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Modular Structures in a Multinational Force Headquarters

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This paper is the 8th 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.

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Abstract

When organisations operate in an environment that is dynamic, complex and unpredictable they need to develop more flexible structures if they are to increase their chances of surviving. Organisational complexity increases when the constituent elements involved belong to different nationalities. Advances in information and communication technology (ICT) implemented with the appropriate process and structural changes offer the prospect of improving the flexibility of organisations. It is proposed that future Multinational Force (MNF) military headquarters (HQ) can achieve this flexibility through a modular organisational structure enabled by networked information management and communication technologies. This paper provides a critical examination of the human factors issues that would be involved in the future implementation of a modular structure to a MNF HQ.

Introduction

Advances in ICT, implemented with the appropriate process and structural change, offer the prospect of improving the flexibility of organisations¹. However, in the military context, the ability to create more adaptable and flexible command and control (C2) structures and processes is compounded by the need to be robust and reliable. In considering future military organisation designs in which UK forces will invariably form part of an alliance or coalition, it is important to balance the need for increased flexibility with the potentially competing needs for robustness and reliability.

Achieving reliability requires an ability to respond appropriately to unexpected events and problems. Organisations that are particularly good at doing this are called High Reliability Organisations (HROs). HROs, such as those operating nuclear power plants, function in complex, demanding, and potentially hazardous environments, but still manage to achieve outstanding safety records[1]. Processes used by HROs to achieve reliability in demanding environments include prioritising safety and reliability, establishing standards against which they evaluate themselves, a preoccupation with identifying and learning from failures rather than successes, a concern with building a richer awareness of the state of the organisation, a preparedness to identify anomalies and concerns, and a culture that reinforces the appropriate values, beliefs, and interpersonal trust [1,2].

These characteristics of HROs are critical to reliable performance in complex, changing environments and future MNF HQ. HROs use organisational structure to mitigate risk in dynamic environments[2]. In particular, HROs attempt to remain reliable by ensuring that the variety of the organisation matches the variety of its environment. It is proposed that a modular organisational structure achieves requisite variety by employing modularity both as a tool to address the dynamism likely in the future military environment, but also provides the core stability necessary for an organisation to function reliably in a complex and hazardous environment.

¹ Use of the term organisations throughout this paper applies to all organisations operating in complex, dynamic environments, not just military organisations. Many commercial organisations operating in environments with similar challenges to those faced in some military operations have successfully (or in some cases less successfully) deployed ICTs to revolutionise their operations, and there are valuable lessons to be learnt from their experiences.

In practice, multinational forces are created based upon political strategic requirements and it is only within this context that there is the opportunity, at the operational level, to draw upon the range of capability available to create the most appropriate organisation for the relevant campaign. This is likely to be simplest within a standing alliance such as NATO where technical interoperability and standardisation of procedure have created the opportunity for flexibility. Multinational forces offer the opportunity to draw on a larger number of modules, and in theory they may provide access to a wider variety of capabilities. There is, however, no guarantee that future 'coalitions of the willing', perhaps created to enable the sharing of political strategic risk, will be coalitions of the *capable*.

It is proposed that modular organisational structures should be supported by a 'plug and play' (PNP) architecture, composed of people, processes and networked information management and communication technologies, which provides a means of managing and mediating the flow of information around the HQ modules. It is necessary to consider the challenges raised by multinational forces to this vision of the future. Several scenarios are possible, each problematic. First, even where nations all possess ICT this may not be interoperable. For example incompatibility of data formats might lead to an inability to share information or there might be an inability to link systems owing to incompatibility of hardware. Just as likely is the situation where some national contingents may simply not possess the necessary equipment. In such cases, it may be possible for the lead or framework nation to provide equipment, but for a number of reasons relating to 'non-technical interoperability'² contingents may not have the means by which to incorporate networked information management and communication technologies into their way of C2. This does not de-value the use of modular structures. It means that the connections between them will need to rely on the communication and connectivity technology available at the time.

The case of multinational forces perhaps raises the most severe challenges to the utilisation of a modular structure enabled by networked ICT. It is, however, a useful test case and emphasises the importance of non-technical considerations, including training of personnel, compatibility of procedures, and standardisation of terminology. It cannot be emphasised enough that such non-technical considerations are also relevant within national contingents, particularly joint organisations.

This paper describes a rationale for designing more flexible organisations and the means by which a MNF HQ could operate efficiently. Drawing on the research literature, some of the organisational design and context issues associated with modularization are identified. Following this, a recent investigative experiment designed to explore some of the technological and organisational design issues associated with modularization are described. In closing, some of the key issues and challenges for modular structures in MNF are discussed, and suggestions for improving the chances of successfully evolving military organisational designs are offered.

² Interoperability in multinational forces generally refers to compatibility of hardware and software. Connectivity alone, however, does not confer capability and must be accompanied by interoperability of people, process, and organisation. These latter aspects have been labelled 'non-technical interoperability' (NTI) [3].

Rationale for Flexible Organisations

Appropriate exploitation of information, the use of ICT to support new ways of organising and communicating, and the development of flexible organisational structures, are three ways that enable an organisation to deal effectively with its environment. Technology can be used to support organisational process and structure change because it allows new organisational forms and activities to be developed. ICTs create opportunities for new ways of managing and conducting work that may not have been possible (or at least not practical) before the advent of these technologies. Technology also provides the means to exploit information more effectively as it allows better information collection and dissemination, superior knowledge management and facilitates new ways of organising to use the information advantage gained.

Within the modular structure concept, the emphasis is on using technology as an *enabler* of a wider process change wherein technology is used to exploit information more effectively in order to enhance capability. For example, effective exploitation of information will enable improved situation awareness (SA) which could facilitate superior decision-making processes and enable increased tempo of operations, thereby creating advantage over opponents. Technology is being used to support more efficient and effective organisational processes, with the overall goal of improving organisational competencies in line with strategic goals. It is good management practice to be clear about the goals of the proposed organisational change so that it is driven by the strategic goals of the organisation, rather than being driven by technology or management fads [4,5].

Successful organisations attempt to develop processes that capture the informal, interdisciplinary and individual aspects of knowledge [6]. Examples might include the creation of a knowledge-sharing culture or the use of internal networks to create communities of practice [6,7]. It is this type of process that is central to creativity and innovation. One of the roles of ICTs is to support organisations in gathering, processing/filtering, manipulating and disseminating information, which, if applied appropriately, can facilitate knowledge sharing and support communities of practice. This information supports human cognitive, social and sensemaking processes, which enhances the ability of organisational members to adapt, respond to, and shape their environment effectively, increasing the organisation's chances of gaining competitive advantage [7].

Technology development, implementation and its use do not occur in a vacuum. Culture is a 'mediating variable' influencing how new technologies will actually be adopted and used within the organisational context [8,9,10,11]. Organisational and military research clearly shows that technology tends to be adopted by users for their own purposes, and exactly how it is used is heavily influenced by the extant organisational culture [8,11,12,13]. As was discussed earlier, culture is also an important feature of HROs. Therefore, in order to achieve the envisaged organisational enhancements facilitated by ICTs, there needs to be an organisational culture that can effectively support and exploit ICTs. As was stressed by [14] one factor with the potential to undermine the effectiveness of multinational forces is the interaction of the diverse organisational cultures represented within the coalition or alliance. For this reason, even where contingents are able to field similar, interoperable, systems, unless adequate non-technical interoperability of personnel

process and organisation is achieved, there is little prospect of effective collaboration. This issue is referred to later in the paper where way of command is discussed.

Nadler and Tushman [15] point out that there is no single organisational design that will achieve perfect flexibility. Any particular configuration will involve trade-offs. Continual redesign is becoming accepted in an increasingly complex and competitive environment. Successful organisations will learn to create flexible architectures that can accommodate constant change, but without leading to massive disruption to the organisation. One approach makes use of 'organisational Lego' that consists of modular components removed or attached without causing significant disruption to the organisation. The ultimate design will be flexible enough to accommodate the company's core competencies but with porous external boundaries [15,16]

Organisational survival is about rapid innovation supported by a relatively stable base [17]. To survive in the ever more turbulent and dynamic environment characterised by increased globalisation, competition and uncertainty about the future, organisations should develop stable, yet flexible, component processes, structures and relationships[5,17]. Modular structures based around a relatively stable core may provide the adaptability and flexibility necessary for command and control in a range of situations. It provides for HQ either to be concentrated in one location or distributed across the battlespace or to change dynamically between being tactical HQ to an operational level as required by the operational environment. A module can be a co-located team or a distributed team. For example, it may have one or two members deployed as part of the HQ and the rest of the team located in the rear of the battlespace or back in the UK. The role of the module is to support the Commander in his/her operational decision-making activities.

As envisaged by Thackray [16], a Core Warfighting C2 Module, within which the HQ Commander sits, can be augmented by a Joint C2, Multinational C2 or an Other Ops C2 Module depending on the situation. Modular augmentation can be achieved by a 'Plug and Play' system or prior to deployment in the Force Preparation phase. Modularity enables a HQ's C2 function to change its configuration, size, location and function flexibly in accordance with the operational environment it faces, by appending or removing specialist modular teams.

It is envisaged that a modular system will give a HQ the necessary capability to work virtually³ and temporarily with other commands to solve military problems. It can also allow the 'plugging-in' of UK-based support and provide access to constant, almost 'real-time' updates of intelligence sensors and in-theatre support functions, thus providing the flexibility to adapt to environmental events *via* improved information mediation. This in turn can improve situation awareness, decision making and organisational response. This way of organising work in the digitised operational environment represents a possible instantiation of a network-enabled organisation.

³ Virtually here meaning the ability of HQ staff to work collaboratively with other HQ staff whilst not being co-located. Virtual in regard to computers: "Not physically existing as such but made by software to appear to do so from the point of view of the program or the user" Oxford English Dictionary [20].

Organisational Design and Context

In order for an organisational modular structure to work in the manner prescribed within a deployed operational and MNF setting, it is important to address a range of organisational design and context issues that could support or undermine the successful implementation of modularization. Drawing upon the research of Mintzberg [18] and Groth [19], a range of contextual or contingency⁴ factors are identified here. In addition, the implications of these factors for future operational level HQ design and modularity are explored.

A deployable joint operational level HQ operates within a complex environment that is subject to rapid change. Such an environment provides impetus for the concept of modularization, and the associated concept of network enabled capability, since by adding and subtracting modules the HQ gains the capacity to respond appropriately and with agility to the environment. However, external control from government and higher HQ may limit the extent of modularization that can occur, since the need for accountability may tend to drive the HQ toward centralised decision making, undermining the ability of plugged-in modules to make a worthwhile contribution to the decision-making process.

An additional influence that could also encourage more centralised decision making is the temptation for higher formation Commanders to take over, or micromanage subordinate Commanders, enabled through the improved information dissemination and aggregation that network-enablement could provide. Anecdotal evidence based upon trials of future C2 systems collected during a recent interview study suggests that ICT will support commanders' preferred way of command. Thus, micromanagers will be able to use the technology to supervise and control efficiently, and mission commanders will be able to transmit their intent and monitor progress of the plan as they see fit. Clearly this has the potential to undermine the doctrine of Mission Command. In addition, it sets up a challenge for those developing future doctrine in deciding how these possibilities should be managed. This appears to have been the case in the Australian Forces led East Timor campaign whereby the reins of C2 were held firmly by the deployed Australian HQ due to their unwillingness to trust the multinational coalition forces involved in the campaign. This was felt to be due to a lack of familiarity between the Australians and much of the coalition force's modes of operation. Moreover, we cannot assume that all contingents declared to a multinational force will subscribe to the UK interpretation of Mission Command. Orders that contain too much detail can constrain subordinate forces, for example forcing them to accept higher levels of risk than they deem appropriate and raising the likelihood that they will play a 'red card'. Conversely, mission orders can overtax the planning capability of forces that are used to receiving a high level of direction.

The Modularity Investigative Experiment

The issues that emerged from subject-matter expert (SME) interviews (see Christie and Fidock [21]) were used to define the content of questionnaires and helped to refine the observations undertaken in a recent investigative experiment. The aim of the experiment was to observe and report on the ways in which the experimental

⁴ Contingency factors can be thought of as the conditions that influence the structures adopted by organisations. Such factors include the environment, organisation size and age, technical systems and power relationships [18].

participants interacted and used enhanced ICTs, new organisational structures and ways of working. It is hoped that that this investigative experiment will assist in the development of hypotheses for future experiments in modularity and MNF.

The experiment was a repeated measures design whereby two teams were each split into a forward cell (Operational Liaison and Reconnaissance Team (OLRT)) and a rear or home cell (Joint Task Force HQ (JTFHQ)). Each team was required to plan collaboratively for non-combatant evacuations in a peacekeeping operation whilst the two planning cells were non-co-located. For the initial condition, the teams planned using current ICT (telephone, email, etc). In the second condition, the teams planned using state-of-the-art, web-based information portals. Modularity was achieved by the 'plugging-in' of the Forward OLRT into the rear-based JTFHQ following commencement of the planning scenario.

In terms of experimental outcomes, researchers and participants both agreed that the teams generally behaved like psychologically discrete entities. This means that they conducted the planning task allocated to them within the physically co-located cell and did not consider the non co-located cell as an adjunct to their planning team. The teams appeared to believe that the task they had before them did not require that they involve the other half of their planning team in anything other than some information exchange.

In the initial condition, where current ICTs were used, when the teams became overloaded with information or the decision-making tempo and planning requirements increased, the participants relied on other members of their physically co-located cell and did not attempt to involve their non co-located team members in alleviating their workload. Thus, it appeared that they reverted to attempting to complete the requirements of the task using the processes and methods they had been trained in and knew how to use rather than incorporate new methods. They appeared to engage in 'satisficing' [22] in that participants used a process which they knew generally worked, rather than spend the time and energy in developing procedures which would optimise team performance.

Also, in the initial condition, the teams had poor information management strategies and relied on tried and trusted methods of information dissemination and communication – intra-team verbal and inter-team email / telephone methods of communication. The teams missed required information or did not identify disseminated information because they did not access their emails due to overload and task shedding, so the planning process was hampered. Tasks were allocated along traditional functional lines and the cells were observed to have difficulty in trusting information they received from their non co-located cell.

In the subsequent condition, where new technologies were used, face-to-face discussion and telephone/email were still the preferred means of disseminating information. However, teams changed the way they undertook tasks. They formed their teams more along two lines:

- Information extraction and dissemination: cell members were assigned to identify means and modes of information exchange and information traffic (either through email / web-based information portal or through the Geographical Information System) and direct the information to the required decision maker; and

- Filtering and analysis: cell members were assigned the task of making sense of incoming information, and passing their knowledge on to the appropriate decision maker.

The important observation is that participants attempted to incorporate new task functions through 'work-arounds' or improvisation (the bane of Control but the godsend of Command, according to Pigeau and McCann[23]). This finding appears to lend support to the contention voiced by the SMEs that task functions within the HQ must change in line with the advent of new ICTs. When participants had to convey context-rich information, they chose communications modalities that allowed those human cues and non-verbal messages to get through, i.e. face-to-face, telephone and Netmeeting (a Microsoft software program that allows computer-generated visual conferencing not unlike Video Teleconferencing (VTC)). For a MNF HQ, this appears to lend support to the development of a liaison system incorporating both human and virtual elements. The liaison system should be built on already well established procedures that can ensure that context-rich information HQ wish to convey is disseminated.

In summary, an investigative experiment was conducted to explore the interplay between people, processes and technology in terms of the key concepts underlying a modular structure. The aim was to explore some of the processes and technology required to enable an effective modular capability. Observations of ex-military personnel with C2 experience working in a modular environment showed that information overload and task shedding did occur. To alleviate this, participants changed their task functions from the traditional NATO J1-J9 staffing structure to more situationally-specific task functions. Other observations included issues of trust of information sources, sharing of team situational awareness and the reversion to voice and visual communication when attempting to convey context-rich information.

Several of the human factors issues identified by SMEs in previous research [21] have been further reinforced by this experiment. It is anticipated that hypotheses can be generated from this information to shape future research relating to MNF HQ.

Conclusions

From an organisational design perspective, a significant challenge to the modularity concept appears to be its introduction into a joint and/or multinational situation. The often *ad hoc* collection of nations, together with problems of technical interoperability, as well as doctrinal and cultural differences⁵, could make the implementation of a modular structure very difficult, if these challenges remain unaddressed. A modular capability would be of use only if the information requirements were widely agreed, or able to be negotiated, and where the various information systems could be made interoperable.

This paper has drawn upon a series of discrete, yet related, studies conducted under the UK MOD's Future Command HQ programme, with a view to anticipating some of the advantages and challenges of implementing modularity in future multinational forces.

⁵ Non-technical interoperability [3]; Co-operability [26]; Organisational Interoperability [27].

The specific implications of the above discussion in relation to the implementation of a socio-technical enhancement such as a modular structure based upon ICT are as follows:

- As was demonstrated in the experiment, the particular psychological challenges associated with virtual co-location [e.g. 24] should be examined further. The question of how to develop a degree of whole-team cohesion where individuals or possibly cohesive small units are distributed geographically, and co-operating only temporarily, is likely to be considerable. Such challenges are likely only to be compounded by the requirement for multinational inter-working.
- A human / virtual Liaison Officer system requires development to enable the transmission of context-rich and tacit information that ICTs will have difficulty conveying. The liaison system should build on the established processes already in place in military C2 functions and be capable of relaying understanding of operational differences and cultural awareness. Essential to this process is the requirement for the liaison function to ensure the amplification of explicit intent and the clarification of *implicit* intent[23]. The assumption that improved ICT will remove the requirement for liaison officers is premature [25]. There is no question, however, that achieving liaison in a modular environment, where geographically dispersed units may connect only for a few hours, will provide new challenges.
- The new systems and processes enabled by new technologies should provide evidence that some administrative positions within the HQ will no longer be required. It should also be shown that organisational engineering and design specialists (and any other specialist or support advice that can be provided from a rear area) could be provided *via* reachback⁶. It is suggested that the development of new staff/task differentiations (for example changing the current J1-J9 staff functions to new roles such as Information Manager, Visualisation Manager, etc) may be necessary to enhance effectiveness and efficiency of HQs in line with these changes in structure and ways of working. This implication has been supported by the findings of the investigative experiment outlined earlier in this paper in which participants did change their job functions in line with new ways of working due to their use of new technologies. A radical restructuring of roles of this kind would require co-operation between likely multinational partners, most likely within a standing alliance, to ensure that compatibility of functions could be fully understood and maintained in any future multinational force.
- Any improved HQ staff work processes, artificial intelligence systems or computer supported co-operative work tools implemented will need to support and revolve around the stable core ‘warfighting’ command team. This is because this team is critical to the functioning of the HQ. In any conflict, and in terms of military C2, the ultimate reversionary mode that must be maintained and supported in order for the HQ to survive is the team comprising the Commander and senior planning team conducting the tasks of relaying to units the Commander’s intent and orders.
- It may be appropriate, in certain circumstances, to bypass the joint operational level HQ due to strategic or political imperatives. However, proven doctrine such as Mission Command must be retained and inculcated in training as it is

⁶ Given the advent of new ICTs, it will become feasible for certain staff functions to be performed outside the traditional area of operations; either in a more secure rear area or back in the home base [28].

imperative that the commander on the ground with the most intelligence and knowledge at his disposal has the ability to 'call the shots' if the situation demands it.

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