



NAVY COMMAND: MARCAP

AdM

Additive Manufacturing

NEWSLETTER

Accelerating Development of AdM for Defence Through Knowledge Sharing, Collaboration and Co-innovation

SPECIAL POINTS OF INTEREST:

■ Defence Industry Collaborative Innovation.

■ Sharing the latest AdM developments in practice, process and technology

■ Creating a spiral development roadmap for AdM capability development

■ HMS DUNCAN

'Using 3D printers and AdM the ship's company continues to strive to innovate.... 'Challenge the norm, develop ideas, overcome issues, and ultimately improve the daily running of the ship.'

PO Green
HMS Duncan AdM



Welcome to the 1st AdM bulletin

This regular bulletin will share MOD and Defence Industry innovative ideas and experience under the governance of the Defence Logistics Force Development Board (DLFDB). Events are facilitated by Team Defence and are open to all industry providers. RN MARCAP leads the AdM Sub-Working Group (SWG) across the extended Defence Support Enterprise to seek out, understand and exploit disruptive and innovative technologies with military potential.

The first meeting of the SWG, hosted in Leonardo, allowed an understanding of activity across

Navy, Land and Air Commands. Industry complemented this with a technical capability overview.

Articles within this first edition include the RN's experimental approach to AdM projects globally; Dstl's scientific studies; and emerging opportunities such as Wire Arc and Cold Spray to add to 3D printing on deployed operations. This first issue also sets out some of the governance arrangements and early priorities for collaborative workstreams.

This is your AdM bulletin, so please do engage, share ideas and innovate.

Con Burns



Warship broken

Main Engine selector switch replaced with a 3D printed item at sea

Logistic Technology Investigations Project

Defence Science and Technology Laboratories (Dstl) are establishing a commercial research framework to deliver the Chief Scientific Advisors funded research programme for logistics. With an estimated value of £7m over the next three years the thematic areas for investigation

include Data Science and Artificial Intelligence, Additive Manufacture, Automation, Maintenance, Future Energy and Culture. Competition is via R-Cloud and it is anticipated that the framework will be in place by shortly.

(More details are available at: <http://etc>)
Emma Japes

NavyX and activity from the FLCs

NavyX the Royal Navy's new Autonomy and Lethality Accelerator, which will rapidly develop, test and trial cutting-edge equipment and their innovation team, DARE (Discovery, Assessment and Rapid Exploitation) has energised and accelerated the roll out of Polymer 3D printers across the Naval Service for experimentation in support of operational capability.

Sailors are designing, modifying and repairing equipment across the globe at sea, in HMS DUNCAN in the Middle East, and within Naval Bases and Air Stations.

Innovations include money and time saving efficiencies that reduce maintenance;

dedicated repair work; support to obsolescent equipment and innovative solutions to problems.

The next step is implementing a policy to support the existing printers, improving access to more units, and investing in Metal Printing experimentation for 1710 Naval Air Squadron (NAS). Lessons are being shared across the other Commands.

As part of a Capability Investigation, Army HQ are deploying 3D Printers to 5 Battalion REME, the Royal Engineers, Medical Services and to Belize.

42 Group RAF are similarly drawing on 1710 NAS expertise with the aim of supporting a common defence approach.

AdM Approved Repair Scheme

Difficult to manufacture Moulds are used to make preformed structural repair patches for helicopters. These ensure that composite repairs meet the stringent tolerances required to meet airworthiness standards.

Leonardo recently trailed and approved the use of scanning and AdM technologies to produce an ALM Mould Tool quickly at low cost.

This will allow OEM helicopter airframe repair schemes to be sent with the digital file included to enable deployed units to print their own mould tools as required.

Leonardo now plan to trial the repair instruction with the WildCat Delivery Team and Royal Navy.

Bill Dutton



The ALM mould tool was printed in Ultem 9085 with a honeycomb infill at a cost of £74.01



Final repair patch with adhesive gap of less than 0,125mm

Military Aircraft Structural Airworthiness Advisory Group

MASAAG Paper 124, Issue 1, provides guidance notes on the qualification and certification of metallic AdM parts for use in military aviation. This paper covers metallic parts for aircraft structures (Grade A parts) and engines (Critical parts).

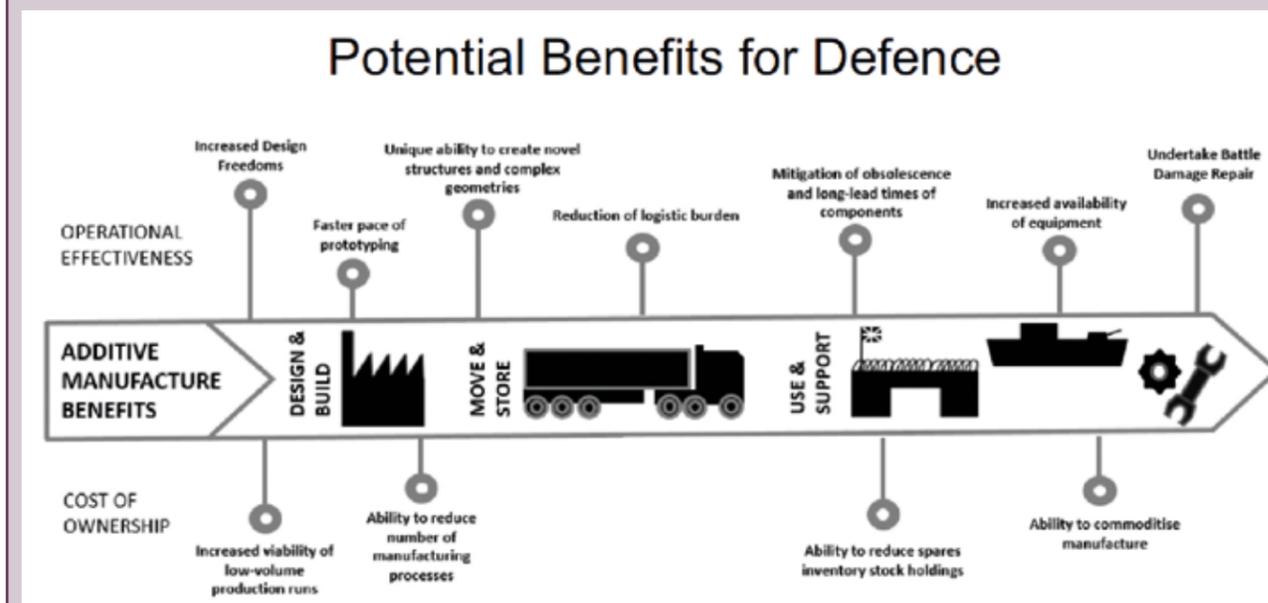
Non-metallic parts and aircraft systems have not been specifically addressed. Within the paper, the existing military and civil regulatory material, relevant to AdM parts, has been reviewed (Chapters 3 and 4). In addition, a significant proportion of the paper

(Chapter 5) has been devoted to describing the various methodologies used for AdM part design and build. Where appropriate, existing standards for AdM or other relevant manufacturing or test methods have been identified and are referenced. (Link?)



Defence Logistic AdM Concept Note

Defence Logistics Concept and Force Development have produced a paper describing AdM for Defence out to 2030+. This paper describes how AdM might be utilised and it hypothesises what the potential benefits might be. Evidence supporting or disproving the hypothesis is captured in the Defence ILIAD programme. The evidence is taken forward through the Defence Logistic Proposition to inform funding lines to realise MoD's strategic direction. Comments and observations on the note are encouraged as are ideas concerning potential experimentation and proof of concept that Defence might undertake.



A COPY OF THE CONCEPT NOTE IS AVAILABLE HERE: [HTTPS://SECURE.TEAMDEFENCE.INFO/FILEREQUEST.PHP?ID=1006821](https://secure.teamdefence.info/filerequest.php?id=1006821).

WHY SHIP ATOMS WHEN YOU CAN TRANSMIT BITS?

Pete Basilliere, Research VP at Gartner

AdM Decision Tree

Last year, as part of a short study group, Leonardo Graduate Engineer Travis Chamberlain developed a Decision Tree to assess the suitability of parts for AM.



Having reviewed different approaches Travis applied his methodology on a helicopter bill of material. The tree identifies a number of potential blockers to AdM including safety, IPR, material and manufacturing cost.

What are you doing in your organization to overcome these blockers? WE WOULD LOVE TO HEAR FROM YOU.

Wire Arc Additive Manufacturing (WAAM)

WAAM utilises a robotically controlled arc welder and specialised feeder wire to build up components and structures that can be post process machined to drawing dimensions. It has been developed by, among others, Cranfield University and is being investigated for use in aerospace by companies such as Airbus and BAE Systems. The Publicly Available Specification (PAS) is currently out for public consultation and is due to be published at the end of July. <https://www.mta.org.uk/resources/pas-6010-6011-6012-invitation-participate-additive-manufacturing>

Ex Joint Warrior 2019 (Sustainable Warrior)

Exercise Joint Warrior in the North Atlantic and Irish Sea designed and led by the UK Joint Tactical Exercise Planning Staff (JTEPS) allowed an opportunity for a range of AdM trials to be conducted in the North Atlantic and Scottish coastal;

A theme of the Exercise was sustainability and this allowed a range of support trials including AdM to be conducted to test logistic interoperability and inform future doctrine. In support DE&S Tech Office developed and deployed an AdM facility.

The trials assessed:

- AMF Design
- Set-up times
- Transportation Resilience
- Environmental Resilience
- Communication of Fleet Demands
- Category and variety of Fleet Demands
- Assessment of increased Capability



Defence AdM Development Roadmap

At the next AdM Sub-WG there will be syndicate workshops to identify and progress activities to drive AdM for Defence forward. These should exploit and align with other government and industry initiatives. Current agenda items include:

- Policy (strategic direction to achieve long-term goals).
- Process (to deliver transformative effect).
- Application (to achieve operational benefits).

WHAT ELSE SHOULD WE INCLUDE? GET IN TOUCH AND LET US KNOW.

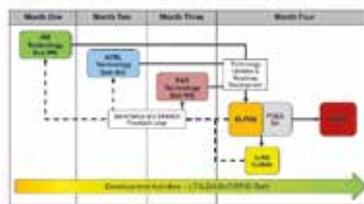
Get Involved

The Defence Logistics Enterprise LOGNET Technology Concept SWGs are a standing, joint MOD-Industry subordinate forum of the DLFD. Their purpose is to support the accelerated development and exploitation of promising technology areas with a view to assisting in the delivery of some of the high-level benefits of the DLV as articulated in the Future Support Force 2035 (FSF 35) Concept. All seek to deliver support in a different way, ultimately to reduce the demand for support, reduce the support footprint and reduce the cost relative to output. Each Sub-WG is guided by the high level CFD-generated Technology Concept Note, aiming to arrive at viable, achievable

and affordable propositions that can be operationalised within the next 15-20 years. The collaborative nature of the SWG will allow Defence and Industry to collectively focus its efforts on proving or disproving the hypotheses and assumptions posed within the concept notes to guide associated Research, Analysis and Experimentation activity across the Defence Support Enterprise (DSE) and the related R&D efforts of industry.

John Vance

AM Sub-Working Group Battle Rhythm



Why attend the AM Sub-WGs?

If you are leading the development of AdM in your organization and want to get involved please email a short statement about your roles and responsibilities along with your contact details and we will add you to our contact list for future events.

How can you promote and share your AdM capability developments:

- Provide a short 125 word article for our newsletter.
- Deliver a 10 minutes presentation at a future workshop.
- Share material from other symposia or raise awareness of developments in other sectors.

14.3M ATI Funded DRAMA Programme

AdM technology can assist the aerospace sector to produce lightweight parts, which will lead to a reduction in emissions and fuel consumption. The AdM process will also maximise the buy-to-fly ratio, with significantly less waste than using traditional subtractive methods. DRAMA (Digital Reconfigurable Additive Manufacturing facilities for Aerospace) is a three year, £14.3m collaborative research project and part of the UK's Aerospace Technology Institute's (ATIs) programme. Through our Sub WG membership lessons will be shared across these related initiatives.

Want to co-innovate?

Submit your ideas for future collaboration and co-innovation between MOD and Industry stakeholders.

Future MOD & Team Defence Information Events:

■ 8 OCTOBER 10
[Support Chain Seminar.](#)

■ 17 OCTOBER 19
[Robotics & Autonomous Systems Sub-WG.](#)

■ 12 NOVEMBER 19
[AdM Sub-WG](#)

■ TBC JAN 20
[AI Sub-WG.](#)

■ 25-27 FEB 20
[AM for Aerospace and Space Birmingham](#)



WANT TO KNOW MORE?

■ CDR CON BURNS
Chair Sub WG

■ MAJ JOHN VANCE
REME
Defence Logistics Advocate

■ REBECCA MANGHAM
DSTL AdM Lead

■ BILL DUTTON
Industry Technical Lead

■ STEVE GREEN
Industry Facilitator

■ INDUSTRY ENGAGEMENT LEAD
Concepts & Force Development
Defence Logistics Strategy
Larch 3b, Mail Point #2309
Abbey Wood, Bristol, BS34 8JH

■ PHONE: +44 (0) 7950 400211

■ EMAIL:
steve.green@teamdefence.info

