

Ready to show its mettle in additive manufacturing space

3D Metalforge (ASX:3MF) is an additive manufacturing (AM) company that provides 3D metal printing solutions. 3MF offers a full range of AM-related services including consultancy, design and engineering, 3D scanning and modelling, printing, post-production, certification, and education and training. It went public on ASX in March 2021.

AM industry poised to scale new heights

AM or additive manufacturing is the industrial production name for 3D printing, a computer-controlled process that creates three-dimensional objects by depositing materials, usually in layers. The AM industry has transformed over time from producing prototypes to manufacturing functional and critical parts. It has gained further strategic importance post the onset of the COVID-19 pandemic as the industry has developed use cases for the healthcare sector and manufacturers are increasingly relying on local 3D printing services for essential parts and supplies. The other tailwinds that will propel the industry include the push for eco-friendly processes involving lower use of materials and transportation, growing demand for customised and complex products, and growth of AM industry standards. Consequently, the global 3D printing market is estimated to grow at a staggering CAGR of 17.3% during 2021–2026, to reach a value of US\$37.2bn.

3MF stands well ahead of competition

We believe the company will be a key beneficiary of the expanding AM market driven by its set of competitive advantages. 3MF is an end-to-end solution provider and more than just a 3D printer seller. It has deep engineering expertise having produced 20,000+ parts and served 500+ clients across varied sectors such as maritime, oil and gas, defence and mining. The company is on the working groups of several standard-setting bodies for the industry and has maintained a strong R&D focus over the years. Further, it has a global footprint with current locations in Singapore, US and Australia that enable it to suitably serve the end markets by providing onshore/near shore production capabilities.

Valuation of \$0.16 per share

We have valued 3MF by comparing its market value to other ASX-listed peers. We believe 3MF is highly undervalued in the market and investors are not factoring in the full potential of the company. Please refer to page 24 for details on share price catalysts and risks.

Share Price: A\$0.09

ASX: 3MF

Sector: Commercial & Professional Services

13 December 2021

Market cap. (A\$ m)	17.3
# shares outstanding (m)	190.1
# shares fully diluted (m)	191.9
Market cap ful. dil. (A\$ m)	17.5
Free float	80.8%
52-week high/low (A\$)	0.350 / 0.091
Avg. 12M daily volume ('000)	264.1
Website	3dmetalforge.com

Source: Company, Pitt Street Research

Share price (A\$) and avg. daily volume (k, r.h.s.)



Source: Refinitiv Eikon, Pitt Street Research

Relative valuation	
Fair valuation range (A\$ per share)	0.16 – 0.17

Source: Pitt Street Research

Analysts: Stuart Roberts, Cheng Ge

Tel: + 61 (0)447 247 909

stuart.roberts@pittstreetresearch.com

cheng.ge@pittstreetresearch.com



Table of Contents

Introducing 3D Metalforge, ASX:3MF	3
Ten reasons to look at 3MF	4
3MF's core technologies	6
Clear sources of competitive advantage	8
<i>End-to-end service provider.....</i>	<i>8</i>
<i>Proven technological competence</i>	<i>9</i>
<i>Strong R&D position.....</i>	<i>10</i>
<i>3MF's global footprint.....</i>	<i>12</i>
Well-defined growth priorities	13
AM market to expand rapidly backed by favourable trends	14
Strong leadership team	19
Comparable companies	21
Valuing 3MF	23
Catalysts and risks	24
Appendix I – Major Shareholders	25
Appendix II – Analysts' Qualifications	25
General advice warning, Disclaimer & Disclosures	26



Introducing 3D Metalforge, ASX:3MF

Founded in 2015, 3D Metalforge (ASX:3MF) provides end-to-end services in the AM market, including design and engineering, consultancy, 3D scanning and modelling, creating files for printers over a range of formats, post-production, certification, and education and training. At present, the company has presence in Singapore, US and Australia. It went public on ASX in March 2021.

3MF has a fast-growing blue chip customer base including multinational companies and government entities in the oil and gas, maritime, defence and high-value industrial sectors. Its list of clients includes Flowserve, ConocoPhillips' Polar Tankers, Royal Dutch Shell, NOV, Par Pacific and PSA (formally Port of Singapore Authority),

3MF has a fast growing blue-chip client base

Phenomenal potential of the AM market underpinned by structural tailwinds

AM or additive manufacturing is the industrial production name for 3D printing, a computer-controlled process that creates three-dimensional objects by depositing materials, usually in layers. 3D printing can be considered more as the act of printing while AM is a broader term which better reflects the professional manufacturing process that differs from conventional, subtractive manufacturing methods. For instance, instead of milling a work piece from a solid block, AM would build the part layer by layer from material supplied as fine powder.

The AM industry has generally moved from prototypes to end-use parts, and within end-use parts, it has moved from non-critical to critical parts. The growing demand for critical and customised parts is fuelling the expansion of the AM market. The global 3D printing market is estimated to grow at a robust CAGR of 17.3% during 2021–2026, to reach a value of US\$37.2bn. As 3D printing has the potential to tackle increasing labour costs and environmental regulations in developed countries, the push for reshoring production and sustainable manufacturing techniques is also driving market growth. Further, the COVID-19 pandemic is benefitting the industry as we witness growing AM applications in the healthcare sector and the flight to onshore or near shore production to avoid supply chain bottlenecks.

AM industry has gained strategic importance, particularly after the onset of the COVID-19 pandemic

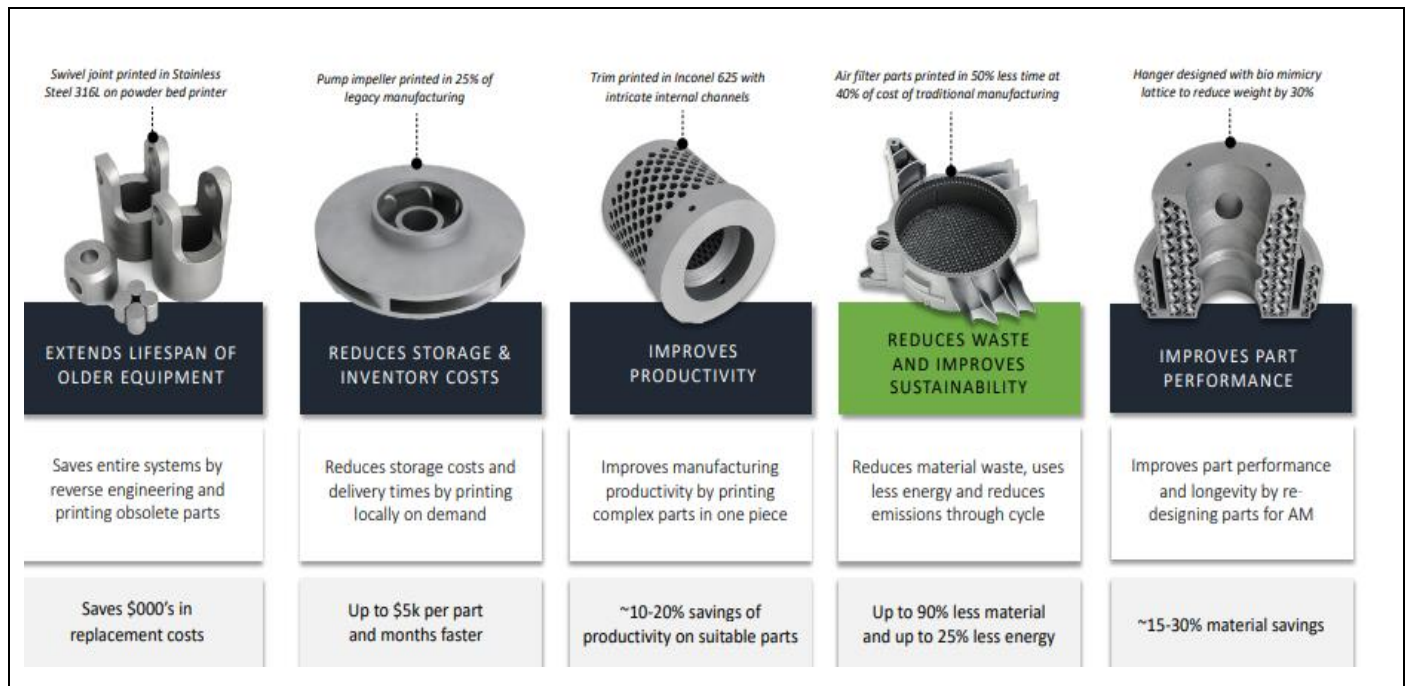
3MF in a strong position to leverage the AM market

Metal AM is a growing sub-segment of the more widespread AM technology. It uses a digital process to create 3D objects by discharging metals, usually in layers, to build the final product. 3MF's primary expertise lies in super alloys with anti-corrosion and high-temperature properties. The company is capable of producing high-demand industrial parts faster (typically in 2-3 weeks vs. traditionally 8-10 weeks), at better quality and at lower cost than conventional manufacturing. 3MF's customers also benefit from reduction in storage costs and delivery time due to localised manufacturing. All in all, 3MF is able to make its clients' supply chains more sustainable, resulting in enhanced return on manufacturing investment (Figure 1).

3MF has multiple and clear competitive advantages



Figure 1: Key benefits of 3MF's technology



Source: Company

While 3MF has been a relatively new entrant in the AM space, we believe it will be one of the key beneficiaries of the expanding AM market due to its multiple and clear competitive advantages which place it ahead of other players. In our view, investors are not fully valuing these advantages and the company's potential, thus undervaluing the 3MF stock.

Ten reasons to look at 3MF

- 1) **3MF's AM technology has multiple benefits.** The company, through its custom-engineered solutions and streamlined processes, enables its clients to build reliable supply chain solutions and print cheaper, faster and better parts with lower environmental impact than traditional manufacturing.
- 2) **Full-service provider.** 3MF is a complete AM service provider. Its focus is not just on selling 3D printers but providing all AM-related services that range from consulting clients to help select printing materials, designing parts, redesigning old/obsolete parts, 3D printing and post-production services such as digital cloud storage and training. The company also offers to set up on-site production facilities (shop-in-shop) of its products on client demand.
- 3) **Blue-chip clients across multiple sectors.** 3MF has a strong client base and its list of clients includes Sembcorp Marine, Flowserve, ConocoPhillips' Polar Tankers, Royal Dutch Shell, NOV, PSA (formally Port of Singapore Authority), and several others, which encompass sectors such as oil and gas, maritime, defence and high-value industrial.
- 4) **Superior AM technological base and high-quality standards.** 3MF has deep expertise in AM having printed over 20,000 parts till date. Its



Singapore facility is fully operational and prints one part every seven minutes. The company possesses expertise in working with critical materials, especially with super alloys with anti-corrosion and high-temperature properties. Further, the company maintains strong quality standards and was amongst one of only seven organisations to be re-certified by Lloyds Register in September 2021, for printing metallic parts. 3MF is on the working groups of several global standard-setting bodies, which help in shaping industry standards for AM.

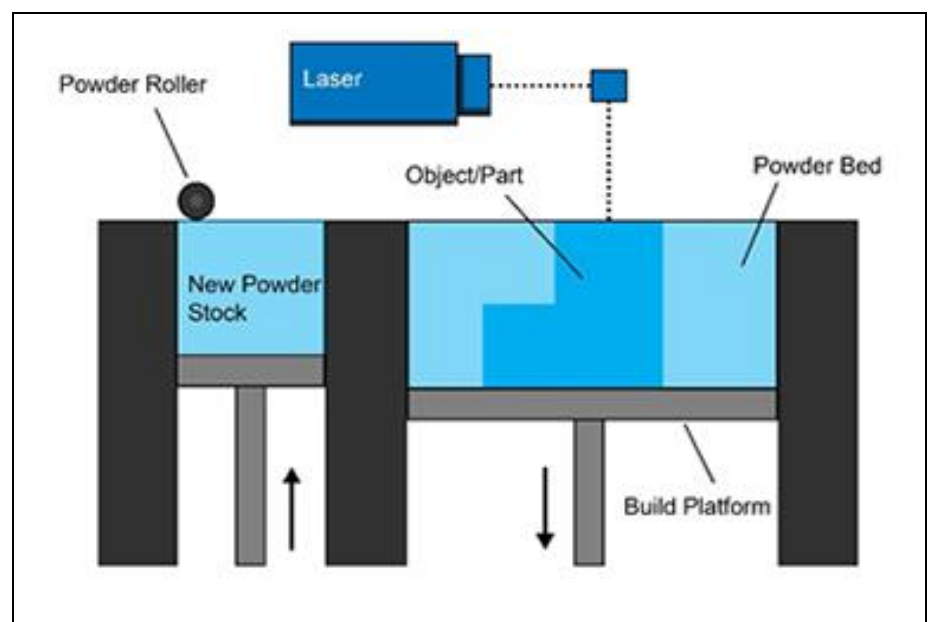
- 5) **Wide range of intellectual property (IP) portfolio and strong R&D focus.** 3MF has developed an IP portfolio consisting of patents, trade secrets, licenses and copyrights to print file library of over 2,000. It also makes high investments in R&D programmes, either directly or through collaborations with educational or industrial research institutions.
- 6) **Global footprint.** 3MF launched its first metal AM centre in Singapore in 2017. Since then, it has expanded in the US and Australia to cater to clients in the oil and gas, and mining sectors. The management is committed to operate in a number of countries to provide AM at point of use as well as drive engineering transformation through its locations at headquarters.
- 7) **Highly experienced management team.** 3MF's leadership has some of the most experienced minds in the AM arena. The company is led by Matthew Waterhouse who has over 20 years of experience in senior management positions across consultancy and engineering firms. Mr. Waterhouse is also the Chairman of the AM Technical Committee in Singapore and is a member of several other standard-setting bodies/committees.
- 8) **3MF operates in a market with immense growth potential.** The 3D printing industry has gained strategic importance over time as its use case has transitioned from producing prototypes to manufacturing functional and critical parts. Several companies are also exploring 3D printing as a sustainable alternative to traditional manufacturing due to lower material wastage and transportation of parts. Moreover, the growing adoption of industry standards in the AM space will further support the long-term potential of the global 3D printing market.
- 9) **3D printing has gained mainstream exposure** due to the impact it made by aiding the rapid production of personal protective equipment (PPE) during the beginning of the COVID-19 pandemic. Further, as the pandemic-induced disruptions in the supply chain make it difficult to source parts from overseas locations, several firms are increasingly relying on local 3D printing service providers to manufacture essential parts and supplies.
- 10) **We believe 3MF is undervalued at its current market value.** We value the company in the range of A\$30–33m, which is significantly higher than its current market capitalisation of ~A\$17m. In our view, the 3MF stock can potentially re-rate to our valuation range if the company continues with its strong trajectory of client wins, top-line growth and inroads in new geographies (e.g., Australia) and sectors (e.g., mining).

3MF's core technologies

There are several AM technologies being utilised by 3MF and the key ones are described below.

Powder Bed Fusion (PBF): This technology is used in a variety of AM processes including selective laser melting (SLM), direct metal laser sintering (DMLS), selective laser sintering (SLS), multi jet fusion (MJF), electron beam melting (EBM) and direct metal laser melting (DMLM). These systems use lasers, electron beams or thermal print heads to melt and fuse ultra-fine layers of material powder in a three-dimensional space (Figure 2).

Figure 2: Powder Bed Fusion

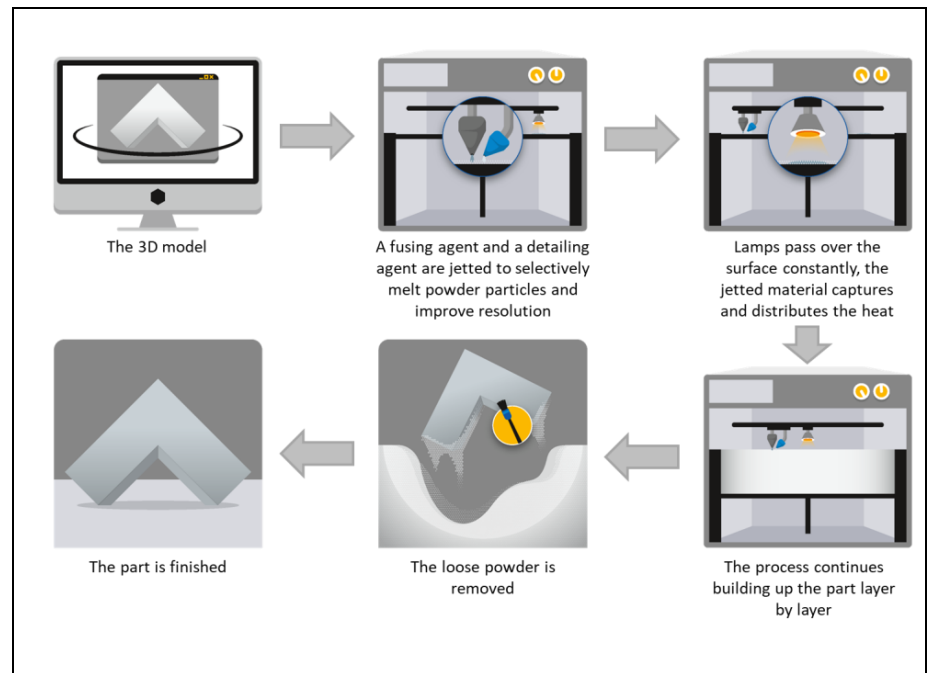


Source: Loughborough University

Multi Jet Fusion (MJF): MJF is a type of PBF technology where a fusing agent is applied to a material layer on which the powder particles are to be fused. Simultaneously, a detailing agent that inhibits sintering is printed near the edge of the part. During the process, a high-power infrared energy source runs through the build bed and sinters the areas where the fusing agent is dispensed, leaving the rest of the powder untouched. The process is repeated until all parts are complete (Figure 3).



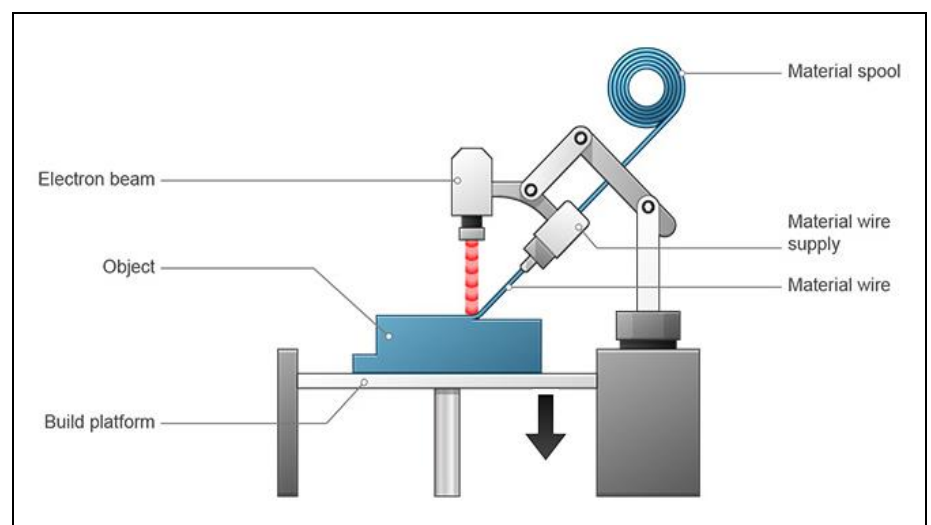
Figure 3: Multi Jet Fusion



Source: Materialises

Directed Energy Deposition: DED process uses a similar melting approach as SLM. However, in the case of the former, the deposition head is mounted on a four-or five-axis robotic arm, giving it a significantly larger print area than PBF printers. The power source is often a plasma beam or laser, while the feedstock is either wire or powder (Figure 4).

Figure 4: Directed Energy Deposition



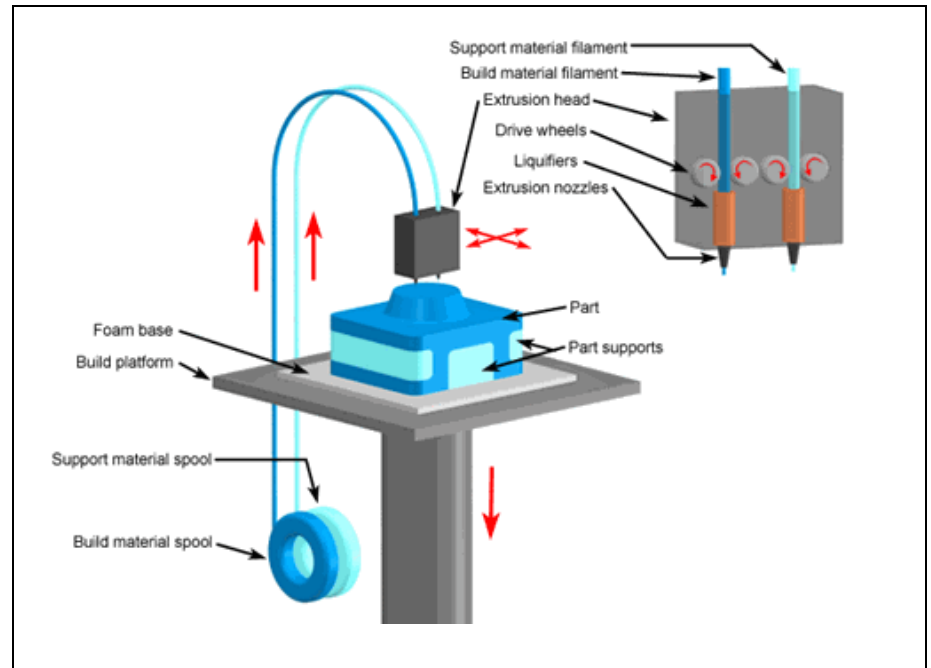
Source: Dassault Systemes

Fused Deposition Modelling (FDM): In FDM printing, spooled polymers are extruded or drawn through a heated nozzle mounted on a movable arm. The nozzle moves horizontally, while the bed moves vertically, allowing the



melted material to be built layer upon layer. Proper adhesion between layers occurs through precise temperature control or the use of chemical bonding agents (Figure 5).

Figure 5: Fused Deposition Modelling



Source: CustomPartNet

Clear sources of competitive advantage

We believe there are a number of factors that provide the company a clear edge against existing and potential competition in the global AM market. The company is an emerging player but has a solid foundation that is necessary to grow in this market.

End-to-end service provider

3MF provides end-to-end services in AM including consulting in choosing the right parts and materials, designing and modelling the parts, printing the parts, testing and certifying them, storing parts in the cloud as well as training clients (Figure 6). This places the company on a higher ground as compared with competitors, many of whom are focussing on supplying 3D printers. In fact, at present, the biggest global market for AM is selling services (US\$6.8bn) rather than selling printers, and this trend is expected to continue in the future.

As the company's focus is not supplying printers, it is able to generate more value for its customers by supporting them in all aspects of transformation to AM. For instance, redesigning parts, including complex honeycombing interiors takes years of experience and a range of expensive software that may not be available with customers and if 3MF helps bridge such gaps, the stickiness of the client relationship improves significantly.

3MF provides end-to-end services to clients rather than just selling 3D printers to them



Figure 6: 3MF provides full range of AM services



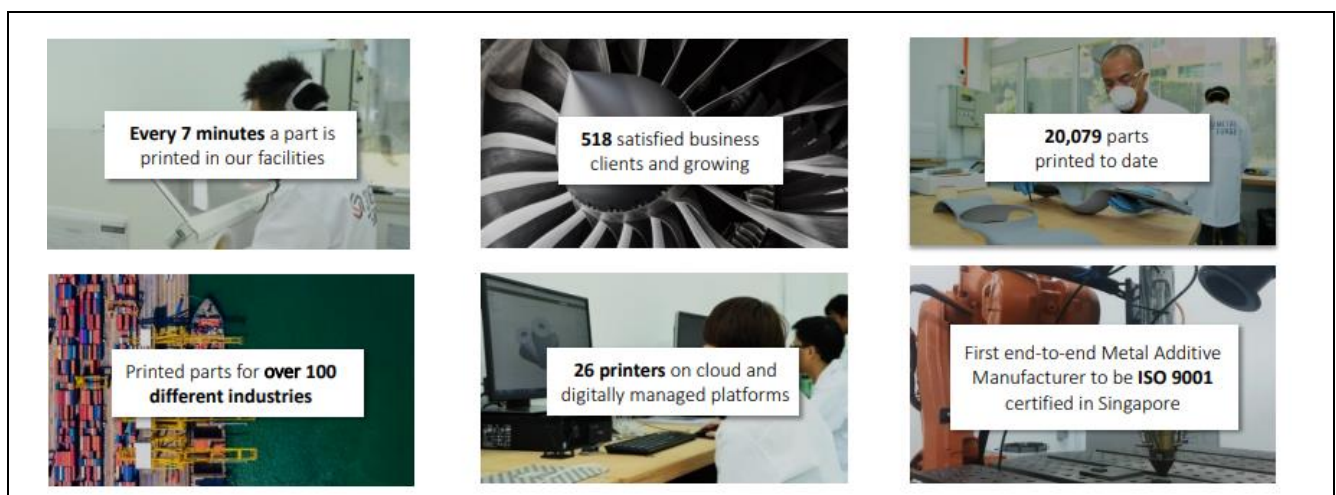
Source: Company

Proven technological competence

The company has a fully operational production facility in Singapore with a part being printed every seven minutes (Figure 7). It has deep expertise in AM having printed over 20,000 parts till date and has a growing client base of blue-chip companies across varied sectors including oil and gas, defence, maritime and high-value industrial. 3MF is capable of producing high-demand industrial parts faster (typically 2-3 weeks vs. 8-10 weeks for traditional manufacturers) and at lower cost than conventional manufacturing, which results in enhanced return on manufacturing investment for clients. An example of its efficiency is its recent contract with Royal Dutch Shell under which it delivered heat exchanger parts to Shell's largest petrochemical production facility in Singapore, in a record time of two weeks.

Deep expertise supports growth in blue-chip client base

Figure 7: A look at 3MF's expertise



Source: Company

Usage of advanced IT tools

Another interesting aspect about 3MF's business model is that it makes full use of latest IT tools, for instance, cloud production/distributed manufacturing, which smoothens the conduct of its business. As an example, 3MF stores its printing files on the cloud so that there is no time lag or



Primary expertise lies in super alloys with anti-corrosion and high-temperature properties

3MF is playing an active role in developing global AM standards

communication gap between its various production facilities, which are situated in different locations.

Provides shop-in-shop facilities

3MF can set up on-site production facilities on customer demand. This is a very interesting model of conducting business, taking the concept of shop-in-shop, to a different level altogether. Producing parts near end users reduces inventory and transportation time, and cost for the customers.

Expertise in critical materials

The company works with a wide gamut of materials but its primary expertise lies in super alloys with anti-corrosion and high-temperature properties. 3MF designs and prints parts in specialist materials for the marine, oil and gas, and defence sectors including Inconels and Maraging steel. For some of these materials, the company has designed the parameters for its blown powder DED printer itself allowing it to print parts in this material, which is usually complex to work with.

High quality standards

The company maintains strong quality standards and was amongst one of only seven organisations to be re-certified by Lloyds Register in September 2021, for printing metallic parts. Lloyds Register is one of the leading standard-setting body for technologies and hardware in the maritime industry and other related fields. Moreover, 3MF's Singapore's production facility is ISO 9001 certified.

Another noteworthy aspect is that 3MF has done a lot of work on standards and is on the AM working groups of several standard-setting bodies such as American Petroleum Institute, ISO and ASTM. Also, 3MF's CEO is the Chairman of the AM Technical Committee, Singapore. Thus, the company is not only serving clients but also shaping the industry in a way.

Strong R&D position

3MF has been investing strongly in building its R&D capability and this will serve as a key barrier for new entrants to the market.

Extensive range of IP

3MF's IP consists of patents, trade secrets, licenses and copyrights to print file library of over 2,000 parts (Figure 8). The IP portfolio includes hybrid part printing processes, secure file storage, advanced production processes and operating parameters for a range of materials and printers, including large format DED printers.



Figure 8: 3MF's IP portfolio

	INTELLECTUAL PROPERTY	PROTECTION METHOD
PATENTS	<ul style="list-style-type: none"> • VisioAM (hybrid print strategy) • SecureAM (Metadata, hash chain data security) • HydroAM (support structure removal) • MaterialAM (parameters for new materials) 	<ul style="list-style-type: none"> • Patent pending • Patent pending • Patent pending • Patent being developed
TRADE SECRETS	<ul style="list-style-type: none"> • Build parameters and strategy for maraging steel • Manufacturing process operations • Additive QMS processes • FacilityAM - setting up AM facility • Detailed pricing strategies and cost sheet tool • Extensive AM supplier list • >250 industry NDA in place • Multiple Approved Vendor List agreements in place • Customer contact list (>3k) • SOPs for complex AM equipment • DataAM - Print log data for >3 years production • Build parameters for PVC and Nylon (in development) 	<ul style="list-style-type: none"> • Confidentiality • Confidentiality • Confidentiality • Confidentiality • Confidentiality • Confidentiality • Confidentiality • Confidentiality • Confidentiality • Confidentiality • Confidentiality
LICENSES	<ul style="list-style-type: none"> • Directed Energy Deposition H-WAAM printer • Directed Energy Deposition Blown powder printer 	<ul style="list-style-type: none"> • Exclusive license • License
COPYRIGHT	<ul style="list-style-type: none"> • StoreAM - Print file library of >2,000 parts 	<ul style="list-style-type: none"> • Confidential copyright

Source: Company

Track record of R&D spend

The company has spent over A\$3m (directly or in conjunction with research/business partners) on R&D programmes for AM over the past five years, with its direct spend being ~A\$1.5m. The management aims to continue investing in R&D to improve the efficiency of its equipment and processes.

Impressive partnerships and collaborations

The company has demonstrated a strong potential to stitch collaborations and partnerships with leading players, some of which are outlined below:

- SIMTech for the development of Laser Aided Additive Manufacturing (LAAM), which can print parts up to a size of 1.5 meters at the rate of 750 gm/hour.
- National Additive Manufacturing Innovation Cluster (NAMIC) and Singapore University of Technology and Design (SUTD) for the development of H-WAAM technology (machining and robotic technology) which has improved cost and time effectiveness of 3MF's operations.
- Ultimaker, to launch South-East Asia's largest printing facility, in Singapore.
- University of New South Wales as part of its education and training requirements.



Futuristic approach towards educating customers

3MF recently signed a Memorandum of Understanding (MoU) with the University of New South Wales, Sydney, with the intent of expanding R&D in AM, while at the same time expanding the knowledge base of everyone interested, in the field of AM. The point to take home here is that the MoU talks about including the idea of machine learning in AM. This in itself is very futuristic. It also talks about the vocational training of people wanting to enrol in this field and the up-skilling of employees and clients. This should help spread greater awareness of the numerous benefits of AM, especially in the Australian market, and help build a client base for 3MF in this region.

3MF's global footprint

The company launched its first metal AM centre in Singapore in 2017, which houses a complete suite of metal 3D printing technology and services, including post-production and finishing. 3MF has since then expanded its presence into the US and Australia (Figure 9).

The company set up its US office in Houston, Texas, to cater largely to the oil and gas sector. The rationale behind this move was that oil and gas companies have manufacturing plants in Singapore but many of their headquarters and engineering operations are located in the US. A US office allows 3MF to be fully involved in value-added engineering decisions of its clients.

The latest addition to the company's footprint is Australia, which is expected to help grow its client base in the mining sector. In December 2021, 3MF signed a channel partner agreement with non-ferrous foundry, Inter cast Australia, under which Inter cast will promote 3MF's products and services to its Australian customers such as BGC, Mineral Resources, Water Corporation, Bradken and RCR Mining Technologies.

3MF is now evaluating opportunities to open offices in the Middle East and Europe for future growth.

The presence of a global footprint is of strategic importance in securing business from global manufacturers and in bringing production closer to demand, which is an important benefit of AM.

3MF currently has presence across three continents

Figure 9: 3MF's global focus

Country	Sector	Why we are there?	Current focus
Singapore	<ul style="list-style-type: none"> Maritime Port services Oil & gas 	Maritime, port services and oil & gas manufacturing and applications	✓
Houston	<ul style="list-style-type: none"> Oil & Gas Space Defence 	Oil & Gas, space and defence engineering and manufacturing	✓
Australia	<ul style="list-style-type: none"> Resources 	Mining and energy applications	✓

Source: Company



Well-defined growth priorities

3MF's management has a clear growth strategy in place to help the company become a more cost competitive entity to handle mid-size production in the medium term. This growth strategy is based on the following key pillars:

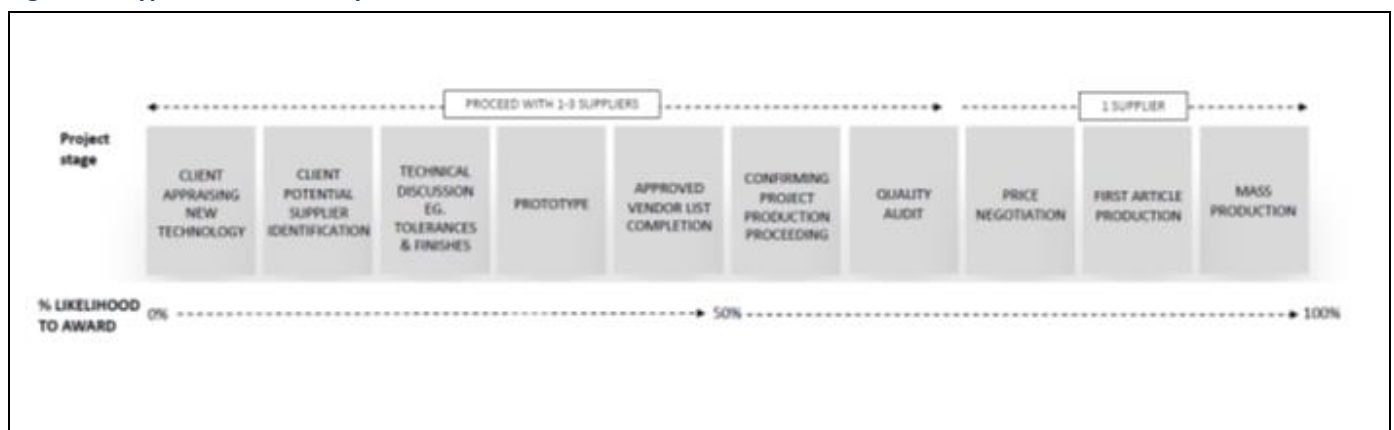
- 1) **Footprint expansion.** The management aims to have at least one facility in all of the key end market sectors. It currently has a sales and engineering office in Australia for mining, and Houston and Singapore manufacturing for oil and gas. In future, 3MF is looking to open offices in Rotterdam for marine and in the Middle East (possibly in Dubai) for oil and gas. The company stands committed to operate in a number of countries to provide AM at point of use as well as drive engineering transformation through its locations at headquarters. We believe footprint expansion will be essential to cater to global companies with manufacturing facilities in multiple locations as well as to create stickiness with such customers.

In addition, the management will be focussing on channel partnerships to accelerate its revenue growth, particularly in new regions. For instance, 3MF has recently signed an 18-month channel partner agreement with Intercast Australia that will allow it to promote its offerings to Intercast's mining customers.

- 2) **Transitioning from early to late stages of deal lifecycle.** Typically, the sales pipeline in this industry is for 18-24 months wherein the initial stages involve testing, proving and qualifying the parts with customers. The early stages have low probability of contract wins and deal values (
- 3) Figure 10). However, once a customer moves ahead in the cycle, the later stages entail a higher deal value and margin profile. We think that 3MF has crossed the early stages for many of its customer deals and it will now be in a position to manufacture parts more cost competitively, thereby earning higher margins, than when it was at the beginning of the pipeline with many of its clients.

3MF aims to have locations at point of use as well as at headquarters to drive engineering decisions

Figure 10: Typical AM deal lifecycle



Source: Company

- 4) **Continuous emphasis on R&D.** The management intends to continue focussing on R&D for its equipment aimed at increasing automation, reducing standby time and reducing the labour component of supervising machines. This will help the company preserve its margins as it scales up its production levels.

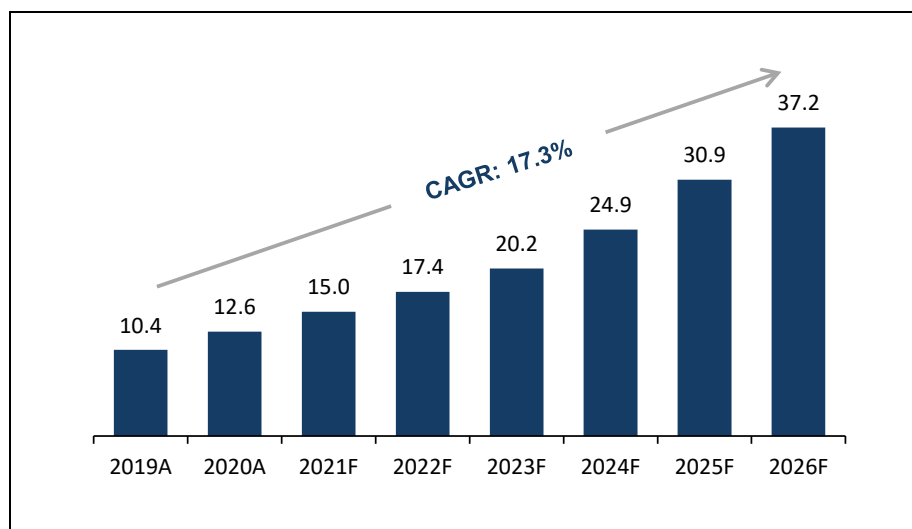


AM market to expand rapidly backed by favourable trends

AM is the industrial production name for 3D printing, while the latter can be considered more as the act of printing. AM is thus a broader term which better reflects the professional manufacturing process that differs from conventional, subtractive manufacturing methods. The best-known forms of AM today depend on the material: SLS, SLA (stereolithography) and FDM in plastics; and DMLS and Laser Metal Deposition (LMD) in metals.

The global 3D printing market was valued at ~US\$10.4bn in 2019¹ and this market is expected to grow at a staggering CAGR of 17.3% by 2026 to reach ~US\$37.2bn (Figure 11). Thus, the market will more than double itself by 2026 as compared with the 2021 level. Despite this growth, the AM market will represent less than 0.3% of the global manufacturing industry, signalling phenomenal upside potential.

Figure 11: Global 3D printing market size (US\$bn)



Source: Hubs

Companies will likely produce or source more 3D printed parts in 2021 vs. 2020

Further, analysis by McKinsey & Co indicates that AM could create up to US\$250bn in value for companies by 2025. Most of that potential will come from the aerospace and defence, automotive, consumer goods and medical industries. The rising demand for customised functional/end-use parts and the high lag time associated with conventional designing and tooling technologies are the key drivers of the AM market. The lack of 3D-printing-grade materials has been a bottleneck in the past, but recent innovations will help solve this problem. The number of material suppliers have doubled during 2017–2019, bringing in new grades of metallic and polymer powders. At the same time, the number of materials that AM can handle has also expanded. A wide range of new plastics has been developed, along with processes and machines for printing with ceramics, glass, paper, wood, cement, graphene and even living cells.

In 2020, AM gained more mainstream exposure due to the impact it made by aiding rapid production of PPE during the beginning of the COVID-19

¹ See 'Additive manufacturing trend report 2021' by Hubs.



pandemic. Several businesses turned to local solutions, which included 3D printing for both prototyping and end-use parts, as global supply chain disruptions made it more difficult to source parts from overseas locations. According to a survey conducted by Hubs, among 1,504 global engineering businesses, 84% of the participants used 3D printing to produce more (54%) or the same number (30%) of functional end-use parts in 2020 compared with 2019. On similar lines, 73% of the participants predicted that they would produce or source more 3D printed parts in 2021 vs. 2020.

We expect the following tailwinds to fuel the AM market growth:

Growing demand of customised products. 3D printing can be used to produce customised products in a more cost-effective manner than the traditional manufacturing processes. Contrary to the layout adjustment costs in conventional manufacturing methods, costs of adjusting the production processes and layouts are very low in case of 3D printing. Some of the key customised products can be found in footwear, eyewear and jewellery market segments. These are attractive markets for companies offering 3D printing services.

Increasing applications in critical industrial parts. 3D printing is experiencing a boom as manufacturers have moved from AM prototypes to AM end-use parts and within the end-use parts, the focus has shifted from non-critical to critical parts. 3D printers today are capable of printing a variety of materials, including metals. Polymers are more suitable for prototypes and certain types of end components, but the trillion-dollar metal parts fabrication market provides a much larger opportunity for 3D printers.

The production of functional parts using 3D printing has skyrocketed in the last 5 years. According to a survey by EY², ~33% of the 900 companies surveyed apply 3D printing to produce at least one functional part, while 18% use the 3D printing technology to make end components; this indicates that 3D printing encompasses far more than just manufacturing of spare parts. For instance, Airbus as a part of its A350 XWB programme has been installing 3D-printed titanium alloy brackets since 2017³, along with latch shafts for the doors. For Airbus, 3D printing delivers improved lightweight structures at a lower cost than traditional manufacturing.

In November 2021, MX3D, a Netherlands based AM company⁴, completed the production of an industrial pipeline clamp using its Wire Arc Additive Manufacturing (WAAM) technology. The pipeline clamps are used in the chemicals, and oil and gas sectors to enhance the safety of employees, while extending the life of the installation and reducing instances of breakdown.

Reshoring and nearshoring, a stimulus for 3D printing. The pandemic-induced disruptions in supply chains have strengthened the call to bring back production to home countries (reshoring) or moving it to countries that are near manufacturing locations (nearshoring). The pandemic revealed weak spots in current supply chains that have led many manufacturers to reassess their sourcing strategy. In developed countries, 3D printing is emerging as an important alternative for boosting reshoring initiatives due to the lower labour requirements and less material wastage that leads to a more cost effective and sustainable production process. During the pandemic and its subsequent lockdown restrictions, many manufacturers faced stock-outs of spare parts; in order to avoid service disruptions, they reached out to local 3D

Manufacturers are increasingly using 3D printing for functional end-use parts

The low labour requirement for 3D printing makes it a strong contender to facilitate reshoring in developed economies

² See '3D printing: hype or game changer?' by EY.

³ See Airbus' market release dated 13 September 2017 and headlined 'First titanium 3D-printed part installed into serial production aircraft'.

⁴ See MX3D's market release dated 3 November 2021 and headlined 'MX3D manufactures critical industrial pipeline clamp using hybrid process'.



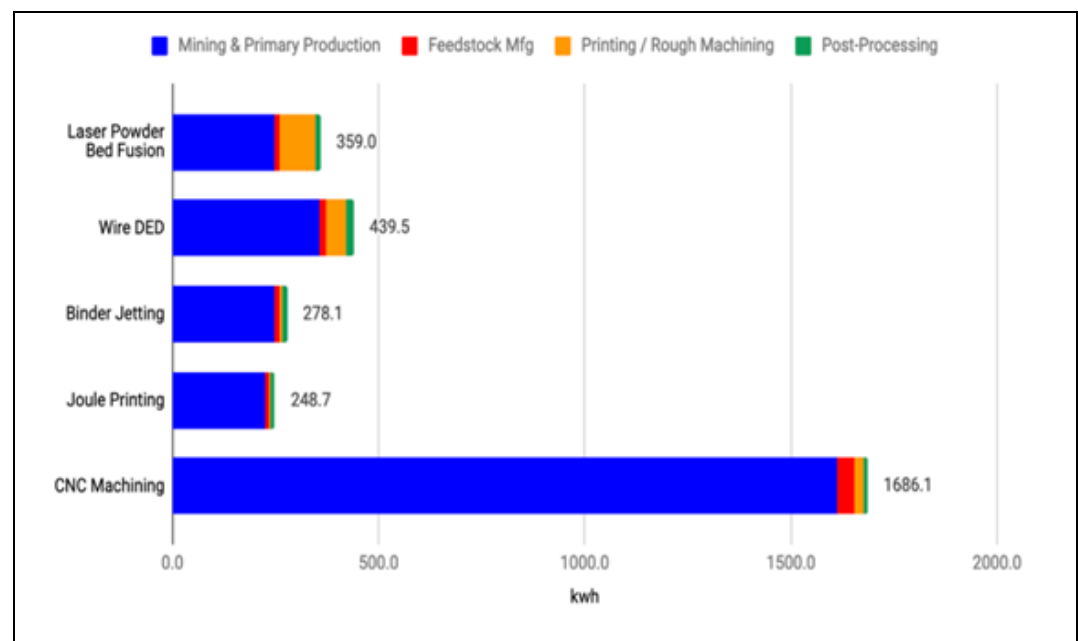
AM poses several potential benefits for sustainability depending on production-run size, technique, end-use application and geometry of parts produced

printing service providers for securing supplies. Going forward, such companies are not only going to view 3D printing as another source of parts, but a crucial part of their supply chain risk-reduction strategy.

Sustainability push for 3D printing. AM technology constructs an object by sequentially forming the cross-section of the final part and bonding thin layers of material. 3D printers, depending on the process, melt, fuse, bind or sinter the exact quantity of material required for the part, but the traditional manufacturing processes – such as machining are subtractive – where the material is cut away from a solid block to create the final part. In many cases, only a small percentage of the original material goes into the final part, with the cut-away material waste often reaching more than 50%. This waste can be reduced by switching to AM technologies.

AM, particularly with metals, is an energy-intensive process. However, some studies show that it can be more energy-efficient than most conventional manufacturing processes. A study conducted by Digital Alloys⁵, a metal 3D printer manufacturer, compared the energy consumption of different AM technologies with CNC machining⁶ (Figure 12). Energy consumption at the printing stage is high for some metal AM technologies, particularly laser PBF. However, when considering material waste and recycling, machining is the most energy-intensive process.

Figure 12: Manufacturing energy consumption for 1 kg of titanium aerospace part (kwh)



Source: Digital Alloys

Growth of industry standards. A set of widely accepted comprehensive quality standards will enable large-scale adoption of the AM technology. Quality standards are imperative for the growth of the AM market, as they will encourage the companies (with limited in-house R&D expertise and knowledge on AM) to source 3D printed parts from external suppliers.

⁵ See 'How Sustainable is Industrial 3D Printing?' by AMFG, 10 March 2020.

⁶ CNC machining is an advanced version of the traditional machining process where the movement of the tools and machinery is directed by a pre-programmed software.



A host of standards regarding storage, handling, transportation and characterisation of materials used in AM – from metals and ceramics to polymers – have been put forth by some standards development organisations, such as the National Institute of Standards and Technology (NIST), National Fire Protection Association (NFPA) and ASTM International. Further, in October 2021, American Petroleum Institute released the first edition of its Standard 20S, 'Additively Manufactured Metallic Components for Use in the Petroleum and Natural Gas Industries'. These new standards will allow more companies to source 3D printed parts as they now have a well-defined set of technical parameters to evaluate product quality.

We believe there are strong structural tailwinds to support the long-term growth potential of the AM industry and this industry has increased in strategic importance for the overall manufacturing sector as it deals with new challenges resulting from COVID-19.

DED technology to shape the future of AM

The industry is witnessing an upward global trend towards the utilisation of DED technology. DED is a metal AM technology in which molten metal is selectively deposited in layers to build dense components. WAAM, LMD, LENS (Laser Engineered Net Shape) and DMD are some of the proprietary names that equipment manufacturers use to differentiate their DED offering.

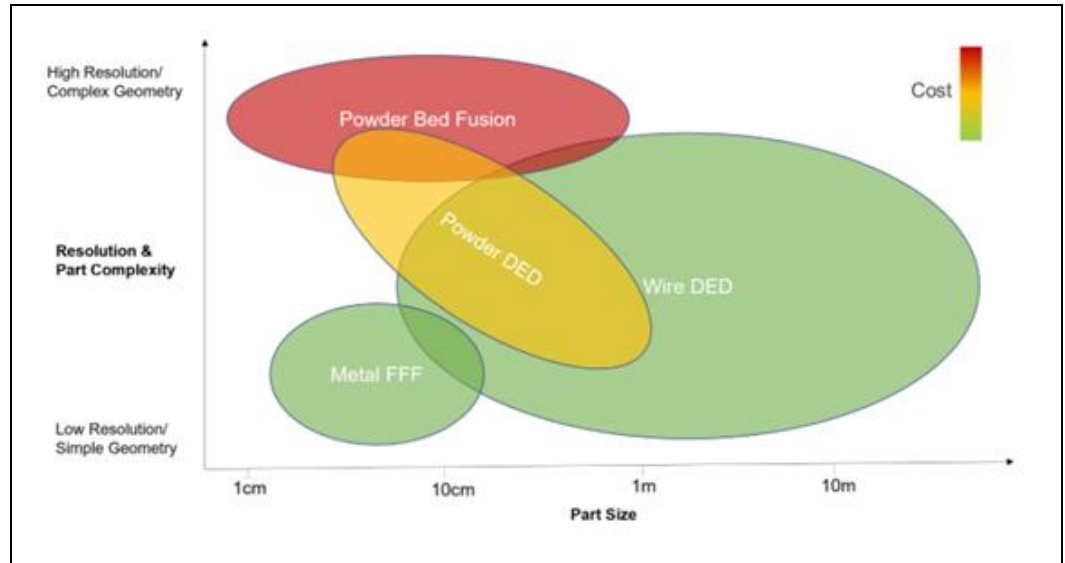
Compared to other metal AM techniques, DED boasts higher deposition rates, which enable large-scale production of components (often 1 metre in size). The trade-off to this level of output is the resolution and complexity of manufactured parts. However, with the development of new DED hardware⁷ (Figure 13), resolution levels similar to that of PBF can be achieved with the costs being as low as metal fused filament fabrication (FFF) process costs.

DED is one of the most extensively used metal AM technology driven by its capability to produce large metal components and faster deposition rate (11 kg metal/hour) as compared with the PBF technology. The technology is increasingly being used to repair parts as the process allows the users to control the grain structure of the parts.

⁷ See 'WHAT IS DED AND WHY SHOULD YOU BE USING IT?' by Robert Bowerman, 3D Printing Industry, 27 October 2021.



Figure 13: Comparison of metal AM technologies



Source: 3D Printing Industry by Robert Bowerman

3MF has strong capability and technological know-how in the field of DED manufacturing. We expect this to aid the company in winning new clients and additional business. Moreover, the industry tailwinds and huge size of the addressable market should provide further upsides to the company's growth prospects.



Strong leadership team

The board and management team (Figure 14) of 3MF has significant experience in the engineering sector and is well placed to guide the company through its growth phase.

Figure 14: 3MF's leadership team

Board of Directors		
	Name and Designation	Profile
	Matthew Waterhouse Chairman and CEO	<ul style="list-style-type: none">Matthew has over 20 years of experience in senior management positions across several multinational companies, including stints with McKinsey & Co as Associate Principal and with Keppel Integrated Engineering as Chief Operating Officer.He is also the Chairman of the AM Technical Committee, Singapore.He has an LLB (Honours) Degree from the University of Liverpool, UK.
	Geoffrey Piggott Non-Executive Director	<ul style="list-style-type: none">Geoffrey has over 50 years of experience in infrastructure engineering. He has been associated with several companies – such as Sydney Water, Black & Veatch, Keppel Infra and Deep Tunnel Sewerage System.He has extensive technical and commercial knowledge of urban and rural infrastructure planning design and construction advice.He is a Chartered Professional Engineer and a member of the Australian Institute of Company Directors.
	Samantha Tough Non-Executive Director	<ul style="list-style-type: none">She has had a distinguished career across energy, resources and engineering industries as both a director and senior executive.She holds a Bachelor's Degree in Law and is a member of the Fellow Australian Institute of Company Directors.



	<p>David Buckley Independent Non-Executive Director</p>	<ul style="list-style-type: none"> – David was working as an advisor for 3MF before being appointed as a board member. – He is the Chairman of Royal Bank of Canada (Europe) and was formerly the Chief Financial Officer for Morgan Stanley (Europe) and International Treasurer for Goldman Sachs.
--	--	--

Management Team		
	<p>Harry Heng Chief Financial Officer</p>	<ul style="list-style-type: none"> – Harry has over 27 years of experience across strategic, management, technical, financial and commercial roles. – Prior to 3MF, he held senior management and finance positions in Mercatus Capital Pte Ltd (technology and business accelerator) and various other emerging enterprises.
	<p>Deborah Ho Company Secretary</p>	<ul style="list-style-type: none"> – Deborah has over seven years of company secretarial experience. Before joining 3MF, she was associated with Deloitte. – She is an Associate Member of the Governance Institute of Australia.

Source: Company



Comparable companies

We have looked at companies in the AM space that are listed on ASX and have market capitalisation below US\$500m (Figure 15). We can observe that there are not many comparable companies that are full-service providers as 3MF and the company is relatively undervalued considering its range of services and market standing.

Figure 15: ASX-listed peers

Company	Code	Location	Pure-Play AM	Into AM Services	Website
Amaero International Ltd	ASX:3DA	Notting Hill, Victoria	✓	✓	www.amaero.com.au
AML3D Ltd	ASX:AL3	Edinburgh, South Australia	✓	X	www.aml3d.com
Aurora Labs	ASX:A3D	Canning Vale, Western Australia	✓	X	www.auroralabs3d.com
Titomic Ltd	ASX:TTT	Notting Hill, Victoria	✓	X	www.titomic.com
333D Ltd	ASX:T3D	Sydney, New South Wales	✓	X	www.333d.com.au
3D Metalforge	ASX:3MF	West Perth, Western Australia	✓	✓	www.3dmetalforge.com

Source: S&P Capital IQ, Pitt Street Research

Amaero International Ltd engages in the research, development, manufacture, and sale of laser-based metal additive products in Australia. It also provides research and development, contract manufacturing, tooling specialists, equipment sales and consumables, training and maintenance services and patented metal alloys. The company serves the aerospace, defence and space sectors as well as the tool and die industries.

AML3D Ltd provides contract manufacturing services to the aerospace, defence, marine, oil and gas, mining and general manufacturing sectors in Australia, Singapore, Japan and Europe. It produces metal components and structures through automated wire-fed 3D printing technology. It designs and constructs ARCEMY 3D printing modules and 3D parts using wire AM technology.

Aurora Labs is focussing on developing industrial-grade 3D printers for oil and gas, mining and industrial sectors. The company is developing a suite of PBF 3D printing technologies with a focus on high-power lasers. It is targeting to reach the go-to-market stage for its technology by October 2022.

Titomic Ltd focuses on the development and commercialisation of the Titomic Kinetic Fusion (TKF) process, an AM technology that is used for the application of cold-gas dynamic spraying of titanium or titanium alloy particles onto a scaffold to produce a load-bearing structure. The company serves aerospace, defence, mining, energy, marine, oil and gas, and transport industries.

333D Ltd makes 3D printed licensed merchandise for sports and entertainment organisations in Australia and around the world. The company was incorporated in 2006.

Besides the listed entities, there are a number of emerging private companies in the global AM space. We have highlighted a few of them in Figure 16 that have witnessed a high interest level from financial and strategic investors or undertaken major private placement in the past two years.



Figure 16: Emerging unlisted players

Company	Location	Investors	Transaction Value (US\$m)	Website
Additive Industries BV	Eindhoven, Netherlands	Highlands Beheer BV	14.0	www.additiveindustries.com
Additive Manufacturing Technologies Ltd	Sheffield, UK	Foresight Group; Mercia Fund Management; Saint-Gobain SA; DSM Venturing BV; 15th Rock Ventures LLP	15.0	www.amtechnologies.co.uk
Azul 3D Inc	Illinois, US	Undisclosed	12.5	www.azul3d.com
Conflux Technology	Waurin Ponds, Australia	Acorn Capital Limited; AM Ventures Management GmbH	-	www.confluxtechnology.com
Continuous Composites Inc	Idaho, US	B. Riley Venture Capital	17.0	www.continuouscomposites.com
Foundry Lab Ltd	Wellington, New Zealand	Founders Fund; Blackbird Ventures; K1W1; Promus Venture Management; WNTVentures; GD1 Management (Fund II) Ltd; Icehouse Ventures	8.0	www.foundry-lab.com
Wematter AB	Linköping, Sweden	Undisclosed	4.5	www.wematter3d.com

Source: S&P Capital IQ, Pitt Street Research

Additive Industries BV designs and manufactures industrial metal AM systems. The company was founded in 2012.

Additive Manufacturing Technologies Ltd develops and manufactures automated post-processing systems for 3D printed parts. The product of the company is a post-processing machine, PostPro3D, which finishes 3D printed components into a sealed and smoothed part suitable for end use applications. The company was incorporated in 2015.

Azul 3D Inc offers high-area rapid printing (HARP), which uses a new version of stereolithography, a type of 3D printing that converts liquid plastic into solid objects. The company was founded in 2016.

Conflux Technology Pty Ltd develops, manufactures, and sells heat exchangers. It offers heat exchangers for use in applications, including pre-coolers, charge air coolers, oil-water coolers, cold plate micro-electronics coolers, auxiliary coolers, inverter/motor coolers, and air dryers for industrial equipment. The company also provides design and engineering, metal additive manufacturing, testing and validation, and research and development services. It serves motorsports and automotive, oil and gas, aerospace, defence, and microelectronics industries. The company was incorporated in 2014.

Continuous Composites Inc manufactures and supplies fibre 3D printing equipment. It serves aerospace, automotive, defence and construction industries. The company was founded in 2015.

Foundry Lab Ltd develops and manufactures AM equipment for metal component production. The company was incorporated in 2018.

Wematter AB provides 3D printing for plastic composites. The Wematter offering consists of both hardware and software products for a complete SLS 3D printing platform. The company was founded in 2016.



Valuing 3MF

Our tentative valuation range for 3MF is A\$30-33m.

When estimating a valuation range for 3MF's existing revenue-generating business, we have employed a comparable valuation approach. This is because 3MF operates on a volatile sales cycle, which makes it difficult to forecast sales and cash flows, in our view. Further, we expect to see a degree of dispersion in project values, which adds to the difficulty and complexity in deriving forecasts on expected revenues. Therefore, we do not believe DCF is the appropriate valuation tool in this case.

We have assembled a set of ASX-listed AM peers, which we believe serves as a comparable comp set for 3MF (Figure 17).

Figure 17: Financial and valuation position of peers

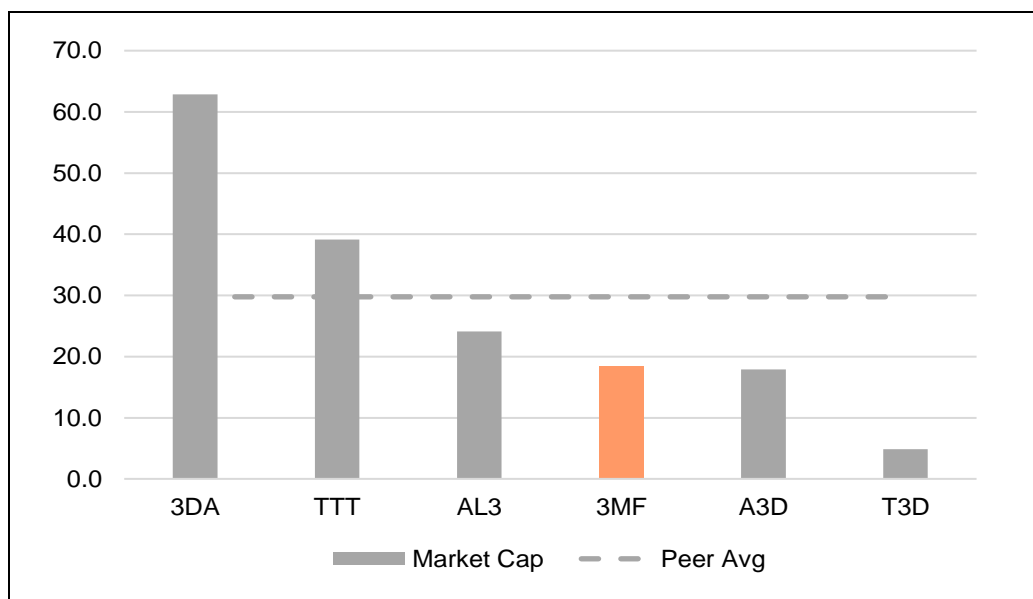
Company	Ticker	MC (AUDm)	Sales FY21	FY21	EV/Sales FY22	FY23	Sales growth (FY21-23 CAGR)
Domestic 3D printing peers							
AML3D	ASX:AL3	24.1	0.6	27.0x	4.7x	2.3x	245.8%
Titomic	ASX:TTT	39.1	2.0	15.7x	3.7x	1.7x	233.7%
Aurora Labs	ASX:A3D	17.9	0.2	na	na	na	na
Amaero International	ASX:3DA	62.9	0.5	107.3x	3.6x	0.9x	963.5%
333D	ASX:T3D	4.9	0.1	44.2x	na	na	na
Peer average				48.5x	4.0x	1.6x	481.0%
3D Metalforge	ASX:3MF	18.4	0.9	17.3x			

Source: S&P Capital IQ, Pitt Street Research

Based on their market capitalisations, we can see that 3MF is currently trading below its peer average of A\$29.8m (Figure 18), implying that investors perceive higher growth potential and/or lower risk for the comparable firms vs 3MF. While we acknowledge that the product/service/technology offered by each of these peers differ, we also note that 3MF operates in the same broader AM market as its peers and therefore should benefit from the same strong overall market growth. As such, we tentatively ascribe a base case valuation of A\$29.8m for 3MF, mirroring its peer average, whilst our bull case valuation is set at A\$32.8m reflecting a 10% premium which we believe could be justified through 3MF's competitive advantages, as outlined earlier in the report. Based on a share base of 190.1m, our valuation range equates to A\$0.16-0.17 per share.



Figure 18: 3MF market cap. vs. peers



Source: S&P Capital IQ, Pitt Street Research

Catalysts and risks

We think the following developments can help 3MF's stock price move towards our fair valuation range:

- Continuation of the growth trend in consolidated income in FY 2021. 3MF has been successfully growing its revenue base during FY 2017–2020. If this trend is sustained for another 1-2 years, it will be a testament to the company's potential and attract investor attention.
- Signing of new blue-chip customers across its key end markets.
- Successful inroads in new geographies (for instance, US and Australia) and sectors (for instance, the mining sector).

We see the following key risks associated with our investment thesis:

- The company's revenue generation is currently not recurring in nature and instead dependent on key projects.
- Risk of unauthorised use or copying of 3MF's products, software, data, specialised technology, or manufacturing processes.
- Any material changes in standards or regulations relating to the company's manufacturing and quality check process can entail high cost and timelines.
- 3MF has exposure to the oil and gas sector. If there is a prolonged contraction in oil prices resulting from efforts to contain the spread of COVID-19, expenditure by major players could reduce and possibly lower demand for the company's services.



Appendix I – Major Shareholders

As of 2 December 2021, the company has three key shareholders:

- Matthew James Waterhouse (CEO and Chairman) – 26.1%
- Khoo Hwhi Min – 14.1%
- David Michael Spence – 4.6%

Appendix II – Analysts' Qualifications

Stuart Roberts, lead analyst on this report, has been an equities analyst since 2002.

- Stuart obtained a Master of Applied Finance and Investment from the Securities Institute of Australia in 2002. Previously, from the Securities Institute of Australia, he obtained a Certificate of Financial Markets (1994) and a Graduate Diploma in Finance and Investment (1999).
- Stuart joined Southern Cross Equities as an equities analyst in April 2001. From February 2002 to July 2013, his research speciality at Southern Cross Equities and its acquirer, Bell Potter Securities, was Healthcare and Biotechnology. During this time, he covered a variety of established healthcare companies, such as CSL, Cochlear and Resmed, as well as numerous emerging companies. Stuart was a Healthcare and Biotechnology analyst at Baillieu Holst from October 2013 to January 2015.
- After 15 months over 2015–2016 doing Investor Relations for two ASX-listed cancer drug developers, Stuart founded NDF Research in May 2016 to provide issuer-sponsored equity research on ASX-listed Life Sciences companies.
- In July 2016, with Marc Kennis, Stuart co-founded Pitt Street Research Pty Ltd, which provides issuer-sponsored research on ASX-listed companies across the entire market, including Life Sciences companies.

Cheng Ge is an equities research analyst at Pitt Street Research.

- Cheng obtained a B. Com in Finance and LL. B from University of New South Wales in 2013. He also completed all three levels of the CFA Program.
- Before joining Pitt Street Research, he worked for several financial services firms in Sydney, where his focus was on financial advice.
- He joined Pitt Street Research in January 2020.

General advice warning, Disclaimer & Disclosures

Terms & Conditions

The information contained herein ("Content") has been prepared and issued by Pitt Street Research Pty Ltd ACN 626365615 ("Pitt Street Research"), an Authorised Representative (no: 1265112) of BR Securities Australia Pty Ltd. ABN 92 168 734 530, AFSL 456663. All intellectual property relating to the Content vests with Pitt Street Research unless otherwise noted.

Disclaimer

Pitt Street Research provides this financial advice as an honest and reasonable opinion held at a point in time about an investment's risk profile and merit and the information is provided by the Pitt Street Research in good faith. The views of the adviser(s) do not necessarily reflect the views of the AFS Licensee. Pitt Street Research has no obligation to update the opinion unless Pitt Street Research is currently contracted to provide such an updated opinion. Pitt Street Research does not warrant the accuracy of any information it sources from others. All statements as to future matters are not guaranteed to be accurate and any statements as to past performance do not represent future performance.

Assessment of risk can be subjective. Portfolios of equity investments need to be well diversified and the risk appropriate for the investor. Equity investments in a listed or unlisted company yet to achieve a profit or with an equity value less than \$50 million should collectively be a small component of an individual investor's equity portfolio, with smaller individual investment sizes than otherwise. Investors are responsible for their own investment decisions, unless a contract stipulates otherwise.

Pitt Street Research does not stand behind the capital value or performance of any investment. Subject to any terms implied by law and which cannot be excluded, Pitt Street Research shall not be liable for any errors, omissions, defects or misrepresentations in the information (including by reasons of negligence, negligent misstatement or otherwise) or for any loss or damage (whether direct or indirect) suffered by persons who use or rely on the information. If any law prohibits the exclusion of such liability, Pitt Street Research limits its liability to the re-supply of the Information, provided that such limitation is permitted by law and is fair and reasonable.

General advice warning

The Content has been prepared for general information purposes only and is not (and cannot be construed or relied upon as) personal advice nor as an offer to buy/sell/subscribe to any of the financial products mentioned herein. No investment objectives, financial circumstances or needs of any individual have been taken into consideration in the preparation of the Content.

Financial products are complex, entail risk of loss, may rise and fall, and are impacted by a range of market and economic factors, and you should always obtain professional advice to ensure trading or investing in such products is suitable for your circumstances, and ensure you obtain, read and understand any applicable offer document.

Disclosures

Pitt Street Research has been commissioned to prepare the Content. From time to time, Pitt Street Research representatives or associates may hold interests, transact or hold directorships in, or perform paid services for, companies mentioned herein. Pitt Street Research and its associates, officers, directors and employees, may, from time to time hold securities in the companies referred to herein and may trade in those securities as principal, and in a manner which may be contrary to recommendations mentioned in this document.

Pitt Street Research receives fees from the company referred to in this document, for research services and other financial services or advice we may provide to that company. The analyst has received assistance from the company in preparing this document. The company has provided the analyst with communication with senior management and information on the company and industry. As part of due diligence, the analyst has independently and critically reviewed the assistance and information provided by the company to form the opinions expressed in the report. Diligent care has been taken by the analyst to maintain an honest and fair objectivity in writing this report and making the recommendation. Where Pitt Street Research has been commissioned to prepare Content and receives fees for its preparation, please note that NO part of the fee, compensation or employee remuneration paid will either directly or indirectly impact the Content provided.