

Tom Drye

VP, Emerging Markets - Innovation & Applic Dev.

Getting Value from IACMI Membership Case study!!

Innovation through Materials Design

Emerging Markets & Innovation (3D & Applic Dev)

TECHNOLOGY. DESIGN. COMMUNITY.



TECHMER PM
POLYMER MODIFIERS

July 23-24, 2019

External Copy

IACMI Members Meeting, Denver

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Agenda

- Who is TechmerPM
- IACMI Influence
- Bio-Renewable
- IACMI & Bottom Line \$

Local Presence with Global Reach



International Sales Offices

- Cologne, Germany
- São Paulo, Brazil

Global Partners

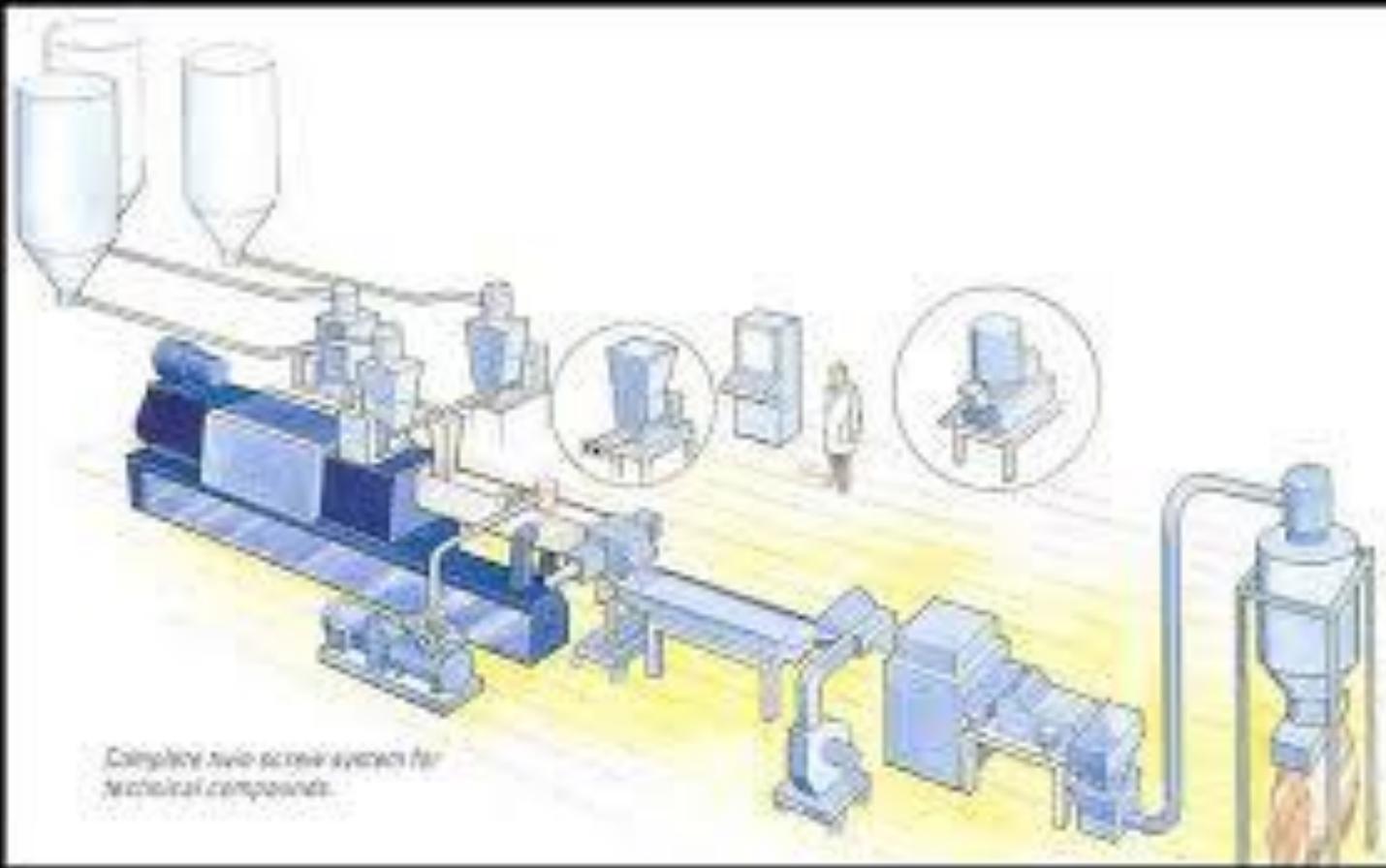


TOKYO ink



TechmerPM Custom Compounder Plastics Extruder

KR 南京凯荣机电科技有限公司
Nanjing Kairong Machinery Tech Co., Ltd



Techmer PM (Custom Compounder)

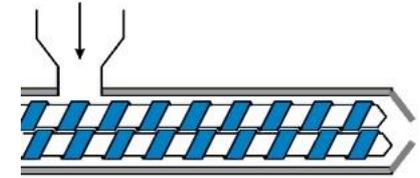
Resin Pellets



CF



Secret sauce



Twin Screw Design

Pelletization



Cooling



Strands



Extruder



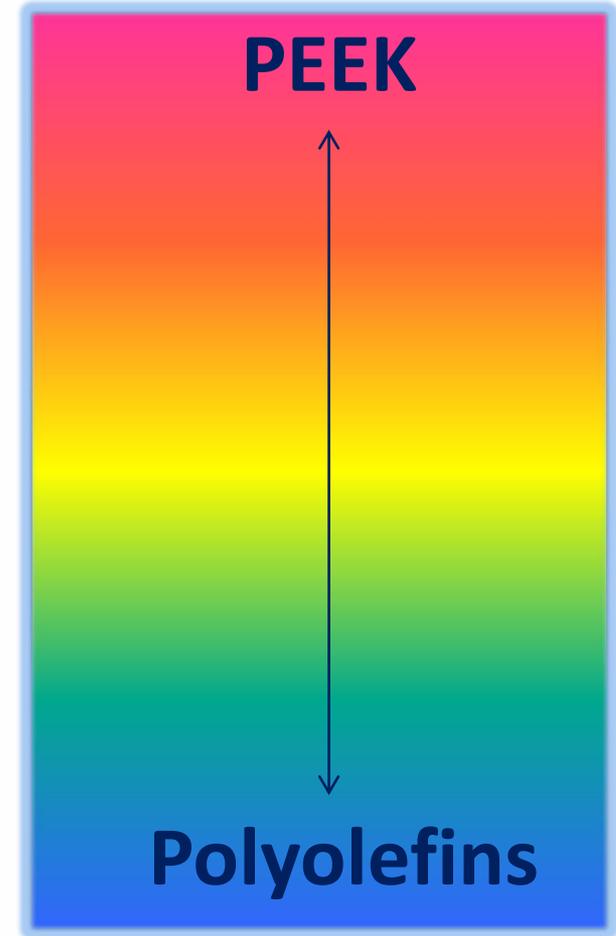
Total Solutions Provider

Resins

HDPE- Polyethylene
LDPE- Polyethylene
Polypropylene
ABS
SAN
Polystyrene
Styrenic Copolymer
Nylon 6
Nylon 6/6
Super Tough Nylon
Amorphous Nylon
Nylon 6/10
Nylon 12
Nylon 11
Nylon 6/12
POM - Acetal
Polycarbonate
Modified PPO
Polyurethane
Thermoplastics Polyester
Polyester Elastomer
PPS – Polyphenylene Sulfide
PEI - Polyetherimide
Polysulfone
Polyethersulfone
PPSU - Polyphenylsulfone
PEEK – Polyetheretherketone

Reinforcements, Additives and Fillers

Flame Retardant Additives
Glass Fiber
Carbon Fiber
Long Glass Fiber (LFRT)
Clay
Mica
Talc
Calcium Carbonate
Wollastonite
Electromagnetic (EM) Absorbers
X-Ray Detectable Additives
Thermally Conductive
Glass Flake
Glass Beads
Hollow Glass Spheres
Chemical Coupling
Custom Colors
Laser Marking
Laser Welding
Metal Powders
High Specific Gravity
Metal Detectable Agents
Lead-free X-Ray Shielding Additives
Polytetrafluoroethylene (PTFE) Powder
Silicone
Graphite
Molybdenum Disulfide
PFPE
Aramid Fiber
Carbon Powder
Multi-wall Carbon Nanotubes
Stainless Steel





TECHMER PM
POLYMER MODIFIERS

Color
Concentrates

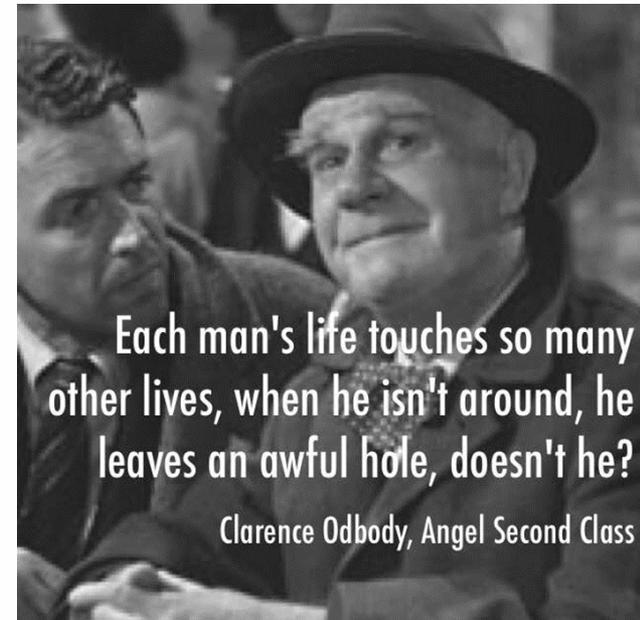
Additive
Concentrates

Custom-
Engineered
Compounds
& 3D

Color
Compounds

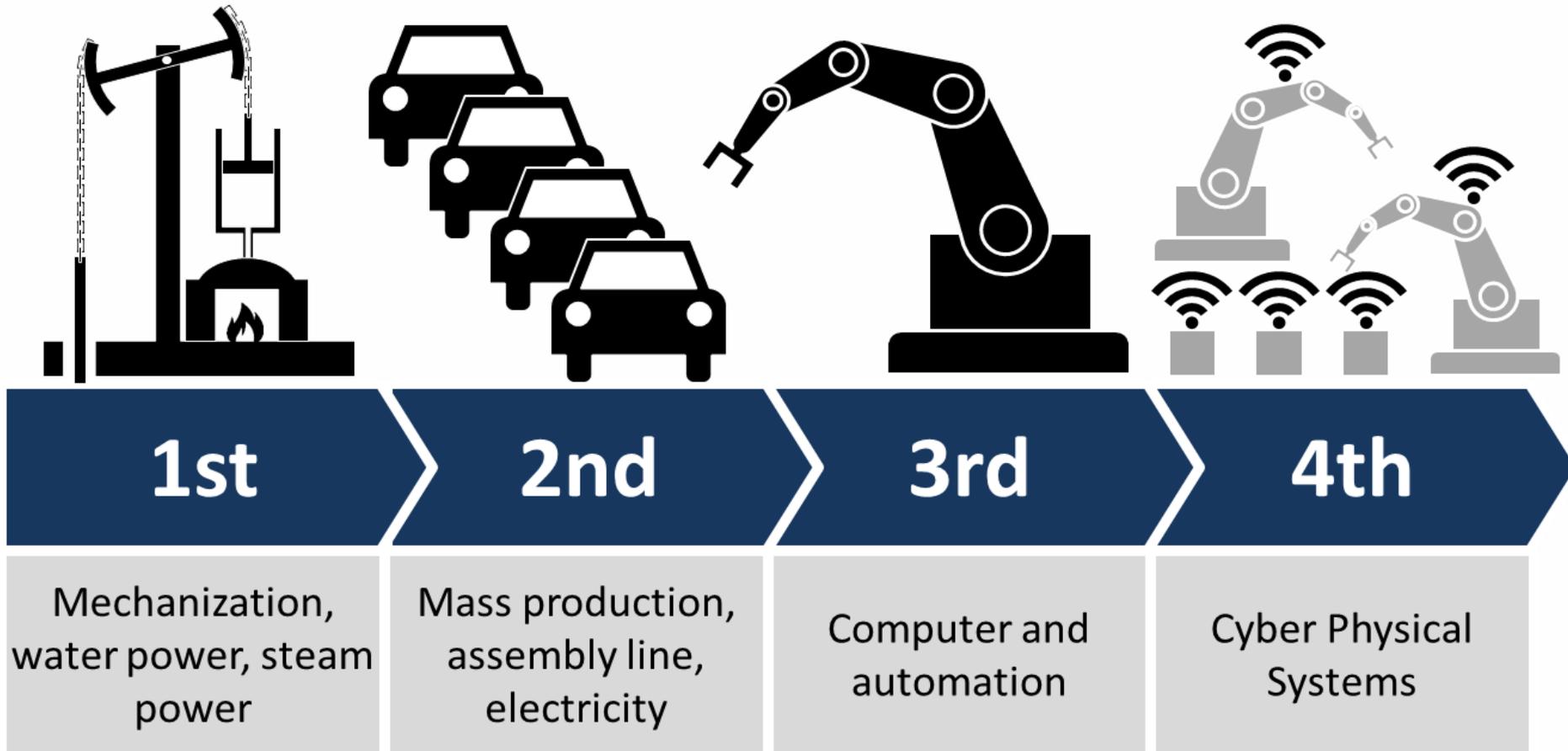
- 160+ Member companies
- \$400MM capital investment
- 11,000 participate in composites WF training
- 2,391 new MFG jobs
- Numerous IACMI projects
- Forum for ideas
- Collaboration

It's a Wonderful Life
1947

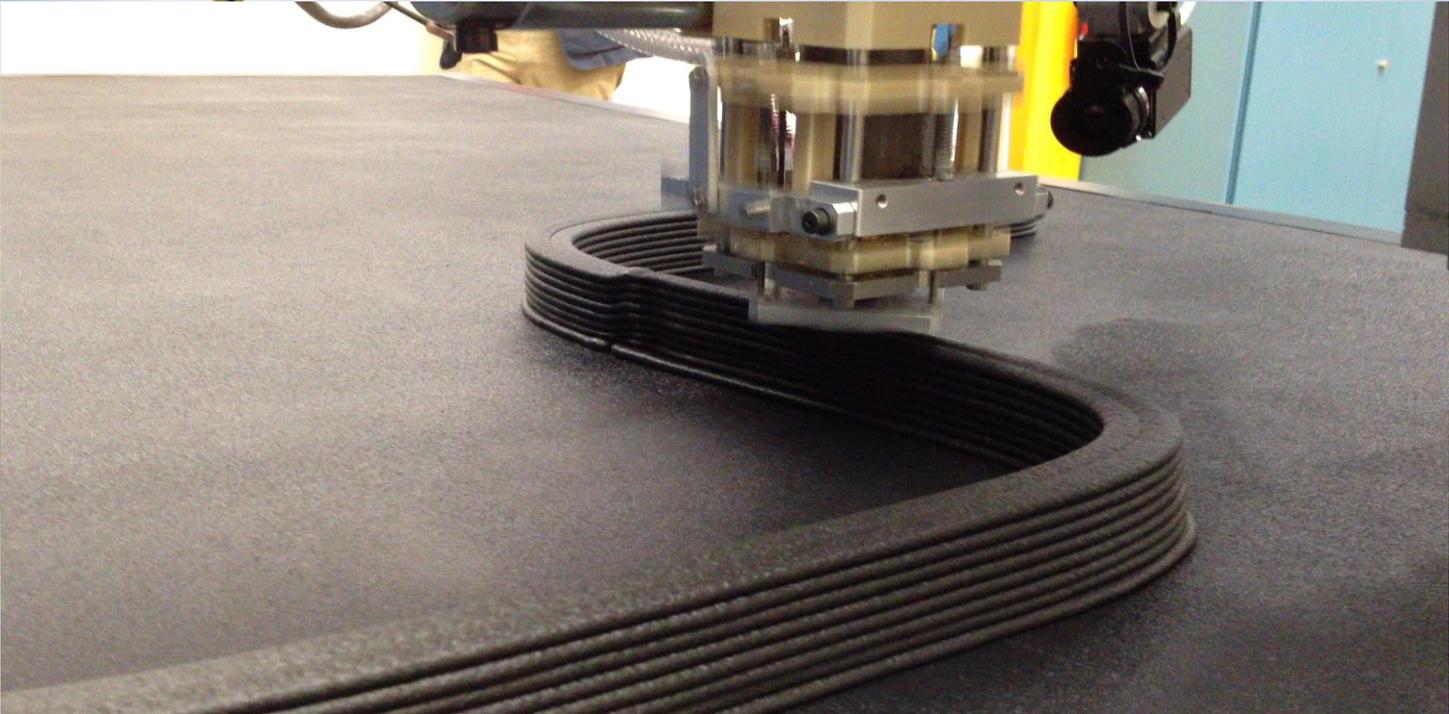


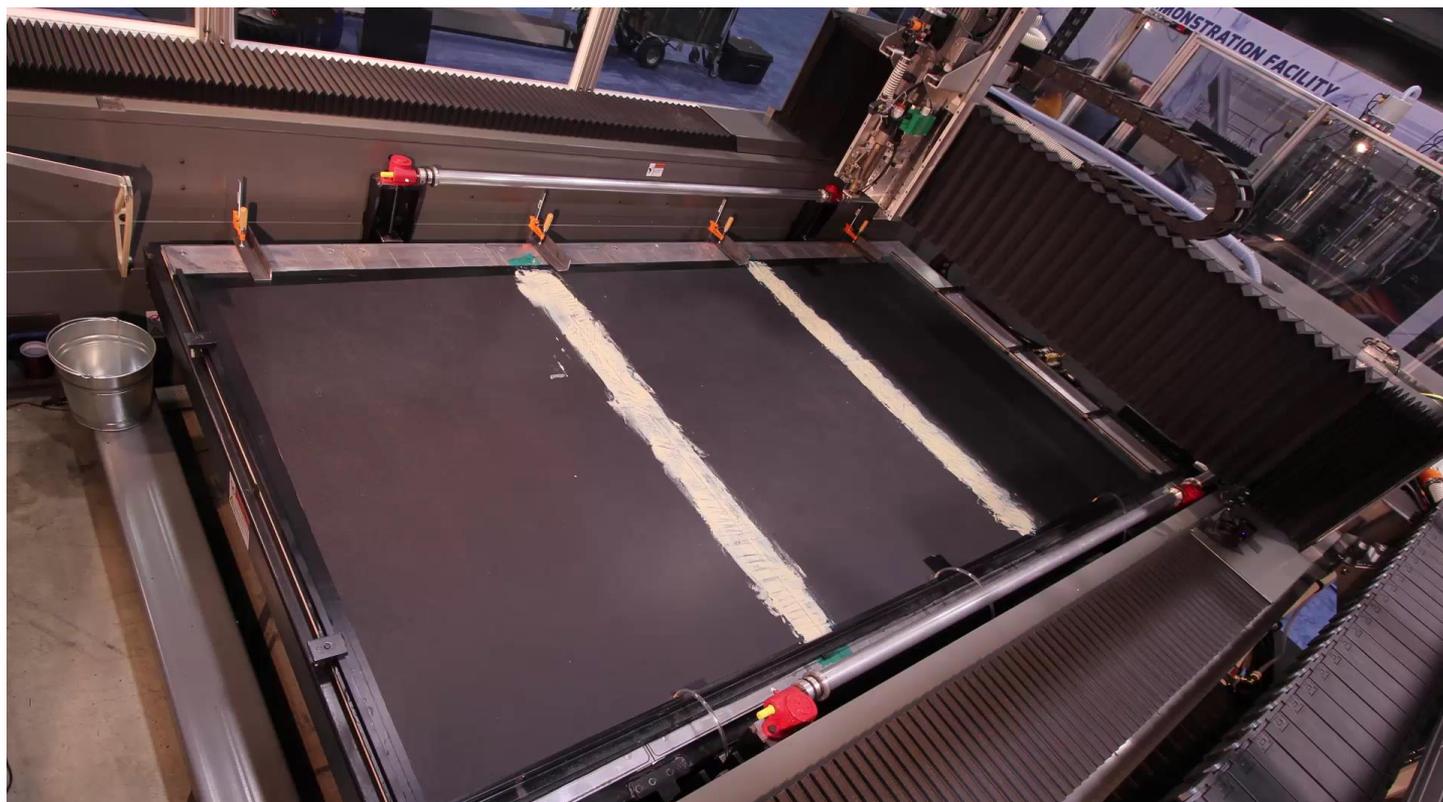
Industry 4.0

Trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing. Industry 4.0 is commonly referred to as the fourth industrial revolution. Wikipedia











Post- Processing-----MACHINING





3DP Additive MFG Overview



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POTUS & VPOTUS Visit Jan 9, 2015





POTUS & vPOTUS visit Techmer TN plant
January 9, 2015

- Transportation





Oak Ridge National Laboratory 3DP Legacy Jeep



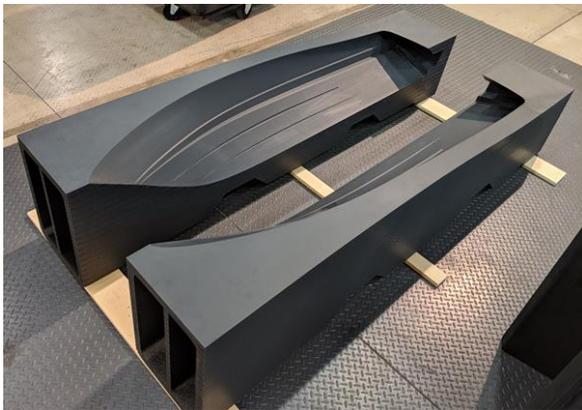


ORNL Assembling the AMIE House

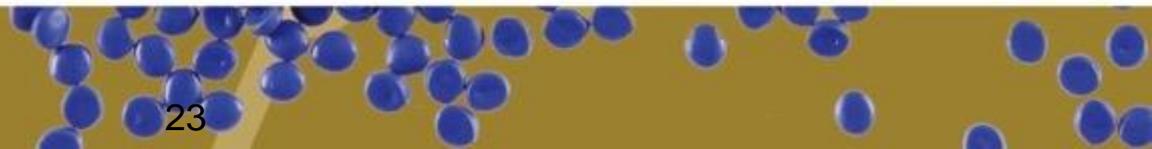




3D Printed on Large Part Printer



Electrafil ABS 1501 3DP
(CF filled ABS)
Dimensional stability, low warp



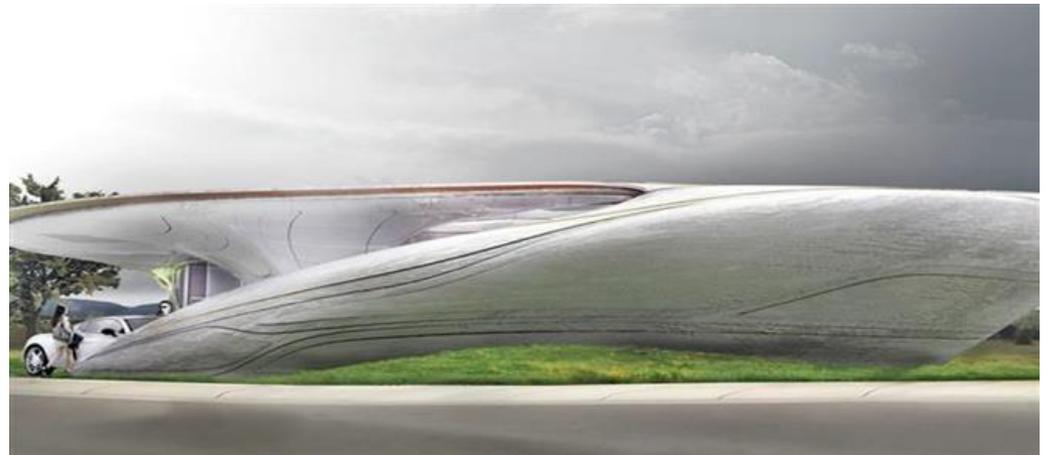
- Construction
- &
- Infrastructure

Excavator displayed at CONEXPO 2017

Cab is 3D Printed
CF reinforced ABS



TECHMER PM



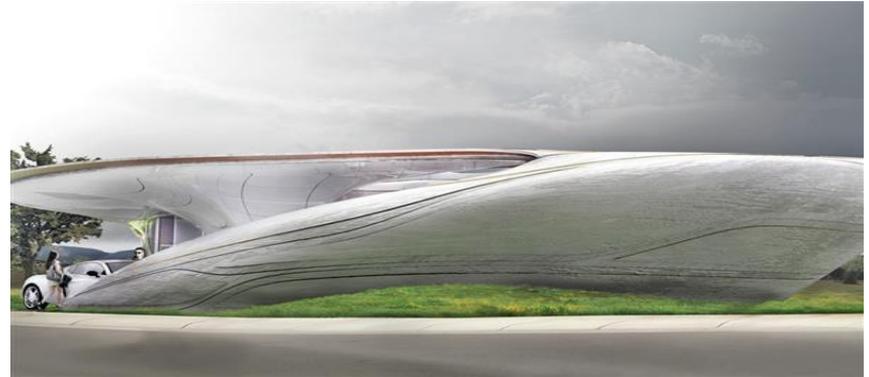
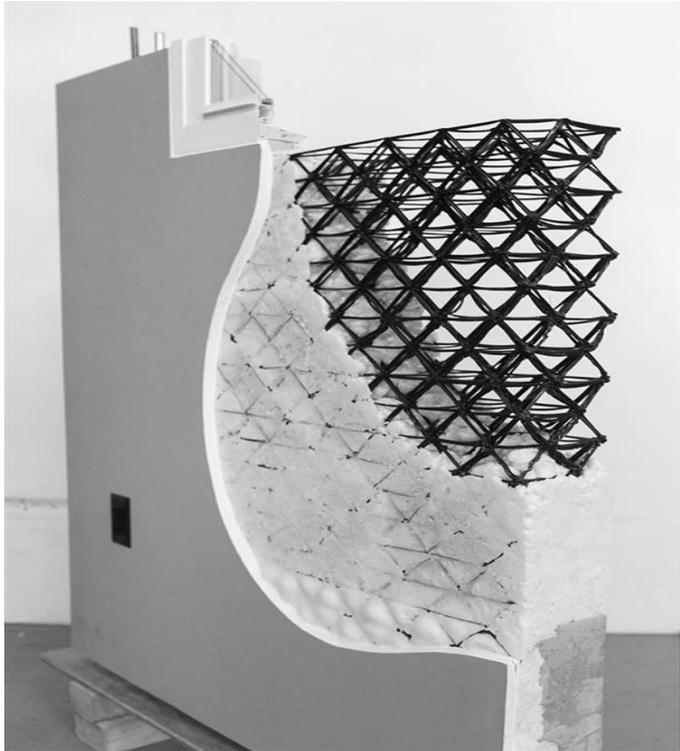
Large 3D printed tooling for composite layup parts manufacture.



3DP 9 Meter Windmill Blade Tooling
7 week shorter lead time –no “plugs” needed



Design Competition – Extending IACMI Reach



**Design
Miami**



 **TECHMER PM**
POLYMER MODIFIERS

Design Miami 3DP Bar, Seating, and Trellis

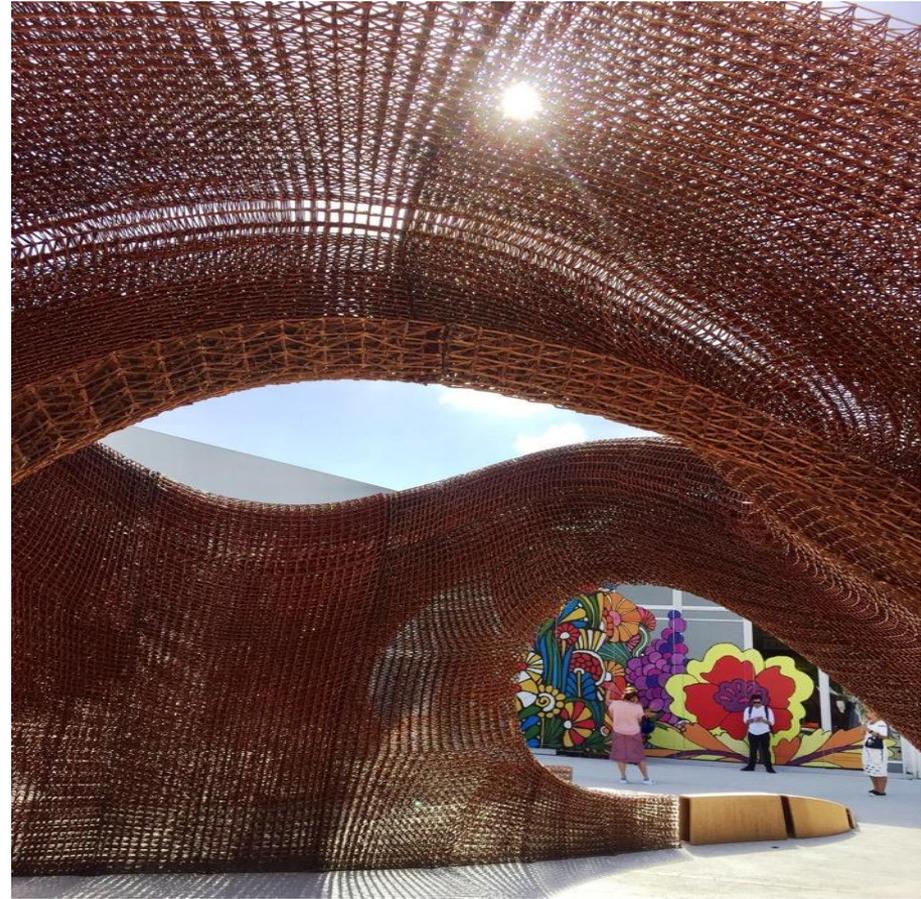
 **TECHMER PM**
POLYMER MODIFIERS

Printing with **renewable** materials.



ORNL 3DP Seating - PLA with Bamboo Fiber





*Design Miami 3DP Bar, Seating, PLA/Bamboo----
Renewable; and Trellis ABS/CF (Now in Kenya)*

(Pre-cast Concrete molds) Domino Window Mold



Electrafil© J-1200/CF/20 3DP
Good Dimensional stability
Reusable

Concrete Column Molds

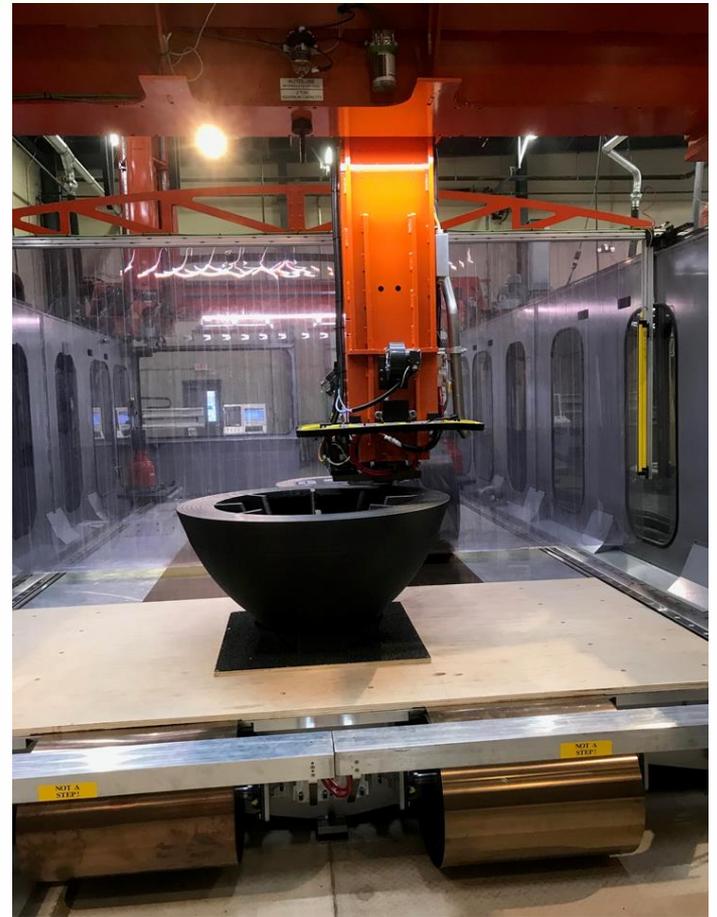
- 3 molds, each printed in 24 individual sections



Miscellaneous Structures



Band Stand Canopy, TN



Submarine nose cone

Bio-renewable PLA-Bamboo



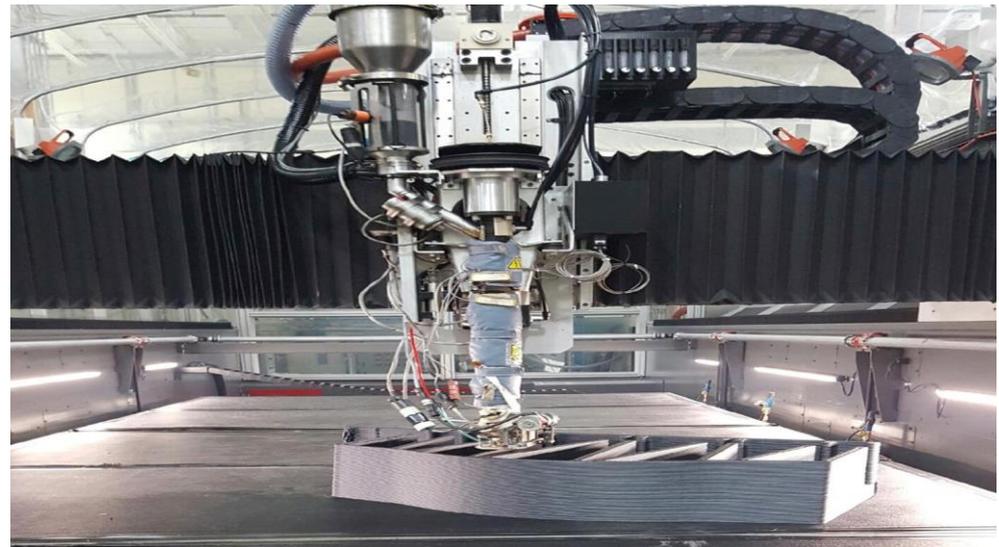
Excavator displayed at CONEXPO 2017

**Cab is 3D Printed
CF reinforced ABS**

**Silver "STICK"
3D printed metal**

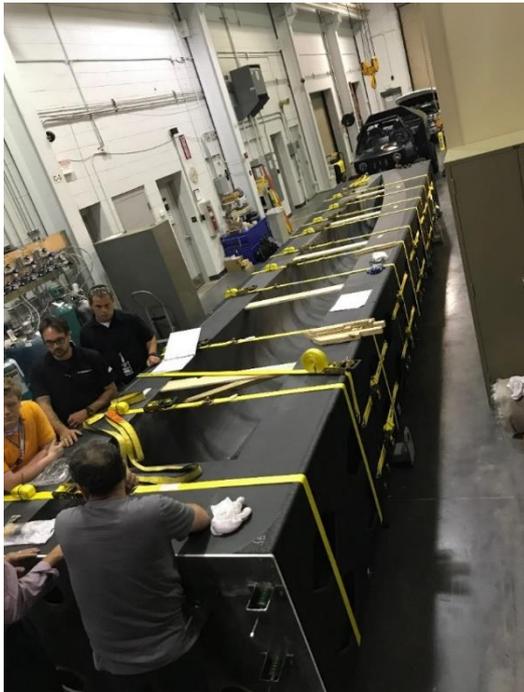


• Tooling



Catamaran Hull Mold

LARGE SCALE TOOLING



F-16 Inlet Duct



Additive Mfg materials and examples

Non-autoclave

100-275F autoclave

350-400F autoclave

Low CTE

Chem Resistant

High Modulus

Low Porosity

Dimensional Stability

Lighter weight

Renewable source

Custom Color

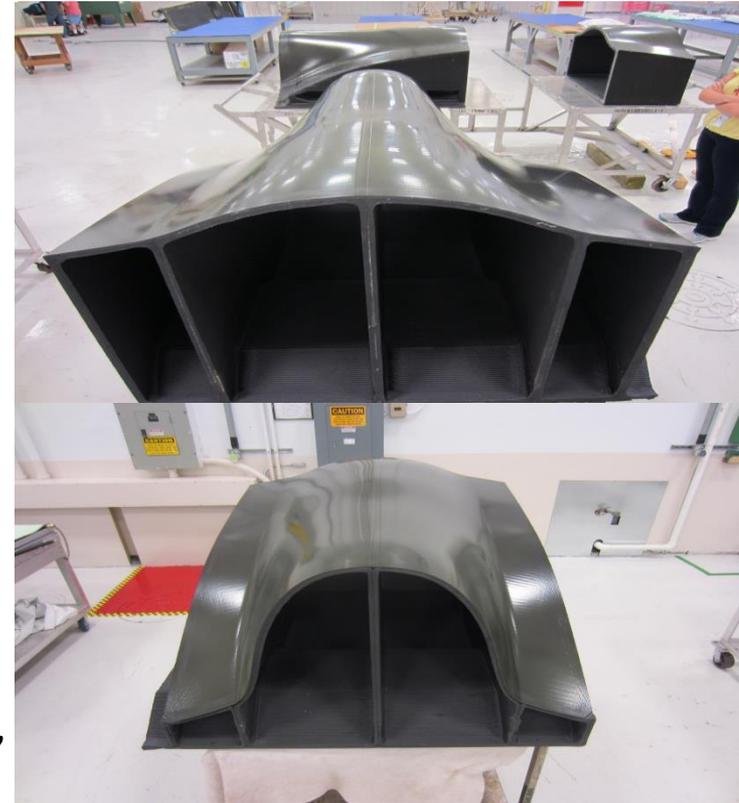
Thermally enhanced

Pellet, powder, filament

Aerospace 3D Print - Finish & Produce a Composite Part in a Week!



- Autoclave Cure Trial
- PPS/ 50% CF
- 350 F @ 100 PSI
- Vacuum Integrity
- Low CTE
- Ketone Resistance
- Minimal "Touch Labor"



Low Material Cost
Oak Ridge National Lab Award for Composite Excellence
(Manufacturing: Material and Process Innovation CAMX 2016)

Tooling ---Metal vs Plastic AM

<u>Feature</u>	<u>Metal (Invar)</u>	<u>Additive</u>
• Cost	• --	++ (1/10 th)
• Time	• --	+++
• Design	• -	++Few limits
• Recyclability	• -/+	++
• Iterative ease	• -	+++
• Inventory	• -	+++
• Size	• -	+Almost unlimited
• CLTE	• ++++	+/-
• JIT Mfg	• -	+++

2017 R&D 100 Award; Autoclavable, 3D Printable, Engineered Compounds



Military/Aerospace





Guinness
Record for
Largest
Continuous 3D
Part
8-29-16



Boeing 777X Component Mold
1,650 lb. 17.5 x 5.5 x 1.5 feet 30 hour print (ABS/20% CF)



Navy Seal Delivery Vehicle



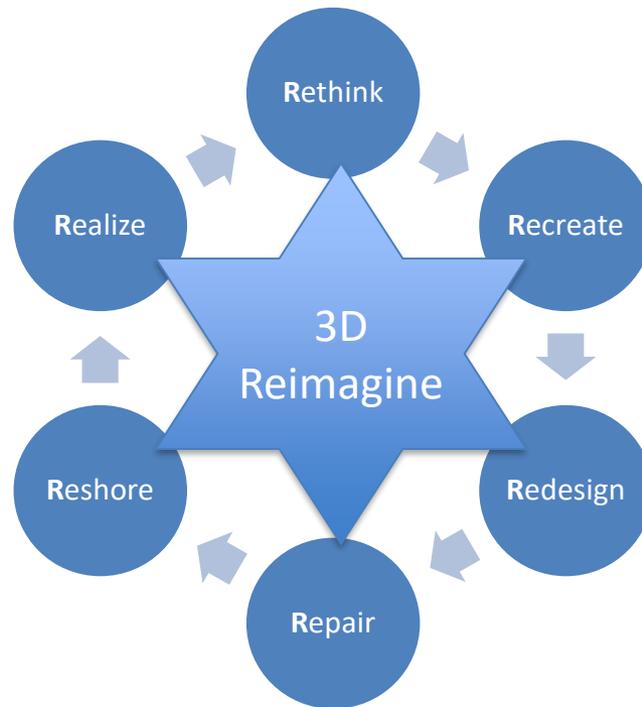
Electrafil ABS 1501 3DP
Low warp
Strength



*Oak Ridge National Lab 3DP “Concept Vessel”
Seal Delivery Vehicle (SDV)*



Large Part 3D..... Disruptive Technology



Standing Inside one of the Large Part 3D Printers (~1,000 Lb Aerospace tool printed in <8 hrs.)



Aerospace Forming Tool (12ft / 2K Lbs)



3D Printing (Land, Sea, Air, & Space)

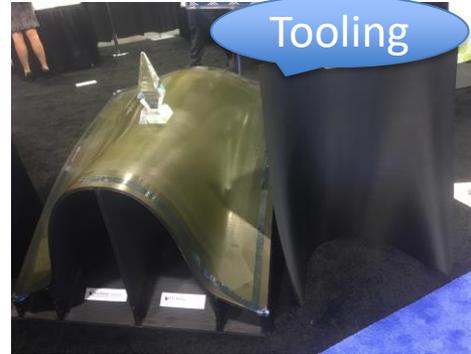
Excavator



Navy Sub



Tooling



Mars Habitat



Boat Hull



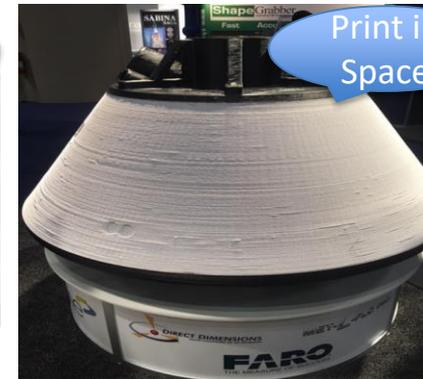
Cobra



F-22 Raptor



Print in Space



NASA

Boundaries moved

Branch

Technologies

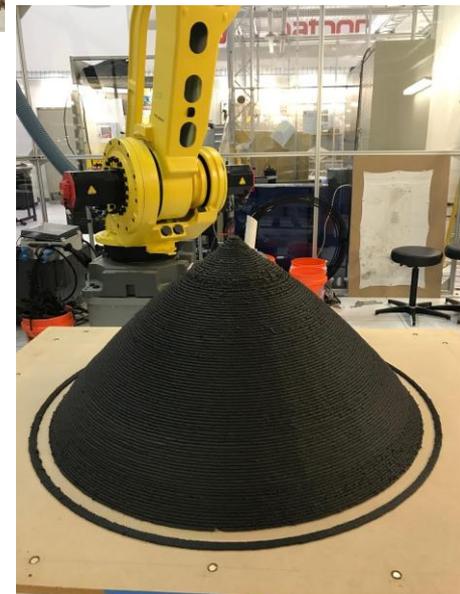
PETG/ Basalt

Mars

Habitat

Challenge

- Recyclable space waste & indigenous construction matter (Regolith)



Space Factory

Video

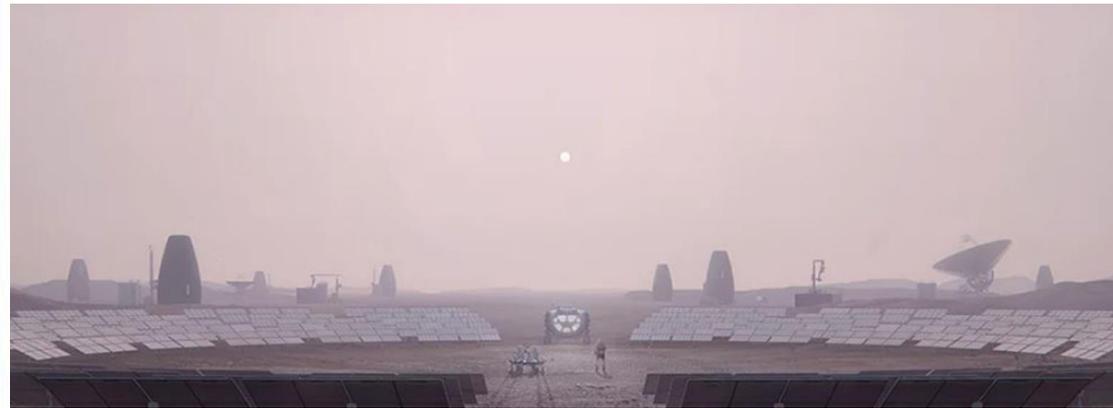
NASA Competition

Level 1 Phase III
2nd place winner

MARSHA

Mars Habitat

Techmer PM Material
PLA & Basalt Fiber



- Video #1
 - MARSHA

Closing comments on 3DP (Disruptive Technology)

- LPAM Polymer Machines did not exist until recent
 - Time of rapid evolution
 - Collaborations; material, machine, processor, OEM
 - Growing the plastics pie larger
- 3D Budget doubling each year.
- Most projects are very confidential until PR'd



Lotus House; WashUniv-Stl

How Big will 3D Printing Machines GO? HUGE!!!

Projections rise from current 120 Lb/hr to 1,100 Lb/hr.



Branch
Tech



Thermwood



Ingersoll



Cincinnati

What does IACMI mean for members?

- **OPPORTUNITY** for workers
 - Business Magnets: ORNL, IACMI, Academia, SuRF, NREL, etc
 - Mfg being drawn to region
 - USA Mfg resurgence
 - Outside business, easy access

Workforce skills:

- Advisory Board TN Dept Educ.
 - Mechatronics
 - Certification training



So, why be a part of IACMI?

- Academia – Funding for research
- Nat Labs (ORNL) - Ingenuity to launch new business
- Industry – Enhance Bottom Line
- IACMI- Platform for Collaboration & US MFG



IACMI Benefit to Techmer over past 4 years

- Sparked Creation of Techmer 3D Group
- \$Multi-MM Invested & growing (people & capital investment)
- Access to strategic high level OEMs
 - Auto
 - Aerospace
 - Defense / NASA
 - Infrastructure
- PR (POTUS, R&D 100, Tradeshows, Articles, employee talent)
- Helped launch a new market for plastics
- Circular manufacturing – Stewards of environment
- Bottom line results
 - **Doubling of 3D material \$ sales every year.**



IACMI – Be involved

- Board of Directors
- Technical Advisory Board
- Sustainability Committee
- IACMI projects
- Workshops
- Internships
- Sub-Committees
- Members Meetings (Meet new people; SME showcase)
- See many familiar faces at tradeshow



Collaborative Partners & Projects

(Some preceding content courtesy of below partners)



NORTHROP GRUMMAN

Clayton



Launch Forth
by Day



LSAM
Large Scale Additive Manufacturing



CINCINNATI



Volkswagen



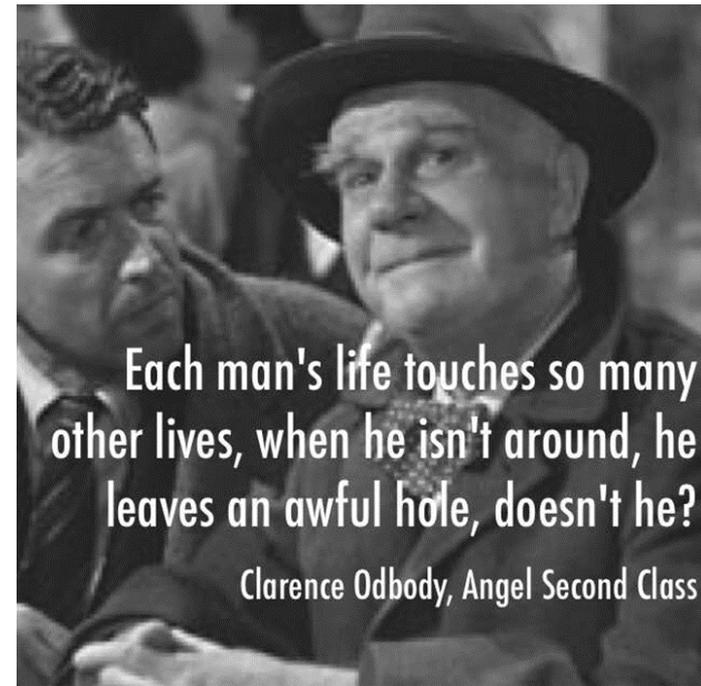
Without IACMI...



- 160+ Member companies do not exchange ideas
- \$400MM capital investment, no
- 11,000 do not participate in composites WF training
- 2,391 new MFG jobs, no
- Numerous IACMI projects do not happen



Re-written----
Each company touches
so many others, when
IACMI isn't around, it
leaves an awful hole,
doesn't it?



Techmer 3D Video...(It's a Wonderful Life)

What Does NOT Happen W/O IACMI

3D Printing (Land, Sea, Air, & Space)



It's a Wonderful Life – With IACMI !!



Techmer PM & Material Design..

