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27 avril 2015

La recherche (mathématique) au service de la Fabrication 3D

Agenda de la présentation

- Grands domaines de recherche en fabrication 3D
  - ✓ Design
  - ✓ Matériaux
  - ✓ Procédés et équipements
  - ✓ Méthodes de tests
- Survol de récents « roadmaps » technologiques
- Maturité des technologies
  - ✓ Technology Readiness Levels (TRL)
  - ✓ Manufacturing Readiness Levels (MRL)
- Opportunités de maillage avec l'industrie

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Grands domaines de recherche en Fab Add

- Design
  - ✓ Nouveaux formats de données 3D, 4D
  - ✓ Optimisation topologique**
  - ✓ Sécurisation des données, traçabilité
- Matériaux
  - ✓ Aluminium, titanium, fibre de carbone…
  - ✓ Caractérisation (poudres…)
  - ✓ Modèles multi-physiques multi-échelles prédictifs**
- Procédés & équipements
  - ✓ Triplet machine /matériau /post-traitement
  - ✓ Contrôles temps-réel
  - ✓ Robotique /fabrication agile /machines hybrides
- Tests
  - ✓ Tests mécaniques non-destructifs
  - ✓ Authentification, traçabilité des objets

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Roadmaps technologiques (‘Research Maps’)

- États-Unis
  - ✓ 2009: Roadmap workshop and findings (Report) funded by the National Science Foundation (NSF) and the Office of Naval Research
  - ✓ 2011: **DARPA Open Manufacturing Program**
  - ✓ 2012: National Network for Manufacturing Innovation (NNMI)
  - ✓ 2013: roadmap for Metal-based AM funded by the National Institute of Standards and Technology (NIST)
  - ✓ 2014: **Advanced Manufacturing Partnership 2.0** Report funded by the President’s Council of Advisors on Science and Technology (PCAST)

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Roadmaps technologiques ('Research Maps')

- Europe
  - ✓ 2013: ***European Space Agency Perspective on AM***
  - ✓ 2013: *The Future of Additive Manufacturing - Exploring the Research Landscape.* Report funded by the Direct Manufacturing Research Center (DMRC), the Heinz Nixdorf Institute (University of Paderborn) and industry partners (Boeing…)
  - ✓ 2014: ***Additive Manufacturing in FP7 and Horizon 2020*** – Report from EC Workshop on AM held in June 2014

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Roadmaps technologiques

- Asie
  - ✓ Singapour
  - ✓ Japon (2013): National Institute of Advanced Industrial Science and Technology (AIST)
  - ✓ **Chine**

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Maturité des technologies

- Technology Readiness Levels (TRL)
  - ✓ NASA / U.S. Dept. of Defense
  - ✓ European Space Agency (ESA)
  - ✓ European Commission (EC)
  - ✓ Oil & Gas Industry…
- Manufacturing Readiness Levels (MRL)
- Gartner 'Hype Cycle' pour l'impression 3D

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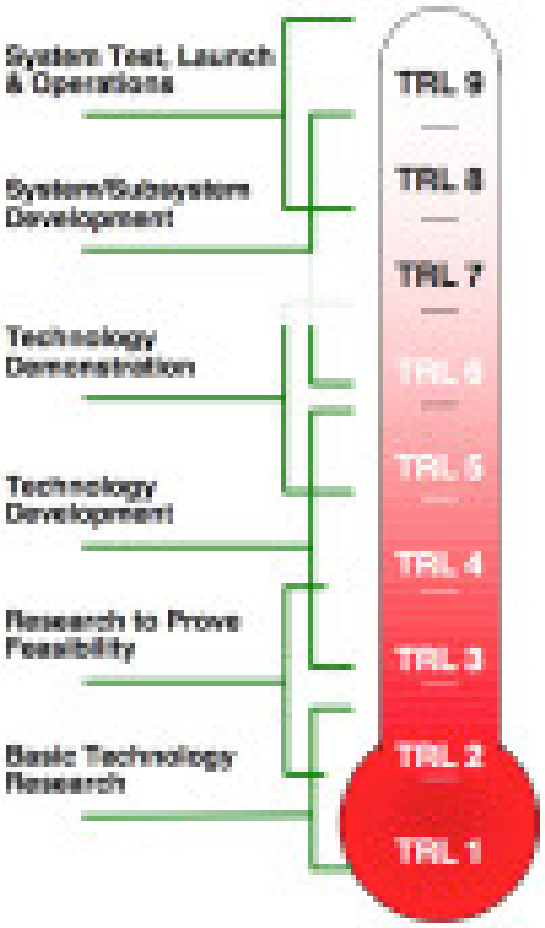
NASA/DOD Technology Readiness Level



Actual system "flight proven" through successful mission operations

Actual system completed and "flight qualified" through test and demonstration (Ground or Flight)

System prototype demonstration in a space environment

System/subsystem model or prototype demonstration in a relevant environment (Ground or Space)

Component and/or breadboard validation in relevant environment

Component and/or breadboard validation in laboratory environment

Analytical and experimental critical function and/or characteristic proof-of-concept

Technology concept and/or application formulated

Basic principles observed and reported

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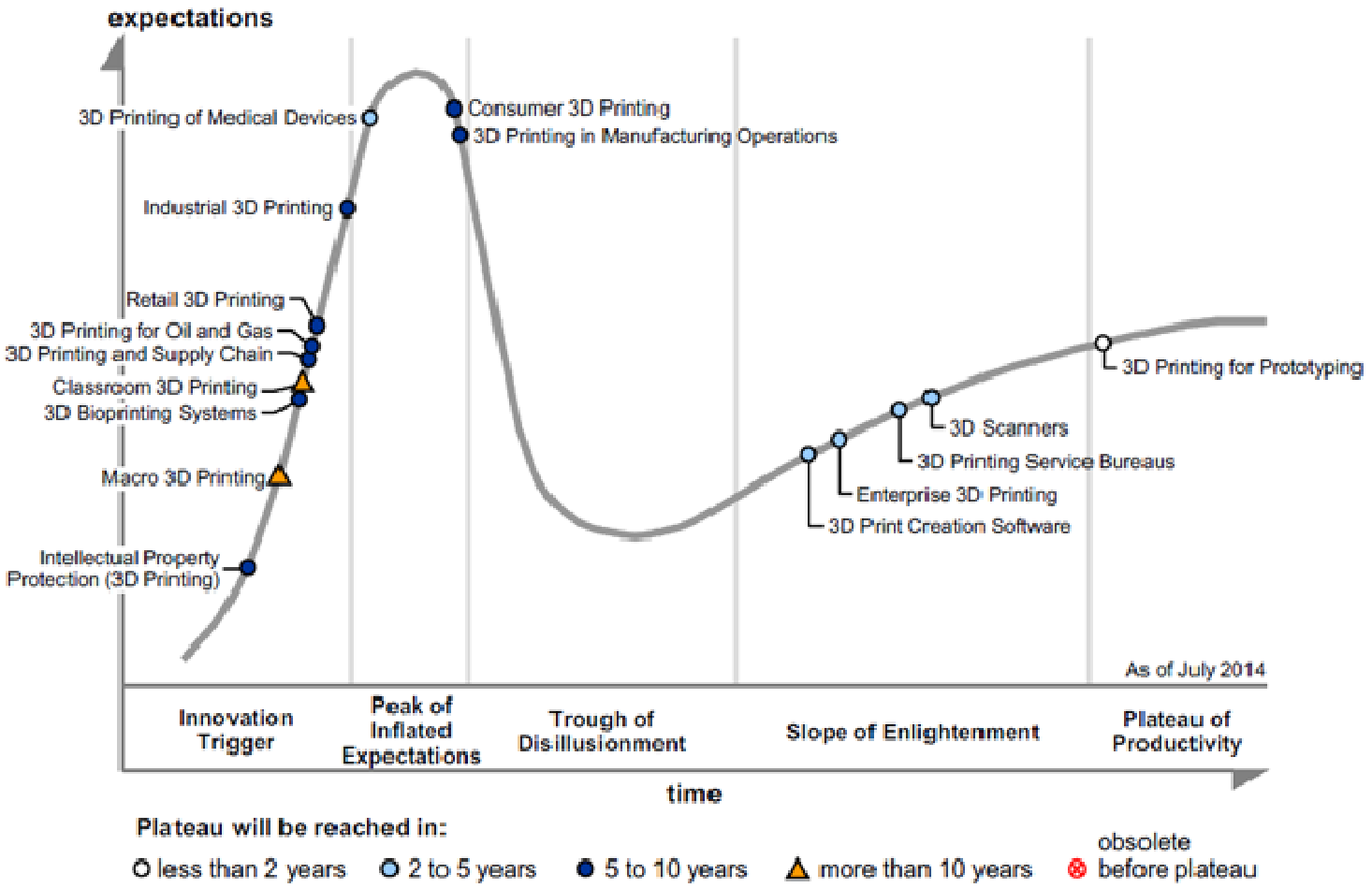
Maturité des technologies – selon Gartner

Figure 1. Hype Cycle for 3D Printing, 2014



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Opportunités de maillage avec l'industrie

- Réseau Québec 3D (CRIQ)
- Canada Makes (Association des manufacturiers et exportateurs canadiens)
- Organismes de normalisation
  - ✓ ASTM F42 + Chapitre de Montréal sur le Design
  - ✓ ISO TC 261- Comité miroir canadien
- Additive Manufacturing Users Group
- Appels à projets CRIAQ
- Assises Européennes de la Fabrication Additive organisées par l'AFPR (20e édition)

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