Information Provision for the Dismounted Close Combat Soldier

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Abstract - The dismounted close combat soldier is of particular relevance to the UK MoD research community at present due to the nature of conflicts both current and foreseen. In this paper an analysis of the information needs of a junior dismounted close combat(DCC) officer is presented based upon the combat estimate process analysed in the context of selected use-cases. Building upon the developed information needs, an analysis of technologies is presented showing how in current and near future timeframes, technology can assist in the provision of information to a dismounted commander in a physically and cognitively efficient manner.

Keywords: DCC, Close Combat, Information Taxonomy, ISTAR, C4I, DPD.

1 Introduction

The dismounted close combat soldier is of particular relevance to the UK MoD research community at the present time due to the ongoing nature of conflict in Afghanistan.

The format of Counter Insurgency (COIN) operations is that in order to achieve military objectives and facilitate political and humanitarian activities it is necessary to dominate territory with dismounted troops present amongst civilian populations. Looking forward from the current conflict to the future it has become increasingly clear that the distinctions drawn between conventional and asymmetric warfare are becoming outdated and the notion of hybrid coalition focused actions [1] would seem the most likely model going forward. The hybrid model is predicated on coalition force structures which will be called upon to deal with mixtures of conventional, irregular, and even criminal groupings.

The purpose of this paper is to describe the challenges faced when trying to construct information systems tasked with supplying situational awareness to dismounted close combat soldiers.

The paper commences with a description of the information needs of the junior commander - a critical component within any dismounted close combat operation. The paper then presents an overview of the technologies that are available, both current and in the near future, to generate information feeds that will satisfy the identified information needs

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2 Information Needs of the Platoon Commander

The focus of this paper is the Dismounted Close Combat (DCC) Platoon Commander. This role is selected in order to highlight the issues associated with the collection, processing and dissemination of information within the dismounted combat environment.

The platoon commander in a UK battlegroup is typically in command of three subordinate section strength units each of eight individuals. Each section in turn is organized into two balanced four man fire teams. The typical dismounted platoon commander also has available a dedicated 2ic and signaller.

The platoon commander role is unique within the command hierarchy. It is typically provided with, as compared with superior command, only sporadic access to the resources afforded by a fixed Combat Information System (CIS) infrastructure. Conversely as compared with the section commander the platoon commander has a greater need to conduct deliberative planning

and reasoning tasks conducted over longer time periods and therefore a need for a deeper and broader information set upon which to base his decisions. The platoon commander however also experiences the exposure to immediate danger and the need to lead from the front that challenges traditional information presentation mechanisms.

It is this mix of reliance on mobile infrastructure, focus on close combat situated decision making and complexity and range of tasks that makes the DCC platoon commander the best subject for consideration within this paper.

2.1 Combat Estimate

In order to analyse the information needs of the platoon commander, the combat estimate process [2] has been used as a structural mechanism to guide the analysis. Integral to the combat estimate are a set of seven questions that are intended to act as an aide memoire in order to ensure critical information is not overlooked. These questions are reproduced below.

1. **What is the enemy doing and why?**
2. **What have I been told to do and why?**
3. **What effects do I want to have on the enemy and what direction must I give to develop my plan?**
4. **Where can I best accomplish each action/effect?**
5. **What resources do I need to accomplish each action/effect?**
6. **When and where do the actions take place in relation to each other?**
7. **What control measures do I need to impose?**

The information needs of the platoon commander are constrained by his Area of Responsibility (AoR). This defines a geospatial area within which the activities of his units are expected to be bounded. There is of course a need to understand the broader context of an operation and in particular those activities bounding on the defined area of the broader Area of Operation (AO) for the overall company unit.

This concept is illustrated in Figure 1.

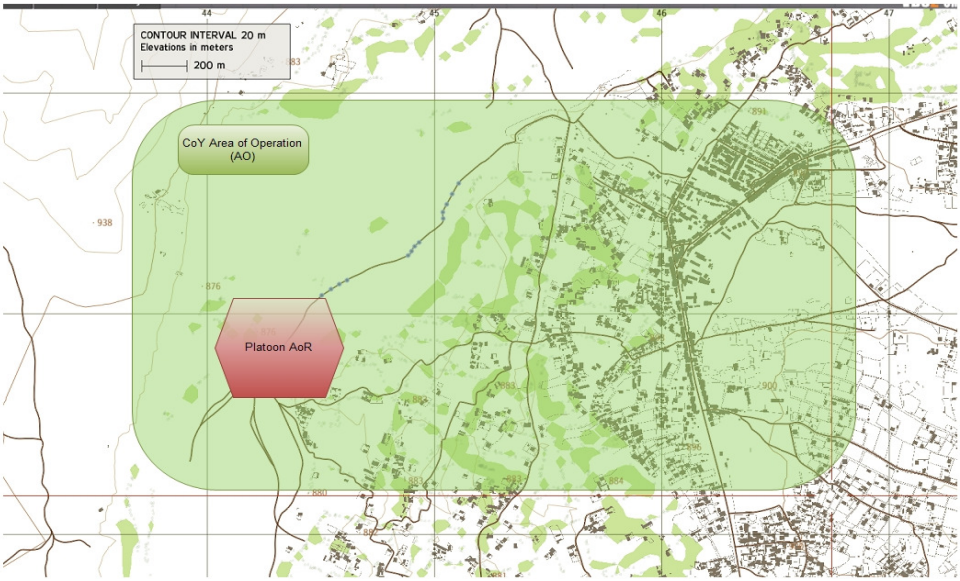

Figure 1 Platoon Area of Responsibility

The following subsections examine a number of these combat estimate questions and the impact these have on the information needs of the commander.

2.1.1 What is the enemy doing and why?

When analysing the information needs implicit in this question it has proved helpful to expand the nature of the question in line with recent doctrinal guidance to incorporate not just the enemy but the full range of enemy, civilian and non-governmental organizations that characterise the battlespace. When considering each of these identified groups it is important to understand their current status i.e. position, direction and speed of travel, current activity but additionally and perhaps more critically it is important to understand why they are doing what they are doing; in other words, their intent.

Threat is also of high import in this context, an individual enemy soldier is unlikely to be of high threat to a dismounted platoon, but a fast jet or tank is another matter entirely. Similarly a dismounted platoon is unlikely to be the appropriate asset to deal with a squadron of heavy armour whilst it may be entirely appropriate for the same platoon to be called upon to clear an enemy compound. It is therefore of importance to understand the number of type of enemy present within the platoon's Area of Responsibility (AoR).

2.1.2 What have I been told to do and why?

Consideration of this question highlights the need for information regarding the direction provided by superior commander(s) in terms of orders given and constraints imposed on action.

This information set includes such things as schemes of manoeuvre, explicit orders, rules of engagement, social, political constraints and any attachment or detachments from standard Order of Battle (ORBAT). It is worth noting that again as well as developing a strong appreciation of the actual orders given it is also important for the subordinate commander to gain an appreciation of his superior's intent. This ability of the subordinate to get inside the head of his commander is vital in a fast moving chaotic environment such as the dismounted close combat battlefield.

2.1.3 What effects do I want to have on the enemy?

Understanding the capabilities of units under control of the platoon commander, both directly in the case of subordinate section assets and indirectly via access to inorganic assets e.g. UAVs, close air support, mortar lines is key in answering this question. These assets span the available coalition (blue) and local national army (green) assets.

When considering friendly forces it is critical to promote both understanding of current position, direction and speed of movement and current activities. It is also important for the commander to have an accurate understanding of the theoretical capabilities of each asset both defensively and offensively and a real time assessment of combat effectiveness.

2.1.4 Where can I best accomplish each action/effect?

This is the first question to explicitly raise geospatial relationships i.e. where things must happen. This in turn leads to the consideration of those elements of the environment that act upon the platoon commander's decision making process. This includes terrain which may hamper or aid mobility such as obstacles or defined routes. It also includes any areas of dead ground with respect to ISTAR, communication or lethality assets and such transitory effects as weather and battlefield obscurants.

2.1.5 When and where do the actions take place in relation to each other?

This question reinforces the need for information about the environment both static and in terms of the relationship between own force (blue/green), enemy force (red) and civilian/NGO (white) activities. It also raises, for the first time, temporal relationships between activities and hence introduces the need to understand timings both for individual actions

and activities and cognitive timings such as mission planning time.

The remaining questions, whilst important to the decision making process, merely reinforce the information elements already identified, via the questions already referenced.

3 C4-ISTAR Information Feeds

The DCC Soldier has available to him a broad spectrum of potential information feeds for C4-ISTAR (Command, Control, Communications and Computing – Intelligence, Surveillance, Target Acquisition and Reconnaissance).

These feeds supplement his own organic senses, which are primarily audible and visual but also the olfactory and haptic senses. The dismounted soldier is burden-sensitive both in terms of physical and cognitive burden so on-body ISTAR assets are at premium.

As part of the work reported upon in this paper the information needs discussed above have been analyzed from a current and near future technology perspective to identify technologies and techniques available to satisfy the information requirements identified. This work has been structured around the doctrinally established [3] Direct, Collect, Process, Disseminate (DCPD) process. This structural organization is presented graphically in Figure 2.

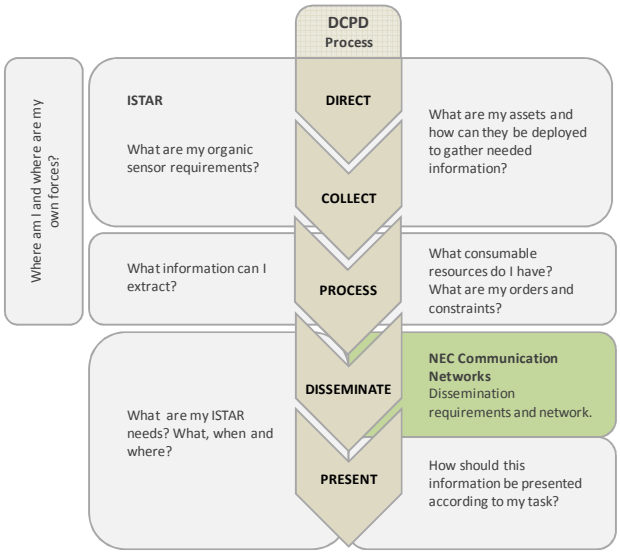

Figure 2 DCPD Process

The DIRECT function represents the sensor tasking activities, be those human assets in the case of a DCC Soldier or dedicated HUMINT resource or automatic tasking of a dedicated autonomous sensor platform such as Unmanned Air Vehicle (UAV) or Unmanned Ground Vehicle (UGV).

The COLLECT function refers to the tasks and activities associated with obtaining raw sensory data intended as the raw material of processed intelligence product. This ranges from hard sensory data such as that obtained from a thermal camera through to transcripts of eavesdropped conversations or formal interviews.

The PROCESS function refers to the activities associated with the generation of processed intelligence product from the raw data provided by the COLLECT activities. This is the core of the data fusion process within which data is filtered, aggregated and fused in order to produce useful intelligence.

The DISSEMINATE function refers to the activities associated with delivery of processed information to the correct individuals. This may, as in the case of traditional ISTAR activities, be in response to well formed Requests for Information (RFI) or may be pushed out to individuals based on role, function and chain of command.

The PRESENT function refers to the mechanisms and activities relating to the presentation of information to the intended recipient. This is additional activity over and above the standard DCPD process highlighting the vital importance of selecting the correct presentation mechanisms if information is to be easily assimilated.

It should be borne in mind that the DCPD process is an ISTAR process and therefore is focussed on providing the recipient with information about the previously unknown. A parallel activity revolves around C2 information and the effective distribution of mission command information.

The following subsections take each of these DCPD activities and provide insight into each from the perspective of identifying appropriate data fusion technologies supporting DCC

operations. In each case the current baseline and potential near future interventions are considered.

3.1 DIRECT

The primary mechanism for providing direction to DCC soldiers when acting as an ISTAR platform remains voice. The DCC soldier is controlled via verbal and/or written instruction from his immediate superior officer. A DCC soldier within UK forces retains a high degree of autonomy however and can be expected to make use of his high degree of mobility and enhanced set of sensors to best position himself to understand the actions of the enemy. In terms of the formal ISTAR process the dismounted close combat soldier is best viewed as a non-traditional uncontrolled ISTAR asset.

Future plans include autonomous assets such as UAV and UGV platforms. There exists a potential requirement for a platoon commander or similar to provide direction to such assets.

Active research is ongoing looking at autonomy of sensor targeting and cueing. One particular interesting research project is the SEAS DTC STARTLE [4] project. STARTLE is a biologically inspired sensor cueing system that adapts its behaviour to possible threat stimuli. This enables STARTLE to learn and disregard the presence of the mundane within the environment and focus on the presence of unexpected or novel stimuli. This mirrors current military doctrine which focuses an observer's attention onto the presence of unusual behaviour or the corresponding absence of expected behaviour. The high level architectural organisation of STARTLE is presented in Figure 3.

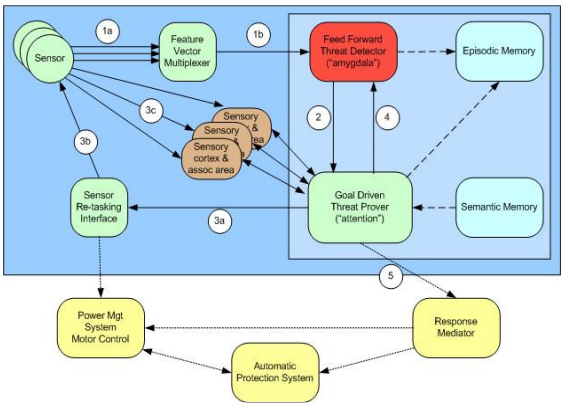

Figure 3 STARTLE Biologically Inspired Threat Detection

Such an architecture could be utilised in a protective manner to strengthen the survivability of the platform or to cue sensor assets onto targets of significance to the dismounted platoon being served.

The problem of matching sensor assets to information needs is a complex one requiring considerable domain knowledge, and has therefore remained largely human-centric within this domain. There is however interesting research work being conducted under the International Technology Alliance (ITA) research programme [5]. In this work a means is described based on an ISTAR ontology to describe tasks semantically, such that automated agent based resource can attempt to facilitate the tasking of sensors.

A similar concept of analysing incoming information requests in order to facilitate the efficient tasking of sensor assets is central to the ongoing UK MoD DABINETT I3M programme [6].

3.2 COLLECT

The process of collection of sensory data begins with the dismounted close combat soldier's own organic assets. In the case of the platoon commander this includes his eyes and ears, providing his own eyes on situational awareness.

As an example of the art of the possible in terms of augmenting the dismounted commander's visual Situational Awareness (SA), consider the recently fielded SOPHIE [7] Urgent Operational Requirement (UOR) system

This device is an excellent example of practical data fusion combining both modern thermal capability with a high quality day optic binocular capability allowing recognition of personnel out to some 2km. An "MF" version is also available further integrating GPS and LASER range finding capabilities. Such a set of capabilities enables the capture of data contributing to a broad spectrum of information needs as captured in Section 2 of this paper.

The audio modality can also be utilized by autonomous sensors to add to the dismounted soldiers overall situational awareness. An example of this approach is provided by the Boomerang Warrior system [8]. This system is an individually deployed acoustic shot warning system capable of supplying individual soldiers with direction and elevation information on incoming hostile fire. An interesting feature of this system is the ability to fuse individual sensor feeds to further enhance the commanders SA. This capability contributes to the satisfaction of red/blue situational awareness information requirements enabling the detection of otherwise concealed threats.

The soldier also has a powerful situational awareness tool available to him in the form of his weapon scope. This is an active area of research in terms of the provision of better quality sensor fabrics and the fusion of Thermal Imaging / Image Intensification (TI/II) and electro optic capabilities within a single scope. Active research is also underway in the area of fusing daylight imagery with TI/II images to produce a true colour night vision capability [9] .

The referenced technologies thus far are viewed as having broad applicability across a wide range of situations and tasks. There also exists more niche technologies applicable to a subset of the tasks carried out by dismounted soldiers. The first of these referenced here is through wall imaging applicable to urban operations such as street clearances. The most promising technology for this application is UWB based sensing either handheld or mounted on a vehicle or UAV. It has been shown that this technology is workable and the advantage of fusing data from multiple viewpoints has also been shown.

The other niche technology is the interception of electronic signals and communications. The UK MoD is in the process of procuring a man-portable electronic warfare capability. One of the core capabilities of this UOR developed by Roke Manor Research is the interception of enemy battlefield communications. This capability is invaluable along with appropriate translation capability if insight is to be gained into enemy intent, activities and plans.

3.3 PROCESS

The bulk of the processing activity carried out with respect to information provided to the dismounted close combat soldier will inevitably be carried out either organically by the commander himself processing data received, or alternatively will need to be processed and assured by superior command elements before being disseminated to the commander.

Decision making at these lowest levels of command is characterized by high pressure short decision cycles. The commander will typically not have the latitude to spend significant periods of time assessing the accuracy and reliability of information presented to him.

To support these observations the concept of a Recognized Land Picture (RLP) has been identified. This is represents a single unified view of the state of the dismounted battlespace.

In support of the production of this RLP a number of fusion and filtering techniques have been identified to reduce the dimensionality of the available data whilst preserving the overall information content.

One such active area of sensor fusion is the fusion of acoustic and muzzle flash detection technologies in order to provide a robust sniper shot detection capability. Such a concept is represented by the FightSight system from Applied Research Associates (ARA). FightSight utilises multiple levels of information fusion. The event-level fusion process combines multiple IR and acoustic events, 3D scene context information, weapon signature and ballistics data, in order to characterise individual shot events (event location, shooting direction, timing, and weapon type estimates). Individual events can then be aggregated in order to

construct higher level information fusion constructs.

This PROCESS area is an active area of research within the EMRS DTC. This DTC work has included work on visually identifying moving targets from a platform which is itself moving [13], initially demonstrated on a UAV platform but applicable to a broad range of platforms including the dismounted soldier. Complementary work has also been conducted enabling the detection of changes in an ongoing visual scene [14]. This work is directly relevant to informing the RLP by providing enabling techniques for a persistent surveillance capability.

3.4 DISSEMINATE / PRESENT

How information is presented to a dismounted soldier is of critical importance if such information is going to be of use to him. The typical dismounted platoon commander is burdened with considerable physical and cognitive burdens, responsible for up to 70kgs of personal equipment and coordinating the activities of up to 27 men in a range of demanding tasks and environmental conditions.

In such an environment the presentation of information in a manner that minimises both the cognitive and physical burden is of utmost importance.

Cognitive Workload models such as the Wickens model have shown that cognitive resource is allocated across a range of potential input modalities. If burden is to be avoided use should be made of all available input media in order to avoid overburdening any one sense. In challenging physical scenarios the visual sense is already heavily burdened, which reinforces the audio sense as a key mechanism for delivering information to such close combat troops whilst in high pressure situations.

Just as the resources available for receiving information is limited, so are cognitive resources for processing complex inputs. There is a need therefore to reduce where possible the dimensionality of the information presented. Is for example Full Motion Video (FMV) data required or could the information be put across as an icon on a map or simplified set of image stills?

The physical mechanism for presentation is of importance also if physical and cognitive burden is to be minimised. The need to maintain local situational awareness is important so technologies such as Head Up Display (HUD) are of relevance if limitations of comfort and field of view concerns can be overcome. The POINTER system that allows own/enemy force information to be overlayed on a data enabled weapon scope is also of great interest for similar reasons. If conventional screen technology is to be used its weight and bulk must be reduced making E-Ink and FOLED flexible displays of relevance.

4 Conclusion

In this paper we have discussed the characteristics required of a detailed information taxonomy representing the broad range of information types that are required in order to inform the junior DCC commander's decision making process. We have moved on to analyse the role played by both organic and inorganic ISTAR assets in providing some of these information needs.

It should not be forgotten however that such an individual does not arrive in a battlefield decision making role bereft of knowledge. The DCC commander is a highly trained individual whom has trained with both his superior and subordinates on an ongoing basis for a period weeks or even months. This training is vital in terms of familiarisation of the commander with the capabilities of his subordinates and decision making processes employed by his superior command, facilitating the understanding of intent emphasised within the combat estimate process.

Once a platoon grouping arrives in theatre they also undergo extensive familiarisation with the theatre of operations, local customs and practices, terrain and so on. The tools and techniques identified within this paper and the broader CIS community are arguably as equally valid during this acclimatisation process as within the actual battlefield decision making process. A broad subset of the information needs

developed can be characterised as fairly static in nature and hence suitable for presentation long before the commander finds himself in a high pressure, cognitively challenging scenario. If such information can be presented prior to such situations, a broader range of tools can be utilised to produce appropriate information and a broader range of larger form factor devices used in its presentation.

When considering how to provide for the information needs of the commander in the battlefield it is right then to focus on those elements of the situation that can be characterised as highly dynamic. Such a commander is highly likely to be highly burdened physically, with analysis showing that such individuals are already carrying up to 70kg of equipment weight. Such an individual is also likely to be heavily cognitively burdened with his focus on his physical environment and the location of friend and potential foe.

Any interventions in terms of provision of sensors and processing capability must therefore be carefully targeted, providing clear battle winning uplift in capability for the individual concerned or they simply will not gain acceptance within this community.

Similarly if presentation capability is to gain acceptance in such a high pressure environment it must mesh well with the need to remain aware of the local situation via maintaining eyes on the local environment. It is for this reason together with the information assurance provided by trusted commanders that voice continues to dominate in this environment. The use of modern lightweight Head Up Displays and novel usage of data enabled weapon scopes both provide a good technological fit with this requirement.

The information provided by such devices must be intuitive, to access imposing a low cognitive burden, and above all must be trusted and assured. If information is only available some of the time and it has genuine utility then other mechanisms must be found for supplying it, negating the utility of the technological intervention.

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