

NEC OUTLINE CONCEPT:
PART 2 - NEC CONCEPTUAL FRAMEWORK¹

OVERVIEW

1. This report describes the work done to explain the fundamentals of NEC.
2. The world order has changed significantly over the last decade, and continues to do so. To meet this the UK requires an agile and adaptable military capability that can be deployed globally to counter threats ranging from traditional attrition style conflicts to those that are very asymmetric in nature. The military aspirations for the UK Forces will provide the goal for which NEC will be a prime enabler.
3. NEC aspires to enable platforms and C2 capabilities to exploit shared awareness and collaborative planning, to support the understanding of command intent, and to enable seamless battlespace management. To accomplish this will require a wide range of network enablers from across the Lines of Development. These enablers have been brigaded into nine NEC Themes:
 - a. Agile Mission Groups.
 - b. Fully Networked Support.
 - c. Flexible Working.
 - d. Synchronised Effects.
 - e. Effects Based Planning.
 - f. Shared Awareness.
 - g. Full Information Availability.
 - h. Resilient Information Infrastructure.
 - i. Inclusive Flexible Acquisition.
4. However, NEC should not be seen as an overarching capability from which all other military capabilities can be defined. Rather it is a context within which capabilities should be defined and acquired. This contextual role is embodied within the NEC Conceptual Framework, which places the NEC Themes alongside military capability rather than above.
5. It is recommended that the NEC Themes, as encapsulated within the NEC Conceptual Framework, be used as the basis for continuing work on all aspects of defining NEC.

BACKGROUND

6. Network Enabled Capability (NEC) encompasses the elements required to deliver controlled and precise military effect rapidly and reliably. At its heart are three elements;

¹ The NEC Conceptual Framework is a high level description of the characteristics and attributes of network enabled capabilities, together with their purposes, inter-relationships, benefits and other impacts.

sensors (to gather information); a network (to support the fusing, exchange and exploitation of information); and strike assets to deliver effects. The NEC Outline Concept, which has been developed in the Applied Research Programme Package 13, sets out the background to NEC, characterises it in greater detail, and charts the route towards its realisation.

7. This report is one of a set of eleven that collectively comprise the NEC Outline Concept. Each report is a stand-alone document that will be updated in the light of ongoing research. The reports are as follows:

- a. **NEC Outline Concept: Executive Summary** - introduces the reader to NEC and contains a précis of all the other reports. This Executive Summary will be updated as individual documents are updated.
- b. **Part 1 - Background and Programme of Work** - introduces the UK NEC programme, contrasts it with the US NCW initiative, and describes work completed and planned to develop it further.
- c. **Part 2 - NEC Conceptual Framework [This Report]** - outlines the military aspirations for UK Forces and describes the NEC Themes required to achieve them.
- d. **Part 3 - NEC Acquisition and Delivery** - discusses the acquisition and delivery issues that will need to be addressed to realise NEC.
- e. **Part 4 - Experimentation and Research** - contains proposals for experimental co-ordination (including ENIF), NEC related research and International Research Collaboration (IRC).
- f. **Part 5 - Military Operations** - provides interim results of subjective analysis of the operational benefit of Network Enabled Capability in a scenario-based example. *[In this issue of the Outline Concept, this report is supplemented by a presentation illustrating the results of analysis of additional scenarios.]*
- g. **Part 6 - Impact on Lines of Development** - outlines NEC issues pertinent to LoDs.
- h. **Part 7 - Speculative Architectures** - considers the architecture (including infrastructure) required to deliver NEC.
- i. **Part 8 - Managing the successful delivery of NEC** - identifies lessons from previous relevant IS initiatives that must be applied to NEC to ensure its success.
- j. **Part 9 - NEC Benefits Analysis²** - describes a method for assessing the benefits of NEC and provides two case studies.
- k. **Part 10 - Glossary** - catalogues the terms used to define NEC.

AIM OF REPORT

8. This report describes NEC in terms of the NEC Themes and the NEC Conceptual Framework.

STRUCTURE OF THE REPORT

9. The structure of the remainder of this report is as follows:
- a. Military Aspirations

² This report was developed under ARP13/RE602 - Capability BOI/Audit (MOEs).

- b. A Vision for NEC
- c. The NEC Themes
- d. The NEC Conceptual Framework
- e. A Definition of Net Ready
- f. Conclusions
- g. Recommendations

MILITARY ASPIRATIONS

10. The world order has changed significantly over the last decade, and continues to do so. To meet this the UK requires an agile and adaptable military capability that can be deployed globally to counter threats ranging from traditional attrition style conflicts to those that are very asymmetric in nature. The military aspirations for the UK Forces will provide the goal for which NEC will be a prime enabler. The military aspirations used to derive the NEC Conceptual Framework have been derived from the Joint Vision documents prepared by JDCC³. The aspirations are for a Force that is:

- a. **Responsive** - Can respond to changes in need, matching tempo to the operational situation
- b. **Robust** - Remaining effective in the face of depletion of its resources or capabilities
- c. **Broad** - Able to operate effectively over a wide range of situations and missions
- d. **Flexible** - Capable of achieving effects in multiple ways, using agile resource groupings
- e. **Adaptable** - Learning from its operating environment and acting accordingly
- f. **Scalable** - Capable of operating in large or small deployments, minimising in theatre footprint
- g. **Interoperable** - Operating jointly across all levels and with allies, OGDs and NGOs
- h. **Synchronized** - Working coherently to deliver co-ordinated effects and avoid internal conflicts
- i. **Proactive** - Rapidly generating and deploying mission groups and achieving aims in reduced timescales
- j. **Responsible** - Operating with minimal fratricide or unintended effects
- k. **Cost Effective** - Delivering effective military capability at reduced cost

NEC REALISATION CONCEPT

11. An aspirational statement describing NEC is required to put the Military Aspirations into a context suitable for NEC to be realised. Towards this end, CM(IS) has provided a high level mission statement for NEC:

³ D/JDCC/7/11/1, The UK Joint Vision, dated 15 June 2001,
JDCC/7/11/7/1, A Concept for Effects Based Operations, Desk Level Draft Version 3 dated 20 May 02.

*"NEC allows platforms and C2 capabilities to exploit shared awareness and collaborative planning, to communicate and understand command intent, and to enable seamless battlespace management. It will underpin decision superiority and the delivery of rapid and synchronised effects in the joint and multi-national battlespace."*⁴

12. In order to deliver this vision, and to realise the military aspirations listed above, it is necessary to consider the vision in the context of some real world constraints, including the following:

- a. In the operational battlespace there will be no underlying infrastructure that assets 'plug into' when deployed; as there will be for some static locations, particularly in the UK. i.e., there is no independent 'network' which assets will join. The deployed assets themselves will be the nodes of the network and hence will include 'network' functionality above and beyond that functionality required by them to do their operational role. The network functionality resident within a particular asset will be dependent upon the role of the asset and the potential altruistic role it could perform for the wider operational community. The definition of the GII and the delivery of the infrastructure will play a crucial part in the definition of network functionality.
- b. An asset's interoperability will be defined in terms of its role as a network node and its operational role. In its operational role interoperability splits into two: technical interoperability and co-operability. Technical interoperability is its ability to 'network' with assets at a technical level. Co-operability is its ability to work with other assets to support an operational mission. Co-operability will be defined by the 'communities' that an asset may wish to participate in; for example Time-Sensitive Targeting missions or collaborative operational level planning. However, in order not to restrict the flexibility of an asset there will need to be a base level of co-operability that all assets can achieve.
- c. What an asset must do to become part of the network and to interoperate and co-operate with other users in the battlespace can be regarded as the definition of 'Net Ready' for that asset.
- d. Resources may be scarce in the future battlespace, and hence will need to be better utilised than present. This will mean, amongst other things, that assets must be able to be shared between mission and mission types, dependent upon their availability.

THE NEC THEMES

13. The NEC Themes define the essence of what NEC is across the six lines of development. Initial analysis of NEC identified a large number of capabilities ranging from sensor exploitation, through collaborative planning to synchronised effects. Grouping these capabilities led to nine themes. Eight of the themes cover equipment capability and one the acquisition process. The themes are shown in Table 1.

⁴ Major General Rob Fulton, CM(IS), 30 April 2002.

Table 1 - NEC Themes

<i>Agile Mission Groups</i>	Enabling the dynamic creation and configuration of Mission Groups that share awareness and that co-ordinate and employ a wide range of systems for a specific mission.
<i>Fully Networked Support</i>	Allowing the ready use of non-frontline government bodies, industry, academia and public service capabilities to support operations.
<i>Flexible Working</i>	Enabling assets to rapidly reconfigure to meet changing mission needs, allowing them to work together with minimum disruption and confusion.
<i>Synchronized Effects</i>	Achieving overwhelming effects within and between Mission Groups by coordinating the most appropriate assets available in the battlespace through dynamic distributed planning and execution.
<i>Effects Based Planning</i>	Taking an approach to planning that focuses on the use of military and non-military effects required against an enemy, and is integrated with other planning processes in the battlespace.
<i>Shared Awareness</i>	Providing a shared understanding and interpretation of a situation, the intentions of friendly forces, and the potential courses of action amongst all elements in the battlespace.
<i>Full Information Availability</i>	Enabling a user to search, manipulate and exchange information of different classifications captured by, or available in, all sources internal and external to the battlespace.
<i>Resilient Information Infrastructure</i>	Ensuring information resources can be managed and that secure and assured access is provided with the flexibility to meet the needs of Agile Mission Groups.
<i>Inclusive Flexible Acquisition</i>	Co-ordinating process across MOD, OGDs and industry that promotes the rapid insertion of new technologies, facilitates coherence between acquisition programmes and provides an incremental approach to delivering 'net-ready platforms'.

14. **Agile Mission Groups.** The formation of network-centric forces must not be constrained by 'hardwired' equipment configurations based on organisational structures. The network-centric force will be composed of capability components brought together to form Agile Mission Groups to undertake specific operational tasks. The tasks may be long lasting, for example protection of an airhead, or transient, for example destruction of a communications mast. Once complete, the elements of the Agile Mission Group will return to their host, functionally or environmentally oriented organisation. Shared awareness within an Agile Mission Group will need to be very high in order to understand and achieve their common goal, but lower between it and other Agile Mission Groups, where a general understanding of the intent or position may be all that is required. The high level of Shared Awareness will require elements within an Agile Mission Group to have a corresponding high level of 'application interworking' to ensure the synchronisation of planning, control and effects. The concept of 'asymmetric collaborative working'⁵ makes attainment of a high level of application interworking complex. This concept recognises that capability components within an Agile Mission Group may have very different levels of IT support (or indeed training and expertise). For example, An Agile Mission Group composed of dismounted infantrymen and HQ based users. This requires an interworking regime that can cope with differing levels of capability.

15. **Fully Networked Support.** The membership of operational forces, including Agile Mission Groups, should not be restricted to the in-theatre forces but will include non-frontline

⁵ Asymmetric Collaborative Interworking is a term coined by Dr Martin Young of QinetiQ.

government bodies, industry and public services. Hence, a dynamic resourcing mechanism is required 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.

16. **Flexible Working.** Agile Mission Groups will be how network-centric forces exert effect within the battlespace. Ideally, Agile Mission Groups will always be made up from elements suited to the role they have been tasked with. However, this will not always be possible. Elements will need the flexibility to:

- a. Undertake tasks not supported by their primary roles.
- b. Work with elements that it was never intended to work with.
- c. Work in multiple Agile Mission Groups simultaneously, maintaining coherent 'situational representation' between the Agile Mission Groups and not compromising their role in any of the Groups.
- d. Be able to change rapidly from one Agile Mission Group to another without disrupting the operation of either Group.

17. **Synchronized Effects.** An efficient, effective dynamic planning and C2 system is a key element of NEC, and is vital to co-ordinating the multiple and diverse strands of operations to achieve synchronicity. Without it, the complexity of planning and managing a number of simultaneous tasks with different tempos, and of making dynamic use of resources, will not be feasible. This will require breaking down the barriers within command and control and exercising it as a single process; the hard distinction between planning and execution must be broken down and replaced by a single dynamic planning, tasking and execution process, thereby increasing tempo and responsiveness. The battlespace will contain many separate such planning teams, who themselves could be distributed, and their planning processes must be synchronised; thereby creating a more synchronised force. The co-ordination between the planning groups will include the co-ordinated use of the battlespace environment, which encompasses such diverse elements as airspace, waterspace and RF spectrum. This co-ordination is done as part of 'command management'.

18. **Effects-Based Planning.** Network centric forces will have access to many other effectors within the battlespace above and beyond the traditional 'attrition' effectors. In particular, Information Operations, considered currently as a separate, stand-alone capability, should be brought 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. To fully utilise all these effectors operational planning will have to change from an attrition based process to an effects-based one. The following are required to allow the full scope of Effects Based Planning (EBP) and Effects Based Operations (EBO):

- a. A fully capable EBP capability, operational through all levels in the Ministry of Defence and in all other Government Departments that has an impact on political/military/economic aims (including Foreign Office, Home Office, Treasury). Within the MoD (and potentially elsewhere) this capability will have to be able to operate with the dynamic, distributed planning systems required for the delivery of synchronised effects and the management of Agile Mission Groups

- b. Modelling tools that can allow prediction and "what-if"ing across the whole domain of Effects Based Operations (EBO), including predicting the interaction between military, diplomatic and financial effects.
- c. Tools to assess the effects of operations across all domains. These will expand on traditional BDA tools for assessing military effect, capitalising on the greater sharing of information to allow more rapid/simultaneous assessment, and add assessment of the effect in non-military domains (political and economic).

19. **Shared Awareness.** Shared awareness is a central facet of NEC and underpins many of the other themes, including Agile Mission Groups, Synchronised Effects and Effects Based Planning. Achieving awareness is a cognitive activity that results in a gaining of a personal understanding of what is happening, why and what could happen in the battlespace. Gaining understanding requires appropriate processes and training as well as supporting equipment. Shared awareness, in the context of NEC⁶, is the ability to communicate an individual's understanding to others in order that, as a group, there is some level of shared understanding. Shared Awareness has two principal elements.

- a. The gathering, maintenance and presentation of relevant information. This will include extracting information from all relevant, available sources (including coalition partners, OGDs and NGOs as appropriate), seeking specific additional information and/or clarification, and combining all this information to produce a local representation or 'picture' that meets an individual user's needs. However, Shared Awareness will only be supported if separate local 'pictures' are consistent with each other. The goal for NEC is a set of consistent pictures across the battlespace rather than a common one. This approach is aligned with the concept of a Joint Operations Picture (JOP) defined⁷ as:

“The total set of shared information on a particular operation, or Joint Operations Area, available through a secure information environment on operational CIS networks to support situational awareness and decision-making by UK commanders, and to facilitate information sharing with allies and partners in Joint and multinational operations.”

- b. Developing a shared *understanding* of the situation. Understanding exists not in the underlying information gathered from across the battlespace, but in the mind of the user. To achieve a common shared awareness, the understanding must be communicated to others. If the users are co-located then verbal and non-verbal (body language) means can and are used. If the users are distributed equipment must be used to support the 'encoding of understanding' and the transmission of it. The equipment could attempt to replicate co-location, for example video conferencing, or could encode understanding for presentation on standard IT equipment, for example using text and graphics.

20. **Full Information Availability.** The future battlespace will be teeming with information. NEC will make much of this information available to users. This will include

⁶ The author appreciates that this does not match the academic definition of shared awareness. In fact strictly speaking awareness cannot be shared, it is individual's understanding, gained from awareness, that can be shared.

⁷ Working definition taken from D/DJW/CBM/40/3, Draft UK Policy for the Joint Operations Picture, dated 4 Jul 02.

access to the widest range of information sources, including military sources (ISTAR, intelligence sensors, weapons sensors etc), civil sources (news feeds, environmental information, etc), encyclopaedic information, archived information, information available from sensors of opportunity and information collected but not fully exploited. However, this does not mean that all this information will be pushed to the user; overwhelming him with irrelevant information. On the contrary, only a very small part of this information ‘pool’ will be presented to any user (for example orders, plans and pre-defined information needs). The rest of the information the user, or application, will have to actively search for from across and beyond the battlespace. To enable this, the user, software application or system, will be provided with the capability, tools and mechanisms, to proactively, rather than reactively, search for, manipulate and exchange information. The capability must allow the searching and exchanging to take place not only within national systems but also those of coalition partners and the Internet. This will require the tools and mechanisms to handle data of different classifications securely. In summary, this proactive searching mechanism must be an adjunct to, not a replacement of, other information management mechanisms such as selected information push and broadcast, providing the user with a rich set of information access and retrieval mechanisms.

21. **Resilient Information Infrastructure.** A Resilient Information Infrastructure is required to provide a secure and assured environment to meet the requirements of a dynamic battlespace equipment capability, and in particular the demanding, dynamic requirements of Agile Mission Groups. Many of the aspirations of the Resilient Information Infrastructure Theme are captured by the GII concept. The requirements of the Resilient Information Infrastructure include:

- a. The capability to share information across the battlespace, and allow all users (human or machine) access to the information that they require for planning, execution and monitoring of operations. This capability should allow information to flow transparently across domains, be robust in the face of communications limitations and ECM, and should support the information user (human or machine).
- b. Efficient management of information sharing, as demanded by the operational situation, and the requirements for information access.
- c. The provision of an assured end to end performance based upon the business need.

22. **Inclusive Flexible Acquisition.** The equipment acquisition process must be enabled to 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 military 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. This Theme is covered in more detail in Part 3 of this document set⁸.

NEC CONCEPTUAL FRAMEWORK

23. The NEC Themes have been derived from analysing what NEC will enable within the battlespace. Hence they only cover the NEC related aspects of the Lines of Development.

⁸ Dstl/IMD/SOS/500/2, NEC Outline Concept Part 3 - NEC Acquisition and Delivery, Issue 2.0 dated 2 May 2003.

This means they cannot be used to define any of the Lines of Development in a top down manner; rather, they should be used by developers within the Lines of Development as a 'style', or the operating context, within which they should consider their particular area.

24. The diagrams shown at Figure 1 and Figure 2 show how this style could be applied to the analysis of a component of military capability. Figure 1 shows a generic layered model of a component of military capability (the remainder of this section uses 'an offensive air capability' as an example of a component of military capability);

- a. The two lowest levels are the Military task and the Capability Component that will perform it. In the case of an offensive air capability this could be the range of target types and a description of the capability to counter them.
- b. The Capability Component has a local infrastructure, in the case of the offensive air capability this could be an airframe, sensors and weapons systems all connected via Mil Std 1553b databus.
- c. The Local Infrastructure supports the aircrew gaining Situation Awareness from information derived from his Local Information Sources (sensors).
- d. Finally, having gained Situation Awareness, the aircrew will require Decision Making support to create Local Battlespace Effects (fire their weapons).



Figure 1 - Conceptual Framework for Stand-alone Capability Component

25. Figure shows how each step could be considered in the context of the NEC Themes:
- a. The Task must be considered in the context of larger Mission, for example a Capability Chain.
 - b. The Capability Component must be considered in terms of Agile Mission Groups, of which it will be a part. The Themes of Fully Networked Support will provide a global context for the Agile Mission Group (reachback) and Flexible Working provide the context for the Capability Component operating in more than one Agile Mission Group at one time. This analysis will identify the interoperability requirements for the Capability Component.
 - c. The Local Infrastructure must be considered in the context of the Resilient Information Infrastructure. This will identify infrastructure services which are available from the wider battlespace and those services which the Local Infrastructure could provide to other users.
 - d. Local Information Availability must be considered in the context of Full Information Access. So the aircrew are no longer constrained to information from local sensors but now can benefit from information elsewhere in the battlespace. In return, local sensor information is made available to the wider community.

- e. Situation Awareness must be considered in the context of Shared Awareness. The aircrews' own situation awareness will be heightened by assimilation of others' awareness and understanding of the situation, and vice versa.
- f. Decision making must be considered in the context of Effects Based Planning. How do the aircrews' decisions impact on, and are impacted by, other decisions in the battlespace?
- g. Local Battlespace Effects must be considered in the context of Synchronised Effects. How do effects caused by local weapon systems impact on, and impacted by, other effectors within the battlespace?

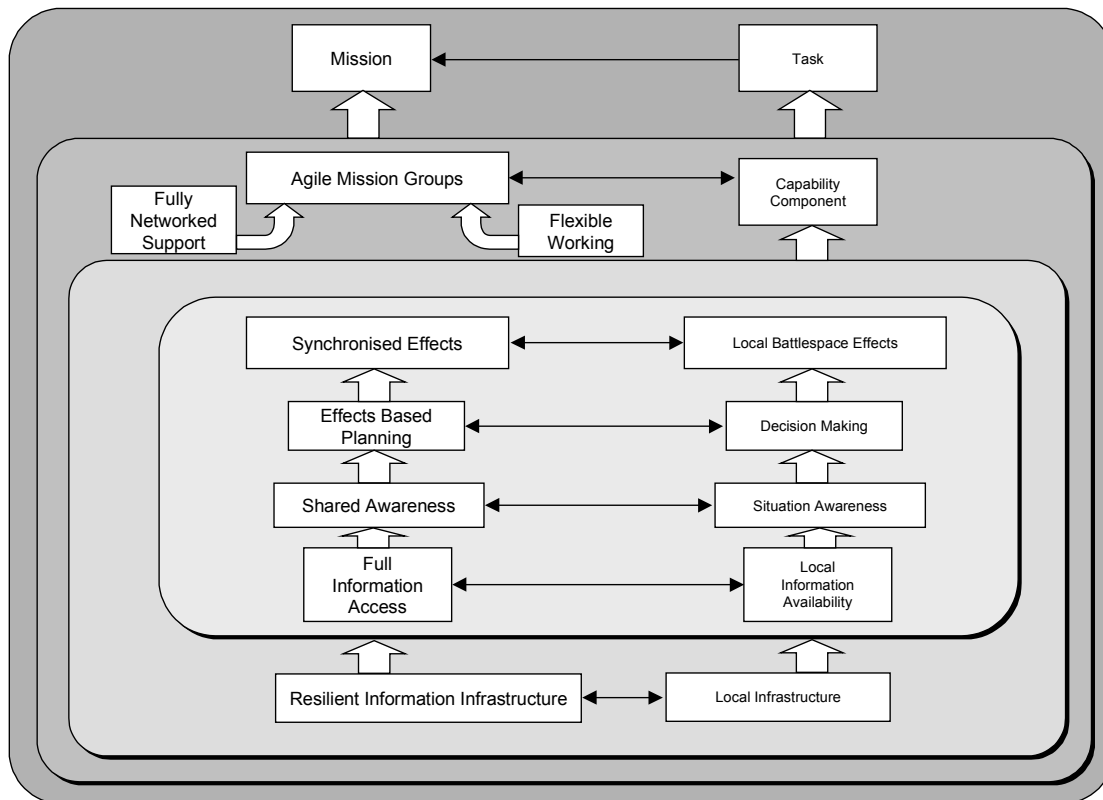


Figure 2 - The NEC Conceptual Framework

A DEFINITION OF NET READY

26. The objective of these diagrams is to demonstrate how NEC will influence Capability Component definition. There will not be an NEC definition that Capability Components will add to their definition; rather they will define the Capability Component in terms of NEC. Hence, the NEC-related requirements taken on by a Capability Component are unique to that Component and can only be derived through an understanding of the role of that component. This can lead to a possible definition for the term 'Net Ready' - that is those NEC-related requirements that a Capability Component must satisfy if it is to be deemed ready to become part of the network. Two very important issues result from this:

- a. Only the host capability can define what it means for it to be Net Ready. This cannot be done by an independent NEC body.

- b. The two sets of requirements, capability component and Net Ready, must be treated a single set. All solutions to meeting the requirements must treat them as a holistic set.

27. Whilst the requirements associated with being Net Ready cannot be supplied by an independent NEC body, co-ordination across capabilities is required to ensure that all definition of Net Ready are consistent. This can and should be done by an independent body.

CONCLUSIONS

28. The NEC Conceptual Framework provides a useful way of encapsulating the essence of what NEC is and what it is trying to achieve. It can be used as the basis for describing other views of NEC, for example, defining what it means for them to be Net Ready and how NEC impacts the Lines of Development.

RECOMMENDATIONS

29. It is recommended that:

- a. The NEC Conceptual Framework be adopted as the basis for continuing work on all aspects of defining NEC
- b. Further work is done to complete the definition of the NEC Conceptual Framework. In particular:
 - i. In its current form, it is too high level to provide the context for capability definition. A further level of decomposition is required.
 - ii. It should be linked to the NEC Metrics Framework.