eats-sandwich-180952972/> [↑](#footnote-ref-33)
35. <https://www.youtube.com/watch?v=KpJR2yfLUU0> [↑](#footnote-ref-34)
36. <http://www.chapelgatehome.uk/our-blog> [↑](#footnote-ref-35)
37. <https://en.wikipedia.org/wiki/Environmental_impact_of_concrete> [↑](#footnote-ref-36)
38. <https://en.wikipedia.org/wiki/Cement_industry_in_the_United_States> [↑](#footnote-ref-37)
39. 10 cent cement cost for a 20 lb block, and 2 cents gasoline cost. [↑](#footnote-ref-38)
40. <https://www.ebay.com/itm/30hp-Kohler-Engine-1-1-8-D-Command-15Amp-Exmark-CH750-0026/132423001888?epid=26011371639&hash=item1ed506a720:g:4YUAAOSwH2VaS3-h> [↑](#footnote-ref-39)
41. <https://sleequipment.com/dovetail-utility-trailer-7x20-with-3500lb-axles.html?fee=8&fep=524834&gclid=EAIaIQobChMIws349azn2AIVBqxpCh1rMwbpEAQYASABEgIeHPD_BwE> [↑](#footnote-ref-40)
42. <http://www.dltimbertech.com/dl-180-swing-blade-sawmill-10-x-20.html> [↑](#footnote-ref-41)
43. <https://www.aquascience.net/grundfos-10sq05-160-230v-10gpm-1-2hp-230v-2-wire-96160140-3-stainless-steel-submersible-well-pump?gclid=EAIaIQobChMIlt-S3PDn2AIVC6tpCh369g34EAQYASABEgJr__D_BwE>. 10’ of this pipe store 4 or 6.5 gallons of water. [↑](#footnote-ref-42)
44. <https://www.discountsteel.com/items/Galvanized_Steel_Pipe.cfm?item_id=172&size_no=11#skus> [↑](#footnote-ref-43)
45. Initially, the house was not in the GVCS - but it was added as the Microhouse. The [↑](#footnote-ref-44)
46. <https://en.wikipedia.org/wiki/Construction#Industry_characteristics> - residential construction is about ⅓ of all construction [↑](#footnote-ref-45)
47. Earning $100k each per year. [↑](#footnote-ref-46)
48. <https://www.openbuildinginstitute.org/> [↑](#footnote-ref-47)
49. <http://www.kitco.com/ind/Albrecht/2014-12-16-How-Green-is-Lithium.html> [↑](#footnote-ref-48)
50. <https://farm.bot/> . By Shuttleworth Fellow friend Rory Aaronson. [↑](#footnote-ref-49)
51. <https://cuesa.org/learn/how-far-does-your-food-travel-get-your-plate> [↑](#footnote-ref-50)
52. <https://en.wikipedia.org/wiki/Automotive_industry#World_motor_vehicle_production> [↑](#footnote-ref-51)
53. <http://opensourceecology.org/wiki/Hydrogen_Production> [↑](#footnote-ref-52)
54. <http://environment.yale.edu/gillingham/hydrogenICE.pdf> [↑](#footnote-ref-53)
55. [http://www.nytimes.com/2004/05/05/business/averag e-us-car-is-tipping-scales-at-4000-pounds.html](http://www.nytimes.com/2004/05/05/business/average-us-car-is-tipping-scales-at-4000-pounds.html) [↑](#footnote-ref-54)
56. <https://en.wikipedia.org/wiki/List_of_fastest_production_cars_by_acceleration> [↑](#footnote-ref-55)
57. <https://www.ptua.org.au/myths/smallcar/> [↑](#footnote-ref-56)
58. <http://driving.ca/hyundai/accent/auto-news/news/these-are-the-ten-lightest-cars-you-can-buy-in-2015> [↑](#footnote-ref-57)
59. <http://www.iihs.org/iihs/topics/t/general-statistics/fatalityfacts/state-by-state-overview#Crash-types> [↑](#footnote-ref-58)
60. <http://asirt.org/initiatives/informing-road-users/road-safety-facts/road-crash-statistics> [↑](#footnote-ref-59)
61. <http://bigthink.com/ideafeed/googles-self-driving-car-is-ridiculously-safe> [↑](#footnote-ref-60)
62. <https://en.wikipedia.org/wiki/Volkswagen_1-litre_car>. The efficiency dropped to 170 mph in a hybrid versio - <http://gas2.org/2009/09/14/volkswagens-diesel-hybrid-1l-concept-gets-170-mpg-available-by-2013/> [↑](#footnote-ref-61)
63. Hydraulic accumulators may be used for peak power. [↑](#footnote-ref-62)
64. <http://opensourceecology.org/wiki/Solar_Car> [↑](#footnote-ref-63)
65. <https://en.wikipedia.org/wiki/Unimog> [↑](#footnote-ref-64)
66. <http://opensourceecology.org/wiki/45.6_Cu_In_Hydraulic_Motor> [↑](#footnote-ref-65)
67. <https://inverterdrive.com/group/Motors-AC/TECA2-200L-4-Pole-B3-High-Efficiency-AC-Motor-200/> [↑](#footnote-ref-66)
68. <https://en.wikipedia.org/wiki/History_of_marketing> [↑](#footnote-ref-67)
69. <http://www.foodaidfoundation.org/world-hunger-statistics.html> [↑](#footnote-ref-68)
70. <http://www.foodaidfoundation.org/world-hunger-statistics.html> [↑](#footnote-ref-69)
71. <https://scholarworks.umb.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1003&context=econ_faculty_pubs> [↑](#footnote-ref-70)
72. <https://www.amazon.com/Small-Beautiful-Economics-People-Mattered/dp/0061997765> [↑](#footnote-ref-71)
73. ref [↑](#footnote-ref-72)
74. <https://wtfeconomy.com/the-corporation-is-dead-long-live-the-corporation-13b787e33b29> [↑](#footnote-ref-73)
75. <http://www.hsnsw.asn.au/Distributism.html> [↑](#footnote-ref-74)
76. <http://opensourceecology.org/wiki/Distributive_Enterprise> [↑](#footnote-ref-75)
77. <https://en.wikipedia.org/wiki/Small_business#Size_definitions> [↑](#footnote-ref-76)
78. Beyond sustainable, as regeneration of people and the environment is important in view of today’s state of the world. [↑](#footnote-ref-77)
79. <https://hbr.org/2011/11/the-for-benefit-enterprise> [↑](#footnote-ref-78)
80. <https://en.wikipedia.org/wiki/Mondragon_Corporation> [↑](#footnote-ref-79)
81. Ref [↑](#footnote-ref-80)
82. <https://www.youtube.com/watch?v=Ls412TYP9JE> [↑](#footnote-ref-81)
83. See the seminal work on the topic by \_\_\_\_\_\_\_\_\_\_\_\_ [↑](#footnote-ref-82)
84. The open source ethic at OSEmeans that you share aggressively, and aim for widespread improvement of society via ethical economic impact. [↑](#footnote-ref-83)
85. This addresses the freeloader dilemma in that anyone is welcome to freeload. However, replicators are not allowed to use any photos that are not their own [↑](#footnote-ref-84)
86. <https://www.forbes.com/sites/stevendennis/2017/06/19/should-we-care-whether-amazon-is-systematically-destroying-retail/#74404c6f6b1f> [↑](#footnote-ref-85)
87. Is monopoly really capitalism? In his authoritative study, *The Economics of Industrial Organization*,William Shepherd provides a list of twenty-two different barriers to entry commonly used by firms to exclude competitors and maintain monopoly power [↑](#footnote-ref-86)
88. <http://tomtunguz.com/years-to-a-billion/> [↑](#footnote-ref-87)
89. <https://www.huffingtonpost.com/2013/06/01/happiness-index-only-1-in_n_3354524.html> [↑](#footnote-ref-88)
90. <http://fortune.com/global500/> [↑](#footnote-ref-89)
91. <https://www.forbes.com/sites/forbesinsights/2014/03/25/the-67-people-as-wealthy-as-the-worlds-poorest-3-5-billion/#3ee2448a11ad> [↑](#footnote-ref-90)
92. Ibid., last paragraph. [↑](#footnote-ref-91)
93. <https://monthlyreview.org/2011/04/01/monopoly-and-competition-in-twenty-first-century-capitalism/> [↑](#footnote-ref-92)
94. *Frederic Laloux,* [*Reinventing Organizations*](http://www.reinventingorganizations.com/) *-* shows many state of art examples. Enspiral is a great example of a collaborative enterprise. None of the examples of these are open source as defined by Distributive Enterprise. [↑](#footnote-ref-93)
95. <https://en.wikipedia.org/wiki/Appropriate_technology> [↑](#footnote-ref-94)
96. Pearce, J.M. Environ Dev Sustain (2012) 14: 425. <https://doi.org/10.1007/s10668-012-9337-9> [↑](#footnote-ref-95)
97. <https://en.wikipedia.org/wiki/Fourth_World> [↑](#footnote-ref-96)
98. Ray Kurzweil is a seminal thinker on the rise of artificial intelligence - <https://en.wikipedia.org/wiki/The_Singularity_Is_Near> [↑](#footnote-ref-97)
99. The word robot has a broad meaning - literally, any device with a microcontroller. <https://www.wired.com/story/what-is-a-robot/> . It can range from a 3D printer to a full humanoid who is smarter and more capable than its human counterpart. [↑](#footnote-ref-98)
100. See Kevin Kelly’s discussion of the next 30 years of technology - <http://longnow.org/seminars/02016/jul/14/next-30-digital-years/> [↑](#footnote-ref-99)
101. <https://en.wikipedia.org/wiki/Natural_Capitalism> [↑](#footnote-ref-100)
102. By wide, we mean on the scale of around 1-2 thousand of developers in any year - basing this benchmark on the current effort of the Linux Project - a model which we are exending to open hardware [↑](#footnote-ref-101)
103. <http://opensourceecology.org/wiki/OSE_Specifications> [↑](#footnote-ref-102)
104. See Lewis Mumford for a critique of centralized tehnology - <https://en.wikipedia.org/wiki/The_Myth_of_the_Machine> [↑](#footnote-ref-103)
105. On fulfillment - 1 in 6 americans take antidepressants or other psychiatric drugs. <https://www.nbcnews.com/health/health-news/one-6-americans-take-antidepressants-other-psychiatric-drugs-n695141> [↑](#footnote-ref-104)
106. <https://www.linkedin.com/pulse/bim-facility-management-operations-justin-aungst/> [↑](#footnote-ref-105)
107. <http://opensourceecology.org/wiki/Cost_of_Building_Highways> [↑](#footnote-ref-106)
108. <https://www.extension.iastate.edu/agdm/crops/html/a3-29.html> [↑](#footnote-ref-107)
109. Production is so extreme in today’s world that marketing has risen as an important function in the Western world. That is, there is such an oversupply of products, that marketing and advertising is required in order to sell them. This is both a major accomplishment and a major bane of civilization - bane in the sense that large numbers of people are relegated to the position of sales and marketing, as opposed to pursuits of more meaningful activities. [↑](#footnote-ref-108)
110. <https://en.wikipedia.org/wiki/Poverty#Measuring_poverty> [↑](#footnote-ref-109)
111. <https://en.wikipedia.org/wiki/Self-determination_theory> [↑](#footnote-ref-110)
112. <http://www.rightlivelihoodaward.org/honour/about-the-right-livelihood-award/what-is-right-livelihood/> [↑](#footnote-ref-111)
113. <http://www.diamandis.com/blog/discovering-your-massively-transformative-purpose> [↑](#footnote-ref-112)
114. <https://www.usatoday.com/story/money/personalfinance/2014/09/20/wall-st-cheat-sheet-money-problems/15832929/> [↑](#footnote-ref-113)
115. <https://www.ted.com/talks/mihaly_csikszentmihalyi_on_flow#t-222899> [↑](#footnote-ref-114)
116. Almost 80% of Chadians live in extreme poverty, <https://en.wikipedia.org/wiki/Extreme_poverty> [↑](#footnote-ref-115)
117. In 2016 - <http://time.com/4389726/harris-poll-happiness-index-2016/>. Nic Marks - TED talk on happiness - <http://happyplanetindex.org/about#how> [↑](#footnote-ref-116)
118. <https://www.ted.com/talks/mihaly_csikszentmihalyi_on_flow#t-222899> [↑](#footnote-ref-117)
119. <https://www.conference-board.org/publications/publicationdetail.cfm?publicationid=2785> [↑](#footnote-ref-118)
120. https://michaelfogler.wordpress.com/un-jobbing/ [↑](#footnote-ref-119)
121. <https://www.statista.com/statistics/228346/people-who-are-self-employed-usa/>. [↑](#footnote-ref-120)
122. <https://fred.stlouisfed.org/series/LFWA64TTUSM647S> [↑](#footnote-ref-121)
123. <https://www.forbes.com/sites/elainepofeldt/2016/10/06/new-survey-freelance-economy-shows-rapid-growth/#599ba61f7c3f> [↑](#footnote-ref-122)
124. <https://dqydj.com/number-of-developers-in-america-and-per-state/> [↑](#footnote-ref-123)
125. This is based on EF Schumacher’s seminal appropriate technology work expressed in the book, *Small is Beautiful*. The Singularitarian may argue that artificial intelligence can expand the size at which a manufactured system breaks down - by providing smarter governance or control. This does not take away from the desirability of decentralization. [↑](#footnote-ref-124)
126. <http://opensourceecology.org/wiki/Distributive_Enterprise> [↑](#footnote-ref-125)
127. <https://mises.org/system/tdf/Against%20Intellectual%20Property_2.pdf?file=1&type=document> [↑](#footnote-ref-126)
128. Steven Weber, *The Success of Open Source*, Cambridge, Massachusetts, and London, England: Harvard University Press, 2004, p. 3 [↑](#footnote-ref-127)
129. Consudering 3-sector theory, primary and secondary production are 30% of the ecomy, and we can state conservatively that 50% of the tertiary sector is based on hardware. Thus, 65% of the global economy appears to be resource-based, or broadly speaking, $50T of the economy. <https://en.wikipedia.org/wiki/Three-sector_theory> [↑](#footnote-ref-128)
130. ref [↑](#footnote-ref-129)
131. <http://www.careerbuilder.com/share/aboutus/pressreleasesdetail.aspx?sd=2%2F6%2F2014&id=pr802&ed=12%2F31%2F2014> [↑](#footnote-ref-130)
132. <https://www.inc.com/leigh-buchanan/us-entrepreneurship-reaches-record-highs.html> [↑](#footnote-ref-131)
133. As in self-determination theory - <http://selfdeterminationtheory.org/> [↑](#footnote-ref-132)