Call for Feasibility Studies

EPSRC Future Manufacturing Hubs

Call Type: Invitation for Proposals

Closing Date: 17:00 on **Thursday 22nd July** 2021

Related themes: Manufacturing the future

Summary

The EPSRC Future Manufacturing Research Hubs in Composites, Electrical Machines, Metrology and Photonics have partnered to offer up to £900k in funding to support a number of Feasibility Studies at TRLs 1 to 3. The funding is available for novel research in manufacturing technologies pertinent to the priority areas identified by each of the four partner Hubs (see: Scope of the Call).

The joint call is open to all UK academics eligible to receive EPSRC funding and is the primary mechanism for new academic collaborators to engage with the four Hubs. The partnership is motivated by the possibility for collaborations spanning multiple Hubs, in projects where the research area is of mutual interest to more than one Hub. In addition to maximising potential research synergies, the joint call also offers projects access to facilities and equipment from all four Hubs.*

Proposals are envisaged to have a maximum duration of six months and maximum value of £62,500 at full Economic Cost (fEC), with funding to be awarded at 80% of fEC.

*(Subject to terms and conditions).

Key Dates

Activity	Date
Call Launched	Wednesday 12th May 2021
Closing date for applications	**17:00 Thursday 22nd July 2021**
Evaluation of applications by	Friday 3rd September 2021
Grants announced and feedback given by	Friday 10th September 2021
Projects must start within 3 months of receipt of the offer letter	

Background

To help manufacturing industries respond to future opportunities and contribute to a prosperous UK, the EPSRC decided to build on the success of the Innovative Manufacturing Research Centres and the EPSRC Centres for Innovative Manufacturing to create a network of Future Manufacturing Research Hubs. Each Hub has a programme of innovative research in the engineering and physical sciences, related to the challenges in commercialising early stage research. The core Hub activity is based in a single location, with other institutions or groups acting as 'spokes', providing specific expertise in particular areas complementary to the lead institution. A key characteristic of the Hub model is that the research is driven by the long-term research challenges of users. User collaboration is therefore an essential aspect for these Hubs. There are currently 13 Future Manufacturing Hubs, four of which have partnered to create this call.

1) The Future Composites Manufacturing Research Hub was established in 2017 to engage academics from across the UK to deliver a step-change in the production of polymer matrix composites. Building on the success of the EPSRC Centre for Innovative Manufacturing in Composites (CIMComp), the Hub is driving the development of automated manufacturing technologies to deliver components and structures for demanding applications, particularly in the aerospace, transportation, construction and energy sectors. The Hub is led by the Universities of Nottingham and Bristol with 13 other academic Spokes and 4 High Value Manufacturing Catapult Centres, supported by 37 industry partners across a range of sectors and tiers.

2)The Future Electrical Machines Manufacturing Hub was established in 2019 and aims to put UK manufacturing at the forefront of the electrification revolution. The Hub addresses key manufacturing challenges in the production of high integrity and high value electrical machines for the aerospace, energy, high value automotive and premium consumer sectors. The Hub combines and capitalises on electrical machine and manufacturing research within the University of Sheffield's Electrical Machines and Drives Group, Department of Automatic Control and Systems Engineering and Advanced Manufacturing Research Centre (AMRC), Newcastle University's Electrical Power Research Group, and University of Strathclyde's Department of Electronic and Electrical Engineering and the Advanced Forming Research Centre (AFRC).

3) The Future Metrology Hub was established in 2017 and aims to transform the UK's manufacturing performance by delivering significant improvements in the speed, accuracy and cost of measurements. This will be achieved by developing ground-breaking embedded metrology technologies and universal metrology informatics systems to be applied across the manufacturing value chain. The Hub is led by the University of Huddersfield with academic research spokes at the University of Bath, Loughborough University and the University of Sheffield. It is supported by the National Physical Laboratory (NPL), and 5 High Value Manufacturing (HVM) Catapult Centres. It is also backed by over 40 leading companies and institutions in the sector.

4) Established in 2016, the Future Photonics Hub is delivering a programme of manufacturing research under the grand challenge of photonic integration. The Hub is led by the University of Southampton in partnership with the University of Sheffield. With four technology platforms, covering fibre, light generation, silicon photonics, and large scale manufacture of 2D and metamaterials, the Hub collaborates with a wide range of partners in academia and industry. By exploiting new functional materials and processes, the Hub is improving the manufacturability and integration of photonics, leading to low-cost manufacturing processes to provide lower-cost, higher-performing integrated sensors, lasers and sub-systems, and accelerating the wider adoption of photonics technology.

Scope of the Call

Research proposals should address challenges at low TRLs (1-3) and be aligned with at least one of the priority areas outlined by the individual Hubs below. Full details of each Hub's objectives and a more in depth explanation of the topics can be found in the relevant annex.

Proposals should demonstrate the potential, if feasibility is demonstrated, to significantly improve the U.K.'s manufacturing capabilities. As such, industry are encouraged to participate as project partners to demonstrate a pathway to manufacturing and exploitation, although cannot receive funding directly.

The Future Composites Manufacturing Research Hub is seeking proposals to address sustainability challenges for fibre reinforced composites. Sustainability is a global priority requiring a huge drive for change, with demanding zero-carbon legislation targets to meet across all industries, in a bid to reduce environmental impact.

Composites are currently helping the drive towards a carbon neutral future, offering light-weighting to reduce emissions and improved durability to increase service life during the use phase, but more can be done to reduce the overall carbon footprint during the component manufacturing stage and at the end of life. The Composites Hub is looking to fund fundamental research projects to address these challenges, by developing either new manufacturing technologies, conducting analytical studies to develop a fundamental understanding of existing manufacturing processes, or developing process modelling and optimisation techniques.

Proposals must focus on sustainable manufacturing of composite components for high performance, demanding structures, rather than focusing on the development of new materials. Only fibre reinforced polymer composites are of interest, with nanomaterials and graphene considered to be out of scope. Informal enquiries are welcome to ensure proposal ideas are within scope. Further details of the scope of this call can be found in the Annex below.

The Future Electrical Machines Manufacturing Hub is seeking proposals that complement existing FEMM Hub Research, fill gaps or add cross-cutting activities. Proposals should demonstrate the potential, if feasibility is demonstrated, to significantly improve the UK's manufacturing capabilities. As such, Industry are encouraged to participate as project partners to demonstrate a pathway to manufacture, although cannot receive funding directly. Topics of interest in call include, but are not limited to, the following:

- Novel coil manufacturing routes
- Process modelling and monitoring
- Manufacturing of features for advanced thermal management
- Aspects of sustainability and circular economy in electrical machine manufacture

The Future Metrology Hub is seeking proposals which address specific industrial challenges in applied metrology. Proposals should seek to develop new metrology technology or techniques or adapt and develop existing methods to be suitable for use in the following applications:

- Novel approaches for the Human-metrology interface
- Novel methods for future inspection in manufacturing

- Novel Methods for improving performance through metrology

Proposals which make use of sensor networks or in-process/embedded metrology are of particular interest.

The Future Photonics Hub is seeking proposals that address the grand challenge of photonic integration, support the development of the technology platforms, or new applications of Hub developed technology. The Hub is seeking proposals in the following areas:

- Photonic integration: The aim of this platform is the grand challenge of integrated devices across all four platforms with an eye on cost reduction, manufacturing efficiency, and the capture of 'smart' value at component level.
- Speciality optical fibre: The focus is on two key challenges in fibre manufacturing to meet short and long-term industry needs: improving loss, gain and power handling and increasing the transmission window to enable new applications.
- Light generation and delivery: Devices such as quantum-cascade lasers, antimonide-based lasers/LEDs and fibre supercontinuum sources have generated new markets in areas such as sensing, imaging, healthcare and spectroscopy. This platform will drive the transition required for growth in these photonics-enabled industries, from discrete components to low-cost, compact, integrated platforms.
- Silicon photonics: Silicon photonics has made major advances in functionality at the chip level, but integration remains an obstacle to the development of the technology. New directions within the Hub include hybrid integration (e.g. for efficient modulators) and multi-layer photonics solutions.
- Large-scale manufacture of metamaterials and 2D materials: Metamaterials and 2D materials provide extraordinary properties that disrupt conventional ideas on device performance. This platform focuses on low-cost, scalable manufacturing of metamaterials that has so far been an obstacle to their proliferation in devices and systems.

Funding available

The Hubs are each seeking to fund between 3 and 5 Feasibility Studies in their subject area. The maximum funding available for each Feasibility Study is £62,500 at fEC, of which 80% will be funded by the Hub (i.e. maximum grant per project of £50,000). Maximum project length is six months and funding is intended to cover the costs of the PI and supporting researchers in undertaking their research feasibility project. As projects must commence within 3 months of the offer letter being issued, funding will not be offered where there is a need to recruit new staff to deliver the research. Funding will therefore primarily cover existing staff time (including associated Indirect and Estates costs), with the remainder supporting consumables and travel. Funding for PhD students is not available.

Equipment

Funding for the purchasing of equipment is not eligible.

The partner Hubs are committed to supporting the U.K.'s research community and have jointly agreed to provide access to facilities and equipment at cost to proposals funded through this call (subject to terms and conditions agreed on a case by case basis). If you believe that your proposal would benefit

from access to specialist equipment available at any of the partner Hubs, please contact the relevant Hub Manager using the details provided in the contacts section. They will be able to advise you on the cost and availability of equipment which can then be incorporated into your proposal.

Eligibility

This call is open to all UK academic institutions (including existing Hub and Spoke institutions), where applicants must be eligible to hold an EPSRC grant. If you need guidance on eligibility, please visit https://www.epsrc.ac.uk/funding/howtoapply/fundingguide/eligibility/investigators/.

How to apply

Feasibility Study applications should be submitted in MS Word and/or PDF format to the relevant Hub Manager using the contact details provided below. If your proposal is relevant to more than one Hub please send a copy to all the relevant Hub Managers, using the details provided in the contacts section, and indicate to which Hub your proposal is most closely aligned.

Applications should be no more than four sides of A4, using 2cm margins and a standard 11pt Arial font. Proposals should include, but not be limited to, the following content:

1. Research title, institution name and full name of the Principal Investigator (PI).
2. Start date and duration. (Projects should typically last for a maximum of 6 months)
3. Identify which call topic(s) is being addressed and identify any elements of the proposal which are relevant to the other Manufacturing Hubs.
4. Context, aim and objectives of the research, including a description to explain how the study fits within the overall vision of the Hub and how it supports one of the research priority areas.
5. A statement of the novelty of the proposed research, including some evidence that it is not being addressed elsewhere.
6. A description of the methodology to be used, including a timing and resource allocation plan.
7. Provide details of any access to Hub equipment or facilities required and include costs and associated timescales.
8. A description of the tangible deliverables from the Feasibility Study (what does success look like?)
9. A plan to show how you will attract further funding if your idea is feasible and the research is successful.
10. Any evidence of industrial interest or support.
11. A brief track record of the applicants relevant to this research area.
12. Justification of resources, summarising Directly Allocated (investigators, estates costs and other DA costs), Directly Incurred (staff, travel, consumables, other DI costs.), and Indirect Costs. For Directly Incurred Staff costs, you must confirm that this is to fund existing staff within your research group (staff do not need to be named in your proposal, although you may wish to do so). Additionally, a limit of 3.75hrs/week is imposed for Investigators, regardless of the number of co-investigators*.

    *(this clause is included to ensure the majority of resources are directed towards carrying out research activities)

Assessment process

Submissions will be considered by a panel consisting of Hub Investigators supported by independent assessors to ensure a fair and unbiased process. In order of importance, the evaluation criteria for applications will be:

1. Suitability: Does the proposal address one or more of the topics outlined in the call and is the proposal at an appropriate TRL?
2. Research Quality: Is the proposal likely to result in high quality research outcomes, in the form of journal publications, patents etc.?
3. Novelty: Does the proposal contain genuine scientific novelty and is the work timely? Is it being addressed elsewhere?
4. Relevance: Is the proposal relevant to the interests of industrial partners or represent the opportunity to significantly improve the U.K.'s manufacturing capability?
5. Ambition: Does the proposal offer suitable levels of challenge, ambition and risk? High-risk, high return studies are encouraged.
6. Potential: Is the approach credible and will the team be able to deliver? If feasibility is demonstrated is there potential for developing a larger collaborative project, either at a similar fundamental level or at higher TRLs?
7. Planning: How well has the proposal been planned? Are the requested resources appropriate to deliver the proposed programme within the timeframe and have they been fully justified?

Contacts

Applicants are asked to consult their university's research office ahead of submitting a proposal to this call, in order to be clear of the requirements for meeting the deadlines set out above.

For more details, please contact the relevant Hub Manager using the details below:

Future Composites Manufacturing Hub – lee.harper@nottingham.ac.uk or alex.hammond@nottingham.ac.uk

Future Electrical Machines Manufacturing Hub – FEMMhub@sheffield.ac.uk

Future Metrology Hub – metrology@hud.ac.uk

Future Photonics Hub – contactus@photonicshubuk.org

Annex A: Future Composites Manufacturing Hub

Research must be novel and fundamental, addressing low TRL (1-3) sustainability problems in composites manufacturing. Applicants are invited to submit proposals that are complementary, but distinct, to the current research being conducted by the Hub (www.cimcomp.ac.uk/#research).

Proposals must clearly address the sustainability issue of fibre reinforced composites, reducing the overall carbon footprint during the component manufacturing stage and at the end of life. Proposals must fit within one of the Hub's priority research themes:

1. High rate deposition and rapid processing technologies

Proposals in this area should focus on overcoming manufacturing related challenges to reduce material wastage and scrap, whilst ensuring suitable quality and rate. Projects developing new feedstock materials or conducting extensive material test programmes will not be funded.

2. Design for manufacture via validated simulation

Proposals in this area should focus on the virtual design and development of composite manufacturing processes, capable of establishing process viability and arising component quality. Simulation tools for example, could support the design for disassembly and value recovery of end of life materials.

3. Manufacturing for multifunctional composites and integrated structures

Proposals in this area should demonstrate cost-effective and sustainable routes to produce multifunctional composite structures at high rate, reducing energy consumption and CO_2 during manufacturing as well as in-service. Multifunctionality may include mass/ heat/ charge transport capabilities, but these must be delivered within structural configurations, such as doubly-curved surfaces, sandwich panels and plates with stiffeners. Projects developing new multifunctional material formulations will not be funded.

4. Inspection and in-process evaluation

Proposals in this area should focus on developing or improving the capability to make in-process measurements to evaluate preform or component quality, enabling corrective action to be taken to reduce/eliminate rework and scrap. Projects developing inspection and NDT techniques for post-moulded or in-service components will not be funded.

5. Recycling and re-use

Proposals of interest in this area include demonstrating manufacturing methodologies with the potential to produce structural components from recyclates at industrial production rates, reducing the dependency on virgin materials. This could include life cycle analysis studies to demonstrate the reduction in energy consumption for new manufacturing technologies that utilise composite recyclates. Projects developing new recycling methods or characterising the properties of recyclates from new fibre recovery methods will not be funded.

All proposals should include a sustainability statement, making it clear how the research will support the sustainable manufacture of fibre reinforced composite materials to produce structural components for high-performance applications. Proposals will only be funded if they express a clear benefit to improving the sustainability of composite components during the manufacturing phase, beyond the well-established lightweighting benefits anticipated during the in-service phase.

Proposals and enquiries should be directed to lee.harper@nottingham.ac.uk or alex.hammond@nottingham.ac.uk

Annex B: Future Electrical Machines Manufacturing Hub

The research programme of the FEMM Hub is structured around two main Grand Challenges:

Grand Challenge 1 – Manufacturing-led innovation in electrical machines

This theme is concerned with realising the dividends that come from much closer integration between innovations in electrical machine design and advanced manufacturing methods.

1.1: Realising novel machine design freedoms from innovative manufacture.
1.2: Manufacturing of features for in-service monitoring.
1.3. Manufacturing of light-weight and multi-functional structural components.

Grand Challenge 2 – Process Innovation, Monitoring and Simulation

This theme is focused on the numerous processes that underpin electrical machine manufacture. The research draws heavily on modelling and simulation to explore the influence of current and emerging processes on final machine performance.

2.1: From nominal core properties to in-service performance.
2.2: Manufacturing high performance coils and ultimate control.
2.3: Manufacturing technologies for flexibility and customisation.
2.4: In-process tracking and tractability for zero-defect manufacture of electrical machines.
2.5: Sustainable manufacturing of electrical machine components for the circular economy.

These two central Grand Challenges are complemented by a series of PhD student projects and feasibility studies funded under first call in 2020 (details of which are available in the 2021 annual report at: https://electricalmachineshub.ac.uk/outputs/reports/)

Proposed research projects must be at low TRL (1-3) but have a potential route to eventual utility to UK manufacturing industry. Proposals are invited that are complementary to, but distinct from, the current research portfolio of the Hub. We would particularly welcome proposals concerned with re-manufacture, recycling or repair technologies for electrical machines to complement our recently initiated new Grand Challenge in the sustainable manufacturing of electrical machines.

Proposals and enquiries should be directed to FEMMHub@Sheffield.ac.uk

Annex C: The Future Metrology Hub

The Future Metrology Hub has two key research themes:

Theme I: Embedded Metrology will build sound technological foundations by bridging four formidable gaps in process and component-embedded metrology.

Theme II: Metrology Data analytics will create a smart knowledge system to unify metrology language, understanding, and usage between design, production and verification for geometrical products manufacturing.

The Hub recently carried out a research roadmapping exercise to determine the academic priorities necessary to meet industry's changing needs. This roadmap has been used to inform our choice of call topics. You may also find the key themes and findings useful in preparing your proposal. A downloadable copy of the report can be found under the engagements page of the metrology Hub website http://metrology.org.uk/ We are seeking proposals which address the following topics:

Novel approaches for the Human-metrology interface

Measurement is affected and influenced by humans in terms decisions of what, how and when to measure. Likewise, results need to be interpreted in line with the purpose for the measurement. In a step towards autonomous metrology-informed control of the manufacturing environment, there are a number of under-researched areas at both ends of this interaction. Proposals are welcomed for, but not limited to, novel ways of (i) interpreting information that influences measurement (standards, operating procedures, etc), (ii) mimicking, augmenting or replacing the human aspects of planning, execution or interpretation of measurement, (iii) visualising or communicating large volumes of measurement data.

Novel methods for future inspection in manufacturing

Manufacturers would like to remove the need for final inspection, which is perceived as a cost, a bottleneck, inconvenient use of factory footprint and in the best case simply verification. A stepping stone towards removing inspection is autonomous, ubiquitous trustworthy measurement with low cost and low impact on production time. We welcome proposals for the feasibility of new types of measurement systems that could make a step change in reducing at least one of the following parameters: cost of measurement, lost production time, environmental impact or uncertainty of final inspection. We will consider proposals related to new in-line or on-machine measurement where the aim is to reduce final inspection.

Novel Methods for improving performance through metrology

The benefits of embedded metrology are not limited to improvements in finished product quality. The ability to continuously measure and monitor variables in service has the potential to significantly improve performance in a variety of ways such as improved testing capability, more efficient and sustainable processes, greater capability etc. Proposals are welcomed for applications of embedded metrology which have the potential to significantly improve process or product performance in areas other than quality. We are particularly interested in proposals targeted at improving sustainability.

For more information about these topic areas or to submit an application to the Future Metrology Hub, please direct enquiries to metrology@hud.ac.uk

Annex D: The Future Photonics Hub

Proposals, and any questions, to be submitted to The Photonics Hub email address: contactus@photonicshubuk.org

1) Photonic integration

Contacts: Prof Jon Heffernan, Prof Gilberto Brambilla

Proposals involving integration of two or more of the above themes are particularly welcome. Example topics could include:

- Integration of 2D materials into III-V and silicon photonics platforms.
- Large-scale, low-cost optical fibre integration with III-V sources.
- Integration of diverse materials to enable quantum technologies such as superconducting nanowires, diamond films and quantum dots.
- Integration of sources with planar passive devices leading to miniaturised systems e.g. for Lidar.
- Methods to enable efficient planar coupling of on-chip waveguides to detectors.
- Novel methods of improving efficient out-coupling from waveguide technology.

2) Speciality optical fibre

Contacts: Prof Jayanta Sahu, Prof David Richardson, Prof Michalis Zervas

The focus is on two key challenges in fibre manufacturing to meet short and long-term industry needs: improving loss, gain, power handling and increasing the transmission window to enable new applications.

- Developing volume-scalable, cost-effective, manufacturable special (passive and active) fibres for use in ultra-high-power light sources and transmission.
- Designs and processes for cheaper, more reliable and efficient near-IR fibre lasers and systems.
- High power diode pumped Raman fibre lasers.
- Diode-pumped visible fibre lasers.
- Next-generation solid-core and microstructured fibre technologies interfacing with other optical and electronic platforms.
- Manufacturing technologies such as 3D printing for making optical fibre preforms.
- Optical coating materials for optical fibres in high power lasers and harsh environment applications.

3) Light generation and delivery

Contacts: Prof Jon Heffernan, Prof Francesco Poletti

Novel devices emitting in the near- to mid-infrared spectral region, such as semiconductor lasers/LEDs and fibre supercontinuum sources that generate new markets in areas such as:

- Sensing, imaging, healthcare and spectroscopy. This platform will drive the transition required for growth in these photonics-enabled industries, from discrete components to low-cost, compact, integrated platforms.
- New methods for low energy and resource efficient manufacturing of semiconductors wafers.
- Reliable and integrated mid-IR delivery fibres.
- A manufacturing platform for compound-glass hollow-core fibres.
- Novel fabrication methods for microstructured fibre pre-forms (e.g. 3D printing) to improve fibre precision, yield, flexibility and integration with new light sources.

4) Silicon photonics

Contacts: Prof Graham Reed, Prof Goran Mashanovich

Silicon photonics has made major advances in functionality at the chip level, but integration remains an obstacle to the development of the technology. This platform focuses on solutions to this key challenge.

- Hybrid integration of silicon with different materials including $LiNbO_3$, $BaTiO_3$, $Pb(Zr_xTi_{1-x})O_3$.
- Multi-layer photonics solutions.
- Fabrication of large arrays of switching elements and control of those switching elements via electronic integration.
- Backside coupling into/out of photonic chips.
- Integration with novel devices such as detectors and sources for mid-IR wavelengths.
- Growth, deposition and characterisation of mid-IR materials for sensing applications.
- Integration with microfluidics.
- Fabrication techniques for couplers between waveguides of different heights on the same chip.
- Novel aspects of programmable photonics.

5) Large-scale manufacture of metamaterials and 2D materials

Contacts: Prof Nikolay Zheludev, Prof Kevin MacDonald, Prof Dan Hewak, Prof Martin Charlton

Metamaterials and 2D materials provide extraordinary properties that disrupt conventional ideas on device performance. This platform focuses on research areas including:

- Large scale manufacturing of metamaterials.
- Electrically pumped compound chalcogenide semiconductor lasers.
- 2D Chalcogenide FET sensors for quantification of enzymes and bacteria.
- Energy storage using emerging chalcogenide based compound semiconductors.
- Novel devices or manufacturing processes for flexible photonics, nanostructured photonics, and hybrid displays.

For more information about The Future Photonics Hub, see www.photonicshubuk.org

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