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Lessons Learnt for Networked Enabled Capability

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Lessons Learnt

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ABSTRACT

Lessons Learnt For Network Enabled Capability (NEC)

This paper describes the first stage of a project to exploit lessons identified from operational, exercise, and other sources for evidence of the benefits of NEC, and to produce lessons to aid the development of a NEC delivery strategy. The project is in two parts: the development of a method to achieve these aims, followed by analysis of the data and the publication of a report.

Because of the widely differing sources of data, it was decided to develop a method from which a useful set of lessons could be produced in the context of current and future military processes, which accommodated this variety. The learning cycle process used identified four types of lessons by which the data could be initially classified. Using Checkland's methodology to include socio-technical aspects emphasised the importance of having a conceptual model central to the learning process to provide consistent understanding of the military business. Such a model was developed using a human activities model and the NEC conceptual model. From this, a taxonomic matrix was constructed within which each cell was uniquely defined. Using this, the data could be categorised with the understanding conveyed by the model and a series of lessons derived by distilling and validating the contents of each cell and abstracting them to a higher level.

A sample set of data was analysed using this method and the results showed that such categorisation was possible and meaningful. Work is in progress on the full analysis.

INTRODUCTION

The United Kingdom (UK) Defence Scientific and Technology Laboratory (Dstl) has recently begun a research project within the programme supporting the delivery of Network Enabled Capability (NEC) to see if lessons identified (LIs) from operational, exercise, experimental, research and other sources could be exploited to provide evidence of the benefits of NEC. In addition, it was felt that the process of analysis should produce lessons that would aid the development of a pragmatic and effective strategy for the delivery of NEC. The scope of the work includes UK national, coalition and multinational aspects, as well as evidence from the experiences of commercial and public organisations.

The project was initiated because of the apparent super-abundance of data after recent publication by the UK and other nations of Lessons Identified /Learnt reports consequent on operations in Iraq, Afghanistan and elsewhere such as East Timor. The project envisaged two parts: the development of a method to achieve these aims and to collect data, to be followed by analysis of the data and the publication of a report.

It was soon apparent that the body of data collected as 'LIs' or 'observations', was extremely diverse in content and quality, and particularly in the way in which they were identified and analysed by the various responsible agencies. Few reports or relevant doctrinal publications contained any indication of the process adopted to collect, analyse and implement the lessons. While it was evident in many cases that there had been an analytic element, what this was, how it had been done and with what consistency, remains unclear. For example, it was not obvious whether a LI was a distillation of a number of others or whether it was based on a single but highly significant event, and some LIs were found to be solutions to unstated problems. In addition, no concept of 'testing' or validating a lesson was apparent, especially one which takes regard of system (including non-technical) effects, such as the identification of undesirable emergent properties. Such validation, and its method, is considered essential to understanding the implications of LIs for both current and future operations, to which the impact of NEC adds yet another dimension.

Central to the whole 'LI' process, therefore, is the need for a clearly expressed understanding of the military business that provides consistency to all its aspects. As a consequence, the first stage of this project was begun by returning to the fundamental question of what the 'LI' process was or should be, a major element of which would the expression of a model of the military business.

The purpose of this paper is to describe the work carried out in this initial phase of the project to develop an appropriate methodology that would provide consistency in process while taking account of the implications of NEC and the inconsistency of the available data.

THE PURPOSE OF LESSONS IDENTIFIED – THE LEARNING CYCLE

Before the great diversity of LIs could be in anyway resolved or interpreted, it was considered important to define what an LI was and, in doing so to, to define its purpose and the process for developing it into something useful Historically, 'Lessons Learnt' were collected by the military in order that shortcomings, mistakes and failures, particularly in equipment, could be understood and rectified for future operations. Within the United Kingdom, this process has continued, in the form of 'Lessons Identified': *"All commanders directly involved in operations, in theatre, in the command chain or elsewhere, were asked to make reports through their chain of command on their experiences during the operation, and to recommend areas where they felt improvements can be made to equipment or procedures for future operations*." [1] Since then the requirement has expanded to include success: "*Such reports highlight areas where things worked well, but there is a deliberate focus on identifying lessons in areas where we need to continue to improve in the future"* [2]„.

In general terms, there are two purposes to the LI process; the first is to gain a clear understanding of the problem, and the second is to decide on the appropriate corrective measures. It can be viewed as a process to measure the effectiveness of and validate the operational endeavour, in addition to being fundamental to the generation of corporate knowledge. In other words, process should be seen in the context of quality control ('are we doing the right thing?') and risk assessment (the adequacy of resources, training and the like) strategies and should, therefore, form a key part of any audit process.

Organisational learning can be regarded as a cyclical process, the key components of which are shown in Figure 1, adapted from a model used by British Petroleum in the context of its work on knowledge management. This illustrates the essential steps in a learning cycle but is greatly over-simplified, omitting, for example, the important feedback loops within it that short circuit the process. The process does not differ regardless of whether learning takes place before, during or after an event. What the cycle does emphasise, though, is that learning is not a one-off event, but an ongoing dynamic.

The first half of the learning cycle concerns the identification of those events from which there is something to be learnt and the development of sound solutions. Monitoring of the delivery activity, in the military case, the conduct of operations and exercises, including adverse events, provides a basis for asking questions about how improvements can be brought about and errors avoided. A key part of this process is 'sensemaking'[3], ensuring that individuals and organisations understand the true nature of their experience so that it provides a sound basis for learning. It is far more difficult for effective learning to take place if the initial understanding of what has occurred is seriously flawed. In particular, it is important to consider experiences in the context of the various systems in place and the way these interact, because only in this way is it possible to come to sound conclusions about the nature of potential and actual risks faced.

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[1] *Kosovo: Lessons from the crisis*. MOD, Comd 4724, June 2000, HMSO, London.
[2] *Operations in Iraq; Lessons for the future*. MOD, December 2003, London.
http://www.mod.uk/linked_files/publications/iraq/opsiniraq.pdf
[3] *Sense-making in organisations*. Weicke, K.E. 1995, Thousand Oaks CA. Sage Publications.

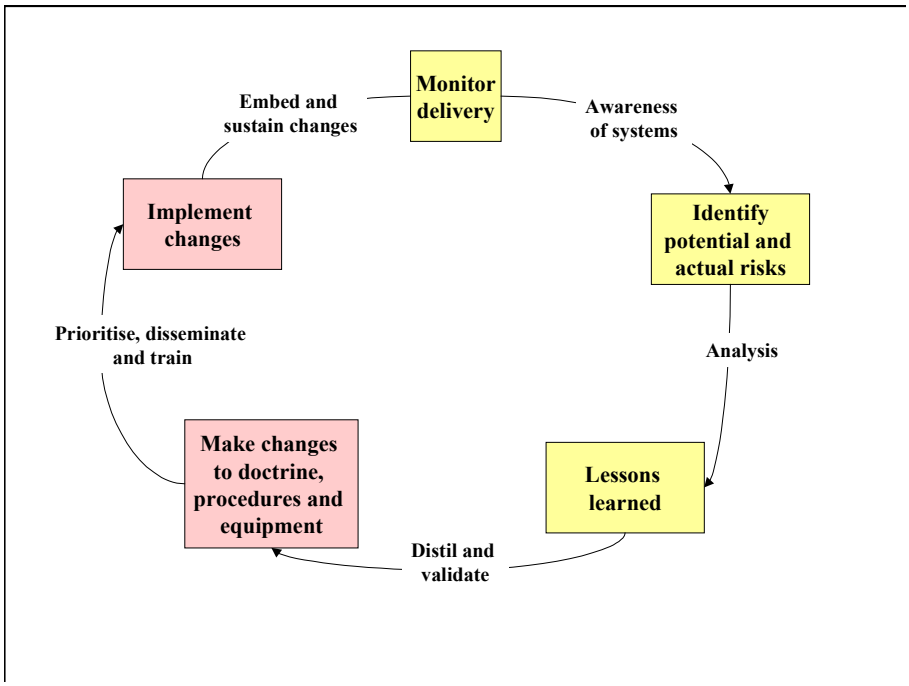

Figure 1. The Learning Cycle[4]

Once potential and actual risks have been identified, they must be properly analysed to identify lessons for policy and practice. Lessons can be extracted from the pool of available information through analysis, but then need to be distilled to make sure that the essence of the learning points is properly captured, and their validity tested in theory or practice. Validation is important particularly in the context of future operations but it is also a key step in learning from experience within a team or an organisation. It is easy to reach a conclusion or draw a lesson which appears obvious, but which does not stand up in testing. The initial assessment may be flawed, or the solution identified may not in practice address the issue effectively.

The second part of the learning process, once sound solutions have been derived, is to make sure that they are put into practice. Learning needs to be translated into practical policies and actions that can be implemented at the appropriate level. These practical changes then need to be prioritised, to provide a clear agenda for action, and disseminated to the relevant audience. Training is a vital tool in ensuring that information on change is both disseminated and acted on. Action to implement and apply improvements on the ground is an essential part of the learning process. Finally, continuous monitoring of changes and improvements in practice is an essential part of ongoing learning and improvement. All the evidence suggests that the latter stages in this learning process are critical in ensuring that organisational behaviour is actually changed as a result of the lessons drawn from adverse incidents, and that true 'learning' requires more than just the identification of valid lessons[5].

[4] Adapted from a model developed by BP Amoco. See footnote 5.
[5] *An organisation with a memory: a report of an expert group on learning from adverse events in the HNS*. Chief Medical Officer, Department of Health, 2000, HMSO, London. The Life Cycle figure and the text above is adapted from Chapter 3.

With this understanding of the learning cycle, it is possible to define terms more closely:

- Lesson stimulated: the raw data and observations arising before, during or after the critical event.

- Lesson identified: the appreciation of the event in terms of understanding its cause and the consequences.

- Lesson learnt: the identification of the changes which would ameliorate the situation.

- Lessons implemented: the acceptance and putting into practice the changes to doctrine, procedures and equipment resulting from lessons learnt. Implicit in this is an action to monitor implementation to ensue that the lessons become embedded.

All these rely on analysis supported by a clear and consistent understanding of the military business. These definitions and the construct of the learning cycle means that it is possible to do an initial sort of the many and diverse 'LIs' in order to see what they are: lessons stimulated, identified, learnt or implemented. Inevitably there will 'LIs' which cannot be categorised in this way because of insufficient data, that will need to be catalogued and discarded or the source material found.

ANALYSIS

Having understood the nature of the learning cycle, its purpose, and the 'LI' process, the next area to be considered was the method of analysis whereby lessons learnt are developed from LIs. Given the human basis of the learning cycle and the 'soft' issues involved, the use of the methodology proposed by Checkland[6] (Figure 2) was considered appropriate.

The methodology aligns well with the learning cycle where stages 1 and 2 describe the process of identifying the problem or critical event ('stimulating' the lesson) and putting it in context ('identifying' the lesson). The purpose of this stage is to ensure that the cause and the circumstances of the event are fully understood. These can then be analysed in terms of a conceptual model, which reflects an understanding of the military business, to develop the lessons learnt from which the necessary changes to doctrine, procedure and equipment can be made and implemented. To do this in the context of NEC requires that the conceptual model reflects how our understanding of NEC will affect the delivery of military capability in the form of improved decision making, agile mission grouping and synchronised effects and provides the means whereby LIs can be transformed into lessons learnt.

[6] *Systems thinking, systems practice*. Checkland, P. 1981, John Wiley and Sons, Chichester. Page 163 *et seq*.

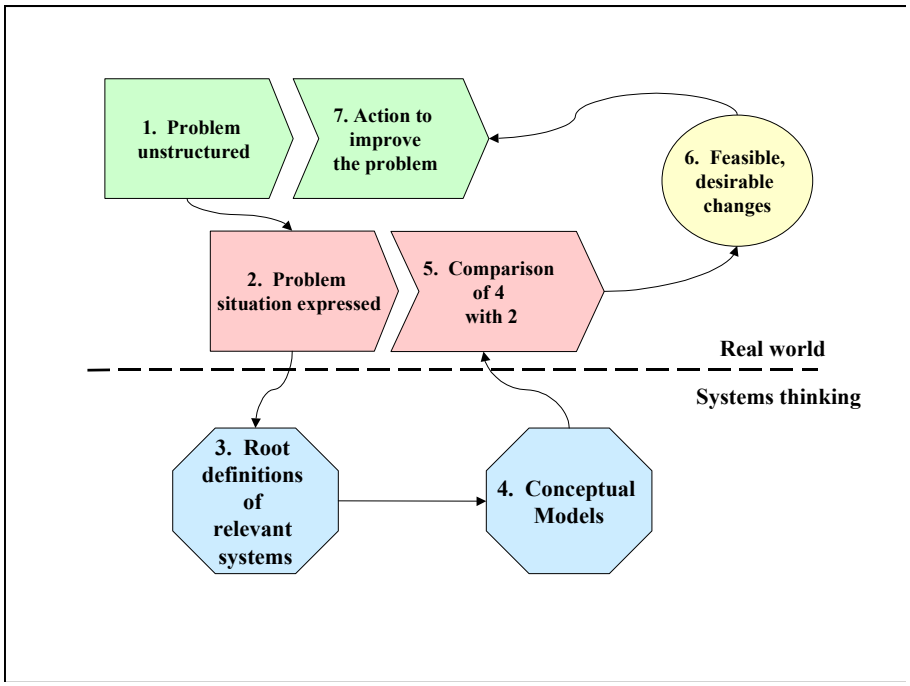

Figure 2. The Checkland Methodology in summary.

The key requirement of stages 1 and 2 are, as Checkland notes, to build up 'the richest possible picture' by collecting as many perceptions about the event as possible from the widest possible range of stakeholders. In particular, it is important to discover the structures, the processes, and the relationship between them, as it these that describe the 'climate' of the situation, frequently the contextual core of the event.

In this sense when considering a military operation, we can apply a general model of human activity in which the following are major contributing factors:

- Organisation, roles and relationships of those involved (stakeholders).
- Doctrine, policy and procedures espoused, that is the formal process.
- Operational environment, that is, the physical environment in which the event took place.
- Team dynamics.
- Individual characteristics.
- The mission in which the stakeholders were engaged.
- The influence of the adversaries and partners in, for example, a coalition.
- The social, cognitive and behavioural processes that produce the informal communication networks and 'ways of working' through which we most easily engage with each other to make the formal processes work.

Thus, for a LI to have utility and meaning requires not only a description of the event, but that the full context surrounding event is captured in a way that includes the factors listed above. Without context, it is doubtful if the LI can be of real value within the learning cycle.

MAKING CHANGES

While this set of lessons is valuable in itself, validation is needed in current or future operational contexts through modelling, experimentation and /or simulation. One of the prime reasons for doing this is identify and remove contradictions between lessons identified, to identify any undesirable emergent properties that may only be observable when the system is highly stressed and to measure the benefit to be gained by making the changes. Only then can they used to institute change as shown in the learning cycle and in Checkland's' methodology (stage 6). These changes are not as the learning cycle suggests confine to doctrine, procedures and equipment but will affect all the Lines of Development[7] Thus each validated lesson needs a further stage of analysis to do this.

Each lesson needs to be seen in two contexts; that of current military processes and that of future processes where NEC will have great effect in what it enables and enhances. The transition can be envisaged as one of spiral development through a number of intermediate stages in which any changes provoked by a lesson must remain relevant. While modelling the lesson using current processes is relatively straight forward in that suitable scenarios and models exist to do this, doing so in a future operational context requires that a model of future business process exists.

Earlier work[8] to support the delivery of NEC developed a capability architecture for 2020 based on the nature of the concepts described in the Joint High Level Operating Concept (HLOC)[9], whose its principle aspirations for NEC are that it should:

- Allow the creation of agile forces.
- Provide an adaptive command and control system.

The architecture is concerned with *structures* in the form of Deployed Operational Groups and the higher command organisation, the relationship between these structures in terms of both their *command relationships* and *the integration of common functions* as described by the components of the Defence Capability Framework (DCF)[10], together with the *rules* that allow this to happen in manner that that accords with doctrinal concepts. Together these describe how Effects Based Operations, the doctrinal requirement, and the aspirations of HLOC will be supported by agile mission grouping, the NEC enabler.

The functional integration described in the analysis and incorporated into the capability architecture commits to a 'communities' view in which entities work together in a basic structure to carry out a task[11] and gain or lose degrees of functionality according to the need to adapt to the task through a process of deliberate and dynamic planning. Within the architecture, military capability is provided by environmentally based stable utilitarian operational groupings, Deployed Operational

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[7] UK Defence Lines of Development: *Training, Equipment, Personnel, Information, Doctrine and Concepts, Organisation, Infrastructure, Logistics*. (JDCC proposed framework as at Oct 04). Similar to the US: Doctrine, Organisation, Training, Material, Leadership Development, Personnel and Facility (DOTMLP-F).

[8] A Capability Architecture for 2020. Dstl. March 2005. DSTL/TR12998

[9] Joint High Level Operating Concept, JDCC 2004.

[10] UK Joint Vision, 15 Jun 01. The Defence Capability Framework comprises 7 components of capability: Command, Inform, Protect, Operate, Sustain, Project and Prepare.

[11] As they would need to do anyway, even in the Universalist view!

groups, such as the current brigade or task group, able to share functionality between groupings to adapt their capability according to circumstance. Integrating like functions across the components of military capability, as expressed by these stable, utilitarian operational groupings, results in a defined set of functional integrations through which resources can be shared and variety found. This is shown diagrammatically in Figure 3.

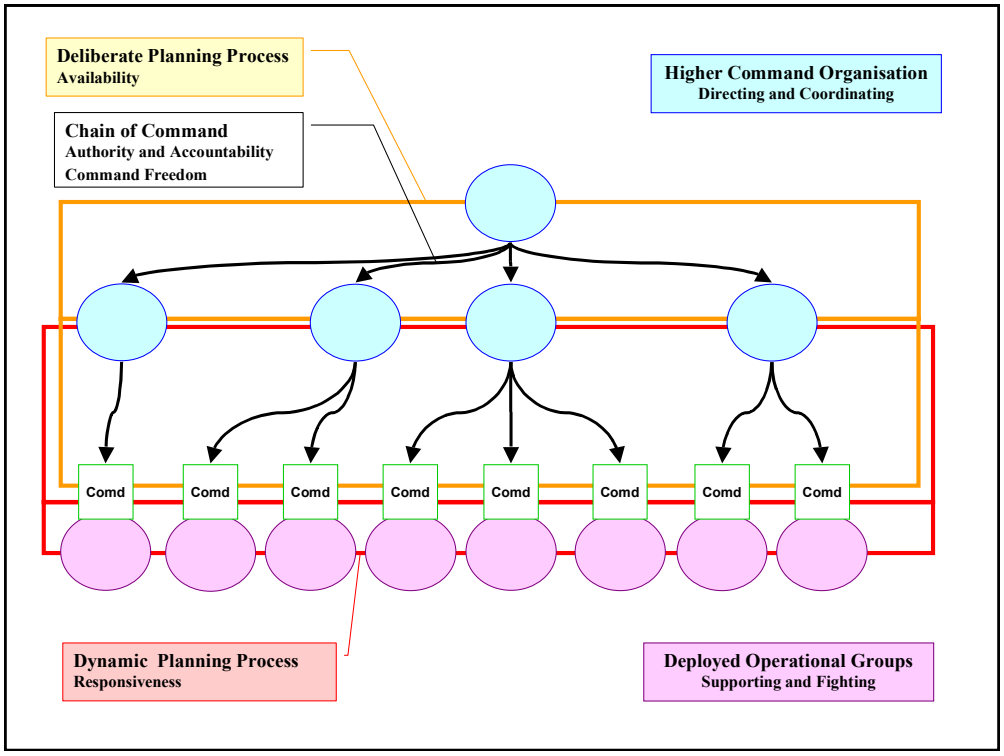

Figure 3 Outline capability architecture.

Using the capability architecture allows modelling to take place in a future context where NEC is embedded in the context. Functional integration can be viewed as the provision of a set of managed services that support not only command and ISTAR, but Joint Strike, Joint Manoeuvre, Joint Force Protection, Joint Logistics and other functions. Validating the lessons learnt in such an environment will, therefore, show how such integrating functions can be implemented and the changes necessary to do so.

In order to evaluate the benefits of such change, metrics need to be developed. This is work in progress but follows the outline proposed by NATO[12]

[12] NATO Code of Best Practice for C2 Assessment. NATO. Revised 2002 and reprinted by CCRP, Washington. Chapter 5, Measures of Merit, refers.
http://www.dodccrp.org/publications/pdf/NATO_COBP.pdf

THE CONCEPTUAL MODEL

The conceptual model used in the methodology was developed to provide consistency and understanding throughout the process. As a basis, it was decided at a workshop of subject matter experts to consider the NEC conceptual model developed by Dstl for the UK NEC programme[13]. This model developed from the NEC Themes, shown in Annex A, and while this provided the necessary NEC framework, the workshop appreciated that it failed to capture the socio-cognitive processes essential to effective working, and especially the informal ones. This was achieved by incorporating additional categories from the general human activities model that described the more cognitive, networking and co-operative effects as shown in Figure 4 below.

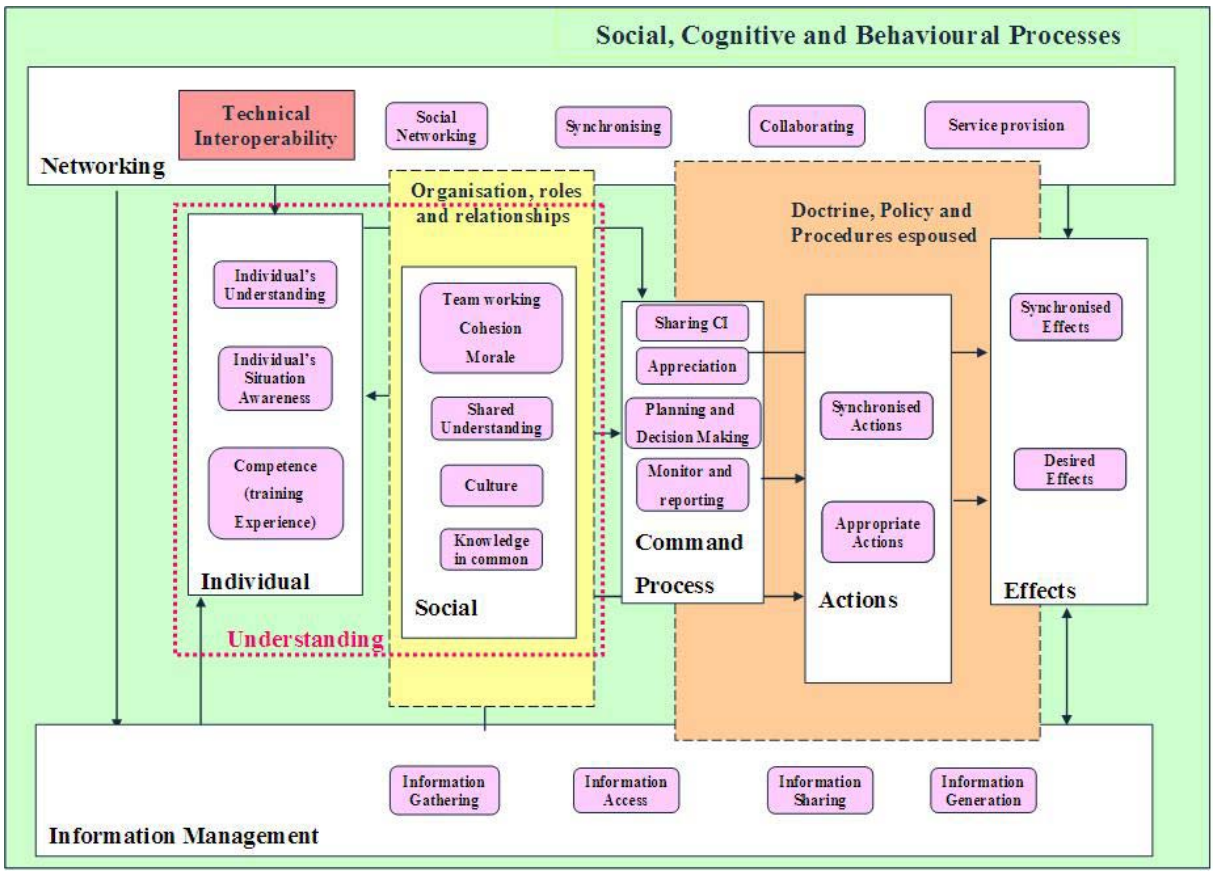

Figure 4. The Conceptual Model.

[13] *NEC Conceptual Framework*. 15 April 2004, Dstl/IMD/SOS/500/2 Issue 2.1. The model was developed in a workshop (13/14 November 2003) with Dr David S Alberts, Director of Research, US OASD (NII), and Director, Command and Control Research Programme and Dr Richard E Hayes, President and Chief Scientist, Evidence Based Research, Inc, Vienna, Virginia. A prime purpose of the workshop was align the UK framework with the US framework developed by EBR for John Garstka, US Office of Force Transformation, notwithstanding differences in perception of the value of information. (See *Network Centric Operations Conceptual Framework*. Version 1.0 November 2003. Evidence Based Research Inc, Vienna VA 22182. Available at http://www.iwar.org.uk/rma/resources/ncw/ncw-conceptual-framework.pdf).

A continuation of the workshop developed the model further to provide full definitions for component and element within the model which given in Annex B and this provided a useful taxonomy which could be used to categorise LIs. However, the human activities factors (cognitive, social and behavioural; organisation, roles and relationships; and doctrine, policy and procedures factors) now incorporated in the model have an effect on some or all of the NEC elements, and the whole can best be represented as a taxonomic matrix, where each cell within the matrix can be defined. The skeleton of the matrix is shown in Figure 5 and the detailed definitions for each cell at Annex C.

Categorisation of lessons, therefore, is a helpful process that prompts understanding of the military business as the factors being considered impact directly on both the understanding of the cause and the remedial action necessary. Defining the meaning of each cell makes matrix much more than simply a database, since it implies an understanding of the military business which is brought to bear in each individual case.

Category		Social, cognitive and behavioural processes	Organisation, roles and relationships	Doctrine, policy and procedures
Networking	Technical Interoperability			
	Social Networking			
	Synchronising			
	Collaborating			
	Service Provision			
Information Management	Gathering			
	Access			
	Sharing			
	Generation			
Individual Understanding	Understanding			
	Situation Awareness			
	Competence (training, experience)			
Social Understanding	Teamworking, cohesion, morale			
	Culture			
	Shared Understanding			
	Knowledge in common			
Command Process	Sharing Command Intent			
	Appreciation			
	Planning and decision making			
	Monitoring and reporting			
Actions	Synchronised			
	Appropriate			
Effects	Synchronised			
	Desired			

Figure 5 – Taxonomic Matrix Skeleton.

In terms of the learning cycle, categorising the LIs using the taxonomic matrix begins the transformation process whereby they can be aggregated into lessons learnt. In terms of the Checkland methodology, categorisation produces a product which can then be validated against the original LIs as fully expressed in their context (stage 5)

to ensure that the substance of the original contention has been captured in the lesson learnt.

The natural expectation is that there will be a distribution of LIs across the cells, allowing that, because of the way in which they have been collected, some cells may have none while others may have several. That there are none does not invalidate the matrix but suggests that none have yet occurred that can be categorised to that area or cell. The matrix also allows a single LI to recorded in a number of different cells if warranted. In simple terms, the number of LIs recorded in each cell highlights where the most common problematic or most successful areas are.

Having categorised each LI and recorded it to a particular cell, the sense of the LIs in that cell is distilled to produce a generic lesson learnt for that cell. To do this places great stress on the accurate recording of the LIs and in particular of the context, without which this is extremely difficult to do.

The next stage is one of further distillation or abstraction to produce generic lessons learnt for each element and then each component in the matrix. For example, generic lessons learnt are derived for the 'gathering' element of the Information Management component and then, in conjunction with 'access', 'sharing', and 'generation', for Information Management itself. This is done similarly for the human activities factors that provide the matrix columns.

The end result therefore is a set of lessons learnt that typify Networking, Information Management, Understanding, Command Process, Actions, Effects, Cognitive, social and behavioural processes, Organisation, roles and relationships and Doctrine, policy and procedures.

TESTING THE METHOD.

Having developed the method, a small sample was examined as a test. As described at the outset, the data available is extremely variable and some of the practical issues that arose on inspection of the sample were:

- Some of the lessons describe something that has been observed but not the actual root cause of a problem and others describe what actions should be taken but not the reasons that they are being taken.

- In what context are we trying to classify the lesson? The cause, the effect or the remedial action to be taken?

- From whose point of view are we classifying them? The unit commander that is going to be directly affected by the remedial action or the JTFC who may not see any visible signs of action being taken.

- Some of the lessons were very long and covered a multitude of issues. Since these would therefore appear in a number of the categories in the framework, they would need decomposition in order to be mapped.

It is only with understanding provided by the learning cycle (or 'LI' process) and the conceptual model that these problems can be seen in a sensible perspective. A sample of 338 LIs were selected to test the categorisation process to give as broad range of type and quality as possible. Examples, from Operation TELIC, that have been analysed are shown in Table 1.

Serial	Subject	Lesson	Classification
1.	Information Campaign Timing	An information campaign, to be successful, needs to start as early as possible and continue into the post-conflict phase of an operation.	Social, cognitive and behavioural processes – Planning and decision making
2.	Non-technical/ Technical Interoperability	Regular training and cross-fertilisation with US forces are required to promote interoperability when UK forces are deployed in a US-led or backed coalition. Achieving interoperability requires extensive information sharing between the US and UK	Doctrine, policy and procedures – Technical Interoperability. Organisation, roles and relationships – Sharing Command Intent. Doctrine, policy and procedures – Team working, cohesion, morale
3.	Training	UK forces' excellent individual command and leadership training was clearly demonstrated during the Iraq operation. Training nonetheless needs to be reviewed to keep pace with the rapidly evolving demands of modern warfare	Doctrine, policy and procedures – Team working, cohesion, morale Doctrine, policy and procedures – Competence

Table 1. Sample Lessons Identified.

This showed that of the total sample of 338 lessons it was possible only to classify 179 of them because they were either in appropriate in dealing with equipment only issues, or there was insufficient contextual information to categorise them with any confidence. The 179 suitable led to 283 assignments to categories indicating that some lessons fell into more than one area.

In addition it was found that:

- 9.5% of the lessons fell under Social, Cognitive and Behavioural processes.

- 27.9% of the lessons fell under Organisation, Roles and Relationships.

- 62.6% of the lessons fell under Doctrine, Policy and Procedures[14].

From these results, it is concluded that the method and the conceptual model provide a suitable way in which to categorise lessons from recent operations and exercises and derive meaningful changes that can be made to current and future military processes.

[14] It is of interest to note in this context that in a historical analysis of stabilisation operations, an important conclusion was that 'the overwhelming majority of C2 failings were due to organisational, rather than technical, deficiencies'. *Drawing lessons from the past: a historical analysis of stabilisation operations*. Irwin C and Morley February 2005. Royal United Services Institute (RUSI) Journal Vol 150 No1, London.

NEXT STEPS

Based on the preliminary results gained from the sample set of data, there is sufficient confidence in the model's ability to handle diverse data sources to continue with the project. It is proposed to analyse fully a larger set of data to further confirm the validity of the model and ensure that the classification is working sensibly. Once that is completed satisfactorily, the remaining data will be analysed.

Of immediate interest will be to see where the emphasis of the analysis lies and the import of that emphasis for the introduction of NEC constructs such as 'joint fires'. Of key concern will be the cost-benefit analysis attached to changes proposed by the lessons learnt.

ANNEX A

NETWORK ENABLED CAPABILITY (NEC) THEMES

1. The NEC Themes[15] define the essence of NEC and drive future development. Early analysis utilised the knowledge gained from previous UK initiatives to implement enterprise wide CIS in support of operations, such as the Joint Battlespace Digitization programme and DOCIS, and from an understanding gained through involvement with the US Network Centric Warfare (NCW) programme[16] and the Force Transformation process that it inspired. The UK view derived from this analysis is one of a capability enabled by networking rather than the network centric doctrine espoused by US. Importantly, therefore, in UK terms NEC is an 'enabler' for the conduct of operations.

2. This analysis recognised from the outset that any discussion of NEC could not be done solely in technical terms as there was a very strong human and social component that had to be included. This led to the view currently held of NEC as being a complex socio-technical capability that must be considered holistically across all Lines of Development[17]. The NEC Themes derive from this holistic view and define the essence of NEC. They are shown in *italics* Table 1.

3. By defining a capability architecture the NEC themes can be extended to provide a more detailed description of how they are achieved, as shown below.

Theme	**Description, refined by CA 2020**
Inclusive Flexible Acquisition	*Co-ordinating processes across MOD, OGDs and industry that promote the rapid insertion of new technologies, facilitates coherence between acquisition programmes and provides an incremental approach to delivering and maintaining 'net-ready platforms'.* Uses CA 2020 to provide a coherent view for technological systems integration and technology insertion.
Resilient Information Infrastructure	*Ensuring information is managed coherently across the battlespace and that the potential for secure and assured connectivity is provided to all battlespace users.* Supports a range of managed services to levels agreed through SLAs. These reflect the bounds of IM set by Command Intent in the context of organisational structure and the socio-technical capabilities of the network

[15] Dstl/IMD/SOS/500(FY03)/2.1: Refined NEC Concept: Part 2 – Revised NEC Core Themes and Conceptual Framework.
[16] See, for example, Power to the Edge, DS Alberts and RE Hayes, CCRP, Washington, June 2003.
[17] UK Defence Lines of Development: *Training, Equipment, Personnel, Information, Doctrine and Concepts, Organisation, Infrastructure, Logistics*. (JDCC proposed framework as at Oct 04). Similar to the US: Doctrine, Organisation, Training, Material, Leadership Development, Personnel and Facility (DOTMLP-F).

Full Information Accessibility	*Enabling users to search, manipulate and exchange relevant information of different classifications (respecting security constraints) captured by, or available in, sources internal and external to the battlespace.* Provided by managed services that enable users to disseminate and /or access information. Services include the generation, compilation and dissemination of rich pictures (functional and multifunctional) and directed (eg peer-to-peer) task-orientated exchanges.
Shared Understanding	*Enabling each user to generate an understanding of the battlespace that is appropriate and adequate to their task and consistent with the understanding of other users. This understanding covers the interpretation of the situation (current situation, its history, and potential developments of all battlespace participants) and of Command Intent (the effects and outcomes higher command wants to achieve).* Facilitated by membership of, and subscription to information services offered by communities which are based on DOGs, the functions through which they are integrated and the dynamic 'virtual' groupings created on top of them to execute particular co-operative tasks.
Dynamic Collaborative Interworking	*Enabling agile command and control within and between mission groups through the ability to concurrently plan and execute operations in a way that is dynamic, continuous and synchronized. Thus, it allows all entities (including non-frontline MOD bodies, Other Government Departments, industry, academia and public service as well as military) to work together dynamically to meet changing mission needs.* Brought about by the federation of dynamic planning processes within and between DOGs, superimposed on the planning capabilities (deliberate and dynamic) of the higher command organisation. Achieved through dynamic 'virtual' groupings characterised by co-operative behaviour (e.g. service provision, supporting/supported relationships) and IM policies tuned to command intent.
Agile Mission Grouping	*Enabling the dynamic creation and configuration of task orientated mission groups that share understanding and that employ and co-ordinate available assets to deliver the desired effect.* Organisational agility achieved on two timescales: TASKORG creates groupings whose composition reflects deliberate planning; their characteristics then enable the construction of dynamic 'virtual' groups through functional integration, potentially across the TASKORG, in response to tasking as a result of dynamic planning. There are also cognitive and procedural dimensions to agility.
Effects Synchronisation	A*chieving the desired effects through the synchronization of activities within and between mission groups*. Achieved through a spectrum of methods, ranging from the network wide expression of command intent and explicitly choreographed co-operative activity.

ANNEX B

HIGH LEVEL DEFINITIONS

Category	Definition
Networking	Overall name given to all those activities implying interacting for information and communication exchange. Incorporating both the social and behavioural elements and the technological support necessary to support these activities when individuals and teams are not co-located.
Technical Interoperability	The ability of technological systems and platforms to interconnect at levels of interoperability (use LISI) varying from ability to connect to actual ability to synchronise effectively
Social Networking	The actual social process of people communicating to exchange information, ideas, plans, co-ordinate task behaviour, etc - in some cases directly face to face, or in some cases facilitated or enabled by some form of technology (phone, email, CSCW tool)
Synchronising	Achievement of co-occurrence of action or effect in time and/or space.
Collaborating	This is the means by which activities in the battlespace are correlated or deconflicted. The strength of coupling may vary from complementary (independent but contributing to same goal), co-ordinated (e.g. mutually supportive, or needing to be deconflicted), coherent (pursuing a joint goal which requires both parties to interact co-operatively) - ultimately if the activities are so tightly bound together that the individual contributions cannot be distinguished, this would be a unitary form of collaboration (melding together into a single construct).
Service Provision	The provision of the appropriate technology to support task(s)
Information Management	The whole process of dealing with information from its identification, through to processing, sharing and most importantly for NEC aims, exploiting the information and using it to change or conduct a process/create an effect that in some way contributes to capability. Includes doctrine and processes for how information should be managed and shared as well as training.
Gathering	The process of dealing with information from its identification, through to its processing. Information exploitation is made up of the gathering and sharing of information
Access	Information Accessibility includes the need to manage, administer and exploit our information through the provision of appropriate doctrine, training, structures and tools – in short being able to know it exists and to find and use it when we want it.
Sharing	Procedures and day to day processes associated with transfer and dissemination of information between individuals and teams. Not just the tools to allow them to do so but providing an atmosphere in which sharing is not only permitted and defined in official procedures (see info management in general) but where it is genuinely part of people's every day tasks and activities to do this and processes exist by which they can and should and there is a directly perceived benefit for them in doing so, so it doesn't become a 'chore'.
Generation	We need to be able to generate required information and intelligence. There is the need to develop our corporate knowledge and there is the need to rapidly surge capacity to meet more immediate information demands.

Individual Understanding	The individual's understanding will be arrived at via input from and interactions with other members of the team and as a result of his/her networking and information management activities - hence links to these two areas. Further their cognitive activities are generated within, and framed by, the organisational context and the day-to-day social cognitive and behaviours in which they engage.
Understanding	Individuals generate mental models (inaccurate representations of the world that simplify it) so that they can interact with systems/teams/tasks and perform mental operations on them in their current situation. These mental models are developed by current dynamic input from sensory/perceptual sources and their interactions with the current context, but are interpreted in the light of existing schemata in long term memory and in the light of previous experiences and training.
Situation Awareness	A constant *process* of perceiving events around the individual, comprehending them, and projecting about what the situation and events mean in terms of the individual's goals so that eventually a *product* (a mental model) is developed that we call situation awareness and of which we can measure the explicit part. Much of this knowledge we call SA is implicit and is generated unconsciously, particularly in those who are experts in their domain and have undergone much training.
Competence (training, experience)	Knowledge, skills and abilities + training and past experience
Social Understanding	Teams who train together and who share experiences are more likely to have what are called 'shared mental models' because they may frame new experiences in a similar way and thus arrive at similar or compatible interpretations of the current situation. These teams experience similar relationships and their experiences are gained as a result of networking together and experiencing a similar organisational context and similar social cog and behavioural experiences - hence the link to all these.
Team working, cohesion, morale	Teams develop teamwork mental models of what behaviours to expect from particular members as a result of past experiences together and generate shared mental models as described above.
Culture	Culture can be defined simply as 'the way we do things around here'. Value systems, behavioural standards or norms surround these fundamental assumptions, and on the very outermost level of a culture are the obvious artefacts that can be seen even by outsiders, such as an organisation's dress code or buildings.
Shared Understanding	Enabling each user to generate an understanding of the battlespace that is appropriate and adequate to their task and consistent with the understanding of other users. This understanding covers the interpretation of the situation (current situation, its history, and potential developments of all battlespace participants) and of Command Intent (the effects and outcomes higher command wants to achieve).
Knowledge in common	These are obviously linked to the concept of mental models, described earlier. Also heavily influences by the wider team/social context and the organisational/social contexts that will frame understanding and knowledge, hence their position in these boxes

Command Process	Command has been described by Pigeau and McCann as the creative expression of human will to achieve an end. The command process is the process through which this creative expression is linked to actions and effects. Command is, first and foremost, a cognitive process - however it is underpinned by more procedural activities which may characterised in informational terms, suggesting that the process can be decomposed into the elements below. The command process also involves a number of players and hence its execution is a collaborative activity, and hence social and behavioural characteristics play a significant part in shaping the emergent process.
Sharing Command Intent	Command Intent describes the outcome a commander is expected to achieve in relation to the higher level end state. Command Intent describes a much richer concept of operations than the current 'commander's intent', resulting, as it does, from the integrated efforts of commanders and their staffs at different levels and from the incorporation of each commander's perspective into the whole. What emerges must become the Intent of the whole command. This Intent will change over time; parts may remain extant throughout while other parts may change very rapidly as new situations occur. The hallmark of the successful sharing of Command Intent is operational proactivity in achieving desired outcomes.
Appreciation	Appreciation implies the construction of a mental model, the transformation of the information presented into an understanding which can informa planning and decision-making. A mental model is a personal construct [so shared appreciation is, at best, a loose term], but it will be heavily influenced by the wider team/social context and the organisational/social contexts that will frame understanding and knowledge. Appreciation will also be heavily influenced by any extant role or mission.
Planning and decision making	These elements of the command process have the most tangible products and therefore are the most easily described in procedural terms (i.e. the Estimate Process); in practice they are team-based and potentially distributed activities, and social & cognitive elements have an important role in steering them to a successful outcome, i.e. commitment to a decision, enabling orders to be generated from the elements of the plan to be adopted.
Monitoring and reporting	Reports and returns are formal military messages through which the situation 'on the ground', including the effects of the commander's orders are made visible to him. In practice there are cognitive elements and informal mechanisms in support of monitoring and reporting.
Actions	
Synchronised	Achieving the desired effects through the synchronization of activities within and between mission groups.
Appropriate	An activity carried out in accordance with a commander's mission in order to achieve the desired effects.
Effects	
Synchronised	Effects synchronisation implies a causal network of effects in which co-occurrence of two or more effects is sought in order to lead to one or more consequential effects. *Effects Synchronisation attempts to refine, collate, and synchronise the selected Effects to Nodes (Targets) to Actions to*

	Resources (ENAR) sequence so as to achieve for the commander the highest probability of success.
Desired	The effect whose desired achievement has resulted in specific actions being carried out.

Social, cognitive and behavioural processes	These are the day-to-day processes that individuals go about in the organisation as they conduct their tasks some of which will be individual, some team, all of which will be influenced by the organisational context and its culture, so they are in effect the emergent behaviours framed by the organisational culture, the organisational culture in practice. e.g. how people use technology in practice, who they communicate with and how, how they conduct their daily tasks. This is the reason they are the backdrop to everything as it were.

Organisation, roles and relationships	Structure represents a particular view on roles and relationships, which define patterns of activity across the organisation in response to stimuli. Formal roles and relationships, defined in terms of power, authority and responsibility, can be described in an organisational structure chart (showing who reports to whom, who is responsible for what and who). In practice, these relationships are always refined by informal processes grounded in day-to-day social, cognitive and behavioural processes, including previous experience and friendships, and prosecuted through informal meetings and consultations. These informal processes, though less easy to articulate than the formal organisational structure, supplement and sometimes subvert the roles and relationships as inferred from the formal organisational structure - ultimately, the behaviour of individuals is driven by their perceived roles and relationships, which may or may not be identified in the formal model.

Doctrine, policy and procedures	This is the codification of practice, i.e. the formal counterpart to the organisational culture. It is the formalisation of 'how things should be done around here' (as opposed to 'the way things are actually done around here' in practice, c.f. social, cognitive and behavioural processes above).

ANNEX C

FULL DEFINITIONS

Category		Social, cognitive and behavioural processes	Organisation, roles and relationships	Doctrine, policy and procedures
Networking	Technical Interoperability			Doctrine for training, design and procurement of kit. Standards, protocols, repair & maintenance policy
	Social Networking	Acquiring info by informal means, e.g. chatting in corridoors, tea room, etc	Formal & informal relationships within and between organisations built up through personal contacts	Communities of practice, doctrine on knowledge management tools, capture of social networks, knowledge engineering
	Synchronising	Informal and cognitive dimensions to the establishment of strong coupling between activities. Explicit case is synchronising behaviour towards shared goals (see Teamworking), but there are also implicit examples where the coupling is induced by SCB factors without explicitly-declared intent - such 'accidental' synchronisations may be beneficial or damaging, in different circumstances.	Synchronisation of teams (within and between organizations) by technical and non-tech methods (LOs, virtual liaison, information-sharing, collaborative planning / execution, …)	Doctrine to support liaison and synchronisation.

	Collaborating	Collaboration implies a more general coupling than synchronisation, between individuals or between groups. SCB factors may impact on explicitly-defined collaborations but may also induce informal collaborations in the pursuit of the individuals' or groups' activities (more likely for day-to-day processes than exceptional?)' The use of Liaison Officers supports collaboration, potentially both bridging and buffering between structures as the need for coupling varies.	Provides the framework within which collaboration arises between teams, within the org'n and with teams external to the org'n, towards a specific shared goal. Captures the formal dimensions of collaboration (e.g. who is involved in collaborative planning).	Doctrine, policy and procedures in place to support collaboration, including MOUs in place for collaborating with other nations. Absence of agreed doctrine (e.g. for UK working under US command) means arrangements have to be established 'on the fly' and confusions may ensue.
	Service Provision	A service is a particular form of coupling mediated by a Service Level Agreement, which identifies Provider and Consumer roles. Services may be persistent, in which case they develop an SCB 'wrapper' over time, or they may be fleeting (in which case they must be procedurally defined and SCB factors may be of less significance).	Provides the framework for expressing the formal dimensions of service provision (e.g. quality of service: Assured Support, etc.). Also indicates the command authority to allocate these services.	SLAs should be established using agreed procedures reflecting doctrine and policy.

Information Management	**Gathering**	Unless initiative for the gathering of information has been vested entirely in technology, judgements about useful sources, query-posing, acceptance / rejection of available information will be influenced in part by SCB factors, e.g. mental models, long-term memory, etc.	Provides starting point for the organisational network needed to be able to gather information, recce units, UAVs, etc. Competence, technical capability, information and ownership are all grounded in the first place in the formal description of the organisation, roles and relationships.	IM Directive, eWoW, SOPs
	Access	It is possible to narrow the definition of access to the purely technological & procedural. But the definition on Sheet 1 suggests it accommodates an element of perception into 'Access', reflecting the cognitive and socio-cognitive processing of information - mental models, long term memory, etc.	Organisational policies for access; security policies for different organisations are a policy driver.	Access policies derived from organisational constraints - security, need to know, etc
	Sharing	Made up of two aspects: collaboration and social networking. Information sharing leverages the knowledge that the organisation needs in order to conduct operations more effectively and efficiently.	Information sharing is defined on, and binds together, the formal and informal organisational structure. Information sharing supports shared Command Intent, Shared Situational Awareness and Dynamic Collaborative Interworking, all of which work towards the fulfilment of	Doctrine in place to support organisational info sharing

			organisational goal-directed tasks and the maintenance of oversight and stewardship responsibilities.	
	Generation	People generating info within a team and teams with each other. Information generation occurs when events are detected or other information is fused, understood, becomes knowledge and generates either new information or action.	Competence, technical capability, information and ownership in relation to generated information are all grounded in the first place in the formal description of the organisation, roles and relationships.	Doctrine in place to support info generation
Individual Understanding	**Understanding**	Understanding formed from mental models, previous experience, etc. Improved through training and experience.		SOPs for gaining understanding, e.g. 7 questions of mission analysis, how info should be processed.
	Situation Awareness	A constant process of perceiving events around the individual, comprehending them, and projecting about what the situation and events mean in terms of the individual's goals		SOPs for gaining understanding, e.g. 7 questions of mission analysis, how info should be processed.
	Competence (training, experience)	Competence is the capability or capacity to achieve something. There are SCB elements to this as well as more-easily captured		Effective selection, training and posting procedures in place.

		elements such as records of training.		
	Team working, cohesion, morale	The SCB dimensions are the dominant factor here, and reflect mental models and behaviours which are built up over time. Training of teams together and common membership of establishment structures (e.g. Bde) are key contributors - without these, it is impossible to achieve team working and cohesion, and difficult to emulate by other means.	Co-location of team, virtual teams, ad-hoc/agile teams. Inter team processes, cross organisational teams. Leadership issues could be raised here as well	Doctrine for team working, SOPs, Field manuals, etc
	Culture	Interpersonal behavioural values. Shared goals, values and purpose. Shared operational approach. Evolves from behaviour and guides behaviour, constantly changing	Organisational culture - "this is the way it has always been done in this organisation". Informal culture - how it is done in practice	Formal culture - how it should be done. Prescribed in DPP, SOPs, etc
	Shared Understanding	Arrived at from Individual Understanding and Teamworking. Communication and co-ordination between parties	Underpins both successful sharing of information (through mutual awareness of different roles and relationships) and failures in shared understanding (failure in Liaison, breakdown in communication and co-ordination processes, misinterpretation due to different perspective).	Doctrine for understanding, SOPs & Field manuals at team or HQ level. Job descriptions

	Knowledge in common	Arises from Long term memory, shared mental models and shared understanding	Can be characterised by corporate knowledge generated in people by training, indoctrination, experience in organisation. Also experience of similar role in organisation	Policies, etc for training, seletion, doctrine, skill matching
Command Process	**Sharing Command Intent** .	SCB factors colour explicit Intent, and drive the appreciation of 'Implicit Intent', which requires an understanding of personnel, military and cultural expectations. Achieved through education, training, team building, and continual personal interaction. Common language.	Sharing of command intent across different levels of hierarchy, different groups within organisation and between organisations. E.g. Misunderstanding of an **order** between different levels of command in the same or different organisations	DPPs - set out in a certain way in order to avoid misunderstanding of implicit/explicit intent
	Appreciation	Development of an appreciation/understanding within the context of Command Intent & an overall plan	Team appreciation of Command Intent and appreciation across different levels of hierarchy, different groups within (and between) organisations	SOPs
	Planning and decision making	SCB factors have a profound impact on Planning and Decision-Making, and any attempt to drive them out and reduce military PL/DM to a totally mechanistic process is doomed to failure. Whether at the individual or collective level, effective PL/DM depends upon	Ability to (selectively) federate and co-operate at the planning level - planning across organisations (DCP)	Set out in doctrine

		all of the contributory factors in this column.		
	Monitoring and reporting	Formal, procedural monitoring and reporting is augmented by selective, ad-hoc and/or spontaneous activity driven by SCB factors.	Formal, procedural monitoring and reporting is defined in ORB terms	Set out in doctrine
Actions	**Synchronised**	SCB factors may facilitate, but could also impede, the coupling between two individuals or groups to achieve synchronisation. (The need for synchronizations may be perceived as disruptive by a team with its immediate objective in sight.)	ORB factors have structural impacts on the ability or otherwise of the organisation to deliver synchronised actions	SOP's
	Appropriate	"In accordance with a commander's mission" implies an appreciation of that mission, a willingness to pursue an action agreed and/or the willingness to use initiative in relation to the mission. Information will remain a poor substitute for moral leadership and maintenance of team dynamics.		Doctrine of mission command. Ends, Ways and Means

Effects	**Synchronised**	The 'synchronisation of effects' occurs in the real world and in the mind of the commander or commander(s) who conceived of their need. If this is true 'self-synchronisation' or [more realistically, mutual synchronisation between peer commanders / teams], then the ability to synchronise effects will depend on all the other factors in this column. But a 'synchronisation of effects' induced by a superior commander could be achieved independently of the effects delivery team's appreciation.	ORB factors have structural impacts on the ability or otherwise of the organisation to deliver synchronised actions	SOP's
	Desired	Implies an appreciation of the effects sought, a willingness to use initiative in relation to the effect and a willingness to pursue an action agreed as the result of effects analysis / planning.	Implies delegated authority to use initiative in relation to the effect - mission command is an ORB issue	SOP's