The best way to predict the future is to design it

Exploration in future possibilities from an Industrial Design perspective

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ABSTRACT

The main problem discussed is what one should design towards in general terms and what rationale can back up designing in general. The article is aimed at professional designers and students of design looking to broaden their philosophical basis for design practice. R. Buckminster Fuller's literature is assessed. Critical questions are raised about the industrial design profession, constructive and destructive abilities are discovered. Through Fuller's perspectives, open source, open design, digital fabrication and the blockchain are found to be potential remedies for humanity's shortcomings in sustainably operating Spaceship Earth.

KEYWORDS: R. Buckminster Fuller, Industrial Design, Total human success, Spaceship Earth, Ephemeralization, Real Wealth, Open Source, Open Design, the Blockchain, Digital Fabrication.

1. INTRODUCTION

This article discusses perspectives, principles and implications of R. Buckminster Fuller´s philosophy in the light of modern industrial design. It tries to establish a consensus about what we should design towards, and what a designer's responsibility and contributions could be. Finally it looks at concepts in contemporary technology relevant to Fullers visions and ideas.

This article reviews literature from the following texts by R. Buckminster Fuller; Operating Manual for Spaceship Earth, Education Automation, Ideas and Integrities, Synergetics, Utopia or Oblivion, It came to pass – Not to stay and Critical Path. Further, concepts from the book Open Design now by Bas Van Abel, Lucas Evers, Roel Klaassen and Peter Troxler, as well as Design for the Real World by Victor Papanek are taken into

consideration, in addition the analyses of digital fabrication, open source, open design and blockchain technology is assessed through published articles.

1.1 Origins

In exploring the role of industrial designers, a preliminary understanding of the origins of the Industrial Design profession is required. The question of whether Industrial Designers are true advocates for innovation or profit-driven stylists is raised.

R. Buckminster Fuller points out that "The name *industrial design* was invented about 1926 by the professional advertising company forefathers of what is now known as Madison Avenue on behalf of large banking groups investing in the automobile industry."[1] (P.101) The assertion

here is that real innovation was too expensive for securing profitable investments into automotive industry. At the same time the public had acquired a deep sense of appreciation for the inventiveness of the automobile industry, displayed annually at car shows. The solution to this dilemma was the invention of the industrial designer, and his tool of choice, the airbrush. The authentic inventors in the car industry where dismissed and the public was exposed to a series of cars that were robbed of genuine inventiveness replaced by artificial face-lifts.

Similarly Victor Papanek in his book, Design for the real world points out: "In America, Industrial Design, … was a child of the depression. At first glance the swollen belly of a child suffering from malnutrition gives it the appearance of being well fed; later you notice the emaciated arms and legs. The products of early American industrial design convey the same sleek obesity and have the same weaknesses. For the Depression market, the manufacturer needed a new sales gimmick, and the industrial designer reshaped his products for better appearance and lower manufacturing and sales cost."[2]

Emphasizing the superficial origin of industrial design, Papanek also mentions: "Harald Van Doren, Norman Bel Geddes, Raymond Loewy, Russel Wright, Henry Dreyfuss, Donald Deskey, and Walter Dorwin Teague were the pioneering practitioners of design in America. It is significant that all of them came from the field of (theater) stage design and/or window display. " [2]

1.2 Established abilities

In contrast to the corrupted origin of the industrial design profession, constructive and useful abilities have developed. Argued by both Fuller and Papanek, [1-3] World War 2 had positive effects on the profession. In a time of material scarcity and a forced focus on survival needs, the industrial designers working on commercial products were steered in a direction of honest and functional design. Designers who took on the needs of the army, also quickly adopted a functional emphasis and sense of responsibility, as the products were not intended to sell, but to be used to keep people alive. This point highlights designer's important abilities in a certain mindset. If the right emphasis and goal is integral in design practice, useful products and services emerge. What this emphasis and goal could be is discussed later on.

Moreover in today's world of increasingly specialized specialists, we find that the designer also has an important contribution to make in providing a holistic perspective and vocabulary. Papanek notes: "Frequently the designer may be the only one who speaks the various technical jargons."[2] In an era of ever more complex projects and inventions, the need for bridging gaps between specialized academic languages is becoming evident. In other words, designers are able to comprehensively understand projects and communicate across multiple specialized languages. [3]

Designers are also capable in non-algorithmic working processes. They have methods for working on problems or potentials without the need for a defined outcome, or a well-defined process. There are numerous models depicting the design process, trying to make sense of, and structure the methodology of design, but convincing narratives are also proposing that general algorithms for design are impossible, as designers deal with what Rittel and Webber refers to as wicked problems [4].

The following section highlights perspectives mainly proposed by R. Buckminster Fuller that are found useful for designers, then the concept of Comprehensive Anticipatory Design Revolution is discussed as a practice incorporating these perspectives, finally contemporary trends and technology found relevant to Fullers perspectives and prognostications are examined.

2. PERSPECTIVES

The dystopian origins of the Industrial Design profession, combined with its established

beneficial abilities can leave a paranoia concerning a lack of direction. One's own Professional pride in beneficial abilities has little value if these abilities can only be seen in a monetary context. When students are taught to utilize their talents exclusively as capitals tool to exploit humanity's curiosity towards newness, confidence and self-esteem is displaced by distrust in design and oneself as a representative of the industrial design profession.

Designers of today should dare to be autonomous in their thinking. Thoroughly assess the job at hand to see if it is really worth their attention. In achieving this self-reliance and trust in one's own judgment, perspectives mainly found in Fullers literature are proposed to guide designers in their own thought development.

2.1 Spaceship Earth

"There are no passengers on Spaceship Earth. We are all crew" - Marshall McLuan.

Buckminster Fuller originally coined the term Spaceship Earth. It is in itself a powerful statement and could be an essential building block for a designer's perspective on the world. In realizing that the Earth we currently inhabit is a chunk of matter flying through the emptiness of space at incredible speeds, we obtain a sobering affirmation regarding our priorities. We need to obtain a perspective incorporating the totality of our spaceship, not just look at one nation, one town or one political issue. We need to understand that we are on a spaceship miraculously capable of sustaining life regeneratively, in an otherwise cold and thus far discovered; lifeless Universe[5].

The effect and usefulness of such a perspective is perhaps best described by the numerous accounts offered by astronauts on the phenomenon called the "overview effect".[6] This term describes a reported cognitive shift, experienced by astronauts orbiting Earth. Astronauts report that the firsthand experience of seeing our Earth as one planet in the incredible

vastness of space, gave them a sense of protectiveness for Earth, her ecology and for other people.[7]

This perspective is so important because it has the potential to give designers a glimpse of a unified human family. His Holiness the Dalai Lama also expresses the importance of such a perspective[8]. Regarded often as a religious leader, it is noteworthy that he stresses the fact that he is first and foremost a human being. No matter what religion, country, political party, profession or education one associates the strongest with, we are all human. Later we will discuss the concept of comprehensive anticipatory design revolution, and we will here review the importance of designers incorporating a solid comprehension and perspective regarding humanity's role in the Universe.

2.2 Real wealth

From this planetary perspective of our great spaceship Earth soaring through space, the notion of wealth is examined. Creating wealth is a noble concern, but only if a sensible definition of wealth is in place. Fuller provides an interesting definition: "We assume the measure of real wealth to be the magnitude of technologically organized capabilities of humanity to cope with the life support of so many humans for so many forward days under reasonably predictable Life-favoring environmental conditions" [9] (p. 95). This definition provides a refreshingly new and much needed emphasis on the collective human aspects of wealth. It outlines what one could call "trans-money" wealth, and also provides some clue as to what we ought to aim humanity's overwhelmingly large accounting power at. Fuller's definition tries to establish what is actually worth collecting.

This definition also emphasizes a time dimension in our understanding of wealth. The Merriam Webster dictionary's definition of wealth: "A large amount of money and possessions" [10] does not include the fact that these possession

and money have no value if life-support functioning is scarce, or that having these possessions and money have no value if there is no time to utilize their potential. Further assessment of money and possessions as the sole measure for wealth, reveals that this measure in reality only gives an understanding of a group or individuals ability to exchange goods or services, but it includes no inherit measurement of the usefulness and life-support capability of the mentioned goods and services.

To further elaborate the inadequacies of our standard wealth definition, the story of a rich man at sea with all his gold, money, bonds and securities by his side might be enlightening. If the ship sinks, and there is one life preserver onboard, who is the wealthiest, the man with the gold or the man with the life preserver?

"It's the "capability" wealth that really counts." [11] (p. 72)

2.3 Synergy

Synergetic perspectives are also of much value to designers. Synergy means the behavior of whole systems unpredicted by the behavior of their parts evaluated separately.

"Going from micro to macro, each more inclusive aspect of Universe is unpredicted by any of its respective subparts taken separately. Universe is a synergy of synergies. It is a corollary of synergy that the known behavior of wholes plus the known behavior of a few of their parts enables discovery of other parts and their behavioral characteristics. In order to really understand what is going on, we have to abandon starting with parts, and we must work instead from the whole to the particulars."[11] (p. 29)

This notion is a hard one to efficiently integrate into design practice, because it implies a comprehensive assessment of total systems. Although this holistic approach might seem like a daunting task, designers are one of few professionals that have capabilities in rapid

micro-macro oscillating multidisciplinary consideration. The importance of synergy in design is further emphasized by Fullers statement:
"Because the meaning of design
Is that all the parts are interconsiderately arranged
In respect to one another" [9] (p. 122).

2.4 Total human success

In this bundle of perspectives there is one that can potentially have huge impact on our thinking; the acknowledgement of the immediate feasibility of total human success. That is, the realization that our current human know-how, combined with humanity's current inventory of material, is sufficient to provide the entire human population with standards of living higher than what has ever before been achieved by anyone. For a long time we have been operating under the Malthusian-Darwinian assumption of us-or-them, only the fittest survive. This assumption is now totally obsolete if our technological efforts are exclusively aimed at livingry instead of killingry.[1, 5, 9, 11]

In further exploration of the assertion of total human success, Fuller provides an enlightening narrative explaining how we ended up acting like there is not enough for everyone. Starting with Thomas Robert Malthus in the 19Th century and his discovery that sustenance production was growing in an arithmetic rate and population growth was geometric; therefor the population will eventually outstrip the food supply. There is not enough for everyone.

After Malthus, Charles Darwin came along. In his book the origins of species [12] he attributes natural selection as the main driving force behind evolution. Harbert Spencer later coined the term "survival of the fittest" to describe the mechanism of natural selection. These prominent figures in the history of scientific inquiry had thus provided us with compelling evidence that there is not enough for everyone, and only the strongest survive.

Fullers narrative continues with Karl Marx, who accepted Maltus´ and Darwin´s discoveries. Marx divided society into two distinct categories, the laboring working class and the ruling class. He found the working class the most fit to survive because they were the ones directly involved with production of sustenance. The ruling class would have to perish. With these three influential figures, collective understanding developed to; a world with insufficient life-support, only the strongest survive and two distinct categories of people fighting for the right to survive.

Politics of today still seem like an effective propagator of this biased conception of the human situation. This is not to say that politicians are consciously conspiring to misinform the population, it is rather that the structure or playing field defining how politics is practiced is built on old and dysfunctional ideas. "Capitalism and socialism are mutually extinct. Why? Because science now finds there can be ample for all, but only if the sovereign fences are completely removed. The basic you-or-me-not-enough-for-both-ergo, someone-must-die-tenets of the class warfaring are extinct." [5](p. 48)

2.5 Ephemeralization

At the heart of our option for total human success, is the principal of ephemeralization. This is the word Buckminster Fuller uses to describe humanity's proven ability to progressively do more with less. As our technological and scientific know-how accumulates, and our minds keep discovering new general principals, our ability to accomplish more and more functionality with less and less energy, material and time investment expands. Ephemeralization is one of the most important guidelines for design in general; do more with less [1, 5, 9, 11, 13].

2.6 Personal success

People wish to have success, but few have a solid definition of what it is. In our pursuit of success we often get caught up in measurable quantities to give affirmation regarding our success; money, position at our job or the amount of likes on our facebook page etc. This attitude regarding success renders us useless at attaining an internal source for feelings of success, and makes us dependent on external input. Earl Nightingale explains in his book Greatest Discovery a refreshing account of what success actually is: "Progressive realization of a worthy ideal"[14]. This definition is sobering in the way it emphasizes that success is a continuous state of mind, and not a place or time one can reach. This understanding of success is a powerful resource for designers in combination with Buckminster Fuller's mission statement, which most certainly is a worthy ideal:
"To make the world work
for 100% of humanity
in the shortest possible time
through spontaneous cooperation
without ecological offence
or the disadvantage of anyone"
[11] (p. 24)

3. COMPREHENSIVE ANTICIPATORY DESIGN REVOLUTION

"Don't attempt to reform man. An adequately organized environment will permit humanity's original, innate capabilities to become successful... Politics and conventionalized education have sought erroneously to mold or reform humanity." [15] (p. 366) Comprehensive anticipatory design revolution is the phrase R. Buckminster Fuller uses to express his true intent and the goal of his designs. To reform the environment, not people, to facilitate their innate capability for success [1]. For designers it can be seen as a label intended to awaken the same sense of urgency and life-support emphasis found in the war-era design practice, without the us-or-them someone-has-too-die-tenets of war, and without a central authority issuing the prescription for our effort.

3.1 No more social reform

Comprehensive anticipatory design revolution is the opposite of social reform. The idea of telling people what they ought to do is in Fullers mind useless as a way to introduce the necessary change in our world and way of living. It is way more effective to design the environment in such a way that people spontaneously adapt to a more sensible way of living. "We must design our way to positive effectiveness, and not just be negative about politicians and what they are doing" [1](p.398)

The use of the word revolution can in this context be misleading, because our associations with this phenomenon often implies violent rioting and prosecution of the current power structure. It is essential to emphasize that comprehensive anticipatory design revolution is a silent and unobtrusive revolution. Uncompromised by the blame game, the point is to consciously co-create a sane and sustainable way of living, without the need to violently confront or attack the status quo.

As mentioned in *2.4 Total human success*, the capitalist versus socialist conflicts preoccupying politicians, is not necessarily the most effective way to deal with problems facing humanity. Comprehensive Anticipatory Design Revolution is a concept we could use to label our non-political, environment-reforming design and innovation initiatives towards total human success.

"Revolution by design and invention is the only revolution tolerable to all men, all societies, all political systems anywhere" [15](p. 205)

3.2 A sense of responsibility

An integral part of the comprehensive anticipatory design revolution is an individual sense of responsibility. Designers and creators should incorporate a deep appreciation, commitment, and responsibility for regenerative Universe itself. The aim should be to exclusively assist the regenerative capability of our great Spaceship Earth, through our design initiatives.

"My own conclusion is that we have been given the capability to alter and accelerate the evolutionary transformation of the a priori physical environment. That is, to participate objectively, directly, and consciously in universal evolution" [11] (p. 36)

The idea of working for this or that corporation, this or that institution, or this or that nation is rendering itself useless and illogic as a main motivation and reason for designing. Cooperation is at the core of our evolution, so this is not to say that our future design initiatives are to be solo adventures. It is trying to point at a higher goal, a holistic approach that layers the specific partners in collaboration under the main goal of securing the forward existence and propagation of scenario Universe. Preferably continuing with humans as one of the pattern integrities displaying the weightless phenomena life.

This Sense of responsibility is what the perspective mentioned in section *2.1 Spaceship Earth* is intended to evoke. We are all integral components of a beautiful synergetic unfolding. Our current position in this universal unfolding is onboard our magnificent spherical Spaceship Earth. Let´s make it work for all of us.

3.3 Don't wait for permission to make the world work

As mentioned in section 2, the need for designers to be autonomous in their thinking is proposed. This self-reliant critical assessment of the problem at hand is important, because there is no comprehensive analysis required for hiring designers, architects or engineers to solve a given problem.

Fuller states that individual initiative by designers, architects and engineers seem to be the only probable means of shifting the direction of humanity's activities [11]. There is no time to

sit around and wait for permission to make the world work. We cannot expect other people or institutions to initiate the thinking and doing for us. Moreover our current specialization fixation leaves no other "professionals" more prepared to deal with the broad, multidisciplinary problems facing humanity [5].

This cry for individual initiative seems frustrated by our normal means of prescribed operation, and the fact that a master's or bachelor's degree in design, architecture or engineering normally comes with a substantial dept.

In the book Open Design Now, the notion that designers should in theory be well positioned to have a pivotal role in the negotiation of competing futures, perspectives and timescales for sustainability is raised. The practice of this theoretically assessed pivotal role is unfortunately frustrated, because designers are at the same time as being comprehensive in their assessment, idealistic in their initiative and earnest in their research, " ...engulfed by a tentacular creative industries framework that lauds creative autonomy without providing much more than precarity compensation, while short product cycles and the volatile attention economy of real-time communications networks limit the potentially disruptive force of the call for sustainability."[16]

The questions raised about the actual implementation of comprehensive, anticipatory, sustainable design practice, leaves us at the junction between utopia and reality. The argument is that designers have an important contribution in operating our great spaceship Earth, but we are seemingly not automatically positioned in the control room. Furthermore we are buried in debt from the moment we step out of academia. With no time to spare we must rush into moneymaking without a clear comprehension of where our efforts are needed, and seemingly without the option to choose areas worth our attention if they do not provide sufficient debt reducing income.

3.4 A shift

Central to Fullers philosophy and thinking is a shift in conception, focus and intent. The concept of comprehensive anticipatory design revolution epitomizes this shift. Fuller felt inadequate in the game of moneymaking, and acknowledged he was much more effective in working for other people, and purposes other than capital gain. This shift or epiphany is explained in different ways in his literature, but the central theme is a shift from taking to giving. A big part of his literature is assigned to explaining the rationale of giving. The question should not be what can I take from the Earth, societies or institutions, but instead be; what can I give? What is my position and purpose in this Universal scheme? What can I do to make the world work? [11]

"Man must be able to dare to think truthfully and to act accordingly without fear of losing his franchise to live" [5] (p. 125)

Fuller transitioned from being an American citizen preoccupied with "making a living" in the building industry, to becoming a local Universe problem solver preoccupied with propagating a comprehensive anticipatory design revolution through his research, designs and inventions.

In relaying the feasibility of working for the Universe and still being nourished, housed and clean, Fuller provides his life as Guinea Pig B as "proof" of the feasibility of thriving as an individual on earth while still only working for the benefit of all. "Making a living" is an obsolete obsession, if you work exclusively for Universe, you will be sufficiently compensated [1].

Fuller claims to have been on the verge of suicide, penniless, with a wife and child and devastated by his inability to function properly in the game of moneymaking. He decided that he would commence on his own initiative to unlearn all the adopted reflexing he had acquired, and finally do his own thinking. What can be done by a single individual, on behalf of total humanity that cannot be accomplished by great nations,

great religions or private enterprise, was his initial question. He would proceed to solve the problems he found that needed attention, and that no one else was working on. "Making a living" would never again be part of his agenda [11].

Important to this cognitive shift, is the synergetic realization of Universe being a well-designed eternally regenerative scenario. Central in this eternal regeneration is our minds syntropic capability, the energetic counterpart to the entropic nature of every physical system, as described by the second law of thermodynamics. Corollary to this position is that Earthians have a function or purpose to fill in supporting this eternal regeneration.

If convinced of the feasibility of total human success (mentioned in section 2.4) and the notion of Universe as eternally regenerative, the shift from taking to giving seems a natural progression. If one sincerely incorporates the possibility of total human success and eternal regeneration into one's own thought process, the rationale of value extraction loses validity. Generating collective value becomes a more sensible approach to motivate initiative. Fuller convincingly assures us that this does not result in degraded standards of living, collectively or individually, but it does rely on faith in the eternally regenerative integrity of scenario Universe.

This reported shift in Fullers initiative leaves designers with an interesting question: Am I a designer for accumulating capital profit, or am I a local Universe problem solver? To what cause should I employ my effort?

4. FULLERS INVENTIONES

4.1 Why they are so important

Taking Fullers perspectives seriously requires him to produce inventions clearly demonstrating his philosophic and intellectual position. As he states multiple times in his literature, social reform is obsolete, and the job of the comprehensive anticipatory design scientist (which is the label he uses to describe his "profession") [5] is to transform environments to enable the option of total human success. He stresses the fact that his ideas and visions must be translated into physical artifacts abiding his statement: "Ever more effective and satisfying human life support artifacts." [5]

4.2 Geodesic domes

Buckminster Fuller's most famous and utilized physical example of his philosophy and attitude is the geodesic dome. This is a spherical structure drastically reducing the amount of material necessary to encapsulate a given space. Geodesic domed are Fuller's most accessible practical example of ephemeralization. There are an estimated 100.000 geodesic domes in use today (about 300.000 counting play structures) [17].

4.3 Other inventions and initiatives

Geodesic domes are structural and architectural contributions to society, but Fuller did not regard himself as an architect. His work spans across multiple disciplines, and his work includes the dymaxion car (gas efficient, aerodynamic, sustainability focused car seating 11 people), the dymaxion house (popularly called the wichita house), the dymaxion map and Synergetics. The latter being Fullers hypothesized coordinate system of Universe, rendering the Cartesian coordinates currently employed ancient and unnecessarily complicated. Here it is important to note that whether you employ the traditional Cartesian coordinates or the tetrahedral, 60-degree coordinates proposed in Synergetics [18], the extreme willingness to question our current models of comprehension and thinking displayed by Fuller is the essence. We cannot continue doing things the way they have always been done.

5. CONTEMPORARY TECHNOLOGY

Are there signs in contemporary technology and innovation that offers legitimacy to Fullers prognostications? Has the comprehensive anticipatory design revolution begun? A glance at contemporary technology is commenced through the lens of Fullers perspectives and prognosis.

5.1 Digital fabrication

The first line in Neil Gershenfelds article, How to Make Almost Anything; the digital fabrication revolution, is as follows: "A new digital revolution is coming, this time in fabrication." [19] This statement refers to the rapid introduction of tools that replace machinists with computers. The need for a highly trained professional machinist to guide the tool path of tools like a milling machine is disappearing.

Although the root of this technological advancement dates back to 1952 [19], it is only in recent years it has gained considerable traction. Popularity and utilization of this technology is expanding because it is progressively becoming cheaper and easier to use. The milling machine was the first tool subject to this means of operation, but later developments include laser cutters, 3D-printers and water jets into the family of computer controlled digital fabrication tools.

In light of Fullers philosophy, especially and most directly the concept of ephemeralization, this new paradigm of digital fabrication holds a lot of promise. As previously discussed, the concept of ephemeralization is our proven human ability to progressively do more with less. One key aspect to the connection between ephemeralization and digital fabrication is the opportunity it provides to produce tangible objects on-demand. The idea of on-demand production of artifacts adheres to the concept of ephemeralization in the way it counters overproduction and invites local repair.

Another radical, and perhaps more fundamental way in which digital fabrication enables humanity to do more with less, is the way it effectively enables global collaboration combined with local manufacturing. Because digital fabrication tools are controlled by a digital input, a design conceived in Norway, can be transported to New Zealand in a matter of seconds, with negligible use of energy, then modified and produced locally at arrival. Neil Gershenfelds statement regarding this emerging production infrastructure neatly sums up the potential: "The ability to send data across the world and then locally produce products on demand has revolutionary implications for industry." [19]

Furthermore, digital fabrication also enables faster learning in correlation with the "by-trial-and-error-only learning capability of humanity."[9] (p. 102) Digital fabrication tools has the advantage of being extremely flexible compared to previous fabrication paradigms, in turn allowing much faster iteration rates. The first wave of utilization of these tools has been in rapid prototyping, mainly because of the fast iteration rates they allow.

Also included in this on-demand flexible production, is the possibility for extreme customization. These new tools will cater to one-person markets. Neil Gershenfeld highlights an important question posed by the rapid advancements in digital fabrication, which seems highly relevant to designers: "How will we live, learn, work, and play when anyone can make anything, anywhere?" [19].

Gershenfeld refers to a new digital revolution [19], the previous revolution being in computing. The parallel between the development of computers and digital fabrication is clear. Starting with huge, expensive and inflexible mainframe computers, only affordable to large corporations, governments and elite institutions, it progressed to relatively cheap, small and user-friendly laptops available to the public at large. The way we look at computers was drastically changed forever. The basis for Gershenfeld's use of the word revolution in terms of fabrication springs from this parallel, and he claims that fabrication is undergoing much of the same development, as computers did, by transitioning from analog to digital operation.

For designers this emerging fabrication paradigm is something to be watched closely. New and previously unimaginable possibilities for distribution and production are emerging.

5.2 Open Source and Open Design

The word open source was first used in software engineering, open source software is software that can be freely used, changed, and shared (in modified or unmodified form) by anyone. Often, large numbers of decentralized contributors collectively develop and improve open source software. Yochai Benckler has named this open way of working: "commons-based peer production" [20].

To lay the tone for exploration into the domain of open source and open design a quote by John Thackara is appropriate: "Openness is more than a commercial and cultural issue. It´s a matter of survival." [16] (Into the Open) The sense of urgency and life-or-death seriousness in Thackaras statement, combined with the decentralized cooperation in open source developments, positions open source in the middle of Fuller's proposed comprehensive anticipatory design revolution.

As mentioned, the rapid advancement in digital fabrication is unleashing a potential to collaborate globally and produce locally. To enable this collaboration to function, we need new infrastructure, new attitudes and perhaps a new understanding and a new collective narrative about humanity's role in the Universe. Open source or more generally openness could be an important component or contribution to this narrative and understanding.

Though the idea of open source first surfaced in software development, it is now emerging in physical fabrication, in design and in other areas as well. In assessing the idea of open source in relation to Fullers philosophy, it appears to be a logical step in the right direction. If we revisit the notion of Spaceship Earth, it is immediately sensible to distribute and share progress. When beneficial artifacts are created, useful code is written or essential data is collected the only rational preceding is to enable others to utilize, build upon or collaborate in order to collectively make our world work. Keeping progress unavailable through patenting or secrecy makes no sense when considering our collective faith of being situated on a great chunk of matter soaring through the emptiness of space.

Furthermore the concept of ephemeralization adheres to the practice of open source development. It is much easier to do more with less, if when conceiving an idea or solution, one can build on existing software or modify existing artifacts, we do not have to start from scratch every time. Open source is a mode of action that profits from continually moving forward and accumulating collective and individual knowledge, this is in stark contrast to the industrial economy "which depends on a command-and-control business model and militant copyright protection" [16] to ensure profit.

Fullers' definition of real wealth is also highly relevant to the concept of open source and open design. As mentioned, Fuller defines real wealth on the scale of humanity, with life-support over a given time as the intrinsic parameters. Open source design, products, software, research and governance can be seen as a practice in which we add to humanity's collective or common wealth. According to Fuller the only real wealth. [5](p. 93)

Synergy is another concept advocated by Fuller that might flourish in an environment of open development. Seeing synergetic potential in a broad range of developed technology will get you nowhere if patents and secrecy heavily protect the technological components involved in the envisioned synergetic possibility. A culture of openness invites synergies. If we recall Fullers mission statement in section 2.6, a key aspect is spontaneous cooperation. To enable and facilitate for spontaneous cooperation openness is essential.

"Systemic challenges such as climate change, or resource depletion – these 'problems of moral bankruptcy' – cannot be solved using the same techniques that caused them in the first place. Open research, open governance and open design are preconditions for the continuous, collaborative, social mode of enquiry and action that are needed." [16] (Into the Open)

Open source, open design and openness in general correlate beautifully with the principals of comprehensive anticipatory design revolution. Open source solutions are not in direct conflict with the status quo, and they are not merely social reform. Open source also embraces Fullers shift from taking to giving, by opening up to collective progress, instead of restricting it. Also Fuller's notion of compensation for effort on behalf of humanity is embraced.

Considering the end-user, having open and accessible software or artifact designs is obviously beneficial, you do not have to teach or convince them why they should use it. It is perhaps more surprising to see thriving businesses emerge in the open source space. Examples of such businesses are: Arduino (open source microcontrollers), OpenSpecimen (open source BioBanking informatics platform) and Linux (open source operating system), to mention a few. Highlighting the fact that businesses are functioning in the open source space and being compensated for their services is important, because it emphasizes the fact that open source is not merely a naïvely altruistic buzzword. It works in both ends of the equation. For the individuals and businesses, it is a feasible way to do profitable business. For our collective human faith, it is a way of sharing and distributing progress to accumulate collective wealth.

Highlighting some of the already mentioned aspects of digital fabrication and open source, Neil Gershenfield notes: "Instead of trying to restrict access, flourishing software businesses have sprung up that freely share their source

codes and are compensated for the services they provide. The spread of digital fabrication tools is now leading to a corresponding practice for open-source hardware." [19]

5.3 Design in the open

In this vast open space, what is the role of the designer? To start the exploration into the designer's role in this area, another remark by John Thackaras is perhaps reassuring: "Crowds may be wise – but they still need designers." [16] To get all this openness to function beneficially a great deal of comprehensive assessment is needed, and "Like any innovation, open design by itself is neither good nor bad. Its social value depends entirely on how it's used." [16] (Sherable)

To sober up this utopian characterization of open source, emphasis is needed on the fact that it is not yet complete, more people, businesses and governments need to be included, and functional comprehensive infrastructure needs designing. It is also highly important to note that open designs are not good merely by being open; it is both possible and plausible to create resource-intensive and short-lived products for distribution in the open source space. "The long-term value of open design will depend on the questions it is asked to address." [16] (Into the Open)

Fullers perspectives presented in section 2 are proposed as a starting point for formulating the questions we should ask open design to address. Total human success, ephemeralization, real wealth, synergy, eternal regeneration and our great spaceship Earth are all important considerations regarding our open design initiatives.

5.4 Template culture and wicked products

To address designers potential future tasks and Gershenfields remark regarding vast possibilities in what people can make, a concept presented in the book Open Design Now is relevant; template

culture [16]. This phenomenon is the emergence of templates for customer's own designs. Businesses like Squarespace [21] provide ready-made templates allowing end-users to easily create their own websites within an already created template. HTML and CSS are the main languages used to structure and style a website. These languages are too complicated to learn for making a single website. Squarespace and others provide an environment in which to build your website without the need to learn programming. The end-user is given freedom in expression, a sense of ownership and accomplishment, but designs are still carried out within a pre-designed set of parameters.

This emerging template culture might also become relevant to designers working on physical artifacts. This relevance is brought on by the advancements in digital fabrication and the growth of the open source space. The idea of meta-designing, or production of "wicked products" might be a plausible practice for future generations of professional designers.

Instead of designing unalterable consumer products, our activity might transition to production of templates, or solution spaces for prosumers and end-users to generate their own unique solutions based on a designed set of parameters.

"Wicked products" are artifacts that are meant to be alterable and hackable. In contradistinction to today's emphasis on products that are closed and intended to be used in a highly defined context, "wicked products" have, as wicked problems [3], no hard solutions, and invites users to understand and expand them. An open source manifesto presented by Thackara underlines the essence of "wicked products": "Don't judge an object for what it is, but imagine what it could become."[16] (Into the open)

5.5 The Blockchain

Disruptive potential is evident in production through digital fabrication and in cooperation through open source and open design. With the blockchain there is potential to disrupt our conception of value, and also further disrupt our means of cooperation.

At the heart of this potential for disruption is Satoshi Nakamoto's statement: "We have proposed a system for electronic transaction without relying on trust."[22] (p. 8) The blockchain is in essence a commons-based or distributed ledger. This means that all users of the blockchain have a complete copy of the transaction history of the entire network of transactions. Much like every cell in the human body houses a complete copy of the DNA.

This distributed ledger is global, permanent, immutable and transparent, and mathematical law, not trust, backs the validity of the record.

The first and thus far most noticeable utilization of the blockchain is by the digital crypto currency named BitCoin [22]. This is a radical innovation potentially unifying humanity's value transactions. BitCoins represent a safe way for individuals to exchanging value between nations, across political structures and across cultures without the need for a centralized authority validating transactions.

"A new, physically uncompromised, metaphysical initiative of unbiased integrity could unify the world. It could and probably will be provided by the utterly impersonal problem solutions of the computers. Only to their superhuman range of calculative capabilities can and may all political, scientific, and religious leaders face savingly acquiesce."[5] (p. 45)

The blockchain is a staggering example of comprehensive anticipatory design revolution. Individual initiative has envisioned, developed and launched this initiative, and the source code is available to everyone. In addition the blockchain is not in direct conflict with current power structures. It elegantly maneuvers around the previous paradigm and offers a much

improved, corruption free way of exchanging and keeping track of values or assets.

The blockchain is also a prime example of ephemeralization. With BitCoin as the example, the notion of allowing safe transactions without banks is doing a whole lot more, with a lot less. The idea of replacing huge amounts of banking infrastructure, with a secure, decentralized, public record is almost unimaginable, but this is what BitCoin is proposing. "Sovereign-powers-backed legal tender" [5] is losing its position as the most sensible and efficient way of exchanging value.

"Currency is not the killer app, it's just the first app." [23] This quote is included to highlight the fact that the blockchain is not exclusive to currency. It has a whole myriad of potential applications. "Move beyond the superficial public discussions about Bitcoin, and you'll discover a software breakthrough that could be of enormous importance to the future of commoning on open network platforms." [24] For organizing our autonomous, decentralized effort for total human success, we might have stumbled upon a decentralized, immutable, trustworthy, infrastructure. "These new tools have the potential to greatly amplify the trend *social web* and network effects in general by providing a robust framework for trust among network participants." [25]

The blockchain technology itself is a synchronized, securely time stamped database that can store information about ownership, and does so in a completely decentralized way. What this means for humanity's future endeavors in Universe is still unanswered, but designers certainly has new and interesting tools, ideas and possibilities at their disposal.

8. SUMMARY

To summarize, we departed with the question of industrial designers are true advocates of innovation or profit driven stylists. According to Fuller and Papanek the profession was invented

to deal with the latter. War-time design effort provides proof of constructive abilities in a certain mindset. When life-support was prioritized, the air-brush was replaced by comprehensive thinking.

Perspectives where proposed to expand our comprehension of what we are involved in, and to initiate thought processes, that according to Fuller are necessary for human continuance in Universe: Spaceship Earth, Real wealth, Synergy, Total human success and ephemeralization. In addition to the thought processes these perspectives evoke, they also outline aspects of an expanded vocabulary. Designers are perhaps in need of innovations in language to deal with the problems facing humanity.

Another potential addition to this extended vocabulary was proposed by comprehensive anticipatory design revolution. No more social reform, individual responsibility, no excuse for waiting to initiate and a shift from taking to giving. This shift was accompanied by Fuller's assurance that egocide will not result in starvation or homelessness.

Furthermore the concept of comprehensive anticipatory design revolution questions individual designer's relationship to life, collectively and individually. Why are we here? Is there a purpose for our existence? Fuller's answer is selfless assistance in eternal regeneration. That is why we are here, and that is what we should do. Complicating this message is Fuller's hesitance to provide an algorithm for our assistive efforts. When an aspiring student asked Fuller: "what can I do to make the world work?" His challenging but sobering response was: "You must ask yourself that question; that is what I had to do – that is what the individual is all about; it is not about following some prescription or formula that I can give out" [11] (p. 19).

Fuller's inventions was briefly assessed to highlight his practical approach to philosophy, and to give some concrete examples of what all these grand concepts materialized into.

Contemporary technologies and trends where then included as a way of bringing Fuller into the 21st century. His ideas where way ahead of his time and ridiculously ambitious, but Open source, Digital fabrication and the Blockchain where all found to be in line with his philosophy. Perhaps there is still time to save humanity from self-annihilation?

Finally we can conclude with the fact that we are collectively going to design our future. What we want this future to be is up to us; we should consider truthfully what is important, and what is not. We should also in our pursuit of constructive practice, allow ourselves the privileged of letting go of "lovingly administered nonsense" and do our own thinking.

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