Advanced Materials and the Mobility of Production Functions

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Theme 3: Research Issues

• 2014-2016
  – Advanced Materials
  – Additive Manufacturing
  – SMEs & Knowledge Transfer
  – Internet of Things
  – Industry 4.0

• Theme: The Digitization of Production Value Chains
Tool, Die & Molding Case

• Windsor ON: TDMM Custer
  – 300 firms; 4 of 10 in NA

• Competition from China Plastics Injection Molding Industry
  – Injection Moldmakers

• Digitally enabled mold design & processing
AM & Plastics Injection Molding
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Injection Molding Engineering Ratio

• Environment & Light weighting: Coke & Cars
• Advanced Materials & Machining
  – Key Engineering Ratio
  – Wall Thickness / Height of Container
    ➢ Ratio: 1:200
    ➢ Failure Rate: 0.001 inches

• Good Enough for Coke then good enough for Aerospace.
  – Enabling technology: Hybrid Metallics Additive Manufacturing & Advanced CNC
Hybrid AM CNC Technology

![Image of Hybrid AM CNC Technology process]

From the idea to the finished workpiece on a DMG MORI machine:

1. Idea from the idea to the CAD model
2. CAM programming with NX CAM by Siemens
3. 1:1 Simulation with the DMG Virtual Machine
4. Manufacture with DMG MORI machines
Auto Steel Case

• New Materials Enabling New Design
  – Visualization, Simulation & Assembly

• Additive & Digital Manufacturing
  – New Geometries. Simulate BIW & New Steels

• CAFÉ Standards: OEM, Tier 1 Supplier, Steel Company
  – Design solution from Steel Company
  – Neither Design nor Steel existed previously
AM: Interface of Advanced Materials and Software

• Advanced Materials:
  – Not just specialized and price premium
  – Micro-behaviour of the materials determines macro-behaviour of the product

• Role of Software
  – Research, visualize and compose materials
  – Micro-structural manufacturing
Simulating the BIW for New Steels

Arcelor Honda Door Ring
BIW Open Source Parts
New Steels & Auto Design Cycle

• Old 5 Year Design Cycle
  – Year 1: OEM Signs off on Platform Design
  – Year 2-3 Tier 1 and Lead Stampers included
  – Year 4 Steel & material suppliers included

• New 5 Year Design Cycle
  – Year 1: OEM Signs off on Platform Design
  – Year 2-3 Tier 1, Lead Stampers & Steel Companies included
  – Year 3-5 steel companies act as material advisors to stampers
Conclusion

• New Advanced Materials as Enabling Technologies
  – Manufacture with an advanced material that allows new geometries and designs to emerge
  – Materials enable microstructural manufacturing of new complex assemblies

• Shift in Boundaries of Firms along the Value Chain: Design-Manufacturing-Assembly