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EDITORIAL

Editorial PIAM October 2019

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By the time this issue is published, most of us would be ushering the New Year. As we look back around 35 years ago, Additive Manufacturing (AM) or 3D Printing was still in its infancy. Charles W. Hull (Chuck Hull) was one of the early pioneers of AM, having invented Vat Polymerization or better known as Stereolithography (SLA). On 8 August 1984, he applied for a US patent that was later granted on 11 March 1986 for an "Apparatus for production of three-dimensional objects by stereolithography." His first 3D printer was the SLA-1 Stereolithography (SLA) printer which started the foundations for his company, 3D Systems. Around the same time, Steven Scott Crump invented and patented the Fused Deposition Modelling (FDM) technology where one of his earliest patents was granted on 9 June 1989 for an "Apparatus and Method for Creating Three-Dimensional Objects", that then led to the founding of Stratasys. Since then, there has been a proliferation of numerous other AM processes, variations of processes and even hybrid processes. Some of these processes are trademarked by companies, such as FDM is associated with the company Stratasys. To abide law trademarks and to ensure consistent use of vocabulary, International Standards play an important role. In 2011, ASTM International and the International Organization for Standardization signed a Partner Standards Developing Organization to eliminate duplication of effort while maximizing resource allocation within the AM industry. Both committees have agreed to work together to fast track the adoption process of ASTM International standards as an ISO final draft international standard; adoption of a published ISO standard by ASTM International; joint maintenance of published standards; and with other publication, copyright and commercial arrangements. Key to this is the Standard document ISO/ASTM 52,900:2015 "Additive manufacturing— General principles—Terminology" that aims to establish and define the vocabulary used in AM technology, where such terms have been classified into specific fields of application and new terms emerging from the future work within ISO/TC 261 and ASTM F42 will be included in upcoming amendments and overviews of this International Standard. This Standard document may later be renamed as "ISO/ASTM 52900 Additive manufacturing—General principles—Fundamentals and vocabulary" for further clarity. Within this document, it lists seven process categories in a clear and concise manner and also ensuring that it does not infringe upon existing trademarks. The seven processes include *binder jetting*, an AM process in which a liquid bonding agent is selectively deposited to join powder materials; *directed energy deposition*, an AM process in which focused thermal energy is used to fuse materials by melting as they are being deposited; *material extrusion*, an AM process in which material is selectively dispensed through a nozzle or orifice; *material jetting*, an AM process in which droplets of build material are selectively deposited; *powder bed fusion*, an AM process in which thermal energy selectively fuses regions of a powder bed; *sheet lamination*, an AM process in which sheets of material are bonded to form a part; and *vat photopolymerization*, an AM process in which liquid photopolymer in a vat is selectively cured by light-activated polymerization. This means that terms such as FDM and SLA are not used and are instead replaced by material extrusion and vat photopolymerization, respectively. Recently, I had the opportunity to deliver a Keynote Speech at the Progress in Digital and Physical Manufacturing (ProDPM'19) Conference at the Polytechnic Institute of Leiria that was organised by Dr. Henrique Almeida who is an Editorial Board Member, and Dr. Joel Vasco who is a Review Board Member. During the Keynote, I spoke about the growing importance of Standards, particularly for AM and stressing on the three aspects derived from the Economist [1] where physical production will evolve with the economics of digital production, in which the value of a product will no longer be in the physical item, but in its design; adopting AM requires a highly skilled workforce with a substantially different skillset from conventional manufacturing and AM may be able to bring jobs back to advanced

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economies from low-wage economies through proper training and reskilling; and critical parts need to be thoroughly checked and verified to ensure they have the structural integrity and the big issue is the certification process. Standardization efforts will no doubt play a huge role in these three areas and beyond. For example, ISO/TC 261 Joint Groups 54 and 57 are currently developing design process guidelines for AM. ISO/TC 261 Joint Group 74 is looking to standardize Qualification of AM Training. The certification of parts remains a challenge, in which other Joint Groups are seeking to develop either technical reports or standards documents to aid the certification process such as for aerospace or for medical implants of AM parts. Standards are an agreed way of doing something, capturing industry good practices and developed through international consensus. AM Standards will be here to stay and they will continue to develop. Many of our PIAM members are involved in the work of AM standards. If you are keen to get involved, reach out to us, or continue reading our articles to keep abreast of new developments.

I also take this opportunity to wish all authors and readers a very successful 2019.

Eujin Pei
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Reference

1. The Economist, Intelligence Unit (2018). Adding it up: the economic impact of additive manufacturing. https://eiuperspectives.economist.com/sites/default/files/Addingitup_WebVersion.pdf. Accessed 5 Oct 2019