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ARTORG CENTER
BIOMEDICAL ENGINEERING RESEARCH

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ARTORG Rapid Prototyping Core Facility

- How to work with us -

Version of September 8, 2017

1. Introduction

ARTORG, ISTB and SITEM operate a Rapid Prototyping Core Facility. As part of this Core Facility, we are obliged to support the various needs for rapid production of 3D structures for various clinical and pre-clinical research projects. The Core facility offers:

- In-house rapid prototyping (RP) facility for quick and accurate printing of 3D models from CAD or medical image data.
- Knowledge support around the topics of model generation, model optimization for a specific printing process and optimal choice of printing methods
- Full service solutions for creation, production and maintenance of RP models

Our services aim to support and enrich ongoing research activities rather than competing (in price) with commercially available printing solutions.

1.1. Contacts

3d-printing@artorg.unibe.ch

http://www.artorg.unibe.ch/research/3d_printing/index_eng.html

1.2. Available 3d-Printer

Stratasys Eden260VS¹: This printer uses liquid polymers and hardens them with UV-light. Different materials can be printed, however, only one model material can be selected for each project. Ridged and flexible materials in different colors as well as biodegradable and heat resistant materials are possible. The precision of the polymer printer is 40 μm on the horizontal axis and a layer thickness of 16 μm .



¹ <http://www.stratasys.com/de/3d-drucker/design-series/objet-eden260vs>

Other methods: Other printing methods using a great variety of materials (metal...) can be arranged for through cooperation with existing 3D printing solution providers. Just ask us.

2. Production Costs

In general, before each order, we will create an estimate on the expected production costs, containing the following elements.

2.1. Printer

Machine costs are charged to partly cover acquisition (100k CHF) and service costs (15k CHF p.a.). They are computed for the printer to be running 700 hours per year. The following machine costs are assumed

- Models requiring less than 5h to print: 45 CHF/h
- Models requiring more than 5h to print: 40 CHF/h
- Models requiring more than 10h to print: 35 CHF/h

For larger projects requiring many hours of printing, an individual cost model can be discussed.

2.2. Material

Material costs are charged with an overhead of 25% from the pricelist of the official Swiss supplier Alphacam. The overhead is used to cover material changes, machine failures and human errors.

Material Name	Properties	Price
VeroWhitePlus	White, rigid	0.20 CHF/g
VeroClear	Transparent, matt, rigid	0.22 CHF/g
VeroBlue	Blue-gray, rigid	0.20 CHF/g
Tango+	Yellowish-transparent, flexible	0.22 CHF/g
Support705	Jellylike, hydrophobic	0.08 CHF/g
Support707	Waxy, water-soluble	0.08 CHF/g

- The water-soluble support Support707 can only be used with VeroWhitePlus, VeroGray, VeroBlue and VeroClear.
- Other materials exist, but are not currently in stock

- Rigid transparent RGD720, VeroGray, VeroBlackPlus,
- Simulated Polypropylene: Rigur RGD450, Durus RGD430,
- High temperature RGD525,
- Clear bio-compatible MED610,
- flexible TangoBlackPlus, TangoGray, and TangoBlack)

2.3. Model preparation

Image based segmentation, virtual model preparation and other preparation steps are charged as follows:

- 100 CHF/h

2.4. Post processing

Post processing of the 3d model, except for removing support material, is charged as follows:

- 80 CHF/h

This includes special treatment or coating of the printed model.

3. Ways to reduce production costs

There are many ways to keep production costs as small as possible. Typically a discussion is required prior to printing on how an efficient and optimal production is achieved. The following points should be considered.

3.1. Reduce machine costs

Reduce Model height: Every printed layer takes time and is attributed in machine cost. Models with reduced height dramatically reduce printing costs. Low heights can be achieved through modularizing of components (i.e. 3 small pieces instead of one large piece)

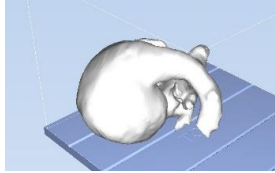
Pooling: The cost of a single prototype can be reduced, by printing multiple copies at the same time. Also printing multiple individual projects at the same time can reduce the printing costs, since the printing time does not increase linearly with the volume, but is largely dependent on the height of the highest model being printed.

3.2. Reduce material costs

Hollow design: By using support material within the model, model material can be saved. Depending on the geometry this can reduce the costs.

4. Cost Examples

4.1. ARTORG vs. Commercial Service



Heart 1:1

Production intensive models (i.e. 24h) are typically cheaper to be purchased through commercial providers due to lower machine costs per hour (because they can run their systems 24-7). We can check for cheaper solutions if desired.

	ARTORG RP	Materialise.com	3d-activation.ch
Model	1625 g		30 μ m layers
Support	1044 g		
Printing Time	24 h \times 35CHF		
Cost	1360 CHF	589 CHF	834 CHF

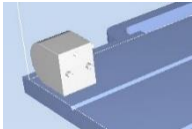
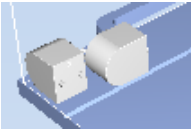
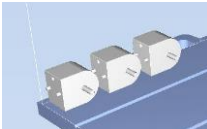
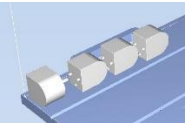
4.2. Effect of optimal orientation during print

We will optimize the object orientation in terms of production time and to minimize deformations, due to non-isotropic material properties while printing. This example should give an idea, how modularization can be used to reduce production costs.

	Horizontal	Vertical
Model	8 g	20 g
Support	12 g	26 g
Printing Time	0.75 h	5.5 h
Cost	38 CHF	230 CHF

4.3. Pooling

A few small pieces arranged next to each other during the printing process are faster (i.e. cheaper) to produce than one single unit. **Consider possible modularization.**

				
Model	36 g	68 g	99 g	133 g
Support	20 g	36 g	52 g	69 g
Printing Time	1.75 h	2 h	2 h	2 h
Cost	90 CHF	110 CHF	120 CHF	130 CHF
Cost per piece	90 CHF	55 CHF	40 CHF	30 CHF
Commercial Service: www.Materialise.com (Minimum order Volume 108.-)				
Cost per piece	57 CHF	41 CHF	39 CHF	36 CHF
Commercial Service: www.3dActivation.ch (Minimum order Volume 108.-)				
Cost per piece	79 CHF	66 CHF	63 CHF	60 CHF