

## Manufacturing in Developing Countries

Coming from a U.S. perspective, manufacturing in developing countries entails some special considerations.

- Resource availability is probably the single greatest concern; one cannot take for granted many of the things available in the U.S.
- For ongoing repair and maintenance, replicability of components – choosing things that are already used in other technologies, i.e. the standard bicycle design in a country -- is also quite important.

### ***Four paradigms of manufacturing***

There are many pressures toward the urban – urban model. But beware of assuming the technology will only be used in the urban environment, even though it might simply design and manufacturing.

#### Special Considerations for Developing Countries

- Job Creation
- Resource Availability
- Scale
- Scope
- Replicability

#### Four Paradigms

- Manufactured locally  
Assembled locally  
Maintained locally
- Manufactured in urban centers  
Assembled in urban centers  
Maintained locally
- Manufactured in urban centers  
Assembled locally  
Maintained locally
- Manufactured in urban centers  
Assembled in urban centers  
Maintained in urban centers

### ***Examples: Haiti***

These photos show a village blacksmith. With only a few tools – hammer, chisel, anvil – they can accomplish remarkable things.

Overall, we tend to underestimate what they can do through the power of ingenuity; and tend to overestimate what materials are specifically available. For example, you may specify rivets for a device, but you'll probably find rivets hard to come by. Instead, the blacksmith will use a common nail, trim it and pound into a rivet shape.

The last slide shows welding and brazing. This specific capability is hard to get around with just ingenuity, so it's actually more available than you might think.



### **Examples: Senegal**

These photos show steel fabrication for one of Amy's grain mills. Most impressive, they were able to create a truly round hole in the steel using only a straight chisel (right-side photo).

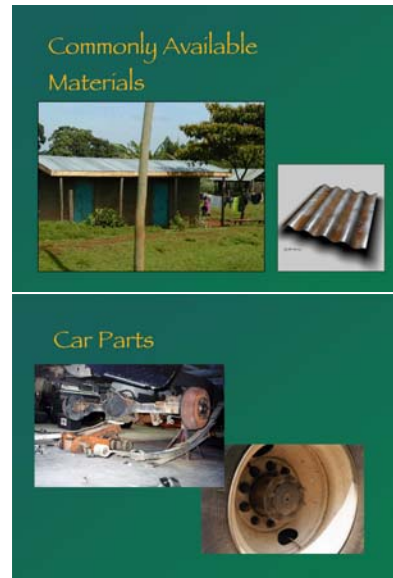


### **Resource Availability**

Corrugated metal roofing is an example of a commonly available material that is frequently repurposed and recycled. Pounded flat, it becomes a favored source of sheet metal.

Abandoned cars are another good resource. For Amy's hammer mill, an old leaf spring was turned into a grinding blade.

Widely available, relatively inexpensive, and generally built in standard dimensions that allow interchangeability, bicycles are another favored source of mechanical materials.



### **Video – Manufacturing in Ghana**

The class watched the video "No Spare Parts." (Directed by David Springbett, produced by Asterisk Productions. Bullfrog Films, 1990. ISBN: 1560293799). The following notes are based on content from this video.

Suame Magazine is a massive unplanned industrial district filled with small artisans, craftspeople and micro-enterprises. This district is the setting for many of the scenarios in the video.

Consider the manufacture of nuts and bolts – essential parts for many machines. The indigenous manufacturing solution is found among the Suame Magazine blacksmiths, where each bolt and nut is handmade individually with great skill by a blacksmith. The imported industrial nuts and bolts are simply too expensive and hard to come by. In recent years, the small **capstan lathe** has been introduced as an intermediate technology, greatly increases local capacity to make affordable nuts and bolts.

"Weaning mix" is a common transition food, bringing toddlers from nursing to solid food. It's made from corn and other local grains, but grinding by hand is very labor intensive – almost prohibitively time consuming. A local enterprise uses the capstan lathe to manufacture an affordable corn mill from salvaged truck axles, making weaning mix much easier to get.

Most metal for Ghanaian light manufacturing is recycled from car/truck scrap. Sophisticated metal work and smelting in Ghana dates back to 2<sup>nd</sup> century AD. Unfortunately the local industry was killed off during 19<sup>th</sup> c. British colonialism. Iron smelting has just begun to reemerge post-independence (1957).

Palm oil is a useful and valuable local commodity, but indigenous methods of extraction are time-consuming and labor-intensive. A locally manufactured palm oil press now found in many village co-ops is replacing many hours of hand pounding, making palm nut harvesting financially viable for the first time.

A locally-made circular saw bench (again, made with the small capstan lathe) has created a thriving timber industry. Replacing the hand saw, it's enabled a 5-fold production rate improvement, and supported a square kilometer's worth of small woodshops in nearby Anloga.

Notice how the capstan lathe (an intermediate technology) was the new enabling technology behind so many of these solutions.

### ***Wheelchair Manufacturing in Zambia***

We've previously discussed the DISACARE wheelchair project in some detail. Following are some more points on this project, specifically regarding manufacturing.

- With a lathe and mill available locally, you can work around temporary interruptions in key supplies...for a while anyway.
- Don't assume you can find any particular tool or device you might take for granted in the U.S. For example, it's really hard to find a good bench vice in Zambia.
- Locally-made assembly jigs and welding fixtures are essential resources, necessary to have a scalable operation.
- Welding and brazing technologies have been a challenge. DISACARE had a TIG welder (very high-tech!), but it broke after about 3 months, and there's no local repair available. At this point it seems like \$500 wasted.
- Front tires/wheels take a beating in this environment. They need to be very durable, and available as spare parts/repairs for customers. How do you make tires in Zambia? Virgin rubber is expensive, so you'd like to use recycled tires as much as possible. Following the model of retread tires for cars and trucks, they opted to be able to make their own retread tires -- got a machine shop to build them a mold, and then use a mix of recycled and virgin rubber that can be re-vulcanized.
- They've been exploring tricycle designs. The frame has been a compromise, lots of 90 degree angles to simplify the manufacture.