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 comes 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, 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?

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

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 built, 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 you’re 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 potential to address each of the individual goals in the order presented by the United Nations Agenda 21 I will only cover the first 11 out of the 17 due to the length requirements of this paper but am more than willing to take questions in regards to: responsible consumption, climate action, life below water, life on land, peace and justice, and creating partnership opportunities for the goals.

**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 developing 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 it’s 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 Center for Renewable Energies test hemp crop.

For the education of children maker 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 situation 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 loaded 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 administered 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 too, 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 code-athons. 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 everyone blossoms.

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 developing communities 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: 2 billion people live without access to electricity**

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 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 / agricultural equipment which 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: 470 million jobs are needed globally**

So in Louisville Kentucky the adoption of makerspaces has created a number of specific jobs just dealing with the operations and maintenance of the facilities. We have 4-5 makerspaces in the art districts, we have 4-5 makerspaces in elementary and high schools, we have afterschool makerspaces, we have innovation centers associated to the University Level, the public library now host an learn a thing day and manages a smaller makerspace, we have makerspaces in low income neighborhoods and more. Each one of these just through its shear existence creates the opportunity for “good jobs”. Now it’s not 470 million jobs but it at least creates a handful. The rest is really dependent on the community.

In the official blog for the National League of Cities, USA, they state that the maker movement, *“has the ability to draw production back into the cities where consumption occurs. This can have a profound economic and social benefit. In addition to added jobs, proximity means more innovative potential for workers.”* Now that’s a pretty bold claim but that’s America where you have lots more specialization and education how can we say that the same holds true for a rural remote village? This can be found in the previous section entitled, No Poverty.

<https://citiesspeak.org/2016/02/12/does-the-maker-movement-hold-the-key-to-economic-growth/>

**Innovation and Infrastructure: 1 in 3 children without adequate shelter**

Locally my hackspace lvl1.org has actually been innovative and tackled some infrastructure issues. In regards to housing they have facilitated the building of tiny houses, retrofit busses, built temporary pop up facilities, geodesic domes, floating concrete and more. So I think now the real question becomes how using a hackerspace can lead to better roads, houses, and pretty much anything else.

For roads I go back to my old trail humping days up in the North East United States. With a double bit axe, a hoe and a chain saw we cut clean paths through the mountain side, with water diversion, bridges and temporary lean too camp sites. All of this so that the draft horses could log deeper in the thick of the North East Kingdom. This process has been done by every major mountaineering club in the country. The Appalachian Mountain Club maintains a huge swath and offer support services on 1800 miles of the Appalachian Trail. They have a complete online guide of projects, tools and techniques. I feel that once they have the tools, concern for their road and the time to maintain it we could see some of the most amazing hand built drainage systems in the world.

While living in New England I had the common community experience of the barn collapse. Every year as more and more snow gathers on older and older lumber the frames of the barns eventually buckle leading to collapse. New England is known for being agrarian and the larger barns are for dairy operations. Immediately the entire town, any willing and able bodies, meets at the collapsed facility and spends the entire evening pulling out cows from up to 10 feet of snow. The next day you saved some of the cows but your barns still in pieces and the real fun starts. The entire town, from the neighbor with the portable saw mill to the guy down the street with a bucket loader, all pitch and rebuild the facility. This is also a common practice with Mennonite, Amish and even how Patch Adams got his hospital complex built. With the right tools and community this rural wastelands can easily be turned into massive cities.

As an ex carpenter and woodsman my proposal is to include in each facility the best handmade roads and trail guides along 3 sets of traditional hand tools. Along with that I would include 5 full carpentry belts loaded with the basics and one Dewalt power tool kit with 5lb boxes of both 10 and 6 penny galvanized nails. If the area is in a hurricane ridden location, similar to places in South America that are near the equator and coast lines, we might have to consider concrete structures but that would have to be phased in due to the cost of materials, the distribution of resources and the cost associated with large batch mixing.

Trails and Roads

<http://www.outdoors.org/conservation/trails/index.cfm>

https://amcstore.outdoors.org/amcs-complete-guide-to-trail-building-and-maintenance

Barn Raising

<https://www.youtube.com/watch?v=go2XubvCqDo>

<https://www.youtube.com/watch?v=QZNHxUvcSi0>

**Reduced Inequalities: Only 12% of the millionaires on this planet live in undeveloped regions**

So the hackspace in Louisville Kentucky creates the opportunity for anyone in the city to not only learn marketable skills but join in the comradery that comes using those skills for commercialized ends. In some-ways the very creation of this paper is a testament to that fact. Through my participation I’ve been able to watch a computer repair guy sell his company, start making rave clothing and transition into a rather well off individual.

Through the use of hackspaces thus far we have demonstrated how they can tackle economic inequality in barter based economies of scale and even lead to international product exchange in the free market while tackling issues related to intercommunity gender relations and sustainable internal economics intern creating opportunities for a better quality of life. They key statement from the United Nations in regards to their Sustainable Development Goals is that, *“Income inequality cannot be effectively tackled unless the underlying inequality of opportunities is addressed.”* In my humble opinion this might be the only solution that got probably empower communities by giving them the tools that go beyond survival but allow them to innovate beyond what their economy would naturally allow. For further information please refer to the other sections of this paper.

<http://www.un.org/sustainabledevelopment/inequality/>

**Sustainable Cities and Communities: On average women walk 6 kilometers a day for water**

So at this point in the paper this is starting to feel somewhat repetitive. So in this section I’d like to highlight one portion that we haven’t covered in regards to sustainable cities, transportation systems. If you look at the section entitled Clean Water and Sanitation, you will see that we denote that a lot of the water processing in non-developed regions is really about walking jugs of water around. Now at this point in the paper everyone has their micro-factory with a water purification system, renewable energy micro-generation facilities and actively working on expanding their communities by maintaining their roads and building villages the last missing piece is advancing that communities ability to deliver products to market.

In Louisville the cooperative version of a bicycle repair facility called, Falls City Bike Works, has addressed some of the transportation needs of what is deemed a low income neighborhood. Now to us something like a bicycle wouldn’t work but when we are talking about people who couldn’t afford insurance or even the gas that goes into a car something like a fixed gear bike holds a lot of potential for expansion of their transportation infrastructure.

In developing regions makerspaces have had a huge impact on spurring the creation of similar projects. One key case study project in Africa is called the Ghana Bamboo Bikes Initiative. Essentially this is the best case study you can really ask for. Women in Ghana got together to build bamboo bicycles and have become, I quote, *“We are a team of young forward-looking thinkers with a penchant for attacking the big problems of society;****unemployment, poverty****and growing threat of****climate change****using the simplest cost-effective and result-driven techniques.”* From just building simple transportation systems they have grown and their facility now has a Bamboo Bio-Gasification Electrical System.

In India a man with simple tools out of shear love for a women converted a bicycle so that he could cross the Nile and later was picked up in a Discovery Channel Short. The need is there and the people are naturally building these devices they just need help with the overall dispersion and deployment. Through the use of cooperative micro factories we can easily expand the innovation process and gear it to a sustainable growth paradigm

Each micro-factory will include a park tools road race repair kit and associated bicycle stand for the modification of bicycles. If the community is having problem with raw material stock bamboo with its unique growth patterns could easily be used as a primary community input as long as it isn’t evasive to the area.

<http://www.cnn.com/2011/HEALTH/04/29/drinking.water/>

<http://ghanabamboobikes.org/>

<https://www.youtube.com/watch?v=REx9rMDbqRg>

So due to the requirements due to this submission I am effectively running out of paper space but I am prepared to address any follow up commentary about the following goals which include but are not limited to: Responsible Consumption, Climate Actions, Life below Water, Life on Land , Peace and Justice, and Partnership for the Goals.

In conclusion I would like to reiterate that the issues underlying each one of the major goals that are associated to creating sustainable access inside individual communities really just comes down to access. Without it happening inside the community we will only get short term unsustainable solutions beyond that many of these issues go well beyond just handing over money. We can look at the sovereignty of Ukraine as a prime example. Here we have a situation where a semi industrialized nation under Russian dictatorship through brute force has made the transition to establishing itself as a sovereign nation. Billions of dollars have been pumped into the country and it still only has demonstrated artificial stability with semi unsustainable growth. The only single bullet solution is to allow these communities, village by village innovate from within. Makerspaces, hackspaces, tech hubs, cooperatives or whatever else you would like to call them hold the answer. There isn’t much on south east Asia do to the communistic government but I did one unique read which I have saved until now.

# In Dr Silvia Lindtner paper “Hackerspaces and the Internet of Things in China: How makers are reinventing industrial production, innovation, and the self”, she states that the contribution of hackspaces in rural china contribute in three ways. *“First, it fills a gap in current research by providing an account of a culture of technology production. Second, it proposes the analytical lens of 'making subjectivities' to open up the concept of the netizen, illustrating the importance for Chinese Internet research to consider not only technology use, but also the culture and materials of its production. Third, it demonstrates that maker culture is better understood as a parasitic culture rather than a counterculture, altering the system from within, contributing to our understanding of the relationship between technology use, production, society, activism and the state.”*

# When looking at this paper and this statement through our new found lens, I feel what she meant by this is that the micro factory cooperative approach leads to culturally adaptive innovation that can be focused on the needs of the individual communities without direct supervision and grow similar to a kudzu in an environment in which it is an invasive species. The real trick is to provide the necessary access in which the growth can be propelled specifically toward sustainable economic and socially just solutions.

# An excellent example of this would be that during my time in Speed School, If you look just at Louisville Kentucky, with a makerspace community that started at an abandoned brothel on east Broadway it successfully morphed. Now we have Kids hackerspaces in schools both public and private, the public library, the University Level, Industrial manufacturing with GE First build, the girl scouts, a mobile unit makerspace, a makerspace in Indiana, two programming groups with their own spaces, an active drone community, a gladiator esq makerspace in Lexington, a yearly festival and much more.

<https://www.researchgate.net/publication/274325873_Hackerspaces_and_the_Internet_of_Things_in_China_How_Makers_Are_Reinventing_Industrial_Production_Innovation_and_the_Self>

I have included this list of you tube videos highlighting a number of general innovation being developed in third world countries.

<https://www.youtube.com/watch?v=yIpOzihSd1I>

https://www.youtube.com/watch?v=SclN-2CteXM

<https://www.youtube.com/watch?v=1yPRhamr27Q>

<https://www.youtube.com/watch?v=eB3ZOQRTOl8>

<https://www.youtube.com/watch?v=4fWJajX4Di8>

<https://www.youtube.com/watch?v=FeBOfD7R2G8>

<https://www.youtube.com/watch?v=hjKbRbcoN9E>

<https://www.youtube.com/watch?v=ABdLSIMSboE>