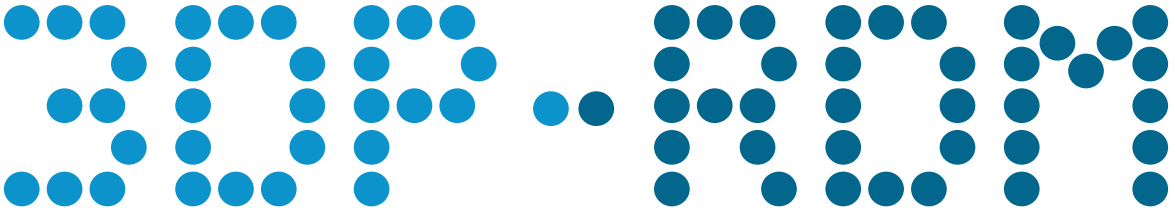


Defining the research agenda for 3D printing-enabled re-distributed manufacturing

Scoping Workshop

Institute for Manufacturing, Cambridge

30th January 2015

IfM Centre for Technology Management

http://www.dfab.info

UNIVERSITY OF CAMBRIDGE

About 3DP-RDM

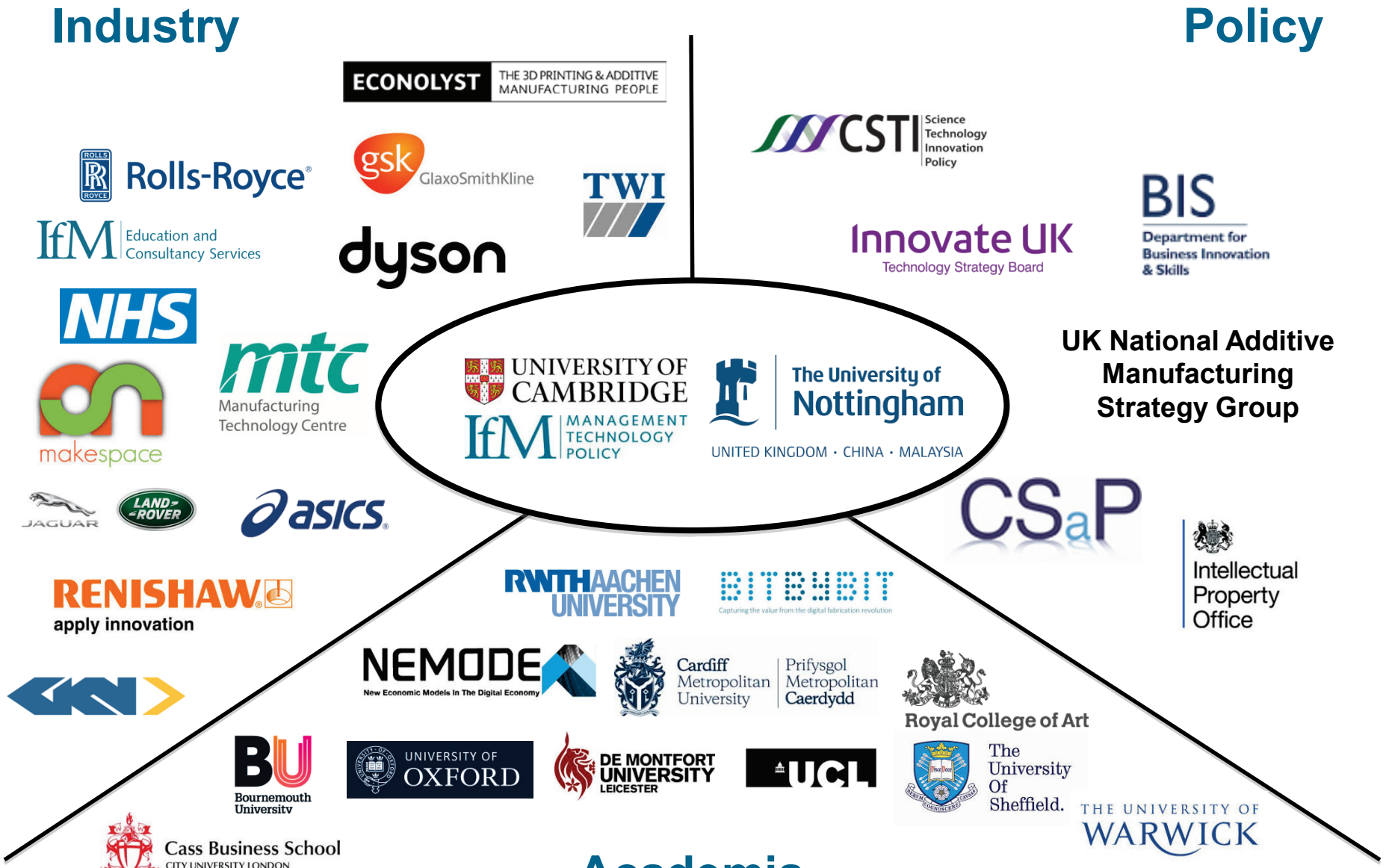
- One of five winning proposals from the EPSRC/ESRC under the “Re-distributed Manufacturing Network Call”
- Started in January 2015 and runs for 2 years
- One of three 3D printing projects we’re involved in:
  - 3DP-RDM
  - Bit by Bit: Capturing the value from the digital fabrication revolution
  - National Additive Manufacturing Strategy

Objectives of 3DP-RDM

- To provide the research councils with guidelines on the research challenges in this area and the research they should support in the future
- To run workshops that bring together academia and industry from different research domains and sectors
- To operate feasibility study competitions and commission 4-6 studies of £35k-£65k (2-3 in year 1, 2-3 in year 2)

Research aims of 3DP-RDM

- The features of 3D printing technologies that help enable re-distributed manufacturing
- How re-distributed manufacturing may accelerate the diffusion of 3DP technologies, and vice-versa
- Sector specific and generic aspects of 3DP enabled re-distributed manufacturing


Industry
Policy
ECONOLYST
THE 3D PRINTING & ADDITIVE MANUFACTURING PEOPLE
Rolls-Royce
gsk
GlaxoSmithKline
TWI
CSTI
Science Technology Innovation Policy
IfM
Education and Consultancy Services
dyson
Innovate UK
Technology Strategy Board
BIS
Department for Business Innovation & Skills
NHS
mtc
Manufacturing Technology Centre
makespace
UNIVERSITY OF CAMBRIDGE
IfM
MANAGEMENT TECHNOLOGY POLICY
The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA
UK National Additive Manufacturing Strategy Group
JAGUAR
LAND ROVER
asics
CSaP
Intellectual Property Office
RENISHAW
apply innovation
RWTH AACHEN UNIVERSITY
BITBUBIT
Capturing the value from the digital fabrication revolution
NEMODE
New Economic Models In The Digital Economy
Cardiff Metropolitan University
Prifysgol Metropolitan Caerdydd
Royal College of Art
GKN
BU
Bournemouth University
UNIVERSITY OF OXFORD
DE MONTFORT UNIVERSITY LEICESTER
UCL
The University Of Sheffield.
THE UNIVERSITY OF WARWICK
Cass Business School
CITY UNIVERSITY LONDON
Academia
IfM
Centre for Technology Management
3DP-RDM
UNIVERSITY OF CAMBRIDGE

Objectives of today

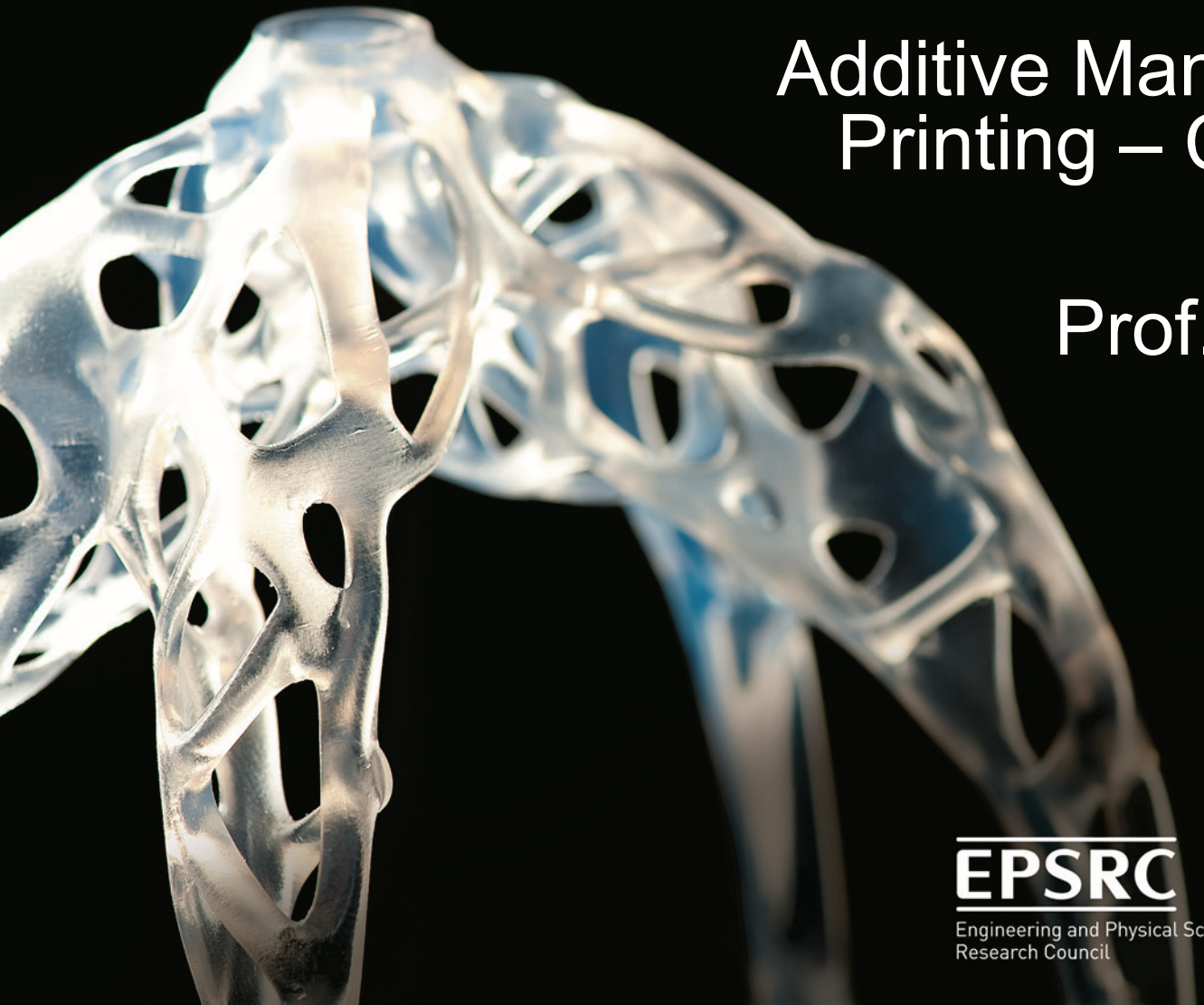
- To facilitate multi-disciplinary discussion and new academia-academia and academia-industry connections
- To develop a high-level view of the research issues at the intersection of 3D printing and re-distributed manufacturing
- To support your identification of possible feasibility studies in 3DP-RDM
- To inform you about the 3DP-RDM feasibility study competition process

- To inform you about the National AM Strategy

Agenda

12:30	*Buffet lunch and networking*
13:15	Welcome and introductions
13:30	Overview of 3D printing and re-distributed manufacturing
14:00	What are the research issues? Small group discussion, landscaping activity and prioritisation
15:15	*Refreshments*
15:30	Exploration of specific research topics Small group discussion
16:30	Feedback from small group discussions
17:15	Next steps
17:30	*Close and refreshments*

EPSRC Centre for Innovative Manufacturing in Additive Manufacturing



Additive Manufacturing/3D Printing – Current Status

Prof. Phill Dickens

EPSRC
Engineering and Physical Sciences Research Council

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

What is it?

- **ASTM F2792**
  - a process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies

- **Radically different to conventional processes such as:**
  - Machining
  - Casting
  - Forging
  - Moulding
  - etc.

What can it do?

EPSRC Centre for Innovative Manufacturing in Additive Manufacturing

- Increasingly being used in demanding applications
- Ideal for Complex, High Value, medium-low volume, customised products
- Plastics, metals, ceramics, bio

3D-ROM

EPSRC Engineering and Physical Sciences Research Council

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

What can it do?

- Fuel nozzles for GE LEAP-56 engines
  - Cobalt Chrome
  - Part count from 20 to 1
  - Decrease in fuel burn due to weight reduction (-25%)
  - x5 durability
  - Initial production – 85,000
  - 40,000/yr by 2023
  - https://www.youtube.com/watch?v=rMzVSbNebCg
  - Took 15 years to get to this

Why is it of interest?

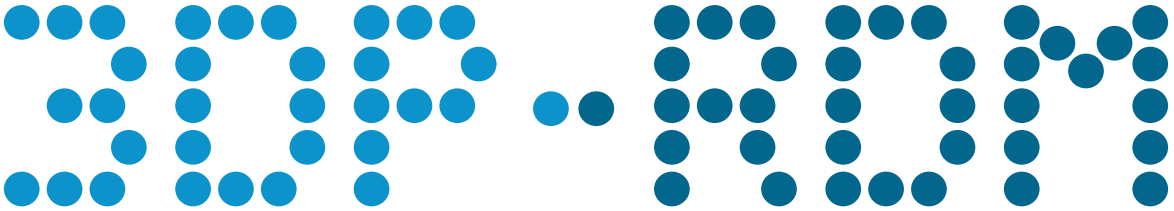
- Numerous possible benefits
  - Greater design freedom
  - No tooling
  - Less fixed investment
  - Production numbers can be low
  - Fast response to orders
  - Combine parts – reduce assembly
  - Cheaper than conventional processing
  - Customised products
  - Many materials
  - Replacement body parts
  - Possible to manufacture in new locations – home?

Where are we headed technically?

- Faster machines
- Greater size range
- Better quality – mat properties, accuracy, finish etc.
- Greater capability
- More materials
- Multiple materials
- Full colour

Where are we headed commercially?

?



Re-distributed manufacturing

Dr Tim Minshall
University of Cambridge

What is Re-Distributed Manufacturing (RDM)?

“Technologies, systems and strategies that change the economics and organisation of manufacturing, particularly with regard to location”

EPSRC Re-distributed Manufacturing Workshop Report 7-8 November 2013.

Why is RDM important now?

- ‘Re-balancing’ of the UK economy
  - Geographically and sectorally
- Emerging technologies
  - Enabling new ways of producing
- Emergence of the ‘Maker’ movement
  - Stimulating product-based entrepreneurship
- Connecting science, technology, innovation, regional and industrial policies
- Sustainability – the Circular Economy

RDM-related academic domains include:

- Economic geography – cluster theory
- Supply chain management – network capability
- Innovation and industrial policy – national & regional
- Asset management – servitisation
- Open innovation
- Entrepreneurship
- Intellectual Property Rights management
- Diffusion of innovations
- .. and many more

...>

Re-distribution of manufacturing ? **3DP / Additive Manufacturing**

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3DP-RDM

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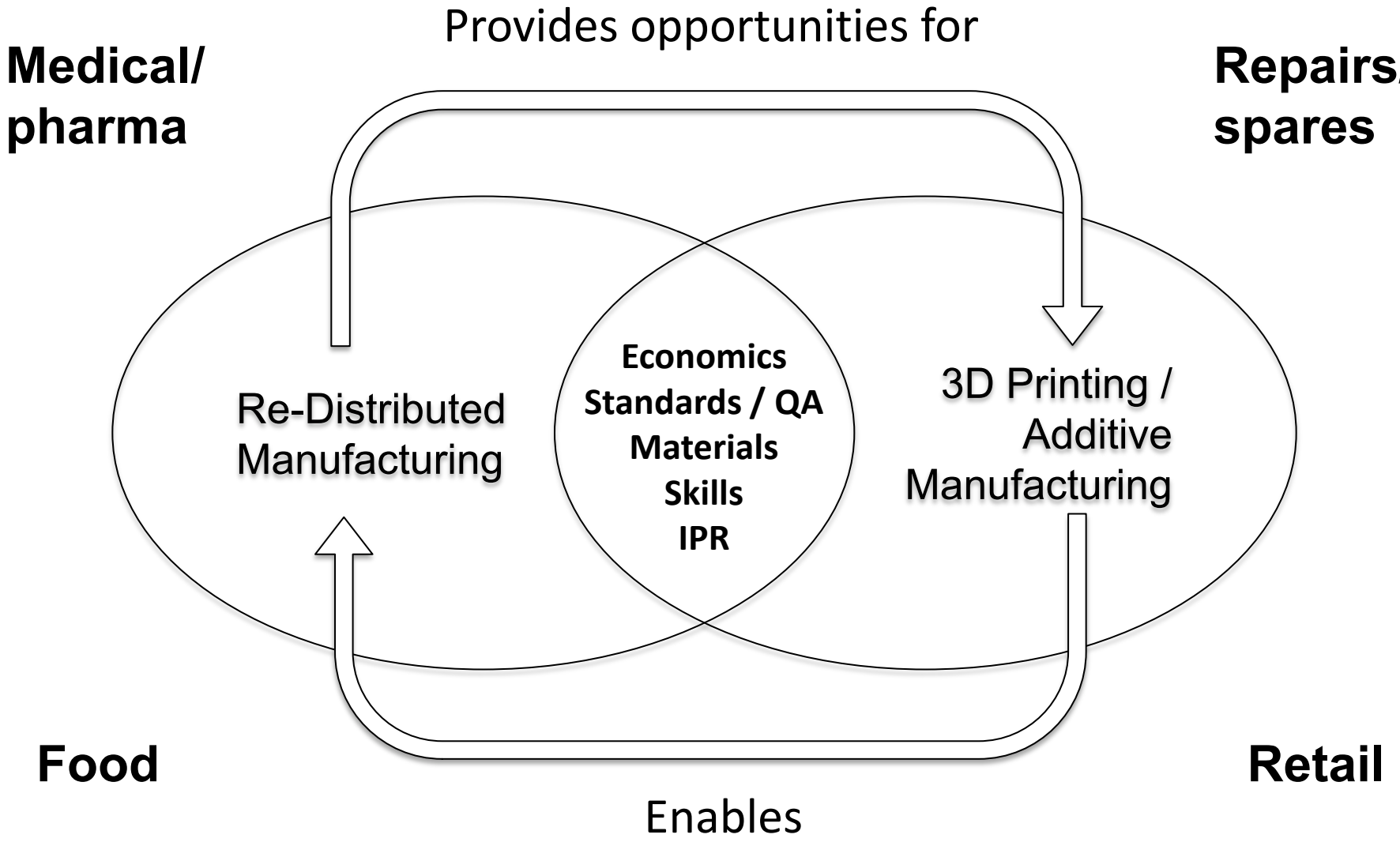
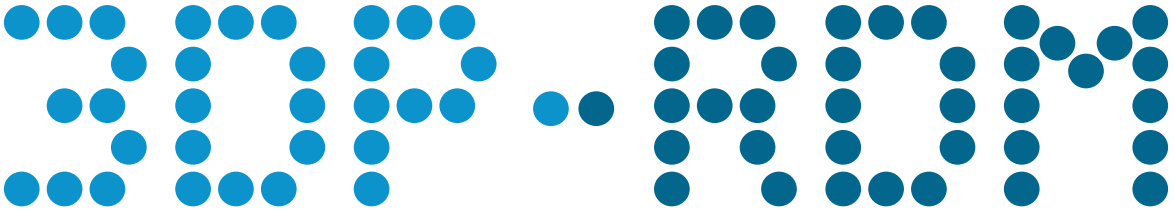
Focus of this network





What are the research issues at the intersection of 3D printing and re-distributed manufacturing?

Small group discussion,

landscaping activity and prioritisation

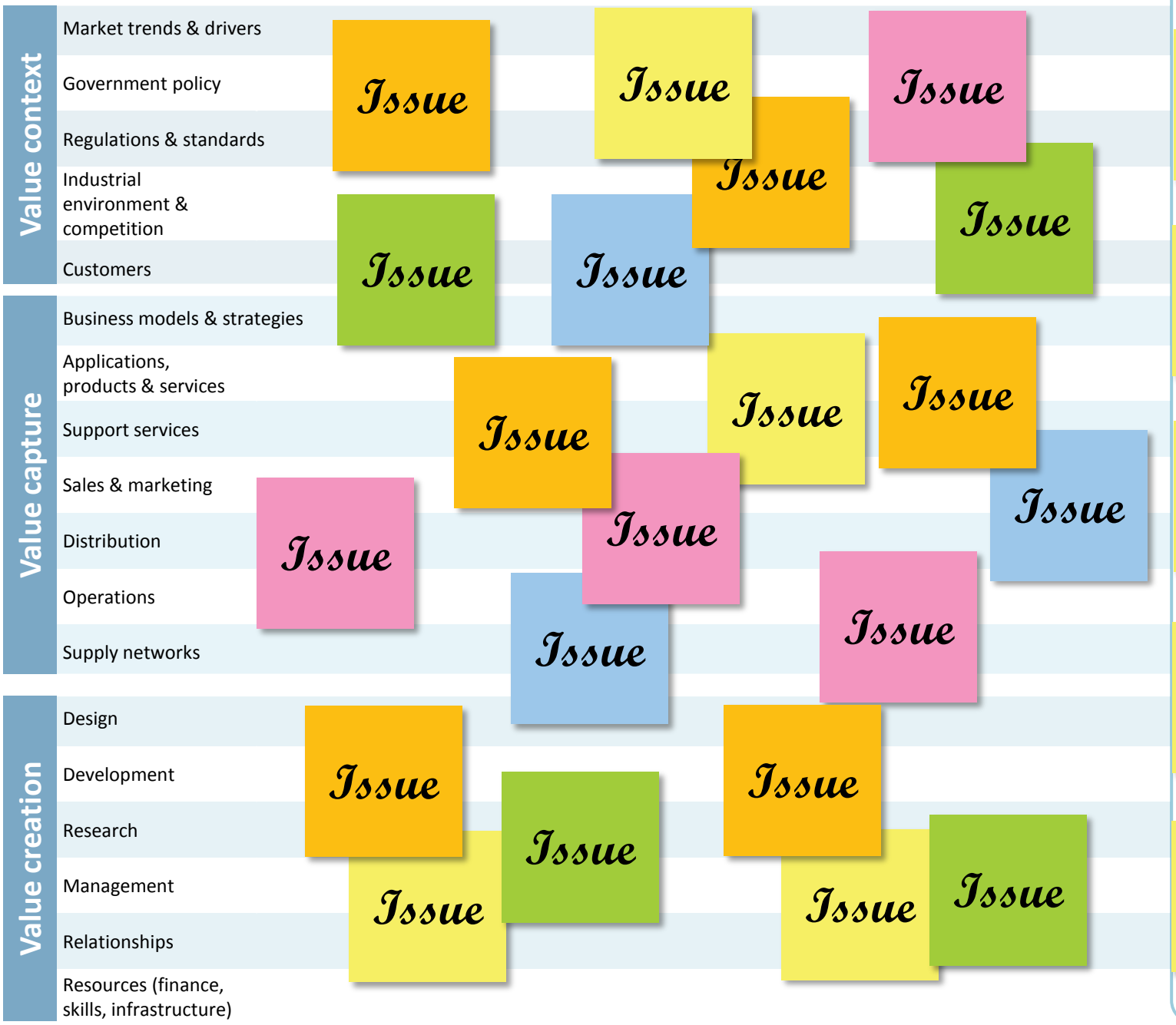
Stage 1: Group discussion (30 minutes)

Use the posters, Post-its and pens on your table to answer the following:

What are the research issues at the intersection of 3D printing and re-distributed manufacturing?

- Take some time to generate Post-its individually, then share with the group
- Identify Top 5 topics for sharing with whole group

Group: 3



Top 5 topics

3 Topic #1

3 Topic #2

3 Topic #3

3 Topic #4

3 Topic #5

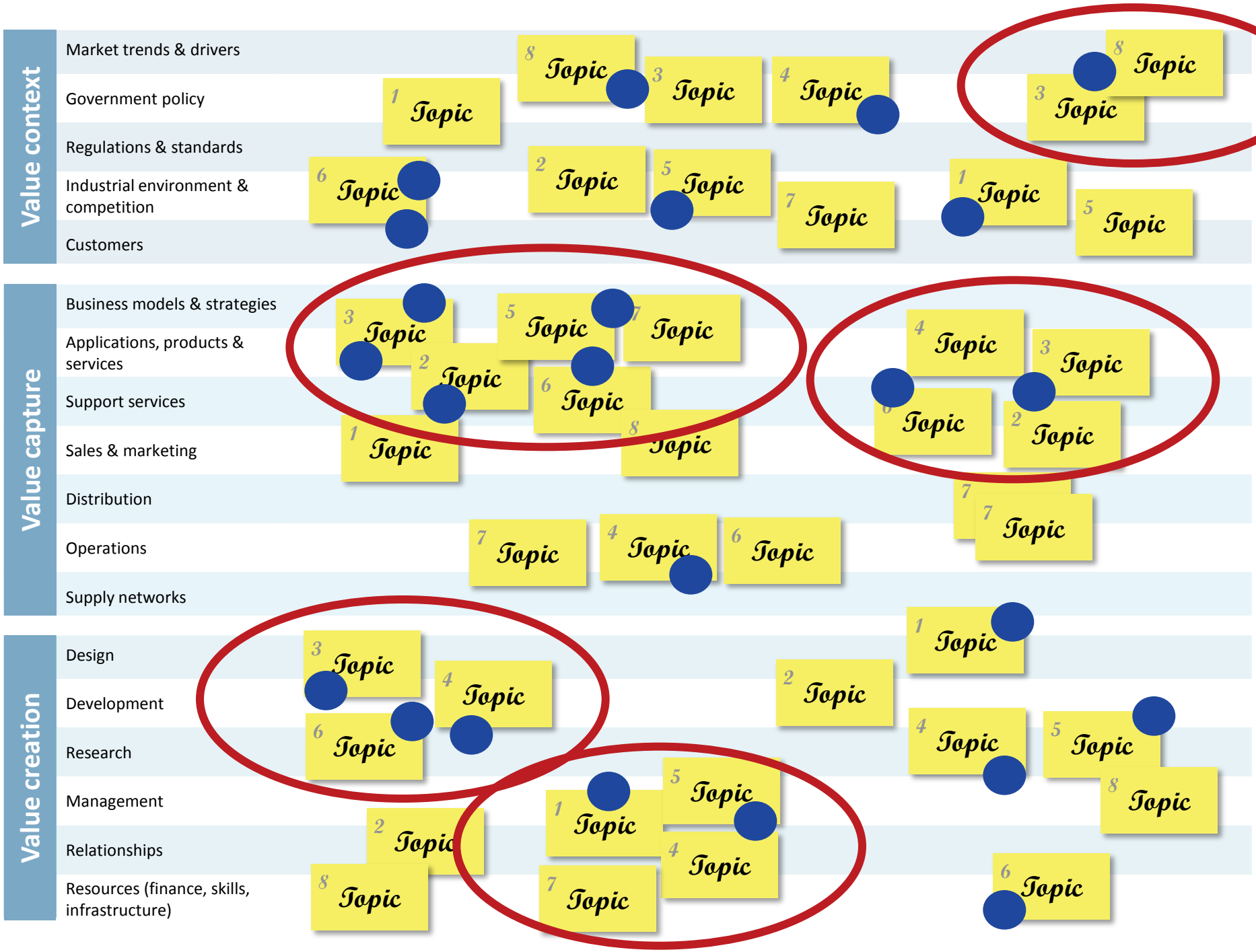
Stage 2: Landscaping (20 minutes)

- Feedback from the small groups to hear about their Top 5 topics


Value context
Market trends & drivers
Government policy
Regulations & standards
Industrial environment & competition
Customers
Value capture
Business models & strategies
Applications, products & services
Support services
Sales & marketing
Distribution
Operations
Supply networks
Value creation
Design
Development
Research
Management
Relationships
Resources (finance, skills, infrastructure)
Topic

Stage 3: Prioritisation (15 minutes)

- Each person has 5 dots, which each represent a ‘vote’
- With these votes you are stating which topics you think need to be investigated through feasibility studies in this first year of the network
- Rule: only one dot per Post-it note or Post-it cluster
- Once done, refreshments served outside in atrium and Session 2 begins at 15:30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Resources (finance, skills, infrastructure)
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Group discussion (30 minutes)

Use the posters, Post-its and pens on your table to answer the following:

What are the research issues at the intersection of 3D printing and re-distributed manufacturing?

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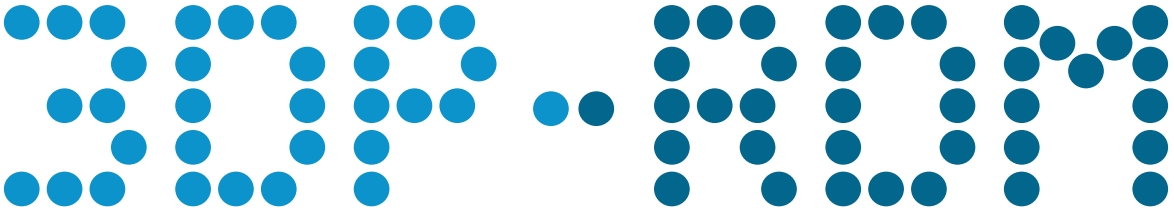

Landscaping activity

Prioritisation

- Vote for the topics you think need to be investigated through feasibility studies in this first year of the network
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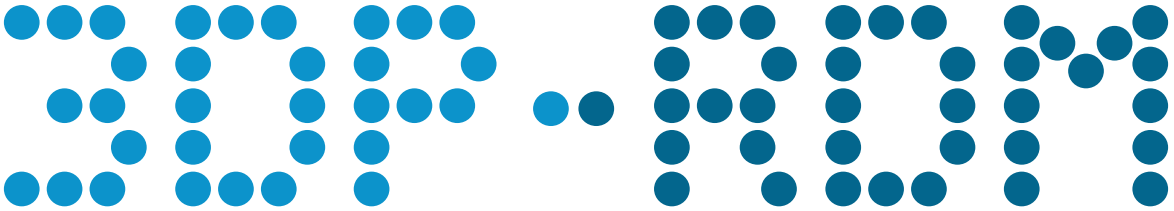

Session 2

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Highest priority topics for feasibility studies

Group	Topic	Votes
1	Material supply chain	13
2	Standards + compatibility + regulation + certification	12
3	Reconfiguring supply chain – consumers become prosumers	11
4	Software requirements and infrastructure in RDM environment – how is it accessed?	11
5	How will value be created and captured in 3DP-RDM economy?	11
6	Gap between hardware and design methods & tools	11
7	Liability and IPRs – traceability and certification	8
8	'Facebook' problem – who owns/shares designs in 3DP-RDM hubs?	8
9	Do we need a new IP regime to enable 3DP-RDM?	6
10	Changing business model	6

1. Topic: *Priority topic #1*

2. Group participant

3. Background and research interest

Name
Interests

Name
Interests

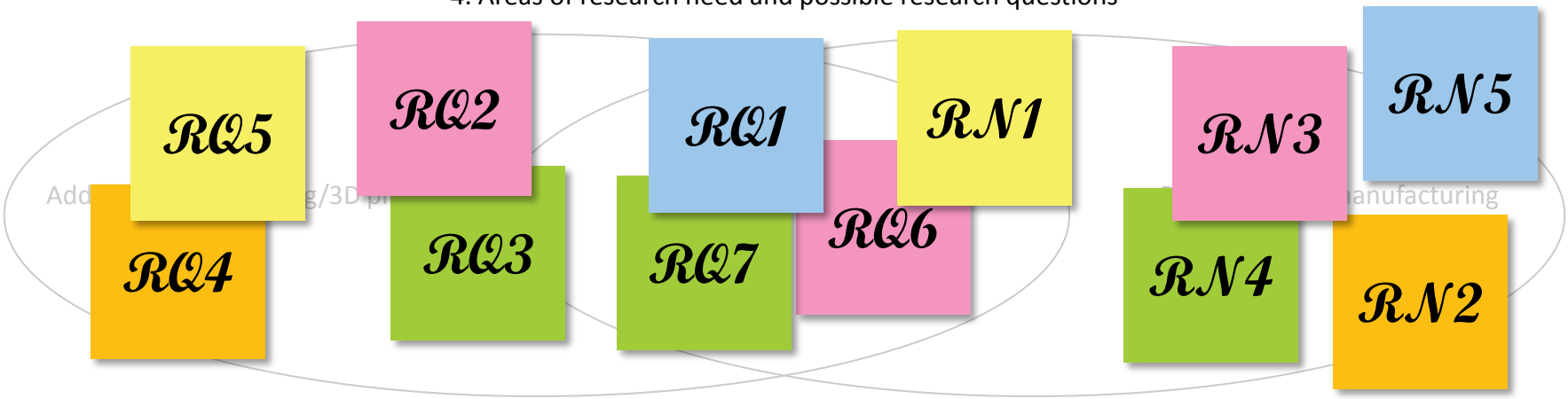
Name
Interests

Name
Interests

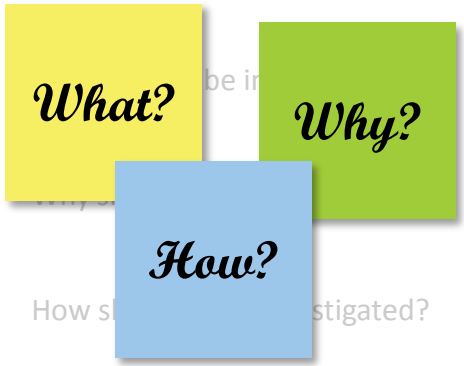
Name
Interests

6

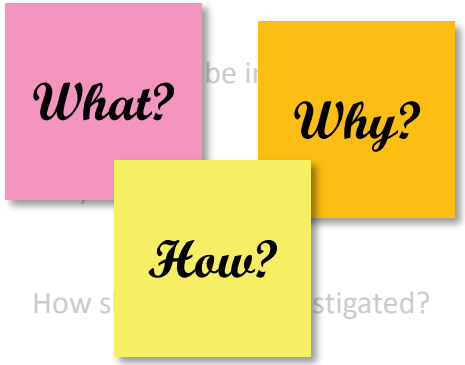
4. Areas of research need and possible research questions



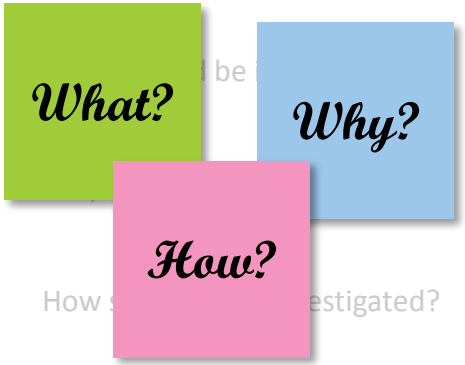
5a. Feasibility study idea #1



5b. Feasibility study idea #2



5c. Feasibility study idea #3



6. Priority rank 1 / 2 / 3

Priority rank 1 / 2 / 3

Priority rank 1 / 2 / 3

Group formation

- Priority topics will be investigated in groups of 4-5 people
- Pick the topic that you're most interested in investigating and move to the numbered poster on the wall
- If there's a lot of interest in a group we'll subdivide
- ~50 minutes for discussion into this topic
- Feedback will focus on the Top 3 ideas for feasibility studies

Highest priority topics for feasibility studies

Group	Topic	Votes
1	Material supply chain	13
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3	Reconfiguring supply chain – consumers become prosumers	11
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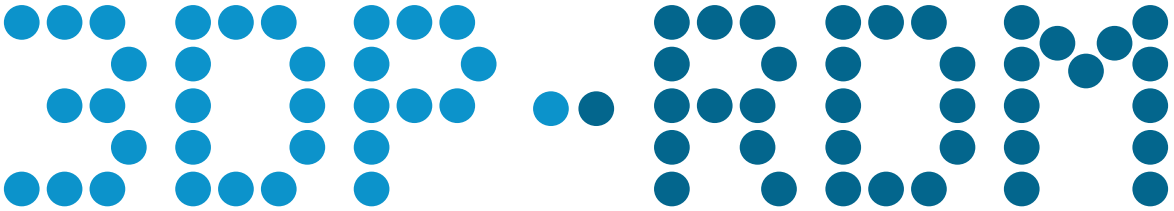
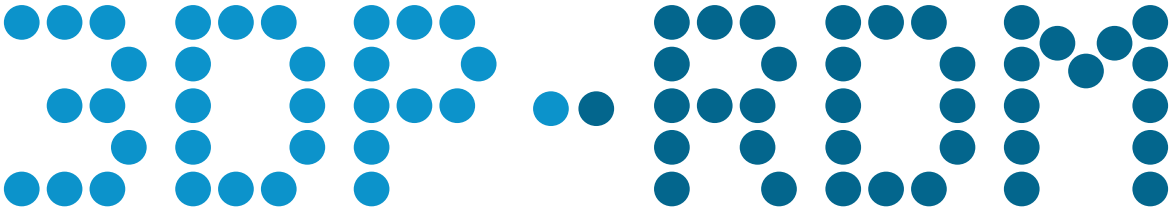


Group feedback



Next steps

3DP-RDM Feasibility Study Competition

- 2-3 feasibility studies will be commissioned for this calendar year
- Budgets for feasibility studies should be £35k-65k at 100% full economic costing
- You will be reimbursed at 80% full economic costing

- Collaborations are possible – and encouraged – but only academic institutions can receive funding

3DP-RDM Feasibility Study Competition

- Applications should follow template in participant pack
- Digital versions of the call for proposals and the template will be available on our Bit by Bit and 3DP-RDM blog: https://capturingthevalue.wordpress.com/
- Submitted to Simon Ford, sjf39@cam.ac.uk by 12pm on 2nd March

Key dates

Today	Announcement of feasibility study competition at 3DP-RDM Scoping Workshop
2 March	Deadline for feasibility study proposal submissions – 12pm
18 March	Review of submissions completed, with winners announced shortly thereafter
1 April – 1 July	Feasibility studies begin
17-18 September	Interim reporting at 4th EPSRC Manufacturing the Future Conference, Churchill College, Cambridge
31 December	Deadline for deliverables from feasibility studies
14-15 January 2016	Provisional dates for dissemination workshop and 2016 scoping workshop

EPSRC Centre for
Innovative Manufacturing in
Additive Manufacturing

UK AM Strategy Development

We need <u>your</u> help

EPSRC
Engineering and Physical Sciences Research Council

The University of Nottingham
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Why have a UK Strategy for AM?

- Ensure UK maximises benefits of AM
- Ensure joined up activity;
  - Involving all parties (industry, academia, government, finance etc.)
  - Covering research, innovation, exploitation and training
  - Considers the entire supply chain
- Reduce the risk of duplication and critical gaps
- Focus effort to give the most effective outcome
- Raise awareness of the potential impact of AM
- Accelerate learning /knowledge transfer
- Ensure immediate opportunities are addresses but not at the expense of capability building for the long-term sustainability

AM strategy

Must be:

- Independent
- Inclusive
- Industry driven
- Integrated with UK Government Industrial Strategy

Getting started

Initial working group established – September 2014

- Neil Mantle – Rolls Royce
- Rob Sharman/Dan Johns – GKN
- Robin Wilson – Innovate UK
- Chris Carr/Clare Marett/Brian Greenwood – BIS
- Rob Scudamore – TWI
- David Wimpenny – MTC
- Tim Minshall – IfM, Cambridge
- Phill Dickens – University of Nottingham

Progress to date

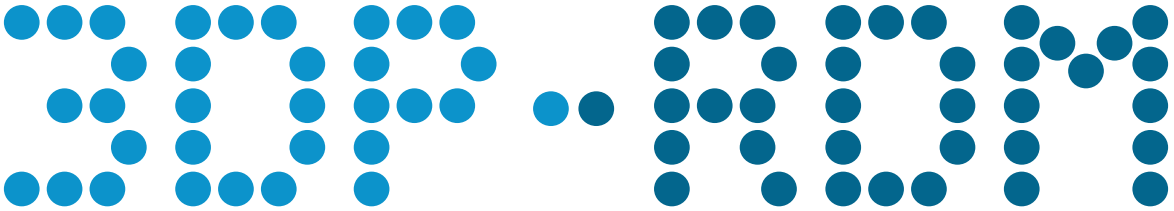
- Letter from Industrial leaders to Mathew Hancock (Minister of State for Skills & Enterprise)
- Very positive response from Mathew Hancock who has requested a meeting with the industry leaders in March
- Position Paper on AM in the UK is being prepared to highlight the importance of AM for the UK (Rob Scudamore et al)
- Website is being set up to share information

Next steps

- Promote the activity to ensure wide engagement
- Arrange series of workshops to gain input from different sectors
- Use the information gathered to produce an AM strategy
- Draft by end of 2015 for review
- Final version issued Q1 2016
- Update the strategy regularly

Consultation

- Industry led based on sectors
  - Aerospace
  - Automotive
  - Agricultural Technologies?
  - Construction
  - Information Economy
  - Life Sciences
  - Nuclear
  - Offshore Wind
  - Oil and Gas
  - Professional and Business Services
  - Plus others
- Research and training bodies



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