RiHN
Redistributed Manufacturing in Healthcare Network

EPSRC Redistributed Manufacturing in Deployed Medical Care

Network Plus Feasibility Study Funding

Clinical Fluids Manufacturing

Notes for Applicants

1. The Redistributed Manufacturing in Healthcare Network

Redistributed Manufacturing (RDM) in healthcare involves moving production closer to the point-of-care, helping clinicians to deliver better outcomes through medical products, technologies and therapies that are available on-demand and tailored to patient needs.

The UK Engineering and Physical Sciences Research Council (EPSRC) first funded the Redistributed Manufacturing in Healthcare Network (RiHN) in February 2015 and a cross-disciplinary team of six Universities delivered pioneering feasibility studies and a comprehensive white paper[1] to guide future research and investment.

This new research programme was devised at a national strategic road-mapping workshop, collaboratively delivered by RiHN investigators and Defence Medical Services (DMS) in the UK.

The workshop involved expert participants from a range of disciplines, including experienced practicing military and emergency clinicians, defence laboratory and procurement professionals and academic researchers covering engineering, manufacturing, operations and innovation management.

The EPSRC provided RiHN with a Network Plus grant, to commence from July 2020. With a new team of investigators and partners, the RiHN has over £1m to fund novel applications of RDM for use in challenging mobile environments, supporting the practice of humanitarian, military and emergency medical care.

The Network has six research themes (see fig.1), covering four priority areas of manufacturing engineering research with the remaining two providing an integration research role by focussing on 'operational requirements' and systemic factors affecting 'translation' into practice.

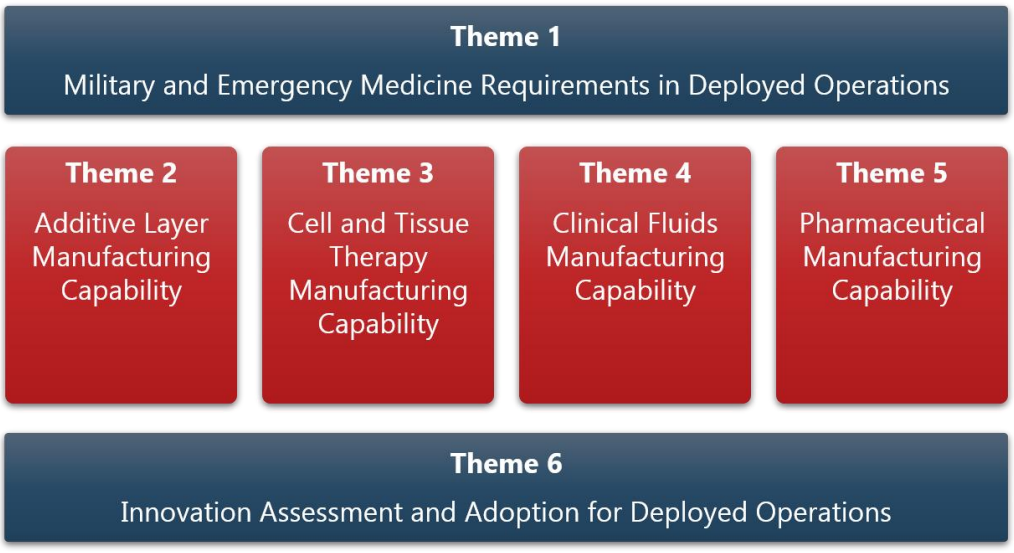

Figure 1 – Research Themes

For more information about the Network, please visit www.rihn.org.uk and for further background reading on RDM, download the RiHN white paper, made freely available on our website.

[1] http://rihn.org.uk/wp-content/uploads/2020/05/RiHN_WP_Full_double_web.pdf

2. Deployed Medical Care

Medical professionals and first-responders face the ongoing challenge of rapidly responding to urgent and unforeseen consequences in a range of logistically constrained environments, such as conflict zones, disaster relief, terrorist incidents and global pandemics.

The standard approach in such situations involves evacuating any seriously injured or ill casualties away from high risk zones to a more permissive location where an appropriately resourced medical capability can continue further treatment more effectively. However, the usual medical pathway cannot always be relied upon and emergency care, including urgent surgical interventions, or prolonged field care may be required in more austere conditions. A range of deployed medical treatment facilities and vehicle platforms exist - ranging from light, highly mobile and basic facilities to more static and capable field hospitals of differing configurations.

Breakthroughs in 'advanced manufacturing' have offered the potential to transform the treatment of patients closer to the point-of-injury, reducing loss of life and the risk of sustaining longer-term disability or rehabilitation costs. However, further research is required to develop and evaluate the feasibility of redistributed manufacturing systems that can operate effectively in the more austere environment of deployed operations as well as produce products and therapies that can bring added value to both clinical personnel and patients alike.

High-level findings from our strategic roadmapping workshop (presented at an international conference[2]) provide an important guide for feasibility study proposals by setting out broad requirements for innovation in advanced manufacturing in deployed operations, these include:

- Increasing agility and immediacy for clinical effect (improved diagnostics, faster recovery)
- Enabling Prolonged Field Care (PFC) or immediate recovery stages before or after, according to operational demand/circumstances
- Enabling genuine transformation of medical activities in deployed operational locations, rather than facilitating improvisation/compromise
- Reducing complexity – allowing for reconfigurability, adaptability, modularity, reduction in raw materials dependence and, if beneficial, new designs that make use of delayed final assembly at the point of need
- Resilient, survivable, integrated, adaptive manufacturing units/devices or networks
- If applicable, units/devices allowing secure integrated data transmission or portability of useful data (i.e. anthropometric)

Applicants should read our conference paper[3], which is available on request and provides directions for further background reading.

[2] Phillips et al. (2020) Innovation in healthcare manufacturing: transforming deployed medical care, The ISPIM Innovation Virtual Conference – held on 7-10 June 2020

[3] http://rihn.org.uk/research/

3. Clinical Fluids Manufacturing

3.1 Background

Potable water, sterile water and certain clinical fluids (such as intravenous solutions) are critical in a range of deployed medical care scenarios and are often integral to resuscitation and fluid replacement techniques (e.g. treating hypovolemia and various types of shock), for drug delivery, wound irrigation and cleaning; particularly at forward areas for care pathways close to the point of injury. The medic or first-responder is often limited in terms of what they can carry into the field, which places significant limitations on medical interventions. Water and clinical fluids are heavy and bulky and represent a large logistic load. Similarly, mobile medical facilities operating in remote locations are logistically constrained with operational challenges such as temperature-sensitive storage of fluid, blood and therapeutic products. Research relevant to Clinical Fluids Manufacturing capability will focus on:

- Demonstrating the capability to rapidly produce intravenous or other required fluids in deployed conditions, utilising portable, efficient and adaptable production equipment
- Pioneering new fluid manufacturing techniques or innovatively repurposing/reengineering existing technologies for cost-effective adoption in deployed medical care settings
- Advancing the generation of blood products on-demand (including synthetics) or related therapeutics that can be used to stabilise casualties and to facilitate later treatment
- 'Freedom from fridges' – techniques that reduce, or obviate, the requirement for temperature-controlled environments to store therapeutics and clinical fluids

3.2 Scope of the call

This call places significant emphasis on engineering research that aims to alleviate the pressures of deployed medical care in austere and extreme environments. This covers a broad range of areas, including but not limited to:

- Manufacturing, bio-manufacturing and processing technologies
- Novel techniques that can offer mobile, 'on-demand' production and processing of potable and sterile water, clinical fluids and therapeutic solutions without subsequent 'shelf-life' constraints
- Generation of 'donor-less' red blood cells and blood product substitutes utilising robust, mobile fabrication processes
- Adaptation of leading-edge production technologies from hi-tech sectors (such as space and low earth orbit) and their application to humanitarian, military and emergency medical service environments
- Analytical techniques which would support the most efficient and effective application of clinical fluids manufacturing processes and even offer the potential for bespoke, patient-focused therapeutics (i.e. personalised intravenous fluid for different conditions)
- Produce viable alternatives to existing water-based sterilisation ('autoclave') facilities, water recovery or recycling techniques to increase efficiency and support sterile service capability (i.e. for surgical instruments or biological decontamination).

3.3 Expected activities and outputs

Proposals must outline a clear pathway to providing demonstrable clinical value within the deployed medical care setting. Technology development may be focused upon individual capability development or 'stage-gated' through iterative levels, each producing a viable solution for implementation.

Projects may conduct feasibility studies, lab tests, or proof of concept and design specifications which focus on the development of novel manufacturing technologies, or the customisation or modification/repurposing of existing approaches to better suit the deployed operational setting.

Ideally, projects will have established a collaborative support arrangement with an end-user[4] beneficiary organisation. This relationship is expected to help steer how the proposed research may impact on current operational procedures and patient outcomes.

[4] The RiHN may be able to provide links to potential end-users but it is the responsibility of the applicant to secure their support and provide evidence such a letter of support

4. How to apply

4.1 Research guidance

This call will support proposals that seek to advance high-value applications of RDM research that have the potential to transform future deployed medical care capability. This document provides details for the Clinical Fluids theme, which is one component of our four areas of funding, listed below in order of priority:

1. Clinical Fluids Manufacturing
2. Cell and Tissue Therapies
3. Additive Layer Manufacturing
4. Pharmaceutical Manufacturing

For this second-round competition, RiHN has allocated funding of around £400,000 at 80% Full Economic Cost (FEC) which will be awarded to around 4-6 successful proposals. In exceptional cases we may consider innovative research proposals that seek to investigate an aspect of practical RDM engineering research that applies across disciplines.

Research project proposals are expected to take the form of a feasibility study, proof-of-concept or prototype development and testing (ideally[5] TRL **Level 3** but seeking progression to 4), normally lasting from 3 to 6 months. Ongoing small projects are also welcome where close collaboration with RiHN's research theme leaders and achievement of objectives may allow for stage-gate control of funding tranches.

Proposals should clearly demonstrate industrial/practical relevance and ideally include at least one organisational partner(s) operating in relevant areas such as humanitarian, military or emergency medicine. Letters of support (1-2 pages per organisation) should accompany proposals. RiHN may be able to support early requests to identify potential partners.

Although it is not a requirement, we actively encourage exploratory discussions and participation in RiHN's pre-competitive workshops and online events, to gain feedback on early-stage propositions and potentially establish new links with other researchers or organisational collaborators. We advise all potential applicants to familiarise themselves with the application process and expectations for participation in the wider EPSRC Redistributed Manufacturing in Healthcare Network (RiHN) research programme.

[5] https://epsrc.ukri.org/research/ourportfolio/themes/healthcaretechnologies/strategy/toolkit/landscape/

4.2 Submission guidance

In all cases, please use our RiHN **application form**, which can be requested through our website: http://rihn.org.uk/funding/ . Please observe the word count limits and as a minimum, use an 11-point size font and maintain 2cm margins for all pages. Also, please note the following guidance for each section of the application form:

SECTION 1 – RESEARCH DETAILS

- *Please indicate the main area of research by ticking one box only*
- *We may consider proposals that cross several or all themes – however, in such cases it is recommended that you contact us for further guidance before preparing your application*
- *Following EPSRC grant arrangements, the RiHN will only fund 80% Full Economic Cost of the total funding and the host institution(s) must fund the remaining 20%*

SECTION 2 – RESEARCH BACKGROUND

- *Succinctly state the context of the proposed topic; rationale for research; problems and gaps.*
- *Explain relevance to RDM in deployed medical care and potential beneficiaries*
- *What is the maturity of the technology; current state of research (national and international)*

SECTION 3– AIMS AND OBJECTIVES

- *Succinctly state the context of the proposed topic and rationale for research, in particular explaining how the project will embrace the needs of application in deployed settings*
- *Set out the research idea and overall aim of the project*
- *Include measurable objectives against which the outputs of the research will be assessed*

SECTION 4 – NOVELTY AND TIMELINESS

- *Explain the value of this topic, why it is not addressed elsewhere and extent of scientific ambition*
- *How will this lead to further research or funding?*

SECTION 5 – METHODOLOGY

- *Detail and justify the research methodology*
- *Describe the work programme, including structure of research and impact related activities*
- *Identify the contribution of the research team including any project partners and stakeholders*
- *Provide objectives and milestones that will be used to monitor progress and explain how the project will be managed (include a GANTT chart)*

SECTION 6 – PROJECT DELIVERABLES

- *Provide a summary of anticipated outputs resulting from the research*

SECTION 7 – PROFILE OF INVESTIGATORS

- *Provide a brief profile of all investigators and track records in the proposed area of research*

SECTION 8 – JUSTIFICATION OF COSTING

- *Who will conduct the research, over what duration, and what % of their time is dedicated?*
- *What resources are needed to prepare your data?*
- *Provide a full break down of costs, such as how many are travelling, where they going, and why*
- *Justify any resources requested to support impact activities, where appropriate*
- *Provide details of any contributions from project partners*

SECTION 9 – DECLARATIONS

- *Please state how all parties will comply with expected ethical standards and any mandatory governance requirements, including the handling of data and intellectual property*

All completed applications should be submitted via email to Dr Dharm Kapletia dharm.kapletia@uwe.ac.uk following the guidance in this document.

Please check our website for confirmation of funding call deadlines.

We particularly welcome proposals where a second funder is prepared to match (50%) the funding amount requested from RiHN (50% @80%FEC). In such cases compliance with EPSRC funding rules will still apply. Contributions from a match funder must clearly state actual monetary and any payment-in-kind values, correctly formatted for the financial details section of our application form.

Applications may only be submitted by staff at a UKRI qualifying institution. Funding is not available to support directly allocated staff, nonetheless it is expected that a permanent senior member of staff will supervise the delivery of the project. RiHN seeks to encourage participation of Early Career Research (ECR) staff (within 15 years of receipt of a doctoral qualification). Please consult your relevant bid/contracts team to ensure that financial information is prepared appropriately.

5. Assessment process

Proposals will be reviewed on an ongoing process and will receive a decision within 4 weeks, or further communication will be provided within that timeframe as to the earliest date of assessment.

All submissions will be considered and reviewed by the relevant RiHN investigator team and other independent experts from academia and practice.

The assessment panel will consider the following criteria:

1. Degree of fit to the RiHN's call
2. Potential for the development of further research and subsequent funding applications
3. Evidence of industrial, clinical or end-user interest and commitment to the study, especially in support for any follow-on project or funding
4. The likelihood of successful delivery of the project
5. Relevance of the project to the interests of the RiHN programme and its partners
6. Potential for attracting new members to RiHN
7. Involvement and development of ECRs
8. Track record of the applicants in the proposed area of study

To ensure a fair and objective selection process, final decisions will be subject to scrutiny by the RiHN's Advisory Board. Proposals should state details of any conflicts of interest.

This call for funding will not support:

- Fundamental scientific or epidemiological research
- A literature or systematic review
- Research that is out-of-scope of the EPSRC remit
- A software development project
- Mature applications of RDM that would qualify instead for higher TRL funding competitions (i.e. TRL 5-9)

6. Governance and Impact

6.1 Target Audience

The RiHN programme includes close collaboration with potential end-users of RDM research and innovation. It is anticipated that research proposal outputs will reach this audience and other national and international bodies involved in delivering deployed medical care. These include but are not limited to medical professionals and first responders operating in healthcare service bodies (MoD, NATO, NHS, WHO), policy makers/influencers, government departments and regulators (DoH, MHRA, RAND, RUSI), humanitarian organisations (MSF, UN), as well as industry scientific R&D and academic research communities. The ultimate goal of this programme is to pull through innovative research that has the potential to transform how patients are treated in deployed operations and in the end improve long-term outcomes.

Research funded through this programme is expected to be widely disseminated, especially through peer-reviewed journals and conferences. Researchers are also encouraged to consider innovative methods of dissemination where appropriate, including the preparation of content/media for the RiHN website and material for end-user community engagements. The mandatory, formal output from each project will be an end of grant report. The RiHN team will work with researchers to maximise opportunities for dissemination and impact.

6.2 Management and reporting

Successful proposals will have demonstrated as part of the assessment process that they have relevant governance procedures in place. The grant holders will be responsible for obtaining all ethics approvals required for the project and are also expected to meet relevant organisational and legal information governance requirements.

Projects may only commence after institutional contractual agreements are signed. Project progress will be monitored through regular update meetings between a dedicated assigned RiHN investigator(s) and the research project lead or representative(s).

All funded projects must work collaboratively with RiHN researchers who have responsibility for providing an integration role, focusing on ‘requirements’ and ‘innovation’, as illustrated in fig 1. This is intended to be a mutually beneficial aspect of the programme and will assist funded researchers to develop outputs that are relevant to practice.

7. Further Information

If you have further questions about this funding opportunity, technical queries concerning the scope or content of the research can be directed to:

- **Professor Nik Willoughby**, Heriot Watt University (n.a.willoughby@hw.ac.uk)
- **Professor Jonathan Benger**, University of the West of England (Jonathan.Benger@uwe.ac.uk)
- **Dr Paul Hunt**, Defence Medical Services (paul.hunt1@nhs.net)

Any questions about programme strategy and collaboration should be directed to:

- **Professor Wendy Phillips**, UWE Bristol (wendy.phillips@uwe.ac.uk)
- **Dr Dharm Kapletia**, UWE Bristol (dharm.kapletia@uwe.ac.uk)