Network Enabled Fires - A NEC/NCW Use Case

Paul Saunders, Colin Hagger, Alison Reid

QinetiQ

(Working for the UK MOD Applied Research Programme)

Malvern Technology Centre
St Andrews Road
Malvern
WR14 3PS
United Kingdom
Tel: +44 (0)1684 897398
Fax: +44 (0)1684 896011

psaunders@qinetiq.com

Network Enabled Fires - A NEC/NCW Use Case

Paul Saunders, Colin Hagger, Alison Reid

QinetiQ
Malvern Technology Centre
St Andrews Road
Malvern
WR14 3PS
United Kingdom
psaunders@qinetiq.com

Abstract

Employment of Fires has traditionally been regulated using procedural deconfliction measures. This system is characterised by a lack of flexibility and responsiveness. In addition, the introduction to service of long range artillery and attack helicopters, at the same time as the rise of the manoeuvrist doctrine, poses significant challenges to the current process. Defining processes that address the challenges will provide a robust, more flexible and efficient means of employing Joint Fires, to Joint ends, across the battlespace.

Applying a practical, pragmatic approach to this problem has provided the necessary insight into this militarily significant 'Use Case'.

The research has shown that central to the successful implementation of a Joint Fires capability is the provision of Joint, real time situational awareness. This relates not only to force dispositions but also the dynamic, continually changing control measures that need to be implemented. This requirement leads to the concept of a Deep Operations Picture, providing the necessary integrated Situational Awareness.

The means of producing a Deep Operations Picture at the operational level of Command is discussed, along with a limited form of Network Centric behaviour that is likely to emerge when a Deep Operations Picture is fielded.

1. Introduction

Revolutionary changes within military organisations can be difficult to achieve at the best of times, given entrenched cultural attitudes. When the need to make best use of scarce resources, while maintaining operational readiness, is added to the mixture, a pragmatic, evolutionary approach becomes unavoidable.

In this same pragmatic spirit, recent research has investigated the application of network technology to existing force structures and organisations, with the aim of increasing the efficiency and effectiveness of employment of Joint Fires.

The work started by gaining a full appreciation of the scope of the problem, through literature searches and collaboration with current military practitioners. The outcome of this initial analysis identified Situational Awareness (SA), especially relating to position and intent, as the central component that determines the extent to which all other aspects of Joint Fires employment can be successfully achieved.

A concept for creating and maintaining networked SA was derived. The concept was then analysed, using process and benefits modeling approaches to find out how it would enhance the employment of Joint Fires. The outcome of this analysis shows that some aspects of a Network Enabled Capability can be realised even with modest interventions. This paper indicates some areas where a limited form of NEC-like behaviour would be expected to emerge if the concept was to be implemented.

2. Joint Fires Challenges

Fires are defined as "the effects of lethal or non-lethal weapons"[1]. Joint Fires is therefore the name of the process responsible for co-ordinating the use of Fires across environments, domains and Component Commands.

The employment of Joint Fires has traditionally been regulated using pre-planned, procedural deconfliction measures. This arrangement has generally been highly successful, in avoiding fratricidal encounters and in providing a well defined framework within which to conduct operations.

However, the system can also be characterised by a lack of flexibility and responsiveness, especially in the face of unforeseen events. In addition, the introduction into service with land force of long range artillery and attack helicopters, at the same time as the rise to prominence of the United Kingdom's doctrine of a manoeuvrist approach to warfighting, poses significant challenges to the current process.

Whether measured by efficient, flexible and agile use of resources, simultaneity of effects or maintenance of operational tempo, the pre-planned Joint Fires processes cannot be judged as wholly satisfactory on the contemporary or future battlefield.

The factor which, more than any other, has influenced the need to maintain procedural deconfliction measures is the lack of real time or near real time SA. Figure 1 shows how SA sits at the centre of the Joint Fires process and helps to explain why the whole process has to be run 'offline', if SA is not available in close to real time.

Figure 1 - The central role of SA in the Joint Fires process

[1] DoD Joint Publication 1-02

3. A Concept for Cross-Component Situational Awareness

Initial investigations were carried out in conjunction with serving military staff who were chosen for their intimate knowledge of the problems with the current arrangements and came predominantly from artillery, fixed wing ground attack, attack helicopter, intelligence and combat operations backgrounds. Through exploratory discussions, it emerged that the major block on the required co-ordination processes was the requirement to channel all the necessary information through liaison officers. These officers have tended to be equipped with limited inter-component communications capabilities and similarly have had limited access to accurate information on evolving force dispositions and intentions.

Automated position and status information from tactical level units either does, or soon will, flow up to component command level. Examples of this type of information are Blue Force Tracking and Link 16 PPLI. It was therefore considered most important to concentrate effort on streamlining (through automation) the inter-component data exchange mechanisms.

At this point, it should be clear that the problem requires consideration of interoperability at all levels, from data transfer to cognitive understanding. Digitised links between components are beginning to appear; therefore, data transfer is not considered the major issue. From this point upward though, work is required to establish common data formats, enabling automated processing, through to establishment of coherent Joint Doctrine, allowing common interpretation and action on information provided.

At the doctrinal level, there has been significant debate regarding whether the future intention should be to integrate or to deconflict Fires. We contend that this debate boils down to semantics. Fires must be integrated, to achieve the desired synergy, flexibility and efficiency of employment. However, deconfliction must still be applied, albeit on much shorter timescales and with much finer granularity than at present, if safety and related operational effectiveness is to be maintained.

The primary requirement for data exchange, between components, is therefore positional information for tactical units (along with hostile forces, targets and neutral elements) and deconfliction boundaries for effects systems.

4. The Deep Operations Picture

The concept for Cross-Component SA for Joint Fires is therefore quite simple. It involves the transfer of the following information:

- Blue positions
- Red positions (and targets)
- Neutral positions
- Dynamic Control Measures, changing rapidly according to current requirements

over digitised inter-component links. Synchronised databases at each component should maintain a consistent picture based on the information passed and Joint Doctrine should provide the means to interpret the pictures in

different components in a consistent and coherent manner. The required data model should consist of a very small number of commonly agreed elements and would most conveniently be captured, stored and manipulated in the form of an XML schema.

A further requirement, implicit in the concept, is the existence of information management personnel equipped to compile, control, fuse, aggregate and share information, electronically. In this way, a coherent picture containing the essential features of the battlespace, with appropriate coverage and currency could be assembled.

We have chosen to call the envisaged picture the 'Deep Operations Picture (DOP)', since this captures its raison d'être as an aid to prosecution of the Deep battle i.e. operations that are, in general, well separated from Blue force elements. Underlying this restriction on the use of the picture is the assumption that for Close operations the time delays inherent in producing and synchronising the picture at Component Command level would introduce unacceptable latency and therefore inaccuracy into the picture. In addition, the overlapping effects systems, which would require the information, are generally those which are optimised for Deep operations and which belong directly to formations at, or close to, the Operational level of command.

The DOP is envisaged as a tool that is applicable beyond the operational level headquarters. The picture would also be provided, via digitised links, to Deep effects systems (long range artillery, fixed wing air, attack helicopter) and relevant ISR assets. For most of these systems the necessary links already exist - procurement and installation, in the light of the DOP requirements, are all that needs to be done.

5. Analysis

Having established what we considered necessary as a baseline capability for the successful prosecution of Joint Fires coordination in near real time, we moved on to analysing the potential benefits that should flow from the concept.

5.1 Benefits Modelling

The first approach to assessing the usefulness of the concept was a 'Benefits Modelling' approach, where subjective judgement was applied in a structured manner to gain insight.

To perform the analysis it was necessary to break the execution of the Joint Fires process into small component activities that could be reliably assessed against the following metrics:

- Time - Time taken for individual processes
- Flexibility - Degree of choice (plans, assets, outcomes)
- Co-ordination - Alignment of assets in time, space and purpose
- Situational Awareness - Degree of awareness and understanding of surrounding battlespace
- Optimality of Resources - Degree to which assets are optimally used
- Mission Success - Degree to which mission objective was achieved

Following on from detailed examination, through process modeling, of several candidate Joint Fires 'kill chains' (including a contemporary Joint Air Attack Team or JAAT) the following generic process elements were identified:

- Communicate
- Collate and create intelligence product
- Disseminate Intelligence products
- Assess target and establish required effect
- Decide if ISR or effector required
- Decide which ISR or effector
- Plan and deconflict
- Task ISR or effector
- ISR or effector preparation
- Transit
- Find target and gain ISR
- Engage target

Analysis of process elements against metrics, for the concept being considered, resulted in the following matrix:

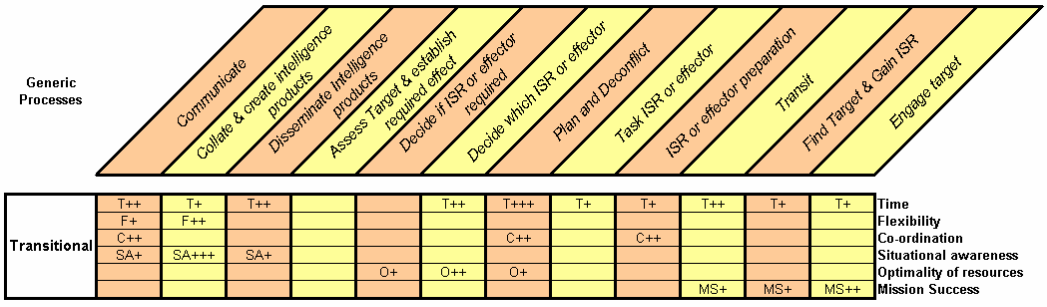

Figure 2 - Benefits Matrix for the Deep Operations Picture concept (NEC Transitional Epoch)

Each cell in the matrix represents a potential area for an improvement or degradation in performance. The signs following the letters within each cell represent the level of expected change (+++ being best, --- being worst). A cell with no entry represents no change from the current situation.

5.2 Architectural Analysis

An architectural analysis was also performed, using products from the DoDAF Architecture - notably a 'Functional Flowchart' process diagram, Systems Interface diagrams and an Information Exchange Matrix. The major finding from this strand of work was that work patterns exhibiting 'Network Centric' behaviours can be expected to emerge from a system following the outlined concept.

5.2.1 Agility

Consideration of the process diagram showed that formation of platform groupings to perform specific tasks would become much more flexible, given the existence of a DOP. The essential feature is the increased flexibility in tasking engendered by the removal of unnecessarily large and lengthy reservations of real estate.

Rapid allocation and deallocation of areas for Fires and/or manoeuvre would be the main driver for integration of effects. The effects could even come from different components, such that previously they would never have been considered as viable contenders for co-ordinated Fires towards a common mission aim. The Fires assets would not need to co-ordinate directly between themselves either; they need not necessarily ever be aware that they are participants in a coherent, task oriented grouping. All the necessary co-ordination would occur at the operational headquarters level, with the Combat Ops personnel, across components, making decisions on which targets to strike and with which assets in a flexible, agile manner. The Combat Ops personnel would effectively take the role of distributed commanders of short term groupings, forming and disbanding according to the situation.

5.2.2 Self-Synchronisation

Creation and dissemination of a DOP would provide effects platforms with levels of Situational Awareness that have previously been unachievable. Provision of this level of SA leads to the possibility that the platforms will become able to make independent decisions regarding the conduct of their mission - this represents, at least, a limited form of Self-Synchronisation.

An example that emerged from the 'kill chain' analysis was that of a fixed wing attack aircraft, requiring Suppression of Enemy Air Defences (SEAD) to be carried out by long range artillery. It was concluded that, as soon as the long range artillery Battle Damage Assessment (BDA) process is complete the results could be posted on the DOP. The attack assets receiving the DOP could then make an independent decision to continue with their mission, without further reference to higher authority.

On the other side of this argument, it is considered that Self-Synchronisation (even in this limited form) is only achievable for small, well trained groups who share a high degree of common understanding. In short, our analysis of Joint Fires and the DOP has led us to question "How scalable is the concept of Self Synchronisation?" Clearly, this is another research question, in its own right, and will not be discussed further here.

5.2.3 Command Structure

In the course of the research, we were asked, "What place does 'Functional Command' have in the future prosecution of Joint Fires?" In this context, Functional Command refers to an organisational structure where work groupings are determined by role or function rather than by domain or parentage.

We concluded that for reasons of logistics and basing it would not be appropriate to amalgamate the command elements responsible for operational

employment. However, the construction of the DOP was considered a task that would be continuous, providing a constant and relatively well defined workstream for ISR and Intelligence personnel. For this reason, we believe that the construction of a DOP should be a Joint process at the operational level of command, conducted in close to real time. It would be organised on the basis of the task performed, using personnel from all appropriate services albeit possibly working collaboratively at various distributed locations.

6. Conclusion

The capability to perform Joint Fires routinely and efficiently is becoming more important with the introduction of systems, across components, with overlapping areas of influence. These systems are relevant mainly to the Deep battle.

Analysis has shown that the most important factor in employing Joint Fires in a safe, efficient and flexible manner is Situational Awareness (SA). The Deep Operations Picture represents an evolutionary concept for providing this SA, between component command headquarters, without having to make significant, disruptive changes to the existing command structure a prerequisite.

Investigations of the implications of the DOP concept suggest that improvements would be realised at nearly every stage of the Joint Fires process. In addition, some aspects of Network Centric behaviour would begin to emerge, most notably in the areas of Agility and, in some cases, a limited form of Self Synchronisation. Changes in command structures, with an evolutionary shift towards more functionally oriented groupings may also be a consequence of the widespread sharing of information at the Component Command level.