Autonomous Manufacturing

Call type: Expression of interest

Closing date: 16 April 2015 16:00

Related themes: Digital Economy, Engineering, ICT, Manufacturing the future

Summary

High-value manufacturing industries play a key role in enhancing the economic competitiveness of the UK. Regardless of the industrial sector, UK manufacturing is driven by technological change and intellectual ingenuity. Academic research is a vital component of the UK’s highly-skilled manufacturing pipeline – improving production systems, incorporating modern ICT, and training the next generation of manufacturing professionals.

Autonomous systems, which have the ability to learn, adapt and take decisions, have already been labelled as revolutionary technologies of the future in many sectors (Eight Great Technologies). Their application in manufacturing presents the opportunity to increase productivity, flexibility and reliability, add value in a competitive arena and compensate for an ageing skilled workforce. However, their complexity has prevented their widespread adoption and a number of challenges remain before this can be realised.

EPSRC’s Manufacturing the Future theme works to create, capture and accelerate the benefits of ground-breaking research for future UK manufacturing. Two priority research areas for the theme are Innovative Production Processes and Manufacturing Informatics. Autonomous manufacturing is at the interface of these priority areas.

EPSRC expects to fund a number of research programmes of up to 5 years in length, focused on the research challenges that underpin autonomous manufacturing. EPSRC will aim to support a number of large, long-term, multidisciplinary research projects and will provide up to £10 million for this call.

This call seeks expressions of interest to submit a full proposal. The submitted expressions of interest will be assessed at a short-listing panel in early May 2015 and those that align most appropriately with the scope for this call will be invited for the full proposal stage. The deadline for full proposals will be July 2015 and funding decisions are expected to be made in December 2015 with projects expected to start in February 2016.

Background

Autonomous systems are those that can gain information about their environment, adapt and make decisions without the need for human intervention. Such systems can lead to decisions being made that reduce waste and risk while increasing productivity and repeatability. In the context of
manufacturing this can refer to the control of a particular task or process, the system that it is a part of or the entire supply chain.

Autonomous systems have the capacity to replace, augment or complement human activity. They have the potential to work collaboratively with humans, machines or other autonomous systems and significantly advance both physical and intelligent capabilities.

Robotics and autonomous systems (RAS) are one of the Eight Great Technologies and their application in the manufacturing sector has been identified as being important to future competitiveness and added value by recent reports including:

- A Landscape for the Future of High Value Manufacturing in the UK (http://www.ifm.eng.cam.ac.uk/resources/government/ukhvmlandscape/)

The successful adoption of information technology advances into the industrial environment is also a key feature of Industrie 4.0, a strategic initiative recently lauded by the German government. Industrie 4.0 envisages smart production facilities where autonomous systems are able to communicate with one another along the entire value chain.

The EU framework and Horizon 2020 programme also support a number of relevant activities in the area of autonomous manufacturing, and it is included as strategic priorities under both the Factories of the Future and Robotics Multi-Annual Roadmaps.

Recent EPSRC and Innovate UK (formerly the Technology Strategy Board) initiatives have built a strong research base in this area which is multi-disciplinary and has good links with industry:

- EPSRC calls for ‘Future ICT-enabled Manufacturing’ and ‘Flexible and Reconfigurable Manufacturing’
- EPSRC Centres for Innovative Manufacturing (including the Centre for Innovative Manufacturing in Intelligent Automation)
- TSB-EPSRC joint call in Manufacturing Through Automation
- EPSRC awards for RAS Capital for Great Technologies and the associated EPSRC UK-RAS Network
- EPSRC Autonomous and Intelligent Systems call (funded in collaboration with strategic industrial partners BAE Systems, NNL, Sellafield Ltd, Cisco, Scisys and Network Rail)
- 3 RCUK Digital Economy Hubs including Horizon at the University of Nottingham
- 4 EPSRC Centres for Doctoral Training:
EPSRC CDT in Robotics and Autonomous Systems
EPSRC CDT in Future Autonomous and Robotic Systems
EPSRC CDT in Autonomous Intelligent Machines and Systems
EPSRC CDT in Embedded Intelligence

For more information about EPSRC’s portfolio and strategies, see our website: http://www.epsrc.ac.uk/research/ourportfolio/

Scope
The aim of the call is to further knowledge, understanding and innovation of the research challenges underlying the implementation of autonomous systems in UK manufacturing.

Autonomous manufacturing includes the hardware, software, sensors and communication technology that support the reasoning, planning and decision making required to achieve strategic self-directed goals. It is expected that such autonomy would confer advantages to manufacturing such as enhanced productivity, flexibility, efficiency, reproducibility or safety.

Application oriented concepts or individual solutions are within the scope of the call and these may apply to single or multiple sectors, from automotive and aerospace to food and pharmaceuticals. Approaches may yield a system that is fully autonomous or semi-autonomous (augmenting or complementing human capabilities) as appropriate to the targeted output and expected added value.

The scope does not necessarily apply only to complete systems but also to the enabling technologies that can be incorporated into autonomous manufacturing tasks or processes, such as next generation sensors or intuitive interface technologies. However research solely focussing on such technologies without incorporating these into the development of an autonomous manufacturing task or process would not be considered within scope.

Autonomy embraces traditional engineering and ICT, and as such we would expect to see interaction between research areas which may include, but are not limited to, computer science, control, design, machine learning, instrumentation, mechatronics, human computer interface and socio-technical research communities.

The expected outcome of this call is a diverse set of multidisciplinary research programmes that span manufacturing applications, processes, and value sectors, that exploit novel and adventurous research for the advancement of autonomous production technologies and systems in the factory environment.

In September 2014 EPSRC held a workshop on the theme of Autonomous Manufacturing. The outputs of the workshop (http://www.epsrc.ac.uk/newsevents/pubs/autonomous-manufacturing-workshop-report/) identified a number of key research challenges which this call wishes to address. These include:

- **Advanced collaborative working.** How can autonomous systems replace, augment or complement human activity in a real production...
environment, leading to advances in physical and intelligent capabilities, in a safe and effective manner?

- **Learning and decision making.** How can autonomous systems gain information about their environment, situation and the complex task they need to carry out, adapt and independently make decisions and plans based on reasoning? How will this lead to enhanced manufacturing capabilities e.g. flexibility and reconfigurability?

- **System design and behaviour.** How can a system for autonomy, through-life learning, collaborative working with humans (and other machines), safety and integration into the current factory environment (including legacy systems) be designed? Can a system be designed for modularity and flexibility across multiple tasks, processes and products?

- **Advanced sensing and sensor integration.** How can the multiple and variable sensor inputs present in the factory environment be managed in an accurate, reliable and robust manner, leading to data analysis and interpretation appropriate to the integrity of the data and the task? How can novel next-generation sensors for future autonomous manufacturing processes be integrated and used flexibly?

Proposals must form a coherent programme of innovative and adventurous research that takes into account one, or more, of these key research challenges. Proposals must clearly define the added value for manufacturing and relate back to the aims of the call. The majority of activity must be within EPSRC’s remit.

Some examples of types of research that could be included into research programmes are:

- Development of innovative smart architectures and control paradigms for managing multiple objectives, collaborative decision making, reasoning with partial or inconsistent information and process variability.

- Advanced modelling and simulation capabilities to capture complex tasks and processes as well as human behaviour prediction and understanding.

- New human factors knowledge and methods that specifically advance the potential for autonomous manufacturing opportunities.

- Products, machines and systems that are networked across the value chain, enabling them to independently respond to and control the manufacturing process.

- Novel approaches to the embedding of intelligence (microprocessors, software) and associated signal processing and control into existing manufacturing systems and hardware e.g. robotics.

- A step change in flexibility and physical dexterity to advance human/machine collaborative working or precision manipulation of deformable, difficult to handle or sensitive materials/products.

- Design and development towards virtual factory test-beds using simulation and predictive modelling capabilities to fully understand system behaviour (including efficacy and safety).
Examples of research that will **not** be considered within the scope of this call include:

- Research solely focussing upon enabling technologies e.g. sensor technologies or robotics in manufacturing without incorporating these into the development of an autonomous manufacturing task or process.

- Research in autonomous systems which does not have a clear manufacturing application.

- Manufacturing of autonomous products where the product autonomy does not directly link to control and enhancement of the manufacturing process.

- Industrial development and deployment (TRL >3) since this would fall in the remit of Innovate UK.

**Research programmes**

We would expect successful research consortia to:

- Conduct a programme of innovative research that is focused on promising new opportunities for manufacturing using autonomous systems.

- Draw upon emerging scientific capability in the engineering and ICT communities.

- Be multidisciplinary and where appropriate cross-sectorial (with respect to sharing of best practice and developing technology with more than one application).

- Develop a suite of people-based activities to help strengthen the essential cross-disciplinary and industrial collaborations, develop new research activities and increase impact in this area (both nationally and internationally). This might include activities such as seminars, workshops, community-building activities, mobility, cross-disciplinary research translators and outreach to industry.

- As appropriate, make use of existing networks and equipment available that are the result of previous funding initiatives.

- Have strong alignment with industry needs and a strategy for engaging with companies and other potential users of the research.

- Give consideration to downstream commercialisation, including the barriers to adoption by industry e.g. validation and verification, trust, legislation, potential impact on factory workers and the UK supply chain. In this respect, experts in the fields of economics, behavioural psychology and social science may make a useful contribution.

- Have a strategy for the progression of successful research beyond EPSRC funding. Including, for example, direct partnership with industry, involvement in Innovate UK programmes and/or collaboration with the High Value Manufacturing Catapult Centres.

- Reflect on EPSRC’s recently published Responsible Innovation framework and integrate appropriate working approaches into their application: [http://www.epsrc.ac.uk/research/framework/](http://www.epsrc.ac.uk/research/framework/)
Funding available

EPSRC are committing up to £10M for this call to support a number of large, long-term multidisciplinary research programmes (with up to £2M-£2.5M EPSRC contribution per project) of duration up to 5 years.

Proposals should incorporate an appropriate ethos of flexible funding, giving consideration to a proportion of the requested budget being used for activities such as feasibility studies, relevant networking, and realisation of a broad pathway to impact. The funding will allow the flexibility to change direction during the grant and explore new opportunities as they arise, but there should be a clear decision-making process in place to do this.

Management structures for proposed research programmes should be clearly articulated from the outset, to allow the programme to achieve the stated research objectives (including outlining structures for independent advice and oversight, deployment of financial and people resource, and increasing user engagement).

Co-creation of proposals with industry and other research users is vital to Manufacturing the Future. All proposals must be supported by at least one industrial project partner, and their support for the proposal clearly articulated.

Multi-institutional bids are welcome, although a single Je-S form must be submitted if a full proposal is invited.

Equipment

EPSRC has limited funding for capital equipment. Where possible, researchers are strongly encouraged to make use of existing facilities and equipment, including scale up facilities which may be available within the High Value Manufacturing Catapult or other universities (see Press Release for recent 'Capital for Great Technologies’ call).

If equipment is needed as part of the research proposal, applicants must follow EPSRC’s rules for requesting equipment over £10,000 in value. Individual items of equipment up to the current OJEC (Official Journal of the European Communities) procurement threshold can be included on research proposals submitted through this call, but research organisations will be expected to make a contribution to the cost.

All requests for single items of equipment above the current OJEC threshold will need to go through a separate process which will assess the strategic need for the equipment and how to ensure maximum usage. These proposals will be assessed through the separate Strategic Equipment peer review process.

For more information on equipment funding, please see: http://www.epsrc.ac.uk/research/ourportfolio/themes/researchinfrastructure/subthemes/equipment/.

The current OJEC threshold can be found at: http://www.epsrc.ac.uk/research/facilities/equipment/
Eligibility

For information on the eligibility of organisations and individuals to receive EPSRC funding, see the EPSRC Funding Guide: http://www.epsrc.ac.uk/funding/howtoapply/fundingguide/

As this call is a targeted funding opportunity provided by EPSRC, higher education institutions, and some research council institutes and independent research organisations are eligible to apply. A list of eligible organisations to apply to EPSRC is provided at: http://www.rcuk.ac.uk/funding/eligibilityforrcs/

How to apply

Submitting application

Stage 1: Expression of Interest (EoI)

Applicants should complete the Expression of Interest (EoI) form by the deadline of 16:00 Wednesday 16 April 2015. At this stage, we will not accept any other documents such as annexes, a work plan or letters of support; however the Expression of Interest should detail any communications with relevant collaborators pertinent to the co-creation of the research programme.

Although applications may be multi-institutional, only one form should be submitted per bid.

The electronic EoI form (available on the call website) contains the following sections:

- Organisation where grant would be held;
- Project title;
- Start date and duration;
- Applicants;
- Summary of the research vision (2000 characters);
- Proposed research programme (5000 characters);
- Summary of resources (including possible contributions from project partners and equipment to be requested, if any).

EOI assessment criteria

- Fit to scope of call as described in this document
- Suitability of methodology and quality of intended outputs/deliverables
- Strength of the research team
- Suitability of management plans – a brief outline of management arrangements is required. A project plan will not be required at this stage.

An EPSRC panel (with independent academic and industry representation) will short-list the EoIs based on the information provided and by assessing how the research ideas satisfy the criteria listed above.
Shortlisted EoIs will then be invited to submit a full grant proposal, subject to any specific advice that the panel may give to better align the proposed research to the scope of the call.

We reserve the right to reject proposals that are substantially outside the scope of the call or wholly beyond the remit of EPSRC without reference to peer review.

**Stage 2: Full proposals**

After short-listing the Expressions of Interest, we will invite a number of applicants to prepare and submit full proposals using the Research Councils’ Joint electronic Submission (Je-S) System (https://je-s.rcuk.ac.uk/). We will send further details on this process to applicants following the first stage (with the invitations to submit full proposals).

Please note that EPSRC reserves the right to reject a full proposal where the resources are substantially different from those indicated in the EoI form or where there have been other significant changes from the EoI.

Full proposals will be sent to independent peer reviewers, including at least one nominated by the applicant. The peer reviewers’ role will be to provide comments on the proposal against the full proposal assessment criteria. Those proposals with sufficiently favourable reviewers’ comments will be invited to respond to the reviewers’ comments and then be assessed at an interview panel.

This interview panel will include independent assessors from both industry and academia, as well as observers from EPSRC. The interview panel will rank the proposals against the full assessment criteria, using the reviewer comments, applicant’s response and overall interview performance. The panel will be asked to make funding recommendations to EPSRC.

**Full proposal assessment criteria**

In addition to ensuring that the programme of proposed research fits within the scope of the call and addresses any recommendations made by the panel (based on the EoI submission), full proposals will be assessed on:

- Quality of the proposed research including novelty, timeliness, ambition and appropriateness of the proposed methodology
- National Importance and how the research underpins or contributes to manufacturing challenges and emerging industries
- The pathway to impact and effectiveness of the activities identified to help realise these impacts, including the resources requested for this purpose.
- Applicant ability to deliver the research, effectively operate any equipment requested and the balance of skills within the research team
- Appropriateness of resources requested and management plans.

**Additional grant conditions**

In addition to the standard terms and conditions for grants, successful applicants will be required to have a signed collaboration agreement in place before the grant starts.
Key dates

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<th>Activity</th>
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<tr>
<td>Call launched (EOI stage)</td>
<td>02 February 2015</td>
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<tr>
<td>Closing date for EOIs</td>
<td>16:00 16 April 2015</td>
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<td>Short listing Panel</td>
<td>Early May 2015</td>
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<td>Call opens for invited full proposals</td>
<td>End May 2015</td>
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<tr>
<td>Closing date for full proposals</td>
<td>End July 2015</td>
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<td>Postal peer review</td>
<td>Aug-Oct 2015</td>
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<td>Assessment (interview) panel</td>
<td>November 2015</td>
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<td>Grants announced</td>
<td>December 2015</td>
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<td>Expected start date</td>
<td>1 February 2016</td>
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Contacts

If you have any questions about the call, please contact:

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Change log

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