UK National Strategy for Additive Manufacturing

Development of UK strategy

Phill Dickens
University of Nottingham
Added Scientific Limited
Additive Manufacturing Strategy Steering Group

My background

- University of Nottingham
- Research
  - Basic Research
  - Research Council projects
  - PhD students

  (approx. 115 staff and PhD students)

- Added Scientific Limited
- Development
  - Work for companies
    - Additive Manufacturing (AM)-specific design expertise and bespoke software (topology optimisation, latticing, slice files)
    - Material development solutions (for laser sintering, laser melting, ink-jetting, etc.)
    - Additive Manufacturing process enhancement and control
    - Characterisation services for final product materials
    - General AM consultancy

Overview

- UK AM Strategy
  - Background of the exercise
    - The additive manufacturing community (industrial, research,
    - government) context
    - The initial motivation for the exercise
    - Related programmes
- The Main Stages
- Current Status

The additive manufacturing community

- Where is Additive Manufacturing in the UK?
  - UK led the concept and early research
  - Sectors at very different stages
    - Aerospace – advanced thinking & research, long timescales

Image courtesy of Rolls-Royce plc

    - Defence - advanced thinking, little implementation

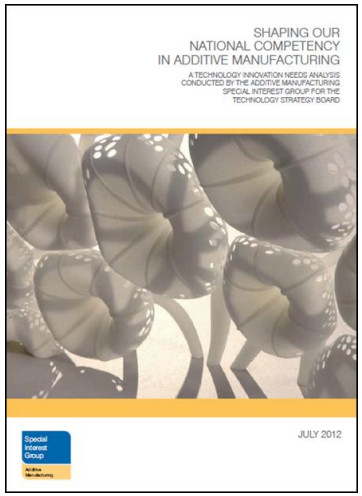
Image courtesy of risingindia.biz

    - Jewellery – advanced use

    - Medical and Dental – advanced use

The Motivation

- 2012 – TSB AM-SIG report
  - Opportunity and ‘state of play’
  - Did not present a strategy



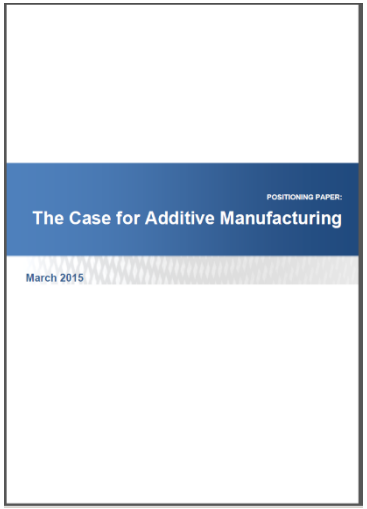
- 2013 - Foresight Report
  - “in Additive Manufacturing…… There needs to be a thorough review ….. resulting in an action plan with clear deliverables, timing and responsibilities for implementation”

The Main Stages

- 2014
  - Push concept of AM Strategy to key players:
    - BIS
    - MTC/TWI
    - EPSRC
    - Innovate UK
  - Discussed process with Composites Strategy
  - Letter from 10 ‘Captains of Industry’ to Matt Hancock (Minister of State Business, Innovation and Skills)
  - Start to develop Steering Group

The Main Stages

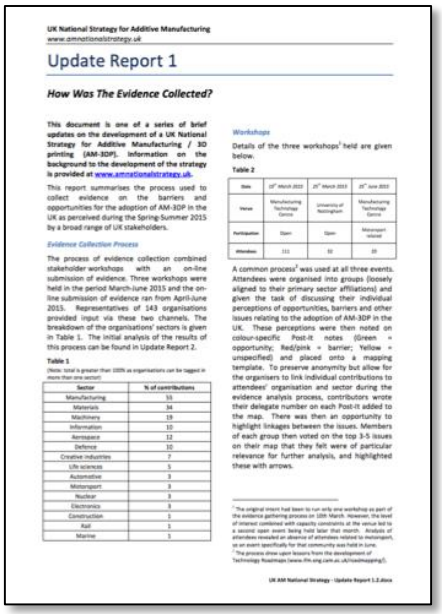
- 2015
  - Neil Mantle, Rolls-Royce plc becomes Chair of Steering Group
  - March - Positioning Paper



  - March - Meeting with Matt Hancock (Minister of State Business, Innovation and Skills)
    - Demonstrated industrial need
    - Demonstrated possible government support

The Main Stages

- 2015
  - March – Initial industry workshop
    - Initially ‘key sectors’
  - June – Produce web site
  - June – Evidence collection re opportunities and barriers



UK National Strategy for Additive Manufacturing
www.amnationalstrategy.uk

Update Report 1

How Was The Evidence Collected?

This document is one of a series of brief updates on the development of a UK National Strategy for Additive Manufacturing / 3D printing (AM-3DP). Information on the background to the development of the strategy is provided at www.amnationalstrategy.uk.

This report summarises the process used to collect evidence on the barriers and opportunities for the adoption of AM-3DP in the UK as perceived during the Spring-Summer 2015 by a broad range of UK stakeholders.

Evidence Collection Process

The process of evidence collection combined stakeholder workshops with an on-line submission of evidence. Three workshops were held in the period March-June 2015 and the on-line submission of evidence ran from April-June 2015. Representatives of 143 organisations provided input via these two channels. The breakdown of the organisations' sectors is given in Table 1. The initial analysis of the results of this process can be found in Update Report 2.

Table 1

(Note: total is greater than 100% as organisations can be tagged in more than one sector)

Sector	% of contributions
Manufacturing	15
Materials	14
Machinery	13
Information	10
Aerospace	12
Defence	10
Creative industries	7
Life sciences	5
Automotive	3
Motorsport	3
Nuclear	3
Electronics	3
Construction	1
Rail	1
Marine	1

Workshops

Details of the three workshops[1] held are given below.

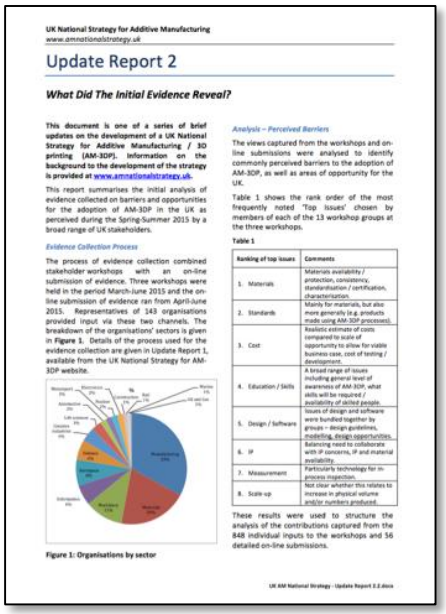
Table 2

Date	10th March 2015	25th March 2015	25th June 2015
Venue	Manufacturing Technology Centre	University of Nottingham	Manufacturing Technology Centre
Participation	Open	Open	Motorsport related
Attendees	111	32	10

A common process[2] was used at all three events. Attendees were organised into groups (loosely aligned to their primary sector affiliations) and given the task of discussing their individual perceptions of opportunities, barriers and other issues relating to the adoption of AM-3DP in the UK. These perceptions were then noted on colour-specific Post-it notes (Green = opportunity; Red/pink = barrier; Yellow = unspecified) and placed onto a mapping template. To preserve anonymity but allow for the organisers to link individual contributions to attendees' organisation and sector during the evidence analysis process, contributors wrote their delegate number on each Post-it added to the map. There was then an opportunity to highlight linkages between the issues. Members of each group then voted on the top 3-5 issues on their map that they felt were of particular relevance for further analysis, and highlighted these with arrows.

[1] The original intent had been to run only one workshop as part of the evidence gathering process on 10th March. However, the level of interest combined with capacity constraints at the venue led to a second open event being held later that month. Analysis of attendees revealed an absence of attendees related to motorsport, so an event specifically for that community was held in June.

[2] The process drew upon lessons from the development of Technology Roadmaps (www.ifm.eng.cam.ac.uk/roadmapping/).



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Update Report 2

What Did The Initial Evidence Reveal?

This document is one of a series of brief updates on the development of a UK National Strategy for Additive Manufacturing / 3D printing (AM-3DP). Information on the background to the development of the strategy is provided at www.amnationalstrategy.uk.

This report summarises the initial analysis of evidence collected on barriers and opportunities for the adoption of AM-3DP in the UK as perceived during the Spring-Summer 2015 by a broad range of UK stakeholders.

Evidence Collection Process

The process of evidence collection combined stakeholder workshops with an on-line submission of evidence. Three workshops were held in the period March-June 2015 and the on-line submission of evidence ran from April-June 2015. Representatives of 143 organisations provided input via these two channels. The breakdown of the organisations' sectors is given in **Figure 1**. Details of the process used for the evidence collection are given in Update Report 1, available from the UK National Strategy for AM-3DP website.

Figure 1: Organisations by sector

Analysis – Perceived Barriers

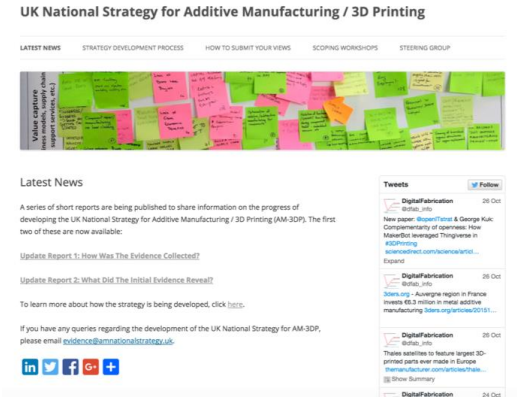
The views captured from the workshops and on-line submissions were analysed to identify commonly perceived barriers to the adoption of AM-3DP, as well as areas of opportunity for the UK.

Table 1 shows the rank order of the most frequently noted 'Top Issues' chosen by members of each of the 13 workshop groups at the three workshops.

Table 1

Ranking of top issues	Comments
1. Materials	Materials availability / protection, consistency, standardisation / certification, characterisation.
2. Standards	Mainly for materials, but also more generally (e.g. products made using AM-3DP processes).
3. Cost	Realistic estimate of costs compared to scale of opportunity to allow for viable business case, cost of testing / development.
4. Education / Skills	A broad range of issues including general level of awareness of AM-3DP, what skills will be required / availability of skilled people.
5. Design / Software	Issues of design and software were bundled together by groups – design guidelines, modelling, design opportunities.
6. IP	Balancing need to collaborate with IP concerns, IP and material availability.
7. Measurement	Particularly technology for in-process inspection.
8. Scale-up	Not clear whether this relates to increase in physical volume and/or numbers produced.

These results were used to structure the analysis of the contributions captured from the 848 individual inputs to the workshops and 56 detailed on-line submissions.



UK National Strategy for Additive Manufacturing / 3D Printing

LATEST NEWS | STRATEGY DEVELOPMENT PROCESS | HOW TO SUBMIT YOUR VIEWS | SCOPING WORKSHOPS | STEERING GROUP

Latest News

A series of short reports are being published to share information on the progress of developing the UK National Strategy for Additive Manufacturing / 3D Printing (AM-3DP). The first two of these are now available:

Update Report 1: How Was The Evidence Collected?

Update Report 2: What Did The Initial Evidence Reveal?

To learn more about how the strategy is being developed, click here.

If you have any queries regarding the development of the UK National Strategy for AM-3DP, please email evidence@amnationalstrategy.uk.

Tweets

DigitalFabrication @dfab_info 26 Oct
New paper: @openITstrat & George Kuk: Complementarity of openness: How MakerBot leveraged Thingiverse in #3DPrinting sciencedirect.com/science/articl...
Expand

DigitalFabrication @dfab_info 26 Oct
3ders.org - Auvergne region in France invests €6.3 million in metal additive manufacturing 3ders.org/articles/20151...

DigitalFabrication @dfab_info 26 Oct
Thales satellites to feature largest 3D-printed parts ever made in Europe themanufacturer.com/articles/thale...
Show Summary

DigitalFabrication 24 Oct

The Main Stages

- 2016
  - January – Set up working groups
  - September– Platform for engagement report
  - November – Started writing Strategy report (to be published end of Q1 2017)

Objective

- ***To enable UK industry to maximize the opportunities and benefits of additive manufacturing.***

- UK can win up to 8% or £5bn of worldwide market for AM products and services equivalent to 63,000 jobs by 2020.

- *"*The unique value to be gained by specifically designing for, and manufacturing by, AM is clear. Whilst not suitable for every component, we cannot perceive the advancement of power systems without the concurrent industrialisation of AM*"*

  Neil Mantle, Rolls-Royce plc

The Barriers

Issue	Summary of common perceived barriers
Materials and Processes	Understanding properties in different processes / machines / applications, size, throughput, QA, costs, availability (IP constraints, independent suppliers), use of mixed materials, recyclability, biocompatibility.
Design	Need for guides and education programmes on design for AM – better understanding of design for AM constraints, availability of AM-skilled designers, security of design data.
Skills/ Education	Lack of appropriate skills (design, production, materials, testing) preventing adoption, up-skilling current workforce vs. training of next generation, education of consumers, awareness in schools.
Cost/ Investment/ Financing	Funding to increase awareness and reduce risk of adoption (testing, scale-up, machine purchase) – especially for SMEs, understanding of full costs (including post-processing, testing), cost of materials.
Standards/ Regulation	Perceived or actual lack of standards – all sectors / sector specific (especially aero / health / motorsport), for processes / materials / software / products / applications.
Measurement/ Inspection/ Testing	Need data libraries, standards for tests (general and sector specific), materials/ in-process / final part, tests for higher volumes, non-destructive testing, QA through lock-in c.f. open access to data.
IP / Protection/ Secrecy	Balancing need for openness to share knowledge with need for commercial protection to capture value from investments, enforcement of IP rights.

How to achieve this vision….

- 5 key Themes
  - 1. Co-ordination and communication
  - 2. Strengthen the industry sectors
  - 3. Developing knowledge and skills
  - 4. Invest in UK capacity
  - 5. Measuring progress

How will Strategy influence actions of people?

- Identifies commercial opportunities
  - Generally across many sectors
  - Specifically from Strategy activities e.g. training
- Identifies market failings – where Government will need to intervene
- Identifies broader strategy and policy needs with national bodies e.g. Sector bodies, HVMC Catapult, EPSRC, Innovate UK, BEIS, LEP's, Professional Engineering Institutions, Education Sector etc.
- Provides direction to individuals and organisations to get things done

Current Status

- Working Groups have produced list of requirements
  - Costs and Finance
  - Design
  - IP and Security
  - Materials and Processes
  - Measurement, Test & Inspection
  - Standards
  - Skills and Education

Current Status

- Working Groups requirements – main categories
  - Awareness and Understanding - £3-4m
  - Supply Chain strengthening - £10m
  - Research, development, and demonstration - £40m
  - AM Skills - £84m

- These are very rough figures

Current Status

- Chairman of Steering Group standing down due to pressure of work
- KTN Special Interest Group in AM approved
- Strategy Report due April 2017
- Green paper on Industrial Strategy due today
- Research & Innovation Budget to increase by £2bn per year

- Take home message – Bright future for AM in the UK

Thank You

http://www.amnationalstrategy.uk/