Shaping the Future of 3D Globally

Thursday, September 24, 2015

KEYNOTE
9:30 AM
Medical Additive Manufacturing: A New Era!
Jules Poukens, Cranio-maxillofacial Surgeon, Biomedical Sciences, University Hasselt and Leuven (Belgium)

Prof. Dr. Jules Poukens is a Cranio-Maxillofacial Surgeon at the Medical Center Sittard/Heerlen in the Netherlands. He is currently a lecturer and researcher at the Biomed Research Institute of the University Hasselt and the University of Leuven in Belgium. He has participated in several European Community funded projects on medical rapid prototyping and manufacturing and was acting chairman of the Board of Directors of the EU funded project CUSTOM-IMD. He was the leading surgeon that designed and implanted the world’s first 3D printed total mandibular implant and was one of the pioneers in using 3D printed skull implants. Jules Poukens has been an SME member since 2011.

Presentation Summary: The presentation will encompass and give examples of clinical cases where 3D printed implants, devices and prosthesis are used to provide custom and patient specific care to the patient. Clinical cases of implants (skull, jaw), dental structures and bioprinting will be highlighted.

PANEL
10:30 AM
PANEL: Transition to Production
Eric Barnes, Engineering Fellow, Northrop Grumman
Barbara Negroe, Advanced Manufacturing Initiatives Group, GE Corporate
Jules Poukens, Cranio-maxillofacial Surgeon, Biomedical Sciences, University Hasselt and Leuven (Belgium)
-Ing Frank Wöllecke, Head of Technology Scouting, Impulse Projects, BMW Group

Panel Summary: Opportunities and challenges abound in moving additive manufacturing technology to full part production. Hear how these experts in additive manufacturing facilitated their transition from prototype to full production volumes. Materials, processes and quality will all be discussed for the industries represented.
Mr. DeGrange has a B.S in Industrial Engineering from the University of Iowa, M.S. in Mechanical Engineering from Washington University and professional engineering certificates from MIT and Georgia Tech. Current Chief Commercial Officer of Impossible Objects, former Stratasys Vice President ond major AM industrial user as Boeing’s Research and Development Corporate Innovation leader for additive manufacturing materials and processes provides a 360 degree perspective in the field of additive manufacturing. During his tenure at Boeing, Jeff led the effort to certify and qualify additive materials and processes for flight hardware on both commercial and military aircraft including the F/A-18 Super Hornet and 787 programs. He was one of the founders and the past chairman of the Direct Manufacturing Research Center (DMRC) at Paderborn University in Germany.

**Presentation Summary:** CBAM is a new additive manufacturing technology for high-performing, fiber-reinforced composite (carbon, aramid, glass) parts and tooling. Advantages include faster build speed (projected to near injection molding), higher part strength (2-10 times greater than other 3D printing technologies) and increasing larger palette of usable materials (without needing specially formulated polymers). Composite parts with high strength-to-weight ratio are critical for national goals of energy efficiency by reducing weight in automobiles, aircraft, spacecraft payloads, robotics and other applications. CBAM parts can also help lighten equipment for military and law enforcement personnel and individuals with needs such as prosthetics. CBAM composite parts are not only lightweight yet strong, but also can be made (1) in complex geometries not possible through traditional manufacturing, and (2) without molds or other tooling. This not only saves significant time and cost in manufacturing, but makes complexity and customization free, opening the door to a whole new world of part types that can be made with materials such as carbon fiber, aramid and fiberglass.

With degrees in engineering Mr. Daniel J. Hutchinson, President/CTO (Postprocess Technologies LLC), a former Naval flight engineer, oversees the research and development team investigating new technologies and applications primarily within the finishing requirements of additive manufacturing. Prior to his role at Postprocess Technologies, Daniel worked at Northrop Grumman providing advancement within Combat Electromagnetic Environment SIMulator (CEESIM) and ground breaking Signal Measurement System (SMS).

**Presentation Summary:** The presentation will be based on the “closed loop” and “open loop” post-process of additive manufacturing. The comparisons will demonstrate how customer requirements can be met with reduced man power and increased work center efficiency. The presentation will show results of third party testing on support removal, surface finish and coatings following up with a discussion on additive manufactured materials in respect to finishing. Our process will be on display showing support removal and surface finish. Our presentation will include before and after pictures of complex geometries along with a time lapse video of different parts being processed. As a market leader in break-through projects, our technologies have been on display in places from Hollywood to the ground breaking 3dprinted car at IMTS2014. Postprocess Technologies utilizes both engineering and passion to empower the additive manufacturing industry. Our application engineering staff will be available to answer questions and perform equipment process demonstrations. Bring your complex geometries; we will
educate/evaluate you on which finishing process is best for your finishing requirements. We have also pioneered a variety of coatings including: Color, Ceramics, Stainless, Zinc, Hastelloy, Stellite, Chrome Carbide, PVDF, PFA, Monel and PTFE. We have proved out the process of metal/polymer coated applications on additive manufactured parts.

Room M
11:30 AM
Standardization of Medical 3D Image and Printing
YoungLae Moon PhD, Professor, Orthopaedic Department, Chosun University Hospital

Head of Chosun University Medical School, is a leader, Chair of Medical 3D Standardization group in IEEE-SA. This team developing standardization of 3D medical modeling, printing, simulation and platform management.

Presentation Summary: Medical Simulation by 3D Image and Printing  The standardization of medical 3D technology is urgent needs for designing medical devices that use 3D models and printings, for evaluating the stability of medical instruments that use the 3D printing, or for evaluation of hardware and software producing or using medical 3D models and simulations. Therefore, we investigates technical standards for medical 3D images, which include medical 3D modeling, visualization, simulation, data management, 3D printing. A complete medical CAD/CAM workflow for medical practice has 3 steps: 1) Pre-operative virtual planning of the clinic work, 2) CAD/CAM and 3D printing of medical instruments, and 3) computer-aided practice. This presentation will regarding the issues of standard Medical Modeling and Printing for it.

Room M
12:00 PM
Bridging the Gulf - From Industrial AM to Prosumer 3D Printing in Dental
Steve Maginnis, CDT, Research & Development, Glidewell Laboratories

Steve Maginnis is a CDT working in dental materials research and development at Glidewell Laboratories in Newport Beach California. Current projects include expanding 3D printing capabilities for casting and glass pressing operations. Other notable contributions in dental are in technical ceramic materials development and processing (zirconia, etc.) as well as various machine and process design and development for dental device production.

Presentation Summary: There has been a perception that serious industrial additive manufacturing is a world of difference in quality from inexpensive desktop 3D printers. Perhaps rightfully so--until recently. Within the bounds of acceptable precision, small open DLP SLA printers have begun to make headway into space once occupied only by large closed systems costing tens or hundreds of thousands of dollars. Such large systems have kept the power of additive manufacturing out of the hands of smaller business entities. But in the case of dental technique it has been our observation that even with our rigorous demand for geometric tolerance, it is possible to replace the higher end machines with much more accessible machines for use in casting and glass pressing operations. And further, to do this on a very large scale by creating farms of printers running small numbers of parts in parallel. While we often hear that the cost performance of doing so against traditional large systems is negligible, we have found the cost benefit to be an order of magnitude different. For this we have gained not only a significant improvement in profit margin, but have laid the foundations for a dynamic and rapidly scalable production architecture.

LUNCH BREAK
Room R
14:00
**Powder Quality and Characterization Critical to Functional Components in Additive Manufacturing**
Phil Kilburn, Commercial Director, LPW Technology

Mr Phil Kilburn joined LPW as Commercial Director in 2014. Phil has worked in the metal AM industry for 7 years having been involved in the general AM industry for the last 22 years, and will be drawing on his skills and expertise to drive the company’s software provision strategy forward; as well as developing business opportunities to build on LPWs expertise in alloy development and powder analysis.

Formerly Phil has worked as a Production & Project Engineer for a world leading medical device manufacturer, operating a SLA in New Product Development; then moving on to become a Rapid Tooling Specialist and SLA Applications Engineer for a global leader in consumer and industrial 3D printing. In 1999 Phil became Managing Director of a UK AM service bureau and prior to moving to LPW was Metal Sales Manager for an AM production service provider.

**Presentation Summary:** Understanding the behaviour of metal powders in AM machines is increasingly vital for the precisely controlled production of sophisticated, functional components. Identifying which powder properties control AM performance supports both the optimisation of metal powders for specific applications, and the reliable evaluation of used powders for further processing. Powder reuse is essential for the long-term sustainability of the industry. The industry had long used traditional testing techniques, but these have inherent limitations in providing relevant data for AM. Powder testing is a critical part of what LPW Technology do, both in the development of new powders and as a service for customers looking to optimise existing AM processes. LPW’s focus on new research in typical production environments assesses the impact of processing on metal powders, an essential step in assessing the feasibility of re-use. The case studies elucidate how powder degradation reduces the quality of Titanium Aerospace and Medical components, and how cross contamination and foreign object detection can be identified and mitigated to reduce the risk of part failure. The analytical data from this work will also be used to demonstrate a novel software solution for powder management, LPW POWDERSOLVE™. This package can be used to maintain traceability, document powder aging, and highlight contamination prior to powder use, thereby ensuring the highest levels of quality control, throughout the lifecycle of the powder and final component properties.

Room R
14:30
**Powder - The Basis of Additive Manufacturing**
Jim Ryan – Specialist & Market Development, Carpenter Powder Products

28 year career in gas atomized powder manufacturing, sales, marketing and product management. Experience with materials for additive manufacturing, PM, thermal spray, laser and cold spray powders, and brazing.

**Presentation Summary:** There is often a mistaken impression that any powder with the correct alloy composition will perform satisfactorily when producing Additive Manufacturing (AM) components. Particle size determination (PSD) requirements can vary significantly depending on whether the manufacturing equipment uses an electron beam or laser power source. The metallic powder used is often an afterthought with most consideration being given to the type of AM machine being used, type of power and wattage, scan speed, spacing, dwell time and the effect of these parameters on part structure and quality. In reality, the powder used for AM manufacturing needs to be customized for the process and specific equipment being used. While alloy composition and PSD are critical for AM manufacturing, other factors can be critical to the overall manufacturing cycle. Powder flowability and residual fine powder particles can affect equipment performance. Other powder
attributes such as shape, cohesiveness and moisture content can seriously affect the manufacturing of components. In addition, the use of recycled powder has many implications with regard to part quality and performance. Metallic powders are complex in nature and need to be thoroughly characterized for most AM applications. The purpose of this presentation is to discuss how powder attributes, including the effect of recycled powder, in addition to chemistry and PSD can affect the manufacturing of AM components.

Room R
15:00
How 3D Printing is Being Used for Direct Manufacturing of Everyday Objects
Martin Forth, Vice President Sales Europe, Sales and marketing, envisionTEC GmbH

Martin Forth has Dipl. in Mech. Eng and graduated from Bedford College, UK. After graduation he worked at Vauxhall Motors/ Opel in their tooling design department. Martin Forth joined Matra Datavision during the early 1990’s as the UK sales manager for 3D CAD/CAM software products. He entered the world of Additive manufacturing in 1995 and worked as a sales manager for 3D systems and DTM. He was one of the original management team that established envisionTEC GmbH in 2003 and is currently their VP of Sales.

Presentation Summary: Leading international companies are now using low cost production solutions from envisionTEC for direct manufacturing from their range of 3D printing machines. Much has been spoken of for some time as as potential solution, but envisionTEC has made significant research and development into Photocurable materials that has lead to the adoption of envisionTEC's DLP process as becoming the manufacturing standard for the production of personal Hearing aid, Jewelry, dental, eyewear and biomedical applications. More recently envisionTEC have produced a range of high temperature/high strength materials that has lead to Injection moulding companies now producing tooling within hours than can be used with standard injection moulding presses to produce parts moulded from the design intent materials.

Room R
15:30
Additive Manufacturing Across GE
Edward D. Herderick PhD, Additive Technologies Leader, GE

Dr. Edward D. Herderick is the Additive Technologies Leader for GE Corporate Supply Chain and Operations. In this role he is responsible for leading efforts to increase the speed and depth of additive manufacturing insertion across the GE supply chain. In addition to his AM work, he has worked on ceramics technologies for extreme environments for gas turbines and nuclear power gen. Ed is a lifelong Buckeye, born and raised in Columbus, Ohio and received his PhD in materials science and engineering from The Ohio State University.

Presentation Summary: Additive manufacturing is among the fastest growing, most talked about manufacturing technologies on the planet and it is providing diverse opportunities for new product design and manufacturing. At GE, efforts such as the additively produced LEAP engine fuel nozzle demonstrate how GE Aviation is leveraging these technologies in innovative ways. This presentation will cover fundamentals of industrial AM, show case studies for its insertion into the supply chain, and provide context and future views on potential of this exciting suite of technologies.
**Room R**

16:00

**IP in an Additive World**

William J. Cass Esq., Partner, Co-Chair Litigation Department, Cantor Colburn LLP

Bill has tried cases in state and federal courts since 1988 and has been the Co-Chair of Cantor Colburn’s Litigation Department for the last 10 years. He holds a mechanical engineering degree from Worcester Polytechnic Institute, where he concentrated in robotics, and also holds a commercial multiengine instrument rating, a commercial single engine instrument rating, an SIC Cessna Citation 500 Series Jet Certification, and is an FAA advanced ground instructor. Bill combines his litigation experience with his engineering and aviation education to assist clients in technically complex matters. His cases involve complex technology, including additive manufacturing, medical devices, circuitry, mechanical engineering, material science, chemistry, and computer software.

**Presentation Summary:** Understanding the challenges concerning the intellectual property (IP) rights associated with additive manufacturing is key to the development and use of this technology. The increased ability to replicate designs through various technologies (such as laser scanners) and convert them into CAD (design) files and STL (printing) files means that the technology has the potential to be a disruptive technology. The expiration of key patents, technical improvements and the changing legal landscape, mean that traditional ways of addressing IP need to be revisited. This presentation will address all the aforementioned issues and will also discuss other intellectual property issues in additive manufacturing.

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**Room R**

16:30

**Additive Manufacturing – A New Perspective in Aircraft Design**

Dr. Jens Telgkamp, R&T Leader on Additive Layer Manufacturing

Jens Telgkamp has a background in stress and design of structures and a PhD in nonlinear mechanics / fracture mechanics. In his Airbus career since 2001, he has been working in damage tolerance of structures, design principles and integration and he has been head of fuselage structure design team. Since mid 2014, he is leading the research & technology team on Additive Layer Manufacturing.

**Presentation Summary:** The worldwide growth in civil air traffic, together with the ambitious targets of CO2 emission reduction require the development of even more efficient airframe structures. Airbus has the relevant concepts in place to answer to this challenge. One set of manufacturing methods with significant technical potential is the family of Additive (Layer) Manufacturing also referred to as 3D Printing Technologies. Looking at the envisaged applications it is clear that the full potential of these technologies can only be achieved when the component design and sizing takes into account the specific manufacturing capabilities of the technology to make shapes that take full advantage from these manufacturing methods. This requires a new set-up of the whole development and production chain to have the full benefit, including significant changes to processes, methods and tools of development (design, stress) and industrial set-up. Examples for the additive manufacturing applications are shown as well as a view on the future challenges and strategy.
**Towards Personalized Orthopaedic Implants**

Nico Verdonschot, Professor of Biomechanics, Radboudumc

Professor Nico Verdonschot is professor at the Biomechanical Engineering department at Twente University and at the Orthopaedics department of the Radboudumc. Prof Verdonschot is trained as a mechanical engineer and work at the Orthopaedic Research Laboratory for the last 27 years. He was coordinator of two European Consortia focusing on orthopedic-biomechanics problems. One such European project is TLEMsafe in which patient-specific models were generated of patients requiring severe surgery to their musculoskeletal system (tumor surgery or hip revision surgery). Furthermore, he is past-president of the European Orthopaedic Research Society, past-president of the International Society for Technology in Arthroplasty and co-author of over 220 peer-reviewed publications. Recently his research is focusing on generation of patient-specific computer models using CT, MRI and ultrasound scanning. With these models he wants to reproduce the musculoskeletal system of humans in the computer and predict functional outcome after surgery.

**Presentation Summary:** I am analyzing the mechanical behavior of orthopaedic implants for about 25 years. Although much progress is made to improve the longevity of the implants patients are not satisfied. One of the causes is that the implants impose other movements and forces around the joint. In this presentation I will demonstrate these differences and indicate where patients could benefit if we would be able to personalize the implants.

**Benefits for AM Porous Titanium Foams in Biological Environment**

Emanuele Magalini, R&D Manager, Additive Manufacturing, Eurocoating s.p.a.

Degree in Material Engineering at the University of Trento. From May 2005 I’ve been working for Eurocoating developing some R&D projects. These projects are focused on medical devices made with new and innovative materials including plastic, metals, ceramics and composite. In particular I follow the mechanical and physio-chemical characterization of the metallic material done with Additive Manufacturing technologies and, in some cases, of the improvement of the production/manufacturing process. I take care of all the phases of the process from the software elaboration and preparation of the jobs to the finishing and post treatment. I’m also in charge to coordinate many of the activities correlated with the AM: validation, in vivo and in vitro tests, characterization of and design of the lattice structure.

**Presentation Summary:** This talk focus on two specific AM technologies—electron beam melting (EBM) and direct metal laser manufacturing (DMLS) used to produce parts made of implantable titanium alloy (Ti6Al4V). One of the most appreciated features enabled by AM of titanium is the design and production of orthopedic components with a surface structure suitable to promote bone colonization and ingrowth to improves device fixation strength. Eurocoating developed and characterized several engineered trabecular highly porous surfaces suitable for bone colonization. Once components with their trabecular surfaces are additive manufactured, they may and sometimes must be subjected to further critical post process steps such as machining, when high dimensional accuracy is required for coupling the component with another, removal of contaminants, thermal treatments, hipping and coatings. However, when AM technologies are properly used, from designing to all the manufacturing steps, number of different topographic structures can be realized with excellent biological performances. Evidences were collected through in vitro and animal testing. Specifically, in recent Eurocoating sponsored in vivo studies, extensive biomechanical fixation for random size macroporous titanium foams both manufactured by EBM and DMLS can be shown. Nowadays Additive Manufactured permanent orthopedic implants are used both for serial production and for specific custom implants.
Certified Additive Manufacturing of TiAl6V4 Implants
Ingo Uckelmann, Technical Manager Metal 3D Printing, Materialise GmbH

After my studies of mechanical engineering at the RWTH Aachen, I started my career at BEGO in 2001, where I developed metal 3d printing for the dental industry. I joined Materialise just recently as the technical manager for metal 3d printing.

Co-Speaker: Christophe Blanc, Application Engineer, Materialise GmbH

Education: Dipl.-Ing. at the Faculty for Mechanical Engineering (Technical University Munich) M. Sc. Industrial Engineering (ICAI, Universidad Pontificia Comillas, Madrid, Spain) Previous position: 2011 – 2012: Mechanical Engineer at Fraunhofer Center for Manufacturing Innovation, Boston, MA, USA Full design of a multi-material FDM 3D Rapid Prototyper for Tissue Engineering. Current position: Since 2013: Application Engineer for Software for AM at Materialise GmbH, Munich, Germany

Presentation Summary: To enhance patient’s lives, Materialise has developed a process chain for the validated and certified additive manufacturing of implants. Materialise is able to design the patient specific implant and manufacture it made of TiAl6V4.

Additive Manufacturing of Ceramics for Biomedical Applications
Grégory Nolens, M.Sc., SIRRIS & CERHUM

Grégory Nolens, M.Sc., has done his PhD in Biomedical sciences, with an orientation in medical engineering from the University of Liège in Belgium. With a past in research, clinical trials, and medical devices, Grégory found a balance in the development of new products and innovation. Grégory really enjoys to combine (bio) materials, manufacturing processes with regards to regulatory affairs for industry. He has many years of experience in Project management that lead to industrial products and innovation. He helps companies to develop new products but also advise them to set products on European markets. He is busy at the technological research centre “SIRRIS”, in Belgium, in the field of Additive Manufacturing. He also founded a service company, CERHUM, providing custom additive manufacturing of Ceramics. Grégory also gives lessons at the University of Namur (Belgium) because he strongly believes that students should consider the industrial reality while developing new medical devices.

Presentation Summary: Ceramics 3D printing was mainly know for prototyping and design. This presentation will show that Additive Manufacturing of Ceramic is now a reality for small, medium and mass production, with a focus on biomedical applications. AM of Ceramics gives new opportunities for several biomedical applications, because of new design, tailored shapes, controlled porosities, and patient specific allowed by mature AM process. This presentation will show case studies on new medical devices developed and manufactured by AM. It will show how AM of ceramics can improve life of patients, and physician daily work. Finally, it will describe perspectives of using AM of ceramics.
3D Printing of Surgical Implants (Soft Tissue)

Achala de Mel PhD, Lecturer in Regenerative Medicine, Division of Surgery & Interventional Science, UCL Centre for Nanotechnology & Regenerative Medicine

Lecturer in Regenerative Medicine, University College London, UCL Centre for Nanotechnology & Regenerative Medicine, Division of Surgery & Interventional Science

Achala de Mel is a lecturer in Regenerative Medicine at UCLs Division of Surgery and Interventional Sciences, and a member of the UCLs centre for Nanotechnology and Regenerative Medicine. Her primary interests are in optimizing cell-material interactions for Regenerative Medicine applications. She is currently leading a research team funded by the EPSRC on aspects of 3D printing of thermoplastic nanocomposites for surgical implants

Presentation Summary: Cellular integration including printing a ‘living’ implant and 3D printing challenges related to instrumentation will be discussed. Focus will be on the use of additive manufacturing for regenerative medicine, need for patient-specific implants, 3D printing materials, biomimicry, and biofunctionalized TPU and applications.

Applying Novel-Classification Systems and Object Memory for Medical Applications of Additive Manufacturing, Jukka Tuomi, Aalto University

Jukka Tuomi is the research director at Aalto University, Finland started working with 3D Printing technologies in 1991. Jukka is president of Finnish Rapid Prototyping Association, FIRPA. He has written over 50 scientific papers about 3D Printing, 3D Modeling and Product and Production Development. He has been international scientific committee member in over 20 conferenced and he has been presenting in over 50 international conferences and seminars in about 20 different countries worldwide.

Presentation Summary: Additive manufacturing technologies are widely used in several areas of medicine. There is a clear need to unify and harmonize the patterns of their use worldwide. We present a 5-class system to aid planning and documentation of these applications as well as communication between various actors involved in this field. So called Object Memory concept will be introduced. The classification system and applied Object Memory concept will help the community to structurally develop both research innovations and clinical applications of additive manufacturing.
KEYNOTE
9:30 AM
Informing the Future of 3D Printing by Looking at 2D's Past
Stephen Nigro, President, 3D Printing Business, HP Inc.

Stephen Nigro is the President of HP Inc.’s 3D Printing business. In this role, he is responsible for bringing disruptive innovations to market, leveraging our proven technology and 2D expertise to lead the 3D print market. Stephen previously served as the Senior Vice President of HP’s Imaging & Printing business, bringing the industry’s leading imaging and printing solutions to market. He has over 30 years of print expertise spanning business leadership, product, and technical roles – all in driving the success of HP’s print business. Stephen career involves leading many of the new breakthrough initiatives in the business. As one of the early inkjet pioneers, Stephen was part of the team that developed and delivered HP’s first color inkjet printer. He was responsible for setting up the first HP inkjet manufacturing operation outside the US. Stephen led the team that delivered HP’s first off-axis Inkjet printer targeting the office market. Stephen was responsible for the creation and scaling of the HP Graphics business. Most recently his team developed and delivered HP’s PageWide strategy taking Inkjet into new markets. He holds a B.S. in mechanical engineering from the University of California, Santa Barbara and a M.S in electrical engineering from Stanford University. Stephen is based in Vancouver, WA where he lives with his wife. An avid sportsman who follows college basketball and football, his key passions are golf and skiing.

PANEL
10:30 AM
Ecosystem of Additive Manufacturing/ 3D Printing
Rob Gorman, Deputy Director America Makes
Ingomar Kelbassa, Fraunhofer Innovation Cluster, Fraunhofer ILT
Stephen Nigro, President, 3D Printing Business, HP Inc.

Presentation Summary: The Ecosystem of Additive Manufacturing panel will focus on additive manufacturing and it’s dependency on a larger industry ecosystem to continue its growth. A discussion of how research advancements, developing technologies and supplier capabilities play into the future of this game-changing technology.
Possibilities for Tooling Manufacture using a Hybrid CNC + AM platform
Peter-Jon Solomon, Hybrid Manufacturing Technologies

Peter-Jon Solomon is the senior Technologist at Hybrid Manufacturing Technologies, a 3D printing start-up equipping CNC machines with AM capabilities. Peter-Jon leads applications development and manages collaborative research activities. He is a fully skilled toolmaker with nearly a decade of experience in mold and die production. Previous to joining Hybrid, Peter-Jon managed tool making operations with a host of machinists, toolmakers and CNC machines. Peter-Jon has a BEng (Hons) degree in Engineering.

Presentation Summary: The addition of Additive Manufacturing (AM) capability to CNC machines brings a new level of flexibility to manufacturing. Hybrid CNC machines with laser cladding capability are ideal for component repair and feature addition. In a mold tool context, the ability to add metal enables improved mold performance and maintenance at reduced costs. Most importantly in-process finishing brings CNC quality surface finishes and precision to added/repaired features all in a single setup. This presentation will also address the changes required to upgrade a CNC machine with metal deposition technology.

Broadening the Use of Technical Ceramics
Richard Gaignon, President, 3DCeram

Richard Gaignon graduated from ENSCI ceramic engineer school and HEC executive MBA. He is former Chief Executive Officer and Director of Business at Ceric (engineering). Richard Gaignon is co-president of 3DCeram company.

Presentation Summary: The ceramics industry is currently experiencing newfound freedom and creativity, thanks to the rapid development of 3D printing that is no longer limited to prototype production: it has become a significant production tool for mass customization. 3D printing forms a close fit with other conventional manufacturing technologies and makes ceramics more accessible, by cutting development times and simplifying the production process (no tooling). A 3D printer dedicated to ceramics has been developed that uses laser technology. Laser stereolithography (SLA) has emerged as the best solution for the fabrication of dense ceramics with very good resolution. The parts made with that printer have the same characteristics as ceramic parts produced using traditional technologies (dry pressing or injection). A relatively broad range of ceramic pastes, which are made of 80% ceramic powder and 20% resin, is available to meet manufacturers’ needs, including alumina, zirconia, hydroxyapatite, etc. Ceramists have all the cards in hand to explore the possibilities offered by this technology. Case studies (Luxury and biomedical industries) will help to understand all the benefits (and limits) of the technology.
Room M
11:30 AM
From Materials Characterization to Technology Integration
Guido Palazzo, Plastics Research and Development Center, National Institute of Industrial Technology, INTI-Plastics

Graduated from the University of Buenos Aires with a Bachelor of Science degree in Chemistry, actually pursuing a post-graduate specialization in processing and environmental impact of plastics at UNSAM, Guido Palazzo is a member of the National Institute of Industrial Technology of Argentina (INTI). With 9 years of experience in analytical chemistry, previously in the agroindustrial and pharmaceutical sectors, his current focus as a researcher in the Materials Technology Unit is to further the AM materials and technology development in Argentina.

Presentation Summary:
Gathering meaningful information on materials for Additive Manufacturing can pose a challenge. For instance, AM still has to produce its own standards for testing (injection molding data is still widely used by default). Moreover, we are facing a new paradigm given AM came to scene to "revolutionize" standardization in traditionally manufactured products. The freedom to produce new geometries poses great challenges in proper material characterization since a single part can have different chemical, physical, mechanical, optical, magnetic properties within a few inches apart. Polymers are found not only in Fused Filament Fabrication (FFF) but also in Powder Bed or Binder Jetting, SLA, DLP, SLS, 3D printed ceramics, HP’s new process, and many more. Yet polymers may become the main component of a certain object or they can be no more than a temporary companion of other materials within a 3D printed part. Additive Manufacturing is less about breaking apart from prior technologies and more about integrating processes.

Room M
12:00 PM
The Market Change from Rapid Prototyping to Rapid Manufacturing
Arnaud Guédou, Sales & Marketing Director, PRODWAYS

Trained as an engineer, Arnaud Guédou has worked his entire professional career in 3D Printing. In the mid-90s, he was sales manager for 3D Systems (USA), contributing to its growth over several years. He then joined DSM (ND) and organized its European sales management. He is now known in the profession as one of the best 3D Printing business development specialists. His track record has allowed him to gain a unique understanding of the market’s need for fast production from both the technical and commercial point of view. Today, Arnaud Guédou is Sales and Marketing Director of Prodways.

Presentation Summary: Additive manufacturing market is in a migration phase from rapid prototyping to rapid manufacturing. New technical solutions are currently ready to support this migration and propose industrial technologies for short series production.

LUNCH BREAK
Next Generation Industrial 3D Metal Printing Systems: Opportunities, Requirements & Solutions
Daan A.J. Kersten, Co-founder & CEO, Additive Industries b.v.

Industrial entrepreneurship has stolen Daan’s heart at young age. Master degrees in both mechanical engineering and business administration have created a solid basis for his professional career and multiple ventures. In 2012 Daan founded, together with Jonas Wintermans, Additive Industries, a high tech start-up company industrialising 3D printing for functional parts in various metals. The ambition of Additive Industries is to bring additive manufacturing and 3D printing from lab to fab and allow the high tech manufacturing industry to capitalise on the opportunities additive manufacturing has to offer in creating lighter, compact, integrated, more complex products & parts with better thermal performance/characteristics. Their next generation metal additive manufacturing system will be the first modular, integrated and automated solution for demanding markets like aerospace, medical, automotive and other high tech applications.

Presentation Summary: After its inception in 2012, Additive Industries, based in Eindhoven, The Netherlands has worked in stealth mode on the development of a clear vision on industrialisation of metal additive manufacturing. After a broad study on industrial 3D metal printing, the company has developed a comprehensive vision, product portfolio and proposition for the manufacturing industry. In 2015, Additive Industries will officially launch and allow for the first sneak preview of the integrated and automated industrial additive manufacturing solution the team of engineers in Eindhoven has been working on. In addition the 2015-2020 roadmap is presented and experts are invited to join and assist to shape the next generation of industrial additive manufacturing equipment.

Design for Additive Manufacturing: Topology Optimization
Lars Pursche, Director, Partner Sales, solidThinking

Lars Pursche is the Director of Partner Sales, EMEA at solidThinking working with customers and resellers and promotes Topology Optimization all over Europe. Has a master degree in computer science and received a Ph.D. in rapid prototyping of 3D molded interconnect devices as a mechanical engineer.

Presentation Summary: When topology optimization is utilized to generate designs for additive manufacturing, many exciting new benefits present themselves (lightweight parts, stronger parts, no wasted materials, cost savings, etc.). This presentation will answer a number of questions. What is topology optimization? Why does topology optimization makes sense for additive manufacturing? How does topology optimization work? Who has been applying topology optimization? Why should topology optimization be on a designer’s desktop? What are the future opportunities? This presentation will include multiple real-world examples of companies using topology optimization to design for and enhance the benefits of additive manufacturing.
The Future Process and Quality Demands of Additive Manufacturing

Phill Dickens PhD, Professor of Manufacturing Technology, University of Nottingham

Phill Dickens is Professor of Manufacturing Technology at University of Nottingham and also a Director of Added Scientific Ltd which is a scientific consulting company to help companies throughout the AM supply chain. He has been working in this area since 1990 and has experience of many processes for prototyping, tooling and manufacturing. In 1996/7 he undertook the first work to show the commercial feasibility of these processes to compete against conventional processes such as injection moulding.

Presentation Summary: We currently have a range of processes to build parts which generates them mostly in a single material. There is some commercial use of these processes but to enable widespread use a number of challenges need to be overcome:

Quality and Process Variability in Ti-6Al-4V Powder Bed Electron Beam Additive Manufacturing

Eric Fodran PhD, Prod Ops Manufacturing Technology Development, Northrop Grumman Corporation

Dr. Fodran is a manufacturing engineer within the Manufacturing Technology Development group at Northrop Grumman. He has been supporting R&D efforts within the Manufacturing Technology Development as well as Advanced Materials & Presses Development organizations for the past 9 years on several aircraft platforms including F-35, F-18, B-2, T-38, and future combat systems. His focus has been predominantly in the areas of additive manufacturing, structural materials fabrication and processing methods, as well as high temperature thermal protection systems. His practical experience has also been based in lunar rover metallic materials while at the NASA Jet Propulsion Facility, and his previous R&D background has been in a diverse spectrum of processes and materials including: elevated temperature aluminum based alloys and intermetallics, rapid solidification processing methods, and amorphous bulk materials for structural application. Dr. Fodran's educational background includes completion of his undergraduate degree in Materials Science from California Polytechnic State University San Luis Obispo, and a Ph.D. also in Materials Science from the University of Florida.

Presentation Summary: Northrop Grumman has executed a series of design of experiments to develop Ti-6Al-4V powder bed electron beam process parameters to understand the effects on geometric control and surface finish. Additionally, the overall quality from the standpoint of NDI detected voids are also being correlated to process variation. Arcam additive manufacturing processes have been employed to fabricate a series of representative components as well as full scale components. In doing so process parameters such as incoming starting powder, beam speed, layer thickness, and beam intensity/spot size have varied and optimized for surface finish. The effect of process variation on geometric quality has been quantified and a set of optimized process parameters have been identified. Evaluation of the effect of process variables on overall component quality is also ongoing.
Maturation of High Temperature Laser Sintering Technologies and Infrastructure for Air and Space Vehicles

Pedro Gonzalez, Manufacturing Engineer, Northrop Grumman

Pedro A. Gonzalez joined Northrop Grumman Aerospace Systems in 2011 as a Manufacturing Engineer within the Manufacturing Technology and Development group. Mr. Gonzalez identifies, develops, and validates manufacturing processes/procedures for Additive Manufacturing (AM) relative to production and prototype programs; provides solutions to variety of technical problems as well as fully competent in understanding AM design and engineering requirements. He’s been involved in the industry, both Additive Manufacturing and Subtractive Rapid Prototyping for over 10 years. Pedro is currently leading or involved with multiple Contract Research and Development and Independent Research and Development programs focused on development and implementation of AM technologies for air and space vehicles.

Presentation Summary: Additive Manufacturing polymers are currently flying on multiple air vehicles providing a low cost, rapid alternative to traditional fabrication processes. There is, however, a need for higher temperature Additive Manufacturing polymers for air and space applications that current polymers are not capable of achieving. Current available materials are either not capable of achieving a higher temperature or non-recyclable driving up already high material costs. This briefing highlights efforts on providing multiple sources of a material capable of meeting the needs for air and space vehicles while keeping material costs lower. This effort includes development of a high temperature design allowable data base that will give component engineers a better understanding of mechanical performance at various temperature ranges.

A 3D Printing Adventure: From Perfect Bone Implants to Complex Satellite Parts

Maikel Beerens, CEO, Xilloc

During his award-winning thesis medical engineer Maikel Beerens developed a methodology to design, manufacture and market perfectly fitting Patient-Specific Implants, surgical guides and anatomical models. He founded his medical device company Xilloc and had 2 worldwide premieres with the first 3D printed titanium skull implant in 2006 and the first 3D printed full titanium mandible in 2011. Soon Xilloc will launch CT-Bone®, a 3D printed ceramic implant that will be converted into real bone by the patient. Maikel received numerous entrepreneurship awards and recently secured a big investment for the purchase of multiple high-end Additive Manufacturing machines, which will help grow Xilloc also into industrial application areas like aerospace and automotive.

Presentation Summary: The startup and growth of a medical device company, specialized in patient-specific products will be presented. The focus will be on the advantages and possibilities, but also the hurdles and limitations of 3D printing as a manufacturing technology for Patient Specific Implants, surgical guides and anatomical models. A new bone-like material will be introduced that can be 3D printed to the exact anatomy of the patient: CT-Bone®. These implants are converted into real bone by the patient. The entrepreneur will also announce the launch of an industrial business unit, after obtaining a significant investment to acquire multiple high-end additive manufacturing machines for producing metal, polymer and ceramic parts.
Moving 3D Printing to Finished Parts
Dan Oliver, CoFounder, Voxel8

Daniel Oliver is a Cofounder and the Business Lead for Voxel8. Dan is a former systems engineer with Honeywell Aerospace and founder of Intelligent Mobility International, a social enterprise he established to provide long lasting, low cost wheelchairs throughout the world. After earning his MBA from Harvard Business School, Dan was selected as a Blavatnik Fellow, where he spent a year commercializing science from the Lewis Lab. Dan received his B.S. in Mechanical Engineering from California Institute of Technology.

Presentation Summary: Many companies have used 3D printing to create prototypes rapidly. Relying on these applications has been successful, yielding hundreds of millions of dollars in revenue for 3D Systems and Stratasys. The high valuations of these companies around the beginning of 2014 were based upon the notion that they would continue to grow and grow quickly. This assumption is rooted in the belief that 3D printing will soon be used to create finished parts, tapping into a $11.5 trillion global manufacturing market. When the Wohlers Report projected that the 3D printing industry will grow to $10.8 billion by 2021 a tenfold increase from today they assume that 3D printing will account for less than 1% of global manufacturing. So why hasn’t 3D printing made this transition to finished parts? There are 4 key challenges that need to be overcome. To be fully accepted as a manufacturing tool, 3D printing must address a number of challenges:
- Limited materials palette
- Multi material printing
- Embedded electronics
- Throughput

Laser Additive Manufacturing to Digital Photonic Production
Ingomar Kelbassa, Deputy Director, Fraunhofer Innovation Cluster, Fraunhofer ILT

Adj. Prof. (RMIT) Akad. Oberrat Dr.-Ing. Ingomar Kelbassa has studied mechanical engineering at RWTH Aachen University, Germany and has been working in the field of Laser Material Processing at the Fraunhofer Institute for Laser Technology ILT and the Chair for Laser Technology LLT, RWTH Aachen University, since 2000. Currently, he is Deputy and Academic Director of LLT, RWTH Aachen University and Department head LLT at Fraunhofer ILT, Aachen, Germany. In 2014, he was Director of Fraunhofer CLT, Plymouth, MI, USA. Since March 2011, Ingomar Kelbassa is member of the Fraunhofer Vintage Class, a Fraunhofer internal qualification program for the next generation of Fraunhofer Institute Directors. His expertise is shown by approx. 50 scientific publications. In 2011 and 2012, Ingomar Kelbassa has received three – two German and one U.S. American – major innovation awards for his achievements in Laser Additive Manufacturing. In 2012, Dr. Kelbassa spent 4.5 months at the Royal Melbourne Institute of Technology, RMIT University, Melbourne, Victoria, Australia to write the majority of his habilitation treatise on "Laser Additive Manufacturing: Laser Material Deposition". In February 2014, Ingomar Kelbassa accepted an honorary position with RMIT University as an Adjunct Professor. Additionally and since mid 2014, he holds two Visiting/ Guest Professorships in the People’s Republic of China – one at Nanjing University of Aeronautics and Astronautics NUAA as well as one at Harbin Institute of Technology HIT.

Presentation Summary: This tutorial focuses on the fundamentals of the two laser based Additive Manufacturing AM processes, Selective Laser Melting SLM and Laser Material Deposition LMD – from their basic characteristics, via their influence on conventional process and supply chains, over new challenges toward the vision of Digital Photonic Production DPP. Success stories of real OEM parts, that are already in industrial production, complete the tutorial.
16:00
**Closing Keynote**

**Bringing Additive Manufacturing To Space**
Jason Dunn, CTO, Made In Space

Jason is a rocket scientist holding two degrees in aerospace engineering from the University of Central Florida. Jason is a Heinlein Scholar, Space Frontier Foundation Advocate, and a proud SEDS alumnus who co-founded the only student-formed and led team to compete in the Lunar XPRIZE. He believes that by learning how to colonize space, entirely possible within our lifetime, we will solve many more of Humanity's “Grand Challenges” here on Earth.

**Presentation Summary:** In 2014, Made In Space placed the first 3D printer on the International Space Station (ISS) as a demonstration of the possibilities of on-site, on-demand manufacturing in space. A follow on, permanent additive manufacturing facility will be installed on ISS in 2015. Enabling the ISS with commercially available hardware will change the way space mission planning is handled, while simultaneously opening up faster, cheaper hardware development for businesses, individuals and researchers on Earth.

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**Euromold is proud to present the RAPID 3D Printing Fashion Show on Sept 25th at 1:30 PM (13:30 PM)**

**Location:** Hall 16, Booth D61

The RAPID 3D Printing Fashion Show highlights the new, creative approach to fashion design that’s made possible by 3D printing. You’ll see the latest in 3D fashion from the world’s leading 3D print designers.

The RAPID 3D Printing Fashion Show is curated and directed by Natacha Alpert.

**Designers Include:**
Holy Faya
Rachel Nhan
Sabina Saga
Lionel Dean & Future Factories
Dilek Sezen
Paul Redmond