RECONSTRAINED DESIGN: CONFRONTING OBLIQUE DESIGN CONSTRAINTS

CONTROLS

ENGAGEMENTS

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ABSTRACT

This paper presents the identification and analysis of a set of four 'oblique constraints'—named as *progress dogma*, *future nudge*, *means and ends*, and *infrastraints*—which act as pervasive but often unacknowledged constraining influences that shape design practice and by extension limit future possibilities.

We ask: How and why is power exerted? How might this lead to impoverished or problematic futures? How can this dynamic be changed from a design perspective? Drawing from examples of recent work around renewable energy we show how design can be *reconstrained* to reveal new pathways and encourage more inclusive, holistic, and environmentally responsible futures.

INTRODUCTION

Power—specifically social and political power—may be defined as the ability to influence the course of events. Power has a temporal aspect, in the sense that 'influence' means acting in the present to change the future. When this situation is applied to design, there are: **forces** (of power) that influence **people** (designers) and therefore also (designed) **events.**

On one level, this is not news to designers. Design practice always happens under a particular set of forces or conditions, commonly known as constraints. These constraints may be straightforward and indisputable, such as a physical or material quality—the force of gravity or the tensile strength of a structural beam. Constraints of this basic type influence the design process by informing choices and decisions.

But constraints can also be more abstract, hidden or complex (e.g. legacy infrastructure), meaning that they are often overlooked by designers as they focus on more practical, material, and (seemingly) apolitical concerns. The pervasive nature of these grander constraints results in a narrower range of technological possibilities than we might otherwise experience. They keep us to a limited path or trajectory, and in some cases condemn us to repeating the same mistakes over and over again. Rather than acting directly, their path of influence is **oblique**.

This paper draws on historical and contemporary examples to identify and examine four constraining factors shaping our possible futures. From another perspective, the constraints we identify could be described as barriers to a more responsible design practice. The constraint of *progress dogma*, for example, blinds future-shapers—scientists, technologists, politicians, designers—from the potentially negative implications of their proposals. The simple story of progress is: technology is good, and as long as technology takes the lead, the future will be better than the present. The three other major constraints on how the future happens that are discussed in the first part of this paper include: *future nudge*, *means and ends*, and *infrastraints*. The pervasive and hard-to-pindown nature of these constraints means that they are often ignored, taken for granted, or treated as immutable laws. This acceptance serves the interest of those with the power to benefit from their continuance.

Underpinning this paper is the basic question: What is a better future? Our goal is to improve our understanding of: a) how and why power is exerted, b) how this may lead to impoverished or problematic futures, and c) how this dynamic could be changed from a design perspective. To address the last point, in the second part of this paper we draw from examples of our recent work to show how design can be *reconstrained* to reveal new pathways, and how design practiced apart from traditional large-scale oblique constraints might encourage more inclusive, holistic, and environmentally responsible futures.

IDENTIFYING (AND RETHINKING) OBLIQUE CONSTRAINTS

We now present four oblique constraints to illustrate how design practice can be inadvertently restricted by indirect, but powerful, influences.

PROGRESS DOGMA

Charles Eames once described design as ‘a plan for arranging elements to accomplish a particular purpose’ (Eames 1972). The appeal of this simple statement is that it operates across multiple scales, material complexities, and timeframes: from a piece of furniture to a city plan; from a length of wood to biological parts (now seen as designable through synthetic biology); or from the marketplace of tomorrow to a distant future world. But especially relevant is the phrase ‘a particular purpose’. In general terms this is the arranging of available elements to create useful objects designed to exist and usually to be sold. Increasingly these elements are technological, and as such the designer can be seen as tasked with translating technological potential into useful, usable, desirable products. The assumption is that these products make life better.

The first oblique constraint we approach, therefore, is the fundamental belief that technological development will simply and inevitably lead to a better future—the constraint of *progress dogma*. According to political theorist Langdon Winner:

> ‘It is still a prerequisite that the person running for public office swear his or her unflinching confidence in a positive link between technical development and human well-being and affirm that the next wave of innovations will surely be our salvation.’ (Winner 2010: 5).

Belief in technology has a strong foundation. Christian Schussele’s painting *Men of Progress* (Figure 1) was commissioned in 1857 by Jordan Mott, the inventor of a coal-burning stove, to celebrate a group of key scientists and inventors who were thought to have positively altered the course of contemporary civilisation. The group included Cyrus McCormick (mechanical reaper), Charles Goodyear (vulcanised rubber), Elias Howe (sewing machine), and William T. G. Morgan (surgical anaesthetic). It would be difficult to argue that these four inventions were not instrumental in improving people’s lives in significant ways. There are others featured in the painting, however, whose inventions were more ambivalent—most notably Samuel Colt (the revolving gun).

Figure 1: Christian Schussele’s *Men of Progress* (1857).

Colt’s legacy is informative, since his success in selling a particularly questionable agenda was built on the exploitation of novel techniques that highlight how power can be acquired, manipulated, and maintained. Colt pioneered bold and innovative marketing methods, such as commissioning artist George Catlin to produce a series of paintings that romanticised the use of Colt weapons in exotic scenes with wild animals, native Americans, and bandits (Houze, Cooper, and Kornhauser 2006: 203). He also solicited the support of government officials and other prominent individuals by giving them custom engraved weapons. The historian Barbara M. Tucker has suggested that through his marketing techniques Colt transformed the firearm from a basic utilitarian object into a central symbol of American patriotism (Tucker 2008).

The twentieth century saw a refinement and proliferation of similar methods of public manipulation, perhaps best exemplified by Norman Bel Geddes’s Futurama exhibit at the 1939 New York World’s Fair. The installation featured a 35,738 square foot (3320 m2) model depicting a utopian vision of America set 25 years in the future. The technology that inspired Bel Geddes’s proposal was the internal combustion engine, his client General Motors’ core product. He designed super highways to connect America’s cities, revolutionary run-offs allowing the cars to join and leave the motorways without slowing down, and the sprawl of a perfect picket-fenced suburbia.

For visitors whose outlook had been influenced by the Great Depression, this future was compelling. It was a place that was clearly better than the present, and American consumers bought into the dream. As a result, many aspects of Futurama became reality. Futurama was of course motivated by other interests than simply creating a better future, not least the selling of a particular political and corporate agenda—interests that are strikingly revealed in E. L. Doctorow's 1985 novel *World's Fair*. As a family leaves the ride, the father says:

'"It is a wonderful vision, all those highways and all those radio-driven cars. Of course, highways are built with public money," he said after a moment. "When the time comes General Motors isn't going to build the highways, the federal government is. With money from us taxpayers." He smiled. "So General Motors is telling us what they expect from us: we must build them the highways so they can sell us the cars."' (Doctorow 1985: 285).

Futurama provides a valuable historical lesson, in that through hindsight we can compare the promise of a corporate future with the reality that came to pass. Highways were built and millions of cars were sold. But Bel Geddes's vision—a vision constrained by his role as a designer working for a corporate client with the brief to glamourise and sell the technology—neglected to present obvious shortcomings. These shortcomings included not only traffic jams, smog, accidents, and road rage, but also more complex societal consequences such as insurance fraud or the decline of cities that relied on automobile manufacturing.

Far from being simply positive, then, technological progress is often problematic in complex and unforeseen ways. This point has been argued many times in the past: by William Blake and the Romantics, William Morris and the Arts and Crafts movement, and by avant-garde provocateurs like Dada. Yet somehow, as Winner (2010) noted, the real-life implications of technology are easily overwhelmed by the seductive power of a well-crafted techno-utopia such as Futurama.

Herein lies the oblique constraint: designers, whether working for clients on market-focused projects or in research-based roles on public engagement, are seldom encouraged to explore what could go wrong with a particular emerging technology or its products. Negativity does not sell. Progress dogma has the effect of constraining designers under its power to present only positive outcomes.

Reconstraining progress dogma facilitates a different approach to utopian future narratives by accepting that when a new technology is released into the world things also inevitably go wrong. The method might be described as follows:

1. Arrange emerging (not yet available) technological 'elements' to hypothesise future products and artefacts.
2. Apply alternative plans, motivations, or ideologies to those currently driving technological development in order to facilitate new arrangements of existing elements.
3. Develop new perspectives on big systems.

With the purpose of:

1. Asking what is a better future (or present).
2. Generating a better understanding of the potential implications of a specific (disruptive) technology in various contexts and on multiple scales—with a particular focus on everyday life.
3. Moving design 'upstream' to not simply package technology at the end of the technological journey but to impact and influence that journey from its genesis.

Ultimately the aim is to facilitate a more responsible approach to the technological future. One early example is 'Audio Tooth Implant' (Auger-Loizeau 2001), which examined the implications of implantable technology for human enhancement by proposing possible applications and access points for technology to enter the body. Building on the growing popularity of mobile telephones at the time, the resulting product was an implantable telephone. The project was presented at the Science Museum in London in an exhibition called 'Future Products'. From here it quickly entered the public domain through both the popular press and specialist media.

The reconstraint of progress dogma means critical responses become equally relevant to positive ones, with the discussion raised by dissemination being the key output of such a project. As Rachel Metz wrote in *Wired*:

'Auger and Loizeau measure success by reactions to their idea, not the venture capital money (which Auger said they turned down) that stemmed from the swell of media coverage. What gratifies them are the hundreds of e-mails they received from people (including several dentists) interested in learning more, and a Slashdot mention that garnered 437 comments.' (Metz 2006).

The goal is to add a space for considered appraisal that predicts what might go wrong with a design before a product is made available to a wider public. This approach essentially tests applications before they happen, building in a layer of responsibility and allowing for adjustments to be made rather than dealing with problems after the event.

FUTURE NUDGE

Product lineages are often mistakenly imbued with an evolutionary logic that gives them the appearance of rightness and inevitability. Comparisons between, or conflations of, natural and technological evolution have been made as far back as the nineteenth century, when Charles Darwin first published his theory of evolution (Darwin 2009). This revolutionary work inspired philosophers, writers and anthropologists such as Marx and Engels, Samuel Butler and Augustus Pitt-Rivers to suggest that technological artefacts evolve in a manner similar to natural organisms. There are, however, key differences between biological and technological evolution, including the role humans play in shaping change. As George Basalla points out when describing the difference between the theories of Darwin and Marx:

'In Darwin's theory biological evolution was self-generating; in the Marxian scheme the evolution of technology is not self-generating but is a process directed by wilful, conscious, active people and molded by historical forces.' (Basalla, 1989: 207).

This description bears a resemblance to 'artificial selection', the term Darwin himself used in 'Variation under domestication', the opening chapter of *On the Origin of Species*:

'One of the most remarkable features in our domesticated races is that we see in them adaptation, not indeed to the animal's or plant's own good, but to man's use or fancy.' (Darwin 2009: 18).

Other attempts at achieving an understanding of technological evolution have been put forward, most notably Gilbert Simondon's seminal work *On the Mode of Existence of Technical Objects* (Simondon 1958), and Bernard Stiegler's *Technics and Time: The fault of Epimetheus* (Stiegler 1998). For the purposes of this paper, however, a more appropriate method of classification is one proposed by Basalla that emphasises the value of the artefact:

'A theory of evolution cannot exist without demonstrated connections between the basic units that constitute its universe of discourse. In technology those units are artefacts ... it becomes apparent that every novel artefact has an antecedent. This claim holds true for the simplest stone implement and for machines as complex as cotton gins and steam engines.' (Basalla 1989: 208).

From the design perspective the artefact approach is appealing. This is because technology can be viewed simply as a means to an end—the systems, techniques and materials that support the existence and function of the product. Technological progress, therefore, facilitates the iterative development of the lineage.

Figure 2a (left) and 2b (right) magnify the incremental design steps that result in the artificial evolution of a product.

We describe this kind of incremental technological change as *future nudge*, that is, a process that appears to be evolutionary but in fact is not random, and is therefore not evolutionary. The automobile provides a good example. As Figure 2a shows, travel becomes instrumentalised as we focus on the object rather than the act of travelling. The car iterates in small steps made possible by advances in specific areas, similar to the development of mobile devices such as the iPhone (Figure 2b)—seven phones in seven years—where each new device is a small advancement on the previous one.

The typical progression follows Moore's Law—smaller, more powerful, more efficient—and has been successful in generating new sales revenue with new models released each year. Describing the way technology and technological products evolve, so that what comes next will be similar to what came before, the economist Robert Heilbroner wrote:

'All inventions and innovations, by definition, represent an advance of the art beyond existing base lines. Yet, most advances, particularly in retrospect, appear essentially incremental, evolutionary. If nature makes no sudden leaps, neither, it would appear, does technology.' (Heilbroner 1967: 9).

In this process we can only design what the product could realistically evolve into. Smart products, for example, are usually existing products simply updated with 'smart' technology.

Precisely because future nudge is an artificial form of selection, we can use it to explore who decides, and who makes the future, both historically and in the present. In the past, for example, the lobbying power of automobile companies held sway over America's future, as evidenced in the Futurama exhibit discussed above. Unpacking power relations in future nudge is tricky: it is partially a faux-force, a lack of imagination; instrumentalised thinking coupled with a blinkering of alternative possibilities and other ways of life.

One approach to reconstraining future nudge is to use counterfactual histories (Bunzl 2004) and alternative presents—both of which provide insight into how certain aspects of life might look if different choices had been made or different paths were taken in the past—to imagine what might happen if we stepped out of an existing product lineage. Another Auger-Loizeau work, the 2003 'Iso-phone' (Figure 3), was developed to challenge the telecommunication industry's progression towards efficiency and ubiquity through the growth of the mobile telephone sector. The question the project asked was, what if, rather than directing development towards availability and mobility, designers prioritised a qualitative approach to focus on the experience. The concept used sensory deprivation techniques to minimise distractions, facilitating a total focus on the conversation.

The question where agency in artificial selection is concerned is, who chooses? Who makes the decisions? How do we 'take back control', in that much abused phrase? How can we use a speculative approach to imagine new coordinates and new constraints—and thus escape a naturalised view of technological evolution as something no one controls? At present, stepping outside the forward march of future nudge is a privilege of the wealthy. This is satirised in 'An Ikea Catalogue From the Near Future' (Near Future Laboratory 2015), where the most expensive sofa, called the 'Nostalgi', is described as being reassuringly *not* 'smart'—while everyone else is sold the next micro-iteration of a predictable product line.

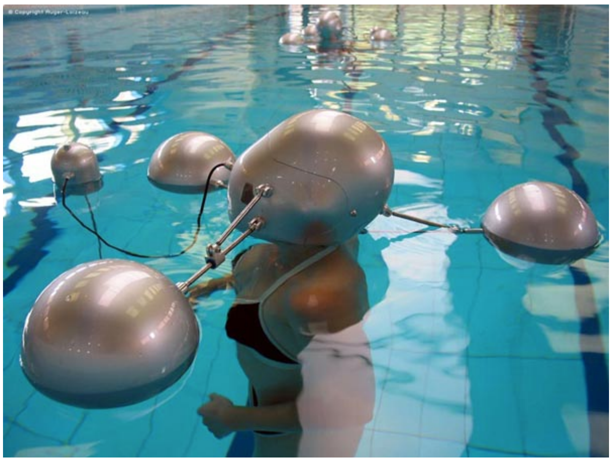

Figure 3: Auger-Loizeau's 'Iso-Phone' is a solution focused on the experience and not the efficiency of communication.

MEANS AND ENDS

In 1927 Paul Mazur of Lehman Brothers made the following (now infamous) statement:

'We must shift America from a needs to a desires culture. People must be trained to desire, to want new things, even before the old have been entirely consumed. We must shape a new mentality in America. Man's desires must overshadow his needs.' (Quoted in Curtis 2002).

The statement, made during an interview with the *Harvard Business Review*, signals the rise of conspicuous consumption and the worship of gadgets. Designers were, and still are, complicit in this process.

The philosopher Albert Borgmann has another way of describing this historic shift in emphasis, through what is known as his 'device paradigm'. For Borgmann, *things* are inseparable from their context: we engage and interact with them in their worlds. *Devices*, on the other hand, unburden us of their contexts through the operation of complex background machinery; the more advanced the technology, the more invisible or concealed the machinery. Borgmann used the fireplace or hearth as an example of a thing: it provides a focal point for the household, links people to the local terrain through the gathering of firewood, and demands an idea of how much wood is required to get through the winter. In contrast, the central heating system 'procures mere warmth and disburdens us of all the other elements', while the means become invisible, intangible, controlled and managed by others (Borgmann 1984: 42).

Designers and consumers alike have become obsessed with the end, the device—the glossy and glamorous product—while the systems that produce these ends have become increasingly opaque. This pathway essentially leads to automation, where devices (such as the Nest thermostat) satisfy all of our needs as efficiently as possible through techniques such as machine learning and prediction algorithms. Jean Baudrillard was already describing the effects of automation in the 1960s when he wrote (in *The System of Objects*) about the passivity of the modern consumer:

'When it becomes automatic … its function is fulfilled, certainly, but it is also hermetically sealed. Automatism amounts to a closing-off, to a sort of functional self-sufficiency which exiles man to the irresponsibility of a mere spectator.' (Baudrillard 2005: 118).

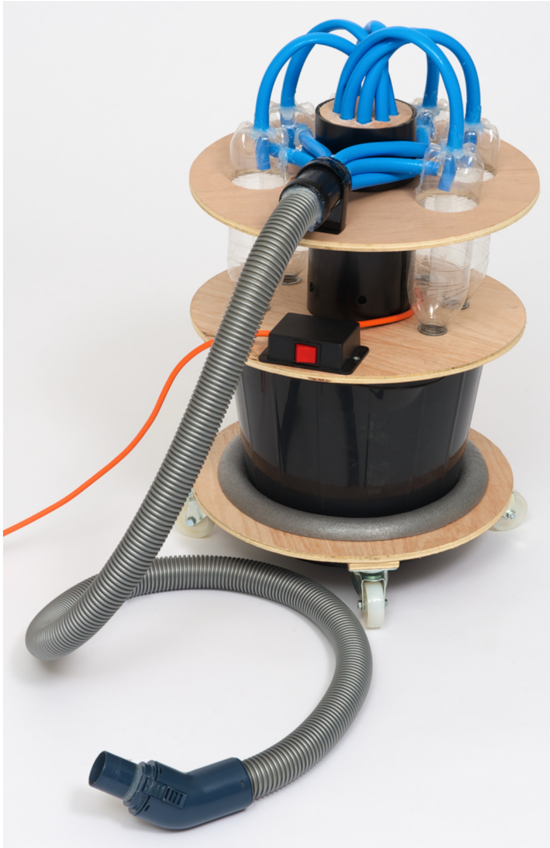

Figure 4: Open hardware vacuum cleaner by Tom Lynch.

The perfect example of a device is Yves Behar's $700 Juicero, a juicer that uses QR code and a Wi-Fi connection to check fruit packs for freshness and refuses to operate if the system determines that the fruit is out of date. Such examples epitomise the consumer goods industry's current habit of steering consumers towards the end, giving the designed artefact an almost religious status in contemporary society. This has allowed the means to go ignored, to remain hidden, unquestioned or undetected. Bespoke tamperproof screws, non-accessible batteries, warranty seals, technology telling us when our fruit is fresh, intentional and increasingly rapid obsolescence—these practices are becoming the norm.

By removing the constraint of end-focus, designers can reclaim the means on behalf of their products and the people who use them. Solutions can be adapted to local terrains or can engage with local systems, materials and making. Figure 4, for example, shows an open-source hardware vacuum cleaner designed by Tom Lynch. All elements were sourced or made locally and the whole process was documented on the project's wiki—the result being a fully functional and replicable product for under €50.

INFRASTRAINTS

Infrastructural and legacy constraints inform almost everything we do and everything we design—from food systems to transport, manufacturing to entertainment. We are locked into paths determined by decisions or choices made in previous eras, when the world was a much different place. For various reasons these legacies stubbornly persist through time, constraining future possibilities and blinkering us from alternative ways of thinking.

The remainder of this paper will focus on the subject of energy. Tesla's invention of alternating current at the end of the nineteenth century won out over Edison's direct current because it allowed electricity to be transmitted over large distances. This afforded the building of huge power stations in the countryside, generating power through the burning of fossil fuels and distributing it radially across national grid systems. Power arrives as if by magic at our houses via sockets in the walls. These sockets, and the plugs that are inserted into them, dictate how all electrical products are used and how all products are designed.

We have been thinking about how to change this relationship—how to *reconstrain* our approach to energy. The island we live on, as a location with ample sun, wind, rain, and sea, would seem to be a place where renewable approaches to energy might thrive. What you see when you fly over the island supports that notion: banks of solar photovoltaic panels line several of the hillsides, and wind farms are exposed to the full force of the gales blowing in from the sea. However, beneath this optimistic surface lies a darker reality.

The problem, stated simply, is as follows. Solar PVs only generate energy while the sun shines. Wind farms generate energy when the wind blows. The wind is unpredictable and the sun shines during the day when most people are at work, meaning that energy cannot realistically be consumed in real time. The only viable option at the moment is to sell energy back to the grid; but unfortunately this conflicts with the power company's business model. As things stand, users of renewables still rely on the grid during dark or windless periods, and therefore utility owners argue—with some reason—that these users should pay for grid upkeep.

So while the infrastructure battle continues, what else can be done? We decided to reimagine energy infrastructure on our island based on the implementation of renewables. This brings us to the second part of the paper: reconstraining energy through locally based bespoke design solutions.

ENERGY RECONSTRAINED: RECENT WORK

As technology advances it becomes increasingly concealed, hidden in complex systems, its actions determined by invisible algorithms or unseen actors. In Borgmann's terms, this has the effect of dislocating *ends* from *means*. As outlined above, the present tendency is for designers and consumers alike to focus on the instrumental end—the object of desire—while ignoring the means, the obscure and complex infrastructures that allow the device to work. Nothing illustrates this estrangement of means and ends better than our attitude towards energy. Electricity, as a form of energy, comes through sockets on the wall that deliver a seemingly endless supply. These ubiquitous and generic sockets determine the design of every electrical product, providing a neat end to the designer's role and responsibility. Our lives are energy rich, but our relationship with energy is threadbare—ethereal and distant, a number on a meter, a bill at the end of the month.

In our community-centred approach to energy we aim to break down the wall. One example of a design approach that goes through the wall—and out of the box—is the Zimbabwe Bush Pump (de Laet and Mol 2000). The assembly for this clean water pump contains instructions for the whole community, all of whom are involved in the installation. The pump is designed to be robust but also fluid in its components, so that if one component breaks it can be replaced with something to hand. Our project is similarly committed to designing a thing that solves a problem such as energy storage, but does so using local materials, the local environment, local people and their skills.

Our first in a series of working prototypes, the Gravity Battery, is an open source energy generation and storage solution. It is built from a combination of natural materials, which provide a source of energy or a means to store energy, and cultural materials, such as tools, artefacts, and components that are made, recycled, and re-appropriated. We chose the research space based on our local context: knowledge, materials, and terrain. This is an example of a new approach towards technological application that places an emphasis on local production over global, community engagement over alienation, and participation in the design process over the simple consumption of products.

All parts are sourced or made locally. Solar power lifts the mass during the daytime, storing it as potential energy. (The real-life context could be, for example, one of the local homes that are built on the cliff sides of the island.) When it is needed the energy is released by dropping the weight, in this case 15kg, which in turn rotates the motor—now a generator—to produce electrical energy. The power available is determined by the size of the dropping mass, the speed at which it drops, the gearbox ratio, and the drop distance.

The latest iteration (Figure 5) uses a locally found scrap motorcycle engine as the gearbox, ready-made and super efficient, minimising complex making. Normally the motorcycle engine burns fossil fuel (petrol) to move the piston down, which is converted to rotary motion with the crankshaft. Rotary motion (or RPM) is modified by the gearbox and ultimately rotates the rear wheel via a chain drive providing forward linear motion to the motorcycle and rider.

We reverse this situation: instead of fossil fuel, gravity spins the rear wheel, using it as a pulley attached to the falling mass. This in turn spins the drive sprocket, increasing RPM in the gearbox and finally driving the crankshaft at a speed determined by the selected gear, the diameter of the pulley, and the falling mass. For communication purposes we had to think of a use for the generated energy, so we decided it would power a self-contained vinyl record player.

In practical terms the gravity battery provides a demonstration of how means and ends, or products and their infrastructure, can be reconsidered to facilitate a more engaging and responsible relationship with energy. The project is currently in progress: we have developed several functional prototypes using the battery in combination with a variety of products such as record players, lights and kitchen devices to explore how interactions change. The next stage is to move into local communities to test the concept in the wild.

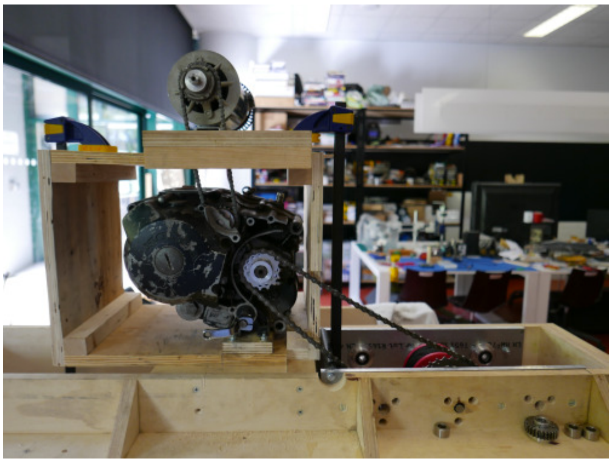

Figure 5: Example of reconstrained design: the Gravity Battery.

CONCLUSIONS AND FUTURE WORK

The four categories we have identified and examined in this paper—progress dogma, future nudge, means and ends, and infrastraints—are not meant to represent a fully comprehensive list of oblique constraints. Part of our future work will consist of identifying and analysing further constraints and finding the means to rethink or work around them. By reconstraining design with new sets of coordinates, we hope to create a space in which it becomes possible to apply plans, motivations, or ideologies that are different to those currently driving technological development—in order, ultimately, to facilitate new arrangements of existing elements and to develop new perspectives on large-scale systems.

As we described in the second part, our current work is with renewable energy. By thinking about what lies beyond the wall—local contexts, landscapes, materials, skills, culture—it becomes possible to develop bespoke solutions which question existing power relations and envision preferable futures. Where we live in Europe, local terrain means cliffs and cliff-side communities.

This local terrain has already provided inspiration for one solution—the gravity battery—to grid storage issues that problematise solar panels. The most striking aspect of the gravity battery design is the tangible relationship that it affords with energy. Turning up the volume on the gravity-powered record player makes the mass fall faster, reducing the time available to listen to the music. (In the immediate next steps we plan to boil a kettle, toast some bread, power a reading lamp, and so on.)

Looking further ahead, we are working on a book of one hundred alternative energy ideas. The concepts in this book will range from small operational prototypes such as our low-power gravity battery, which exploits the vertical nature of the island, to more spectacular and ambitious concepts such as a huge series of elevators in the capital city.

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