

World Engineering Day 2026 Presentation

Localized Development of Fused Deposition Modelling for Low Volume Manufacturing

Presenter
Eng. Mpuuga Henry

Authors

Eng. Mpuuga Henry¹

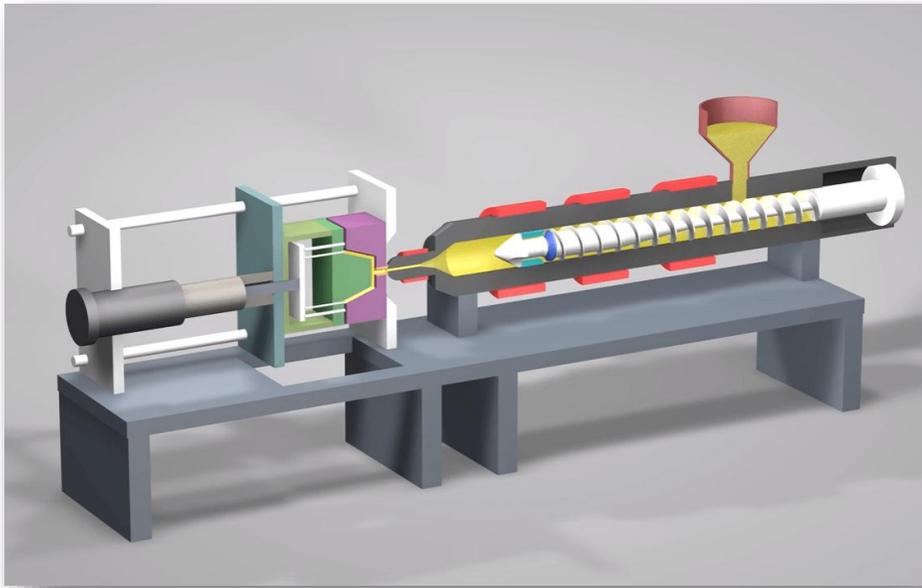
Mr. Ntege Gonzaga²



Background



- ❖ Small and medium manufacturers need affordable ways to make short-run plastic parts
- ❖ Conventional processes (e.g., injection molding) require high upfront capital and high volumes
- ❖ Imported 3D printers and filament increase cost and reduce adoption
- ❖ Localizing FDM reduces cost, builds skills, and strengthens domestic value addition



What we are solving?

Accessibility and affordability

Reliable FDM printers are still expensive for most schools, makers, and small enterprise

Reliability and maintainability

Imported machines are hard to service and lack support.

Low-volume manufacturing gap

SME's lack capacity to undertake low volume manufacturing due to high capital demand



How are we solving?



E-waste



Student Internships



Local
Filament Production

Design for Local Fit

- ❖ Repurpose components (steppers, fans, rods, wiring) from out of service photocopiers



Capacity Building

- ❖ Train student interns to assemble, test, and calibrate printers



Value Chain Development

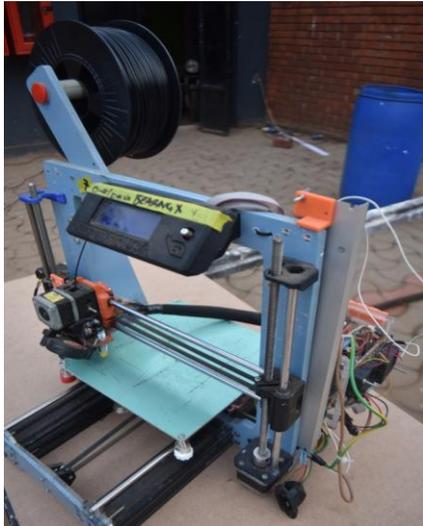
- ❖ Develop recycled filament production to reduce overheads
- ❖ Develop a print-as-service platform for SME's



Our journey



Xunda v1.0



Atmega2560 A4988



Upgraded from Acrylic to laser cut steel to achieve printer accuracy and reliability



Modified base from aluminum extrusions to steel threaded rods to reduce import dependency.



Upgraded electronics from Arduino ramps board v1.4 to BTT SKR mini e3 board for reliability



Upgraded general design for performance and aesthetics

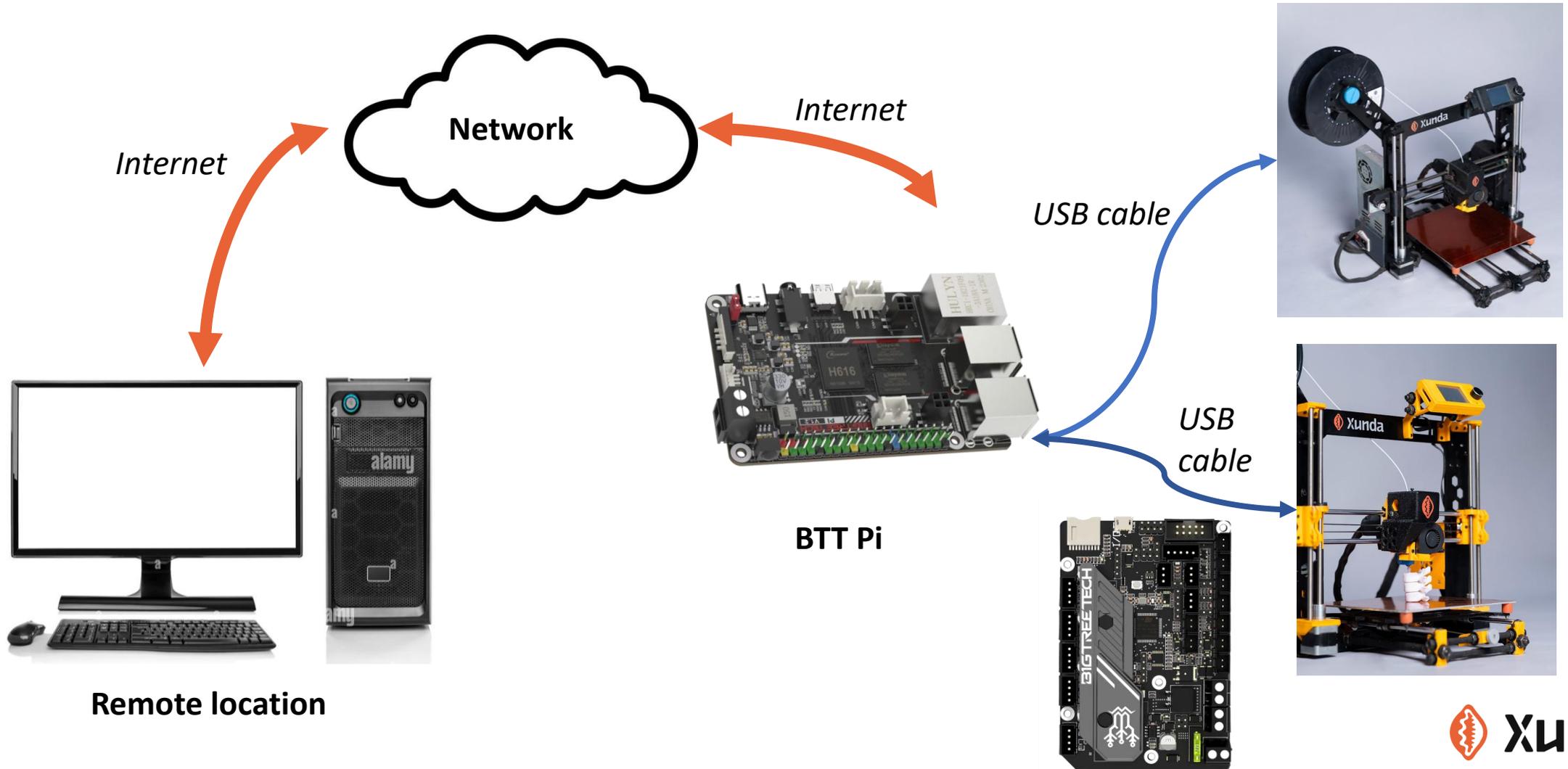
Xunda v2.1



STM32 TMC2209



Our journey: Networking



Value Chain Capability

What we can do

- ❖ Build and repair printers locally (reduced dependence on imports)
- ❖ Produce filament locally (targeting recycled PET)
- ❖ Print functional parts and products from local filament
- ❖ Reuse printers to make components for more printers (self-reinforcing growth)

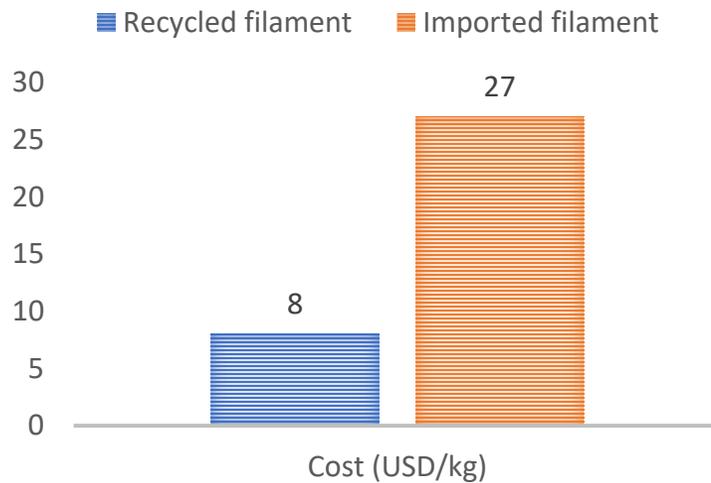
Why this matters

- ❖ Lower total cost of ownership for SMEs and schools
- ❖ Faster iteration from design → prototype → product
- ❖ Local jobs: technicians, operators, designers
- ❖ Reduced waste through recycling and additive manufacturing

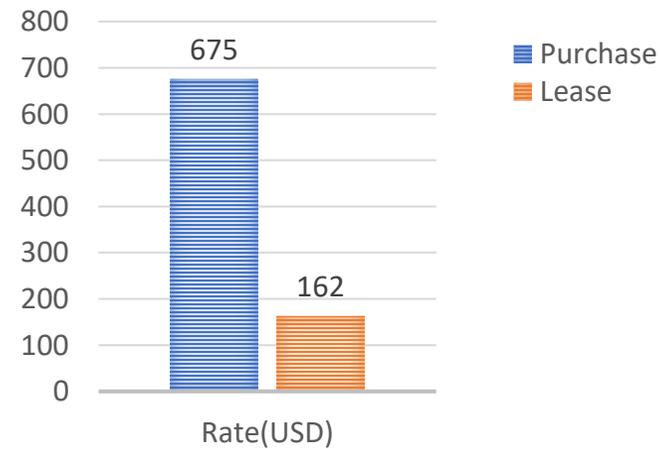


Economics of the value chain

Cost of Filament

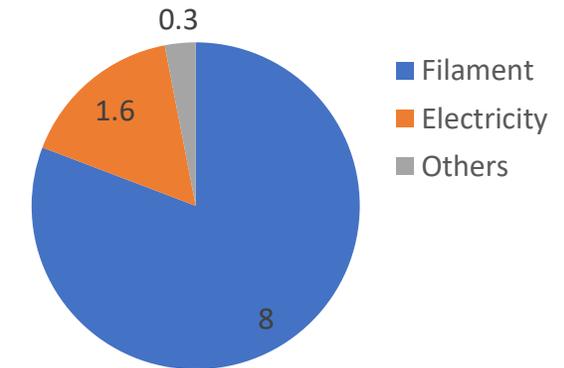


Cost of Leasing Vs Purchase



*Lease value for 1 year exclusive of filament and maintenance costs

Cost of Production per kg of Part (printing)



Weight: **80g**
 Units per Kg: **12**
 Cost: **10 USD**
 Revenue: **130 USD**

*For recycled filament



Economics of the value chain

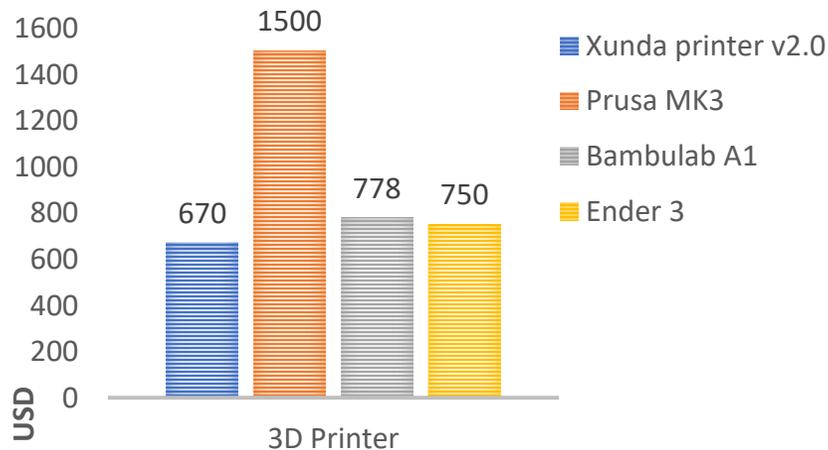
Cost drivers

- ❖ Printer BOM (motors, electronics, mechanical components)
- ❖ Energy and maintenance
- ❖ Filament production: cleaning bottles, processing
- ❖ Network upgrade: controllers (BTT pi), connectivity, management software

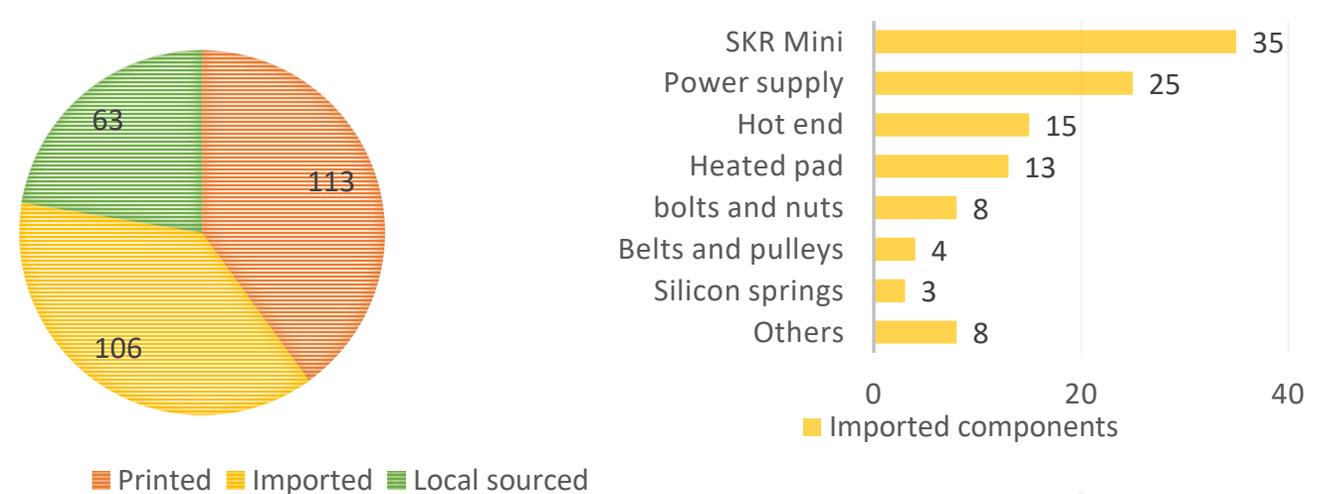
Value capture

- ❖ Sale/lease of printers
- ❖ Filament sales
- ❖ Print-on-demand parts for SMEs
- ❖ Training + maintenance services
- ❖ Parts and spares produced locally

Comparative prices of 3D printers (USD)



Cost of production of the Xunda 3D printer (USD)



Challenges so far

- ❖ Variable quality of e-waste components (motors/bearings). Quality checks set up.
- ❖ Market awareness and adoption barriers for SMEs. Website development and trainings.
- ❖ High cost of imported components. Local sourcing possibility.



Conclusions



- ❖ Localized FDM development is feasible and is building practical manufacturing capability.
- ❖ Combining printer builds, filament production, and printed parts creates a scalable value chain.
- ❖ Networked printing enables shared production capacity and better utilization.
- ❖ Addressing market adoption is essential for scale.



- ❖ Quality assurance for the e-waste and other locally sourced parts should be adhered to.
- ❖ Run pilot product lines with SMEs to prove economics (cost per part, lead time, durability).
- ❖ Establish clusters: shared spares, training, maintenance, and design support.
- ❖ Localize the production of the imported electronics and mechanical components.

Thank you!
Questions & discussion

