

2022

# The 3D-Printers

YOUNG ENTREPRENEUR EXCHANGE PROJECT  
TOGETHER WE PRINT

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## 1. Business model

### 1.1. Overview

#### **Mission:**

Using creativity of each students to convert their idea into reality. Give them the power of creating!

#### **Vision:**

Creating a sustainable 3D-printer shop in Ethiopian

#### **Values:**

User friendly, because we have two options of ordering!  
Environment friendly, because we think about the future!  
Fair price-quality ratio, because we have 3 different quality/costing options!  
Strong quality, because we care for tidiness and cleanliness!

### 1.2. Actual pains / problems

- Not enough opportunity, to get new parts if they are broken
- High costs of buying new parts
- No experiences with using 3D-printers
- Not existing sustainable circle-economy of plastic

➔ The solution – The 3D Printers

#### 1.2.1. Main tasks of the 3D-printers

A deeply market research has found out, there is a big need of 3D-printed parts, especially for students. The main goal is to create a 3D-printer shop, which will work as follow:

#### **Option 1, for users with experience in AutoCAD:**

Export your created model into a STL file and give it to the shop. Afterwards we will take responsibility for the rest of it.

#### **Option 2, for users without experience in AutoCAD:**

Give the shop a sketch of your idea, and we will do the rest.

### 1.3. Market / Stakeholders

- Engineering department (civil, mechanical, electromechanical, urban, chemical)
  - o Using parts for a project
  - o Broken parts user



#### 1.4. Marketing-Activities

- Send E-Mails for each stakeholder group
- Creating a big advertisement on the school campus
- Take movie, to explain future customers the different options they have
- Create some flyers / cards, give it customers after finished their printings.
- Create a Facebook platform with the most important informations about the shop

#### 1.5. The way to be more sustainable

- Using a melting machine which can produce some filament again
- Different processes are possible
  - o Useless parts -> melting -> producing new filament -> using again
  - o Plastic bottles -> melting -> producing new filament -> using again
  - o Useless structure -> melting -> producing new filament -> using again
- Maintenance of each 3D-printer, this includes:
  - o Keep the printer and the office clean and tidy
  - o Frequently controlling of any kind of lacking
- Education of yourself



## 1.6. Roadmap (short-term)

### 1.6.1. Week 1 (Hackathon Week)

**Tasks:**

- Assembly 3D printer
- Construct an enclosure for the printer
- Program an interface to remote-control the printer
- Develop video tutorials
- Carry out a market research
- Develop a business model

### 1.6.2. Week 2 – 3 (Marketing and organising)

**Tasks:**

- Hiring people for each position
  - o 1x Coordinator, 2x Designer, 1x Maintenance, 1x Financial
- Marketing activities
  - o See in business-plan
- Finding a place for the shop

### 1.6.3. Week 4 - 5 (Marketing and organising)

**Tasks:**

- Organise your shop
- Create awareness for the 3D-printer
  - o Give flyers to the different stakeholders
  - o Talk to all possible people about your shop -> propaganda
  - o Take care for all social media platform
  - o ...
- Board meeting, planning for next month
  - o What are the goals?
  - o How much money do you want to earn?

### 1.6.4. Week 6 – 7 (First ordering)

**Tasks:**

- Ongoing process with business

**Important:**

- Do all month at least one meeting together, and talk about your vision, your plans for the future, your goals with the 3D printer shop

## 1.7. Roadmap (long-term)

### 1.7.1. The first 6 month:

- Have done all the important task for starting the business
- Increasing marketing strategies
- Business is working

### 1.7.2. For the next 1 year:

- Do another market research for new stakeholders, also on the campus of Hawassa
  - o Find new market: for example 3D-parts for personal

### 1.7.3. For the next 2 years:

- Decreasing your costs by using:
  - o A melting machine (Watch out the attachment, there are some possibilities to buy)
    - Recycling bottle
    - Recycling all the old plastic waste of the streets
    - Recycling old and useless parts

### 1.7.4. For the next 5 years:

- New market research to get recognition from the city administration
- Expanding business through Hawassa industry

## 1.8. Financials

Task	Cost	Unit
Maintenance	0,3	birr / gram
Salary	1	birr / gram
Security fees	0,15	birr / gram
Filament	2,25	birr / gram
Profit	1,3	birr / gram
<b>Costs low quality</b>	<b>5</b>	<b>birr / gram</b>
<b>Costs medium quality</b>	<b>7,5</b>	<b>birr / gram</b>
<b>Costs high quality</b>	<b>15</b>	<b>birr / gram</b>
Designing	30	birr / hour
<b>Total</b>	<b>30</b>	<b>birr / hour</b>

Please notice, detailed calculations you can find in the attachment!



## 1.9. Value Offer

### 1.9.1. Colors

- Sky blue
- Blue
- Luminous Green
- Electric, vertigo ad metallic Grey
- Pink
- Gold
- Signal yellow
- Orange

### 1.9.2. Materials for the build

- PLA
- TPU
- PVA

### 1.9.3. Price

#### ➔ Costs for printing itself

##### ○ Quality options

- Low = 5 birr / gram
- Normal = 7,5 birr / gram (1,5 times more)
- High = 15 birr / gram (3 times more)

#### ➔ Costs for designing itself

- 30 birr / hour

### 1.9.4. Maximum size of the product

- Volume =  $0.01\text{m}^3$  (L = 0.24892 m, W = 0.21082 m, H = 0.21082 m)

### 1.9.5. Warranty and discount price

If the part will be broken after the following shorts of time, then has the customer the opportunity to get a new part without any additional costs

→ 1 month for medium quality customers

→ 3 month for high quality customers

### Special customer offer

#### a. Based on annual events

➔ 5% discount ( can be done on holiday season ) (discount Is considered from the profit)

\*Can be modified later on



### b. based on the quantity they order to be printed

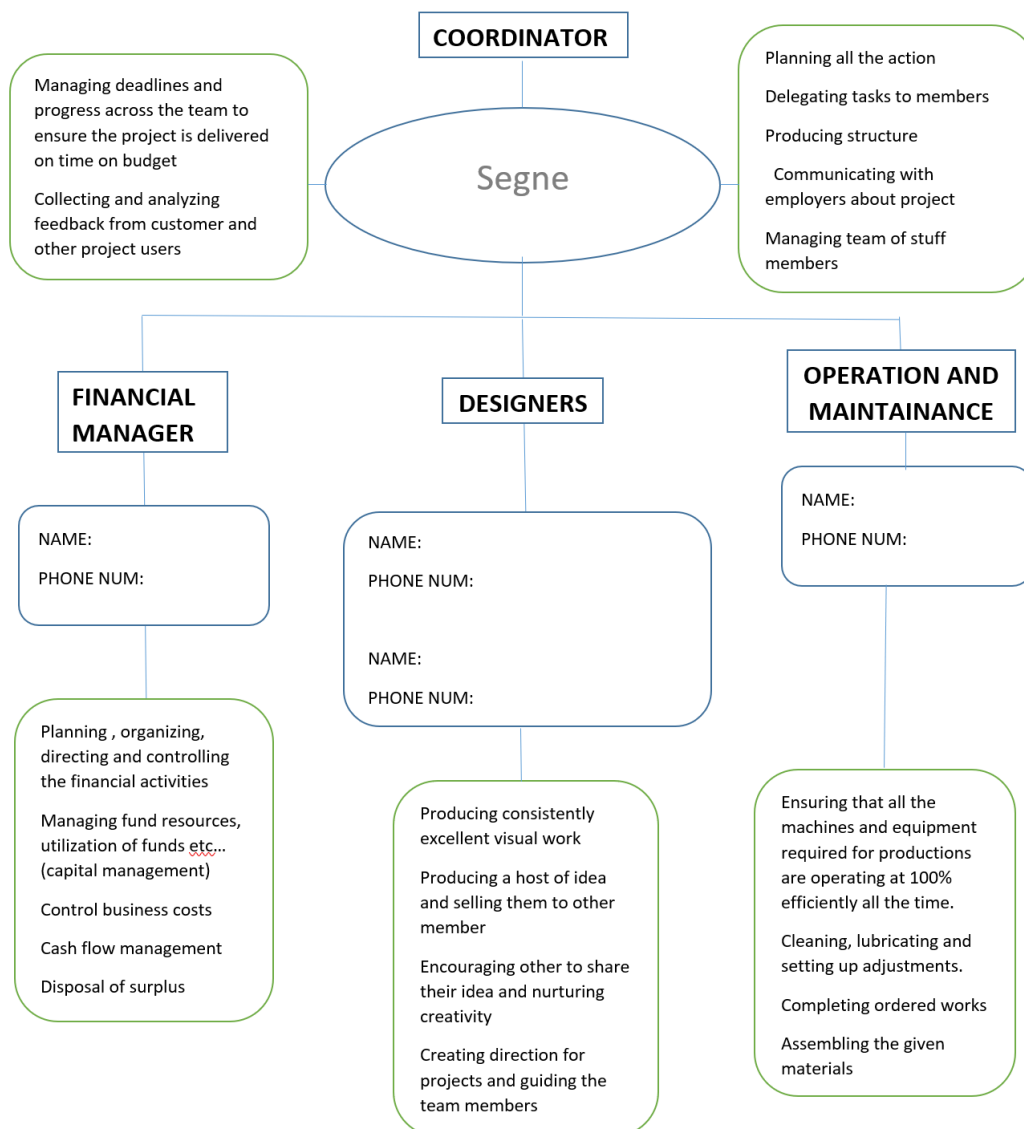
- ➔ 2.5% discount for customers ordering 10 product (all at once)
- ➔ 3% discount for customers ordering 15 product
- ➔ 5% discount for customers ordering more than 20 product

### 1.10. Overview of team-structure

To handle all task which will have to be done by running a 3D-printer shop, it is needed to have 5 people for it. There are:

- 1x Coordinator
  - Segne has taken already the responsibility for this task. After finishing the Hackathon week, he is going to take care about the future of the 3D-printer shop!
- 1x Financial Manager
- 1x Maintenance and Operator
- 2x Designer

The following overview will give an idea, which task should be done in each position.



## 2. Additional Informations

### 2.1. Maintenance-plan

To make sure everything works as it should the maintenance plays a big role. Because technical machines, like our 3D-printer is one, are really sensitive against dirt and other foreign stuff. Because of this the team has decided to gather some informations about the maintaince from this 3D-printer. As well it's possible to avoid high costs. Because if the printer is maintained well, all the parts will last longer and marks of the using could be reduced to the minimum. Because of all these facts we have developed an maintenance-plan for the 3D-printer. This plan will be given to the responsible person and hopefully followed as good as possible. We create the plan as an Excel list, so the responsible can confirm, all the controlled points with an cross. Also the dates when the tasks have to be done are given. The list looks like this:

<u>Date:</u>	20.04.2022	22.04.2022	24.04.2022	26.04.2022
<b>Fees:</b>				
Control the filament				
Control the wires				
Control the extruder				
Control the printing bed				
Visible control				
Control the spindles for Z-axis				
Control X-axis				
Control Y-axis				
Make sure the raspberry is safe				
Make sure the ventilator works as it should				
Control the scrolling-wheel				
Control the display				
Control all the screws				
Clean the extruder				
Do a calibration				
Change the belt				
Change the spindles for Z-axis				
Replace the ventilator				
Maintaince succsesfully done?	not completed	not completed	not completed	not completed

It has to be respected, that these maintenance fees are calculated with the full working time. This means, if the 3D-printer is printing eight hours per day. Otherwise the fees can be calculated by the operators.

#### 2.1.1. Definitions maintenance fees:

**Control the filament:** Check the roll of filament. Make sure the filament is enough for the next printing task. Make sure the filament is rolled up pleasant. This task has to be done bevor every start oft he printer

**Control the wires:** Have a look at all wires of the printer. Make sure the wires aren't broken or damaged.

**Control the extruder:** Have a look at the extruder. Make sure the filamnet can pass through it without any problems. Make sure the extruder is clean.

**Control the printing bed:** Make sure the printing bed is clean. If necessary clean it with a towel.



**Visible control:** Have a look at all moving parts of the printer. Make sure they are in a good technical state. This task has to be done before every start of the printer.

**Clean the intake filter:** Remove the enclosure of the filter. Clean up the net which is inside. Make sure there is no more dirt in it.

**Control the spindles for Z-axis :** Have a look at both spindles. Make sure they are not damaged. Have a look at the sledge of the Z-axis when it's moving towards the spindle. Make sure it moves without problems.

**Control Y-axis :** Make sure the Y-axis can be moved by hand. There is no air between the sledge and the rails.

**Control X-axis :** Make sure the X-axis can be moved by hand. There is no air between the sledge and the rails.

**Make sure the raspberry is safe :** Have a look at the raspberry. Make sure there is no dirt inside the box. Make sure there is no water inside the box.

**Make sure the ventilator works as it should :** Move the ventilator by hand. Make sure it doesn't make some noise if it's moved by hand. Make sure the ventilator rolls without problems.

**Control the scrolling wheel :** Make sure the display reacts if the scrolling wheel is moved. Make sure the scrolling wheel is fixed exactly.

**Control the display :** Make sure every pixel of the display works. Make sure it reacts if the scrolling wheel is moved.

**Control all the screws :** Make sure all screws are tightened. If not, tighten them down. This task has to be done every month.

**Clean the extruder :** Take a little screwdriver or a needle to clean up the extruder. Work sensitive. Make sure you don't break any parts of the extruder. Make sure, that the filament is floating through the extruder without problems. It has to be done all two months.

**Replace the active-carbon filter :** Replace the filter which is located behind the ventilator. Make sure the polluted air can pass without problems through the new filter. This task has to be done all 12 months.

**Replace the intake filter:** Replace the filter on top of the enclosure. Make sure the new filter fits right. Make sure the air passes through the filter without problems. This task has to be done all 12 months.

**Do a calibration :** Calibrate the 3D-printer. Make sure the calibration was successful. This task has to be done all six months.

**Change the belts :** Change the belts. Make sure the belt fits right. Make sure the tension from the belt is enough. Do a calibration afterwards. This task has to be done all 24 months.

**Change the spindles for Z-axis:** Change the spindles for Z-axis. Make sure the sledge moves right over the spindles. Do a calibration afterwards. This task has to be done all 24 months.

**Replace the ventilator:** Replace the ventilator. Make sure the new ventilator works as it should. Make sure the new ventilator doesn't touch the enclosure from the ventilator. This task has to be done all 24 months.

## 2.2. Priority list

The business group decided to make a map with all the decision factors in it. So we could be sure, that the coordinator will choose the right decision afterwards. Because sometimes it's really hard to choose the right plan for the costumers. But with this list this work is already done. The coordinator has to fill in the name, the importance, the number of parts, the application date and the time which is needed to print one of the parts. In relation to this intakes which has to be done, only the importance of the project has to be estimated from the coordinator. All other factors will be given after the slice with the slicer software. Or the application date is given from the customer himself. After filling in all the parameters the map will calculate a ranking in which the orders have to be made to be as efficient as possible.

In this picture is an example how it should work like. There are a few students from Switzerland who were taken to show the principal:

Ranking	Name of applicator	Date of application	Importance (1-10)	Number of parts	Needed time (minutes)
1	Andrea	14.04.2022	10	10	100
3	Daniel	15.04.2022	9	20	100
2	Michael	16.04.2022	8	10	100

In the picture above you can see, the application date for Michael is the latest one. But because of the importance and the number of parts this order has to be as second one.

## 2.3. Pricelist

To have an overview about the price for an order we decided to make a pricelist. In this list all costs who have to be covered for the team are included. So the applicator has to fill in the quality and the weight from the part. After the map will calculate the price for the whole part. In this price is the salary, the filament, the maintenance, a security fee and the profit included. So if the map will be use, the team will be economical independent.

### Pricelist

Weight (gram):

Quality: 

Low	Medium	High
<input type="text"/>	x <input type="text"/>	<input type="text"/>

Final price (Birr):

In this example you can see the calculated price. For this there must be the weight in gram and the decision for the quality. After the map calculated the price they have to offer for the part.

**Important:** You can find all these things in the excel sheet "Working\_sheets"

## 2.4. Spare parts

### 2.4.1. Shops



Even if a maintenance program is available for the printer, there could be damages. Because of this it's very important to have one or several addresses to order some spare parts. In relation to this we found a few shops where parts can be ordered. Naturally the prusa webshop is always available and also the delivery to Ethiopia is possible. But the price is very high as you can see in the picture on the right side. In conclusion to this we started a research for cheaper shops.

There are a few shops that import parts from china. As if we would like to support regional shops, but there is no possibility. Because there aren't any shops in Ethiopia, which sell parts for Prusa i3 MK3S+. Because of this we looked for other shops in the whole world. We propose to order parts in the future from those two shops.



<https://www.3djake.com/spare-parts-upgrades/original-prusa?page=2>

<https://www.3dprintronics.com/Prusa-3D-Printer-Spares-c40975239>

Der Preis für den Versand wird je nach Lieferort und Inhalt des Warenkorbs festgelegt

Land  Äthiopien PLZ  56770

**Versanddienst wählen**

 <b>Fedex International economy</b> 5-6 Tage	<b>36,91 €</b>
 <b>Fedex International Priority</b> 2-3 Tage	<b>40,89 €</b>

Sie müssen eine Versandart auswählen

[Rabattcode eingeben](#)

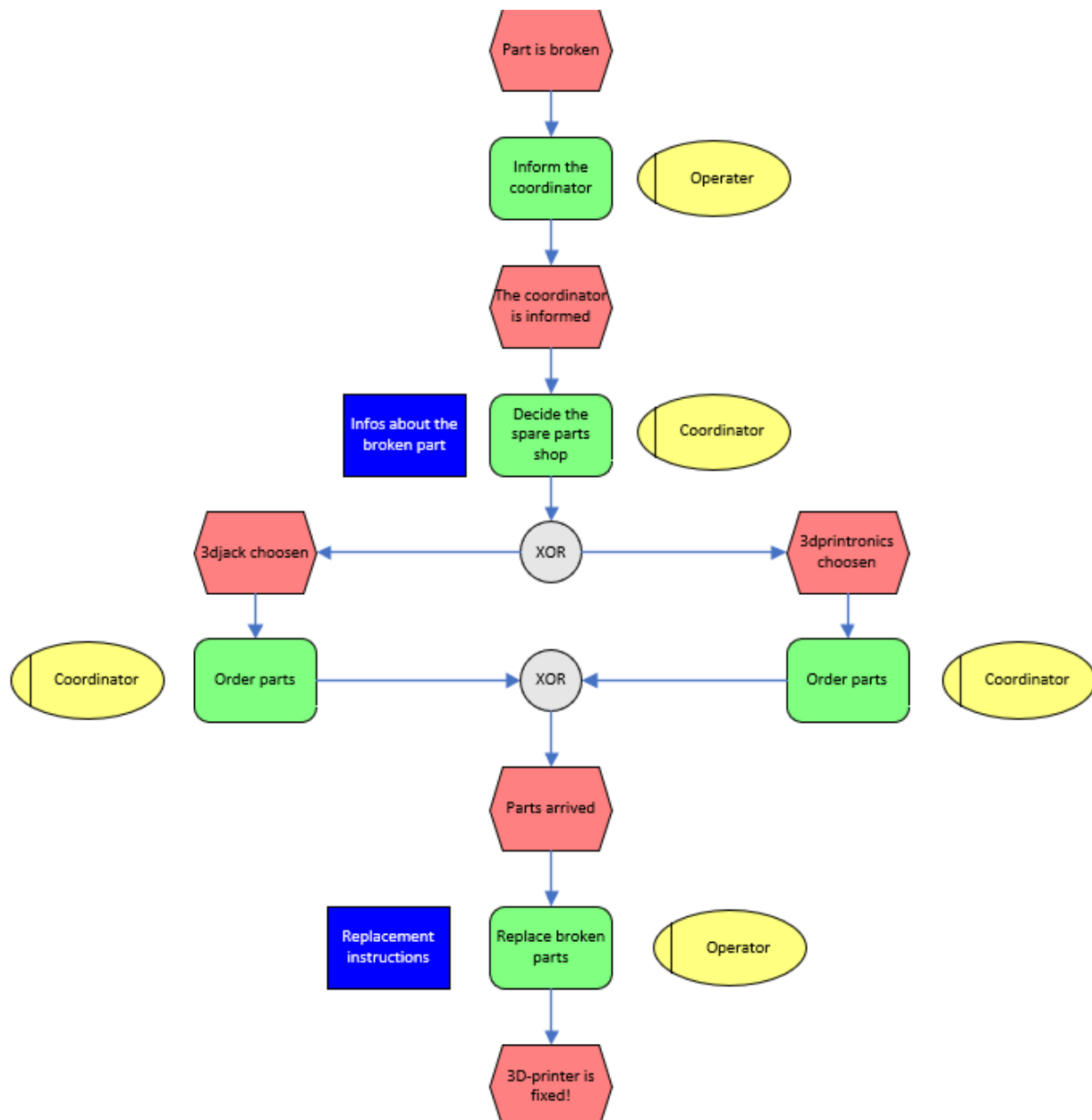
Gesamtpreis der Produkte 7,65 €

**Total 7,65 €**

Sie müssen eine Versandart auswählen

**Fortfahren zum Bestellen**

## 2.4.2. Process



The whole process begins with the broken part. The operator has to inform the coordinator about this issue. After the coordinator will take a decision from which shop the team will order the part. This means he must have the informations about the broken part and where it's located at the printer. If the coordinator has decided a shop, the part will be ordered there. In case that both shops don't sell the part who is needed, it's also possible to order it on the official website from prusa. But the other shops should be preferred so we didn't show the way with prusa in the process picture.

When the part is arrived, the coordinator will bring it to the operator, who will replace the broken part. For this step he needs all the instructions to fix the printer correctly.

### 3. Attachment

#### 3.1. Comparison of filament melting machine

Name	Difficulty	Price	Speed	Supported material	Link
3devo	easy	\$7,500	1Kg/hr	PLA, ABS, PC, nylon, and more	<a href="https://3devo.com/">https://3devo.com/</a>
Wellzoom	easy	\$650	100g/hr	PLA	<a href="http://wellzoomextruder.com/">http://wellzoomextruder.com/</a>
ReDeTec	easy	\$3,500	500g/hr	PLA, ABS, nylon 12, and more	<a href="https://redetec.com/">https://redetec.com/</a>
Noztek Pro	easy	\$1,600	500g/hr	PLA, ABS, PP, and more	<a href="https://www.noztek.com/product/noztek-pro/">https://www.noztek.com/product/noztek-pro/</a>
Lyman Extruder	Medium	\$600	250g/hr	PLA, ABS, and more	<a href="https://all3dp.com/2/best-filament-extruder-maker-diy-buy/">https://all3dp.com/2/best-filament-extruder-maker-diy-buy/</a>
Felfil Evo	Easy to medium	\$350-\$700	200g/hr	PLA, ABS, and more	<a href="https://felfil.com/">https://felfil.com/</a>
Filastruder Kit	Medium	\$300	150g/hr	PLA, ABS, PP, PC, and more	<a href="https://www.filastruder.com/products/filastruder-kit">https://www.filastruder.com/products/filastruder-kit</a>
Precious Plastic Extruder	hard	\$200-500	5 kg per hour	HIPS, LDPE, PP, and more	<a href="https://all3dp.com/2/best-filament-extruder-maker-diy-buy/">https://all3dp.com/2/best-filament-extruder-maker-diy-buy/</a>

### 3.2. Material comparison

Material	Advantage	Disadvantage
PLA	<ul style="list-style-type: none"> <li>-biodegradable (reusable)</li> <li>-made by natural components</li> <li>-high quality</li> </ul>	<ul style="list-style-type: none"> <li>-low temperature resistance</li> <li>-deform on summer season</li> <li>-not durable (not used for storing something)</li> </ul>
PVA	<ul style="list-style-type: none"> <li>-good quality</li> <li>-wide application</li> <li>-dries fastest at room temperature</li> <li>-quick drying</li> <li>-flexible</li> <li>-permanent</li> </ul>	<ul style="list-style-type: none"> <li>-toxic if we eat it (may be for kids at home)</li> <li>-degraded and broken easily by algae, bacteria and yeast.</li> <li>-can't use outdoor</li> </ul>
TPV	<ul style="list-style-type: none"> <li>-non-toxic and safe</li> <li>-wide range of hardness</li> <li>-has excellent coloring</li> <li>-weather resistance</li> <li>-fatigue resistance and temperature resistance</li> <li>-can be recycled and effectively save energy</li> </ul>	<ul style="list-style-type: none"> <li>-it's physical property decreases with increasing temperature</li> <li>-limited application</li> </ul>
NYLON	<ul style="list-style-type: none"> <li>-abrasive resistance</li> <li>-variety application</li> <li>-light weight</li> <li>-water resistance</li> <li>-drier quickly</li> <li>-durable</li> <li>-resistance to stains, UV rays, heat and other chemicals</li> </ul>	<ul style="list-style-type: none"> <li>-lacks dimensional stability</li> <li>-poor resistant to sunlight</li> <li>-heat sensitive</li> </ul>
PET	<ul style="list-style-type: none"> <li>-Durability</li> <li>-heat resistance</li> <li>-smooth</li> <li>-resist degradation</li> </ul>	<ul style="list-style-type: none"> <li>-very sensitive to heat</li> <li>-can be damaged in dump situation</li> </ul>





### 3.3. Question for market research

Introduce yourself to and tell them what you are doing...

- From which department are you?
  
  
  
  
  
  
  
  
  
  
- Do you know what a 3D-printer is?
  
  
  
  
  
  
  
  
  
  
- What kind of parts do you imagine to print with the 3D-printer?
  
  
  
  
  
  
  
  
  
  
- How familiar are you with CAD- programmms (5=very familiar/1=never seen)  

1	2	3	4	5
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
  
  
  
  
  
  
  
  
  
  
- Have you ever designed a part with CAD?
  
  
  
  
  
  
  
  
  
  
- How much would you pay for each example printed part?
  
  
  
  
  
  
  
  
  
  
- How should a 3D-Printer shop looks like in your opinion? Have you ever seen a kind of 3D printer shop in your environment?

### 3.4. Financial calculations

#### 3.4.1. Filament

- Researched
  - 8 filament / year
  - 1 filament is 1000 gram
  - 1 kg of filament gives 60 hours of printing
  - Average price of a filament: 2250 birr / 1 kg
    - From Ethiopian: 4000 birr / 1 kg
    - From foreign countries: 500 birr / 1 kg
- Own calculations
  - 20 hours of printing in one week
    - 4 hours of printing in one day
  - There are 250 working days / year
    - $4 * 250 = 1000$  working hours / year
  - Amount of filament / year
    - 1000 working hours of one year / 60 hours of printing for one filament  
= 16,6 filament / year
    - -> around 20 filaments / year
    - -> 20'000 gram / year
  - Costs for the filament / year
    - $20 * 2250 \text{ birr} = 45'000 \text{ birr} / \text{year}$

#### 3.4.2. Maintenance

- Researched
  - Maintenance costs are around 3500 birr / year
    - For nozzle
    - For printing bed and adhesives
    - For parts replacements
- Own calculations
  - Includes a safety factor of 1.5
    - $1.5 * 3500 \text{ birr} / \text{year} = 5250 \text{ birr} / \text{year}$
  - Costs for one gram
    - $5250 \text{ birr} / 20'000 \text{ gram} = 0,26 \text{ birr} / \text{gram}$
    - -> **0,3 birr / gram for maintenance**

#### 3.4.3. Salary

- Own calculations
  - Amount of working hours for one month
    - 2 parts are needed to design by ourself
      - 1 part needs around 8 – 12 hours
    - Estimated working hours
      - Designing:  $10 \text{ hours} * 2 \text{ parts} = 20 \text{ hours} / \text{month}$
      - Maintenance: 2 hours per week = 8 hours / month
      - Coordination: 2 hours per week = 8 hours / month
      - Financing: 2 hours per week = 8 hours / month
    - -> 44 hours / month (for all 5 people)
    - -> 2,2 hours per day (44 hours / 20 days)

- Cost for salary per gram
  - 30 birr / one hour of working
  - 30 birr \* 2,2 hours = 66 birrs / day
  - 66 birr \* 250 working days = 16'500 birr / year
  - 16'500 birr / 20'000 gram = 0,825 birr / gram
  - **-> 1 birr / gram for salary**

#### 3.4.4. Security fees

- Own calculations
  - 200 birr / month
  - 2400 birr / year
  - 2400 birr / 20'000 gram = 0,12 birr / gram
  - **-> 0,15 birr / gram**

#### 3.4.5. Options of printing quality

- Amount of per gram
  - Best option: 1 g / 0,63 h
  - Medium option: 1 g / 0,135 h
  - Normal: 1 g / 0,09 h
- Factor of different options
  - 1 – 1,5 – 3 (Low – Medium – High)

### 3.5. Ordering Process

