IMS: a suitable organisation to support an International Platform for Additive Manufacturing

14th AM Platform meeting

General Assembly

Date: June 3th 2014

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About Intelligent Manufacturing Systems (IMS)

IMS is an industry-led, international business innovation and research and development (R&D) program established to develop the next generation of manufacturing and processing technologies through multi-lateral collaboration.

The IMS program provides the framework and support for conducting international research among large business enterprises, small-to-medium enterprises, universities, and research institutions

IMS provides global services to institutions from its supporting Regions including the European Union, Mexico, and the United States of America. Other Regions are encouraged to join the IMS program.

IMS offers international consortium building and coaching services provided at no charge to researchers from member countries.

IMS Services – to facilitate access to International resources, technologies & markets

- MTP Project Facilitators (Coaches) – Personalized one on one service
  - -Project formation
  - -Consortium building
  - -Project brokerage
- MTP Project Workshops
  - -Project formation and networking
  - -Consortium building
  - -Project brokerage
  - -Review ongoing research
  - -Dissemination of results
- Premier sponsor of the World Manufacturing Forum
  - -High level governments officials and industry executives
  - -Discuss issues and solutions to challenges in manufacturing
- Marketing
  - -Publications
  - -Speaking engagements in conferences, seminars and workshops
  - -Participation to manufacturing events

What are the Requirements for an MTP initiave?

- Two or more participating Regions sign a Memorandum of Agreement
- Minimum resource funding level of $1M
- Funding for meetings workshops provided by each partner or participating IMS Region
- Minimum duration of 12 months
- Partners will meet a minimum of two times per year

Through collaboration in the IMS program, each Region intends to strengthen its own manufacturing and enhance the quality of life of the world community.

Reasons for participating to IMS projects

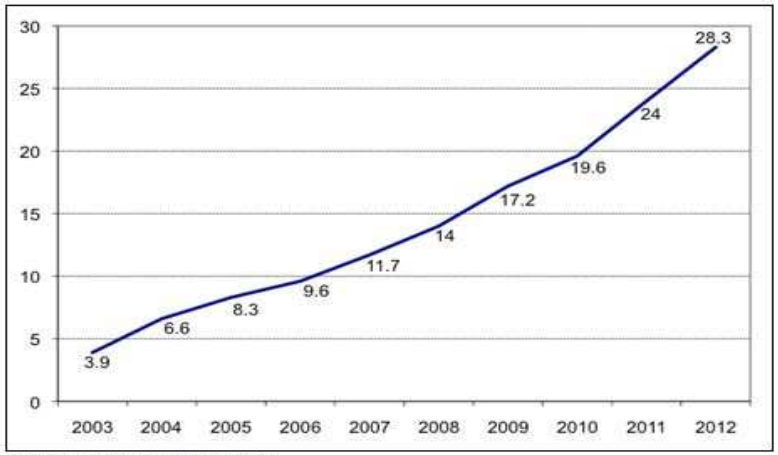
- Address global scale problems
- Make use of dispersed knowledge
- Increase cooperation
- Exchange of experience
- Improve R&D economies of scale
- Increase access to research infrastructures
- Increase level of innovation
- Increase human capital
- Improve market orientation
- Increase competitiveness
- Increase research capabilities
- Achieve research excellence
- Develop common strategies

IMS Strategy

- The present Manufacturing Technology Platform Program is very broad with scattered projects.
- Need for focus on specialized areas to be able to
  - better serve IMS participants
  - better assess impact of actions
  - better use of resources
- Search for 5 priority areas - Advanced Specializations
  - Additive Manufacturing (AM) and 3D printing – Agreed at the March 2014 HoD meeting as a pilot action
  - Nanomanufacturing?
  - Robotics?
  - Cyber Security?
  - Etc.....?

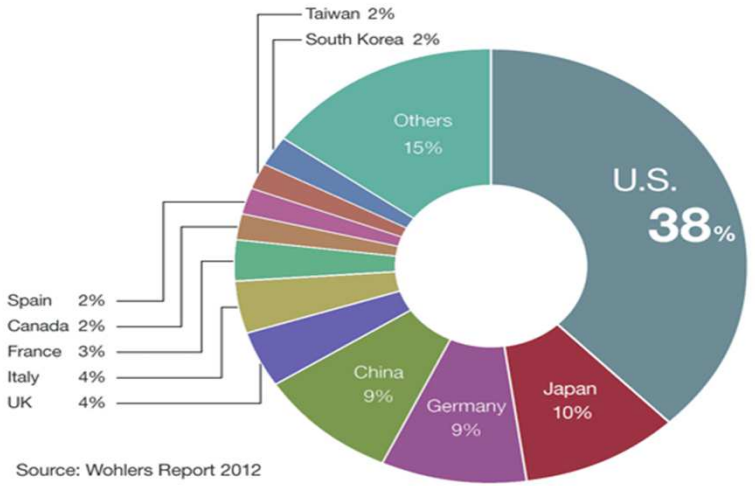
Why Additive Manufacturing?

- A disruptive technology



Source: Wohlers Report 2013

- A market in the rise



Source: Wohlers Report 2012

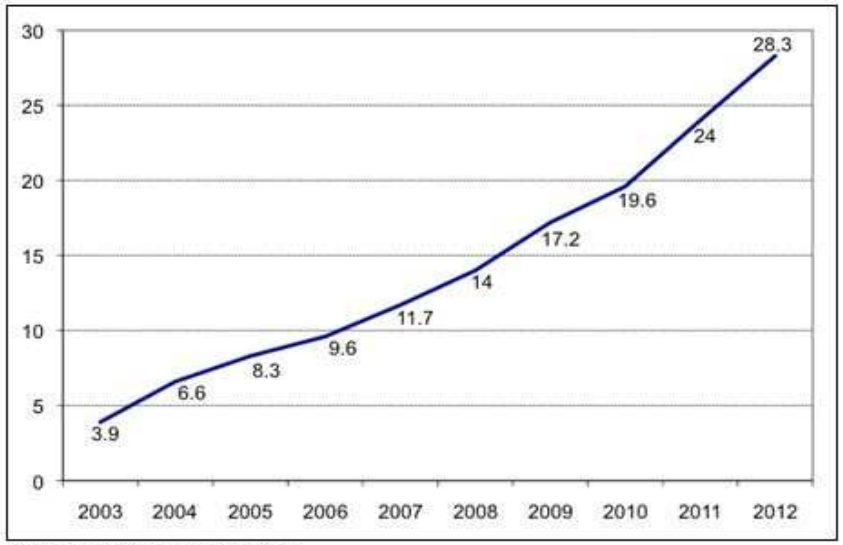
- A leading partner

❑ A Disruptive Technology (for a new manufacturing world that will potentially reshape the future of manufacturing)

- ❑ Huge opportunity with high interest at stake
- ❑ Need for scale up
- ❑ Share of costs and burden through collaborative efforts
- ❑ Broad applications
- ❑ Profound impacts on competitiveness and national security

❑ A market in the rise

Wohlers Report 2014 shows that the market for 3D printing, grew to $3.07 billion in 2013. The compound annual growth rate (CAGR) of 34.9% is the highest in 17 years. The CAGR for the past three years (2011-2013) was 32.3%.



Source: Wohlers Report 2013

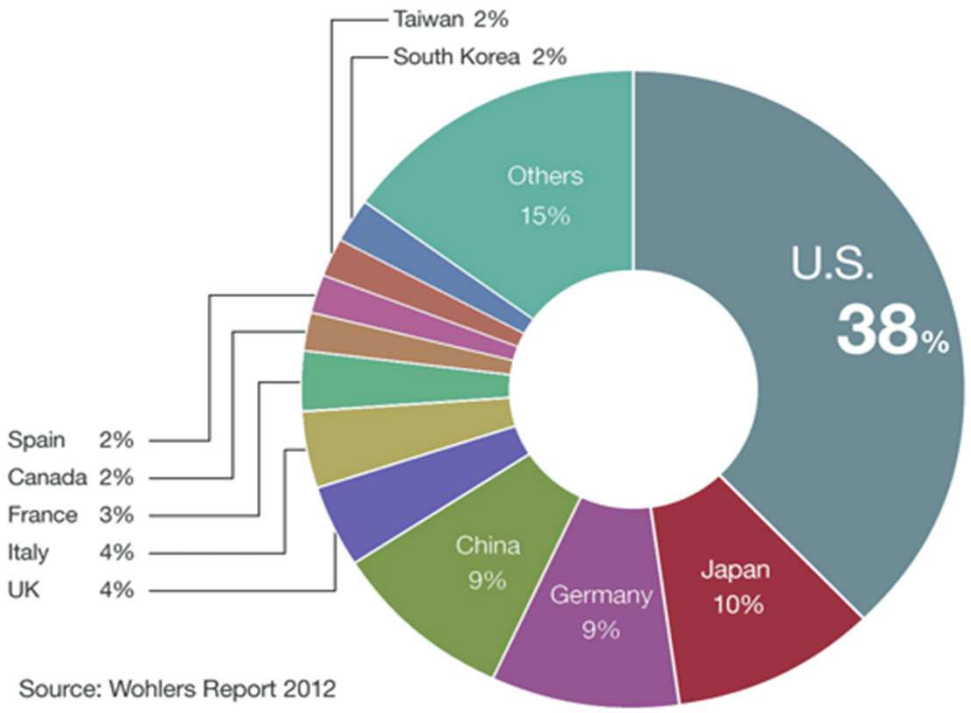
By 2017, sales of 3D printing products and services will reach $6 billion worldwide.

The total 3D printing market will nearly quadruple to $12 billion in 2025.

Rapid gains are expected in China.

❑ A leading partner

The U.S. continues to lead the world with the largest installed base of AM users. Wohlers Report 2013 indicates that 38% of all industrial AM installations are in the U.S.



The US will remain by far the largest national 3D printing market in the world, accounting for 42 percent of global sales in 2017. Additive Manufacturing has become a US National Technology Focus.

What the US could offer to IMS on AM on the basis of Mutual Opening of Programs

- **NIST- National Institute of Standards and Technology – IMS Regional Secretariat**

Measurement Science – 4 major projects in metal based AM

- **Real–Time control of AM processes**
- **Qualification for AM Materials, Processes and Parts**
- **System Integration for AM**
- **Characterization of AM Materials**

- **America Makes (former NAMII)** **National Center for Defense Manufacturing and Machining (NCDMM)**

Research Program

1st call – 07 projects awarded/April 2013 kick off

Investments - $ 4.5 M Govermnent Funds

and $ 5M cost share

2nd call – 15 projects - 75 individual partners

Investments - $9M Government Funds
and $ 10.3 M cost share

Some of Major AM Stakeholders in the US

- **Industry : Stratasys, 3D systems, GEs Global, Research Center, ExOne, Morries Technologies (GE), Boeing, EWI, Harvest Technologies, Georgia Tech, Goodrich, Honeywell, Lockheed Martin, Medical Modeling, Pratt & Whitney etc….**
- **Universities: CMU, Virginia Tech, Louiseville, NCSU, UTEP, UoTat Austin , UoA, PSU, UoC, YSU, ETC..**
- **Standards : ASTMF42, ISO/TC261, NIST…**
- **Additives Manufacturing Consortium (AMC)-33 partners**
- **Interagency working group on AM :OSTP, NASA, Army, Air Force, DoE, NIST**
- **Federal Agencies: LLNL, ORNL, AFRL, ARL, NRL**

The IMS Team will locate stakeholders around the US to engage in dialogue for cooperation.

MEXICO AM network in formation by four founding entities.

- Center for Applied Science and Technology Development (CCADET) from the National Autonomous University of Mexico (UNAM).

- Center for Advanced Technology (CIATEQ), which is a national research center belonging to the national network of research center of the Mexican National Council for Science and Technology (CONACYT).

- Advanced Materials Research Center (CIMAV), which is also a national research center belonging to the national network of research center of the Mexican National Council for Science and Technology (CONACYT).

- Center for Innovation in Design and Technology (CIDyT) from the Tecnológico de Monterrey.

Potential Candidate countries to join the IMS Additive Manufacturing Platform

Australia

In 09-2010, Wohlers was commissioned by CSIRO an industry-aligned additive manufacturing (AM) technology roadmap for Australia. Its focus was metals with a particular emphasis on titanium.

Canada

Awakened to additive manufacturing, especially for its aerospace industry around Montreal. – Mohawk College of Applied Arts and Technology Additive Manufacturing Resource Centre - (AMRC)

South Africa

The Council for Scientific and Industrial Research (CSIR) in South Africa, together with the Department of Science and Technology (DST), National Research Foundation (NRF), Aerospace Industry Support Initiative (AISI) and Aerosud, has launched an additive manufacturing platform.

Israel

Emerged as a global player due to a single company, Objet Geometries, Stratasys merged with Objet.

Switzerland

3D-Model.ch, 3D-Tech GmbH, Ecole Polytechnique Fédéral de Lausanne [EPFL], FME AG Mechanical Engineering, inspire / IRPD, Proform, etc…

Other countries

Standards and Standardisation

❑ Understand better the land scape

- ❑ ASTM Committee F42 on AMTs
- ❑ ISO/TC 261 on AMTs

ASTM and ISO signed a PSDO (Partner Standards Developing Organization) cooperative agreement.

ASTM International Signs MoU with National Additive Manufacturing Innovation Institute

- ❑ Standardization in Additive Manufacturing (SASAM)
- ❑ CEN and CENELEC STAIR (STAndardization, Innovation and Research) STAIR
- ❑ Platform on Additive Manufacturing, "STAIR-AM"
- ❑ National Standardisation organisations
- ❑ NIST- National Institute of Standards &Technology (NIST & ASTM partnership)
- ❑ Inspire-irpd (Switzerland) started in 2008 the IMS initiative, called "Additive Manufacturing ***Standardisation".***

❑ Discuss the AM issue as a whole at the IMS HoD meeting

❑ Work out a questionnaire for an IMS Strategy for International Co-operation on AM

IMS will promote and coordinate the formation of international Reseach Projects and related events on AM Standards within the IMS regions, present and future.

America Makes projects 1/3

- **In-Process Quality Assurance (IPQA) for Laser Powder Bed Production of Aerospace Components.**
  Led by General Electric Aviation in partnership with Aerojet Rocketdyne; B6 Sigma, Inc.; Burke E. Porter Machinery Company; Honeywell Aerospace; Montana Tech of The University of Montana; and TechSolve, Inc.
- **Developing Topology Optimization Tools that Enable Efficient Design of AM Cellular Structures.**
  Led by University of Pittsburgh in partnership with Acutec Precision Machining Inc.; Alcoa Inc.; ANSYS, Inc.; and ExOne
- **AM of Biomedical Devices from Bioresorbable Metallic Alloys for Medical Applications.**
  Led by McGowan Institute for Regenerative Medicine at the University of Pittsburgh in partnership with ExOne and Magnesium Elektron Powders
- **Refining Microstructure of AM Materials to Improve Non-Destructive Inspection (NDI)**
  Led by EWI in partnership with Lockheed Martin and Sciaky, Inc.
- **Development of Distortion Prediction and Compensation Methods for Metal Powder-Bed AM.**
  Led by GE Global Research in partnership with 3DSim, Inc.; CDI Corporation; Honeywell Aerospace; Pan Computing LLC; Penn State

America Makes projects 2/3

❑Development of a Low-Cost Lens® Engine
Led by Optomec in partnership with Lockheed Martin Missiles & Fire Control; MachMotion; TechSolve, Inc.; and US Army Benet Laboratories

❑ Development of Knowledgebase of Deposition Parameters for Ti-6Al-4V and IN718.
Led by Optomec (Applied Optimization Inc.)

❑ Automatic Finishing of Metal AM Parts to Achieve Required Tolerances & Surface Finishes.
Led by North Carolina State University in partnership with Advanced Machining; CalRAM Inc.; FineLine Prototyping, Inc.; Iowa State University; John Deere; Kennametal Inc.; and Productivity Inc.

❑ Electron Beam Melted Ti-6Al-4V AM Demonstration and Allowables Development
Led by Northrop Grumman in partnership with CalRAM Inc.; Concurrent Technologies Corporation; General Electric; and Robert C. Byrd Institute

❑ 3D Printing Multi-Functionality: AM for Aerospace Applications
Led by University of Texas - El Paso in partnership with Lockheed Martin; Northrop Grumman Corporation; rp+m, Inc.; Stratasys, Ltd.; The University of New Mexico; and Youngstown State University

❑ Metal Alloys and Novel Ultra-Low-Cost 3D Weld Printing Platform for Rapid Prototyping and Production
Led by Michigan Technological University in partnership with Aleph Objects, Inc.; ASM International; Miller/ITW; ThermoAnalytics, Inc.; and The Timken Company

America Makes projects 3/3

❑ **Accelerated Adoption of AM Technology in the American Foundry Industry**
Led by Youngstown Business Incubator in partnership with American Foundry Society; ExOne; Humtown Products; Janney Capital Markets; the University of Northern Iowa; and Youngstown State University

❑ **A Database Relating Powder Properties to Process Outcomes for Direct Metal AM**
Led by Carnegie Mellon University in partnership with AMETEK Specialty Metal Products; ATI Powder Metals; CalRAM Inc.; Carpenter Powder Products Inc.; FineLine Prototyping, Inc.; Medical Modeling Corporation; North Carolina State University; Oxford Performance Materials; Pratt & Whitney; Robert C. Byrd Institute; TE Connectivity Ltd.; United Technologies Research Center; and Walter Reed National Military Medical Center

❑ **High-Throughput Functional Material Deposition Using a Laser Hot Wire Process.**
Led by Case Western Reserve University in partnership with Aquilex Corporate Technology Center (AZZ, Inc.); Lincoln Electric Company; rp+m, Inc.; and RTI International Metals

❑ **Optimization of Parallel Consolidation Method for Industrial Additive Manufacturing**
Led by Stony Creek Labs in partnership with Grid Logic; Michigan Economic Development Corporation; MSC; Oakland University; and Raytheon Missile Systems

Thank you for your attention!

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