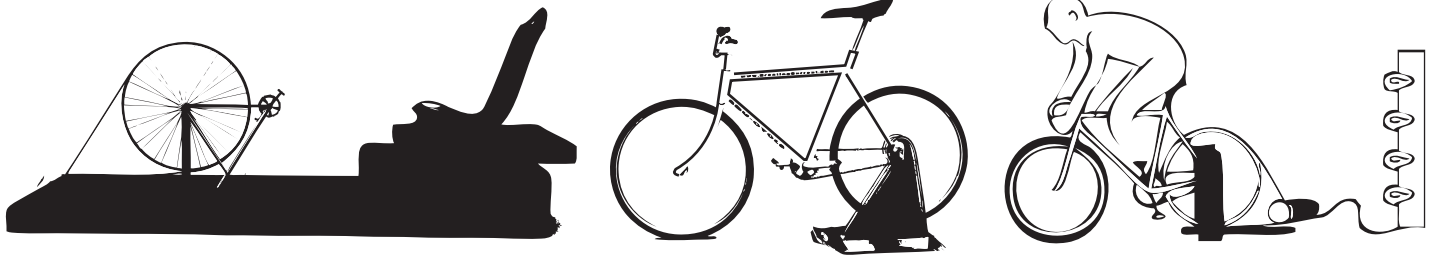


CREATING CURRENT

Knowledge Economies with the implementation of Power on Demand



Title: Creating Current

Author: Jesse Lee Harrington

Degree: Masters of Fine Art

Industrial Design - School of Design

Date Submitted 04-29-2011

Date Approved _____

What you're about to witness

Approvals

Acknowledgements

Abstract

Knowledge Economy

Learning Styles
Why Electricity?

Pedal Power

Why Bikes
History
Uses

What I did

www.creatingcurrent.blogspot.com

RMSC-Accommodative Learners

Edu-Cycle - Kinesthetic Learners

DIY Plans - Tactile Learners

Outcomes

Works Cited

Approvals **Please sign and print**

Stan Rickel - Chair RIT Graduate Industrial Design

Date

Dr. James Myers - Director of Multi-disciplinary Studies RIT

Date

Kim Sherman - Senior Lecturer RIT Industrial Design

Date

Patti Lachance - School of Design Chair & Associate Professor, School of Design Date

Acknowledgement

Without the following people I could not have started a current.

Rochester Museum and Science Center (TAGG Team) especially Jim Meyer.

Dr. James Myers, Lyndsey Mcgrath and the staff of American University of Kosovo.

Ian Gatley and the student center for Innovation.

The entire staff and student body of the RIT Industrial Design department.

The good people at Global Cycle Solutions especially Caroline Hane-Weijman.



Abstract

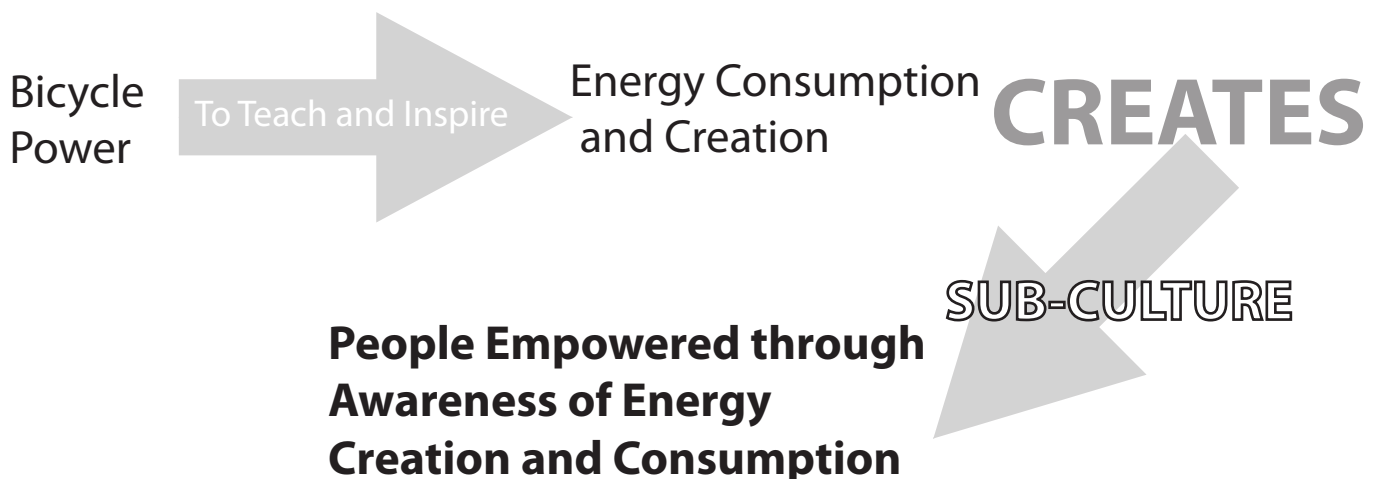
CREATING CURRENT

Knowledge Economies with the implementation of Power on Demand

What if we could bring education to the masses explaining how to develop a particular product without having to mass produce the actual product? The pursuit of creating knowledge economies using power on demand as an idea worth spreading is how I have attempted to answer this question. Through identifying three styles of active learning, I designed three idea spreading mechanisms. Kinesthetic, Accommodative and Tactillian learners are all active learners, they want physical involvement with their education. These three concepts; a bicycle generator museum exhibit (accommodative), a traveling bicycle generator exhibit (kinesthetic) and a set of DIY/DIT (Do it together) bicycle generator plans (tactillian) help facilitate this process in order to gain a wide user audience, making the spreading of ideas more successful. All three are designed to give the user the building blocks for further exploration.

Chosen for its world wide relevance, power on demand (POD) is the notion of utilizing human power in order to gain mechanical power, be it electric or non-electric. Bicycles are one such means to produce mechanical or electrical energy, located throughout the world and easy to manipulate. This simplicity is essential to help facilitate future interest in creating ones own means of energy.

The end result is three learning mechanisms that utilize pedal power and can be spread to a mass audience without being individually purchased. The first is currently on display at the Rochester Museum and Science Center and is a stationary bicycle generator hooked up to multiple kinds of light bulbs to teach users how much wattage they need to pedal out in order to power a florescent bulb versus an LED. The second is a traveling bicycle generator tailored for classroom style group learning, it can be hooked up to multiple household items and is able to run a series of experiments . The third is a set of DIY/DIT plans that are completely graphical and can be used by anyone in the world regardless of language as the user teaches other users or creates more refined models. The learning mechanisms show users physically how much energy the objects around them consume as well as showing how to create your own source of energy.



Knowledge Economies

Knowledge Economy- Also referred to as “human capital,” is an economy of knowledge focused on the production and management of knowledge in the frame of economic constraints. In a knowledge economy, **knowledge is the product**. In the context of this thesis the knowledge economy is the end goal. The larger the economy created the more successful the product.

In Bruce Mau’s “Massive Change,” he refers to the specific areas of our global social construct as separate economies, Knowledge Economies cover the area of education as a device to create change.

“Design has emerged as one of the world’s most powerful forces. It has placed us at the beginning of a new, unprecedented period of human possibility, where all economies and ecologies are becoming global, relational, and interconnected. In order to understand and harness these emerging forces, there is an urgent need to articulate precisely what we are doing to ourselves and to our world. This is the ambition of Massive Change.”-Bruce Mau “Massive Change”

Knowledge economy at a glance (11)

- The economics are not of scarcity, but rather of abundance. Unlike most resources that become depleted when used, information and knowledge can be shared, and actually grow through application.
- The effect of location is diminished, in some economic activities: using appropriate technology and methods, virtual marketplaces and virtual organizations that offer benefits of speed, agility, round the clock operation and global reach can be created or, on the contrary, reinforced in some other economic fields, by the creation of business clusters around centres of knowledge, such as universities and research centres. However, clusters already existed in pre-knowledge economy times.
- Laws, barriers, taxes and ways to measure are difficult to apply solely on a national basis. Knowledge and information "leak" to where demand is highest and the barriers are lowest
- Pricing and value depends heavily on context. Thus the same information or knowledge can have vastly different value to different people, or even to the same person at different times.
- Communication is increasingly being seen as fundamental to knowledge flows. Social structures, cultural context and other factors influencing social relations are therefore of fundamental importance to knowledge economies.

Through the creation of the learning mechanisms, the user upon interaction will have access to the knowledge product. The spreading of this product for example will be based upon how effectively transparent each exhibit is. Upon approach each user should be able to take away a basic understanding of how to create a source of power utilizing an ordinary bicycle. Through the simplicity of the mechanics and the shared experience of using the device the users should then feel compelled to tell others about their experience or best case scenario attempt to re-create their experience and share it with others.

It is in the sharing and inspiration that the project is successful. Those who feel inspired by the museum exhibit or the traveling exhibit will seek out the DIY/DIT plans and the website. On the website they can share their experience with a wider audience that will in turn be inspired. This ripple effect is the basis of the knowledge economy and of the creating current thesis.

Learning Styles - Taking an active approach to learning.

John Dewey (American philosopher) identifies the education process as the growth of experience. Where experience is to be understood more in active terms, as involving doing things that change one's objective environment and internal conditions. This definition is universal to every nation developing or not. (3)

Active learning refers to techniques in which students do more than listen to a lecture. Students are active in discovering, processing, and applying information. Active learning "derives from two basic assumptions: one, that learning is by nature an active endeavor and two, that different people learn in different ways." (Meyers and Jones, 1993) Research shows greater retention of material when students engage in active learning.(5)

Within active learners there are several different levels of comfort. It is similar to say just because I like to make a peanut butter and jelly sandwich does not mean that I would like growing my own grapes/peanuts and baking my own bread. If I were only to give out DIY plans then only those with enough technical confidence and drive would be able to create the learning vessel. On the other side of the coin, if I was to only build museum exhibits then only those fortunate enough to access the museum could gain knowledge, severely limiting my audience.

In this thesis I have defined three areas of active learners based heavily on the work written by Kolb and Fleming. Their research covers all aspects of learners, both active and inactive detailing all levels of students and showing how the majority of them take in knowledge. The three areas I have created and the terms I have used are borrowed from a compilation of their text and research. Taking that into consideration here are the definitions I am using for the three learning styles.

Accommodative learners. Accommodative learners excel at accomplishing tasks by following directions, meticulously planning, and ultimately seeking new experiences (Kolb, 1984). They are characterized as being opportunistic, action driven and risk takers. The accommodative label comes from their ability to adapt themselves to changing circumstances and they rely heavily on other people for information rather than on their own analytic ability (Grochow, 1973; Stabell, 1973). The learning modes associated with accommodative learners include concrete experience and active experimentation(7).

The museum exhibit fits this learning style perfectly, the user is given a certain fixed experiment with specific pre-identified results and then is able to physically play out the experiment to acquire the desired information.

Kinesthetic Learners. Kinesthetic learners absorb information best by doing, experiencing, touching, moving or being active in some way. They are characterized by having great hand-eye coordination, technology is a great interactive tool to use while studying. Writing information down helps kinesthetic learners study. Making lists, taking notes, writing down examples, using concept maps, and collecting photographs are all ways people with kinesthetic intelligence will learn, understand, process, and organize information(8).

Bringing a bicycle into the classroom that is preset with experiments such as with the edu-cycle brings this learner to his/her full potential. Having an instructor be able to assist them run test and document results will aid in the kinesthetic learner being able to retain the information gained from the experience.

Tactile Learners. Tactile learners like to experience the world and act out events. To remember a phone number, tactile learners may remember the pattern of their fingers as they press the numbers(9). They are more apt to use a website like Instructables.com as a starting point for their projects. Very rarely will they write down or take notes on a project, because they will remember the physical action and process the information through that physical memory. They are best when given brief instructions and then to let tinker and figure out the answers for themselves.

DIY/DIT instructions are perfect for the tactile learner as well as those who do not have ready access to exhibits such as the edu-cycle or the museum. They are simple but not constrained, giving the tactile learner room to do their own test and find their own solutions.

Why is it important to learn about electricity?

Recent rolling brown outs in CA and the upcoming energy crisis seem to be enough of a problem to justify learning more about how electricity is originated and how much of it our appliances consume. In America and several other more developed nations we have what is called the magic box mentality. We have no concept of what happens when we leave a television plugged in all day, or a computer, or even a microwave. A loss in electric is supposed to be taken care of by someone else, somewhere else. The magic holes in the wall provide us comfort from an unknown source.

The problems occur because there are 6.8 billion people in the world and a very small percentage of us are using up most of the resources. If we can educate ourselves in how much energy we use on a daily basis, we can then realize the limitations of those resources and make things like wind and solar energy a more likely possibility. A great way to witness how much energy each device is consuming is to make the user feel physically how hard they would have to work in order to power a device such as a television, or how long it actually takes to charge an ipad only using human created energy. At this point of discovery is also when we can truly start thinking about those of us in the world who do not have regular access to electricity.

Without access to reliable electrical energy, it becomes more difficult to survive in the post-industrial and developing worlds. Deprivation of electricity also denies the use of other significant technologies including: powered-lights, radio, medical devices, agricultural equipment(s), as well as devices for metal and wood-work, which provide valuable shelter(s) that would otherwise be constructed of lesser materials.

Empowerment is the process of increasing the capacity of individuals or groups to make choices and to transform those choices into desired actions and outcomes. Central to this process are actions which both build individual and collective assets, and improve the efficiency and fairness of the organizational and institutional context which govern the use of these assets"(dictionary.com).

By permitting users to create their own power, we are creating a direct connection from device to user. This connection removes the power company from the situation, and frees the users to create their own personal power grid. This leads to the empowerment of the user(s) who needs not rely on power companies, the government or a foreign agency, that charge for use of electrical energy.

These two cultures, the developing and the developed have created a unique case of people from two separate sides of a problem being able to come together to learn in the same area. The developing and developed worlds can both learn strong lessons from anyone of the three mechanisms created in this thesis, the genius of it is they are learning for separate reason to come about similar outcomes.

In conclusion why do we wait for energy? We have set up a system that holds us hostage to the energy companies. People that live in places that have scattered energy to rolling blackouts feel helpless and await ways to gain more efficient means of mass produced energy.

Empowerment - People that utilize human powered devices are not beholden to the power company (2).

Visibility -Using human power, our exertion makes visceral what we take for granted from the grid (2).

Inspire- Providing the building blocks for the creation of electricity can inspire users to think of alternative ways to create or conserve their own power.

Number of people living without electricity

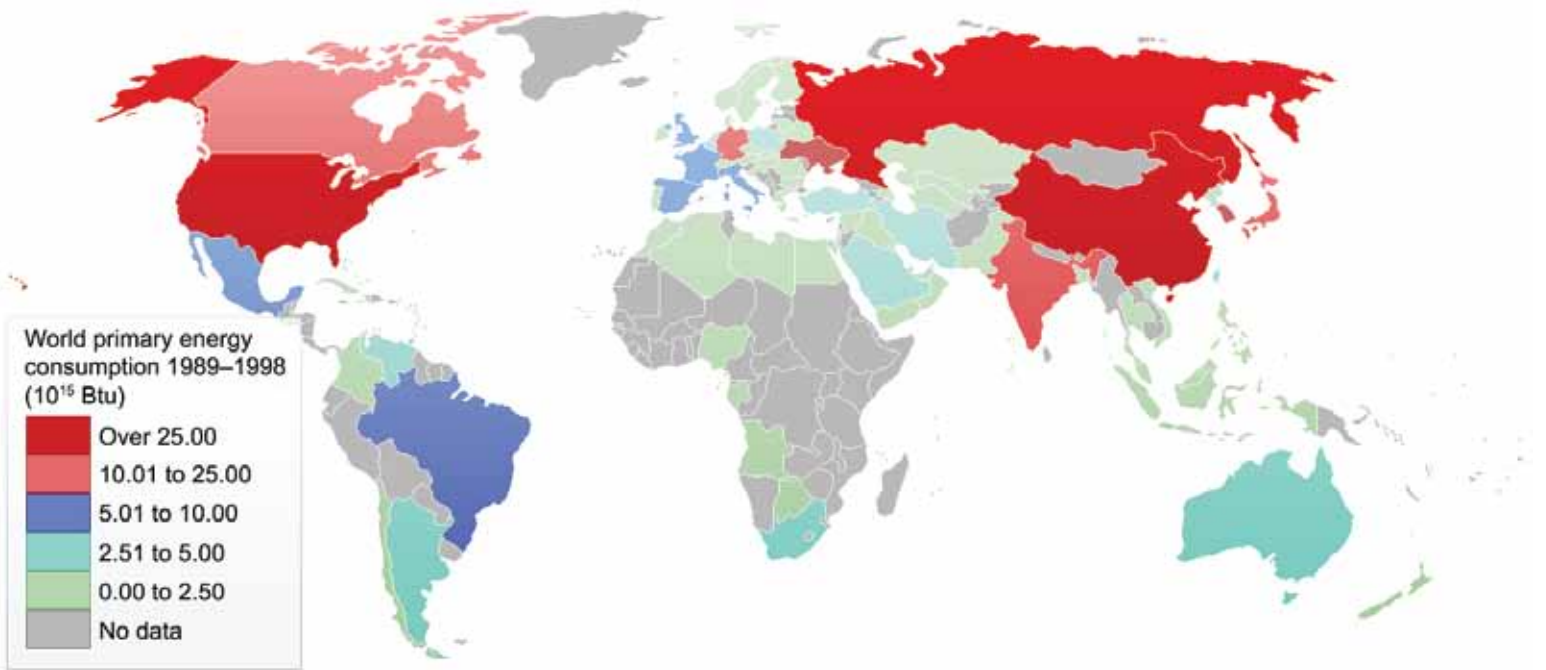
1.6 billion people — a quarter of humanity — live without electricity:

Breaking that down further:

Regions without electricity (Millions)

South Asia	706
Sub-Saharan Africa	547
East Asia	224
Other	101

World wide energy consumption



Why Bicycle power?

There are about 105 million bicycles built every year. If one were to estimate that a bicycle has an average 10 year life, this would work out to about 1.1 BILLION bikes in use today.



chart made by http://www.princeton.edu/~ina/images/infographics/transportation_big.jpg

The rationale behind choosing to use bicycles is bicycles are simple, elegant and available. Bicycles are accessible by most, when you are thinking about global problem solving there are very few places in the world that do not have access to bicycles and also have the knowledge to do the simple mechanics to alter them. We can all be inspired by the story of William Kamkwamba, a remarkable young man from a remote village north of Malawi's capital city. Forced to drop out of school due to lack of funds, William turned to self-education and, after seeing a picture of a windmill in a textbook, decided to build one to power his families home. He built it out of spare bicycle parts because they were easy to manipulate and he did not have to weld anything. (12)

Dan Little of Rochester Community Bikes, Rochester, NY would be the first one to admit that you can teach anyone to fix up a bicycle and he has. RCB has already given out 199+ bikes in 2010 and are not stopping anytime soon. They also host a weekly workshop to instruct anyone interested on how to fix minor problems and give their bikes a tune up.

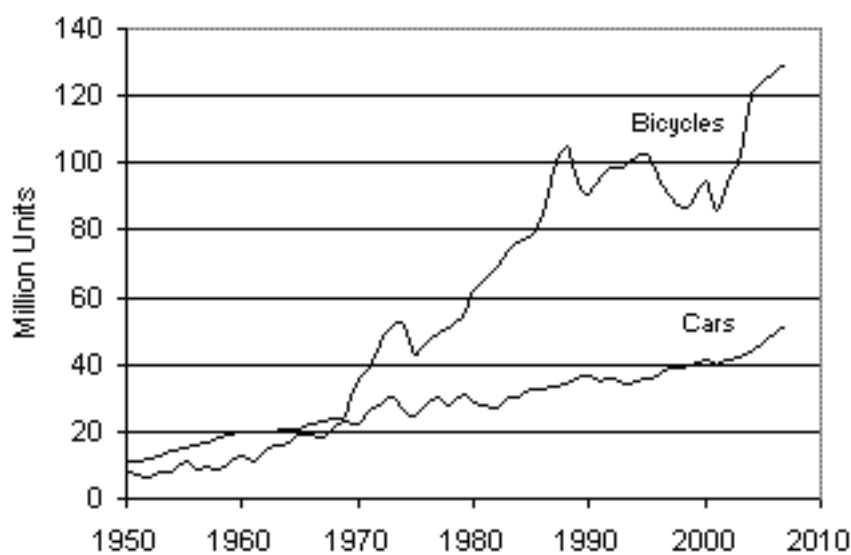
Bicycles also fit into the category of human powered devices that I have labeled "Power on Demand". Power on Demand or POD is any device that you can power at anytime with out an external source of power. It's the idea that you do not have wait for wind, tides, or fossil fuels to achieve your objective. Its also known when utilizing a bicycle for energy as "Pedal Power."

Another reason to choose the bicycle generator is that it gives the building blocks for anyone to create electricity, within that you can also develop wind, hydro, and tidal power. If you can show people how simple most of the technology is then they can build of that knowledge and move forward with more innovative ideas.

The history of innovation surrounding the bicycle is also very rich, people are attracted to the simplicity and how easy they can customize the simple mechanics. Orvil and Wilber Wright (also bike mechanics) utilized the bicycle for many prototypes of the first powered human flight machine. There are uncountable internet sites that are just compilations of things that others have built out of bikes, everything from furniture to high end sculpture, not to mention the amount crazy new bikes or "Human Powered Vehicles" that people are creating on a seemingly daily basis from all sorts of materials.

There is also a health factor for the people that would consider taking this to extremes. Three hours of bicycling a week can reduce your risk of heart disease by 50%(10) Caloric intake was also thought about when thinking about POD's . If you use the calorie calculator on creatingcurrent.blogspot.com, you will quickly see that losing too many calories for people in developing countries will not be a problem. The calorie calculator can be found here (<http://www.mne.psu.edu/lamancusa/ProdDiss/Bicycle/BIKEcalc1.HTM>).

World Bicycle and Automobile
Production, 1950-2007



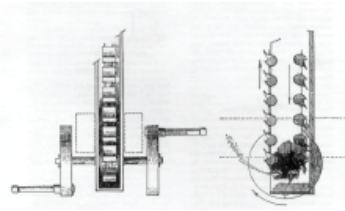
Source: Worldwatch; Eike Europe; Global Insight

Organizations like Maya pedal (13) have taken the bicycle and started creating devices along with costumers like waterpumps, grinders, threshers, tile makers, nut shellers, blenders (for making soaps and shampoos as well as food products), trikes, trailers and more. Maya Pedal is a Guatemalan NGO based in San Andrés Itzapa. They accept bikes donated from the USA and Canada which they either recondition to sell, or use the components to build a range of "Bicimaquinas", (pedal powered machines).

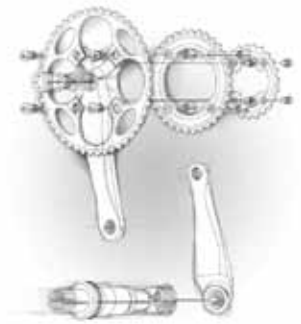
Pedal power can be harnessed for countless applications which would otherwise require electricity (which may not be available) or hand power (which is far more effort). Bicimaquinas are easy and enjoyable to use. They can be built using locally available materials and can be easily adapted to suit the needs of local people. They free the user from rising energy costs, can be used anywhere, are easy to maintain, produce no pollution and provide healthy exercise.

"Great ideas originate in the muscles"-Thomas Edison

Pedal Power History(brief)



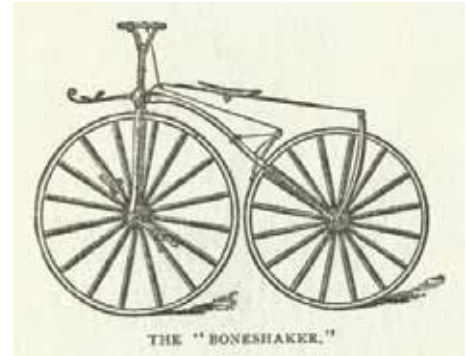
Roman Empire- Bilge Pump



1418 - Giovanni Fontana built the first human powered land vehicle -- it had four wheels and used an endless rope connected via gears to the wheels.



1821 - Prison Pump



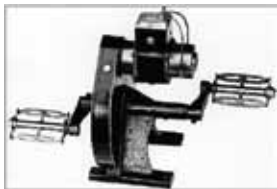
1863 - Bone Shaker or Velocipede Bone Shaker or Velocipede: Made of stiff materials, straight angles and steel wheels make this bike literally a bone shaker to ride over the cobblestone roads of the day



1872 - Hand Crank air pump

1890 - W. F. & John Barnes- Grinding and Polishing Machine

1908 - Hurley Machine Company of Chicago



1929 Mrs. Gertrude Rothery of Augustus Downs, operates the first pedal radio.

1938- Bike powered gas pump

Oct. 6, 1977 - EMMAUS, Pa. - A manufacturer here has come up with two multi-purpose pedal- powered machines to save fuel energy indoors and out. Fringe benefit they can also help trim your waistline.

Dec. 13, 2009 - A Danish hotel is pioneering a pedal-power electricity generation scheme it hopes will catch on in other countries.



Pedal Power Uses



Pedal One Laptop Per Child



Pedal powered concert at Coachella



Pedal power water pump



Pedal power sculpture



Charge cell phone while riding



Pedal washing machine developed world



Pedal apple grinder



Pedal washing machine for the developing world



Pedal mower

* Pedal powered charging system for portable "Jump Start" systems. These devices feature lights, air compressors, battery chargers, power meters, 12 Volt DC outlets, and of course jumper cables.

* Pedal powered backup generator for solar electric systems or other off-grid power systems.

* Pedal powered biodiesel circulation pump or biodiesel transfer pump

* Pedal powered washing machine

* Pedal powered clothes dryer

* Pedal powered whole-house ventilation fan

* Pedal powered pump and watering system

* Pedal powered emergency sump pump

* Pedal powered energy source to power astronomy equipment

* Pedal powered whole-house (central) vacuum cleaner

* Pedal powered backup circulation pump and backup air pump for tropical fish,

* Pedal powered generator, emergency bilge pump

* Pedal powered air compressor

* Pedal powered offset printing press, sewing machine (an ancient idea), hand tools (grinder, disk sander, buffer, drill, reciprocating saw, lathe), mulch grinder

* Pedal powered public address systems, projectors, or amplifiers for music -

Basically, any device that was hand cranked, foot-powered, or powered by a fractional horsepower electric motor could potentially be converted to pedal power.

What I did

The following pages are a more in-depth view for what I created for each division of learner as well as the web blog I created to track my thesis process. My process was extremely hands-on for each project and this experience was critical in understanding what my users would go through. I have created each part of thesis with two things in mind, the type of learner and the audience. These two criteria are equally important and dependent on each other.

The learner type assist in creating a demographic that can excel by best retention of content, but this also establishes the audience. It is not feasible to say that everyone in every circumstance will be the correct learning type for the situation. In a science classroom while using the edu-cycle, it would be presumptuous to say that all the students are in fact kinesthetic learners. They are captive in their experience and thus the edu-cycle does not discriminate its user. The learning type is to give a design rationale to the specific type of learning that helped to create the design. An example would be that the edu-cycle was created with the learning method that kinesthetic learners utilize as a foundation, but not specifically for only kinesthetic users . Another way of saying would be to say that each piece of the thesis, the museum exhibit, the edu-cycle and the DIY/DIT plans were inspired by these types of active learning styles and designed for use by any interested party.

RMSC-Bicycle Powered Exhibits

**Inspired by Accommodative Learners
intended for Museum learning**

Edu-Cycle

**Inspired by Kinesthetic Learners
intended for Classroom learning**

DIY / DIT Plans

**Inspired by Tactile Learners
intended for all interested individuals or teams**

As I move through each segment , I will discuss the following.

- **Design inspiration**
- **Possible use scenarios**
- **Intended outcomes**
- **The process of creation**
- **The final design and features**

What I did: Weblog

Creating Current- Current meaning both electrical current and symbolically meaning the spreading of an idea with gaining momentum such as a river has a current.



In June of 2009 I started a blog entitled Creating Current. This blog would serve multiple purposes, for one it was a way for me to mark my progress and gather my research. Secondly and more importantly it was a way to connect with the outside world and start spreading this idea that you can create your own power and you don't have to wait for a power company to come to you.

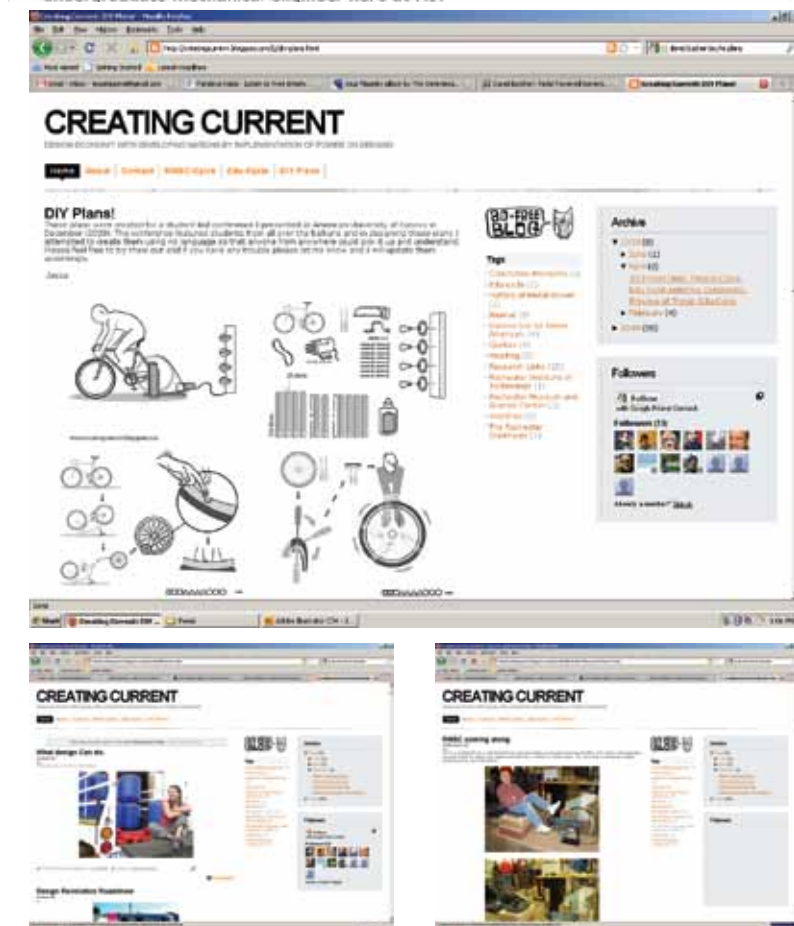
I posted all of the information that I found on similar sites for the blog to act as a central hub for others looking into building bicycle powered devices. I also made separate tabs for all three exhibits to allow the visitors to track my progress. The most viewed is the downloadable DIY plans. Nowhere else on-line could I find free plans that gave basic information to generate electricity from a bicycle.

Another function of the blog is to assist in spreading the message of my thesis to a wider venue. This brings the total up to four separate ways of learning about pedal power. Notably the blog is really just a compilation of information that I have found over the past year. Through searching out other peoples research I did not come across a site that was trying to pull everything together. A lot of what is currently on the web is for making it's own profit. Sites such as David Butcher's pedal power generator give a lot of information, but shy away from giving us other places that he found information. Even though he has created a very interesting model, his method is sophisticated and may not be the best solution for someone without access to the parts that he was privileged enough to obtain.

The goal is to spread the core of an idea not a specific way of achieving it.

There are also interviews on the site with Global Cycle Solutions (shown on following page), a non-profit out of the Boston area that has created multiple devices for utilizing bike power.

To this day I get e-mail from people all over the world inquiring about getting plans to build their own POD or finding out more about the research I have found.



"Power from the People"- David Butcher

Interview with Global Cycle Solutions

Hi Jesse,

I am Caroline Hane-Weijman, one of the team members working with GCS. I am an undergraduate mechanical engineer here at MIT with great interest in entrepreneurship in the developing world.

We all appreciated your e-mail to us- it's always exciting to get feedback from others with the same intentions and interests as us. I answered your questions below but would gladly set up a phone interview with you if you have further questions.

> Tell me a little about the decision to start Global Cycle Solutions?

Jodie initially went to Tanzania summer of 2008 in hope of bringing affordable, simple, and accessible technology to those living on those living on less than a dollar a day. The target group was small-acreage farmers and as the staple crop in Tanzania is corn, she focused on using bicycles as a means to increase efficiency for shelling corn. Our technology was created through her collaboration with some of the locals. The decision to start Global Cycle Solutions grew not only from the wonderful positive feedback from end-users but also from the business model that the locals themselves initiated. They took the bicycle and the adapted corn sheller and cycled around to multiple farmers in the area, providing the pedal-power corn sheller as a service and thereby creating revenue enough to pay for the corn sheller within a week! Thereafter, she returned to MIT, recruited us to help set up a business model for GCS and further develop the technology.

> Paul Polak writes in his 12 steps for practical problem solving that number one is to go where the action is, how do you choose where to implement your products?

We've chosen our initial markets that are conducive to our first line of products- the sheller and grinder- (Mexico and Tanzania both have corn as a staple crop) These are also two locations where we have a lot of contacts and a broad network to work with. There are multiple other countries that we see ourselves in the near future but in the beginning, as this is our first summer truly launching, we need to focus on specific markets.

> What's coming up for GCS, what are the next steps?

There are a lot of things happening right now. To summarize broadly: We currently have three members on location right now. We are trying to set up distributors, market ourselves, possibly partner with a bicycle organization, finalize our prototype of our product, and collaborate with micro-finance institutions to help with the initial capital investment. I would suggest going to our blog and reading about our updates from the field- I think that would be more useful for a better idea of the progress we are making: <http://globalcyclesolutions.blogspot.com/>

> Any advice for someone like me working on similar projects?

I would suggest a few things;

-Regarding the implementation of your product- Direct sales is very difficult and limiting, especially in Africa, if you do not have a large sales force. Try to create a business model that relies on distributors or partner with an organization with an existing infrastructure (NGOs have been very interested in working with these types of projects). You will be able to reach more people and minimize overhead costs. Furthermore, it will benefit locals on multiple levels- providing income generating possibilities and creating a more sustainable model for the community. Don't only provide locals with the end technology; provide them with knowledge and skills.

-Recruit a good team with the necessary skills to help you

-Stay focused- start small and grow big. Easy to get distracted by too many offers and too many possibilities. Know your capabilities and limits.

-Don't be discouraged!! Things will seem impossible and overwhelming, but be resilient if you believe in what you are doing.

- Don't hesitate to contact people for whatever you need

- Stay organized- record contacts, possible partners, press, accomplishments, documents etc. Things can happen very quickly and its useful to keep documents of "catchy pitches", summaries, information brochures etc and with all the people you meet that may prove to be useful in the future.

- Take advantage of the Green movement at the moment- a lot of investor events focus on green tech.

Hope this was helpful for you,

Don't hesitate to to ask for more information if you need. As mentioned, our blog has more updated information than our website- so feel free to follow our progress and stories in the future. Best of luck with your projects and thesis.

Best,
Caroline

What I did. RMSC

RMSC-Bicycle Powered Exhibits

Inspired by Accommodative Learners
intended for Museum learning

Design Inspiration: The idea for the museum exhibit was inspired by Accommodative learners, learners that are retain information best through intentional actions followed by intentional outcomes. The museum setting was chosen because of its accessibility to this learning style. When users are confronted with an interactive museum exhibit they are goal driven. They want to view the intended outcomes and gain the intended information. When approaching the bicycle powered exhibit users see a place to sit as well as a recognizable bicycle form attached to a series of light bulbs. They will by the power of inference automatically understand that pedaling the bike will light the bulb. This done because of the intended action of both objects. Bicycles are a kinetic object that's only action (when balance is taken away) is to pedal. Light bulbs only intended action is to be lit. Thus when the user sees bicycle they know to pedal and see the bulb they know it should turn on. The connection from one object to another is done through transparency in the exhibit, making everything open to the viewer so there is not magic box and all wire are shown makes it easy to trace the power source to the action.

Possible Use Scenarios: Museums, This exhibit was created solely for the museum, its robustness and permanence is intended for thousands of users a day to be able to operate it safely. It was also built with museum safety and ADA guidelines in mind making it difficult to become a feasible design for any scenario that it would have to be re-located.

Intended outcome: Create a rich user experience that helps users understand how much power everyday objects consume as well as showing how to generate power from a bicycle.

Challenge: What is the safest interactive way to teach ages 5-85 about alternative energy using power on demand?



The Rochester Museum and Science Center, Rochester NY

What I did. RMSC

The Process of Creation: In order to create a true museum exhibit I worked with Jim Meyer and the TAGG Team at the Rochester Museum and Science Center. The Rochester Museum and Science Center's volunteer group TAGG is a group of retired or out of work teachers, engineers, scientist and hobbyist. They meet once a week on Tuesday mornings to work on upcoming exhibits for the RMSC. They turn out about 9 exhibits a year and each member comes with a unique skill set. The group unites together around a common joy for creative and active problem solving.

When first meeting with Jim, I found out that museum was currently working on a series of alternative energy exhibits and some of those exhibits were intended to be bicycle powered (what luck!).

I joined the group every Tuesday morning for 8 months and assisted them on several pedal power exhibits. Our greatest challenge was how to create 9 bicycle stations that would power a series of exhibits based around different energy needs.



The TAGG group is a great example of bringing people together through a love for education.

Working with the team at RMSC was invaluable, the time spent in the shop understanding how their individual perceptions of what was being built led me to fully understanding why it was important to create several types of exhibits. One question that came up daily was "what are we trying to teach?" This is something that I have kept close to me through the duration of this process.

Watching them work I also realized that just because they are men of science and engineering does not necessarily mean they are good with tools or comfortable building things. These are men that understand principles and come up with ideas that they would like to try out. They are perfect examples of Kinesthetic learners, Kinesthetic learners are what inspired the Edu-cycle they are learners that value being able to interact in the assembly process of the lesson.

One intention of the exhibit was to provide a source for families and strangers to spark a conversation about energy issues based upon their experience at the museum. Some of the proposed exhibits involving the bike are competitive in nature that will allow for a greater interaction between users. The design material of the shell being transparent exposes the direct connection between power source and output.

What I did. RMSC

Over the eight months, we came up with several prototype versions of bicycle powered devices. One (pictured below) that would show the amount of force needed through pedaling to gain device appropriate wattage. We attached a bike to a training stand and then with a v-belt attached the naked back wheel to a pulley hooked to an alternator. The alternator was wired to a leaf blower with a hollow tube on top and a ball inside. The harder you pedal the higher the ball goes. A later iteration let us add a digital read out of the amount of wattage coming from the alternator. The average person can get up to around 200 watts readout and be able to sustain it for a 2-3 minute duration. The fit person can sustain 200 watts for 45 minutes to an hour. That is well over long enough to charge a computer battery or run a television.

The major challenge that we faced was how to create this device that so that both a 5 year old and a tall 55 year old could use it.



Rochester Museum and Science Center's volunteer TAGG group and prototypes of a bike generator and air compressor



Myself putting out 129 watts at RMSC , Jim Meyer putting out 120 watts outside RMSC

What I did. RMSC

Our solution was a recumbent style bike made from a scrapped automatic car seat and a sawed off ten speed. The sawed off ten speed was inverted and careful thought was put into making sure we could still tell it was a bicycle. The car seat motor and switch was then mounted on a flat platform and utilized a joystick to control the seat distance from the bicycle. While this solved the problem of both size groups being able to sit and use the exhibit, it did not solve the more important factor, safety. There are "pinch points," at almost every point on the bicycle. There are also countless things that would be really fun to push things like pens or pencils though. A majority of the visitors to the museum are kids. To design this exhibit safe we had to cover every inch of it.

To combat the safety issue I designed a large shell that would fit over the entire bicycle portion of the exhibit. It was important to us to make it transparent so that the user could make a direct connection between their physical efforts and the power being generated. The goal is to illuminate the magic box mentality that is associated with electricity.

The shell utilizes the crank part of the bicycle as a fulcrum so it can be easily lifted off for maintenance. Which is of constant concern to the staff of the museum.



TAGG volunteer testing the recumbent prototype, Recumbent prototype with adjustable automatic car seat, Prototype of safety casing to assist in keeping kids with 10 fingers and 10 toes.



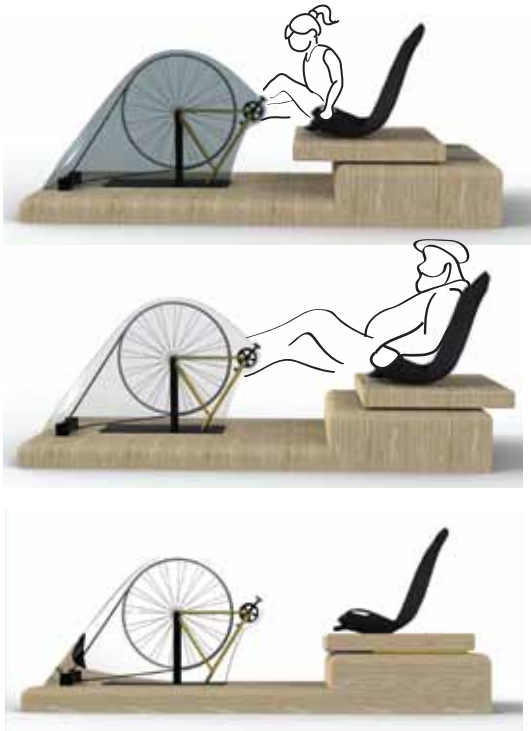
Solidworks model of final design with clear shell, working model on its way to hit museum floor.

What I did. RMSC

The final design Features:

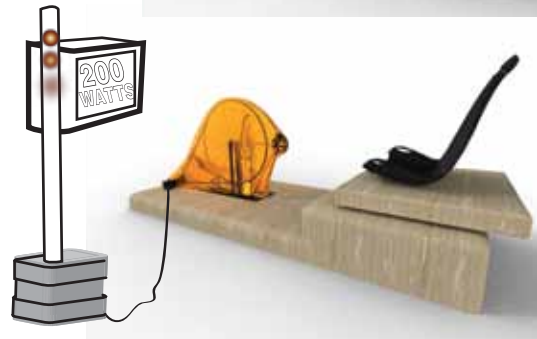
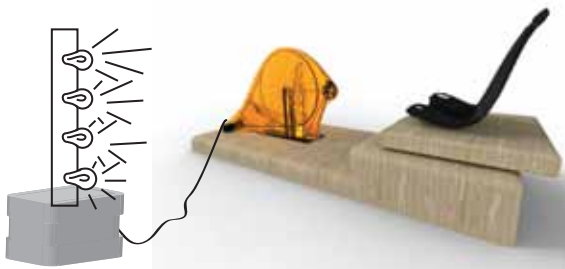
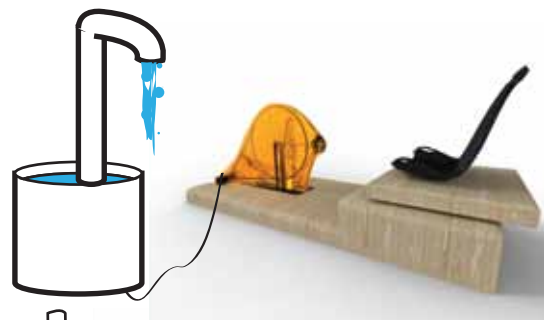
- Adjustable carbon fiber seat with a two grips embedded for users hands as well as automatic forward / backward switch to move users into ideal pedaling position.
- A clear acrylic shell covering the bicycle and alternator that is hinged on the crank shaft of the ten speed, to be easily lifted for small repair.
- A welded steel mounting base for the bike to sit on and be attached to the hollow wooden base.
- Ideally I would have liked to have kept the base wooden and keep a self made look to it. But for some reason the museum has to stick to its strange shades of laminate.

The real genius of this design is that it can used as an exhibit within itself showing pedaling wattage creation or it can be used to power other exhibits that show the difference between power consumption in light bulbs or numerous other ideas as I have shown with the pedal powered devices. The possibilities are seemingly endless.



A permanent exhibit that can be used to power other exhibits and be one on its own.

- Washing Machine
- Grain Sheller
- Television
- Forklift
- Blender
- Computer
- Instruments
- Everything?



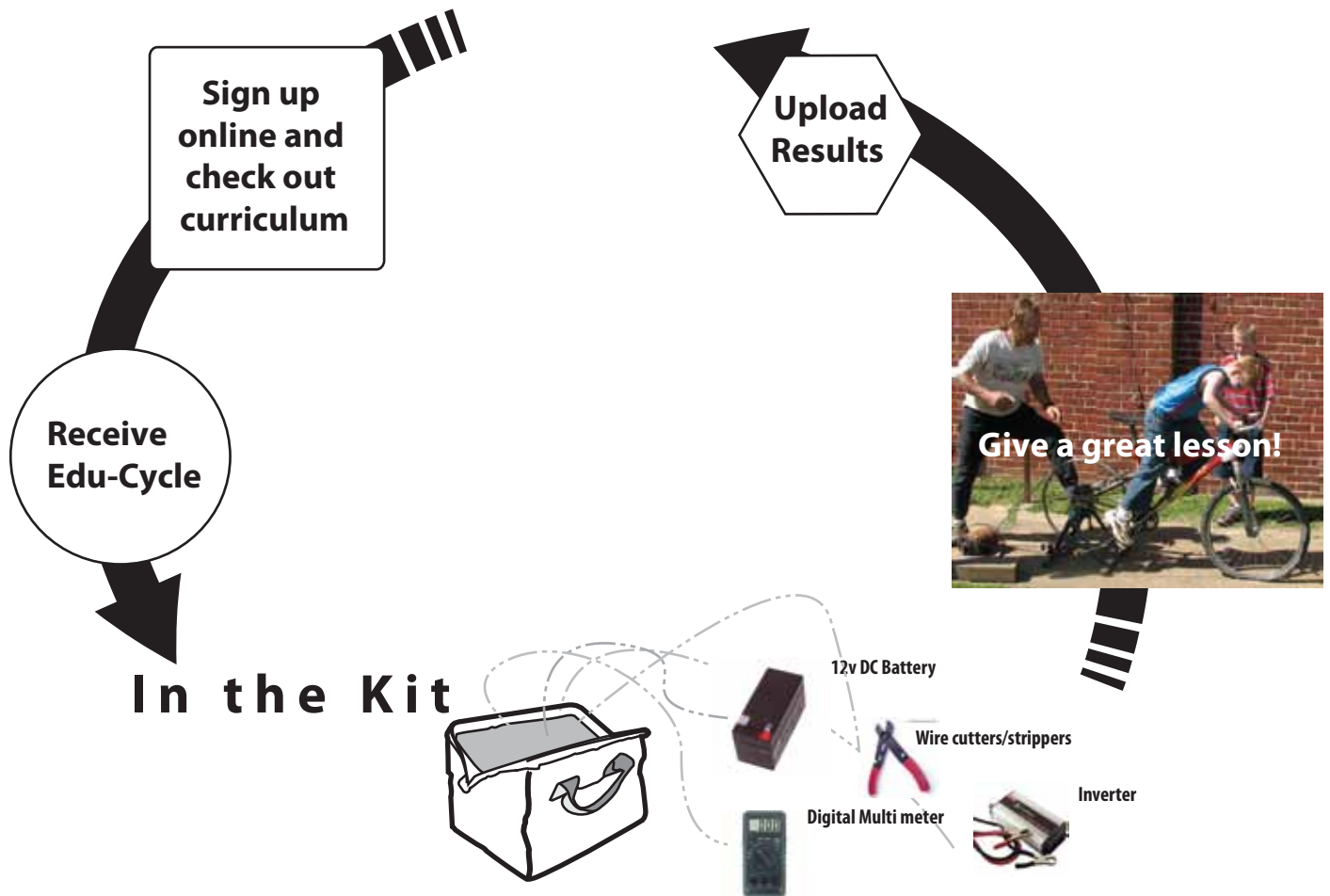
What I did. Edu-Cycle

Design Inspiration: The design of the Edu-Cycle was inspired by the Kinesthetic learner. The exhibit requires some assembly but everything comes in a prepackaged kit. This provides the instructor or user to utilize what they do best and create fun experiments without having to build an edu-cycle from the ground up which is intimidating and can be difficult. The system for the Edu-Cycle is by far the most conceptual of the three parts of the thesis.

I set out to create a traveling exhibit that could assist anyone who wanted to expose the mysteries of electricity, but who were not of the mechanical and electrical mind to be able to create something such as this for themselves. "It lets the Scientist be the scientist. The virtue of science is transferred to design. The virtue of science is curiosity, not knowledge. A scientist wants to find."-Otl Aicher

Possible Use Scenarios: The intended use is for the classroom, but because of its versatility it could literally be used anywhere that you could fit a bike and some people. The design is meant to be ridden from classroom to classroom and then from school to school like a rented exhibit. It comes with it the basics to preform a series of test and is easily adaptable to preform teacher created curriculum. The way the system is set up it would be easy to run one bike at a time or twenty depending on the capacity of those running the program. I also see this program being run by local science museums and distributed in their communities. It is low cost and low maintenance.

Intended Outcomes: The true intention was to reach out to those who may not have access to a museum and also would like to run more in-depth experiments than a typical museum atmosphere can offer. Also before and after the instructor receives the Edu-Cycle they can check into www.edu-cycle.com (not currently up) and download a curriculum or upload their test and results. This creates an online community of users that are sharing data.



What I did. Edu-Cycle

Final Design and Features: When the user receives the Edu-cycle it is a rideable bike. The design of the stand makes it easy to rotate down into the testing position. Upon rotation through the "J" shaped channel cut into the stand that attaches to rear wheel mounting bolts, the bike's back tire is now resting on the pulley that is attached to the motor. The motor is fit with two exit wires that are positive and ground.

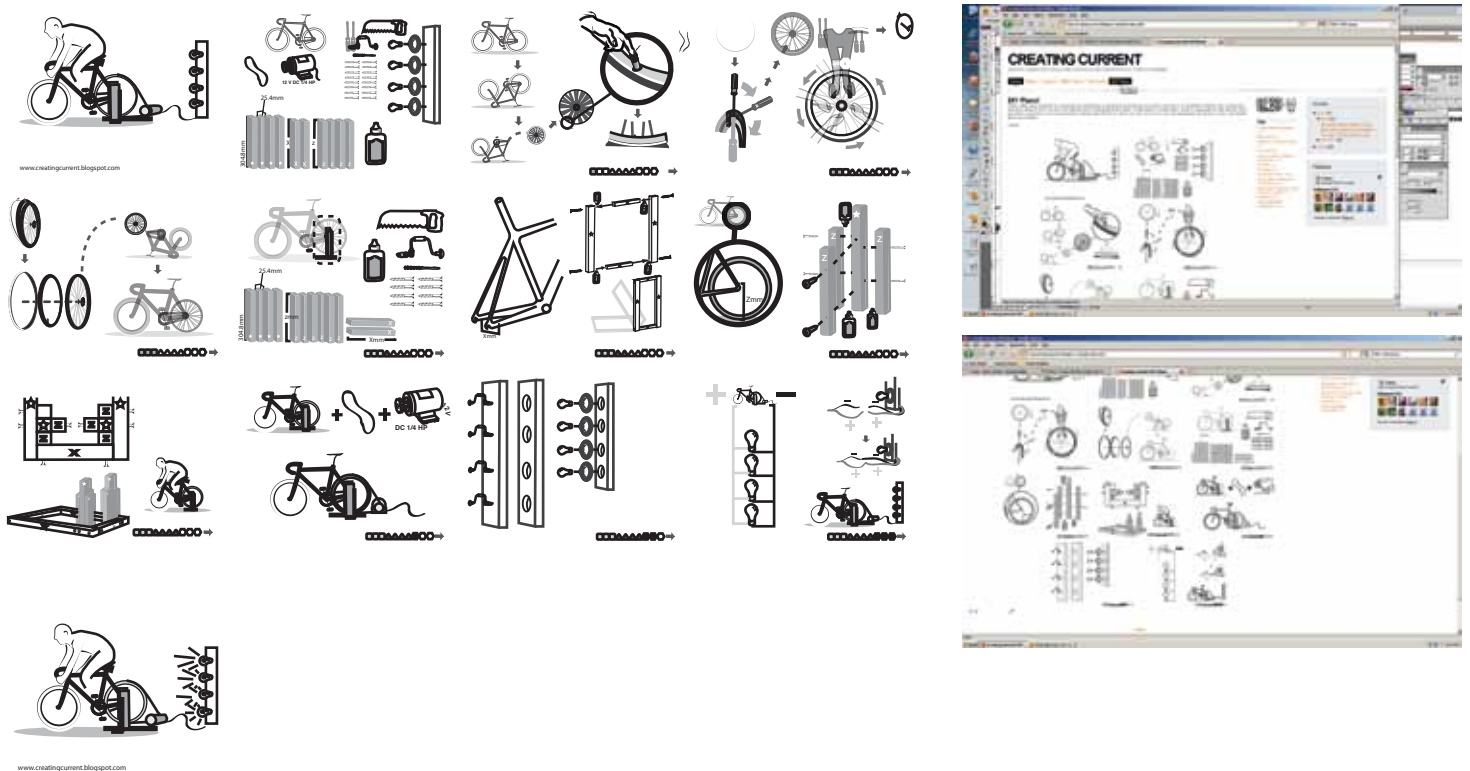
The Kit, the bag or box for the kit will be sourced, because it seems to defy the purpose of the system to manufacture another bag or box when there are so many readily available. The kit is fixed onto of the stand well riding and should be removed before setting into testing position.

The bike, the bike is a refurbished road bike, custom painted with the web address on the crossbar. The stand is created for the bike to have 27 inch road tires.

The stand, beyond what is mentioned above the stand is wide enough to support some rider rocking and has a bent lip so when it comes down its natural instinct is to scoop itself under the back wheel. The material should be durable such as poly-carbonate or lexan. The expense would factor out in the durability.



What I did DIY/DIT plans



Design Inspiration: The fourth step in creating current was to create a set of plans that were available for use by any culture in the world. They were inspired by Tactilian learners, those of us that learn best through trial and error, this is where tinkerers and makers usually fit. The document was meant to be a “how to” step by step guide on the basics of how to make a bicycle generator.

Possible use scenarios: This document was designed to be used by anyone with internet and bicycle access. It is language free and graphical in nature, so it can be used anywhere in the world.

Intended outcomes: The intended outcome was to find out if anyone in the world could interpret this set of instructions and create a bicycle generator, also if they could comprehend it well enough to pass that information onto others.

The process of creation: The process for this project was a ton of user testing. I would create illustrations and go up to strangers and ask them what action they thought was being represented. I attempted to create graphics as opposed to photographs because graphics read clearer than photographs when photocopied and are more open to interpretation than a photograph. When I had a set of instructions that I thought were worthy of an actual test I was invited to present them at a workshop during the South East European Future of Energy Leadership Conference in Prestina Kosovo. This would prove to be a true test of their global ability. The following pages are a detailed account of that workshop.

The goal of the workshop was to show 60 students how they could create energy from a bicycle with hopes to re-create the bicycle exhibit in their local communities. The only tools they were given were, the instructions, the bikes, alternators, light bulbs, wire and wire cutters.

What I did DIY/DIT plans

The minute-by-minute breakdown of the workshop is as follows.

"You can't always get what you want, but if you try sometimes you get what you need"

- Sir Michael Philip "Mick" Jagger

The bikes were laid out as to give everyone enough space to work. The women filming the conference demanded that I stand in the center of the room with a bike on either side and the students' circled around like viewers in a roman coliseum. That was a little uncomfortable to say the least. I was reminded of a first time bull-fighter in the center of a ring, people more watching to see if you survive then to see how beautiful your fighting style is. After a brief but wonderful introduction by Peter Boyd (Media and Communications; AUK Academic Director) I was set to go. I gave a short history of what I do; intentionally leaving out certain things to give a little bit of twist as to where I was coming from. This was about the time that I became very unsure that bikes would actually light anything up and thought that it would be great to get something far more amazing out of this than just a mechanical puzzle-solving workshop.

I ask the students to find someone whom they have not yet spoken to and please locate themselves next to that person. This went smoothly so I waved my arms and sliced the room into two groups, A and B. The A group would work in this room and the B group work in the larger room next door. The first task each group had to accomplish was to have each team member write on a sticky pad, 1. What their field of study was 2. A skill that they possessed that could not be directly inferred by their field of study, such as if they are a public policy major they would list "public policy/ play guitar." Upon completion of each sticky note they stuck them onto the wall and read through them in order to figure out what assets they had. The most interesting part of this exercise is this, asking the students what common factors that they see in all their skills and then you receive blank stares. The commonality is that a majority of their study fields are soft sciences but all of their outside skills are hands on or physical things. This means that with this gigantic array of assets there is almost nothing these teams can't do given the correct tools (which I provided almost none) and an ample amount of time.

The students were then let go on the bikes; their goal was to light up the four lights that came in the kit that I created for them. I was careful to not add too many more instructions than that. This would be a great way for them to share knowledge and attempt to achieve their perceived goal. Each station had: a bike, a stand, an old VW alternator, electrical wire, a box cutter, 4 bulbs, 4 light fixtures, a board with four holes cut into it and enough screws to attach everything together. It was right about now that I truly understood why the lights would never work and even though we by some sort of magic had lit one up the previous night we would never be able to do replicate that with four lights.



What I did DIY/DIT plans

The problem was that the 12v DC alternators that we got only put out electricity in 12v's, the lights were US standard and sucked up a mighty 120v in order to light up. This meant that no matter what they did it would not light up the lights. So at this point I was feeling like I missed something somewhere and could not believe that I did not catch this sooner. The second problem that was occurring was that I had no real way of telling what kind of old beat up alternators that we had acquired and what kind of shape they were in. Normally when using alternators you can start them using a battery or if you work a little harder they will start up in a matter of seconds. These did not. Within the next hour some really amazing things happened. Several students started interacting that otherwise never would. Also several students were forced to come out and lead where they normally would not have. An even more interesting thing happened by splitting the different groups. Group A started of by testing out a single bulb, they were almost immediately frustrated. Group B started of by making a beautiful parallel circuit and putting everything together first, then testing the alternator, their teamwork was amazing.

I gave the students one hour to complete the task and then called them all back into the room for last minute observations. I made sure to let them know that it was not their fault and that there is no way that they could have powered those lights. Thinking that this was a conference for them and that their comments are what was really important, I suggested that they make their own closing remarks. "This really shows us that creating energy is very difficult and that we should appreciate the power we have and where it comes from"

"I would like to continue to use this and go into high schools to show people how hard it is to power a light bulb." I then informed them of all the other things you can power using "power on demand" and briefly told them the story of the young man in Africa that powered his village using a similar system that he created. "If there is a will and a passion you can create anything from the simple building blocks that I have provided you today."

Both teams used the instructions and set up the bikes perfectly. Only needing to ask questions about the alternators that they (and I) had to assume were the correct item to use.



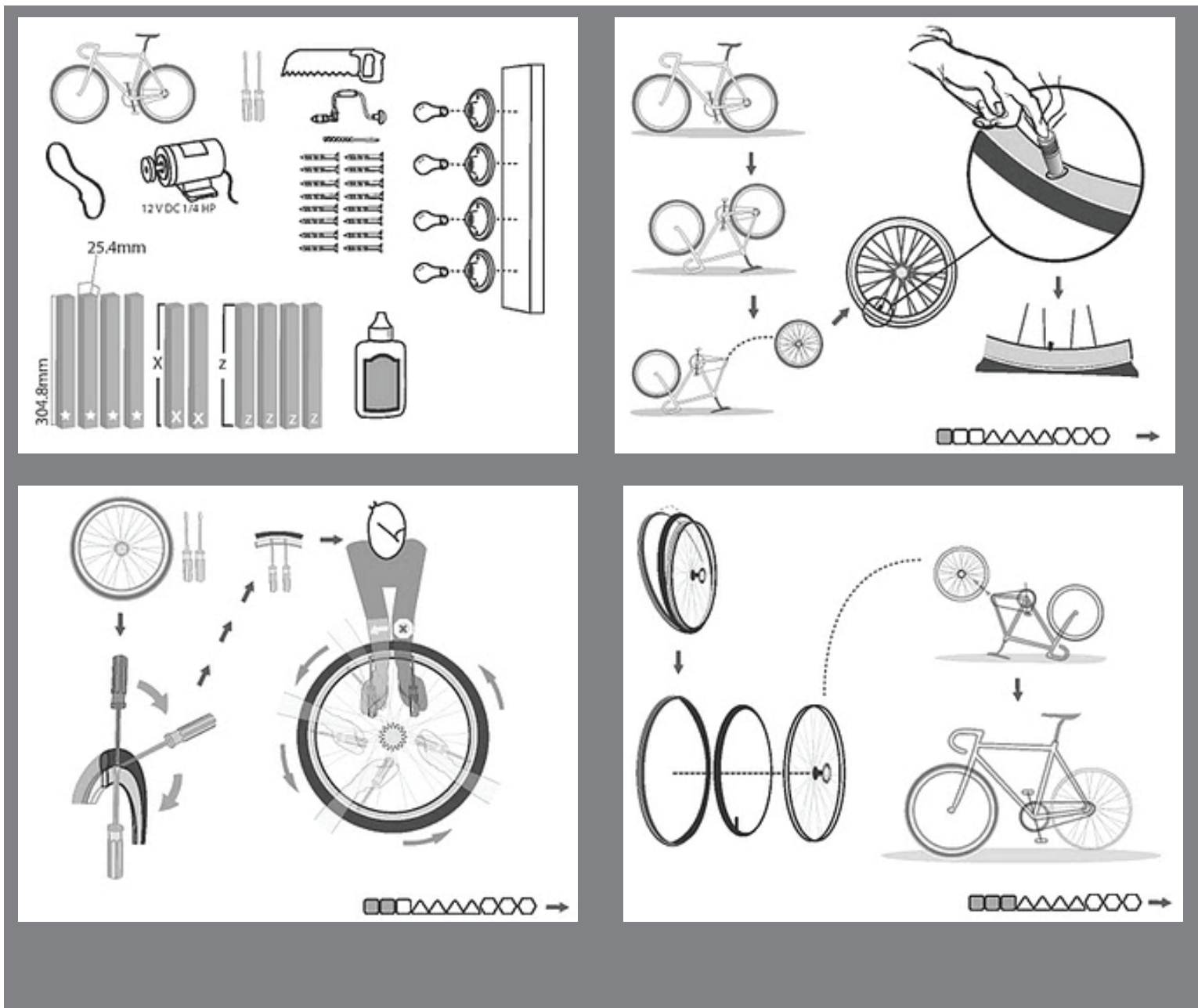
What I did DIY/DIT plans

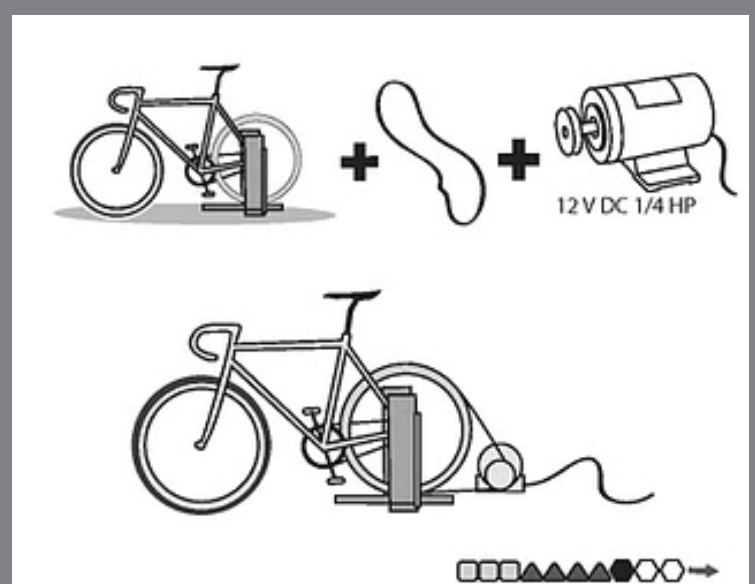
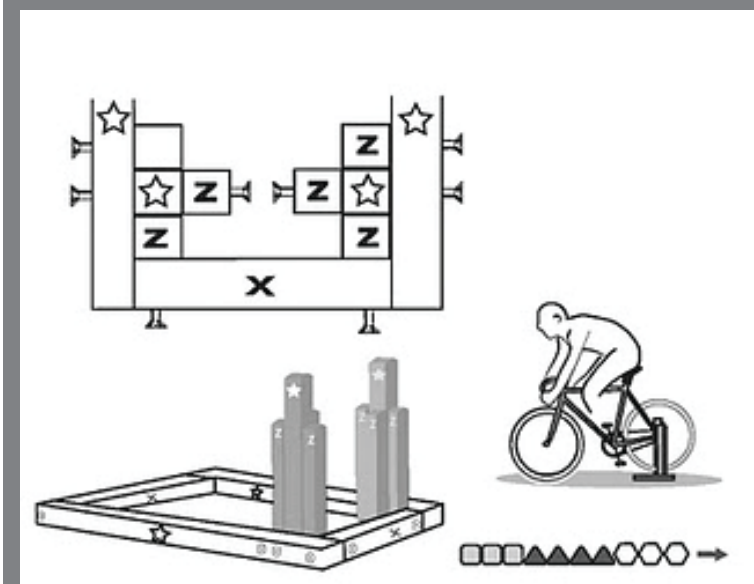
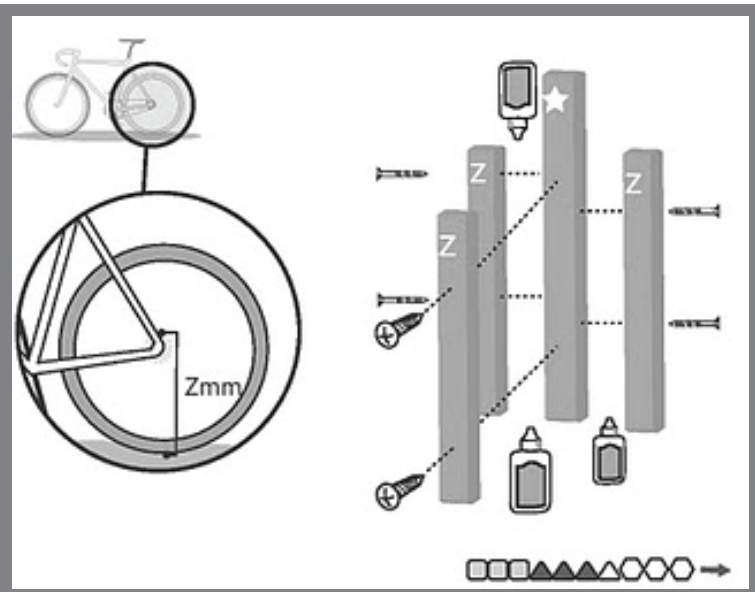
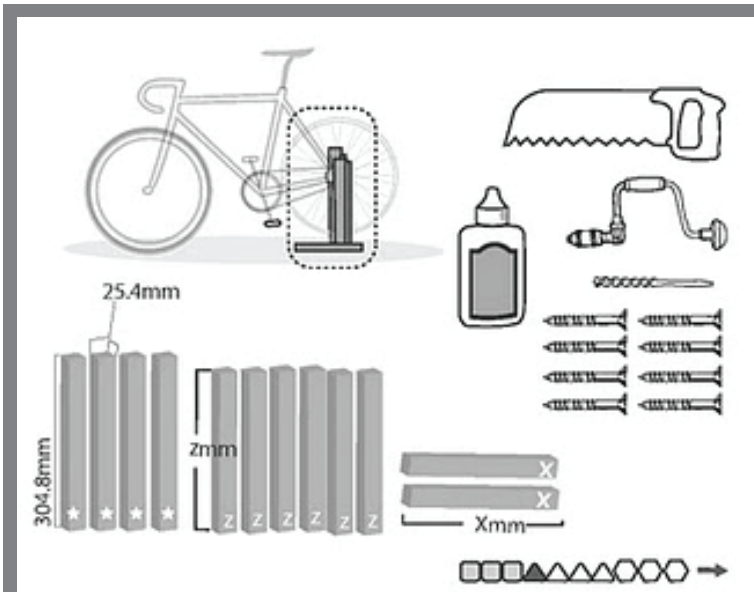
Final Design features: The document has gone through many iterations. It relies on symbols to move you through it. Those symbols are shown below and are square, triangle, rhombus. Rhombus was used because in early testing circles were confusing to users. As those shapes get filled in you can chart your progress throughout the instructions. Color printing is still expensive and color carries so much weight with it culturally that I was forced to leave to it out. What is left is a fully image based, black and white document that explains how to take apart a bike, build your own stand, and hook up a generator to a series of lights.

All the illustrations are based upon the best symbols thought to represent the objects. For instance a bottle with a label on it might not represent glue until you see the action that is being preformed with it.

The measurements based upon the size of the bicycle they were using to allow them to be more universal.

The first page of the document is a "needs," page showing all the graphics in the document that you will need to create the generator.





The other pages assist the user through the process. The most difficult step was leaving things specific yet vague enough to be left up to interpretation. What becomes very interesting about this is that once users get into it, because of the vagueness they trust their own building instincts to make the project work. If I had given photographs or more detailed drawings users would rely only on those drawings and feel the need to find the exact objects shown.

I believe these plans will be forever evolving as more and more people experiment, but that is the genius of it. By users writing me and telling me they altered the plans and are sharing those plans we are just creating a stronger larger community of learners.

Thesis Outcomes

Conference

+ Face book group has 88 members within 3 days of conference. 613 photos and 1 video.(387 pics were of the conference and not of site group activities 83 of those are of the Power on demand workshop that's 21% of the 3 day conference photos are of the 2 hour workshop)

+ Face book comments, "I would like thank everyone who is responsible for making this conference and big congratulation on doing truly amazing job! I hope to see you all soon on some conference :))"

+ Students talk about the workshop through out the conference as a way to help educate the youth of their countries about power usage.

+ Students receive handout and are excited about being able to download a copy

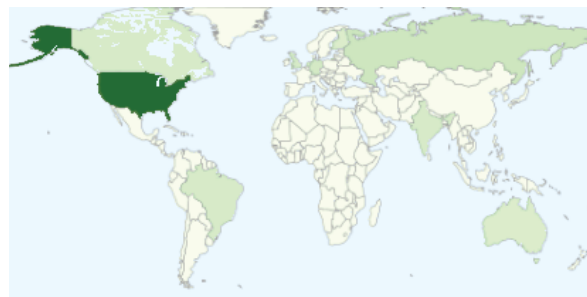
Website, DIY Plans and Edu-cycle

+ Emails received from Africa, England, India and San Francisco wanting to know more about the project and how to start their own edu-cycle program.

Page Views Since tracking software become available in May 2010



Audience



United States	1,230
Russia	113
Germany	76
Netherlands	70
India	68
United Kingdom	56
Brazil	53
Canada	53
Finland	39
Australia	37

+ Exhibit team has built and placed bicycle powered exhibit in the Rochester Museum and Science Center, with a very positive response from visitors.

Bibliography

- (1) Design Revolution (100 products that empower people), Emily Pilloton. Metropolis Books, Los Angeles, CA 90013-1320 ISBN 978-1-933045-95-5
- (2) Massive Change. Bruce Mau. Phaiden Press 2004, NY, NY ISBN 0714844012
- (3) Cambridge Dictionary of Philosophy, Cambridge University press. 32 Avenue of the Americas, New York, NY 10013, 1999. ISBN 13978-0-521-6722-0
- (4) The World as Design. Otl Archer. Ernst Et Sohn Verlag Fur Architectur und technische-wissenschaften, Berlin. ISBN 3-433-02404-9, C. 1994 by inge aicher-scholl
- (5) Active Learning, Kathleen McKinney. Center for Teaching, Learning & Technology © 2010 Instructional Technology & Development Center
301 S. Main St. • Campus Box 6370 • Normal, IL 61790-6370
<http://www.cat.ilstu.edu/additional/tips/newActive.php>
- (6) http://en.wikipedia.org/wiki/Knowledge_economy
- (7) <http://www.sicet.org/journals/ijttl/issue0501/Richmond.Vol1.Iss1.pp45-54.pdf>
- (8) <http://www.emporia.edu/csi/studentsuccess/documents/KinestheticLearner.pdf>
- (9) http://www.homepages.dsu.edu/paulicr/glossary/definitions/Tactile_Learners.htm
- (10) <http://www.pccsc.net/pdfs/Bicycle%20Facts%20-%20PCC%20Press%20Conference.pdf>
- (11) Peter Drucker, (1969). The Age of Discontinuity; Guidelines to Our Changing Society. Harper and Row, New York. ISBN 0-465-08984-4
- (12) <http://www.williamkamkwamba.typepad.com/>
- (13) <http://www.mayapedal.org/>

Reference

Design Like You Give a Damn: Architectural Responses to Humanitarian Crises
by Architecture for Humanity (Author), Kate Stohr (Editor), Cameron Sinclair (Editor)
Metropolis Books, Los Angeles, CA 90013-1320

ISBN-10: 1933045256

ISBN-13: 978-1933045252

The Experience Economy: Work Is Theater & Every Business a Stage]

by Joseph Pine, James H. Gilmore

Harvard Business Press

ISBN-10: 0875848192

ISBN-13: 978-0875848198

Bicycling Science

by David Gordon Wilson

The MIT Press

ISBN-10: 0262731541

ISBN-13: 978-0262731546

The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm

by Tom Kelley, Jonathan Littman, Tom Peters

Broadway Business

ISBN-10: 0385499841

ISBN-13: 978-0385499842

The Laws of Simplicity (Simplicity: Design, Technology, Business, Life)

by John Maeda

The MIT Press (August 21, 2006)

ISBN-10: 0262134721

ISBN-13: 978-0262134729

Pedaling Revolution: How Cyclists Are Changing American Cities

by Jeff Mapes

Oregon State University (March 1, 2009)

ISBN-10: 0870714198

ISBN-13: 978-0870714191

for web references, please visit www.creatingcurrent.blogspot.com

Reference continued.

Pedal Power: In work, leisure and Transportation

Edited by James C. McCullagh With Contributions From:

David Gordon Wilson; Stuart S. Wilson; John McGeorge; Mark Blossom; Diana Branch

Copyright 1977 Rodale Press

ISBN 0-87857-178-7

The Human Powered Home-Choosing muscle over motors.

by Tamara Dean

Publisher: New Society Publishers

ISBN: 9780865716018

Out of Poverty, What works when traditional approaches fail

by Paul Polak

Berrett-Koehler Publishers;

ISBN-10: 1576754499

ISBN-13: 978-1576754498

Design for the other 90%

by Cynthia E. Smith

Editions Assouline

ISBN-10: 0910503974

ISBN-13: 978-0910503976

"We are no longer in the artifact business, we are in the consequence business."- Emily Pilloton

