



The Printer Working Group

3D Printing BOF

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PWG F2F Meeting

Toronto, ON

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Purpose of this BOF

- Provide a brief overview of 3D Printing
- Discuss whether the PWG Semantic Model is applicable to 3D Printing
 - If so, what kinds of changes would be required to support 3D Printing?
- Discuss whether the PWG should continue to hold 3D Printing BOFs
 - If so, what additional vendors, organizations, and/or individuals should be invited to participate?

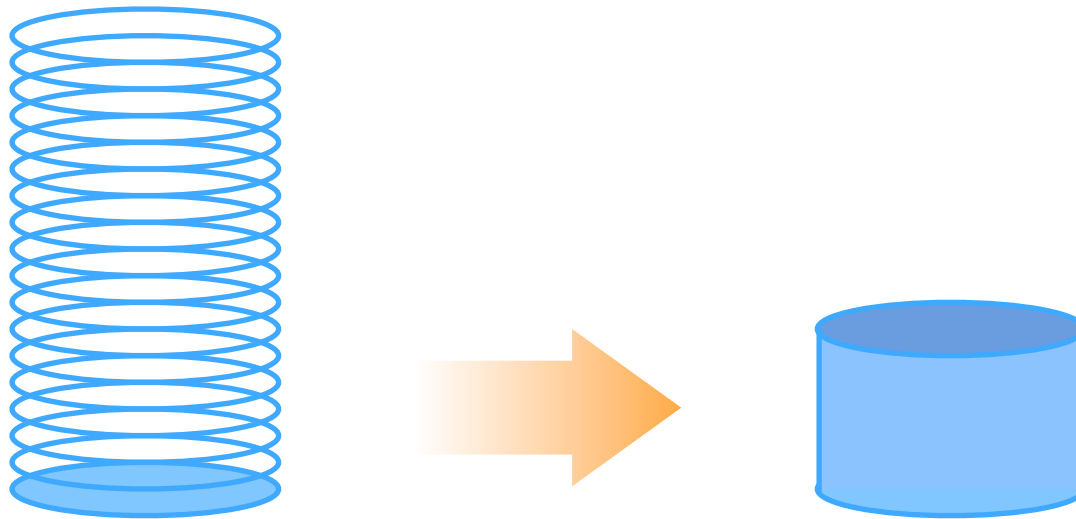
Introduction

- 3D Printing is a marketing term/name typically used for Additive Manufacturing (AM) such as Fused Deposition Modeling (FDM)
- Can also include traditional Subtractive Manufacturing (SM) techniques such as CNC milling where material is removed instead of added
- Some products are a hybrid - paper-based 3D printers cut and laminate printed sheets to produce colorful 3D objects
- Useful web pages:
 - <http://3dprintingindustry.com/3d-printing-basics-free-beginners-guide/>
 - http://en.wikipedia.org/wiki/3D_printing

Introduction



- In Additive Manufacturing, material is added to form three-dimensional objects, typically in deposited horizontal layers:





Introduction

- 3D printing often uses a single source material to produce a finished object, for example “blue PLA filament”.
- 3D printing often uses “rafts” and other support structures to maintain the shape of objects while they are printed.
 - These supports are removed after printing, either manually (break them off by hand) or with finishing hardware.
- Printing can be very slow, although speeds continue to improve with every new generation of products.
- Common printer faults such as running out of the source material can cause ruined objects.



- End User software is mainly designed for experts and dedicated “makers” (inventors/enthusiasts).
 - 3D object files (STL, etc.) do not specify units of measure, making sizing/scaling problematic.
 - Objects often need to be “water tight” (no holes) to work with layering software.
 - Rafts and other support structures can affect the usable build volume.
 - End Users need a expert understanding of the capabilities and limitations of the printer and software being used.
- Networked 3D printers typically provide little or no feedback to the client device - most errors are only reported on the 3D printer.
 - So End Users need to monitor the 3D printer console closely for issues to prevent a ruined object.



- Common file formats used for 3D printing:
 - Input 3D object formats: 3DMF, Collada, DXF, OBJ, STL, VRML97, X3D
 - Layer definition/instruction formats: AMF, G-code
- Network protocols used for 3D printing:
 - Teph: RESTful web service API
 - S3G: Makerbot network protocol
 - Various vendor-specific solutions
- Standards groups for 3D printing:
 - ASTM International Committee F42
 - <http://www.astm.org/COMMITTEE/F42.htm>
 - ISO TC261
 - http://www.iso.org/iso/standards_development/technical_committees/other_bodies/iso_technical_committee.htm?commid=629086

Is the Semantic Model Applicable to 3D Printing?



- **Device/System Object**
 - Subunits
 - Is the extruder part of the marker subunit, or something new?
 - Is code that does the G-Code/STL translation part of the interpreter subunit?
 - Supplies
 - Same state model as for a regular imaging device/system?
- **Services**
 - Re-use Print service?
 - Same state model, maybe additional state reasons?
- **Jobs**
 - Same state model, maybe additional state reasons?

Is the Semantic Model Applicable to 3D Printing?



- Documents
 - Input digital documents
 - Input "hardcopy" documents (3D objects)
 - Output "hardcopy" documents (3D objects)
- Resources
 - Input digital documents from memory cards
 - Output digital documents to memory cards

Next Steps



- Should the PWG continue the 3D printing BOFs?
- Should the PWG prepare a marketing white paper for outreach to the 3D printing industry?