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Communities and their contribution to agile mission grouping

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This paper is 5th in a set of 13 presented to the 9th ICCRTS by staff of the Defence Scientific and Technical Laboratory (Dstl) and QinetiQ plc, relating to 'command in the network enabled era'. The papers are based on research undertaken for the United Kingdom Ministry of Defence's 'Network Enabled Capability' programme and, unless otherwise stated, are covered in whole or in part by Crown Copyright.

Communities and their contribution to agile mission grouping [1]

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Abstract

Community models can play a pivotal role in the development of defence / military capability. They provide a powerful language for capturing the socio-technical context for information system (IS) provision. Whether describing current practice or offering projections of the future, the critical factor is that they express the variety of activities and interactions which information and communications technologies (ICT) must enable.

The power of community models comes primarily from:

– Their economy of expression (compared for example with conventional analysis of 'atomic' information exchange requirements).

– Their capture of practical (as opposed to formal) relationships in the study of organizations in terms of structure, command and control.

The distinctive contribution of community models is their ability to provide a single construct to which operational, organizational, informatic and technical views can be related.

In this paper, communities are introduced initially as a descriptive medium, a way of codifying and representing existing or intended practice. In this guise, communities are of practical value in the expression of business contexts in User Requirements Documents (URDs) for ICT projects and the evaluation of proposed architectures.

Subsequently, communities will be discussed in relation to agile mission grouping, the ability to reconfigure continually the military organization (at multiple levels) to reflect current opportunities and threats, in the context of Network-Enabled Capability (NEC). This positions community models as a key enabler of command management, the establishment of command arrangements in support of the commander's conceptualisation of the operation.

Introduction

Principles of communities

Communities express the simple truth that participants in the battlespace work together in groups. Communities may be mission-based or capability-based. Such groups may be localised or dispersed; some groups will endure regardless of re-configuration, others will be transient or even 'fleeting'; but at any one time the activities of a participant will be tied into one or more sets of interactions with other defined participants. Each set of interactions can be expressed as a community, which is defined in terms of a language (e.g. a message set and/or data model), a set of structural relationships (including formal organizational structures) and a set of procedures.

> Communities also act as a vehicle for softer social constructs such as informal structures, dependence on training and experience, behavioural norms and characteristics to do with reliance and trust. Their key facets are summarised in

Figure 1 .

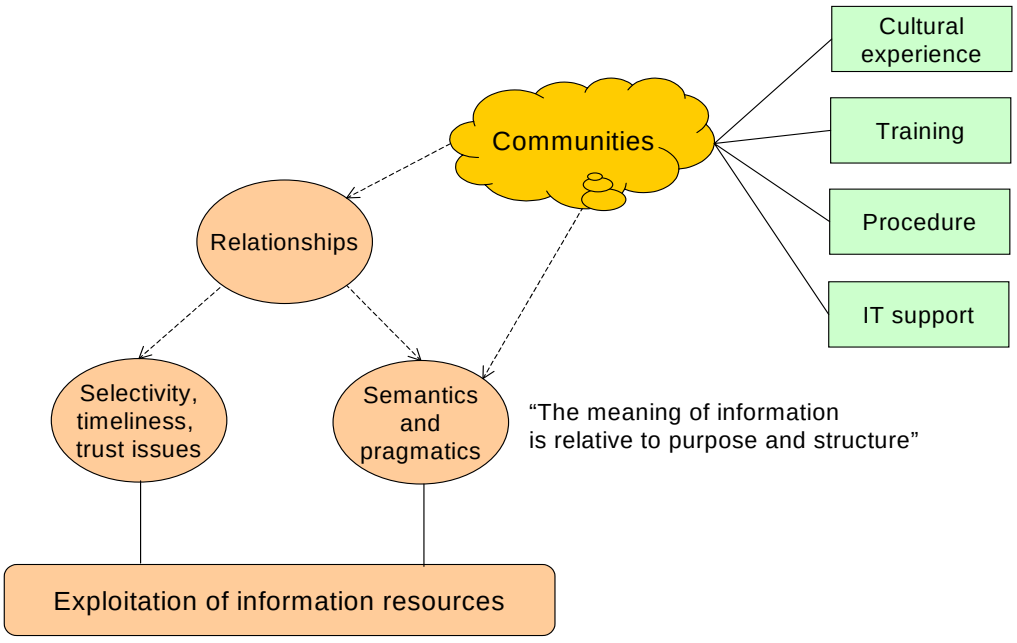

Figure 1: Key facets of communities

Communities and Information

Communities concepts represent the codification of a number of practical observations which will resonate with many practitioners with experience of business / IS interactions and alignment, across both the defence and civilian worlds. For example:

- People share information most easily with those with whom they are inter-working, where 'ease of sharing' relates to willingness, mutual understanding and the ease with which information value is recognised.

- People put more effort into information-providing or information-absorbing when they are closely related to 'foreground' or work-prosecuting activities than if they are perceived as 'background' activities.

These abstract principles can be compiled into a number of well-known slogans such as "Successful data entry depends on the people doing the data entry perceiving value in it for themselves." More profound is the realisation that information (data endowed with relevance) and work are usually so tied together that mapping one effectively means mapping the other[2].

Community concepts aim to capture enduring truths, rather than merely reflecting the consequence of technological limitations which may evaporate with the widespread availability of high-speed communications and semantic-web facilities The communities themselves may change radically with the introduction of new technologies[3], but so will the nature of the 'work done' by organizations: the outcome will be new structures in which information and work are again aligned, rather than divergent[4].

It is taken as read that this discussion relates to real communities and actual working and information-sharing practices, not just formal organizational structures and theoretical process descriptions. Communities bring concepts such as covert structures and tacit knowledge into play. One of the consequences of this is that the behaviour of totally new types of community is unpredictable, and community models are best employed to reason about communities which are analogous to existing community instances.

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[2] Advocates of this approach would point to the difficulties in exploiting information *in the absence of* effective work-interactions (e.g. trying to interpret information products generated by unfamiliar work processes).

[3] This assumes that technology insertion is not allowed, through piecemeal acquisition, to solidify existing structures into 'islands of capability'.

[4] The idea that communities represent stable forms to which organizations tend to relax aligns with Reference [1], which envisages (information) communities coalescing and adapting as operations develop. Reference [1] cites Vice Admiral Cebrowski, Head of the US DoD Office of Transformation, as reporting that US experimental experience indicates that communities of interest self-configure very rapidly once information starts circulating around a network.

Application of community principles in relation to UK Land Digitization

Introduction

The first formal use of the 'communities' term in MOD's Applied Research Programme came with the Shared Information Environment (SIE) work (ARP13 FY01) [Ref. 2]. This used the idea of communities to describe a group of people working together (and sharing information) in a common physical location (e.g. a static HQ). In addition the SIE used the concept of communities of interest to describe a group of people with a common interest in information and who might be distributed across a number of physical locations.

The principles of communities have been refined through a number of studies. This Section focusses on applications of community concepts in support of UK Land Digitization[5] in the tactical domain. Here, community models have been used to underpin descriptions of organizational structure and activity in various operational contexts and thus to provide the starting point for the analysis to transition to informatic views and (further) to system-technical views.

A Divisional Information Architecture

An early use of community concepts involved the definition of a Divisional information architecture for 2006, consisting of:

- A description of the major HQs, and cells within those HQ, from Divisional level down to sub-Unit level, for a generic large scale deployment of UK Land Forces.
- Allocation of force elements to one or more information 'buses', which were logical channels of information-sharing between functional[6] elements.
- Identification of formal military messages (which imply content, meaning and handling procedures) which are used by the different information buses.
- Identification of information-handling processes within major HQ, describing in particular how the contents of incoming reports and returns are compiled into tactical pictures underpinning shared situational awareness.

Figure 2 shows an extract from the information architecture, showing the force elements and the communities (here labelled as 'buses') to which they belong.

[5] The UK Land Digitization programme is known now as the Command and Battlespace Management (Land) (CBM(L)) programme.

[6] In this context, functions refer to specialist Arms and Services; later in the paper, the term is used in a more generalised sense.

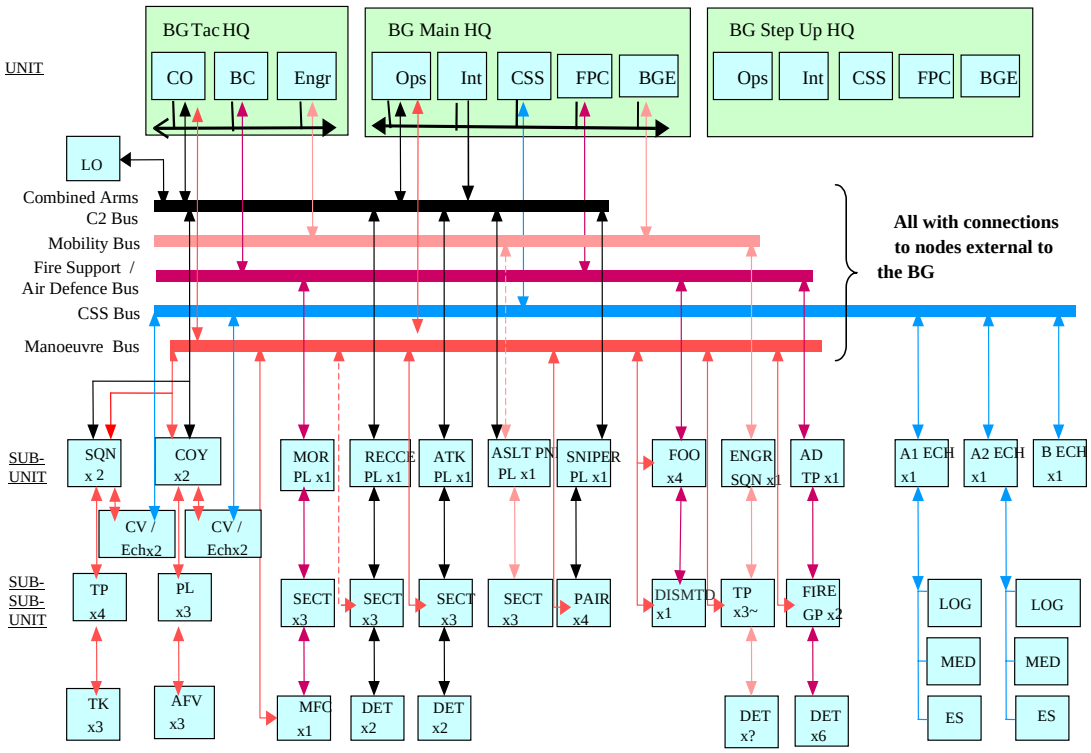

Figure 2: Extract from the Divisional information architecture for 2006

Sharing of information within a function (e.g. the Mobility bus) utilises wide area communications characterised by limited bandwidth and the potential for unreliability. The impact of these factors is ameliorated by the reliance on procedures, defined message sets and shared appreciation of the general situation within that functional specialism; these are properties which are characteristic of functional communities.

During operational phases in which momentum and initiative can be maintained, the main flow of critical information is down the chain of command through orders and instructions. In more static situations, such as the bridge demolition guard and defence, the flow of information is more from the sub-sub-units informing the chain of command's decision-making. In the 2006 era, information sharing *between* functional communities takes place at defined physical locations (HQs, CPs) at which physical proximity and the use of common facilities (e.g. a bird table) provide more generous opportunities for structured and unstructured exchanges. Away from major HQs, cross-functional interactions are shown simply as elements which belong to multiple communities, reflecting the current practice of access to multiple radio nets. Within and between the major HQs, there is a specific cross-functional community (Combined Arms C2) coupling the functions together and supporting the commander.

Note that the different instances of communities have some properties in common but also some differences. The Fire Support and Air Defence communities have an interest in near-real time exchanges which is not found in the Combat Service Support community. The Combined Arms C2 community resides in part in environments supported by relatively high-speed communications (LANs) and can

utilise information-sharing paradigms (e.g. client-server configurations) which would be totally unsuitable over combat net radio.

Note also that some individuals are simultaneously members of multiple communities (e.g. their functional specialism and the Combined Arms C2 community). The Commander, for example, needs to be able to affiliate when necessary to the Manoeuvre community.

Temporal issues

In the Divisional information architecture, temporal issues are discussed only in annotations to the textual descriptions of formal messages.

Subsequent work has focussed on the execution domain, where a more explicit treatment of time becomes important. This modelling work captures:

- A series of informatic-events showing how key stimuli (e.g. a contact report) result in a pattern of information propagation across the force.
- A series of vignettes (expressed in a mixed causal net and information flow formalism) showing common activity sequences known as military drills.

These introduce a temporal dimension missing from the earlier representations

Modelling structural changes over time

The Divisional information architecture provides a very static representation: there is no indication of the way in which the structure changes to achieve specific operational goals and elements are put together for a particular task, e.g. when an Infantry Platoon is attached to an Armoured Squadron.

Further analysis has proceeded at the BattleGroup (BG) level with a view to the 2006-2010 timeframe. Here it has not been necessary to go beyond extant doctrine (in the Army Field Manual [Ref. 3]) to obtain a picture of a force which undergoes substantial Task re-Organization (effectively 'structure-morphing') in addressing the situations involved in advance to contact, obstacle crossing, reserved demolition and withdrawal, for example.

The analysis has resulted in a number of different views of event and activity sequences, reflecting the customer's desire for a clear presentation of time and space issues:

- Temporal views, showing timelines, dependencies and the time-criticality of particular activities (vignettes captured as a sequence of freeze-frame views).
- Organisational views, reflecting the involvement of participants at different levels of command and/or belonging to different arms & services within the BG.
- Communicational views, showing the connectivity of participants across the battlespace.
- Geographical views, emphasising the physical proximity or separation of participants in the activity by presenting temporal sequences on top of a a sketched geographical background.

Emerging methodology

The resultant representation of BG architecture consists of a set of building blocks and rules for composing them. These building blocks and rules are expressed

entirely in terms of communities and the rules for their interaction. This architecture is in part inferred from vignettes, but it is also informed by an appreciation of feasible and useful organizational structures and elements.

The novelty lies in the relationship established between the vignettes and the static representation of building blocks and rules which can be called 'architecture' or 'the architectural framework'.

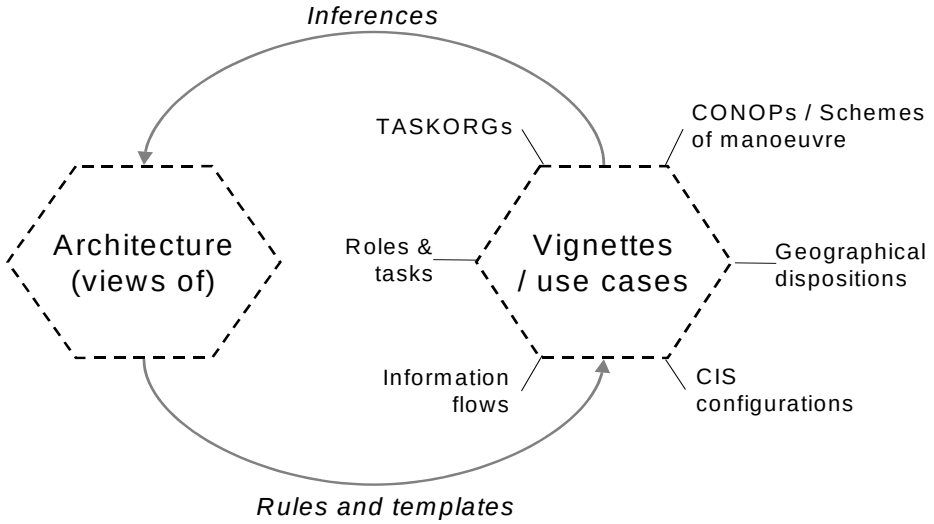

Figure 3: Relationship between architecture and vignettes in the BG Fightability model

Figure 3 suggests that the architecture is inferred from patterns discerned in the vignettes[7], and is then used to normalise the vignettes (i.e. imposing a common vocabulary, a set of rules about permitted connectivities, etc.). The architectural representation itself consists of a set of building blocks and rules for composing them. These building blocks and rules are expressed entirely in terms of communities and the rules for their interaction. Hence communities appear both in the 'static' view of the BG (a generic view of capability integration) and the 'dynamic' view of the BG in action (in the series of vignettes).

Concluding remarks

Up to this point, communities have been portrayed primarily as having a descriptive role. The next section focusses on the BG architecture itself, with the community increasing playing the role of a building block of capability. In turn, the BG architecture will exemplify a particular view of agile mission grouping in the Network Enabled Capability (NEC) era, based again on the formula "Architectural Rules + Building Blocks => Flexible Configuration".

[7] This is slightly disingenuous: there has, in addition, to be some grasp of feasible and useful organizational structures and elements.

Battle Group Architectural Principles

Introduction

Reference [3] defines a BG as a task organisation formed by cross-attachment of sub-units. Not all of these may be under full command: different elements may be in different command states[8]. BG characteristics include:

- A focus on execution processes, as distinct from planning.
- Forms of situational awareness whose primary focus is on the task in hand (e.g. 'spatial awareness') rather than on the broader picture.
- Direct co-operation between functional elements (i.e. not requiring BG Main HQ to act as the intermediary).
- Integration of diverse platforms.

A BG architecture expressed in terms of communities

The functional communities (current Arms and Services specialists) and the Combined Arms C2 community can continue to be part of the flexible Task Organized BG[9]. It is assumed that the BG continues to have a recognisable HQ Main, in particular to maintain the interactions between G2/ISTAR and G3(Ops) elements. In particular, this enables the Decision Support Overlay and the Synchronisation Matrix (in current parlance) to be maintained, which enable the control and dynamic re-planning of execution activities at BG level. In addition, the HQ is the centre of gravity of a particular aspect of situational awareness which may be termed *memory*: the ability to recall earlier information with a bearing on the present without having to perform laborious and unfocussed searches[10].

A number of technical and non-technical (e.g. procedural) constraints have to be overcome in order to achieve the integration of asset- or platform- centric systems in support of functional execution activities. Application-level battle management tools will also be required to support execution-monitoring and dynamic re-planning, which give rise to significant non-functional requirements (e.g. currency, ease of rapid comprehension).

Reference [3] explains that functional structures can be supplemented by placing force elements from other functions under command (or under control). This

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[8] States of command (e.g. OPCOM, OPCON, TACOM, TACON) allow the possible states of commanders' authority and responsibility, in relation to the various aspects of military operations and administration, to be differentiated.

[9] The performance of these structures has the potential to be enhanced by modern information and communications technologies, in that these technologies *could* support existing human relationships (rather than destroy them) and *could* accelerate processes (without disrupting them or introducing new processes).

[10] Memory is clearly also relevant to planning / replanning and to control of current tasks. Knowing what has been requested or tasked will underpin the appreciation of the current state of play and hence the recognition that revised requests / tasking may be required. But situational awareness may place particular significance on memory by virtue of the open-ended nature of the relevant information, potentially making it harder to devise efficient mechanical approaches to cueing and retrieval.

process is already more dynamic at the sub-unit level (where the time-criticality of execution activities may preclude the BG HQ being involved), than at the BG level. The most dynamic occurrences relate to the Manoeuvre communities, which are the 'home' communities of the Squadron and Company elements engaged in direct combat. The indirect-fire organizations are also frequently joined by other collaborating elements (e.g. Close Recce).

This approach gives rise to a third type of community which we term Packets of Dynamic Execution (PDEs). In direct emulation of current practice, these dynamically-created communities are constructed by a process of affiliation to host (functional) communities.

The way in which the three types of community come together is sketched out in Figure 4, which is an example of a template (Figure 3). The dots marked on the figure represent the hosting of dynamic PDEs by functional communities. This reflects (a) the provision to the PDE of a functional commander and controller and (b) the PDE's connection back to the Combined Arms C2 community in terms of both command and information (e.g. provision of broader situational awareness). If the principles of mission command are being followed, the BG commander will be monitoring PDE activity and intervening only as necessary (and reporting via the functional community of the PDE's commander / controller may be adequate). Any need for closer involvement on the BG commander's part effectively makes him part of the PDE, which in turn generates technical challenges as well as procedural ones.

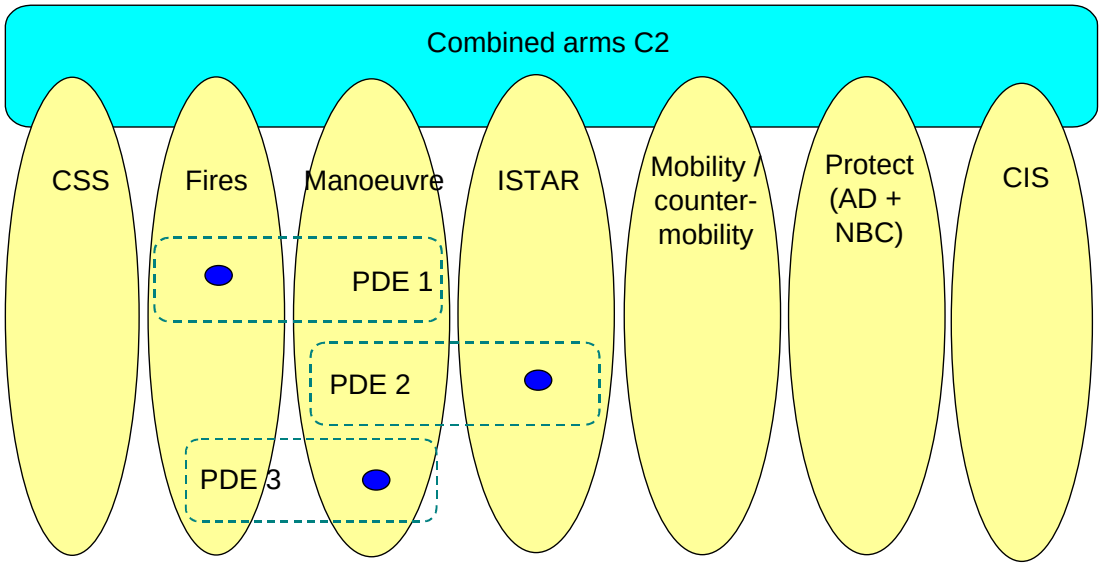

Figure 4: Schematic and 'static' view of capability integration in the BG

The earlier discussion (at Figure 3) introduced the idea of a set of rules by which permissible configurations can be built from architectural building blocks. In the case of the BG, these rules reflect the possible affiliations between functional communities required in order to create PDEs. There is a need also to distinguish the modalities of interaction between communities, such as enduring or dynamic affiliation, and interaction effected via BG HQ cells or effected directly at locations remote from the BG HQ.

To achieve the required ability of the BG to adapt its structure in the digital era will require high levels of integration, in particular:

- Systems integration within platforms which are organic to the BG.
- Integration of CIS within unit- and sub-unit- level HQs.
- Integration between organic assets (e.g. the FIST-enabled section) and HQs, and between the BG elements and external assets (e.g. airborne elements).

Integration implies both technical interoperability and broader aspects, such as common semantics, a common approach to information management, and procedural and doctrinal integration. The technical and non-technical (e.g. procedural) constraints associated with the integration of asset- or platform-centric systems (as discussed in Section 4) now take on a cross-functional perspective. This threatens a potential combinatorial explosion in inter-operability conditions unless the number of such interactions can be constrained or common standards imposed (which is a challenge in terms of technical standards, and may be simply infeasible in the non-technical dimensions). In this regard, the key feature this analysis is that it suggests that the required agility can be delivered through a *finite* set of affiliations.

Information and C2 in the NEC era

Introduction

The community-centred approach with regard to information is clear:

> *The meaning of information is relative to the military purposes which personnel are pursuing and the organizational structures within which they are working, i.e. the meaning is relative to the community.*

It should be recognised at this point that the communities model constitutes a particular hypothesis about Network Enabled Capability (NEC) [Ref. 4] and the meaning of full information availability and resilient information infrastructure. The communities hypothesis is that, given the way in which people work in practice, there will still be *clusters of information exploitation*[11] at any one time, although these may transcend traditional boundaries, and may be subject to frequent and even dynamic re-configuration. People still have particular skills and ways of working (in which they will have trained). Some information may still be 'pushed' rather than 'pulled', in the sense that (regardless of the underlying technical implementation) it is the producer's initiative which results in the arrival of the information with the consumer. With regard to wider Information Age thinking [Ref. 5], this could be regarded as a *radically conservative* position[12], and it is in sharp contrast with some other hypotheses (about Global Information Grids, emergent collaborative structures, etc.).

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[11] I.e. groupings for which there is a high level of commonality in employment of particular classes of information. This may or may not imply high levels of explicit information exchange in the operational environment, and it does not seek to minimise the importance of information sharing *between* clusters.

[12] Of course, the communities model also reflects a pragmatism born of the UK's time and cost limitations and the need to make full use of current and planned equipment.

On command and control (C2), community models offers a hypothesis about a particular form of network-enablement in which people continue to work in recognisable structures and are subject to command relationships (however fleeting):

C2 is defined and exercised relative to group structure and purpose.

Again, this hypothesis is again in sharp contrast with (for example) the views of NCW espoused in [Ref. 6], which eschews traditional notions of command (and, in particular, command hierarchies) and argues for a form of widespread empowerment.

Agile mission grouping

The concept of *agile mission grouping* emphasises the commander's ability to assign missions to force structures whose constituent capabilities are matched to those missions' characteristics. It is defined as:

> "*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*" [Ref. 4].

The drivers for agile mission grouping are primarily the ability to achieve joint tactical innovation and the need to exploit scarce resources and assets. This makes agile mission grouping a specialisation of the broader concept of agility, which also includes the ability to respond to unexpected threats. Agility could include the effective dissolution of boundaries between military and civilian structures, which goes far beyond agile mission grouping in its current form.

This paper asserts that there are significant dimensions of agile mission grouping which simply build on the traditional concepts of Task Organization and Regrouping, extended to allow the assembly of structures in response to specific missions:

- At a variety of scales, from campaign planning to the creation of dynamic groupings to execute specific missions or tasks.
- With a wider variety of assets and resources than hitherto possible (e.g. supporting joint tactical missions).
- With a wider variety of relationships with other TASKORGs and other resource/asset-holding organizations.

Out of this variety of possibilities, we have discerned three particular models which express these dimensions of agile mission grouping at three different scales:

- The commitment of Deployed Operational Groups (DOGs) to missions.
- Task Organization into Units of Tactical Engagement (UTEs).
- The creation of dynamic groupings for tactical execution (PDEs).

These three models of agile mission grouping activity are described in more detail below. In each case, communities have a key role in explaining how the process is achieved, in other words how assets and resources are brought into groups with other assets. The products of agile mission grouping are structures which can be regarded as either:

- A single community (in the case of a PDE).

- A set of interacting communities (some larger PDEs; UTEs and DOGs).

Commitment of deployed operational groups to missions

Operational groups are force structures which are resourced to a prescribed level, e.g. a brigade rather than a division, composed of elements drawn potentially from all services, in a form which is suitable for deployable and capable of carrying out missions in its own right. Examples of operational groups are a Ground Manoeuvre Bde, an Air Manoeuvre Bde, a Carrier Task Group and an Amphibious Task Group. Operational groups are usually self-sufficient, encompass many if not all of the elements of the Defence Capability Framework (Command, Inform, Prepare, Project, Operate, Protect, Sustain) [Ref. 7] and are deployable.

Once in theatre, a DOG is an enduring organization. However, the mission-committing commander may *augment* or *diminish* its existing asset and resource as befits its mission and the needs of other DOGs. This means that one or more of its constituent communities are strengthened (by the affiliation of incoming elements) or diminished (by the disaffiliation of departing elements). *Affiliation* to a community implies:

- A capability to affiliate (in terms of equipment and understanding of process, procedure, rules and information semantics).
- An affiliation process (which includes provision of relevant information resources).

In contrast with augmentation, *supplementing* a DOG means adding a community which is not already present, but for which the DOG has a blueprint for inclusion. DOGs of different types have pre-defined capacities to host particular 'visitor' communities.

There is a distinction between *membership* of a community and *participation*, and one which runs parallel with traditional distinctions of command state. Membership is the stronger condition, and reflects assets being placed under command or under the control of the commander (i.e. he 'owns the effect', if not the asset). The affiliations to PDEs, as described in the BG architecture, were all concerned with membership, albeit on a dynamic basis. In contrast, participation (without membership) implies the provision of a service to that community, possibly on a non-exclusive basis. The provision of Naval Fires to a Ground Manoeuvre DOG would be an example of such a service.

Task Organization

There is a characteristic set of templates by which mission groups can be created by Task Organization, of which the BG is a prime example. Unlike DOGs, the products of this process, UTEs, are not enduring organizations: they are created and resourced as the committing (superior) commander believes appropriate to the current mission for the group.

The blueprint for a UTE, as with the BG architecture, is an architecture expressed in terms of communities and associated rules. Of course some sub-structures may arrive more or less intact from predecessor communities, for example an HQ which provides the focal point for a UTE's Combined Arms C2 community.

Creation of dynamic groupings for tactical execution

Sensor-decider-shooter structures provide an illustration of a particular type of PDE. PDEs may be heterogeneous in composition and they may be much more dynamic than the mid-sized TASKORGs, but their commanders may not have the same degree of empowerment. Again, a PDE has a blueprint (ruleset), but a pragmatic way of constructing a PDE rapidly is to take an existing community within a UTE and augment it as necessary.

The formation of PDEs gives rise to a number of community issues and constraints, some of which are exemplified by the affiliations within the BG:

- Communities which are capable of coherent dynamic interworking must have properties which we normally ascribe to a team (as opposed to an accidental collection of individuals). This includes issues of mutual awareness, shared goals, trust and confidence. Team building and training are currently understood in the main in terms of functional teams and stable structures; seeking to gain team-like behaviour from contingently-assembled groupings could present a considerable challenge[13], particularly if activities are time-sensitive. Current affiliations to communities (as in the BG) work because (a) they are finite in number and (b) the strength and dynamics of the resultant collaborations may be limited.
    - There is no single model for maintaining shared awareness across the PDE community[14], the means depending on:
    - The degree of familiarity between participants.
    - The ability to follow a well-understood procedure or drill for the activity[15].
    - The extent to which the community is required to be able to reason about its own situation and devise alternative approaches and plans in response to contingencies (which relates to the degree of empowerment of the PDE commander / controller).
- The sustainment requirements of assets and resources allocated to a PDE need to be considered. If the PDE is relatively short-lived, the conventional dimensions of logistics may not be too problematic, but there are also notions of informatic sustainment: some sophisticated platforms may expect to download platform data continuously (e.g. for condition monitoring purposes), and other elements (e.g. ISTAR assets) may require constant updating of their own functional picture.

Common to many of these facets is the ability of individuals and subsystems to (a) belong to more than one community at once and (b) to leave and join communities

[13] There is a view that unfamiliarity can to some extent be overcome by increased information sharing. Apart from the technical implications (see below), this also raises issues of commonality of information models and the willingness of individuals to share information with others.

[14] This discussion relates primarily to awareness as it pertains to the task in hand (e.g. plans, tasking, situation 'on the ground' within Area of Responsibility) as opposed to the broader situation ('background situational awareness).

[15] This may enable a lean communications regime of exchanging a limited number of cues and slot-fillers (instance data) in relation to a well-defined script, along with ad hoc exchanges stimulated by contingencies and clarification of enemy activity.

dynamically. As well as technical considerations, this raises the question of what information, in what form, needs to be provided to an individual or subsystem joining a community as a member or participant.

Concluding remarks

Community models can be viewed as a transitional perspective on NEC, and one which accepts a practical constraint on the variety of configurations which are possible. An alternative view is that community models of NEC represent the limit of our current ability to visualise agile mission grouping, given:

- MOD's current appreciation of the command process and the behaviour of military organizations.
- The need to capitalise on MOD's substantial legacies in terms of current and planned acquisitions, and the need for incremental change through incremental acquisition and adaptation.

Community models embrace a variety of community-types and provide (through the analysis of feasible organizations) a tangible basis for identifying training needs for the NEC era. Community models neither resolve, nor seek to avoid, the issues and constraints associated with NEC, such as how contingently-constructed groups of force elements can be expected to exhibit team-like behaviour. They do, however, help to focus attention on these issues and they provide a mechanism for feeding practical constraints back into architectural principles.

Conclusions

Community models represent a powerful descriptive medium for existing or intended practices for co-operative working and information sharing information. They are also a key tool of command management [Ref. 8], which is concerned with establishing the structures and procedures through which the operation envisaged can be carried out.

- They describe the structures in place for distributed collaborative interworking, in terms of participants, aims, relationships, processes and procedures.
- They describe the constraints and opportunities which must inform the commander's design of the organization to carry out his operational intentions, and allow the commander to reason about feasible and infeasible organizations.
- Once the commander's decisions have been made, community models provide a language for the process of instantiating structures and procedures, e.g. using notions of community membership, affiliation, shared information models and services.

Community models can be viewed as a transitional perspective on NEC, and as described in this paper they exhibit a continuity with many of today's practices and structures. How NEC might evolve beyond this perspective remains a matter of speculation, but it may well be that the communities concept itself evolves to become a fully-fledged part of Information Age thinking.

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