Holey Roket Eco-centric vernacular design

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Holey Roket

Eco-centric vernacular design

by Rok Oblak

BAA Academy of Fine Arts and Design, University of Ljubljana, Slovenia, 2004

A thesis submitted in partial fulfillment of the requirements for the degree of

Masters of Applied Art in Design

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Abstract

Holey Roket is a cooking stove *type* designed to improve existing cooking systems. Recognizing that more than fifty communities in Africa, South America and Asia use briquettes as a primary cooking fuel, this design project seeks to help improve local cooking solutions. Designed to use the biomass briquettes similar to those available in rural communities around the world, Holey Roket was developed in collaboration with Legacy Foundation, an Oregon-based NGO advocating alternative fuel technology. Designed for biomass briquettes, Holey Roket aims to dramatically reduce fuel consumption and harmful emissions.

Borrowing from existing stove technologies and working in collaboration with local entrepreneurs, this design typology and social network has evolved as the fabrication of briquettes improves and knowledge about this alternative fuel is shared. Holey Roket is based on the understanding that, together with stove design and briquette fabrication, information sharing is necessary to help create better cooking systems. Holey Roket designs are currently being tested in four international contexts: DR Congo, Chad, Uganda, and Cambodia. Existing briquette manufacturing enterprises in each place represent different sets of socio-cultural relations and demand an adaptable consultant-design methodology capable of working with different materials, briquette recipes, gastronomic cultures, and social structures. Holey Roket represents a methodology designed to connect with local entrepreneurial networks and involves communicating information about stove technology and the adaptation of a Holey Roket typology across different contexts.

This project is informed by the eco-centric concept of "ecosophy" developed in writings of Arne Naess and Felix Guattari. Ecosophy recognizes the philosophical milieu as a field of intrinsic social, economic, and cultural

relations where one needs to find ways of partaking in non-anthropocentric collaboration. Extending ecosophy to a design context, Holey Roket looks at ‘vernacular’ building processes that unfold according to traditional, site-specific designs. Holey Roket engages with the virtual environment as a form of direct action. Accumulated information from various environments contributes to the single product-type data-base, and brings diverse local knowledge to a common table. Adaptations of Holey Roket show how experimentation gradually becomes tradition, and in the process, resilient, ever-more efficient cooking stove concepts are adapted to an increasing number of environments.

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Acknowledgements

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In March 2009, I was sponsored by Partnership for Clean Indoor Air (PCIA) to visit an international forum on indoor air pollution in Kampala, Uganda. I would like to thank PCIA for this great opportunity that has allowed me to visit local briquette manufacturing centers in Kampala.

I would also like to acknowledge Emily Faculty: Dr. Glen Lowry, my supervisor, for helping to take my thinking to the next level; Karolle Wall, for additional encouragement and support in the writing of this thesis; and Dr. Patrick Chan for additional academic advice. In addition, I would like to thank the following Emily Carr staff for help in project realizations: Leon Popik, ceramic studio; Ian Rhodes, metal studio; Simon Lysander, Intersections Digital Studio; Bobbi Kozniuk, sound studio; Carlos Mendez, Digital Output Centre.

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Hugs to my family: Olga, Lojze and my brother Matej.

This project is dedicated to my lovely Tina.

(…) nature herself, in the experience of history, became a conscious cultural model, an intellectual alternative choice to culture.

—*Massimo Montanari,* Food is Culture

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I

> The departure point for this history of space is not to be found in geographical descriptions of natural space, but rather in the study of natural rhythms, and the modification of those rhythms and their inscription in space by means of human actions, especially work-related actions. (Lefebvre 117)

Eco-centric theories believe in natural systems as a foundation for conceptualizing our work, or in this case, design processes. They challenge the notion of the human being as a dominant figure who is constantly capable of changing or appropriating elements of the environment to fit to his or her own needs. As a creative discipline, design is based on the premise of the importance of change, innovation and progress, and thus, design processes tend to situate human beings as protagonists who posses a special ability to control the environment. Beginning with an eco-centric approach, this research project sets out to challenge the role of the designer as a conventional 'developer' and position him/her in the middle of a forest of complex relationships where diverse environmental imperatives rather than an individual designer or universal design sets the agenda.

According to Arne Naess, organisms and milieux are intrinsically connected: "organisms presuppose milieux" (56). His concept of ecosophy rejects "the man-in-environment image in favor of the relational, 'total field image' of organisms as knots in a field of intrinsic relations" (28). To help me understand, how Naess's notion of ecosophy might be developed within a design situation, I set out to participate in a series of collaborative experiments.

During the first year of my graduate research, I worked with designers and artists to define and represent certain ideas about our varying relationships to things and spaces, design objects/projects and different environments. The core idea of these projects, which are presented in the following experiments, is a dialog with the various notions of ecosophy: work conceived and unfolding in an immediate relation to a specific milieu. In each of these aesthetic or conceptual experiments, the environment is given the role of the protagonist. The environment is considered in terms of its raw phenomenological, visual or conceptual materiality.

The most representative project of this conceptual framework was the design of the apparatus that enabled *live* sound-transmission from one environment to the other. The idea was oriented around the phenomena of how sound projections from remote spaces might awaken spontaneous *mental images* or imaginary visual experiences. A sound-transmitting device was built to enable the listener to become exposed to the sounds of natural landscapes (or 'sound-

Figure 1: sound transmitting device installation in the Kitsilano beach park, April, 2008: representation of the ambient with the projected sound

scapes') in the home interior. Disguised as a wooden birdhouse the apparatus was installed in a park, sometimes capturing lively discussions of dog-walkers, hours of silence, wind noises and bird-songs. Every moment represented the possibility for unpredictable and random sounds.

The service was planned to function as an online live-sound library freely available on the Internet, and individual pieces could be downloaded in the form of a sound screen-saver. A generic installment draft was made, like an open-source suggestive design that could be upgraded by anyone and potentially hooked up in a virtual network. Participants were invited to produce collages that could be redistributed in the live mode. The 1.8W transmitter functioned on an 88-91MHz FM band and connected to a 12V battery with the option of using solar cells to provide increased functionality.

In *Supermarket Viscourses*, the shopping experience was addressed as something beyond logical planning that is usually practiced in consumer environments with a rational mission to promote the items being sold. The notion of presenting or displaying familiar, everyday grocery items was addressed in an unfamiliar way. Various images sourced from a collection of *National Geographic* magazines (1925 to 2004) were juxtaposed with food items in a local grocery store in Vancouver. The design approach was opposed to the usual graphic design process: metaphors for food items were sourced before choosing the addressed item itself. Browsing random magazines helped give us ideas and to set the design agenda. These images were suggestive: a ritual with bamboo-sticks in Papua New Guinea became a tag for spaghetti; 3 meter blueberries were distributed with a carrier-ship; Jerusalem was built on

Figure 2: Supermarket viscourses in Kitsilano in Vancouver, June, 2008: spaghetti, blueberries, chocolate, bananas, tomatoes

chocolate; tomatoes were hand woven from the 50's; and bananas were carried with donkeys in a picturesque Colombian rain-forest.

As a 'guerilla design' intervention in public space, the store's visual identity was made to appear closer to private-owned stores in developing countries, where owners decorate their spaces more expressively, according to individual or local tastes rather than larger corporate branding initiatives. The particular shop-owner we approached for this experiment became enthusiastic about working with images that might be amusing to his customers, even though he was skeptical at first because of the possibility of the project confusing customers. Very different interpretations of the images were possible, the juxtaposed images created semiotic tensions.

This case study draws on Rene Dubos and his ideas discussed in *So Human an Animal.* In this book, Dubos addressed our built environment in relation

to our immediate biological environment. He argues that many details of our environment are over-designed in terms of safety, ergonomics and passivity of our physical performance. Thus, I developed 'En(danger)ed playgrounds,' which depicts climbing as a generic body-movement and attempts to imagine a situation in which the whole body is in motion. This proposal attempts to offer an interesting potential for application to an everyday environment in the context of a 3-dimensional space.

Figure3: study of tree-climbing for an architectural concept, June2008:
a model (toothpicks), tree-climbing, 3D rapid prototype, installation representation

For me, the activity of tree-climbing represents the most natural way of performing full-body movement. To create a climbing apparatus, I looked at tree-branches as a construction element. Their structure was scanned using a 3-dimensional scanner. The gathered data served as a model for thinking about a new architectural building material that might be used to construct generic spaces, in which the human body would be allowed to move freely in all 3 dimensions, while remaining somewhat protected (at least in relation to the dangers involved in climbing real trees.

The final piece of this project was a proposal that suggested a site-specific climbing tower in Queen Elizabeth park for Vancouver tourists where they could take in an overview of the city, much like people in ancient times who navigated their position in large, flat landscapes by climbing trees. The sculpture was printed in 3-dimensions using a *rapid-prototyping* printer.

Buy a Shopping Day engaged with the idea of an alternative participation within the built environment. In collaboration with four other international students from the Emily Carr MAA program, I created in a short video piece that looks at the idea of a hyper-real shopping experience that takes place in the forest was. The story-line followed a couple with a shopping cart as they pick over-sized apples in a dense forest. This video work attempts to idealize a future 'freegan' society, which is based on a particular life-style where people survive on free, organic local produce.

Figure 4: a video-shooting process: a shopping cart on a forest path, 'cast-crete' apples imitating the biggest apple in the world, high-definition camera in use, final scene

Even though the presented experiments were not directly related to the core project of designing cooking stoves, working with these ideas was essential to my design research. It allowed me to further develop an alternative eco-centric perspective on the product design process. The research was attempted to look beyond the classic notion of the designer as one who creates a finite and optimal object according to a specific problem. Instead, I was more interested in addressing the design processes within the everyday living and to shift strategic product development away from the industrial sector and from a drive for large-scale commercial success. According to Bill Adams, who discusses design work in relation to the developing world, eco-centric notions represent post-materialistic thinking that promotes a participative relation to our environment where we *do design* within the process of living itself. He refers to this mode of thinking as a "Green strategy" (179) that emphasizes micro-revolutions, local experiments, and intuitive, open and concrete solutions, mostly based within the small community settings. The projects conceptualized in the collaborative experiments in my first year of research were aimed at exploring a 'green strategy' through developing *suggestive* designs and engaging in *collaborative* processes.

To further develop this concept, my research in *everyday design* draws on Felix Guattari notion of 'eco-art,' which he defines as an 'opening-out' practice, where "an artist may be led to alter his work after the intrusion of some accidental detail, an event-incident that suddenly makes his initial project bifurcate, making it drift far from its previous path, however certain it had once appeared to be" (52). What Guattari wants to imply is the importance of understanding and working with the precarious nature of the *immediate situation,* which as he

suggests is the primary to milieu in which the artist (as opposed to the 'strategical' designer) tends to function. This notion was reflected in my experimental projects because they engaged the designer with his lived, immediate local milieu. Rather than products, these studies were looking at creating site-specific situations or thinking about the social spaces in which objects exist.

Working in close proximity with the environment is an element of design that was 'stolen' or disappeared with industrialization, mass production and the emergence of global markets. The modern design process often focuses on research on remote environments and 'focus groups' to which the designer has limited access but for whom the designer is supposed to create better, more useful products. In the case of this study, one might say that designing a single cooking stove for use across numerous globally dispersed community settings is a representative (an ultimate) scenario of this type of disengaged design: a one stove fits all solution. In contrast, my research attempts to find ways of working simultaneously across a great variety of dynamic and diverse ecosystems that form different geographical, social and cultural structures and that presuppose relative processes of product *adaptation*. Amos Rapoport articulates these structures as *genre-de-vivre* in which, we might say, 'form follows the milieu': "natural, spiritual, material and social aspects (culture, ethos, world view, national character) which affect the form" (48). Collaborative stove design unfolding across diverse *genre-de-vivre* thus requires a very different approach to design research and knowledge development/sharing.

A major role in realizing the stove projects represents working with entrepreneurs already engaged in stove-development. These entrepreneurs possess advanced knowledge of local materials and a profound understanding of social and executive relations with the local community. In the process of stove's-type adaptation, where the authority of the production (and thus production and usability innovation) is in local entrepreneur's hands, the

designer's intervention represents merely the initiative idea facilitation. The key phase of design process unfolds when the stove type is adapted according to each local milieu.

As Adams suggests in reference to the work of David Pepper:

> The environmental struggles (of the developing world) are still about the basic requirements for an environmentally secure life, which is a distant world from the obsession with aesthetic aspects of the environment and the rhetoric of sustainable development planning in industrialized countries. (180-181)

To help understand and work through the implications of the gap in design processes and situations that are usually involved in creating products for use in the developing world, this thesis research sets out to establish a product development process where all environments seem to relate to each other in an independent but connected cohabitation, in somewhat 'inter-independent' relations of autonomous communities. This notion helps to define the concept of what is meant by sustaining *heterogeneity,* which Guattari defines as "expression of desire, of a becoming that is always in the process of adapting, transforming and modifying itself according to its environment." He suggests that 'heterogenesis' is a "continuous singularization" of local milieux where the design intervention is projected (49). The process of introducing a new stove type to or adapting it for an existing cooking system or context represents an opportunity for each local iteration.

Therefore, the eco-centric designer attempts to position him/herself in non-hierarchical relations where his/her authority only *suggests* different

interventions in a form of dialogue. The designer does not try to use the local fabric as his study-field, but lets it unfold through interactions with independent collaborators—entrepreneurs—living in the field. The *autonomy* of these independent actors can play an interesting and important role in the design process, particularly when communication is able to expand on a cross-cultural level.

To realize this change in design process or approach, the concept of time has to adapt accordingly. Strategic thinking in design has to position itself in a more flexible relation to different environments and planning has to adapt much shorter cycles. To this end, I would suggest that we look at the figure of the *vernacular builder* and extend the idea to the concept of a vernacular design process, based on involvement with international networks of briquette-users. David Rapoport's *House Form and Culture* defines a vernacular process as an immediate action, taking place according to the context of the situation in the present moment. And social scientist Henri Lefebvre describes a similar *eco-centric* process using the image of the spider making a web in which the construction of the space is closely dependent on the 'laws of nature': "The relationship between nature and space is immediate in the sense that it does not depend on the mediation of an external force" (172). He refers to 'primitive life' as lived experience and bodily intelligence that exists before analyzing thought. "Intentionality," for Lefebvre, thus represents a "late development" (174). Yochai Benkler, who speaks from the perspective of social networking, suggests that the design process should be adjusted to the situation, and it should not be imposed by the time-based design schedule. The vernacular designer should let the schedule unfold by itself in dialogue with local constraints.

II

> African economies depend on wood-fuels for up to 90% of their energy requirements and in many areas this is having a quite devastating effect on forests. (Bennet, 14)

The majority of the world's population is still using cooking systems that have been known from times when humans started to use fire to broaden their gastronomic repertoire. The assembly of a '3-stone fire' is probably the most fundamental 'product' or representative object that has been used from the beginning of humanity's cultural endeavors. The features of the "3-stone fire" are extremely convenient: the assembly of the stones can be fit to almost every pot, and they can be found anywhere and are super-durable. It is difficult to compete with the 3-stone fire, especially in situations in which rural families cannot afford more efficient products.

The situation that often drives people to rethink their cooking practice is the critical scarcity of local fuel. Most problematic are dense-populated rural areas, where the natural-grown wood has been over-harvested and has resulted in serious deforestation problems and where the prices for urban-fuel (liquid fuels, gas fuels, charcoal briquettes) are too high. Low density, locally manufactured biomass briquettes made of organic waste materials are emerging as an alternative on all continents. Since the late 1980's, many communities have embraced this new technology despite the effort required in the manufacturing process. A great advantage with locally manufactured briquettes, however, is that they can be tailored to specific end uses and make use of different materials and shapes, according to local resources and conditions.

In traditional cooking systems, people use briquettes as charcoal or wood-fuel and simply lay them on top of the fireplace with the hole directing the flames from the fireplace to the pot. The form of the briquette is designed according to the airflow dynamics of the combustion process. The briquette is ignited through the hole, where the flames radiate the heat one against another, as compared to sticks of wood, where the heat is being dispersed away from the fuel mass. This also represents a powerful marketing feature of briquettes, as the effect is visually recognizable. It has been one of the key features when demonstrating briquettes to local communities. People appreciate the notion of the designed, technological advanced modern briquette form because it also represents a step up the social ladder. The hole of the briquette is an important feature or design element for users.

Figure 5: traditional, inefficient cooking systems using biomass briquettes

According to Ian McChesney, a briquette researcher working in the field, traditional briquette manufacturing results in an inefficient burn: not enough energy output has been produced during the first phases of the burn. McChesney as suggests that poorly designed briquettes are difficult to ignite and –they cause too much smoke to be present in the kitchen. In fact, excessive amounts of kitchen smoke, represents one of the biggest health hazards for many communities and individuals living in developing countries.

Recent studies at Aprovecho in January 2009 provided me with an opportunity to further evaluate the Holey Roket design. Aprovecho is a cooking stove research center in Eugene, Oregon, and its basic mission is to scientifically evaluate the new stove models with the help of advanced technology. Research at Aprovecho confirmed McChesney's findings and showed critical levels of carbon-monoxide (CO) being produced in the burn. CO represents one of the major factors of indoor air pollution (IAP) – generated largely by inefficient and poorly ventilated stoves burning biomass fuels such as wood, crop waste and dung, or coal. According to the World Health Organization, IAP "is responsible for the deaths of an estimated 1.6 million people annually" (WHO). These emissions tend to be worse in traditional cooking systems that use briquettes as the only 'combustion chambers' and are, especially bad in open fires. This fact represents a great danger in communities that rely on conventional fuels because they have no way of measuring CO presence: CO is invisible and cannot be smelled, only traceable with advanced technology. Eliminating the CO emissions therefore represents one of the key benefits of improved cooking stove technologies for biomass briquettes and is one of the important contributions high-tech, industrialized design can add to the conversation.

Dr. Larry Winiarski, a technical director at the Aprovecho research laboratory formulated a very basic, but long studied solution to the problem of efficient combustion for traditional fuels. Under the name of the 'rocket' stove, he devised a set of design principles that define the optimum combustion process and improve the heat transfer to the pot. Basic features include the 'elbow' shape of the combustion chamber that allows the fuel (wood) to burn only at its tips, an insulated material for the combustion chamber that prevents cooling down the combustion process, and a precise set of dimensions that help users and designers to optimize the pot rim/interface.

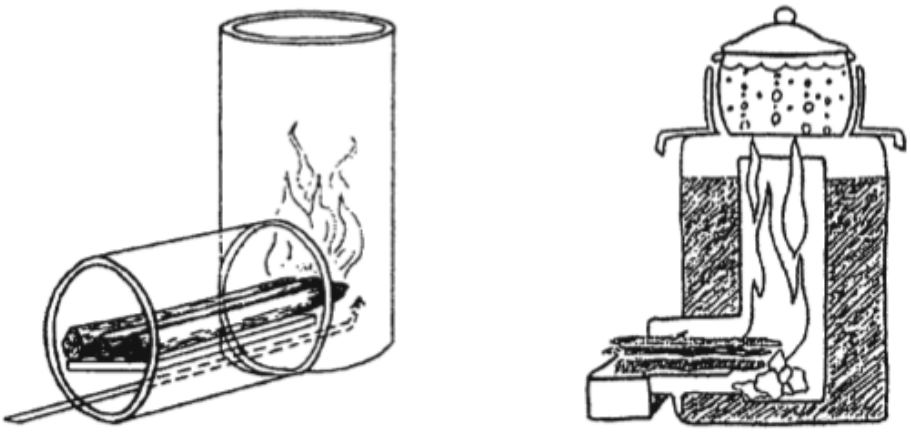

Figure 6: diagram of the 'rocket' stove technology developed by Dr. Larry Winiarski and Dean Still in Aprovecho research center

Holey Roket takes Winiarski's rocket design and modifies it for use with custom-designed, doughnut-shaped briquettes. The name 'Holey Roket' refers to a hollow briquette, or the hole in the centre of it. In contrast to stove systems that use wood as a fuel, the briquette and the stove of the Holey Roket are designed together as interdependent parts in the cooking system. My research in this specific engineering field investigates the construction and material variables of this system. Winiarski's combustion model is one of the existing universal applications that can be used as a reference technology; however, my work appropriating the hollow briquette and designing a cooking system for household use significantly extends an area of stove engineering that has not yet been explored in depth. At the Stove Camp in August, 2008, the rocket technology was applied to burning briquettes as an experiment together with Dr. Winiarski. First tests showed a great potential in this application as the form of the briquette, with its central hole, extensively helped the rocket combustion process. With further research performed through several prototypes of briquette shapes and cooking stoves constructions, the technology was further developed at Emily Carr University and these were again tested at the Aprovecho laboratory in January 2009.

In the Holey Roket prototype, the hole in the biomass briquette provides an essential part of the combustion process. The briquette is pushed into the stove from the side, as opposed to classic top-fed briquettes where the cold fuel-mass directly exposed to flames chills down the fire causing smoke and harmful emissions The combustion process is similar to classic rocket stoves used for wood fuel; however, the refined briquette with its hole provides an extension of the stove's combustion chamber and follows the form of the stove. The combustion of gasses takes place in the briquette's hole before they are allowed to enter the center of the stove's combustion chamber, resulting in an extremely clean burn. This new design with its change in the position of the briquette has the benefit of enabling quick ignition. Incoming air is drawn directly into the hot central chamber of the stove. The burning is very economic and steady, with a convenient option for volume regulation where we limit

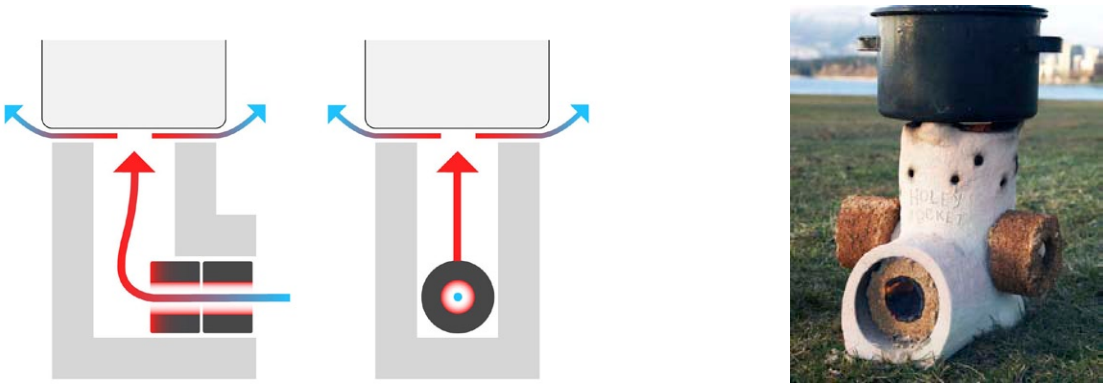

Figure 7: diagram of the Holey Roket stove type: two briquettes inserted in the combustion chamber of the stove body. The air enters through the briquette hole where pyrolysis takes place and continues through the (insulated) stove body to the pot; the dimensions can vary according to different materials and cooking processes

the incoming excess air with blocking the briquette's hole. Also because briquettes are inserted from below, there is no longer a need to remove the pot to feed the stove with new briquettes. This in turn allows the cook to maintain eye contact with the fire.

McChesney recognizes two important factors of briquette cooking systems: first, the convenience of using different fuels with one stove, and the other, the need to combine different fuels in one burning process. This is especially true in rural areas, where people cannot always afford to switch to exclusive briquette use. These issues were important in the development and promotion of the new stove type. Cooking with Holey Roket enables the use of different fuels or even the ability to combine wood and briquettes. Wood-sticks can also be inserted into the hole of the briquette, which allows them to maintain higher heat output further in the process. This capacity to burn different fuels is also useful in the ignition phase as wood burns faster.

Figure 8: process of making the Holey Roket using plastic pipes to make briquettes

The construction of the Holey Roket's ceramic body is based on many existing technologies, but the stoves conception was based on no drafts whatsoever. Its basic form is a mold that represents the exact same plastic pipe that is used for

> Primitive's people indicators of measurement remained purely qualitative in character (Levebvre, 1991).

manufacturing briquettes. The clay is mixed with sawdust (or ashes, vermiculite, pumice-rock, rice-husks) to improve the insulation and represents an essential feature of the stove material. When the stove is fired in a kiln, the sawdust burns out, making tiny air-bubbles that insulate the stove body from cold air. The combustion chamber is constructed by simply piling clay mixture around the pipes in the same thickness, left to dry and fired in a kiln such as that used to make building bricks, which is the one and only truly universal manufacturing enterprise in rural areas of developing countries. Originating the idea of stove design and development based as much as possible on briquette production, this makes the best use of an available resource at hand. All the product development sketching took the form of 3D prototyping because the only viable way to proceed under the circumstance was to develop a functioning model. The making of the prototype without paper, but relying on our perceptual, memory and skill sets, and using existing materials at hand, is consistent with a 'vernacular' building process. Paper-drafts and careful calculations are being replaced by rough estimations, recognized on higher gestalt levels of a cooking system as a complex set of interdependent variables at play. Like with the vernacular process, the development was a manifest of a direct action, an "unselfconscious translation in physical"(Rapoport 2). The design process is one of models and adjustments or variations. According to Rapoport, the vernacular process was supposed to be a profoundly flexible precisely due to its non-fixed, not measured reality. It adapted a tradition-driven generic product type according to local environments and let the user depict its final function with the actual participation in its conception and final use. The concept of designing a *type* can thus be extremely resilient and able to adapt to and sustain the heterogeneity of local environments where the stove is being adapted.

Figure 9: overview on the prototyping process of the Holey Roket tyipe. Following from top left: 1. A functional improvisation model at Aprovecho Stoves Camp, 2008. 2. A ready-made combustion chamber from a ventilation pipe. 3. An aluminium mock-up of the 'elbow' design. 4. A clay/sawdust model with plastic pipes; 5. The same model in action. 6. Briquette holders provide dry and warm briquettes before burn; 7. The front door provide a simple but efficient fire-volume manipulation. 8. Introduction of the rocket principle to WWF's Mdula stove. 9. A thicker-wall version of the stove for slow-burn performance and improve heat transfer to the pot with a wider top rim. 10. An attempt to test double feed with inserting two briquettes from opposite sides to improve the heat output

Regular use, that is cooking, was an important part of the design process and the continuous development of prototypes of the Holey Roket. Cooking is and was a continuous testing practice. It was a rather representational action of the *lived* experience of the designer and functioned as an alternative or addition to conventional product design and the dependence on scientific, goal-oriented testing. In November and December 2008, Emily Carr University facilities at 1612 West 3rd Avenue were used as a household space where briquettes were made and meals cooked on the everyday basis. The complexity of meals cooked evolved with cooking skills, starting with simpler recipes and shorter cooking times. At first, meals were consisted of simple items, like instant noodle soups, marshmallows or sausages. When basic manipulating skills with fire were accomplished and the prototype improved, there was time and ability to cook more complex recipes, like rice, cooked vegetables and sauces. Approximately 20 cooking sessions were performed with more than 80 briquettes burned.

Figure 10: a 'household' cooking space at ECUAD studio space on West 3rd Avenue: Roket Mdula stove with a carpet, Holey Roket stove, improvised briquette-making

A more qualitative approach to the testing practice provided a rich body of knowledge directly related to the designer/cook's experience. The information and knowledge developed through practical use provides an important experiential background for the designer, which will enable a sincere communication with the users in the field. Even though meals, ingredients and cooking processes will be different, the experience of working with the stove will help give the designer a shared vocabulary with users in the field and has been valuable to the development of prototypes.

In addition to everyday experience with the stoves and a commitment to vernacular design process, I had the opportunity to test aspects of the Holey Roket in a state-of-the-art research facility at the Aprovecho research center in Eugene, Oregon. I call this part of the experimentation "scientific cooking."

So far, low-density biomass briquette burning was undergoing very few laboratory-based tests. Briquette fabrication represents many variables, including locally differentiated briquette materials with radically different burning properties, different weights or densities of the material and the production of char residues. Using a one-recipe approach is unable to not provide results that can be guaranteed in the field. Despite this fact, one test was performed at Aprovecho in 2007, using one stove designed to burn wood that has never been used with briquettes in the field and the other designed by Joel Chaney, an engineer at the University of Nottingham, to work solely with biomass briquettes. This comparison test with solid briquettes proved that briquettes with a centre hole were much more efficient in terms of output power.

Tests were focused on emission exhaustion and heat output. The tests used the Enerac 3000E, a computer designed to measure the air-flow of the combustion process and providing with detailed statistics of the current heat output and CO emissions. This state of the art performance/emission tester, specifically designed to test low-powered biomass cooking stoves, was extremely useful in helping add to knowledge and information about the burning process, especially on Carbon Monoxide (CO) emissions. Following the qualitative testing in Vancouver, the live-feed data was used to monitor the current process to see if the measured output matched my initial observations. The use of Enerac enabled a dynamic dialogue in

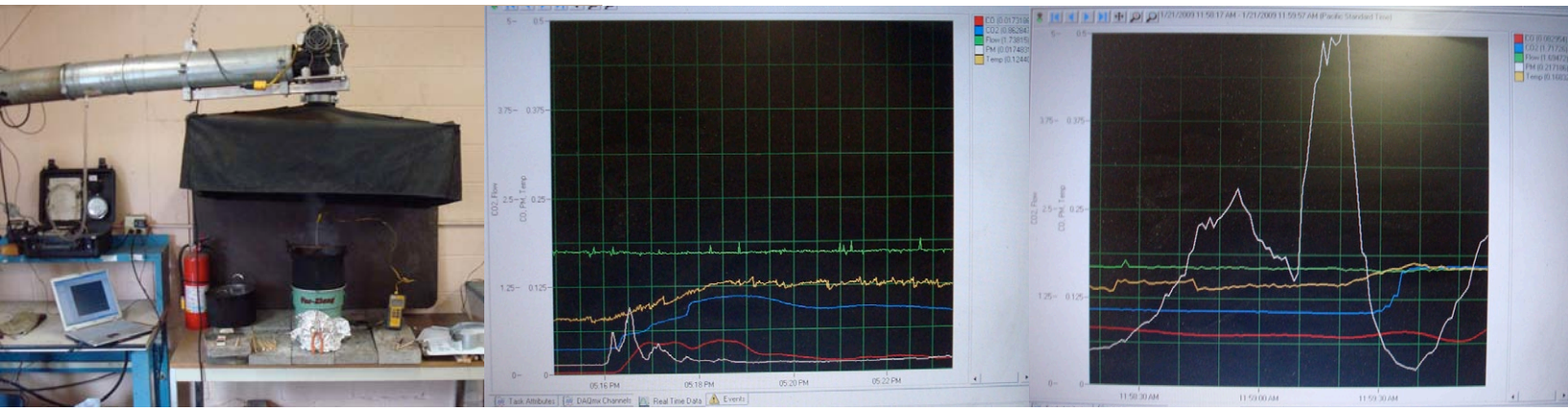

Figure 11: emission testing at Aprovecho research center: Enerac 3000E, live-feed data: CO (red), CO2 (blue), PM/smoke (white), flow (green), T (yellow)

which learning was pursued through introducing disturbances to the burning process and read how the system reacts. These tests were very useful to find out when the CO would appear, how CO levels relate to the stove's heat output, and how we can avoid or reduce CO emissions with different interventions to the fire. This scientific information is critical because CO is impossible to detect in regular use. One of the key challenges of this stove development design has to do with informing users and entrepreneurs about CO emissions, or better, to embed the functional solutions into the model so they can copy it when adapting their stoves accordingly.

Different stoves were tested, sourced from Aprovecho's global stove-library. Each test was consisted of 3 briquettes made of the same material with about the same weight (100 g), boiling one liter of cold water without a lid and simmering it till the fuel was providing enough power.

Figure 12: tested stoves: '3-stone' fire, Aprovecho 'China' stove, Holey Roket, Larry Winiarski rocket stove (Nicaragua), an improvised very high combustion chamber

My active participation in introducing disruptions to the burn process helped me to better and faster understand the pattern of briquette combustion. The live-feed data provided a detailed reading of the process that was not possible in my initial visual observations. I wanted to imaginatively examine the awareness the instrument enabled for understanding the burn. Referring to Peter Senge and his description of the notion of scientific measurement, I acquired a position of a 'native realist' as someone who "intuitively experiments the process" (196); therefore, with continuous shaping my knowledge and immersion in the process *I became a prototype myself!*

"Staying connected to the larger will while in action builds on the capacities for 'sensing', 'presencing' and 'crystallizing' intent: the capacity for prototyping isn't actually separate from these but includes and grows from them. The result is action shaped by the field of the future rather than by the patterns of the past" (148).

This shift from the classical testing practice points towards opening stove's implications to new emerging contexts, not to close itself on its measurement statistics as "it can easily become elevated to a sweeping generalization about reality" (192). Diverse experiences will be valuable in consulting the briquette performance to different, yet unknown environments. As the process as such is tied in its immediate environment, it lives independently from the actual product type implementation, but because it is tied up with the designer's subjectivity, it works as an investment in his knowledge accumulation. Senge articulates this qualitative, tacitly acquired knowledge as 'the sacred mind': "the unbounded awareness within which all individual experiences occur, the living matrix where minds meet and engage" (Senge, 161). What is crucial is that the information from the tests will be immediately shared through the network of designers and users connected to Legacy Foundation 'briquetting community', rather than protected as proprietary knowledge.

III

When we address the process of product development and the communication of these ideas to remote environments, we have to distinguish the process of *adaptation* of cooking stoves from their *implementation.* With implementation, a certain design model is developed and distributed as a finite product. One of the world's biggest stove manufacturing projects signifying this concept was revealed at the 2009 ETHOS Stoves Conference in Seattle. It initiated in 2008, when Aprovecho researchers were able to come up with a universal solution of the 'rocket stove' that is capable of covering the majority of global cooking methods. Manufactured in China by one of the biggest traditional pottery makers, this stove model is of high quality and can be distributed for a low price. The other scenario of stove implementation is one conceived by Philips Design, which developed a very efficient but expensive stove innovation. Philips devised an ingenious stove burning waste material with a help of an electric fan that powers itself with the actual waste-fuel being used for cooking. A significant endeavor of this project is how Philips, being a large global corporation, is able to re-appropriate the economic system of local, rural environments with their own, locally based micro-financing grid so people can purchase the stove with a loan. These two projects currently represent the biggest universal improved stove introductions in the history of developing countries and are still in their starting phases.

My 'Mdula' stove project, an earlier stove project conceived for WWF in Malawi in 2003, involved the development and implementation of a stove 'recipe' that would allow local users to create home-built stoves that were fabricated out of mud with the help of a simple wooden mold based on pre-set measurements. This project represents an important change in the design process, switching to the information transaction as a basic tool to communicate the product. However, Mdula project is still trapped in a static, non-resilient focus on the product form. Thus the Holey Roket

stove, which still essentially a recipe, endeavors to create or work within a situation or network that will allow for continued development of the product as it is adapted to/by locally existing technologies, available resources and labor. In this process, based on the open-source collaboration, where the users conceive the final product according to their needs and desires, the designer is a facilitator of the idea and a consultant in the further phases of the process. The design methodology developed with this research represents an attempt to move beyond the dominant mode of industrial design, which tends to be based on a system of proprietary knowledge. The conventional notion of intellectual property has no particular value here; instead the stove type is intentionally designed to be copied by anybody, with technology exposed and open to adaptation. The process of adapting the stove type to the local environment represents a key element of the design process. Demanding commitment from the local entrepreneur and an openness to simultaneous innovations by remote users, this project expects that the final product design will be taken away from the ultimate control of the designer. The project is successful when the design is taken up and adapted to fit the social and economic needs of local users.

The relational bonds between people in the work process in the developing societies functioned with little or no differentiation in the use of space and labor, where the initiatives and actions were taking place everywhere. According to John Zerzan who elaborates on the values of 'primitivism', hunter tribes existed on a very non-hierarchical, autonomous level for every individual taking various functions, but all food and commodities were collectively shared. A design structure sourcing from this concept challenges a classic categorical separation between a user, designer and manufacturer. All people are being independently engaged on all levels of the (adaptation) process. Philosophically, my understanding of the design process thus

borrows from the writing of Ulla Johansson, a radical social scientist who based her ideas on Mary Parker Follet's work: (1868-1933). Johansson proposed that human beings are a holistic entity. Her knowledge draws on Whitehead and Hegel, as well as on chaos and complexity theories, and she has worked as a strategist, working for H&M and IKEA. Johansson's suggests that design leadership should be recognized as a type of *behavior*, rather than as a *role*. In her thinking, the social context of design is extremely important. Designers bring specialized knowledge to the process, but the context appropriates that specialized knowledge and uses in conjunction with local genre-de-vivre.

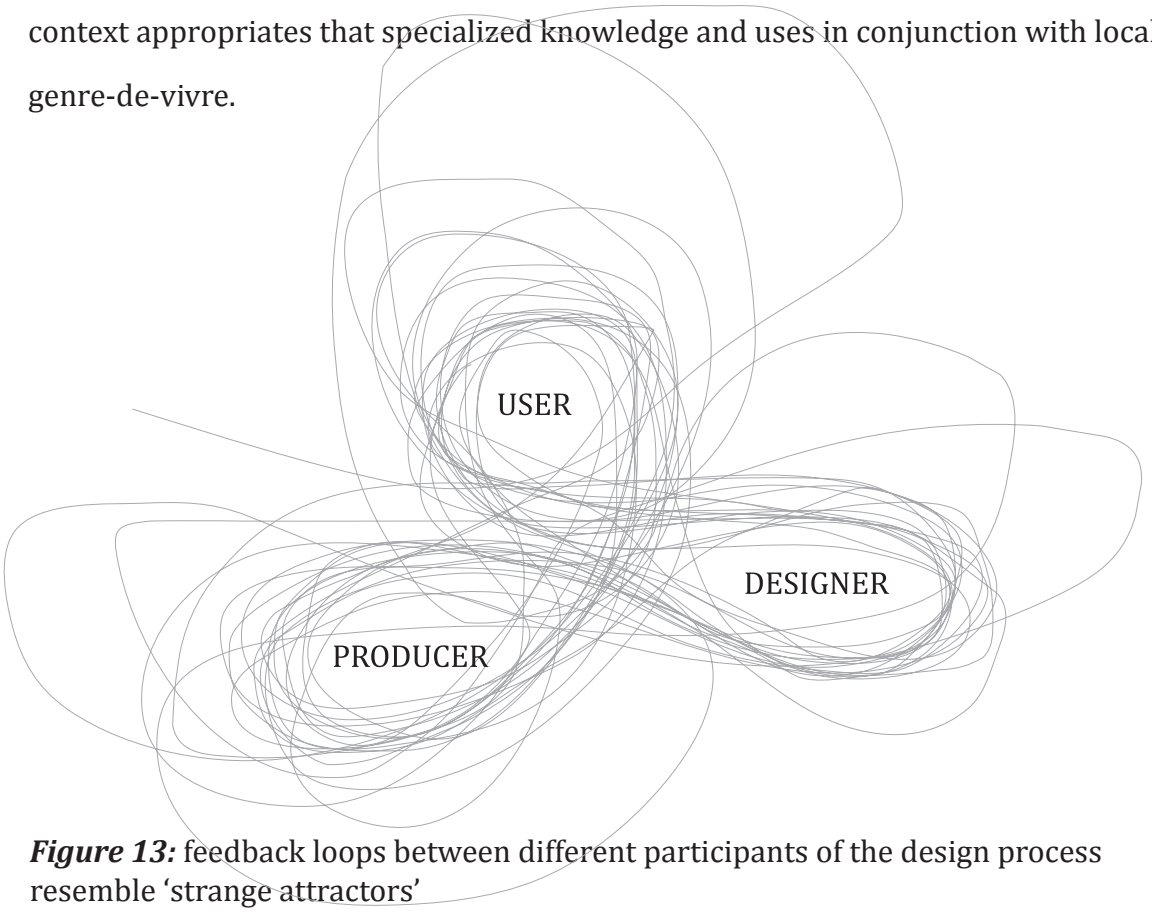

Figure 13: feedback loops between different participants of the design process resemble 'strange attractors'

Another interesting and exciting idea that might be related to this design process with regard to understanding and developing dynamic relationships might be recognized in the concept of the 'strange attractors': relational fields of juxtaposed simple mathematical equations. For these relational systems, introducing small (and possibly diverse or even contradicting) bifurcations to the process is essential, where it is not the *critical mass* that nurtures the idea but a *critical relation*. Margaret

Wheatley, who speaks of 'open systems' states that "when a system is non-linear and webbed with feedback loops, repetition feeds the change back on itself, causing it to amplify and grow" (120). "In a non-linear world, there is no relation between the strength of the cause and the consequence of the effect "(121). When the system is far from *equilibrium,* singular or small influences can have enormous impact. The stove adaptation process is based on feedback loops between participants managing its development. Loops travel out of the designer's range, coming back or just getting lost in the field. This represents a shift in the perspective of the role of the designer. Again the design context plays the role of the protagonist. For Wheatley, the idealized plans are not effective, since they plan to re-appropriate the environment. Or they use enormous energy, like the Philips stove project. The fluctuations in social relations are essential to the process; anything that "disturbs the system plays a crucial role in helping to self-organize into new form of order" (Wheatley 87). As Johansson writes, these social situations should take precedence over principles: "what is required for the situation at hand should be the ultimate order" (Johansen, 2008).

Following Mary Parker Follet's work, Johansson suggests that the design process should be less analytic and more holistic and iterative. She constantly moved between the individualist and collectivist perspectives (personal contribution to a collective thought) as a vibrant place to suggest ideas. Chaos and structure should always collaborate in contradictory ways, and the design process needs to allow itself to be open to *coincidences.* The sparks of new ideas initiate with the introduction of random elements into the design process, but to realize the powerful potential of these sparks we have to be free of conventional product design constraints. Through the process of continuous improvisation, we have to open to planning for future developments and innovations by the users.

We can identify many commonalities of the unfolding process in this paper with Participatory Action Research (PAR). PAR is a methodology that is situated within counseling psychology and involves a primary relationship between researcher/

counselor and a community PAR might be used as a qualitative approach to (design) research practice, it believes in a dialectic movement between action and reflection, where the people being studied have control in defining the relationship with the researcher. More than a method, PAR defines a designer attitude towards the context, and it potentially "requires the researcher to alter beliefs that are entrenched in Western culture" (Sean A. Kidd, Michael J.Kral, 188). According to this definition of PAR, the relation of the designer to his/her participant is inextricably linked to action and needs of a particular community, blurring the hierarchical separation between the two. In the case of a cooking stove *adaptation,* the designer's behavior is taken further as s/he is in parallel relation with the participant. Like the local entrepreneur, the designer contributes his product and his accompanying local milieu where the product has been developed (in this case Vancouver). He is integrated in the process, can reflect to the other and is therefore a valid participant on a non-hierarchical, non-anthropocentric level. This is an essential part of the designer's credibility.

According to David Rapoport, work unfolds within forms of personal relationships, with a great respect to other person's needs and desires, and paying close attention to the local environment. The process is performed in "the simplest, most unobtrusive way possible, with a lack of theoretical and aesthetic pretensions" (5). Vernacular work is driven by the traditional knowledge and a heritage accumulated through years or even generations of working (and design) experiences. The stove with its distinctive, but locally adaptive construction type carries with it certain social patterns that are similar to Rapoport's concept of the vernacular, but coming in a much shorter time-frames and various geographical positions. The designer is the expert, but his or her collaboration with local entrepreneurs is integral to the design process and sets the final product form. Vernacular design might be seen as a process of working within a given order that is *as cultural as it is natural.*

An interesting and inspiring idea comes from thinking of stories as products. According to Alenka Goljevsek, the Slovenian writer who writes about folk ritual, every

teller presents a new original version of the story. What is useful here is the notion of the teller's contribution to the tale that becomes a new entity that can be very different from the 'original.' In the individual telling, only structure (or type) of the story remains the same; the story is different. Time and space add new dimensions to the tale, as the tellers contemporary spirit updates the content subconsciously – when he forgets a detail, he adds something from his own experience, or he adds a detail to retain attraction for the listener. The specificity of the supposedly 'first' tale (which we never really know), takes off with different interpretations leaving the first one behind, creating new entities. The Holey Roket Stove aims at a similar process. That is, it imagines a social process that is marked by 'tradition', where the Holey Roket represents initiative content that is capable of accumulating different interpretations in the continuing process. The vernacular designer doesn't posses the power to lead the process. Instead, the vernacular process bifurcates and lives on its own as users become responsible for new design elements.

An essential factor of an adaptive and vernacular design process is to build new knowledge based on the use of existing materials and social relations. The stove project initially started with an existing network of local entrepreneurs who are working with biomass briquettes and who have established relationships with end-users and stove manufacturers over many years of briquette manufacturing practice. The Holey Roket was prototyped to a stage where it can be applied to environments with complex, existing infrastructure and where it can help suggest adaptations to existing cooking systems. Currently, four briquette centers are developing the model out of different materials but according to my suggestions: DR Congo, Chad, Tanzania and Cambodia. Each of these centers represents a different network of researchers, communities, and other interested parties: the stove project in DRC is running under

project Katudu, which helps sexually abused women in DR Congo regain confidence through briquette manufacturing as a 'social' micro-enterprise. Mark Heath, working in Chad, has taken the Holey Roket model to the stage of a commercially available final product. In Cambodia, the Holey Roket is in experimental stage, where a local pottery expert is sophisticating the clay material to achieve best performance. The stove will be part of the Grady Grossman school program, educating kids in sustainable development. Mr. Bosco Epila, situated in Uganda has tried first prototypes, but the briquettes failed with burning and further consultation is expected. The project in Uganda was introduced by Legacy Foundation as part of their 'training of the trainers' process for making briquettes in the local community in Kampala.

Regarding progress of development phases, I will use DR Congo and Chad as representative *case studies* to inform the theoretical inquiry from the practical perspective of stove adaptation process to the local environments. Mark Heath, a research-entrepreneur working with briquettes in Chad, developed a metal version of the Holey Roket model. In his scenario, pictures of two existing models were sent from Chad, where the rocket principle was adapted to the stoves with a new, side-feed introduction. Since my work with metal stoves is somewhat limited, I only suggested the basic intervention to the construction: the side-feed. Heath has since taken the model to the next level, where he recognized the need for a briquette support that functions like a grate. His estimation was oriented around the space where ashes would be collected as his experiences with briquettes were based on a long cooking. With this feature, the ashes are collected in a small chamber under the briquette.

Virginia Echavarria, a Portuguese entrepreneur located in DR Congo developed a metal Holey Roket model with the help of local craftsmen. The outcomes were somewhat surprising. I suggested they redesign one of their ingenious, low-cost bucket stoves, which could be, from my point-of-view, easier, quicker and more ingrained within the existing production, but the photo was more suggestive as a ready-made functional model. The construction of the metal stove was closely copied

Figure 14: Chad Prototype; an existing stove; a sketch over the photo to suggest the construction adaptation (part of the Creative Commons initiative); the prototype of an adapted stove (photo: Mark Heath, February, 2009)

Figure 15: DR Congo prototype; a metal prototype from Vancouver; a local entrepreneur; the new prototype in Congo (photo: Virginia Echavarria, December, 2008)

at the bottom part from my photo of the first metal prototype made in Vancouver, while at the top, the craftsman has taken more freedom and designed a complex set of round, bent metal beams and made a pot stand. The briquettes were burning slowly due to the fact that the burn hole was too small and did not provide not enough excess air into the combustion chamber. New briquettes are being made to pursue further testing.

The innovation, the alternative use of briquette 'side-feed' is visually recognizable and presents a curiosity, thus it functions as internal motivation for the entrepreneurs to experiment with the design within their own locality. The combustion principle is so clear, that usually no questions are asked about it but rather immediate prototyping takes place. The designer no longer posses complete authority for the project. The designer's intervention is expanded by the local initiatives at the very beginning of the adaptation process. It is essential though to recognize that feedback loops and information sharing are regular aspects of the design process following the first phase. Some product features demand attention to detail, especially in aspects of dimensions, materials and relation to local briquette recipes. Experiences of the designer and other users in relation to burning different briquette systems come into play here. If the function of the entrepreneur's design is not discussed, it is possible that the new system might not work optimally, and enthusiasm for further implementation of the new type might stop. Thus, communication networks are a vital part of the Holey Roket design process.

This design project aims to further implement the Holey Roket technology in several other local communities and environments, and it is primarily focused on briquette centers with most experiences and largest manufacturing output. These centers represent a development space for other 'followers' to become active in sophisticating the briquetting technology. East Africa currently represents a major stove and briquette development context. During my recent visit to Kampala, Uganda, new relations were established with Deutsche Gesellschaft fur Technische Zusammenarbeit GmbH (GTZ) (on behalf of the German Federal Ministry for Economic Cooperation and Development) which is forming a new research center, similar to Aprovecho in Eugene, Oregon. Further work with the Holey Roket will unfold within this center, and the GTZ will provide an immediate environment of development where the local community might take over the scientific development endeavor.

IV

> "(...) a product that a user-innovator develops and freely reveals might be perfectly suited to that user-innovator's requirements but less well suited to the requirements of free riders [those who take from the discussion without contributing]. Innovation communities thus illustrate a "private-collective" model of innovation incentive" (Von Hippel 11)

Eric Von Hippel addresses user participation within 'open-innovation' networks in an interesting way by speaking of very personal contributions from innovators' own local development milieu that are not perfectly available for 'free-riders' or other users. Following this, we might theoreticize that other users have to participate more actively to successfully implement the user-innovators idea. Simultaneously, that these committed users contribute their own personal milieu to product development. Hippel aims at showing how the virtual networking enables or even demands recognition of heterogeneity in product development process.

Household Energy Network (HEDON) is a stove resource network, where people can source information about stoves from a collective knowledge database and join the discussion group. The debate is very vibrant (5-10 messages daily); the critical mass of participants has grown rapidly over the last few years. All the information is collected on one web-site (http://www.hedon.info), but the discussion of participants is somewhat separated from the representational space of stoves 'exhibited'. Briquette Google group (http://groups.google.com/group/fuelbriquetting) on the other hand represents a much quieter space, where discussions usually unfold with accompanying visual material. The community consists of a much smaller number of participants and the relationships are more informal, sometimes even personal. This allows for

the sharing of even smaller-grained contributions and the involvement of participants with less technical experiences but valuable micro-information. As an extension to the Google group network, a personal weblog Mdulastove (http://mdulastove.wordpress.com), documents the process of developing the WWF project of 'Mdula' stove and later Holey Roket stove. The virtual space is set as a working architecture: continuously rebuilding itself as a side-product of the development consultations involved in adapting the Holey Roket stove to local environments. The focus of this weblog is to carefully document the residues of the design process whether in-field or in the virtual space. Guattari marked this moment as *capturing* (the work)-in-time. The design process stays immediate in its nature, while its consequences are mapped according to what already happened or is still happening and used in further development process. The space functions as a virtual library database, a tool for the designer communicating ideas. It's available and usable for the public, but its reality is bound to manifest design as service, a consultation.

More than merely offering a generic 'open-source' platform to other active members of the community, these virtual networks allow the designer to participate on the same hierarchical level with local entrepreneurs and to share his own set of specific skills, contributing to and sourcing from the common shared material. With active participation, the designer is directly engaged in collective production and adopts a user perspective himself. The designer's immediate environment thus contributes its own diversity and requires 'free-rider' entrepreneurs to adjust the innovation features according to their local milieu using their-own skills and local resources. The product development thus depends on each individual environment and its representative.

Designers act within socio-relational systems and their work often functions on the basis of micro-initiatives. It is a profound difference from strategically planning larger-scale product designs with its focus on developing the process of *heterogenesis*. Each local milieu develops their stove from the ground-up, accumulating its material

within a time/space frame. In *Shaping Things*, Bruce Sterling calls this specific history of a product or environment a 'meta-history': a historical inscription of geographic, socio-cultural material. Designers cannot control it, but they can access feedback on micro-interventions.

A very useful extension of this concept comes into play with Yochai Benkler and his book *The wealth of networks*, where he addresses 'open production' in contemporary networking systems:

> we are seeing the emergence of a new folk culture—a practice that has been largely suppressed in the industrial era of cultural production—where many more of us participate actively in making cultural moves and finding meaning in the world around us. These practices make their practitioners better "readers" of their own culture and more self-reflective and critical of the culture they occupy, thereby enabling them to become more self-reflective participants in conversations within that culture. *(Benkler 15)*

Benkler offers an excellent contribution to the process of dealing with the *heterogenesis* of local environments similar to those engaged with stove development project. Virtual environments represent a convenient space for participation, which do not need to be bound to external time frames. Entrepreneurs just don't respond if they don't feel the need. This instance sustains the autonomy of the remote environments.

The design process necessary to developing a satisfactory functional product might take up more prototypes, as models are adjustments or varied. But the quantity of prototypes here can represent a valuable richness for other centers from different cultures. The diversity of skills across cultures has great amplitude on a material or construction or usage level. Nigel Thrift speaks of how new spaces for innovation might turn up anywhere, and how they bifurcate according to particular conditions. Re-appropriating Elizabeth Sanders expression: 'the fuzzy front end' (of the design

process), we might think about a 'fuzzy never end': a process of *continuous fluctuation,* as Wheatley, referring a scientific metaphor, might put it.

Through virtual networks, design features are altered through information transaction. Benkler speaks about the great convenience of participation in the virtual space: the Internet architecture represents a more informal and finely grained structure that allows micro-contributions. Networking evolved through the recognition of this need by users themselves. It allows smaller innovations to be shared and potentially amplified and used in other contexts. This turned out to be especially convenient for new stove-entrepreneurs who are yet not recognized within the virtual community but who have valuable knowledge to contribute to the discussion. Informal social relations get stronger and support this process by ignoring formal social or economic constraints that are external to the local community. Benkler refers to Maurice Godelier and his book *Enigma of the Gift,* where he speaks about the essence of the social exchange in both, the modern and the ancient societies: "The mark of the gift between close friends and relatives (...) is not the absence of obligations, it is the absence of calculation "(Benkler and Godelier, 109).

In the world of advanced capital, the switch to exclusive gift-economy seems a rather vague and fuzzy medium for work-related information exchange, but in some 'peasant' societies it was a very crisp relation that was based on respect for tacit knowledge. The point is that even if social exchange does not require formal defining of gestures "it still requires tremendous investment, acculturation, and maintenance. But once functional, however, social exchanges require less information crispness at the margin" (110). Benkler is surprised social production is ignored as an economic phenomena, even though it has a great deal of influence on the work done. Stove network and the relation are first and foremost based on social production and internal motivation of the entrepreneur to initiate the product idea in his or her environment.

We can recognize the emergent independence of participants that is being enabled by virtual networks. The 'peer' contributions on the Internet are very diverse in their quality, quantity, and focus, in their timing and geographic location. Its not that the designer would constructively departure from authority altogether, he doesn't even have the access to the control of the product or design process any more. From the product perspective, this can be a very romantic notion, and you never know where your project is being developed, in what kind of a bifurcated state it may departure or exist. The adaptation process will not be limited to a single effect, but is likely to spread out in ever-widening patterns. It may be amplified by interdependent feedback loops, which may completely obscure the original source. Legacy Foundation has distributed over 1000 'e-manuals', describing the process of initiating briquette manufacturing locally, and this has proved to be a very efficient tool to spread briquette technology. The series consists of eight issues, ranging from purely technological to more entrepreneurial skill-sets. The text is easy to access and understand. Legacy Foundation keeps a very well followed prototyping community of 5-10 biggest manufacturing centers, where 'training of the trainers' is taking place and the most in-depth feedback is tracked. The information is shared globally as an open-source variation, where the results cannot be tracked anymore. The design process "by increasing the rate of innovation and invention through the acceleration of connective mutation" (Thrift 281) is not defined in relation to a final endpoint. The production process "has no final goals, no natural target or final user, but rather continuously feeds on itself" (Thrift 295).

V

> Open innovation' cannot be seen only as one of the next big management fads but also as a means of challenging current property regimes by building new kinds of creative commons through a wider culture of knowledge (Thrift 301)

Thrift suggests the new form of *efficacy* (of the design process) lies somewhere between business and art with three main deportments: *epistemological, economical and aesthetic*. Following Thrift, the Holey Roket stove development has come to depend on open-source sharing of design ideas and information with users and entrepreneurs as actual designers in the field. This innovative approach to product development, with its background in ecosophy and a radical, non-anthropocentric positioning of the designer as an educator or facilitator of specialized knowledge, attempts to challenge current property regimes and the conventional process of product innovation. What we might call a *milieu-centered* design becomes remote from the designers intentions and positions the project right in the middle of Thrift's design process efficacy definition.

In the development of Holey Roket as an *open-source* design project, the interdependent relations between the object in development and the space where the process unfolds was addressed in a way that finally challenges the physicality or primacy of both. Moving the design process into a virtual space enabled the stove to become dematerialized information that consists of many models: prototypes and final products but represented by one single stove *type*. In the historic vernacular, a cooking stove type represents a development of many product generations through a dynamic, ever-evolving process of adjustments. With actual use (in dwellings and as tools), users themselves finished the product development, or the product remained

at the prototype phase and their existence continuously changed or developed over time. In a local vernacular, the Holey Roket stove type exists in the space of the virtual through an emerging open-source database, that is becoming ever more resilient with entrepreneurial participation. This somewhat *experimental design ecology* is based on continuous interactions with diverse users, and this has resulted in greater emphasis on rapid experimentation in the production process.

Novelist Bruce Sterling fictionalizes the open-source product development in the virtual space, taking the concept to its ultimate ends. In *Shaping Things* Sterling shifts the locus of production to consumers, and he demonstrates how users' intellectual labor can itself be a powerful source of innovation. With rhetorical inventions like *Spime, Wrangler, Meta-history* and *Synchronic society*, his terminology is also useful within the Holey Roket project definition. According to Sterling's fictionalized design process, every Spime represents a product that has been *wrangled* – discussed and developed through feedback in the virtual space by *We - wranglers* – individuals who surf Internet and engage in product conception and development. Thus, Holey Roket represents a product that is currently being wrangled by entrepreneurs in specific local environments, stove community members, designers, or other interested individuals. Every stove model contains (and is continuously forming) its own *meta-history* – a time/space related description of it, a database documenting its failures and successes. This information or feedback loop than constitutes the future of the product design and development.

The stove community is composed of diverse cultures participating in the process of adaptation that is both actual and virtual. This community is what Sterling calls a *synchronized society* that synchronizes multiple histories of the stove *spime* and enables the product to evolve in time and space as information accumulates. In Sterling's vision, the conception of a shared dialogue and database overrides the conventional ecological process of design, a process that tends to be bound to control and inspection of the designer who is outside the circuits or communities of use. The

virtual environment formed as a weblog or Google-group enables storage system that is capable of remembering failures as well as successful design adaptation. The Holey Roket design process recognizes that in different contexts (times or space) that may represent great opportunities for further development or innovation.

For advocates of open source development, the level of progression, credibility and ethics of 'wranglers' far exceeds the power of corporate or private product development initiatives. The users that contribute to specialized networks about the product development usually represent expert users who are often more capable or committed than employees. The virtual network represents a decentralized organization for development that is better able to respond to the needs of users and entrepreneurs, outside of the economic or political situations that tend to define corporate relations. Returning to the writing of Henri Lefebvre, we might say this that theoretical and practical foundation is aimed at constructing an autonomous and dynamic *representational space* for product development. In this space, designers might practice the making of stoves as a *continuous consultation* or *collaboration* with briquette manufacturing centers. Thus, a lived and creative (social) space has been constructed, similar to what Lefebvre signifies with his definition of a *peasant dwelling*: "No matter how prosperous or humble such a dwelling may be, it is as much a work as it is a product, even though it is invariably representative of a type. It remains to a greater or lesser degree, part of nature. It is an object intermediate between work and product, between nature and labor" (83). It is simultaneously "immediate and mediated, given and artificial" (84).

Biomass briquette use represents a direct reflection on Lefebvre's description of the dwelling space in which the household is engaged in processing organic waste material and making mud-stoves on the basis of a local vernacular. This notion of vernacular design extends its implications to *mental, environmental* and *social ecologies* (Felix Guattari): the ephemeral stove and fuel life-cycle together with production provides people with a better understanding of the natural material-

flow where waste material becomes a precious and respectful resource. Briquette production establishes community settings where ideas are exchanged, fostering simultaneous innovation in the vernacular sphere. In addition, the *new design space* resides in the new virtual-vernacular extending its implications across an alternative time/space paradigm. My research suggests that the designer should no longer be thought of as the employee of a particular corporate or organizational strategy, but instead he or she much be understood to function within a very diverse and open-social structure. This space might incorporate individuals and groups as well as users and engineers, and people working in so-called developing and developed countries. This design strategy opens itself to embrace the ubiquity and ambiguity with its extensions in the *unknown*, remote situations—material and social—where the designer has a limited access and essentially no control to strategically modify according to a systemic plan. Ultimately, it is design space that unifies these fragmented or scattered product-histories while simultaneously constructing a new *synchronic society.*

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