UK NEC AND CAPABILITY DEVELOPMENT

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Abstract

Following the demonstrated success of the US NCW (Network Centric Warfare) programme the UK has initiated a parallel network centric initiative, titled Network Enabled Capability (NEC). NEC will re-orientate the UK MoD Equipment programme by looking at the military need from an information viewpoint; information sharing, shared awareness, collaborative decisions and synchronised effects. NEC will not form an equipment specification from which all equipment requirements will be derived. Rather it will provide existing equipment acquisition projects with additional requirements designed to realise the aspirations of network centricity above and beyond those describing the equipment's core purpose. This paper describes NEC and how it was derived.

1. Introduction

Following the success of the concepts behind the US NCW programme, as demonstrated in the Afghanistan conflict, the UK has stated that network centricity is to be core to the definition and operation of its future equipment capability. The initiative to take this forward has been titled NEC.

NEC is built upon many of the same principles as NCW; namely, military operations in the future will be enhanced if there is an environment in which:

- Information is shared.
- All users have an awareness of each other perception of the battlespace (including an understanding of the commander's intent).
- Decisions are made collaboratively.
- Effects in the battlespace are synchronised.

However noble these aims may be they are not in a form suitable to directly provide an understandable requirement for military, or specifically equipment capability.

The issue for this work has been how to specify equipment capability in such a way that it will realise the aspirations of NEC whilst complying with the UK equipment acquisition process.

2. NEC Acquisition Context

Equipment to support the aspirations for NEC will be realised through the MoD's current equipment acquisition process, titled Smart Acquisition [MoD, 2002]. Within the context of Smart Acquisition, systems are acquired by independent projects to meet their own set of user requirements within established time and funding limits. There will not be any NEC projects. The aspirations for NEC will only be met through the combined effects of many of these independently specified and procured systems. This requires, as a minimum, additional NEC requirements to be placed on contributing systems above and beyond those required to meet their core purpose.

The challenge of the work reported in this paper is how to specify NEC requirements on each of the contributing systems that ensures they exhibit the desired NEC capability when brought together as a system of systems.

Much work has been done in the UK to determine the nature and behaviour of system of systems, primarily in a MoD context. Particular attention has been paid to their performance and to how they should be specified and acquired to ensure this [Taylor, 2002], [Alston *et al.*, 1999], [Foley *et al.*, 1999]. Two major conclusions can be drawn from this work that are directly relevant to NEC:

- Large system of systems cannot be defined top-down; that is decomposed in a hierarchical fashion from a single statement of requirement. There is a growing body of opinion that believes that the system of system behaviour is an emergent property of bringing together individually acquired systems and that these emergent properties cannot be 'designed in' to each component part.
- Each equipment within the system of systems has a number of stakeholders with their own, often conflicting, requirements. NEC will provide yet another set of requirements that will need to be balanced and traded.

The consequence for NEC is that it will provide requirements to some, if not all, equipment acquisition programmes in the same way as any other stakeholder, this is shown in Figure 1. If NEC is to be achieved the NEC requirements will have to be given a high priority if they are not to be traded out in the usual cost and requirements balancing exercise.

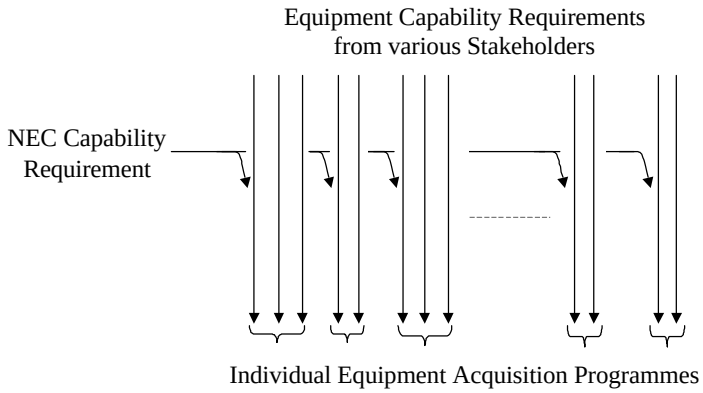

Figure 1. Integration of the NEC Capability Requirements

The NEC requirements have been defined to a set of rules to aid their integration by equipment programmes:

- NEC requirements should contain only NEC related requirements. This is to avoid usurping other stakeholders' legitimate roles by introducing alternative requirements.
- NEC requirements should be atomic. An NEC Capability should be specified in such a way that an acquisition programme can take it in its entirety.
- NEC requirements should be independent of one another. An acquisition programme must be able to take a requirement without having to take on a collection of other dependent requirements.

3. **Method of Analysis**

3.1 ***Ends, Ways, Means Analysis***

The NEC requirements have been derived using an 'Ends, Ways, Means' analysis, as shown in Figure 2. As shown it is a sequential, left to right, analysis starting with the statement of the desired end state, through a statement of the how this will be achieved and ending with a statement of what equipment is required. However, in order to take full account of future technology trends the actual analysis to derive the NEC requirements was done from the ends in, with the 'vision statement' providing the 'doctrinal push' and the equipment capability the 'technology pull'.

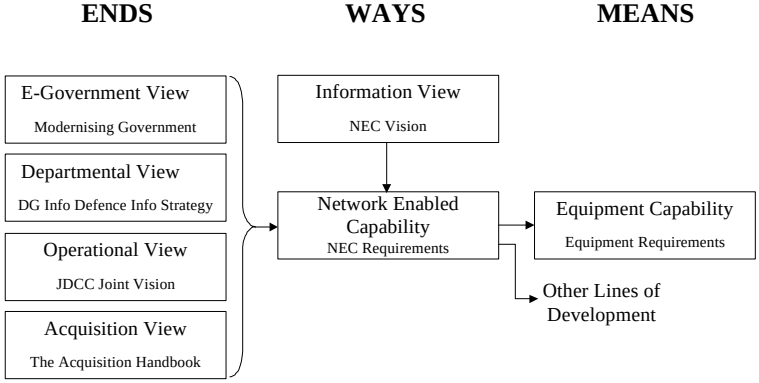

Figure 2. Method of Analysis

3.2 ***Ends***

The Ends are a description of the desired end state. In the context of this study it is a description of how the UK Government generally, and the MOD specifically, wishes to conduct its business in the future, including how it will acquire equipment. Four views were examined:

- The e-Government view responsible for describing how Her Majesty's Government plans to operate in the information age.
- The Departmental view that describes how the MoD wish to operate, as part of the e-Government view.
- The Operational view detailing how the UK forces wish to conduct operations in the future.
- The Acquisition view providing the details of the MoD equipment acquisition process.

3.3 ***Ways***

The Ways are a description of how the Ends will be realised. This is the definition of NEC; the purpose of this study. The NEC has been defined by examining the Ends statements and analysing them from an Information Viewpoint, whilst taking account of the trends in future information age technologies.

The Information View, the NEC Vision, is the way chosen to analyse how to enhance the way MoD operates. Other views could be examined; improving on what is done now, through higher precision and more lethal weapons, or by buying more fighting systems. But taking advantage of the enormous and rapid advances in IT, to share information and work collaboratively, potentially offers the greatest gain.

3.4 ***Means***

The Means are a description of the products, processes and people required to achieve the Ways. In the UK these are covered by six Lines of Development:

- Concepts and Doctrine.
- Personnel.
- Training.
- Force Structures.
- Equipment/Technology.
- Sustainability.

The UK NEC initiative is primarily being studied by the Applied Research Programme, which is heavily biased towards equipment. Hence, it is to be expected that the Equipment/Technology Line of Development will be the most impacted by NEC, although the others will be affected. It is outside the scope of this paper to quantify which parts of the Equipment/Technology Line of Development will be most affected.

4. **Network Enabled Capability**

4.1 ***Introduction***

NEC describes the 'functionality' within the battlespace that will realise the desired Ends. NEC has been derived to meet all the aspirations of the vision statements, examined from an information viewpoint. The principal vision statements, extracted directly from the source documents, are presented in Table 1.

Four principal documents have been used to capture the Ends:

- The e-Government Vision. Modernising Government [HMG, 1999] is an initiative aimed at modernising the UK's public services. One aspect that is concentrated on is the effective use of Information Technology to enable improvement in the public sector. Of particular relevance to NEC is the drive towards 'joined-up' government, both in terms of information sharing and better joint processes.
- Departmental Vision. DG Info's Defence Information Strategy [DG Info, 2001] aims to improve the way MoD conducts its operational and non-operational business, by focussing on the better use of information. The Defence Information Strategy is the MoD's response to the Modernising Government initiative.
- Operational Vision. JDCC's Joint Vision paper [JDCC, 2001] describes the UK future warfighting capability in the 2015+ timeframe. Of all the governmental vision statements it is this on that provides the largest input to the NEC initiative.
- Acquisition Vision. The aim of the Smart Acquisition initiative [MoD, 2002] is to enhance defence capability by acquiring and supporting equipment more effectively in terms of time, cost and performance. How equipment is acquired is central to achieving the aims of NEC.

e-Government Vision: Modernising Government
Make it easier for businesses to deal with government Offer services and information through the internet Improve communications between different parts of government Make it easier for different parts of government to work in partnership Improving access to, and organisation of, information
Departmental Vision: DG Info's Defence Information Strategy
Managing our information better Being more joined-up Giving our people the right skills and competences Establishing the information governance framework Achieving the Modernising Government aims and targets (See Government Vision) Establishing the appropriate risk balance
Operational Vision: JDCC Joint Vision
Manoeuvrist Approach Mission Command Joint and Integrated Operations Rapid and Graduated Response Swift Strategic Deployment Effects Based Approach Information Operations Framework for Deep, Close and Rear Ops Integrated Effects
Acquisition Vision: The Acquisition Handbook
Deliver projects to performance, time and cost parameters Acquire military capability progressively Cut time for key new technologies to be introduced Whole life approach Clearly identified customers: ECC responsible for identifying the capability required Second Customer responsible for converting capability provided by ECC into Military Capability Effect trade-offs between system performance, whole-life costs, annual cost of ownership and time

Table 1. Vision Statements

4.2 ***NEC Analysis***

NEC has been derived from examining the vision statements and postulating what capabilities are required to realise them, when viewed from an NEC information viewpoint; encapsulated by the NCW/NEC principles:

- Information is shared.
- All users have an awareness of each other perception of the battlespace (including an understanding of the commander's intent).
- Decisions are made collaboratively.
- Effects in the battlespace are synchronised.

The analysis led to five Capability Themes and eighteen Capability Requirements. Four of the themes cover equipment capability and one the acquisition process. All the themes and capability requirements are shown in Table 2.

Capability Themes	Capability Requirements
Synchronised C2	Strategic Level Effects-Based Planning Effects-Based Planning Distributed Collaborative Planning Integrated Planning Dynamic Planning and Execution Auxiliary Support
Shared Knowledge and Information	Shared Awareness Full Information Access
Adaptable Capability	Agile Mission Capability 'Net Ready' Capability (Operational)
Robust Information Infrastructure	Team-based Information Mgt 'Net Ready' Capability (Technical)
Responsive Acquisition	Co-ordinated Requirement Definition Aligned Programmes Co-ordinated Programmes Technology Exploitation Managing the Interoperability Life-cycle Demonstration of Benefit

Table 2. NEC Themes and Requirements

Table 3 below shows the mapping of the NEC requirements to the Vision Statements.

NEC Requirements	e-Government View						Departmental View								Operational View											Acquisition View								
	Make it easier for businesses to deal with government	Offer services and information through the internet	Improve communications between different parts of government	Make it easier for different parts of government to work in partnership	Improving access to, and organisation of, information		Managing our information better	Being more joined-up	Giving our people the right skills and competences	Establishing the information governance framework	Achieving the Modernising Government aims and targets (See Government Vision)	Establishing the appropriate risk balance		Manoeuvrist Approach	Mission Command	Joint and Integrated Operations	Rapid and Graduated Response	Swift Strategic Deployment	Effects Based Approach	Information Operations	Framework for Deep, Close and Rear Ops	Integrated Effects		Deliver projects to performance, time and cost parameters	Acquire military capability progressively	Cut time for key new technologies to be introduced	Whole life approach	Clearly identified customers:		ECC responsible for identifying the capability required	Second Customer responsible for converting capability into Military Capability	Effect trade-offs between performance, whole-life costs, annual cost of ownership and time
Strategic Level Effects-based Planning			●	●				●	●							●			●	●		●								●			
Effects-based Planning								●	●						●	●			●	●		●								●			
Distributed Collaborative Planning								●	●					●	●	●			●	●		●								●			
Integrated Planning								●	●					●	●	●			●	●		●								●			
Dynamic Planning and Execution								●	●					●	●	●			●	●		●								●			
Auxiliary Support	●	●	●	●				●	●						●	●	●	●				●								●			
Shared Awareness				●			●	●	●					●	●				●			●								●			
Full Information Access	●	●	●	●	●		●	●	●							●			●	●										●			
Agile Mission Capability								●	●					●	●	●	●	●				●								●			
Net Ready Capability (Operational)								●	●								●	●			●												
Community-based Information Mgt		●			●		●	●	●							●					●	●											
Net Ready Capability (Technical)								●	●								●	●			●												
Co-ordinated Requirement Definition					●		●	●	●	●		●																	●			●	
Aligned Programmes				●				●	●			●												●	●				●			●	
Co-ordinated Programmes				●				●	●			●												●	●				●			●	
Technology Exploitation	●								●			●												●		●						●	
Managing the Interoperability Lifecycle	●						●		●	●		●													●		●			●			
Demonstration of Benefit									●			●															●		●			●	

Table 3. Mapping NEC Requirements to Vision Statements

4.3 *The NEC Themes and Requirements*

4.3.1 *Synchronised C2*

The Synchronised C2 Theme is concerned with breaking down the barriers within command and control and how it can be exercised as a single process. It break downs the wall around Information Operations and brings this into the mainstream of military planning and execution; thereby treating Information Operations as just another battlespace effector and hence providing more operational scope to the battlespace commander. It abolishes the hard distinction between Planning and Execution and presents a single dynamic planning, tasking and execution process; thereby increasing tempo and responsiveness. It recognises that the battlespace contains many separate planning teams and that individual planning processes must be synchronised; thereby creating a more synchronised force.

The Synchronised C2 Theme has six Capability Requirements:

- **Strategic Level Effects-Based Planning.** An open planning approach that considers all effectors, military, economic and political, focussing on the effects required on the adversary.
- **Effects-based Planning**. A planning process that ensures the use of the most relevant effectors in the battlespace to achieve the desired overwhelming effects, wherever and whenever required.
- **Distributed Collaborative Planning**. Collaborative team planning sessions that are distributed in time and/or space.
- **Integrated Planning**. Separate team planning sessions conducted in such a way that all planned actions are synchronised and de-conflicted.
- **Dynamic Planning and Execution**. The combination of the planning and execution phases into a single, dynamic planning/tasking/re-tasking/execution process.
- **Auxiliary Support**. A dynamic resourcing mechanism that makes use of non-frontline government bodies, industry, academia and public service capabilities to support the in-theatre capability, e.g. logistics, data/image analysis and medical.

4.3.2 *Shared Knowledge and Information*

The Shared Knowledge and Information theme recognises that codifying knowledge and sharing information are key to achieving the aims of NEC; in particular, understanding how an individual commander builds awareness, how IT can enhance this, and how it can be shared with other commanders. Fundamental to this is enabling the commander to be proactive in information gathering; rather than being presented with a catalogue of information sources he will require tools that will allow him to browse the battlespace and beyond for the information he requires.

The Shared Knowledge and Information Theme has two Capability Requirements.

- **Shared Awareness**. A process, with supporting equipment, that ensures all elements in the battlespace develop their awareness through having access to coherent battlespace situational information, the intent of friendly forces and the enemy's potential courses of action.

- **Full Information Access**. The ability for a user to search, recover and manipulate information from all available sources both internal and external to the battlespace.

4.3.3 *Adaptable Capability*

The Adaptable Capability Theme recognises that in order to meet the requirements of a very dynamic battlespace the military capability must be able to adapt and change dynamically as the situation changes. This theme covers the human factors and business process aspects of enabling the dynamic battlespace (the Robust Information Infrastructure theme covers the technology aspects). Principally, this theme covers the ability of units to work together with compatible tools and information representations and to dynamically manage working sessions with other users, to meet the ever changing operational mission requirements.

The Adaptable Capability Theme has two Capability Requirements:

- **Agile Mission Capability**. Mutually aware task-based communities, dynamically created and configured to meet the needs of specific missions, capable of employing co-ordinated use of effector and non-effector systems (e.g. weapons, C2 and sensors).
- **Net Ready Capability (Operational)**. Operational elements (systems, units and assets) capable of 'application' interworking to support an end-to-end operational process.

4.3.4 *Robust Information Infrastructure*

The Robust Information Infrastructure Theme is the sister to the Adaptable Capability Theme, in that it provides the underpinning technology to meet the requirements of a dynamic battlespace equipment capability. This theme includes the requirements for both robust Information Management and underpinning Information Infrastructure. In particular, the ability of a unit to 'plug in and out of' and 'log on and off' the infrastructure.

The Robust Information Infrastructure Theme has two Capability Requirements:

- **Team-Based Information Management**. A process, with supporting equipment, which ensures information resources can be managed and that access is provided to meet the requirements of members of task-based Teams.
- **Net Ready Capability (Technical)**. Operational elements (systems, units and assets) capable of 'infrastructure' interconnection/disconnection to/from the networked force without disrupting the operation of the force.

4.3.5 *Responsive Acquisition*

The Responsive Acquisition Theme puts requirements on the acquisition process that will allow it to realise the aspirations of NEC. These requirements range from a more co-ordinated approach to equipment capability definition through to a holistic view of the equipment programme; the relationship between individual acquisitions and the delivery of coherent packages of capability. Of prime importance in a domain where the fundamental technology is evolving rapidly is the ability to take advantage of new technology. Without this agility exploitation of leading edge technology will be impossible.

The Responsive Acquisition Theme has six Capability Requirements:

- **Co-ordinated Requirements Definition**. A high level Equipment Capability specification providing the context for individual equipment specifications.
- **Aligned Programmes**. An Equipment Capability programme, across the whole of government, providing continuous alignment of evolving, inter-dependent projects.
- **Co-ordinated Programmes**. An acquisition process enabling trade-offs across all Government acquisition programmes and which involves industry in the process.
- **Technology Exploitation**. A responsive acquisition process enabling the insertion of new technologies.
- **Managing the Interoperability Lifecycle**. An acquisition process that ensures enduring equipment capabilities through the management of interoperability from equipment roll out to disposal.
- **Demonstration of Benefit.** The development of models and analysis that demonstration NEC related operational benefit, in support of acquisition funding bids.

5. Conclusion and Way Ahead

This paper has presented NEC, how NEC Requirements have been derived and how they can be used in the equipment acquisition process. However, NEC has utility beyond the definition of equipment capability requirements; it has already been used to define future research goals, identify gaps in the Equipment Programme and identify 'quick wins' (what can be done in the next one to two years to enhance current, in-service equipment).

Whilst having proved useful, there is still work to be done on the NEC:

- Clarification of the scope and coverage of NEC.
- Study into the level of detail required in the definition of the NEC Requirements.
- Investigation of the impact of the NEC Requirements on the Equipment /Technology Line of Development.
- Broaden the investigation of the impact of the NEC Requirements to take account of the other Lines of Development.
- Compare the NEC with the US NCW Enabling Capabilities. If they are aligned investigate whether they could be used as the basis for future collaboration; in particular, the derivation of a set of NEC metrics that can be used in formal Balance of Investment studies
- Investigate how NEC could influence the system design phase of equipment acquisition. Figure 1 showed how NEC impacts the capability definition of the equipment acquisition programmes. However, this may not ensure coherent equipment design. Figure 3 shows that another 'NEC architecture' document, or set of documents, may be required to influence the equipment designs.

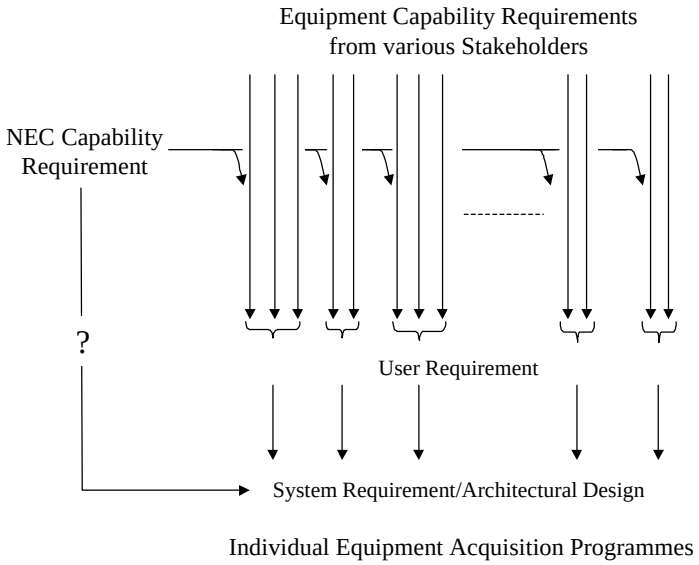

Figure 3. NEC Capability impact on Equipment design

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