The New Strategist Journal

The New Strategist

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Fighting Complexity With Complexity: Recognising the New Science in NSS

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> There are known knowns; there are things that we know that we know. . . there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns, the ones we don't know we don't know.
>
> Donald Rumsfeld, US Secretary of Defence (February 2002)

Rumsfeld's comment — while hardly succinct — accurately describes the 'new and unforeseen threats' (Her Majesty's Government 2010a, p. 4) of the international environment midway through the second decade of the twenty-first Century. There are threats that we know and act on, those that we make predictions and plans on and those that we can do nothing about until we know more. Providing security in this ever-expanding threat environment, whilst enduring a share of cross-Governmental funding withdrawals, strategic actors face a monumental task. To overcome this two pronged challenge we must make important efficiency gains, but more critically, we must re-evaluate the role of the British armed forces in the twenty-first century. If we are to maintain the existing capability of our armed forces and fulfil the fiscal duties to the Exchequer, we must explore fundamentally new perspectives on our ends, the means at our disposal and critically, the ways in which we seek to achieve them. Complexity Science offers one such perspective.

This article highlights core principles of complexity science that can be extracted from their origins in natural science and reapplied in the many different realms of the social sciences. It then demonstrates how the implicit adoption of these principles in both doctrine and reform has created substantial improvements in capability and efficiency. Finally, it establishes the potential for effective reform and greater value for money by explicitly recognising complexity science as a policy-generating concept, and through a greater embrace of its principles at an organisational, strategic and operational level in the NSS and the Strategic Defence and Security Review (NSS/SDSR) 2015.

The arguments and recommendations of this paper rest on two assumptions, the first and most fundamental is that security in the global threat environment is directly linked to capability in conflict situations. Consequently, an effective warfighting force will see a more secure Britain, whether this force is actually engaged or an idle deterrent. The second assumption is based on the work of Antoine Bousquet in *The Scientific Way of War*, that tracks parallel paradigms between science and warfare. Therefore, the increasing evidence of a complexity paradigm in science has

— and will continue to — prompt a shift towards complexity warfare. (Bousquet 2009, pp. 163-215) Based on these assumptions, an early recognition of complexity science as a new paradigm within security will foster strategic innovation in the field of warfare that is likely to develop in the coming decades. Strategic innovation along complexity principles offers a fresh approach to tactical and strategic defence practices and may see us ahead of the game in force development solutions. Of course, being ahead of the game in defence means ensuring greater security in a changing world.

It may seem that the argument of this paper is to embrace a paradigm for strategic thought — and in some ways this is correct. However, to avoid the 'paradigm scepticism' of Paul Cornish one can simply describe the complexity paradigm in his own terms: 'there is no paradigm: anything goes.' (Cornish and Grouille 2010, pp. 16-18) Complexity science seeks to embrace the unknown, to recognise the limits of our knowledge and act to deal with whatever uncertainties may arise, it seeks — very simply — to generate order from chaos. (Holland 1998)

To establish complexity science as an effective model for security policy, two conditions must be met: first, that the concepts from the science are applicable to defence; and second, that there have been demonstrated benefits from initial adoption of complexity principles — even if this has been done implicitly. The first two sections of this article will address each concern, before the final section will look towards NSS2015 and make recommendations for explicit adoption and further complexity inspired reforms that might help to regenerate British defence to better face the challenges of twenty-first century complexities.

1   Complexity, strategy and complex strategy

1.1   Complexity

Complexity science is a systems-based science that seeks to explain the world through a different set of assumptions and processes to traditional scientific methods. In place of reductionist modelling, complexity theorists embrace the holistic properties of complex systems that defy traditional scientific techniques using various concepts, often developed through new dialects of the 'language of mathematics.' ('Casti 1994, p. 3) This section highlights the key concepts that can be applied to defence and security. Mitchell Waldrop (1992, p. 11) describes something complex as a system where 'a great many independent agents are interacting with each other in a great many ways.' Whilst hardly comprehensive, this highlights the fundamental property of complex systems — they revolve around the linkages between many agents, not simply the agents themselves. Complexity science studies this interaction and it is the importance of linkages that renders traditional reductionist science inadequate in dealing with complexity, and that leads to the principle that the whole is greater than the sum of its parts: the concept of emergence.

Emergence describes the second stage of organisation. The interaction of various simple elements simultaneously creates complexity and leads to the emergence of a greater system than the sum of its parts. The same principle applies to amino acids that form proteins, which form cells, which form human organs, which form humans, which form societies. At every stage, the combination of agents creates a greater whole and emergence forms any complex system. Emergence generates complex systems, but complexity science adopts the term complex adaptive systems. This

clarification specifies the nature of the systems as organic, in flux, and thus constantly evolving. These biological terms help to illustrate the active, dynamic properties of complex adaptive systems. Through the dynamic collaboration of many agents, these systems create a self-organised state. Mitchell Waldrop (1992, pp. 11-12) argues that it is this dynamism that separates 'complex systems' from merely 'complicated systems.'

Understanding that the complex systems visible in the world are built from subsidiary systems or 'clusters' (Waldrop 1992, p. 171) and the linkages between these clusters, and understanding that the systems and their clusters at every level offer properties greater than their contributing agents, explains the component parts of complex adaptive systems, but doesn't explain the process of how this self-organisation actually occurs. The concept that does is prediction and positive feedback. The organic system is constantly looking to the future, since each agent within a complex system is affected by interactions going on between other agents as well as those actions it is taking itself. As such, even at a cellular level, agents are making predictions, as John H. Holland emphasised: 'every living creature has an implicit prediction encoded in its genes.' (cited in Mitchell Waldrop 1998, 146) Essentially, Holland argues that every creature gambles for survival with its gene pattern. In a complex adaptive system, each agent makes a prediction based on its own assumptions — or models — of how the world is, or is likely to be. Given this, the constantly shifting outside world means constant feedback into these prediction models and thus constant adaptation of the whole system to maintain its position.

The final major principle, that is best known through chaos theory's 'butterfly effect' [1] is that of non-linearity: initial inputs into a complex environment can have exponentially large impacts later on. This means that traditional 'mechanistic,' (Bousquet 2009, pp. 37-53) Newtonian physics cannot suffice in explanation. New mathematical principles and concepts must be created to account for the almost incomprehensible range of possible outcomes. However, even with mathematical innovation, the limits of science must be recognised and therefore, as Casti (1994, p. 276) highlights: there must be an 'explicit recognition that system complexity is a subjective, not an objective, property.' Despite the growing ability of mathematicians, physicists, biologists, computer scientists and the many other applied disciplines to understand and increasingly predict complex systems: chaos is not confounded. [2]

These concepts of *emergence*, *complex adaptive systems*, *dynamism*, *self-organisation*, *prediction* and *nonlinearity* [3] form the basis of complexity science, the systems, prediction and adaptation expressed through them is the basis for application to British defence and security. Before directly applying these to the present threat environment, these principles will be assessed against existing classic and contemporary strategic literature.

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[1] The first use of this metaphor is attributed to Edward Lorenz on 29th December 1979 at a meeting of the American Association for the Advancement of Science.

[2] Allusion to Gray, C. S. *Strategy for Chaos: Revolutions in Military Affairs and the Evidence of History*, 2002, Frank Cass Publishers: London, pp.80-103

[3] The key principles summarised here will continue to be italicised throughout the paper to make clear their application at all stages.

1.2   Complexity & classical strategy

Clausewitz is a common citation in strategic discussion a thinker of great prestige whose agreement with one's own argument seems to assure its validity. In a sense a very similar tactic is used here, however the wealth of evidence of complexity principles within *On War* justifies this endorsement — and further evidence will be examined to justify the evidence of complexity within current strategic studies.

One might respond to the professed complexity in Clausewitz by emphasising that he builds a polarity between 'yourself' and 'your enemy' built on linear and simplistic premises: what benefits him harms me 'in equal measure' and vice versa. However, the wisdom in Clausewitz's writing lies in his shift to reject this polarity. Further, having established the 'pure concept of war,' (Clausewitz 1984, p. 86) Clausewitz proclaims that 'the probabilities of real life replace the extreme and the absolute required by theory.' (1984, p. 89) As Beyerchen (1993, p. 61) suggests, '[Clausewitz] understands that seeking exact analytical solutions does not fit the nonlinear reality of the problems posed by war.' Clausewitz's contribution to the complexity school can be best represented by three concepts: *friction*, *probability* and *adaptability*.

Friction is the term that explains why the pure concept is insufficient in explaining real war: 'everything in war is very simple, but even the simplest thing is very difficult.' (Clausewitz 1984, p. 138) Clausewitz expresses the countless difficulties that emerge to deny any decision-maker an efficient mobilisation and deployment of force. Friction, in twenty-first century terms, is uncertainty. Clauzewitz's recognition of the complexity in war is further evident in the claim: 'no other human activity is so continuously or universally bound up with chance.' (1984, p. 96) Not only do things happen purely by chance, the effects of this are shaped and shape further events depending on other factors that occur by chance — a process both 'continuous' and 'universal.' The ripples of *non-linearity* follow such, that even breaking down all of the first stage of options can never hope to secure an answer for what occurs at the tenth stage. Chance, therefore is nineteenth century terminology for complexity.

Given the fact that total engagement isn't a reality, a commander's strategy must essentially assess threats, risks and probabilities of both the surrounding political and geographic environment and of his enemy. To assist in this process, Clausewitz seeks to provide bounds to the range of probabilities along different scales: 'moral, physical, mathematical, geographical and statistical.' (1984, p. 215) narrowing the extremes of scope but allowing for any outcome within these bounds. Utilising his process of eliminating extremes and examining probability we generate a system of strategic *emergence*, and *self-organisation*. But regardless of the strength of strategy generated, probability is not certainty and 'with uncertainty in one scale, courage and self-confidence must be thrown in the other to correct the balance.' (Clausewitz 1984, p. 97) Strategic *emergence* coupled with the boldness to act on one's intuition comprise the commander's tools to effectively manage the volatile and uncertain environment. Essentially, they generate his *adaptability*.

The uncertain environment cannot be understood through the mechanistic 'pure' concept, and instead must allow for the continual existence of 'known unknowns and... unknown unknowns.' (Rumsfeld 2002) The genius in Clausewitz's work was his dismissal of pure war as nothing more than a useful thought experiment; his explanation of chance, probability and adaptability are in context synonymous with several of the complexity principles. Terminology aside, the evidence of his analysis seems to suggest that Clausewitz was a complexity pioneer.

1.3   Complexity in current strategy

Complexity science has increasingly been evident in current strategic discourse — this paper is by no means the first to make the link. Broadly, two arguments have been made: first, the widely accepted claim that the conflict environment is inherently complex and second, the less developed idea that we should adopt complexity principles in our engagement in it. James Moffat (2003, p. 49) offers a concise contribution to both of these ideas via the following table:

Complexity Concept	Information Age Force
Nonlinear Interaction	Combat forces composed of a large number of nonlinearly interacting parts
Decentralised Control	There is no master 'oracle' dictating actions of each and every combatant.
Self-Organisation	Local action, which often appears 'chaotic,' induces long-range order.
Nonequilibrium Order	Military conflicts, by their nature, proceed far from equilibrium. Correlation of local effects is key.
Adaptation	Combat forces must continually adapt and co-evolve in a changing environment.
Collectivist Dynamics	There is a continual feedback between the behaviour of combatants and the command structure.

This model suggests an 'Information Age Force' capable of operating in the complex war environment and — though termed differently — the concepts are interchangeable with the complexity concepts expressed in this paper.

T. Irene Sanders (1998, p. 74) offers a strategic application to prediction in the complex business environment. She claims that 'the key to foresight is learning to recognise your system's initial conditions as they are emerging, so that you can see change coming, respond early, or influence it to your advantage.' This *nonlinearity* is developed as Irene Sanders highlights these initial influences — or 'strange attractors' (1998, p. 66) — as the force that holds complex systems together, creating boundaries and allowing dynamism within each system. (1998, p. 67) Understanding the strange attractors — or what in security might be termed 'potential trigger points' (PTPs) — means a far greater knowledge of the system as a whole. Though not termed as such, these are the principles underpinning 'Risk Analysis' — a pre-existing example of complexity science applied in strategy. By seeking to assess likelihoods and create bounds to the area of choice, the strategist seeks to account for uncertainty. Cornish and Dorman (2013, p. 1194) propose a greater shift to a risk-based approach to strategy allowing us to 'understand strategic challenges... [and] also to improve the quality of our engagement with them.' Adopting risk embraces the idea of uncertainty and complexity and seeks a strategy to mitigate against it.

With core scientific principles; an expression of the classical strategic relevance; and an understanding of some contemporary literature; the established concept of complexity has sufficient credibility for application to British defence. Thus the concepts of *emergence, complex adaptive systems, dynamism, self-organisation, prediction* and *nonlinearity* form the theoretical background for further analysis

2 Britain — complex adaptive strategy or stationary state?

The United Kingdom naturally has a very large strategic bureaucracy crossing several government departments. Rather than assess the many departments contributing to security, this analysis will focus on government-wide and defence strategy.

2.1 A strong Britain in an age of complexity?

The cross-governmental strategy as laid out in the NSS (NSS) and Strategic Defence and Security Review (SDSR) attempted to reconcile the widening threat environment with management of the ten-year £38 billion overspend; matching ever-expanding ends with ever-tightening means. The generated strategy shows clear evidence of complexity principles, implicitly suggesting the concept as one mechanism for solving the dilemma.

Complex Adaptive Systems (CAS) and *emergence* are evident at three strategic levels: through international networks, governmental networks and military networks. Since Military networks are covered in detail in Defence doctrine, focus at this stage will remain with the political levels. The NSS evaluates the United Kingdom's strategic position in the context of the 'increasingly interconnected world,' where uncontrollable 'shocks' could have profound economic or geopolitical effects. (HMG 2010, p. 16) However, alongside this threat is the opportunity for Britain — 'at the heart of many global networks-' (HMG 2010, p. 21) to exploit international economic networks for security purposes and use 'the networks we use to build our prosperity. . . to build our security.' (HMG 2010, p. 9) Highlighting opportunities and threats in the international system demonstrates a clear recognition of our national position within the global *complex adaptive security system*, however, there is also persistent reference to a 'whole of government approach,' [4] (HMG 2010, p. 10) highlighting the need for policy *emergence* from all areas of the national security bureaucracy. This commitment is embodied in the creation of the National Security Council (NSC) that is meant to offer 'prompt, coherent, coordinated and informed decision-making on all strategic defence and security issues.' (HMG 2010, p. 69) Persistently reinforced by the intention to be 'better connected, (HMG 2010, p. 18) cross-governmental networking on security issues emerges with international networks as two key themes across the NSS and represent a vital adoption of complexity through strategic networks at the national and international level.

Prediction and *non-linearity* in security terms mean the identification of risk and early impacts to control them or what might be termed 'horizon-scanning' and 'upstream threat control.' Recognising the importance of PTPs, the NSS embraces 'horizon scanning' through the adoption of risk analysis through a 'strategic all-source assessment,' (HMG 2010, p. 66) allowing decision makers to 'prioritise the risks which present the most pressing security concerns.' (HMG 2010, p. 26) Just as Clausewitz recognised complexity and sought to eliminate extremes to narrow our range of strategic options, analysing risk generates a mechanism for managing complexity and allocating resources effectively. Building a 'cross-Whitehall approach to horizon scanning' (HMG 2010, p. 67) seeks to enable a better chance of anticipating and responding to threats as they emerge. Just as John H. Holland's genes are implicitly predicting in order to survive, so too are strategists explicitly in order to secure.

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[4]Emphasis removed.

Prediction is useless without a commitment to action and — considering *non-linearity* — the best action is to 'tackle at root the causes of instability.' (HMG 2010, pp. 11, 33) Upstream threat control commits the UK to engaging in initial conditions (PTPs) to pre-empt and disrupt potential future threats. Again, focussing on a cross-governmental approach, the SDSR points to the NSC as the structure to 'integrate diplomatic, intelligence, defence and other capabilities on preventing international military crises.' (HMG 2010, p. 10) A combined recognition of *prediction* and *non-linearity* in the NSS is seen through the dynamic perception of climate change as a 'risk multiplier,' compounding unrest and instability in fragile states, with a disproportionate effect on the developing world. (HMG 2010, p. 17) Overall, *non-linear threat prediction and early action* through horizon scanning and upstream engagement with PTPs represents a key asset for the continual development of the UK's security strategy.

Upstream action though necessary is not sufficient to maintain security, an ever-changing world requires an ever-changing force. *Dynamism* is consistently represented in national doctrine through two terms: adaptability and resilience. On the former, the NSS expresses the strategic imperative of recognising uncertainty and remaining adaptable to manage this. (HMG 2010, p. 15) The SDSR then proposes the actual requirements for providing this adaptability by; diversifying and extending helicopter capabilities, building 'broad spectrum...capabilities' and extending the reserves to 'make the Army more mobile and flexible...better adapted to face current and future threats.' (HMG 2010, pp. 4, 17 & Independent Commission to Review the United Kingdom's Reserve Forces 2011) With the latter, the NSS offers a comprehensive explanation of 'Risk and Resilience' summarised in the seventh 'National Security Task': to 'Provide Resilience for the UK by being prepared for all kinds of emergencies, able to recover from shocks and to maintain essential services.' (HMG 2010, p. 33) Seeking adaptability to act effectively in conditions of uncertainty and ensuring resilience to recover and manage shocks demonstrates attempts to ensure a dynamic security provision able to deal with the complex environment.

The NSS demonstrate clear complexity trends at three levels: organisational, strategic and operational. When applied, the complexity principles generated in Section One combine into these areas: organisationally through *multi-level strategic networks*; strategically through *non-linear threat prediction and early action*, and operationally through *dynamic forces*.

2.2 British defence — complex adaptive security system?

Given the apparent doctrinal evidence of complexity principles at a national strategic level, the diffusion of this to defence level doctrine is the first stage in determining the success of its adoption. Since national government decides the budgets for the MoD, it is unsurprising that the MoD will seek to pander to the national strategic priorities, however a genuine adoption of the complexity concept should see expansion from the ideas presented in the NSS and an embrace of the ideas at both service and departmental level. Considering complexity science at the organisational, strategic and operational levels established through the NSS it appears that there is substantial development in the British Defence Doctrine (BDD) and through the process of defence reform since 2010.

Organisational: multi-level strategic networks

The network focus of NSS primarily highlights the international context of the national strategic network emphasising the opportunities to exploit our existing international trade networks for strategic gain. (HMG 2010, p. 21) The BDD affirms the national network through cross-government cohesion in force development for the international threat environment through the 'Defence Conceptual Framework,' (Ministry of Defence 2011, pp. 4-6) however — as expected — the primary network focus of BDD is on military networks. The complexity enabled focus ranges from contextual understanding of actions and multiplied impacts on all parties in a crisis, to Network Enabled Capability (NEC), and most prominently through 'joint action.' (MoD 2011, pp. 5-7) NEC presents perhaps the most natural embrace of complexity principles by 'allowing effective decision-making and agile synchronisation of activity' (MoD 2011, pp. 4-15) through integrated information systems such as Intelligence, Surveillance, Targeting, Acquisition and Reconaissance (ISTAR) systems. (Defence Reform Steering Group 2011, p. 44) This NEC capability — advocated particularly in the *Royal Air Force's British Air and Space Power Doctrine* (2009) combines the networked organisational concept with *dynamism* and *self-organisation* and represents an important complexity enabled concept. However, it is the extensive commitment to providing a 'joint force approach' (DSRG 2011, p. 7) that represents the major organisational shift towards a military network.

The Defence Reform report published by an independent commission offers details on the creation of a '*Joint Forces Command*' (DSRG 2011, pp. 44-47) to manage cross-service programmes, 'deliver output focussed capabilities and capitalise on potential synergies to deliver enhanced joint operational effect.' By allocating certain funds to a joint body, the military will be able to fully fund 'promising forms of macro-innovation to obtain new capabilities.' (Luttawak 2012, pp. 85-97) Interestingly, all three services recognise their role in the joint force concept and — in doctrine at least — appear willing to offer capability to joint forces, either nationally (Army 2012a, p. 124) or as part of a 'joint multi-national and multi-agency force.' (Royal Navy, p. 3) This organisational shift recognises the uncertainty regarding the roles forces will have to adopt in the future and demonstrates a very significant shift to providing a more organic management process for defence provision

Strategic: non-linear threat prediction and early action

The scope of horizon-scanning and upstream engagement is less prevalent at the MoD doctrinal level since these activities require a cross-governmental approach, somewhat beyond the strategic remit of the MoD. The military is primarily a crisis management tool and is unlikely in their own doctrine to focus on wider measures of economic incentives, aid provision and development investment; however the BDD recognises the military as one component of an 'integrated approach' (MoD 2011, pp. 1-11) across government. For example, the Royal Navy highlights its upstream 'International Engagement' role through humanitarian operations and disaster relief. (Royal Navy, p. 4) The primary focus in the core defence function is on the non-linearity in conflict — preparing for your 'known unknowns,' allowing for 'unknown unknowns' and planning for the unplanned. The BDD emphasises that 'commanders should anticipate the effects of being surprised...[and] make appropriate contingency plans.' (MoD 2011, pp. 2-6) While defence level doctrine adds little to upstream prediction and action, the MoD's recognition of the *non-linear* threat

environment stresses the importance of preparing for the unexpected and positioning itself at the 'global seams,' (The Royal Marines n.d., p. 4) generating *dynamic* response capability.

Operational: dynamism and self-organisation

Adaptability and *Resilience* were championed characteristics in national strategic doctrine, and are fully embraced in both the BDD and the Defence Reform report:

> The British Military are renowned for their ingenuity. The innate ability to make do, and to respond to unexpected circumstances with pragmatism and industry, gives the Armed Forces the capacity to adapt and to overcome both opponents and local difficulties. (MoD 2011, 5A-4)

At the very core of the British forces is *dynamism*, and thus the preservation of a 'culture that encourages people to think creatively, and to be resourceful and imaginative,' is a priority for the MoD (2011, pp. 2–7). This is seconded by a similar approach to developing strategy by allowing 'fresh thinking and innovation, distilled in doctrine' (MoD 2011, pp. 5–12) and allowing our defence organisation to be 'lean and agile such that it can continually improve and adapt to changing circumstance.' (DSRG 2011, p. 11) Clearly, the principles of *dynamism* within the complex systems of defence and government are reflected consistently in both political and military doctrine. Notably, this expressed commitment to the culture of innovation, develops into an integration of the principles of *self-organisation* and *emergence*.

Defence level *dynamism* is clearly represented through service doctrine due to its direct relevance in military strategy and tactical operation. The Royal Marines — for example — regard 'acute situational analysis, lateral thinking, creativity, nimbleness and incisive independence of mind' as essential to working in complex 'hybrid conflicts.' (2011, p. 4) *Transforming the British Army* (2012, p. 1) expresses the Army's need to 'place adaptability and responsiveness at the core of its design.' Chris Donnelly states this point with even greater emphasis, stating that 'we should subject any new idea, reform or proposal to a simple test: will it increase our adaptability?' (Army 2012b, p.192) The Royal Navy's vision also highlights the requirement to be 'an agile, learning Navy' ensuring swift updates in doctrine and strategic practice in response to environmental and political changes. Clearly, there is a wealth of service-level commitment to the provision of a *dynamic* force.

The *self-organising* capacities are generated through increasing commitment to decentralisation of command. Developing from a desire to avoid political intervention at higher decision-making levels, at lower levels is a doctrinal commitment to 'a style of command that promotes decentralised command, freedom and speed of action and initiative.' (MoD 2011, pp. 5-4) In the Air Force Doctrine (2009, p. 65) this is developed via NEC, allowing 'mission command to be extended, with confidence, down through the tiers of command.' By allowing semi-autonomous elements to *self-organise*, the defence system can utilise these connections to ensure the first point in the Defence Reform report: the emergence of 'a single Defence framework that ensures the whole is more than the sum of its parts.' (DSRG 2011, p. 4) Thus *self-organisation* — the final complexity principle — is evident as a key aspect of the *dynamic* force. The doctrine of the Armed forces represents a system that is adaptive, *dynamic* and *self-organising*, but through a prism of organisational structures and techniques.

2.3   Conclusions on the doctrinal adoption of complexity principles

In the application of the complexity principles distilled in Section One, three levels
of applied complexity emerged, relating to the three vital levels of strategic deci-
sion making: organisational, strategic and operational. There is clear and extensive
doctrinal evidence of complexity science within several levels of British strategic bu-
reaucracy. The core, abstracted concepts of complexity have organically produced
the themes of *multi-level strategic networks*, *non-linear threat prediction and early ac-
tion* and *dynamism and self-organisation*. These themes form the framework through
which the actual impacts of complexity will be analysed.

3   Embracing complexity and enabling capability

Doctrinal adoption of complexity principles appears widespread at all levels of de-
fence strategy, however the defence bureaucracy is notoriously resistant to major
reform. If there is little actual adoption of the advocated principles, then there will
be little evidence of their success and the strength of recommendations for further
adoption is questionable. Analysis shows that the diffused complexity principles
evident in British strategic and military doctrine have — perhaps surprisingly —
impacted substantially on defence and security provision, particularly given the ex-
tensive reforms since the 2010 NSS/SDSR.

A balanced account of the extent of reform must take into account more than
just the Government's own reports since they can tend to overstate the effective
implementation of reform proposals and national strategic directives. Departmental
reviews are considered alongside Parliamentary committees' own assessments; the
independent annual reports of Lord Levene; and an independent report on reserves
in the future force, in order to assess the translation of complexity principles from
doctrine to practice regarding the three defence complexity themes.

The organisational doctrine of *multi-level strategic networks* has been exten-
sively translated at many levels from international to military. However, certain
failures in reform at the national level have called into doubt the full adoption of
networking principles. At the international level, the Government's *Annual Report
on the NSS and Strategic Defence and Security Review* (ARNSS/SDSR) has recog-
nised that there has been limited progress on 'working in [international] alliances
and partnerships' (HMG 2013, p. 8) but also claim that this is often due to in-
ternational constraints, rather than lack of UK effort or Government failure. On
a wider level, embracing international networks appears to have been successful.
The ARNSS highlights successes in strengthening our diplomatic network, expand-
ing our influence across the world; (HMG 2013, p. 11) in international cooperation
on counter-proliferation; in global counter-terrorism efforts; and in developing an
effective response to the growing cyber threat.' (HMG 2013, p. 14) Generally then,
international network development — both organisationally and in terms of key se-
curity priorities — seems to have been successful — even if only presented in the
Government's own review of its progress.

In developing national strategic networks the NSS was most ambitious and —
perhaps unsurprisingly — this appears the area where the most difficulty has emerged
when implementing change. The House of Commons Joint Committee on the NSS
specifies two shortfalls in the role played by the NSC; first and most fundamental in
terms of national networking — the NSC is not 'enabling the Government to work

as a coordinated whole.' (Joint Committee on the NSS 2012, p. 4) Considering the initial purpose of the NSC to bring a 'tightly coordinated approach across the whole of government,' (HMG 2010, p. 9) this represents a major weakness in reform implementation and the adoption of complexity principles. Linked to this, the Committee report that they 'continued to look for evidence of the NSC considering long term and blue skies topics and... found little.' (JCNSS 2012, p. 9) This strategic deficit in the highest governmental security authority is echoed by the Public Administration Select Committee Report, '*Who does UK National Strategy?*' (Public Administration Select Committee 2010, p27-29) They recognise that strategic thought must 'adapt... to changes in our strategic environment,' but claim that they are 'yet to see how [the NSS] marks any significant improvement in qualitative strategic thinking from its immediate predecessors.' Claiming a lack of strategic networking, they argue that 'different departments discuss and understand strategy in different and incompatible ways.' Thus, 'departmental collaboration... falls short of what individual departments can do independently,' a far cry from ensuring that the 'the whole is more than the sum of its parts.' (DSRG 2011, p. 4) Overall, the Parliamentary criticism appears damning, however this critique of national strategy development does not reflect the wider developments in the national strategic network that have seen a huge shift in emphasis and adoption of networked collaboration.

The Defence Select Committee's publication Towards the next Defence and Security Review: Part One (2014, p. 76) recognises the success of 'the comprehensive approach' during the operations in Afghanistan and Iraq. The key success is represented in the execution of the National Security Tasks as laid out by the SDSR. Their assessments made at six month intervals claim that as of October 2013, 90% of the 220 tasks determined by the SDSR are 'on track,' with 28% 'completed,' 33% 'fully on track,' 30% satisfactory and just '6% problematic.' (Her Majesty's Government 2013, p. 5) Further, specifically in strategic networking areas — such as supporting bilateral relationships, developing an international diplomatic networks, multi-lateral counter proliferation approaches and a Government-wide commitment to international development programmes — there were no objectives lower than 'satisfactory.' The multi-department 'Conflict pool' has led to the NSC's development of the £1 billion Conflict, Stability and Security Fund (CSSF), and demonstrates progressive national collaboration in upstream action. Despite the strategic concerns of the Public Administration Select Committee, the implementation of the SDSR has translated the vast majority of its intended outcomes into reality — meaning that the *multi-level strategic networks* evident in doctrine have progressed in reality.

As established in BDD and Defence Reform, the development of defence level strategic networks lies primarily in the joint force concept and NEC. Lord Levene, in his second annual review on defence reform highlights that the established JFC is a 'lean and agile organisation [and]... a model for other parts of Defence.' (DRSG 2013, p. 3) It is this joint command centre that develops significant tactical networking capability through funding and development Defence Information Systems such as C4ISTAR [5] (DRSG 2013, p. 3) capabilities. Finally, military networks are developing in the informational sphere. In the battle-space complex adaptive information network 'every individual is considered to be a sensor... able to contribute to a *Shared Situational Awareness* (SSA) [which allows us] to make better decisions before our adversaries can make theirs. This 'self synchronisation' (Cebrowski and Garstka

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[5]C4ISTAR — Command, Control, Communication, Computing, Intelligence, Surveillance, Target-Acquisition and Reconnaissance.

1998) — enabled by this multi-nodal, collaborated information system — almost returns to the biological origins of complexity science, but offers a substantial insight into the developing informational networks allowing sensory agents to coordinate and self-organise in complex conflict environments.

Development of non-linear threat prediction comes through risk-based approaches. The publication of a review of 'horizon scanning' by John Day in January 2013 looked to form a new 'cross-government horizon scanning programme [that] joins up existing work and groups within different departments to form 'communities of interest' so as to maximise capability.' (HMG 2013, p. 35) This integrated approach sees horizon scanning come under the remit of the Cabinet Office — allowing an effective flow of conclusions and reports to the NSC through the Minister of the Cabinet Office. A coordinated approach to horizon scanning alongside a new 'Countries at Risk of Instability Index' (HMG 2013, p. 10) and the CSSF demonstrates a very clear effort to provide effective *non-linear threat prediction* and is reflected at a lower strategic level through a renewed emphasis on risk management within the MoD as outlined in the *Improvement Plan*. The shift has involved private consultation and sees 'Chief Risk Officers' employed at each TLB area with a Defence Board member overseeing them. This structure allows strategic risk to be identified alongside a 'risk owner,' [6] resulting in an action plan to be developed in order to allow systematic mitigation and management of risk. In this case, the MoD combines *prediction* and *early action* in order to mitigate the emerging threats.

On a less causal level of 'risk + action plan,' the wider Government seeks to act to mitigate risks in the international context. Primarily this upstream engagement is a multi-departmental system based under the 'Building Stability Overseas Strategy (BSOS). Consisting of 'Early Warning Analysis' complimented by an 'Early Action Facility (EAF) of £20 million per annum,' (HMG 2013, p. 9) the BSOS programme demonstrates a wider Governmental commitment to embracing non-linearity and attempting early conflict-prevention. The success of the conflict pool programme has meant a development into the previously mentioned £1 billion CSSF. At both the national and defence-wide levels, *non-linear prediction and early action* have been made a high priority, demonstrating financial commitment to a fundamental complexity principle.

Government level *self-organisation* is often difficult given central guidance from Cabinet, however, the Government's NSSreview highlights the Cabinet Office Briefing Rooms (COBR) as an effective 'mechanism for coordinating decision-making and emergency response across Government.' (HMG 2013, p. 34) Lord Levene's second annual report — the first after the 'New Operating Model' became fully operational — praises the genuine adoption of decentralisation, restating that 'universal support for the concept of greater empowerment and shared top level determination [can] make [decentralisation] work effectively.' (2013, p. 2) Effective decentralisation of the six Top Level Budgets (TLBs) (MoD 2014, p. 7) allows for a more organic self-organisation process between Head Office, the Defence Infrastructures Organisation, Joint Forces Command and the three service chiefs. Finally, the independent approach saw adaptability generated through adopting a 'Whole Force Concept' involving greater integration of specialist reserve troops such as doctors and nurses — in numbers that would be unaffordable as full time regulars. In addition, the GEMS Ideas scheme, created by the MoD draws ideas through an online platform for 270,000 MoD employees fostering innovation into developing capabilities and new

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[6]Risk bearer might offer a clearer representation.

ways of cutting bureaucracy. (MoD 2014, p. 11) These creative solutions express elements of innovation that have surpassed Lord Levene's radical defence reform concepts, further developing the importance of specialist agents' role in providing *dynamic* capabilities within the complex adaptive force structure.

Given the perceived nature of Government bureaucracies as a leviathan-like creature, resistant to change and embroiled in political horse-trading, the speed and extent of reforms to defence and security systems since 2010 is remarkable. The result is evident, within the Government's drive to improve the efficiency, capability and cost-effectiveness of our defence provision, *multi-level strategic networks*, *prediction and action in the non-linear threat environment* and *dynamism* and *self-organisation* emerge as a codification of many different principles proposed by academics and strategic reformers in the last decade. Given its pervasion, and given the now justified assumption that adopting complexity principles can remove inefficiencies no longer acceptable with today's tightening budgets; the final section of the analysis points towards further adoptions that may continue to generate improvements in providing security.

4   The future of complexity in a complex future

4.1   Organisational: multi-level strategic networks

The Multi-Level Strategic Networks concept emerged from complexity principles applied to the political, defence and service level doctrines. However, this concept has potential to clarify organisational understanding of the entire security environment. Embedded in this idea is recognition that the polar distinction between 'Grand Strategy' and 'Military Strategy' (PASC 2010, p. 7) is too simplistic. Instead the developed, multi-departmental security system operates on several strategic planes: the international network; the national network; the defence network. Understanding strategy as the ways to match given *means* to desired *ends*, (Cornish 2012, p. 70) recognises that at each network level, different *means* and more specific or broader *ends* require different strategies. Recognising different network levels helps improve two strategic processes: improved communication with other agents or organisations on the same network level and clear horizontal platforms to establish formal vertical governance structures between higher and lower levels. To understand this improved communication, consider the recent expansion of diplomatic personnel in the international network. Rooted internationally, diplomats can collaborate with DFID civil servants and Secret Intelligence Service Officers, align themselves with embassy defence attaches, and communicate effectively with representatives in multilateral institutions such as the UN, NATO and the IMF — all horizontal communication in the international network. Equally, these international network agents can engage in other network levels through the vertical governance structure of the FCO. The FCO is able to translate international network communication through the Foreign Secretary into Cabinet, and thus into other national level network agencies.

A ready developed opportunity for integrated cross-network governance structure is the NSC, which could provide the crucial link between different security providers operating in their own networks with their own means (Defence, Home Office, security services, FCO etc.). The NSC could provide strategic collaboration through the integration of network-level strategies from these departments into a coordinated security strategy for the UK. Developing the concept of the NSC as a multi-network

coordination structure, there should be a further development of the NSC to address the problem of strategic shortage made by the Joint Committee on the NSS. In order to operate as a more effective strategic coordinator, the NSC should be leading the development of national strategy. To do this, it should have three contributing elements:

First, a *permanent horizon scanning team*: remaining within the cross-government horizon scanning programme under the remit of the Minister for the Cabinet Office — since he also sits on the NSC. National security horizon scanning should be active and reporting routinely — not simply on a commissioned basis — so that the NSC can frequently update strategic objectives. The Joint Intelligence Committee could contribute to this through the provision of real time information that can build a more complete picture of future threats and PTPs. [7] Whilst developing from the network concept, this constant reevaluation, funded separately from the fiercely guarded budgets of individual agencies and departments seeks to create effective prediction and will ensure that future PTPs are constantly being revisited and reevaluated, and new threats are also highlighted as early as possible.

Second, an *expert panel of strategic planners* able to take the horizon scanning team's results and provide coherent and coordinated threat management plans for emerging PTPs. Consisting of specific agency experts, academics and other less partisan experts this group will generate response plans for all major PTPs and for multiple combinations. Rather than COBRA having to generate crisis management strategy in real time under high pressure, they will be able to refer to and adapt previously considered strategic responses to more efficiently combine security capabilities into bespoke force packages. Thus the network concept also helps to generate *early action*.

Third, *agency representatives* to relay strategy to all strategic bodies. In the event of a developed threat, these central plans, then reconsidered and adapted by the COBR mechanism can be diffused to the relevant security providers with strategic guidance — the developed operational plan can then be formulated at agency level within the remit of the strategic directive provided. These representatives are vital for the functioning of the concept. They must be within the highest levels of their agency in order to ensure an effective difussion of the strategies generated in the NSC. Without this link, the NSC's influence will be limited and its strategic coordination ineffectual. However, with effective diffusion, the *prediction*, *early action* and efficient coordination generated through the NSC's strategic network will foster an evolving and adaptive strategic narrative and provide a constantly innovating strategic body right at the centre of Government.

Further embracing NEC — arguably the most direct application of complexity science — can enable rapid battlefield coordination, information superiority and potentially decision-making superiority. Utilising the principle of complex adaptive systems and thus understanding each information receiver as an information sensor allows us to adopt a Shared Situational Awareness (SSA) system of information provision. This opportunity to translate technological innovation into capability transforming systems must retain two caveats: first, information security, and second, C2 discipline. With an SSA model, every actor on the battlefield is linked into the network; just one sensor captured by the enemy could mean the elimination of any information advantage. Thus, technology must be used to ensure access is only available to the intended user — whilst retaining its utility in a high-pressure

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[7]Potential Trigger Points (See Section One)

conflict environment. Basic fingerprint recognition for example is unhelpful in a high intensity contact situation. The challenge then is to provide an easy-to-use and secure method for unlocking information technology devices — be they visual or audio: security measures must not reduce utility. Secondly, operational command of a SSA system is vital to avoid information overload. Computer systems will be vital in combining different intelligence strands into patterns in the command hub. However, commanders must be wary of issuing tactical directives — NEC systems will not allow command a closer view of the immediate vicinity than the soldier on the ground. Commanders must focus on ensuring that soldiers and officers have maximum information of the wider battle situation, allowing them to make informed tactical decisions. The results of highly trained, well-informed soldiers with a clear strategic direction could emerge into a devastating combination to enemy combatants.

4.2   Strategic: prediction and early action

The recent developments in risk analysis and management through the horizon scanning represent a commitment to accessing quantifiable 'uncertainty embracing' techniques. Recognising our limited control in the threat environment, documents such as *Strategic Trends out to 2040* and *Future Character of Conflict* published by the Development, Concepts and Doctrine Centre (DCDC) offer tangible *prediction* on which strategic decision makers can base their risk management plans. Provided the NSC and other decision-makers establish these plans and maintain 'capability slack' to account for unpredicted possibilities or the 'unknown unknowns', this process of *prediction* and planning offers an effective model. Risks and trends considered, adopting a non-linear approach to threats promotes early engagement to neutralise or influence PTPs. Again, there is a caveat: upstream engagement such as the EAF should always be enacted with caution. Just as successful action to influence PTPs can prevent risks evolving into major threats, poorly considered upstream intervention can cause exponentially large problems down the line. Since non-linearity has no regard for 'good' and 'bad' intervention, maintaining caution in upstream engagement is essential to avoid exponentially damaging effects.

Successful early engagement in the international threat environment — through upstream engagement — requires an integrated cross-governmental approach, and the UK has had this. The integrated BSOS programme is now a fundamental aspect of *early action* to prevent security crises, but it also represents an improving sociological, anthropological and political understanding of other states in the international network. Establishing this anthropological intelligence can help perceive the specific context in which engagement might be sought. Combining it with the NSC's PTP management planning can be a vital key in developing an agile, adaptive and appropriate engagement strategy that will not have negative non-linear repercussions. Thus, through a process of early investigation of PTPs — through diplomatic networks, for example — decision makers should generate strategy from the future and the present: *predictive* capabilities emerge from both horizon scanning and the international network.

4.3   Operational: adaptability and self-organising coordination

To maintain the same capabilities under severe budget restrictions and force reductions, there must be an improvement in the adaptability of remaining forces. The

Future Force 2020 model recognised this and formed a brigade force structure reflecting a complex adaptive system model, whilst maintaining the traditional bounds of the system based on hierarchy. An agile, high-readiness reaction force with specialist add-ons provides a swift, but enabled deployment of a tailored force package to suit the specific demands of an operation. The embrace of complexity science has allowed this more efficient use of the limited means available by improving the adaptability of those means.

Justifying self-organisation in a system based on centrally diffused strategy and coordinated operational orders is difficult. However, the British success throughout history is regularly attributed to the adaptability, 'ingenuity' and 'initiative' of forces personnel. (MoD 2011, p5A-4-5; Farrell 2008, p. 788) Lord Levene recommended the decentralisation of TLBs to the six key defence providers, highlighting the value of a central strategic direction alongside allowing '*delivery units. . . the levers they need to run their business.*' (DSRG 2011, p. 7) The same logic at the lower level would see strategic objectives diffused from central command, and operational command decentralised to specific capability providers. If the strength of British defence is in the quality and initiative of its people (Army 2012b, p. 182) and decentralised command is an effective management strategy, it follows that a broadly *self-organising* command model should have distinct advantages. There is logic behind the shift to a 'federal' management system rather than a strictly 'hierarchical' diffusion of command, however the MoD should always conduct systematic evaluation of each decentralisation decision 'on its own merits.' (DRSG 2011, p. 7) As with *early action*, poorly managed decentralisation can be dangerous, leading to lack of direction and losing the tight coordination brought about by networks — always centrally diffused strategy must remain paramount.

Further, before any further decentralisation takes place, there must be a complete reevaluation of the education and training given to armed forces. Mungo Melvin's contribution to *The British Army 2012*, 'Educating and Training the Army for an Uncertain World' outlines this need to develop intellectual capital within the service at command level, but also to develop 'in-service education' equipping soldiers with the capacity to 'learn, and successfully relearn, how to successfully employ different forms of military power.'**(2012: 185)** In the age of the 'strategic Corporal,' (Makay and Tatham 2009, p. 5) embracing the multi-dimensional soldiering of twenty first century conflict — educating our people to fulfil that adaptive role and then empowering them with certain operational freedoms within the broader strategic remit — could provide the sort of *self-organising* command structure that transcends the inefficiencies and communicative problems of the traditional hierarchical force structure and fosters a more dynamic, evolving defence provision. This includes educating soldiers at all levels on the principles of complexity within war and security. The potentially enormous strategic effects of events such as Sergeant Blackman's murder of an Afghan fighter in September 2011 — if adopted by the Taliban as counter-coalition propaganda — should be used to demonstrate to soldiers the non-linear consequences of mistakes in the field. A full understanding of this, as well as of the organisational, strategic and operational complexity ideas expressed here, can educate soldiers and officers to better understand some features of the current threat environment. The demands are extensive: we require better-educated, more adaptable, agile, effective and empowered troops in the 21st century; but the reason is simple — to maintain our defence capability, we need to provide more with less.

Finally, more important than any specific adoption of specific complexity ideals

is an intellectual recognition and embrace of complexity science's value in security strategy. Paul Cornish's theory of 'paradigm scepticism' (2011) should be heeded — complexity does not have all the answers. However, the fundamental premise of complexity is that we don't know everything. Hence, intellectual engagement with complexity will allow research into further strategic applications of its principles, either through predictive mathematics, or through further network developments. From here an evolving environment of strategic investigation could emerge. This intellectual process may lead to no substantial discovery — the findings may be inconclusive — however, given the evidence already of its initial success, it may also offer the next revolution in understanding and improving our strategic defence and security capability.

4.4   NSS: Embracing the New Science

Core complexity principles from a range of scientific literature were found to be present in traditional strategic theory. When examined against British doctrine at the national, defence and service levels all three adopted complexity ideas and generated three themes of defence and security applications: *multi-level strategic networks*, *non-linear threat prediction and early action* and *dynamism* and *self-organisation*.

There has been real implementation of the doctrine during reform with successful consequences and therefore British defence and security can be beneficially influenced by complexity science. The following represent a summary of the complexity inspired policy recommendations for NSS:

Major reform of the NSC

a. Emphasis on its core role as a strategic network hub, combining information and strategy from all major levels of strategic governance.

b. An inbuilt permanent horizon-scanning team to constantly update on the developing threat environment.

c. A threat management team of expert strategic planners, generating plans for the PTPs that are uncovered by the horizon-scanning team.

d. An information structure combining evidence from government officials across departments based across the world to inform both horizon-scanning and threat management teams.

e. Further development of our anthropological knowledge of countries highlighted as or within PTPs.

f. Agency representatives from all involved parties, significantly senior within their department to ensure effective and complete strategic diffusion at all levels.

g. Funded through the Cabinet Office in order to remain firmly at the centre of Government strategy.

Further Defence reform

a. Tangible commitment to employing better educated troops.

b. Providing further political and strategic education to all forces as part of basic training. This includes an understanding of the complexity principles within security.

c. Once achieving this, investigate and experiment with different options of decentralised command and generating exercises to test 'swarming' as a tactical concept.

Explicit strategic engagement with Complexity Principles

a. Funding for existing bodies, such as the DCDC, to engage with complexity ideas and mathematical techniques with a view to the strategic and military gains that can be made.

b. A recognition of complexity as a new way for strategists to approach providing security and departmental management. Focus must further shift towards providing adaptable capabilities.

Of these three areas, two require funding and political leadershiThe third, though economically simpler requires a substantial change in mindset — and so may be equally as difficult to achieve. However, the reformed structures above would provide a dynamic, future-orientated strategic bureaucracy. With the NSC generating strategy in the very centre of Government with contact and information from all its limbs, a tightly coordinated and coherent strategy can develop a full spectrum of threat management plans that can assist Cobra in the event of a crisis. More consistent horizon-scanning will enable even greater commitment to upstream intervention. The continuing shift to having a better educated and more adaptable but smaller force will accord with the continuing budget constraints whilst maintaining and potentially even extending our capability.

Finally, this analysis has sought to codify many innovations in security and defence policy through an established scientific construct. Through a broader perception of complexity science as a capability-enabling concept, further research into strategic and defence applications alongside the scientific and mathematical techniques might ensue. Greater strategic investigation of complexity science's applications could foster even further capability generation and organisational reform. Through an early strategic engagement with complexity science as a discipline, the British strategic decision makers should look to exploit non-linearity and develop exponential development in strategic advantage. An ongoing process of strategic development on complexity lines could at worst explore new avenues and at best contribute to a more secure and prosperous UK.

References

Army (2012a). *The British Army 2012*. Newsdesk Media.

— (2012b). *Transforming The British Army*.

Beyerchen, Alan (1993). "Clausewitz, Nonlinearity, and the Unpredictability of War". In: *International Security* 17 (3).

Bousquet, A. (2009). *The Scientific Way of Warfare: Order and Chaos on the Battlefields of Modernity*. Columbia University Press.

Casti, J. L. (1994). *Complexification: Explaining a Paradoxical World Through the Science of Surprise*. Abacus.

Cebrowski and Garstka (1998). "Network-Centric Warfare: Its Origin and Future". In: *Proceedings* 124, p. 1.

Clausewitz, Carl von (1984). *On War*. Ed. and trans. by Michael Howard and Peter Paret. Princeton University Press.

Cornish, P. (2012). "National Strategy in the Early 21st Century: Innovating for Uncertainty". In: *International Symposium on Security Affairs*. Vol. 15. NIDS, pp. 69–83.

Cornish, P. and A. M. Dorman (2013). "Fifty Shades of Purple? A risk-sharing approach to the 2015 Strategic Defence and Security Review". In: *International Affairs* 89 (5), pp. 1183–1202.

Cornish, P. and O. Grouille (2010). "Land Forces Fit for the 21st Century". In: *International Security Programme*.

Defence Reform Steering Group (2011). *Defence Reform: An independent report into the structure and management of the Ministry of Defence*.

— (2013). *Second Annual Report*.

Defence Select Committee (2014). *Towards the Next Defence and Security Review: Part One*.

Farrell, T. (2008). "'The Dynamics of British Military Transformation". In: *International Affairs* 84 (4), pp. 777–807.

Gray, C. S. (2002). *Strategy for Chaos: Revolutions in Military Affairs and the Evidence of History*. Frank Cass Publishers.

Her Majesty's Government (2010a). *A Strong Britain in an Age of Uncertainty: The NSS*.

— (2010b). *A Strong Britain in an Age of Uncertainty: The Strategic Defence and Security Review*.

— (2013). *Annual Report on the NSS and the Strategic Defence and Security Review*.

Holland, J. H. (1998). *Emergence: From Chaos to Order*. Addison Wesley.

Independent Commission to Review the United Kingdom's Reserve Forces (2011). *Future Reserves 2020*.

Joint Committee on the NSS (2012). *Planning for the next NSS: Comments on the Government's response to the Committee's First Report of Session 2010–2012*.

Luttawak, E. N. (2012). "Reinventing Military Innovation". In: *International Symposium on Security Affairs*. Vol. 15. NIDS, pp. 85–97.

Makay, A. and S. Tatham (2009). "Behavioural Conflict-—From General to Strategic Corporal: Complexity, Adaptation and Influence". In: *Shrivenham Papers* 9.

Ministry of Defence. *Strategic Trends Programme: Future Character of Conflict*.

— *Strategic Trends Programme: Strategic Trends — Out to 2040*.

— (2011). *The British Defence Doctrine*. JDP 0–01.

— (2014a). *How Defence Works*. Version 4.01.

— (2014b). *Ministry of Defence Improvement Plan*.

Moffat, J. (2003). *Complexity Theory and Network Centric Warfare*. CCRP.

Public Administration Select Committee (2010). *Who does UK National Strategy? First Report of Session 2010–11*.

Royal Air Force (2009). *British Air and Space Power Doctrine: AP 3000*.

Royal Navy. *Future Navy Vision: The Royal Navy Today, Tomorrow and Towards 2025*.

Rumsfeld, D. (2002). *US Department of Defense News Briefing*.

Sanders, T. Irene (1998). *Strategic Thinking and the New Science*. The Free Press.

The Royal Marines. *Vision: Think Commando*.

Waldrop, M. Mitchell (1992). *Complexity: The Emerging Science at the Edge of Chaos.* Simon & Schuster Paperbacks.