My concept on a larger scale has worked both nationally and internationally to address the new set of the United Nations Sustainability goals. It has also tackled the more specific proposed focus points of the ASCE Student paper competition, “Thinking Globally Acting Locally”. In this two part paper we will be outlining how my idea tackles each individual goal with specific case studies of the wide range of uses. You may be sitting there asking yourself so what is the idea? How can a single bullet be used to address every aspect to sustainable development? All of this seems too good to be true?

What if I was to tell you that the primary issues we are facing come down to just access? Let’s start with just some general statistics. According to UNESCO, as of right now 1.1 billion people in the world lack access to safe water supplies and 3 billion lack basic sanitation. Millions of hours are spent collecting water from polluted sources. 61 million primary school-age children where not enrolled in school this year and those living in rural environments are twice as likely to be out of school. Almost half the world, approximately 4 billion live on less than $2.50 a day. 1-3 children don’t have access to adequate shelter and overall approximately 10.6 million die before they reach the age of 5. To top it all off Over 2 billion people live without electricity and in some places almost a third are malnourished and another 2/3rds don’t have access to internet. As you can imagine from the image we just created your probably sitting there going okay so now we are talking, economics, education, energy, transportation, infrastructure, housing, agrarian systems and internet. So what could be so grand that it could help with all of these and do it in a way that allows the communities to create sustainable economies of scale?

Though I am not Jewish I have a great quote which we have all heard before, as you read this paper I want you to come back here and say this quote out loud,

“Give a man a fish and you feed him for a day; teach a man to fish and you feed him for a lifetime”-Maimonides.

My proposal is not unique, only slightly sexy but has the potential to make almost anyone a fishermen in any geophysical space on this planet and can be tailored specifically to a communities sustainable development goals. Through my work in the non-profit sector I have been on the ground and had lots of success with issue relating to community resilience. Of the successful non-profits I have helped build one unique possibility exists, is cost effective, portable, and be used to tackle any issue you throw at it. Being active in the international community of makerspaces, and watching various renditions flourish I feel compelled to propose a scaled down version of a manufacturing cooperative in an air droppable shipping container. Organizationally a manufacturing cooperative is a social enterprise working for the benefit of its members with any surplus generated being reinvested back into the Co-operative.

The cooperative manufacturing model mixed with the access created through a well-designed portable micro-factory facility with an emphasis on inspiring communities to come up with sustainability solutions specific to the needs of that community while simultaneously linking the deployed facilities to each other for skill share makes this the only cost effective, economically sustainable and self-sufficient solution to solving the issues directly related to access. So your probably sitting there like.. I still don’t get what it is?

If we can agree that most of the problems can be solved by creating access, and access is really about bringing the product to the communities then the next step is to talk about how makerspaces nationally and Internationally have solved the UN goals and then if you still agree design a micro-factory around the general needs of those communities. At this point you can skip to the end of this paper for a full cut sheet, cad files and general discussion. If you want more of a case by case goal oriented discussion please continue. I will go through how my concept has the potentially to address each of the individual goals in the order presented by the United Nations Agenda 21.

**No Poverty: 4 billion on less than 2.50 a day**

Makerspaces at their core really are about creating opportunities for incubating startups. Locally our lvl1.org has managed to launch two or three patentable products including an EKG machine. We are rapidly seeing developments occur at GE Firstbuild dealing with appliance innovation. Through the creation of providing a space where anyone can manufacturer you open up the possibilities for quirky idea’s which anyone can participate in on any level. Let’s take a look at some of the developments in third world regions.

Makerspaces in Africa have become an economic incubator and are considered the missing component in the African technology ecosystem. Makerspaces have been attributed to developing devices to scare-away lions, start automobiles with cell phones and even create renewable energy devices. Honathan Kalen said it best in his recent article focusing on what they call over there “tech hubs”, “In a region with a near-total absence of true “3rd spaces”- physical spaces like coffee shops, libraries, and internet cafes, Africa’s “hub boom” has emerged to fill the gap, fostering openness, access, collaboration, education and sharing in Kenya’s tech community, while offering nodes for international exchange.”

Through my proposed design we essentially create access to the basic fundamental carpentry tools required to build almost anything. This will allow these communities to be able process natural resources from trash to raw materials and change them into potential products that they can innovate and trade. The longer the facility is in operation the more ingenuity the community with demonstrate as their knowledge of manufacturing increases. Eventually they will start trading products with other communities and if its good enough maybe even on an international scale.

<https://vc4a.com/blog/2013/02/27/makerspaces-incubators-and-accelerators-why-africas-tech-community-needs-more/>

**No Hunger: 2/3 of people in non-developed “agrarian” regions considered malnourished**

My makerspace here in Louisville Kentucky has had classes in chicken husbandry, built the UofL Community Garden and even gone as far as recommended agricultural amendments to the CONN Centers test hemp crop.

For the education of children makers like spaces have been deployed through various Waldorf facilities and have demonstrated their abilities for fostering sustainable agricultural education. Waldorf schools and 4H actually have a complete open source agricultural educational package According to the National Geographic write up of agriculturally related makerspaces, “A Makerspace education turns students into farmers, gardeners and cooks-not just in the future but in the moment. “

Through historically not a primary pursuit of the makerspace mold what would be provided through the creation of the micro factory are the tools required to compost, dig, irrigate and build, along with language oriented resources for sustainable agricultural systems to that region. A side caveat to my design is creating outdoor community facilities where agrarian professionals in the service community can meet and interact before starting their daily chores.

In India makerspaces have been credited with making plants that can water themselves with no internet connection

<http://theplate.nationalgeographic.com/2014/11/24/school-makerspaces-growing-farmers-gardeners-and-cooks/>

<http://www.hindustantimes.com/more-lifestyle/have-you-used-a-3d-printer-yet-india-s-got-a-host-of-new-maker-communities-and-you-can-join-in/story-lPl01I4myfZ6YIXfcS82tM.html>

**Good Health: 2.2 million children die each year because of immunization**

Good health is a result of a process but through my work with the United Nations I have had the privilege to work with groups like Supplies Over Seas and a few MD’s locally who are ending cervical cancer in Haiti by building shipping container hospitals. Since air quality and asthma are major health issues in my community my makerspace lvl1.org prototyped and delivered a cost effective air quality monitor.

Hospitals without Hope, a different group, have even gone as far as to create something they call “A Clinic in a Can. Their first two prototypes featured three exam rooms, a laboratory and a small storage area for a grand total of 12,000 dollars a pop”, they also expanded their operation to include a surgical suite, recovery area, an X-Ray, an inpatient treatment area, exam rooms and a laboratory. There is no reason why we couldn’t facilitate a partnership with them and expand our concept of the container factory to be one that goes a step further as community demand increases for more facilities.

Beyond creating the possibility of community oriented space inside places considered third world my proposal includes the installation of computer that would have a hard copy of web md along with a suppository of general medical supplies which can be resupplied through community partners. As medical needs expand and the economics to the community grow internally through the trading of each communities manufactured solutions it couldn’t be farfetched that the brotherhood, comradery and economic would result in expansion of community facilities making it easier for external medical professionals to interact internally and host things like immunization clinics.

<http://www.bbc.com/news/world-radio-and-tv-14931745>

<http://www.kansas.com/news/local/article1021575.html>

**Quality Education: 61 million students not enrolled this year**

In Louisville Kentucky the interim president of the University gave the 2016 community engagement partner award winner to the Brown School of their development of a makerspace inside the school district. He viewed it as a crowning achievement in the advancement of education for low income communities in America and a primary driver for facilitating STEM education. Through the incorporation of hands on manufacturing in line with traditional understanding we can directly demonstrate how something as simple as the mathematical formula for a circle can be used to create a ring. Now what about third world?

In 2010 Sugate Mirta, plonked a computer in the middle of a backward and remote village called Kalikuppam in Tamil Nadu India and located it with molecular biology educational material in English and disappeared. *“The children of remote Kalikuppam, aged ten to fourteen years of age, apparently didn’t know what this strange beast called a computer was, let alone the internet. They couldn't speak any English and lived amidst some of the worst health, nutrition and sanitation conditions in the world.”* So long story short the guy returns and administers a test, the kids could answer 1 in 4 questions, this continued and each time he left and returned they could answer more and more. Currently Sugata Mitra won a 1 million TED prize to further develop the School in the Cloud.

My facility will include a computer and a large array of raspberry pi’s pre-loaded with all of the content of Wikipedia, web MD, and Khan Academy. There is also potential to connect with one of the various Open Source Higher Level Educational Facilities MIT Open Courseware to provide higher education in remote third world villages. There is also the opportunity to through the international consortium of hackspaces to provide web based manufacturing training. The long term hope would be to connect the facilities to a cloud based web education platform and to create the opportunity for community based schools through this and many other potentially online educational partners including instructables and thingiverse.

<http://www.zdnet.com/article/how-semi-literate-children-in-a-remote-indian-village-taught-themselves-molecular-biology/>

<https://www.khanacademy.org/>

<https://en.wikipedia.org/wiki/Wikipedia:Database_download>

<https://ocw.mit.edu/index.htm>

<https://wiki.hackerspaces.org/List_of_Hacker_Spaces>

**Gender Equality: Women spend at least twice as much time as men on domestic work**

In third world countries we see stark differences in the freedoms and civil liberties given to women. Many times women out of shear love for their children coming from a typical broken existence are stuck not only walking miles to get water but growing and cooking food. This leaves very little time for anything else. We will talk a little bit about how we can solve some of it by creating access to clean water and better sanitation in the next goals, Clean Water and Sanitation, so in this section let’s really focus on income and economic equality.

In Louisville Kentucky the makerspace serves as a safe place where everyone gets a voice. We even have transgendered regulars who participate in codeathons. We have seen large numbers of women participate in the Mobile Hacking Station events and learn a thing workshops hosted by the public library. We have also seen that when the space is provided to learn in setting of equality that they blossom.

Through the use of Community Based Manufacturing Cooperative all partners are created equal. The community based equality aspect is inherent in the business model so how has this model created this? According to the Committee for the Promotion and Advancement of Cooperatives research bulletin entitled “Cooperatives, Women and Gender Equality”, we find some very unique statistics. Through the use of the cooperative model their research has shown 49% of worker cooperatives in Spain are women, 132% increase in women’s participation in agricultural cooperatives in Uganda and generally speaking, “Cooperatives have an increasingly positive impact on women and their inclusion in the labor force and formal economy, they enhance their ability to empower women by collaborating with civil society and gain government recognition and can further facilitate the development of policies to support women from within”.

Through the use of creating access to the modular manufacturing cooperative we tackle this issue by given the opportunity for every individual to work on creating a better community. It’s through the process of women being allowed to participate next to their male counterparts that the real healing can begin and their true value as members of the community can be respected and grow. Beyond just the keys of garnering community buy in and long term economic stability of the facilities, this is essentially the quenticential reason I choose the cooperative organizational model for the operations protocols of all the potential facilities which could be deployed. When women stand next to the men developing idea’s that will help their communities and educate with their peers they will naturally gain respect and be empowered by the cooperative.

<http://mediashift.org/2016/04/maker-spaces-gender-gaps-and-helping-young-women-to-succeed/>

<http://www.copac.coop/wp-content/uploads/2015/07/COPAC_PolicyBrief_CoopsWomen.pdf>

**Clean Water and Sanitation: 1,400 Children Die every day from disease linked to clean water**

In Louisville Kentucky my makerspace lvl1.org had the privilege to work with one of the most successful Water Purification nonprofits in the country called Water step. Water Step, somewhat like a water purification manufacturing cooperative, makes chlorination generators out of PVC and car batteries. They distribute these to third world countries. I am sure they would love to partner with a project that plans to have established community facilities inside third world countries and potentially provide water testing and cleaning technologies to run parallel with this system.

Generally speaking makerspaces have led to a number of developments in regards to homemade purification technologies. From 3d printable carbon filters, sand based solar purification tubes to water purification testing and training. All of these things become possible when you create the access for community members to tackle the issues facing their communities.

My design will include the recommended water treatment package from WaterStep for water purification and testing along with any digital educational materials that they would be willing to provide. This would put the power of water purification into the hands of the community members who are active with the manufacturing cooperative and potentially given them a product to reverse engineer with the facilities to do this in.

<http://waterstep.org/get-involved/training/water-treatment-health-education/>

<http://makezine.com/2016/01/29/carbon-filters-get-3d-printable-makeover-for-global-clean-water-initiative/>

<http://stamps.umich.edu/creative-work/stories/making-the-future>

<http://www.unwater.org/statistics/en/>

Renewable Energy

In Louisville Kentucky my makerspace lvl1.org created a solar panel manufacturing oven for use with waste solar cell stock. Through the use of a simple heating coil installed between two metal plates held together with spacers and a vacuum pump we were able to make a solar panel. International very unique renewable energy devices have come out of similar facilities.

In Africa makerspaces have been used to develop such things as bladeless turbines and water pumping technologies which resulted in the creation of the inventing company Saphon Energy. The bladeless sail like design cost less to produce and 50 percent less to deploy. This one device can be deployed throughout all of African and be the initial start to creating decentralized electrical micro stations.

According to Forbes another unique renewable energy device came out of Africa. Through the use of electrolytic cells that separate hydrogen four teenage girls were able to generate six hours of electricity out of their urine. The technology they derived came from the is now being researched by Tenured chemical and biomolecular engineers around the country and lead one professor to found E3 Clean Technologies in 2011 garnering a coveted DOD research contract to upscale the device.

In India a makerspace is credited with prototyping a tidal wave energy harvester for houses on the coast In South America Los Gaviotas a precursor to the makerspace and manufacturing coop with a heavy emphasis on rainforest preservation has become a premier research facility with even a sea saw that pumps water to a solar purifier and motorbike and agricultural equipment are powered by a bio resin conversion.

To guarantee an initial input of energy into a community each facility will be set up as a micro grid power station with a mix of solar, wind, battery and biofuel generation capacity you can provide the necessary inputs to run the micro facility and potentially use it for the initial power supply inside of a community. This can be modeled with NREL HOMER software package.

<http://www.afrigadget.com/2012/09/21/blade-less-wind-turbine-blows-fresh-air-into-power-generation/>

<http://www.forbes.com/sites/matthewdepaula/2012/11/08/teens-create-a-way-to-use-urine-as-fuel/#3d4a3ecc5555>

<https://yourstory.com/2016/03/workbench-projects-makerspace/>

<http://www.unep.org/forests/Portals/142/docs/Las%20Gaviotas.pdf>

<http://www.nrel.gov/analysis/models_tools.html>

Good Jobs and Economic Growth

Innovation and Infrastructure: 1 in 3 children without adequate shelter

Reduced Inequalities

Bicycle Coop

Sustainable Cities and Communities

Responsible Consumption

Climate Actions

Life below Water

Life on Land

Peace and Justice

Partnership for the Goals

<http://www.globalissues.org/article/26/poverty-facts-and-stats>

<http://www.manufacturing.coop/>