Abstract #1642

English

APPLIED LESSONS IN THE USE OF ADDITIVE MANUFACTURING FOR DEVELOPMENT OF THE PROMPT (PERCUSSIVE AND ROTARY MULTI-PURPOSE TOOL) TOOLSET

Additive manufacturing technologies have made significant advances in recent years. Particularly due to the technology's ability to allow the production of unique and complex geometries, additive manufacturing has seen both significant hype and real-world successes, with several high-profile case studies in the aerospace industry. When tasked by the Canadian Space Agency to develop the PROMPT toolset, Deltion Innovations was challenged to develop drilling and percussive tools containing components with unique geometries and operational conditions. Partnering with Atlas Copco and Canadore College to design and produce the prototype tools, the team sought to explore the potential of additive manufacturing technologies to allow increased design freedom and prototyping potential. Taken from the practical perspective of a lab facility tasked with producing high quality prototype parts using a variety of additive technologies, this paper will discuss the lessons learned by the team as they moved through the process from initial design through to physical part manufacturing. In this paper, I hope to present both the successes and challenges experienced during the prototyping process, including clarifying many initial assumptions that were proven wrong, and likewise the expected and unexpected benefits achieved by using additive manufacturing. I will summarize by outlining the process that was ultimately followed in order to achieve success in the prototyping process, emphasizing key steps and considerations that were most critical to the process.

French

No abstract title in French

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Additive Manufacturing For Prototype PROMPT Tool Ends

Applied Lessons in the Use of Additive Manufacturing for the Development of the PROMPT Toolset

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Background

PROMPT – (Percussive and Rotary Multi-Purpose Tool)

1. Interchangeable tool-ends on a single automated system, to-be mounted on a robotic platform
2. Toolset includes core drilling, sampling, socket wrenches, abrasive ends… 12 individual tool ends

Project Objective

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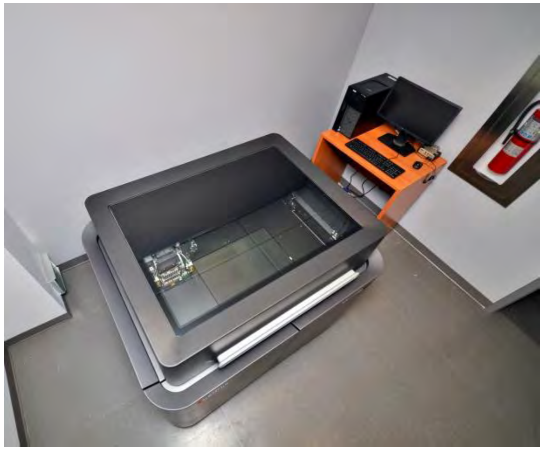
"Apply Additive Manufacturing to enable the production of prototypes for 12 individual PROMPT tools"



Development Approach

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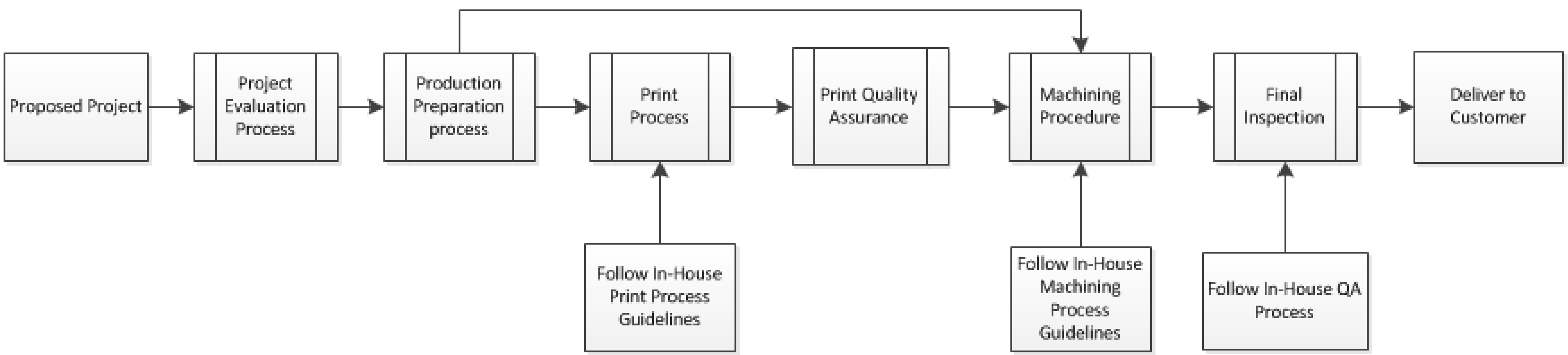
1. Design Refinement
2. Production Process Development /Partial Prototyping
3. Final Prototype Production

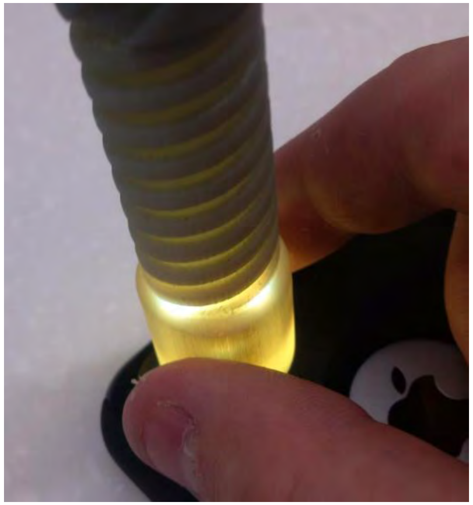
Concurrent processes (items 1–2)

Additive Manufacturing/Post Machining Project Flow Chart

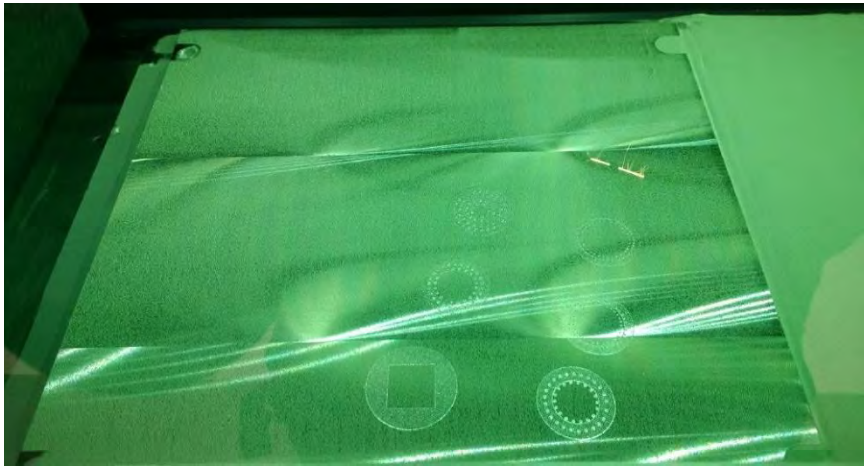


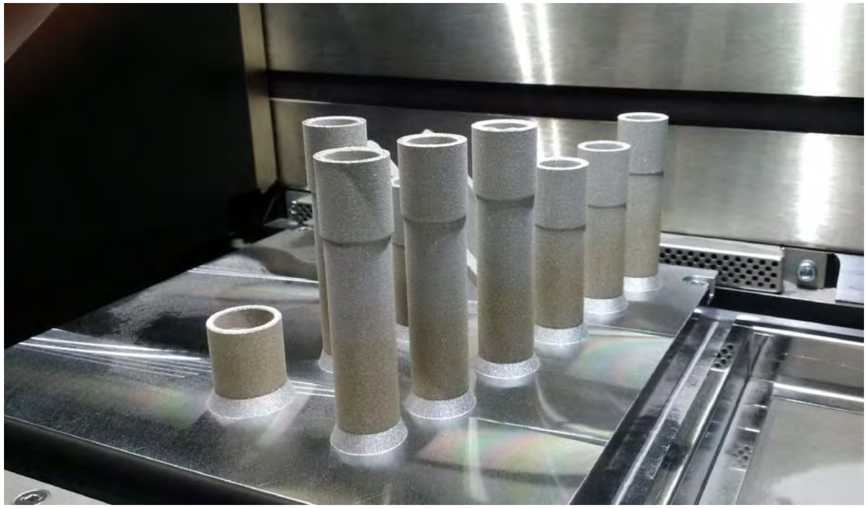
Refine Design/Build Strategy

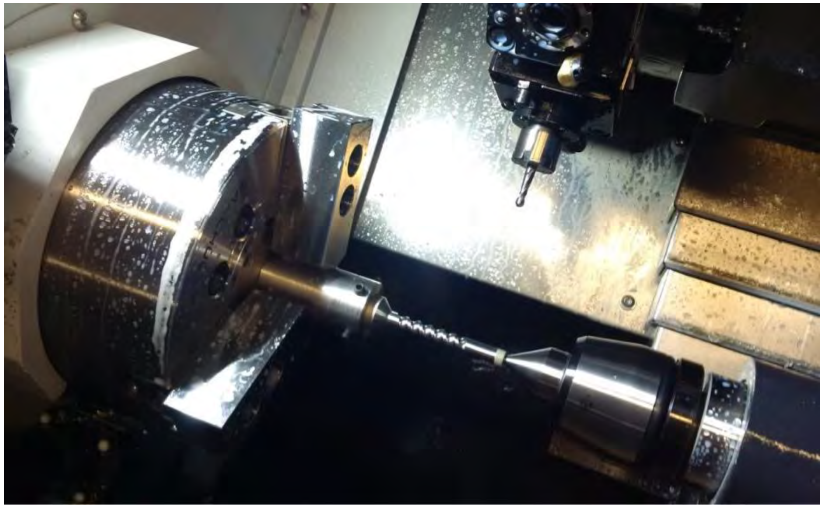
- Validate Process Selection
- Validate Material Selection
- Validate Print Strategy
- Validate Geometry (fit/tolerance)
- Validate Machining/Surface Finishes



Final Production







Next Steps

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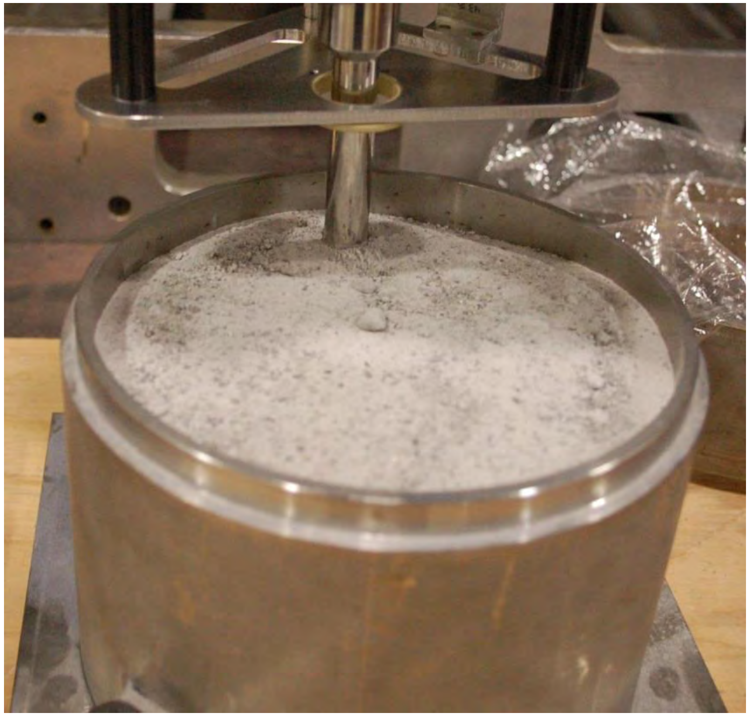
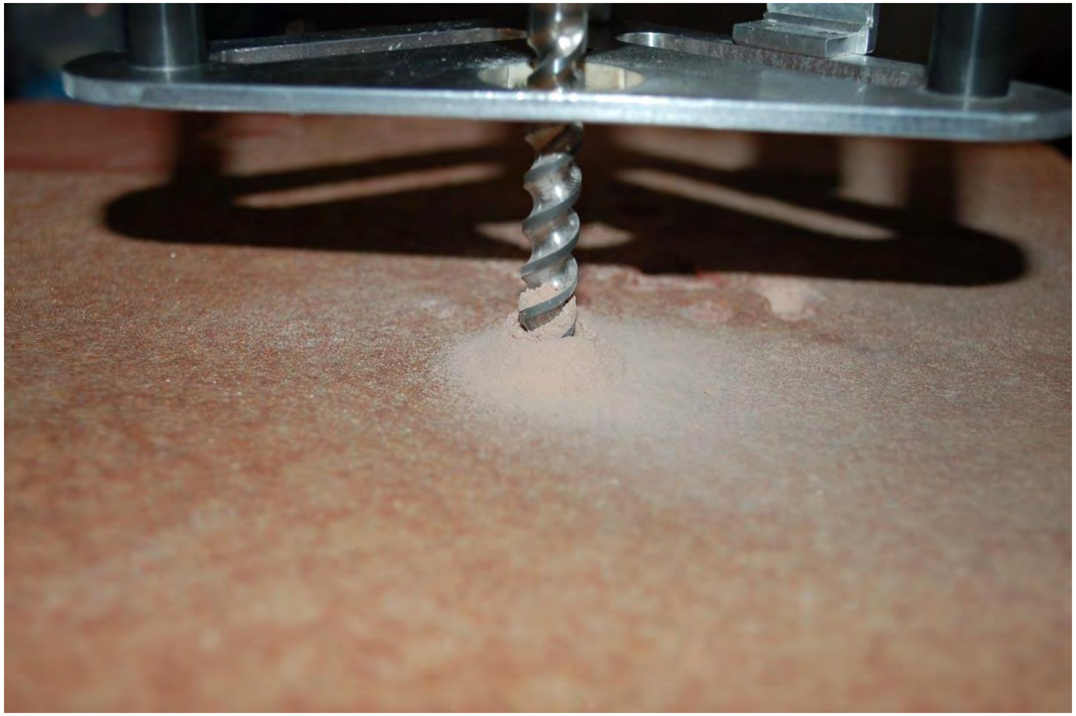


Push Tube tests in simulant



Auger tests in sandstone

Lessons – Benefits of Metal AM

1. **High complexity** and **small quantity/size** of tools made additive beneficial for this application
2. **Optimize** the designs, reduce number of parts
3. Production of small quantities with **high variability**
4. **Custom tooling**

Holding tool printed using AM

Assembly Tool printed using AM

Additional Notes

1. **Integration of design and manufacturing strategy –** New rulebook for design/manufacturing means collaboration between designers and manufacturers is necessary

2. **Industry maturation is required - but happening fast**
   – Increasing full-cycle productivity and best-practices
   – Standards for quality assurance being developed
   – More comprehensive material data being produced

Long Term Applications - AM in Space

AM as a class of technology is an obvious option for in-situ construction in the medium-to-long term

1. Uses only material required
   - Whether ISRU, or reducing mass-to-orbit
2. Provides best design freedom

Current work is proving out the potential and limitations of each class of AM technology

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