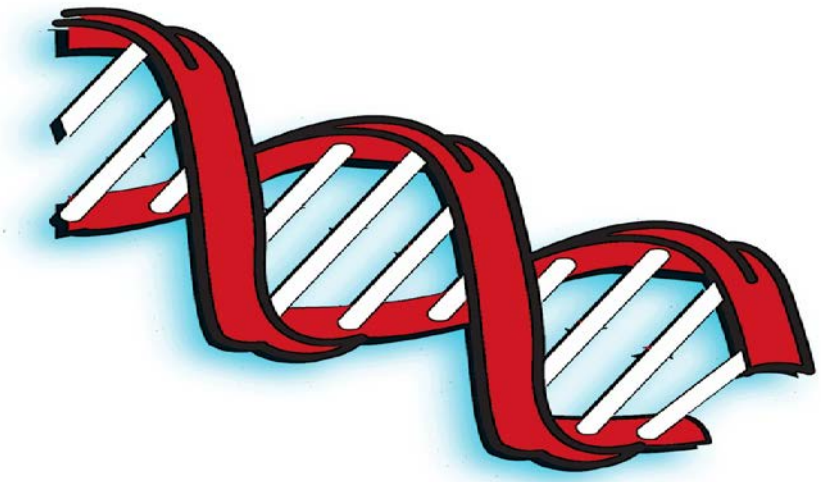
Centre for Defence Enterprise

CDE proves the value of novel, high-risk, high-potential-benefit research. We work with the broadest possible range of science and technology providers, including academia and small companies, to develop cost-effective capability advantage for UK armed forces and national security.

Synthetic biology applications in defence



This CDE themed competition for short-term, proof-of-concept research proposals aims to reach out to all sectors for highly innovative synthetic biology approaches relevant to defence and security. This will involve cutting-edge, multidisciplinary research through the application of existing synthetic biology tools and techniques, but using novel research approaches.

The total funding available for this competition is £1 million.

Competition networking event: Tuesday 30 September 2014 in Scotland at 200,St Vincent Street, Glasgow

Competition close: 6 November 2014 at 5pm

CDE: www.gov.uk/dstl/cde
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[dstl]

Defence Science and Technology Laboratory

Ministry of Defence

Synthetic biology applications in defence

Synthetic biology is an emerging, multidisciplinary research area that includes engineering, bioscience, chemistry and information technology.

Synthetic biology aims to design and engineer novel biologically-based parts, devices and systems, as well as redesign existing natural biological systems for useful purposes. It brings the principles of engineering into classical biotechnology.

In common with most emerging technologies, the potential applications of synthetic biology approaches are broad. It has the potential to address some of the more difficult problems facing UK defence and security, and opens new avenues in protecting the armed forces and civilian populations.

Technology challenges

Your proposals should address at least one of the 3 challenges described below, could address more than one of the challenges, but don't have to address all the challenges. All proposals must include a synthetic biology component, but don't have to be exclusively met by synthetic biology.

Challenge 1: exploiting synthetic biology for protection

We're seeking initial concepts for a range of uses in protecting members of the armed forces. The protection can be against challenges including physical attack (ie projectiles or blast), chemical and biological agents and lasers. We're particularly interested in novel materials with unique properties that may be useful in defence. Examples of such materials could include:

- lightweight but strong compounds that could be used to provide armour protection to equipment or personnel (we're particularly interested in very lightweight flexible armour solutions for dismounted soldiers)
- novel camouflage solutions, including active or reactive colour change materials, variable emissivity surfaces and very high performance acoustic absorbers
- self-cleaning or decontaminating coatings
- materials for eye protection, covering physical and laser protection
- materials to protect physical sensors on equipment, eg against dazzle or jamming, without blocking performance of the sensor
- novel approaches to decontamination
- novel antimicrobials for use against systemic intracellular pathogens
- wear-resistant coatings suitable for helicopter rotor blades operating in challenging environments (sand/dust/rain/snow). These coatings need to be very thin, low mass, relatively easy to apply, repairable in the field, and easy to remove without damaging the substrate
- novel, robust and practical approaches to saving lives, eg traumatic injury, sea survival, crash and post-crash survival, aircraft ejection
- materials to protect service personnel from the elements in hostile environments, eg open ocean, extreme heat and cold, humidity, desiccation, rarefied atmosphere and wind

Any novel materials proposed must involve synthetic biology at some stage of their production, but chemical modification of biologically-derived precursors is acceptable. The proof-of-concept would be a novel material structure, and production of sufficient material to demonstrate its desired property (eg strength, density). A military application must be identified, but identification of additional commercial applications is encouraged.

We're seeking novel approaches to decontamination of surfaces (may include complex and sensitive surfaces, such as electronics) and people. You must consider environmental impact acceptability.
Decontamination may be of biological (spores, vegetative cells, viruses) or chemical agents, but must be active against more than one chemical or single bacterial genus.

Decontamination must result in inactivation of the agent, ie tie-down approaches are not required. The approach must include a synthetic biology component, but doesn't have to be exclusively focussed on synthetic biology.

For novel antimicrobials, we're interested in the development of new classes of compounds with broad-spectrum activity. We're looking for synthetic biology approaches to develop novel compounds, which are systemic, not topical therapeutics. We're not interested in synthetic biology routes to existing compounds.

Challenge 2: novel sensor technologies

We're seeking novel sensor technologies whose targets could include:

- chemical and biological threat agents
- explosives
- protective coating integrity
- environmental conditions that may affect storage or transit settings, eg shock, temperature and humidity of a storage environment
- in-ground, -air or -water magnetic fields, acoustic, visible light, infra-red, and ultra-violet wavelengths (and beyond?)
- contaminants or signatures in air, water or soil that may indicate personnel or platforms such as ships, submarines or ground-based radar

Preference will be given to platform technologies applicable to a wide range of biological or chemical challenges.

Your proposals should describe how you've demonstrated preliminary feasibility. The proposed work under this competition should focus on issues such as improving confidence in outputs (high sensitivity, low false-alarm rates), and reducing the logistic burden (eg reduced weight, ease of use to reduce training requirements).

Sample acquisition, preparation and pre-processing are of particular interest, and consideration of this should be included in your proposal. Any synthetic biology approaches to address these aspects will be of great interest.

The project must include a relevant agent or analyte where these are the targets, and the platform must be flexible to allow the range of targets to be updated rapidly and easily to cope with changing threats and scenarios.

We'll prioritise novel sensor technologies that will be tested in challenging environments (fluctuating background containing potential interferents), differing matrices (air, surfaces, soil, water, body fluid) and with an agent in differing physical form (vapour, aerosol, liquid and solid).

Sensors in earlier stages of development against other signals will be considered, such as remote gravity fluctuations induced by large equipment. Other signals could include infrared or visible wavelengths, heat, sound and pressure but the relevance to defence and security must be clearly identified. Alternatively, on-the-spot identification of individuals against forensic database samples could be a security application based on analysis of biological materials.

Challenge 3: potential revolutions

We'll consider applications not covered in the 2 challenges above where existing synthetic biology applications could be modified for a defence and security purpose. Examples could be:

- very lightweight materials to be used in manufacture of remotely piloted vehicles
- multi-function materials, eg materials that provide lightweight structures and can be used as an energy store
- durable novel materials with an application to specific environments, eg high altitude, high velocity, ice and snow
- materials that can be used to produce or store power. This may be from physically very small to support an individual device or person, to large that may be fitted in a static location or large vessel (power outputs would be commensurate with the host platform's needs, eg a soldier = radio)
- reduced logistic burden supporting deployed forces, eg on-site water purification, on-site fuel production, on-site non-agricultural approaches to food production, waste disposal/recycling
- functional materials, eg self-disclosing for fatigue and corrosion, non-visible damage

However, we don't want to be prescriptive and encourage proposals where a short-term investment will allow the defence and security applications to be explored.

Any novel materials must involve synthetic biology at some stage of their production, but chemical modification of synthetic biology-derived precursors is acceptable. A military application must be identified, but identification of additional commercial applications is encouraged. These projects must offer a significant benefit over existing solutions, and we particularly welcome interdisciplinary approaches.

What we want:

- highly innovative approaches, which are significantly different from existing technologies and could bring additional operational military benefit or increased affordability
- approaches that will lead to a feasible defence application. Approaches with civil applications in addition to a defence and security application are acceptable
- multi and inter-disciplinary approaches
- proposals that consider relevant ethical, social and legal issues that may impede exploitation

What we don't want:

- existing solutions or technology, which has already been tested and found to have limited utility
- proposals that comprise a paper study, review or similar
- solutions requiring the release of genetically modified organisms into the environment
- proposals in areas where there is already a significant research effort (eg regenerative medicine, food production, water purification and biofuels).If it is a clearly defined *new* application relevant to defence and security and synthetic biology can be demonstrated, this could be acceptable
- proposals without a synthetic biology component in the approach

Exploitation

Potential routes to exploitation of the successful outcomes from completed projects will be considered on a per-project basis. Each project will be assigned a Technical Partner who'll provide the interface between the project and the defence and security community. They will, where appropriate, develop potential routes to exploitation, including exploitation outside defence if suitable. Potential routes that could be available include additional research to develop or use the technology for Ministry of Defence programmes.

Although we're seeking high-risk approaches, you should consider that the resulting materials and solutions must have the potential to be affordably manufactured at an industrial scale.

Successful projects will be required to be represented at a stakeholder day, to be held at Dstl Porton Down, to present the outcomes from the project and review exploitation routes.

Up to £3 million is available for funding follow on work in phase 2.

A final deliverable for phase 1 proposals should be a follow on proposal for potential phase 2 funded work.

Important information

Proposals for funding must be submitted **by 5pm on 6 November 2014** using the CDE portal.
Please mark all proposals for this themed competition with **'Synthetic biology applications in defence + challenge 1, 2 or 3'** as a prefix in the title. Proposals will be assessed by subject matter experts from MOD, Dstl, Engineering and Physical Sciences Research Council (EPSRC) and Biotechnology and Biological Sciences Research Council (BBSRC) using the MOD Performance Assessment Framework (PAF). If you would rather proposals were only assessed by MOD and Dstl experts please state this clearly in the innovation description at the front of your proposal.

Technical queries should be sent to **diet@dstl.gov.uk**

General queries (including how to use the portal) should be sent **cde@dstl.gov.uk**

Invitation for CDE proposals

This competition will be supported by presentations given at the launch seminar on 30 September 2014. These will be available to download via the 'synthetic biology applications in defence' competition page.

Proposals are invited from industry and academia in the UK and overseas for research that can demonstrate a proof-of-concept to meet one or more of the challenges for "Synthetic biology applications in defence".

There is no cap on the value of proposals but it is more likely that at this stage a larger number of lower value proposals (ie up to £100,000) will be funded than a small number of higher value proposals.

Proposals should focus on a short, sharp, proof-of-concept phase – up to 12 months in duration with deliverables completed by January 2016. Proposals should include a descriptive scoping for a longer programme of any duration but the proposal must be clearly partitioned with a costed proof-of-concept stage which is the focus of this CDE competition. Proposals for further work beyond the proof-of-concept stage will only be considered after the proof-of-concept stage has delivered, using the understanding gained to make an informed decision.

Read important information on what all proposals must include on our website.

CDE proposal submission process

Key dates

- 30 September 2014 Competition launch event at *200, St Vincent Street, Glasgow*
- 14 October 2014 Post-launch webinar
- 6 November 2014 Competition closes at 5pm
- January 2015 Contract placement initiated and feedback provided
- January 2016 Proof-of-concept research complete

Queries and help

As part of the proposal preparation process, queries and clarifications are welcomed:

- **Technical queries** about this specific competition should be sent to **diet@dstl.gov.uk**
  Capacity to answer these queries is limited in terms of volume and scope. Queries should be limited to a few simple questions or if provided with a short (few paragraphs) description of your proposal, the technical team will provide, *without commitment or prejudice*, broad yes/no answers. This query facility is not to be used for extensive technical discussions, detailed review of proposals or supporting the iterative development of ideas. Whilst all reasonable efforts will be made to answer queries, CDE and Dstl reserve the right to impose management controls when higher than average volumes of queries or resource demands restrict fair access to all potential proposal submitters.

- **General queries** (including how to use the portal) should be sent directly to CDE at **cde@dstl.gov.uk**