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Defence Scientific Advisory Council

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**REPORT OF A WORKING PARTY ON
MOD SCIENCE AND TECHNOLOGY SPENDING LEVEL REPORT -
PHASE 2: A DSAC PERSPECTIVE**

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This is a report by the Defence Science Advisory Council (DSAC). DSAC is established to provide independent advice to the Ministry of Defence (MOD) in the fields of Science, Technology, Engineering, Analysis and Maths (STEAM). The report does not necessarily represent the final views of the MOD or its Agencies. It should not be distributed outside the MOD without the written permission of the DSAC secretary.

Recommendations

DSAC commends the complementary arguments set out in this paper to the MOD. And we offer the following recommendations:

- R-1. Having identified a wide range of benefits that *could* be derived by the MOD from research spending, in addition to the current aims and distribution mechanisms employed for present research spending, it is DSAC's opinion that the present scope of MOD research, within its almost entirely requirements-led paradigm, is neither adequate nor fully effective. In particular, we believe that MOD needs to engage in a fully committed manner with the UK's world-class science and technology base and to exploit novel research and innovations that have the potential to underpin future game-changing capabilities. In our opinion, these critical capabilities are unlikely to be foreseen from the perspectives of present day users (customers) or traditional equipment suppliers. We also believe that, in order to offset reductions in its internal intellectual capacity and capability, the MOD needs to gain access to the "best of the best" research minds to strengthen its ability to exert influence and to build authority at both national and international levels.
- R-2. At present, we can see no credible balance between research responding to "pull" (from the existing customers or from the existing suppliers), extending essential capabilities, and research responding to the "push" (from the accelerating and broadening S and T space) that will provide radical options for MOD in the future.
- R-3. DSAC recommends that, as a matter of policy, the MOD should identify an element of its Science and Technology (S&T) research programme that is completely independent of the customer-led programme. We estimate, based upon the reasoning given in the report, that this would require a commitment of at least £150M pa in additional spending to develop opportunity-led "push" research. This activity should be designed to
- reposition the MOD within the national innovation and research ecosystem;
 - embrace an open innovation networking approach;
 - gain international authority and leadership; and
 - provide open ended, game changing, options and thus agility.
- R-4. In this report, we make a number of specific suggestions regarding possible elements and mechanisms to be adopted within such a change, including direct engagement with non-MOD players, such as major universities and the research councils, and the need for novel business and engagement models that better incentivize all potential research providers.

- R-5. The specification, procurement, funding mechanisms, delivery, and evaluation of research outcomes generated from current research spending, very largely led by internal customer requirements, should be further examined independently of the recommendations given in above.

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Introduction

1. The MOD's scientific, technological and social research objectives must underpin and enable the elements of strategy that are set out in the last SDSR¹, and are likely to be perpetuated in the next one. Here it is emphasized and accepted that the "age of uncertainty" will be subject to both "known unknowns" as well as possibly transformative "unknown unknowns". The principal panacea to such ills is said to be "agility": yet one cannot be agile without the possession of underpinning intelligence and knowledge, coupled with the ability to identify options. As a result, we believe that research is now more important to MOD than it has ever been. Unfortunately, neither this critical dependency, nor the need to exploit novel advances for operational advantage, appear to be embedded, or even recognised, within the culture of the MOD. Currently, it appears that close to 100% of the *actual* MOD research is requirements-led, effectively addressing customers' "known unknowns". Yet the SDSR clearly stated that "We need to balance long-term research focused on potential future conflicts with the immediate application of expertise on today's battlefields." At present, we believe that there is no such credible balancing.
2. Today's research spending (on requirements) is entangled with the further development and improvement of existing capabilities. Whilst it is clearly to MOD's advantage that some research is invested in incremental improvements within current capabilities, platforms, etc., by those best placed to do so, it is simply not clear that the most beneficial work is being undertaken within the current research spending limit, not least because the full range of potential benefits are not factored into the research prioritization. Determining the "right" level of such funding requires greater clarity of the potential benefits and confidence that the most effective means to achieve them is being pursued. In fact current research spending process invests 60% of the total through the suppliers, yet it is questionable whether the outputs achieved fully meet the aspirations articulated at the time of such investments². Some such S&T Research and Development (R&D) programmes³ are used to keep a prime active within key technological fields rather than generating novel research; or else may be realigned to serve the priorities of the suppliers themselves.⁴
3. We argue that the long-term focus on the nature, location, environment and vectors for future conflicts is currently receiving too little attention. MOD's research investment should be providing a capability to safeguard the nation's defence and security against

¹ Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review, HMSO, October 2010.

² At the recent 2013 Customer Board the customers themselves expressed the need to develop more meaningful measures of success against the customer requirements

³ For example the BAE Systems' Mantis and Taranis programmes.

⁴ For example Data and Information Fusion Centre, headed up by General Dynamics UK (£5m pa for 3 years) was particularly keen to turn efforts away from novel R&D towards work related to the Bowman tactical communications, for which it was the UK prime contractor.

currently unforeseeable (and currently unexpected) threats, yet this does not appear to be the case. Game changing capabilities will not emerge by simply improving or optimizing the current paradigms and platforms. In our view the current approach is too prescriptive. It is too sharply focused on either today's issues and those of the world of thirty years hence, with little consideration of intermediate timescales. Moreover, we believe that the processes and mechanisms for the procurement and distribution of current research funding (as opposed to development funding) are predicated on the false assumption that the local priorities of the current customers, primes, and suppliers, will meet future (as yet unarticulated) requirements through various managed research programmes, that are inevitably designed to extend and enhance the industry's own existing paradigms and platforms.

4. Previously⁵ DSAC has set out its view on the benefits to MOD of becoming more influential within the UK's wider, world-class research ecosystem⁶. Intellectual excellence is one of the most powerful assets that the UK possesses and yet defence research fails to recognize how to cultivate and develop this excellence for the long-term and how to stimulate adventurous and novel science in the short and medium terms. This must change. MOD should attain world-class positioning across those fields of Science, Technology, Engineering, Analysis and Mathematics (STEAM) that can anticipate novel developments in warfare and security within digital, social, urban and physical environments. This requires conclusive domain expertise and authority. It would provide the UK with international diplomatic and political benefits, as well as positional benefits within future alliance and coalitions, plus real options and leverage for "customers" within MOD and beyond (whose authority and performance will certainly prescribe future engagements, and operations).
5. **DSAC proposes that the MOD should, as a matter of policy, identify an element of its research programme that is completely independent of the development programme, enhance its overall research programme, and complement its current spending on customer requirements-led "pull" research, with a commitment of at least £150M pa in research spending on opportunity-led "push" research⁷. This should be designed to gain international authority; to provide open-ended, game-changing agility and leverage and to reposition the MOD within the national innovation and research ecosystem (the customers for this would be Chief Scientific Advisor (CSA) and Director General Security Policy.**
6. This level of spend is based upon reasoning from a number of independent directions.

⁵ MOD Science and Technology Spending Level Report - A DSAC Perspective. Phase I - Why MOD should invest in its own research programme? Version 11.1, DSAC December 2013.

⁶ In addition to the defence primes the UK has a world class, intellectually driven, well integrated and networked higher education system that is barely exploited. Most innovation comes from Small and Medium sized Enterprises acting alone (not as subcontractors to defence primes).

⁷ MOD might introduce the concept of a "Defence Research Council" here with the advantages of direct comparisons with activities in other departments, and a suitable cross government partnering vehicle.

- By comparing the responsive (push) and managed requirements (investments) balances made by Business Innovation and Skills (BIS) and the research councils⁸.
 - As the *price of entry* necessary to attract the “best of the best” minds and achieve leverage within the research ecosystems (working bottom up, costing out strategic priorities and mechanisms – see Appendix 1)⁹;
 - Through a direct comparison with the relevant elements of US Defence Advanced Research Projects Agency (DARPA) spending, on game changing science and technologies, appropriately scaled for the UK.
7. We suggest this can fulfil the MOD’s needs while at the same time helping to shape and meet part of its Comprehensive Spending Review commitment to increase expenditure through the Small Business Research Initiative (SBRI) up to £100M pa, whilst gaining further intellectual leverage and influence within other government departments, the UK’s centres of excellence within Higher Education Institutes (HEIs), and research spending by present and prospective allied nations.

⁸ A research council such as EPSRC would invest 1/3 of its funding into responsive (non managed) mode; Technology Strategy Board invests all of its funding through managed, requirements led, calls though, leading to critical deficiencies in the Small Business Research Initiative.

⁹ Within research council mode there is a known investment cost to run programmes that are research led and that are big enough to engage the UK Higher Education sector and to create communities (as has been achieved with some Research Councils UK programmes, for example). Scaling such research council investments takes some guesswork out of such costings.

Innovative Research Push

8. Research excellence and innovation, together with the ability to follow the evidence where ever it may lead, are the UK's main (only) insurance against the unforeseen. It can build new and exploitable knowledge, intelligence, expertise, adventure, early insights and authority that, in turn, can be exploited to provide options, agility and opportunities for intellectual and financial leverage. In our view, the current situation is woefully unresponsive to scientific and technological "push" and to scientific innovations. Moreover the SDSR objectives should be set against the STEAM¹⁰ research context, where the pace of change of discovery of new knowledge is actually accelerating and where the internet ensures that it is safest to assume that everybody, whether ally of aggressor, can know everything. Hence, it is essential for MOD science to be ahead of the game, rather than handicapped by being totally requirements-led, or inhibited by excessive secrecy in some areas.
9. In "Securing Britain" such research needs to underpin and justify the UK's international position as an authority and "thought leader" for next generation security, to create international partnerships in the future and to place the UK in the best possible position, playing the right role, within future coalitions. Consequently, our allies will invest in, and work with, the UK on defence because of the knowledge and capabilities that we have and they do not.
10. In our opinion, the current approach to defence research puts the nation's capability to defend and secure the future at risk. This risk can, and must, be mitigated by simulating research into novel and imaginative science through a belief in, culture of and mechanisms for speculative research. To mitigate this serious risk requires all three:
 - There should be a recognition of the absolute need for and trust in the value of novel, high quality science and knowledge as the provider of the capability to address threats and weaknesses that are both foreseeable and unforeseeable¹¹;
 - There must be a culture of supporting, enabling and providing novel and adventurous science from which significant advances in knowledge and fundamental breakthroughs can be made;
 - Mechanisms must be developed for the proposing, funding, managing, assessing and exploiting speculative, novel and adventurous research against the requirements of advancing knowledge and being good science rather than against the requirements of meeting known threats.

¹⁰ By the term "Science" we include Human, Political, Economic, Physical, Technological, Medical, Biological and Environmental aspects covered by all of the research councils (RCUK: EPSRC, ESRC, NERC, BBSRC, MRC, AHRC).

¹¹ For example, the Urgent Operational Requirements programme for Operation Herrick was only delivered due to STEAM knowledge and experience.

Issues Arising for “Push” and “Pull” Research Investment

11. MOD needs to define a wider set of “customers”. In particular, the current customer requirements-led paradigm must be extended to include those who may best exploit the UK’s excellence and innovation in STEAM research, for diplomatic advantage, positioning within multinational activities, outreach and aid to emerging nations. Note also that the “customer vocabulary” itself is not evidence of real tension, choice, or competition. Neither does it guarantee excellence, efficiency or value for money. The Department of State role of the MOD that links it to the Foreign & Commonwealth Office and the Cabinet Office must be brought to bear as the beneficiary and exploiter of the authority, positioning, and expertise from the innovative “push” research, and to safeguard it from future pressures, so that the past history is not repeated. This is about the “joining up” of interests in defence and security research. Hence there needs to be
 - an extension of the customer base;
 - a revision of the notion of “requirements” to include knowledge and ability to meet unforeseen events;
 - an extension of the STEAM supplier base to include academia and Small and Medium sized Enterprises (SMEs) (the real sources of intellectual power and innovation);
 - an MOD corporate research programme providing inspirational leadership.

12. Customers’ expectations. The expectations of existing MOD customers cannot be met merely by allocating the requirements-led budget to a series of suppliers; this is necessary, but not sufficient. They are to be met by the outcomes of the research programme. At present, all management effort appears to be front-loaded. STEAM “push”-research should both challenge and excite existing customers with innovative prospects and actionable options, that they had themselves neither envisioned nor articulated. Hence there needs to be
 - a supply of innovative knowledge from push research that goes beyond current expectations and challenges MOD thinking;
 - an ability to transform and accelerate the outputs into capabilities;
 - an ability for existing customers to engage with and assimilate “push” research and to follow-up with new requirements.

13. Incentives and Barriers. We believe that MOD needs a new business model for R&D; one that extracts much more value from the research funded. The key requirement is proper incentivisation of those doing the research to exploit it further (within both civilian and defence/security sectors) whilst providing royalty free outcomes (product and services) back into the MOD. This would give MOD sufficient control over, and access to, early stage technologies. At present, we believe that there is a disincentive for

SMEs and others to take on MOD research contracts when the MOD uses competition laws to exclude those early researchers from downstream, competitively placed, “exploiter” contracts. STEAM research spending needs to include

- incentives for researchers in HEIs and SMEs to both invent, develop and exploit;
- activity in which the Intellectual Property Rights is retained by the researchers and research that is open source;
- evaluation of research based on “advantage” rather the monetary value.

14. **MOD-EPSRC.** The MOD should establish a stronger relationship with Research Councils (RCs), particularly Engineering & Physical Sciences Research Council (EPSRC) and Biotechnology & Biological Sciences Research Council (BBSRC), and invest “push” research monies into responsive modes applications. In response, EPSRC and other RCs need to have a MOD sympathetic college of reviewers. MOD’s existing investments achieve some funding leverage, yet too often the MOD (Defence Science and Technology Laboratory (Dstl)) investment is too little to make it a critical influencer and, hence, the intellectual leverage is often very low (see Appendix 2). There is a “price of entry” required to attract aligned effort and investment from major university groups. This is analogous to the successful creation to new and cross disciplinary research communities serving RCUK strategic themes¹², each requiring a typical level of investment of £10M pa over five years.
15. **Finessing the SBRI mechanism.** The MOD commitment to SBRI needs to be nuanced and be appropriate to the defence and security sectors. The BIS / Technology Strategy Board (TSB) format is too prescriptive and 100% reliant upon managed calls. Unlike the Centre of Defence Enterprise (CDE), there is no reactive mode within SBRI where companies can bring forward radical, game changing, proposals. The present mechanism is argued for on the grounds of competition and tension, but, in fact, it reduces innovation by seeking consensus and defining competitive calls. Thus it actually delays investment (by months and years). Tension, as it appears in research council responsive mode, must be provided by competition for resources, not through simplistic like-for-like comparisons. Defence Science & Technology (DST) should welcome such competitive tension between proposals since it fosters a culture of aspiration, adventure and openness to new entrants. For this reason, BIS - should be persuaded to accept a responsive SBRI funding stream, for fast evaluation of research for defence and security applications.
16. **National “Thought-Leading” Centres.** The MOD’s SBRI commitments should include the funding of thematic, multidisciplinary consortia including HEIs, primes, SMEs, start-ups, and international partners. These should include a balance of public and

¹² The RCUK cross-disciplinary programme on the “Digital Economy”, led by EPSRC, is a good example, with the creation of three national hubs and five centers for doctoral training.

commercial interests. National centres, designed to draw in the best HEIs and minds, could be similar to those that are presently funded by EPSRC¹³, other RCs and BIS. Most UK multinational companies involved in science or technology businesses including Rolls-Royce, BP, GSK and Unilever have open innovation University Technology Centres embedded inside world-leading UK universities where industry works with academia at multidisciplinary pre-competitive research across a breadth of topics that no single company can now afford to resource internally. US Department of Defence (DoD) and DARPA have funded similar centres in US universities for many decades. MOD, in partnership with a hosting world-class university, could provide the open-ended research platform (and critical mass funding). In turn, the centres could manage the further MOD investment to co-fund novel and collaborative projects, exploiting the core, with small and large UK companies (spin in, spin out, SME, to primes), accounting for part of SBRI commitment.

17. **International Centres.** An international, topic-based consortium model that has worked well for MOD is the International Technology Alliance (ITA) run jointly with the US Army. Conceived as a means of achieving a high level of mutual benefit for the UK and USA, its key features are:
- the research topic was of recognised importance to both nations
 - the programme comprises of requirements-led research, but mainly S&T driven research on an annual rolling programme basis with innovation and new, high-quality, low TRL science critical to project selection
 - Both nations have 'vehicles' to exploit any research
 - the consortium comprises government laboratories (Dstl and Army Research Laboratory), universities and industry operating as a single research community (not as 'the UK team' and 'the USA team') all led by a single organisation (IBM) acting as a facilitator/team member but not as a prime contractor
 - new members can join and be engaged in projects, if they can make a valuable contribution
18. **International influence and partnership.** MOD, through its multidisciplinary (consortia) centres, should encourage networks and international collaborations that can draw in the best of the best scientists to contribute to its research. Presently, the programme appears to be intellectually cut off. The objective should be to influence and leverage the investments of others, both at home and abroad. These should act strategically to partner with research institutes in emerging nations.

¹³ <http://www.epsrc.ac.uk/innovation/business/schemes/Pages/ikcs.aspx>

19. **Driving the agenda.** We believe that MOD needs to become more proactive and a challenging catalyst for inspiring research done by others. Its current research role is split between its own internal activity and managing and integrating the activities of others. We recognize that the pace of change of science itself is such that the time scale between knowledge, discovery and its effective exploitation is always reducing, whilst the breadth and ambition of our science research communities is vastly increasing (including social and behavioural systems). The UK needs MOD STEAM to be more entrepreneurial within the wider national scientific community, fostering an innovation network, that is a true resource of established and internationally renowned excellence that is supporting MOD's mission.

APPENDIX A: On the Rational Distribution of Future Spending on Push Research

- A-1. DSAC is advocating the creation of a dimension to MOD research that currently does not exist. We are recommending that the funding for this work should not be spent through primes, nor should it be controlled by primes.
- A-2. We believe that it is essential that MOD becomes (again) a direct customer for research being conducted within key HEIs. We recommend the adoption of an “MOD Research Council” model for responsive co-funding and investments into research centres, translation, thought leadership, international cooperation, and talent development activities, plus a degree of partnering with the Research Councils themselves. In essence, we suggest that MOD should adopt the highly effective funding mechanisms already developed by the Research Councils. HEI-based centres should also be used to engage SMEs in novel science and technologies with both defence and civilian applications. This would provide an attractive and flexible alternative to the current “subcontracts with primes” model
- A-3. The following elements and distribution mechanisms are proposed.
- A. MOD-EPSRC and other Research Councils. MOD would share the funding of projects within the existing responsive mode panels and discipline/thematic panels. This is something that EPSRC already does with its corporate partners. MOD should pick up, at an early stage, and part fund those responsive proposals that have multiple routes to exploitation that include some options for defence and security. For example, EPSRC spends £400M per year (2013) across all its panels on “capability” research with approximately half being completely open within the UK research community.
Suggested MOD investment = £25M pa.
- B. MOD Cross Disciplinary Research Centres. These are academic centres, entirely upstream of and more research focused than the centres in D, below). They would be hosted by world class HEIs. By seeking alignment with the hosts’ strategy and investments, cross disciplinary thematic communities (cf Digital Economy initiative) would be created. These would provide cross-disciplinary leaders for further defence and security across all physical, bio and social sciences. A key feature is that they would be integrated and internally tensioned. Host HEIs should receive a 5 year commitment of £5M pa. Governance of these entities would require careful thought. The aim is to broaden the upstream research funnel and supply “game changing” radical options.

Suggested MOD investment = 6 x 5M pa = £30M pa.

- C. Talent Development. This would involve the establishment of MOD Research Fellowships for leading thinkers in the UK. The model would be a five year “buy out” of academics and/or industry scientists. These Fellowships would be hosted at appropriate national and international institutes or Dstl. The aim would be to build thought leaders and an intellectual and fundamental foundation for next generation security and defence: e.g. say 20 concurrent fellows (3/4 academic, 1/4 from industry) including a linked Post Doctoral Research Associate-type position.
Suggested MOD investment = £5M pa
- D. National STEAM Thought Leadership Centres: in collaboration with Royal Society, Royal Academy of Engineering, learned societies etc. These should be funded as consortia and have the ability to, to place shared cost, or fully funded, research with SMEs and other HEIs. Consortia could include primes, SMEs and HEIs and should take a long term (over the horizon) view, with translational activities similar to IKCs.
4 centres x £7.5M pa
Suggested MOD investment = £30M pa
- E. International centres: shared initiatives with international partner countries, for example, ITA type of activity, facilitated by industry or HEIs, governed by defence programmes.
Suggested MOD investment = £30M pa
- F. International Networking: diplomacy through science, spending on building up research partnerships and influence with present allies and allies of the future (BRIC etc)
Suggested MOD investment = £10M pa
- G. Active PM, representation of possible routes to exploitation and of MOD-internal customers’ interests, and evaluation, by Dstl.
Suggested MOD investment = £20M pa

APPENDIX B: MOD and EPSRC

B-1. The current breadth and commitment of MOD's co-investments with EPSRC is not at a level that can achieve significant intellectual leverage or attract the "best of the best" to contribute to MOD's agenda. In this Appendix we summarize the current collaborations and co-funding which amounted £4.1M (£3.8M cash) in the year 12/13, and £12.8M (£11.4M cash) over five years. These figures were kindly provided to DSAC from EPSRC's internal MIS.

B-2. This information is useful for future discussions in the light of our recommendations (given in Appendix 1 and Sections 3.4, 3.6, and 3.7) as it removes some uncertainty, misunderstanding, and possible double counting. It is also clear that often the MOD contribution is a very small percentage of the total grant value. Thus it mostly represents "interest" rather than "commitment", and most likely achieves relatively little influence.

Analysis by Year

Dstl/MOD All Collaboration and Co-Funding				
Decision Date FY	Sum of Total Grant Value	In Kind	Cash	Total Value Contribution
2008/2009	39,319,417	397,502	4,465,860	4,863,362
2009/2010	17,102,009	94,800	2,224,915	2,319,715
2010/2011	23,449,274	444,001	155,000	599,001
2011/2012	11,092,332	262,427	600,278	862,705
2012/2013	35,154,633	158,500	3,971,973	4,130,473
Grand Total	126,117,665	1,357,230	11,418,026	12,775,256

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MOD SCIENCE AND TECHNOLOGY RESEARCH SPENDING - PHASE 2: A DSAC PERSPECTIVE

Analysis by scheme

Dstl/MOD All Collaboration and Co-Funding				
FYDecisionDate	(All)			
Grant Category and Scheme	Sum of Total Grant Value	In Kind	Cash	Total Value Contribution
Fellowship				
EPSRC Fellowship	390,713	10,000	0	10,000
Leadership Fellowships	4,520,215	24,001	0	24,001
Research Grant				
First Grant Scheme	101,559	25,000	0	25,000
Follow on Fund	199,096	20,000	0	20,000
Platform Grants	2,336,273	216,927	0	216,927
Programme Grants	27,631,195	45,000	155,000	200,000
Standard Research	69,453,719	881,302	11,203,026	12,084,328
Training Grant				
Centre for Doctoral Training	21,484,895	135,000	60,000	195,000
Grand Total	126,117,665	1,357,230	11,418,026	12,775,256

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MOD SCIENCE AND TECHNOLOGY RESEARCH SPENDING - PHASE 2: A DSAC PERSPECTIVE

Analysis by responsive/targeted (note large grants, first grants and fellowships are all responsive)

Responsive or Targeted Call				
FY/Decision Date	(All)			
Call	Sum of Total Grant Value	In Kind	Cash	Total Value Contribution
Responsive				
Standard Research	13,446,945	159,801	1,251,172	1,410,973
Targeted				
Autonomous and Intelligent Systems	7,484,759	0.00	600,277	600,277
Centre for Doctoral Training	2,200,000	80,000	0	80,000
Centres for Doctoral Training	19,284,895	55,000	60,000	115,000
Challenging Engineering 2010	885,271	30,000	0	30,000
Creativity in Composites Engineering	6,416,783	12,000	90,000	102,000
Dstl Signal Processing	1,921,800	0	960,900	960,900
Engineering Large Grant	3,630,420	30,000	0	30,000
Engineering Science: Components Panel	395,951	7,500	0	7,500
Enhancing Damage Tolerance	5,647,147	295,000	2,823,573	3,118,573
EPSRC Manufacturing Centres	5,597,150	20,000	0	20,000
Fellowship - Early Career	390,712.88	10,000	0	10,000
Follow-on Fund 5th Call	100,047	10,000	0	10,000
Follow-on Fund 7th Call	99,049	10,000	0	10,000
Graphene Engineering	2,839,350	50,000	0	50,000
Innovative Manufacturing	5,119,391	4,000	0	4,000
Leadership Fellowship 128F1301	1,869,274	1.00	0	1
Leadership Fellowship 128F1417	1,151,930	4,000	0	4,000
Leadership Fellowship 128F1460	1,499,011	20,000	0	20,000
Materials Responsive Mode	1,733,313	0	560,985	560,985
Maths-Manufacturing Call	948,883	35,000	0	35,000
Platform Grants	2,336,273	216,927	0	216,927
Programme Grants	21,214,411	33,000	65,000	98,000
Signal Processing (Full)	7,484,206	0	3,742,103	3,742,103
Integrated Knowledge Centres	4,569,566	1	0	1
IDEAS Factory: The Batt IF1436	1,915,174	0	1,264,015	1,264,015
First Grant-Revised 2009	101,559	25,000	0	25,000
EPSRC Centres for Innovation	5,834,394	250,000	0	250,000
Grand Total	126,117,665	1,357,230	11,418,026	12,775,256

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APPENDIX C: TORs and Working Party Membership

C-1. Study Terms of Reference

The study sponsor is Minister for Defence Equipment Support and Technology. The purpose of the study is to provide a DSAC perspective on research spending with particular emphasis on future needs. This is to inform the Minister and senior civil servants within MOD of DSAC's view and justification of the appropriate level of spending on research

C-2. Anticipated impact of the study

A clearer understanding of what research is, why it is done, and how much it costs
Any MOD milestones or decision points that affect the timing of the study

This issue was to be addressed in two phases.

- Phase 1 - addressing the question 'why S&T research is essential to MoD?'
- Phase 2 - addressing the questions 'how much should be spent and on what?'

C-3. This document summarises DSAC's Phase 2 response. Phase 1 was summarised in an earlier report (MOD Science and Technology Spending Level Report - A DSAC Perspective: Phase I - Why MOD should invest in its own research programme? Version 11.1, DSAC December 2013.)

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